Mullard technical handbook

Book one

Semiconductor devices

Part eight

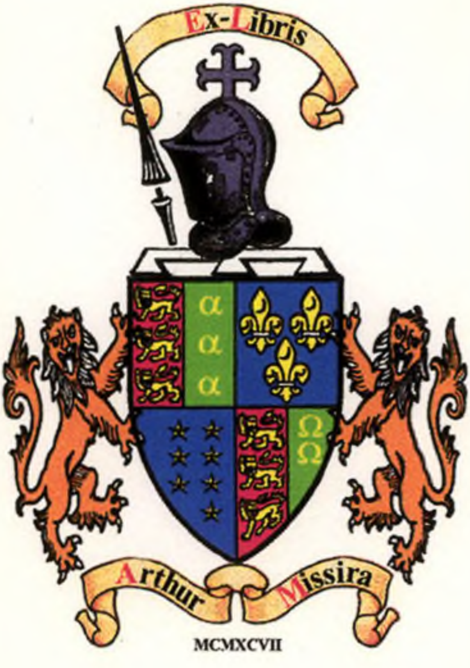
Microwave semiconductors and components

June 1979

Mullard Book 1 Part 8

Microwave semiconductors and components

June 1979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MICROWAVE SEMICONDUCTORS AND COMPONENTS

CONTENTS

Book 1 comprises the following parts—

Part 1A	Small-signal transistors
Part 1B	Low-frequency power transistors
Part 2	R.F. power devices
Part 3	Diodes
Part 4	Power diodes
Part 5	Thyristors, triacs
Part 6	LOCMOS digital integrated circuits
Part 7A	Consumer integrated circuits
Part 7B	Professional analogue integrated circuits
Part 8	Microwave semiconductors and components
Part 9	Opto-electronic devices (to be issued later)

PLUS—

Signetics Technical Handbooks

- Memories
- Microprocessors
- Analogue
- Logic

Printed by Unwin Brothers Limited
The Gresham Press, Old Woking, Surrey
A member of the Staples Printing Group

BOOK 1 (Part 8)

SEMICONDUCTOR DEVICES

Microwave semiconductors
Microwave components

Mullard manufacture and market electronic components under the **Mullard, Philips** and **Signetics** brands.

MULLARD LTD., MULLARD HOUSE, TORRINGTON PLACE,
LONDON, WC1E 7HD

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DATA HANDBOOK SYSTEM

The Mullard data handbook system is made up of three sets of books, each comprising several parts, plus the Signetics technical handbooks.

The three sets of books, easily identifiable by the colours on their covers, are as follows:

Book 1	(blue)	Semiconductor devices and integrated circuits
Book 2	(orange)	Valves and tubes
Book 3	(green)	Passive components, materials, and assemblies.

Each part is completely reviewed annually; revised and reprinted where necessary. Revisions to previous data sheets are indicated by an arrow in the margin.

The data sheets contained in these books are as accurate and up to date as it is reasonably possible to make them at the time of going to press. It must, however, be understood that no guarantee can be given here regarding the availability of the various devices or that their specifications may not be changed before the next edition is published.

The devices for which full data is given in these books are those around which we would recommend equipment to be designed. Where appropriate, other types no longer recommended for new equipment designs, but generally available for equipment production are listed separately with abridged data. Data sheets for these types may be obtained on request. Older devices for which data may still be obtained on request are also included in the index of the appropriate part of each book.

Requests for information regarding the data handbook system (including Signetics data) and for individual data sheets should be made to the

Technical Publications Department
Mullard Limited
New Road
Mitcham
Surrey CR4 4XY
Telex: 22194

Information regarding price and availability of devices must be obtained from our authorized agents or from our representatives.

SELECTION GUIDE

SECTION B – GUNN, IMPATT AND NOISE DIODES

Gunn Effect Devices

P_{out} min. (mW)	Type No.	Description	Operating Voltage (V)	P_{tot} max. (W)
5	CXY11A	Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band	7.0	1.0
10	CXY11B		7.0	1.0
15	CXY11C		7.0	1.0
100	CXY19		8 to 15	6.0
200	CXY19A		8 to 15	6.0
300	CXY19B		8 to 15	7.5
50	CXY21		8.0	2.5
5	CXY14A	Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in J-band	7.0	1.0
10	CXY14B		7.0	1.0
15	CXY14C		7.0	1.0
25	CXY24A	Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in Q-band (Ka-band)	3.5	4.0
50	CXY24B		3.5	4.0

Impatt Diodes

P_{out} min. (mW)	Type No.	Description	Operating Voltage (V)	Frequency Range (GHz)
500	BXY50	High efficiency silicon Impatt diodes for the generation of microwave c.w. power	91	8 to 10
400	BXY51		80	10 to 12
300	BXY52		70	12 to 14
650	BXY60		120	6 to 8

Noise Diode

Frequency Range	Type No.	Description	Typ. Excess Noise Ratio (dB)	Typ. Avalanche Voltage (V)
10 Hz to 18 GHz	BAT31	Broadband noise generator	34	20

SECTION C – MIXER AND DETECTOR DIODES

Schottky Barrier Mixer Diodes

Max. Operating Frequency (GHz)	Type No.	Description	I.F. Impedance (Ω)	Max. Noise Figure (dB)
12	BAT10	Plastic package	250–500	7.5
12	BAT11	L.I.D.	280–380	7.0
12	BAT50 BAT50R*	Rimmed coaxial	300–500	6.8
12	BAV22 BAV22R*	Rimmed coaxial	300–550	7.5
12	BAV96A BAV96B BAV96C BAV96D	M.Q.M.	250–450	7.5 7.0 6.5 6.0
12	BAW95D BAW95E BAW95F BAW95G	Reversible cartridge	250–500	8.2 7.5 7.0 6.5
18	BAT39 BAT39A	Mixer pill	250–450	6.5 7.5
18	BAT51 BAT51R*	Rimless coaxial	220–320	7.5
18	BAT52 BAT52R*	Rimless coaxial	220–320	8.5
40	BAT38	Mixer pill	700–1100	10
40	BAT59	Mixer pill	700–1400	10
40	BAV72	M.Q.M.	850–1300	10

*Reverse polarity version.

SECTION C (cont.)

Schottky Barrier Detector Diodes

Frequency Range (GHz)	Type No.	Description	Typ. 1/f noise (dB)	Typ. Tangential Sensitivity (dBm)
8 to 12	**BAV46**	Reversible cartridge	10	–55
8 to 12	**BAV75**	Pill	10	–50
8 to 12	**BAV97**	M.Q.M.	10	–54

Schottky Barrier Diode for Intruder Alarm Applications

Frequency Range (GHz)	Type No.	Description	Typ. 1/f noise (μV)	Typ. Voltage output for –90 dBm input (μV)
8 to 12	**BAV46**	Reversible cartridge	1.0*	40

*1 Hz to 1 kHz from carrier

SECTION D – BACKWARD DIODES

Backward Detector Diodes

Frequency Range (GHz)	Type No.	Description	Figure of merit (M)	Typ. Tangential Sensitivity (dBm)
1 to 18	**AEY17**	Mixer pill	>120	–53
12 to 18	**AEY29** **AEY29R****	Rimless coaxial	>50	–53
1 to 18	**AEY31**	M.Q.M.	>120	–53
1 to 18	**AEY31A**	M.Q.M.	>50	–50
18 to 40	**AEY32**	M.Q.M.	>50	2.0 μA/μW†

** Reverse polarity version

†Zero bias current sensitivity (typ.)

SECTION E – VARACTOR DIODES

Multiplier Varactor Diodes

Capacitance min. (pF)	Capacitance max. (pF)	at V_R (V)	Type No.	Description	V_R max. (V)	Typ. Cut-off Frequency (GHz)
0.25	0.5	6	BXY41	Silicon planar step recovery	25*	200*
0.4	0.9	6	BXY40		25*	180*
0.5	1.0	6	BXY32	Silicon planar epitaxial step recovery. For high order frequency multiplier outputs in X-band	20	150
0.6	1.0	6	1N5157	Silicon planar epitaxial step recovery. For frequency multiplier outputs in X-band	20	200
0.8	1.5	6	BXY29		25	120
0.8	1.2	6	BXY39	Silicon planar step recovery	40*	150*
1.0	2.5	6	BXY28	Silicon planar epitaxial step recovery. For frequency multiplier outputs in C-band	45	120
1.0	3.0	6	1N5155		35	120
1.2	2.0	6	BXY38	Silicon planar step recovery	50*	120*
1.5	2.5	6	BXY56	High efficiency silicon types for multipliers with output frequencies in C and X-bands	60	160*
2.5	3.5	6	BXY57		60	140*
2.0	4.0	6	BXY37	Silicon planar step recovery	70*	100*
3.0	6.0	6	BXY27	Silicon planar epitaxial step recovery. For frequency multiplier outputs in S-band	55	100
4.0	6.0	6	BXY36	Silicon planar step recovery	70*	75*
5.0	7.5	6	1N5152 1N5153	Silicon planar epitaxial step recovery. For frequency multiplier outputs in S-band	75	100
6.0	12	6	BXY35	Silicon planar step recovery	100*	25*
28	39	6	BAY96	Silicon planar epitaxial. For high efficiency frequency multipliers	120	25

*minimum

SECTION E (cont.)

Special Purpose Varactor Diodes

Capacitance min. max. (pF)	at V_R (V)	Type No.	Description	V_R max. (V)	Typ. Cut-off Frequency (GHz)
0.2 typ.	0	CXY10	Gallium arsenide. For parametric amplifiers, frequency multipliers and switches	6	350
0.25 typ.	6	CXY12	Gallium arsenide. For frequency multiplier circuits up to Q-band output frequency	10	500
0.3 0.5	0	CAY10	Gallium arsenide diffused mesa type. For parametric amplifiers, frequency multipliers and switches	6	240

Frequency Range (GHz)	Type No.	Description	Typ. Att. (dB)	Typ. Insertion Loss (dB)
2 to 7 7 to 12	CXY22A CXY22B	Gallium arsenide limiter diodes	20 16	0.2 0.3

Tuning Varactor Diodes

Capacitance min. max. (pF)	at V_R (V)	Type No.	Description	V_R max. (V)
0.8 1.2 3.7 5.7 12 18	4 4 4	BXY53 BXY54 BXY55	Silicon planar epitaxial tuning devices	60 60 60
0.8 1.2 1.2 1.8 1.6 2.5 2.5 3.5	0 0 0 0	CXY23A CXY23B CXY23C CXY23D	Gallium arsenide Schottky barrier tuning devices	12 12 12 12

SECTION F – GUNN OSCILLATORS

This selection represents only a part of the Mullard range of solid state sources. Custombuilt sources, including some with higher output powers, are available on request. Mullard offers a comprehensive capability in the area of general solid state oscillators, with complex phase locked and frequency agile sources for military applications.

Type No.	Nominal Centre Frequency (GHz)	P_{out} (mW)	Minimum Mechanical Tuning Range (MHz)	Minimum Electronic Tuning Range (MHz)	Output Coupling
CL8310	9.4	5	± 50	200	WG16/WR90
CL8630 **CL8630S**	10.687	8	–	–	WG16/WR90
CL8631 **CL8631S**	9.35	8	–	–	WG16/WR90
CL8632 **CL8632S**	9.47	8	–	–	WG16/WR90
CL8633 **CL8633S**	10.525	8	–	–	WG16/WR90
CL8640R* **CL8640T†**	10.49 10.56	6 6	±60 ±60	30 8	WG16/WR90 WG16/WR90
CL8690**	9.375	5	± 75	50	WG16/WR90

* Receiver local oscillator

† Transmitter

** Klystron replacement for marine radars. Complies with B.O.T. specification BOT SBN 115 10057/1.

S following type number signifies a self-oscillating mixer (auto-detector).

SECTION G – DOPPLER AND TRAFFIC RADARS

Traffic radars

Type No.	Description	Detection Range (metres)	A.C. Supply Voltage (V)
CL8880BN	X-band traffic radar sensor. Cable entry through case.	100	110
CL8880BNC	X-band traffic radar sensor. Cable entry through mounting foot	100	110

Doppler modules

Type No.	Description	Centre frequency (GHz)	Power Output typ. (mW)	Voltage Output* typ. (μV)
CL8960	Doppler modules for volumetric presence detection, industrial process control, proximity switching, intruder alarms and similar applications.	10.687	10	40
CL8961		9.350	10	40
CL8962		9.470	10	40
CL8963		10.525	10	40
CL8964		9.900	10	40
CL8965		10.565	10	40
CL8967		10.365	10	40

* Output voltage for input power 100 dB down on power output at 18 dB min. $\frac{\text{signal + noise}}{\text{noise}}$

SECTION H – MISCELLANEOUS

Horn antenna

Type No.	Description	Frequency Range (GHz)	Gain (dB)
ACX–01A	Horn antenna for miniature radars	9.0 to 11	16

Mixers/detectors

Type No.	Description	Centre Frequency (GHz)	Connections
CL7500	Waveguide single ended mixers/detectors	10.687	WG16/WR90
CL7520		9.35	WG16/WR90

Parametric amplifier

Type No.	Description	Gain (dB)	Noise Figure max. (dB)	Bandwidth (MHz)	Frequency Range (GHz)
CL9022	Packaged parametric amplifier in temperature stabilized enclosure	20	2.8	15	2.7 to 3.1

SECTION J – ISOLATORS AND CIRCULATORS

See selection guide in section J

GENERAL SECTION

A

A

MICROWAVE SEMICONDUCTORS
GENERAL EXPLANATORY NOTES

TYPE NOMENCLATURE

Mullard 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

X - multiplier diode such as varactor or step recovery diode

The third letter is T, V, W, X or Y which indicates that the device is designed or developed for industrial, professional or transmitting applications.

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
Mutual 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. forward 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

PRODUCT SAFETY

The most modern high technology materials have been used in these components to ensure the highest performance for the user. Some of them are toxic to man but the quantity used in a single device is so small that the risk of toxic effects are negligible even in extreme circumstances.

EXPLANATION OF HANDBOOK DATA

1. FORM OF ISSUE

The semiconductor data published in the Handbook follows the same pattern, as much as possible, concerning, (a) the forms of issue, (b) the ratings system and (c) the ratings presentation.

1.1 Types of Data

The Handbook data is published either as tentative or final data.

Tentative Data

Tentative data aims at providing information on new devices as early as possible to allow the customer to proceed with circuit design. The tentative data may not include all the characteristics or ratings which will be incorporated later in the final data and some of the numerical values quoted may be slightly adjusted later on.

Final Data

The transfer from tentative data to final data involves the addition of those numerical values and curves which were not available at tentative data stage and small adjustments to those values already quoted in tentative data. Reissue of final data may be made from time to time to incorporate additional information resulting from prolonged production experience or to meet new applications.

1.2 Presentation of Data

The information on the published data sheets is presented in the following form:

—description of basic application and physical characteristics of the device.

—quick reference data giving the most important ratings and characteristics.

—outline and dimensions. Reference to standard outline nomenclature if applicable and lead connections.

—Ratings. Voltage, current, power and thermal ratings.

—Characteristics.

—Application information or operating conditions.

—Mechanical and environmental data if applicable.

—Charts showing ratings and characteristics.

2. RATINGS

A rating is a limiting condition of usage specified for a device by the manufacturer, beyond which the serviceability may be impaired.

A rating system is a set of principles upon which ratings are established and which determines their interpretation. There are three systems which have been internationally accepted and which allocate responsibility between the device manufacturer and the circuit designer differently.

2.1 Rating Systems

Unless otherwise stated the ratings given in semiconductor data sheets follow the absolute maximum rating system.

The definitions of the three systems accepted by the International Electrotechnical Commission are as follows:

ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any device of a specified type as defined by the 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 no responsibility for variations in equipment or environment, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other 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 variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of the device under consideration and of all other devices in the equipment.

DESIGN-CENTRE RATING SYSTEM

Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey 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 variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of all other devices in the equipment. The equipment manufacturer should design so that initially no design-centre value for the intended service is exceeded with a bogey device in equipment operating at the stated normal supply voltage.

DESIGN-MAXIMUM RATING SYSTEM

Design-maximum ratings are limiting values of operating and environmental conditions applicable to a bogey 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 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 variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of the device under consideration and of all other devices in the equipment.

GUNN, IMPATT AND NOISE DIODES

B

B

SILICON AVALANCHE NOISE DIODE

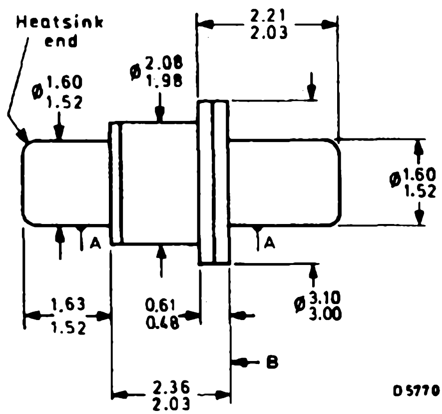
BAT31

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.

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 (fig. 3)	typ.	34	dB

OUTLINE AND DIMENSIONS Dimensions in mm

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

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

LIMITING VALUES (Absolute max. rating system)

I_R	max.	40	mA
P_{tot}	max.	1.0	W
T_{mb}	max.	80	°C
T_{stg} range		-55 to +150	°C

CHARACTERISTICS (T_{mb} = 25 °C)

$V_{BR(R)}$ at I_R = 5 mA	min.	17	V
C_j at V_R = 6 V, f = 1 MHz	min.	0.4	pF
	max.	0.8	pF
I_R at V_R = 6 V	max.	0.1	µA
R_{slope} at I_R = 40 mA, f = 1 kHz 1)	max.	60	Ω
$\frac{R_1}{R_{40}}$ at I_R = 1 mA and 40 mA, f = 1 kHz 1)	max.	2.5	
C_s	typ.	0.2	pF
L_S	typ.	650	pH

1) R_{slope} is the reverse slope resistance and $\frac{R_1}{R_{40}}$ is the ratio of 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 characterized, 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.

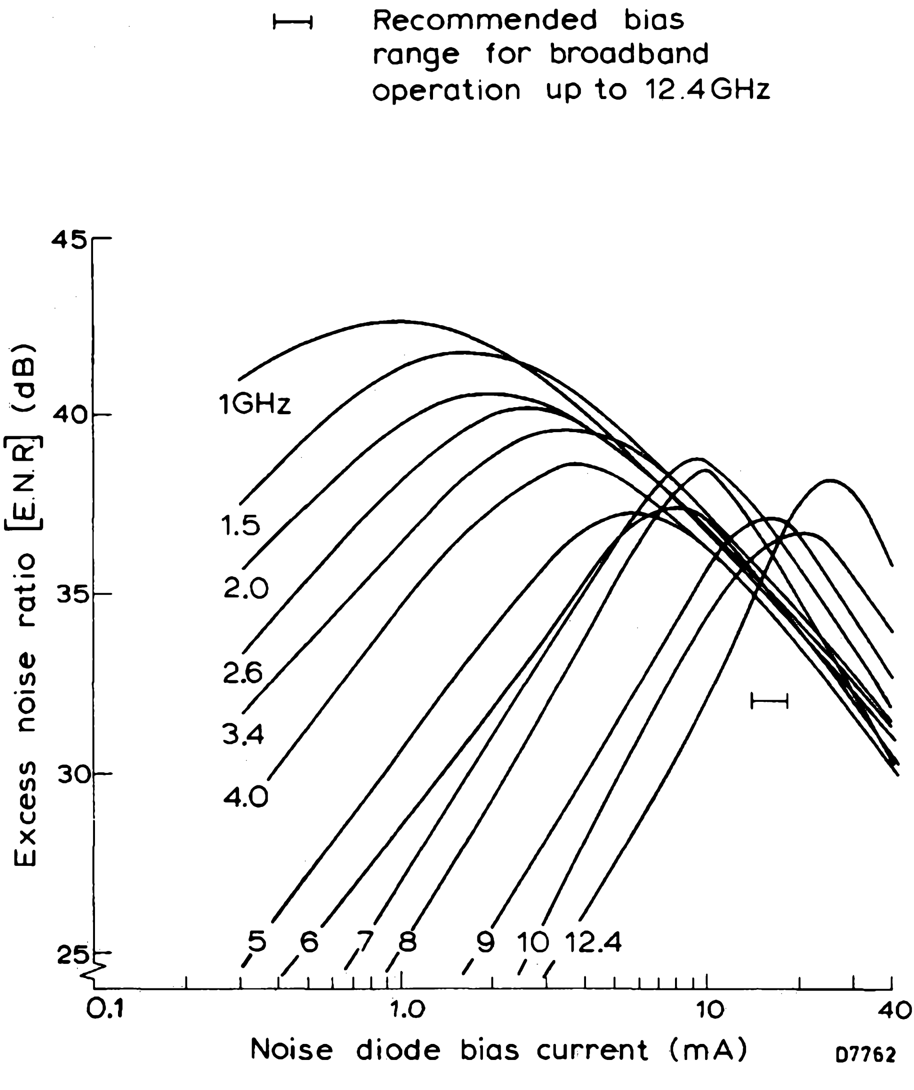


Fig. 1

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

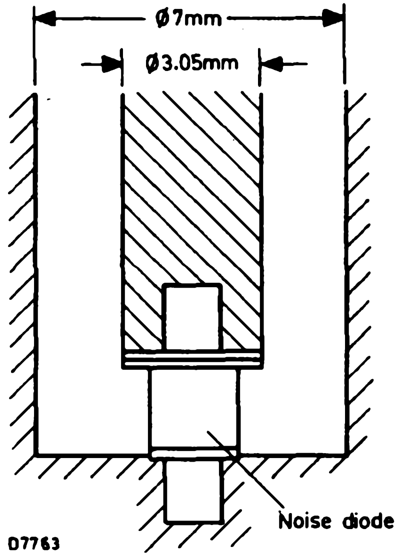


Fig. 2

Device mounted in a 50 Ω 7 mm coaxial line

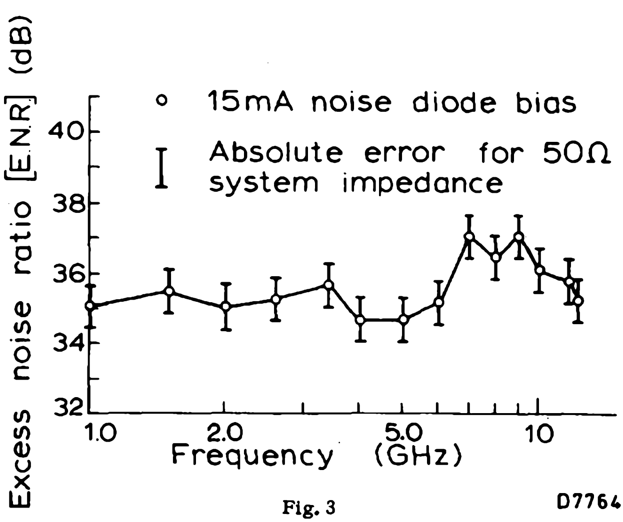


Fig. 3

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

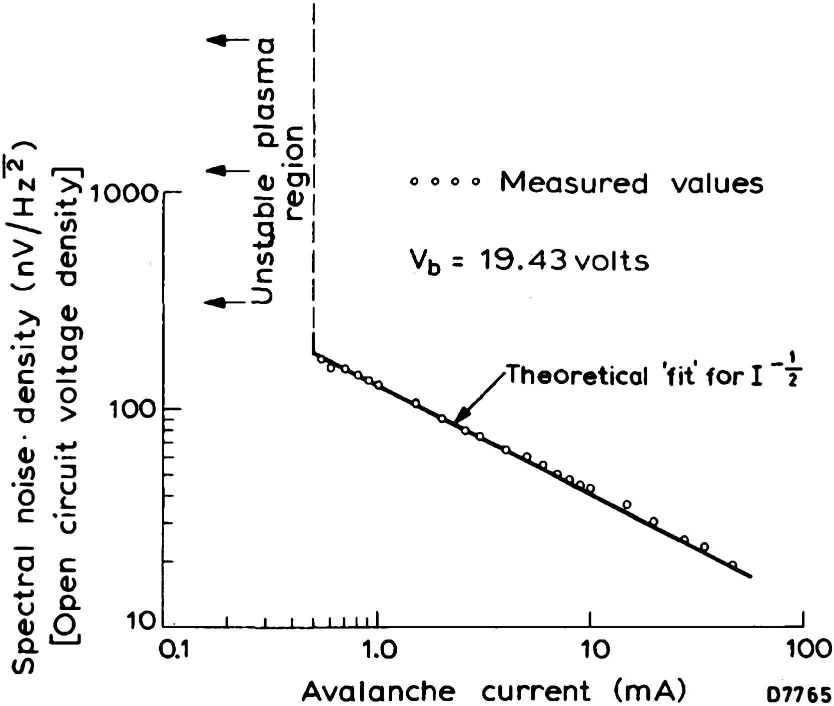


Fig. 4

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

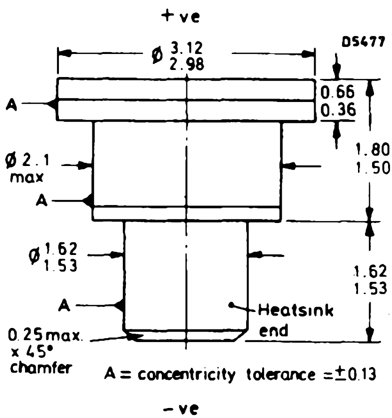
SILICON IMPATT DIODE

BXY50

A high efficiency silicon Impatt diode for the generation of c.w. power at micro-wave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA		
Operating frequency	8.0 to 10	GHz
P_{out} (typ.) (T_{hs} = 35°C)	600	mW
Operating current (typ.)	135	mA
Operating voltage (typ.)	91	V

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

P_{tot} max. (see note 1)	$\frac{200 - T_{hs}}{R_{th}\ (j - hs)}$	W
R_{th} (j-hs) max.	15	^{o}C/W
$T_j - T_{hs}$ max.	165	^{o}C
T_{stg} range	-55 to +175	^{o}C

ELECTRICAL CHARACTERISTICS ($T_{hs} = 25^{o}$C)

		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage (at I_R = 1.0mA)	65	75	85	V
I_R	Reverse current (at V_R = 50V)	-	-	10	μA
C_T	Total capacitance (at $V_{(BR)R}$ =5V)	-	0.9	-	pF

TYPICAL OSCILLATOR PERFORMANCE

	Min.	Typ.	Max.	
Operating current (see note 2)		135		mA
Operating voltage		91		V
Frequency (see note 3)	8.0	-	10	GHz
Output power (see notes 2, 4, 5 and 6)	500	600	-	mW
Efficiency	-	5.0	-	%

OPERATING NOTES

1. The maximum junction temperature is 200^{o}C, therefore care must be taken to ensure that P_{tot} max. $\leq \frac{200 - T_{hs}}{R_{th}\ (j - hs)}$ W,

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

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

   R_{th} (j - 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 burnout. 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. The maximum power supply requirements are 115V and 160mA.

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).

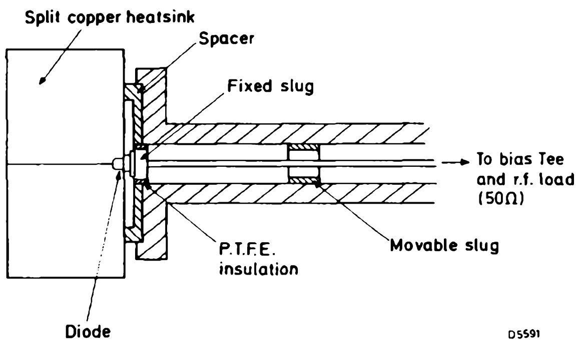
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

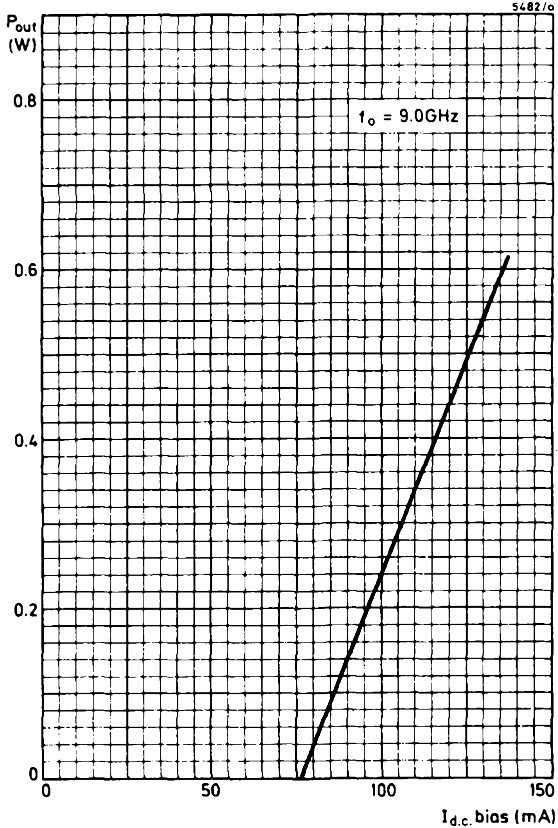
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

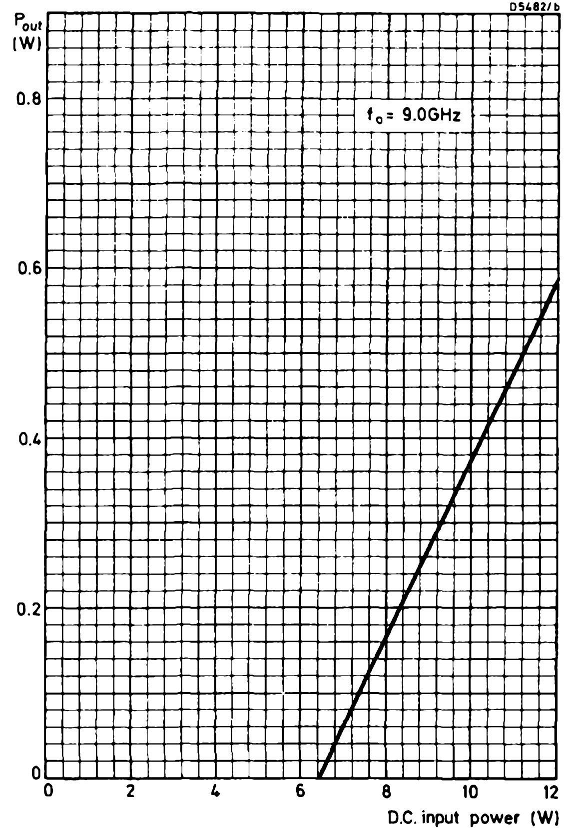
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



TYPICAL OUTPUT POWER AS A FUNCTION OF D.C. INPUT POWER

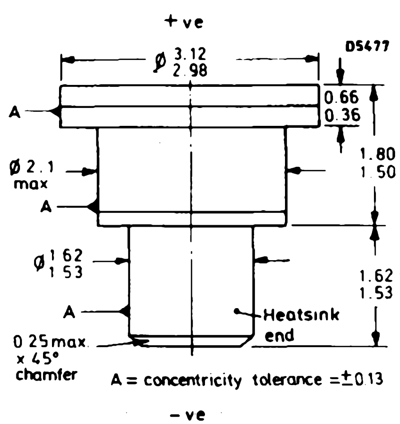
SILICON IMPATT DIODE

BXY51

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA		
Operating frequency	10 to 12	GHz
P_{out} (typ.) (T_{hs} = 35°C)	450	mW
Operating current (typ.)	120	mA
Operating voltage (typ.)	80	V

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

P_{tot} max. (see note 1)	$\dfrac{200 - T_{hs}}{R_{th}\ (j - hs)}$	W
R_{th} (j - hs) max.	19	$^{o}C/W$
$T_j - T_{hs}$ max.	165	^{o}C
T_{stg} range	-55 to +175	^{o}C

ELECTRICAL CHARACTERISTICS ($T_{hs} = 25^{o}C$)

		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage (at $I_R = 1.0mA$)	55	65	75	V
I_R	Reverse current (at $V_R = 45V$)	-	-	10	μA
C_T	Total capacitance (at $V_{(BR)R}$ - 5V)	-	0.85	-	pF

TYPICAL OSCILLATOR PERFORMANCE

	Min.	Typ.	Max.	
Operating current (see note 2)		120		mA
Operating voltage		80		V
Frequency (see note 3)	10	-	12	GHz
Output power (see notes 2, 4, 5 and 6)	400	450	-	mW
Efficiency	-	5.0	-	%

OPERATING NOTES

1. The maximum junction temperature is $200^{o}C$, therefore care must be taken to ensure that P_{tot} max. $\leq \dfrac{200 - T_{hs}}{R_{th}\ (j - hs)}$ W,

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

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

   R_{th} (j - 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 burnout. 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 105V and 170mA.

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

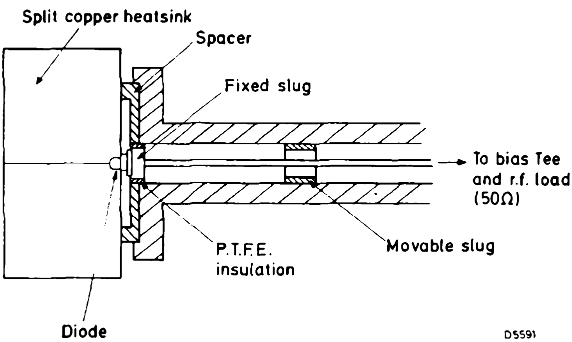
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

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

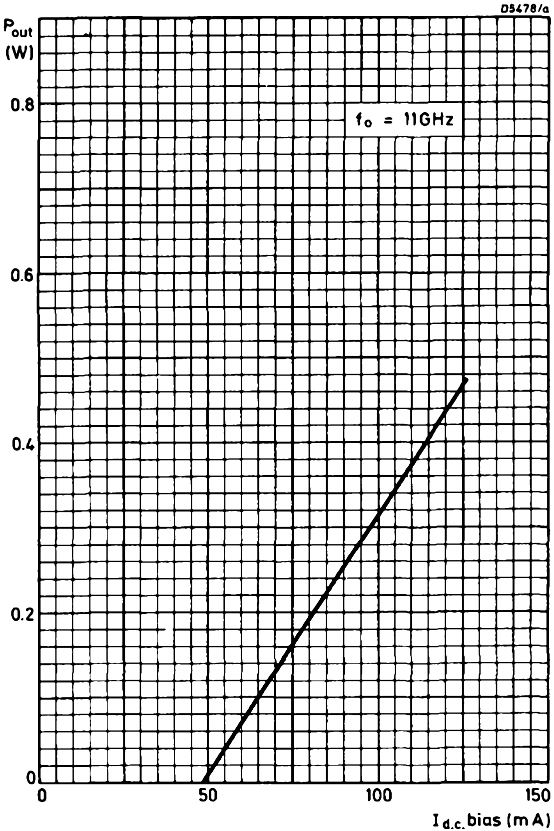
OPERATING NOTES (contd.)

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 single loaded epoxy, such as Epotek H40, may be used.
7. This device may be used as a negative resistance amplifier.

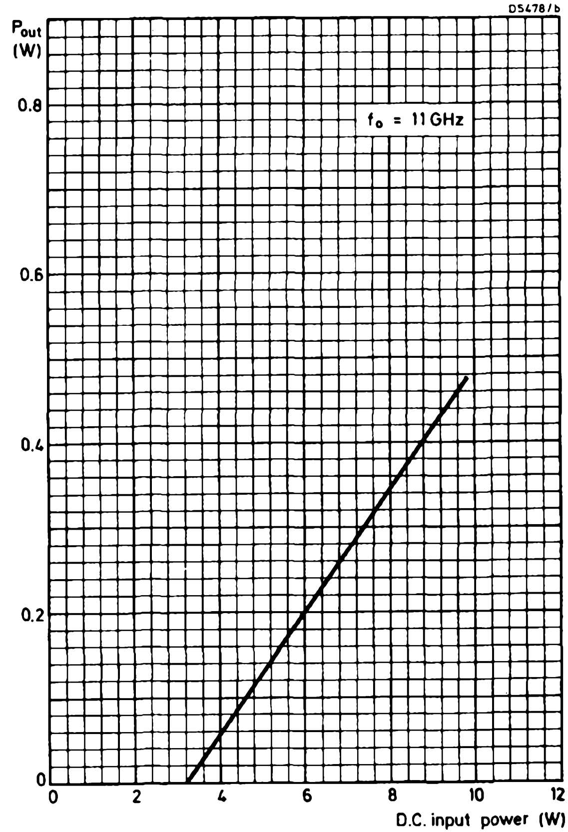
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



TYPICAL OUTPUT POWER AS A FUNCTION OF D.C. INPUT POWER

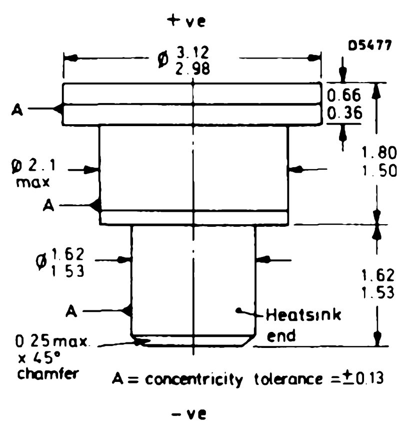
SILICON IMPATT DIODE

BXY52

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA		
Operating frequency	12 to 14	GHz
P_{out} (typ.) (T_{hs} = 35°C)	370	mW
Operating current (typ.)	120	mA
Operating voltage (typ.)	70	V

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

P_{tot} max. (see note 1)	$\frac{200 - T_{hs}}{R_{th}\ (j - hs)}$	W
R_{th} (j-hs) max.	24	$^{o}C/W$
$T_j - T_{hs}$ max.	165	^{o}C
T_{stg} range	-55 to +175	^{o}C

ELECTRICAL CHARACTERISTICS ($T_{hs} = 25^{o}C$)

		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage (at I_R = 1.0mA)	50	55	60	V
I_R	Reverse current (at V_R = 40V)	-	-	10	μA
C_T	Total capacitance (at $V_{(BR)R}$ -5V)	-	0.75	-	pF

TYPICAL OSCILLATOR PERFORMANCE

	Min.	Typ.	Max.	
Operating current (see note 2)		120		mA
Operating voltage		70		V
Frequency (see note 3)	12		14	GHz
Output power (see notes 2, 4, 5 and 6)	300	370	-	mW
Efficiency	-	4.5	-	%

OPERATING NOTES

1. The maximum junction temperature is 200^{o}C, therefore care must be taken to ensure than P_{tot} max. $\leq \frac{200 - T_{hs}}{R_{th}\ (j - hs)}$ W,

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

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

   R_{th} (j - 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 burnout. 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 capacitance across the diode. The maximum power supply requirements are 90V and 150mA.

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).

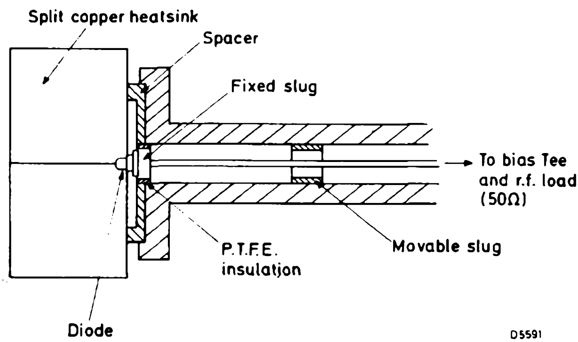
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

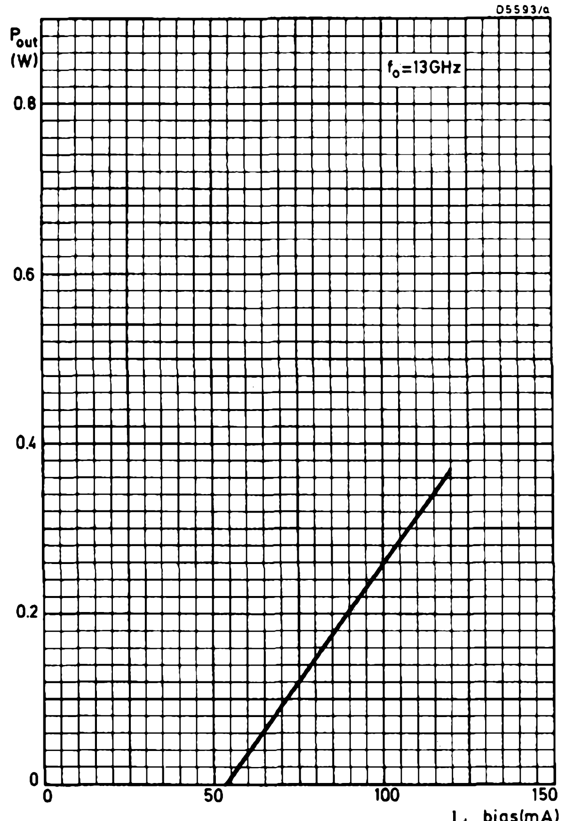
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

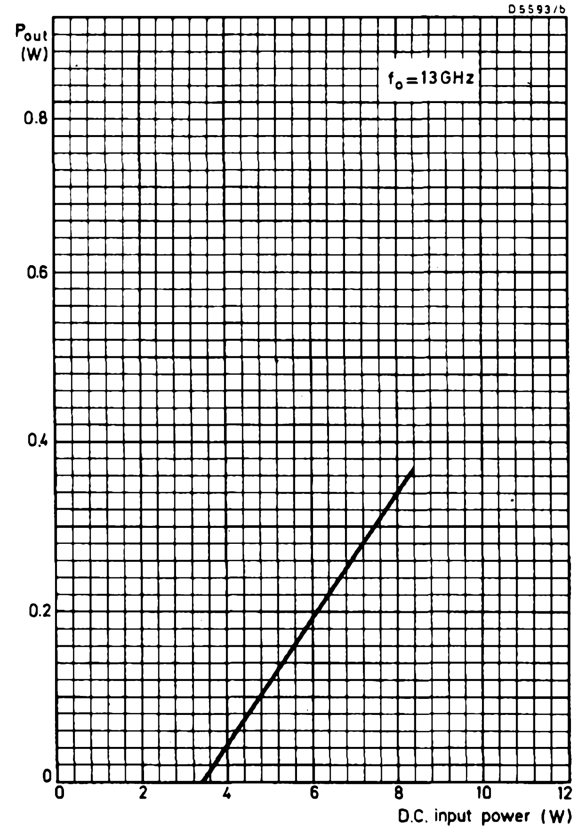
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



TYPICAL OUTPUT POWER AS A FUNCTION OF D.C. INPUT POWER

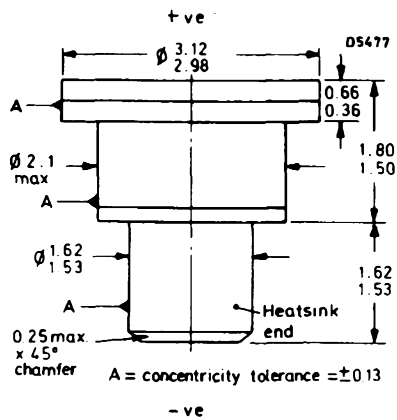
SILICON IMPATT DIODE

BXY60

A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA		
Operating frequency	6.0 to 8.0	GHz
P_{out} (typ.) (T_{hs} = 35°C)	750	mW
Operating current (typ.)	125	mA
Operating voltage (typ.)	120	V

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

P_{tot} max. (see note 1)	$\frac{200 - T_{hs}}{R_{th}\ (j - hs)}$	W
R_{th} (j - hs) max.	14	$^oC/W$
$T_j - T_{hs}$ max.	165	^oC
T_j max.	200	^oC
T_{stg} range	-55 to +175	^oC

ELECTRICAL CHARACTERISTICS ($T_{hs} = 25^oC$)

		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage (at $I_R = 5.0$mA)	85	100	115	V
I_R	Reverse current (at $V_R = 70$V)	-	-	10	μA
C_T	Total capacitance (at $V_{(BR)R} = 75$V)	-	0.97	-	pF
Operating current (see note 2)			125		mA
Operating voltage			120		V
Frequency (see note 3)		6.0	-	8.0	GHz
Output power (see notes 2, 4, 5 and 6)		650	750	-	mW
Efficiency		-	5.0	-	%

OPERATING NOTES

1. The maximum junction temperature is 200°C, therefore care must be taken to ensure that P_{tot} max. $\leq \frac{200 - T_{hs}}{R_{th}\ (j - hs)}$ W,

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

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

   R_{th} (j - 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 burnout. 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 140V and 180mA.

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).

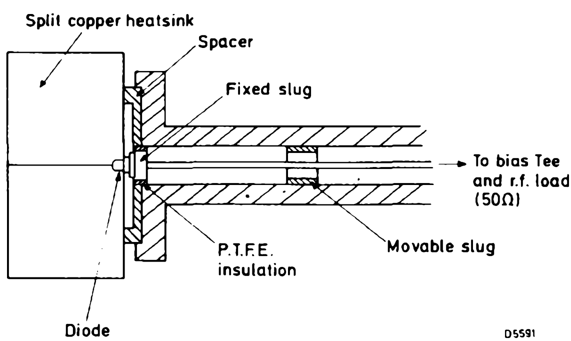
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

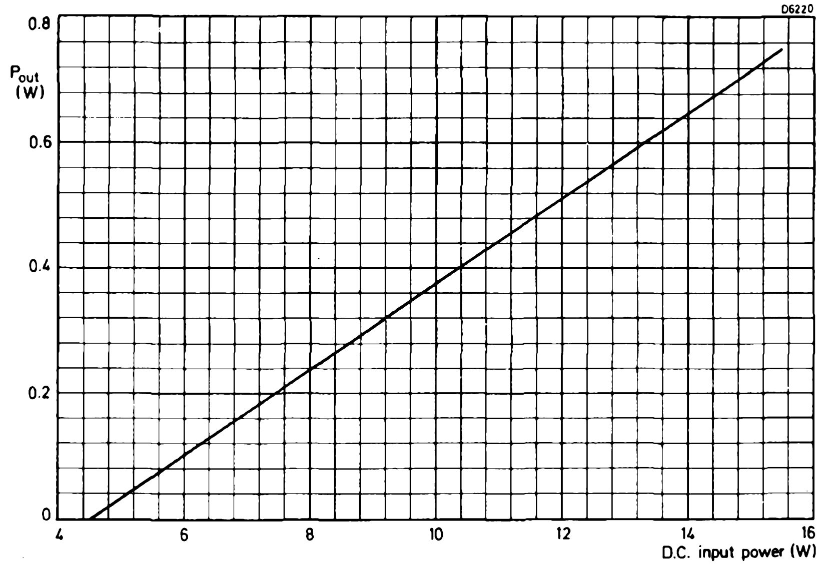
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

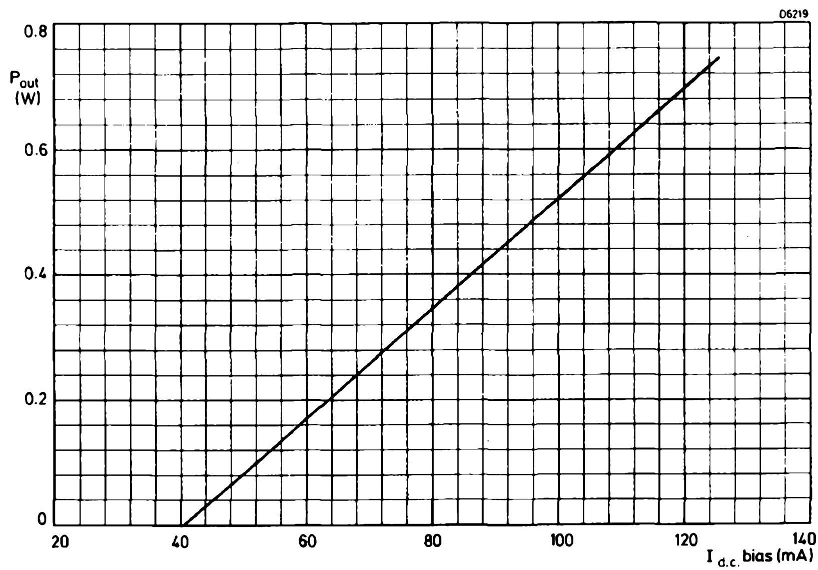
Devices may be selected to suit customers' specific requirements



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

CXY11A
CXY11B
CXY11C

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.

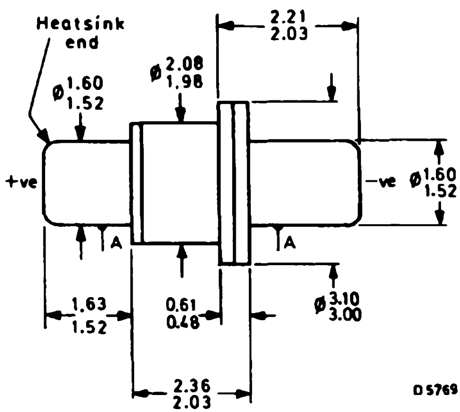
QUICK REFERENCE DATA

Operating voltage (typ.)		7.0	V
P_{tot} max. (T_{mb} = 70 °C)		1.0	W
Operating frequency		8.0 to 12	GHz
P_{out} min.	CXY11A	5.0	mW
	CXY11B	10	mW
	CXY11C	15	mW

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. [1]	7.5	V
V max (for less than 1 ms)	9.0	V
P_{tot} max. (T_{mb} = 70 °C)	1.0	W
Temperature		
T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

→ ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

		Min.	Typ.	Max.	
I_{dc} (at V = 7.0 V) [1]		-	120	150	mA
Frequency [2]		8.0	9.5	12	GHz
P_{out} (at V = 7.0 V) [3]	CXY11A	5.0	8.0	-	mW
	CXY11B	10	12	-	mW
	CXY11C	15	20	-	mW
A.M. noise to output power ratio [4]		-90	-100	-	dB

OPERATING 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 a frequency of 9.5 GHz. Other centre frequencies may be supplied at 8.5, 10.5 and 11.5 GHz by suffixing the type number e.g. CXY11B/10.5 specifies a diode giving 10 mW min. at 10.5 GHz. See the table below.
Diodes with these other centre frequencies 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) The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

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

Complete oscillators using these devices are obtainable from Mullard Ltd.,
Devices may be selected to suit customers' specific requirements.

GUNN EFFECT DEVICES

CXY14A CXY14B CXY14C

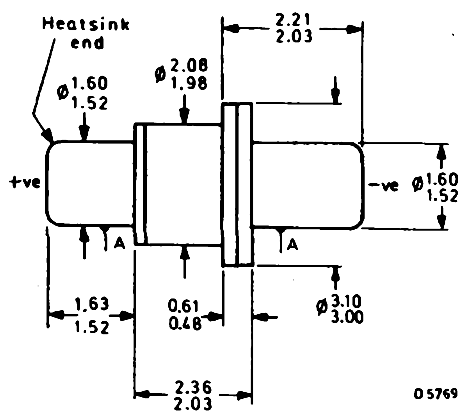
Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. ← oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA			
Operating voltage		7.0	V
P_{tot} max. (T_{mb} = 70 °C)		1.0	W
Operating frequency		12 to 18	GHz
P_{out} min.	CXY14A	5.0	mW
	CXY14B	10.0	mW
	CXY14C	15.0	mW

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. (d.c.)	7.5	V
V max. (for less than 1 ms)	9.0	V
P_{tot} max. (T_{mb} = 70 °C)	1.0	W

Temperature

T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

		Min.	Typ.	Max.	
I_{dc} (at V = 7.0 V) 1)		-	120	145	mA
Frequency 2)		12	14	18	GHz
P_{out} (at V = 7.0 V) 3)	CXY14A	5.0	8.0	-	mW
	CXY14B	10	12	-	mW
	CXY14C	15	20	-	mW

OPERATING 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 centre-band frequency. 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) The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

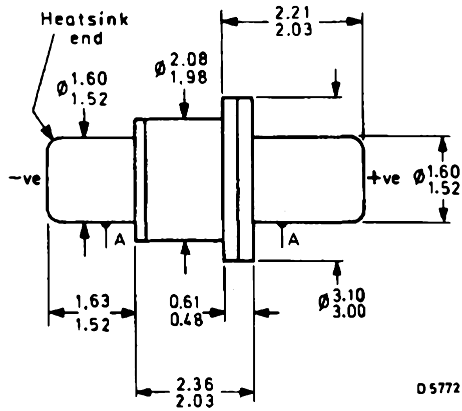
CXY19

Gallium arsenide bulk effect device 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 voltage (note 2)	8 to 15	V
P_{tot} max. (T_{mb} = 70 °C)	6.0	W
Operating frequency	8 to 12	GHz
P_{out} min. (f = 9.5 GHz)	100	mW

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. (see note 1)	15	V
P_{tot} max. (T_{mb} = 70°C)	6.0	W
Temperature		
T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

	Min.	Typ.	Max.	
I_{dc} (at V = 12V) (see notes 1 and 2)	-	450	-	mA
Frequency (see note 3)	8.0	9.5	12	GHz
P_{out} (see note 2)	100	150	-	mW

OPERATING 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 9.5GHz 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.
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 single loaded epoxy, such as Epotek H40, may be used.
5. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

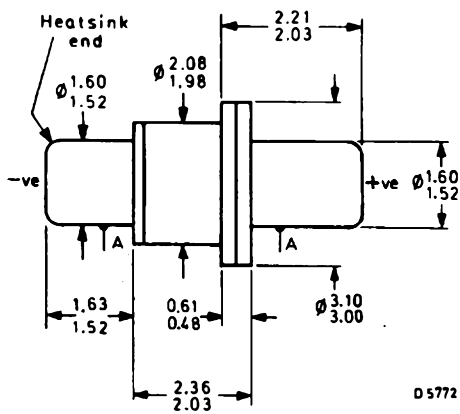
CXY19A

Gallium arsenide bulk effect device 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 voltage (note 2)	8 to 15	V
P_{tot} max. (T_{mb} = 70°C)	6.0	W
Operating frequency	8 to 12	GHz
P_{out} min. (f = 9.5GHz)	200	mW

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. (see note 1)	15	V
P_{tot} max. (T_{mb} = 70°C)	6.0	W
Temperature		
T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

	Min.	Typ.	Max.	
I_{dc} (at V = 12V) (see notes 1 and 2)	-	450	-	mA
Frequency (see note 3)	8.0	9.5	12	GHz
P_{out} (see note 2)	200	250	-	mW

OPERATING 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 9.5GHz 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.

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 single loaded epoxy, such as Epotek H40, may be used.

5. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

CXY19B

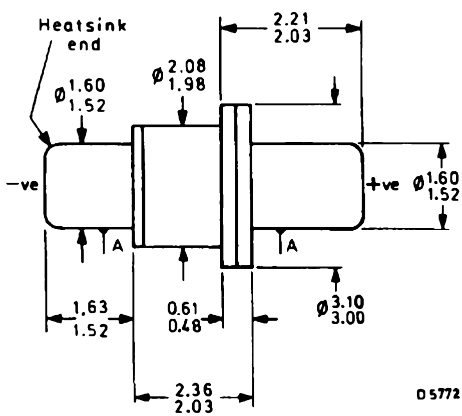
Gallium arsenide bulk effect n^+ sandwich device employing the Gunn effect to produce ← c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA		
Operating voltage 2)	8 to 15	V
P_{tot} max. (T_{mb} = 70 °C)	7.5	W
Operating frequency	8 to 12	GHz
P_{out} min. (f = 9.5 GHz)	300	mW

OUTLINE AND DIMENSIONS

Dimensions in mm

Conforms to B.S. 3934 SO-86



A: concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. [1] [2]	15	V
P_{tot} max. (T_{mb} = 70 °C)	7.5	W

Temperature

T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

	Min.	Typ.	Max.	
I_{dc} [1] [2]	-	650	900	mA
Frequency [3]	8.0	9.5	12	GHz
P_{out} [2]	300	325	-	mW

Devices may be selected to suit customers' specific requirements

[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.

[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 single loaded epoxy, such as Epotek H40, may be used.

[5] The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

GUNN EFFECT DEVICE

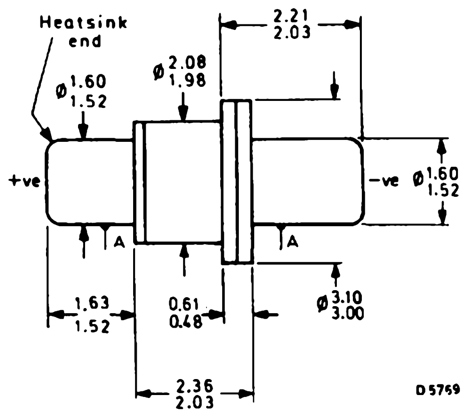
CXY 21

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

QUICK REFERENCE DATA		
Operating voltage	8.0	V
P_{tot} max. (T_{mb} = 70 °C)	2.5	W
Operating frequency range	8.0 to 12	GHz
P_{out} typ. (at f_o = 9.5 GHz)	50	mW

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. [1]	10	V
V max. (for less than 1 ms.)	12	V
P_{tot} max. (T_{mb} = 70 °C)	2.5	W
T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

	Min.	Typ.	Max.	
Frequency range [2]	8.0	-	12	GHz
D.C. operating current (at V = 9.5 V)	-	210	265	mA
→ Power output [3]	40	50	-	mW

OPERATING NOTES

1) The heatsink end is positive. Bias must be applied in such a way that the mounting base end of the device is always positive. Reversal of the bias will cause permanent damage. Care should be taken to prevent the device from transients. An 11 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 power output is normally measured in a coaxial cavity at approximately mid-band frequency. The bias may be optimized to give maximum power output 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 single loaded epoxy such as Epotek H40, may be used.

5) The power supply should be low impedance voltage regulated and be capable of supplying 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements.

GUNN EFFECT DEVICES

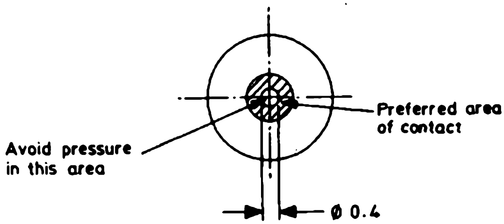
Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. They are encapsulated in metal-ceramic packages suitable for mounting in various types of cavity. The devices will oscillate in Q-band (Ka-band), the actual frequency being determined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

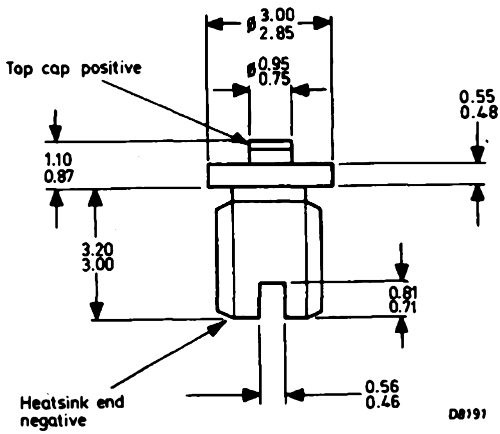
QUICK REFERENCE DATA

Operating frequency range		30 to 38	GHz
Operating voltage	typ.	3.5	V
Operating current	typ.	0.8	A
Power output at 34 GHz CXY24A	min.	25	mW
CXY24B	min.	50	mW

MECHANICAL DATA

Dimensions in mm





RATINGS

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

Transient supply voltage (note 1)	max.	6.0	V
Continuous supply voltage	max.	note 2	
Power input (note 2)	max.	4.0	W
Storage temperature range		−55 to +150	°C
Operational stud temperature (note 3)	max.	+70	°C

CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

		min.	typ.	max.	
Frequency (notes 4,5)		30	34	38	GHz
Operating voltage (notes 1,2)		–	3.5	5.0	V
Operating current (note 6)		–	0.8	1.1	A
Threshold current		–	–	1.6	A
Power output (note 4)	CXY24A	25	30	–	mW
	CXY24B	50	60	–	mW

OPERATING NOTES

1. 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.
2. Each device is supplied with a maximum supply voltage recommendation for continuous operation, within the limits of operating voltage and power input specified above.
3. Good thermal conductivity is essential between the heatsink end of the device and the cavity.
4. Power output is normally measured in a waveguide cavity at a frequency of 34 GHz, at a voltage not exceeding the maximum recommended supply voltage (see note 2).
5. The frequency is governed by the choice of cavity to which the device is coupled.
6. The power supply should be low impedance, voltage regulated and capable of supplying current in excess of the threshold current.

Devices may be selected to suit customers' specific requirements

MIXER AND DETECTOR DIODES

C

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MICROWAVE MIXER/DETECTOR DIODE

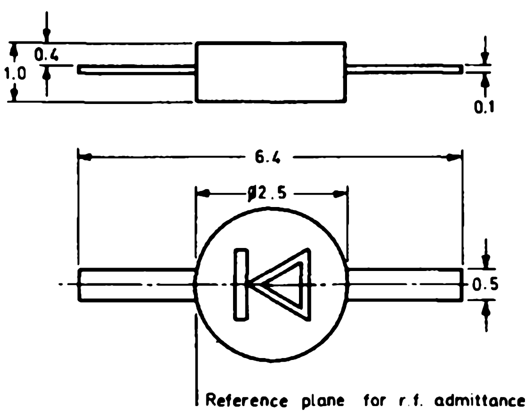
BAT10

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	1.0 to 12	GHz
Mixer:		
Typical noise figure in X-band	7.0	dB
Detector:		
Typical tangential sensitivity in X-band with 100 μA bias	-50	dBm
Typical current sensitivity in X-band with 50 μA bias	5.0	μA/μW

OUTLINE AND DIMENSIONS



All dimensions in mm D3108

LIMITING VALUES (Absolute max. rating system)

Electrical

Maximum peak pulsed r.f. input power at 9.375 GHz, 0.5 μs pulse length	1.0	W
Maximum burn out (multiple r.f. spike, ΔN_o = 1 dB)	20	nJ
	0.2	erg

Temperature

T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

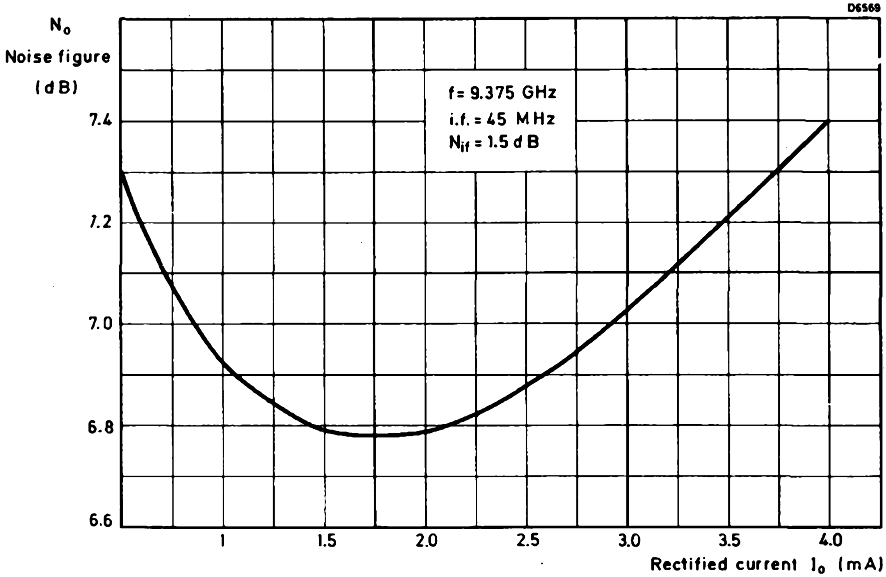
		Typ.	Max.	
Mixer				
N_o	Noise figure 1)	7.0	7.5	dB
v.s.w.r.	Voltage standing wave ratio 2)	-	2:1	
Z_{if}	Intermediate frequency impedance 3)	-	500	Ω
Detector				
S_{ts}	Tangential sensitivity 4)	-50	-	dBm
S_i	Current sensitivity 5)	5.0	-	μA/μW
v.s.w.r.	Voltage standing wave ratio 6)	-	5:1	
Z_v	Video impedance 7)	600	-	Ω
$\frac{1}{f}$	Noise	12	17	dB

NOTES

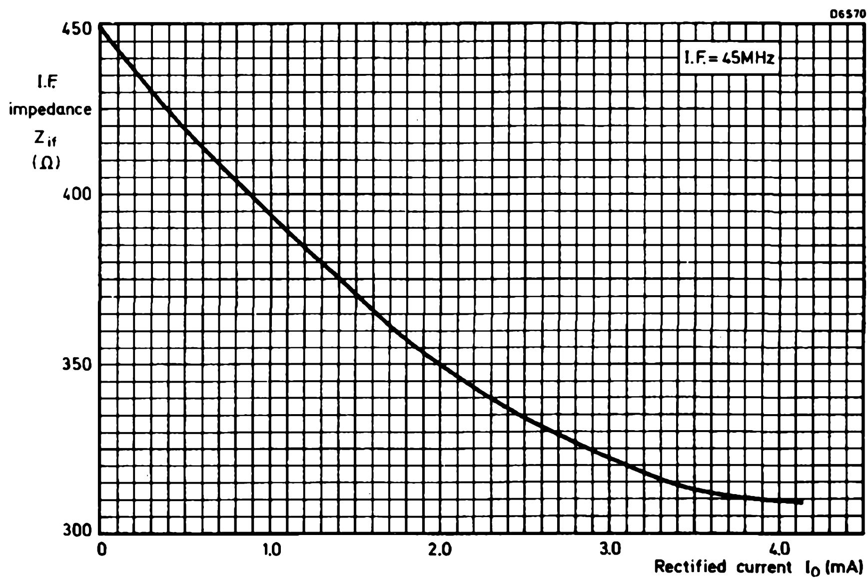
1. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω, i.f. = 45 MHz and i.f. noise figure = 1.5 dB. BS9300.
2. Measured with respect to 50 Ω at f = 9.375 GHz, rectified current = 2.0 mA, and load resistance = 10 Ω. BS9300.
3. Measured in a 50 Ω test mount 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.

