

**PHILIPS**

Data handbook



Electronic  
components  
and materials

# Electron tubes

Book T11

1986

Microwave diodes

and sub-assemblies

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

**IBRAPE**



**Miniwatt**

**signetics**

**Mullard**

**VALVO**

**PHILIPS**

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

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



## MICROWAVE DIODES AND SUB-ASSEMBLIES

|                                     | <i>page</i> |
|-------------------------------------|-------------|
| General .....                       | 1           |
| Gunn, Impatt and noise diodes ..... | 9           |
| Mixer and detector diodes .....     | 43          |
| Backward diode .....                | 113         |
| Multiplier varactor diodes .....    | 117         |
| Tuning varactor diodes .....        | 167         |
| Oscillators .....                   | 193         |
| Mixer and detector modules .....    | 201         |
| Doppler modules .....               | 209         |
| Circulators and isolators .....     | 239         |
| Miscellaneous .....                 | 313         |
| Package styles .....                | 333         |
| Index .....                         | 339         |



## DATA HANDBOOK SYSTEM

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

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

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

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

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

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

Information on current Data Handbooks and on how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.

Product specialists are at your service and enquiries will be answered promptly.

## ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks comprises:

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

Data collations on these subjects are available now.  
Data Handbooks will be published in 1985.

## SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

- S1     Diodes**  
Small-signal silicon diodes, voltage regulator diodes ( $< 1,5 \text{ W}$ ), voltage reference diodes, tuner diodes, rectifier diodes
- S2a    Power diodes**
- S2b    Thyristors and triacs**
- S3     Small-signal transistors**
- S4a    Low-frequency power transistors and hybrid modules**
- S4b    High-voltage and switching power transistors**
- S5     Field-effect transistors**
- S6     R.F. power transistors and modules**
- S7     Surface mounted semiconductors**
- S8     Devices for optoelectronics**  
Photosensitive diodes and transistors, light-emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices.
- S9     Power MOS transistors**
- S10    Wideband transistors and wideband hybrid IC modules**
- S11    Microwave transistors**
- S12    Surface acoustic wave devices**
- S13    Semiconductor sensors**



## INTEGRATED CIRCUITS (PURPLE SERIES)

The purple series of data handbooks comprises:

### EXISTING SERIES

Superseded by:

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

## NEW SERIES

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

### Note

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

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

## COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks comprises:

- C1 Programmable controller modules**  
PLC modules, PC20 modules
- C2 Television tuners, coaxial aerial input assemblies, surface acoustic wave filters**
- C3 Loudspeakers**
- C4 Ferroxcube potcores, square cores and cross cores**
- C5 Ferroxcube for power, audio/video and accelerators**
- C6 Synchronous motors and gearboxes**
- C7 Variable capacitors**
- C8 Variable mains transformers**
- C9 Piezoelectric quartz devices**
- C10 Connectors**
- C11 Varistors, thermistors and sensors**
- C12 Potentiometers, encoders and switches**
- C13 Fixed resistors**
- C14 Electrolytic and solid capacitors**
- C15 Ceramic capacitors**
- C16 Permanent magnet materials**
- C17 Stepping motors and associated electronics**
- C18 Direct current motors**
- C19 Piezoelectric ceramics**
- C20 Wire-wound components for TVs and monitors**
- C21\* Assemblies for industrial use**  
HNIL FZ/30 series, NORbits 60-, 61-, 90-series, input devices
- C22 Film capacitors**

\* To be issued shortly.

# GENERAL



## MICROWAVE SEMICONDUCTORS

### GENERAL EXPLANATORY NOTES

#### TYPE NOMENCLATURE

Microwave semiconductor devices are registered with Pro-Electron.

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

The first letter indicates the semiconductor material used:

- A — germanium
- B — silicon
- C — compound materials, such as gallium arsenide

The second letter indicates the general function of the device:

- A — detection diode, mixer diode
- E — backward diode
- F — r.f. transistor
- L — power r.f. transistor
- X — multiplier diode such as varactor or step recovery diode

The third letter forms part of the serial number.

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

#### Subscripts for quantity symbols

- A, a — anode terminal
- BR — breakdown
- F, f — forward
- I, i — input
- J, j — junction
- K, k — cathode
- O, o — open-circuit, output
- R, r — resistive, reverse, repetitive
- S, s — series, source
- Z, z — impedance

## ELECTRICAL PARAMETERS

|                   | Device               | Associated circuit |
|-------------------|----------------------|--------------------|
| Resistance        | $r$                  | R                  |
| Reactance         | $x$                  | X                  |
| Impedance         | $z$                  | Z                  |
| Admittance        | $y$                  | Y                  |
| Conductance       | $g$                  | G                  |
| Susceptance       | $b$                  | B                  |
| Mutual inductance | $m$                  | M                  |
| Inductance        | $l$                  | L                  |
| Capacitance       | $c$                  | C                  |
| Frequency limits  | $f$ max.<br>$f$ min. |                    |
| Bandwidth         | $\Delta f$           | B                  |
| Noise factor      |                      | N                  |

## Symbols for microwave semiconductor devices

|           |                                           |
|-----------|-------------------------------------------|
| $\eta$    | 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                                        |





## RATING SYSTEMS

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

### DEFINITIONS OF TERMS USED

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

Note

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

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

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

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

Note

Limiting conditions may be either maxima or minima.

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

Note

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

### ABSOLUTE MAXIMUM RATING SYSTEM

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

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

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

### DESIGN MAXIMUM RATING SYSTEM

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

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

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

### DESIGN CENTRE RATING SYSTEM

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

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

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

# **GUNN, IMPATT AND NOISE DIODES**



## SILICON AVALANCHE NOISE DIODE

Epitaxial, silicon planar, broadband noise generator. This is a current controlled device operated at avalanche breakdown and is effective from less than 10 Hz to above J-band. Applications include built-in test equipment (BITE) for surveillance, tracking and weather radars, microwave links, direction finding, p.c.m. systems and noise modulators for electronic countermeasures.

It conforms to the environmental requirements of BS9300 where applicable and can be supplied to NATO stock No. 5691-99-038-3893.

### QUICK REFERENCE DATA

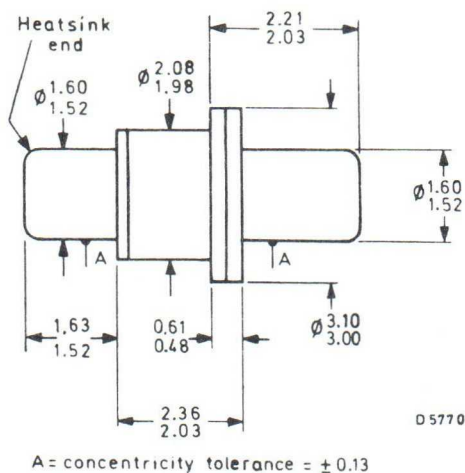
|                                              |      |               |     |
|----------------------------------------------|------|---------------|-----|
| Frequency range                              |      | <10 Hz to >18 | GHz |
| Avalanche voltage                            | min. | 17        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

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

### MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



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

## RATINGS

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

|                           |           |             |                    |
|---------------------------|-----------|-------------|--------------------|
| Storage temperature range | $T_{stg}$ | -55 to +150 | $^{\circ}\text{C}$ |
| Mounting base temperature | $T_{mb}$  | max. 80     | $^{\circ}\text{C}$ |
| Reverse current           | $I_R$     | max. 40     | mA                 |
| Total power dissipation   | $P_{tot}$ | max. 1.0    | W                  |

CHARACTERISTICS ( $T_{mb} = 25^{\circ}\text{C}$ )

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

## Notes

1.  $R_{slope}$  is the reverse slope resistance and  $\frac{R_1}{R_{40}}$  is the ratio of the reverse slope resistance at 1 mA and

40 mA, measured at 1 kHz. This ratio is included in the characteristics to eliminate spurious effects in the noise output/current characteristic.

The reverse slope resistance consists of the space charge resistance  $R_{sc}$ , the spreading resistance  $R_{sp}$  and the 'thermal resistance'  $R_{th}$ , i.e.

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

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

$R_{sp}$  is approximately  $1\ \Omega$

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

2. The location of the top cap should be a hole of diameter 1.8 to 2.2 mm, bearing on flange with a force not exceeding 10 N.
3. Other encapsulations may be made available on request.

## APPLICATION INFORMATION

The device, as characterised, is operated in a  $50\ \Omega$  characteristic impedance measurement system. When used as a noise source in an on-off mode, the device, when off, should appear to be  $50\ \Omega$ . 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  $50\ \Omega$ . For the broadest operating frequency range, an attenuator of approximately 14 dB with a v.s.w.r. of  $\leq 1.2:1$  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<br>dB | Noise temperature<br>$^{\circ}\text{K}$ | 1 Hz bandwidth<br>dBm | 1 MHz bandwidth<br>dBm |
|--------------------|-----------------------------------------|-----------------------|------------------------|
| +100               | $2.9 \times 10^{12}$                    | -74                   | -14                    |
| +90                | $2.9 \times 10^{11}$                    | -84                   | -24                    |
| +80                | $2.9 \times 10^{10}$                    | -94                   | -34                    |
| +70                | $2.9 \times 10^9$                       | -104                  | -44                    |
| +60                | $2.9 \times 10^8$                       | -114                  | -54                    |
| +50                | $2.9 \times 10^7$                       | -124                  | -64                    |
| +40                | $2.9 \times 10^6$                       | -134                  | -74                    |
| +30                | $2.9 \times 10^5$                       | -144                  | -84                    |
| +20                | $2.9 \times 10^4$                       | -154                  | -94                    |
| +10                | $2.9 \times 10^3$                       | -164                  | -104                   |
| 0                  | $2.9 \times 10^2$                       | -174                  | -114                   |

The device may be pulse operated with a rise time of  $\ll 0.5\ \mu\text{s}$

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  $1.6\ \text{k}\Omega$  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.



— Recommended bias  
range for broadband  
operation up to 12.4GHz

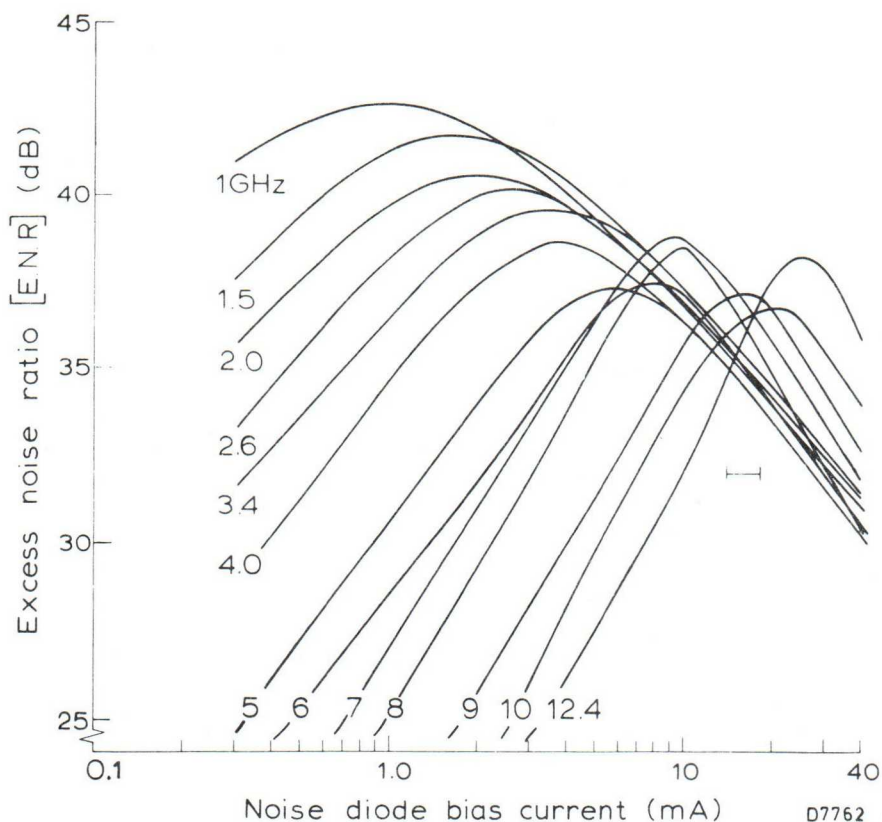
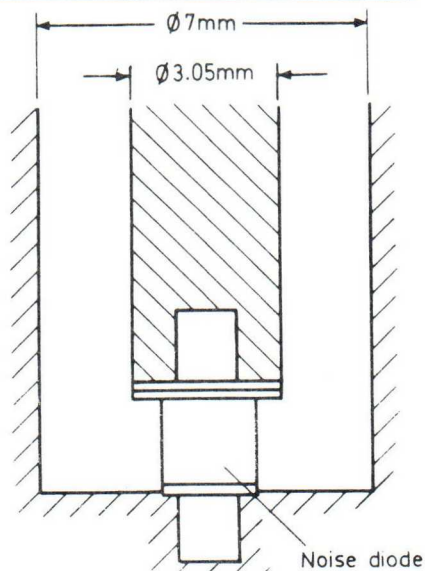


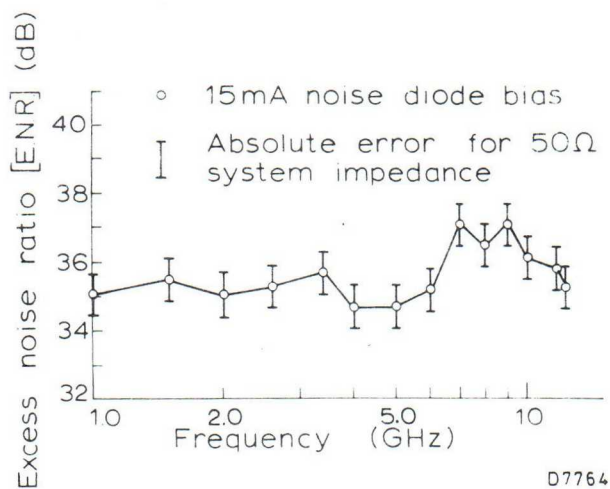
Fig.1

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



D7763

Fig.2

Device mounted in a  $50\ \Omega$  7 mm coaxial line

D7764

Fig.3

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

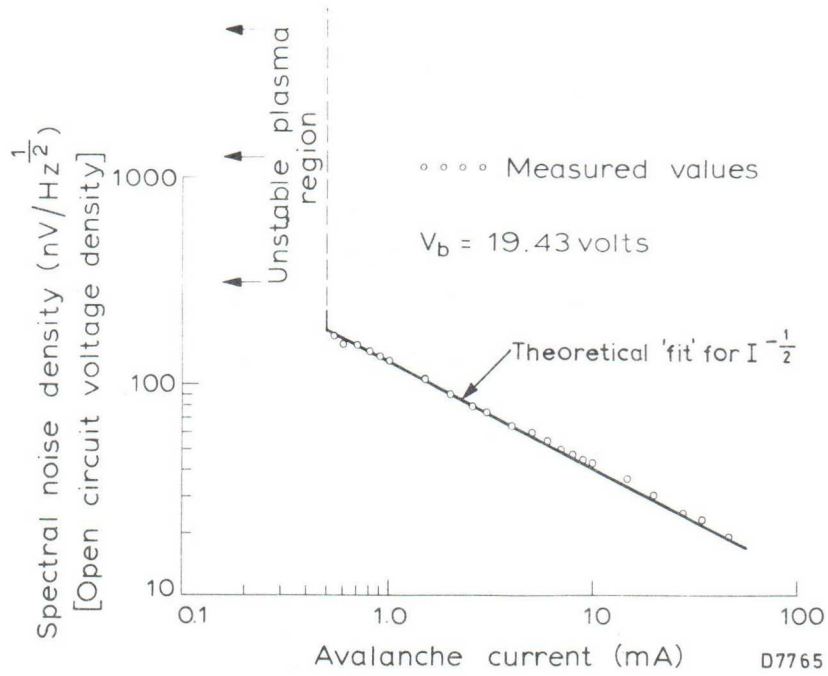


Fig.4

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

# SILICON IMPATT DIODE

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

## QUICK REFERENCE DATA

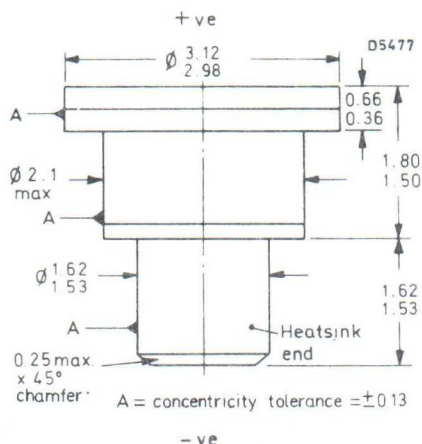
|                                             |           |           |     |
|---------------------------------------------|-----------|-----------|-----|
| Operating frequency                         | f         | 8.0 to 10 | GHz |
| Output power, $T_{hs} = 35^{\circ}\text{C}$ | $P_{out}$ | typ. 600  | mW  |
| Operating current                           |           | typ. 135  | mA  |
| Operating voltage                           |           | typ. 91   | V   |

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

## MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



Devices may be selected to suit customers' specific requirements

# RATINGS

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

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

# THERMAL RESISTANCE

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

# CHARACTERISTICS ( $T_{hs} = 25\text{ °C}$ )

|                                                    |             | min. | typ. | max. |    |
|----------------------------------------------------|-------------|------|------|------|----|
| Reverse breakdown voltage<br>$I_R = 1.0\text{ mA}$ | $V_{(BR)R}$ | 65   | 75   | 85   | V  |
| Reverse current<br>$V_R = 50\text{ V}$             | $I_R$       | —    | —    | 10   | μA |
| Total capacitance<br>$V_{(BR)R} = -5\text{ V}$     | $C_T$       | —    | 0.9  | —    | pF |

# TYPICAL OSCILLATOR PERFORMANCE

|                                    |           |     |     |    |     |
|------------------------------------|-----------|-----|-----|----|-----|
| Operating current (note 2)         |           | —   | 135 | —  | mA  |
| Operating voltage                  |           | —   | 91  | —  | V   |
| Frequency (note 3)                 | $f$       | 8.0 | —   | 10 | GHz |
| Output power (notes 2, 4, 5 and 6) | $P_{out}$ | 500 | 600 | —  | mW  |
| Efficiency                         | $\eta$    | —   | 5.0 | —  | %   |

# Notes

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

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

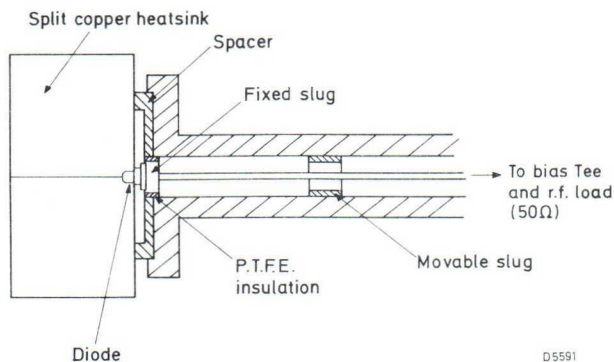
where  $P_{tot} = P_{in} - P_{out}$

$T_{hs}$  = 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 burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 115 V and 160 mA
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

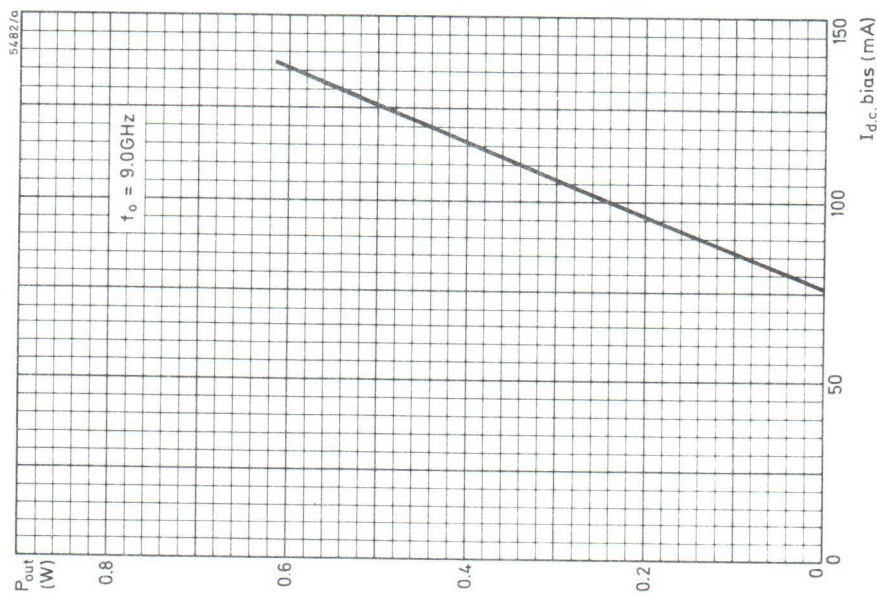
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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



D5591



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



Typical output power as a function of bias current



## SILICON IMPATT DIODE

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

### QUICK REFERENCE DATA

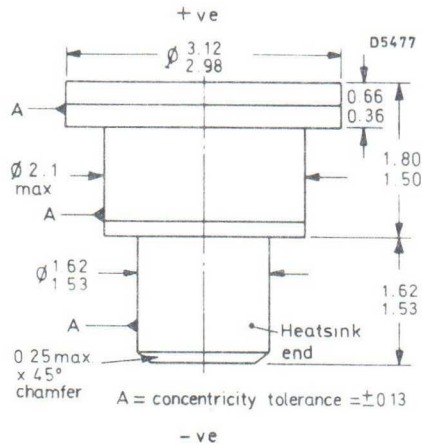
|                                             |           |          |     |
|---------------------------------------------|-----------|----------|-----|
| Operating frequency                         | f         | 10 to 12 | GHz |
| Output power, $T_{HS} = 35^{\circ}\text{C}$ | $P_{out}$ | typ. 450 | mW  |
| Operating current                           |           | typ. 120 | mA  |
| Operating voltage                           |           | typ. 80  | V   |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



Devices may be selected to suit customers' specific requirements.



# RATINGS

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

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

# THERMAL RESISTANCE

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

# CHARACTERISTICS ( $T_{hs} = 25\text{ °C}$ )

|                                                    |             | min. | typ. | max. |    |
|----------------------------------------------------|-------------|------|------|------|----|
| Reverse breakdown voltage<br>$I_R = 1.0\text{ mA}$ | $V_{(BR)R}$ | 55   | 65   | 75   | V  |
| Reverse current<br>$V_R = 45\text{ V}$             | $I_R$       | —    | —    | 10   | μA |
| Total capacitance<br>$V_{(BR)R} = -5\text{ V}$     | $C_T$       | —    | 0.85 | —    | pF |

# TYPICAL OSCILLATOR PERFORMANCE

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

# Notes

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

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

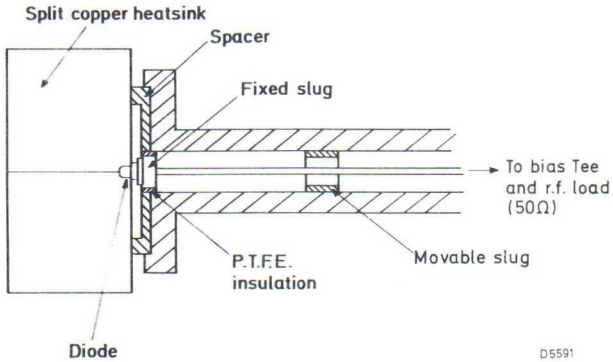
where  $P_{tot} = P_{in} - P_{out}$

$T_{hs}$  = 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 burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 105 V and 170 mA
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

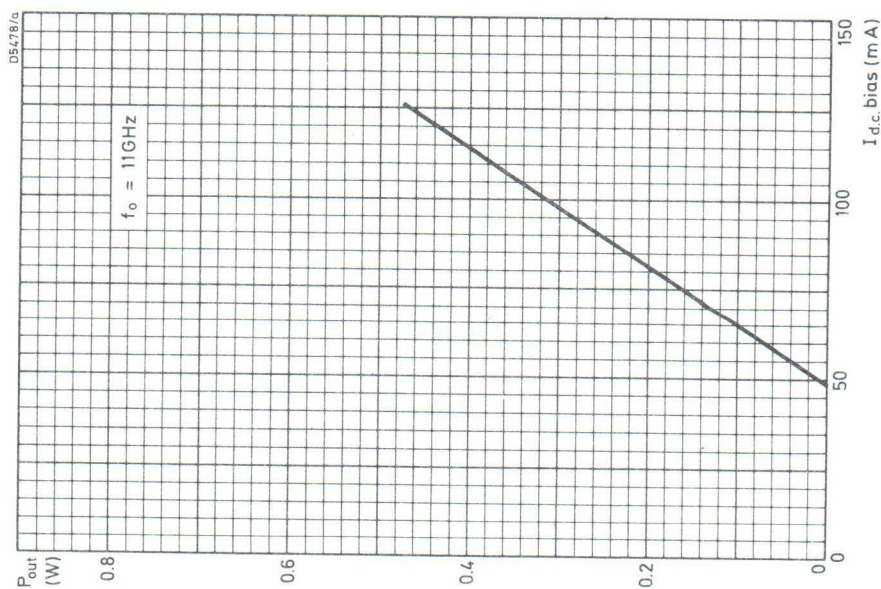
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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



Coaxial test oscillator cavity



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



Typical output power as a function of bias current

## SILICON IMPATT DIODE

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

### QUICK REFERENCE DATA

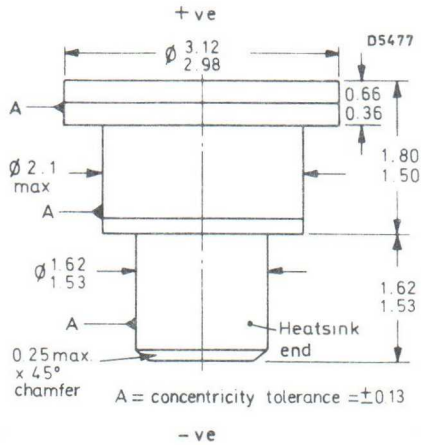
|                                             |           |          |     |
|---------------------------------------------|-----------|----------|-----|
| Operating frequency                         | f         | 12 to 14 | GHz |
| Output power, $T_{hs} = 35^{\circ}\text{C}$ | $P_{out}$ | typ. 370 | mW  |
| Operating current                           |           | typ. 120 | mA  |
| Operating voltage                           |           | typ. 70  | V   |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



Devices may be selected to suit customers' specific requirements.

# RATINGS

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

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

# THERMAL RESISTANCE

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

# CHARACTERISTICS ( $T_{hs} = 25\text{ °C}$ )

|                                                    |             | min. | typ. | max. |    |
|----------------------------------------------------|-------------|------|------|------|----|
| Reverse breakdown voltage<br>$I_R = 1.0\text{ mA}$ | $V_{(BR)R}$ | 50   | 55   | 60   | V  |
| Reverse current<br>$V_R = 40\text{ V}$             | $I_R$       | —    | —    | 10   | μA |
| Total capacitance<br>$V_{(BR)R} = -5\text{ V}$     | $C_T$       | —    | 0.75 | —    | pF |

# TYPICAL OSCILLATOR PERFORMANCE

|                                    |           |     |     |    |     |
|------------------------------------|-----------|-----|-----|----|-----|
| Operating current (note 2)         |           | —   | 120 | —  | mA  |
| Operating voltage                  |           | —   | 70  | —  | V   |
| Frequency (note 3)                 | $f$       | 12  | —   | 14 | GHz |
| Output power (notes 2, 4, 5 and 6) | $P_{out}$ | 300 | 370 | —  | mW  |
| Efficiency                         | $\eta$    | —   | 4.5 | —  | %   |

# Notes

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

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

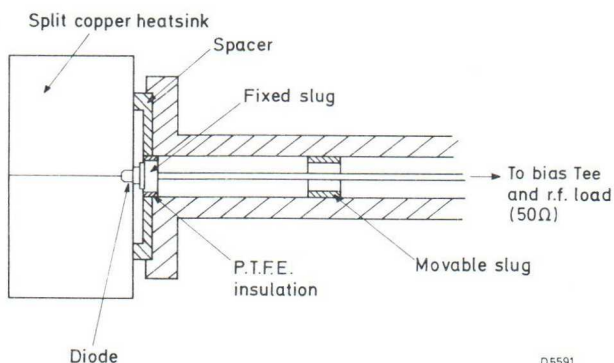
where  $P_{tot} = P_{in} - P_{out}$

$T_{hs}$  = 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 burn-out. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 90 V and 150 mA
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

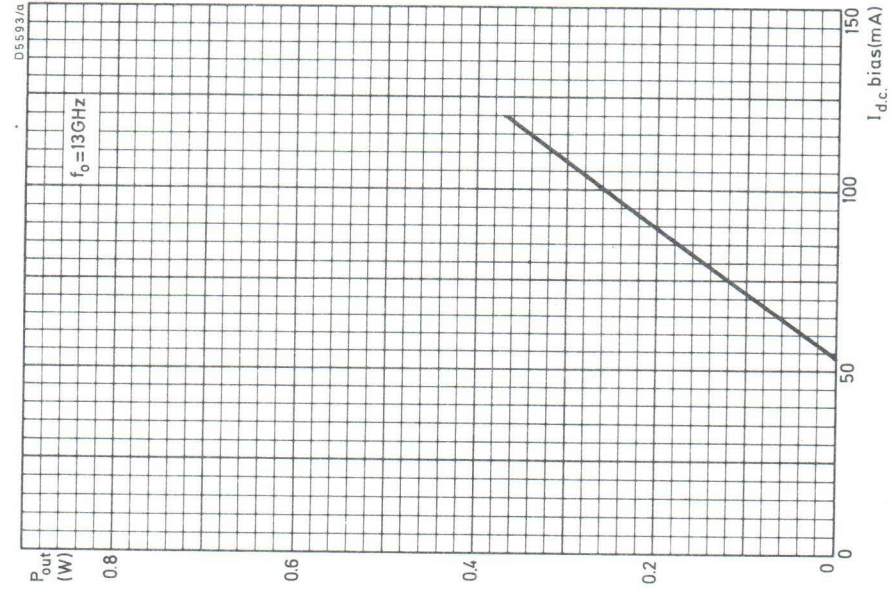
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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



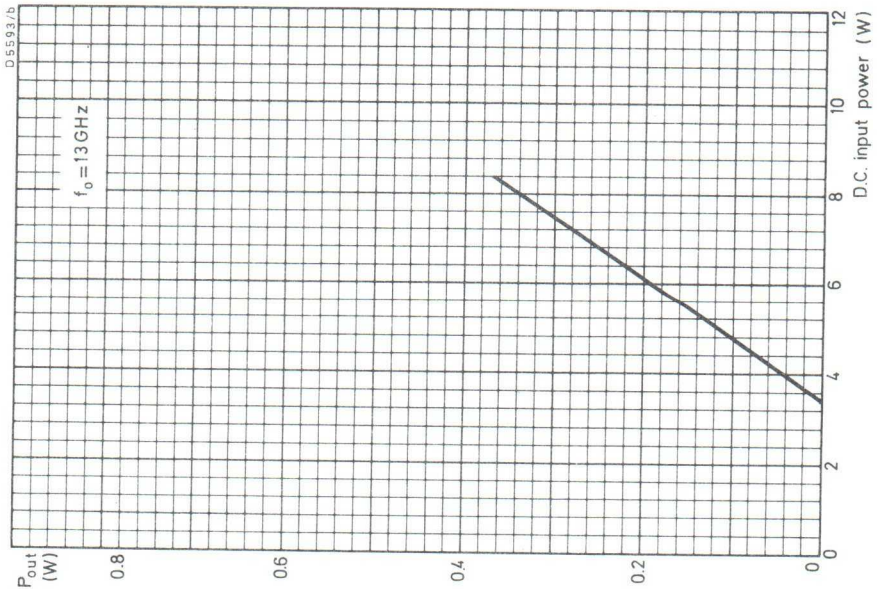
D5591

Coaxial test oscillator cavity





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



Typical output power as a function of bias current

# SILICON IMPATT DIODE

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

## QUICK REFERENCE DATA

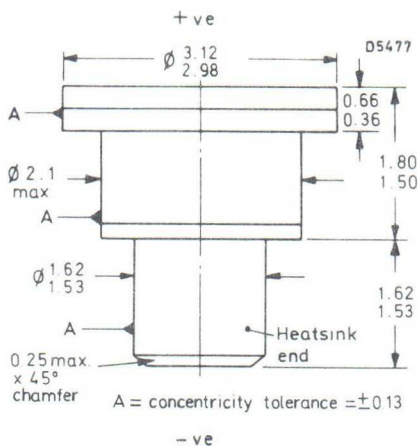
|                                             |           |            |     |
|---------------------------------------------|-----------|------------|-----|
| Operating frequency                         |           | 6.0 to 8.0 | GHz |
| Output power, $T_{hs} = 35^{\circ}\text{C}$ | $P_{out}$ | typ. 750   | mW  |
| Operating current                           |           | typ. 125   | mA  |
| Operating voltage                           |           | typ. 120   | V   |

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

## MECHANICAL DATA

Dimensions in mm

Conforms to SOD-45



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



# RATINGS

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

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

# THERMAL RESISTANCE

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

# CHARACTERISTICS ( $T_{hs} = 25\text{ }^{\circ}\text{C}$ )

|                                                    |             |         |          |          |    |
|----------------------------------------------------|-------------|---------|----------|----------|----|
| Reverse breakdown voltage<br>$I_R = 1.0\text{ mA}$ | $V_{(BR)R}$ | min. 85 | typ. 100 | max. 115 | V  |
| Reverse current<br>$V_R = 70\text{ V}$             | $I_R$       | —       | —        | 10       | μA |
| Total capacitance<br>$V_{(BR)R} = 75\text{ V}$     | $C_T$       | —       | 0.97     | —        | pF |

# TYPICAL OSCILLATOR PERFORMANCE

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

# Notes

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

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

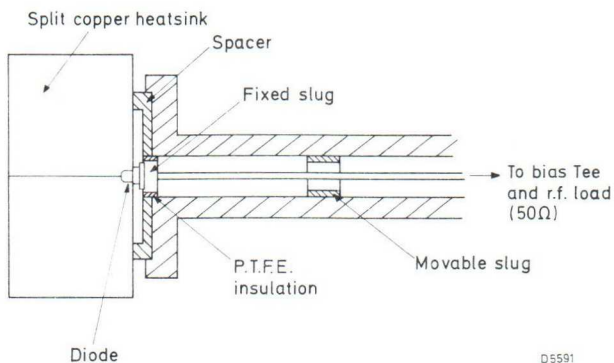
$$\text{where } P_{tot} = P_{in} - P_{out}$$

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

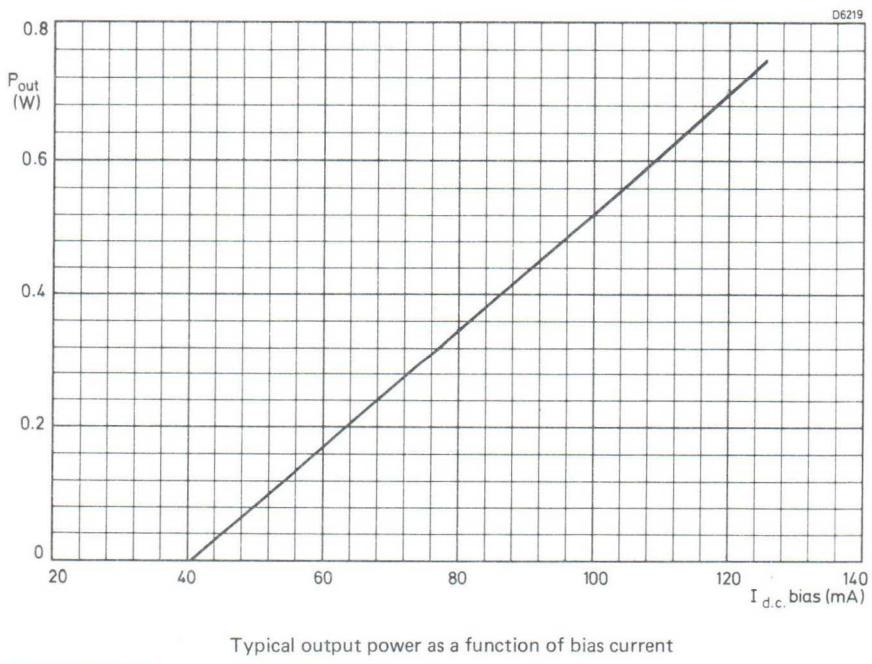
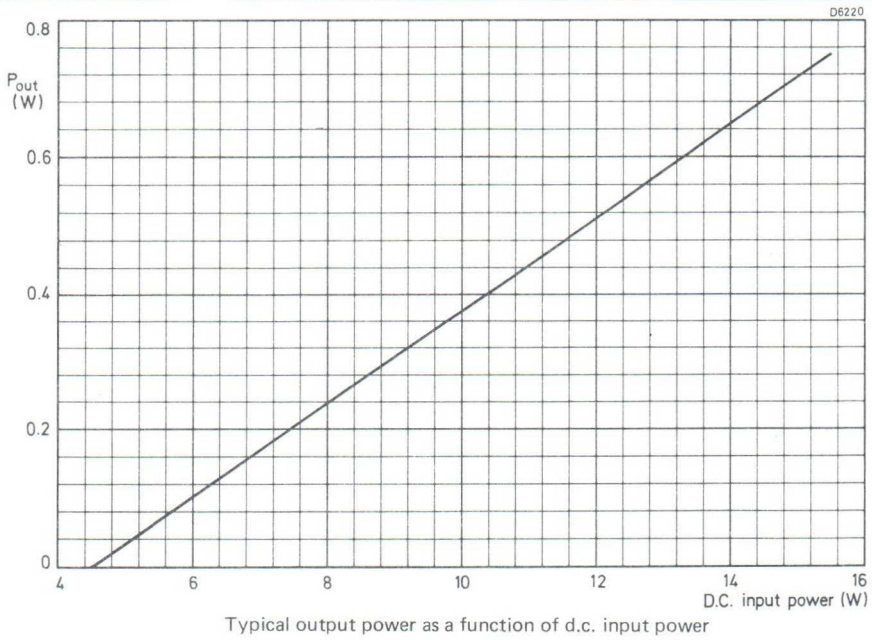
$R_{th\ j-hs}$  = thermal resistance from junction to heatsink in which device is clamped.

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

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



Coaxial test oscillator cavity



## GUNN EFFECT DEVICES

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

### QUICK REFERENCE DATA

|                                                        |           |           |        |
|--------------------------------------------------------|-----------|-----------|--------|
| Operating frequency range                              | f         | 8.0 to 12 | GHz    |
| Operating voltage                                      | V         | typ.      | 7.0 V  |
| Total power dissipation, $T_{mb} = 70^{\circ}\text{C}$ | $P_{tot}$ | max.      | 1.0 W  |
| Output power                                           | $P_{out}$ | typ.      | 8.0 mW |
|                                                        |           |           | 12 mW  |
|                                                        |           |           | 20 mW  |

CXY11A  
CXY11B  
CXY11C

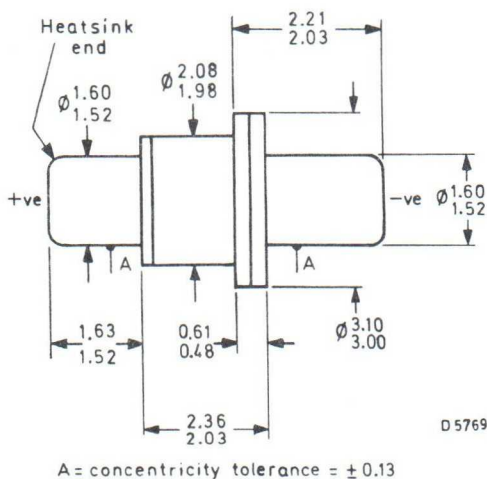
Unless otherwise stated, data is applicable to all types.