MICROWAVE MIXER/DETECTOR DIODE

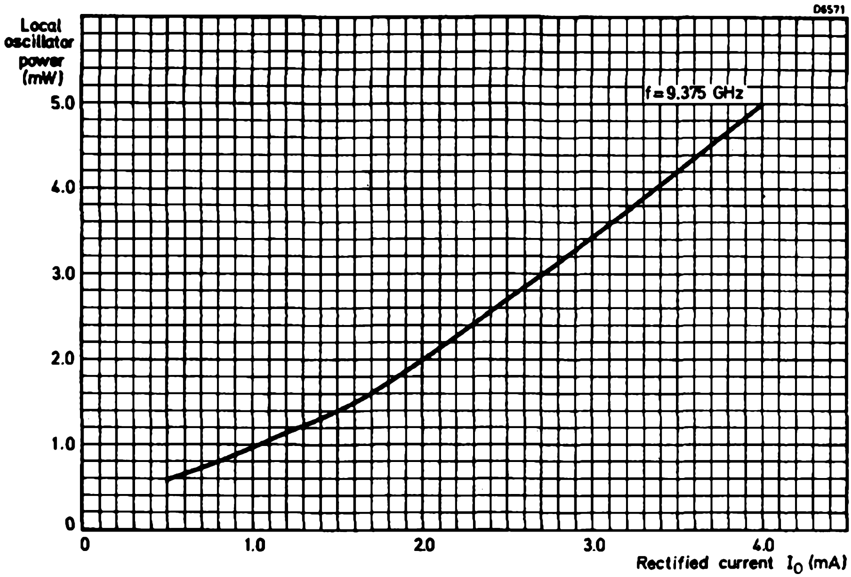
BAT10



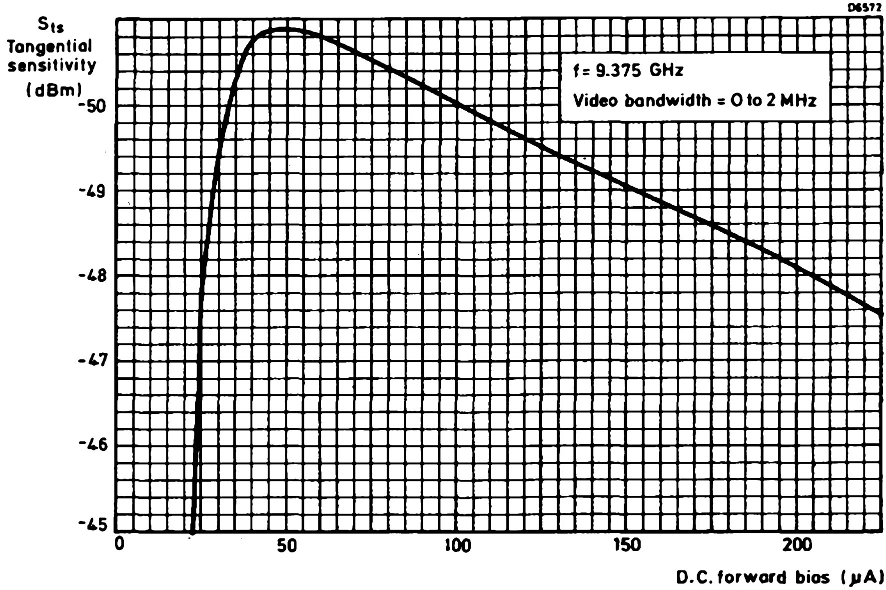
TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



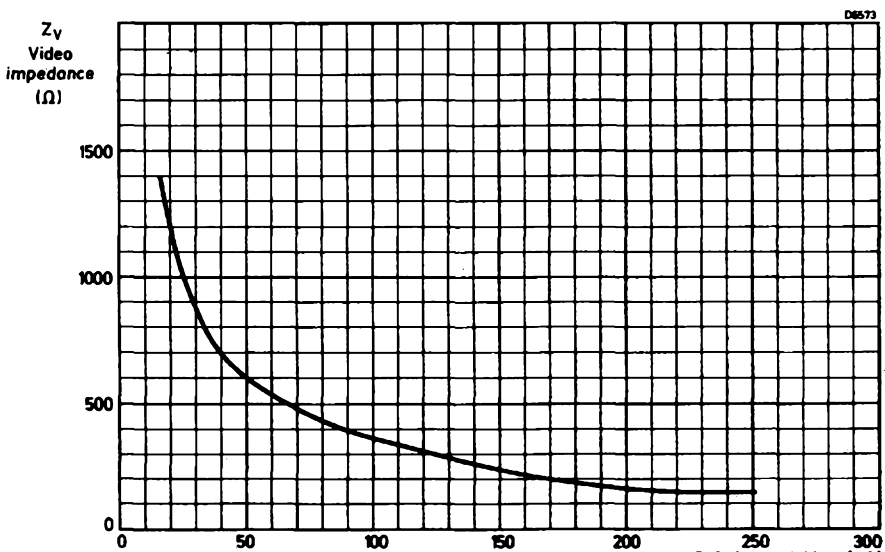
TYPICAL I.F. IMPEDANCE AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



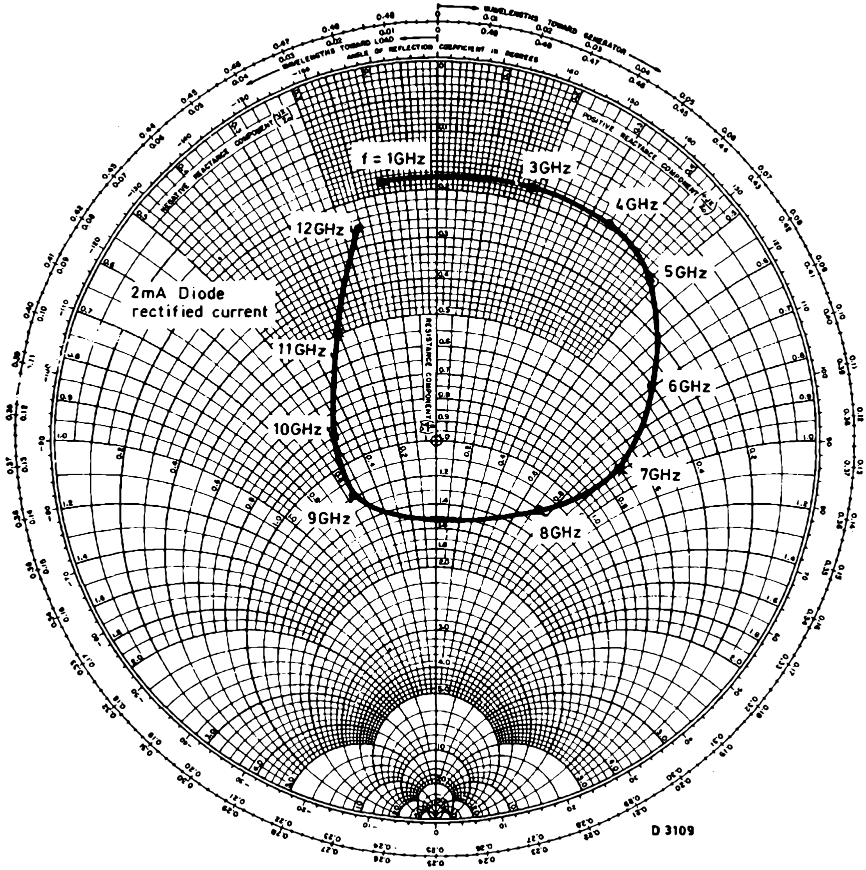
TYPICAL LOCAL OSCILLATOR POWER AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



TYPICAL TANGENTIAL SENSITIVITY AS A FUNCTION OF D.C. FORWARD BIAS CURRENT (DETECTOR APPLICATION)



TYPICAL VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS CURRENT. (DETECTOR APPLICATION)



TYPICAL ADMITTANCE AS A FUNCTION OF FREQUENCY

MICROWAVE MIXER DIODE

BAT11

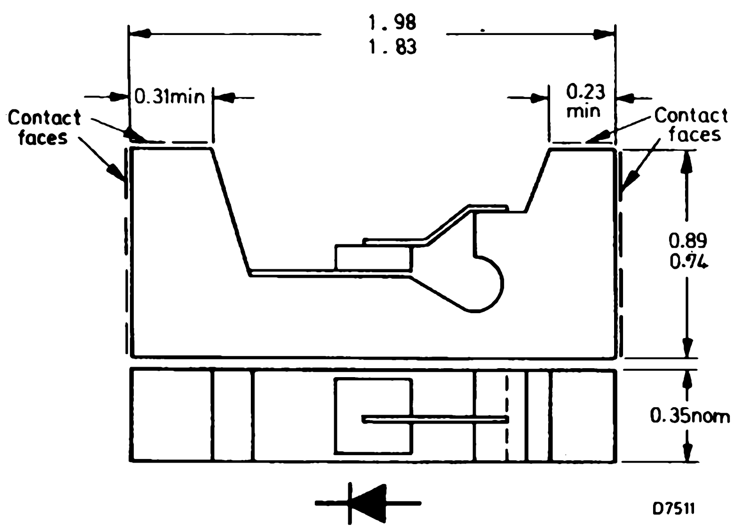
7

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/BAT11 M.

QUICK REFERENCE DATA		
Typical noise figure in X-band	6.5	dB
Frequency range	up to 12	GHz

MECHANICAL DATA

Dimensions in mm



D7511

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (r.f. spike)	20	nJ
	0.2	erg
Max. burn-out (multiple d.c. spike)	30	nJ
	0.3	erg

Temperature

T_{stg} range	-55 to +150	^{o}C
T_{amb}	-55 to +150	^{o}C

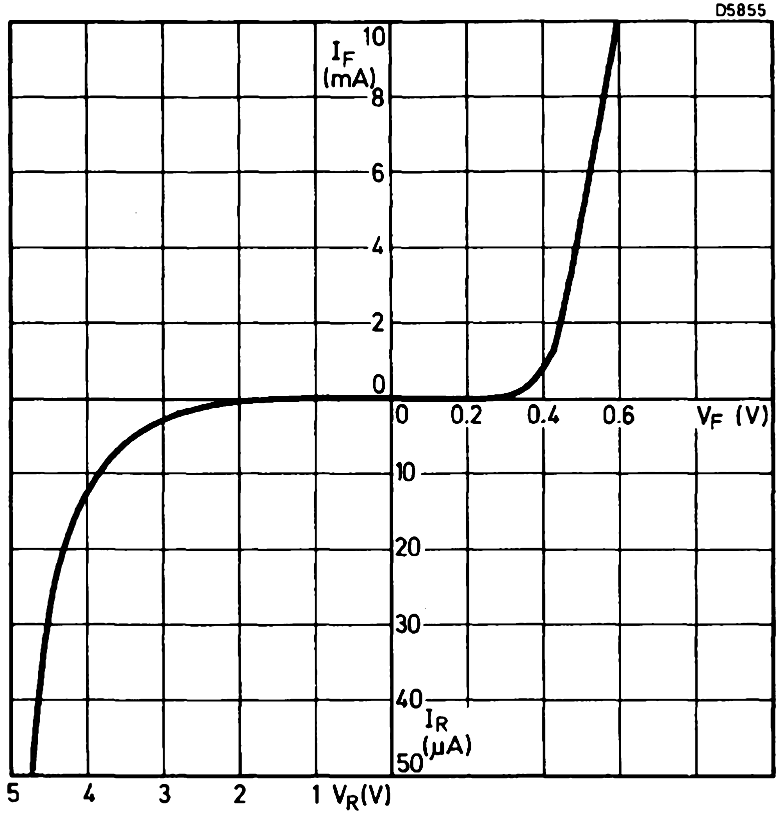
ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{o}C$)

		Min.	Typ.	Max.	
Dynamic					
N_o	Noise figure (see note 1)	-	6.5	7.0	dB
Z_{rf}	R.F. impedance spread referred to 50Ω bounded by co-ordinates (see note 2).		0.6 - j0.3 0.6 + j0.3	0.4 - j0.3 0.4 + j0.3	
Z_{if}	Intermediate frequency impedance (see note 3)	280	320	380	Ω
f	Operating frequency range	-	-	12	GHz

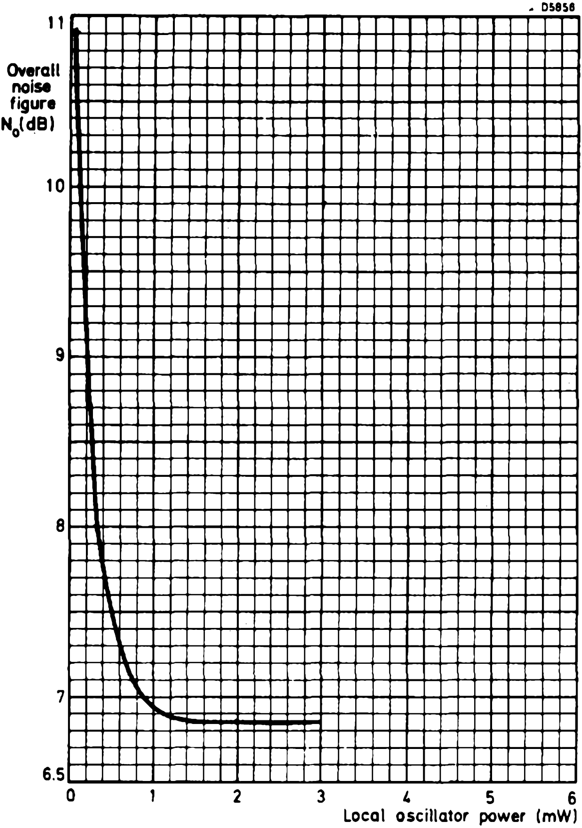
NOTES

1. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω. N_o includes N_{if} = 1.5dB with 45MHz intermediate frequency. BS9321/1406.
2. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω. BS9321/1409.
3. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω, intermediate frequency 45MHz, BS9321/1405.
4. Maximum out of balance condition for a matched pair:

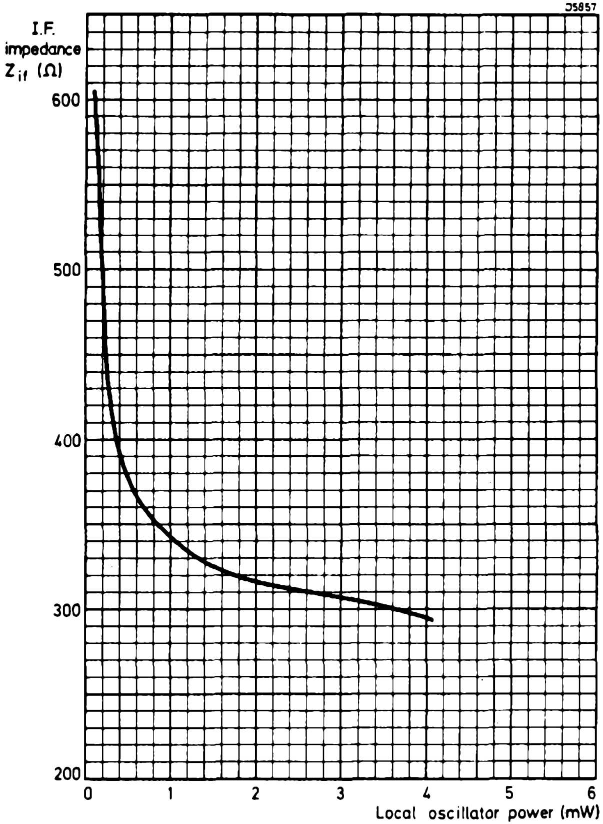
   a) 0.1mA rectified current.
   b) R.F. admittance 1.15:1 with other diode normalized to 50Ω.
5. The diode may be mounted on microstrip, using conventional thermocompression or micro-gap bonding techniques. Alternatively, the application of a single loaded epoxy, such as Epotek H40, may be used, followed by polymerisation at 150°C for 15 minutes. The force applied to the L.I.D. must not exceed 147mN (15gf).
6. Devices may be specially selected with the r.f. impedance measured at a customer's specific frequency in the range 8.4 to 12GHz.



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

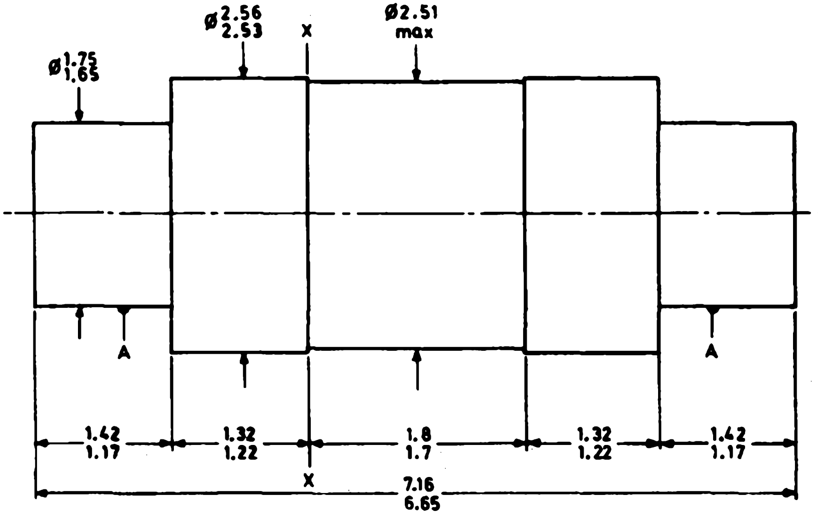
Subminiature silicon Schottky barrier mixer diode for use at Q-band (Ka-band) frequencies. Where applicable, this device conforms to the environmental requirements of BS9300.

QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm



XX = reference plane

AA = concentricity tolerance = ± 0.15

D2527a

Fig. 1

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	typ.	2.0	μA
Forward current V_F = 0.5 V	I_F	typ.	2.0	mA
Overall noise figure				
f = 34.86 GHz, rectified current = 0.5 mA		typ.	8.5	dB
N_o includes N_{if} of 1.5 dB (BS9321/1406)	N_o	<	10	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		typ.	1.4:1	
R_L = 15 Ω (BS9321/1409)	v.s.w.r.	<	1.8:1	
Intermediate frequency impedance				
f = 34.86 GHz, rectified current = 0.5 mA		typ.	900	Ω
R_L = 15 Ω, i.f. = 45 MHz (BS9321/1405)	Z_{if}		700 to 1100	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.

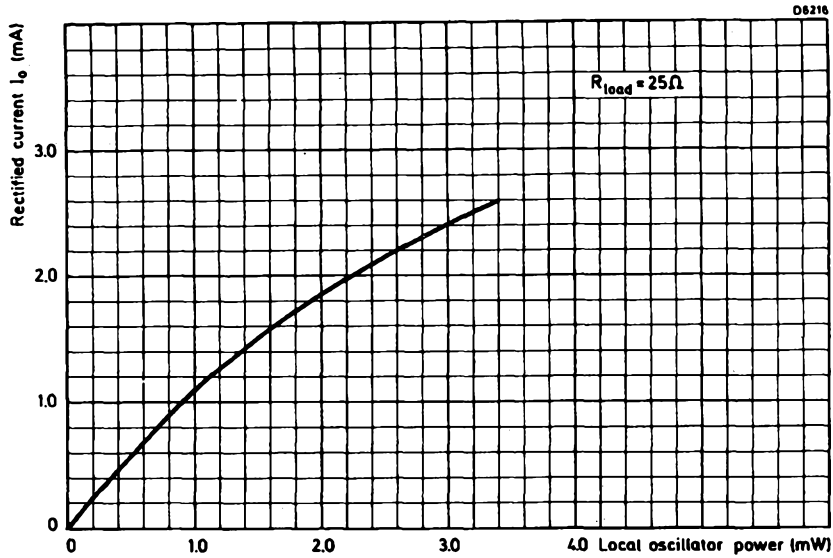


Fig.2 Typical rectified current as a function of local oscillator power at 34.86 GHz

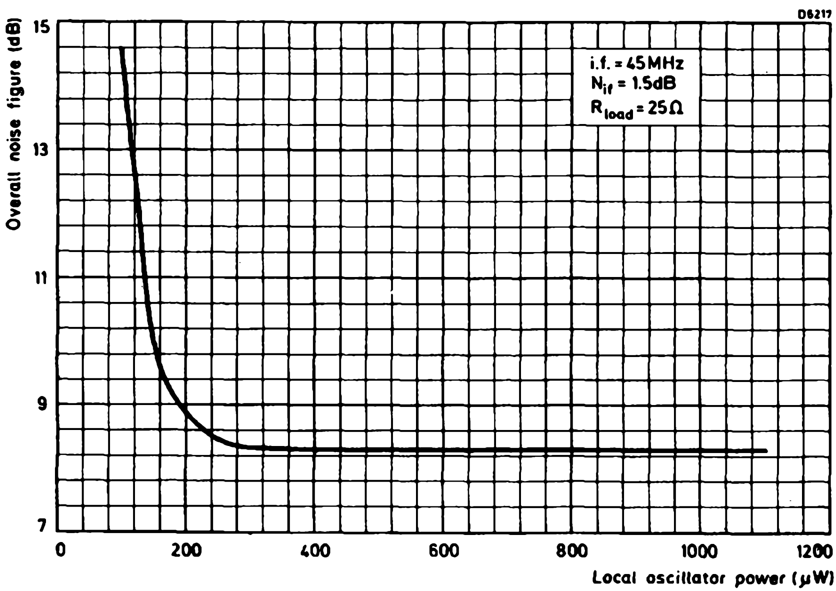


Fig.3 Typical overall noise figure as a function of local oscillator power at 34.86 GHz

MICROWAVE MIXER DIODES

BAT39 BAT39A

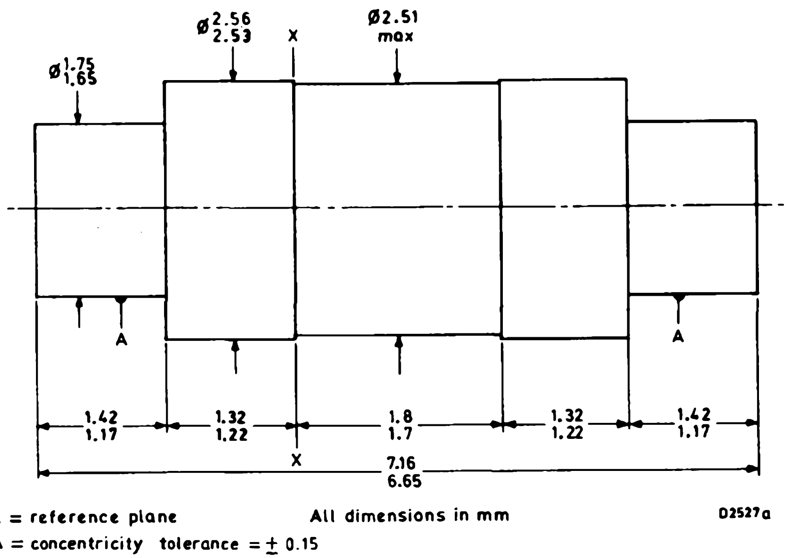
Subminiature silicon reversible Schottky barrier diodes primarily intended for low noise mixer applications in X-band. They are intended as retrofits for AAY39 and AAY39A. Available in a matched pair as 2/BAT39M.

QUICK REFERENCE DATA

Operating frequency			1.0 to 18	GHz
Noise figure at X-band	BAT39	typ.	6.0	dB
	BAT39A	typ.	7.0	dB

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA Dimensions in mm



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

ACCESSORIES

WG16 holders to fit these diodes are available from Marconi Instruments Ltd., (Sanders Division), Gunnels Wood Road, Stevenage, Herts.

RATINGS In accordance with the Absolute Maximum Ratings System (IEC134)

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

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	BAT39	N_o	5.5	6.0	6.5	dB
N_o includes N_{if} = 1.5 dB (BS9300/1406 Method B)	BAT39A	N_o	-	7.0	7.5	dB
Conversion loss	BAT39	L_c	-	4.2	-	dB
	BAT39A	L_c	-	5.0	-	dB
Noise temperature ratio						
I.F. = 45 MHz (BS9300/1407)	BAT39	N_r	-	1.1: 1	-	
	BAT39A	N_r	-	1.2: 1	-	
Voltage standing wave ratio						
f = 9.375 GHz, R_L = 15 Ω, rectified current = 1.0 mA (BS300/1409) Measured in standard test holder		v.s.w.r.	-	-	1.43: 1	
Intermediate frequency impedance						
f = 9.375 GHz, R_L = 15 Ω rectified current = 1.0 mA (BS9300/1405)		Z_{if}	250	-	450	Ω
Operating frequency range		f	1.0	-	18	GHz

OPERATING NOTE

Optimum performance is obtained with BAT39 and BAT39A 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.

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

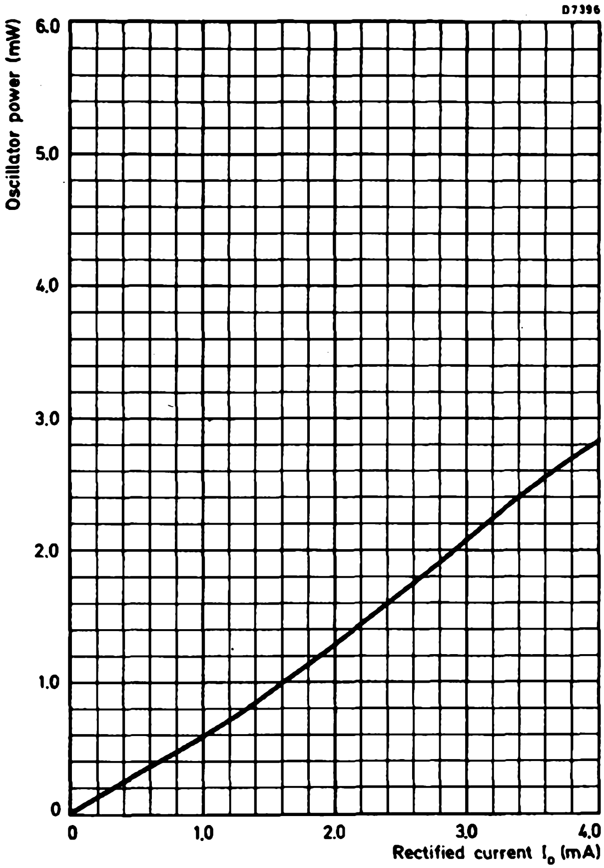
Detector performance

Tangential sensitivity at 9.375 GHz,

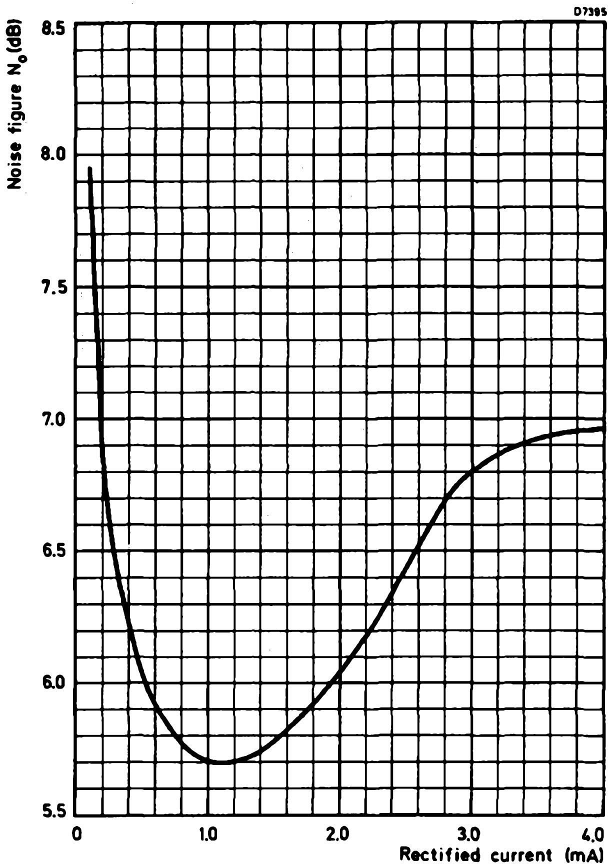
1 kHz to 1 MHz video bandwidth, I_F (bias) = 50 μA (BS9300/1411)	S_{ts}	typ.	-52	dbm

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

MICROWAVE MIXER DIODES

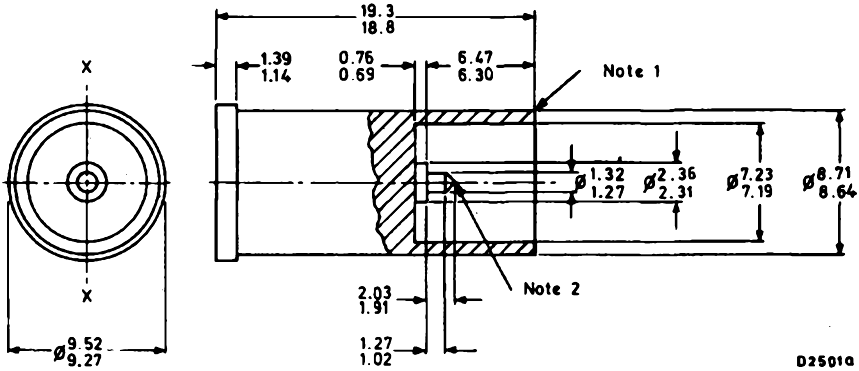
BAT50 BAT50R

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. 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

MECHANICAL DATA Dimensions in mm

Conforms to BS3934 SO-26



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 In accordance with the Absolute Maximum Rating System (IEC134)

Burn-out				
R.F. spike		max.	0.2	erg
Peak pulse power				
$t_p = 0.5\ \mu s$		max.	1.0	W
Temperatures				
Storage temperature	T_{stg}		-55 to +100	°C
Ambient temperature	T_{amb}		-55 to +100	°C

CHARACTERISTICS $T_{amb} = 25\ ^{o}C$

Reverse current $V_R = 0.5$ V	I_R		3.0	μA
Forward current $V_F = 0.5$ V	I_F		7.0	mA
Overall noise figure [1]				
f = 9.375 GHz, rectified current = 1.0 mA, $R_L = 15\ \Omega$, 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 [1] [2]				
f = 9375 ± 10% MHz, rectified current 1.0 mA $R_L = 15\ \Omega$, N_o includes $N_{if} = 1.5$ dB	v.s.w.r.	max.	1.43: 1	
Intermediate frequency impedance	Z_{if}	min. max.	300 500	Ω Ω
Operating frequency range	f	max.	12	GHz

---

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

MICROWAVE MIXER DIODES

BAT51 BAT51R

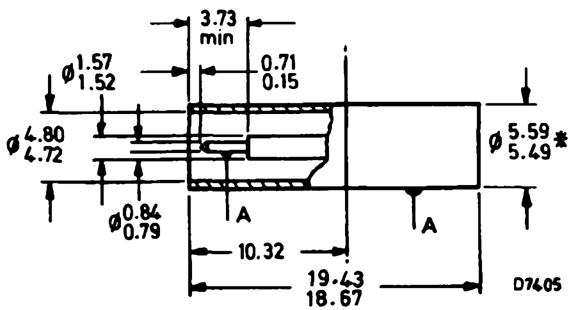
The BAT51 and BAT51R form a reverse pair of mixer diodes for use in balanced mixer circuits at J-band (Ku band). The diodes are of silicon Schottky barrier construction and are intended as retrofits for AAY51 and AAY51R. They are packaged in the standard coaxial outline for this band, similar to 1N78 types. The encapsulation is hermetically sealed and the diodes conform to the environmental requirements of BS9300 where applicable. Available as a matched pair as 2/BAT51 MR.

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

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA Dimensions in mm ←

DO-37



A = concentricity tolerance = ± 0.35

*These limits apply only over 10.32 dimension

Terminal identification

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

RATINGS In accordance with the Absolute Maximum System (IEC134)

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

CHARACTERISTICS T_{amb} = 25 °C

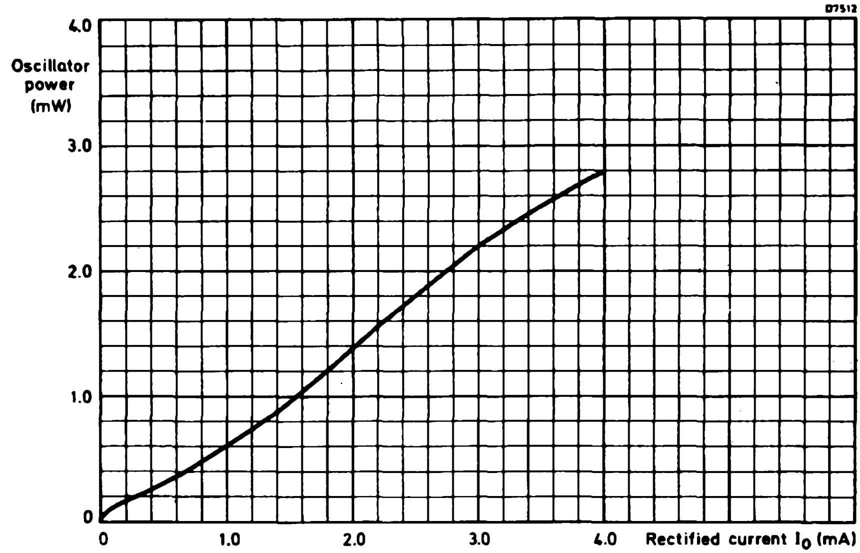
Reverse current V_R = 0.5 V	I_R	max.	0.2	μA
Forward current V_F = 0.5 V	I_F	typ.	7.0	mA
Overall noise figure				
f = 13.5 GHz, N_o includes N_{if} = 1.5 dB	N_o	typ.	7.0	dB
Measured in JAN 201 holder (BS9300/1406 Method A)	N_o	max.	7.5	dB
Conversion loss	L_C		5.2	dB
Noise temperature ratio				
I.F. = 45 MHz (BS9300/1407)	N_r		1.1:1	
Voltage standing wave ratio				
f = 13.5 GHz			1.5:1	
Intermediate frequency impedance	Z_{if}	min.	250	Ω
	Z_{if}	typ.	350	Ω
	Z_{if}	max.	450	Ω
Operating frequency range	f		12 to 18	GHz

FINISH

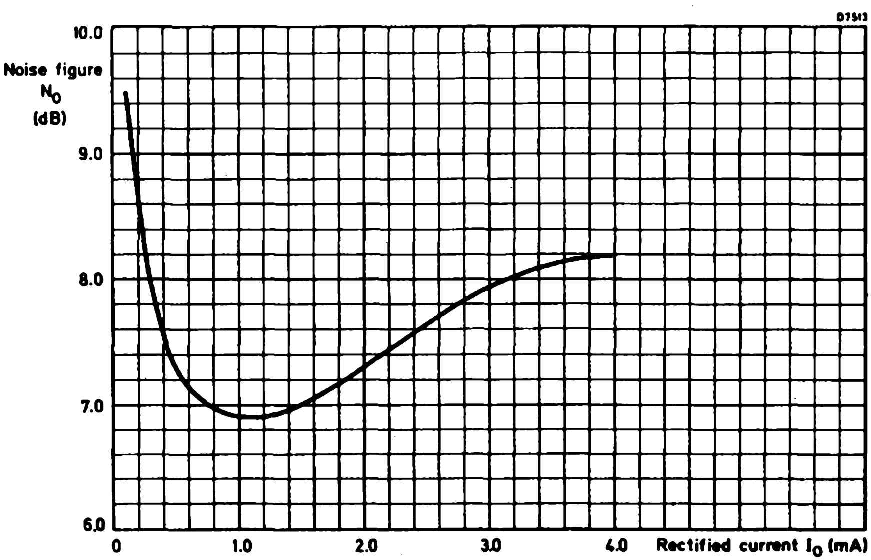
The bodies are cadmium plated in order to be compatible with an aluminium holder

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

BAT52 BAT52R

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 the devices conform to the environmental requirements of BS9300 where applicable. Available as a matched pair as 2/BAT52MR.

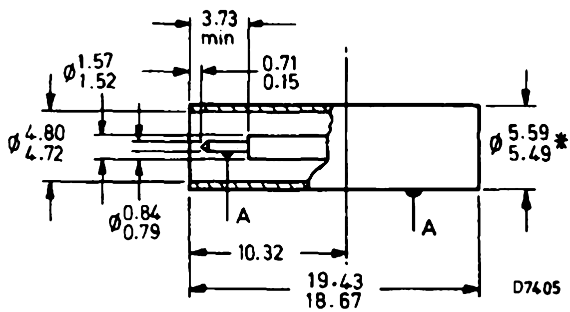
QUICK REFERENCE DATA			
Frequency range		12 to 18	GHz
Noise figure	typ.	8.0	dB

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA

Dimensions in mm

DO-37



A = concentricity tolerance = ±0. 35

*These limits apply only over 10. 32 dimension

Terminal identification

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

RATINGS In accordance with the Absolute Maximum System (IEC134)

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
Temperatures				
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.	0.2	μA
Forward current V_F = 0.5 V	I_F	typ.	7.0	mA
Overall noise figure				
f = 13.5 GHz, N_o includes N_{if} = 1.5 dB, Measured in JAN 201 holder (BS9300/1406 Method A)	N_o	typ.	8.0	dB
		max.	8.5	dB
Conversion loss	L_C		5.2	dB
Noise temperature ratio				
I.F. = 45 MHz (BS9300/1407)	N_r		1.1:1	
Voltage standing wave ratio				
→ f = 13.5 GHz, rectified current = 0.9 mA			1.5:1	
Intermediate frequency impedance		min.	250	Ω
	Z_{if}	typ.	350	Ω
		max.	450	Ω
Operating frequency range	f		12 to 18	GHz

FINISH

The bodies are cadmium plated in order to be compatible with an aluminium holder

MATCHED PAIR

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

MICROWAVE MIXER DIODE

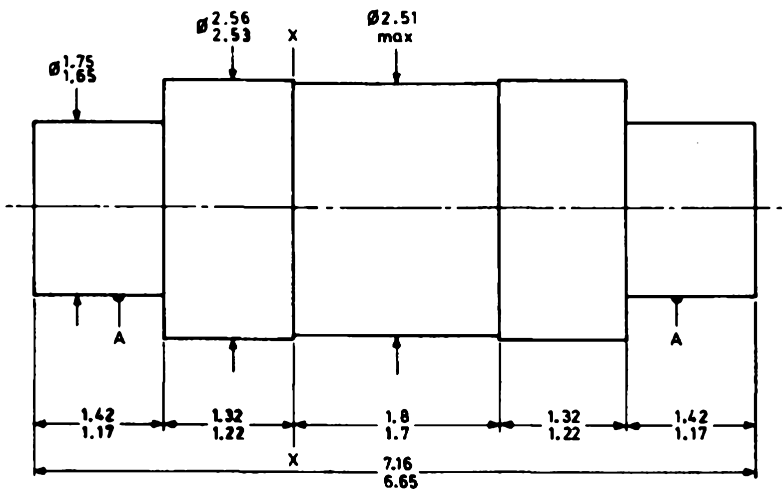
BAT59

Subminiature silicon Schottky barrier mixer diode for use at Q-band (Ka-band). Where applicable, this device conforms to the environmental requirements of BS9300.

QUICK REFERENCE DATA

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

MECHANICAL DATA Dimensions in mm



XX = reference plane D2527a

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 (at 9.375 GHz)

R.F. spike		max.	0.04	erg
Peak pulse power (t_p = 0.2 μs)		max.	0.5	W
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	typ.	2.0	μA
Forward current V_F = 0.5 V	I_F	typ.	2.0	mA
Overall noise figure				
f = 34.86 GHz, rectified current = 0.5 mA	N_o	typ.	8.5	dB
N_o includes N_{if} of 1.5 dB (BS9321/1406)		<	10	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 [1]				
f = 34.86 GHz, rectified current = 0.5 mA	v.s.w.r.	typ.	1.4:1	
R_L = 15 Ω (BS9321/1409)		<	1.8:1	
→ Intermediate frequency impedance				
f = 34.86 GHz, rectified current = 0.5 mA	Z_{if}	typ.	900	Ω
R_L = 15 Ω, i.f. = 45 MHz (BS9321/1405)			700 to 1100	Ω
Operating frequency range	f		26 to 40	GHz

MATCHED PAIRS

The diodes can be supplied in matched pairs under the type number 2/BAT59M. The diodes are matched to ±10% on rectified current and within 150 Ω i.f. impedance.

[1]) Standard test holder.

MICROWAVE MIXER DIODES

BAV22 BAV22R

Coaxial Schottky barrier diodes for use in pre-tuned X- and S-band low noise mixer circuits. The diodes are suitable as replacements for most British coaxial point contact types in these bands, for example, GEM3, GEM4, CV7108, CV7109, CV2154 and CV2155. They conform to the environmental requirements of BS9300 where applicable. Available as a matched pair as 2/BAV22MR.

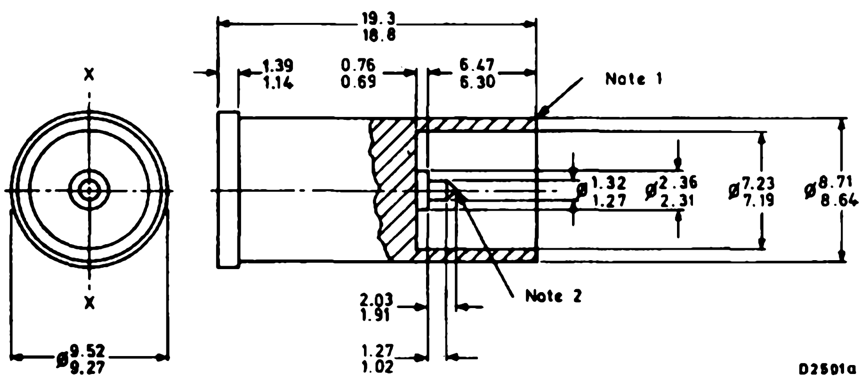
QUICK REFERENCE DATA

Operating frequency	max.	12	GHz
Noise figure at X-band	typ.	7.0	dB
at S-band	typ.	6.0	dB

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA Dimensions in mm

Conforms to BS3934 SO-26



Terminal identification

BAV22	Pin	cathode	BAV22R	Pin	anode
	Body (red spot)	anode		Body (green spot)	cathode

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Maximum peak pulse power (9.375GHz, 0.5μs pulse length)	1.0	W
Maximum burn-out		
multiple r.f. spikes, ΔN_o = 1dB	20	nJ
	0.2	erg
5000 d.c. spikes, ΔN_o = 1dB	35	nJ
	0.35	erg

Temperature

T_{stg} range	-55 to +100	^oC
T_{amb} range	-55 to +100	^oC

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

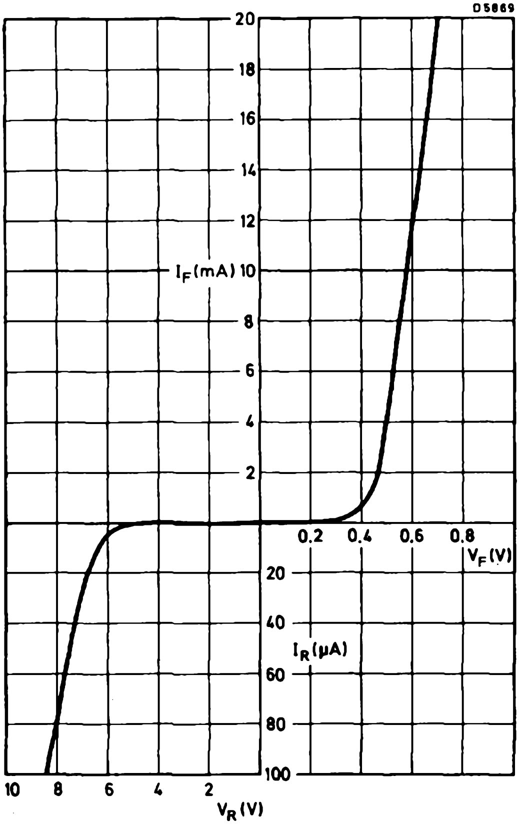
		Min.	Typ.	Max.	
N_o	Noise figure (see note 1)	-	7.0	7.5	dB
N_o	Noise figure (at 3GHz)	-	6.0	-	dB
v.s.w.r.	Voltage standing wave ratio (see note 2)	-	-	1.43:1	
v.s.w.r.	Voltage standing wave ratio (at 3GHz)	-	1.2:1	-	
Z_{if}	Intermediate frequency impedance (see note 3)	300	-	550	Ω

NOTES

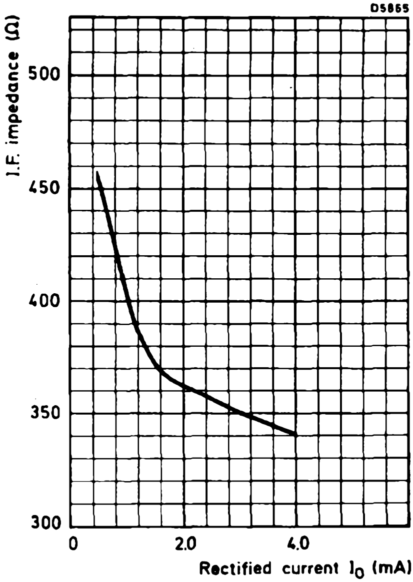
1. Measured at 9.375GHz, 1mA rectified current, R_L = 15Ω. N_o includes N_{if} = 1.5dB with 45MHz intermediate frequency. BS9321/1406.

2. With respect to CV2154 holder at 9.375GHz and 1mA rectified current, R_L = 15Ω. BS9321/1409.

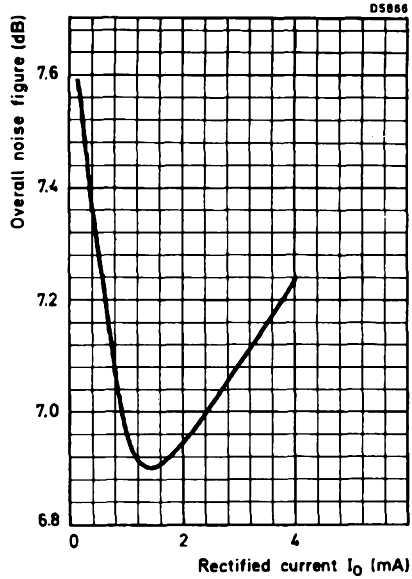
3. Measured at 9.375GHz, 1mA rectified current, R_L = 15Ω, i.f. = 45MHz. BS9321/1405.



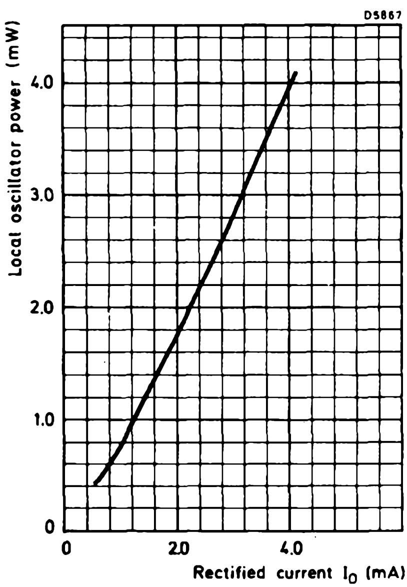
TYPICAL D.C. CHARACTERISTIC



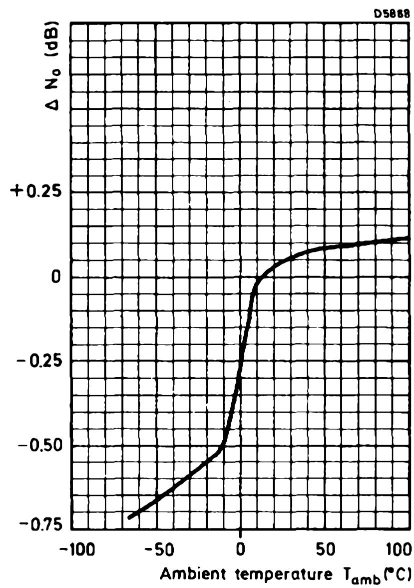
TYPICAL I.F. IMPEDANCE
AGAINST RECTIFIED CURRENT



TYPICAL OVERALL NOISE FIGURE
AGAINST RECTIFIED CURRENT



TYPICAL LOCAL OSCILLATOR POWER
AGAINST RECTIFIED CURRENT



TYPICAL CHANGE IN OVERALL NOISE
FIGURE AGAINST TEMPERATURE

X-BAND MIXER/DETECTOR DIODE

Silicon Schottky barrier diode in DO-23 (1N23) 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.

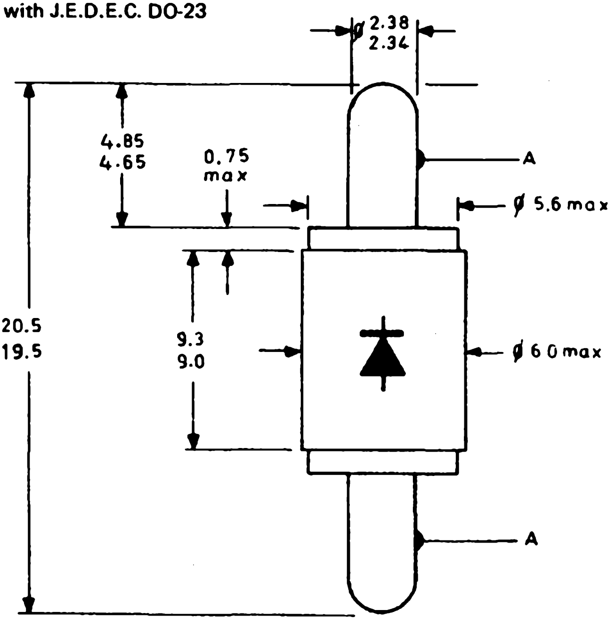
QUICK REFERENCE DATA

Mixer mode			
Voltage output for −90 dBm input power at X-band	typ.	40	μV
$^1/_f$ noise at a frequency 1 Hz to 1 kHz from carrier	typ.	1.0	μV
Detector mode			
Tangential sensitivity in bandwidth 0 to 2 MHz	typ.	−55	dBm

MECHANICAL DATA

Dimensions in mm

Compatible with J.E.D.E.C. DO-23



A = concentricity tolerance = ± 0.2

D4867a

Terminal identification: diode symbol indicates polarity

Accessory: collet type 56321 (see page 4) converts BAV46 to DO-22 outline

RATINGS

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

Storage temperature range	T_{stg}		−20 to +100	°C
Ambient temperature range for operation	T_{amb}		−20 to +100	°C
Reverse voltage	V_R	max.	2	V
Forward current	I_F	max.	10	mA

CHARACTERISTICS (T_{amb} = 25 °C)

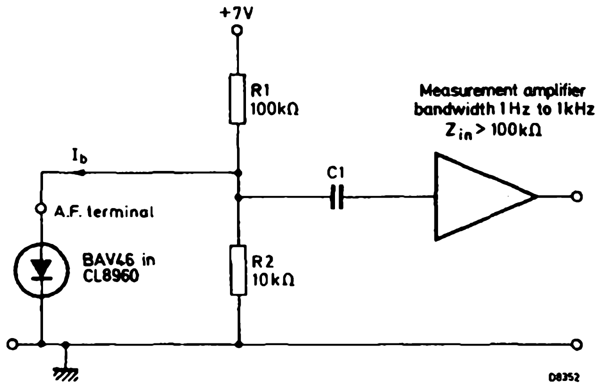
Forward voltage at I_F = 1 mA	V_F	typ.	0.5	V
Reverse current at V_R = 2 V	I_R	max.	2	μA
Mixer mode				
Voltage output at X-band (notes 1 and 2)	V_o	min.	15	μV
	V_o	typ.	40	μV
$1/_f$ noise (note 3)	N_f	typ.	1.0	μV
	N_f	max.	2.0	μV
Detector mode				
Tangential sensitivity (note 4)	S_{ts}	min.	−52	dBm
	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 Mullard 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.

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.

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

3. Noise measured at a frequency 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.

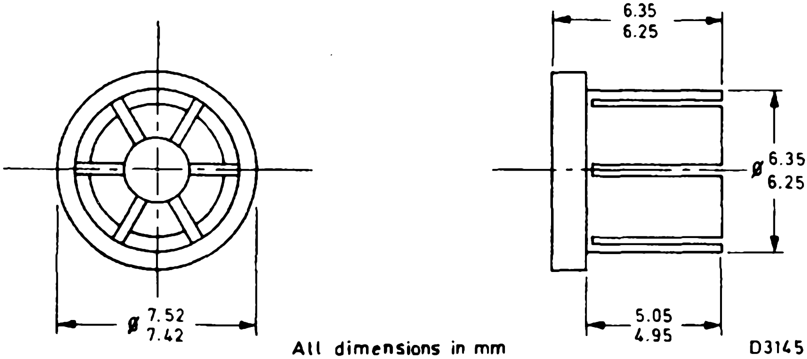
OPERATING NOTES

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.

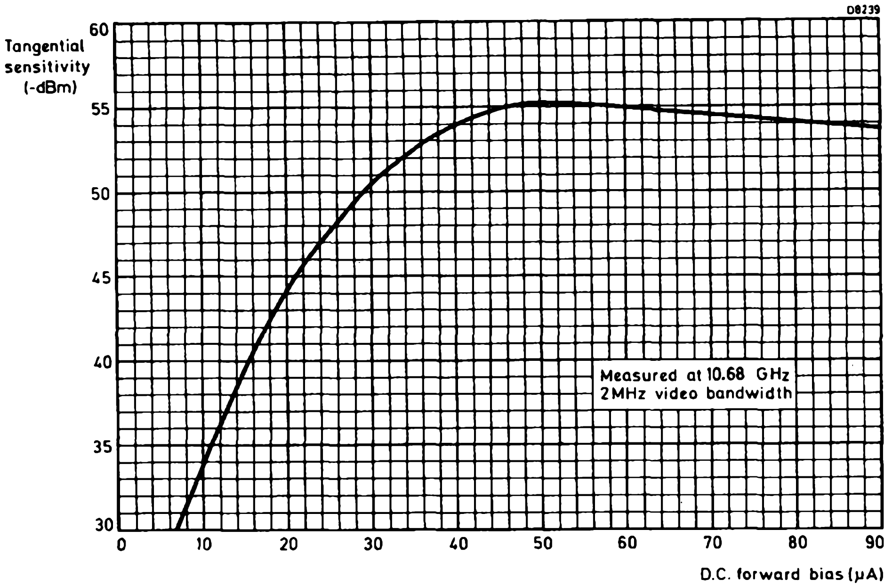
1. The mixer diode has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from the mains supply when soldering to the user's mixer a.f. terminals.
2. Precautions similar to those required for CMOS devices are 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 mixer 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 mixer a.f. and earth 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. It may be increased to 100 μA without affecting sensitivity or noise level.

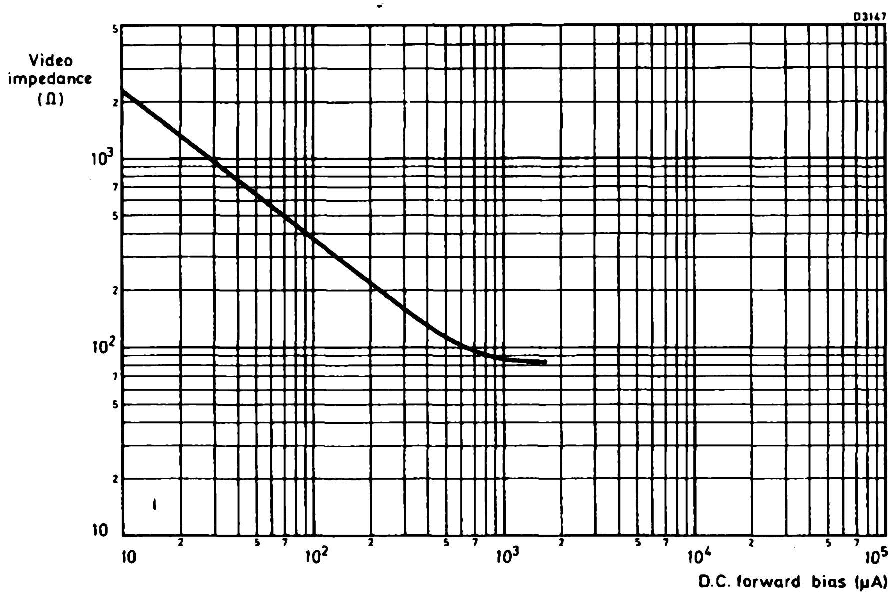
COLLET 56321

Dimensions in mm



All dimensions in mm


D8239
Tangential sensitivity (-dBm)
60
55
50
45
40
35
30
0
10
20
30
40
50
60
70
80
90
Measured at 10.68 GHz
2MHz video bandwidth
D.C. forward bias (μA)


D3147
Video impedance (Ω)
5
2
10³
7
5
2
10²
7
5
2
10
10
10²
10³
10⁴
10⁵
D.C. forward bias (μA)

MICROWAVE MIXER DIODE

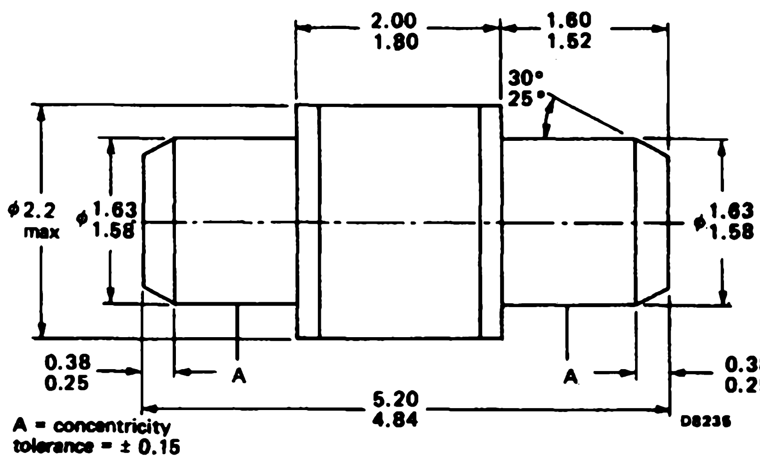
Silicon Schottky barrier mixer diode for use in low noise mixer applications in Q-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Frequency range		26 to 40	GHz
Noise figure	max.	10	dB

MECHANICAL DATA

Dimensions in mm



Terminal identification: red end indicates cathode

RATINGS

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

Burn-out (r.f. spike) (note 1)		max.	0.04	erg
Burn-out, peak pulse power		max.	1.0	W
Storage temperature range	T_{stg}		–55 to +150	^{o}C
Ambient temperature range	T_{amb}		–55 to +150	^{o}C

CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

Static

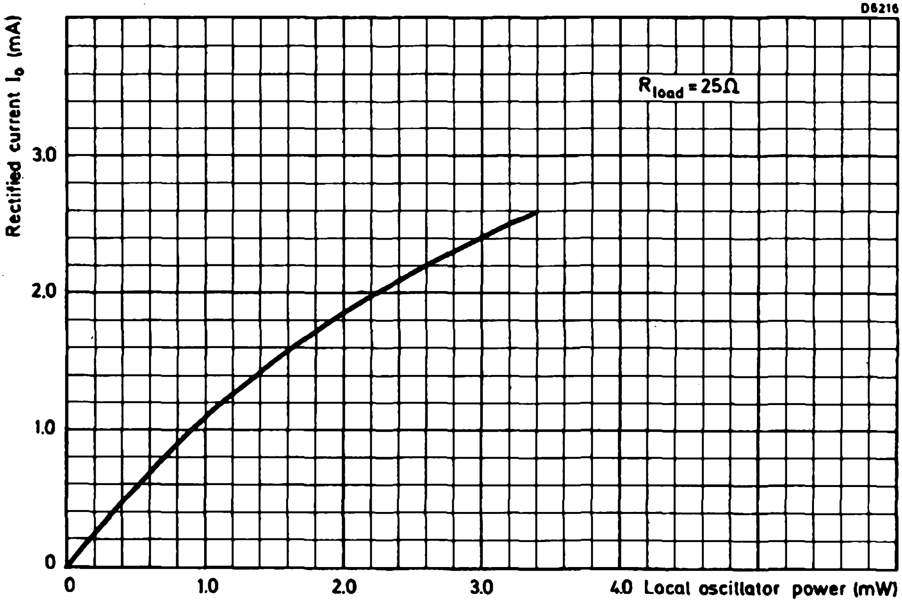
Reverse current (V_R = 0.5 V)	I_R	max.	0.2	μA
Forward current (V_F = 0.5 V	I_F	min.	0.5	mA

Dynamic

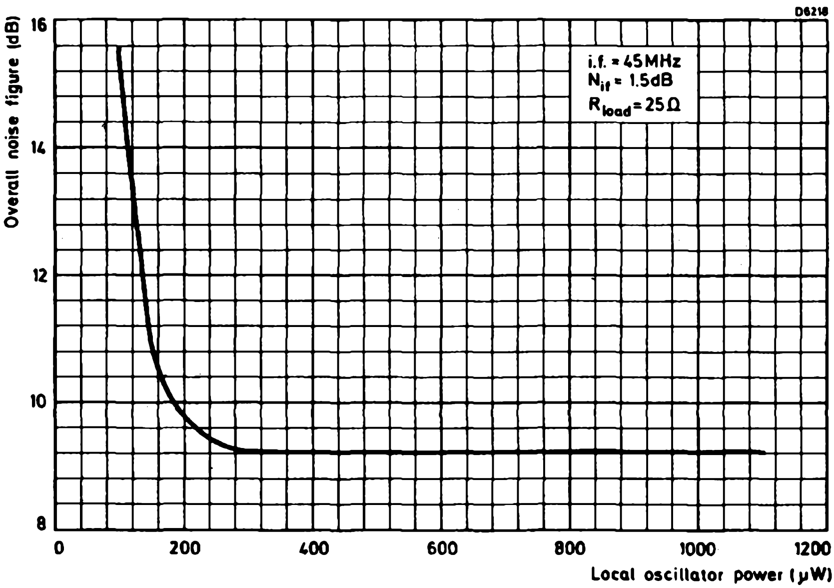
Noise figure (note 2)	N_o	max.	10	dB
Voltage standing wave ratio (note 3)	v.s.w.r.	max.	1.8:1	
Intermediate frequency impedance (note 4)	$Z_{i.f.}$	min.	700	Ω
		max.	1100	Ω
Frequency range	f	min.	26	GHz
		max.	40	GHz
Conversion loss (note 5)	L_c	typ.	5.9	dB
Noise temperature ratio (note 6)	N_r	typ.	1.4:1	

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 ^{o}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 No.1406.
3. Measured with a local oscillator frequency of 34.86 GHz, I_o = 0.5 mA, load resistance = 15 Ω, BS9300 No.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 No.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 Mullard Ltd.