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

### MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



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

## RATINGS

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

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

## CHARACTERISTICS ( $T_{amb} = 25$ °C)

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

## Notes

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

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





# RATINGS

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

|                                                  |           |             |    |
|--------------------------------------------------|-----------|-------------|----|
| Storage temperature range                        | $T_{stg}$ | —55 to +150 | °C |
| Mounting base temperature range                  | $T_{mb}$  | —40 to +70  | °C |
| Operating voltage                                | V         | max. 7.5    | V  |
| Operating voltage for less than 1 ms             | V         | max. 9.0    | V  |
| Total power dissipation, $T_{mb} = 70\text{ °C}$ | $P_{tot}$ | max. 1.0    | W  |

# CHARACTERISTICS ( $T_{amb} = 25\text{ °C}$ )

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

## → Notes

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

## GUNN EFFECT DEVICES

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

### QUICK REFERENCE DATA

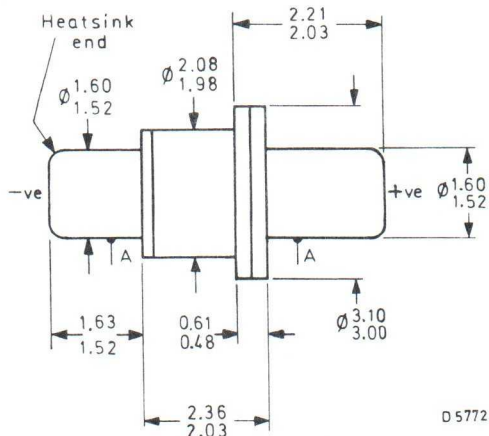
|                                                        |                  |           |        |
|--------------------------------------------------------|------------------|-----------|--------|
| Operating frequency range                              | f                | 8.0 to 12 | GHz    |
| Operating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

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

### MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-86 and to SOD-31



A = concentricity tolerance =  $\pm 0.13$

All dimensions in mm

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



## RATINGS

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

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

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

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

### → Notes

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

## GUNN EFFECT DEVICES

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

### QUICK REFERENCE DATA

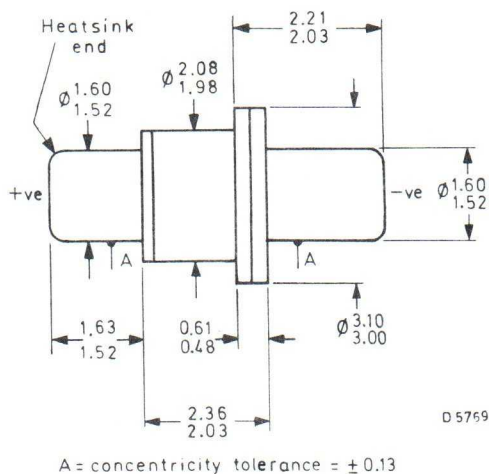
|                                                        |           |           |       |
|--------------------------------------------------------|-----------|-----------|-------|
| Operating frequency range                              | f         | 8.0 to 12 | GHz   |
| Operating voltage                                      | V         | typ.      | 8.0 V |
| Total power dissipation, $T_{mb} = 70^{\circ}\text{C}$ | $P_{tot}$ | max.      | 2.5 W |
| Output power, $f = 9.5\text{ GHz}$                     | $P_{out}$ | typ.      | 50 mW |
|                                                        | $P_{out}$ | typ.      | 35 mW |

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

### MECHANICAL DATA

Dimensions in mm ←

Conforms to BS3934 SO-86 and to SOD-31



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

# RATINGS

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

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

# CHARACTERISTICS ( $T_{amb} = 25\text{ °C}$ )

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

## → Notes

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

## GUNN EFFECT DEVICES

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

### QUICK REFERENCE DATA

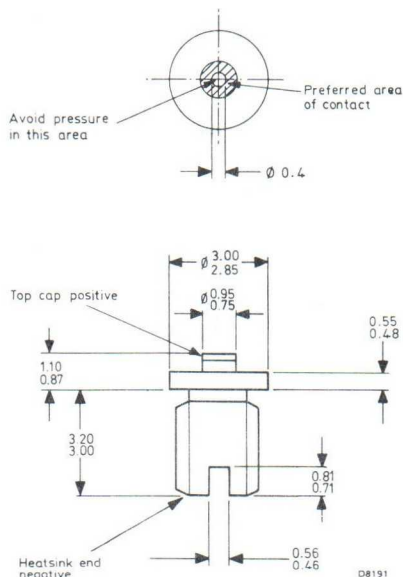
|                           |                  |      |          |     |
|---------------------------|------------------|------|----------|-----|
| Operating frequency range | f                |      | 28 to 40 | GHz |
| Operating voltage         | V                | typ. | 4.0      | V   |
| Operating current         | I                | typ. | 0.7      | A   |
| Output power, f = 34 GHz  | P <sub>out</sub> | typ. | 40       | mW  |
|                           |                  |      | 70       | mW  |

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

### MECHANICAL DATA

Conforms to MO-75

Dimensions in mm



Devices may be selected to suit customers' specific requirements.

# RATINGS

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

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

## → CHARACTERISTICS ( $T_{amb} = 25\text{ °C}$ )

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

## → Notes

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

# **MIXER AND DETECTOR DIODES**



## X-BAND MIXER/DETECTOR DIODE

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

## QUICK REFERENCE DATA

### Mixer mode

|                                                       |      |     |               |
|-------------------------------------------------------|------|-----|---------------|
| Voltage output for -90 dBm input power at X-band      | typ. | 40  | $\mu\text{V}$ |
| 1/f noise in the bandwidth 1 Hz to 1 kHz from carrier | typ. | 1.0 | $\mu\text{V}$ |

### Detector mode

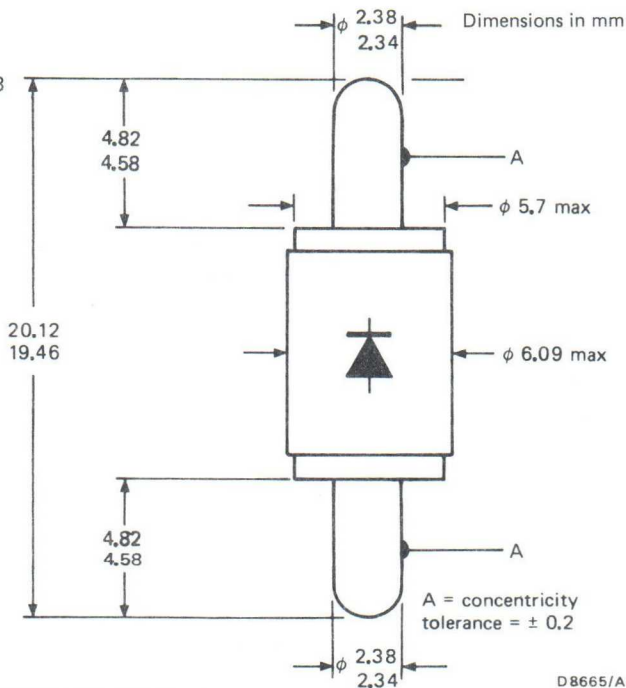
|                                                |      |     |     |
|------------------------------------------------|------|-----|-----|
| Tangential sensitivity in bandwidth 0 to 2 MHz | typ. | −55 | dBm |
|------------------------------------------------|------|-----|-----|

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

### MECHANICAL DATA

Conforms to SOD-48

Compatible with JEDEC DO-23



Terminal identification: diode symbol indicates polarity

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



**RATINGS**

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

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

**CHARACTERISTICS** ( $T_{\text{amb}} = 25\text{ °C}$ )

|                                           |       |          |               |
|-------------------------------------------|-------|----------|---------------|
| Forward voltage at $I_F = 1\text{ mA}$    | $V_F$ | typ. 0.5 | V             |
| Reverse current at $V_R = 2\text{ V}$     | $I_R$ | max. 2   | $\mu\text{A}$ |
| → Total capacitance at $V_R = 0\text{ V}$ | $C_T$ | typ. 0.3 | pF            |

**Mixer mode**

|                                          |       |          |               |
|------------------------------------------|-------|----------|---------------|
| Voltage output at X-band (notes 1 and 2) | $V_O$ | min. 15  | $\mu\text{V}$ |
|                                          | $V_O$ | typ. 40  | $\mu\text{V}$ |
| $1/f$ noise (note 3)                     | $N_f$ | typ. 1.0 | $\mu\text{V}$ |
|                                          | $N_f$ | max. 2.0 | $\mu\text{V}$ |

**Detector mode**

|                                 |                 |          |          |
|---------------------------------|-----------------|----------|----------|
| Tangential sensitivity (note 4) | $S_{\text{ts}}$ | min. −52 | dBm      |
|                                 | $S_{\text{ts}}$ | typ. −55 | dBm      |
| Video impedance (note 5)        | $Z_V$           | typ. 850 | $\Omega$ |

**Notes**

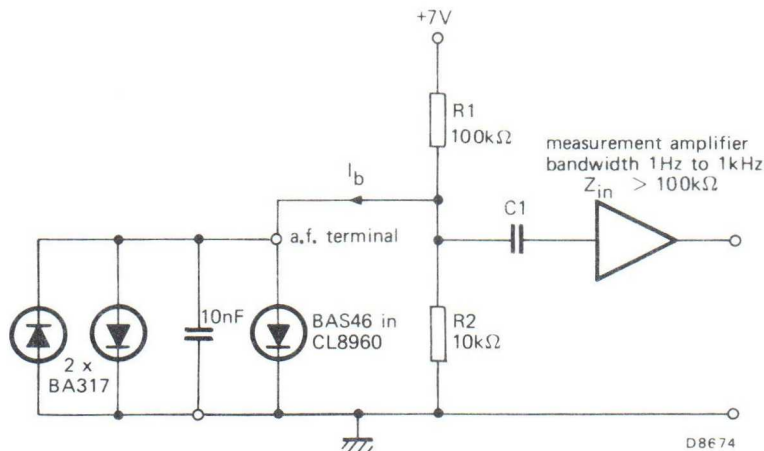
1. Mixer operated with d.c. bias of  $35\text{ }\mu\text{A}$  and r.f. bias of  $-18\text{ dBm}$ , giving a total bias of  $42\text{ }\mu\text{A}$ .
2. Measurement made using CL8960 doppler radar module, output power  $10\text{ mW}$  (typ.). The input power to the mixer of  $-90\text{ dBm}$  is a signal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

A return signal,  $100\text{ dB}$  down on radiated power, is equivalent to that achieved from a man target of radar cross-section  $1.0\text{ m}^2$  at a range of  $15\text{ m}$  when operating the CL8960 with a  $5\text{ dB}$  antenna.

3. Noise measured in the bandwidth  $1\text{ Hz}$  to  $1\text{ kHz}$  from carrier with a d.c. bias of  $50\text{ }\mu\text{A}$ .
4. Bandwidth  $0$  to  $2\text{ MHz}$  and a forward bias of  $50\text{ }\mu\text{A}$ .
5. Measured with a forward bias of  $50\text{ }\mu\text{A}$ .

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

## Measurement circuit:



- N.B. a) The current  $I_b$  should be approximately  $35 \mu\text{A}$  with the Gunn device disconnected and approximately  $42 \mu\text{A}$  with the Gunn device operational and the antenna operating into free space, using the mounting recommended in the CL8960 data.
- b) The coupling capacitor  $C_1$  should have a small impedance compared with  $Z_{in}$ . See measurement circuit above.

## OPERATING PRECAUTIONS

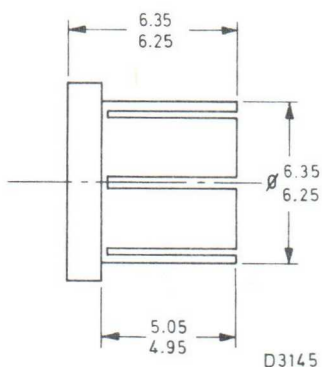
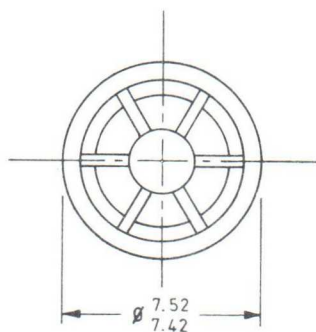
Care must be taken when making measurements that the precautions described in the operating notes are observed and that test equipment does not introduce transients.

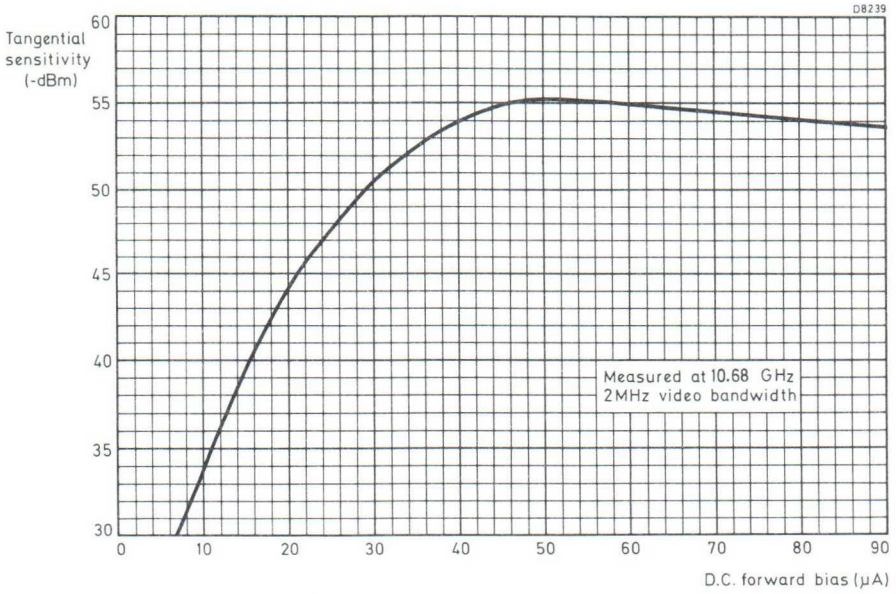
- The diode has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from the mains supply when making soldered connections to the diode.
- Precautions similar to those required for CMOS devices are necessary namely:
  - Earthed wrist straps should be worn.
  - Table tops or other working surfaces should be conductive and earthed.
  - Anti-static clothing should be worn.
  - 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.
- It is recommended that the user incorporates a diode protection circuit. A suitable circuit consists of two BA317 diodes connected in parallel but with one diode reversed, together with a parallel 10 nF capacitor. This circuit should be connected in close proximity to the diode terminals and has been found to afford a suitable degree of protection.
- A d.c. bias level of at least  $30 \mu\text{A}$  must be maintained to ensure adequate mixer performance.

BAS46

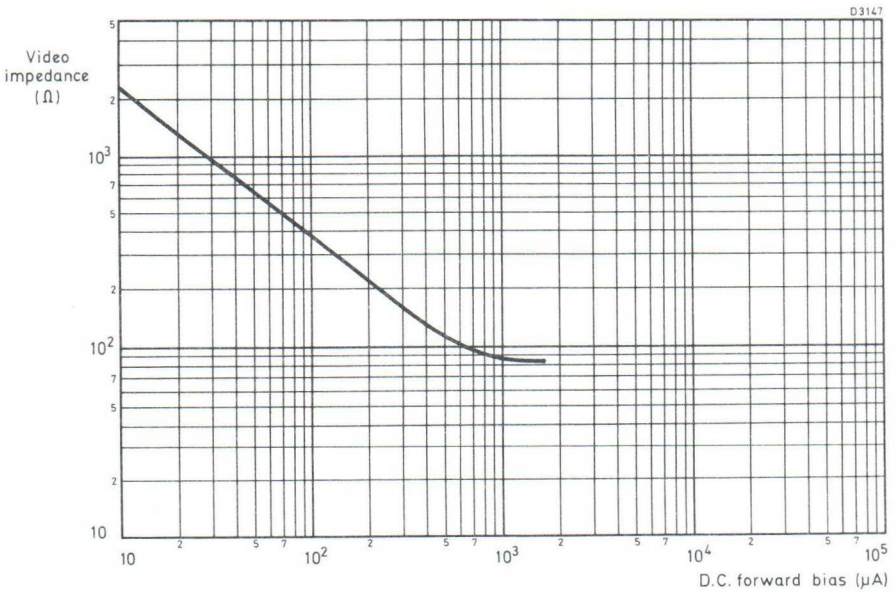
COLLET 56321

Dimensions in mm





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



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



## MICROWAVE MIXER/DETECTOR DIODE

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

## QUICK REFERENCE DATA

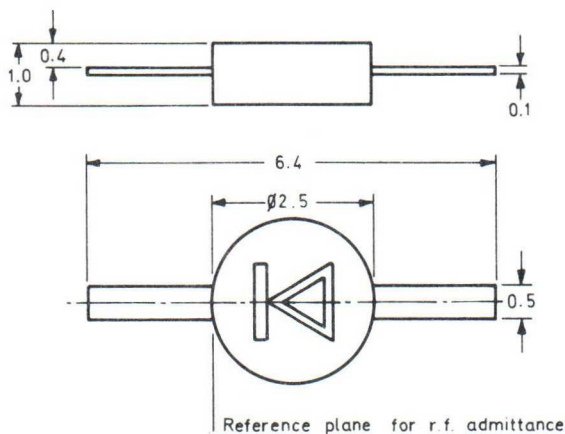
|                                                        |      |         |                  |
|--------------------------------------------------------|------|---------|------------------|
| Frequency range                                        |      | 1 to 12 | GHz              |
| Mixer:                                                 |      |         |                  |
| Noise figure in X-band                                 | typ. | 7.0     | dB               |
| Detector:                                              |      |         |                  |
| Tangential sensitivity in X-band with 100 $\mu$ A bias | typ. | -50     | dBm              |
| Current sensitivity in X-band with 50 $\mu$ A bias     | typ  | 5.0     | $\mu$ A/ $\mu$ W |

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

## MECHANICAL DATA

Dimensions in mm

Conforms to MO-28



D3108

## RATINGS

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

|                                                                     |      |             |           |
|---------------------------------------------------------------------|------|-------------|-----------|
| Storage temperature range                                           |      | -55 to +150 | °C        |
| Ambient temperature range                                           |      | -55 to +150 | °C        |
| Peak pulsed r.f. input power at 9.375 GHz, 0.5 $\mu$ s pulse length | max. | 1.0         | W         |
| Burn out (multiple r.f. spike, $\Delta N_O = 1$ dB)                 | max. | 20<br>0.2   | nJ<br>erg |

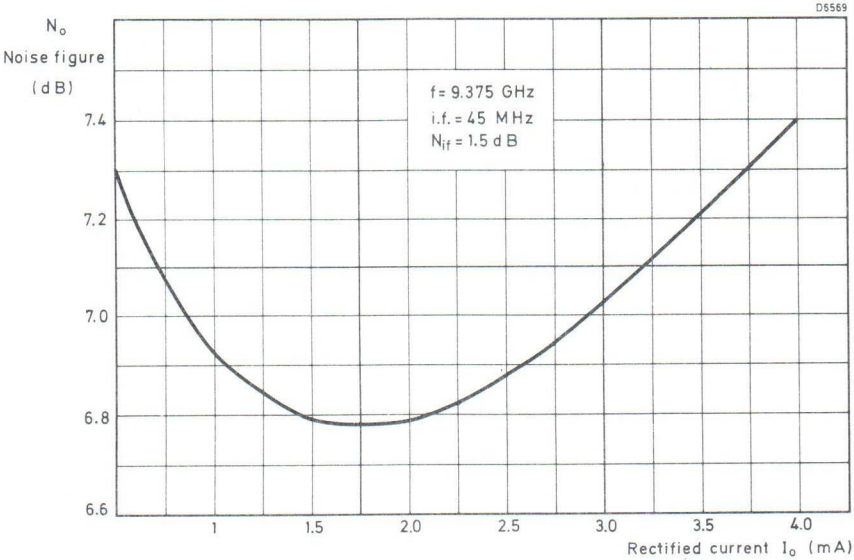
CHARACTERISTICS ( $T_{amb} = 25^\circ\text{C}$ )

| Mixer                                     |          | typ. | max. |                           |
|-------------------------------------------|----------|------|------|---------------------------|
| Noise figure (note 1)                     | $N_O$    | 7.0  | 7.5  | dB                        |
| Voltage standing wave ratio (note 2)      | v.s.w.r. | —    | 2:1  |                           |
| Intermediate frequency impedance (note 3) | $Z_{if}$ | —    | 500  | $\Omega$                  |
| Detector                                  |          |      |      |                           |
| Tangential sensitivity (note 4)           | $S_{ts}$ | -50  | —    | dBm                       |
| Current sensitivity (note 5)              | $S_i$    | 5.0  | —    | $\mu\text{A}/\mu\text{W}$ |
| Voltage standing wave ratio (note 6)      | v.s.w.r. | —    | 5:1  |                           |
| Video impedance (note 7)                  | $Z_v$    | 600  | —    | $\Omega$                  |
| Noise                                     | 1/f      | 12   | 17   | dB                        |

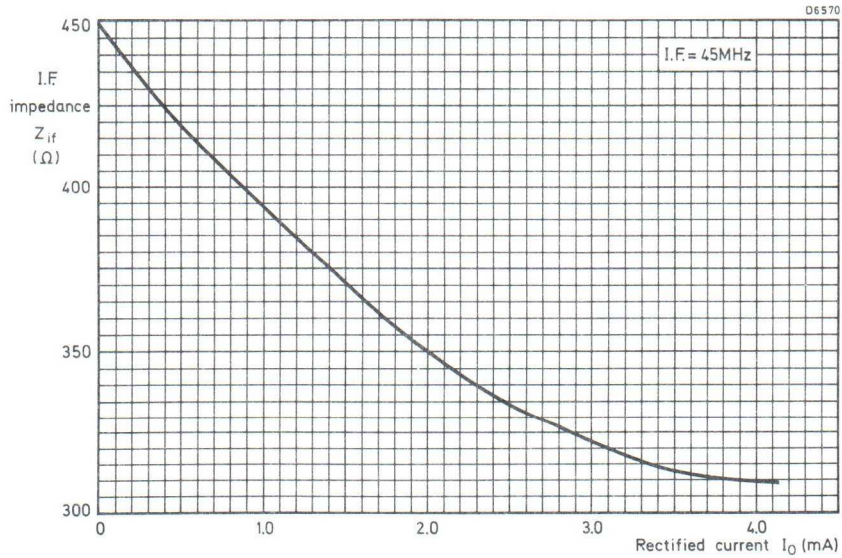
## Notes

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



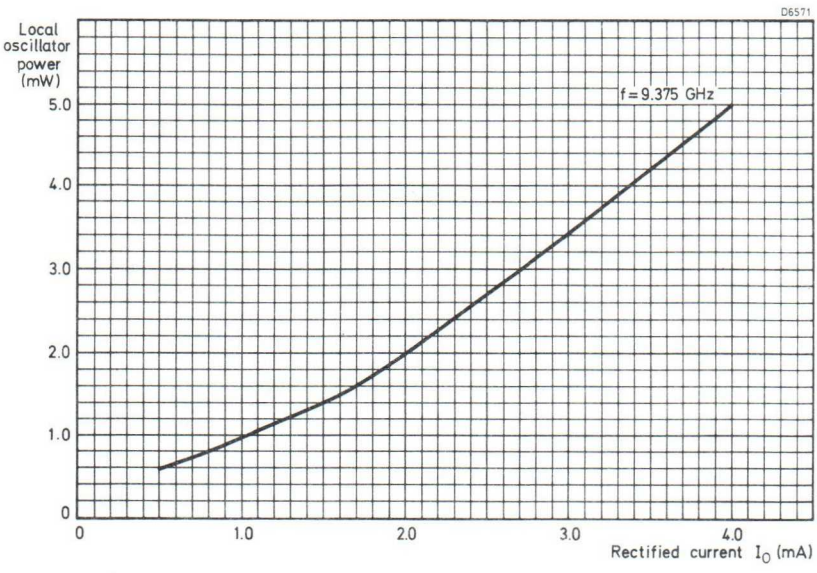


Typical noise figure as a function of rectified current (as a mixer)

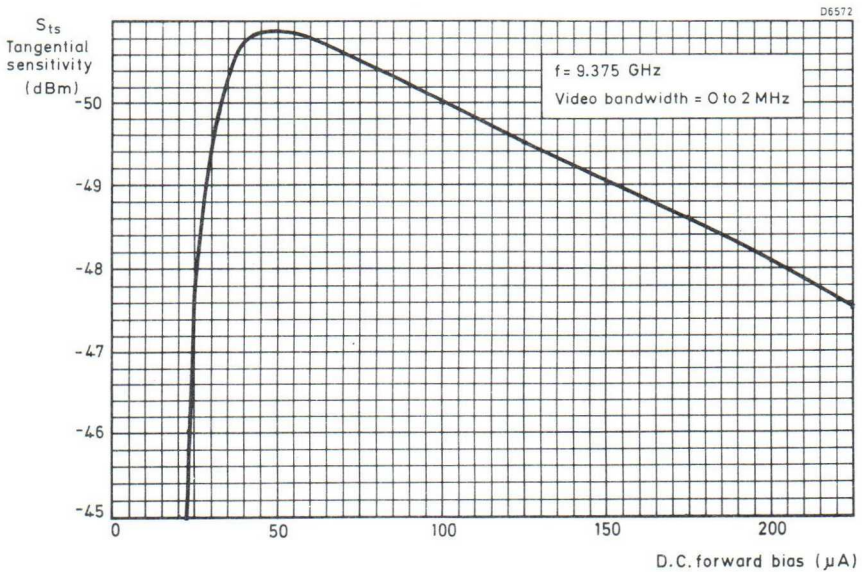


Typical i.f. impedance as a function of rectified current (as a mixer)

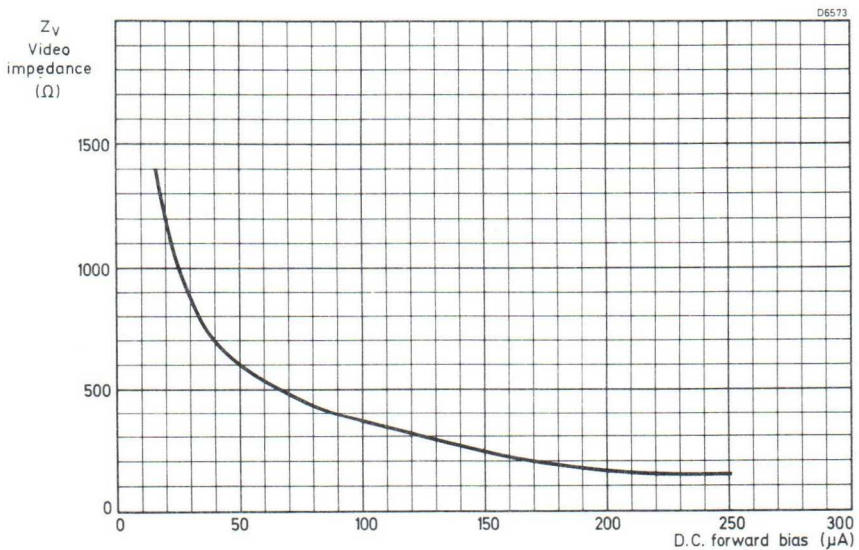




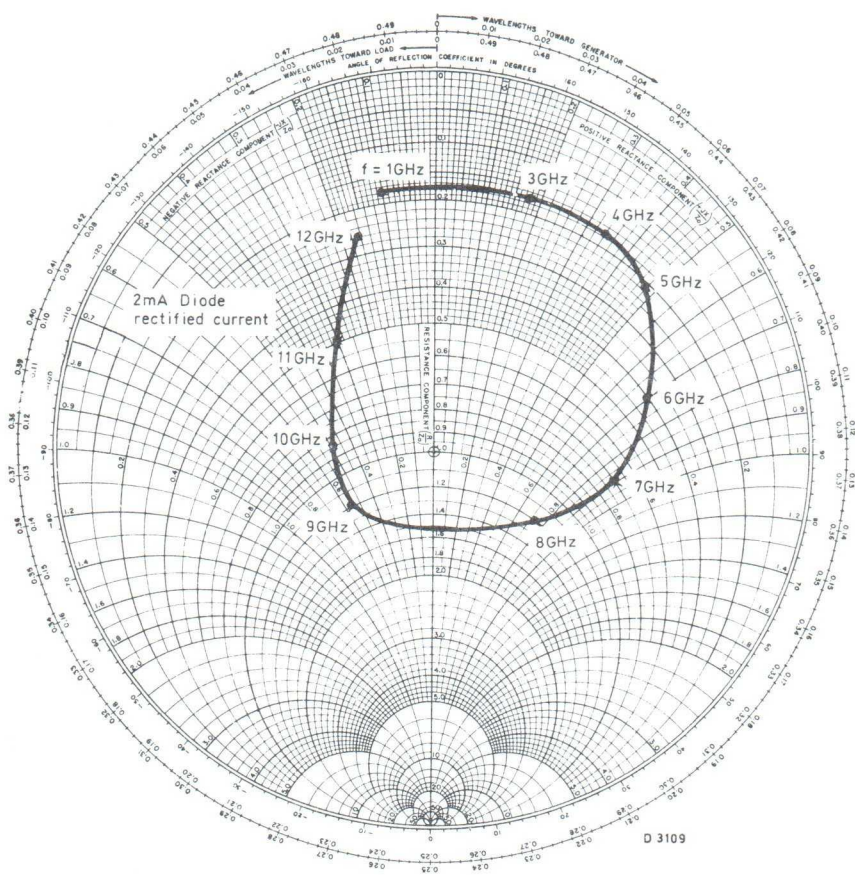
Typical local oscillator power as a function of rectified current (as a mixer)



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



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



Typical admittance as a function of frequency

## MICROWAVE MIXER DIODE

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

### QUICK REFERENCE DATA

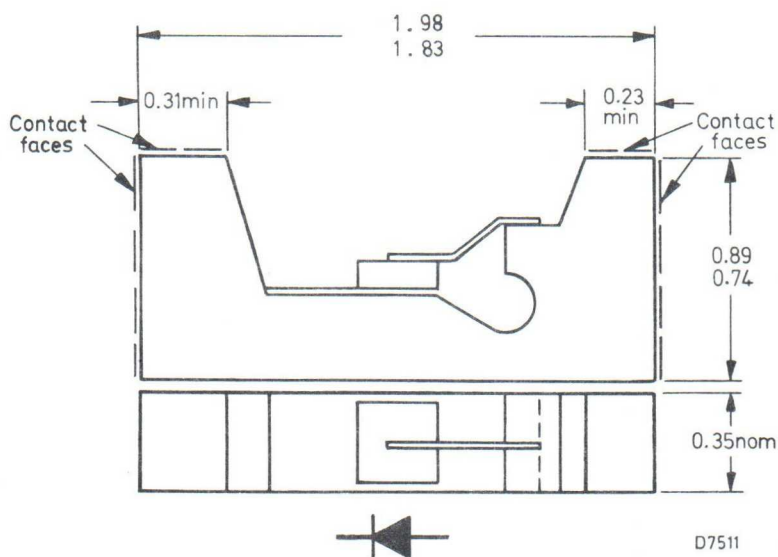
|                        |      |          |     |
|------------------------|------|----------|-----|
| Frequency range        |      | up to 12 | GHz |
| Noise figure in X-band | typ. | 6.5      | dB  |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to MO-27



Contact faces are gold plated, 5  $\mu\text{m}$  over 1.27  $\mu\text{m}$  of nickel.

## RATINGS

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

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

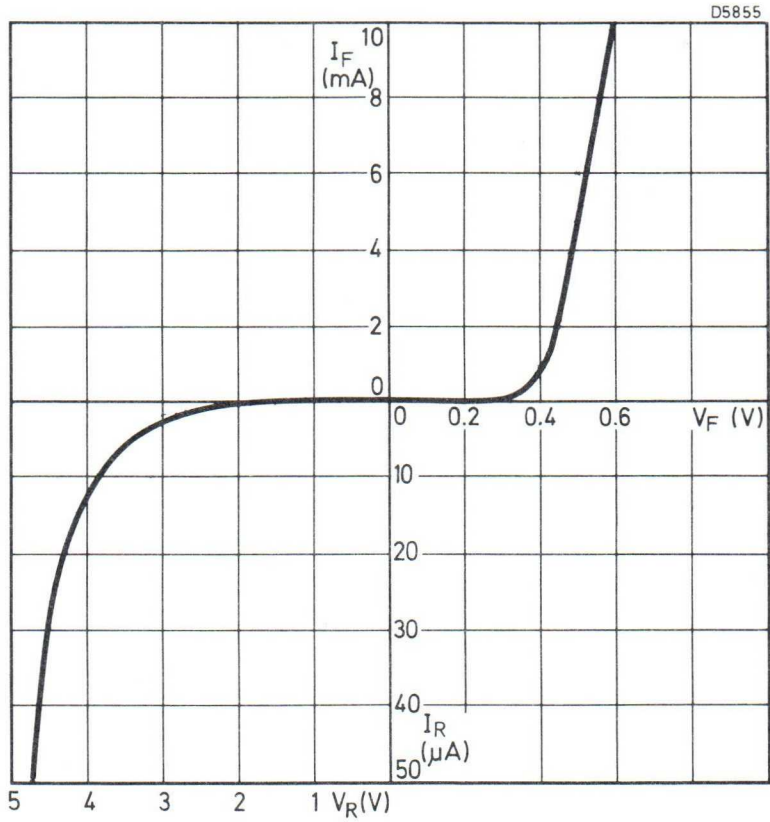
CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

|                                           |          | min. | typ. | max. |          |
|-------------------------------------------|----------|------|------|------|----------|
| <b>Dynamic</b>                            |          |      |      |      |          |
| Noise figure (note 1)                     | $N_O$    | —    | 6.5  | 7.0  | dB       |
| Voltage standing wave ratio               | v.s.w.r. | —    | —    | 2:1  |          |
| Intermediate frequency impedance (note 3) | $Z_{if}$ | 280  | 320  | 380  | $\Omega$ |
| Operating frequency range                 | f        | —    | —    | 12   | GHz      |

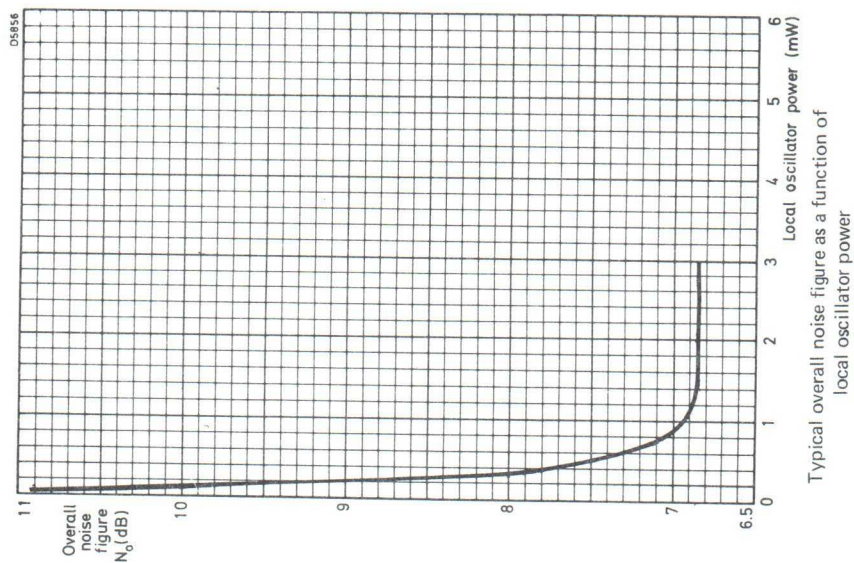
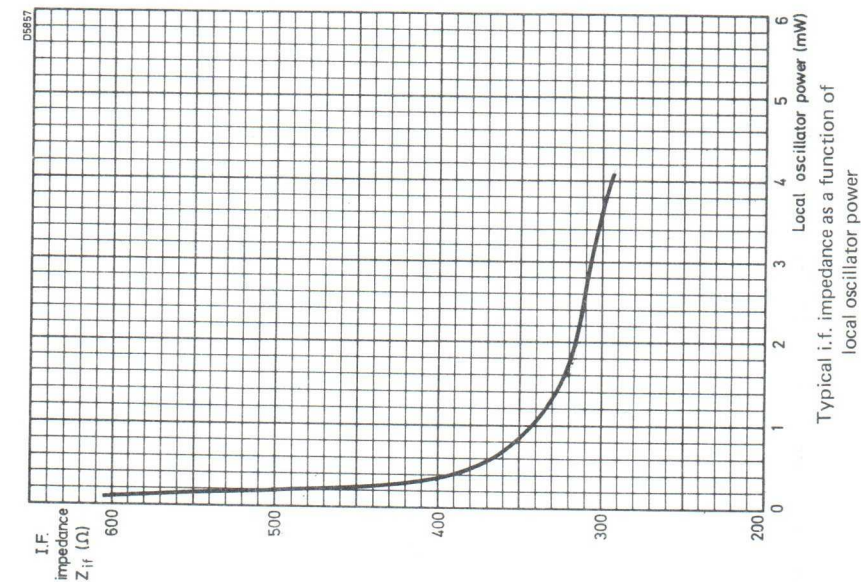
## Notes

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





Typical d.c. characteristic





## MICROWAVE MIXER DIODE

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

### QUICK REFERENCE DATA

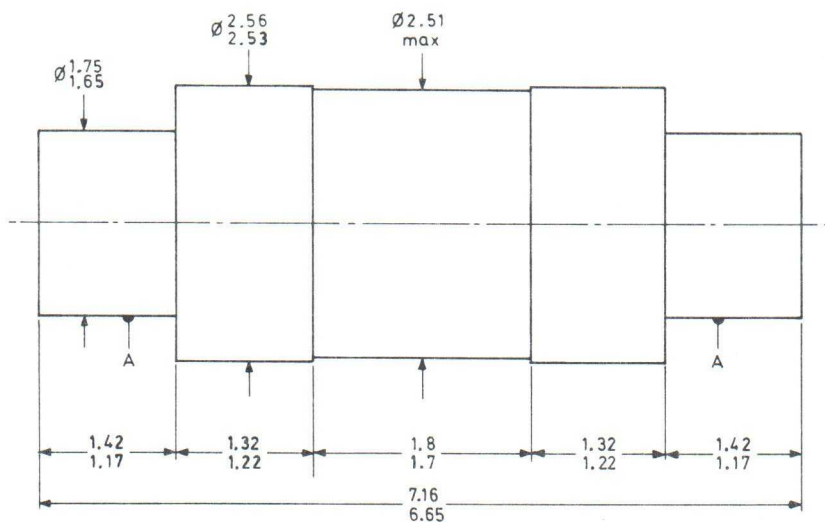
|                 |      |          |     |
|-----------------|------|----------|-----|
| Frequency range |      | 26 to 40 | GHz |
| Noise figure    | typ. | 8.5      | dB  |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to SOD-42



D2527 a

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 ( $t_p = 0.2 \mu s$ ) | 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 $T_{amb} = 25^\circ C$

|                                                                                                                                         |          |              |                    |                      |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------|--------------|--------------------|----------------------|
| Reverse current ( $V_R = 0.5 V$ )                                                                                                       | $I_R$    | max.         | 2.0                | $\mu A$              |
| Forward current ( $V_F = 0.5 V$ )                                                                                                       | $I_F$    | min.         | 2.0                | mA                   |
| Overall noise figure<br>f = 34.86 GHz, rectified current = 0.5 mA<br>$N_O$ includes $N_{if}$ of 1.5 dB. BS9300, method 1406             | $N_O$    | typ.<br>max. | 8.5<br>10          | dB<br>dB             |
| Conversion loss                                                                                                                         | $L_C$    | typ.         | 5.5                | dB                   |
| Noise temperature ratio<br>I.F. = 45 MHz                                                                                                | $N_r$    |              | 1.6:1              |                      |
| Voltage standing wave ratio*<br>f = 34.86 GHz, rectified current = 0.5 mA<br>$R_L = 15 \Omega$ . BS9300, method 1409                    | v.s.w.r. | typ.<br>max. | 1.4:1<br>2.0:1     |                      |
| Intermediate frequency impedance<br>f = 34.86 GHz, rectified current = 0.5 mA<br>$R_L = 15 \Omega$ , i.f. = 45 MHz. BS9300, method 1405 | $Z_{if}$ | typ.         | 900<br>700 to 1100 | $\Omega$<br>$\Omega$ |
| 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  $\pm 10\%$  on rectified current and within  $150 \Omega$  i.f. impedance.

\* Standard test holder.



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

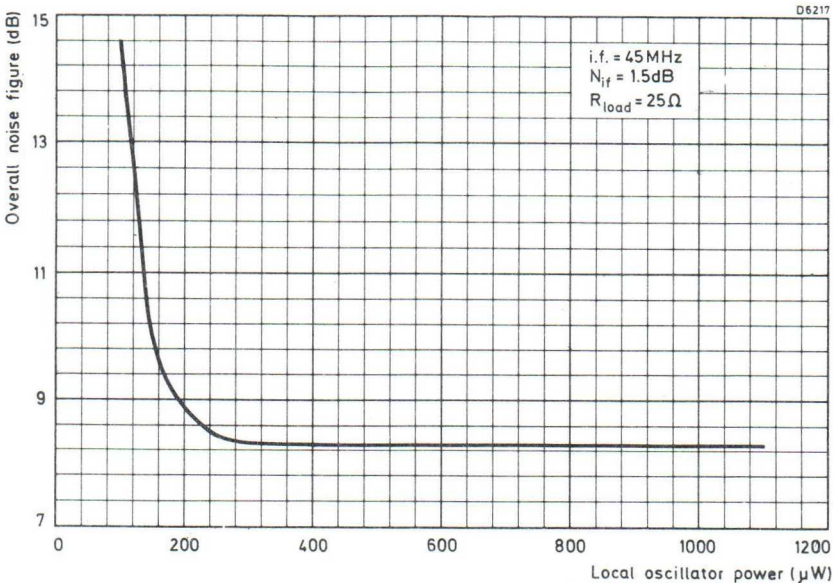


Fig.3 Typical overall noise figure as a function of local oscillator power at 34.86 GHz



## MICROWAVE MIXER DIODE

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

## QUICK REFERENCE DATA

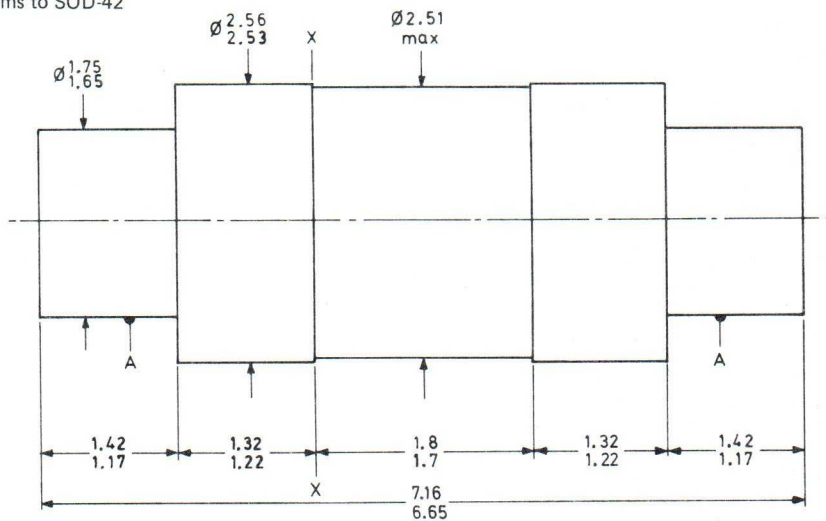
|                           |      |           |     |
|---------------------------|------|-----------|-----|
| Operating frequency range |      | 1.0 to 18 | GHz |
| Noise figure at X-band    | typ. | 6.0       | dB  |

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

## MECHANICAL DATA

Dimensions in mm

Conforms to SOD-42



XX = reference plane

All dimensions in mm

D2527a

AA = concentricity tolerance =  $\pm 0.15$

## Terminal identification:

The BAT39 is colour coded as follows:

That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.

The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

## RATINGS

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

## Temperature

|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +100 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +100 | °C |

Burn-out ( $f = 9.375$  GHz)

|                                                                   |      |      |     |
|-------------------------------------------------------------------|------|------|-----|
| Multiple d.c. spike                                               | max. | 0.1  | erg |
| Multiple r.f. spike (spike width at half peak power = $2 \mu s$ ) | max. | 0.05 | erg |
| Peak pulse power<br>$f = 9.375$ GHz, $t_p = 1.0 \mu s$            | max. | 0.5  | W   |

CHARACTERISTICS ( $T_{amb} = 25$  °C)

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

## OPERATING NOTE

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

## NOTE

Matched pairs of diodes are available to customer specifications.

## APPLICATION INFORMATION

Mixer performance at other than Test Radio Frequency

Measured overall noise figure

 $f = 16.5 \text{ GHz}$ ,  $N_{if} = 1.5 \text{ dB}$ , i.f. = 45 MHz $f = 3.0 \text{ GHz}$ ,  $N_{if} = 1.5 \text{ dB}$ , i.f. = 45 MHz $f = 9.5 \text{ GHz}$ , i.f. = 3.0 kHz

|       |      |     |    |
|-------|------|-----|----|
| $N_o$ | typ. | 7.0 | dB |
| $N_o$ | typ. | 5.5 | dB |
| $N_o$ | 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  $\mu\text{A}$  (BS9300/1411)

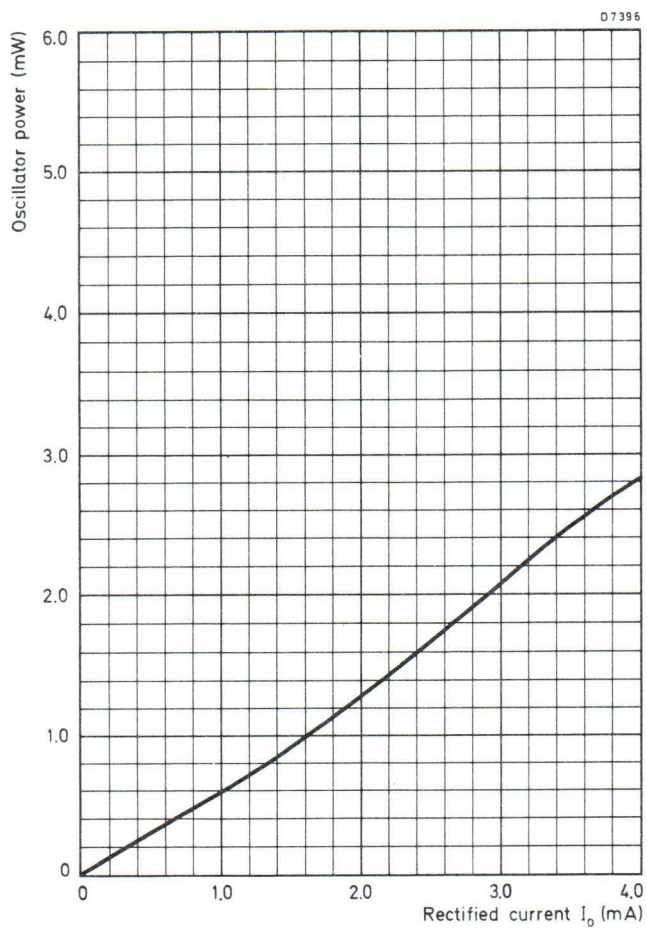
|          |      |     |     |
|----------|------|-----|-----|
| $S_{ts}$ | typ. | -52 | dBm |
|----------|------|-----|-----|

A.C. video impedance

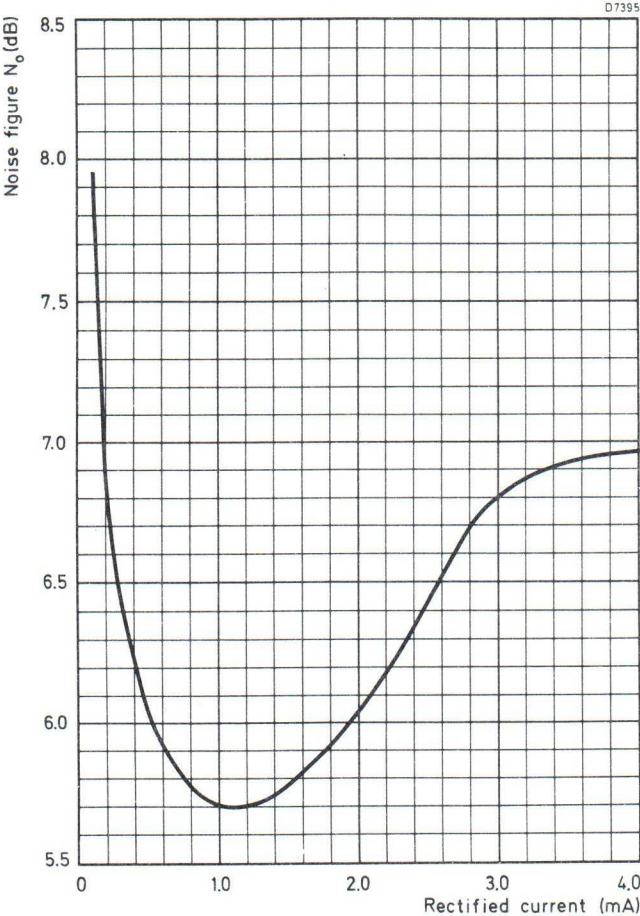
 $I_F$  (bias) = 50  $\mu\text{A}$  (BS9300/1403)

|       |      |     |          |
|-------|------|-----|----------|
| $Z_r$ | typ. | 800 | $\Omega$ |
|-------|------|-----|----------|

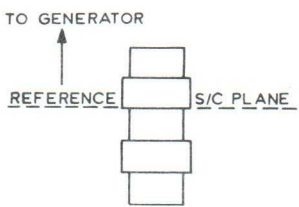
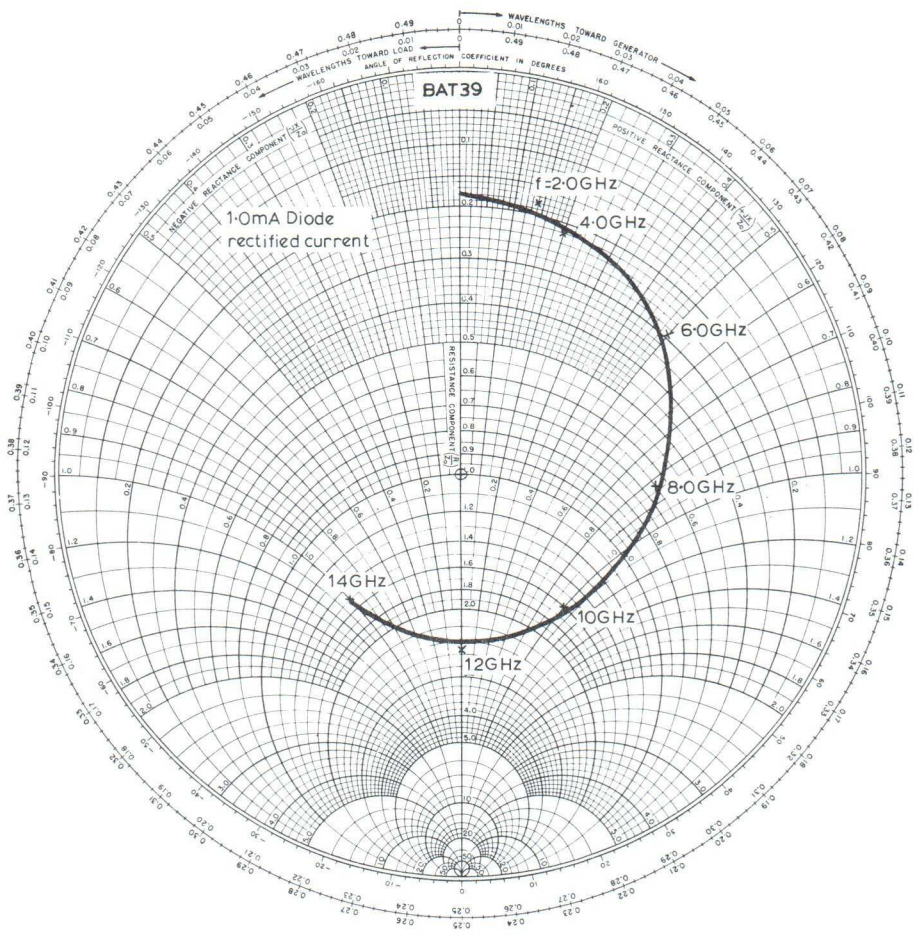




Typical rectified current as a function of local oscillator power



Typical noise figure as a function of rectified current



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

## MICROWAVE MIXER DIODES

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

## QUICK REFERENCE DATA

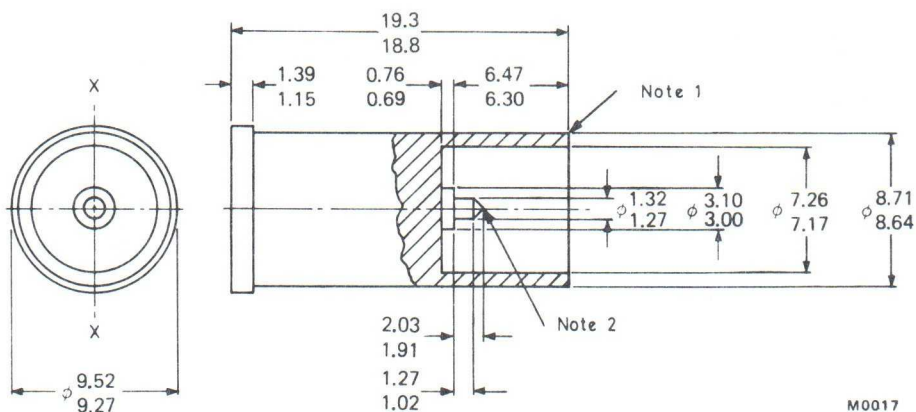
|                     |      |     |     |
|---------------------|------|-----|-----|
| Operating frequency | max. | 12  | GHz |
| Noise figure        | typ. | 6.2 | dB  |

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

## MECHANICAL DATA

Dimensions in mm

Conforms to MO-74



## Terminal identification

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

## ACCESSORIES

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

Note 1 The device is designed to make contact on this open face.

Note 2 Cone tapers to a radius of 0.13 mm nominal.

# RATINGS

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

## Temperature

|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +100 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +100 | °C |

## Burn-out

|                                        |      |     |     |
|----------------------------------------|------|-----|-----|
| R.F. spike                             | max. | 0.2 | erg |
| Peak pulse power ( $t_p = 0.5 \mu s$ ) | max. | 1.0 | W   |

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

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

## Notes

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

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

**OPERATING NOTE**

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

**APPLICATION INFORMATION**

Signal/Flicker noise ratio

$f = 9.5$  GHz. Measured at 2 kHz from carrier  
in 70 Hz bandwidth

typ. 131 dB

Detector performance

Tangential sensitivity,  $f = 9.375$  GHz,  
video bandwidth = 1.0 MHz,  $I_F$  (bias) = 50  $\mu$ A  
video impedance,  $I_F$  (bias) = 50  $\mu$ A

|       |      |     |          |
|-------|------|-----|----------|
| $S_t$ | typ. | -52 | dBm      |
| $Z_v$ | typ. | 800 | $\Omega$ |

**NOTE**

Matched pairs of diodes are available to customer specifications.





## MICROWAVE MIXER DIODES

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

### QUICK REFERENCE DATA

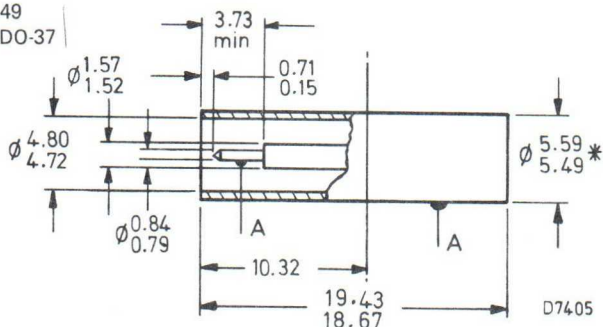
|                 |      |          |     |
|-----------------|------|----------|-----|
| Frequency range |      | 12 to 18 | GHz |
| Noise figure    | typ. | 7.0      | dB  |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to SOD-49  
Similar to JEDEC DO-37



A = concentricity tolerance =  $\pm 0.35$

\*These limits apply only to the 10.32 dimension

### Terminal identification

BAT51 Pin cathode  
Body (red) anode

BAT51R Pin anode  
Body (green) cathode

# RATINGS

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

## Temperature

|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +100 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +100 | °C |

## Burn out

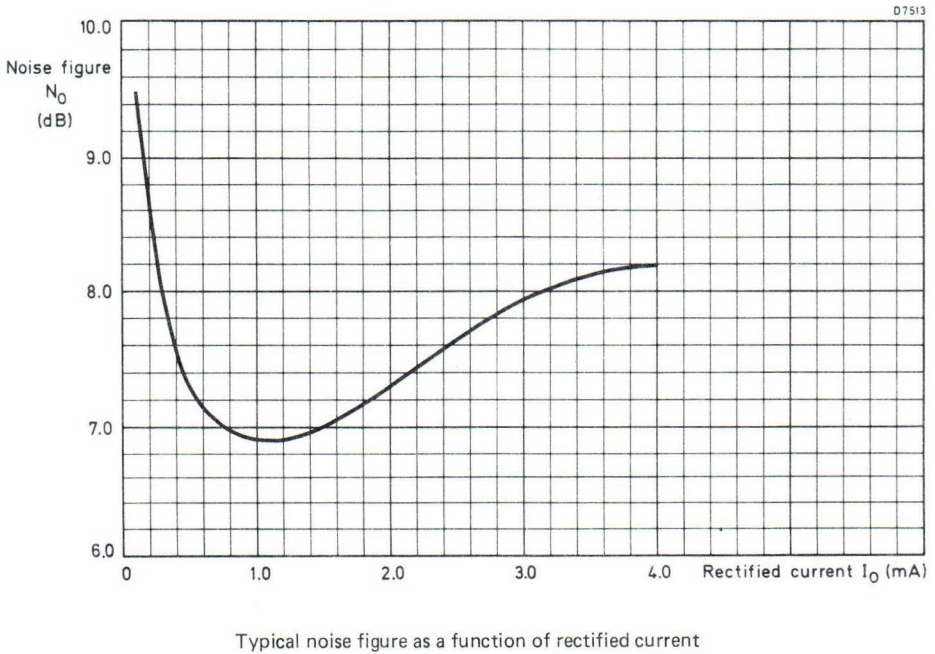
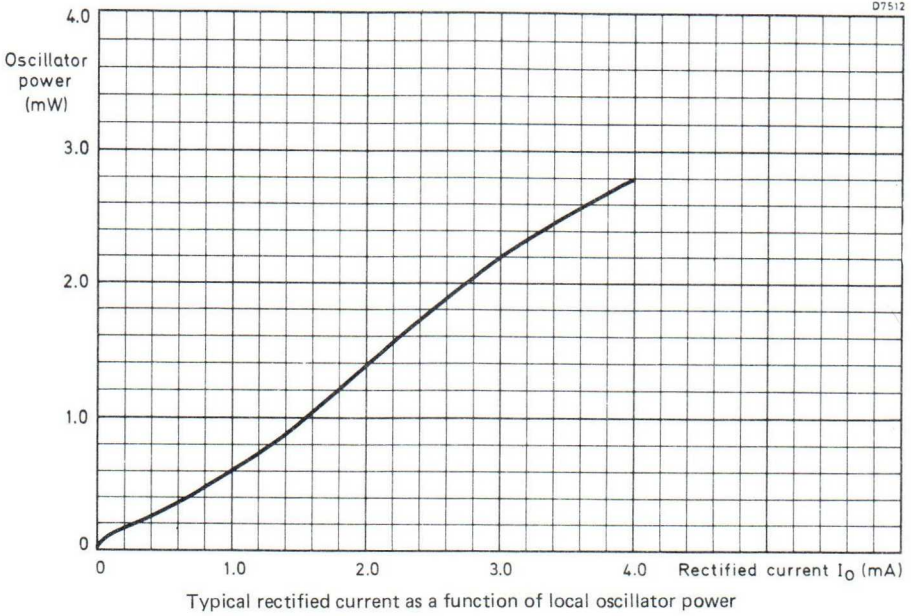
|                                                                                |      |      |     |
|--------------------------------------------------------------------------------|------|------|-----|
| $f = 9.375$ GHz, multiple r.f. spike,<br>spike width at half peak power = 2 ns | max. | 0.05 | erg |
| Peak pulse power<br>$f = 9.375$ GHz, $t_p = 1.0$ $\mu$ s                       | max. | 0.5  | W   |

## CHARACTERISTICS ( $T_{amb} = 25$ °C)

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

## As a matched pair

Maximum unbalance conditions,  
 $Z_{if} = 25$   $\Omega$ , rectified current 0.1 mA.





## MICROWAVE MIXER DIODES

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

### QUICK REFERENCE DATA

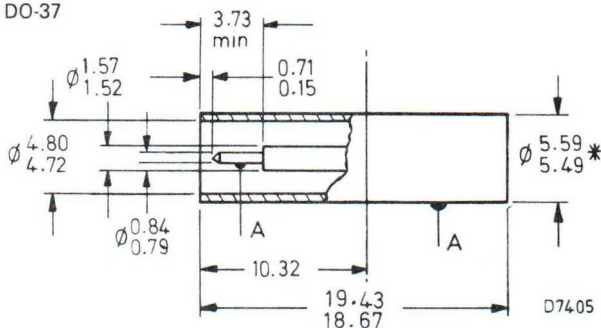
|                 |          |     |
|-----------------|----------|-----|
| Frequency range | 12 to 18 | GHz |
| Noise figure    | 8.0      | dB  |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to SOD-49  
Similar to JEDEC DO-37



A = concentricity tolerance =  $\pm 0.35$

\*These limits apply only to the 10.32 dimension

### Terminal identification

BAT52      Pin  
             Body (red)      cathode  
                                 anode

BAT52R      Pin  
                 Body (green)      anode  
                                 cathode

# RATINGS

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

## Temperature

|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +100 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +100 | °C |

## Burn-out

|                                                                                |      |      |     |
|--------------------------------------------------------------------------------|------|------|-----|
| $f = 9.375$ GHz, multiple r.f. spike,<br>spike width at half peak power = 2 ns | max. | 0.05 | erg |
| Peak pulse power<br>$f = 9.375$ GHz, $t_p = 1.0$ $\mu s$                       | max. | 0.5  | W   |

## CHARACTERISTICS ( $T_{amb} = 25$ °C)

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

## As a matched pair

Maximum unbalance conditions,  $Z_{if} = 25$   $\Omega$ , rectified current 0.1 mA.

## MICROWAVE MIXER DIODE

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

## QUICK REFERENCE DATA

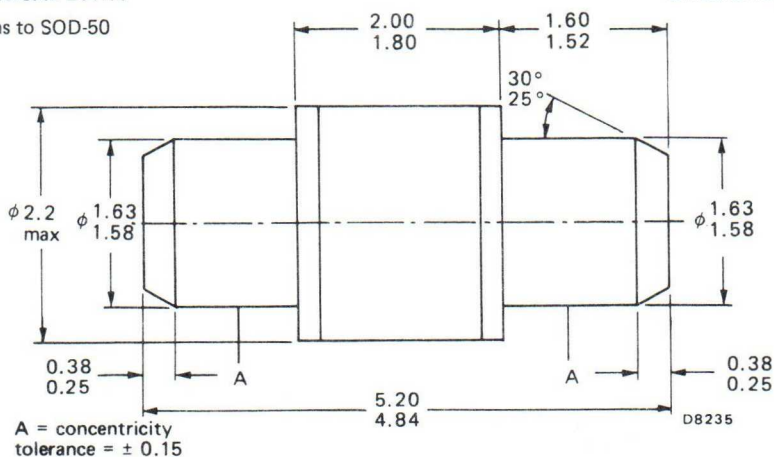
|                 |      |          |     |
|-----------------|------|----------|-----|
| Frequency range |      | 26 to 40 | GHz |
| Noise figure    | typ. | 8.5      | dB  |

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

## MECHANICAL DATA

Conforms to SOD-50

Dimensions in mm



Terminal identification: red end indicates cathode



## RATINGS

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

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

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

## Static

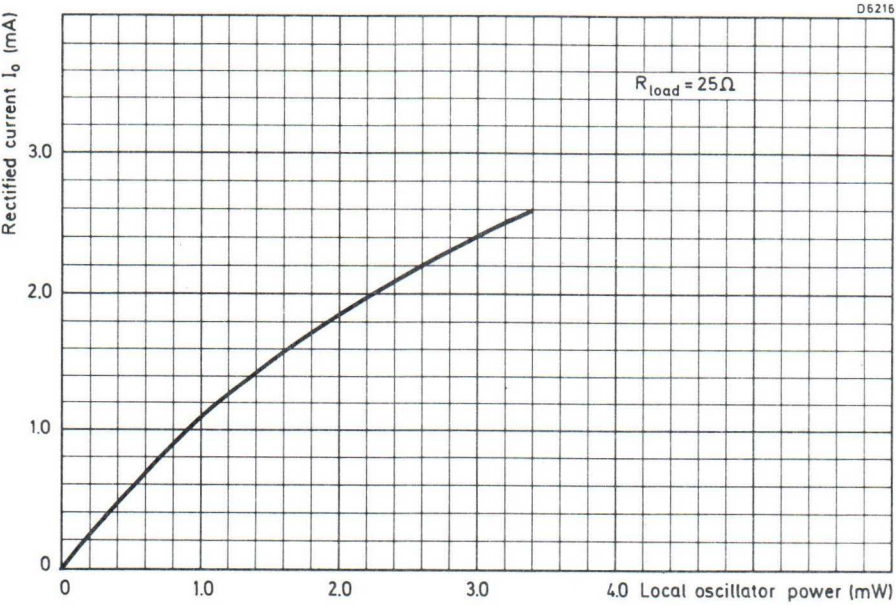
|                                          |       |      |     |               |
|------------------------------------------|-------|------|-----|---------------|
| Reverse current ( $V_R = 0.5\text{ V}$ ) | $I_R$ | max. | 2.0 | $\mu\text{A}$ |
| Forward current ( $V_F = 0.5\text{ V}$ ) | $I_F$ | min. | 2.0 | mA            |

## Dynamic

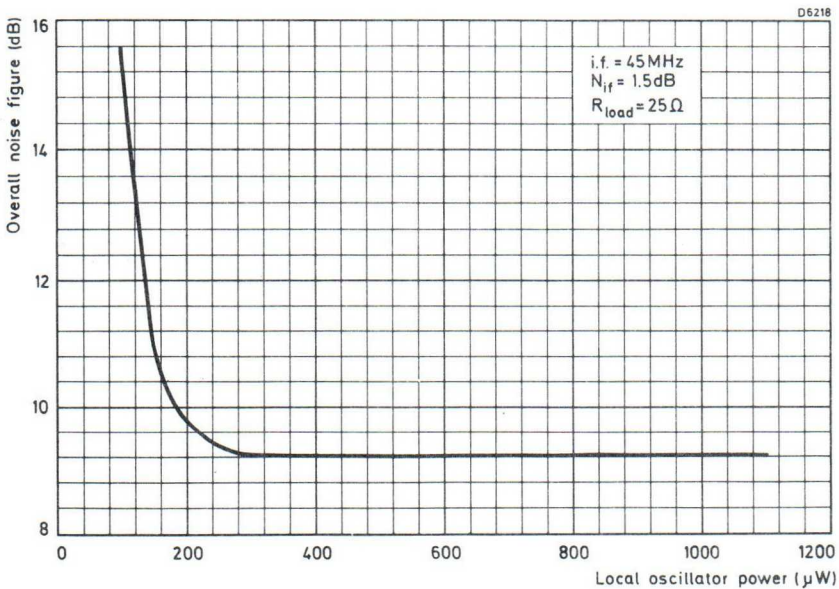
|                                           |          |              |                |                      |
|-------------------------------------------|----------|--------------|----------------|----------------------|
| Noise figure (note 2)                     | $N_O$    | typ.<br>max. | 8.5<br>10      | dB<br>dB             |
| Voltage standing wave ratio (note 3)      | v.s.w.r. | typ.<br>max. | 1.8:1<br>2.0:1 |                      |
| Intermediate frequency impedance (note 4) | $Z_{if}$ | min.<br>max. | 700<br>1100    | $\Omega$<br>$\Omega$ |
| Frequency range                           | f        | min.<br>max. | 26<br>40       | GHz<br>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 =  $6 \times 10^5$ , pulse duration = 2 ns at half peak energy, p.r.f. = 2000 p.p.s., load resistance = 0  $\Omega$ .  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .
2. Measured with a local oscillator frequency of 34.86 GHz,  $I_O = 0.5\text{ mA}$ , load resistance = 15  $\Omega$ , i.f. = 45 MHz. BS9300, method 1406.
3. Measured with a local oscillator frequency of 34.86 GHz,  $I_O = 0.5\text{ mA}$ , load resistance = 15  $\Omega$ . BS9300, method 1409.
4. Measured with a local oscillator frequency of 34.86 GHz,  $I_O = 0.5\text{ mA}$ , load resistance = 15  $\Omega$ , i.f. = 45 MHz. BS9300, method 1405.
5. Measured at 34.86 GHz, 450  $\mu\text{W}$  local oscillator power level and load resistance = 1 k $\Omega$ .
6. Measured at 34.86 GHz and i.f. = 45 MHz.
7. The diodes are measured in fixed tuned Q-band waveguide mounts. Details may be obtained from the manufacturer.
8. Matched pairs of diodes are available to customer specifications



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



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



## MICROWAVE DETECTOR DIODE

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

## QUICK REFERENCE DATA

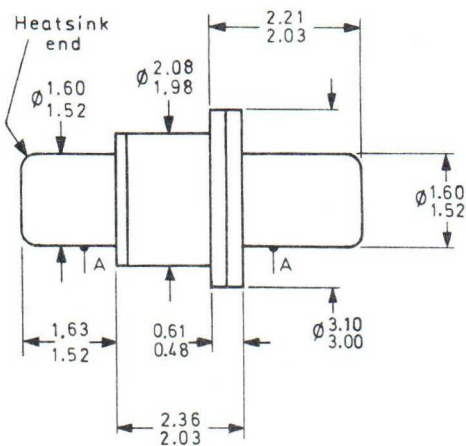
|                                                 |          |     |
|-------------------------------------------------|----------|-----|
| Frequency range                                 | 8 to 12  | GHz |
| Tangential sensitivity with<br>100 $\mu$ A bias | typ. -50 | dBm |

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

## MECHANICAL DATA

Dimensions in mm

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



A = concentricity tolerance =  $\pm 0.13$

$C_S = 0.25\text{pF typ.}$

$L_S = 0.65\text{nH typ.}$



## RATINGS

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

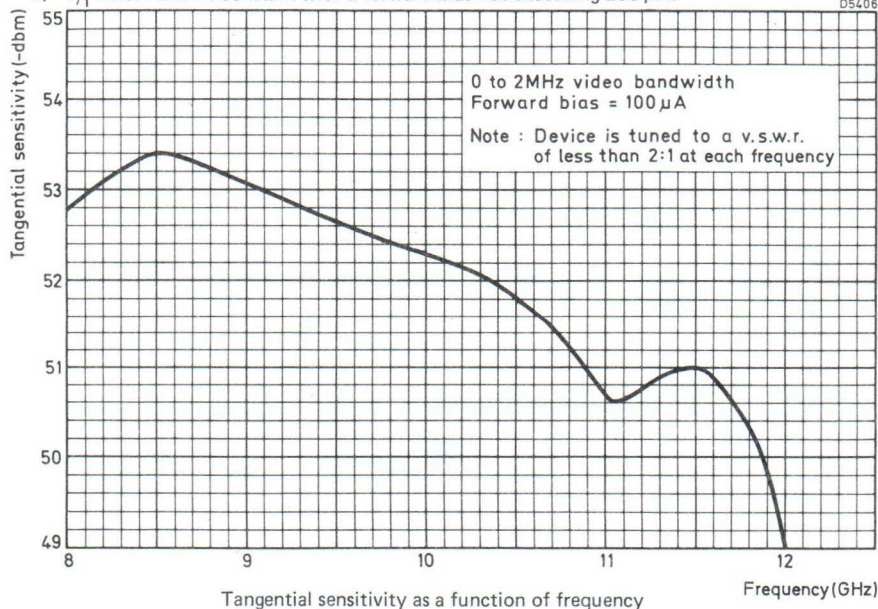
|                                                                        |             |    |
|------------------------------------------------------------------------|-------------|----|
| Storage temperature range                                              | —55 to +150 | °C |
| Ambient temperature range                                              | —55 to +150 | °C |
| Peak pulsed r.f. input power at 9.375 GHz,<br>0.5 $\mu$ s pulse length | max. 0.75   | W  |

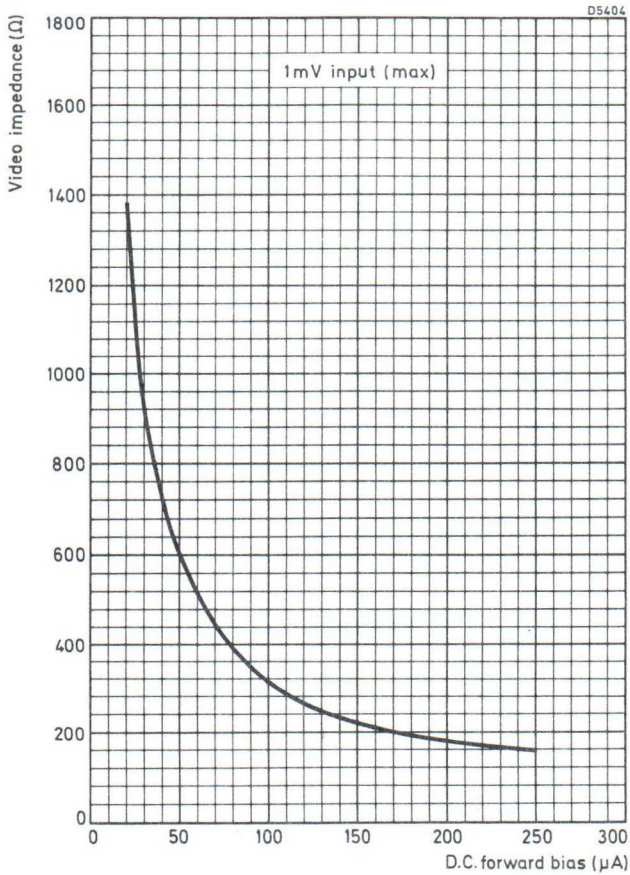
→ CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

|                                                   |          | min. | typ.  | max. |          |
|---------------------------------------------------|----------|------|-------|------|----------|
| Voltage standing wave ratio<br>(notes 1, 2 and 3) | v.s.w.r. | —    | 1:4:1 | 2:1  |          |
| Video impedance (notes 4 and 5)                   | $Z_v$    | —    | 310   | —    | $\Omega$ |
| Tangential sensitivity (notes 1 and 2)            | $S_{ts}$ | —49  | —50   | —    | dBm      |

## Notes

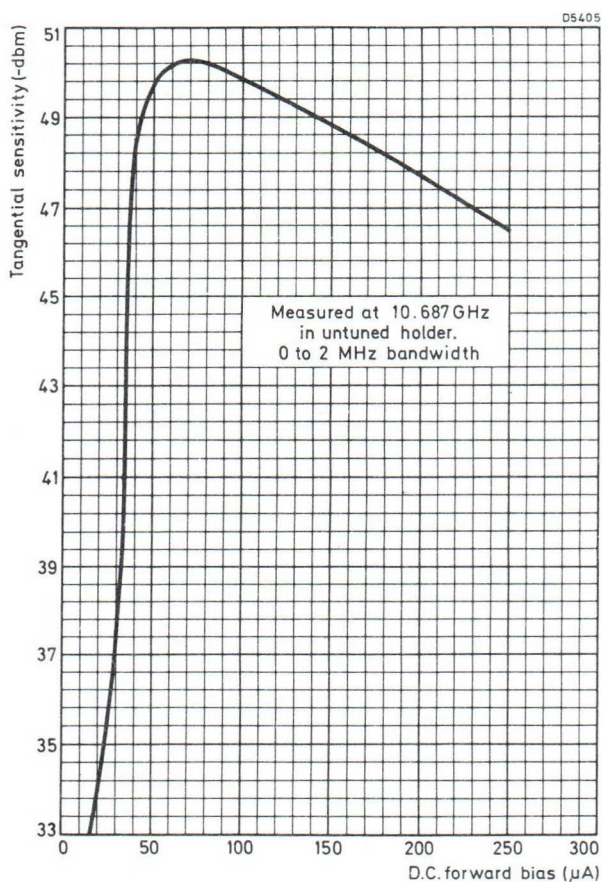
1. Measured at 10.687 GHz with 100  $\mu$ A forward bias.
2. Measured in a reduced height waveguide mount.
3. R.F. input power less than 5  $\mu$ W.
4. Measured with 100  $\mu$ A forward bias.
5. Maximum d.c. input voltage = 1 mV.
6. a) Measured at an i.f. of 1 kHz with 50 Hz bandwidth.  
b)  $1/f$ 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





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





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



## MICROWAVE MIXER DIODES

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

## QUICK REFERENCE DATA

Noise figure in X-band

|        |      |     |    |
|--------|------|-----|----|
| BAV96A | max. | 7.5 | dB |
| BAV96B | max. | 7.0 | dB |
| BAV96C | max. | 6.5 | dB |
| BAV96D | max. | 6.0 | dB |

Operating frequency

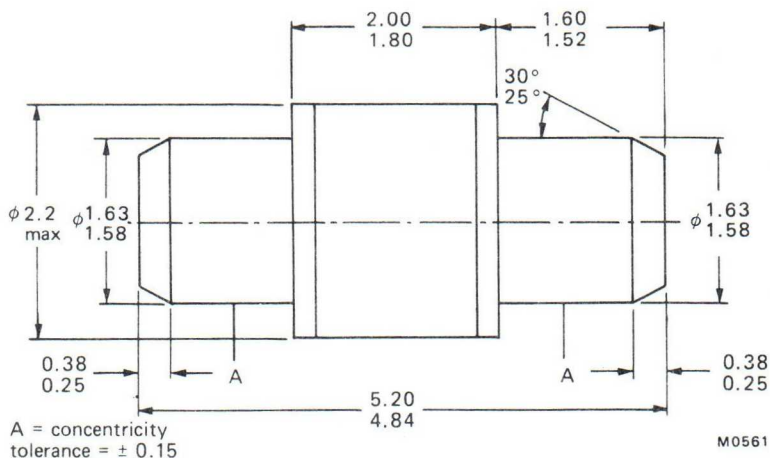
max. 12 GHz

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

## MECHANICAL DATA

Dimensions in mm

Conforms to SOD-50



Terminal identification: red end indicates cathode

## RATINGS

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

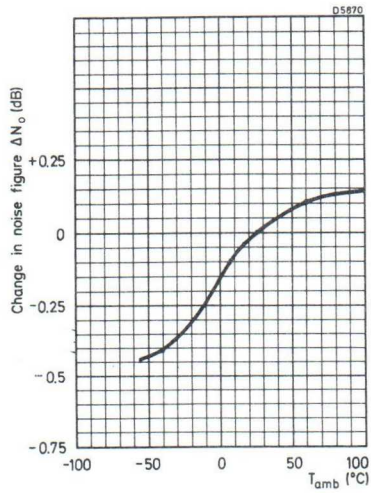
|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +150 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +150 | °C |
| Burn-out (note 1)         | max.      | 15          | nJ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

## CHARACTERISTICS ( $T_{amb} = 25\text{ °C}$ )

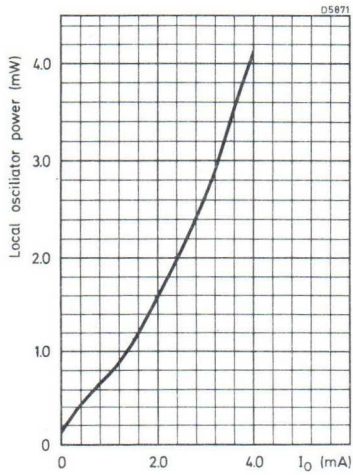
|                                      |        |          | min. | typ.  | max.  |          |
|--------------------------------------|--------|----------|------|-------|-------|----------|
| Noise figure (note 2)                | BAV96A | $N_O$    | —    | 7.0   | 7.5   | dB       |
|              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

## NOTES

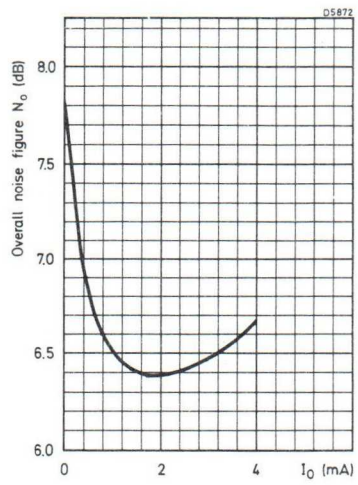
1. Burn out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to  $2 \times 10^8$  pulses of 2 ns width.
2. Measured at  $9.375 \pm 0.1$  GHz. The noise figure includes i.f. amplifier contribution of 1.5 dB, i.f. 45 MHz, d.c. return for diode  $15\ \Omega$  max., rectified current 1 mA. BS9300, method 1406.
3. Measured in a reduced height waveguide mount under the same test conditions as in note 2. BS9300, method 1409.
4. I.F. = 45 MHz,  $R_L = 15\ \Omega$ ,  $f = 9.375 \pm 0.1$  GHz,  $I_O = 1$  mA. BS9300, method 1405.
5. Video bandwidth 0 to 2 MHz, 30  $\mu$ A bias. BS9300, method 1411.
6. Video bandwidth 1 kHz to 1 MHz, 30  $\mu$ A bias. BS9300, method 1411.
7. A suitable holder for this diode is a modified version of Sanders type 6521.