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

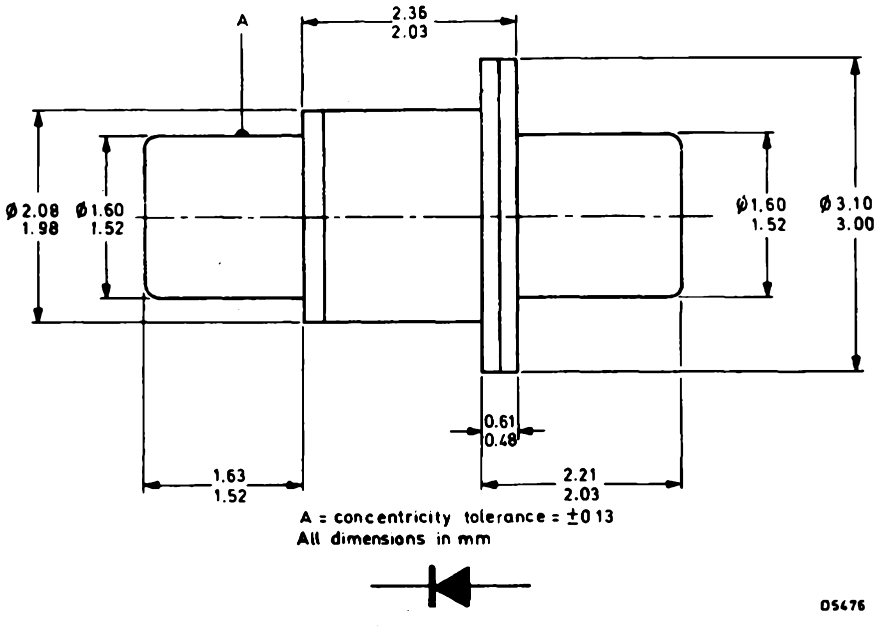
BAV75

Silicon Schottky barrier diode in SO-86 outline, 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	8.0 to 12	GHz
Tangential sensitivity (typ.) with 100 μA bias	-50	dBm

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

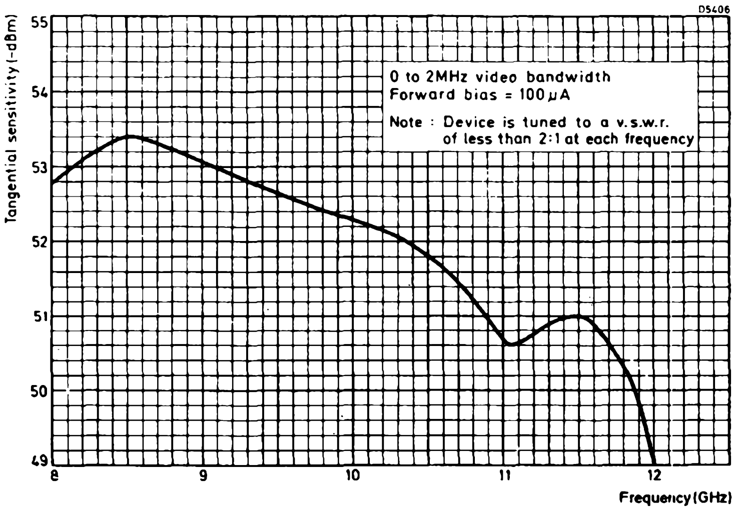
Peak pulse power (max.) at 9.375 GHz 0.5 μs pulse length	0.75	W
Temperature		
T_{stg} range	-55 to +150	^oC
T_{amb} range	-55 to +150	^oC

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25^oC$)

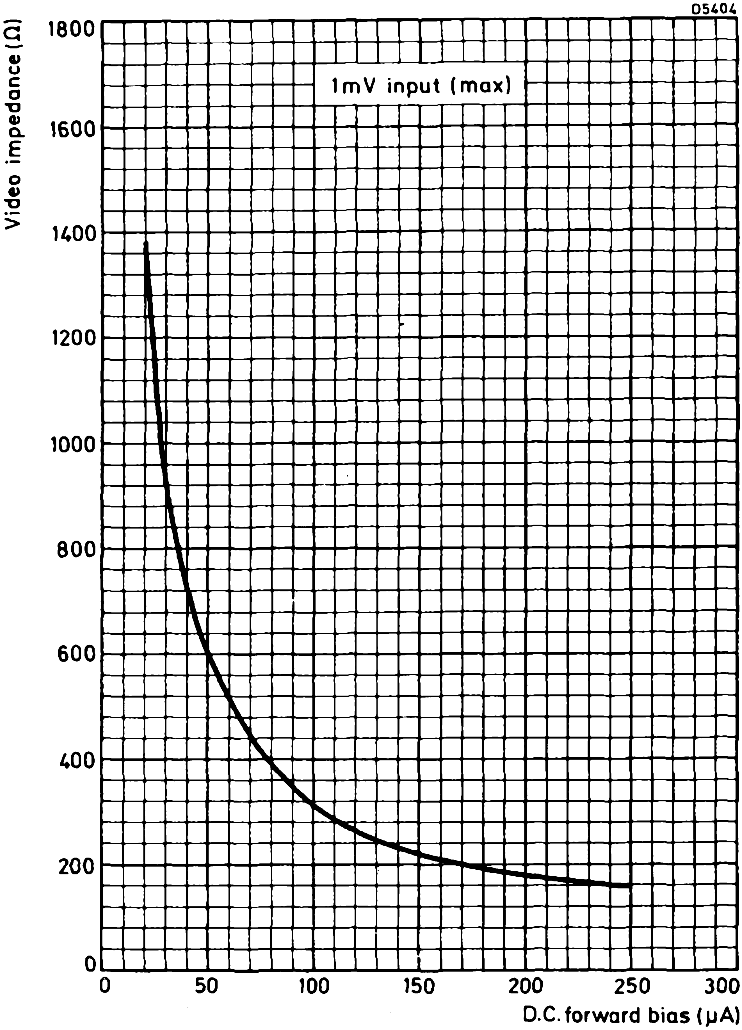
		min.	typ.	max.	
v.s.w.r.	Voltage standing wave ratio (see notes 1, 2, and 3)		2:1		
Z_v	Video impedance (see notes 4 and 5)		310		Ω
S_{ts}	Tangential sensitivity (see notes 1 and 2)	-49	-50		dBm
$1/f$	Flicker noise (see notes 4 and 6)		10	15	dB

NOTES

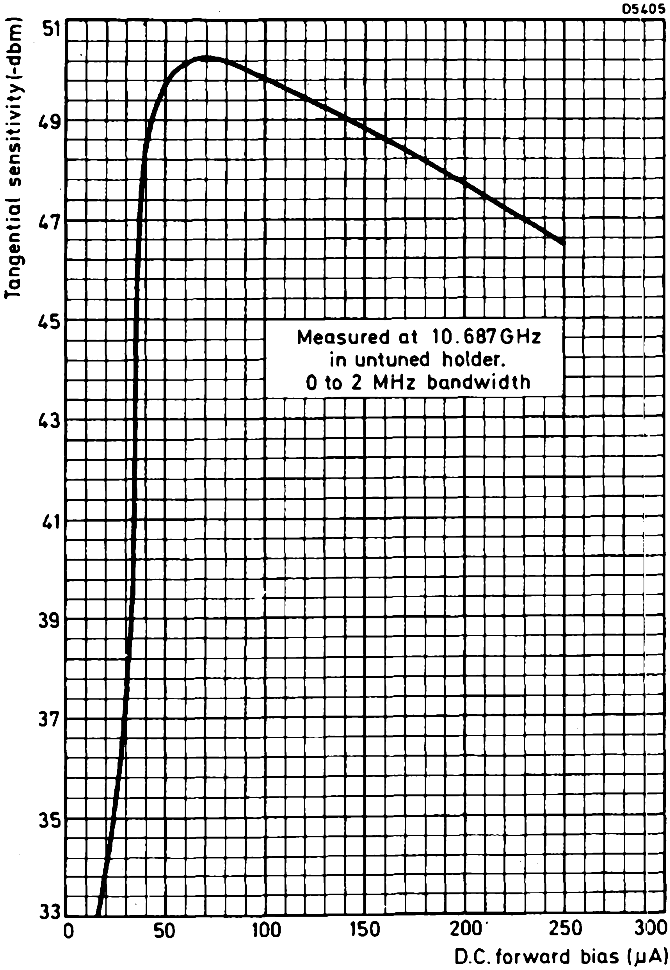
1. Measured at 10.687 GHz with 100 μA forward bias.
2. Measured in a reduced height waveguide mount, (Sanders 6521, modified).
3. R.F. input power less than 5.0 μW.
4. Measured with 100 μA forward bias.
5. Maximum d.c. input voltage = 1.0mV.
6. a) Measured at an i.f. of 1kHz with 50Hz bandwidth.
   b) $1/f$ 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

BAV96A BAV96B BAV96C BAV96D

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

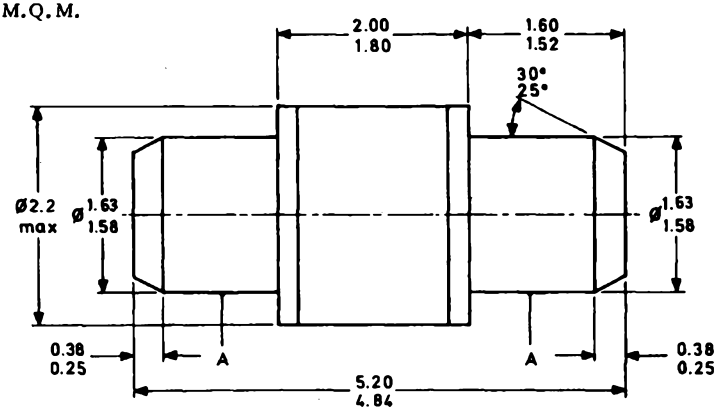
Maximum noise figure in X-band

BAV96A	7.5	dB
BAV96B	7.0	dB
BAV96C	6.5	dB
BAV96D	6.0	dB

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

M.Q.M.



All dimensions in mm A = concentricity tolerance = ±0.15 D1654a

Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Maximum burn out (see note 1)	15	nJ
	0.15	erg

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (Contd.)

Temperature

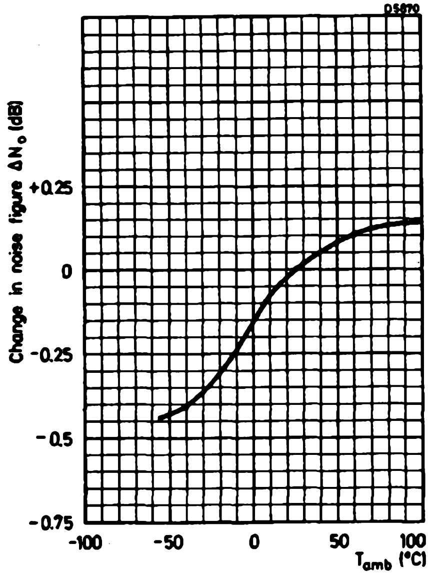
T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

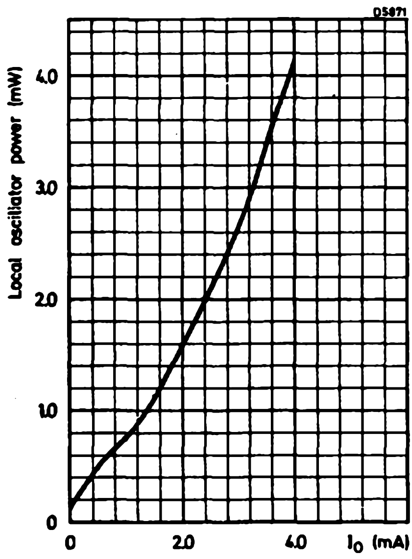
	Min.	Typ.	Max.	
N_0 noise figure (see note 2)				
BAV96A	-	7.0	7.5	dB
BAV96B	-	6.5	7.0	dB
BAV96C	-	6.0	6.5	dB
BAV96D	-	5.5	6.0	dB
v.s.w.r. (see note 3)				
BAV96A	-	1.7:1	2.0:1	
BAV96B	-	1.4:1	1.6:1	
BAV96C	-	1.4:1	1.6:1	
BAV96D	-	1.3:1	1.5:1	
Z_{if} i.f. impedance (see note 4)	250	-	450	Ω
S_{ts} tangential sensitivity (see note 5)	-	-52	-	dBm
S_{ts} (see note 6)	-	-54	-	dBm

NOTES

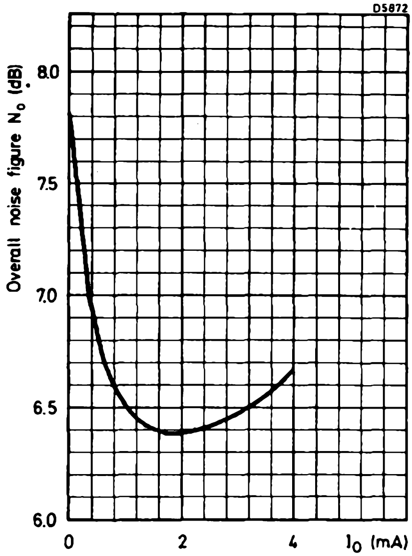
1. Burn out is defined as the r.f. pulse energy necessary to cause 1dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2ns width.
2. Measured at 9.375 ± 0.1GHz. The noise figure includes i.f. amplifier contribution of 1.5dB, i.f. 45MHz, d.c. return for diode 15Ω max., rectified current 1mA. BS9321/1406.
3. Measured in a reduced height waveguide mount under the same test conditions as in note 2. BS9321/1409.
4. I.F. = 45MHz, R_L = 15Ω, f = 9.375 ± 0.1GHz, I_0 = 1mA. BS9321/1405.
5. Video bandwidth 0 to 2MHz, 30μA bias. BS9322/1411.
6. Video bandwidth 1kHz to 1MHz, 30μA bias. BS9322/1411.
7. A suitable holder for this diode is a modified version of Sanders type 6521.



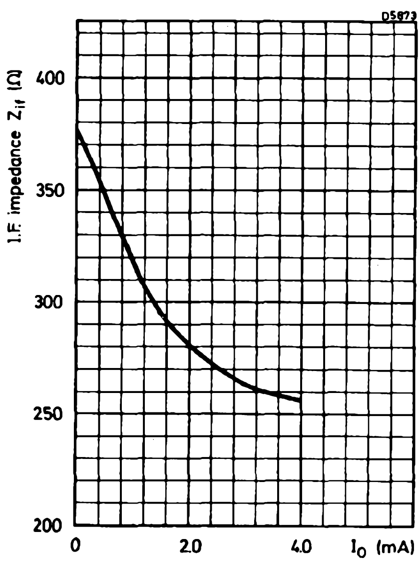
TYPICAL CHANGE IN OVERALL NOISE FIGURE
AS A FUNCTION OF TEMPERATURE



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

BAV97

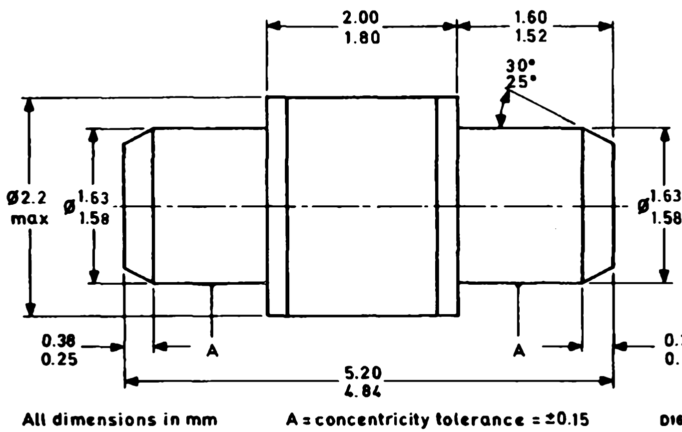
A reversible silicon Schottky barrier diode with excellent sensitivity and very low $\frac{1}{f}$ noise. It conforms to the environmental requirements of BS9300 where applicable.

The metal ceramic case is hermetically sealed.

QUICK REFERENCE DATA			
S_{ts}	Tangential sensitivity (typ.)	-54	dBm
$\frac{1}{f}$	noise (typ.)	10	dB

OUTLINE AND DIMENSIONS

M.Q.M.



Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Maximum burn out (see note 1)	18	nJ
	0.18	erg

Temperature

T_{stg} range	-55 to +150	^{o}C
T_{amb} range	-55 to +150	^{o}C

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{o}C$)

		Min.	Typ.	Max.	
S_{ts}	tangential sensitivity (see note 2)	-52	-54	-58	dBm
$\frac{1}{f}$	noise (see note 3)	-	10	15	dB
Z_v	video impedance (see note 4)	-	500	-	Ω

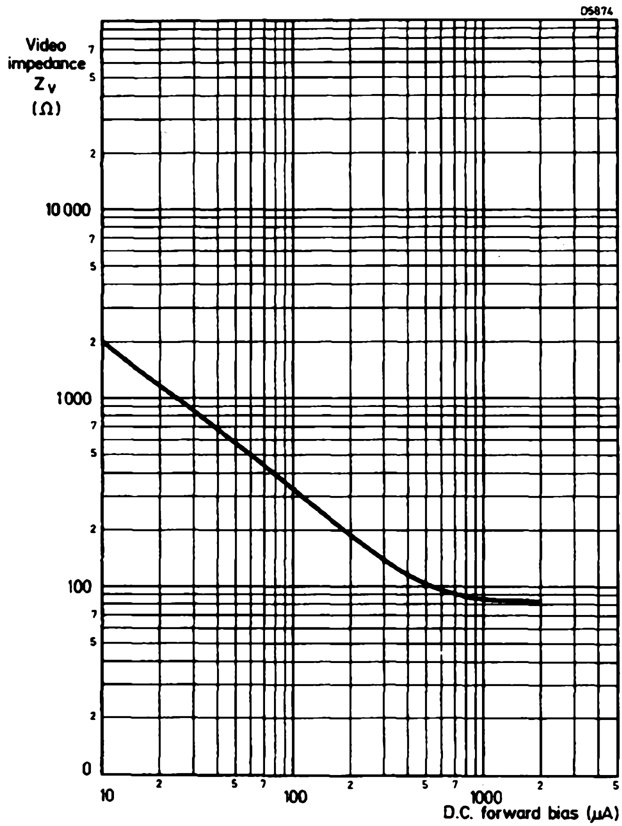
NOTES

1. Burn out is defined as the r.f. pulse energy necessary to cause 1dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2ns width.

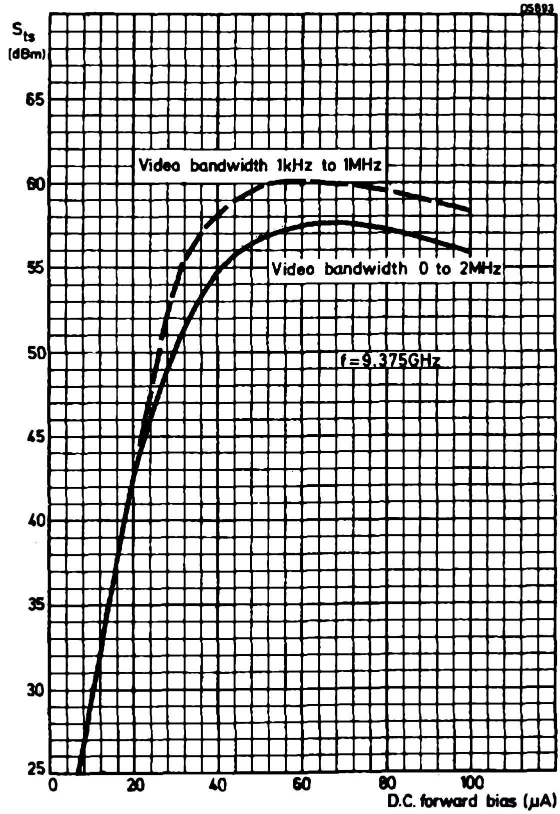
2. Video bandwidth 0 to 2MHz, 50μA bias, f = 9.375GHz. BS9322/1411. (A 2dBm improvement in tangential sensitivity may be obtained by limiting the bandwidth to 1kHz to 1MHz).

3. Measured at 30μA bias, f = 1kHz, 50Hz bandwidth. $\frac{1}{f}$ noise is unchanged with values of bias up to 150μA.

4. Measured at 50μA 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

BAW95D
BAW95E
BAW95F
BAW95G

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 the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

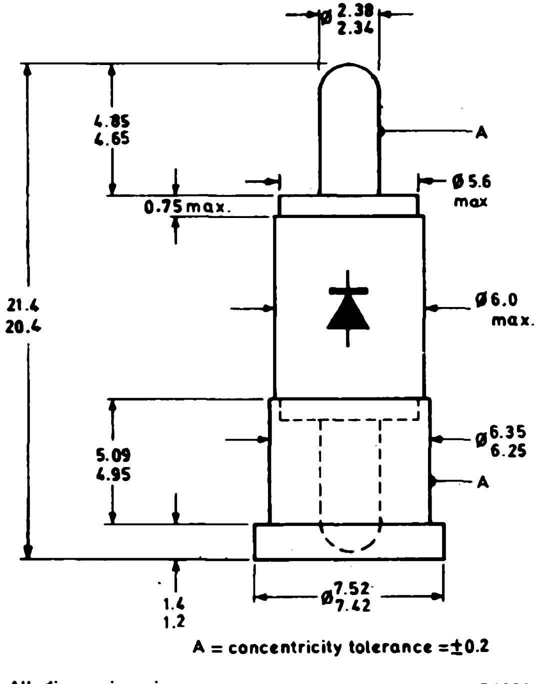
Maximum noise figure at X-band

BAW95D	8.2	dB
BAW95E	7.5	dB
BAW95F	7.0	dB
BAW95G	6.5	dB

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Compatible with J.E.D.E.C. DO-22 with collet
Compatible with J.E.D.E.C. DO-23 without collet



Terminal identification: Diode symbol indicates polarity.

LIMITING VALUES (Absolute max. rating system)

Electrical

Maximum peak pulse power (at 9.375 GHz, 0.5 μs pulse length)	1.0	W
→ Maximum burn out [1]	20	nJ
	0.2	erg

Temperature

T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C

		Min.	Typ.	Max.	
N_o	Noise figure [2]				
	BAW95D	-	7.8	8.2	dB
	BAW95E	-	7.2	7.5	dB
	BAW95F	-	6.8	7.0	dB
	BAW95G	-	6.3	6.5	dB
v.s.w.r.	Voltage standing wave ratio [3]	-	-	1.3:1	
z_{if}	Intermediate frequency impedance [4]	250	415	500	Ω

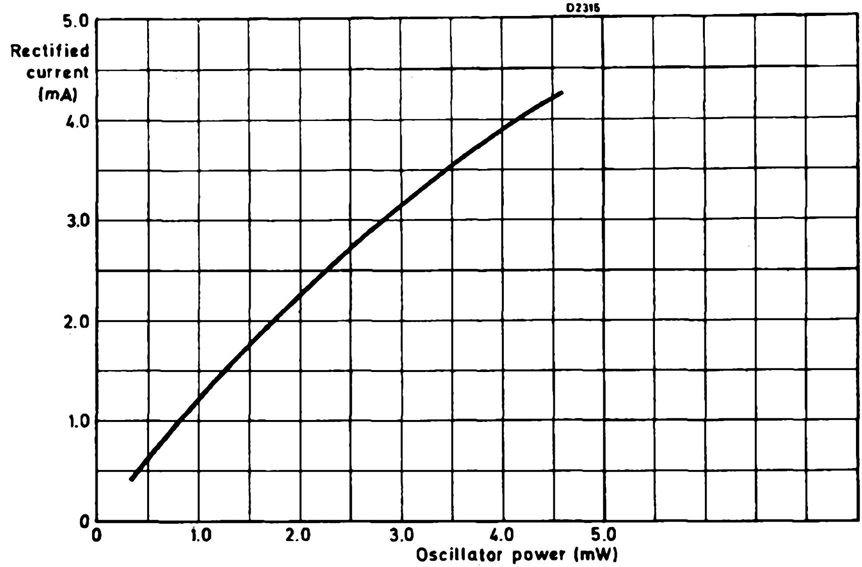
---

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

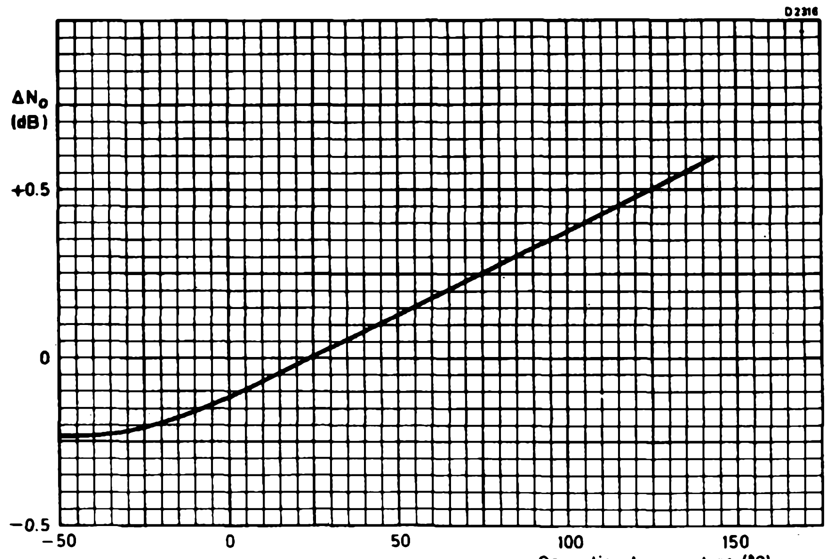
2) Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. N_o includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9321/1406

3) With respect to JAN-106 holder measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. BS9321/1409

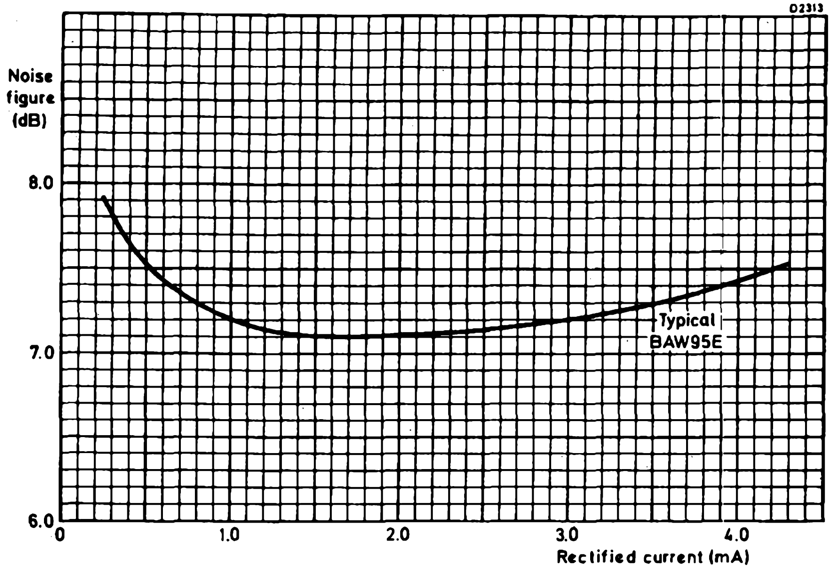
4) Measured at 9.375 GHz. 1 mA rectified current, R_L = 15 Ω with 45 MHz intermediate frequency. BS9321/1405



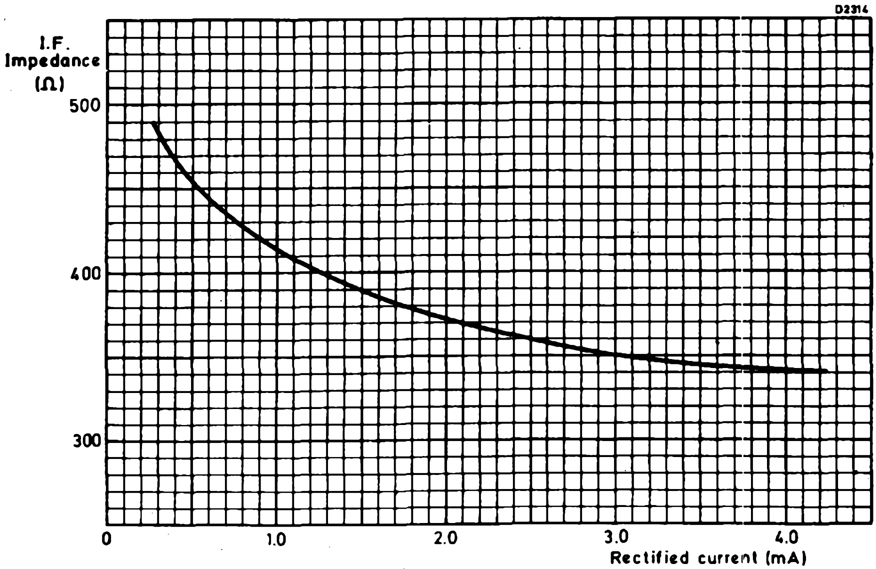
TYPICAL RECTIFIED CURRENT AS A FUNCTION OF LOCAL OSCILLATOR POWER



TYPICAL CHANGE IN NOISE FIGURE WITH TEMPERATURE



TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL DEPENDENCE OF I.F. IMPEDANCE ON RECTIFIED CURRENT

BACKWARD DIODES

D

D

MICROWAVE DETECTOR DIODE

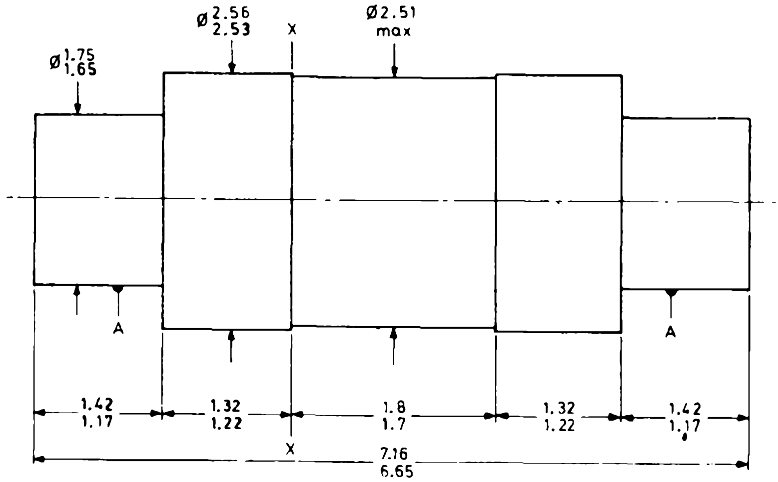
AEY17

Sub-miniature germanium bonded backward diode primarily intended for broadband low level detector applications at X-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Frequency range	1 to 18	GHz
Typ. zero bias tangential sensitivity in X-band	-53	dBm

OUTLINE AND DIMENSIONS



XX = reference plane

AA = concentricity tolerance = ± 0.15

All dimensions in mm

D2527a

TERMINAL IDENTIFICATION

The AEY17 is colour coded according to K1007 Issue 3, Section 1.3.4.4.
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 (ABSOLUTE MAXIMUM SYSTEM)

Temperature

T_{stg} max.	150	^oC
T_{stg} min.	-55	^oC
T_{amb} max.	150	^oC
T_{amb} min.	-55	^oC

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$)

		Min.	Typ.	Max.	
Static					
I_R	Reverse current				
	$V_R = 0.3V$	-	100	-	μA
I_F	Forward current				
	$V_F = 0.3V$	-	12	-	mA
Dynamic					
S_{ts}	Tangential sensitivity (see note 1)	-	-53	-	dBm
M	Figure of merit (see note 2)	120	-	-	
Z_v	Video impedance (see note 3)	-	300	-	Ω
v.s.w.r.	Voltage standing wave ratio (see note 4)	-	-	5:1	

Notes:

1. Measured at 9.375GHz, zero bias, video bandwidth = 1.0MHz. K1007 Issue 3, Section 8B.4.3.
2. Measured at 9.375GHz, M is taken as the product of current sensitivity expressed in μA per μW, and the square root of video impedance in ohms. K1007 Issue 3, Section 8B.4.2.
3. Zero bias, input 1.0mV max. (d.c. or a.c. r.m.s.). K1007 Issue 3, Section 8B.4.8.
4. With respect to 50Ω, measured at f = 9.375GHz, zero bias and c.w. input power less than 1.0μW. The nominal rectifier admittance at a reference plane X-X taken at the end faces of the ceramic insulator (see outline drawing on page 1) is:

$$(2.0 - j\,2.0)\,\frac{1}{50}\ \text{mho}$$

APPLICATION INFORMATION FOR AEY17

1. Detector performance at other than Test Radio Frequency

		Min.	Typ.	Max.	
S_{ts}	Tangential sensitity				
	f=1.0 to 18GHz, B=1.0MHz	-	-53	-	dBm
v.s.w.r.	Voltage standing wave ratio				
	f=1.0 to 18GHz, Z_o=50Ω	-	-	5:1	

2. Mixer performance (I.F. =45MHz)

		Min.	Typ.	Max.	
N_o	Measured overall noise figure				
	f=9.375GHz, N_{if}=1.5dB				
	$P_{L.O.}$=200μW, I_{out}=1.0mA	-	9.0	-	dB
	f=16.5GHz, N_{if}=1.5dB				
	$P_{L.O.}$=200μW, I_{out}=1.0mA	-	9.5	-	dB
z_{if}	I.F. impedance				
	I_{out}=1.0mA	-	130	-	Ω
v.s.w.r.	Voltage standing wave ratio				
	f=1 to 18GHz, Z_o=50Ω				
	I_{out}=1.0mA	-	-	2.5:1	

3. Doppler mixer performance (I.F. =3kHz)

		Min.	Typ.	Max.	
N_o	Measured overall noise figure				
	f=9.375GHz, N_{if}=2.0dB	-	18	-	dB

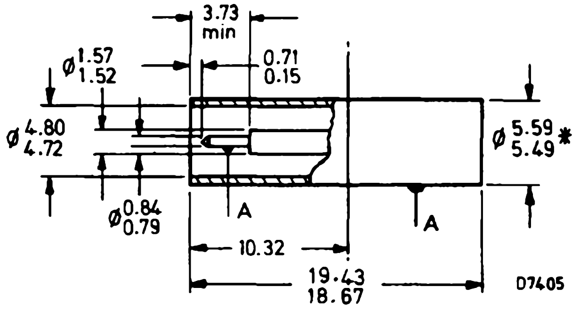
Germanium bonded backward diodes primarily intended for low level detector applications at J-band (Ku band). The AEY29 and AEY29R are packaged in the standard coaxial outline for this frequency band, similar to 1N78 types. The encapsulation is hermetically sealed and the devices conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA		
Frequency range	12 to 18	GHz
Typ. zero bias tangential sensitivity at J-band	-53	dBm

Unless otherwise stated, data is applicable to both types

MECHANICAL DATA — Dimensions in mm

DO-37



A = concentricity tolerance = ± 0.35

*These limits apply only over 10.32 dimensions

TERMINAL IDENTIFICATION

AEY29	Pin	cathode
	Body (red)	anode
AEY29R	Pin	anode
	Body (green)	cathode

→ RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

T_{stg} min.	-55	°C
T_{stg} max.	+85	°C
T_{amb} min.	-55	°C
T_{amb} max.	+85	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

		Min.	Typ.	Max.	
Static					
I_R	Reverse current V_R = 0.3V	-	100	-	µA
I_F	Forward current V_F = 0.3V	-	12	-	mA
Dynamic					
S_{ts}	Tangential sensitivity (see note 1)	-	-53	-	dBm
M	Figure of merit (see note 2)	50	-	-	
Z_v	Video impedance (see note 3)	-	300	-	Ω
v.s.w.r.	Voltage standing wave ratio (see note 4)	-	-	5:1	

Notes:

1. Measured at 16.5GHz in JAN201 holder, zero bias, 1.0MHz video bandwidth. (K1007 Issue 3, Section 8B.4.3.).

2. Measured at 16.5GHz in JAN201 holder, M is taken as the product of current sensitivity expressed in µA per µW, and the square root of video impedance in ohms. (K1007 Issue 3, Section 8B.4.2.).

3. Zero bias, input 1.0mV max. (d.c. or a.c. r.m.s.). (K1007 Issue 3, Section 8B.4.8.).

4. With respect to JAN201 holder, measured at f = 16.5GHz, zero bias and c.w. input power less than 1.0µW.

MICROWAVE DETECTOR DIODES

AEY31 AEY31A

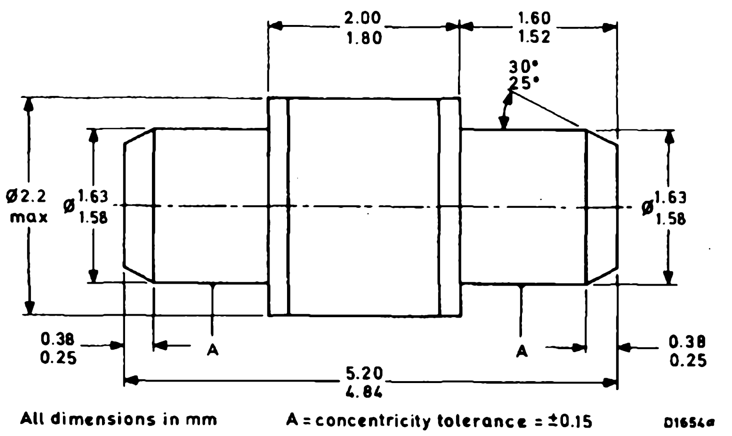
Sub-miniature germanium bonded backward diodes primarily intended for broad-band low level detector applications at X-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Frequency range	1 to 18	GHz
Typ. zero bias tangential sensitivity at X-band		
AEY31	-53	dBm
AEY31A	-50	dBm

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



TERMINAL IDENTIFICATION

The AEY31 and AEY31A are colour coded according to K1007 Issue 3, Section 1.3.4.4. 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 (ABSOLUTE MAXIMUM SYSTEM)

Temperature

T_{stg} max.	150	^{o}C
T_{stg} min.	-55	^{o}C
T_{amb} max.	150	^{o}C
T_{amb} min.	-55	^{o}C

ELECTRICAL CHARACTERISTICS ($T_{amb}=25^{o}C$)

		Min.	Typ.	Max.	
Static					
I_R	Reverse current				
	$V_R=0.3V$	-	100	-	μA
I_F	Forward current				
	$V_F=0.3V$	-	12	-	mA
Dynamic					
S_{ts}	Tangential sensitivity (see note 1)				
	AEY31	-	-53	-	dBm
	AEY31A	-	-50	-	dBm
M	Figure of merit (see note 2)				
	AEY31	120	-	-	
	AEY31A	50	-	-	
Z_v	Video impedance (see note 3)	-	300	-	Ω
v.s.w.r.	Voltage standing wave ratio (see note 4)	-	-	5:1	

Notes:

1. Measured at 9.375GHz, zero bias, video bandwidth = 1.0MHz. K1007 Issue 3, Section 8B.4.3.

2. Measured at 9.375GHz, M is taken as the product of current sensitivity expressed in μA per μW, and the square root of video impedance in ohms. K1007 Issue 3, Section 8B.4.2.

3. Zero bias, input 1.0mV max. (d.c. or a.c. r.m.s.). K1007 Issue 3, Section 8B.4.8.

4. With respect to 50Ω, measured at f = 9.375GHz, zero bias and c.w. input power less than 1.0μW. The nominal rectifier admittance at a reference plane X-X taken at the end faces of the ceramic insulator (see outline drawing on page 1) is:

$$(2.0 - j\,2.0)\ \frac{1}{50}\ \text{mho}$$

APPLICATION INFORMATION FOR AEY31 AND AEY31A

1. Detector performance at other than Test Radio Frequency

		Min.	Typ.	Max.	
S_{ts}	Tangential sensitivity				
	f = 1.0 to 18GHz, B = 1.0MHz				
	AEY31	-	-53	-	dBm
	AEY31A	-	-50	-	dBm
v.s.w.r.	Voltage standing wave ratio				
	f = 1.0 to 18GHz, Z_o = 50Ω	-	-	5:1	

2. Mixer performance (I.F. = 45MHz)

		Min.	Typ.	Max.	
N_o	Measured overall noise figure				
	f = 9.375GHz, N_{if} = 1.5dB				
	$P_{L.O.}$ = 200μW, I_{out} = 1.0mA	-	9.0	-	dB
	f = 16.5GHz, N_{if} = 1.5dB				
	$P_{L.O.}$ = 200μA, I_{out} = 1.0mA	-	9.5	-	dB
z_{if}	I.F. impedance				
	I_{out} = 1.0mA	-	130	-	Ω
v.s.w.r.	Voltage standing wave ratio				
	f = 1 to 18GHz, Z_o = 50Ω				
	I_{out} = 1.0mA	-	-	2.5:1	

3. Doppler mixer performance (I.F. = 3kHz)

		Min.	Typ.	Max.	
N_o	Measured overall noise figure				
	f = 9.375GHz, N_{if} = 2.0dB	-	18	-	dB

MICROWAVE DETECTOR DIODE

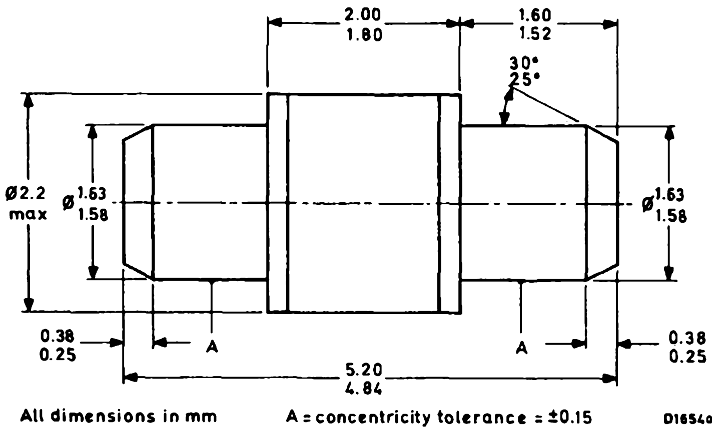
AEY32

Sub-miniature germanium bonded backward diode primarily intended for broadband ← low level detector applications in K-band and in Q-band (Ka-band). It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA		
Frequency range	18 to 40	GHz
Zero bias current sensitivity in the band 18 to 40 GHz (typ.)	2.0	$\mu A/\mu W$

OUTLINE AND DIMENSIONS

M.Q.M.



Terminal identification: red end indicates Cathode

POLARITY IDENTIFICATION

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.

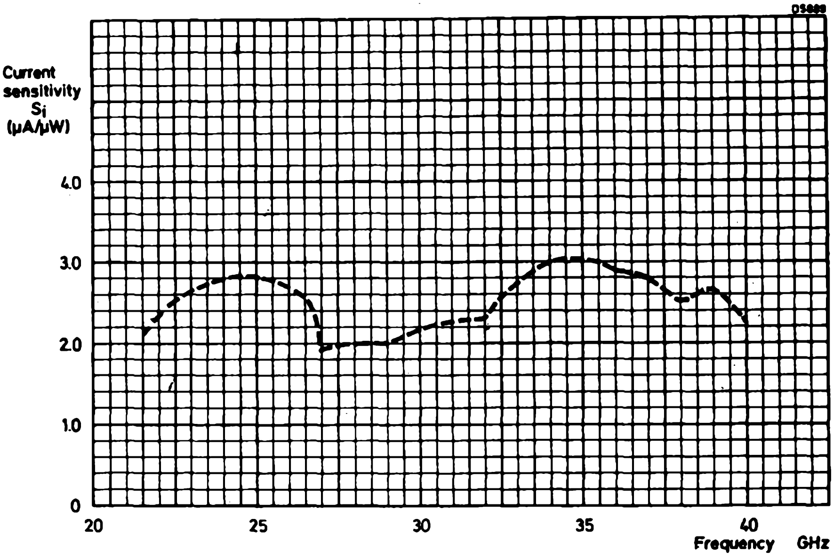
RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Max. pulsed r.f. input power (f = 9.375GHz, t_p = 0.5μs, p.r.f. = 2000 p.p.s.)	40	mW
T_{amb} range	-55 to +100	°C
T_{stg} range	-55 to +100	°C

ELECTRICAL CHARACTERISTICS	Min.	Typ.	Max.	
1/f noise (see note 1)	-	-	7.0	dB
Swept v.s.w.r. (26.5 to 40GHz) (see note 2)	-	-	5:1	
Z_v video impedance (see note 3)	3.0	-	5.0	kΩ
S_i current sensitivity (see note 4)	-	2.0	-	μA/μW
M figure of merit (see note 5)	50	-	-	

NOTES

1. Measured at an i.f. of 1kHz with 50Hz bandwidth and zero bias.
2. Measured in a Q-band broadband mount (Mullard specification 7313-731-0091). The v.s.w.r. measurement is swept over the band 26.5 to 40GHz at a power level not exceeding 100μW and with zero bias.
3. Measured at an i.f. of 1.6kHz with an input not exceeding 1mV and with zero bias.
4. Measured in the same mount as described in note 2 at frequencies of 27GHz, 34GHz and 40GHz, with an input power not exceeding 1μW and with zero bias. Rectified current measured by a microammeter of resistance less than 10Ω.
5. Measured at frequencies of 27GHz, 34GHz and 40GHz. M is the product of current sensitivity expressed in μA/μW and square root of the video impedance expressed in ohms.



Typical current sensitivity as a function of frequency

Typical figure of merit as a function of frequency

VARACTOR DIODES

Multiplier
Special purpose
Tuning

E

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SILICON PLANAR EPITAXIAL VARACTOR DIODE

BAY96

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, DO-4 with stud cathode. It conforms to the environmental requirements of BS9300 where applicable.

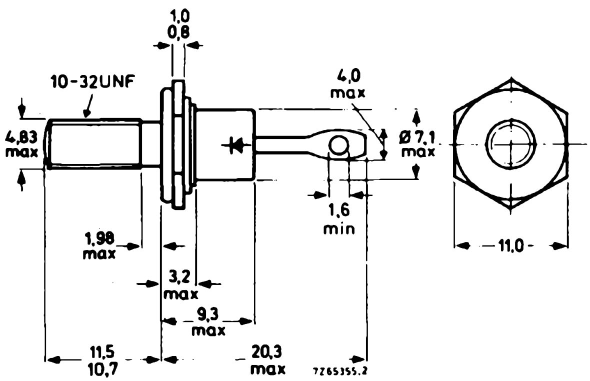
QUICK REFERENCE DATA

V_R max.	120	V
P_{tot} max.	20	W
T_j max.	175	^oC
C_T (V_R = 6.0 V, f = 1.0 MHz)	28 to 39	pF
R_S max. (V_R = 6.0 V, f = 400 MHz)	1.2	Ω
$f_{co} = \frac{1}{2\pi R_S \cdot C_T}$ at V_R = 120 V typ.	25	GHz

MECHANICAL DATA

Dimensions in mm

Conforming to J.E.D.E.C. DO-4



Diameter of clearance hole: max. 5.2 mm

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 mm

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

V_R max.	120	V
P_{tot} max. (T_{mb} = 25 °C)	20	W

Temperature

T_{stg} min.	-65	°C
T_{stg} max.	175	°C
T_j max. (operating)	175	°C

THERMAL CHARACTERISTIC

$R_{th\ j\text{-}mb}$	7.5	°C/W

ELECTRICAL CHARACTERISTICS

		Min.	Typ.	Max.	
C_T	Total capacitance				
	V_R = 6.0 V, f = 1.0 MHz	28	-	39	pF
R_s	Series resistance				
	V_R = 6.0 V, f = 400 MHz	-	0.9	1.2	Ω
f_{co}	Cut-off frequency				
	V_R = 120 V				
	$\frac{1}{2\pi R_s \cdot C_T}$	-	25	-	GHz

APPLICATION INFORMATION

TYPICAL OPERATING CHARACTERISTICS AS A FREQUENCY TRIPLER

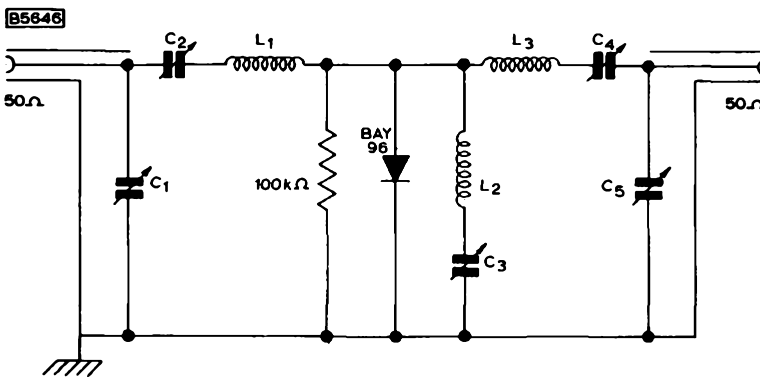


Fig.1

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

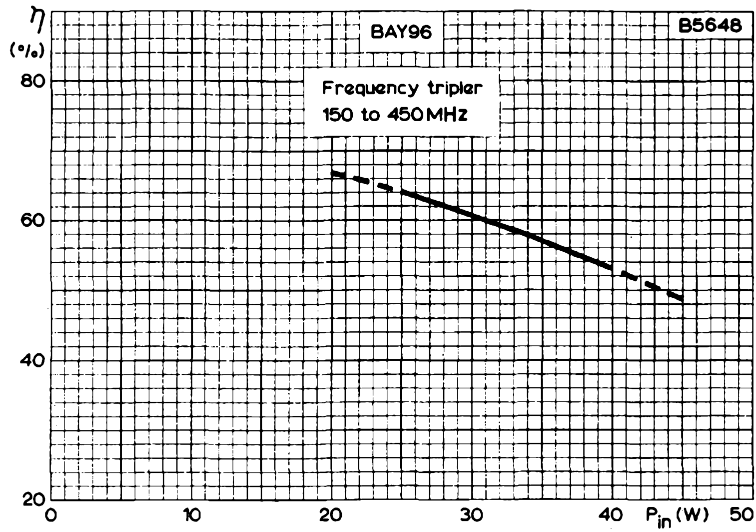
L_3 = 1" × 0.25" × 0.020" copper strip 0.562" from chassis

C_1 = 7.0 - 100pF variable

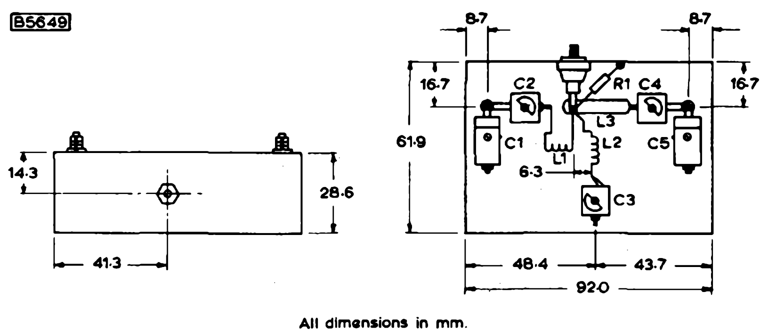
C_2, C_3, C_4 = 2.0 - 13pF variable

C_5 = 2.0 - 25pF variable

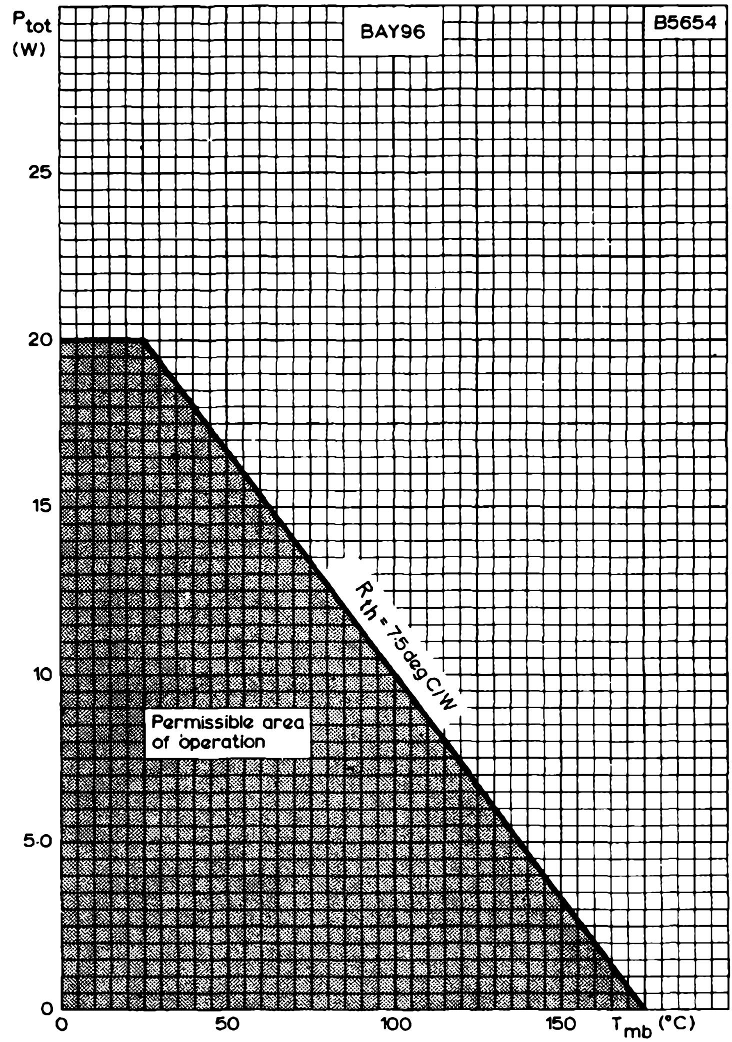
		Min.	Typ.	
η	Efficiency			
	P_{in} = 25W, f_{in} = 150 MHz	60	64	%



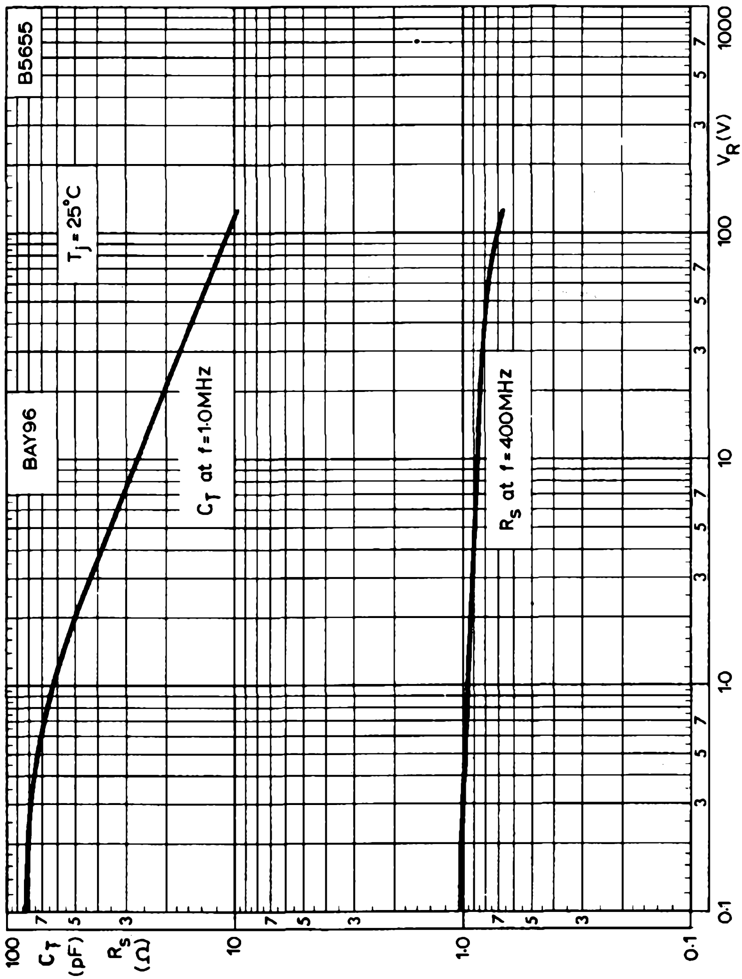
TYPICAL TRIPLER EFFICIENCY PLOTTED AGAINST INPUT POWER
See circuit on page 3



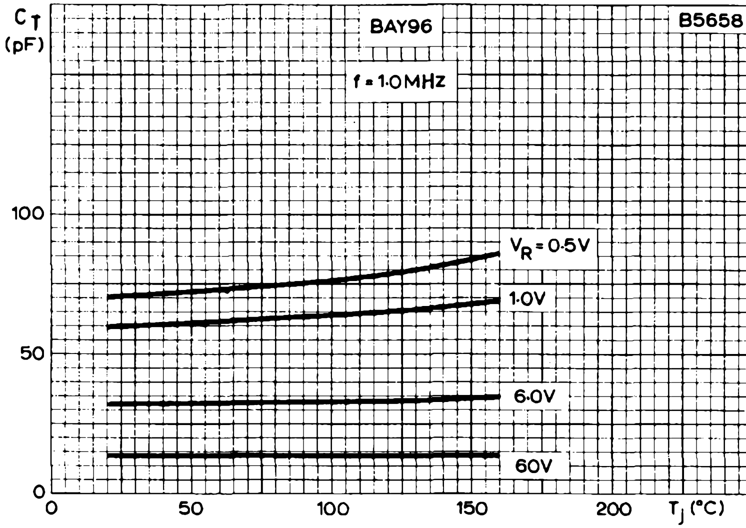
COMPONENT LAYOUT OF TRIPLER CIRCUIT

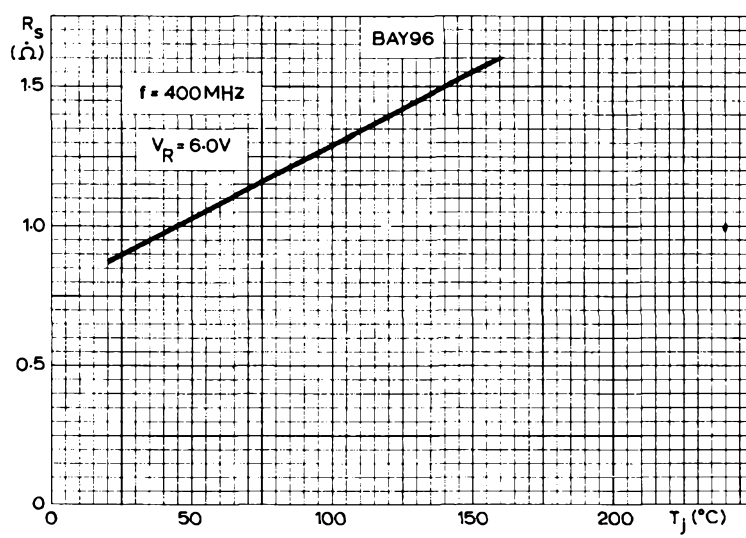


TOTAL DISSIPATION PLOTTED AGAINST MOUNTING BASE TEMPERATURE



TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED AGAINST REVERSE VOLTAGE





TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED AGAINST JUNCTION TEMPERATURE

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY27

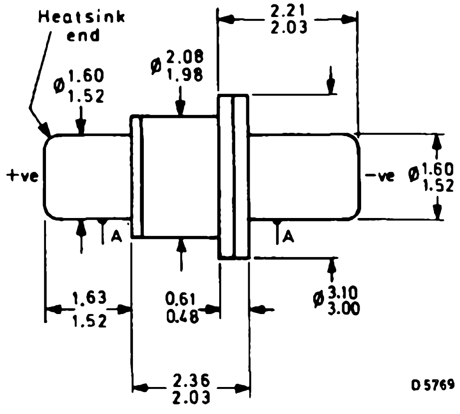
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, ←
especially suitable for use in frequency multiplier circuits up to 'S' band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to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

QUICK REFERENCE DATA

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

P_{in}	10	W
P_{out}	5.0	W
Resistive cut-off frequency typ. (V_R = 6.0 V)	100	GHz
Total capacitance typ. (V_R = 6.0 V)	4.5	pF
T_j max.	150	^oC

OUTLINE AND DIMENSIONS ←



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	55	V
P_{tot} max. R.F., $T_{pin} \leq 70^oC$	4.0	W
$T_{pin} > 70^oC$, derating factor	50	mW/degC

Temperature

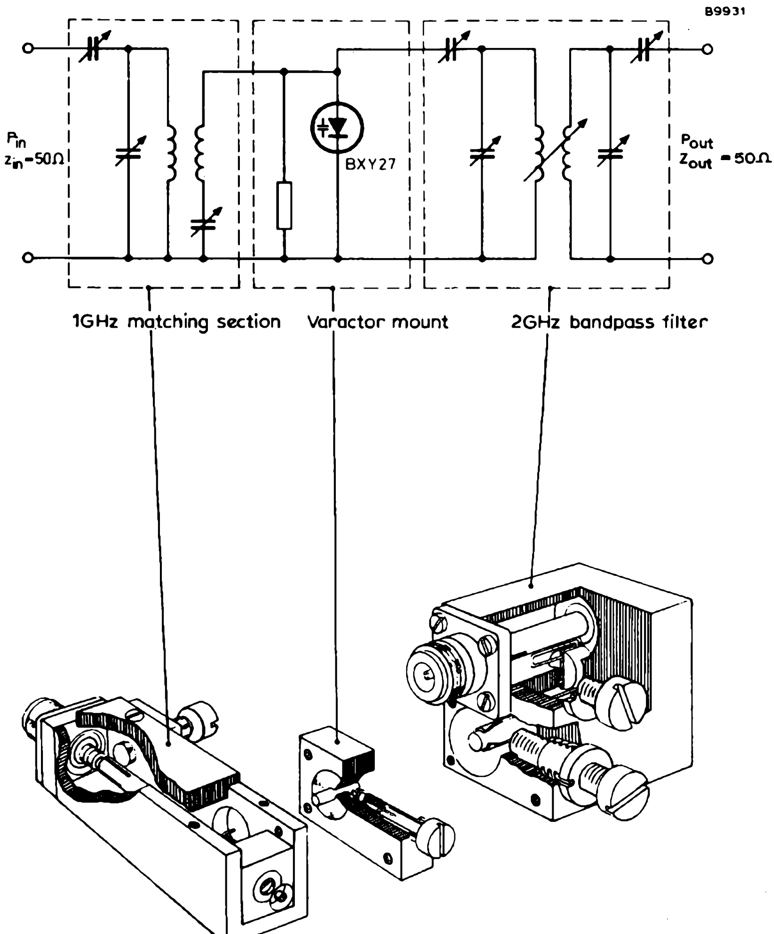
T_{stg} min.	-55	^oC
T_{stg} max.	150	^oC
T_j max.	150	^oC

THERMAL CHARACTERISTIC

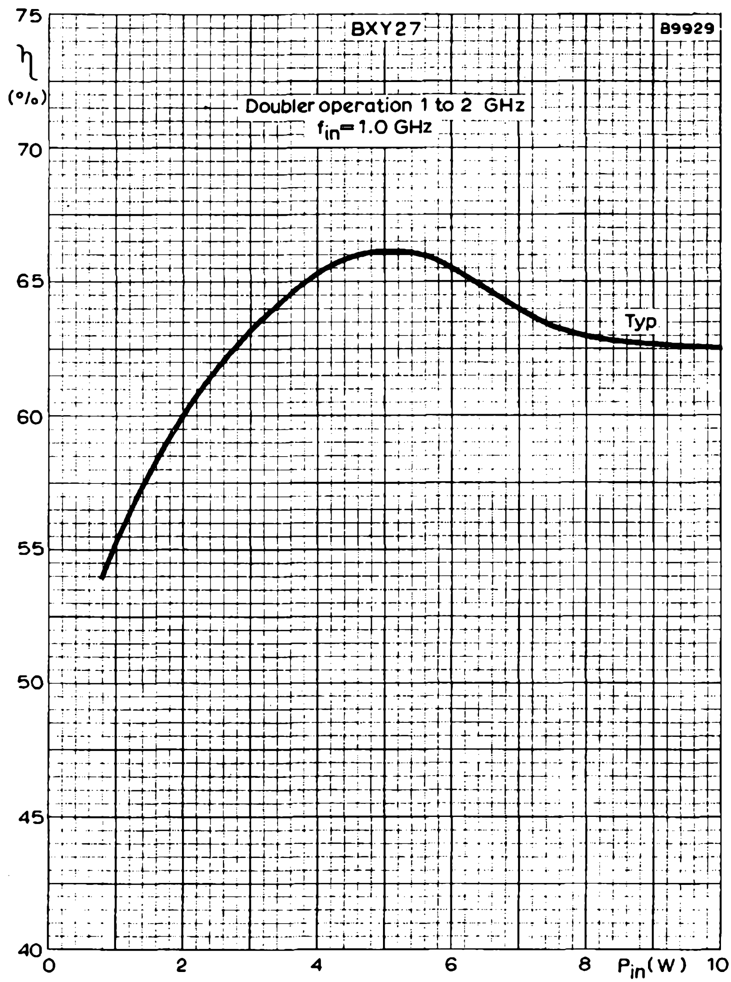
$R_{th\ j\text{-}pin}$ max.	20	degC/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$)

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



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (1 to 2GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY28

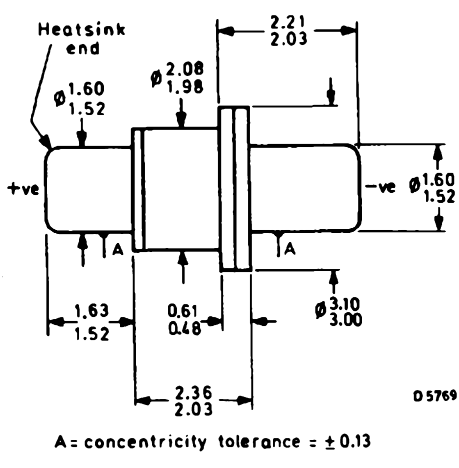
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the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

QUICK REFERENCE DATA

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

P_{in}	7.0	W
P_{out}	3.5	W
Resistive cut-off frequency typ. (V_R = 6.0 V)	120	GHz
Total capacitance typ. (V_R = 6.0 V)	1.5	pF
T_j max.	150	°C

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	45	V
P_{tot} max. R.F., $T_{pin} \leq 70^oC$	2.7	W
$T_{pin} > 70^oC$, derating factor	34	mW/degC

Temperature

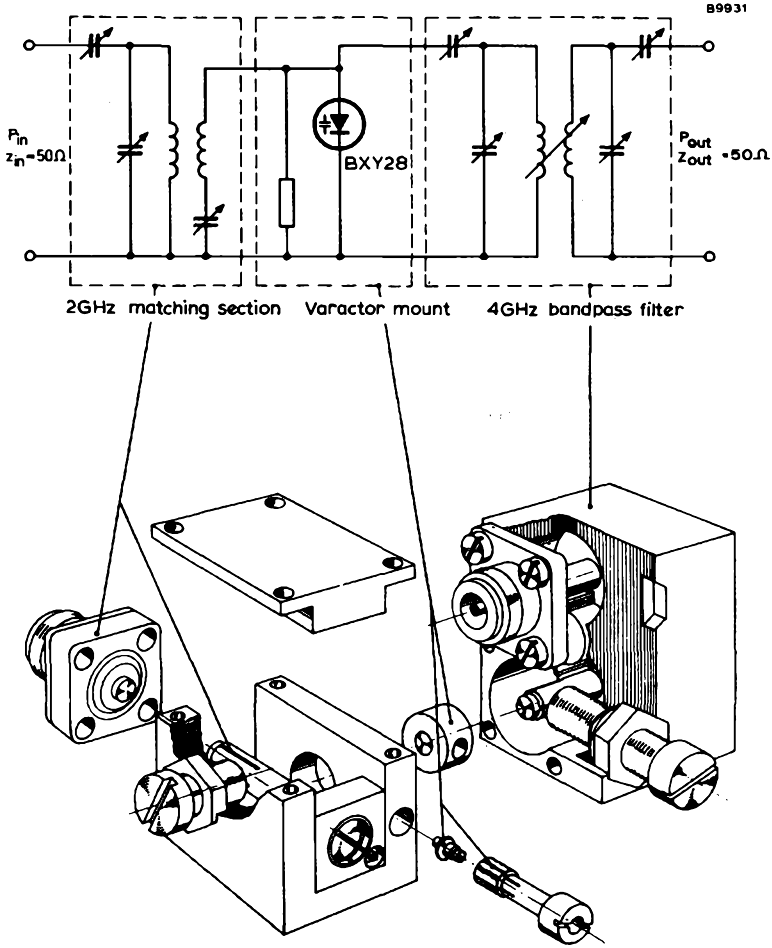
T_{stg} min.	-55	^oC
T_{stg} max.	150	^oC
T_j max.	150	^oC

THERMAL CHARACTERISTIC

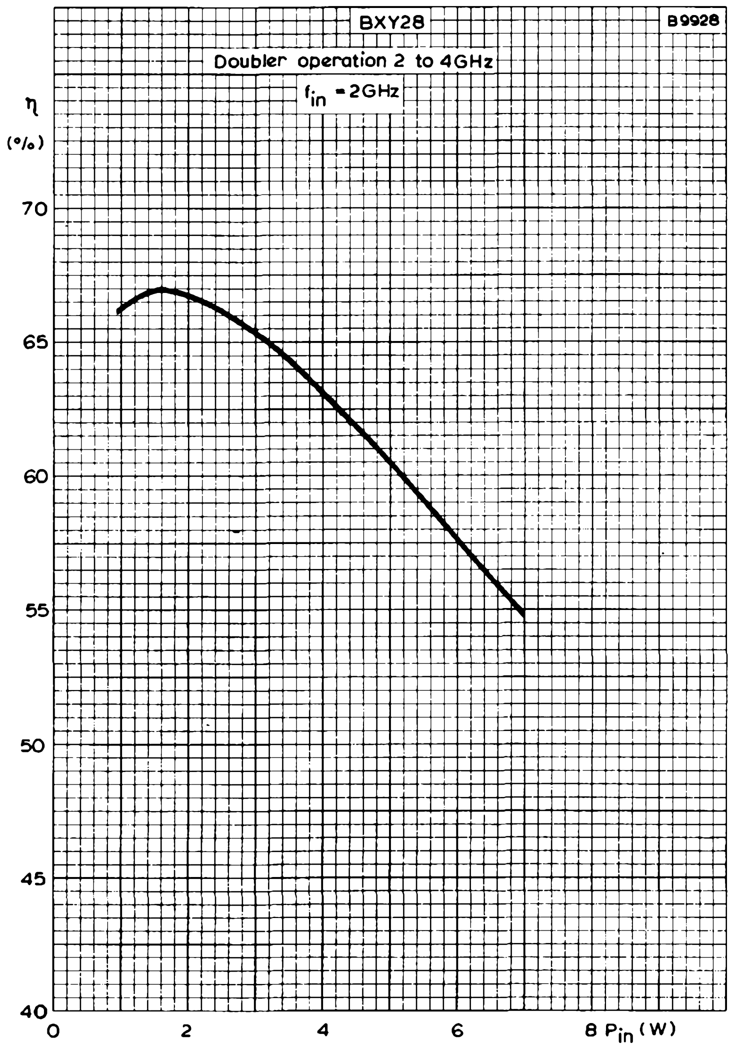
$R_{th\ j\text{-}pin}$ max.	30	degC/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$)

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



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (2 to 4GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY29

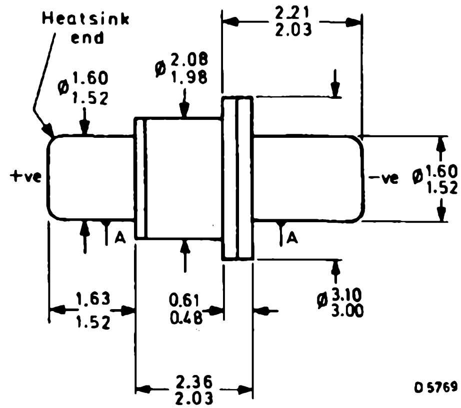
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to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

QUICK REFERENCE DATA

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

P_{in}	1.0	W
P_{out}	0.3	W
Resistive cut-off frequency typ. (V_R = 6.0 V)	120	GHz
Total capacitance typ. (V_R = 6.0 V)	1.0	pF
T_j max.	150	°C

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	25	V
P_{tot} max. R.F. (T_{pin} ≤70°C)	2.0	W

Temperature

T_{stg} min.	-55	°C
T_{stg} max.	+150	°C
T_j max.	+150	°C

THERMAL CHARACTERISTIC

$R_{th\ j\text{-}pin}$ max.	40	degC/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

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

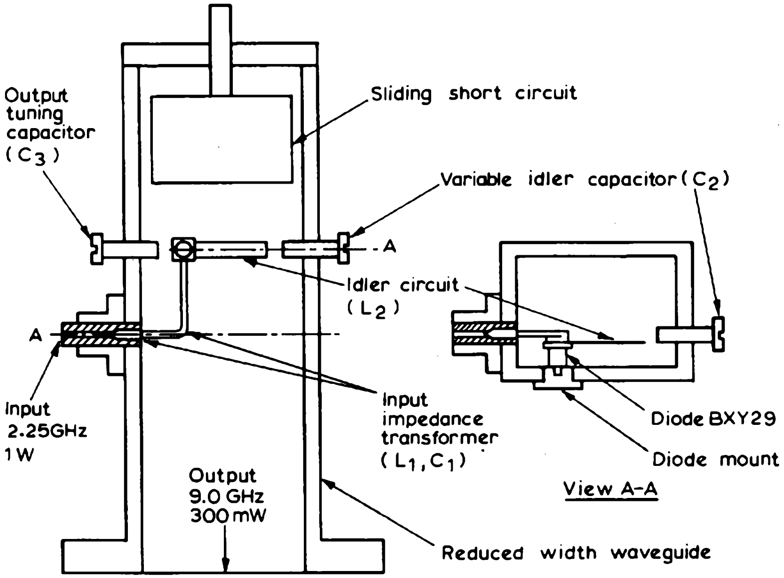
Note. The cut-off frequency f_{co} is defined as:

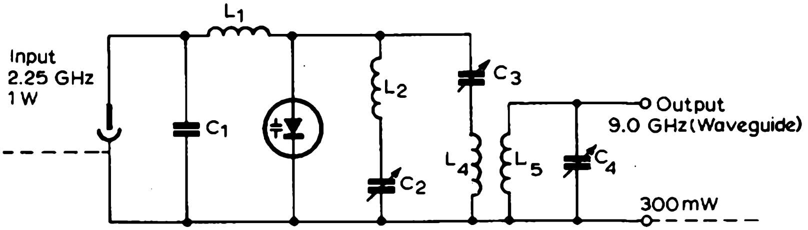
$$f_{co} = \frac{1}{2\pi r_s C_j}$$

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

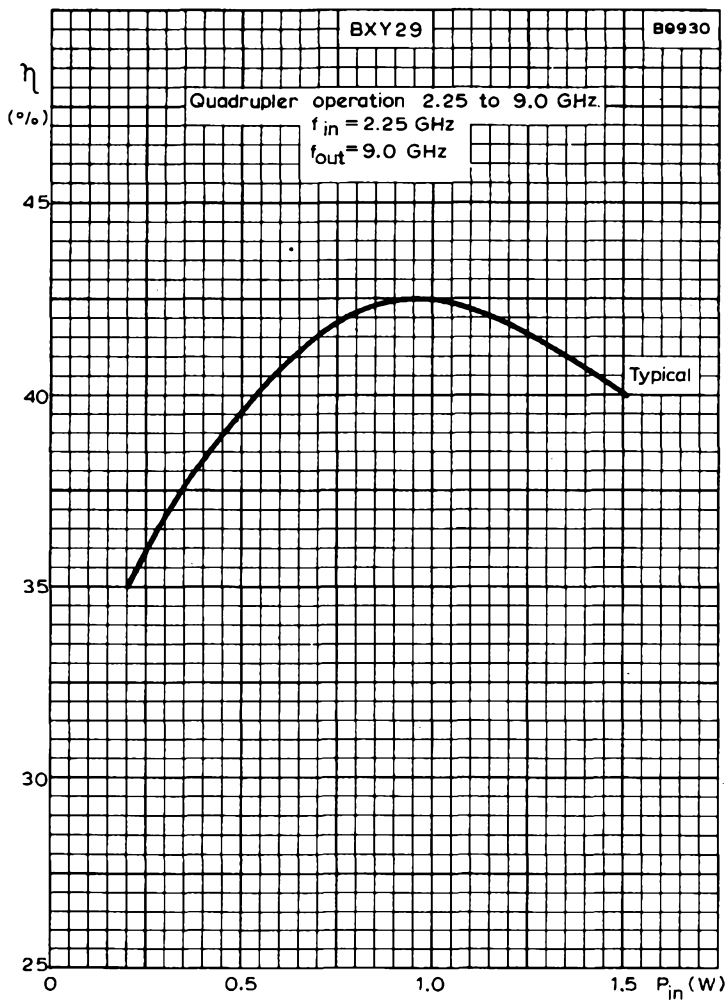
S-X BAND QUADRUPLER

B9937





Approximate equivalent circuit



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR QUADRUPLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY32

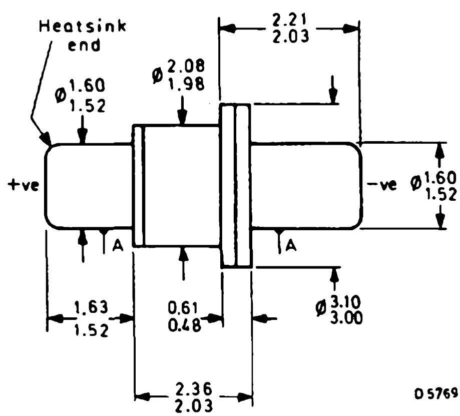
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, ←
especially suitable for high order frequency multiplier circuits up to X-band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms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

QUICK REFERENCE DATA

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

P_{in}	500	mW
P_{out}	20	mW
Resistive cut-off frequency typ. (V_R = 6.0 V)	150	GHz
Total capacitance typ. (V_R = 6.0 V)	0.75	pF
T_j max.	150	°C

OUTLINE AND DIMENSIONS ←



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	20	V
P_{tot} max. R.F. (T_{pin} ≤70°C)	1.6	W

Temperature

T_{stg} min.	-55	°C
T_{stg} max.	+150	°C
T_j max.	+150	°C

THERMAL CHARACTERISTIC

$R_{th\ j\text{-}pin}$ max.	50	degC/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage (I_R = 1.0mA)	20	-	-	V
I_R	Reverse current (V_R = 6.0V)	-	0.001	1.0	μA
f_{co}	Cut-off frequency (V_R = 6.0V) (see note)	100	150	-	GHz
C_T	Total capacitance ($C_j + C_s$) (V_R = 6.0V, f = 1.0MHz)	0.5	0.75	1.0	pF
C_s	Stray capacitance	-	0.25	-	pF
L_s	Series inductance	-	650	-	pH
t_t	Transition time	-	-	150	ps
τ_s	Life time	-	50	-	ns

Note. The cut-off frequency f_{co} is defined as:

$$f_{co} = \frac{1}{2\pi r_s C_j}$$

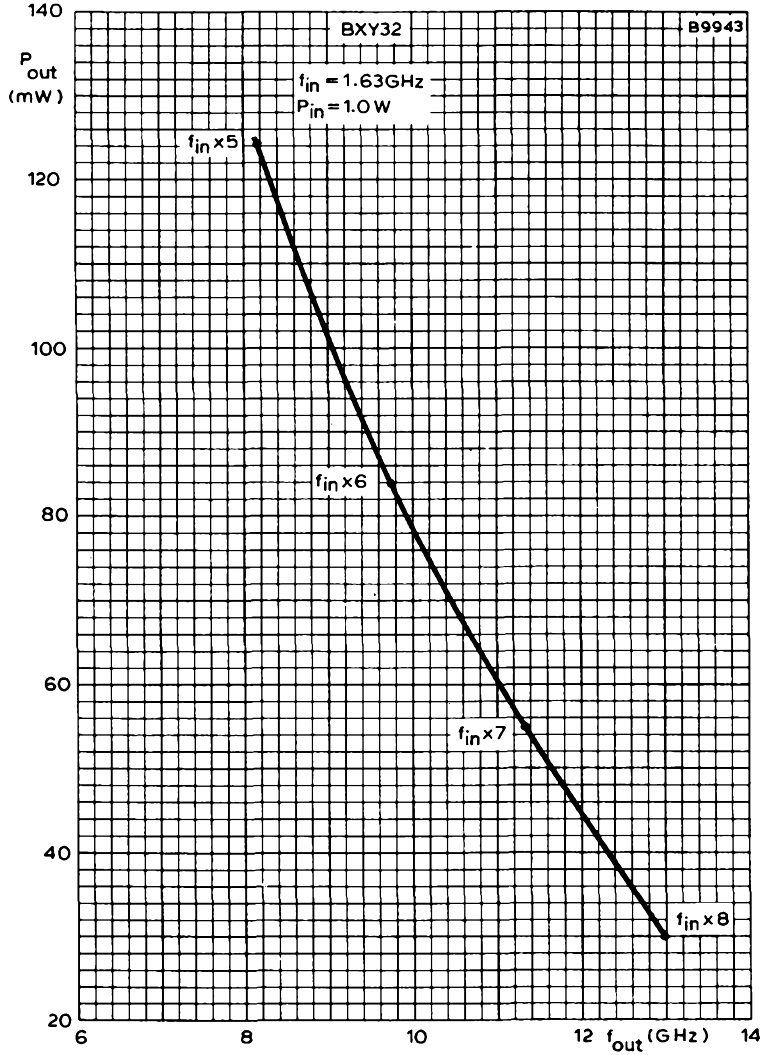
Where, C_j is the junction capacitance and is measured at 1.0MHz
r_s is measured on a slotted line at 8.0GHz

MULTIPLIER PERFORMANCE

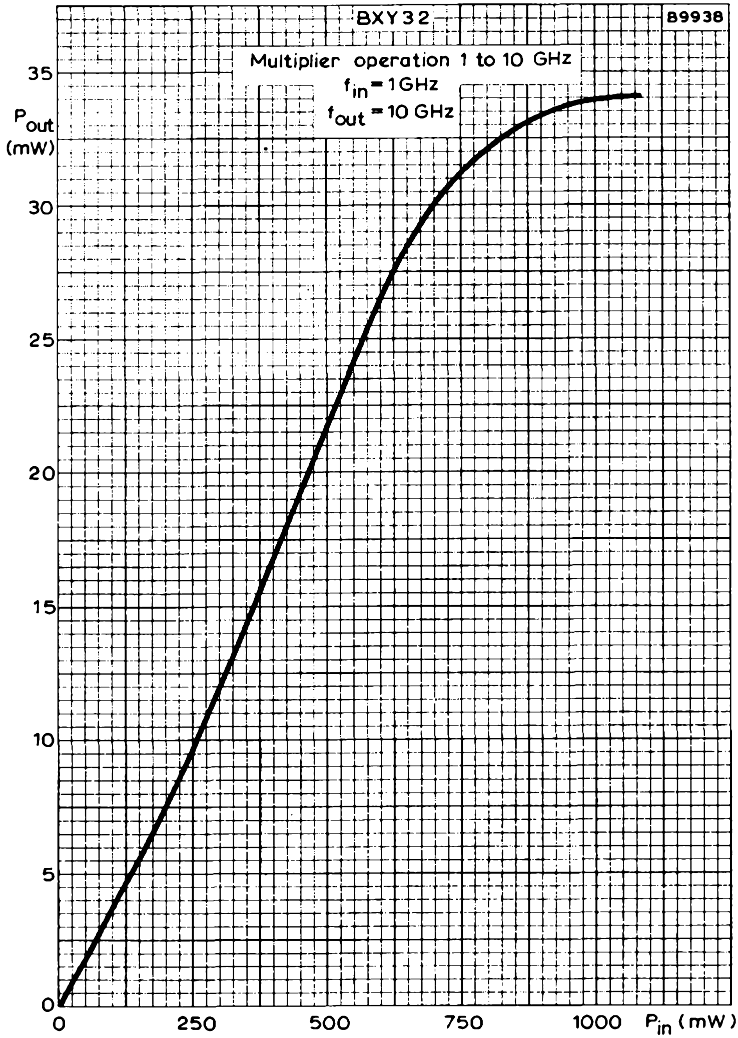
		Min.	Typ.	Max.	
P_{out}	f_{in} = 1.0GHz, P_{in} = 500mW, f_{out} = 10GHz	15	20	-	mW

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY32



TYPICAL PERFORMANCE IN HIGH ORDER MULTIPLIERS



TYPICAL PERFORMANCE AS A FREQUENCY MULTIPLIER

SILICON VARACTOR 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.

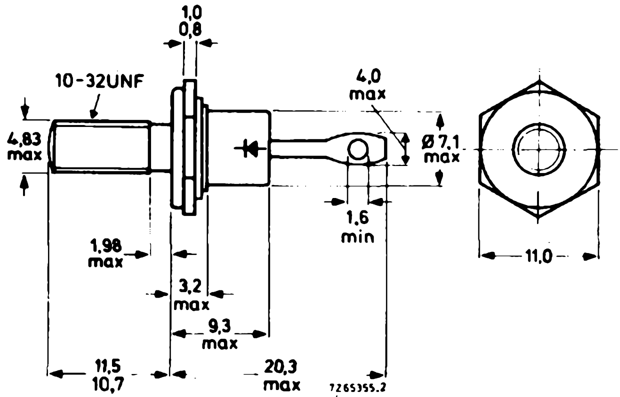
			BXY35	BXY36	BXY37	BXY38	BXY39	BXY40	BXY41	
Reverse breakdown voltage $I_R = 10\ \mu A$	$V_{(BR)R}$	min.	100	70	70	50	40	25	25	V
Cut-off frequency $V_R = 6$ V	f_{co}	min.	25	75	100	120	150	180	200	GHz
Diode capacitance $V_R = 6$ V	C_j	min.	6.0	4.0	2.0	1.2	0.8	0.4	0.25	pF
		max.	12	6.0	4.0	2.0	1.2	0.9	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 and 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 to suit customers' specific requirements

MECHANICAL DATA Dimensions in mm

Outline A

DO-4



Diameter of clearance hole: 5.2 mm

Accessories supplied on request:

56295 (PTFE bush, 2 mica washers, plain washer, tag)

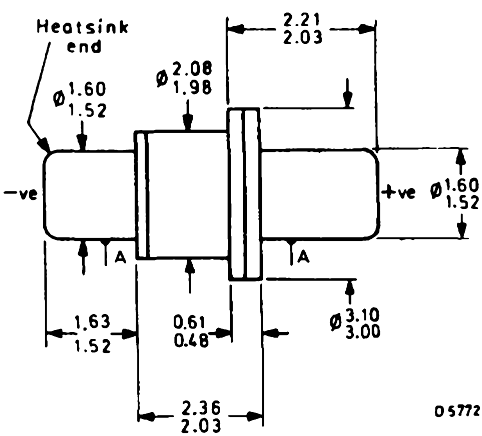
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer

Nut dimensions across the flats: 9.5 mm

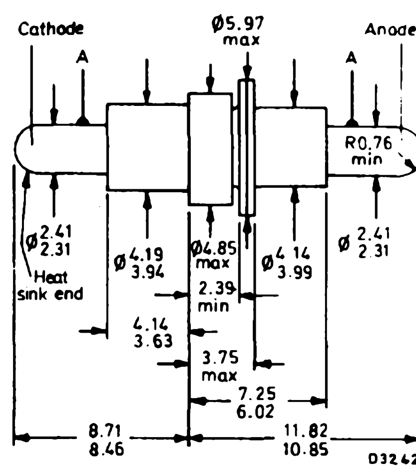
Torque on nut: min. 0.9 Nm
max. 1.7 Nm

Outline B

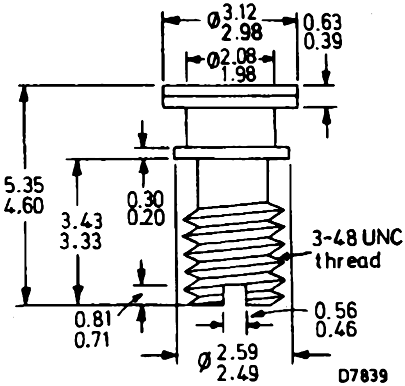


A = concentricity tolerance = ± 0.13

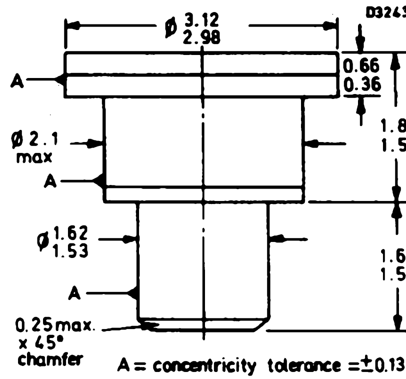
Outline C



Outline D



Outline E



SILICON VARACTOR TUNING DIODES

BXY53 BXY54 BXY55

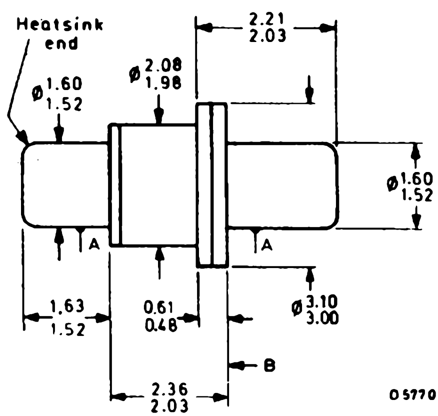
Epitaxial silicon varactor tuning diodes supplied in a standard microwave package. ←
They conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA				
V_R max.		60		V
	BXY53	BXY54	BXY55	
C_T at -4V typ.	1.0	4.7	15	pF
$\frac{C_{TO}}{C_{T60V}}$ min.	4.0	6.5	7.0	pF

Unless otherwise shown, data is applicable to all types

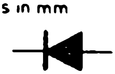
OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A: concentricity tolerance = ±0.13

All dimensions in mm



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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_R	max. (see note 1)	60	V
T_{stg} range		-55 to +175	^oC
T_{case}	max.	125	^oC

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25^oC$)

		BXY53	BXY54	BXY55	
$V_{(BR)R}$ (10μA min.)		60	60	60	V
I_R at 55V	max.	1.0	1.0	1.0	μA
C_T at -4V	min.	0.8	3.7	12	pF
(see note 2)	typ.	1.0	4.7	15	pF
	max.	1.2	5.7	18	pF
Total capacitance ratio $\frac{C_{TO}}{C_{T60V}}$	min.	4.0	6.5	7.0	
Insertion loss (zero bias) (see notes 3,4 and 5)	max.	0.8	0.5	0.25	dB
Phase swing (0 to 60V) (see notes 3, 4 and 5)	min.	80	85	63	degrees
	typ.	72	74	57	degrees

NOTES

1. At 25^oC; below 25^oC this figure must be derated at $7 \times 10^{-2} V/^oC$. Diodes with different values of $V_{(BR)R}$ are available on request.
2. Capacitance tolerances of ±10% and lower are available on request.
3. Measurements made with the diode at the end of a 50Ω transmission line and with small signal conditions.
4. Measured at 2.0GHz for BXY53 and BXY54; at 1.0GHz for BXY55. For values at other frequencies see graphs on page 4.
5. The heatsink pin should be located in a hole of 1.6 to 1.65mm dia. The location of the other end should be a hole of 1.8 to 2.2mm dia., bearing on flange B with a force not exceeding 10 N.

APPLICATION NOTE

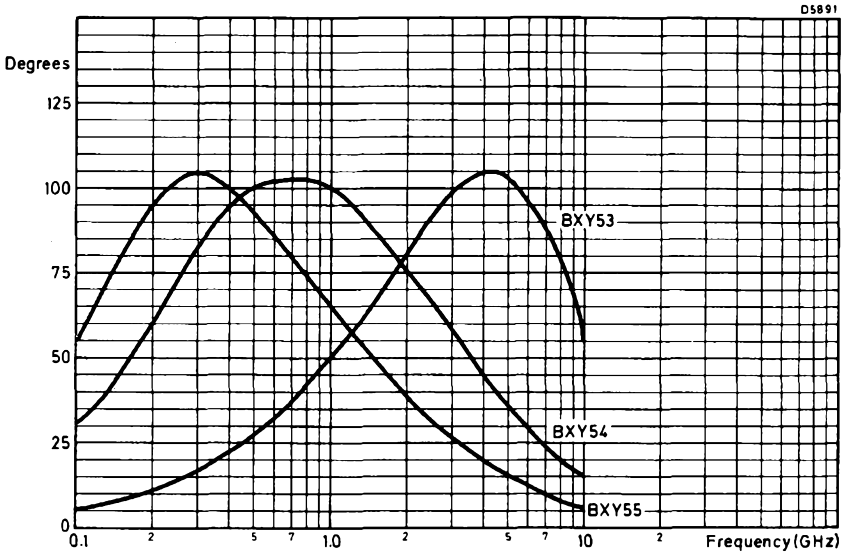
When designing tuning circuits at high frequencies it is not sufficient to specify a capacitance swing and loss resistance in the tuning varactor. The parasitic reactances of the microwave package have a significant effect on the terminal impedance of the device. Although strictly speaking one must consider the entire circuit when quoting impedance values the method of measurement adopted here has been found to give values of useful accuracy in a variety of coaxial and waveguide test mounts.

APPLICATION NOTE (contd.)

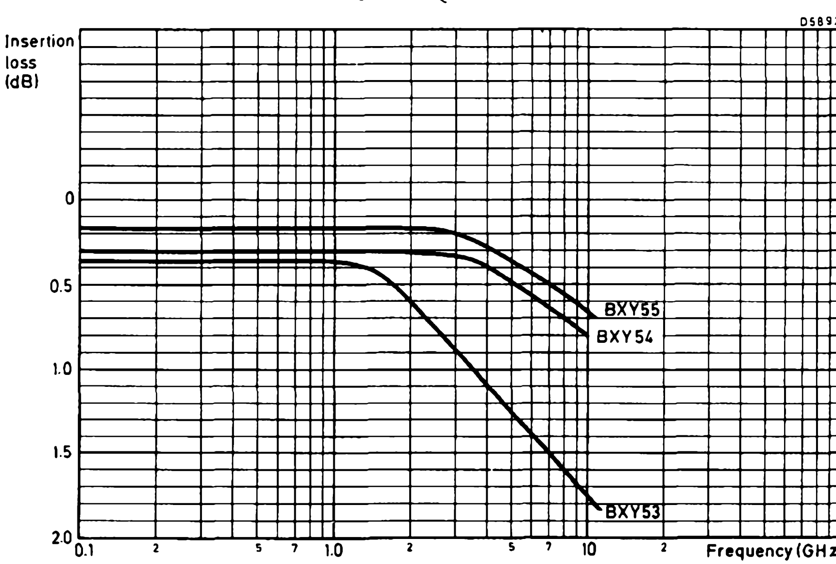
One may simply take the measurements as giving values of r.f. impedance as a function of bias for small signal conditions or they can be used as a more fundamental design aid. This is because the significant factors for the design of a microwave varactor tuned circuit are the available phase swing in the circuit and the loss incurred by the varactor. Both these quantities can be increased or decreased by lowering or raising respectively the characteristic impedance of the circuit. Both these quantities are also invariant under transformation down a uniform loss less transmission line and apply whatever impedance is required to be presented by the varactor circuit.

At large signal levels the r.f. swing may drive the varactor into forward conduction for part of the cycle. This has two effects, firstly there is a rectified voltage built up on the varactor terminal and secondly the effective insertion loss rides at low bias voltages. These effects are fundamental to any varactor diode.

Under forward d.c. bias conditions, the maximum bias current must not exceed 100mA or permanent damage may occur.



TYPICAL PHASE SWING AS A FUNCTION
OF FREQUENCY



TYPICAL INSERTION LOSS AS A
FUNCTION OF FREQUENCY

SILICON VARACTOR DIODES

BXY56 BXY57

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.

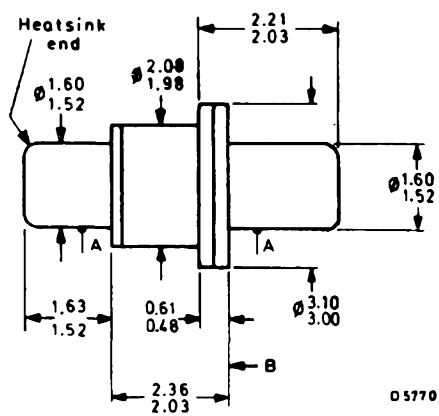
QUICK REFERENCE DATA

$V_{BR(R)}$ min. (I_R = 10 μA min.)			60	V
		BXY56	BXY57	
C_j (V_R = 6 V)	min.	1.5	2.5	pF
	max.	2.5	3.5	pF
f_c (V_R = 6 V min.)		160	140	GHz

Unless otherwise shown, data is applicable to both types

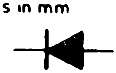
OUTLINE AND DIMENSIONS

Conforms to BS3934 SO-86



A: concentricity tolerance = ±0.13

All dimensions in mm



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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	BXY56	BXY57	
V_R max.	60	60	V
P_{tot} max. (T_{hs} max. 50^oC) (see note 1)	5.2	6.6	W
R_{th} (j-hs) max.	24	19	$^oC/W$
T_{stg} range	-55 to +175	-55 to +175	^oC
T_j max.	+175	+175	^oC

CHARACTERISTICS (T_{pin} = 25^oC)

		BXY56	BXY57	
$V_{(BR)R}$ min. (I_R = 10μA)		60	60	V
C_j (V_R = 6V, f = 1MHz) (see note 2)	min.	1.5	2.5	pF
	max.	2.5	3.5	pF
f_{co} min. (V_R = 6V) (see note 3)		160	140	GHz
t_t typ. (transition time)		150	200	ps
τ typ. (lifetime)		60	150	ns
C_s typ.		0.25	0.25	pF
L_s typ.		650	650	pH

MULTIPLIER PERFORMANCE (see note 4)

Low order multiplier efficiency in a 2.1 to 4.2GHz doubler	60	%
High order multiplier efficiency in a 0.45 to 3.6GHz 8 × multiplier	20	%

NOTES

1. $P_{tot} = P_{in} - P_{out.}$ Derating curves are used for value of T_{hs} greater than 50^oC: -

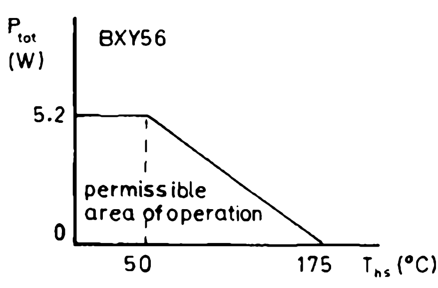


Fig. 1

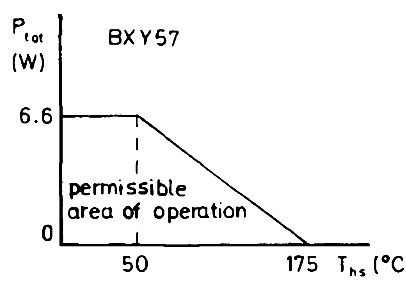


Fig. 2

NOTES (contd.)

2. A particular diode specification within this range may be selected to suit the application. Furthermore, it is recommended that devices are functionally tested by the supplier in the customer's circuit.

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

4. For high power applications it is essential that the heatsink end of the devices 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 hole of diameter 1.8 to 2.2mm. bearing on flange B with a force not exceeding 10 N.

GALLIUM ARSENIDE VARACTOR DIODE

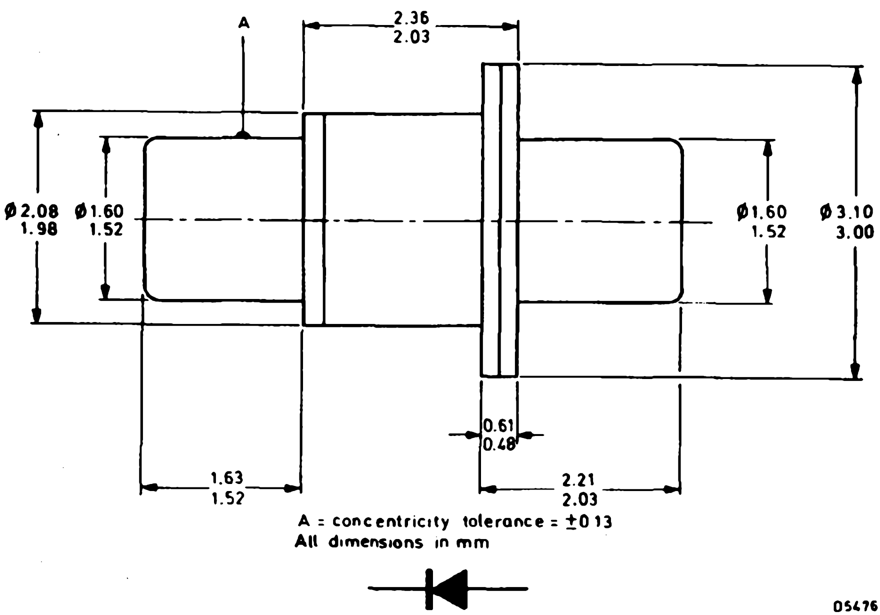
CAY10

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		
V_R max.	6.0	V
$I_{F(AV)}$ max.	70	mA
P_{tot} max. T_{stud} up to 107 ^oC	50	mW
for higher temperatures see derating curve		
Operating temperature range	-196 to +150	^oC
f_c typ. (V_R = 6.0 V)	240	GHz

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO86



A = concentricity tolerance = ±0.13
All dimensions in mm

D5476

Limiting values of operation according to the absolute maximum system.

Electrical

V_R max.	6.0	V
$I_{F(AV)}$ max.	70	mA
P_{tot} max. ($T_{stud} \leq 107^{\circ}C$)	50	mW

Temperature

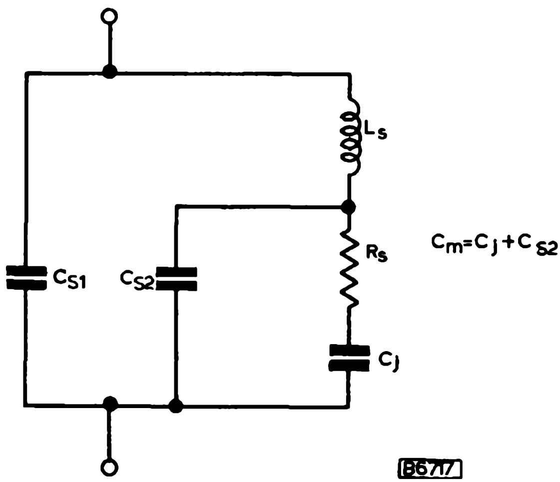
T_{stg} min.	-196	$^{\circ}C$
T_{stg} max.	+150	$^{\circ}C$
T_j (operating range)	-196 to +150	$^{\circ}C$

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}C$)

		Min.	Typ.	Max.	
Static					
I_R •	Reverse current $V_R = 6.0V$	-	0.1	1.0	μA
V_F	Forward voltage drop $I_F = 1.0\mu A$ (see note 3.)	-	0.9	-	V
Dynamic					
f_o	Series resonant frequency Zero bias (see notes 1,2.)	8.9	10	11.6	GHz
f_{co}	Cut-off frequency Zero bias (see note 2.)	125	150	-	GHz
f_c	Cut-off frequency $V_R = 6.0V$ (see note 2.)	-	240	-	GHz
C_{mo}	Effective diode capacitance at X band frequency Zero bias (see notes 1,2.)	•0.3	0.4	0.5	pF
γ	Capacitance variation coefficient (see note 3.)	0.12	0.15	-	
C_{S1}	Stray capacitance (see note 1.)	-	0.10	-	pF
C_{S2}	Stray capacitance (see note 1.)	-	0.15	-	pF
L_s	Series inductance (see note 1.)	-	625	-	pH

Notes

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



2. Measurements 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 and Q_o is the Q factor at zero bias

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

3. The capacitance variation coefficient γ is defined as

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

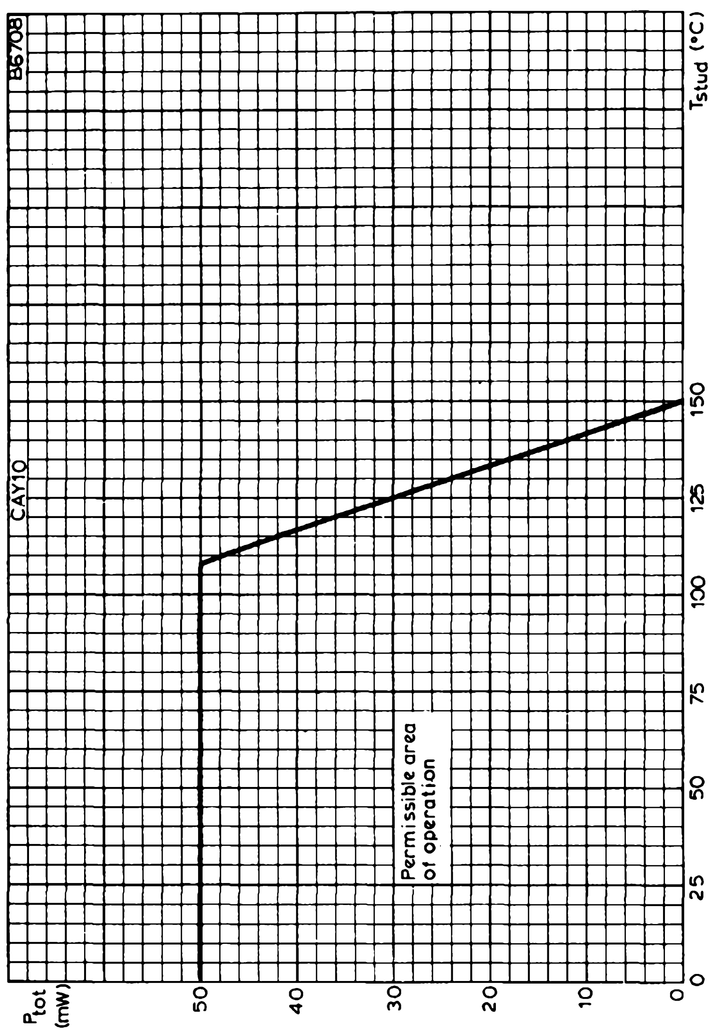
where C_m min. = effective capacitance at $V_R = 1.0V$
C_m max. = effective capacitance at $I_F = 1.0\mu A$

This can be re-written in the form

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

where $V = V_F$ at $1.0\mu A$

$C_{jo} = C_{mo} - C_{S2}$



TOTAL DISSIPATION PLOTTED AGAINST STUD TEMPERATURE

GALLIUM ARSENIDE VARACTOR DIODE

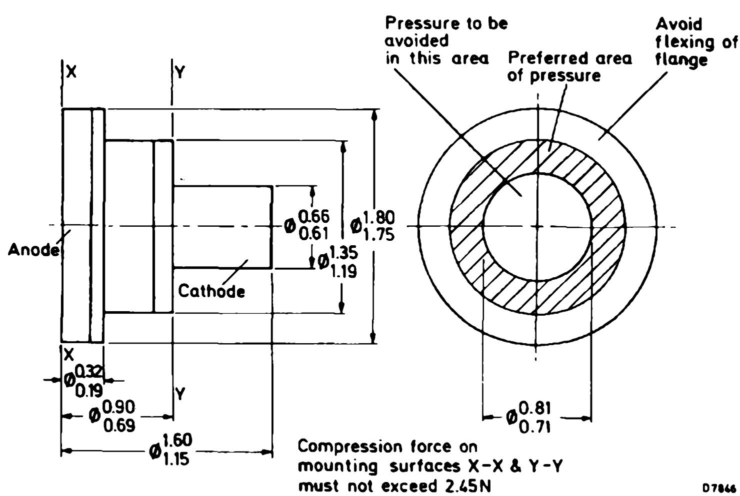
Gallium arsenide varactor diode with a high cut-off frequency suitable for use in parametric amplifiers and may be used in frequency multipliers and switches. The diodes are of the diffused mesa type, mounted in a small ceramic-metal case with a hermetic welded seal and conform to the environmental requirements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

QUICK REFERENCE DATA

V_R max.	6.0	V
P_{tot} max. $T_{pin} \leq 25$ °C	50	mW
Typical X-band parametric amplifier performance		
Signal frequency	8.5	GHz
Gain	15	dB
Bandwidth (3 dB)	70	MHz
Noise temperature	200	°K

MECHANICAL DATA

Dimensions in mm



RATINGS

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

Voltage

Continuous reverse voltage	V_R	max.	6.0	V

Power dissipation

Total power dissipation ($T_{pin} \leq 25\,^{o}C$)	P_{tot}	max.	50	mW

Temperatures

Storage temperature	T_{stg}	– 196 to + 175	^{o}C
Junction temperature (operating range)	T_j	– 196 to + 135	^{o}C

THERMAL RESISTANCE

From junction to pin	$R_{th\ j\text{-}pin}$	max.	0.9	$^{o}C/mW$

CHARACTERISTICS

$T_{amb} = 25\,^{o}C$ unless otherwise stated

		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 at $V_R = 0$ V (note 2)	γf_{co}	35	50	–	GHz
Microwave value of effective device series resistance (notes 1, 4)	R_m	–	2.25	–	Ω
Microwave value of effective device capacitance $V_R = 0$ V (notes 3, 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. γfc is guaranteed by a functional X-band paramp test at room temperature.
   The capacitance variation coefficient, γ, is defined as follows:

$$\gamma = \frac{C_m\,(\max) - C_m\,(\min)}{2[C_m\,(\max) + C_m\,(\min)]}$$

where C_m (min) = capacitance at V_R = 1.0 V

C_m (max) = capacitance at I_F = 1.0 μA

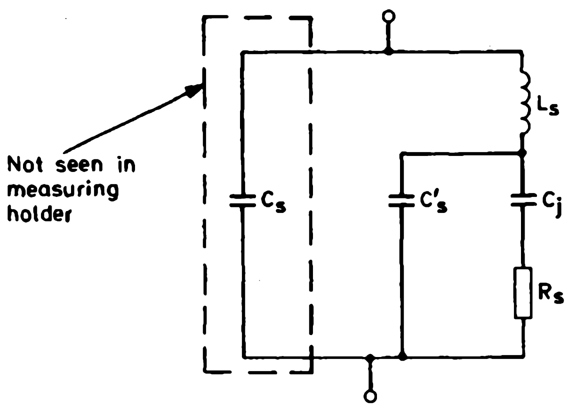
3. C_m is calculated using the frequency cut-off and the series resistance:

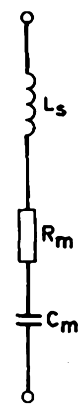
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

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

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

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





D8208 (a) (b)

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.

Devices and alternative encapsulations may be selected to suit customers' specific requirements

GALLIUM ARSENIDE VARACTOR DIODE

CXY12

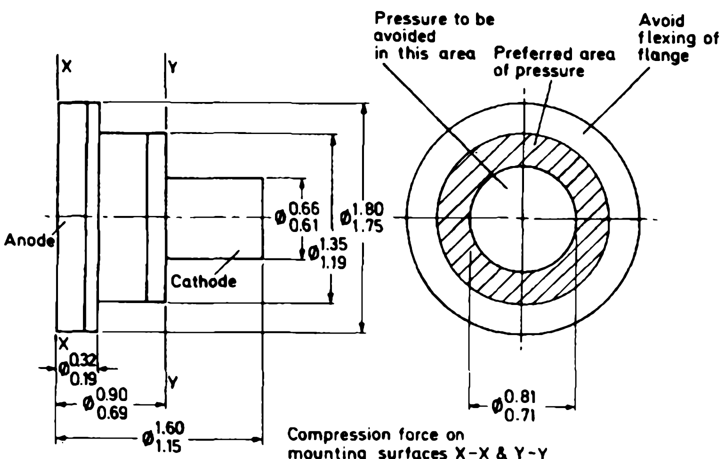
Gallium arsenide varactor diode suitable for use in frequency multiplier circuits ← up to Q-band output frequency. The diodes are of the diffused mesa type, are mounted in a small ceramic-metal case with hermetic welded seal and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

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

P_{in} max.	500	mW
P_{out} min.	50	mW
Resistive cut-off frequency typ. (V_R = 6.0 V)	500	GHz
T_j max.	175	°C

OUTLINE AND DIMENSIONS ←



Dimensions in mm

Compression force on mounting surfaces X-X & Y-Y must not exceed 2.45N

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	10	V
P_{tot} max. (T_{pin} = 25°C) (see note 1)	300	mW
P_{in} R.F. max.	500	mW

Temperature

T_{stg} min.	-55	°C
T_{stg} max.	+175	°C
T_j max.	+175	°C

THERMAL CHARACTERISTIC

$R_{th(j\text{-}pin)}$ max.	0.5	degC/mW

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

		Min.	Typ.	Max.	
$V_{(BR)R}$	Breakdown voltage I_R = 100µA	10	15	-	V
I_R	Reverse current V_R = 6.0V	-	0.001	1.0	µA
f_{res}	Series resonance frequency V_R = 6.0V (see note 2)	27	29	35	GHz
f_{co}	Cut-off frequency V_R = 6.0V (see note 2)	300	500	-	GHz
C_m	Microwave value of effective device capacitance V_R = 6.0V (see note 3)	-	0.25	-	pF
R_m	Microwave value of effective device series resistance V_R = 6.0V (see notes 2 and 4)	-	1.3	-	Ω
C_s	Stray case capacitance (L.F. measurement)	-	0.3	-	pF
L_s	Microwave value of effective device series inductance (see note 3)	-	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 40GHz waveguide wide band low v.s.w.r. transformer to a reduced height of 0.25mm. 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 0.25mm 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

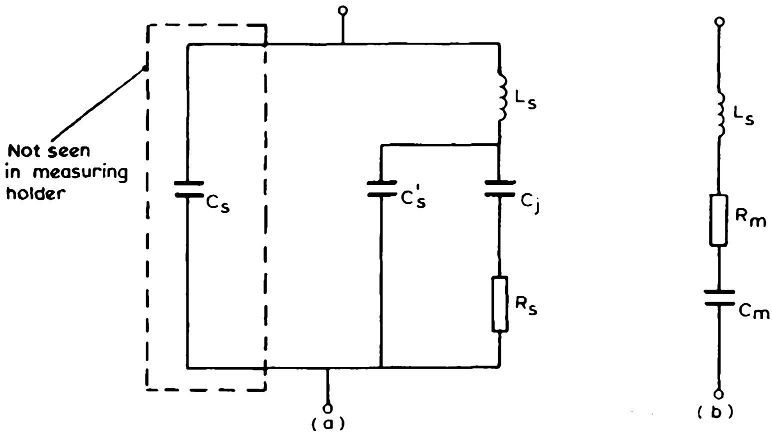
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

   L_s is also calculated using f_{res} and C_m

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

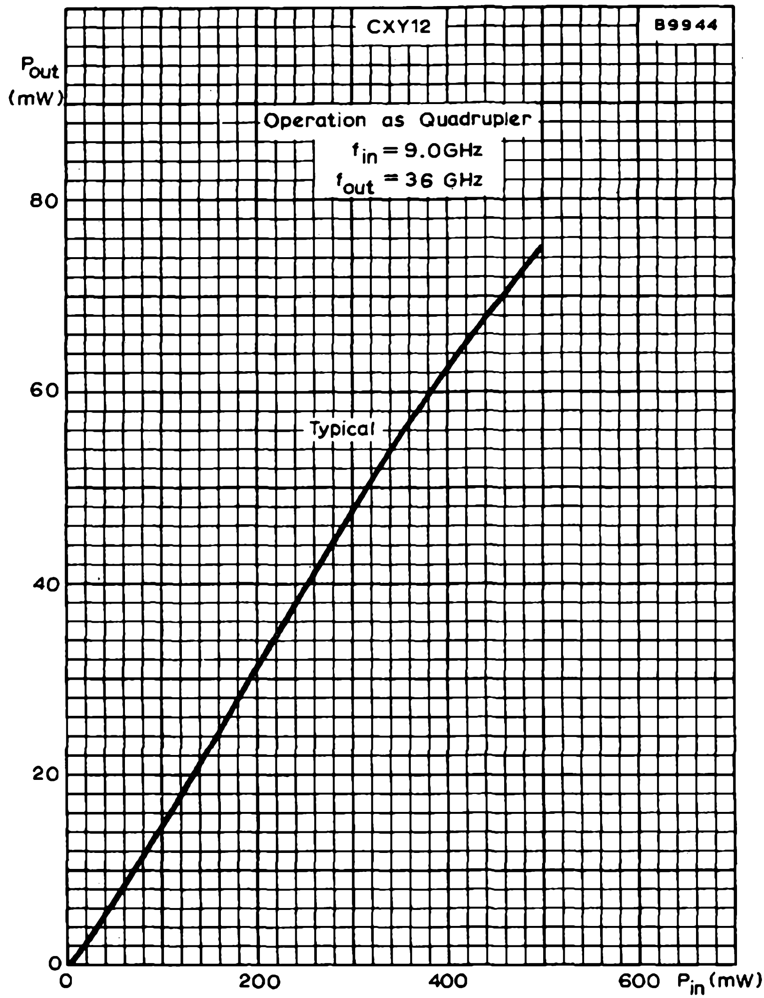
4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.



→ Application note

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



OUTPUT POWER AGAINST INPUT POWER
QUADRUPLER OPERATION

GALLIUM ARSENIDE LIMITER DIODES

CXY22A CXY22B

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

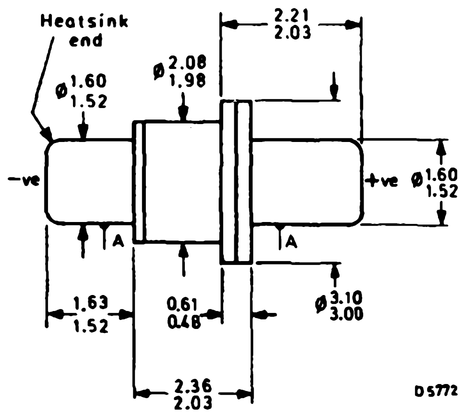
	CXY22A	CXY22B	
Operating frequency range	2.0 to 7.0	7.0 to 12	GHz
C_T at 0V (typ.)	0.85	0.55	pF
Insertion loss* (typ.)	0.2	0.3	dB
High power attenuation* (typ.)	20	16	dB

*Depends on circuit configuration, see page 2

Unless otherwise shown, data is applicable to both types.

OUTLINE AND DIMENSIONS Dimensions in mm

Conforms to B.S. 3934 SO-86



A: concentricity tolerance = ±0.13

LIMITING VALUES (Absolute max. rating system)

V_R	max.	6.0	V
T_{stg} range		-55 to +150	^oC
T_{amb} range		-55 to +100	^oC

CHARACTERISTICS

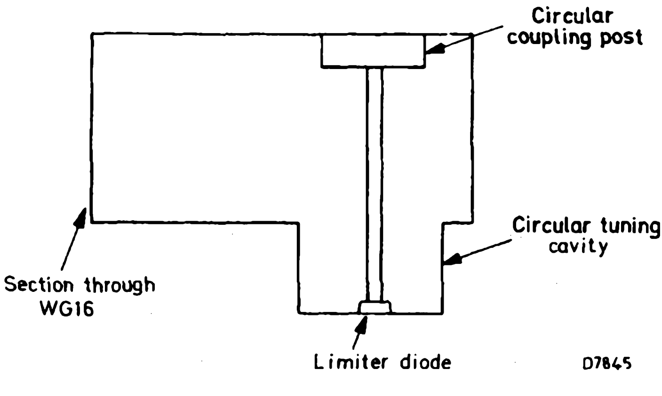
		CXY22A	CXY22B	
I_R at V_R = 6 V	max.	1.0	1.0	μA
C_T at V_R = 0 V, f = 1 MHz	typ.	0.85	0.55	pF
V_F at I_F = 50 mA	max.	1.45	1.45	V
R_S at V_R = 0 V	typ.	1.0	1.2	Ω

TYPICAL X-BAND LIMITER USING CXY22B

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

Centre frequency	f_o	9.4	GHz
Bandwidth (v.s.w.r. = 1.2:1) at 1 mW max.	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 (pk), 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.



A particular diode specification within this range should be selected to suit a particular customer's requirement. It is recommended that the diode is functionally tested by the supplier, in the customer's circuit.
Requests for devices in alternative packages will be considered by the supplier.

GALLIUM ARSENIDE VARACTOR DIODES

CXY23A
CXY23B
CXY23C
CXY23D

Gallium arsenide Schottky barrier diodes having a low series resistance and a wide capacitance range. This ensures low losses with a wide tuning range in microwave applications. They conform to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA

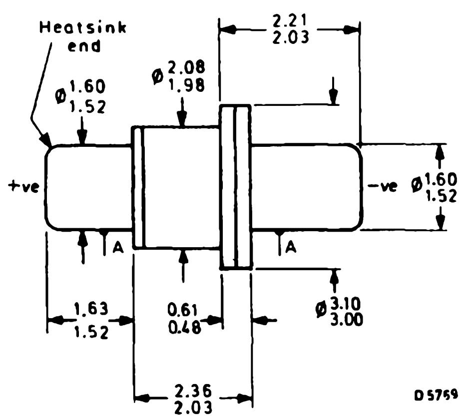
$V_{(BR)R}$ (min.)		12	V
V_R (max.)		12	V
C_j (at V_R = 0V) (typ.)	CXY23A	1.0	pF
	CXY23B	1.5	pF
	CXY23C	2.0	pF
	CXY23D	3.0	pF

(Development Nos. 821CXY/A, B, C and D)

Unless otherwise stated, data is applicable to all types.

OUTLINE AND DIMENSIONS

Conforms to BS 3934 SO-86



A: concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_R (max.)*	12	V
TEMPERATURE		
range	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25 °C)

		Min.	Typ.	Max.	
$V_{(BR)R}$		12	-	-	V
C_j (V_R = 0V)	CXY23A	0.8	1.0	1.2	pF
	CXY23B	1.2	1.5	1.8	pF
	CXY23C	1.6	2.0	2.5	pF
	CXY23D	2.5	3.0	3.5	pF
Capacitance ratio $\frac{C_j (V_R = 0V)}{C_j (V_R = 12V)}$		3.0:1	-	-	
R_S (V_R = 0V)	CXY23A	-	-	3.0	Ω
	CXY23B	-	-	2.0	Ω
	CXY23C	-	-	1.5	Ω
	CXY23D	-	-	1.0	Ω
Pacakage capacitance		-	0.2	-	pF.
V_R		-	-	12	V

*Versions of these diodes with V_R (max.) up to 30V may be made available to special order.

These devices may be supplied in alternative packages to suit customers' specific requirements

SILICON PLANAR EPITAXIAL VARACTOR DIODES

1N5152 1N5153

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 1.0 to 2.0 GHz in a typical circuit.

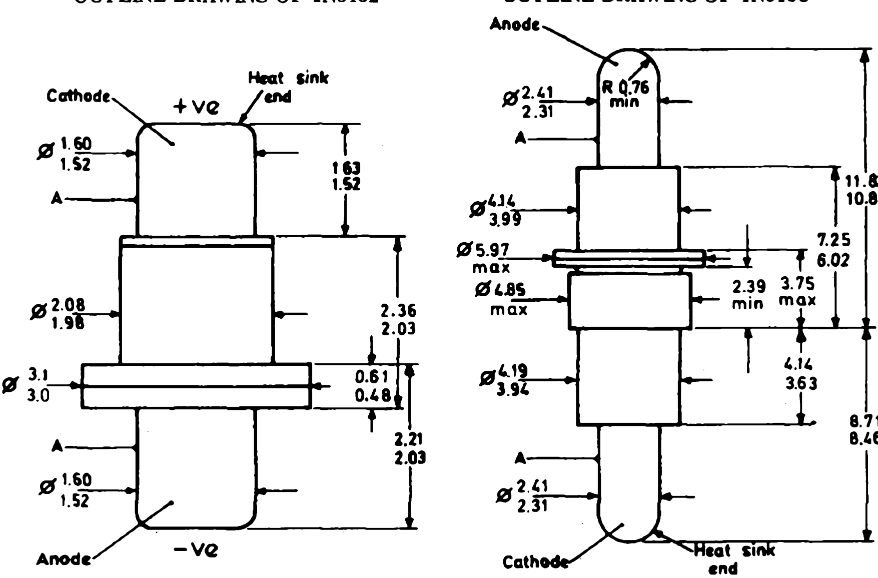
P_{in}	12	W
P_{out}	6.0	W
Typical resistive cut-off frequency (V_R = 6.0 V)	100	GHz
Typical total capacitance (V_R = 6.0 V)	6.0	pF

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS

OUTLINE DRAWING OF 1N5152

OUTLINE DRAWING OF 1N5153



A= concentricity tolerance = ±0.13

All dimensions in mm

D7840

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	75	V
P_{tot} max. R.F. ($T_{pin} \leq 70^oC$)	5.0	W

Temperature

T_{stg} min.	-55	^oC
T_{stg} max.	+175	^oC
T_j max.	+175	^oC

THERMAL CHARACTERISTIC

$R_{th(j-pin)}$ max.	20	degC/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$)

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

1N5155

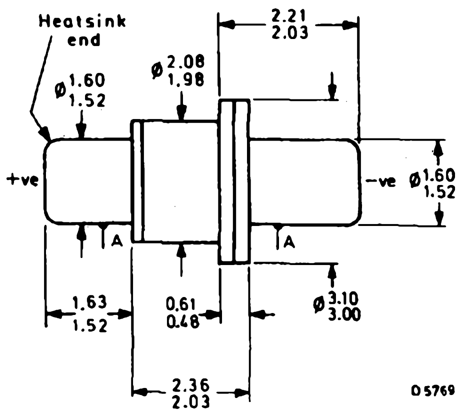
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operating as a frequency tripler 2.0 to 6.0 GHz in a typical circuit.

P_{in}	5.0	W
P_{out}	2.0	W
Typical resistive cut-off frequency (V_R = 6.0 V)	120	GHz
Typical total capacitance (V_R = 6.0 V)	2.0	pF

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	35	V
P_{tot} max. R.F. ($T_{pin} \leq 70^oC$)	3.0	W

Temperature

T_{stg} min.	-55	^oC
T_{stg} max.	+175	^oC
T_j max.	+175	^oC

THERMAL CHARACTERISTIC

$R_{th(j-pin)}$ max.	35	degC/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$)

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

1N5157

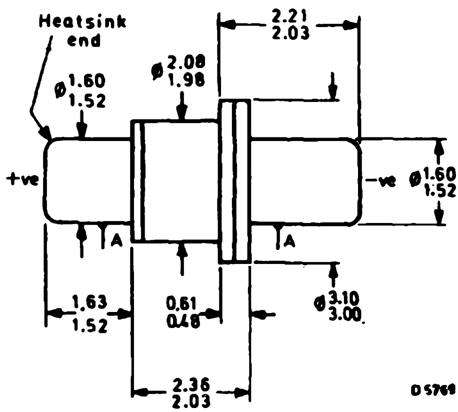
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to X-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 5.0 to 10 GHz in a typical circuit.