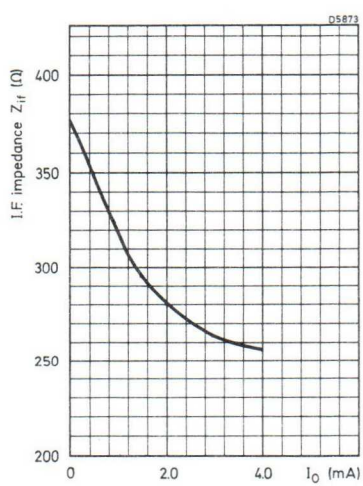
Typical change in overall noise figure as a function of temperature



Typical local oscillator power as a function of rectified current



Typical overall noise figure as a function of rectified current



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

## MICROWAVE DETECTOR DIODE

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

### QUICK REFERENCE DATA

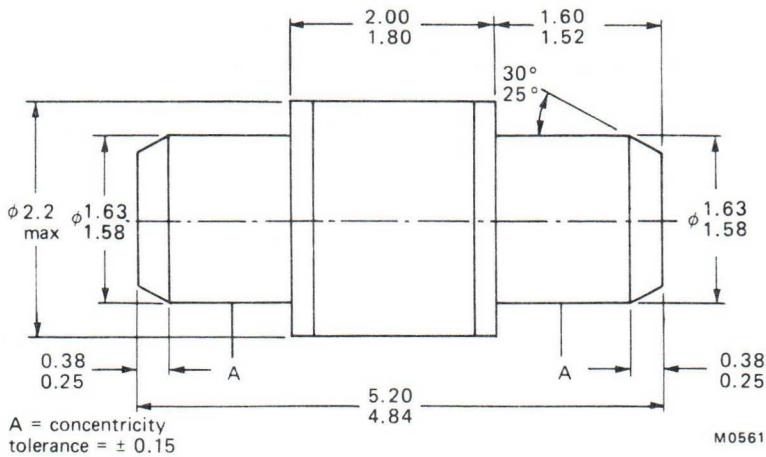
|                        |          |      |     |     |
|------------------------|----------|------|-----|-----|
| Operating frequency    | f        | max. | 12  | GHz |
| Tangential sensitivity | $S_{ts}$ | typ. | -54 | dBm |
| $1/f$ noise            | $N_f$    | typ. | 10  | dB  |

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

### MECHANICAL DATA

Dimensions in mm

Conforms to SOD-50



Terminal identification:

The positive end (cathode) is marked red.

**RATINGS**

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

**Temperature**

|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +150 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +150 | °C |

**Burn-out**

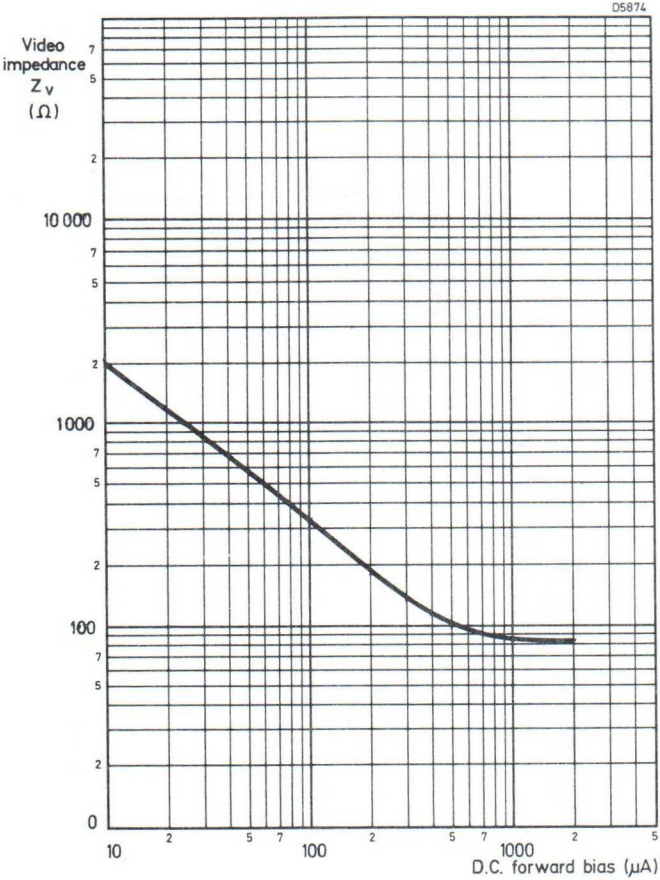
|                   |      |      |     |
|-------------------|------|------|-----|
| Burn-out (note 1) | max. | 18   | nJ  |
|                   |      | 0.18 | erg |

**CHARACTERISTICS** ( $T_{amb} = 25\text{ °C}$ )

|                                 |          | min. | typ. | max. |          |
|---------------------------------|----------|------|------|------|----------|
| Tangential sensitivity (note 2) | $S_{ts}$ | -52  | -54  | -58  | dBm      |
| $1/f$ noise (note 3)            | $N_f$    | —    | 10   | 15   | dB       |
| Video impedance (note 4)        | $Z_v$    | —    | 500  | —    | $\Omega$ |

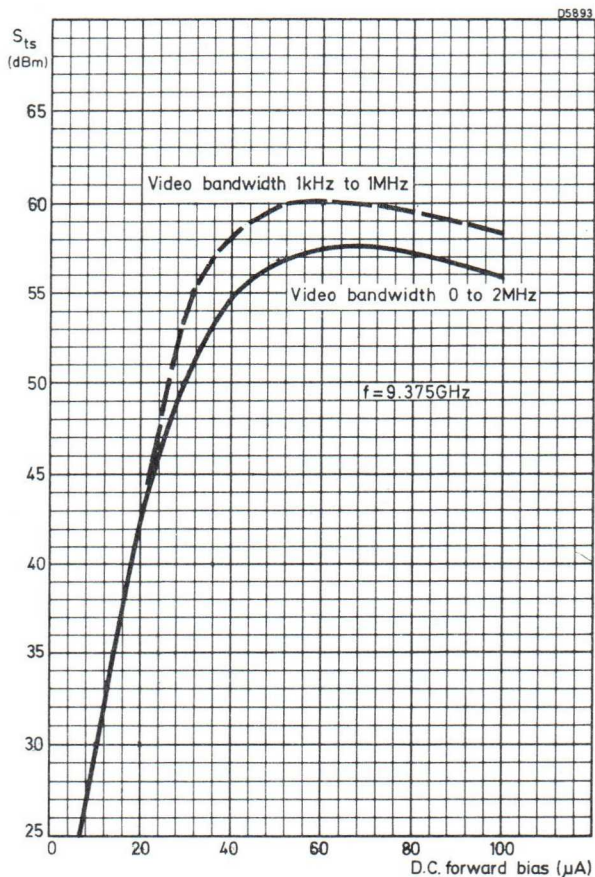
**Notes**

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



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





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

## MICROWAVE MIXER DIODES

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

Unless otherwise stated, data is applicable to all types.

## QUICK REFERENCE DATA

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

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

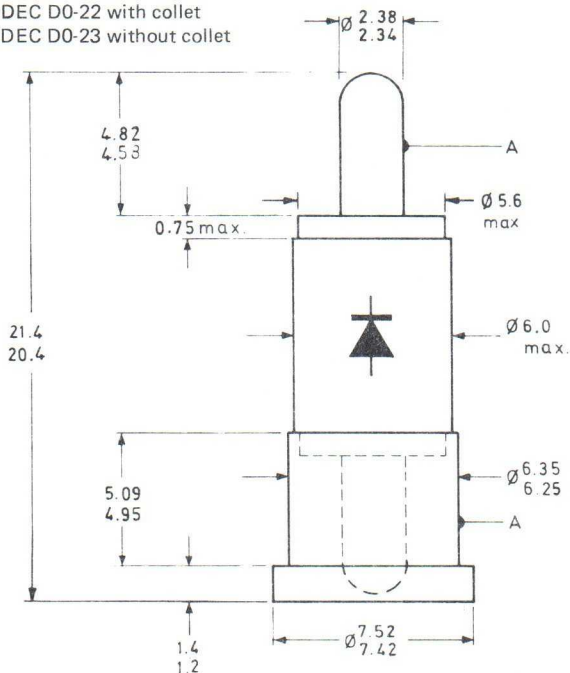
## MECHANICAL DATA

Dimensions in mm ←

Conforms to SOD-47

Compatible with JEDEC D0-22 with collet

Compatible with JEDEC D0-23 without collet



A = concentricity tolerance =  $\pm 0.2$

Terminal identification:

Diode symbol indicates polarity

D4868

## RATINGS

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

### Temperature

|                           |           |             |    |
|---------------------------|-----------|-------------|----|
| Storage temperature range | $T_{stg}$ | -55 to +150 | °C |
| Ambient temperature range | $T_{amb}$ | -55 to +150 | °C |

### Burn-out

|                   |      |     |     |
|-------------------|------|-----|-----|
| Burn-out (note 1) | max. | 20  | nJ  |
|                   |      | 0.2 | erg |

Peak pulse power

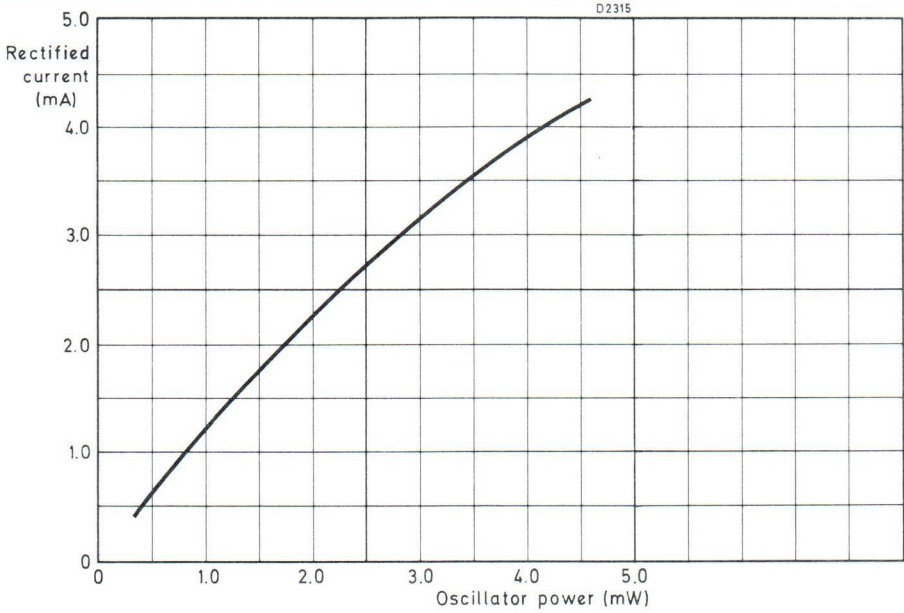
|                                                   |      |     |   |
|---------------------------------------------------|------|-----|---|
| $f = 9.375 \text{ GHz}$ , $t_p = 0.5 \mu\text{s}$ | max. | 1.0 | W |
|---------------------------------------------------|------|-----|---|

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

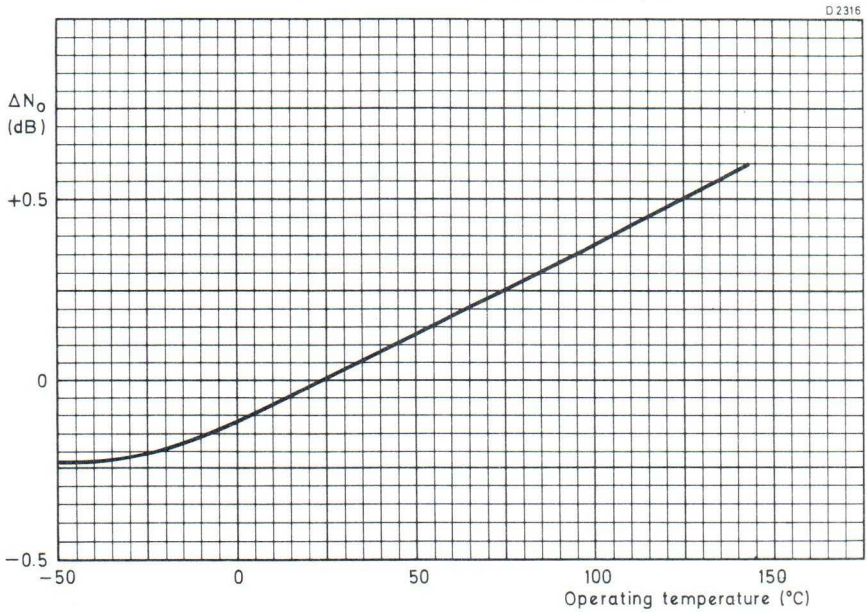
|                                           |          | min. | typ. | max.  |          |
|-------------------------------------------|----------|------|------|-------|----------|
| Noise figure (note 2)                     | BAW95D   | —    | 7.8  | 8.2   | dB       |
|                             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

### Notes

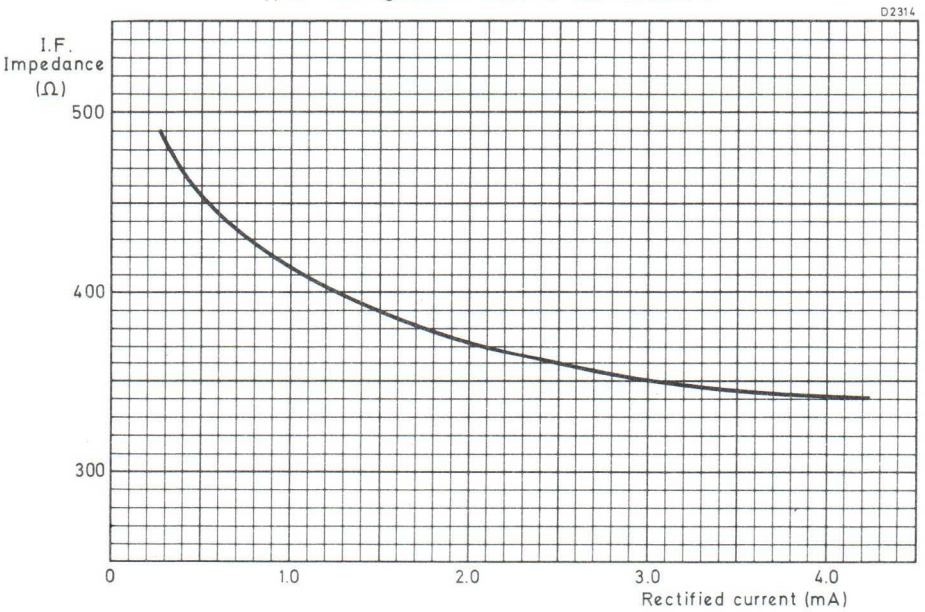
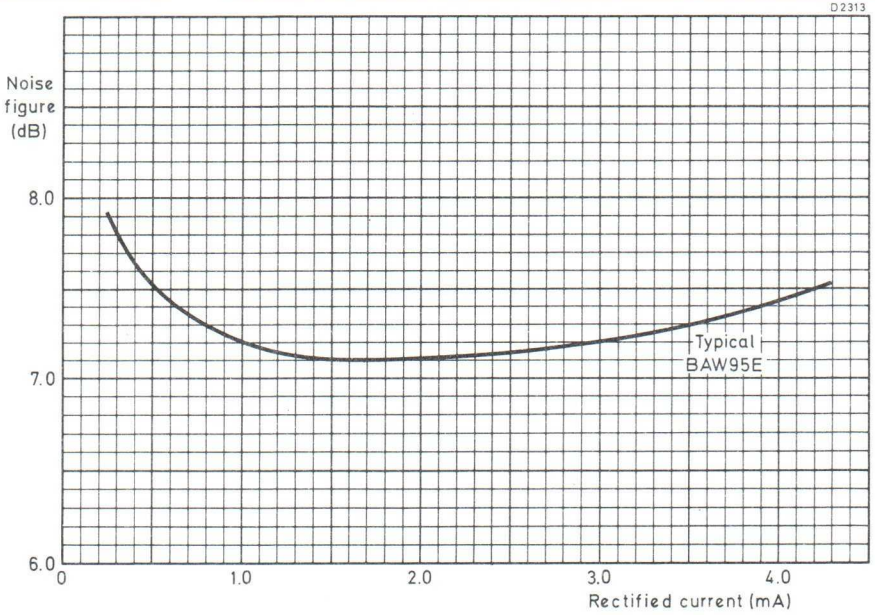
1. Burn-out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to  $2 \times 10^8$  pulses of 2 ns width.
2. Measured at 9.375 GHz, 1 mA rectified current,  $R_L = 15 \Omega$ .  $N_O$  includes  $N_{if} = 1.5 \text{ dB}$  with 45 MHz intermediate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



Typical rectified current as a function of local oscillator power



Typical change in noise figure as a function of temperature



I.F. impedance as a function of rectified current



# MICROWAVE MIXER DIODE

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

## QUICK REFERENCE DATA

Noise figure at X-band

$N_0$

max.

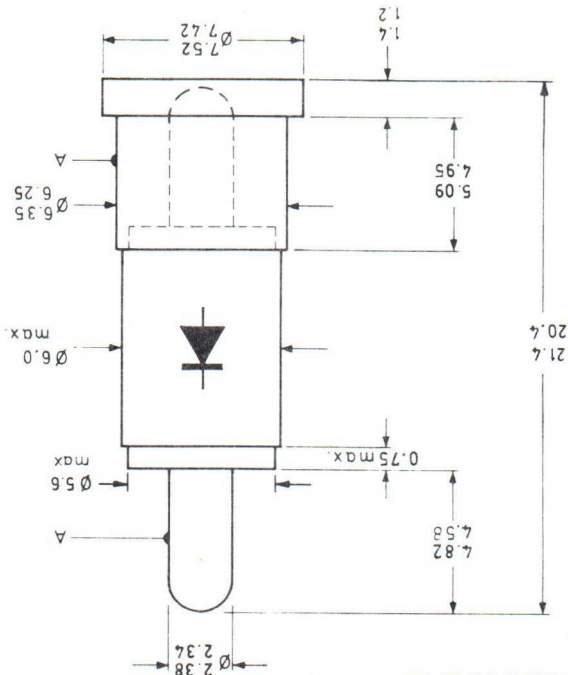
7.5

dB

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

## MECHANICAL DATA

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



Terminal identification:

Diode symbol indicates polarity

D4868

## RATINGS

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

## Temperature

| Storage temperature range | $T_{stg}$   | Ambient temperature range | $T_{amb}$   |
|---------------------------|-------------|---------------------------|-------------|
| °C                        | -55 to +150 | °C                        | -55 to +150 |

## Burn-out

| Burn-out (note 1) | nJ | erg |
|-------------------|----|-----|
| max.              | 20 | 0.2 |
| max.              |    | 1.0 |

Peak pulse power  
 $f = 9.375 \text{ GHz}$ ,  $t_p = 0.5 \mu\text{s}$

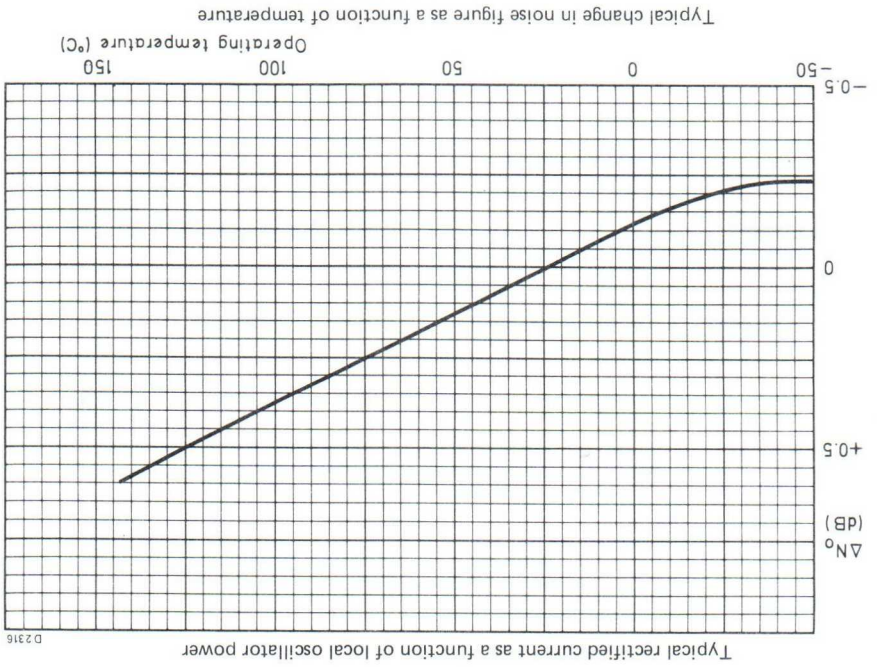
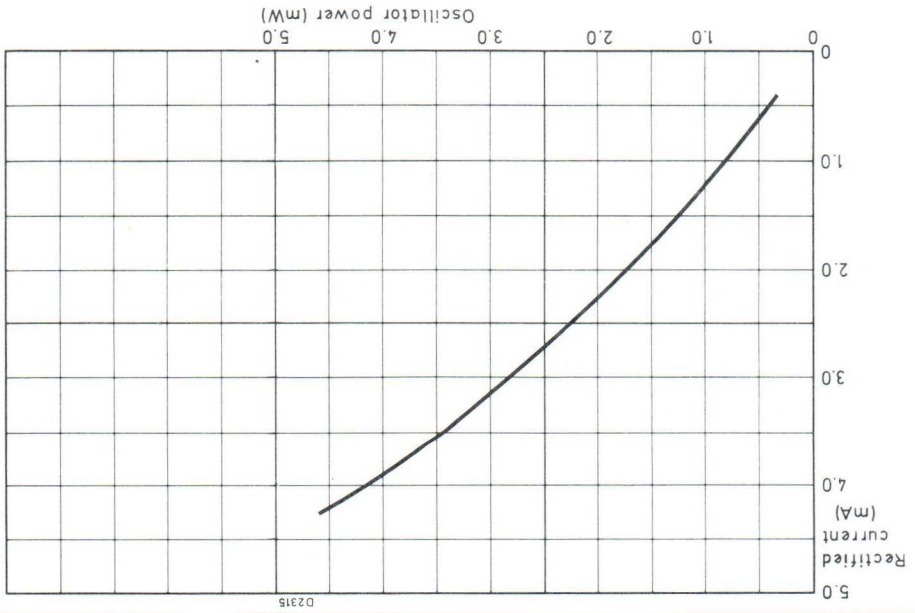
CHARACTERISTICS ( $T_{amb} = 25^\circ\text{C}$ )

| Noise figure (note 2)                     | $N_o$    | $Z_{it}$ |
|-------------------------------------------|----------|----------|
| Voltage standing wave ratio (note 3)      | v.s.w.r. |          |
| Intermediate frequency impedance (note 4) |          | $\Omega$ |

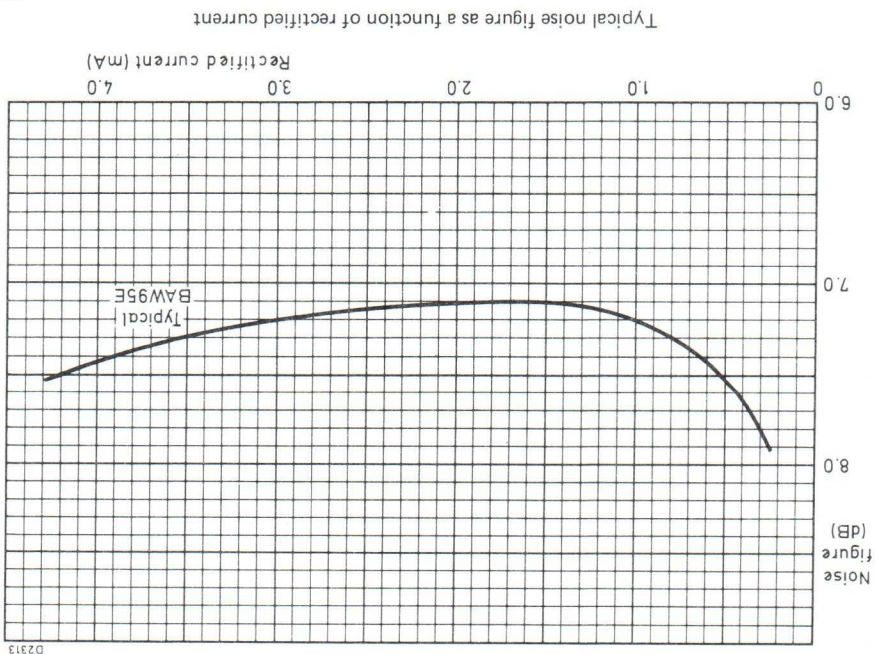
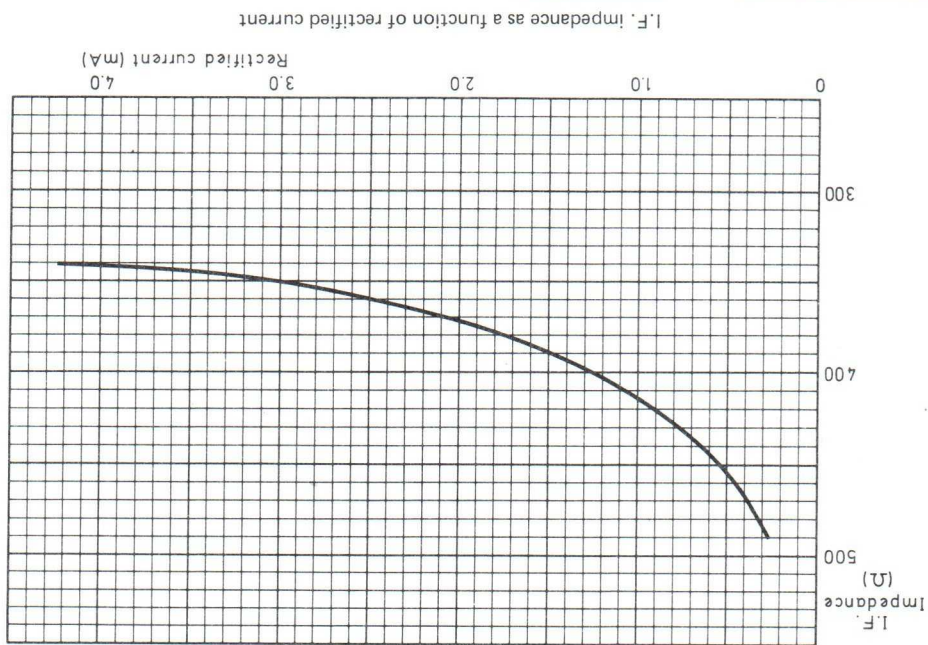
## Notes

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





Typical change in noise figure as a function of temperature



# Ka-BAND GaAs MOTT MIXER DIODE

This is a gallium arsenide Mott mixer diode for use at Ka-band (26.5 to 40 GHz). It embodies several entirely new concepts in millimetre-wave, low-noise mixer diode design. Advanced gallium arsenide planar technology is used to achieve a high cut-off frequency from a robust coplanar chip which has been designed to be mounted directly into planar circuits using a number of simple techniques. Fragile beam leads and the associated inductances have been eliminated. Additionally the stray capacitance associated with the gold bonding pads, which are on a thick gallium arsenide insulating substrate, is minimized. As shown in fig. 1, the variation in capacitance over a wide voltage range is much smaller than that of a conventional Schottky barrier diode. Therefore the advantage of the Mott mixer is that, since the diode capacitance remains constant, the circuit is matched to the diode impedance over a wide range of local oscillator powers and hence the variation in noise figure, especially at low powers, is also significantly less. The active area is protected by a polyimide coating.

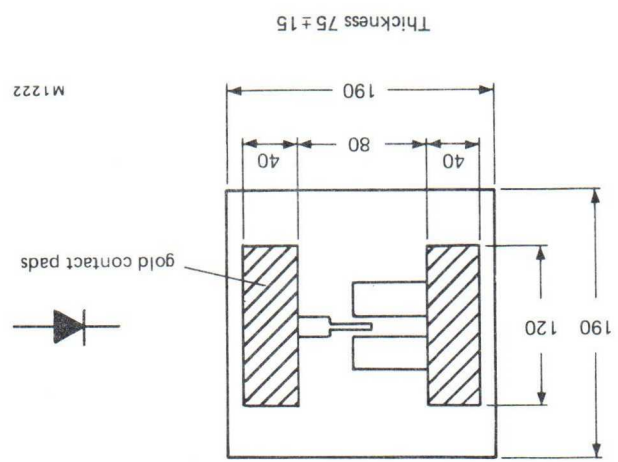
## QUICK REFERENCE DATA

| Frequency range | 26.5 to 40 |
|-----------------|------------|
| Noise figure    | typ. 7.1   |
|                 | dB         |

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

## MECHANICAL DATA

Dimensions in  $\mu\text{m}$



## RATINGS

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

Storage temperature range

$T_{stg}$

-55 to +125 °C

Burn-out power

2.0 W

measured using 200 ns pulses at a p.r.f. of 4.5 kHz to produce a change in noise figure of 1 dB

## CHARACTERISTICS

Noise figure (s.s.b.)

$N_o$  min. 6.5 typ. 7.1 max. 7.5 dB

measured at 35 GHz in a balanced mixer (Mullard type 76CCL0A) with I.o. = 2 mW and 1.5 dB i.f. contribution.

Total capacitance

$C_t$  — 0.05 — pF

at 1 MHz with zero bias

Junction capacitance

$C_j$  — 0.035 — pF

at 1 MHz with zero bias

Series resistance

$R_s$  — 4 —  $\Omega$

Cut-off frequency ( $2\pi R_s C_j$ )<sup>-1</sup>

$f_{co}$  — 1100 — GHz

Reverse breakdown voltage

$V(BR)_R$  2 — V

( $I_R = 10 \mu A$ )

## CIRCUIT MOUNTING

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

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

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

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

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

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

**Flip chip mounting**

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

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

**Space models**

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

## MATCHED PAIRS

These are available as 2/CAY18M.

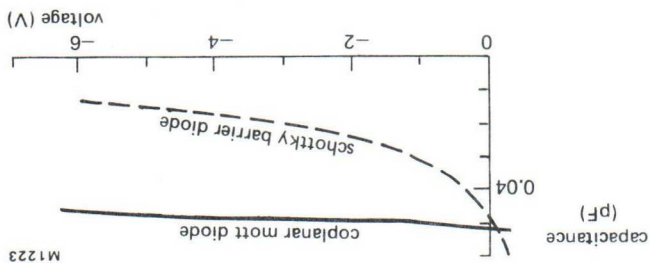


Fig. 1

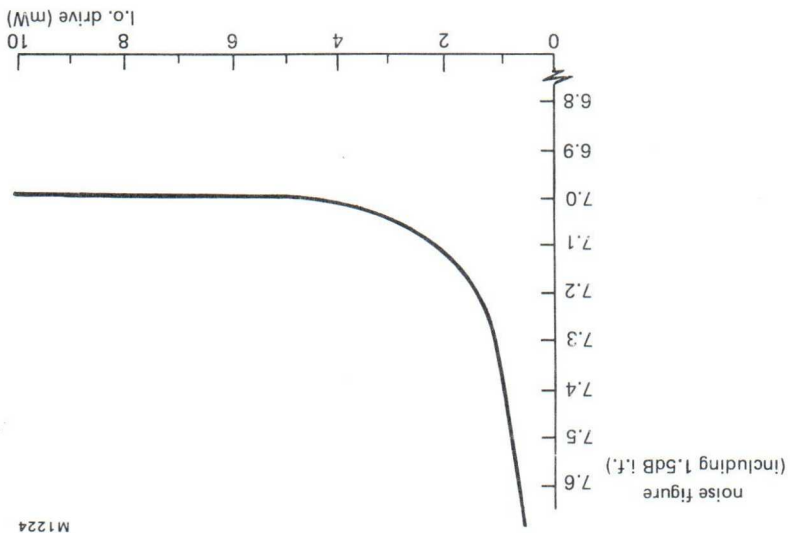


Fig. 2 Typical noise figure as a function of local oscillator drive





# W-BAND GaAs MOTT MIXER DIODE

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

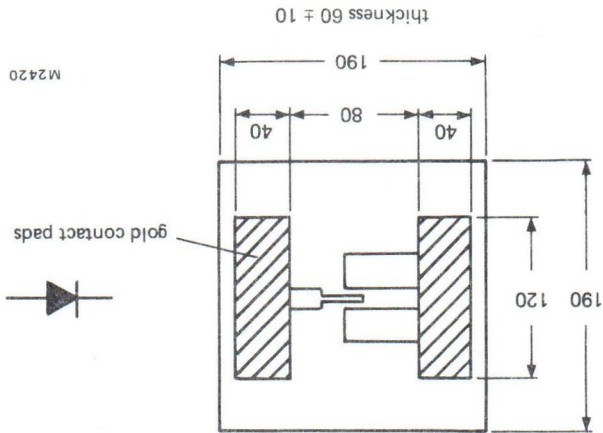
## QUICK REFERENCE DATA

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

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

## MECHANICAL DATA

Dimensions in  $\mu\text{m}$





# RATINGS

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

Storage temperature range

T<sub>stg</sub>

–55 to +100

°C

# CHARACTERISTICS

Noise figure (s.s.b.)

measured at 85 GHz in a balanced mixer  
(Mullard type 760CL5A) with I.O. = 4 mW  
and including 1.5 dB i.f. contribution.

Total capacitance  
at 1 MHz with zero bias

C<sub>T</sub>

0.035

–

pF

Junction capacitance  
at 1 MHz with zero bias

C<sub>J</sub>

0.02

–

pF

Series resistance

R<sub>S</sub>

6

–

Ω

Cut-off frequency (2πR<sub>S</sub>C<sub>J</sub>)<sup>-1</sup>

f<sub>co</sub>

1300

–

GHz

Reverse breakdown voltage  
(I<sub>R</sub> = 10 μA)

V(BR)R

2

–

–

V

# CIRCUIT MOUNTING

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

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

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

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

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

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

**Flip chip mounting**

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

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

**Space models**

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

# MATCHED PAIRS

These are available as 2/CAY19M.

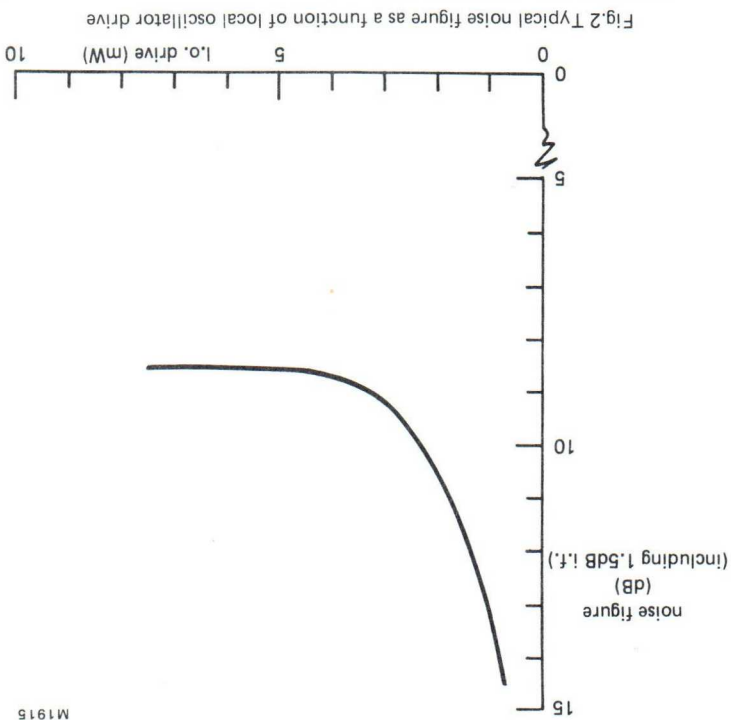
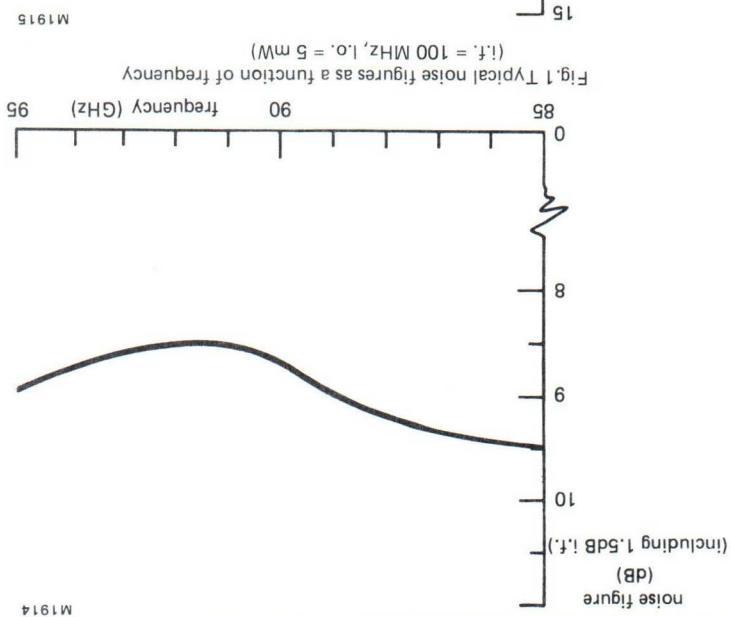
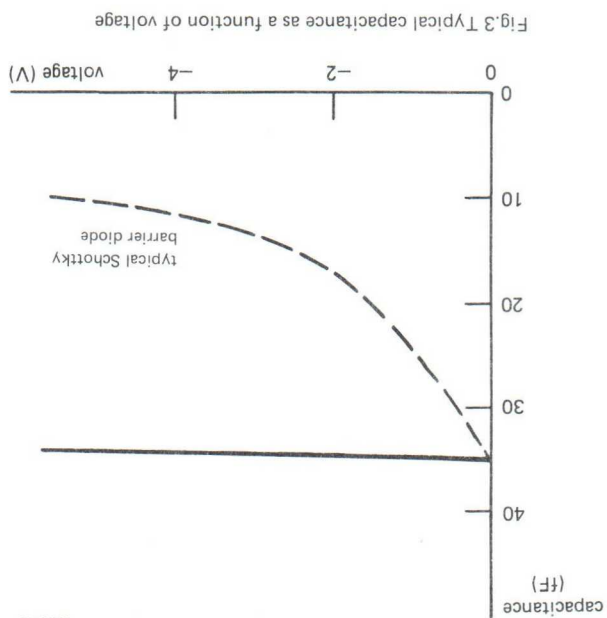


Fig. 2 Typical noise figure as a function of local oscillator drive



M1916

## BACKWARD DIODE



## MICROWAVE DETECTOR DIODE

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

## QUICK REFERENCE DATA

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

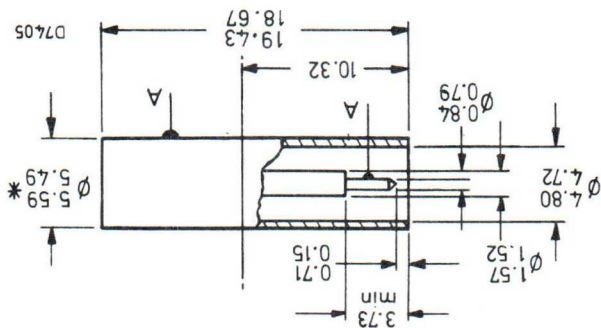
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – MICROWAVE SEMICONDUCTORS

## MECHANICAL DATA

Conforms to SOD-49

Similar to JEDEC DO-37

Dimensions in mm



A = concentricity tolerance =  $\pm 0.35$

\*These limits apply only to the 10.32 dimension

**Terminal identification:**

|         |       |
|---------|-------|
| Pin     | Body  |
| cathode | anode |

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

RATINGS

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

| Storage temperature range | $T_{stg}$ | Ambient temperature range | $T_{amb}$ |
|---------------------------|-----------|---------------------------|-----------|
| —55 to +100               |           | —55 to +100               |           |
| °C                        |           | °C                        |           |

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

Static

|                                      |       |   |     |   |               |
|--------------------------------------|-------|---|-----|---|---------------|
| Reverse current $I_R = 0.3\text{ V}$ | $I_R$ | — | 9   | — | mA            |
| Forward current $V_F = 0.3\text{ V}$ | $I_F$ | — | 150 | — | $\mu\text{A}$ |

Dynamic

|                                                |          |     |     |     |          |
|------------------------------------------------|----------|-----|-----|-----|----------|
| Voltage sensitivity at $-20\text{ dBm}$ input* | $S_v$    | 5   | 10  | —   | mV       |
| Video impedance (note 1)                       | $Z_v$    | 200 | —   | 400 | $\Omega$ |
| Voltage standing wave ratio (note 2)           | v.s.w.r. | —   | 3:1 | —   |          |

Notes

1. Zero bias, input  $1.0\text{ mV}$ , (d.c. or a.c. r.m.s.).
2. With respect to  $50\text{ }\Omega$ , measured at  $f = 16.5\text{ GHz}$ , zero bias and c.w. input power less than  $1.0\text{ }\mu\text{W}$ .

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



# MULTIPLIER VARACTOR DIODES



# SILICON MULTIPLIER VARACTOR DIODE

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

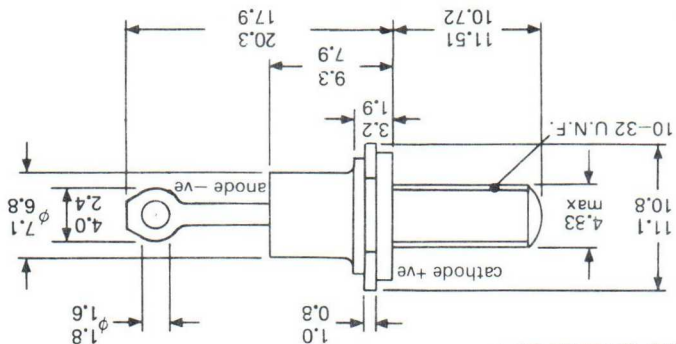
## QUICK REFERENCE DATA

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

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

## MECHANICAL DATA

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



Diameter of clearance hole: max. 5.2  
Torque on nut: min. 0.9 Nm  
max. 1.7 Nm

Accessories supplied on request:  
56295 (PTE bush, 2 mica washers, plain washer, tag)  
56262A (mica washer, insulating ring, plain washer)  
Supplied with device: 1 nut, 1 lock washer  
Nut dimensions across the flats: 9.5

# RATINGS

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

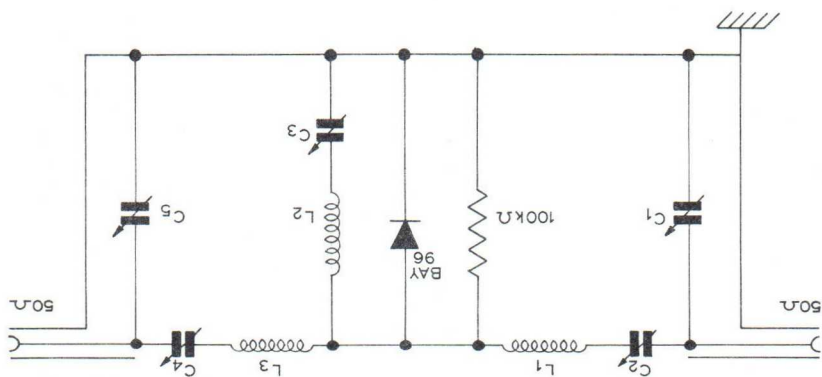
|                                                   |                      |             |      |
|---------------------------------------------------|----------------------|-------------|------|
| Storage temperature range                         | T <sub>stg</sub>     | -65 to +175 | °C   |
| Junction temperature (operating)                  | T <sub>j</sub>       | max.        | °C   |
| D.C. reverse voltage                              | V <sub>R</sub>       | max.        | V    |
| Total power dissipation (T <sub>mb</sub> = 25 °C) | P <sub>tot</sub>     | max.        | W    |
| THERMAL RESISTANCE                                |                      |             |      |
| Thermal resistance from junction to mounting base |                      |             |      |
|                                                   | R <sub>th j-mb</sub> | 7.5         | °C/W |

# CHARACTERISTICS

|                        |                                                  |     |     |          |
|------------------------|--------------------------------------------------|-----|-----|----------|
| Total capacitance      | $V_R = 6.0\text{ V}, f = 1.0\text{ MHz}$         |     |     | pF       |
| Series resistance      | $V_R = 6.0\text{ V}, f = 400\text{ MHz}$         |     |     | $\Omega$ |
| Cut-off frequency      | $\frac{1}{2\pi f_c C_T}$ at $V_R = 120\text{ V}$ |     |     | GHz      |
| <b>CHARACTERISTICS</b> |                                                  |     |     |          |
| $C_T$                  | 28                                               | —   | 39  | pF       |
| $r_s$                  | —                                                | 0.9 | 1.2 | $\Omega$ |
| $f_{co}$               | —                                                | 25  | —   | GHz      |

## APPLICATION INFORMATION

Typical operating characteristics as a frequency tripler



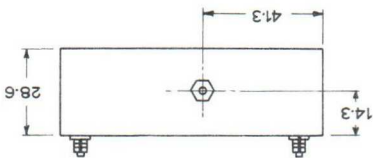
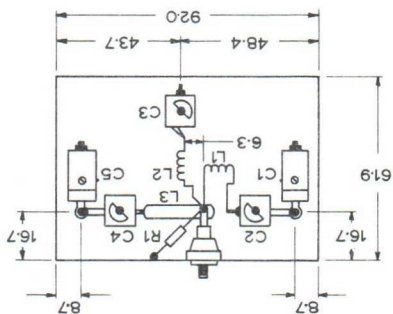
Frequency tripler circuit — 150 to 450 MHz

 $L_1 = 6.5$  turns 18 s.w.g. wire, 0.297" I.D., 0.562" long $L_2 = 2$  turns 14 s.w.g. wire, 0.266" I.D., 0.312" long $L_3 = 1.0'' \times 0.25'' \times 0.020''$  copper strip, 0.562" from chassis $C_1 = 7.0$  to 100 pF variable $C_2, C_3, C_4 = 2.0$  to 13 pF variable $C_5 = 2.0$  to 25 pF variable

Efficiency

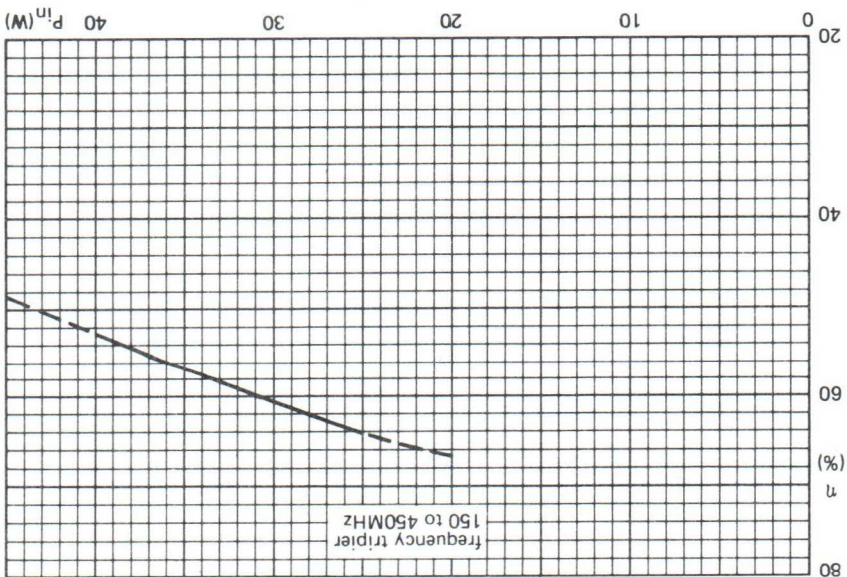
 $P_{in} = 25$  W,  $f_{in} = 150$  MHz $\eta$ min.  
typ.60  
64%  
%

Component layout of tripler circuit



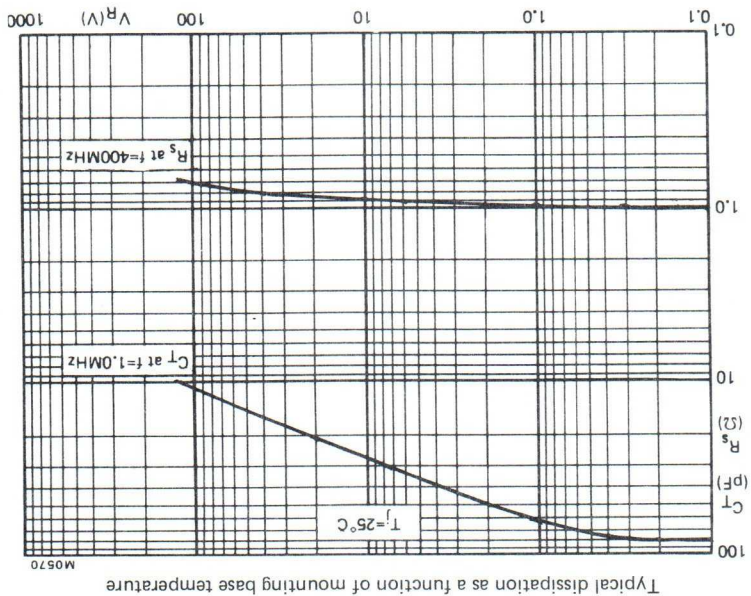
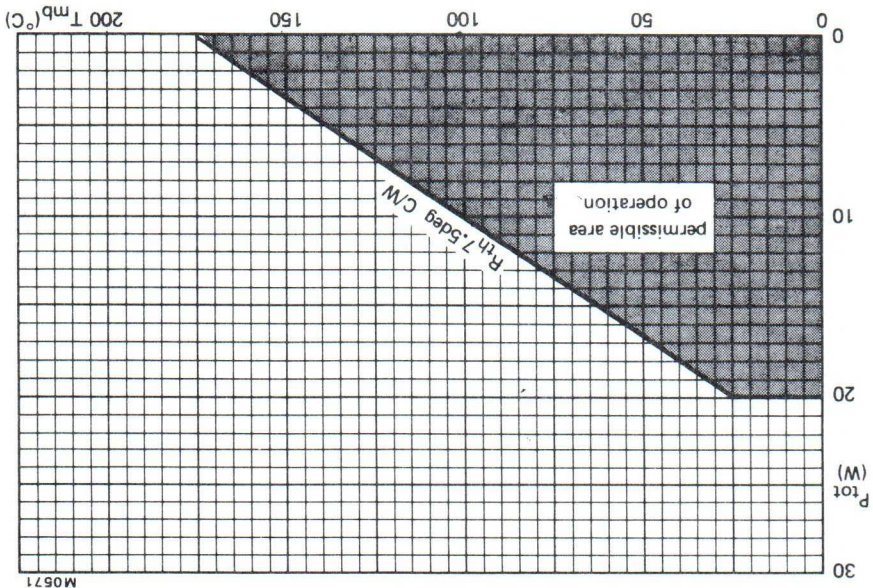
B5649

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



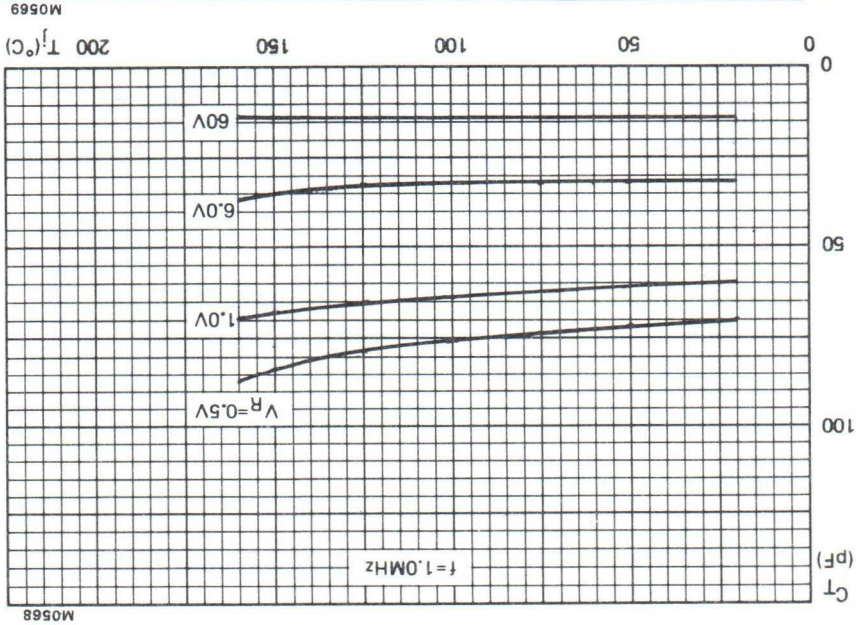
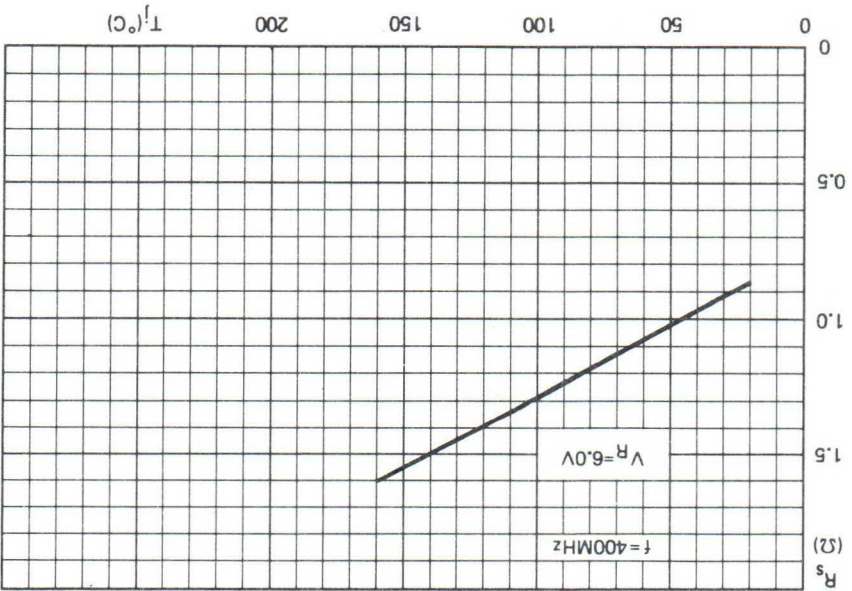
APPLICATION INFORMATION (continued)

M0572





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



## STEP RECOVERY DIODE

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

### QUICK REFERENCE DATA

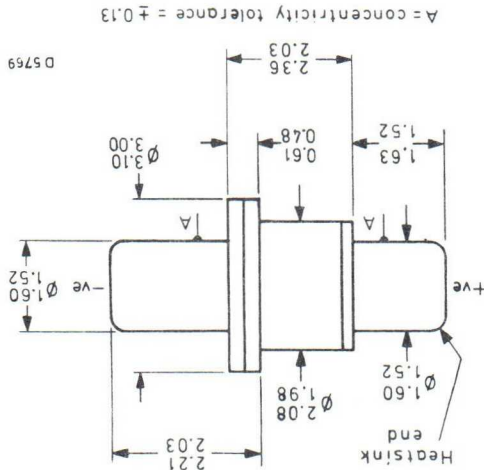
Operation as a frequency doubler 1 to 2 GHz in a typical circuit,

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

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

### MECHANICAL DATA

Conforms to BS3934 SO-86 and to SOD-31



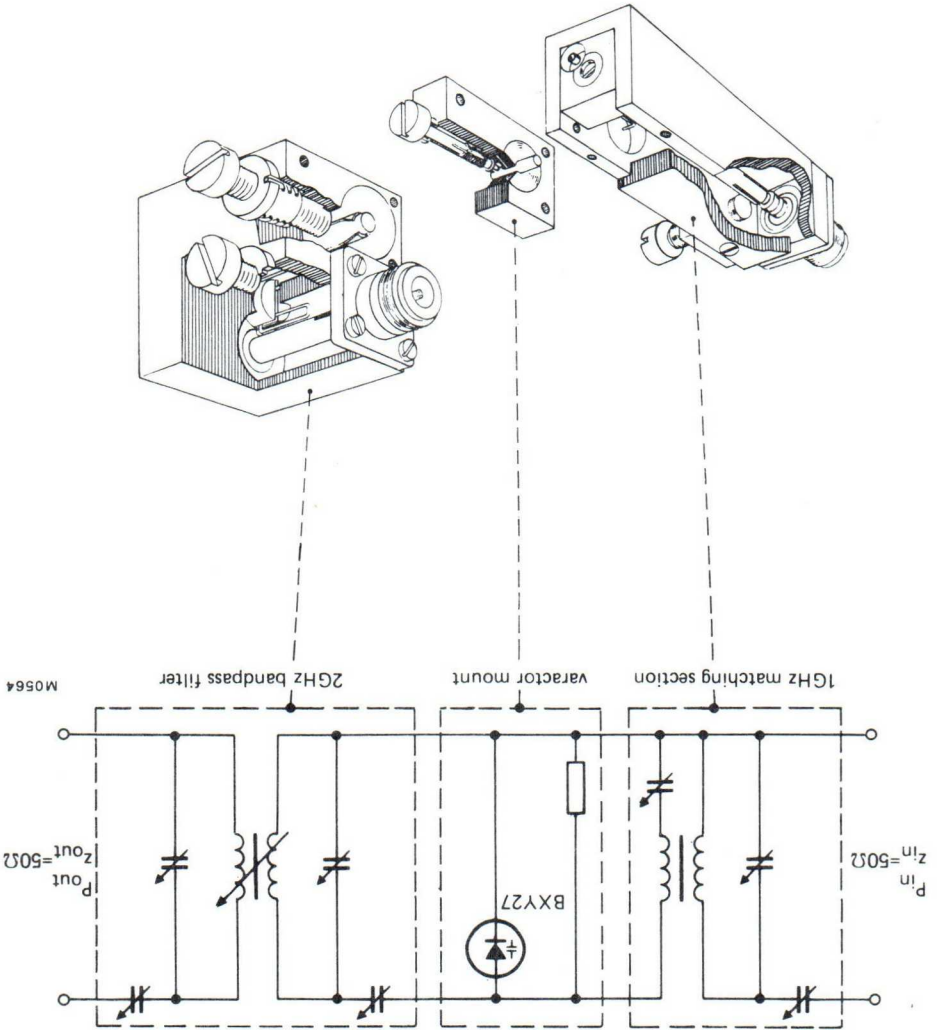
Chips from this range of devices may be supplied in alternative packages to customers' requirements.

# RATINGS

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

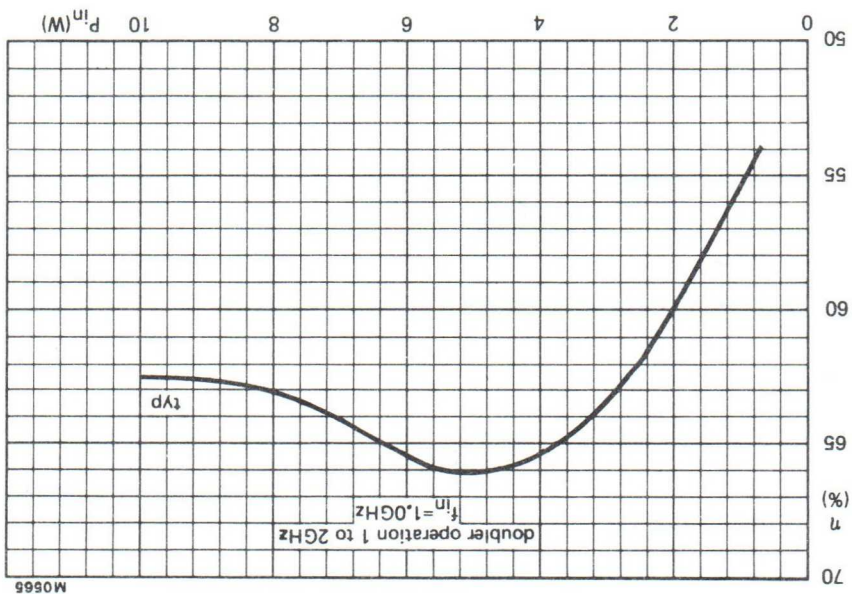
| Storage temperature range                          |  | $T_{stg}$       | —55 to +150 | °C    |
|----------------------------------------------------|--|-----------------|-------------|-------|
| Junction temperature                               |  | $T_j$           | max.        | 150   |
| D.C. reverse voltage                               |  | $V_R$           | max.        | 55    |
| Total power dissipation R.F.                       |  | $P_{tot}$       | max.        | 4.0   |
| $T_{pin} \leq 70^\circ\text{C}$                    |  |                 |             | W     |
| $T_{pin} > 70^\circ\text{C}$ , derating factor     |  |                 |             | 50    |
| Thermal resistance from junction to pin            |  | $R_{th\ j-pin}$ | max.        | 20    |
| °C/W                                               |  |                 |             |       |
| Reverse breakdown voltage                          |  | $V_{(BR)}$      | min.        | 55    |
| Reverse current, $V_R = 6.0\text{ V}$              |  | $I_R$           | —           | 0.001 |
| Cut-off frequency, $V_R = 6.0\text{ V}$            |  | $f_{co}$        | 50          | 100   |
| $\frac{1}{2\pi f C_j}$                             |  |                 |             | —     |
| Total capacitance ( $C_j + C_s$ )                  |  |                 |             | 6.0   |
| $V_R = 6.0\text{ V}$ , $f = 1.0\text{ MHz}$        |  | $C_T$           | 3.0         | 4.5   |
| Stray capacitance                                  |  | $C_s$           | —           | 0.25  |
| Series inductance                                  |  | $L_s$           | —           | 650   |
| Series resistance, $V_R = 6.0\text{ V}$            |  | $r_s$           | —           | 0.4   |
| Overall efficiency                                 |  |                 |             | —     |
| $P_{in} = 10\text{ W}$ , $f_{in} = 1.0\text{ GHz}$ |  |                 |             | 60    |
| frequency doubler                                  |  | $\eta$          | 50          | 40    |
| frequency trebler                                  |  | $\eta$          | —           | —     |

APPLICATION INFORMATION



Frequency doubler circuit (1 to 2 GHz)

Overall efficiency as a function of input power  
for doubler operation



M0565

# STEP RECOVERY DIODE

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

## QUICK REFERENCE DATA

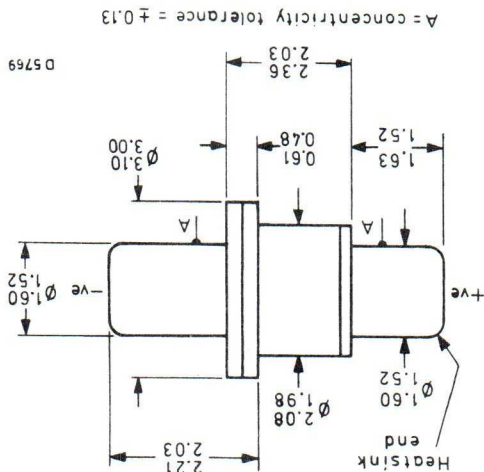
Operation as a frequency doubler 2 to 4 GHz in a typical circuit.

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

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

## MECHANICAL DATA

Conforms to SOD-31 and BS3934 SO-86



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



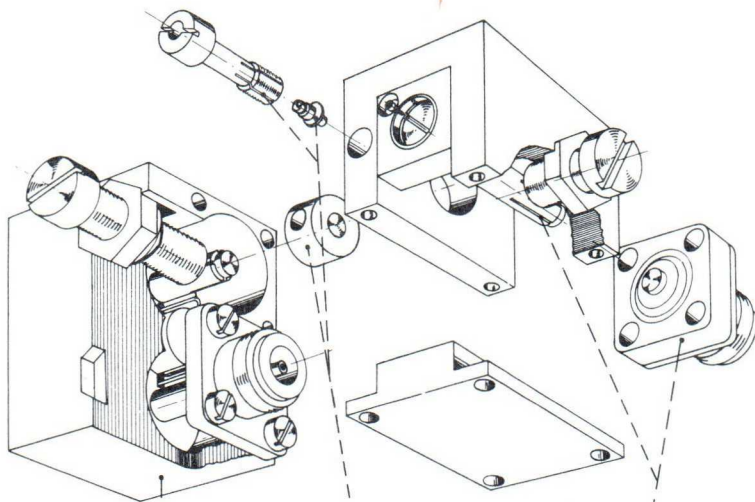
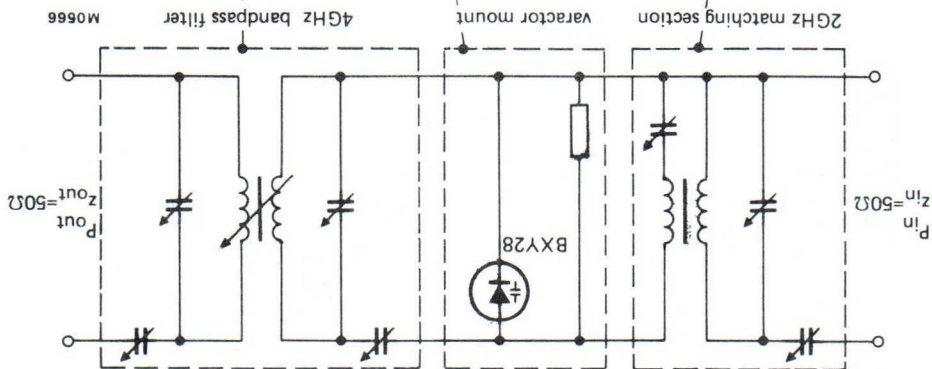
RATINGS

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

|                                                                                 |                |          |                            |
|---------------------------------------------------------------------------------|----------------|----------|----------------------------|
| Storage temperature range                                                       | $T_{stg}$      | OC       | -55 to +150                |
| Junction temperature                                                            | $T_j$          | OC       | max. 150                   |
| D.C. reverse voltage                                                            | $V_R$          | V        | max. 45                    |
| Total power dissipation R.F.                                                    | $P_{tot}$      | W        | max. 2.7                   |
| $T_{pin} \leq 70$ OC<br>$T_{pin} > 70$ OC, derating factor                      |                | mW/OC    | 34                         |
| THERMAL RESISTANCE                                                              |                |          |                            |
| Thermal resistance from junction to pin                                         | $R_{th j-pin}$ | OC/W     | max. 30                    |
| CHARACTERISTICS ( $T_{amb} = 25$ OC)                                            |                |          |                            |
| Reverse breakdown voltage                                                       | $V_{(BR)R}$    | V        | min. 45<br>typ. 60<br>max. |
| Reverse current, $V_R = 6.0$ V                                                  | $I_R$          | $\mu A$  | —<br>0.001<br>1.0          |
| Cut-off frequency, $V_R = 6.0$ V                                                | $f_{co}$       | GHz      | 80<br>120                  |
| $\frac{1}{2\pi r_s C_j}$                                                        |                |          |                            |
| Total capacitance ( $C_j + C_s$ )<br>$V_R = 6.0$ V, $f = 1.0$ MHz               | $C_T$          | pF       | 1.0<br>1.5<br>2.5          |
| Stray capacitance                                                               | $C_s$          | pF       | —<br>0.25                  |
| Series inductance                                                               | $L_s$          | pH       | —<br>650                   |
| Series resistance, $V_R = 6.0$ V                                                | $r_s$          | $\Omega$ | —<br>1.0                   |
| Overall efficiency<br>$P_{in} = 7.0$ W, $f_{in} = 2.0$ GHz<br>frequency doubler | $\eta$         | %        | 50<br>—<br>—               |

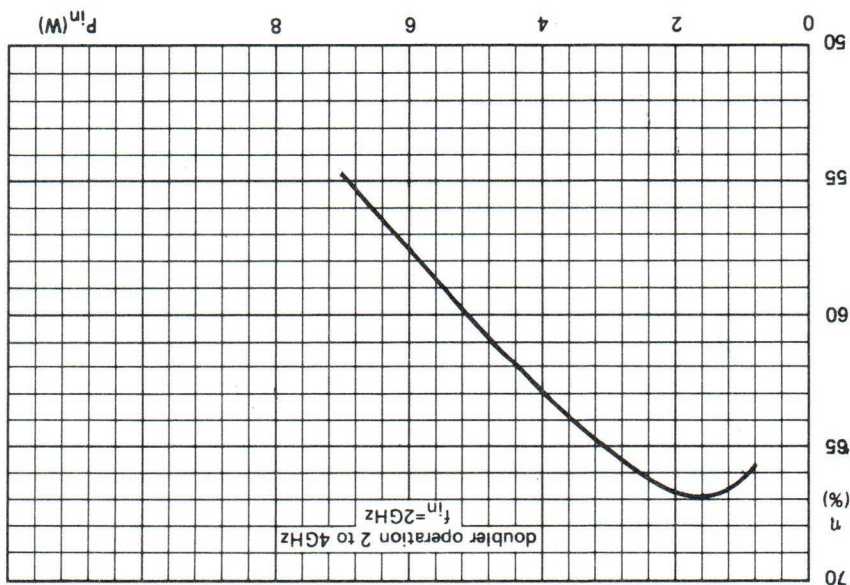


APPLICATION INFORMATION



Frequency doubler circuit (2 to 4 GHz)

Overall efficiency as a function of input power  
for doubler operation



M0667

## STEP RECOVERY DIODE

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

## QUICK REFERENCE DATA

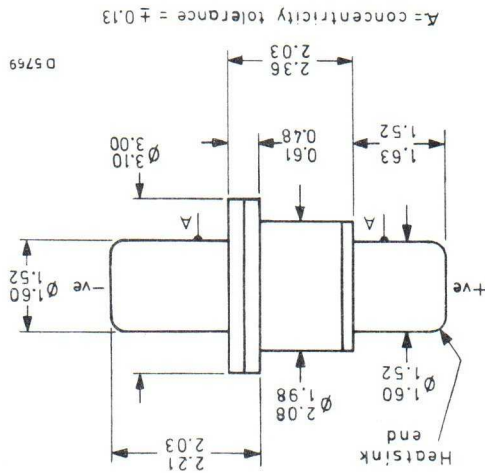
Operation as a frequency quadrupler 2.25 to 9.0 GHz in a typical circuit.

|                             |                  |      |     |
|-----------------------------|------------------|------|-----|
| Input r.f. power            | P <sub>in</sub>  | 1.0  | W   |
| Output r.f. power           | P <sub>out</sub> | 0.3  | W   |
| Resistive cut-off frequency | f <sub>co</sub>  | 120  | GHz |
| V <sub>R</sub> = 6.0 V      |                  |      |     |
| Total capacitance           | C <sub>T</sub>   | 1.0  | pF  |
| V <sub>R</sub> = 6.0 V      |                  |      |     |
| Junction temperature        | T <sub>j</sub>   | max. | °C  |

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

## MECHANICAL DATA

Conforms to BS3934 SO-86 and to SOD-31



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

RATINGS

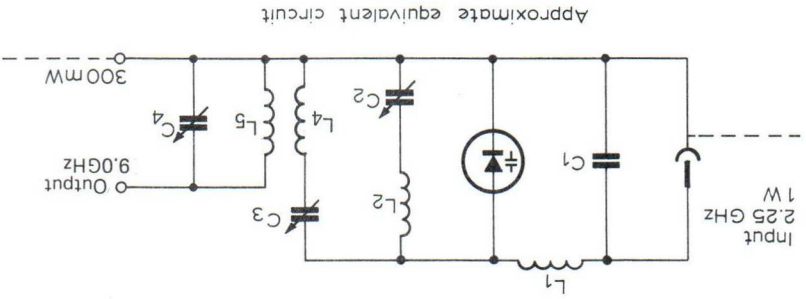
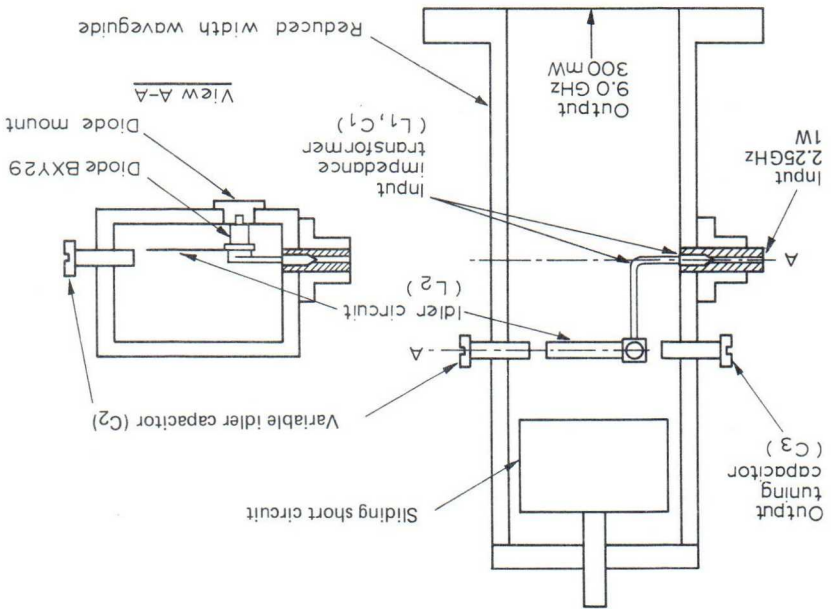
Limiting values in accordance with the Absolute Maximum System (IEC134)

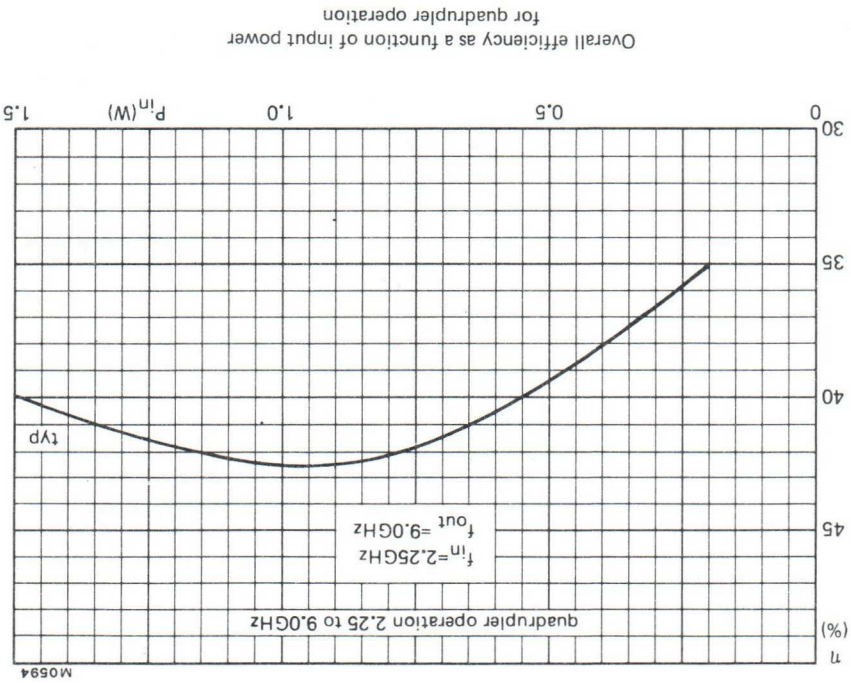
| Storage temperature range               |             |      |  |
|-----------------------------------------|-------------|------|--|
| °C                                      | -55 to +150 |      |  |
| Junction temperature                    |             |      |  |
| °C                                      | 150         | max. |  |
| D.C. reverse voltage                    |             |      |  |
| V                                       | 25          | max. |  |
| Total power dissipation R.F.            |             |      |  |
| W                                       | 2.0         | max. |  |
| THERMAL RESISTANCE                      |             |      |  |
| Thermal resistance from junction to pin |             |      |  |
| Rth j-pin                               | max.        |      |  |
| Reverse breakdown voltage               |             |      |  |
| V(BR)R                                  | 25          | min. |  |
| Reverse current, VR = 6.0 V             |             |      |  |
| IR                                      | —           | typ. |  |
| Cut-off frequency, VR = 6.0 V (note 1)  |             |      |  |
| fco                                     | 90          | min. |  |
| Total capacitance (Cj + Cs)             |             |      |  |
| CT                                      | 0.8         | max. |  |
| Stray capacitance                       |             |      |  |
| Cs                                      | —           | typ. |  |
| Series inductance                       |             |      |  |
| LS                                      | —           | max. |  |
| Overall efficiency                      |             |      |  |
| Pin = 1.0 W, fin = 2.25 GHz             | —           | max. |  |
| frequency quadrupler                    |             |      |  |
| η                                       | 30          | min. |  |
| Notes                                   |             |      |  |

- The cut-off frequency  $f_{co}$  is defined as:  $f_{co} = \frac{1}{2\pi r_s C_j}$  where  $C_j$  is the junction capacitance and is measured at 1.0 MHz,  $r_s$  is measured on a slotted line at 2.0 GHz.

S-X band quadrupler

B 9937





Overall efficiency as a function of input power  
for quadrupler operation





RATINGS

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

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

THERMAL RESISTANCE

Thermal resistance from junction to pin  
( $T_{amb} = 25^\circ\text{C}$ )

|                                                  |             |     |      |      |      |
|--------------------------------------------------|-------------|-----|------|------|------|
| Reverse breakdown voltage                        | $V_{(BR)R}$ | 20  | min. | typ. | max. |
| $I_R = 1.0\text{ mA}$                            |             |     |      |      |      |
| Reverse current, $V_R = 6.0\text{ V}$            | $I_R$       | —   |      |      |      |
| Cut-off frequency, $V_R = 6.0\text{ V}$ (note 1) | $f_{co}$    | 100 |      |      |      |
| Total capacitance ( $C_j + C_s$ )                | $C_T$       | 0.5 |      |      |      |
| Stray capacitance                                | $C_s$       | —   |      |      |      |
| Series inductance                                | $L_s$       | —   |      |      |      |
| Transition time                                  | $t_{tr}$    | —   |      |      |      |
| Storage time                                     | $t_s$       | —   |      |      |      |

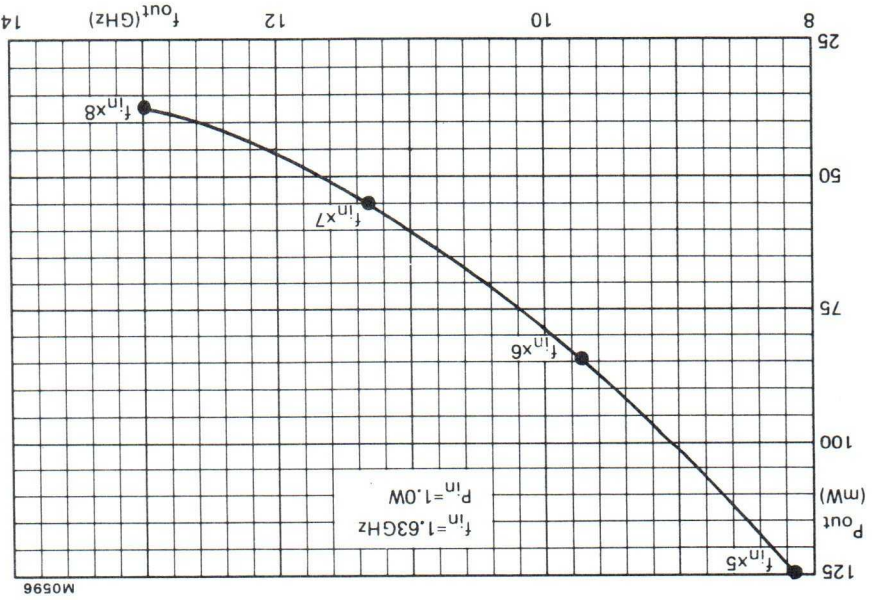
Notes

- The cut-off frequency  $f_{co}$  is defined as:  $f_{co} = \frac{2\pi f C_j}{1}$  where  $C_j$  is the junction capacitance and is measured at 1.0 MHz,  $f_s$  is measured on a slotted line at 8.0 GHz

MULTIPLIER PERFORMANCE

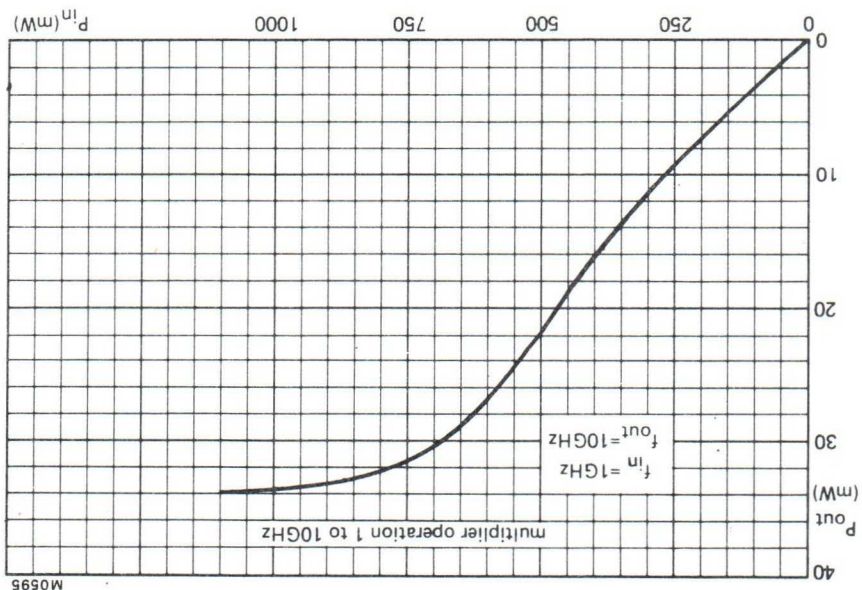
Power output,  $f_{in} = 1.0\text{ GHz}$   
 $P_{in} = 500\text{ mW}$ ,  $f_{out} = 10\text{ GHz}$

|           |      |    |      |    |      |
|-----------|------|----|------|----|------|
| $P_{out}$ | min. | 15 | typ. | 20 | max. |
|           |      |    |      |    | —    |
|           |      |    |      |    | mW   |



Typical performance in high order multipliers

Typical performance as a frequency multiplier



M0595

# STEP RECOVERY DIODES

Silicon planar varactor diodes exhibiting step recovery characteristics, especially suitable for use in frequency multipliers. They conform to the environmental requirements of BS9300 where applicable. This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS -

BXY35 BXY36 BXY37 BXY38 BXY39 BXY40 BXY41

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

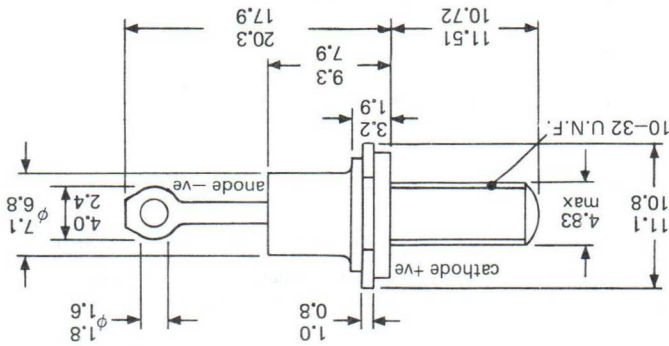
Devices may be selected from this range to suit customers' specific requirements, including further alternative packages.