P_{in}	2.6	W
P_{out}	1.0	W
Typical resistive cut-off frequency (V_R = 6.0 V)	200	GHz
Typical total capacitance (V_R = 6.0 V)	0.8	pF

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	20	V
P_{tot} max. R.F. ($T_{pin} \leq 70^oC$)	2.5	W

Temperature

T_{stg} min.	-55	^oC
T_{stg} max.	+175	^oC
T_j max.	+175	^oC

THERMAL CHARACTERISTIC

$R_{th(j-pin)}$ max.	38.5	degC/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$)

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

GUNN OSCILLATORS

F

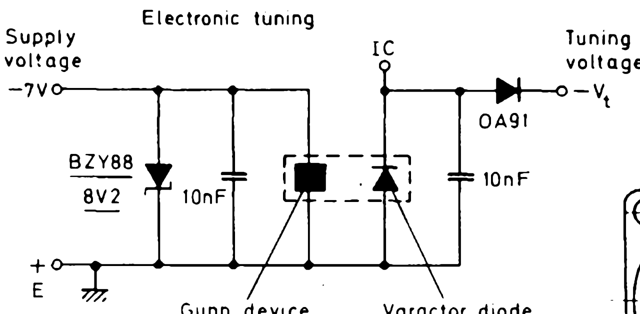
F

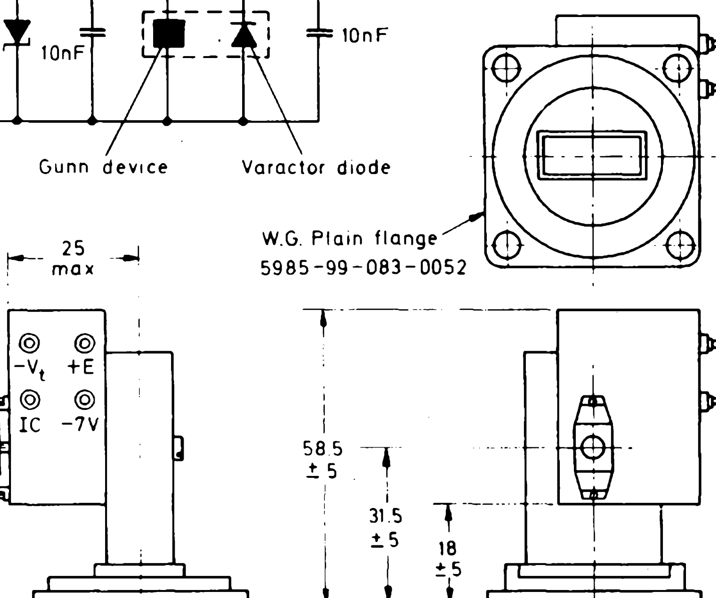
X-BAND GUNN OSCILLATOR

CL8310

QUICK REFERENCE DATA		
Solid state oscillator featuring wide electronic tuning range. For application in local oscillators employing A.F.C. systems.		
Output connector	WG.16/WR.90	
Centre frequency	9.4	GHz
Mechanical tuning range (min.)	±50	MHz
Electronic tuning range (min.)	200	MHz
Power output (typ.)	5.0	mW
Operating voltage	-7.0	V

D6579





All dimensions in mm

OPERATING CONDITIONS

Supply voltage (see note)	-7.0	V
Supply current	140	mA
Tuning voltage	0 to -10	V
Tuning current	1.0	mA
P_{out}	5.0	mW

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max.	-8.0	V
Supply current max. running	200	mA
starting	250	mA
Tuning voltage max.	-12	V
Tuning current max.	2.0	mA
Load v.s.w.r. max.	1.5:1	

CHARACTERISTICS at 25°C

Centre frequency 9.4 GHz

	Min.	Typ.	Max.	
Mechanical tuning range	±50	-	-	MHz
Electronic tuning range	200	250	-	MHz
*P_{out}	3.0	5.0	-	mW
Variation in P_{out} over electronic tuning range	-	1.5	-	dB
Electronic tuning sensitivity	-	25	-	MHz/V
Frequency temperature coefficient	-	-1.0	-	MHz/degC
Frequency pushing	-	30	-	MHz/V

*P_{out} min. measured under all conditions of tuning.

TEMPERATURE

Range max. -30 to +70 °C

OPERATING NOTE

The active element will be damaged if the supply voltage is reversed. The oscillator circuit provides some protection against forward transients greater than -8V but care should be taken to avoid such transients as far as possible.

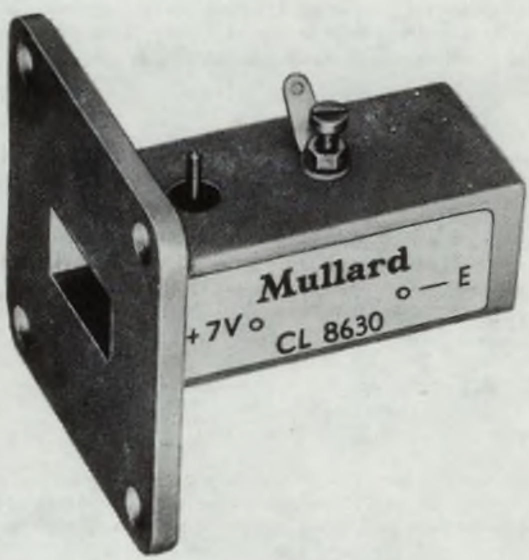
X-BAND GUNN OSCILLATOR

CL8630

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 10.7GHz band. Applications include all forms of miniature radar systems.		
Centre frequency	10.687	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/°C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5: 1	
Starting current max.	200	mA
Running current max.	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max.	+7.5	V
Supply current max. running	160	mA
starting	200	mA
Load v.s.w.r. max.	1.5: 1	

CHARACTERISTICS at 25°C

Centre frequency		10.687		GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.675	10.687	10.699	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	1.5	-	MHz/V
→ A.M. noise to carrier ratio (1Hz to 1 kHz bandwidth)		-94		dB
Second harmonic		-35		dBm

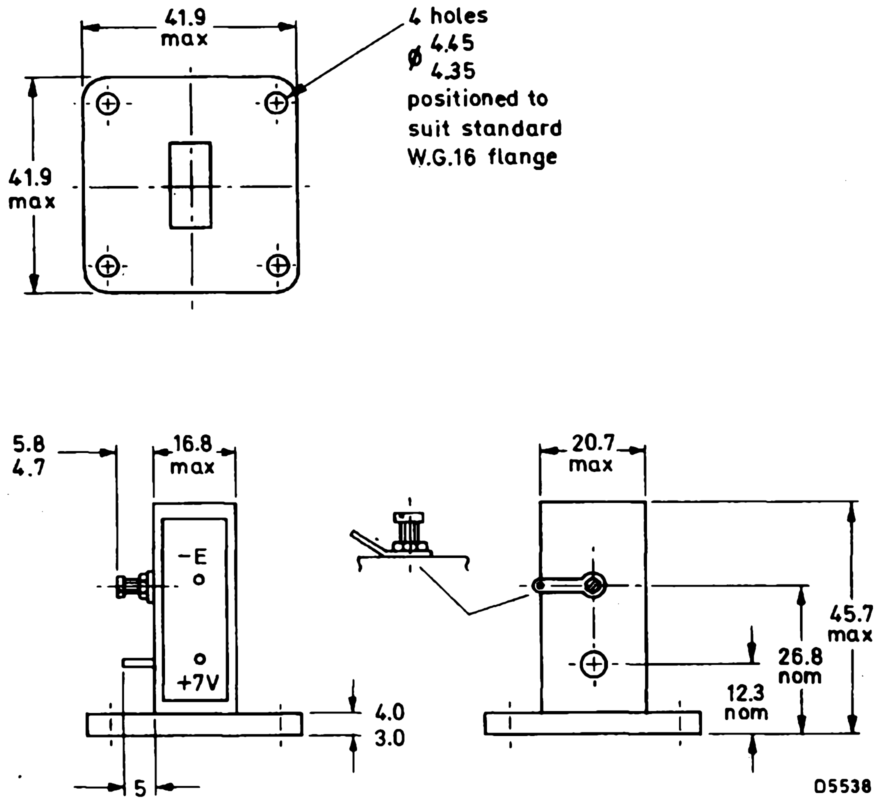
TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. Modulation of the supply voltage within the 1 Hz to 1 kHz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components. The f.m. component may be demodulated by the non-linear response characteristic of the associated detecting element.

OUTLINE DRAWING



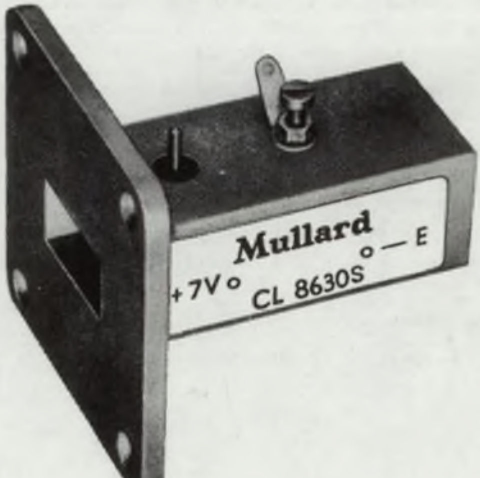
X-BAND GUNN OSCILLATOR

CL8630S

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 10.7GHz band as a self-oscillating mixer (auto detector).		
Centre frequency	10.687	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/^{o}C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Threshold current max.	200	mA
Operating current max.	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max. (d.c.)	+7.5	V
Supply voltage max. (for less than 1ms)	+9.0	V

CHARACTERISTICS at 25°C

Centre frequency		10.687		GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.675	10.687	10.699	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
→ Output voltage for input 66dB down on output power (at 12 dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	80	120	-	μV
Second harmonic	-	-35	-	dBm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

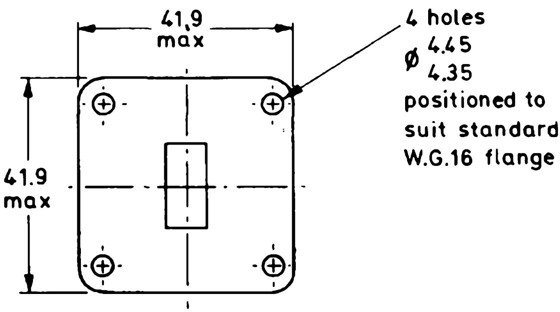
TEMPERATURE

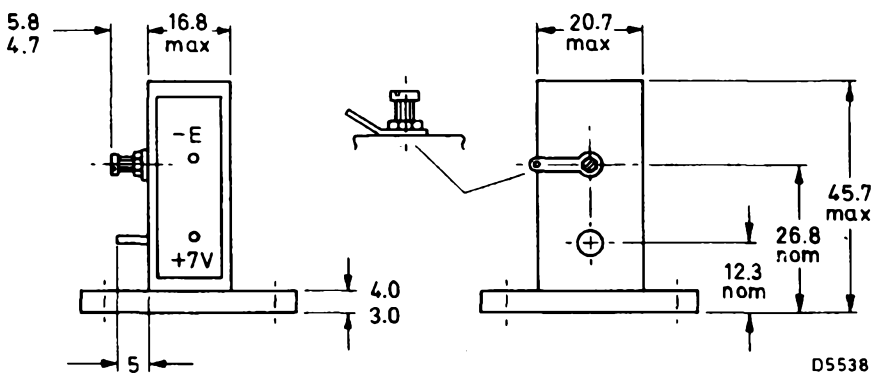
Range max.	0 to +40	°C

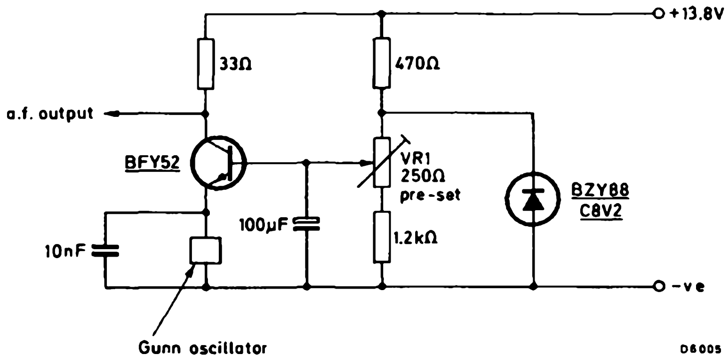
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 12m, when operating with an antenna gain of 20dB.
5. System bandwidth 1Hz to 1kHz.
6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

OUTLINE DRAWING







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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8631

QUICK REFERENCE DATA

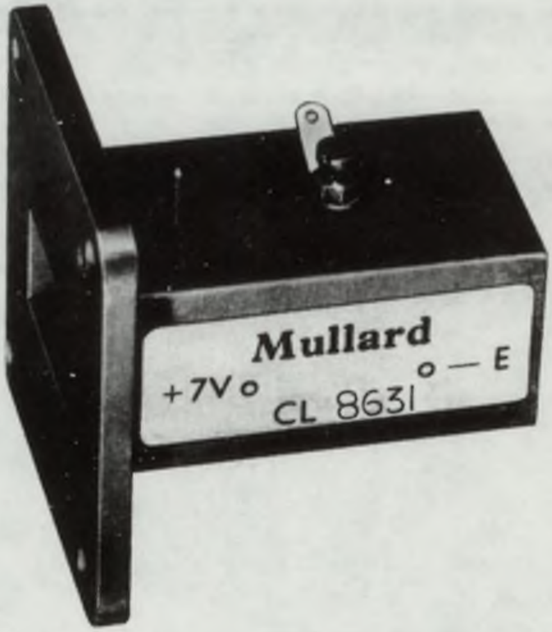
Fixed frequency Gunn oscillator for operation in the 9.35GHz band. Applications include all forms of miniature radar systems.

Centre frequency	9.35	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/°C

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

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Starting current max.	200	mA
Running current max	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max.	+7.5	V
Supply current max. running	160	mA
starting	200	mA
Load v.s.w.r. max.	1.5:1	

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency			9.35	GHz
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	9.338	9.35	9.362	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/degC
Frequency pushing	-	1.5	-	MHz/V
A.M. noise to carrier ratio (1Hz to 1kHz bandwidth)		-94		dB
Second harmonic		-25		dBm

TEMPERATURE

Range max.	0 to +40	°C

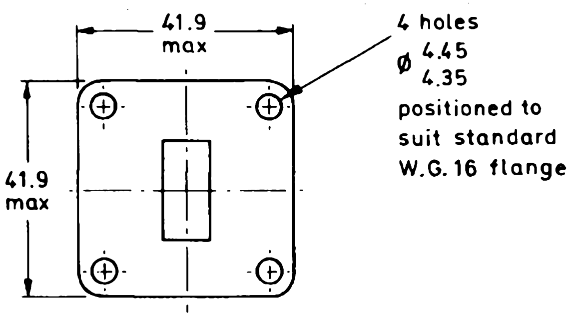
OPERATING NOTES

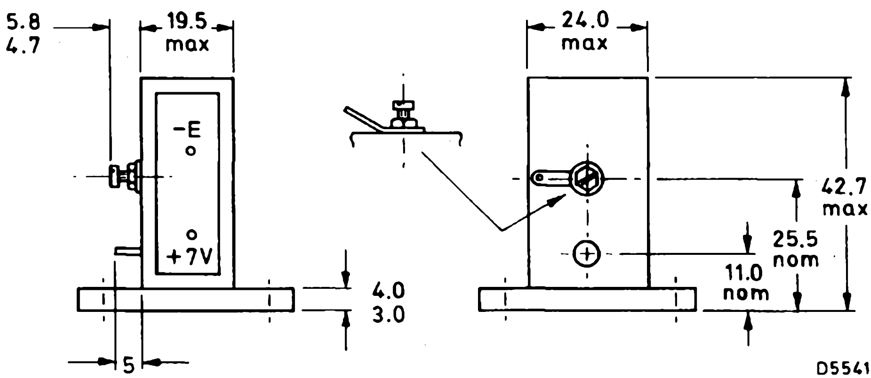
1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. Modulation of the supply voltage within the 1Hz to 1kHz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components.

X-BAND GUNN OSCILLATOR

CL8631

OUTLINE DRAWING





X-BAND GUNN OSCILLATOR

CL8631S

QUICK REFERENCE DATA

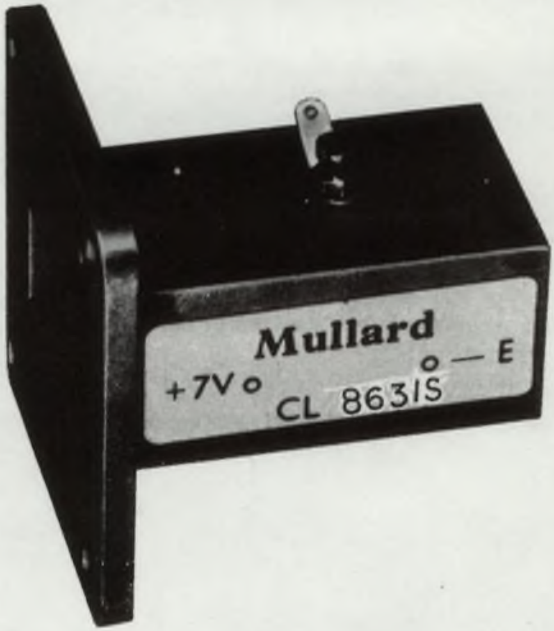
Fixed frequency Gunn oscillator for operation in the 9.35GHz band as a self-oscillating mixer (auto detector).

Centre frequency	9.35	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/°C

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

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Threshold current max.	200	mA
Operating current max.	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max. (d.c.)	+7.5	V
Supply voltage max. (for less than 1ms)	+9.0	V

CHARACTERISTICS at 25°C

Centre frequency		9.35		GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	9.338	9.35	9.362	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Output voltage for input 66dB down on output power (at 12dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	80	120	-	μV
Second harmonic	-	-25	-	dBm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

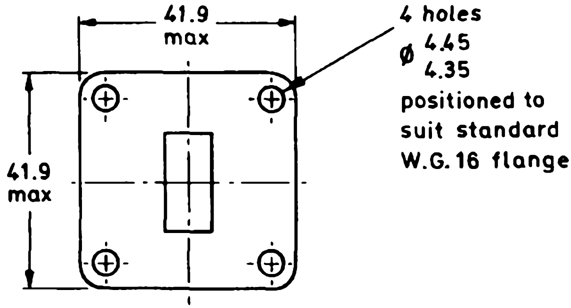
TEMPERATURE

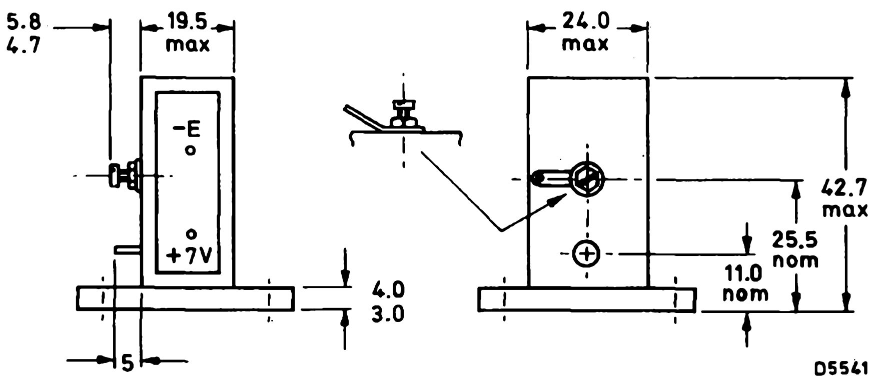
Range max.	0 to +40	°C

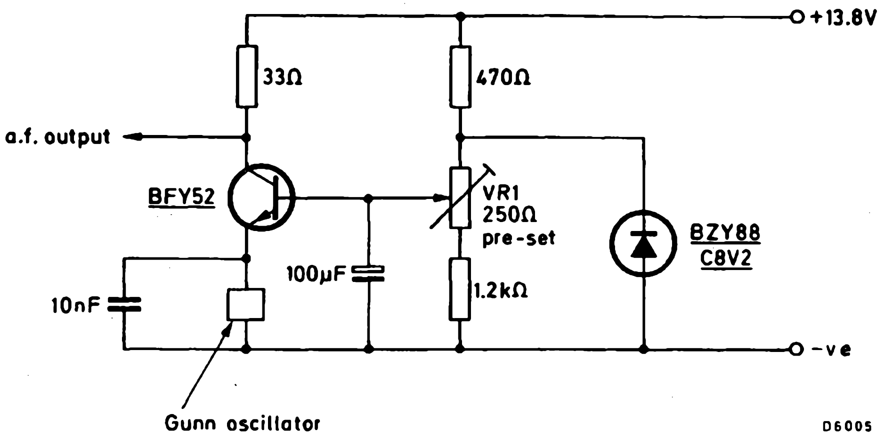
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 12m, when operating with an antenna gain of 20dB.
5. System bandwidth 1Hz to 1kHz.
6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

OUTLINE DRAWING







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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

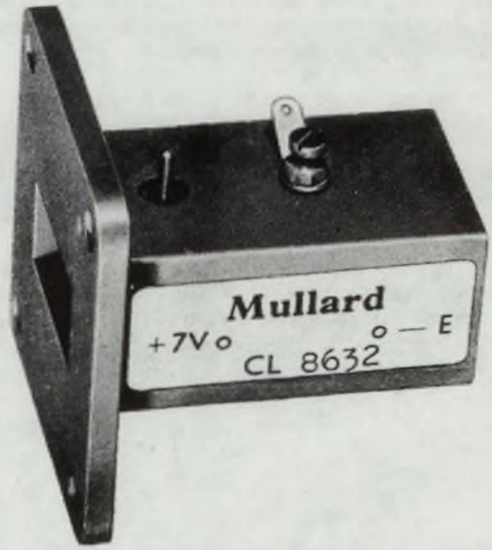
X-BAND GUNN OSCILLATOR

CL8632

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 9.47GHz band. Applications include all forms of miniature radar systems.		
Centre frequency	9.47	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/°C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Starting current max.	200	mA
Running current max.	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max.			+7.5	V
Supply current max. running			160	mA
starting			200	mA
Load v.s.w.r. max.			1.5: 1	

→ CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency			9.35	GHz
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	9.458	9.47	9.482	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/degC
Frequency pushing	-	1.5	-	MHz/V
A.M. noise to carrier ratio (1Hz to 1kHz bandwidth)		-94		dB
Second harmonic		-25		dBm

TEMPERATURE

Range max.		0 to +40		°C

OPERATING NOTES

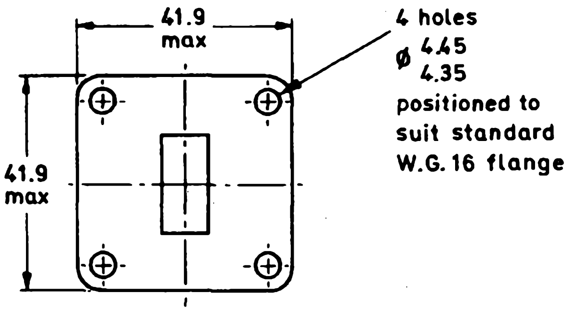
1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.

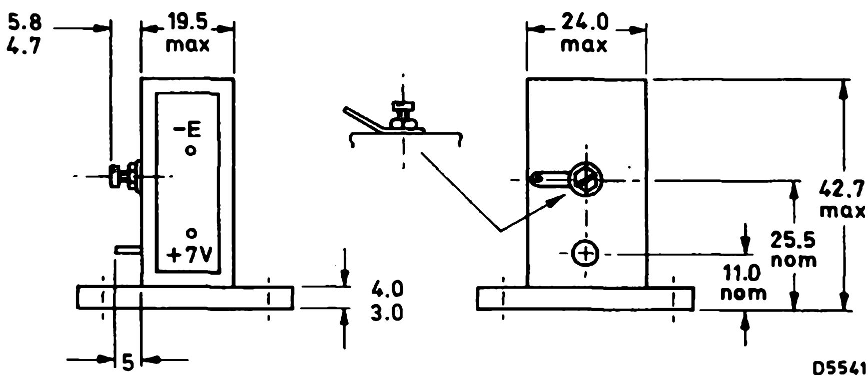
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.

3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

→ 4. Modulation of the supply voltage within the 1Hz to 1kHz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components.

OUTLINE DRAWING





X-BAND GUNN OSCILLATOR

CL8632S

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 9.47GHz band as a self-oscillating mixer (auto detector).		
Centre frequency	9.47	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/^{o}C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Threshold current max.	200	mA
Operating current max.	160	mA

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max. (d.c.)	+7.5	V
Supply voltage max. (for less than 1ms)	+9.0	V

→ CHARACTERISTICS at 25°C

Centre frequency		9.47		GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	9.458	9.47	9.482	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Output voltage for input 66dB down on output power (at 12dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	80	120	-	µV
Second harmonic	-	-25	-	dBm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.

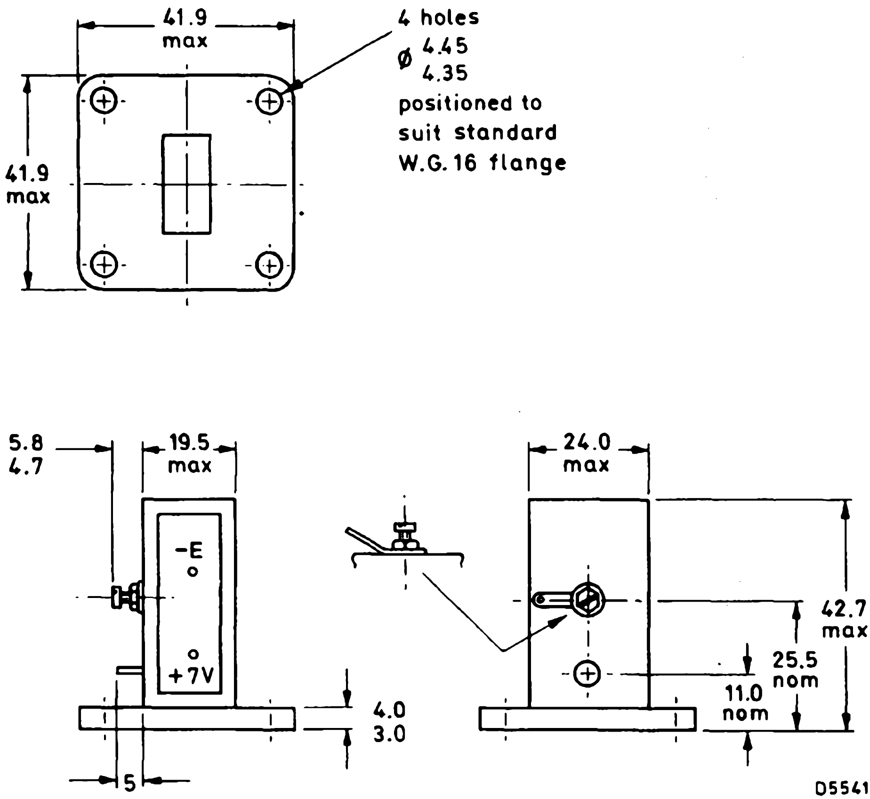
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

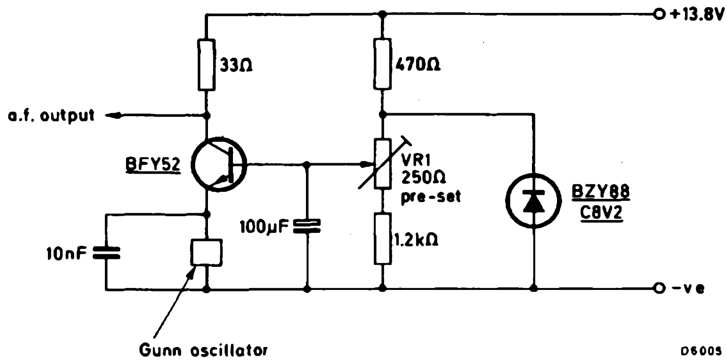
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 12m, when operating with an antenna gain of 20dB.

5. System bandwidth 1Hz to 1kHz.

6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

OUTLINE DRAWING





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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

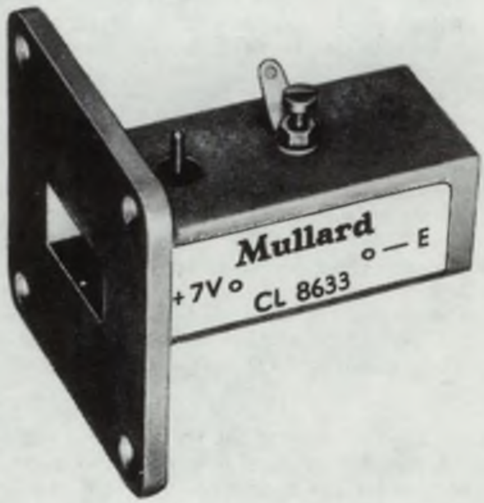
X-BAND GUNN OSCILLATOR

CL8633

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 10.5GHz band. Applications include all forms of miniature radar systems.		
Centre frequency	10.525	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/^{o}C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Threshold current max.	200	mA
Operating current max.	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max. (d.c.)	+7.5	V
Supply voltage max. (for less than 1ms)	+9.0	V

→ CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency		10.525		GHz
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.513	10.525	10.537	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
A.M. noise to carrier ratio (1Hz to 1kHz bandwidth)		-94		dB
Second harmonic		-35		dBm

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.

3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

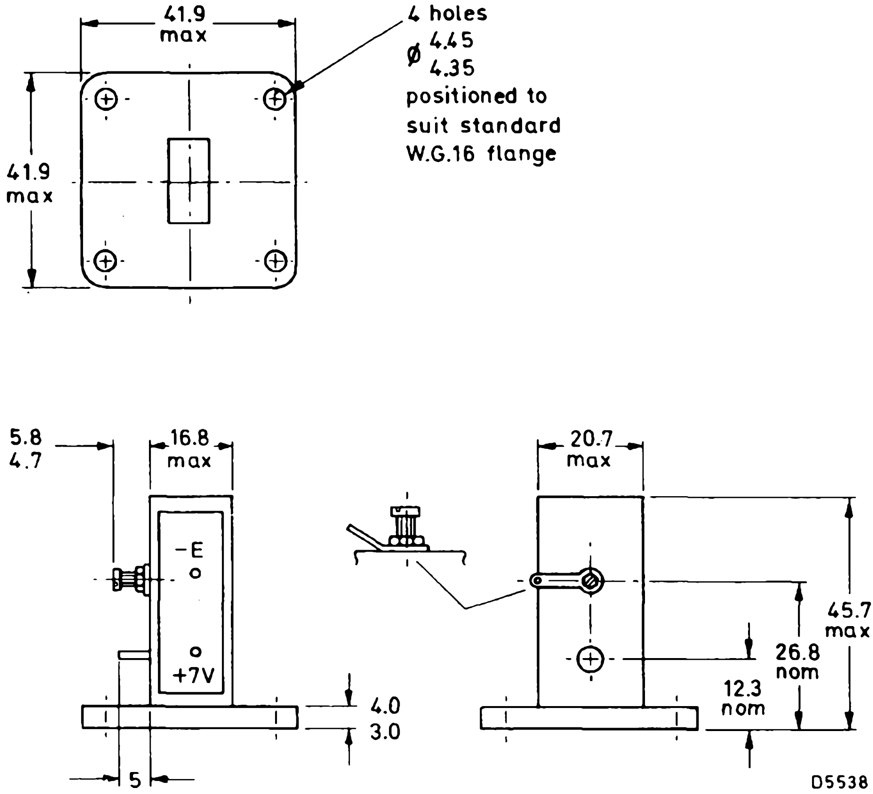
4. When used in a Doppler radar system, modulation of the oscillator supply voltage will degrade the a.m. signal to noise ratio at the output of the associated mixer, as a result of direct conversion by the Gunn device to a.m. and f.m. noise components. The a.m. component will contribute directly and the f.m. component may contribute from demodulation by the slope of the bandpass characteristic of the mixer.

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, Mullard ACX-01A.

X-BAND GUNN OSCILLATOR

CL8633

OUTLINE DRAWING



Mullard

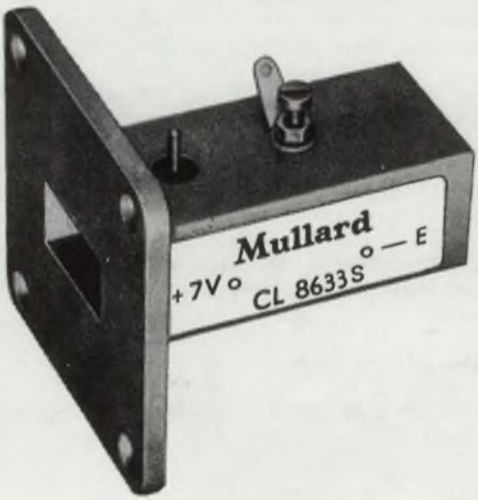
X-BAND GUNN OSCILLATOR

CL8633S

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 10.5GHz band as a self-oscillating mixer (auto detector).		
Centre frequency	10.525	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/°C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating notes)	+7.0	V
Load v.s.w.r. max.	1.5:1	
Threshold current max.	200	mA
Operating current max.	160	mA



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max. (d.c.)	+7.5	V
Supply voltage max. (for less than 1ms)	+9.0	V

→ CHARACTERISTICS at 25°C

Centre frequency			10.525	GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.513	10.525	10.537	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	1.5	-	MHz/V
Output voltage for input 66dB down on output power (at 12dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	80	120	-	μV
Second harmonic	-	-35	-	dBm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.

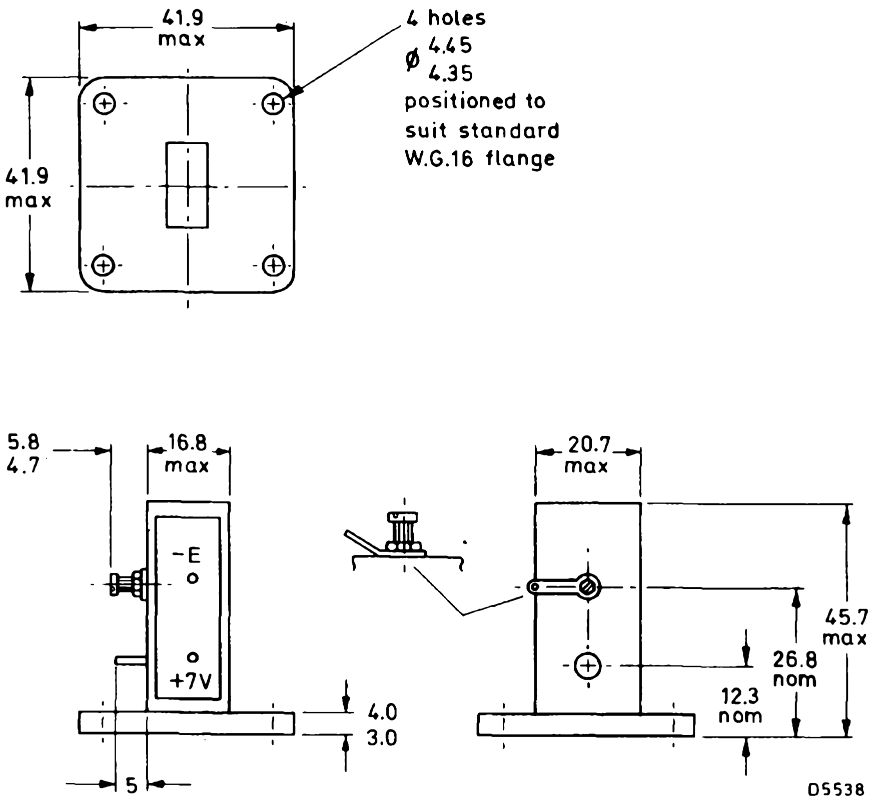
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

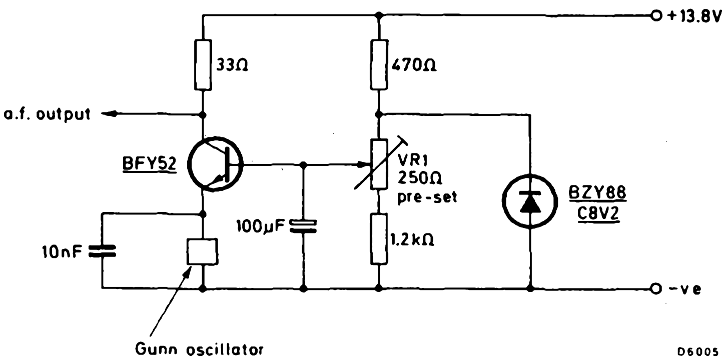
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 12m, when operating with an antenna gain of 20dB.

5. System bandwidth 1Hz to 1kHz.

6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

OUTLINE DRAWING





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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8640R
CL8640T

Mechanically and electronically tuned Gunn-effect oscillators in the 10.5GHz band. The high Q cavity offers frequency stability compatible with application as the transmitter (CL8640T) and receiver local oscillator (CL8640R) in short range data link systems.

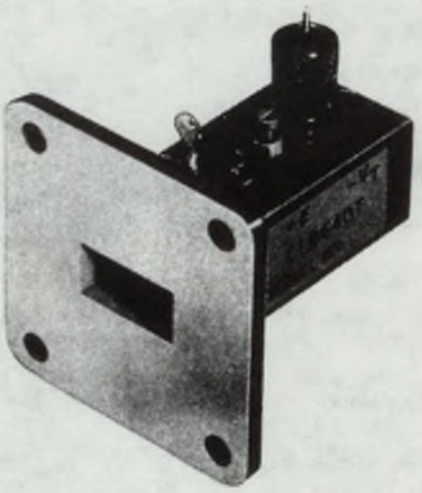
QUICK REFERENCE DATA

	CL8640R	CL8640T	
Centre frequency	10.49	10.56	GHz
Mechanical tuning range min.	120	120	MHz
Electronic tuning range min.	30	8.0	MHz
Power output typ.	6.0	6.0	mW
Operating voltage	-7.0	-7.0	V

Output via square plain flange WG.16,WR90. 5985-99-083-0052

CL8640R - receiver local oscillator

CL8640T - transmitter



TYPICAL OPERATING CONDITIONS

Supply voltage (note 1)		-7.0	V
Starting current		250	mA
Running current		170	mA
Tuning voltage (modulation) (notes 1 and 2)	CL8640R	-0.5 to -7.5	V
	CL8640T	-0.5 to -1.5	V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage max.	-7.2	V
Supply voltage (transient) max.	-8.0	V
Tuning voltage max.	-12	V
Tuning current max.	100	μA
Load v.s.w.r. max.	1.5:1	

CHARACTERISTICS (at 25°C)

Centre frequency	CL8640R	10.49	GHz
	CL8640T	10.56	GHz

		Min.	Typ.	Max.	
Mechanical tuning range		±60	-	-	MHz
Electronic tuning range	CL8640R	±15	-	-	MHz
(notes 2 and 3)	CL8640T	±4.0	-	-	MHz
Power output at -7.0V		4.0	6.0	-	mW
Frequency pushing		-	3.0	-	MHz/V
Frequency pulling (note 4)		-	1.5	-	MHz
Frequency temperature coefficient		-	-0.25	-0.3	MHz/°C
Tuning current		-	-	10	μA

TEMPERATURE

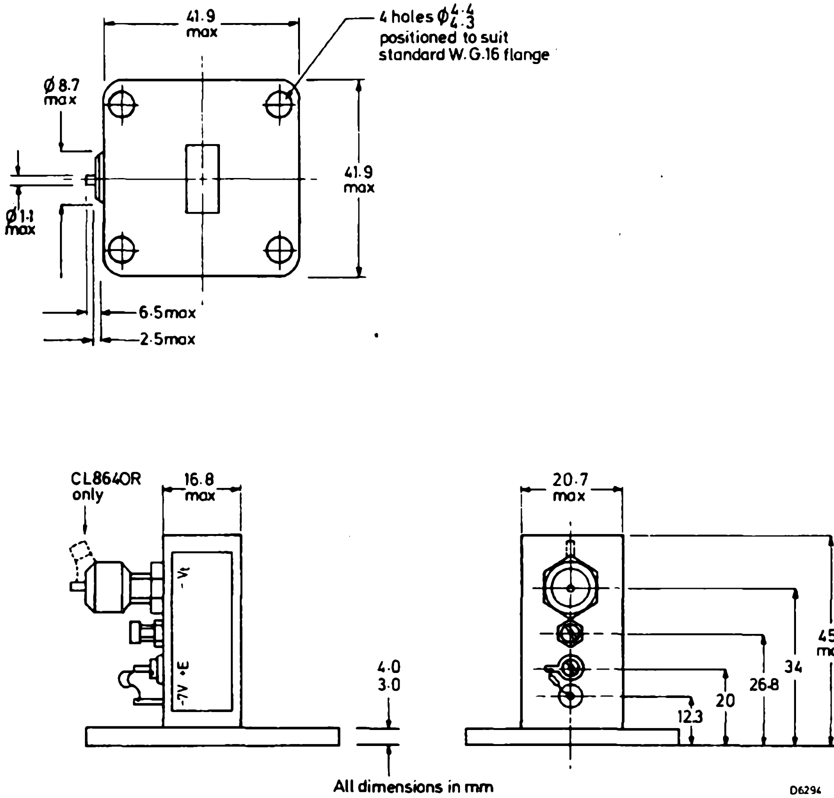
	CL8640R	CL8640T	
Operating range	-15 to +70	+25 to +70	°C
Storage range	-30 to +100	-30 to +100	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in the supply voltage.
2. The electronic tuning provided by the varactor diode circuit is non-linear, following an approximately exponential rate of change of capacitance at low tuning voltages.
3. For CL8640R the tuning voltage range is -0.5V to -7.5V with the electronic centre at -2.5V.
4. V.S.W.R. = 1.5:1

X-BAND GUNN OSCILLATOR

CL8640R CL8640T



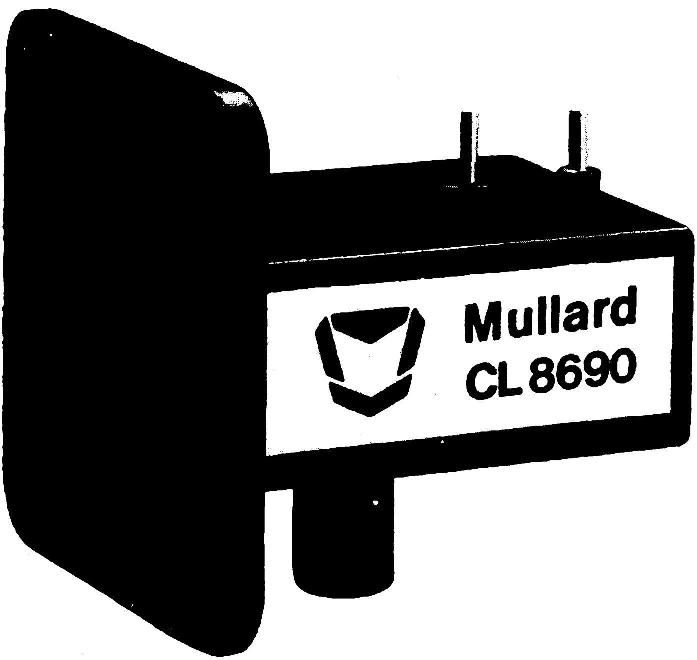
OUTLINE DRAWING

X-BAND GUNN OSCILLATOR

This is an electronically and mechanically tuned oscillator suitable for use as a solid state replacement for reflex klystrons. It may be used as a local oscillator in marine radar systems. The device has been tested to ensure its compliance with the requirements of Board of Trade specification BOT SBN 115 10057/1.

QUICK REFERENCE DATA

Output connector		WG16	
Centre frequency		9.375	GHz
Mechanical tuning range	min.	±75	MHz
Electronic tuning range	min.	±25	MHz
Power output	min.	5	mW
Operating voltage		−7.5	V



TYPICAL OPERATING CONDITIONS

Supply voltage (note 1)		−7.5	V
Supply current		160	mA
Tuning voltage (notes 1 and 2)		−1 to −12	V
Tuning current		10	μA

LIMITING VALUES at 20 °C

In accordance with the Absolute Maximum System

Supply voltage	max.	−8	V
Supply current (note 3)	max.	200	mA
Tuning voltage	max.	−15	V
Tuning current	max.	100	μA
Storage temperature		−45 to +85	°C
Ambient operating temperature		−15 to +50	°C

CHARACTERISTICS at 20 °C

Centre frequency (note 4) 9.375 GHz

	min.	typ.	max.	
Mechanical tuning range	±75	±100		MHz
Electronic tuning range	±25	±30		MHz
Power output (note 5)	5	8		mW
Frequency deviation over temperature range		±15	±25	MHz
Frequency pushing		10	15	MHz/V
Frequency pulling (note 6)			20	MHz
Mechanical tuning rate			250	MHz/turn

Notes

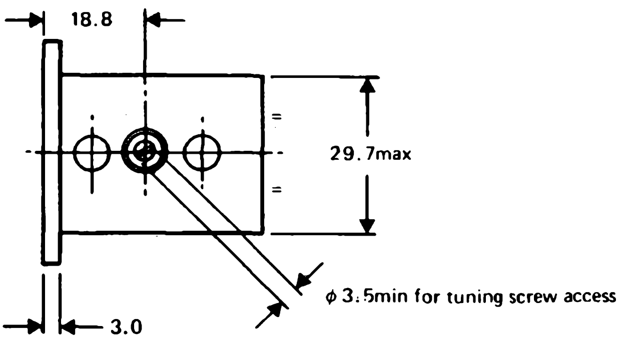
1. The active element will be damaged if the supply voltage is reversed. In addition, care should be taken to avoid transients in the supply voltage as far as possible.
2. The tuning voltage should have a source impedance of less than 1 kΩ.
3. During the switch-on period, the Gunn device current will rise to a peak of up to 300 mA at approximately −4 V and then fall to the specified operating current at −7.5 V.
4. The centre frequency is measured with supply voltages of −7.5 V to the Gunn device and −5 V to the varactor diode.
5. Power output is measured under all conditions of tuning and temperature.
6. The load v.s.w.r. is 1.3 max. Frequency pulling is measured over all phases of mismatch.

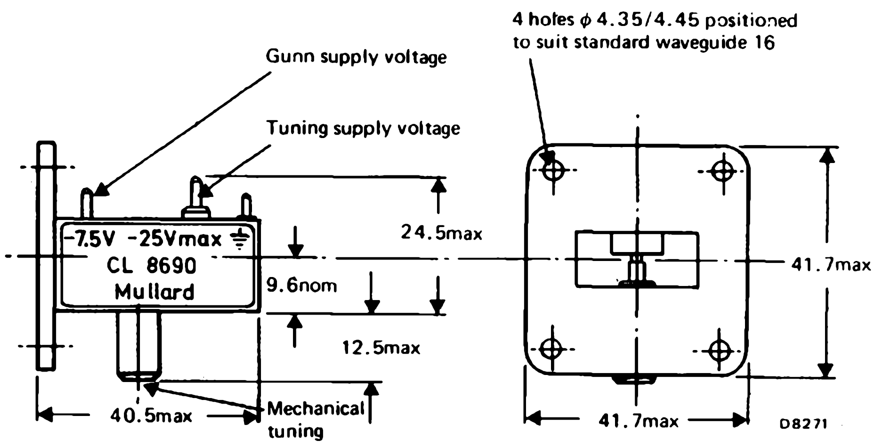
APPLICATION NOTES

1. Three solder pins are provided for connection of the supply voltages and the earth contact.
2. To prevent parasitic low frequency oscillation, a 1 μF capacitor is connected across the Gunn device.
3. The centre frequency may be set within the limits given in the characteristics, by turning the screw.
4. A zener diode should be connected across the Gunn device supply for transient protection.

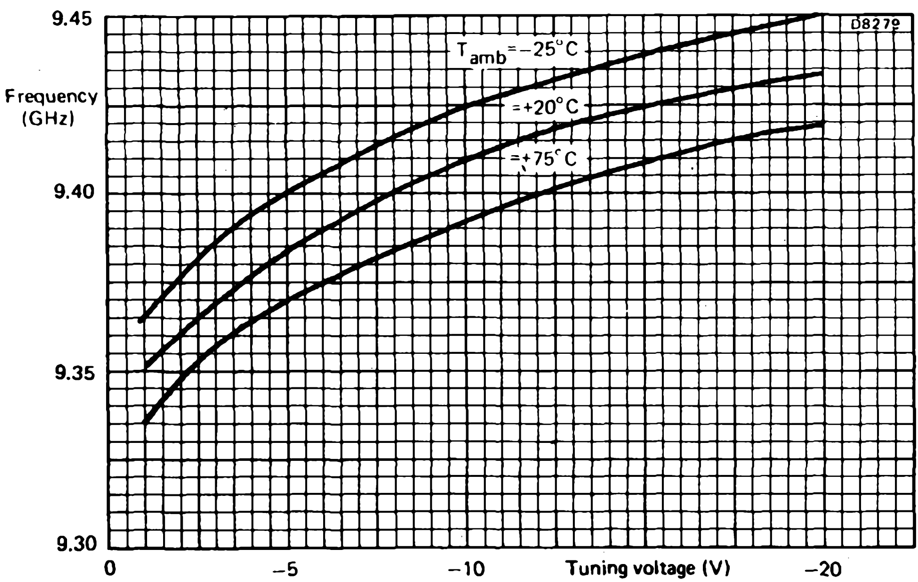
MECHANICAL DATA

Dimensions in mm

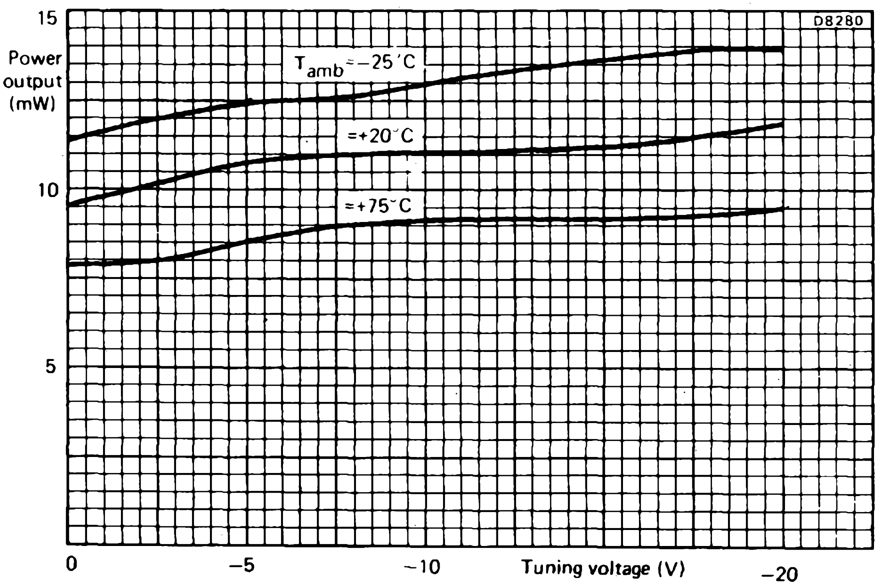




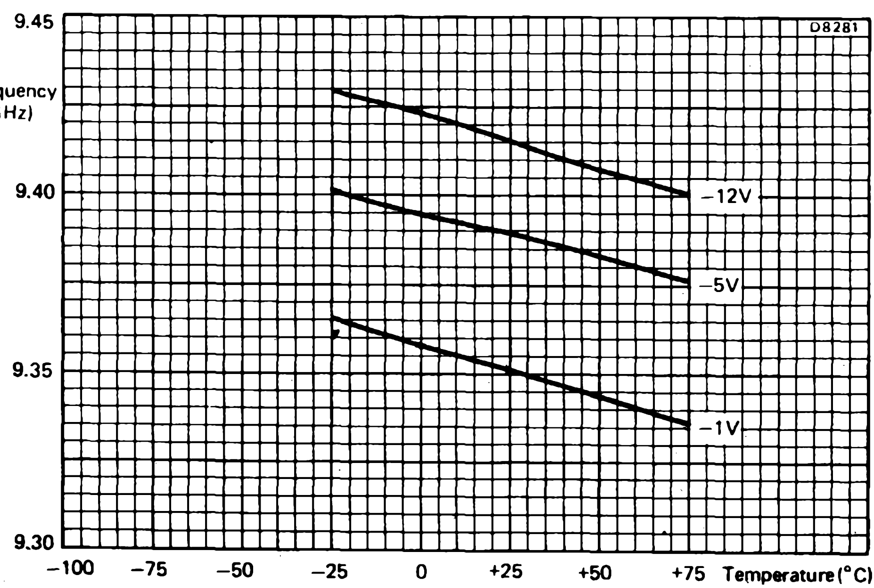
Typical power output and tuning voltage as a function of temperature.
(Output frequency constant at 9.385 GHz)



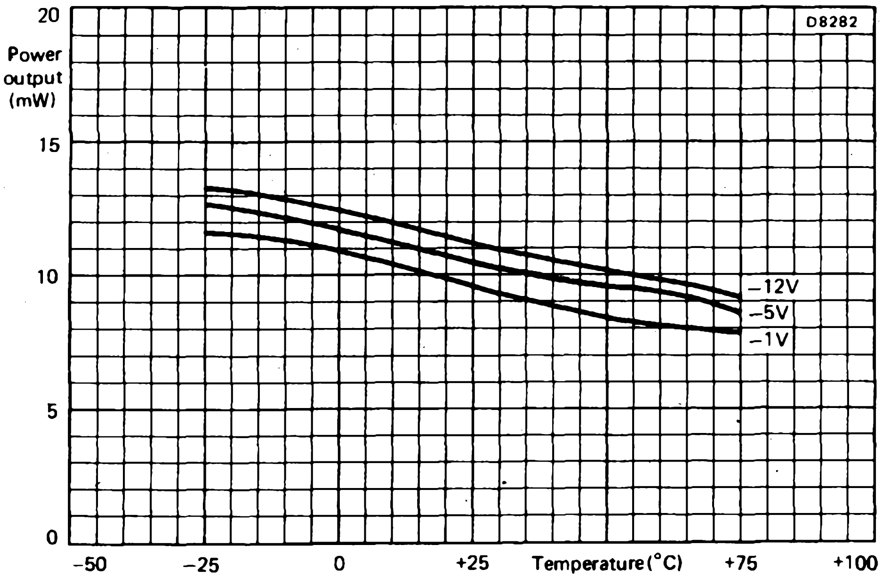
Typical output frequency as a function of tuning voltage at three ambient temperatures



Typical power output as a function of tuning voltage at three ambient temperatures



Typical output frequency as a function of temperature at three tuning voltages.



Typical power output as a function of temperature at three tuning voltages

DOPPLER AND TRAFFIC RADARS

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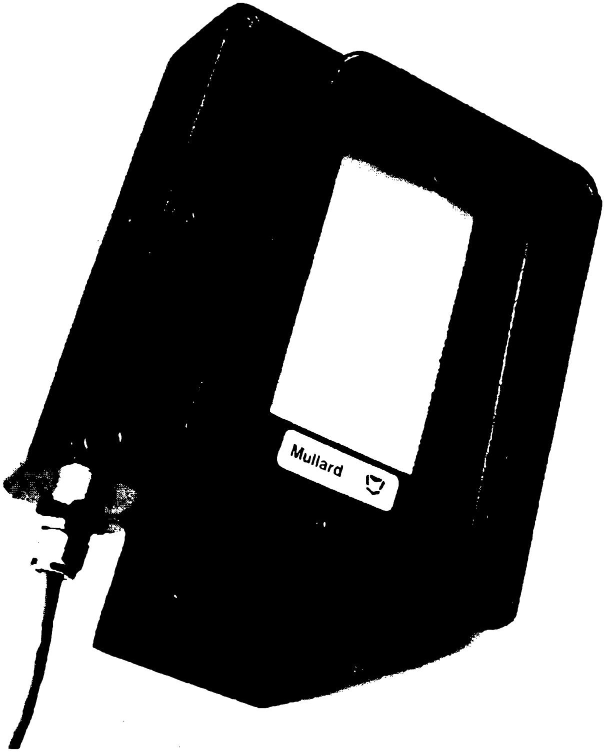
X-BAND TRAFFIC RADAR SENSOR

Fixed frequency radar traffic sensor, with direction sense, for operation in the 10.6 GHz band. The sensor uses Doppler radar to provide vehicle actuation for permanent or portable traffic light signals. It complies with national government regulations (in the U.K. D. o.E. specifications MCE0111, MCE0114 and MCG0500 and Home Office regulation BR14, 1975 specification).

QUICK REFERENCE DATA

Centre frequency		10.587	GHz
Transmitted power	typ.	5	mW
Detection range for small vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface		100	m
Supply voltage (a.c.)		110	V



OPERATING CONDITIONS

Supply voltage (110 V_{ac} centre-tapped)		55–0–55	V
Power consumption	typ.	7	W

LIMITING VALUES

In accordance with the Absolute Maximum System

Supply voltage (a.c.)	55–0–55± 20%	V
Storage temperature	– 20 to + 70	°C
Ambient operating temperature	– 15 to + 50	°C

CHARACTERISTICS

	min.	typ.	max.	
Centre frequency fixed in the range	10.577	10.587	10.597	GHz
Transmitted power	–	5	10	mW
Detection range for vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface	85	100	140	m
Mass		3		kg

CABLE ENTRY

At bottom rear of sensor

OPERATING NOTES

1. The sensor is of single-chassis construction.
2. It is recommended that the sensor is mounted so that the centre of the microwave window (radome) is not less than 150 mm above the cowl of the red signal. There will then be minimal interruption of the beam by the cowl and the near-field performance of the sensor will not be impaired.
3. In operation, the traffic signal controller demand input is connected to the 'relay output' terminals. In the standard unit for use with portable signal heads, the relay is energized closed, except when a demand is present.
4. Units with 'normally open' relay connections are available on request.
5. A 47 Ω resistor in series with the relay output terminals is included for overcurrent and overvoltage protection.
6. Upon detection of oncoming traffic, the relay in the sensor is de-energized and a pair of isolated contacts is opened to signify detection.
7. These contacts remain open during the detection of a stream of oncoming traffic. The minimum open time is nominally 1 second.
8. Signals caused by departing vehicles are ignored.
9. Should a fault occur in the sensor, or its supply voltage be interrupted, then the sensor relay will be permanently de-energized and a continuous demand will be applied to the controller. The traffic signals will then operate automatically in a fixed-time manner.
10. The power supply for the sensor is derived from the main traffic control unit; a 55–0–55 V centre-tapped a.c. supply is necessary.
11. The cable colour code shown in table 1 must be observed.

TABLE 1
Cable colour code

Red	55 V_{ac}
Orange	55 V_{ac}
Black	0 V (centre tap of 110 V a.c. supply)
Green/Yellow, Green	Normally closed output contacts (isolated)

12. The equipment detects lone vehicles approaching the traffic signals in the presence of large departing vehicles or a heavy stream of departing traffic. This is an important feature of the design philosophy of the radar process circuit.
13. The equipment does not give false outputs in the absence of moving targets.
14. Signals reflected from fluttering or waving trees at reasonable distances from the sensor do not cause unwanted outputs, even if the sensor is aimed directly at the trees.
15. For temporary traffic light systems, a 'NUDGE' facility is included.
16. The NUDGE facility is such that in the absence of a demand from approaching traffic for a period of 2½ minutes, a 'phantom' demand is applied. The relay in the sensor is de-energized and the sensor then returns to the vehicle-actuated mode. The period is set by a digital timer which is independent of the ambient temperature.

OPERATING NOTES (continued)

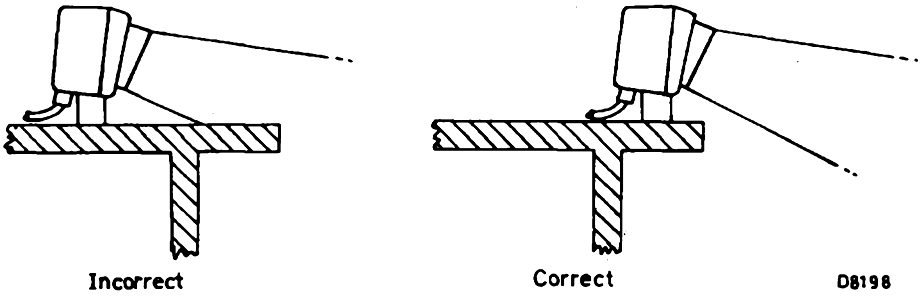
17. The 'phantom' demand overcomes the rare lock-up situations in traffic flow at temporary traffic lights where the possibility of a permanent 'red-red' can occur, caused by the non-detection of approaching vehicles.

SITE TESTS

1. To check the operation of a sensor, set it up in the operating position with the power supplies connected and connect a multimeter such as the AVO Model 8, switched to a resistance-measuring range, across the normally-closed contacts. (Note: high-voltage circuit testers, such as the Megger, must not be used as they will damage the sensor). The measured resistance should be approximately 47 Ω; this is the value of the protection resistor incorporated in the circuit.
2. Check the a.c. supply voltages at the microwave head. The line-to-line voltage should be 110 V_{rms} and the voltage between each line and the 0 V terminal should be 55 V_{rms}. The tolerance on these voltages is ±20%.
3. Arrange for a vehicle, preferably a small car, to be driven towards and past the sensor at approximately 30 m.p.h. When the car is between 140 and 80 metres from the sensor (see fig.2), the measured resistance between the normally-closed contacts should quickly increase to indicate an open-circuit. This condition should continue for approximately 1 second after the car has passed out of the sensor's detection range.

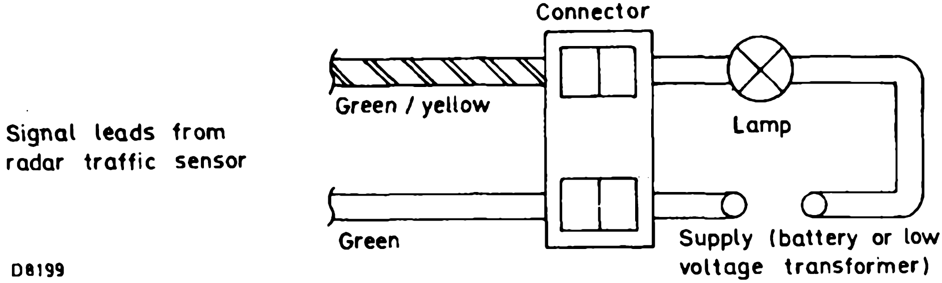
WORKSHOP TESTS FOR INOPERATIVE SENSORS

1. These tests are intended to reveal inoperative sensors only. It must be noted that they do not replace any range tests carried out with a vehicle under site conditions.
   There is no attempt to correlate range measurements with these tests as they will only inform the operator that a sensor is functioning correctly, not functioning or is functioning in reverse. They will, however, ensure that there is some consistency of testing between different operators.
2. Ideally, the sensor should be sited in an environment free, as far as possible, from extraneous movements of large bodies such as people, fork lift trucks, etc.
3. The sensor should be placed on a level surface, e.g. a bench, as near to the edge as possible to avoid reflections from the bench surface.



   It should not be pointed directly at fluorescent lights as they may cause false demands to be registered due to interference.
4. Ensure that the environment is free as far as possible from microwave interference, for example, radar traffic sensors on soak test in the vicinity of the beam could cause interference giving rise to false demands.

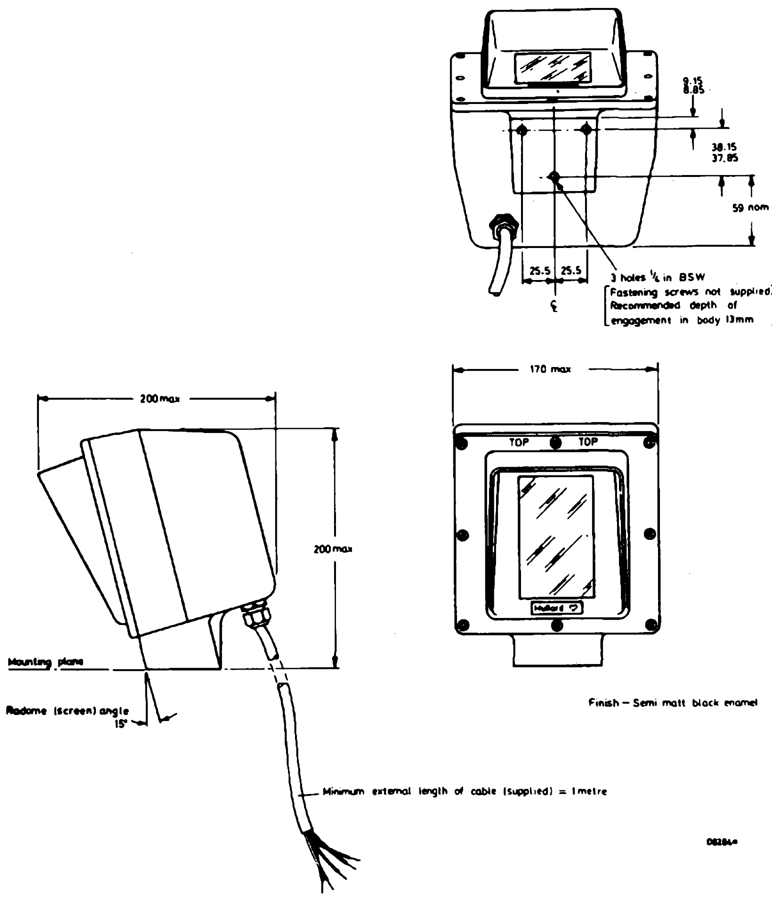
5. The supply cable should be connected in accordance with the coding given in table 1 on page 3.
6. Demands may be observed by connecting the signal output leads (green and green/yellow) to a controller with a lamp which indicates presence of a demand. Alternatively, a bulb and power supply may be connected in series with the signal leads via a simple connector block such as the push-button type 'quick connector' available from Radiospares. See diagram below



This simple method will eliminate the possibility of controller faults.

7. With the supply connected and switched on, the indicator lamp should be illuminated.
8. A demand will be indicated when the lamp is extinguished.
9. Leave the sensor pointing into free space and check for false demands. The lamp should remain alight for approximately 2 to 2½ minutes until the 'nudge' circuitry puts in a 'phantom' demand. These 'nudge' demands will reappear at regular intervals of 2 to 2½ minutes; no other demands should occur between them.
10. With the sensor placed on a level surface, (see note 3), about 1½ metres from ground level, the operator should stand about 5 metres away from the sensor in a direct line with the microwave window (radome) and should have the demand indicator lamp in view. He should then walk at normal walking pace towards the sensor, stopping at about 1 metre from it. If the sensor is functioning correctly, a demand will be registered between starting to walk and stopping. He should then wait for the demand to clear and then walk backwards to his starting point. No demand should be registered. If a demand is observed, the sensor is working in reverse and is therefore faulty.