## BXY35 to BXY41

## MECHANICAL DATA

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

Similar to JEDEC DO-4



Diameter of clearance hole: 5.2

Accessories supplied on request:

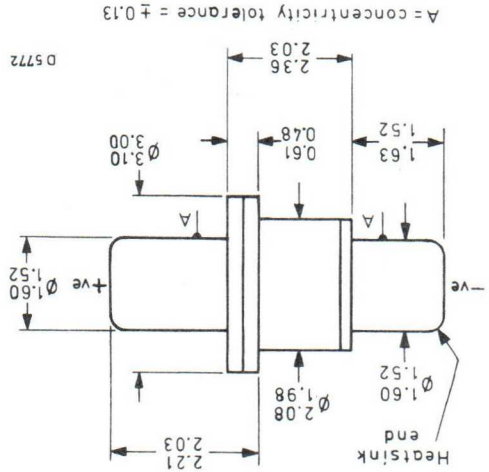
56295 ( PTFE bush, 2 mica washers, plain washer, tag)  
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer

Nut dimensions across the flats: 9.5

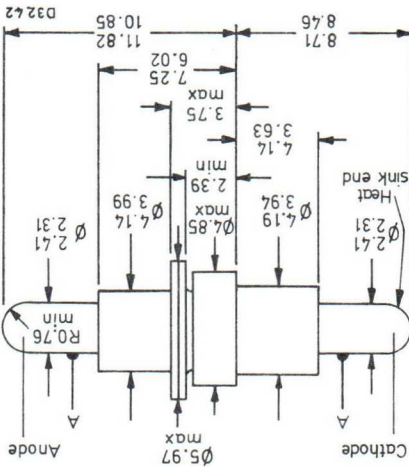
Outline B Conforms to SOD-31 and

BS3934 SO-86



A = concentricity tolerance =  $\pm 0.13$

05772

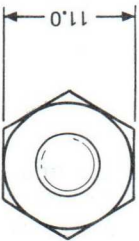


Outline C Conforms to SOD-43

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

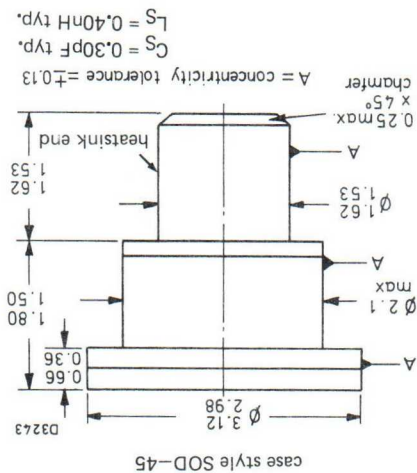
max. 1.7 Nm

M0403A



Dimensions in mm

### Outline E Conforms to SOD-45









# RATINGS

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

|                                                         |           |      |     |             |
|---------------------------------------------------------|-----------|------|-----|-------------|
| Storage temperature range                               | $T_{stg}$ | max. | 175 | -55 to +175 |
| Junction temperature                                    | $T_j$     | max. | 175 | -55 to +175 |
| D.C. reverse voltage                                    | $V_R$     | max. | 60  | 60          |
| Total power dissipation<br>$T_{hs}$ max. 50 °C (note 1) | $P_{tot}$ | max. | 5.2 | 6.6         |

## THERMAL RESISTANCE

Thermal resistance from junction to heatsink

## CHARACTERISTICS ( $T_{pin} = 25\text{ °C}$ )

Reverse breakdown voltage

$I_R = 10\text{ }\mu\text{A}$

Cut-off frequency

$V_R = 6\text{ V}$  (note 2)

Junction capacitance

$V_R = 6\text{ V}$ ,  $f = 1\text{ MHz}$

Stray capacitance

$C_s$  typ.

Series inductance

$L_s$  typ.

Transition time

$t_{tr}$  typ.

Lifetime

## MULTIPLIER PERFORMANCE

(note 3)

Low order multiplier efficiency

in a 2.1 to 4.2 GHz doubler

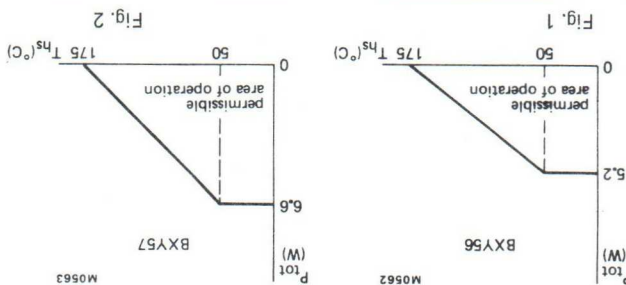
High order multiplier efficiency

in a 0.45 to 3.6 GHz

Bx multiplier

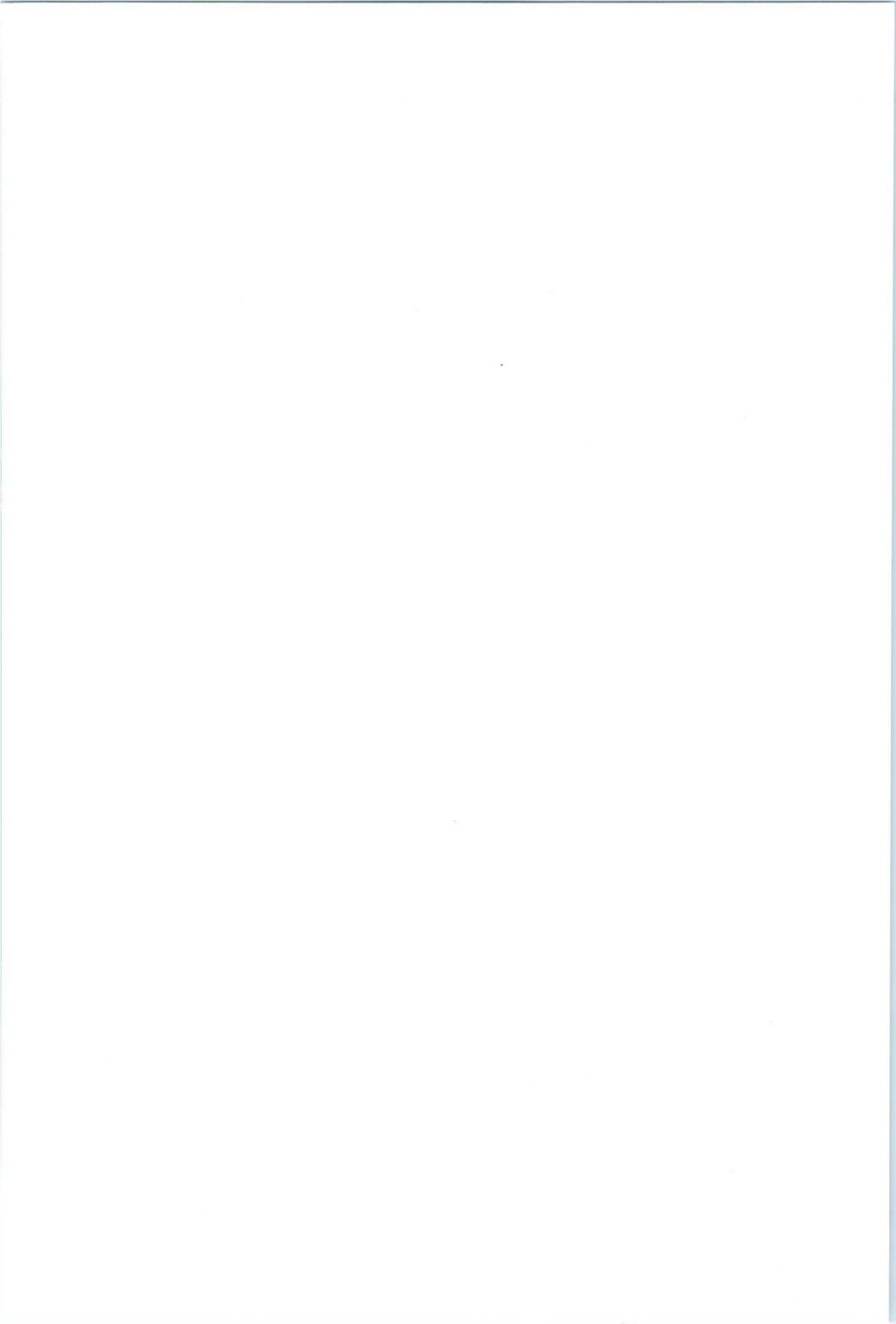
## Notes

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



## Notes (continued)

2. Cut-off frequency is measured using a slotted line system at 2 GHz.  $f_{co} = \frac{2\pi r_s C_f}{1}$
3. For high power applications it is essential that the heatsink end of the device is gripped by a collet or equivalent clamping system to ensure the best possible thermal conductivity. This in turn should be coupled to an adequate heatsink. Care must be taken to avoid unnecessary deformation of this diode pin, as this may cause cracking of the metal-ceramic hermetic seal. The location of the top cap should be a hold of diameter 1.8 to 2.2 mm bearing on the flange with a force not exceeding 10 N.



## GALLIUM ARSENIDE PARAMETRIC AMPLIFIER VARACTOR DIODE

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

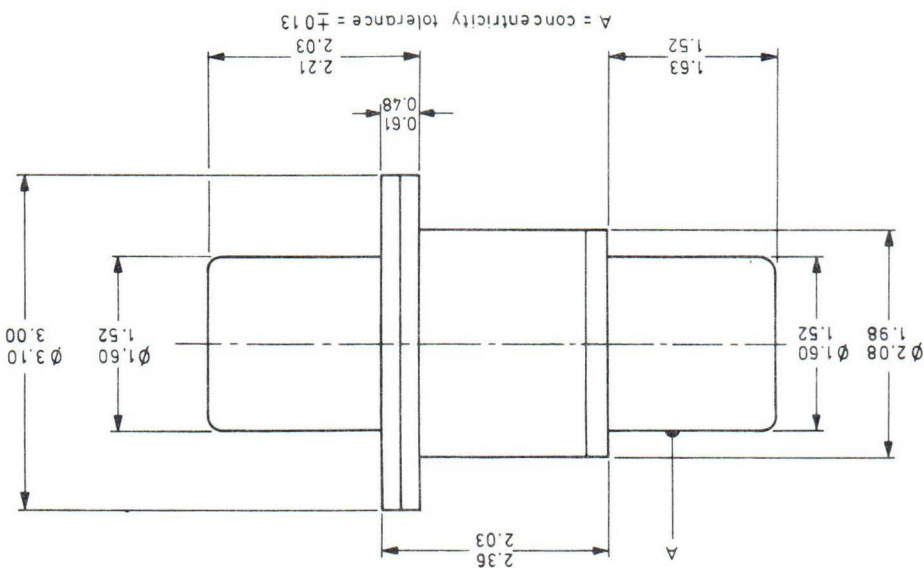
## QUICK REFERENCE DATA

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

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

## MECHANICAL DATA

Conforms to SOD-31 and BS3934 SO-86



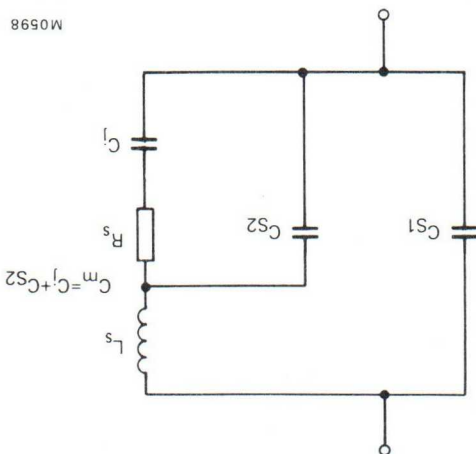
## RATINGS

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

|                                                                            | $T_{stg}$    | $T_j$        | $V_R$ | $I_F(AV)$ | $P_{tot}$ | CHARACTERISTICS ( $T_{amb} = 25^{\circ}C$ ) |  |  |  |  |
|----------------------------------------------------------------------------|--------------|--------------|-------|-----------|-----------|---------------------------------------------|--|--|--|--|
| Storage temperature range                                                  | -196 to +150 |              |       |           |           |                                             |  |  |  |  |
| Junction temperature operating range                                       |              | -196 to +150 |       |           |           |                                             |  |  |  |  |
| D.C. reverse voltage                                                       |              |              | max.  |           |           |                                             |  |  |  |  |
| Average forward current                                                    |              |              |       | max.      |           |                                             |  |  |  |  |
| Total power dissipation                                                    |              |              |       |           | max.      |                                             |  |  |  |  |
| $T_{stud} \leq 107^{\circ}C$                                               |              |              |       |           |           |                                             |  |  |  |  |
| Reverse current, $V_R = 6.0 V$                                             |              |              |       |           |           |                                             |  |  |  |  |
| Forward voltage drop                                                       |              |              |       |           |           |                                             |  |  |  |  |
| $I_F = 1.0 \mu A$ (note 3)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| Series resonant frequency                                                  |              |              |       |           |           |                                             |  |  |  |  |
| $V_R = 0$ (notes 1 and 2)                                                  |              |              |       |           |           |                                             |  |  |  |  |
| Cut-off frequency                                                          |              |              |       |           |           |                                             |  |  |  |  |
| $V_R = 0$ (note 2)                                                         |              |              |       |           |           |                                             |  |  |  |  |
| Cut-off frequency                                                          |              |              |       |           |           |                                             |  |  |  |  |
| $V_R = 6.0 V$ (note 2)                                                     |              |              |       |           |           |                                             |  |  |  |  |
| Effective diode capacitance at X-band frequency, $V_R = 0$ (notes 1 and 2) |              |              |       |           |           |                                             |  |  |  |  |
| Capacitance variation coefficient                                          |              |              |       |           |           |                                             |  |  |  |  |
| (note 3)                                                                   |              |              |       |           |           |                                             |  |  |  |  |
| Stray capacitance (note 1)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| CS1                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| Stray capacitance (note 1)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| CS2                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| Series inductance (note 1)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| $L_s$                                                                      |              |              |       |           |           |                                             |  |  |  |  |
| $\gamma$                                                                   | 0.12         | 0.15         |       |           |           |                                             |  |  |  |  |
| $C_{mo}$                                                                   | 0.3          | 0.4          |       |           |           |                                             |  |  |  |  |
| Capacitance variation coefficient                                          |              |              |       |           |           |                                             |  |  |  |  |
| $f_{co}$                                                                   | 125          | 150          |       |           |           |                                             |  |  |  |  |
| GHz                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| $f_{co}$                                                                   |              | 240          |       |           |           |                                             |  |  |  |  |
| GHz                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| $f_o$                                                                      | 8.9          | 10           |       |           |           |                                             |  |  |  |  |
| GHz                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| $V_F$                                                                      |              | 0.9          |       |           |           |                                             |  |  |  |  |
| V                                                                          |              |              |       |           |           |                                             |  |  |  |  |
| $I_R$                                                                      |              |              |       |           |           |                                             |  |  |  |  |
| $\mu A$                                                                    |              |              |       |           |           |                                             |  |  |  |  |
| Reverse current, $V_R = 6.0 V$                                             |              |              |       |           |           |                                             |  |  |  |  |
| Forward voltage drop                                                       |              |              |       |           |           |                                             |  |  |  |  |
| $I_F = 1.0 \mu A$ (note 3)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| Series resonant frequency                                                  |              |              |       |           |           |                                             |  |  |  |  |
| $V_R = 0$ (notes 1 and 2)                                                  |              |              |       |           |           |                                             |  |  |  |  |
| Cut-off frequency                                                          |              |              |       |           |           |                                             |  |  |  |  |
| $V_R = 0$ (note 2)                                                         |              |              |       |           |           |                                             |  |  |  |  |
| Cut-off frequency                                                          |              |              |       |           |           |                                             |  |  |  |  |
| $V_R = 6.0 V$ (note 2)                                                     |              |              |       |           |           |                                             |  |  |  |  |
| Effective diode capacitance at X-band frequency, $V_R = 0$ (notes 1 and 2) |              |              |       |           |           |                                             |  |  |  |  |
| Capacitance variation coefficient                                          |              |              |       |           |           |                                             |  |  |  |  |
| (note 3)                                                                   |              |              |       |           |           |                                             |  |  |  |  |
| Stray capacitance (note 1)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| CS1                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| Stray capacitance (note 1)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| CS2                                                                        |              |              |       |           |           |                                             |  |  |  |  |
| Series inductance (note 1)                                                 |              |              |       |           |           |                                             |  |  |  |  |
| $L_s$                                                                      |              |              |       |           |           |                                             |  |  |  |  |

## Notes

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



M0598

2. Measured at and about the series resonant frequency, in a suitable waveguide holder, enable the values of  $f_0$  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.

$f_{co} = Q_0 f_0$  where  $f_0$  is the series resonant frequency  
 $Q_0$  is the  $Q$  factor at zero bias

$$C_{mo} = \frac{4\pi^2 f_0^2 L_s}{1}$$

3. The capacitance variation coefficient  $\gamma$  is defined as

$$\gamma = \frac{2(C_{m \max.} - C_{m \min.})}{C_{m \max.} + C_{m \min.}}$$

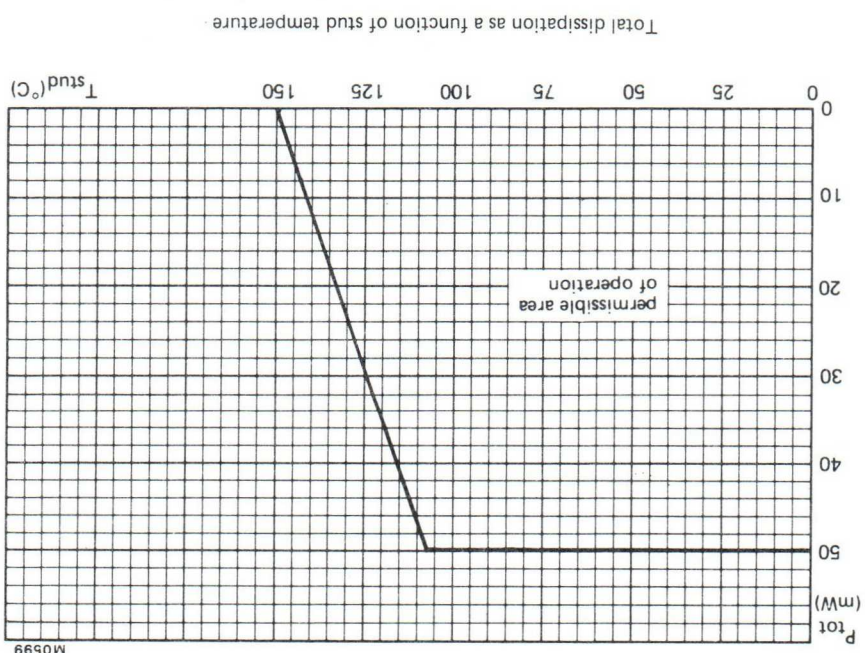
where  $C_{m \min.}$  = effective capacitance at  $V_R = 1.0$  V  
 $C_{m \max.}$  = effective capacitance at  $I_F = 1.0$   $\mu$ A

This can be re-written in the form

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

where  $V = V_F$  at  $1.0$   $\mu$ A  
 $C_{jo} = C_{mo} - C_{S2}$





GALLIUM ARSENIDE PARAMETRIC AMPLIFIER VARACTOR DIODE

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

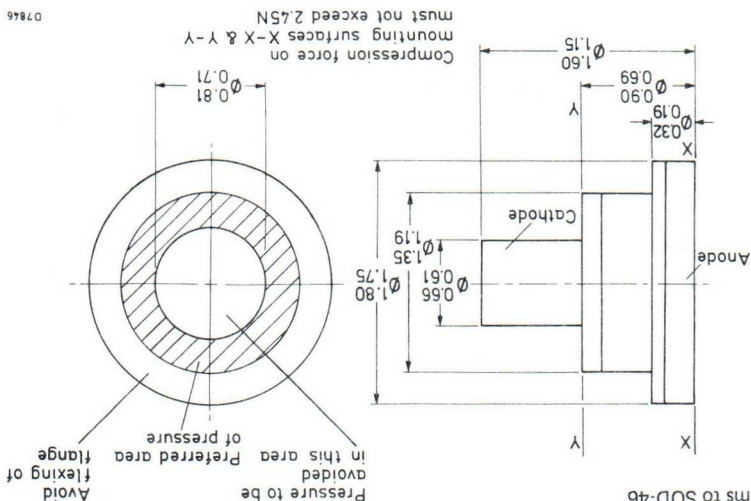
## QUICK REFERENCE DATA

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

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

## MECHANICAL DATA

Conforms to SOD-46



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

RATINGS

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

|                                         |                 |              |       |
|-----------------------------------------|-----------------|--------------|-------|
| Storage temperature range               | $T_{stg}$       | -196 to +175 | °C    |
| Junction temperature operating range    | $T_j$           | -196 to +135 | °C    |
| D.C. reverse voltage                    | $V_R$           | max.         | V     |
| Total power dissipation                 | $P_{tot}$       | max.         | mW    |
| $T_{pin} \leq 25\text{ °C}$             |                 |              |       |
| Thermal resistance from junction to pin | $R_{th\ j-pin}$ | max.         | °C/mW |

CHARACTERISTICS ( $T_{amb} = 25\text{ °C}$ )

|                                                                       |                 |      |      |      |          |
|-----------------------------------------------------------------------|-----------------|------|------|------|----------|
| Reverse current, $V_R = 6.0\text{ V}$                                 | $I_R$           | min. | typ. | max. | $\mu A$  |
| Series resonant frequency                                             | $f_{res}$       | 27   | 30   | 34   | GHz      |
| Cut-off frequency                                                     | $f_{co}$        | 200  | 350  | —    | GHz      |
| Product of capacitance variation coefficient and cut-off frequency    | $\gamma f_{co}$ | 35   | 50   | —    | GHz      |
| Microwave value of effective device series resistance (notes 1 and 4) | $R_m$           | —    | 2.25 | —    | $\Omega$ |
| Microwave value of effective device capacitance                       | $C_m$           | —    | 0.2  | —    | pF       |
| Stray capacitance (L.F. measurement)                                  | $C_s$           | —    | 0.3  | —    | pF       |
| series inductance (note 3)                                            | $L_s$           | —    | 140  | —    | pH       |

Notes

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

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

where  $C_m \text{ min.}$  = effective capacitance at  $V_R = 1.0\text{ V}$   
 $C_m \text{ max.}$  = effective capacitance at  $I_P = 1.0\text{ }\mu A$

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

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

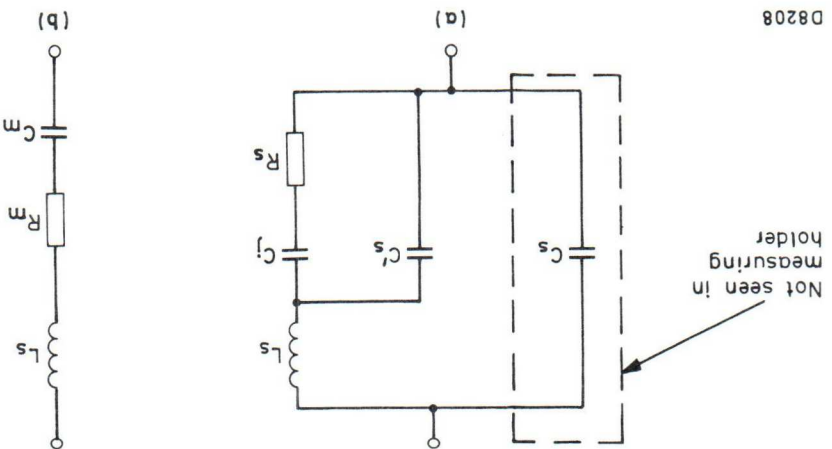
$L_s$  is also calculated using  $f_{res}$  and  $C_m$ :

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

Notes (continued)

4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.



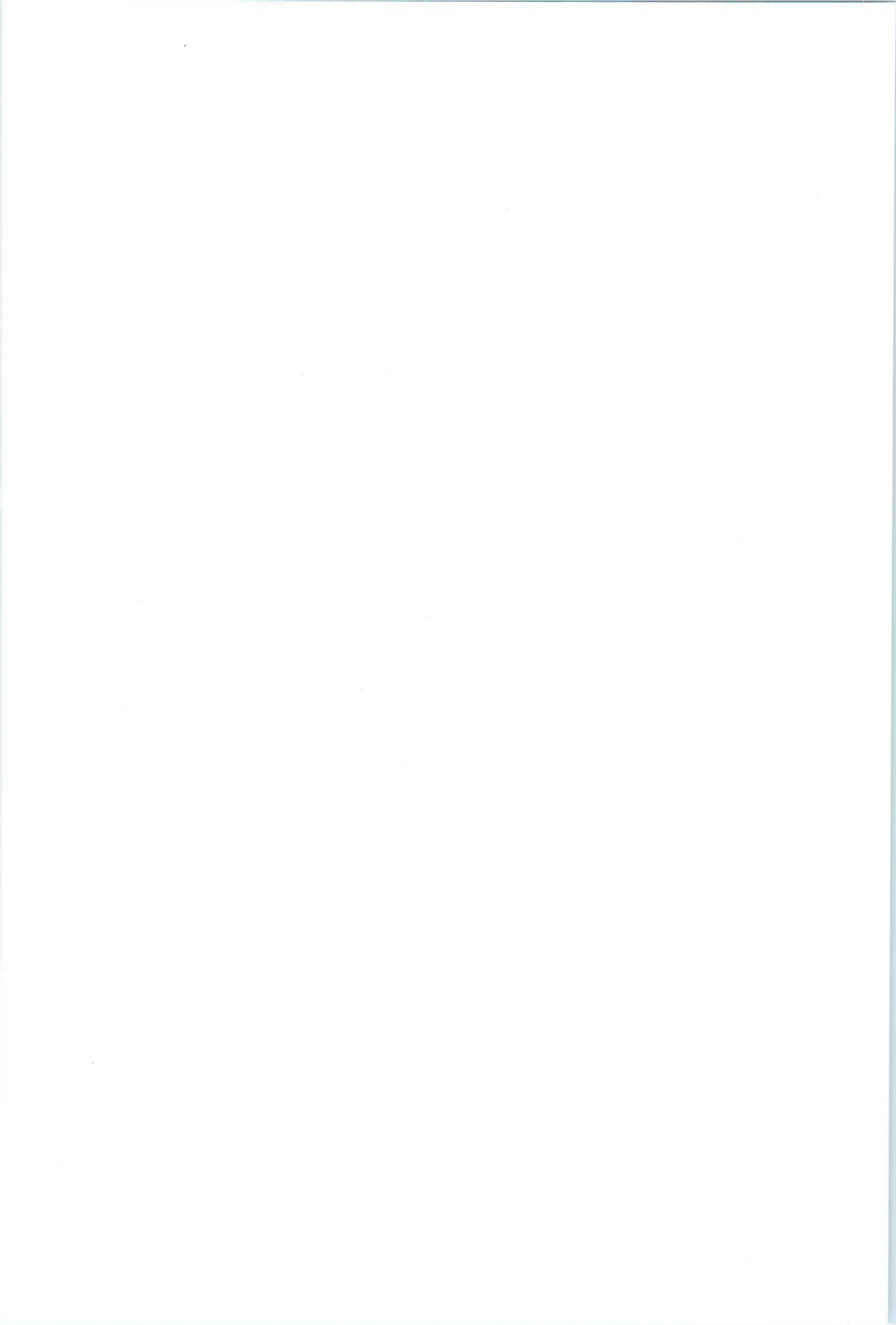
D8208

Operating note

The CXY10 varactor diode will give good noise performance in a parametric amplifier of suitable design. For example:  
The effective input noise temperature of the amplifier, less the contribution due to the circulator, would be typically 200 °K and a maximum of 250 °K, with the amplifier at room temperature under the following conditions:

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

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



# GALLIUM ARSENIDE MULTIPLIER VARACTOR DIODE

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

## QUICK REFERENCE DATA

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

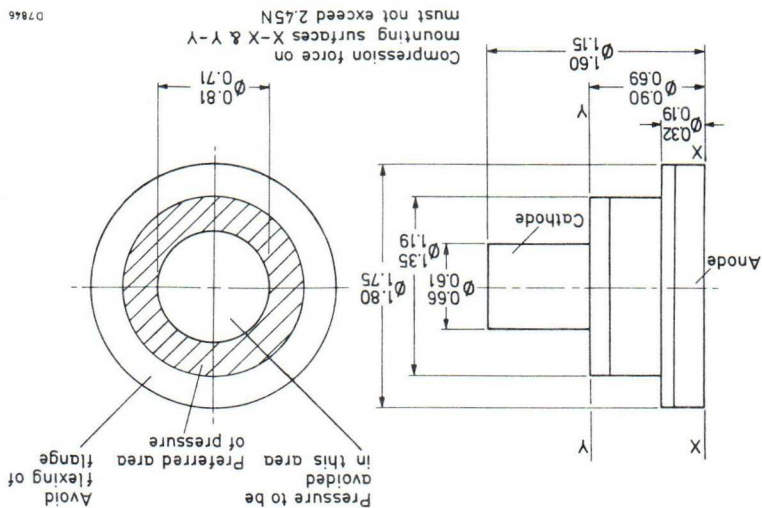
|                                            |           |      |     |     |
|--------------------------------------------|-----------|------|-----|-----|
| Input r.f. power                           | $P_{in}$  | max. | 500 | mW  |
| Output r.f. power                          | $P_{out}$ | min. | 50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

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

## MECHANICAL DATA

Conforms to SOD-46

Dimensions in mm



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

07846

# RATINGS

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

Storage temperature range

$T_{stg}$

-55 to +175

Junction temperature

$T_j$

max. 175

D.C. reverse voltage

$V_R$

max. 10

Total power dissipation  
 $T_{pin} = 25^\circ\text{C}$  (note 1)

$P_{tot}$

max. 300

Input power  $R_F$

$P_{in}$

max. 500

## THERMAL RESISTANCE

Thermal resistance from junction to pin

$R_{th\ j-pin}$

max.

0.5  $^\circ\text{C}/\text{mW}$

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

Reverse breakdown voltage

$V_{(BR)R}$

10

min. typ. max.

Reverse current,  $V_R = 6.0\text{ V}$

$I_R$

—

0.001

1.0  $\mu\text{A}$

Series resonance frequency

$f_{res}$

27

29

35

GHz

Cut-off frequency

$f_{co}$

300

500

—

GHz

Microwave value of effective device capacitance

$C_m$

—

0.25

—

pF

Microwave value of effective device series resistance

$R_m$

—

1.3

—

$\Omega$

Stray case capacitance  
(L.F. measurement)

$C_s$

—

0.3

—

pF

Microwave value of effective device series inductance (note 3)

$L_s$

—

120

—

pH

## Notes

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



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

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

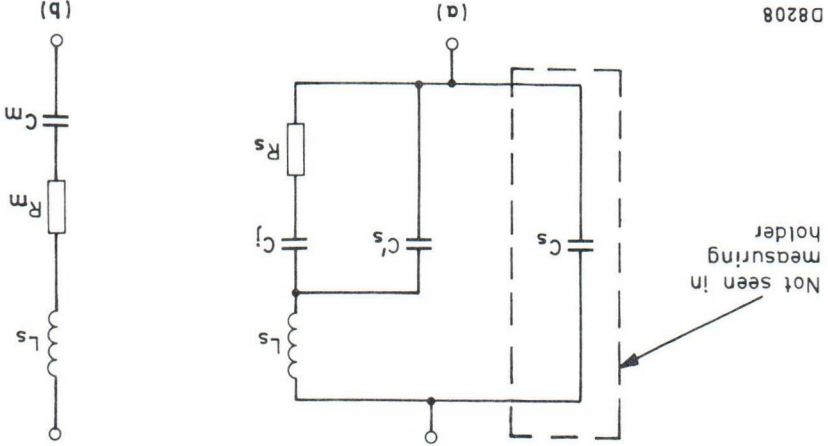
$$C_m = \frac{2\pi R_m f_{co}}{1}$$

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

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

4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.

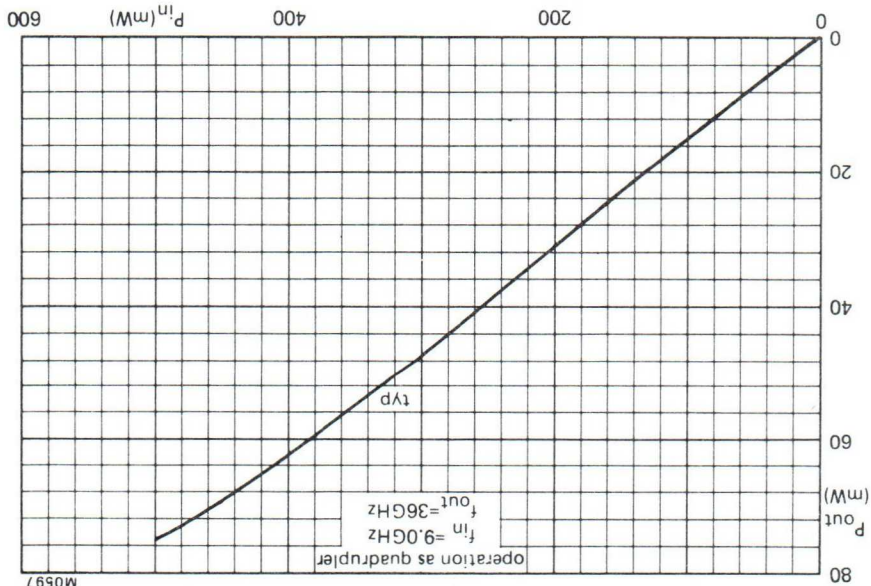


D8208

# Application note

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

Output power as a function of input power  
Quadrupler operation



M0597

## STEP RECOVERY DIODES

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

### QUICK REFERENCE DATA

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

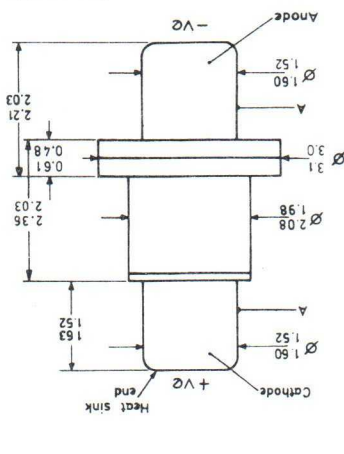
|                                  |           |      |     |
|----------------------------------|-----------|------|-----|
| Input r.f. power                 | $P_{in}$  | 12   | W   |
| Output r.f. power                | $P_{out}$ | 6.0  | W   |
| Resistive cut-off frequency      | $f_{co}$  | typ.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

Unless otherwise stated, data is applicable to both types.

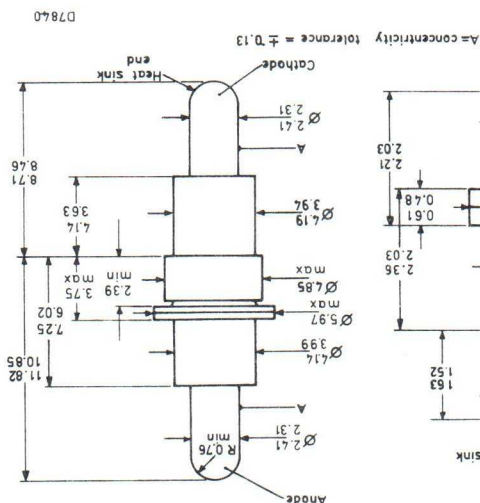
This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS — MICROWAVE SEMICONDUCTORS

### MECHANICAL DATA

1N5152  
Conforms to BS934 SO-86 and to SOD-31



1N5153  
Conforms to SOD-43



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

RATINGS

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

|                                                                                                 |                |             |               |
|-------------------------------------------------------------------------------------------------|----------------|-------------|---------------|
| Storage temperature range                                                                       | $T_{stg}$      | -55 to +175 | °C            |
| Junction temperature                                                                            | $T_j$          | max.        | °C            |
| D.C. reverse voltage                                                                            | $V_R$          | max.        | V             |
| Total power dissipation $R.F.$ , $T_{pin} \leq 70^\circ\text{C}$                                | $P_{tot}$      | max.        | W             |
| THERMAL RESISTANCE                                                                              |                |             |               |
| Thermal resistance from junction to pin                                                         | $R_{th j-pin}$ | max.        | °C/W          |
| CHARACTERISTICS ( $T_{amb} = 25^\circ\text{C}$ )                                                |                |             |               |
| Reverse breakdown voltage, $I_R = 10\ \mu\text{A}$                                              | $V_{(BR)R}$    | min.        | V             |
| Reverse current, $V_R = 60\ \text{V}$                                                           | $I_R$          | —           | $\mu\text{A}$ |
| Forward voltage, $I_F = 10\ \text{mA}$                                                          | $V_F$          | —           | V             |
| Cut-off frequency, $V_R = 6.0\ \text{V}$ ,<br>$f_{measured} = 2.0\ \text{GHz}$                  | $f_{co}$       | 55          | GHz           |
| Total capacitance<br>$V_R = 6.0\ \text{V}$ , $f = 1.0\ \text{MHz}$                              | $C_T$          | 5.0         | pF            |
| Overall efficiency<br>$P_{in} = 12\ \text{W}$ , $f_{in} = 1.0\ \text{GHz}$<br>frequency doubler | $\eta$         | 50          | %             |

# STEP RECOVERY DIODE

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

## QUICK REFERENCE DATA

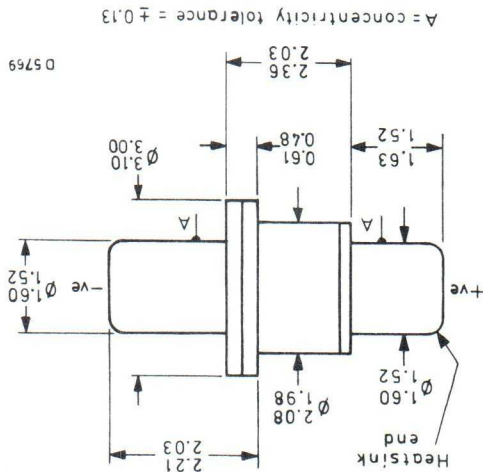
Operating as a frequency tripler 2 to 6 GHz in a typical circuit.

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

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

## MECHANICAL DATA

Conforms to BS3934 SO-86 and to SOD-31



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

# RATINGS

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

|                                                                             |                 |             |               |
|-----------------------------------------------------------------------------|-----------------|-------------|---------------|
| Storage temperature range                                                   | $T_{stg}$       | -55 to +175 | °C            |
| Junction temperature                                                        | $T_j$           | max.        | °C            |
| D.C. reverse voltage                                                        | $V_R$           | max.        | V             |
| Total power dissipation R.F.                                                | $P_{tot}$       | max.        | W             |
| THERMAL RESISTANCE                                                          |                 |             |               |
| $T_{pin} \leq 70^\circ\text{C}$                                             |                 |             |               |
| Thermal resistance from junction to pin                                     | $R_{th\ j-pin}$ | max.        | °C/W          |
| CHARACTERISTICS ( $T_{amb} = 25^\circ\text{C}$ )                            |                 |             |               |
| Reverse breakdown voltage, $I_R = 10\ \mu\text{A}$                          | $V_{(BR)R}$     | min.        | V             |
| Reverse current, $V_R = 26\ \text{V}$                                       | $I_R$           | —           | $\mu\text{A}$ |
| Forward voltage, $I_F = 10\ \text{mA}$                                      | $V_F$           | —           | V             |
| Cut-off frequency, $V_R = 6.0\ \text{V}$ , $f_{measured} = 2.0\ \text{GHz}$ | $f_{co}$        | 100         | GHz           |
| Total capacitance                                                           | $C_T$           | 1.0         | pF            |
| Overall efficiency                                                          | $\eta$          | 40          | %             |
| $P_{in} = 5.0\ \text{W}$ , $f_{in} = 2.0\ \text{GHz}$ , frequency tripler   |                 |             |               |

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

## QUICK REFERENCE DATA

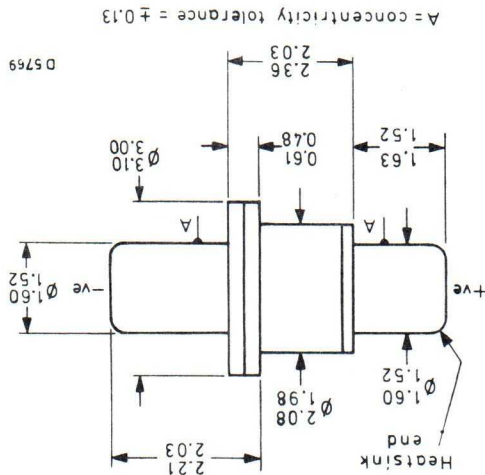
Operating as a frequency doubler 5 to 10 GHz in a typical circuit.

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

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

## MECHANICAL DATA

Conforms to BS3934 SO-86 and to SOD-31



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



RATINGS

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

Storage temperature range

Junction temperature

D.C. reverse voltage

Total power dissipation R.F.

$T_{pin} \leq 70^{\circ}C$

THERMAL RESISTANCE

Thermal resistance from junction to pin

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

Reverse breakdown voltage,  $I_R = 10 \mu A$

Reverse current,  $V_R = 16 V$

Forward voltage,  $I_F = 10 mA$

Cut-off frequency,  $V_R = 6.0 V$

$f_{measured} = 8.0 GHz$

Total capacitance

Overall efficiency

$P_{in} = 2.6 W, f_{in} = 5.0 GHz$

frequency doubler

|                |      |      |      |      |      |      |      |
|----------------|------|------|------|------|------|------|------|
| $T_{stg}$      | max. | max. | max. | max. | min. | typ. | max. |
| $T_j$          | max. | max. | max. | max. | min. | typ. | max. |
| $V_R$          | max. | max. | max. | max. | min. | typ. | max. |
| $P_{tot}$      | max. | max. | max. | max. | min. | typ. | max. |
| $R_{th j-pin}$ | max. | max. | max. | max. | min. | typ. | max. |
| $V_{(BR)R}$    | 20   | —    | —    | —    | —    | —    | —    |
| $I_R$          | —    | —    | —    | —    | —    | —    | —    |
| $V_F$          | —    | —    | —    | —    | —    | —    | —    |
| $f_{co}$       | 180  | 200  | —    | —    | —    | —    | —    |
| $C_T$          | 0.6  | —    | —    | —    | —    | —    | —    |
| $\eta$         | 38   | —    | —    | —    | —    | —    | —    |

# TUNING VARACTOR DIODES



# SILICON PLANAR VARACTOR TUNING DIODES

This is a range of planar epitaxial varactor tuning diodes with highly reproducible abrupt junction performance. The devices are specifically designed for frequency tuning in military and professional applications where high stability is essential.

A  $\pm 10\%$  capacitance tolerance is supplied as standard; closer tolerances are available on request. This series of diodes is available in a wide range of ceramic packages, including those shown here. They conform to the environmental requirements of BS CECC 50.006-010 where applicable.

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

## RATINGS

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

| Storage temperature range | Ambient temperature range for operation | Reverse voltage |
|---------------------------|-----------------------------------------|-----------------|
| -65 to +150 °C            | -65 to +150 °C                          | 20 V            |
|                           |                                         | max. 30 V       |
|                           |                                         | 40 V            |

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

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

Notes

- The customer should specify the required total capacitance value and measurement voltage (0 or -4 V). A  $\pm 10\%$  capacitance tolerance is supplied as standard; closer tolerances are available on request.  
 Capacitance is measured at 1 MHz.
- All junctions are abrupt and obey the following law:

$$C_T = C_{j0} \left( 1 + \frac{\phi}{V_R} \right)^{-n} + C_s$$

where  $C_T$  is total capacitance

$C_{j0}$  is zero bias junction capacitance

$V_R$  is reverse voltage

$\phi$  is 0.65 V, typically

$n$  is 0.46, typically

$C_s$  is package capacitance

- Measurements at microwave frequencies are converted to  $\Omega$  at 50 MHz.
- Case parasitics  $C_s$  and  $L_s$  are shown on the outline drawings.

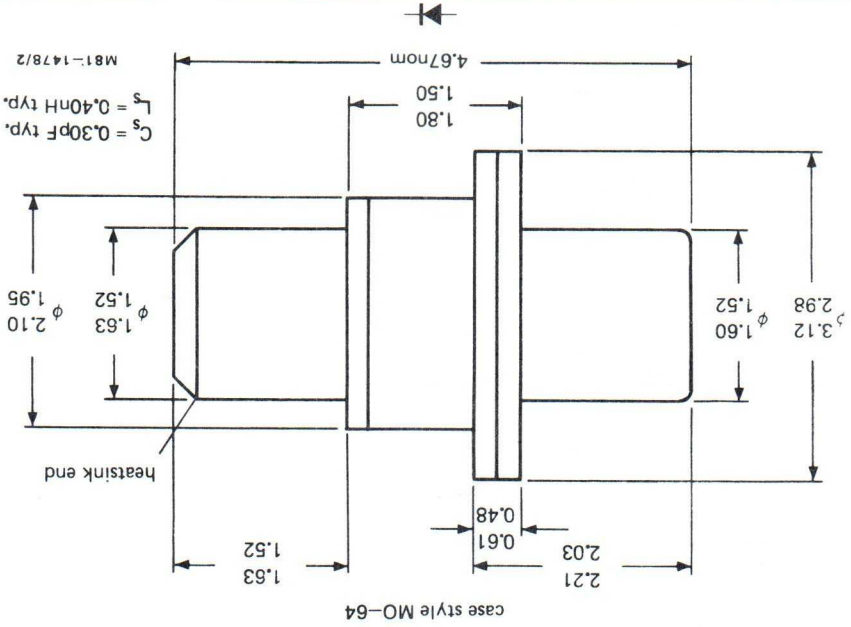
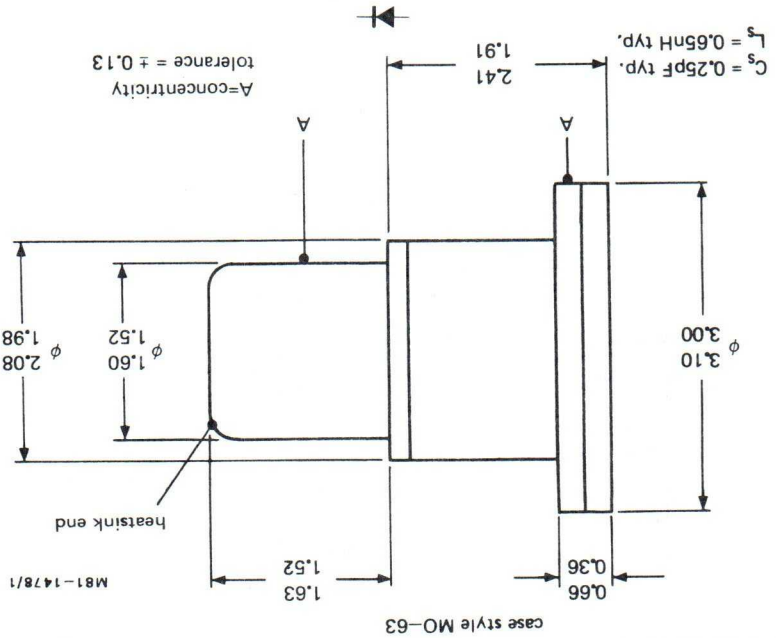
Ordering information

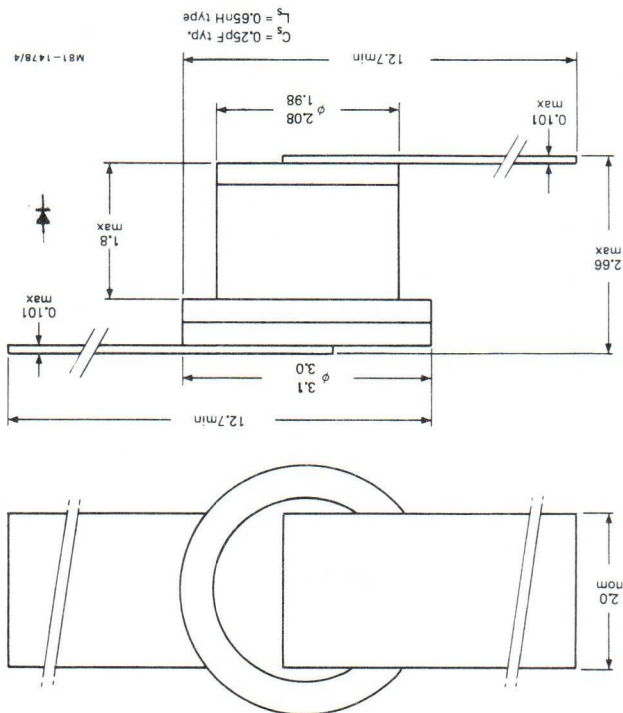
When ordering, please specify:

- Reverse breakdown voltage.
- Total capacitance and measurement voltage.
- Capacitance tolerance.
- Case style.

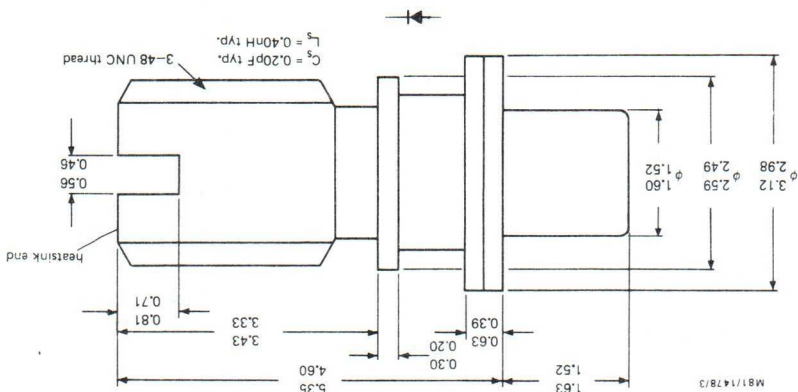
## MECHANICAL DATA

Dimensions in mm



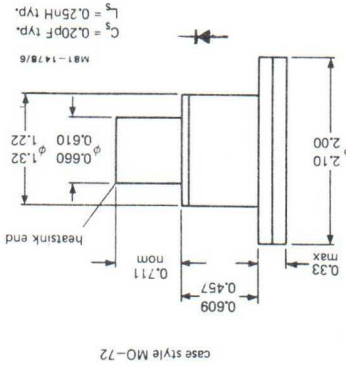


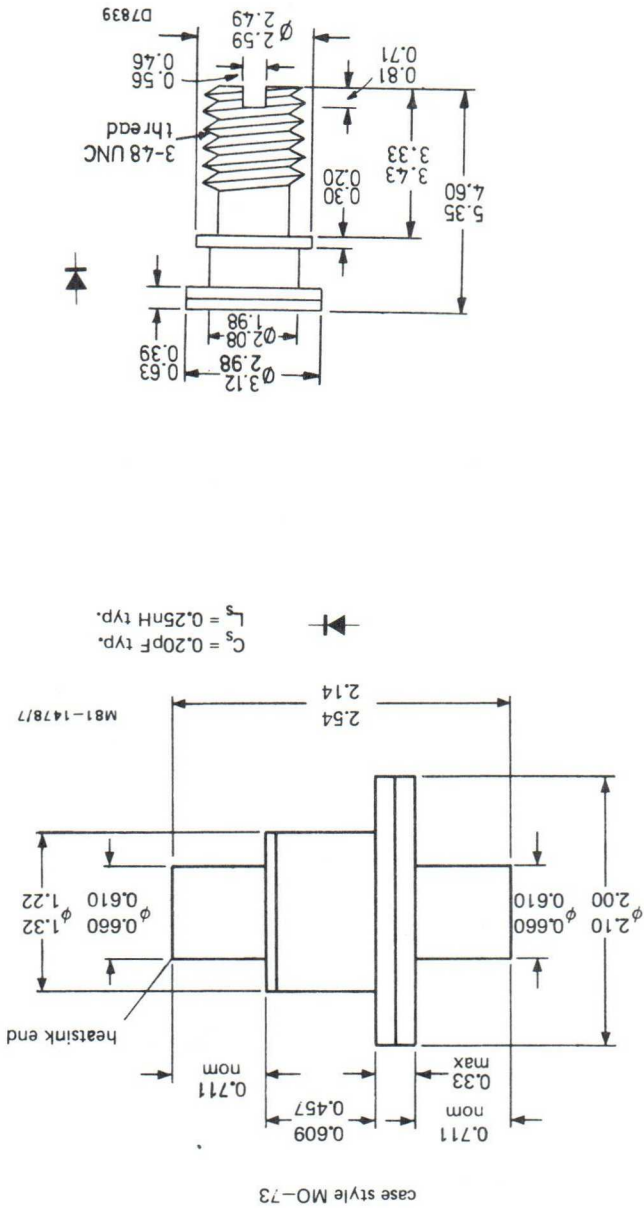
case style MO-66

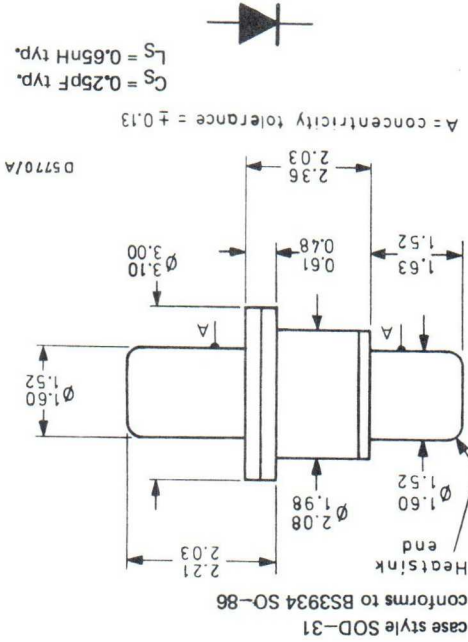
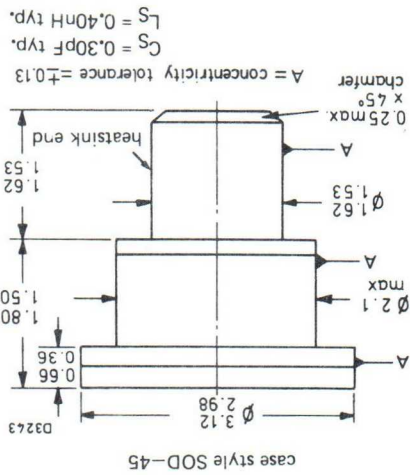


case style MO-65











# GALLIUM ARSENIDE TUNING DIODES

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

This series of diodes is available in a wide range of ceramic packages.

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

## RATINGS

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

| CHARACTERISTICS ( $T_{amb} = 25^\circ C$ ) |                                         |                 |  |
|--------------------------------------------|-----------------------------------------|-----------------|--|
| Storage temperature range                  | Ambient temperature range for operation | Reverse voltage |  |
| —55 to +150 °C                             | —55 to +150 °C                          | max. 30 V       |  |
| $T_{stg}$                                  | $T_{amb}$                               | $V_R$           |  |

| Reverse breakdown voltage, $I_R = 10 \mu A$ | Junction capacitance, 0 V (note 1) | Junction capacitance, —4 V (note 1) | Capacitance law (note 2) | Q at —4 V (note 3) |
|---------------------------------------------|------------------------------------|-------------------------------------|--------------------------|--------------------|
| $V_{(BR)R}$                                 | $C_j$                              | $C_j$                               |                          |                    |
| min. 35 V                                   | 0.6                                | —                                   | 0.3                      | —                  |
| typ. —                                      | —                                  | —                                   | —                        | —                  |
| max. —                                      | —                                  | —                                   | —                        | —                  |
|                                             |                                    |                                     |                          | 6000               |

## Notes

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

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

$$C_T = C_{j0} \left( 1 + \frac{\phi}{V_R} \right)^{-n} + C_s$$

where  $C_T$  is total capacitance

$C_{j0}$  is zero bias junction capacitance

$V_R$  is reverse voltage

$\phi$  is 0.65 V typically

$n$  is 0.46, typically

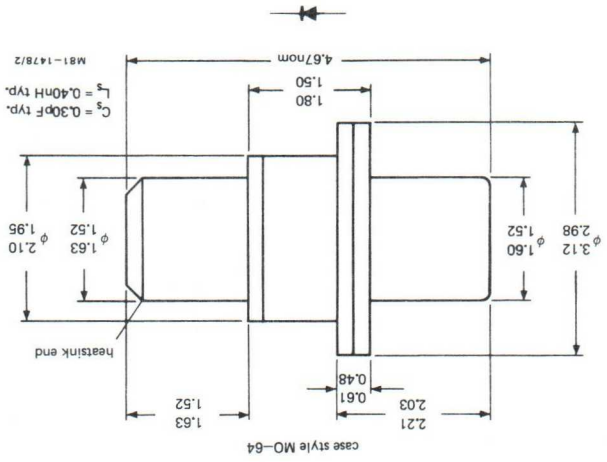
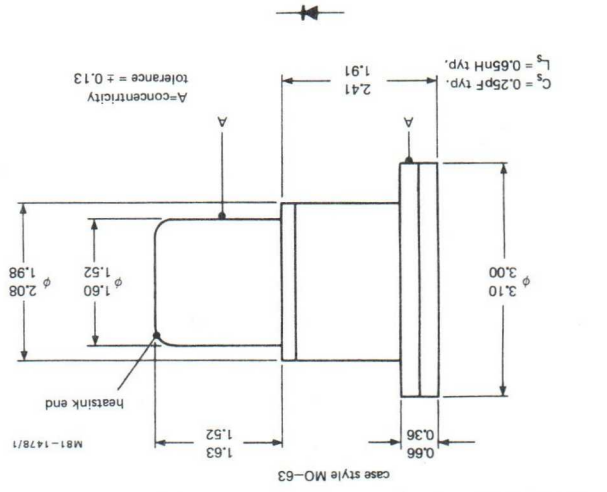
$C_s$  is package capacitance

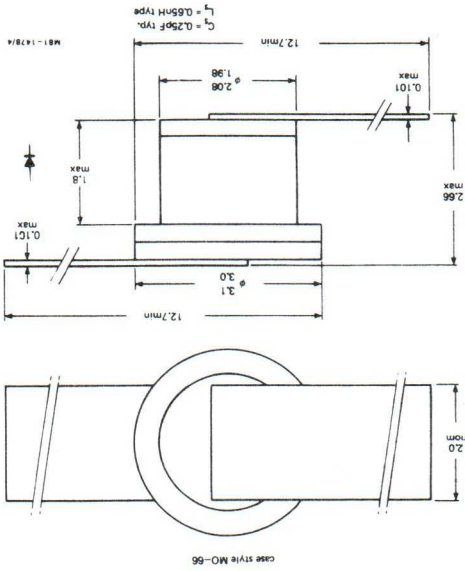
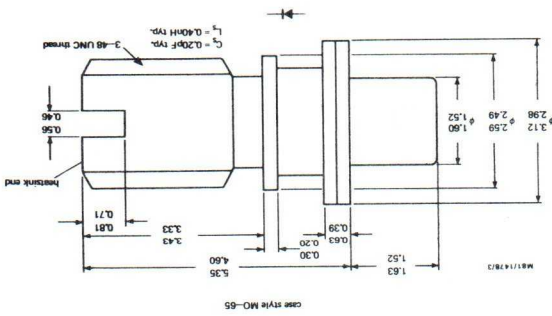
- Measurements at microwave frequencies are converted to  $\Omega$  at 50 MHz.
- Case parasitics  $C_s$  and  $L_s$  are shown on the outline drawings.

Ordering Information

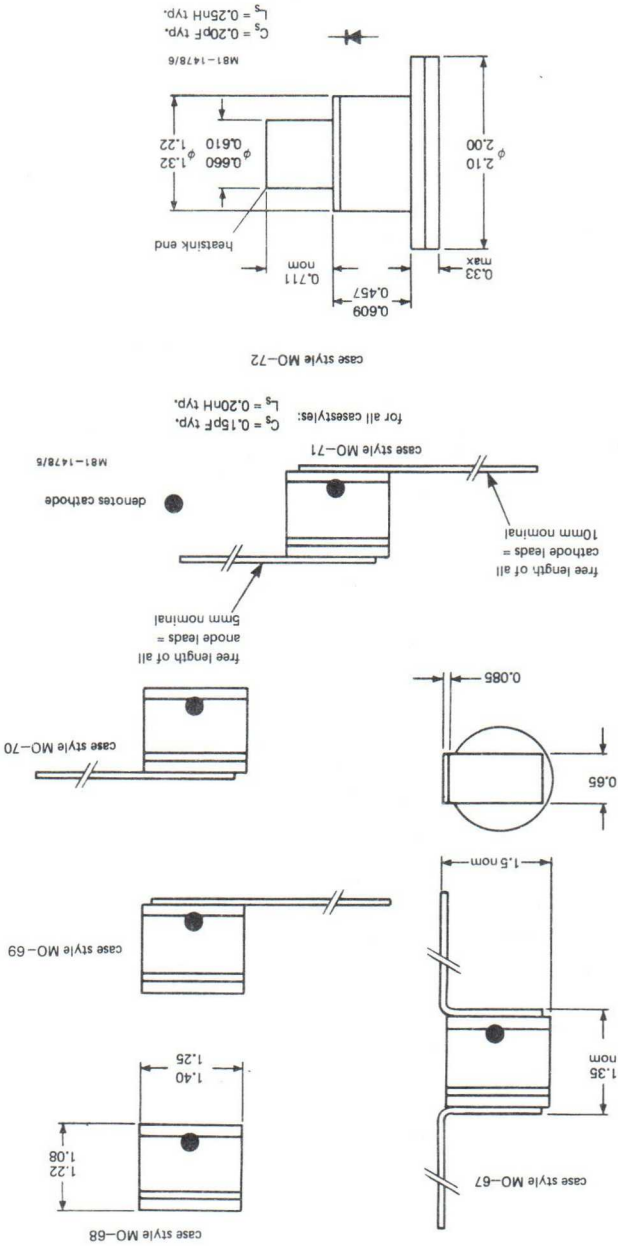
When ordering, please specify:

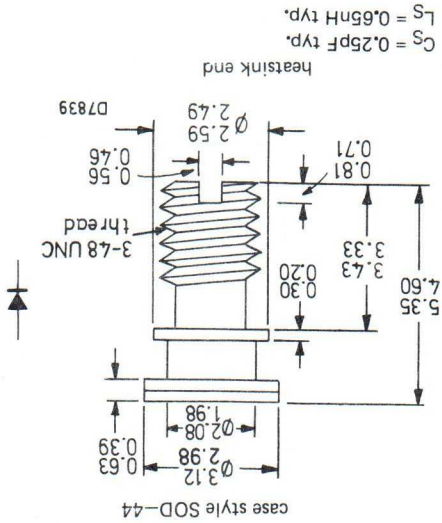
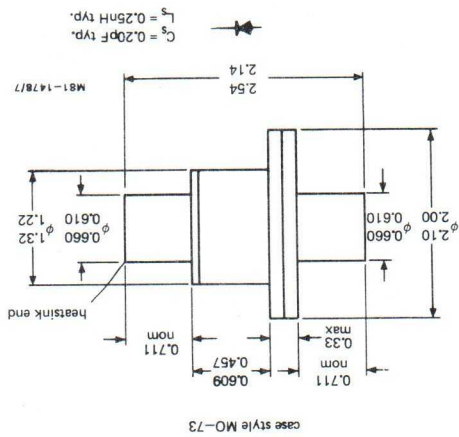
1. Total capacitance and measurement voltage.
2. Capacitance tolerance.
3. Case style.

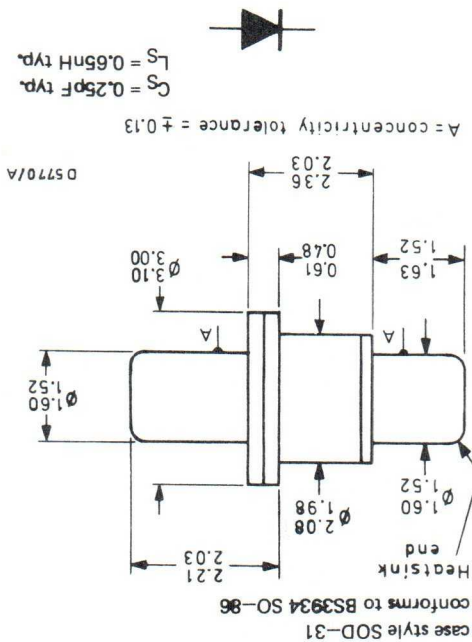
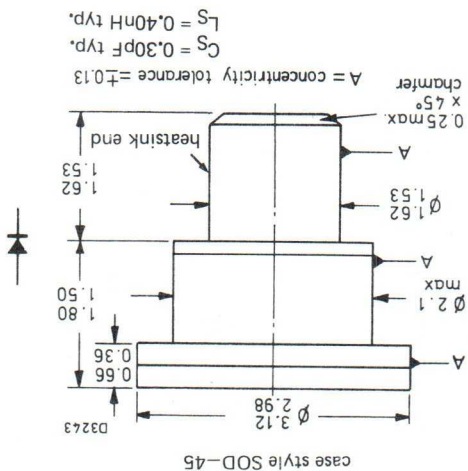












# GALLIUM ARSENIDE HYPER-ABRUPT VARACTOR DIODES

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

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

## RATINGS

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

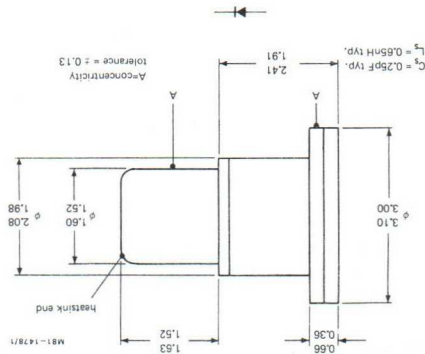
| Storage temperature | $T_{stg}$   | Ambient temperature range for operation | $T_{amb}$   |
|---------------------|-------------|-----------------------------------------|-------------|
| °C                  | °C          | °C                                      | °C          |
| —55 to +150         | —55 to +100 | —55 to +100                             | —55 to +100 |

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

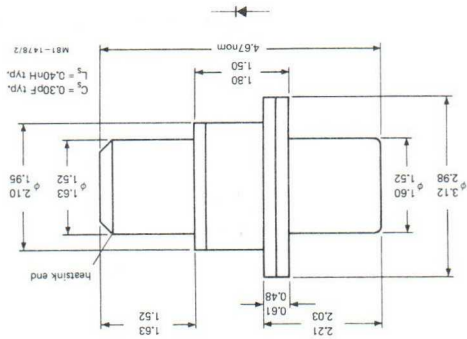
| Reverse breakdown voltage, $I_R = 10\ \mu\text{A}$ | $V_{(BR)R}$ | min. | typ. | max. |
|----------------------------------------------------|-------------|------|------|------|
| 15                                                 | —           | —    | —    | —    |
| Capacitance ratio $C_T(0\ \text{V})$               | $C_T$       | 0.8  | —    | 10   |
| Total capacitance, $-2\ \text{V}$ (notes 1 and 2)  | $C_T$       | —    | —    | —    |
| at 1 pF                                            | at 1 pF     | 6:1  | —    | —    |
| at 5 pF                                            | at 5 pF     | 10:1 | —    | —    |
| at 10 pF                                           | at 10 pF    | 12:1 | —    | —    |
| $C_T = 1\ \text{pF}$                               | 3000        | —    | —    | —    |
| $C_T = 10\ \text{pF}$                              | 1000        | —    | —    | —    |

## NOTES

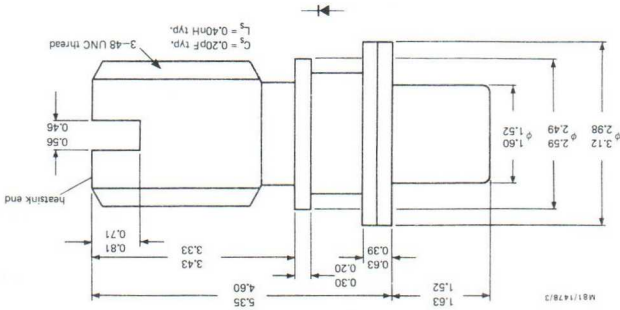
1. Capacitance is measured at 1 MHz in case style SOD-31.
  2. Other capacitances can be made available on request within these limits.
  3. Measurements at microwave frequencies are converted to Q at 50 MHz.
  4. Case parasitics  $C_S$  and  $L_S$  are shown on the outline drawings.
- Ordering information
- When ordering, please specify:
1. Reverse breakdown voltage.
  2. Total capacitance and measurement voltage.
  3. Voltage tuning range.
  4. Capacitance tolerance.
  5. Package data.



case style MO-63

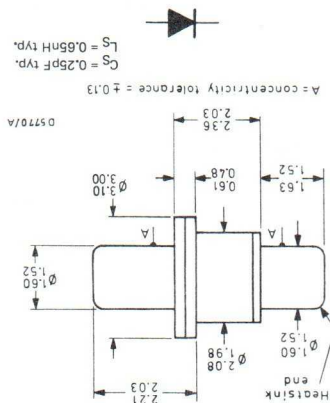
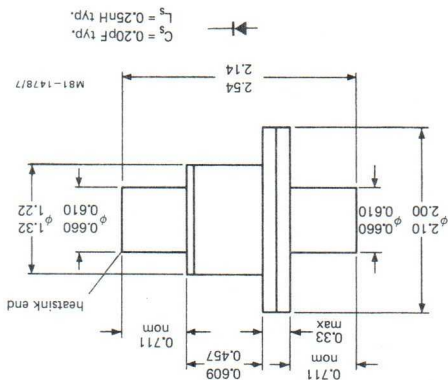
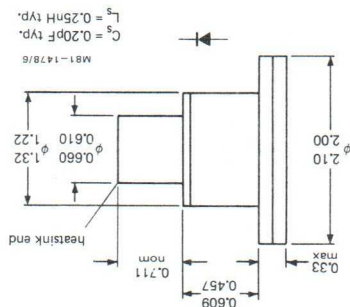


case style MO-64



case style MO-65

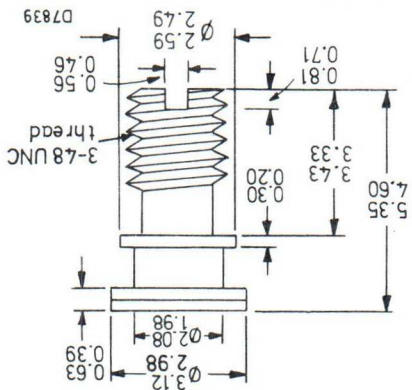


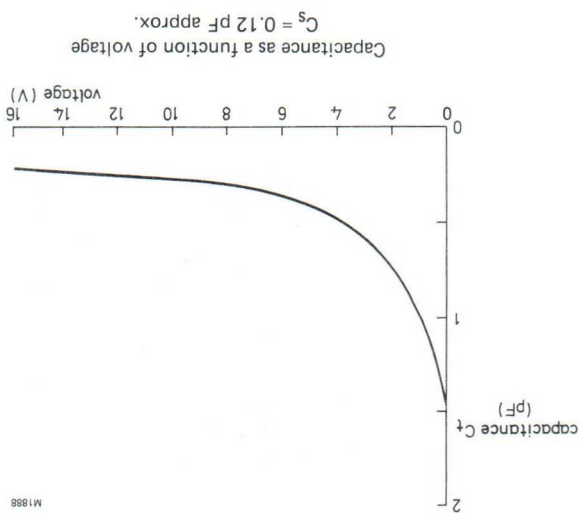


conforms to BS3934 SO-86



case style SOD-44

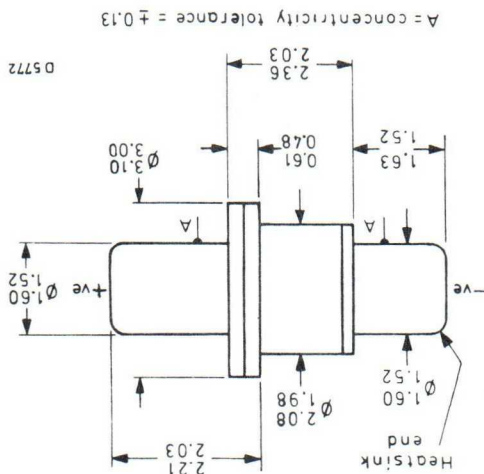




# LIMITER VARACTOR DIODES



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



Conforms to SOD-31 and BS3934 SO-86

## MECHANICAL DATA

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

Unless otherwise shown, data is applicable to both types.

| Operating frequency range | f          | C <sub>T</sub> | Total capacitance at 0 V | Insertion loss* | High power attenuation* | *Depends on circuit configuration, see page 2 |
|---------------------------|------------|----------------|--------------------------|-----------------|-------------------------|-----------------------------------------------|
| CXY22A                    | 2.0 to 7.0 |                | 0.85                     | 0.2             | 20                      |                                               |
| CXY22B                    | 7.0 to 12  |                | 0.55                     | 0.3             | 16                      |                                               |
|                           |            |                | Ghz                      | pF              | dB                      | dB                                            |

## QUICK REFERENCE DATA

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.

## GALLIUM ARSENIDE LIMITER DIODES

# RATINGS

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

| Storage temperature range | $T_{stg}$   | $T_{amb}$   | $V_R$ |
|---------------------------|-------------|-------------|-------|
| °C                        | °C          | °C          | V     |
| –55 to +150               | –55 to +100 | –55 to +100 | 6.0   |

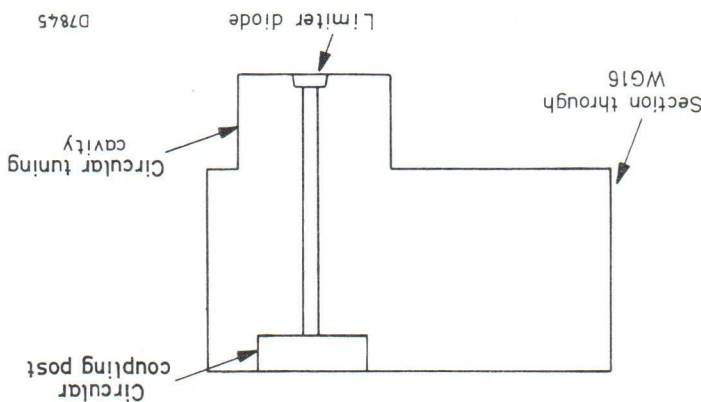
# CHARACTERISTICS

| Reverse current, $V_R = 6.0$ V             | $I_R$ | $V_F$ | $C_T$ | $r_s$    |
|--------------------------------------------|-------|-------|-------|----------|
| max.                                       | max.  | max.  | typ.  | typ.     |
| 1.0                                        | 1.0   | 1.45  | 0.85  | 1.0      |
| $\mu A$                                    |       | V     | pF    | $\Omega$ |
| D.C. forward voltage, $I_F = 50$ mA        |       |       |       |          |
| Total capacitance, $V_R = 0$ , $f = 1$ MHz |       |       |       |          |
| Series resistance, $V_R = 0$               |       |       |       |          |

# TYPICAL X-BAND LIMITER USING CXY22B

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

| Centre frequency                                                                       | $f_0$ | $\Delta f_0$ |
|----------------------------------------------------------------------------------------|-------|--------------|
| GHz                                                                                    | 300   | 0.3          |
| Bandwidth at 1 mW max., v.s.w.r. = 1.2:1                                               |       |              |
| Insertion loss at 1 mW max.                                                            |       |              |
| Insertion loss at 100 mW, c.w.                                                         |       |              |
| Insertion loss at 5 W peak, p.r.f., 1 kHz, 1 $\mu s$                                   |       |              |
| Safe peak power handling*, p.r.f., 1 kHz, 1 $\mu s$                                    |       |              |
| Peak power handling depends on pulse length and duty cycle, as well as circuit design. |       |              |



# OSCILLATORS





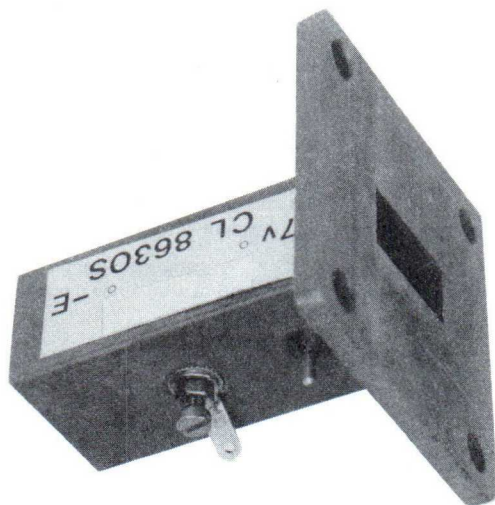
## X-BAND GUNN OSCILLATORS

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

## QUICK REFERENCE DATA

| Type No.                                                         | Centre frequency  |
|------------------------------------------------------------------|-------------------|
| CL8630, CL8630S                                                  | 10.687            |
| CL8631, CL8631S                                                  | 9.35              |
| CL8632, CL8632S                                                  | 9.47              |
| CL8633, CL8633S                                                  | 10.525            |
| Supply voltage                                                   | +7.0 V            |
| Power output (at 7.0 V)                                          | typ. 8.0 mW       |
| Frequency temperature coefficient                                | -0.25 MHz/°C      |
| Output is via a square plain flange WG16. WR90. 5985-99-083-0052 | typ. -0.25 MHz/°C |

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



## RATINGS (at 25 °C)

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

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

## CHARACTERISTICS

|                                   |        |        |        |
|-----------------------------------|--------|--------|--------|
| Power output (at 7.0 V)           | min.   | 5.0    | mW     |
| Frequency temperature coefficient | —      | 0.25   | MHz/°C |
| Second harmonic                   | —      | -35    | dBm    |
| Threshold current                 | —      | —      | mA     |
| Gunn operating current            | —      | 120    | mA     |
| Frequency pushing                 | —      | 4.0    | MHz/V  |
| Frequency (fixed)                 | —      | —      | GHz    |
| CL8630, CL8630S                   | 10.675 | 10.687 | 10.699 |
| CL8631, CL8631S                   | 9.338  | 9.350  | 9.362  |
| CL8632, CL8632S                   | 9.458  | 9.470  | 9.482  |
| CL8633, CL8633S                   | 10.513 | 10.525 | 10.537 |

A.M. noise to carrier ratio (1 Hz to 1 kHz bandwidth)  
CL8630 to CL8633

|                                                                                    |    |     |    |
|------------------------------------------------------------------------------------|----|-----|----|
| Output voltage for input 66 dB down on output power (at 12 dB min. signal + noise) | —  | -94 | dB |
| CL8630S to CL8633S noise                                                           | 80 | 120 | μV |

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

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

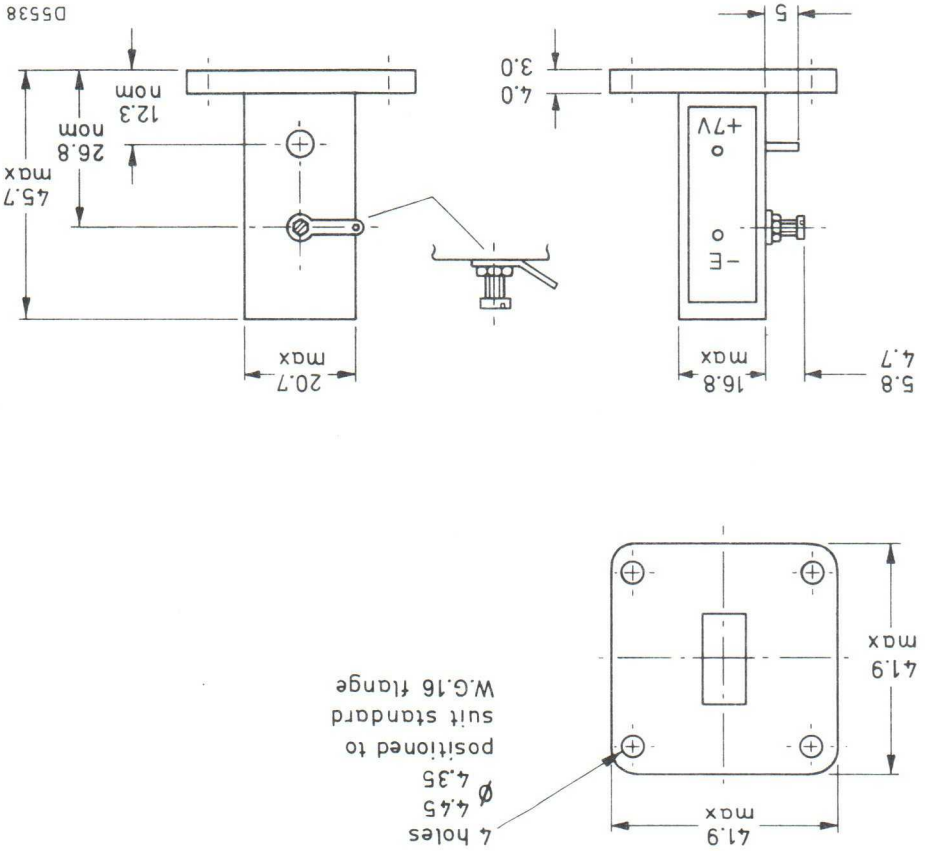
5. Second harmonic level is measured into a W.G.16 load with a v.s.w.r.  $< 1.1:1$  at fundamental frequency. The level is equivalent to that radiated from a low v.s.w.r. X-band antenna, for example, our ACX-01A.
6. A return signal 66 dB down on radiated power will be achieved from a man target of radar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

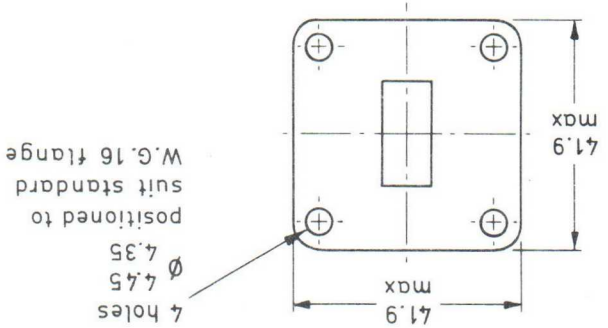
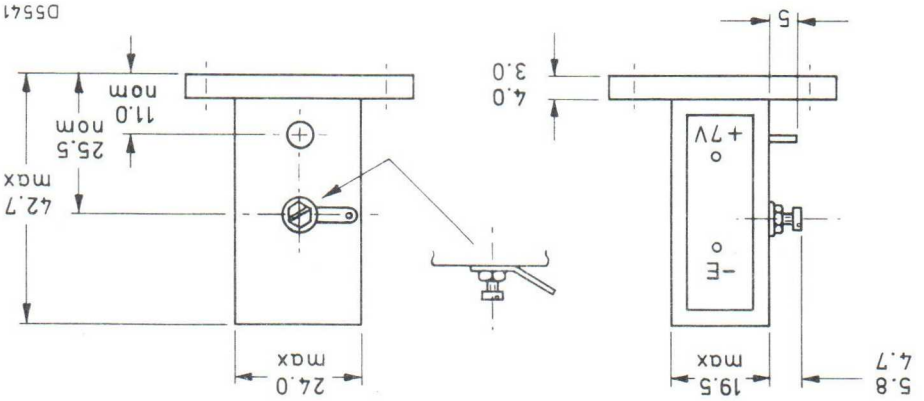
MECHANICAL DATA

CL8630  
CL8630S  
CL8633  
CL8633S

Dimensions in mm

4 holes  
 $\phi$  4.65  
 $\phi$  4.35  
positioned to  
suit standard  
W.G.16 flange





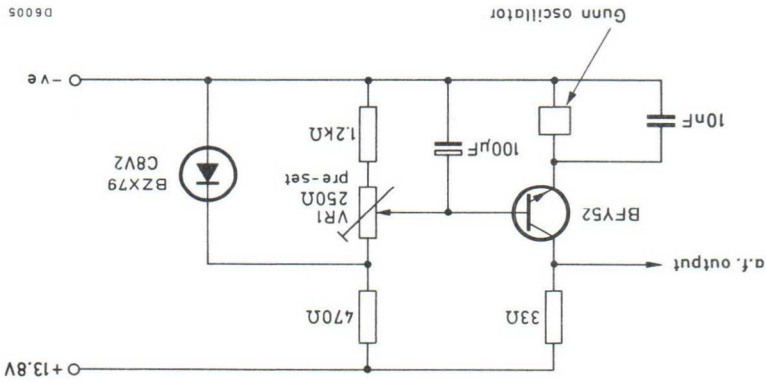
Dimensions in mm

MECHANICAL DATA

CL8631  
CL8631S  
CL8632  
CL8632S

The issue of the information contained in this publication does not imply any authority or licence for the utilisation of any patented feature.