MECHANICAL DATA Dimensions in mm



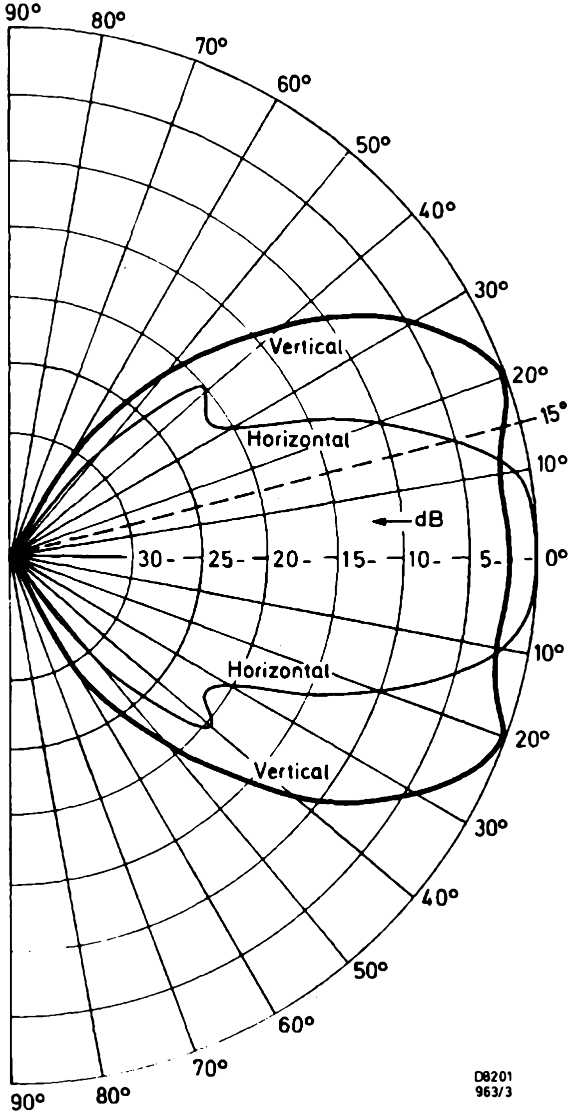


Fig.1 Typical polar diagram of traffic radar sensor.
The broken line indicates the preferred mounting angle of 15°. This affects only the orientation of the vertical pattern

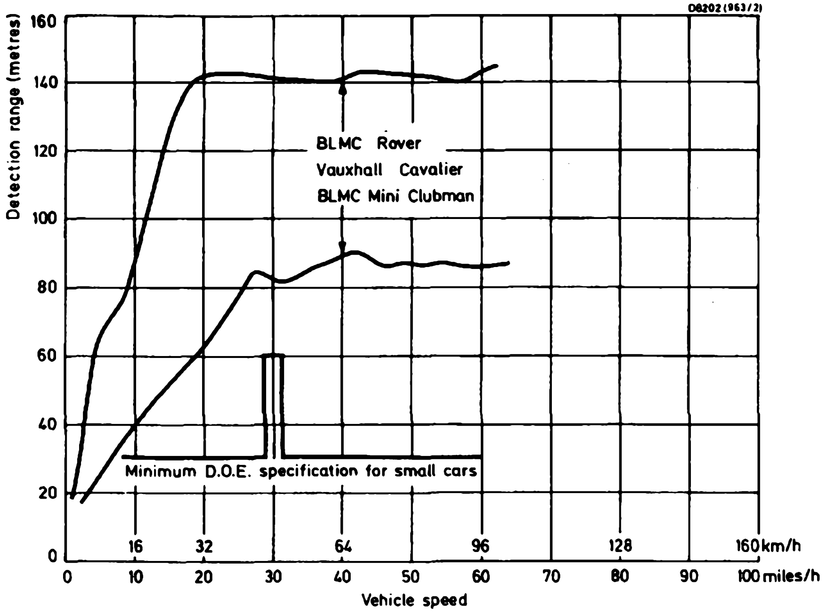


Fig.2 Detection curves obtained from road tests using six different traffic radar sensors

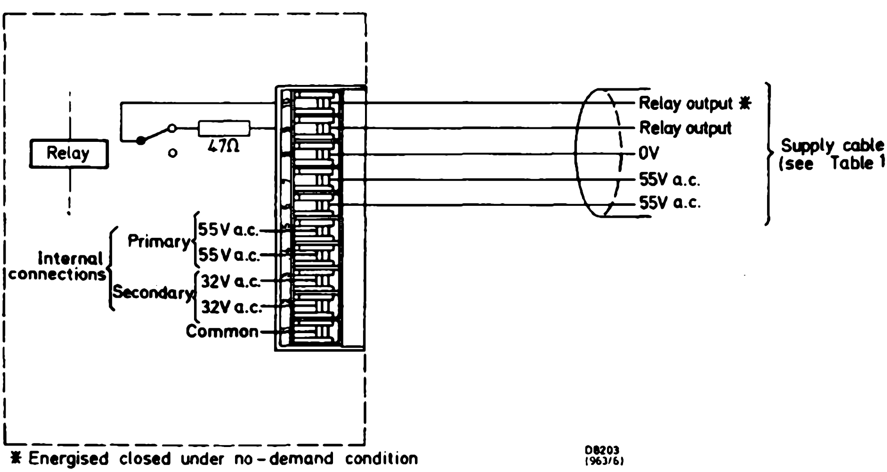


Fig.3 Terminal block connections. The two 55 V terminals on the supply cable are of opposite phase and are part of a 55—0—55 V a.c. supply.

QUALITY APPROVAL OF TRAFFIC RADAR SENSORS

The sensors are currently produced at the Mullard plant at Hazelgrove, Cheshire. The Quality Department within Mullard Hazelgrove operates to standards set by BS9000 and is supported by a resident E.Q.D. inspector. Product developments are steered through a rigorous release procedure; development sample are appraised before approval for production.
In the case of these radar sensors, the individual semiconductor diodes are the subject of a separate quality release exercise, in addition to that carried out on the final sensor. In production, the semiconductor diodes are batch-approved by the Quality Department before assembly.
Quality control procedures for production include:

1. Raw material inspection.
2. Quality control within the assembly areas.
3. 100% electrical testing of primary parameters and sample testing to appropriate A.Q.L.
4. Environmental sample testing.
5. Measurement of secondary electrical parameters on batch samples.
6. Calibration and standardization of test procedures.

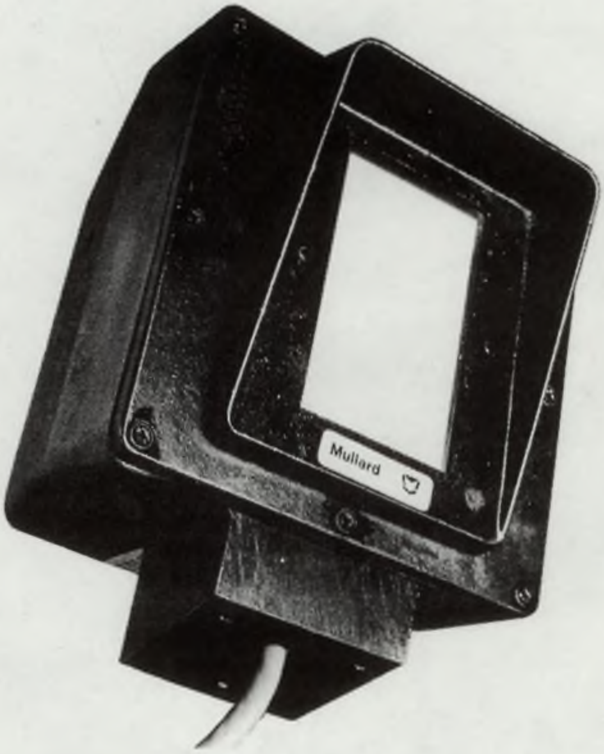
Where customer requirements differ from the standard commercial product, liasion is established with specific customers and suitable procurement specifications are agreed.

X-BAND TRAFFIC RADAR SENSOR

Fixed frequency radar traffic sensor, with direction sense, for operation in the 10.6 GHz band. The sensor uses Doppler radar to provide vehicle actuation for permanent or portable traffic light signals. It complies with national government regulations (in the U.K. D.o.E. specifications MCE0111, MCE0114 and MCG0500 and Home Office regulation BR14, 1975 specification).

QUICK REFERENCE DATA

Centre frequency		10.587	GHz
Transmitted power	typ.	5	mW
Detection range for small vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface		100	m
Supply voltage (a.c.)		110	V



OPERATING CONDITIONS

Supply voltage (110 V_{ac} centre-tapped)		55–0–55	V
Power consumption	typ.	7	W

LIMITING VALUES

In accordance with the Absolute Maximum System

Supply voltage (a.c.)	55–0–55±20%	V
Storage temperature	– 20 to + 70	°C
Ambient operating temperature	– 15 to + 50	°C

CHARACTERISTICS

	min.	typ.	max.	
Centre frequency fixed in the range	10.577	10.587	10.597	GHz
Transmitted power	–	5	10	mW
Detection range for vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface	85	100	140	m
Mass		3		kg

CABLE ENTRY

Through the mounting foot

OPERATING NOTES

1. The sensor is of single-chassis construction.
2. It is recommended that the sensor is mounted so that the centre of the microwave window (radome) is not less than 150 mm above the cowl of the red signal. There will then be minimal interruption of the beam by the cowl and the near-field performance of the sensor will not be impaired.
3. In operation, the traffic signal controller demand input is connected to the 'relay output' terminals. In the standard unit for use with portable signal heads, the relay is energized closed, except when a demand is present.
4. Units with 'normally open' relay connections are available on request.
5. A 47 Ω resistor in series with the relay output terminals is included for overcurrent and overvoltage protection.
6. Upon detection of oncoming traffic, the relay in the sensor is de-energized and a pair of isolated contacts is opened to signify detection.
7. These contacts remain open during the detection of a stream of oncoming traffic. The minimum open time is nominally 1 second.
8. Signals caused by departing vehicles are ignored.
9. Should a fault occur in the sensor, or its supply voltage be interrupted, then the sensor relay will be permanently de-energized and a continuous demand will be applied to the controller. The traffic signals will then operate automatically in a fixed-time manner.
10. The power supply for the sensor is derived from the main traffic control unit; a 55—0—55 V centre-tapped a.c. supply is necessary.
11. The cable colour code shown in table 1 must be observed.

TABLE 1
Cable colour code

Red	55 V_{ac}
Orange	55 V_{ac}
Black	0 V (centre tap of 110 V a.c. supply)
Green/Yellow Green	Normally closed output contacts (isolated)

12. The equipment detects lone vehicles approaching the traffic signals in the presence of large departing vehicles or a heavy stream of departing traffic. This is an important feature of the design philosophy of the radar process circuit.
13. The equipment does not give false outputs in the absence of moving targets.
14. Signals reflected from fluttering or waving trees at reasonable distances from the sensor do not cause unwanted outputs, even if the sensor is aimed directly at the trees.
15. For temporary traffic light systems, a 'NUDGE' facility is included.
16. The NUDGE facility is such that in the absence of a demand from approaching traffic for a period of 2½ minutes, a 'phantom' demand is applied. The relay in the sensor is de-energized and the sensor then returns to the vehicle-actuated mode. The period is set by a digital timer which is independent of the ambient temperature.

OPERATING NOTES (continued)

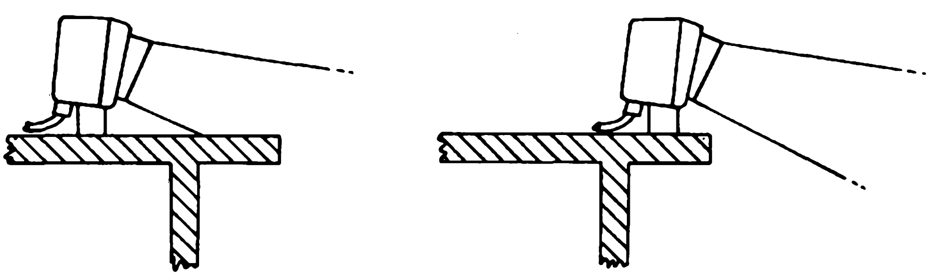
17. The 'phantom' demand overcomes the rare lock-up situations in traffic flow at temporary traffic lights where the possibility of a permanent 'red-red' can occur, caused by the non-detection of approaching vehicles.

SITE TESTS

1. To check the operation of a sensor, set it up in the operating position with the power supplies connected and connect a multimeter such as the AVO Model 8, switched to a resistance-measuring range, across the normally-closed contacts. (Note: high-voltage circuit testers, such as the Megger, must not be used as they will damage the sensor). The measured resistance should be approximately 47 Ω; this is the value of the protection resistor incorporated in the circuit.
2. Check the a.c. supply voltages at the microwave head. The line-to-line voltage should be 110 V_{rms} and the voltage between each line and the 0 V terminal should be 55 V_{rms}. The tolerance on these voltages is ±20%.
3. Arrange for a vehicle, preferably a small car, to be driven towards and past the sensor at approximately 30 m.p.h. When the car is between 140 and 80 metres from the sensor (see fig.2), the measured resistance between the normally-closed contacts should quickly increase to indicate an open-circuit. This condition should continue for approximately 1 second after the car has passed out of the sensor's detection range.

WORKSHOP TESTS FOR INOPERATIVE SENSORS

1. These tests are intended to reveal inoperative sensors only. It must be noted that they do not replace any range tests carried out with a vehicle under site conditions.
   There is no attempt to correlate range measurements with these tests as they will only inform the operator that a sensor is functioning correctly, not functioning or is functioning in reverse. They will, however, ensure that there is some consistency of testing between different operators.
2. Ideally, the sensor should be sited in an environment free, as far as possible, from extraneous movements of large bodies such as people, fork lift trucks, etc.
3. The sensor should be placed on a level surface, e.g. a bench, as near to the edge as possible to avoid reflections from the bench surface.



Incorrect Correct D8198

It should not be pointed directly at fluorescent lights as they may cause false demands to be registered due to interference.

4. Ensure that the environment is free as far as possible from microwave interference, for example, radar traffic sensors on soak test in the vicinity of the beam could cause interference giving rise to false demands.

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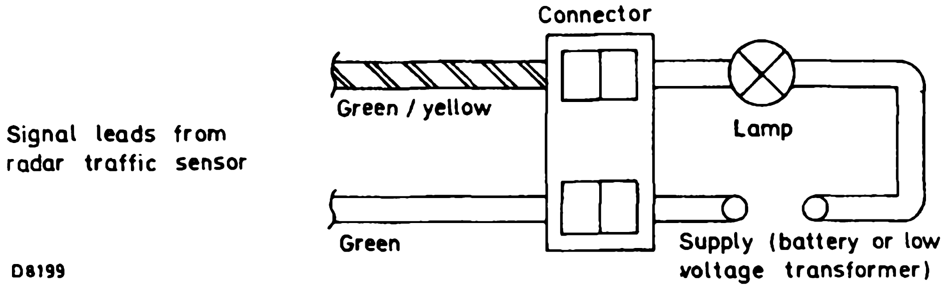

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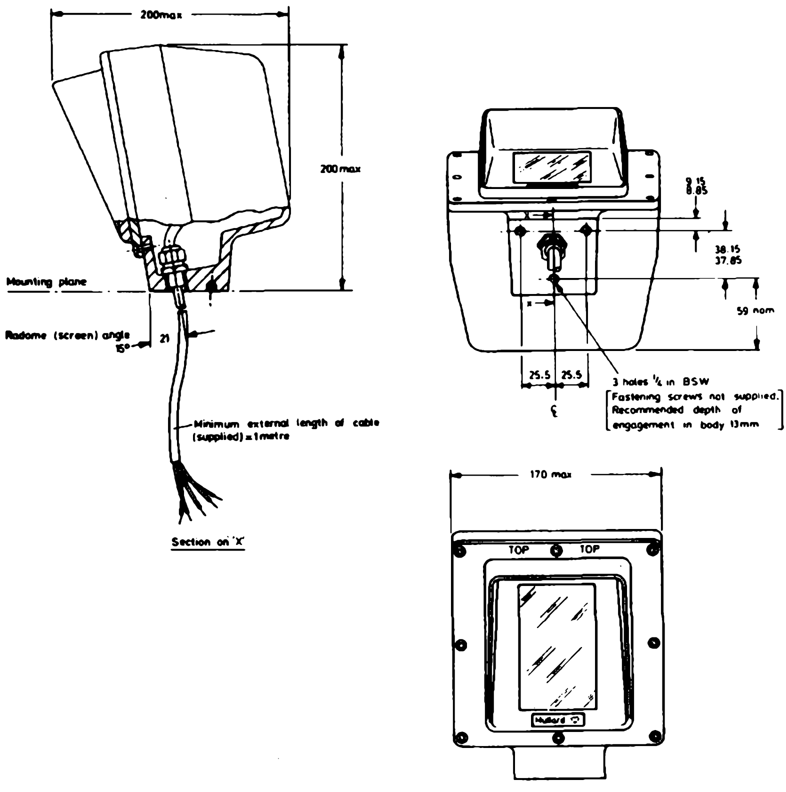
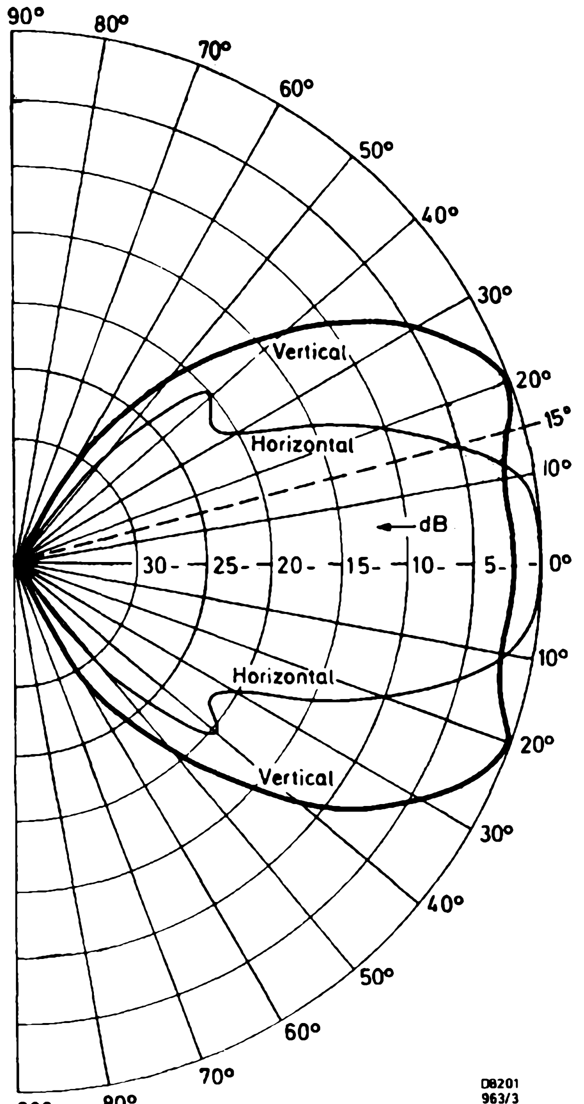
10. With the sensor placed on a level surface, (see note 3), about 1½ metres from ground level, the operator should stand about 5 metres away from the sensor in a direct line with the microwave window (radome) and should have the demand indicator lamp in view. He should then walk at normal walking pace towards the sensor, stopping at about 1 metre from it. If the sensor is functioning correctly, a demand will be registered between starting to walk and stopping. He should then wait for the demand to clear and then walk backwards to his starting point. No demand should be registered. If a demand is observed, the sensor is working in reverse and is therefore faulty.

MECHANICAL DATA

Dimensions in mm



Finish – Semi matt black enamel



Fig, 1 Typical polar diagram of traffic radar sensor.
The broken line indicates the preferred mounting angle of 15°. This affects only the orientation of the vertical pattern.

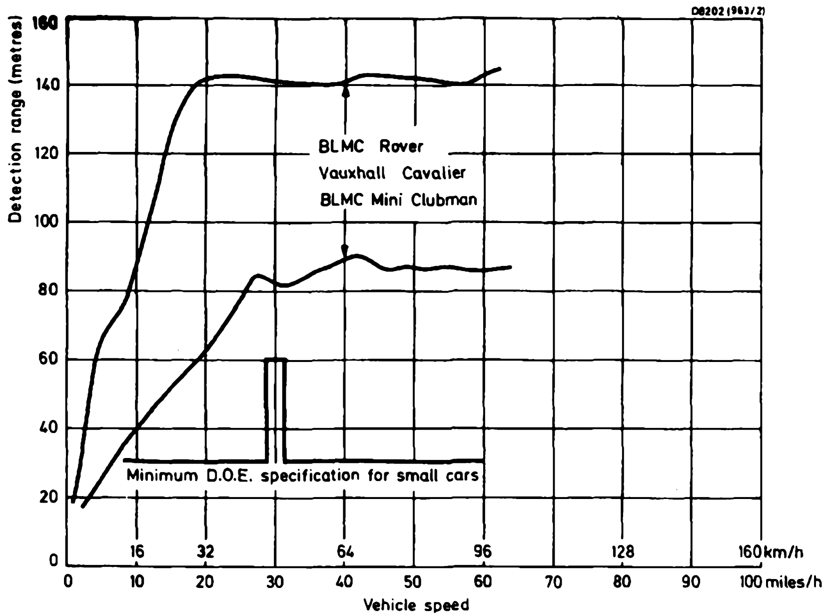


Fig.2 Detection curves obtained from road tests using six different traffic radar sensors

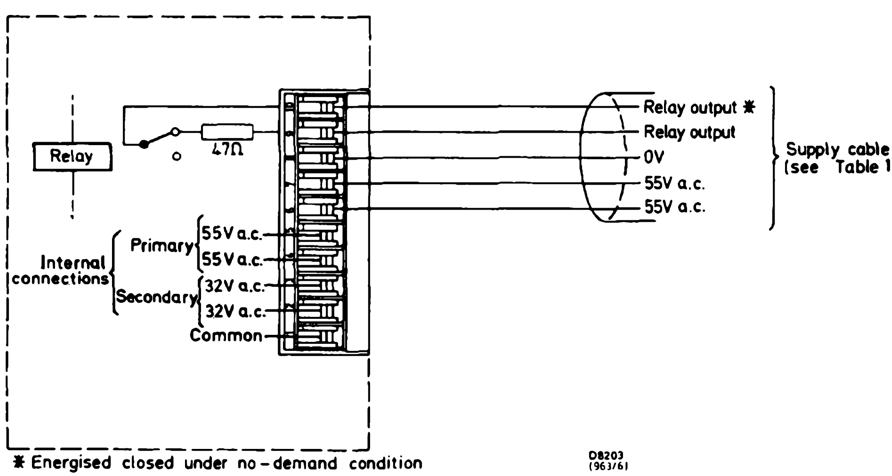


Fig.3 Terminal block connections. The two 55 V terminals on the supply cable are of opposite phase and are part of a 55—0—55 V a.c. supply.

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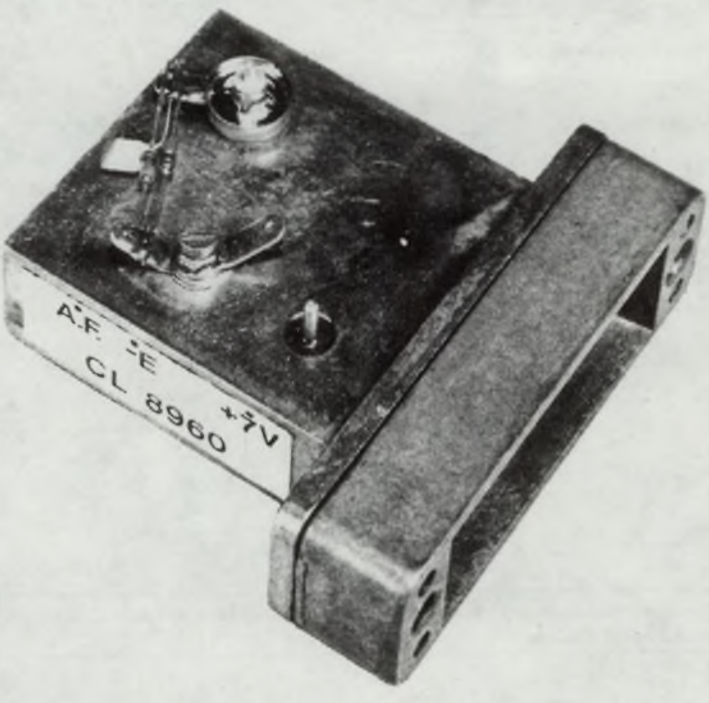
3. 100% electrical testing of primary parameters and sample testing to appropriate A.Q.L.
4. Environmental sample testing.
5. Measurement of secondary electrical parameters on batch samples.
6. Calibration and standardization of test procedures.

Where customer requirements differ from the standard commercial product, liasion is established with specific customers and suitable procurement specifications are agreed.

X-BAND DOPPLER RADAR MODULE

CL8960

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.7GHz band. Applications include all forms of Doppler radar systems.		
Centre frequency	10.687	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	^oC
T_{amb} range	0 to +40	^oC

CHARACTERISTICS at 25 ^oC

	Min.	Typ.	Max.	
Centre frequency	-		-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	10.675	10.687	10.699	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/^{o}C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dBm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS 170 g

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

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section $1.0\,m^2$ at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section $1.0\,m^2$ at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of 16μV 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.

4. Noise measured at a frequency 1Hz to 1kHz 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 that the protection circuit is not removed when all wiring has been completed.

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.

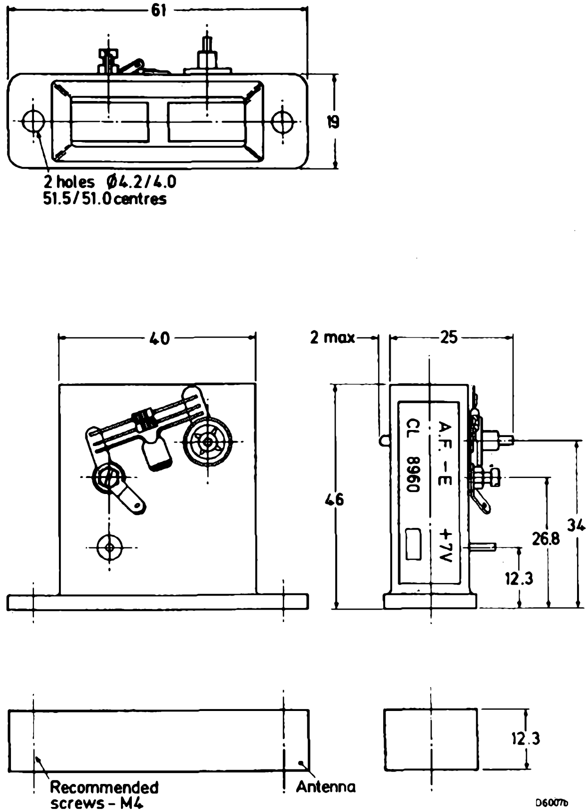
8. The above conditions apply when operated into the antenna supplied with the module.

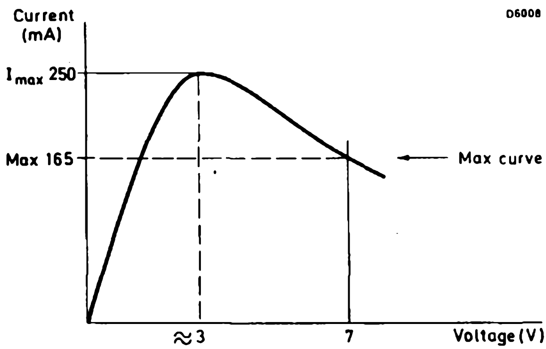
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.

10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

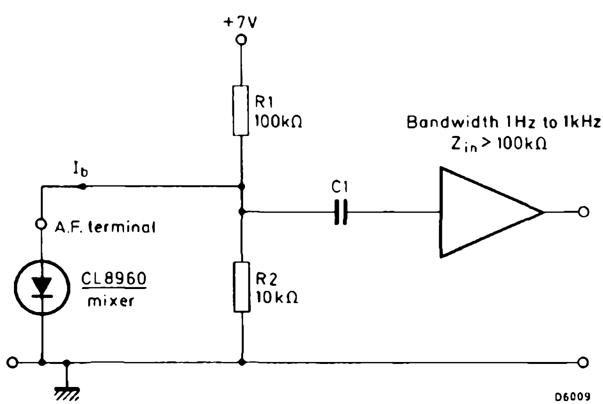
→

OUTLINE DRAWING





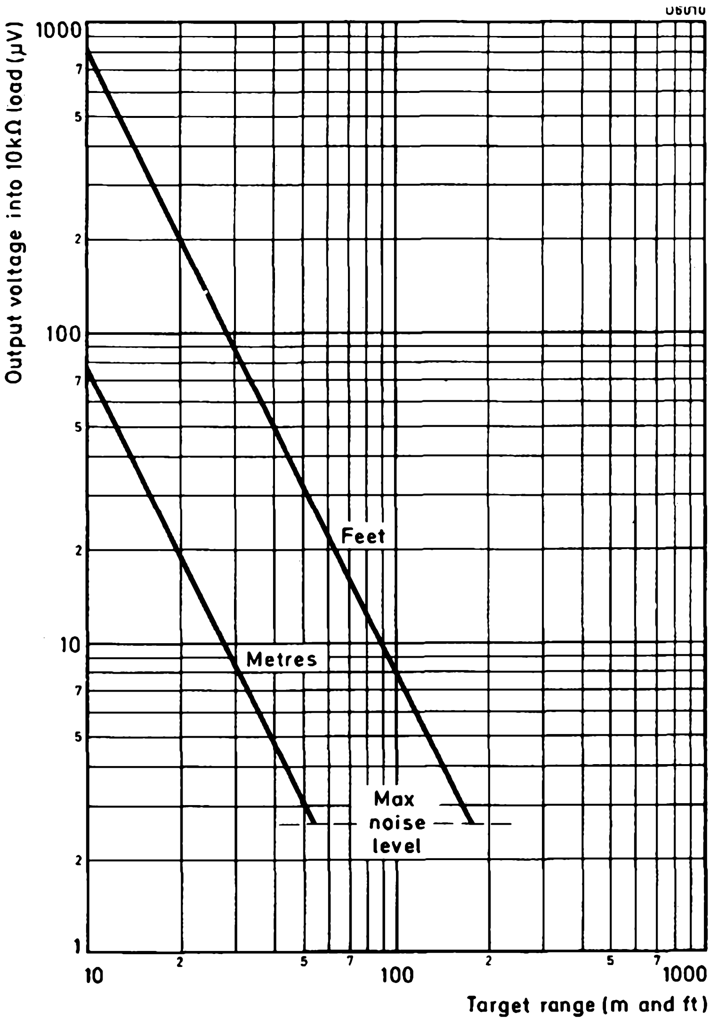
Gunn device characteristic



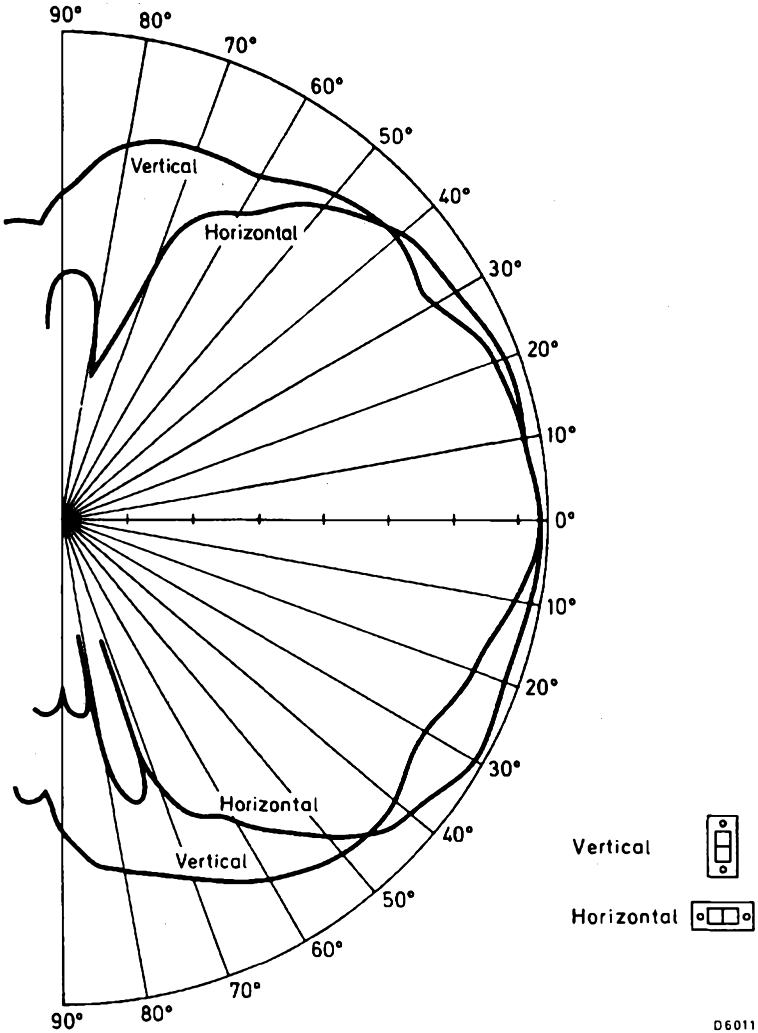
Circuit used to measure A. F. performance

Notes

1. The current Ib should be approximately 35μA with the Gunn device disconnected and approximately 42μA 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



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 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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 42μA. (35μA d.c. bias + 7μA from -19dBm 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 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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 -11dBm 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 'microwave' reflective covering materials, will:

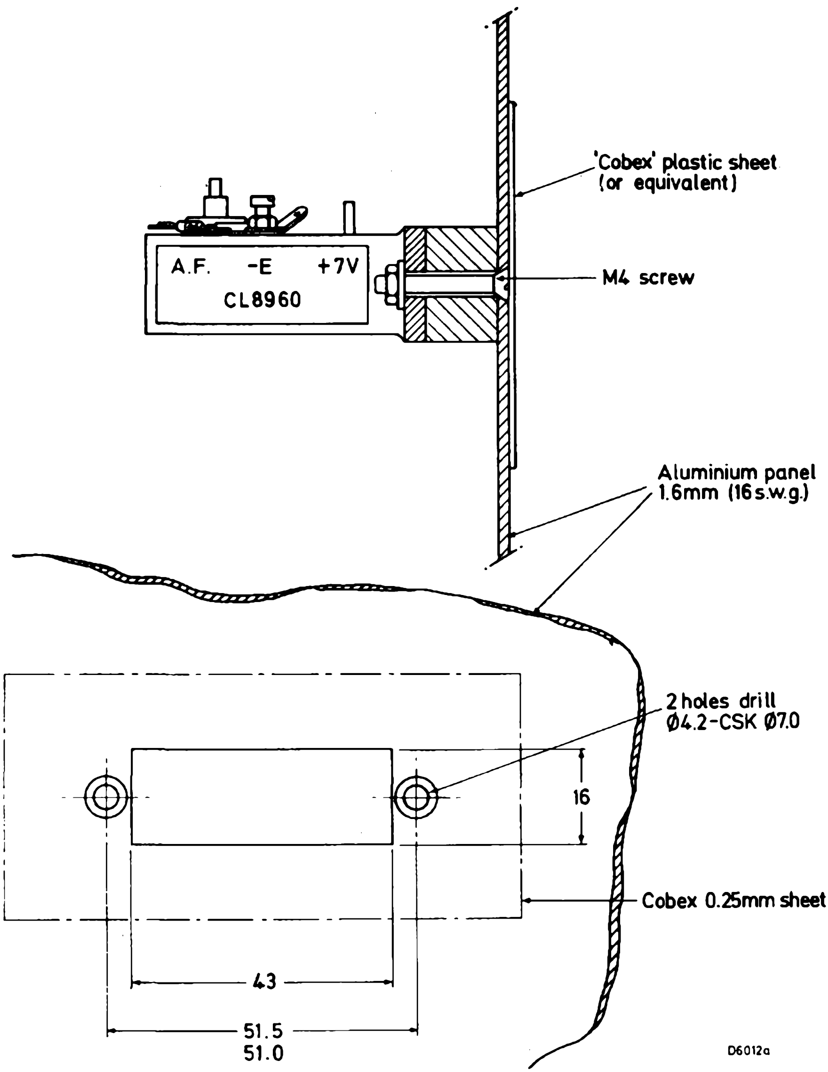
(a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.

(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 2cm expanded polythene or polystyrene
-11	61	0.25mm Cobex plastic
-6	70	0.5mm Cobex plastic

Cobex is a product of: British Industrial Plastics,
Sheet and Film Division,
Brantham Works,
Brantham,
Manningtree, Essex CO11 1NJ



Panel mounting details

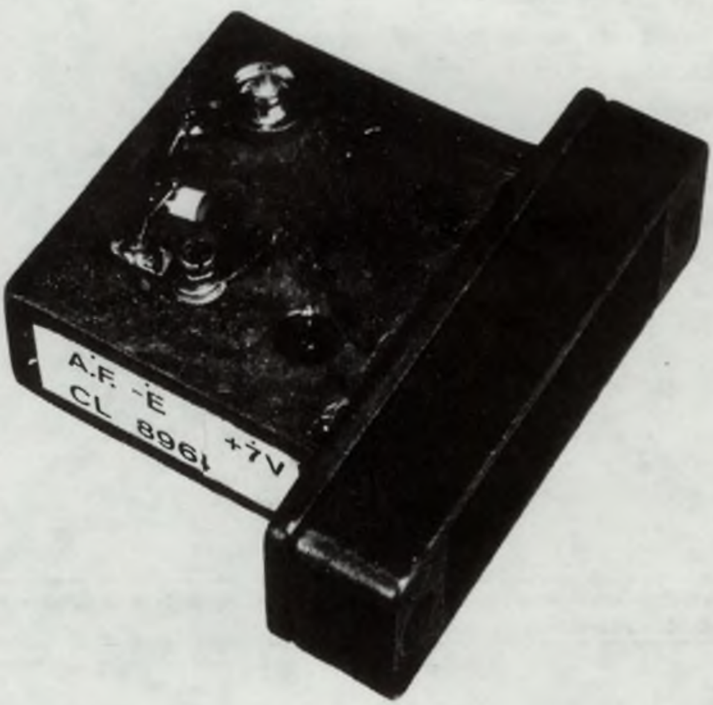
X-BAND DOPPLER RADAR MODULE

CL8961

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 9.4 GHz band. Applications include all forms of Doppler radar systems.

Centre frequency	9.350	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	°C
T_{amb} range	0 to +40	°C

CHARACTERISTICS at 25 °C

	Min.	Typ.	Max.	
Centre frequency	-	9.350	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	9.338	9.350	9.362	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dBm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS	210	g

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

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section $1.0m^2$ at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu V$ 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

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4. Noise measured at a frequency 1Hz to 1kHz 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 that the protection circuit is not removed when all wiring has been completed.

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.

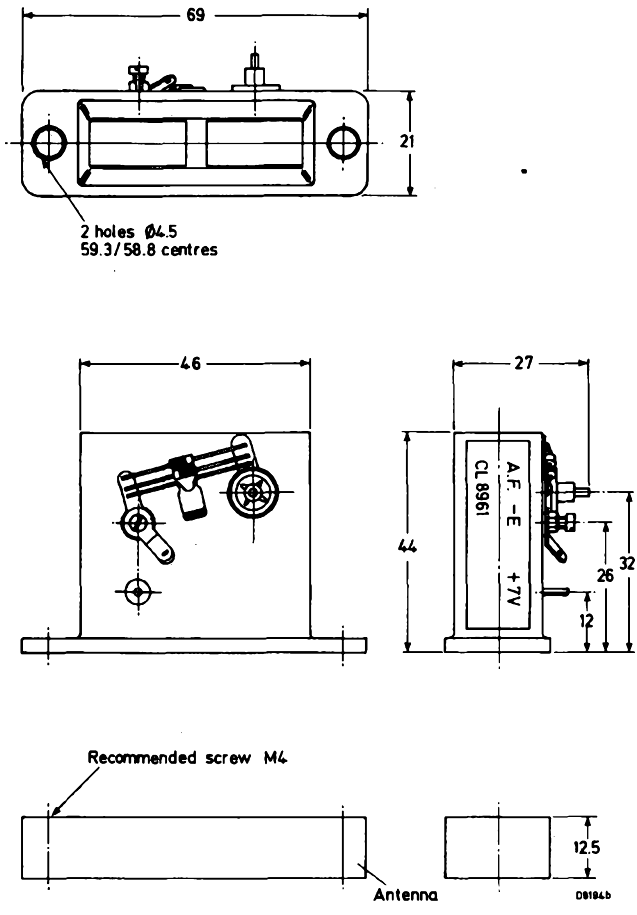
   e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.

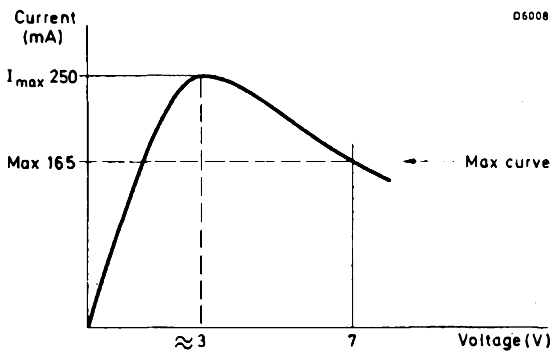
8. The above conditions apply when operated into the antenna supplied with the module.

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

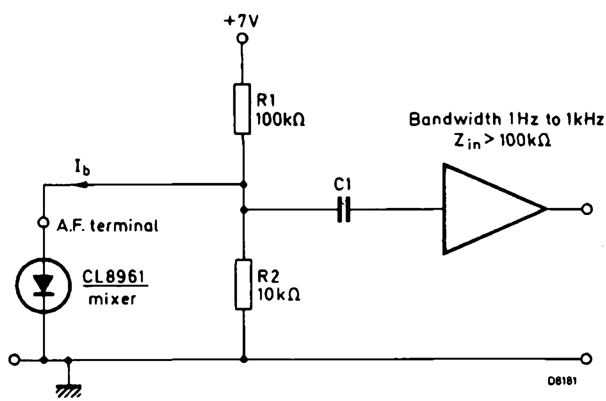
10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





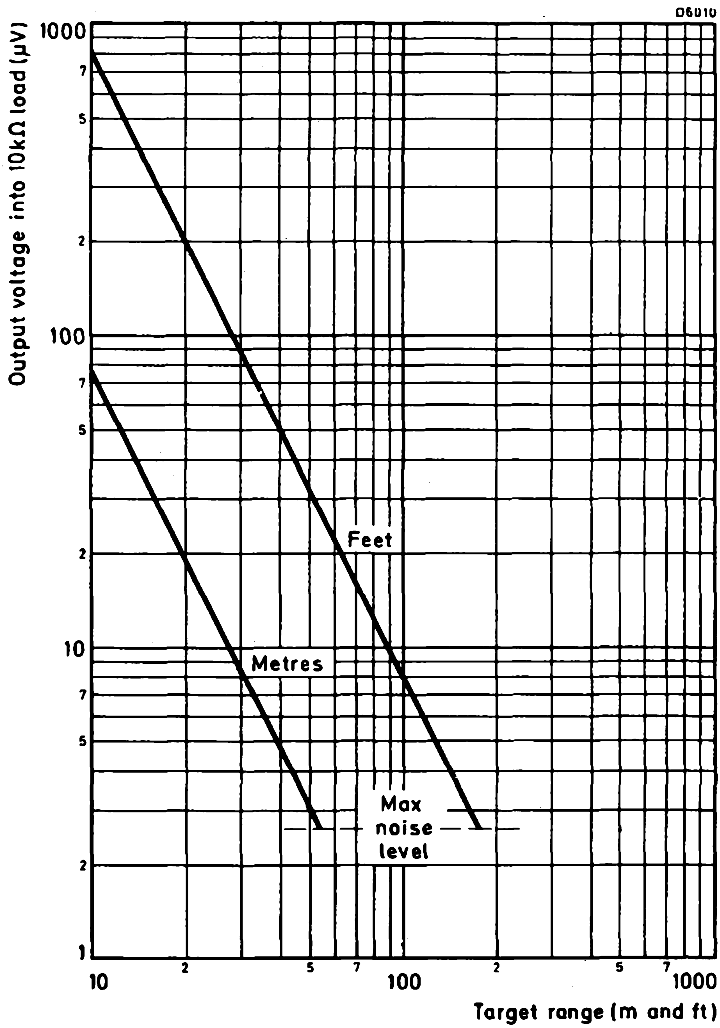
Gunn device characteristic



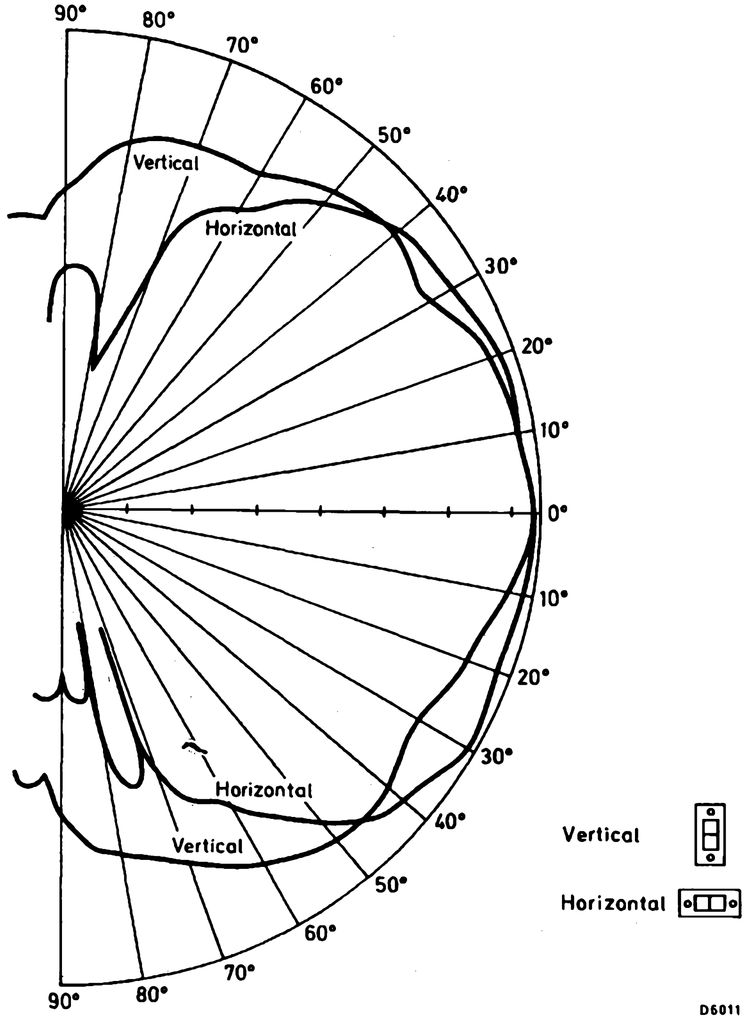
Circuit used to measure A.F. performance

Notes

1. The current I_b should be approximately 35μA with the Gunn device disconnected and approximately 42μA 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



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 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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 42μA. (35μA d.c. bias + 7μA from -19dBm 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 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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 -11dBm 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 'microwave' reflective covering materials, will:

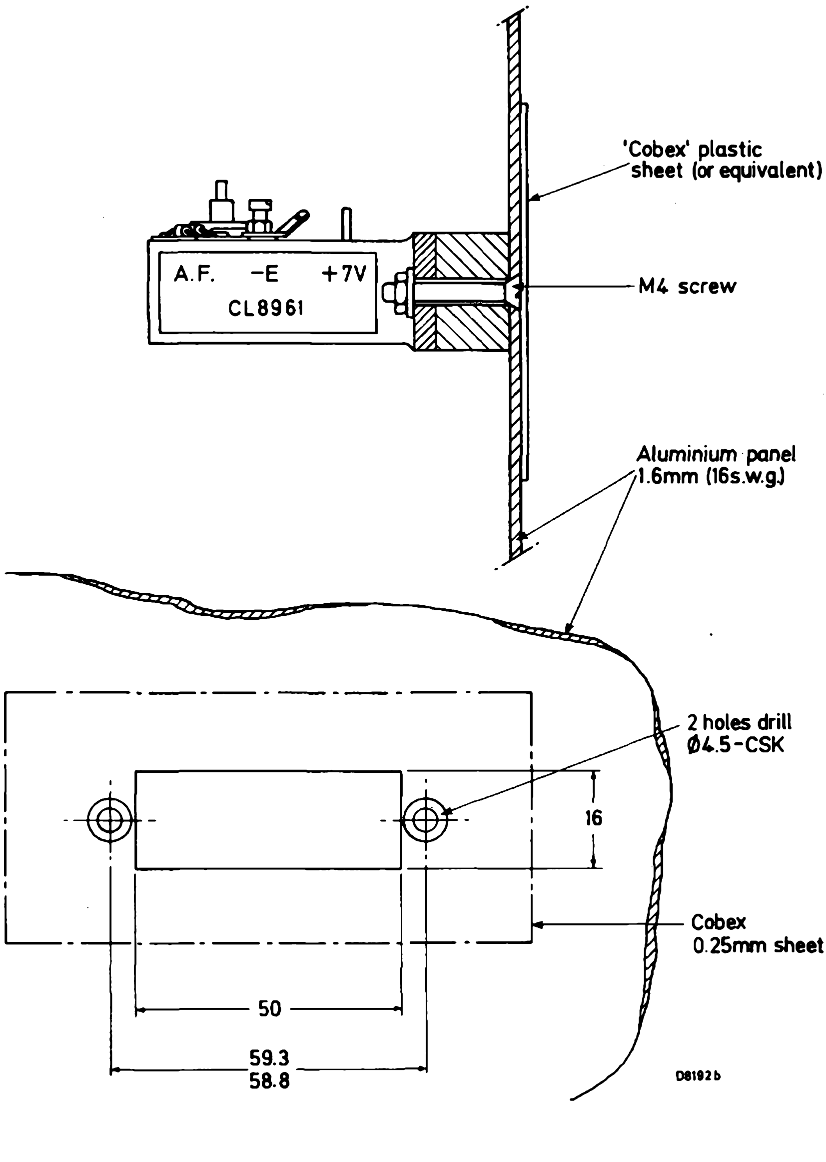
(a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.

(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 2cm expanded polythene or polystyrene
-11	61	0.25mm Cobex plastic
-6	70	0.5mm Cobex plastic

Cobex is a product of: British Industrial Plastics,
Sheet and Film Division,
Brantham Works,
Brantham,
Manningtree, Essex CO11 1NJ


A.F.
-E
+7V
CL8961
'Cobex' plastic sheet (or equivalent)
M4 screw
Aluminium panel 1.6mm (16s.w.g.)
2 holes drill Ø4.5-CSK
16
Cobex 0.25mm sheet
50
59.3
58.8
D8192b

X-BAND DOPPLER RADAR MODULE

CL8962

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator and mixer cavity for operation in the 9.5 GHz band. Applications include all forms of Doppler radar systems.		
Centre frequency	9.47	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V

OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	°C
T_{amb} range	0 to +40	°C

→ CHARACTERISTICS at 25 °C

	Min.	Typ.	Max.	
Centre frequency	-	9.470	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	9.458	9.470	9.482	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS	210	g

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

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section $1.0m^2$ at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu V$ 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.

4. Noise measured at a frequency 1Hz to 1kHz 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 that the protection circuit is not removed when all wiring has been completed.

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.

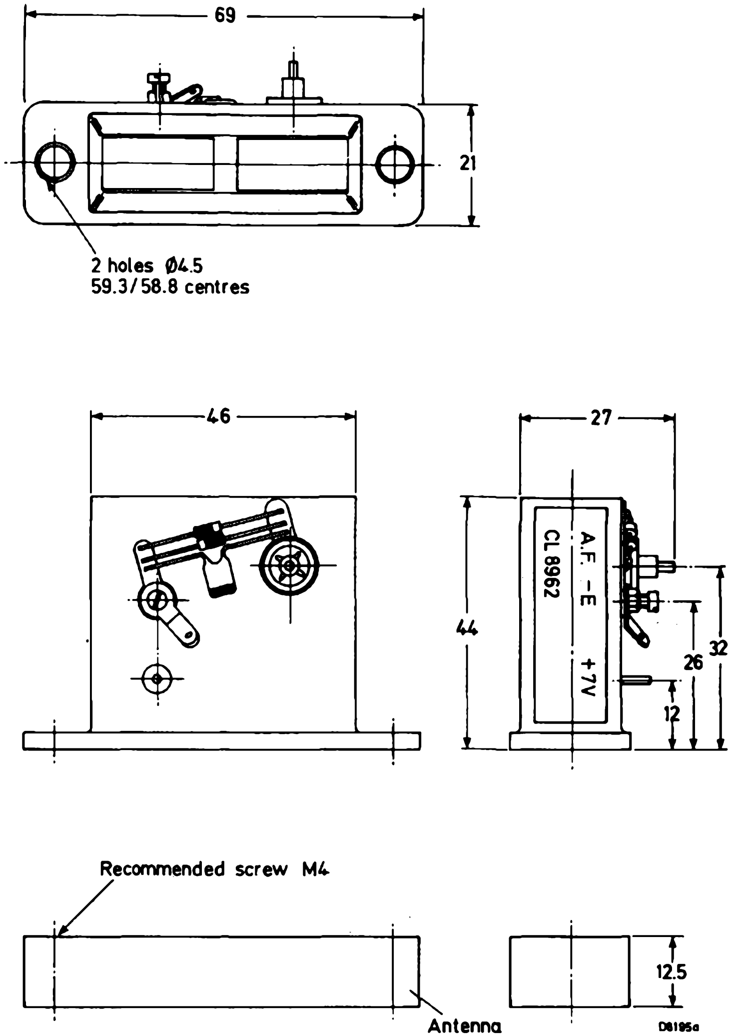
   e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.

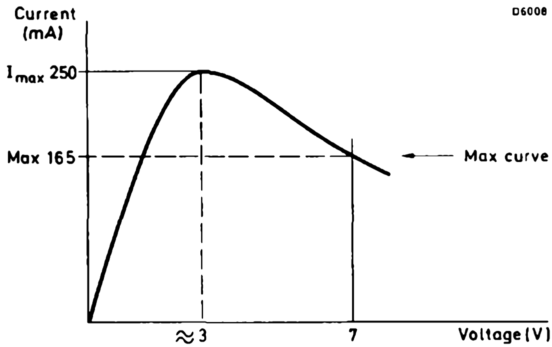
8. The above conditions apply when operated into the antenna supplied with the module.

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

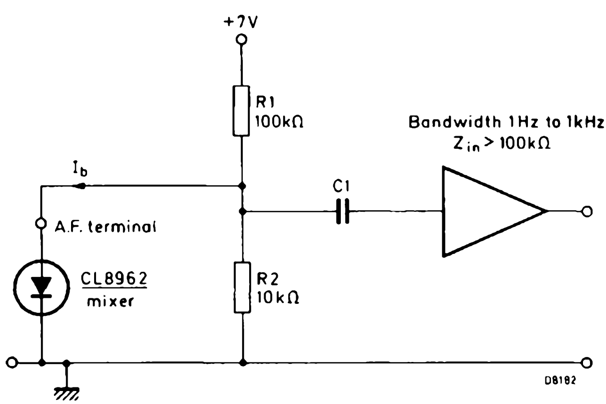
10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





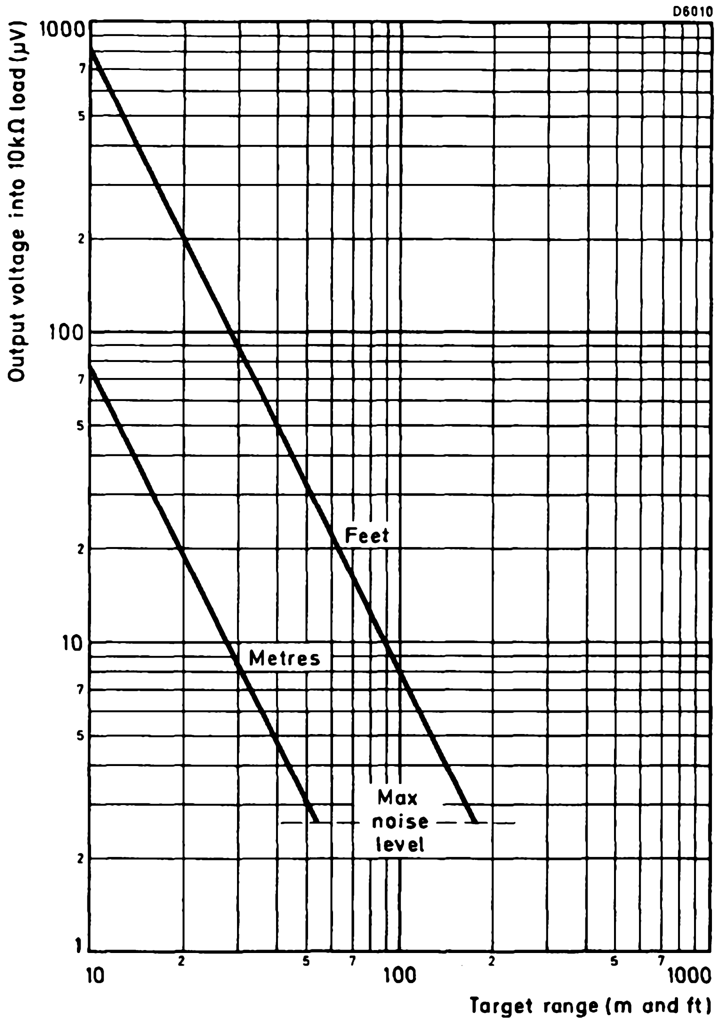
Gunn device characteristic



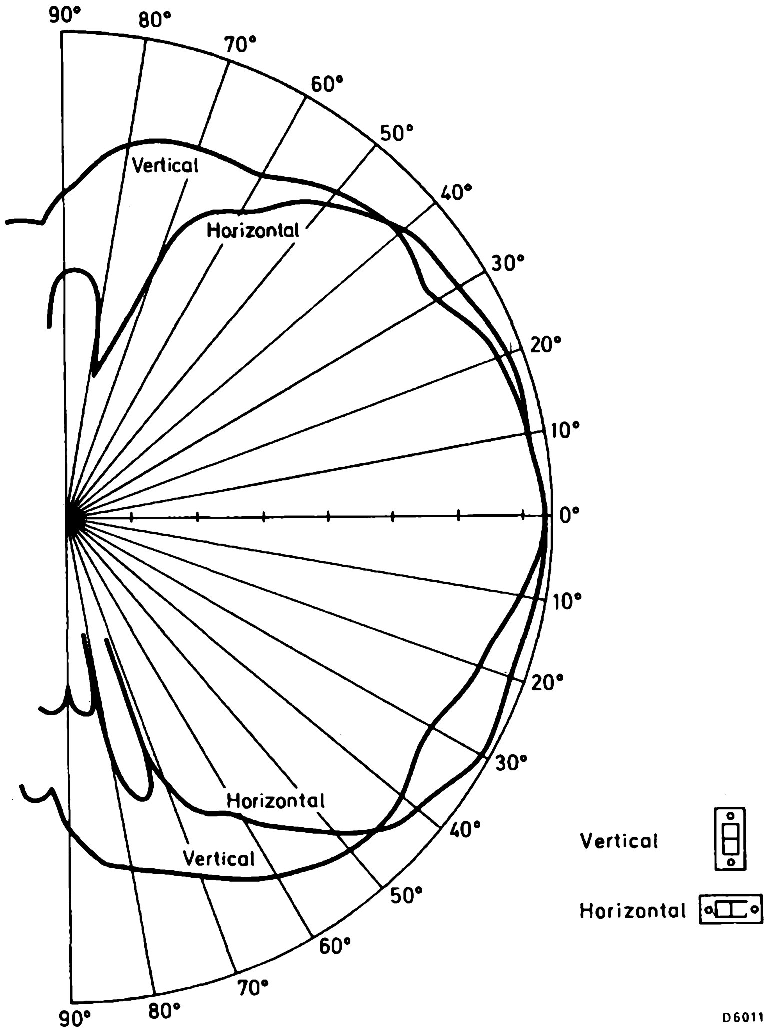
Circuit used to measure A.F. performance

Notes

1. The current Ib should be approximately 35μA with the Gunn device disconnected and approximately 42μA 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



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 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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 42μA. (35μA d.c. bias + 7μA from -19dBm 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 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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 -11dBm 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 'microwave' 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)	-
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-15	50	1 to 2cm expanded polythene or polystyrene
-11	61	0.25mm Cobex plastic
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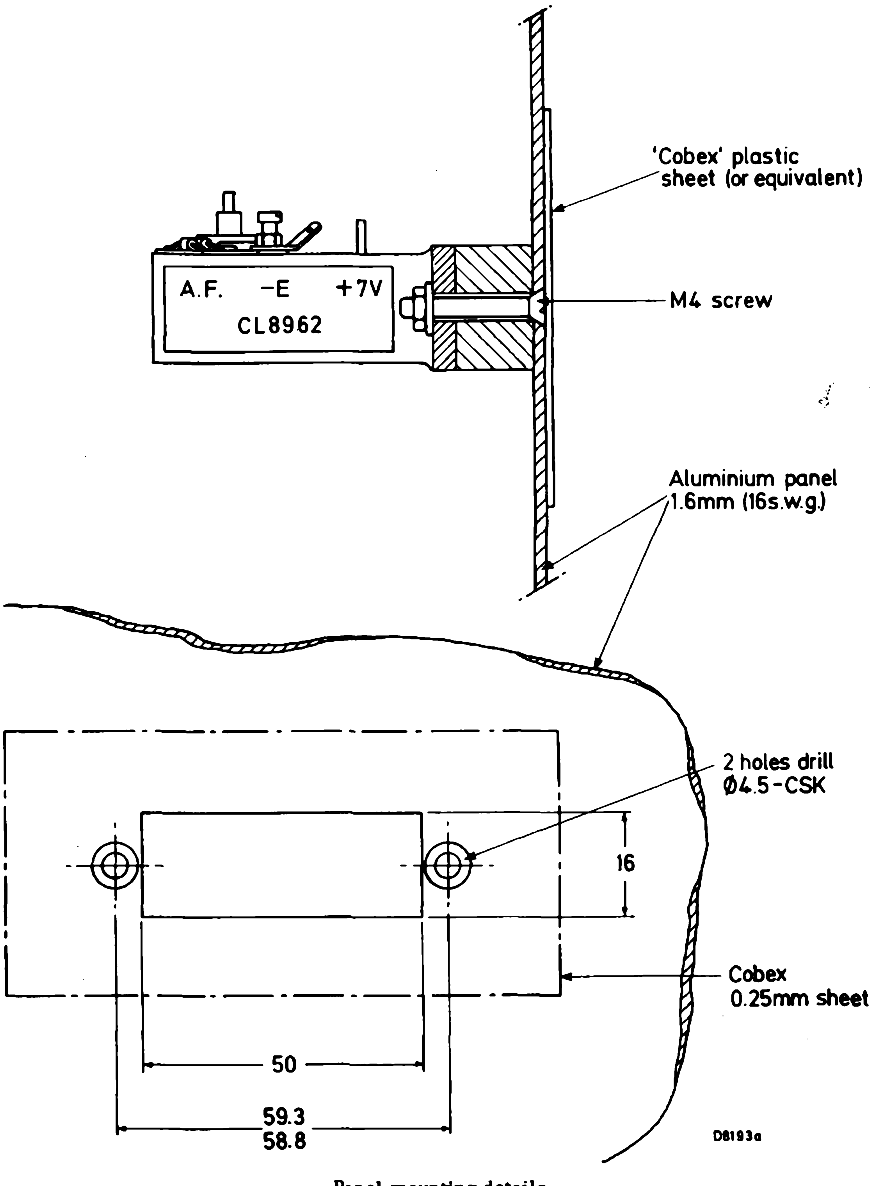
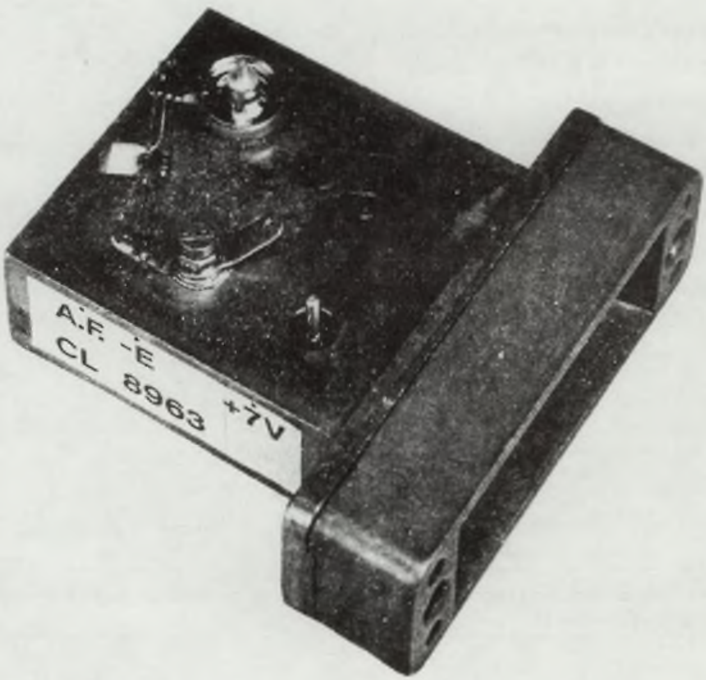


Panel mounting details

X-BAND DOPPLER RADAR MODULE

CL8963

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.5GHz band. Applications include all forms of Doppler radar systems.		
Centre frequency	10.525	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	µV
Supply voltage	7.0	V



Mullard

OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	°C
T_{amb} range	0 to +40	°C

CHARACTERISTICS at 25 °C

	Min.	Typ.	Max.	
Centre frequency	-		-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	10.513	10.525	10.537	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dBm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS	170	g

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

OPERATING NOTES ←

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section $1.0m^2$ at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu V$ 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.

4. Noise measured at a frequency 1Hz to 1kHz 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 that the protection circuit is not removed when all wiring has been completed.

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.

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   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.

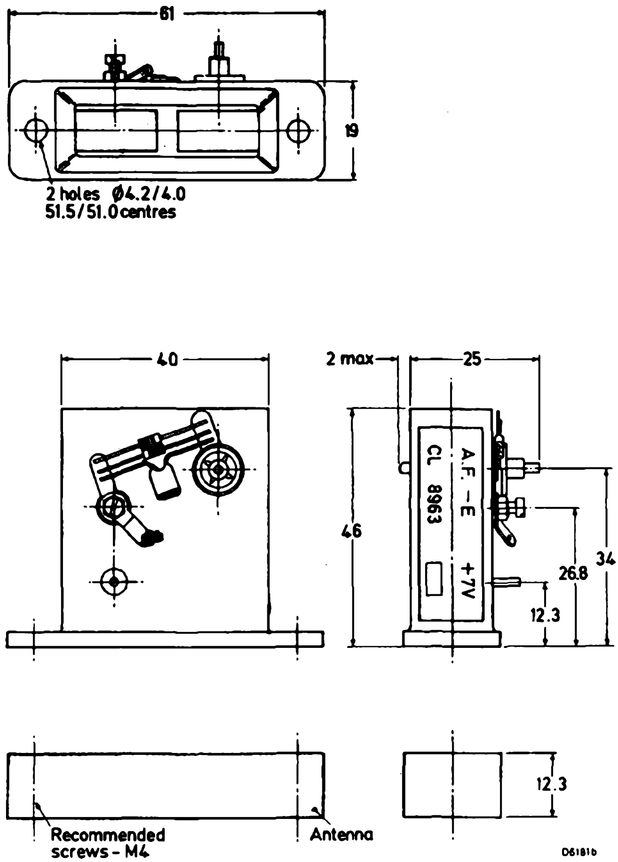
8. The above conditions apply when operated into the antenna supplied with the module.

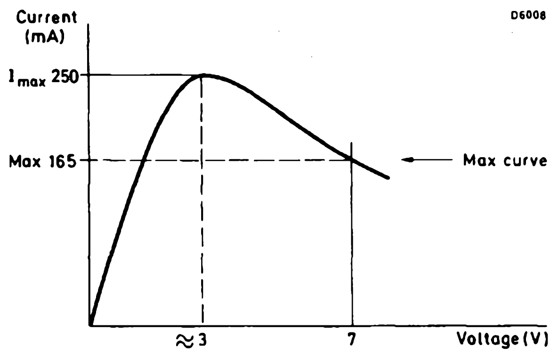
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.

10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

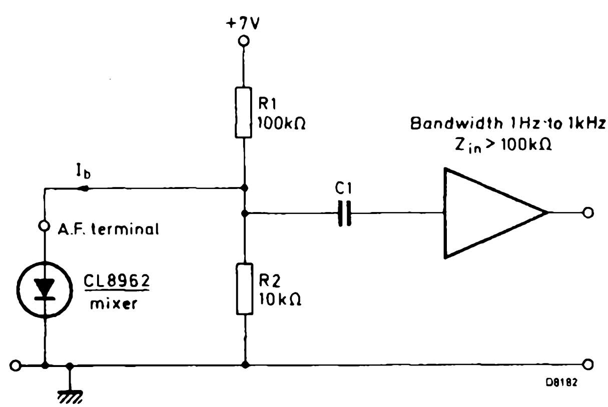
→

OUTLINE DRAWING





Gunn device characteristic



Circuit used to measure A.F. performance

Notes

1. The current Ib should be approximately 35μA with the Gunn device disconnected and approximately 42μA with the Gunn device operational and the antenna operating into free space.
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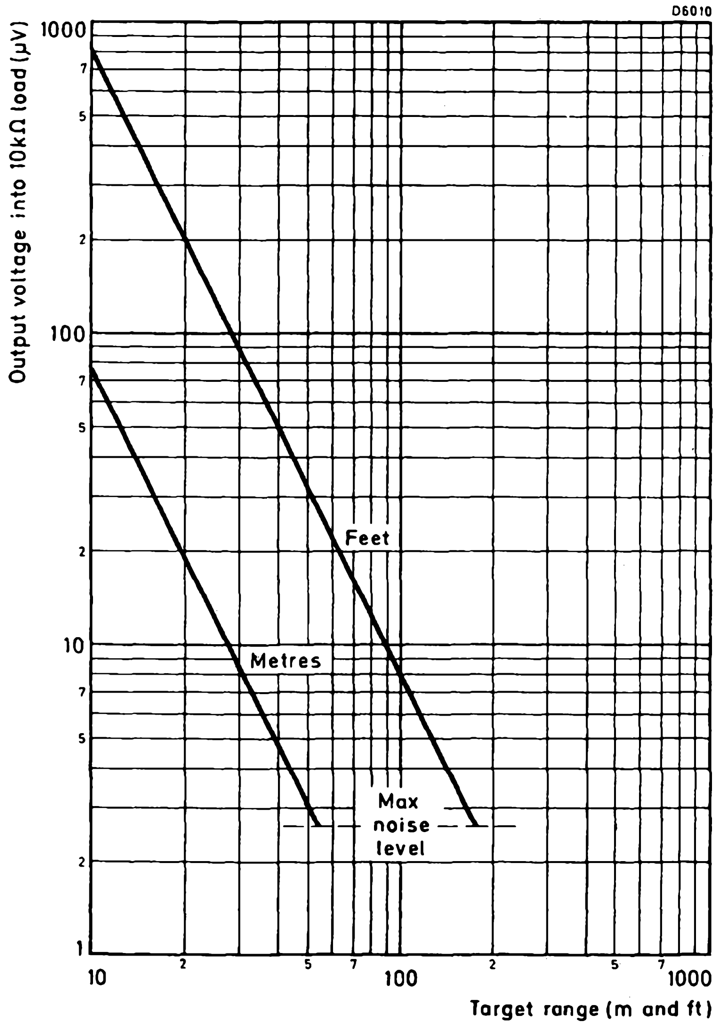
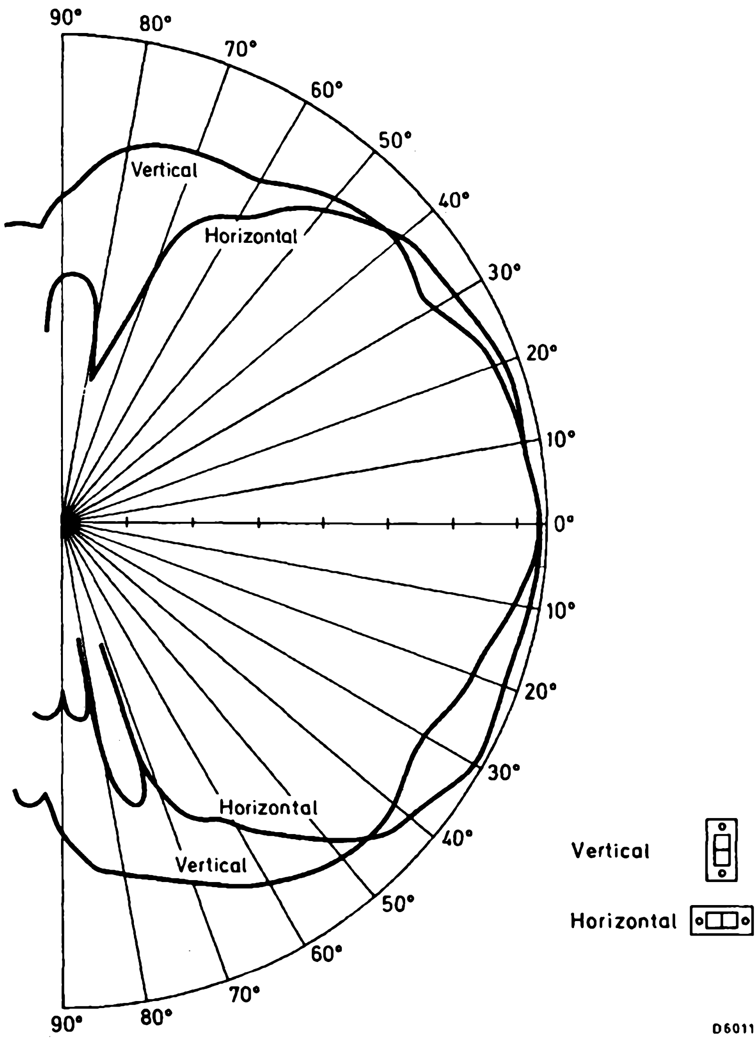


Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

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

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 -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

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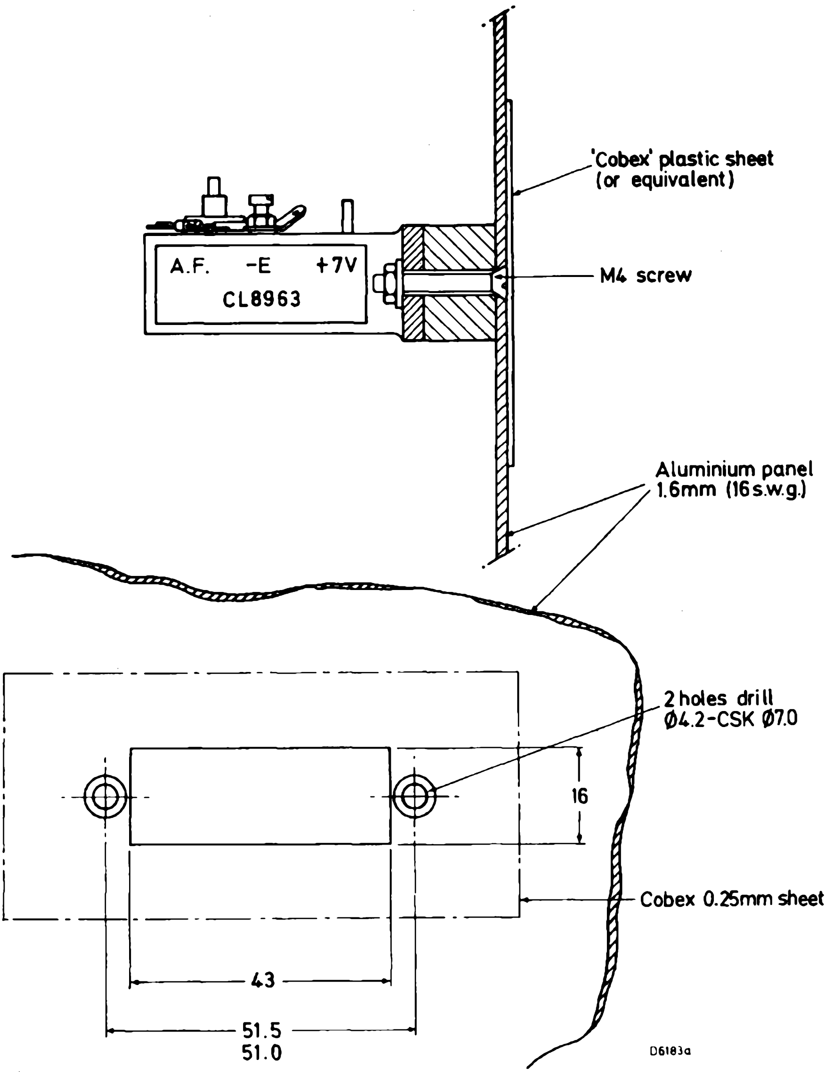
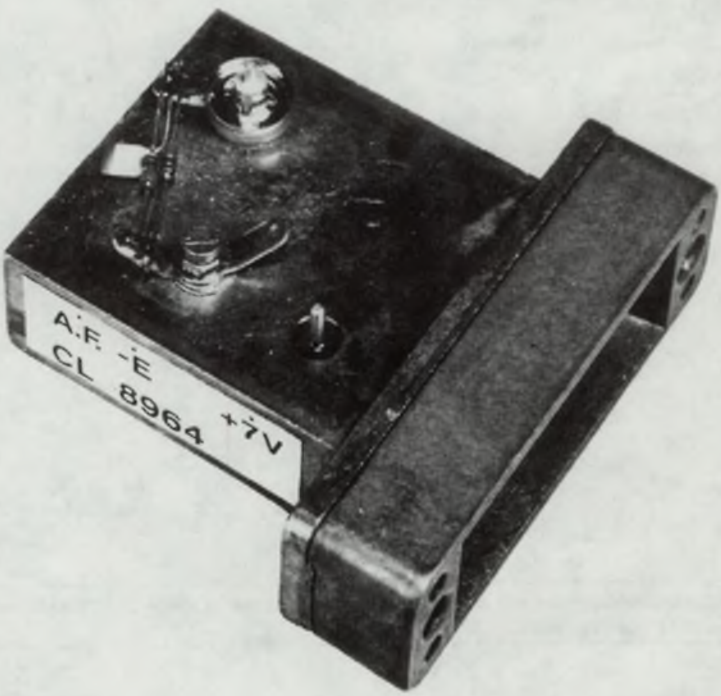


Panel mounting details

X-BAND DOPPLER RADAR MODULE

CL8964

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator and mixer cavity for operation in the 9.9 GHz band. Applications include all forms of Doppler radar systems.		
Centre frequency	9.900	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	°C
T_{amb} range	0 to +40	°C

CHARACTERISTICS at 25 °C

	Min.	Typ.	Max.	
Centre frequency	-	9.990	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	9.978	9.990	10.002	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dBm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS	170	g

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

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of 16μV 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.

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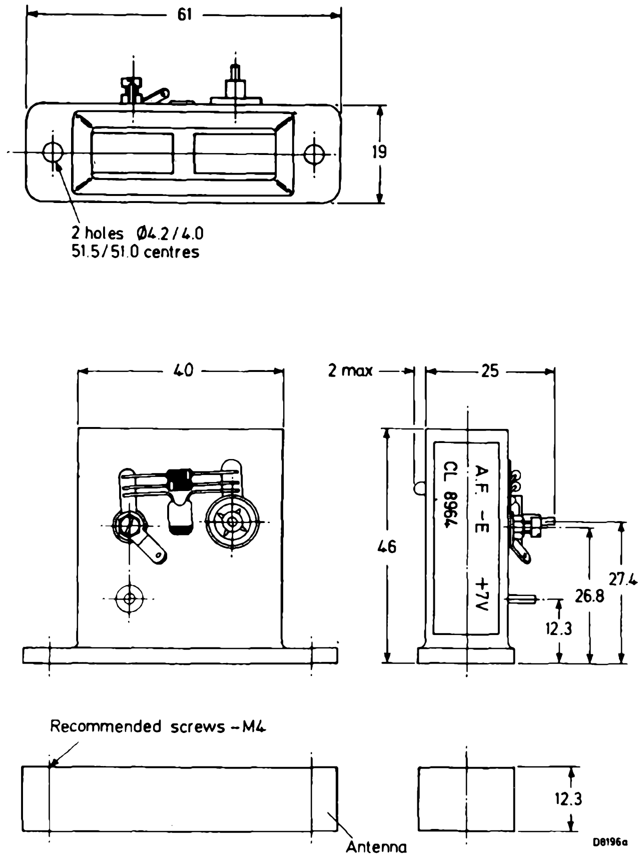
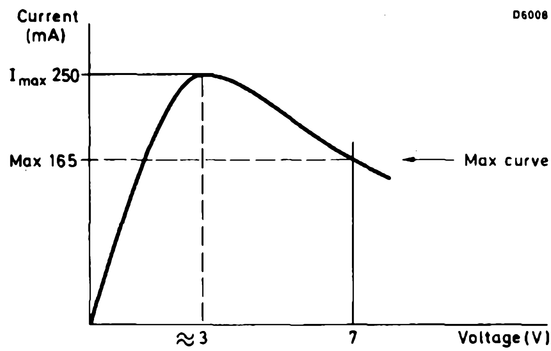
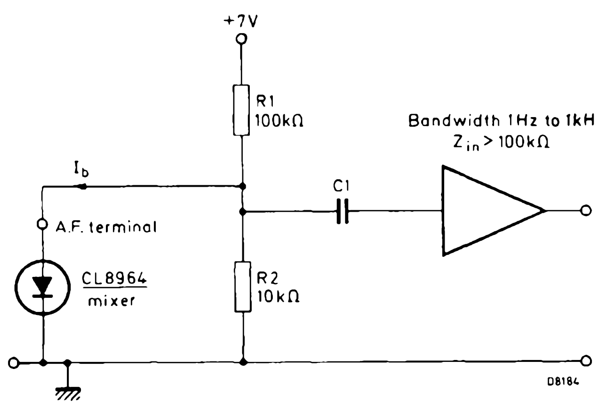
10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





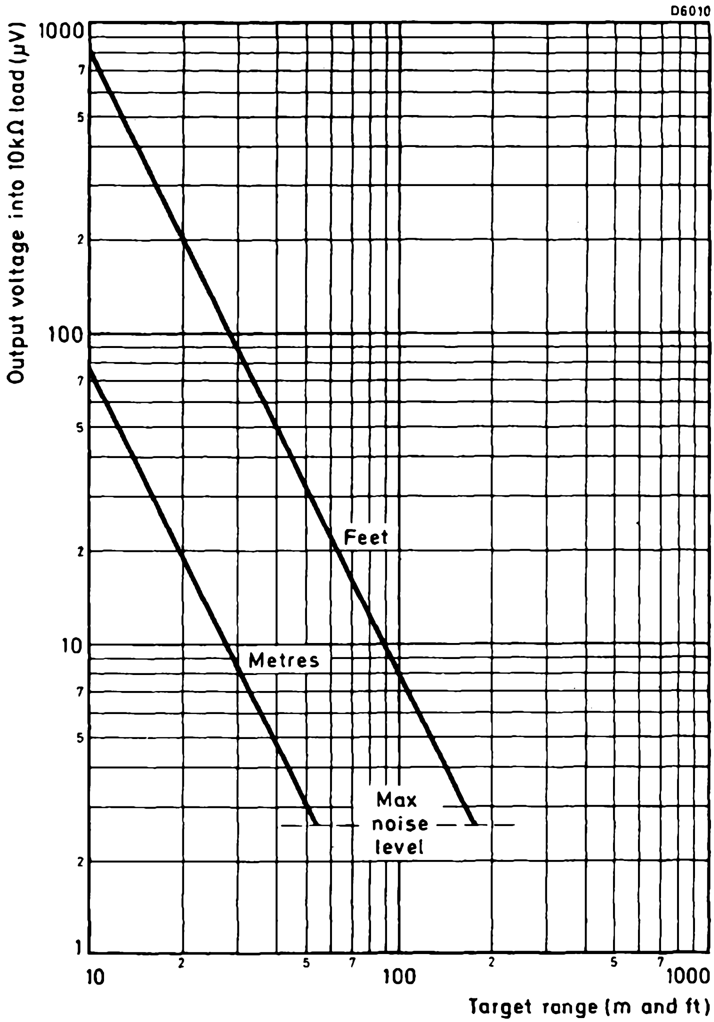
Gunn device characteristic



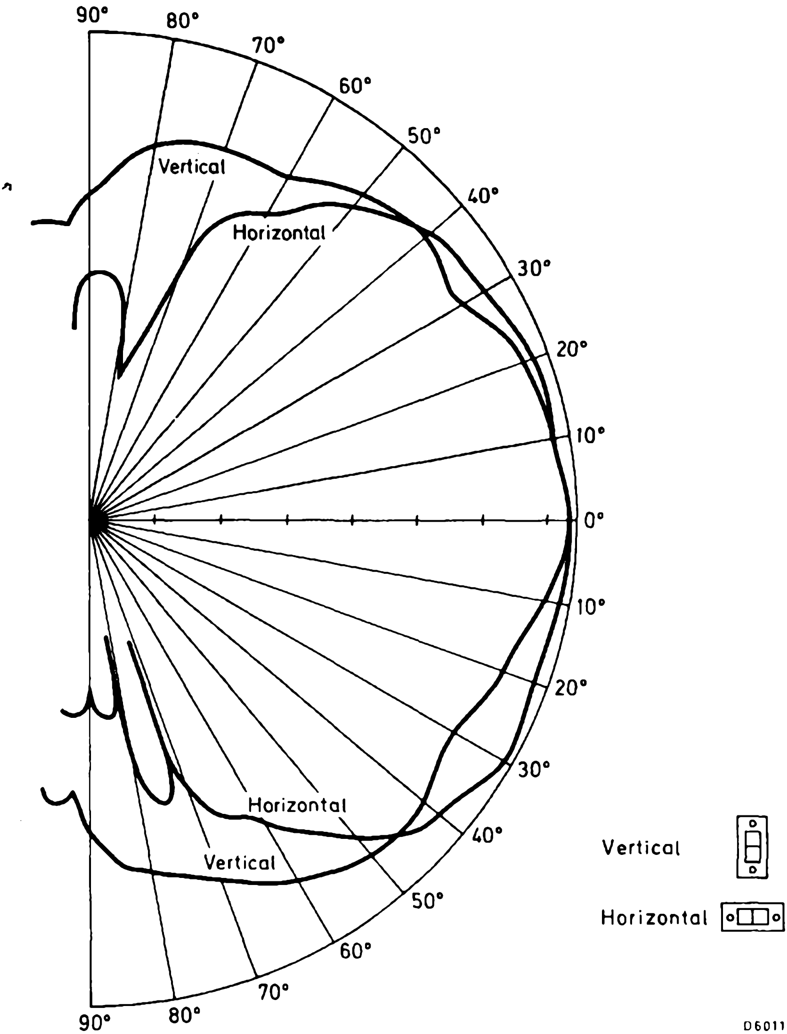
Circuit used to measure A.F. performance.

Notes

1. The current Ib should be approximately 35μA with the Gunn device disconnected and approximately 42μA 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



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 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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 42μA. (35μA d.c. bias + 7μA from -19dBm 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 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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 -11dBm 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 'microwave' reflective covering materials, will:

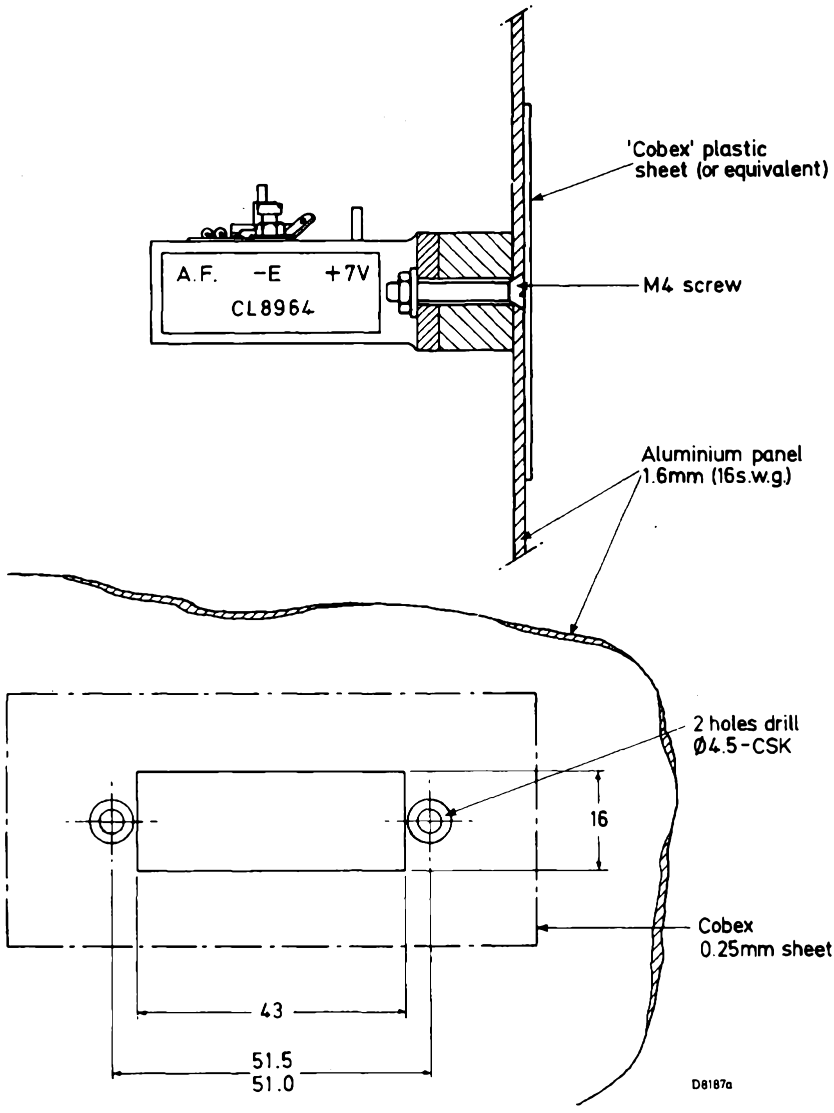
(a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.

(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 2cm expanded polythene or polystyrene
-11	61	0.25mm Cobex plastic
-6	70	0.5mm Cobex plastic

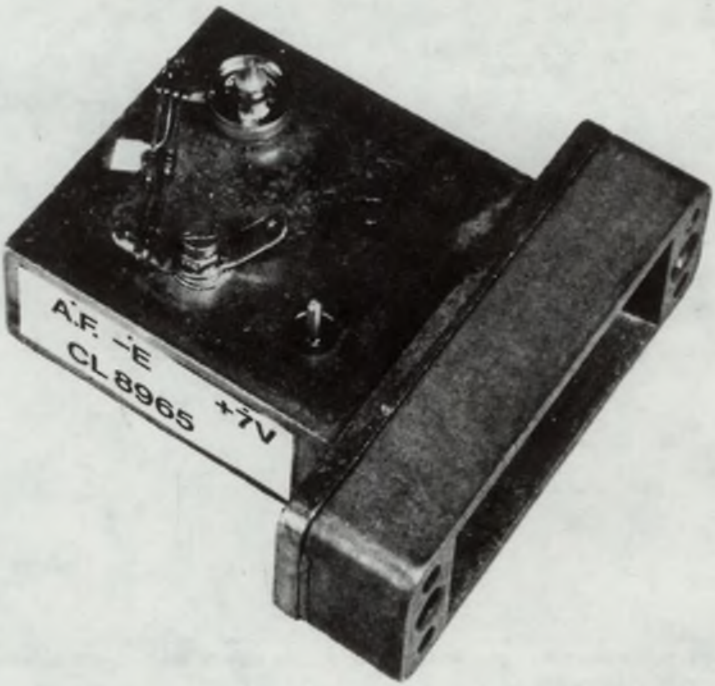
Cobex is a product of: British Industrial Plastics,
Sheet and Film Division,
Brantham Works,
Brantham,
Manningtree, Essex CO11 1NJ


'Cobex' plastic
sheet (or equivalent)
A.F.
-E
+7V
CL8964
M4 screw
Aluminium panel
1.6mm (16s.w.g.)
2 holes drill
Ø4.5-CSK
16
Cobex
0.25mm sheet
43
51.5
51.0
D8187a

X-BAND DOPPLER RADAR MODULE

CL8965

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.6GHz band. Applications include all forms of Doppler radar systems.		
Centre frequency	10.565	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	°C
T_{amb} range	0 to +40	°C

CHARACTERISTICS at 25 °C

	Min.	Typ.	Max.	
Centre frequency	-	10.565	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	10.553	10.565	10.577	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dBm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS	170	g

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

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section $1.0m^2$ at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of 16μV 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.

4. Noise measured at a frequency 1Hz to 1kHz 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 that the protection circuit is not removed when all wiring has been completed.

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.

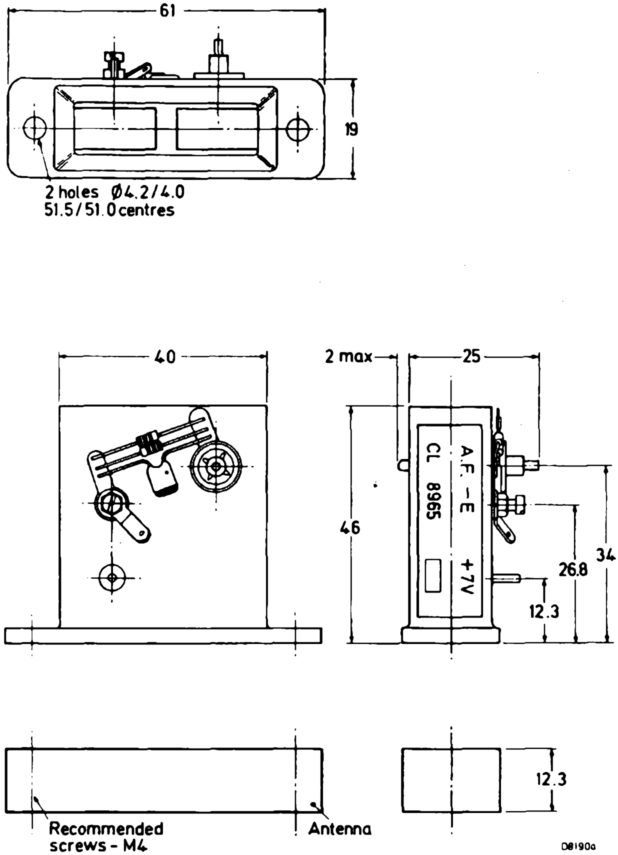
   e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.

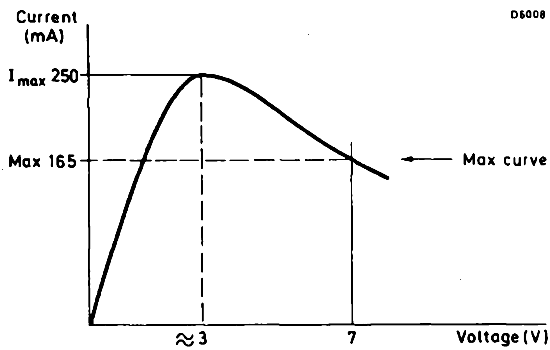
8. The above conditions apply when operated into the antenna supplied with the module.

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

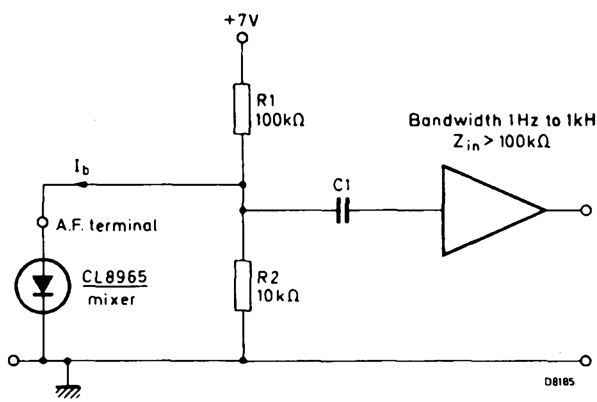
10. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





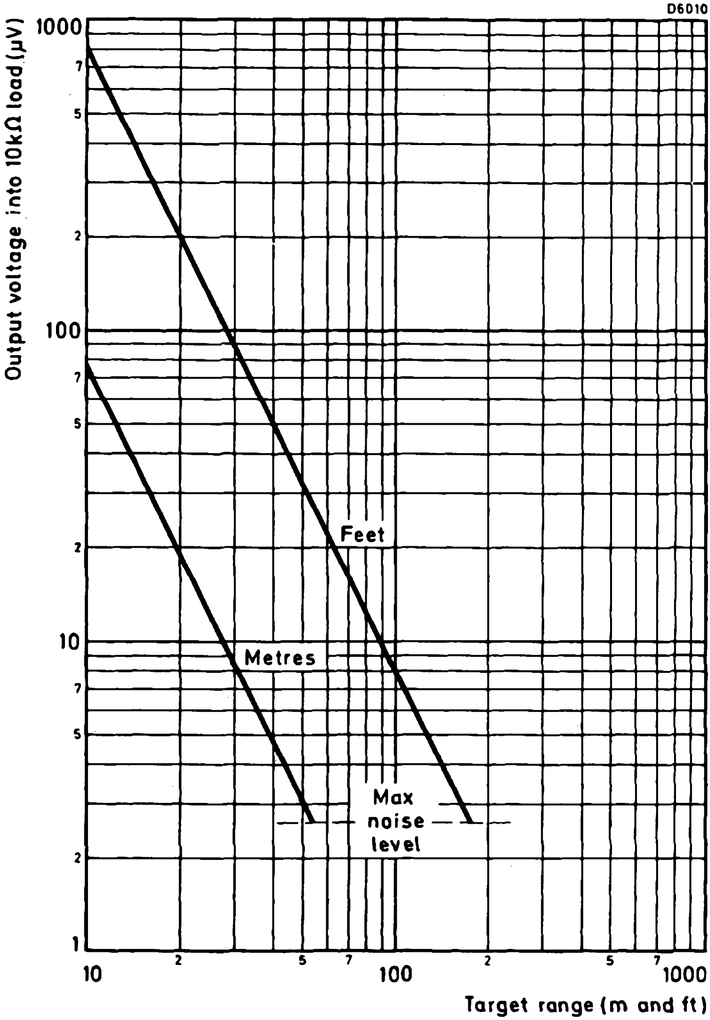
Gunn device characteristic



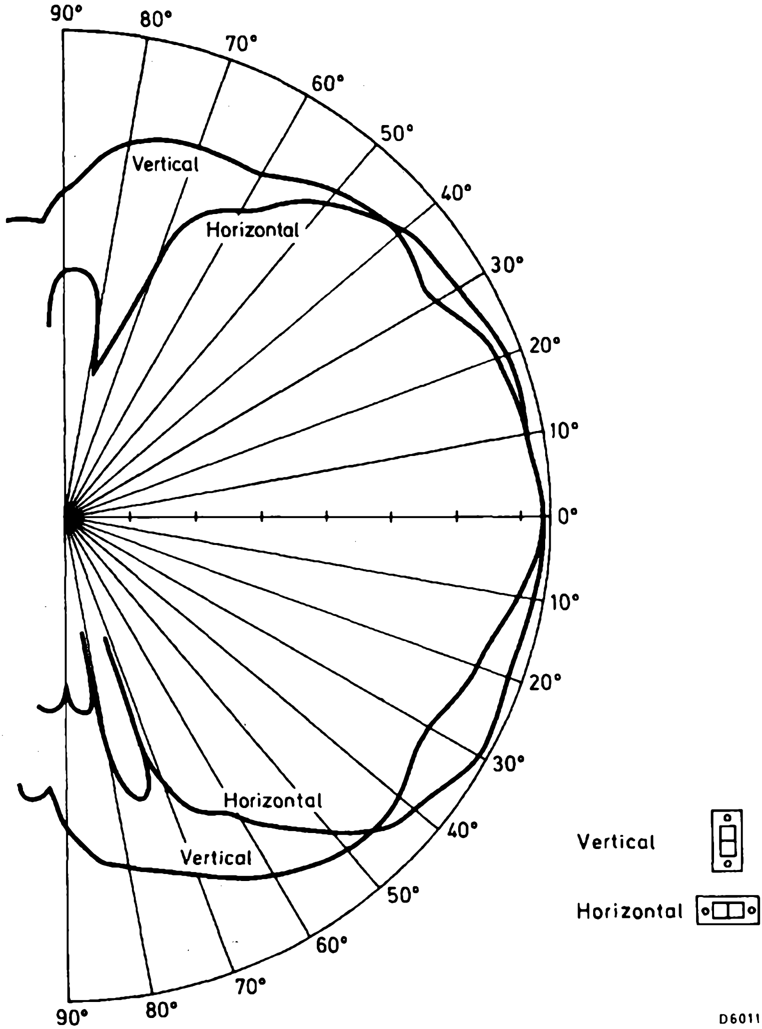
Circuit used to measure A.F. performance

Notes

1. The current Ib should be approximately 35μA with the Gunn device disconnected and approximately 42μA 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



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 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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 42μA. (35μA d.c. bias + 7μA from -19dBm 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 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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 -11dBm 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 'microwave' 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 2cm expanded polythene or polystyrene
-11	61	0.25mm Cobex plastic
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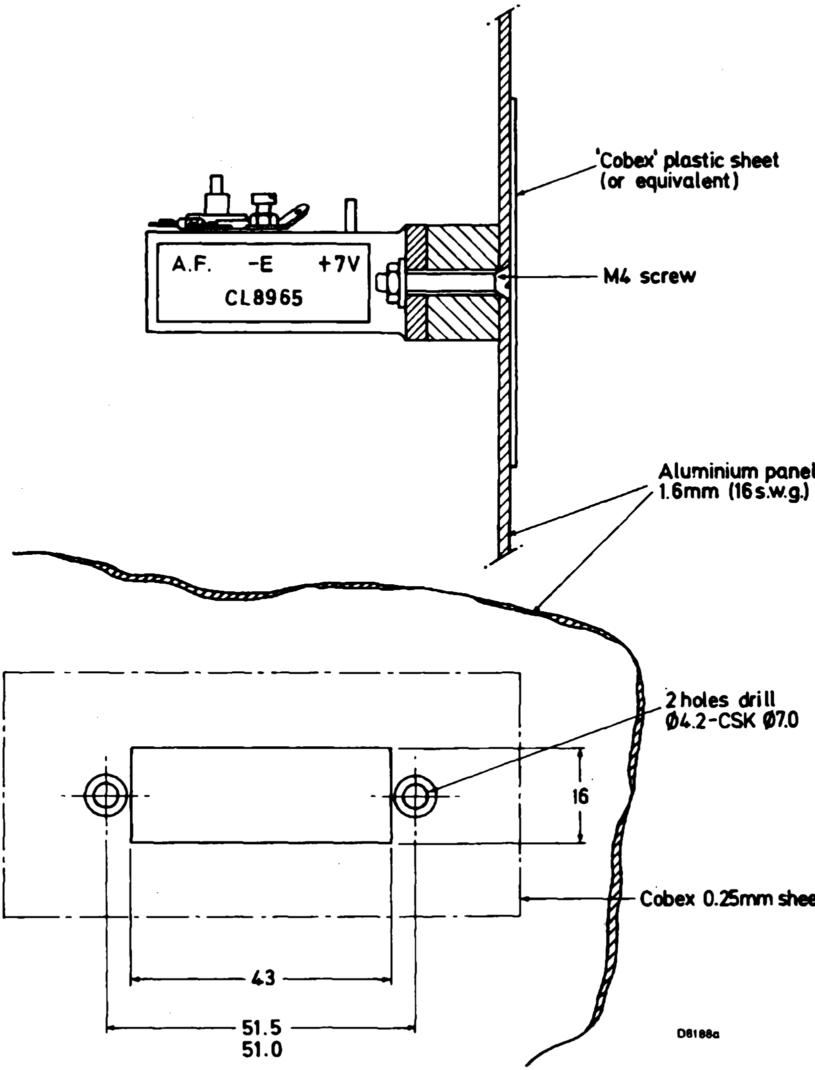
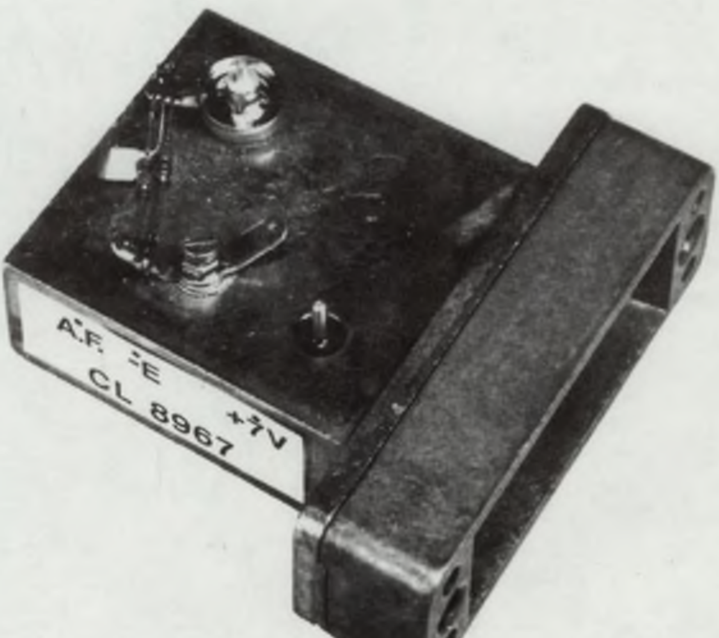


Panel mounting details

X-BAND DOPPLER RADAR MODULE

CL8967

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.4GHz band. Applications include all forms of Doppler radar systems.		
Centre frequency	10.365	GHz
Power output (at 7.0V) typ.	10	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



Mullard

OPERATING CONDITIONS

Supply voltage (see note 2)	+7.0 ± 0.1	V
Supply current (see note 3) (typ.)	140	mA
D.C. mixer bias current (into a.f. terminal w.r.t. earth)	30 to 35	μA
A.F. load (see page 5)	10	kΩ

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Supply voltage (max. d.c.)	+7.5	V
Supply voltage transient max. (1.0ms max.)	9.0	V
T_{stg} range	-10 to +70	°C
T_{amb} range	0 to +40	°C

CHARACTERISTICS at 25 °C

	Min.	Typ.	Max.	
Centre frequency	-	10.365	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	10	-	mW
Frequency fixed	10.353	10.365	10.377	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dBm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

MASS	170	g

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

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section $1.0m^2$ at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB 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, 110dB path loss is obtained from a man target of radar cross-section $1.0m^2$ at a range of 25m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu V$ 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 Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.

3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.

4. Noise measured at a frequency 1Hz to 1kHz 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 that the protection circuit is not removed when all wiring has been completed.

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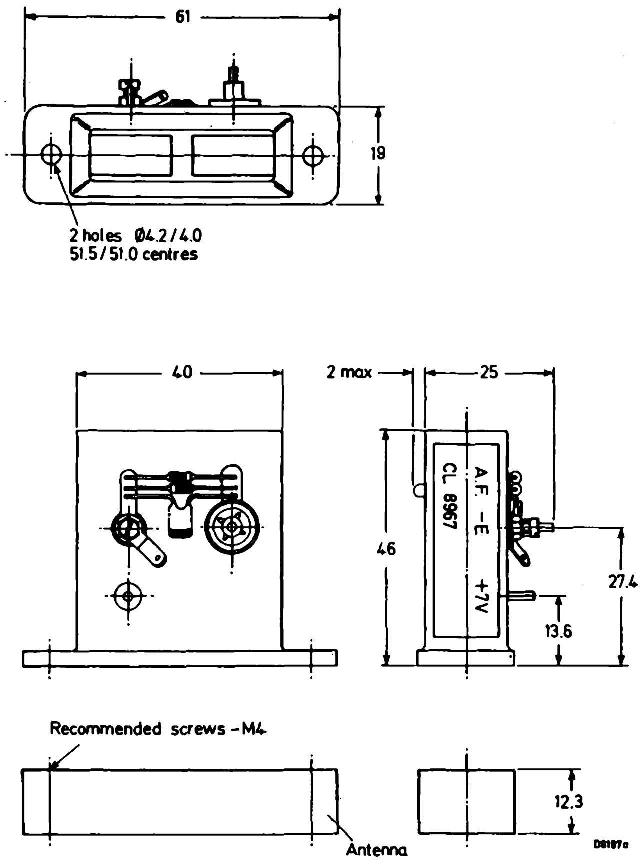
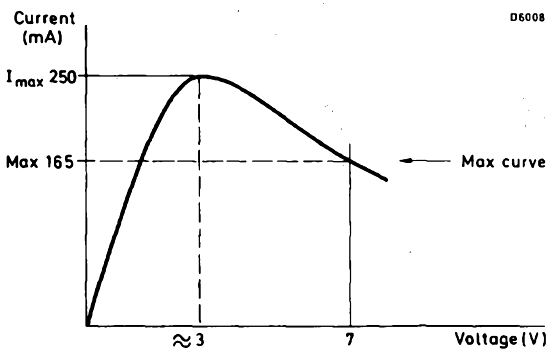
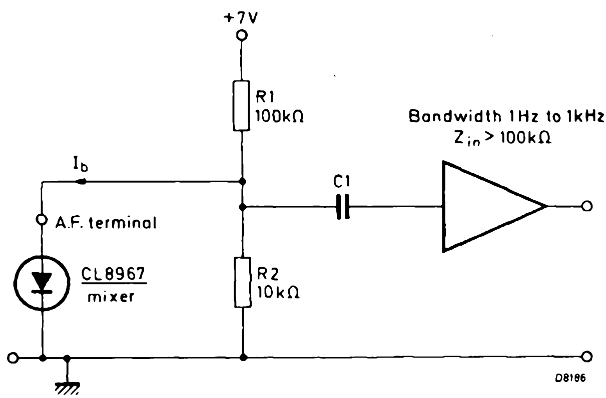
OUTLINE DRAWING





Gunn device characteristic



Circuit used to measure A.F. performance

Notes

1. The current Ib should be approximately 35μA with the Gunn device disconnected and approximately 42μA with the Gunn device operational and the antenna operating into free space.
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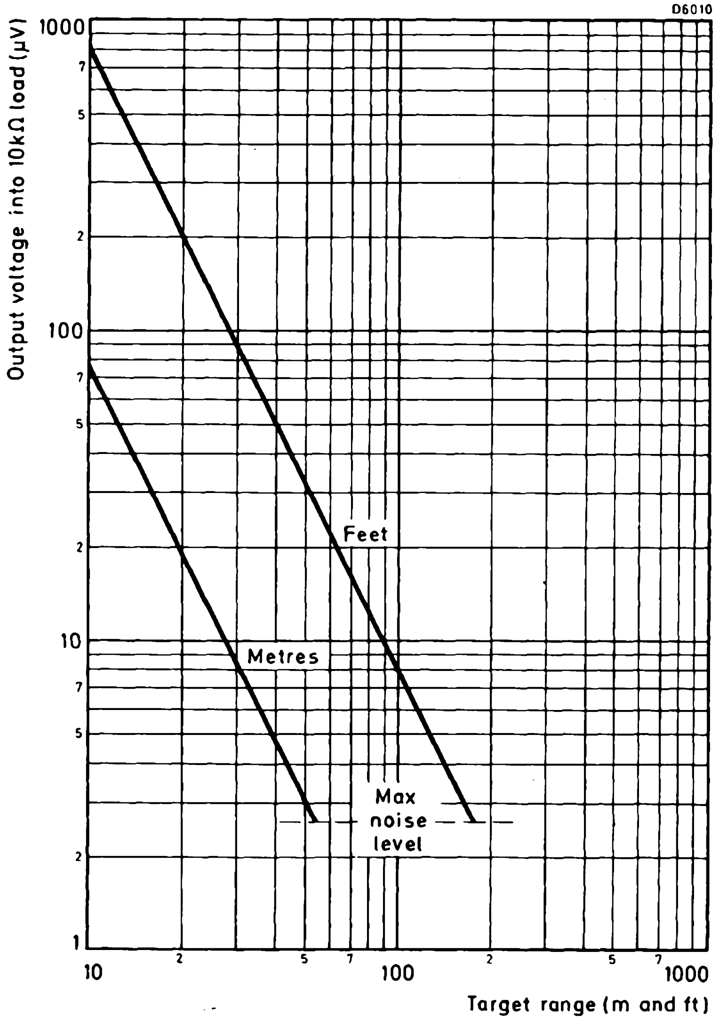
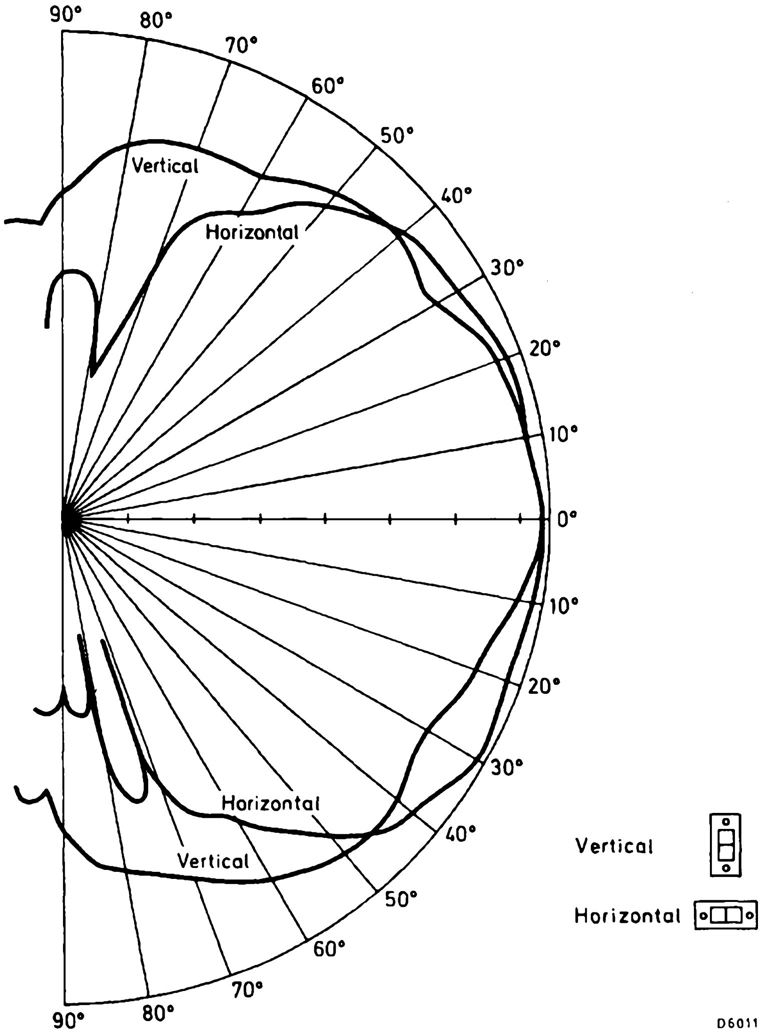


Minimum output for a man target



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 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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 42μA. (35μA d.c. bias + 7μA from -19dBm 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 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' 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
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-11	61	0.25mm Cobex plastic
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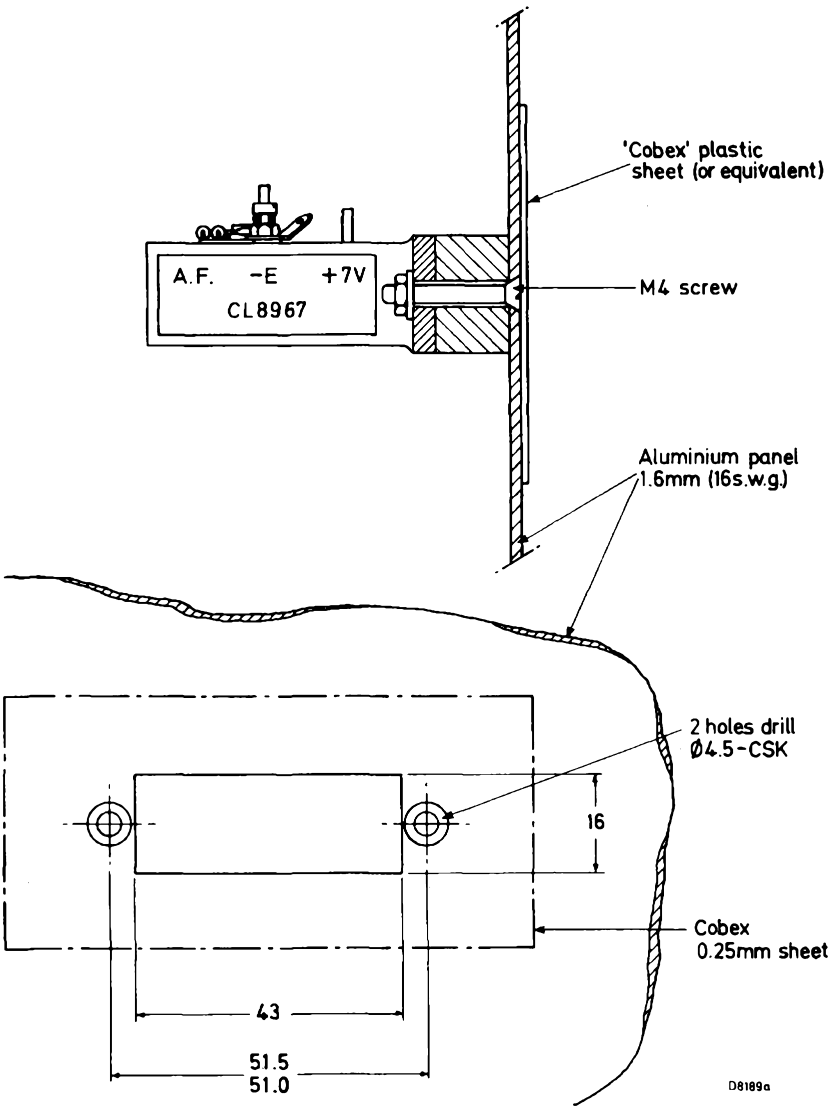

'Cobex' plastic
sheet (or equivalent)
A.F.
-E
+7V
CL8967
M4 screw
Aluminium panel
1.6mm (16s.w.g.)
2 holes drill
Ø4.5-CSK
16
Cobex
0.25mm sheet
43
51.5
51.0
D8189a

MISCELLANEOUS

H

H

MICROWAVE HORN ANTENNA

ACX-01A

TENTATIVE DATA

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.

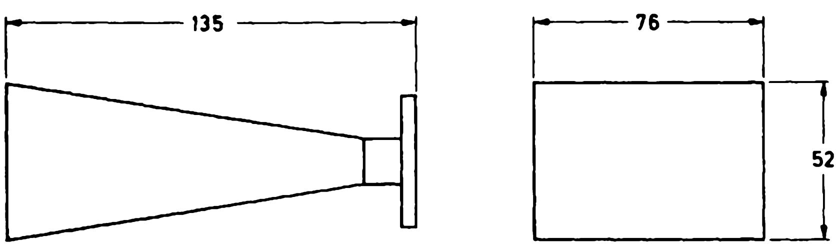
CHARACTERISTICS

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)	

OUTLINE DRAWING



All dimensions in mm

D6006

X-BAND MIXER/DETECTOR

CL7500

Waveguide single ended mixer designed for use in the 10.7 GHz band. It is primarily intended for Doppler control systems, e.g. intruder alarms deriving local oscillator drive from the transmitter output of a Gunn effect device such as Mullard CL8630.
The CL7500 can be used as a microwave detector. Two examples of this are sensing deliberate beam obstruction in a microwave protected area and as receiver in a microwave barrier or fence.

QUICK REFERENCE DATA		
Centre frequency	10.687	GHz
Typical sensitivity for -95 dBm input	15	μV
Typical noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth)	1.0	μV

LIMITING VALUES (Absolute max. rating system)

I_R (max.)	5.0	mA
I_{FM} peak forward current (max.)	10	mA
T_{stg} range	-10 to +100	°C

TYPICAL OPERATING CONDITIONS

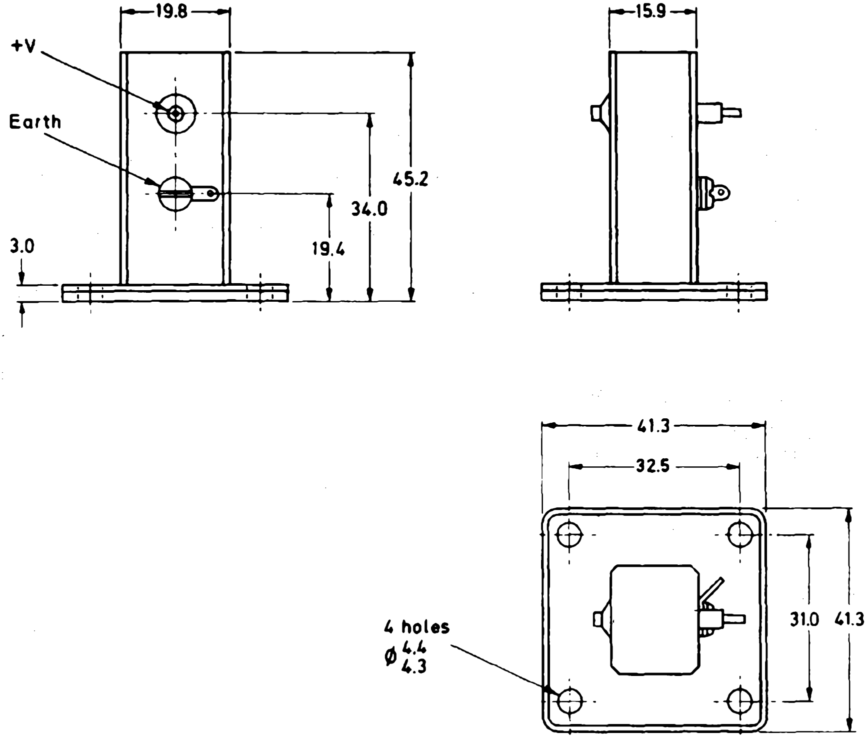
T_{amb} range	-10 to +50	°C
Local oscillator level	-18	dBm
D.C. bias	32	μA
Total load (d.c. and i.f.)	10	kΩ

ELECTRICAL CHARACTERISTICS (at 25 °C)

Centre frequency		10.687	GHz
Mixer			
Sensitivity for -95 dBm input	min.	10	μV
	typ.	15	μV
Noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) 1)	typ.	1.0	μV
	max.	2.0	μV
Detector			
Tangential sensitivity at centre frequency 2)	typ.	-50	dBm
Tangential sensitivity from 10.1 to 11.0 GHz 2)	typ.	-49	dBm

Notes see page 2

OUTLINE DRAWING



All dimensions in mm

D5835a

1) When the local oscillator power is derived from a Gunn source with an a.m. noise to carrier ratio of 94 dB (typically Mullard CL8630), the minimum sensitivity specified represents a signal to noise ratio at the mixer output of 10 dB (typically 17 dB).

2) When operated as a detector with 32 μA d.c. bias, measured in a 0 to 2 MHz bandwidth.

3) The diode may be damaged if the bias supply is reversed.

4) The mixer diode will be damaged by forward current in excess of 10 mA. The module is supplied with a shorting strap 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 shorting strap is not removed until all wiring has been completed.

5) Connections to be made to W.G. 16 components.

X-BAND MIXER/DETECTOR

CL7520

Waveguide single ended mixer designed for use in the 9.35 GHz band. It is primarily intended for Doppler control systems, e.g. intruder alarms deriving local oscillator drive from the transmitter output of a Gunn effect device such as Mullard CL8631 or ← CL8632.
The CL7520 can be used as a microwave detector. Two examples of this are sensing deliberate beam obstruction in a microwave protected area and as receiver in a microwave barrier or fence.

QUICK REFERENCE DATA		
Centre frequency	9.35	GHz
Typical sensitivity for -95 dBm input	15	µV
Typical noise level (32 µA d.c. bias, 1 Hz to 1 kHz bandwidth)	1.0	µV

LIMITING VALUES (Absolute max. rating system)

I_R (max.)	5.0	mA
I_{FM} peak forward current (max.)	10	mA
T_{stg} range	-10 to +100	°C

TYPICAL OPERATING CONDITIONS

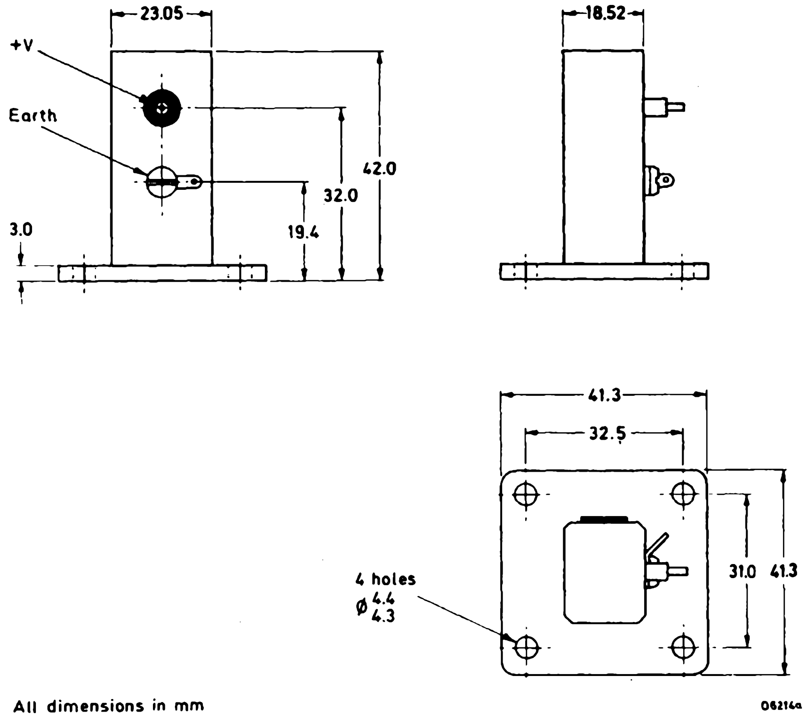
T_{amb} range	-10 to +50	°C
Local oscillator level	-18	dBm
D.C. bias	32	µA
Total load (d.c. and i.f.)	10	kΩ

ELECTRICAL CHARACTERISTICS (at 25 °C)

Centre frequency		9.35	GHz
<u>Mixer</u>			
Sensitivity for -95 dBm input	min.	10	µV
	typ.	15	µV
Noise level (32 µA d.c. bias, 1 Hz to 1 kHz bandwidth) [1])	typ.	1.0	µV
	max.	2.0	µV
<u>Detector</u>			
Tangential sensitivity [2])	typ.	50	dBm

Notes see page 2

OUTLINE DRAWING



→ 1) When the local oscillator power is derived from a Gunn source with an a.m. noise to carrier ratio of 94 dB (typically Mullard CL8631 or CL8632), the minimum sensitivity specified represents a signal to noise ratio at the mixer output of 10 dB (typically 14 dB).

2) When operated as a detector with 32 μA d.c. bias, measured in a 0 to 2 MHz bandwidth.

3) The diode may be damaged if the bias supply is reversed.

4) The mixer diode will be damaged by forward current in excess of 10 mA. The module is supplied with a shorting strap 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 main supplies and that the shorting strap is not removed until all wiring has been completed.

5) Connections to be made to W.G. 16 components.

PARAMETRIC AMPLIFIER

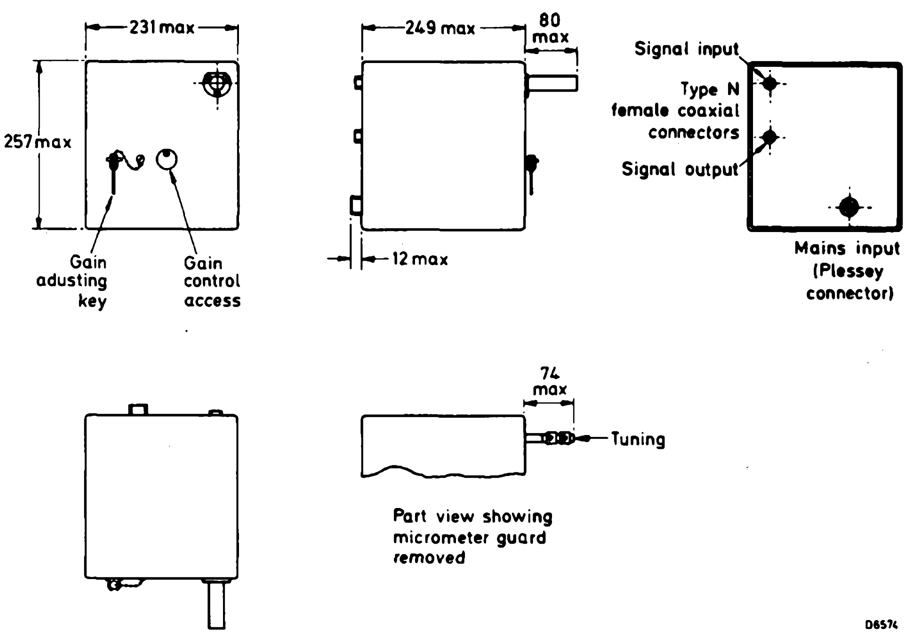
A single-diode non-degenerate parametric amplifier designed for use as a low-noise pre-amplifier in microwave applications. It is supplied in a temperature stabilized enclosure with a solid state Gunn-effect oscillator pump and integral power supply.

QUICK REFERENCE DATA

Power gain	20	dB
Tuning range min.	2.7 to 3.1	GHz
Noise figure max.	2.8	dB
Bandwidth	15	MHz
Input and output impedance	50	Ω
Mains supply	240 V, 2A, 50 Hz	

MECHANICAL DATA

Dimensions in mm



RATINGS

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

Continuous r.f. input power	max.	100	mW
Input spike energy	max.	500	nJ
Mains supply voltage	max.	276	V_{ac}
Ambient operating temperature range		−20 to +55	°C
Storage temperature range		−30 to +70	°C

CHARACTERISTICS (note 1)

T_{amb} = 25 °C

	min.	typ.	max.	
Power gain (recommended setting) (note 2)	–	20	–	dB
Operating frequency	2.7	–	3.1	GHz
Noise figure	–	2.6	2.8	dB
Bandwidth (note 3)	12	–	18	MHz
Input saturation level (note 4)	−35	−32	–	dBm
Gain stability per hour		±0.1		dB
per day		±0.5		dB
Mains voltage supply limits	204	240	276	V_{ac}

MASS		5.4		kg

Notes

1. These are given for matched conditions.
2. The gain-set attenuator is adjusted with the hexagonal key provided.
3. Measured to the 3 dB points at a gain setting of 20 dB.
4. This is the input level at which the gain is compressed by 1 dB, at a gain setting of 20 dB.
5. The amplifier is designed for ease of maintenance; both the temperature control system and the Gunn oscillator power supply use field-replaceable plug-in boards.

ISOLATORS AND CIRCULATORS

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ISOLATORS AND CIRCULATORS

Contents **page**

ISOLATORS AND CIRCULATORS

INTRODUCTION

Only a brief general description of isolators and circulators is given here: those readers seeking fuller information are referred to our Application Book *'Isolators and Circulators'*.

Isolators

An isolator is a passive non-reciprocal device which permits microwave energy to pass through it in one direction whilst absorbing energy in the reverse direction. In the forward direction, that is the direction in which the energy is passed, the insertion loss is usually 0,3 to 0,5 dB in the frequency range for which the isolator has been designed. In the opposite direction the isolation is normally 30 dB but for certain applications isolation can be made as high as 55 to 60 dB.

In the field displacement type of isolator, which is described later, a ferrite bar is mounted in a waveguide and biased by a magnetic field. The non-reciprocal behaviour of this type of isolator is produced by gyromagnetic effects which occur between the high frequency magnetic field and the electrons in the ferrite.

Circulators

A circulator is a passive non-reciprocal device with three or more ports. It contains a core of ferrite material in which 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, the symbols for which are given in Figs 1 and 2.

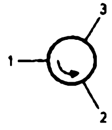


Fig. 1 Symbol for 3-port circulator.

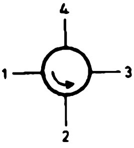


Fig. 2 Symbol for 4-port circulator.

Energy entering port 1 emerges from port 2; energy entering port 2 emerges from port 3, and so on in cyclic order. In this direction of circulation an ideal circulator would have no losses, but in practical constructions there are some losses.

In an ideal circulator no energy would flow in the direction opposite to the circulation direction. Again in practice this isolation is in the order of 20 to 30 dB; in very narrow bands it is even higher. The non-reciprocal behaviour of circulators is the result of gyromagnetic effects in the ferrite when this is biased with a magnetic field.

APPLICATIONS

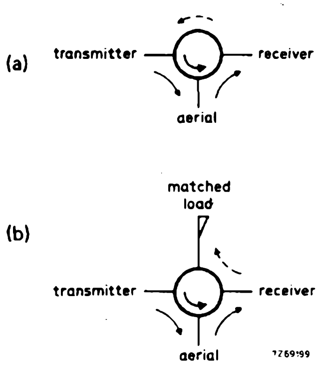
Isolators

The main application of an isolator is to improve the behaviour of klystrons, magnetrons or travelling-wave tubes by isolating the source from the load. The main factor is that an antenna or amplifier cannot be matched ideally to the preceding function over the required frequency range, so that energy would be reflected back into the tube and upset the frequency stability. The isolator will absorb this reflected energy so that the tube is effectively protected from these disturbing influences.

The isolators are provided with adjusting screws that enable them to be matched so that the v.s.w.r. is minimum over a certain frequency range. It is therefore possible to optimize the efficiency of wave-guide runs by matching the isolator to minimum reflection. This means that long line effects can be drastically reduced.

Circulators

The main application of circulators is the duplexing of systems for simultaneous transmission and reception in low and medium-power telecommunication equipment; this is illustrated in Figs 3 and 4.



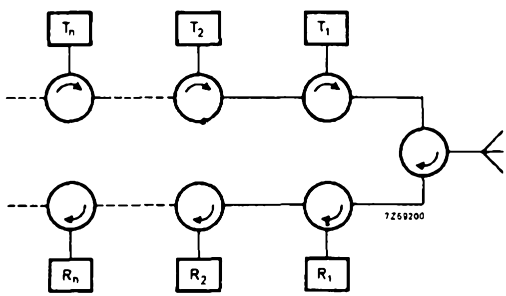


Fig. 3 Duplexing one receiver and one transmitter with (a) a 3-port circulator and (b) a 4-port.

Fig. 4 Duplexing of a number of transmitters (T) and receivers (R).

The reasons that both 3-port and 4-port circulators are used are:

- a 3-port circulator usually has a wider bandwidth than a 4-port circulator;
- a 4-port circulator (of which the fourth port is provided with a matched load, Fig. 3(b)), however, does not require a very accurately matched receiver, so that a much simpler filter can be used on the receiver input.

A 3-port circulator can also be used as an isolator by putting a matched load on one port; Fig. 5. The characteristics of a circulator performing a decoupling function are superior to those of an isolator, particularly at the lower frequencies. Decoupling can be increased by cascading circulators. Decoupling and insertion loss are directly proportional to the number of circulators. For additional information refer to our Application Book *'Isolators and Circulators'.*

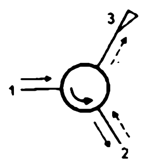


Fig. 5 A 3-port circulator used as an isolator.

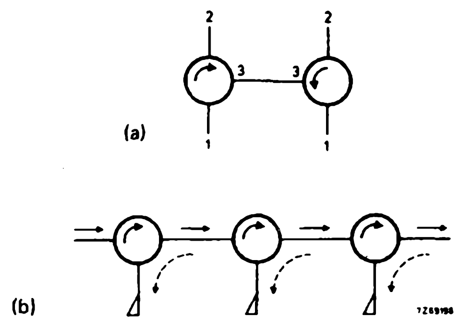


Fig. 6 Cascaded circulators (a) in H-configuration, (b) π-configuration.

CONSTRUCTION

Waveguide isolators

A field displacement isolator is shown in Fig. 7. The ferrite bar (1) can be seen inside the waveguide, flanked by two sets of magnets (2) outside the waveguide. These magnets bias the ferrite bar. The adjusting screws (3) protruding into the waveguide are used to match the isolator for minimum voltage standing wave ratio.

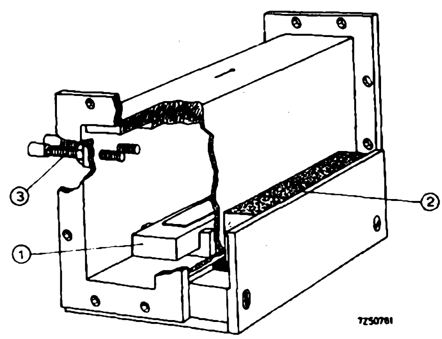


Fig. 7 Field displacement isolator.

Waveguide circulators

Three or four waveguides intersect at angles of 120° or 90° respectively in this type of circulator. A 4-port waveguide circulator of the junction type is shown in Fig. 8. A piece of ferrite (1) is located between two magnets (2) exactly in the centre of the intersection. Posts (3) are placed in the waveguide to achieve a good match.

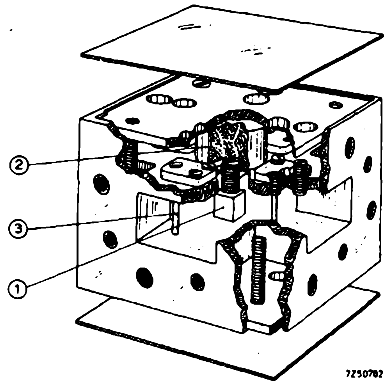


Fig. 8 Construction of a junction type waveguide circulator.

Coaxial circulators

A coaxial circulator of the junction type is shown in Fig. 9. Three copper strips (1) intersect at 120° in the centre of the circulator. The strips are mounted between two earth plates (2) to form a matched high-frequency conductor. Two ferrite discs (3) and magnets (4) are mounted in the exact centre of the circulator.

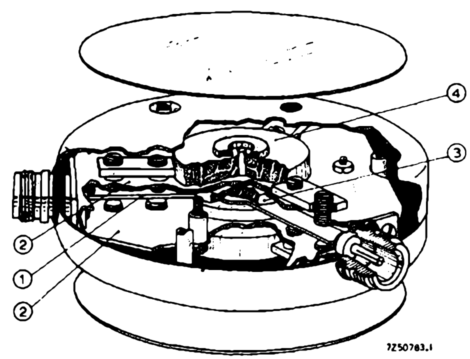


Fig. 9 Construction of a junction type coaxial circulator.

TERMS AND DEFINITIONS

Frequency range

This is the range within which the isolator or circulator meets the guaranteed specification. Outside of this range the electrical properties deteriorate rapidly. Circulators, however, will not be damaged if erroneously subjected to frequencies outside the range.

Isolation

In an *isolator,* isolation is the ratio of the input power to the output power in the reverse direction, expressed in dB. The power measurements are made with matched source and matched load.

In a *circulator,* isolation is the ratio of the energy entering a port to the energy scattered into the adjacent port in the reverse direction to normal circulation, expressed in dB. Measurements are made with a matched source and all other ports correctly terminated. The isolation between ports 1 and 3, α_{1-3}, is equal to α_{3-2} and α_{2-1} (Fig. 1).

Insertion loss

This is the attenuation which results from including an isolator or circulator in the transmission system. Insertion loss is the proportion of power lost between the ports of the device when energy is travelling in the forward direction, expressed in dB. Measurements are made with the input and output matched.

Voltage standing wave ratio

The v.s.w.r. is the ratio of the maximum voltage to the minimum voltage along a lossless line. In circulators the v.s.w.r. is measured with all unused ports terminated by a matched load. Coaxial circulators are designed with a characteristic impedance of 50 ohms.

Maximum power

Under no circumstances should the maximum power value for isolators and circulators be exceeded.

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 v.s.w.r. of 2.

In a *circulator,* the maximum power is the largest power that it can handle at sea level and maximum ambient temperature – and with cooling applied if specified in the data – when one port is terminated with a mismatch having a v.s.w.r. of 2, and the next port is matched having a v.s.w.r. $\leqslant$ 1,2.

The maximum power for coaxial circulators is the maximum continuous-wave power unless a maximum peak power is separately stated. These power levels should not be exceeded.

The peak power is the maximum peak sync power as defined by the CCIR signal standard. This value is given for isolators and circulators at the v.h.f. and u.h.f. television frequencies. If this value is exceeded the isolator or circulator can be damaged by arcing in its internal transmission structure.

Peak power values are valid for one signal passage only.

Since the sound power P_s passes through the circulator twice in a signal-combining circulator, the average power when $P_s = 0{,}2P_{sync}$ is given by $P \approx 1{,}17P_{sync}$.

Under worst-case conditions, the peak power produced for the same signal is given by

$$P_M = \sqrt{P_{sync}} + 2\sqrt{P_s} = P_{sync}\,(1 + 2\sqrt{0{,}2})^2 = 3{,}6P_{sync}.$$

Temperature range

The ambient temperature range within which isolators and circulators 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 be far outside the guaranteed specifications. However, no permanent damage can be expected unless a large temperature rise is caused by excessive power handling.

The storage temperature of isolators may be from –40 to + 125 °C unless otherwise specified in the data.

CAUTIONARY NOTES

1. Isolators and circulators have internal magnetic fields that are carefully adjusted for optimum operation.
2. Isolators and circulators are not to be subjected to strong external magnetic fields.

QUALITY GUARANTEE

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

Under this guarantee the Manufacturer will within one year after shipment to the original purchaser repair or replace at the Manufacturer's option, free of charge, any isolator/circulator proved by the Manufacturer's inspection to be thus defective.

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; duration of one cycle is 1 hour.

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 (v.s.w.r.= 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.

COAXIAL CIRCULATOR SERIES, BANDS IV–V, 100 W, U.H.F., TV

frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
MHz	guaranteed	typ	guaranteed	typ	guaranteed	typ	c.w.	peak sync	°C	*	g	
400–470	> 20	25	< 0,5	0,35	< 1,25	1,15	100	200	–10 to + 60	N-female	400	2722 162 03411
470–600	> 20	25	< 0,5	0,35	< 1,25	1,15	100	200	–10 to + 60	N-female	400	2722 162 01551
600–800	> 20	25	< 0,5	0,35	< 1,25	1,15	100	200	–10 to + 60	N-female	400	2722 162 01561
790–1000	> 20	25	< 0,5	0,3	< 1,25	1,14	100	200	–10 to + 60	N-female	400	2722 162 03261

Notes

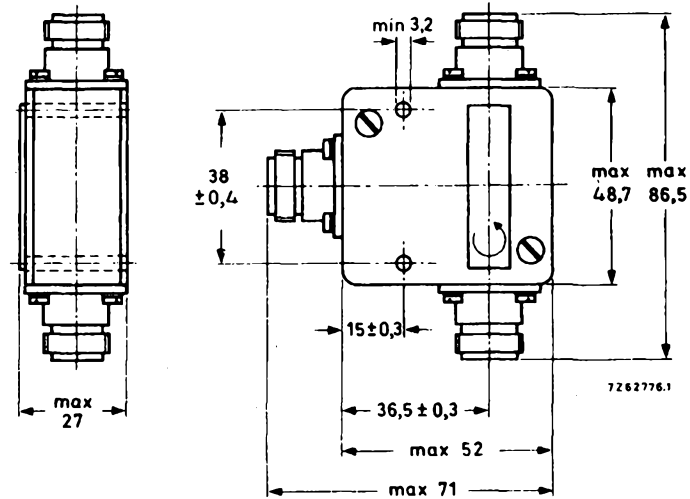
Combinations to form 4-port versions (π or H configurations) can be made to special order.

Isolator versions of these circulators are available.

* These circulators can be made available with different connector types.

OUTLINES

Dimensions in mm



2722 162 03411
01551
01561
03261

COAXIAL CIRCULATOR SERIES, 300 W, U.H.F., TV

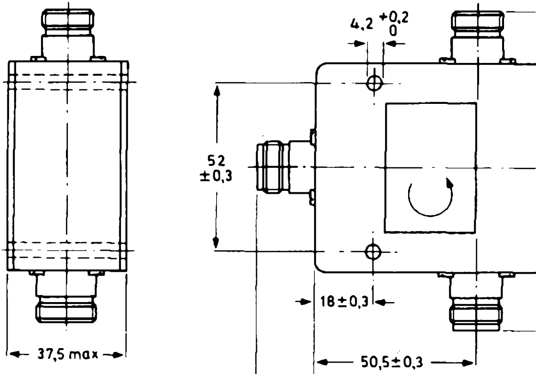
frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
MHz	guaran-teed	typ	guaran-teed	typ	guaran-teed	typ	c.w.	peak sync	°C	*	g	
400–470	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	N-female	1200	2722 162 01572
400–470	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	HF 7/16	1200	2722 162 01622
470–600	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	N-female	1200	2722 162 01582
470–600	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	HF 7/16	1200	2722 162 01632
590–720	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	N-female	1200	2722 162 01592
590–720	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	HF 7/16	1200	2722 162 01642
710–860	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	N-female	1200	2722 162 01612
710–860	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	HF 7/16	1200	2722 162 01662

Note

Isolator versions of these circulators are available.

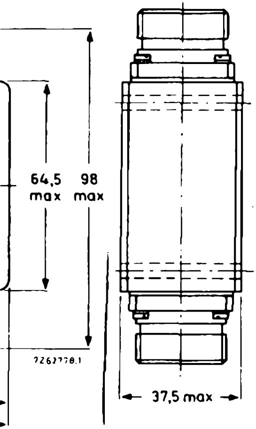
* These circulators can be made available with different connector types.

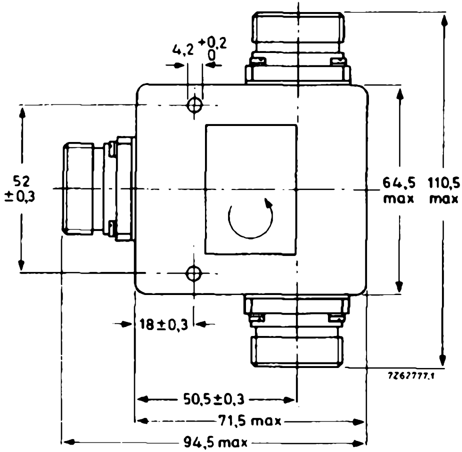
OUTLINES



2722 162 01572
01582
01592
01612

Dimensions in mm





2722 162 01622
01632
01642
01662

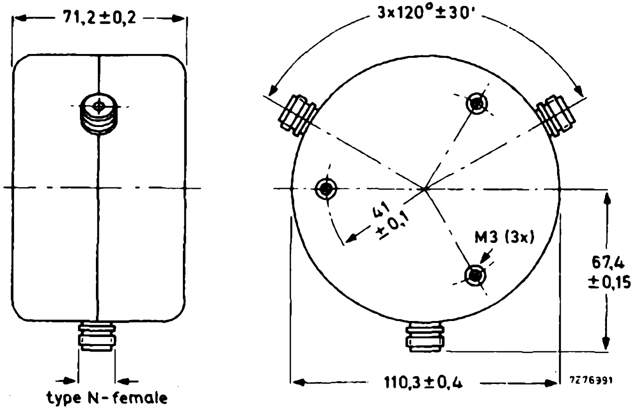
COAXIAL CIRCULATOR SERIES, 500 W/1 kW, V.H.F., TV

frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
MHz	guaranteed	typ	guaranteed	typ	guaranteed	typ	c.w.	peak sync	°C		g	
160–178	> 20	24	< 0,35	0,3	< 1,25	1,15	500	850	–10 to + 60	N-female	2100	2722 162 01871
160–178	> 20	24	< 0,35	0,3	< 1,25	1,15	1000	1800	–10 to + 40*	HF 7/16	2150	2722 162 01901
173–204	> 20	24	< 0,35	0,3	< 1,25	1,15	500	850	–10 to + 60	N-female	2100	2722 162 01861
173–204	> 20	24	< 0,35	0,3	< 1,25	1,15	1000	1800	–10 to + 40*	HF 7/16	2150	2722 162 01891
200–230	> 20	24	< 0,35	0,3	< 1,25	1,15	500	850	–10 to + 60	N-female	2100	2722 162 01851
200–230	> 20	24	< 0,35	0,3	< 1,25	1,15	1000	1800	–10 to + 40*	HF 7/16	2150	2722 162 01881
225–270	> 20	24	< 0,35	0,3	< 1,25	1,15	500	850	–10 to + 60	N-female	2100	2722 162 03171
225–270	> 20	24	< 0,35	0,3	< 1,25	1,15	1000	1800	–10 to + 40*	HF 7/16	2150	2722 162 03181

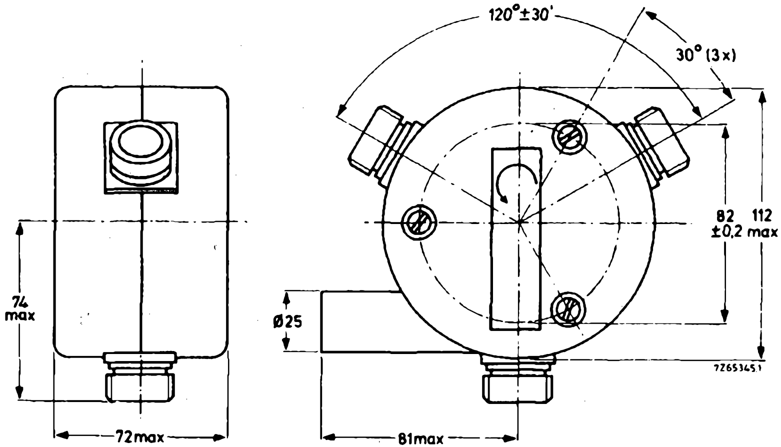
* With air cooling (filtered) at a pressure of 25 mm water column and maximum 40 °C intake temperature, the permissible connector temperature is + 55 °C.

OUTLINES

Dimensions in mm



2722 162 01851
01861
01871
03171



2722 162 01881
01891
01901
03181

COAXIAL CIRCULATOR SERIES, BANDS IV–V, 500 W/2 kW, U.H.F., TV

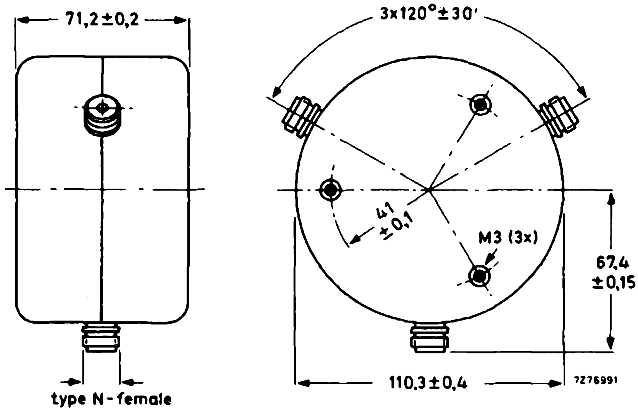
frequency range MHz	isolation dB guaranteed	isolation dB typ	insertion loss dB guaranteed	insertion loss dB typ	v.s.w.r. guaranteed	v.s.w.r. typ	max. power W c.w.	max. power W c.w.+ peak sync	temperature range °C	connector type	mass approx g	catalogue number
470–600	> 22	24	< 0,35	0,25	< 1,2	1,15	500	900	–10 to + 70	N-female**	2080	2722 162 01121
470–600	> 20	24	< 0,35	0,17	< 1,25	1,12	2000	2000	–10 to + 40*	HF 7/16	2000	2722 162 01261
590–720	> 22	24	< 0,35	0,25	< 1,2	1,15	500	900	–10 to + 70	N-female**	2080	2722 162 01131
590–720	> 22	27	< 0,35	0,15	< 1,2	1,1	2000	2000	–10 to + 40*	HF 7/16	2000	2722 162 01281
600–800	> 20	24	< 0,35	0,17	< 1,25	1,13	2000	2000	–10 to + 40*	HF 7/16	2000	2722 162 01331
710–860	> 22	24	< 0,35	0,25	< 1,2	1,15	500	900	–10 to + 70	N-female**	2080	2722 162 01141
710–860	> 22	26	< 0,35	0,16	< 1,2	1,15	2000	2000	–10 to + 40*	HF 7/16	2000	2722 162 01271

* With air cooling (filtered) at a pressure of 25 mm water colomn and maximum 40 °C intake temperature, the permissible connector temperature is + 60 °C.

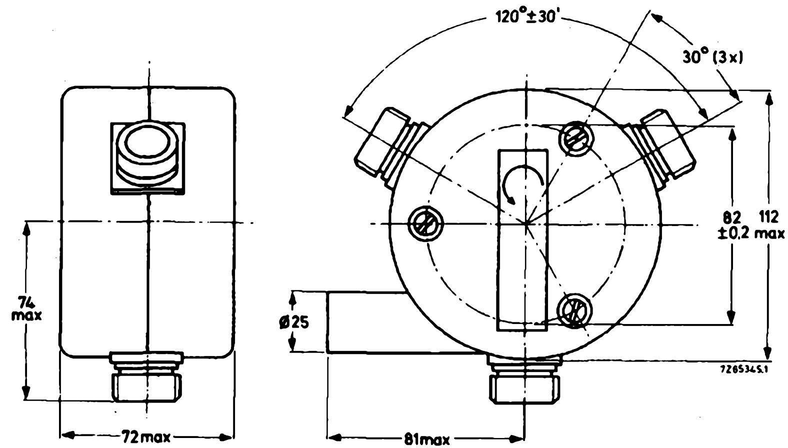
** Also available with connector HF 7/16 (to DIN 47223), EIA 7/8, and EIA 1 5/8.

OUTLINES

Dimensions in mm



2722 162 01121
01131
01141



2722 162 01261
01271
01281
01331

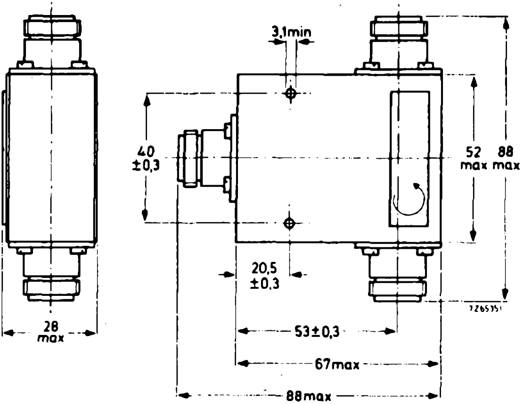
COAXIAL CIRCULATOR/ISOLATOR SERIES, OCTAVE BANDWIDTH

frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
GHz	guaranteed	typ	guaranteed	typ	guaranteed	typ	forward	reverse	°C		g	
2–4	> 20	24	< 0,5	0,35	< 1,25	1,15	50	–	–10 to + 70	N-female	300	2722 162 01491
2–4	> 20	24	< 0,5	0,35	< 1,25	1,15	50	–	–10 to + 70	SMA	300	2722 162 01501
2–4	> 20	24	< 0,5	0,35	< 1,25	1,1	50	5	–10 to + 70	N-female	300	2722 162 02091
2–4	> 20	24	< 0,5	0,35	< 1,25	1,1	50	5	–10 to + 70	SMA	300	2722 162 02101
3–6	> 20	27	< 0,5	0,3	< 1,25	1,1	20	–	–10 to + 70	SMA	120	2722 162 01511
3–6	> 20	27	< 0,5	0,3	< 1,25	1,1	20	5	–10 to + 70	SMA	120	2722 162 02071
4–8	> 20	23	< 0,5	0,3	< 1,25	1,15	10	–	–10 to + 70	SMA	100	2722 162 01811
4–8	> 20	27	< 0,5	0,3	< 1,25	1,15	10	10	–10 to + 70	SMA	100	2722 162 02111
7–12,7	> 20	23	< 0,6	0,4	< 1,25	1,15	10	–	–10 to + 70	SMA	60	2722 162 01821
7–12,7	> 20	25	< 0,6	0,35	< 1,25	1,12	10	–	–10 to + 70	SMA	100	2722 162 02121
12–18	> 18	22	< 0,6	0,35	< 1,30	1,2	5	–	–10 to + 70	SMA	20	2722 162 03301
12–18	> 18	22	< 0,6	0,35	< 1,25	1,2	5	1	–10 to + 70	SMA	20	2722 162 02221

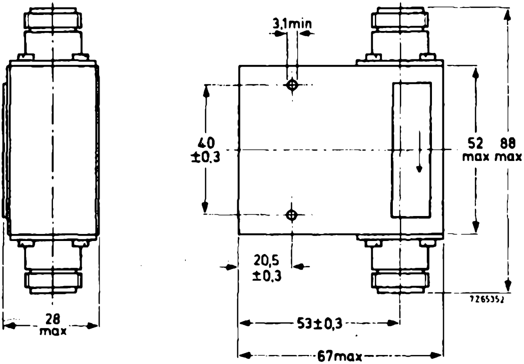
Note

Combinations to form 4-port versions (π or H configurations) can be made to special order.

OUTLINES

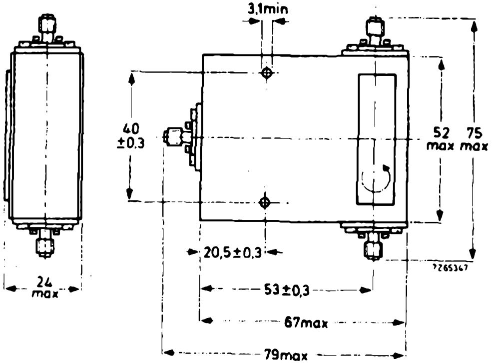


2722 162 01491



2722 162 02091

Dimensions in mm



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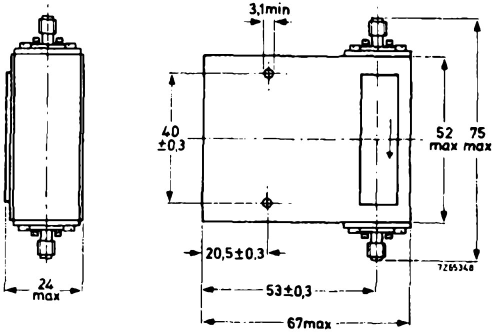

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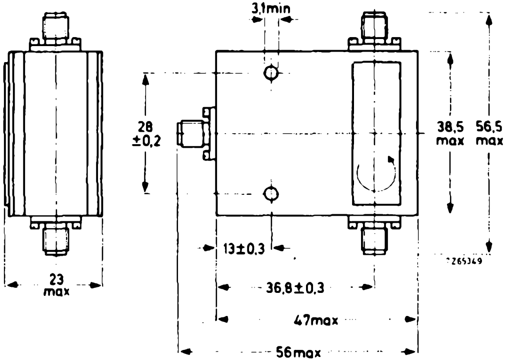

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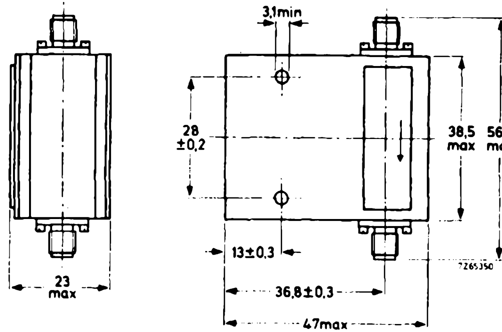

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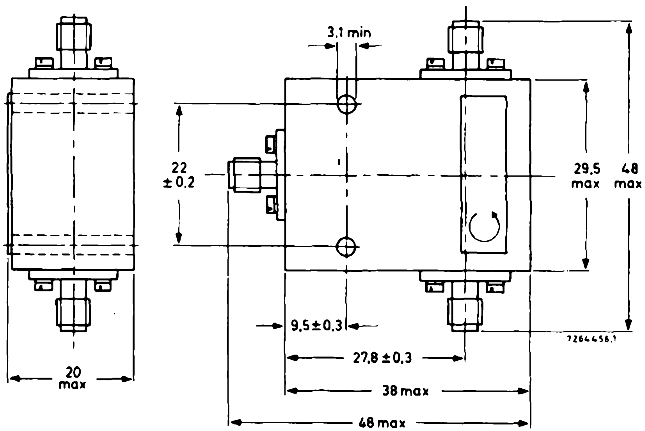
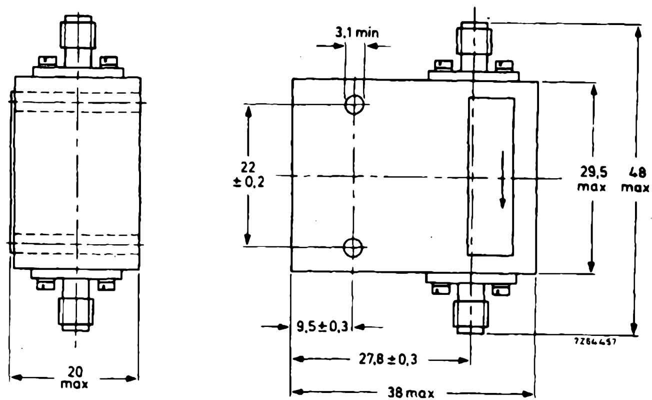
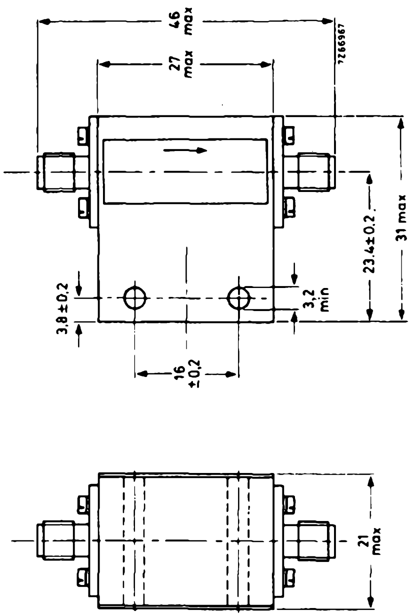


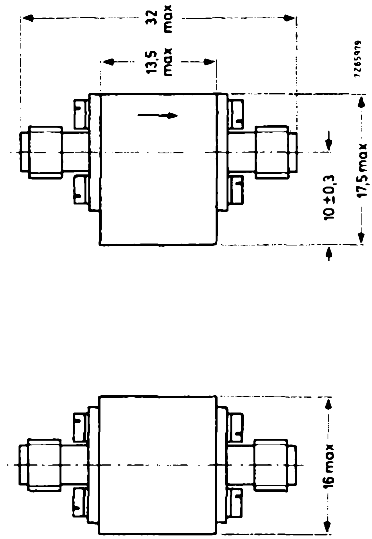
2722 162 01811



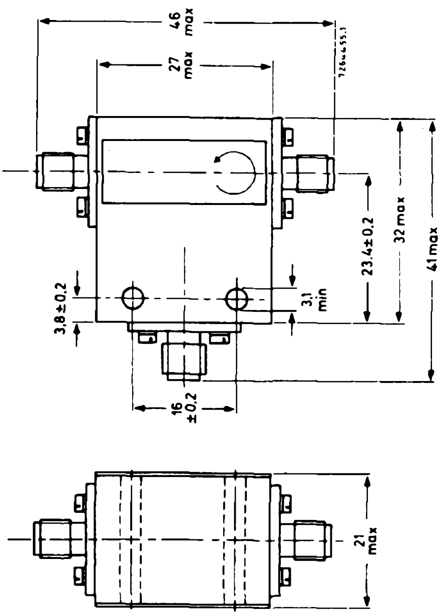
2722 162 02111



2722 162 02121



2722 162 02221



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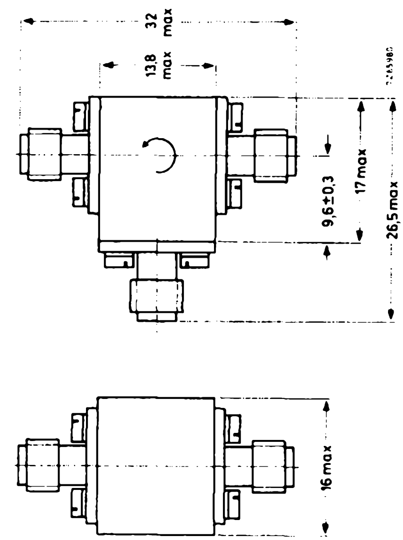


2722 162 03301

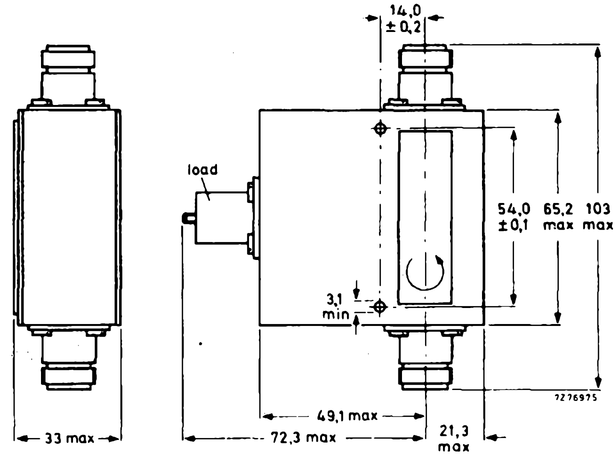
COAXIAL CIRCULATOR/ISOLATOR SERIES (3–PORT VERSIONS), STANDARD BANDS

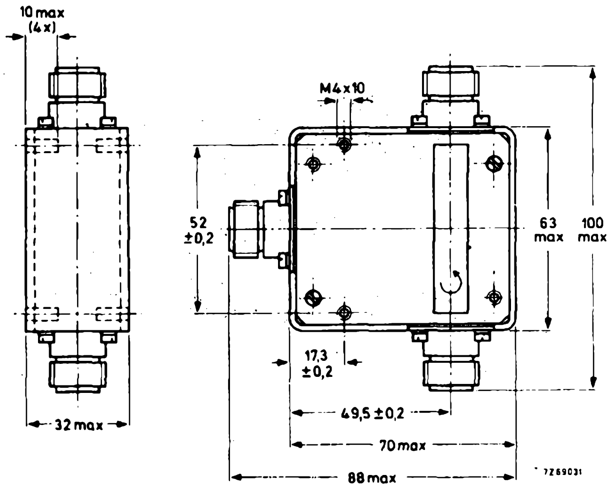
frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
GHz	guaranteed	typ	guaranteed	typ	guaranteed	typ	forward	reverse	°C		g	
0,225–0,27	> 18	21	< 0,35	0,2	< 1,35	1,25	150	–	0 to + 70	N-female	725	2722 162 01931
0,27 –0,33	> 18	21	< 0,35	0,2	< 1,35	1,25	150	–	0 to + 70	N-female	725	2722 162 01941
0,33 –0,40	> 18	21	< 0,35	0,3	< 1,35	1,25	150	–	0 to + 70	N-female	725	2722 162 01951
0,79 –1	> 20	25	< 0,5	0,3	< 1,25	1,14	100	–	–10 to + 60	N-female	400	2722 162 03261
0,96 –1,225	> 20	22	< 0,5	0,35	< 1,25	1,20	100	–	–10 to + 60	N-female	460	2722 162 03591
1,48 –1,95	> 20	28	< 0,3	0,3	< 1,2	1,08	50	2	0 to + 70	N-female	500	2722 162 02041
3,8 –4,2	> 25	27	< 0,25	0,2	< 1,12	1,10	10	–	–10 to + 70	SMA	110	2722 162 03431
4,4 –5	> 25	27	< 0,25	0,2	< 1,12	1,10	10	–	–10 to + 70	SMA	110	2722 162 03441
7,9 –10,4	> 20	22	< 0,4	0,35	< 1,25	1,23	5	1	–10 to + 70	SMA	30	2722 162 02231

OUTLINES

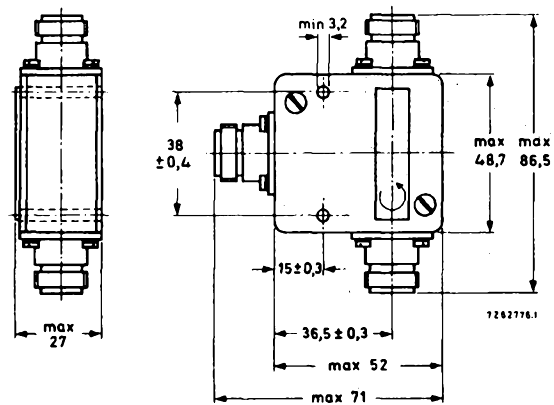
Dimensions in mm

2722 162 02041

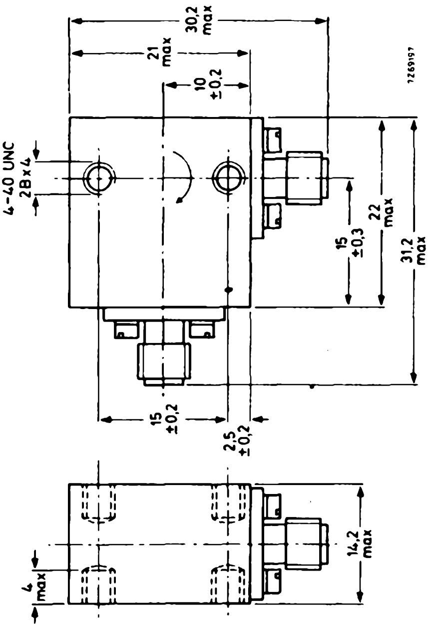




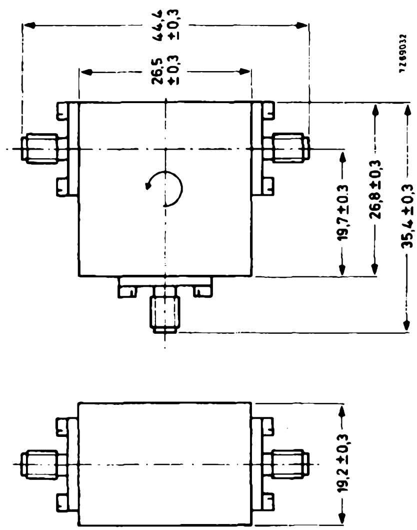
2722 162 01931
01941
01951
03591



2722 162 03261



2722 162 02231



2722 162 03431
03441

COAXIAL CIRCULATOR SERIES (4–PORT VERSIONS), STANDARD BANDS

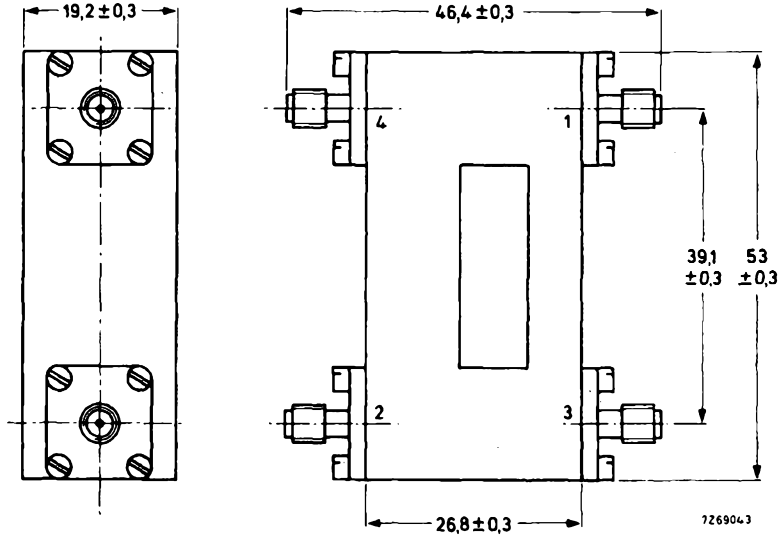
frequency range GHz	isolation (dB) guaranteed		isolation (dB) typical		insertion loss (dB) guaranteed		insertion loss (dB) typical		v.s.w.r. guaranteed	v.s.w.r. typ	max. (c.w.) power W	temperature range °C	connector type	catalogue number
	α_{1-4} α_{3-2}	α_{2-1} α_{4-2}	α_{1-4} α_{3-2}	α_{2-1} α_{4-3}	α_{4-1} α_{2-3}	α_{1-2} α_{3-4}	α_{4-1} α_{2-3}	α_{1-2} α_{3-4}						
3,8–4,2	> 25	> 50	27	52	<0,25	<0,5	0,2	0,4	< 1,12	1,1	10	–10 to + 70	SMA	2722 162 04031
4,4–5	> 25	> 50	27	52	<0,25	<0,5	0,2	0,4	< 1,12	1,1	10	–10 to + 70	SMA	2722 162 04041

Mass of circulators: 220 g approx.

OUTLINES

Dimensions in mm

2722 162 04031
04041



COAXIAL CIRCULATORS STANDARD BANDS

WAVEGUIDE CIRCULATOR SERIES (3–PORT VERSIONS)

frequency range GHz	isolation (dB)		insertion loss (dB)		v.s.w.r.		max. power W	temperature range °C	flange type (IEC) *	mass approx g	catalogue number
	guaranteed	typ	guaranteed	typ	guaranteed	typ					
3,4 –3,8	> 28	35	< 0,4	0,15	< 1,08	1,04	50	0 to + 50	UER40	1500	2722 161 02261
3,8 –4,2	> 28	35	< 0,2	0,15	< 1,08	1,04	50	0 to + 50	UER40	1500	2722 161 02231
5,925–6,425	> 30	35	< 0,2	0,15	< 1,06	1,04	100	–10 to + 70	UER70	950	2722 161 02101
6,425–7,125	> 30	33	< 0,15	0,13	< 1,07	1,04	100	–10 to + 70	UER70	950	2722 161 02081
7,125–7,750	> 30	33	< 0,2	0,13	< 1,06	1,04	100	–10 to + 70	UER70	950	2722 161 02091
7,7 –8,5	> 25	32	< 0,5	0,2	< 1,1	1,05	50	+10 to + 40	UER84	825	2722 161 02191
7,7 –8,5	> 25	28	< 0,5	0,3	< 1,1	1,08	50	+ 10 to + 40	UER84	825	2722 161 02281
7,9 –8,4	> 30	33	< 0,3	0,15	< 1,06	1,04	50	+ 10 to + 40	UER84	825	2722 161 02271

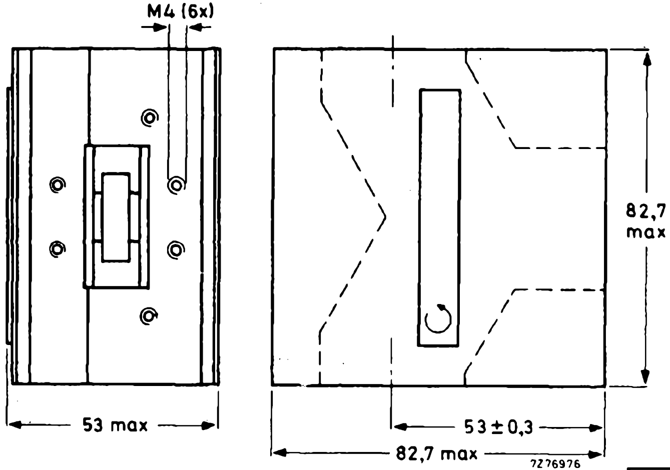
Note

On request, 3-port versions can be coupled to form n-ports.

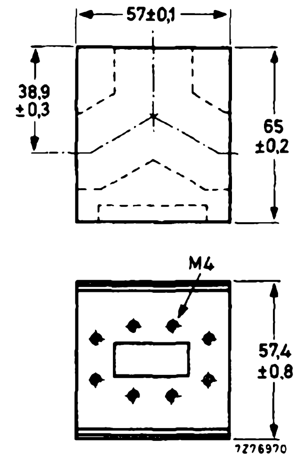
* Material of flanges: aluminium. Finish of flanges: alodine.

OUTLINES

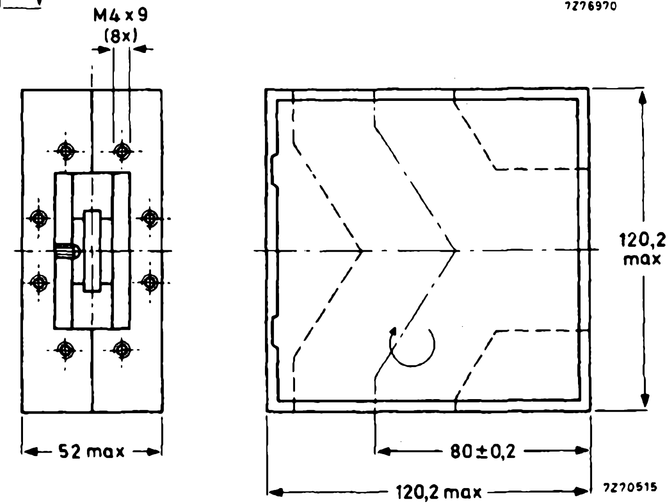
Dimensions in mm



2722 161 02081
02091
02101



2722 161 02191
02271
02281



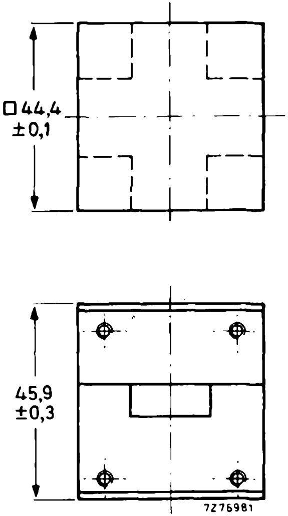
2722 161 02231
02261

WAVEGUIDE CIRCULATOR SERIES (4–PORT VERSIONS)

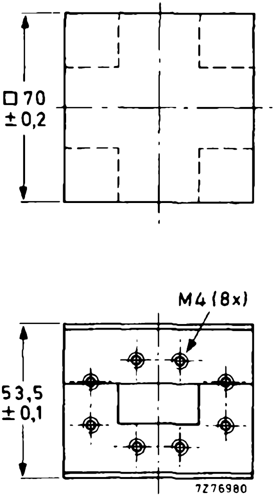
frequency range GHz	isolation (dB)		insertion loss (dB)		v.s.w.r.		nominal power (c.w.) W	temperature range °C	flange type (IEC) *	mass approx g	catalogue number
	α_{1-3}	α_{1-4}	guaranteed	typ	α_{1-3}	α_{1-4}					
5,925–6,175	> 33	> 20	< 0,1	0,10	< 1,05	< 1,04	150	+ 10 to + 60	UER70	920	2722 161 03081
6,125–6,425	> 30	> 20	< 0,1	1,10	< 1,06	< 1,06	150	+ 10 to + 60	UER70	920	2722 161 03091
6,575–6,875	> 25	> 20	< 0,4	0,35	< 1,10	< 1,10	100	+ 10 to + 60	UER70	920	2722 161 03031
6,825–7,125	> 25	> 18	< 0,4	0,35	< 1,08	< 1,08	100	+ 10 to + 60	UER70	920	2722 161 03011
7,125–7,425	> 25	> 18	< 0,3	0,25	< 1,10	< 1,10	100	+ 10 to + 60	UER70	920	2722 161 03001
7,425–7,725	> 30	> 20	< 0,4	0,35	< 1,10	< 1,10	100	+ 10 to + 60	UER70	920	2722 161 03041
10,7 –11,7	> 30	> 18	< 0,3	0,25	< 1,10	< 1,10	25	+ 10 to + 60	UER100	390	2722 161 03061
12,5 –13,5	> 25	> 20	< 0,3	0,25	< 1,10	< 1,10	25	+ 10 to + 60	UER140/ UBR140	320	2722 161 03051

* Material of flange: brass. Finish of flange: gold on silver plate.

OUTLINES

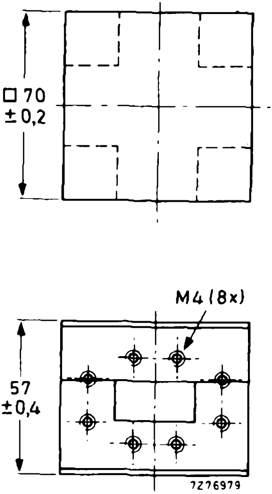


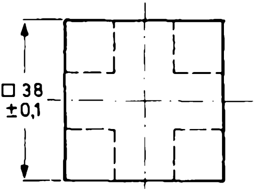
2722 161 03061



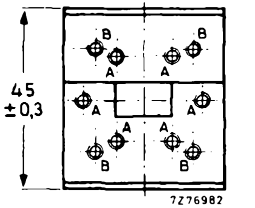
2722 161 03041

Dimensions in mm





A for IEC flange UER 140
B for IEC flange UBR 140



2722 161 03001
03011
03031
03081
03091

2722 161 03051

INDUSTRIAL HEATING ISOLATORS

frequency range GHz	isolation dB		insertion loss dB		v.s.w.r.		max. c.w. power forward/ reverse W	cooling water temp. (°C) (water pressure 600 kPa abs)		flange type (IEC) *	h.f. monitoring terminal	mass approx kg	catalogue number
	guaranteed	typ	guaranteed	typ	guaranteed	typ		inlet	outlet				
2,425–2,475	> 20	26	< 0,3	0,2	< 1,2	1,1	6500	40	50	PDR26	N-female	4,7	2722 163 02004
2,350–2,400	> 20	26	< 0,3	0,2	< 1,2	1,1	6500	40	50	PDR26	N-female	4,7	2722 163 02024

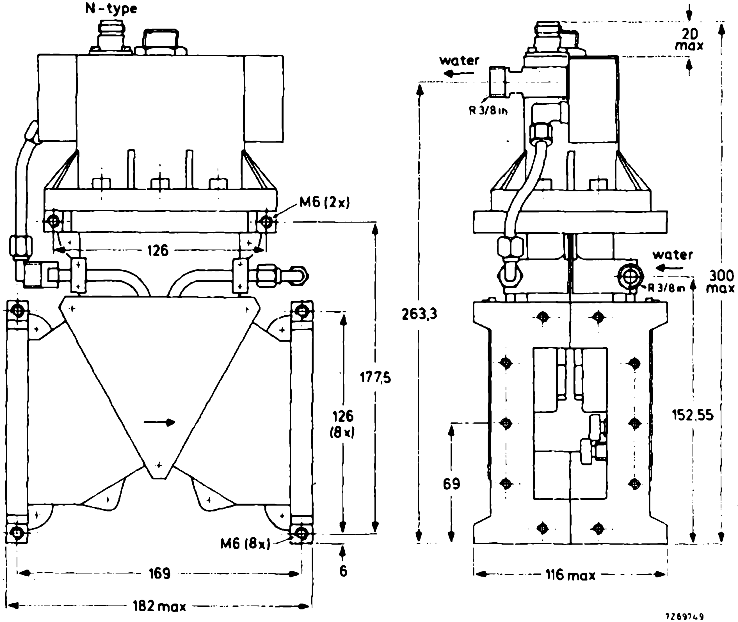
Note

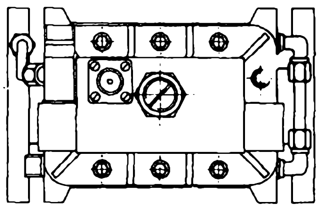
Minimum storage temperature, −10 °C.

* Finish of flange/housing: alodine.

OUTLINES

Dimensions in mm





2722 163 02004
02024

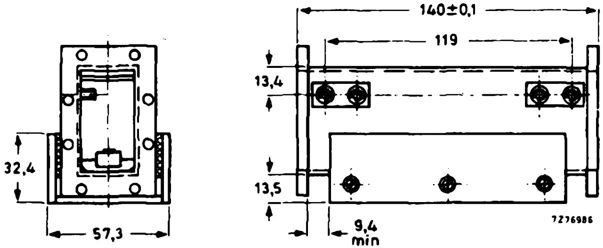
WAVEGUIDE ISOLATOR SERIES

frequency range GHz	isolation dB	insertion loss dB	v.s.w.r.	power (c.w.) W	temperature range °C	waveguide type (IEC)	flange type (IEC) *	mass approx g	catalogue number
3,8 –4,2	> 30	< 0,8	< 1,05	10	+ 10 to + 40	R48	UER48	1700	2722 161 01071
3,8 –4,2	> 30	< 0,5	< 1,05	10	+ 10 to + 80	R40	UER40	2450	2722 161 01081
4,2 –4,6	> 30	< 0,5	< 1,05	10	+ 10 to + 40	R48	UER48	1680	2722 161 01091
4,6 –5,0	> 30	< 0,8	< 1,05	10	+ 10 to + 40	R48	UER48	1680	2722 161 01101
5,925–6,425	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01191
6,425–7,150	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01251
6,825–7,425	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01231
7,125–7,750	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01291
7,250–7,750	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01241
7,4 –8,025	> 30	< 0,5	< 1,05	10	–10 to + 70	R70	UER70	1450	2722 161 01151
7,7 –8,5	> 30	< 0,5	< 1,05	10	+ 10 to + 70	R84	UBR84	1260	2722 161 01161
8,5 –9,6	> 30	< 0,5	< 1,05	10	–10 to + 70	R100	UBR100	420	2722 161 01211
8,5 –9,6	> 15	< 0,6	< 1,15	1	+ 10 to + 70	R100	UBR100	400	2722 161 01221
8,5 –9,6	> 55	< 1,2	< 1,2	10	–10 to + 70	R100	154-UER100**	600	2722 161 01261
8,5 –9,6	> 20	< 1	< 1,15	10	–10 to + 70	R100	154-UBR100**	300	2722 161 01271
10,7 –11,7	> 30	< 0,8	< 1,05	5	+ 10 to + 70	R100	UBR100	430	2722 161 01171
12,5 –13,5	> 30	< 0,5	< 1,05	10	+ 10 to + 70	R140	UBR100	220	2722 161 01181

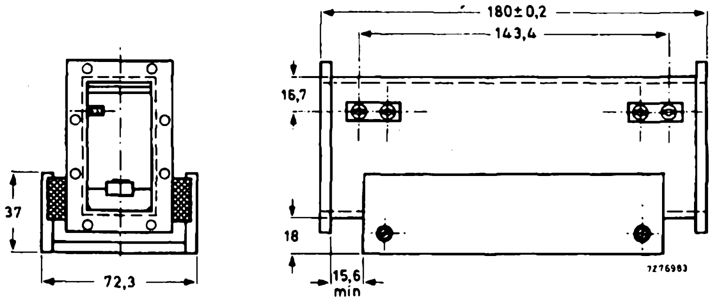
* Other flanges to order. Finish of waveguide and flanges: gold plate.
** Finish of flanges: nickel plate.

OUTLINES

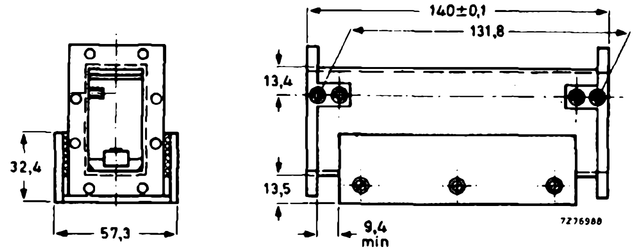
Dimensions in mm



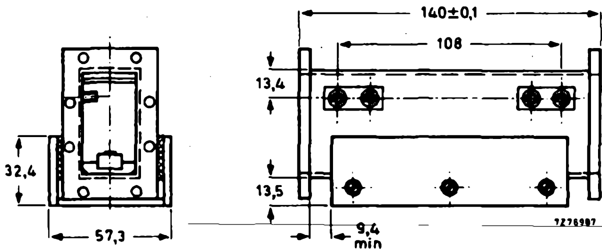
2722 161 01071



2722 161 01081



2722 161 01091



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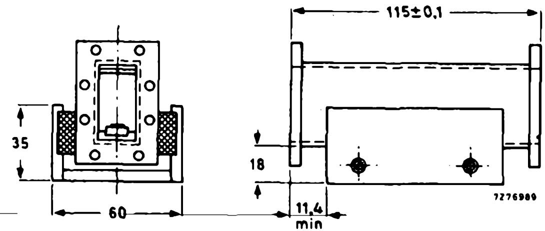
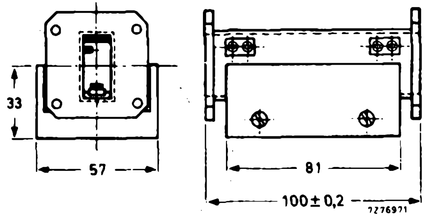
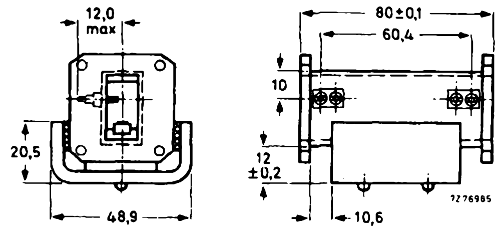


2722 161 01151



2722 161 01161



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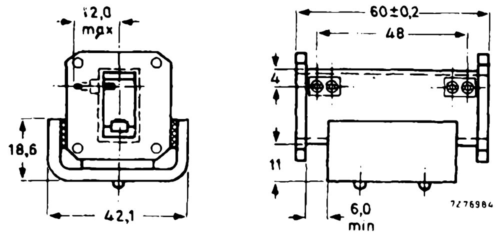

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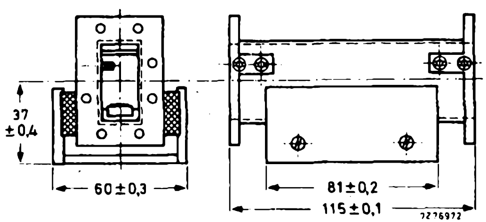

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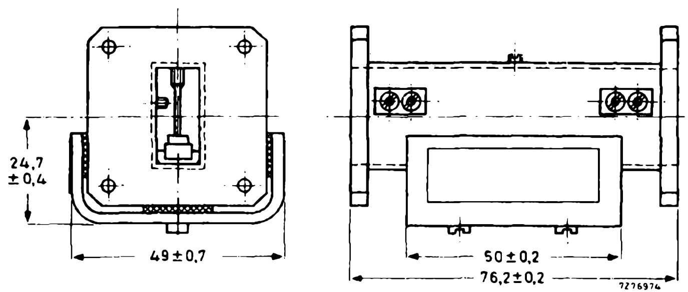

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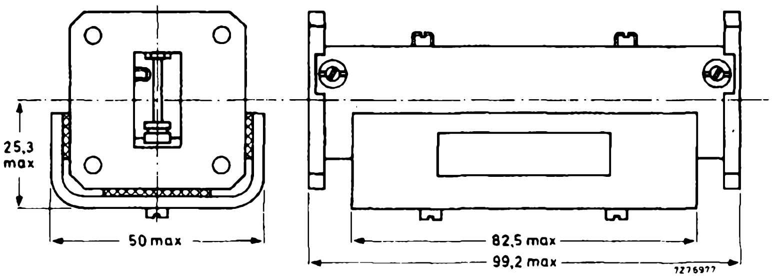

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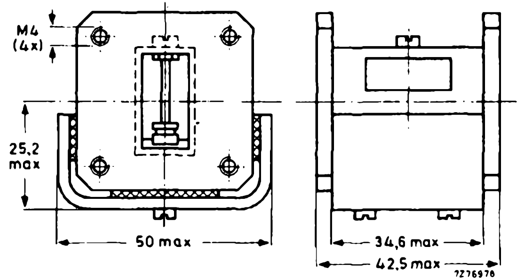

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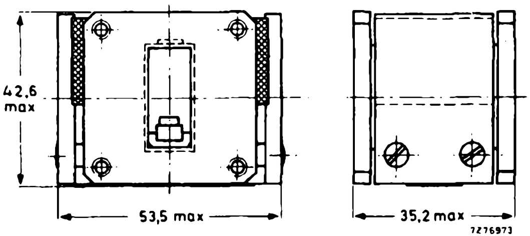

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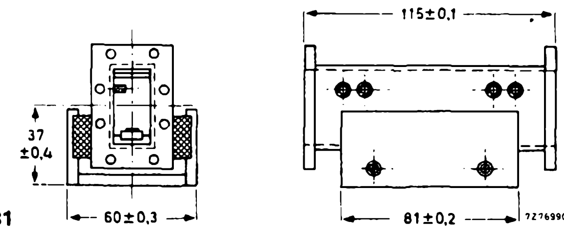

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Microwave semiconductors and components

June 1979

Mullard Limited
Mullard House, Torrington Place, London, WC1E 7HD

Printed in England
TP 1818