VR<sub>1</sub> is used to set voltage at 7.0 V across Gunn oscillator.



06005



# **MIXER AND DETECTOR MODULES**



## X-BAND MIXER/DETECTOR MODULES

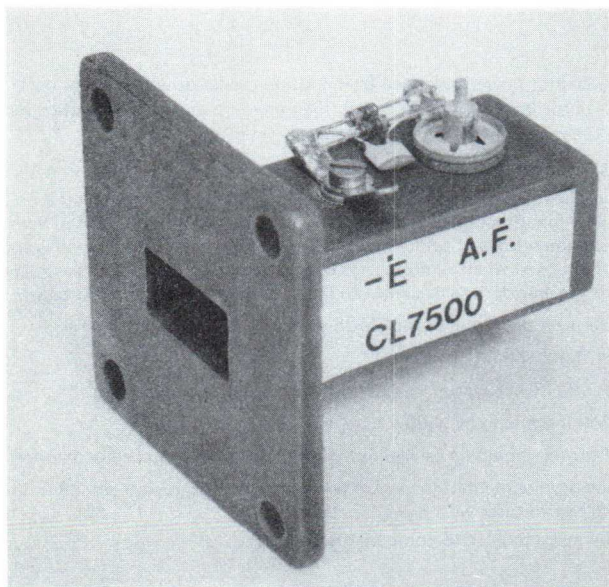
These are waveguide single ended mixers designed for use in the 9 to 11 GHz band. They are primarily intended for Doppler control systems, for example intruder alarms deriving local oscillator drive from the transmitter output of a Gunn oscillator from our CL8630 series.

These devices can be used as microwave detectors. Examples of this application are sensing deliberate beam obstruction in a microwave protected area and as a receiver in a microwave barrier or fence.

## QUICK REFERENCE DATA

|                                                             |      |        |         |   |
|-------------------------------------------------------------|------|--------|---------|---|
| Centre frequency CL7500                                     |      | 10.687 | GHz     |   |
| CL7504                                                      |      | 9.900  | GHz     | ← |
| CL7520                                                      |      | 9.350  | GHz     |   |
| Sensitivity for -90 dBm input                               | typ. | 40     | $\mu$ V |   |
| Noise level (32 $\mu$ A d.c. bias, 1 Hz to 1 kHz bandwidth) | typ. | 1.0    | $\mu$ V |   |

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



## RATINGS

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

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

## TYPICAL OPERATING CONDITIONS

|                            |     |           |
|----------------------------|-----|-----------|
| Local oscillator level     | -18 | dBm       |
| D.C. bias                  | 32  | $\mu A$   |
| Total load (d.c. and i.f.) | 10  | $k\Omega$ |

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

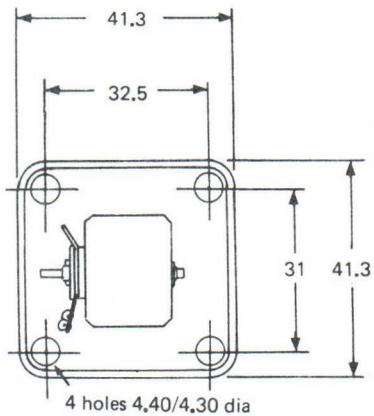
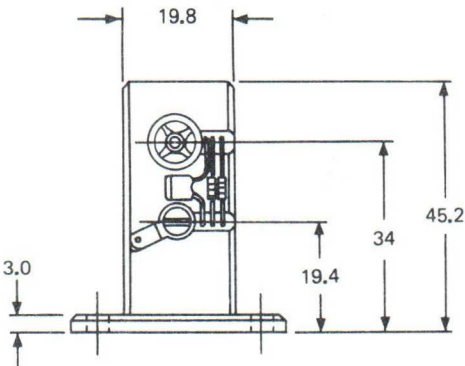
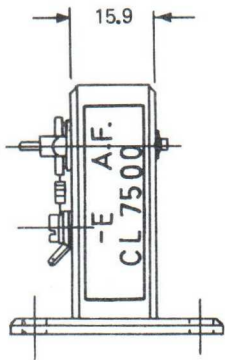
|                                                                         | min.     | typ. | max. |         |
|-------------------------------------------------------------------------|----------|------|------|---------|
| <b>Mixer</b>                                                            |          |      |      |         |
| Sensitivity for -90 dBm input (with a 10 $k\Omega$ load)                | 15       | 40   | -    | $\mu V$ |
| Noise level (32 $\mu A$ d.c. bias,<br>1 Hz to 1 kHz bandwidth) (note 1) | -        | 1.0  | 2.0  | $\mu V$ |
| <b>Detector</b>                                                         |          |      |      |         |
| Tangential sensitivity at centre frequency (note 2)                     | $S_{ts}$ | -    | -50  | - dBm   |

## Notes

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

MECHANICAL DATA  
CL7500

Dimensions in mm

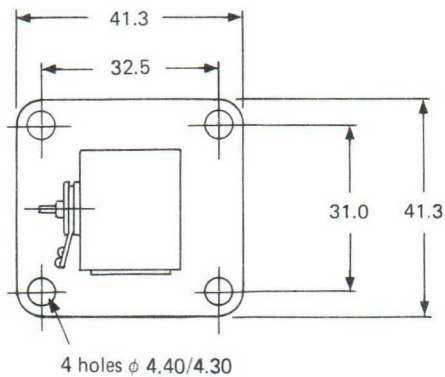
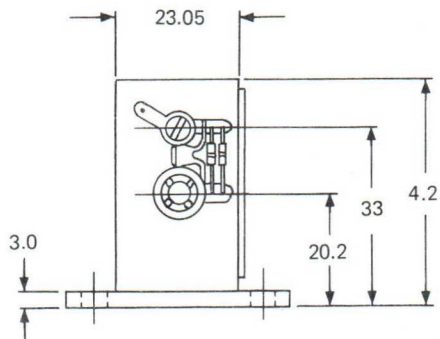
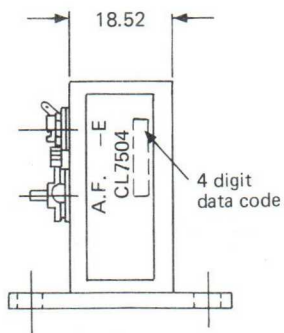


M81-1438/1

CL7500  
CL7504  
CL7520

→ MECHANICAL DATA  
CL7504

Dimensions in mm

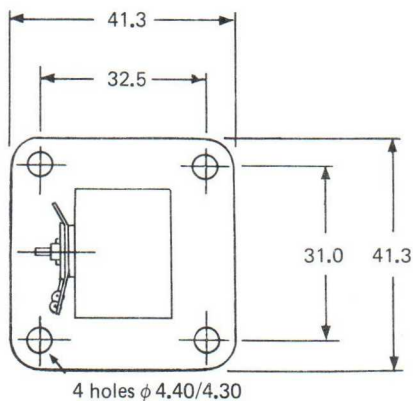
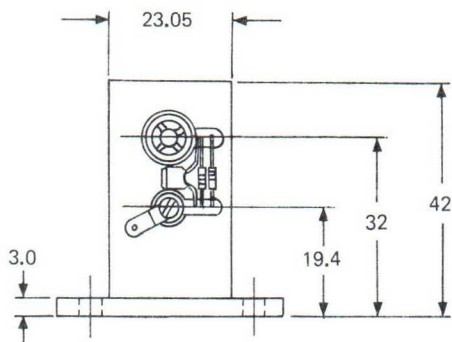
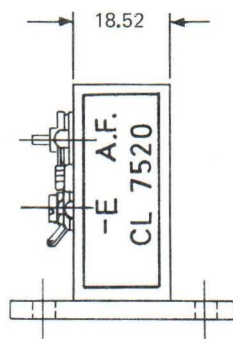


M2244

## MECHANICAL DATA

Dimensions in mm

CL7520



M81-1438/2





## **DOPPLER MODULES**



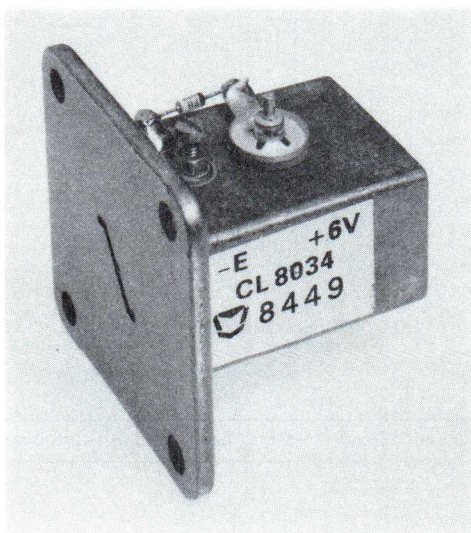
## C.W./PULSED FET OSCILLATOR

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

## QUICK REFERENCE DATA

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

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



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

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

**OPERATING CONDITIONS**

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

→ **CHARACTERISTICS** at 25 °C

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

| Type No. | min.<br>freq. | centre<br>freq. | max.<br>freq. |     |
|----------|---------------|-----------------|---------------|-----|
| CL8030   | 10.675        | 10.687          | 10.699        | GHz |
| CL8032   | 9.458         | 9.470           | 9.482         | GHz |
| CL8033   | 10.513        | 10.525          | 10.537        | GHz |
| CL8034   | 9.888         | 9.900           | 9.912         | GHz |
| CL8035   | 10.553        | 10.565          | 10.577        | GHz |
| CL8036   | 10.658        | 10.670          | 10.682        | GHz |
| CL8038   | 9.508         | 9.520           | 9.532         | GHz |
| CL8039   | 9.818         | 9.830           | 9.842         | GHz |
| CL8040   | 10.413        | 10.425          | 0.437         | GHz |
| CL8041   | 10.538        | 10.550          | 10.562        | GHz |
| CL8042   | 10.575        | 10.587          | 10.599        | GHz |
| CL8043   | 9.938         | 9.950           | 9.962         | GHz |

**OUTPUT**

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

→ **MASS**

100 g

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

## NOTES

1. For c.w. operation, the FET power supply should have a low source impedance and be capable of supplying up to 50 mA at approximately 2 V during the switch-on phase.  
The FET is protected from over-voltage and reverse bias by a 6.8 V voltage regulator diode, but damage may occur if over-voltage or a reversed supply is maintained for an extended period. The voltage regulator should not be removed. ←
2. Noise measured in a 1 Hz to 1 kHz bandwidth from carrier.
3. The FET has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons used for the FET connections are isolated from mains supplies and that the FET voltage regulator diode is not removed when all wiring has been completed. FET and earth connections should be made direct to the appropriate terminals.
4. Precautions similar to those required for CMOS devices are necessary, namely:
  - a) Earthed wrist straps should be worn.
  - b) Table tops or other working surfaces should be conductive and earthed.
  - c) Anti-static clothing should be worn.
  - d) No electrical testing should be carried out without specific, approved and written test procedures.
  - e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
5. Since an iris coupled output is used on this oscillator, it will not operate correctly if used without a waveguide load or horn.

## 6. Pulsed operation

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

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

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

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

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

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

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

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

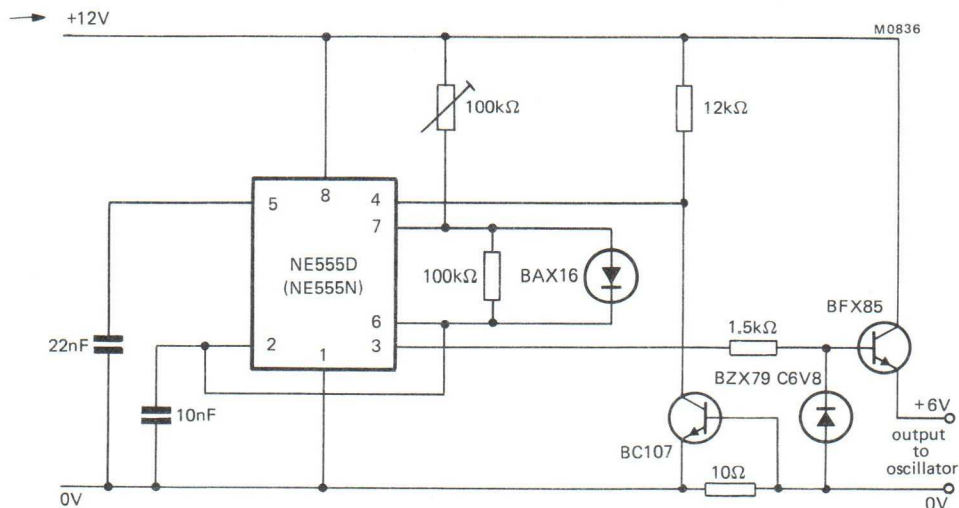
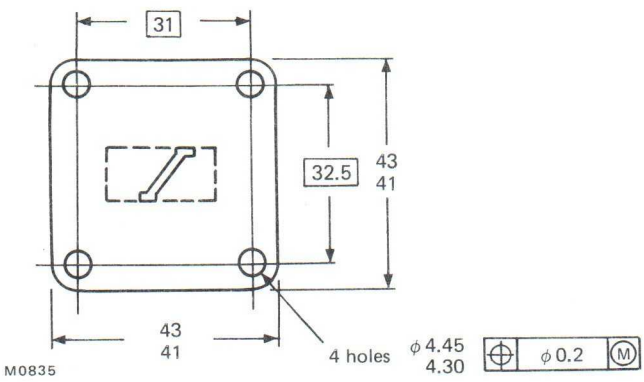
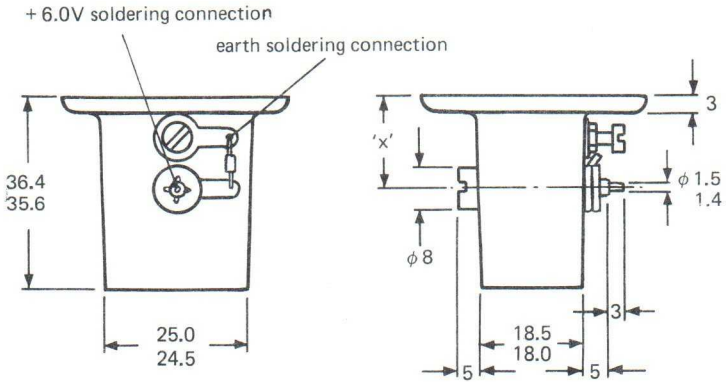


Fig.1 Recommended pulse circuit

MECHANICAL DATA

Dimensions in mm ←

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







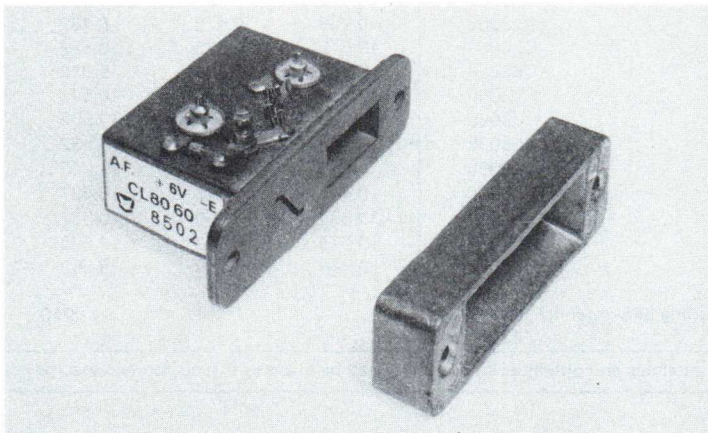
## C.W./PULSED DOPPLER MODULE

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

## QUICK REFERENCE DATA

| Type No.                                                                   | Centre frequency (GHz) |  |         |
|----------------------------------------------------------------------------|------------------------|--|---------|
| CL8060                                                                     | 10.687                 |  |         |
| CL8062                                                                     | 9.470                  |  |         |
| CL8063                                                                     | 10.525                 |  |         |
| CL8064                                                                     | 9.900                  |  |         |
| CL8065                                                                     | 10.565                 |  |         |
| CL8066                                                                     | 10.670                 |  |         |
| CL8068                                                                     | 9.520                  |  |         |
| CL8069                                                                     | 9.830                  |  |         |
| CL8070                                                                     | 10.425                 |  |         |
| CL8071                                                                     | 10.550                 |  |         |
| CL8072                                                                     | 10.587                 |  |         |
| CL8073                                                                     | 9.950                  |  |         |
| Supply voltage (d.c.)                                                      | +6.0                   |  | V       |
| Power output (at 6.0 V d.c.)                                               | typ. 8                 |  | mW      |
| Voltage output for power input 100 dB down on power output (notes 1 and 4) | typ. 30                |  | $\mu$ V |
| Noise output voltage                                                       | typ. 3                 |  | $\mu$ V |
| Supply current (at 6.0 V)                                                  | typ. 25                |  | mA      |

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



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

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

**OPERATING CONDITIONS**

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

→ **CHARACTERISTICS** at 25 °C

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

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

MASS (including 5dB antenna)

210 g

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

## NOTES

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

Extended range may be obtained for a reduced  $\frac{\text{signal} + \text{noise}}{\text{noise}}$  and this may be acceptable if the

environment in which the system operates is stable, i.e. free from extraneous moving or vibrating objects.

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

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

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

Fig.3 describes the preferred arrangement.

10. Pulsed operation

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

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

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

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

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

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

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

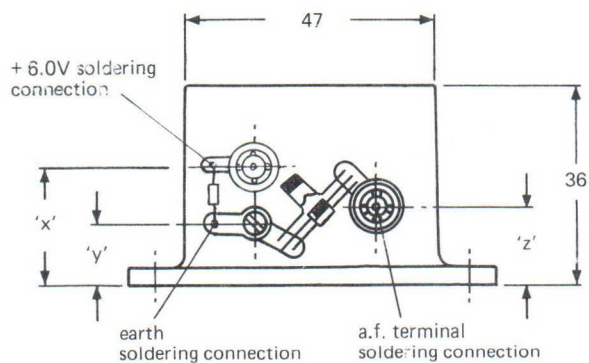
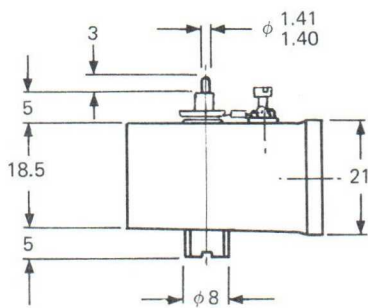
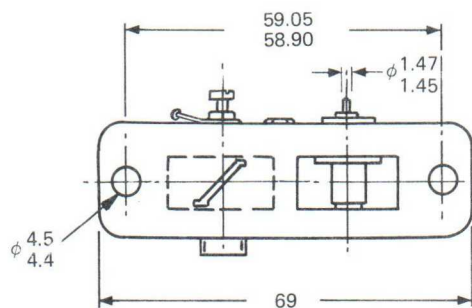
Operation at frequencies and duty cycles below the 50 kHz square wave mentioned earlier is satisfactory. but operation at higher frequencies has not been investigated.

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

## MECHANICAL DATA

Dimensions in mm ←

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



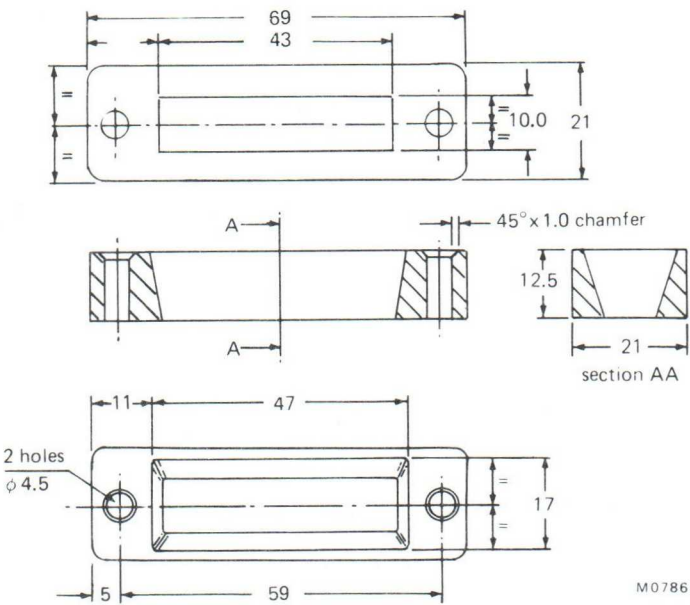
M0785



MECHANICAL DATA

Dimensions in mm

Waveguide antenna



M0786

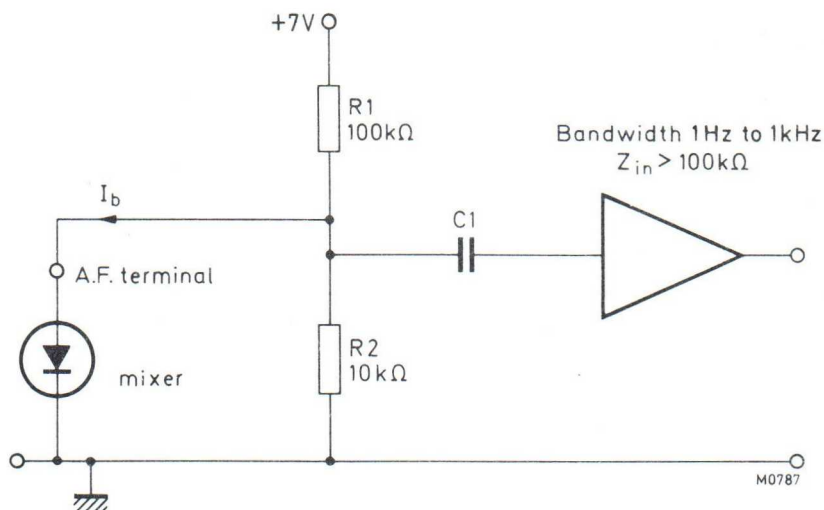


Fig.1 Circuit used to measure a.f. performance

## Notes

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

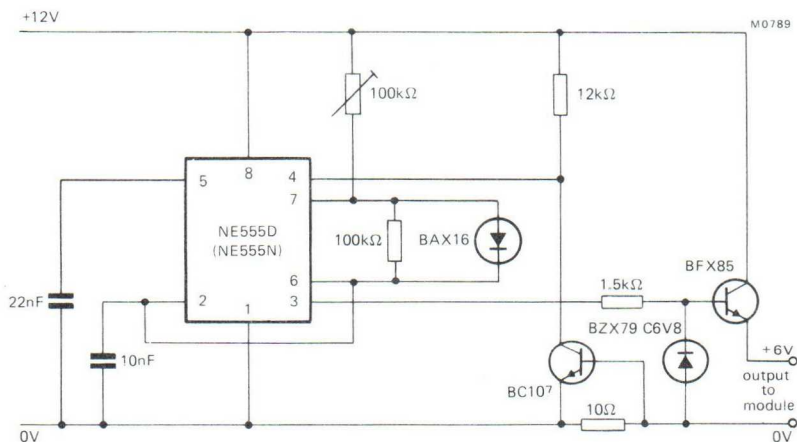


Fig.2 Recommended pulse circuit

## MODULE MOUNTING

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

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

The total mixer bias under the optimum operating conditions is approximately 42  $\mu\text{A}$ . (35  $\mu\text{A}$  d.c. bias + 7  $\mu\text{A}$  from -19 dBm of coupled i.o. power).

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

In this case, the i.o. power coupled to the mixer will be -11 dBm and the total mixer bias current will now be approximately 60  $\mu\text{A}$ .

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

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

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

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

| L.O. coupling (dBm) | Mixer total bias ( $\mu\text{A}$ ) | Antenna covering material                   |
|---------------------|------------------------------------|---------------------------------------------|
| —                   | 35 (d.c. only)                     | —                                           |
| -19                 | 42                                 | No covering                                 |
| -15                 | 50                                 | 1 to 2 cm expanded polythene or polystyrene |
| -11                 | 61                                 | 0.25 mm Cobex plastic                       |
| -6                  | 70                                 | 0.5 mm Cobex plastic                        |

→ Cobex is a product of:

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



PANEL MOUNTING DETAILS

Dimensions in mm

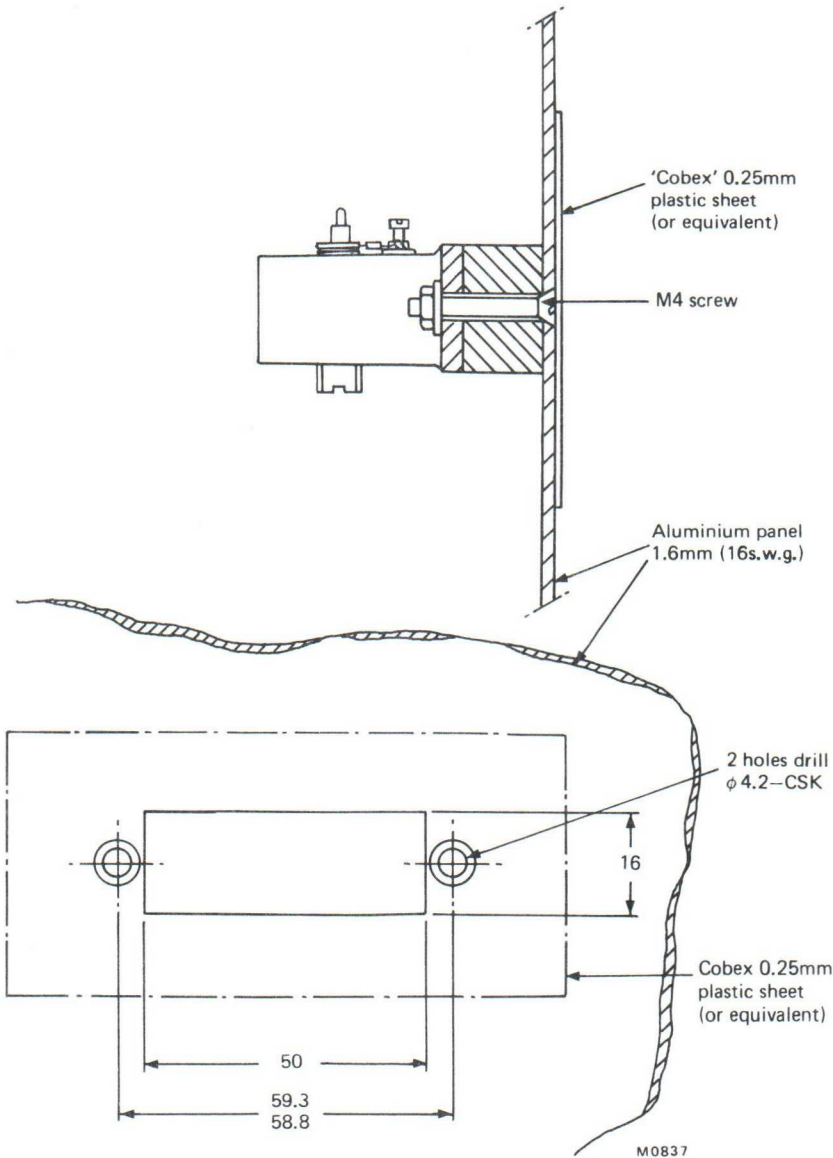


Fig.3



## X-BAND DOPPLER RADAR MODULES

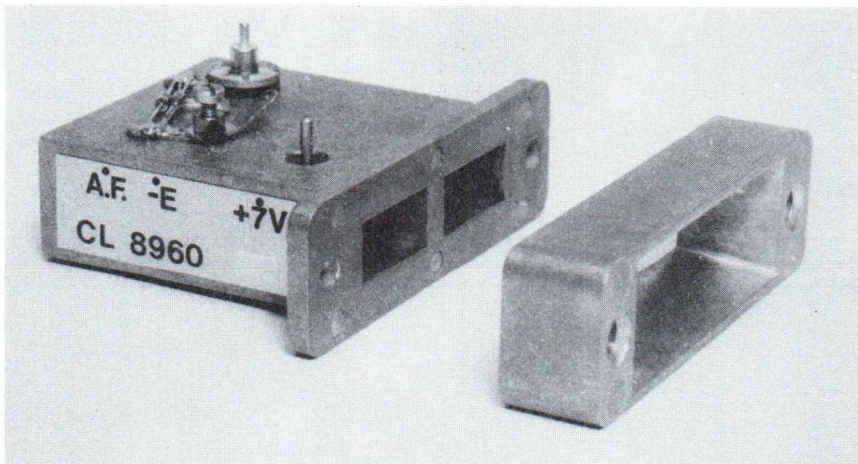
This is a series of fixed frequency Gunn oscillators and mixer cavities for operation in X-band. Applications include all forms of Doppler radar systems.

## QUICK REFERENCE DATA

| Type No                                                                                                         | Centre frequency<br>GHz |         |         |
|-----------------------------------------------------------------------------------------------------------------|-------------------------|---------|---------|
| CL8960                                                                                                          | 10.687                  |         |         |
| CL8961                                                                                                          | 9.350                   |         |         |
| CL8962                                                                                                          | 9.470                   |         |         |
| CL8963                                                                                                          | 10.525                  |         |         |
| CL8964                                                                                                          | 9.900                   |         |         |
| CL8965                                                                                                          | 10.565                  |         |         |
| CL8967                                                                                                          | 10.365                  |         |         |
| CL8968                                                                                                          | 9.520                   |         |         |
| Supply voltage                                                                                                  |                         | +7.0    | V       |
| Power output (at 7.0 V)                                                                                         |                         | typ. 10 | mW      |
| Voltage output for power input<br>100 dB down on power output<br>at 18 dB min. <u>signal + noise</u><br>noise - |                         |         |         |
| (note 1 and page 9)                                                                                             |                         | typ. 40 | $\mu$ V |

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

Module with antenna as supplied



## RATINGS

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

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

## OPERATING CONDITIONS

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

## CHARACTERISTICS

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

MASS

210 g

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

## NOTES

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

Extended range may be obtained for a reduced  $\frac{\text{signal} + \text{noise}}{\text{noise}}$  and this may be acceptable if the

environment in which the system operates is stable, i.e. free from extraneous moving or vibrating objects. For example, 110 dB path loss is obtained from a man target of radar cross-section  $1.0 \text{ m}^2$

at a range of 25 m and the  $\frac{\text{signal} + \text{noise}}{\text{noise}}$  is reduced to 15 dB with an output voltage of  $16 \mu\text{V}$  min.

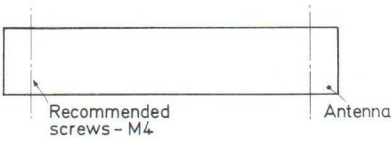
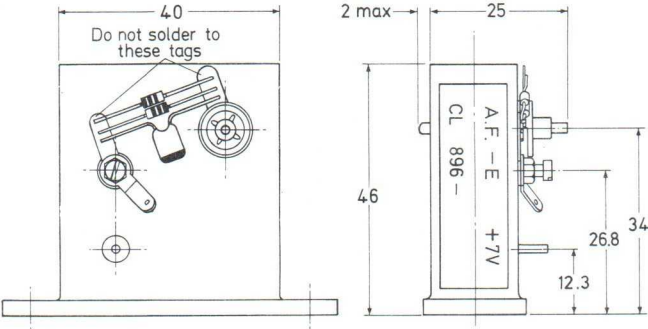
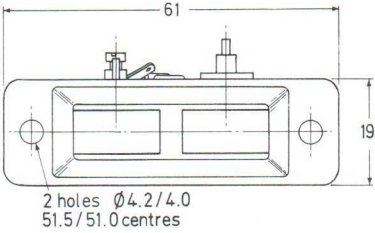
Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to the manufacturer.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7 V) and the d.c. bias supplied to the a.f. terminal. In addition, the soldered connection to the mixer should be made direct to the mixer terminal and not to the associated protection circuit.
3. The Gunn effect device has a voltage current characteristic as shown on page 8. The power supply should have a low source impedance and be capable of supplying up to 250 mA at approximately 3 V during the switch-on phase.
4. Noise measured at a frequency 1 Hz to 1 kHz from carrier.
5. The Gunn device will be damaged if the supply is reversed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and the protection circuit is not removed when all wiring has been completed. Mixer and earth connections should be made direct to the appropriate terminals and not the the protection circuit tags.
7. Precautions similar to those required for CMOS devices are necessary, namely:
  - (a) Earthed wrist straps should be worn.
  - (b) Table tops or other working surfaces should be conductive and earthed.
  - (c) Anti-static clothing should be worn.
  - (d) No electrical testing should be carried out without specific, approved and written test procedures.
  - (e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10 nF capacitor should be connected across and close to the +7 V and earth terminals to suppress parasitic oscillations in the power supply.
10.  $\frac{\text{Signal} + \text{noise}}{\text{noise}}$  performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 12 describes the preferred arrangement.

MECHANICAL DATA

Dimensions in mm

CL8960  
CL8963  
CL8965

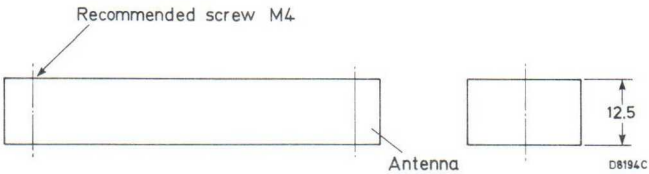
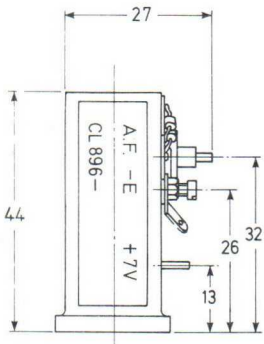
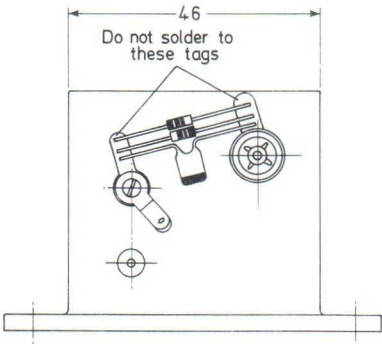
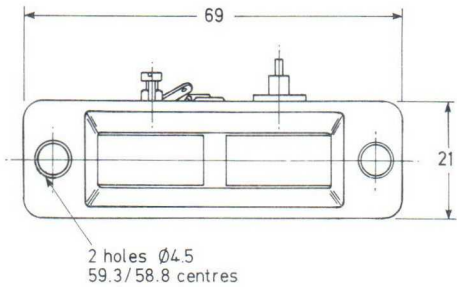


D6007C

MECHANICAL DATA

Dimensions in mm

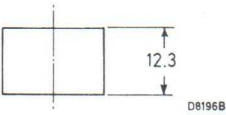
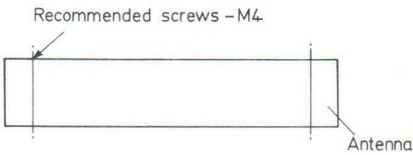
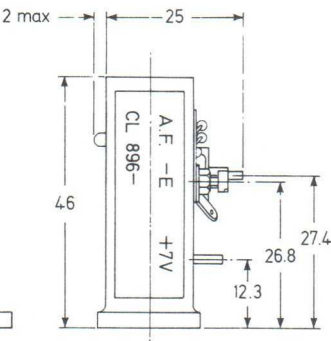
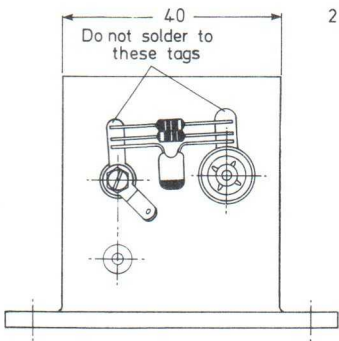
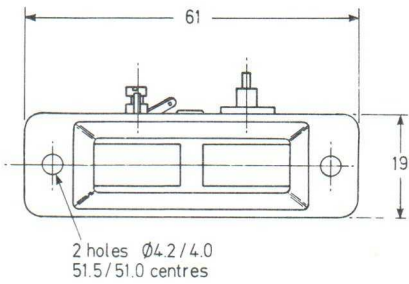
CL8961  
CL8962  
CL8968





MECHANICAL DATA  
CL8964

Dimensions in mm



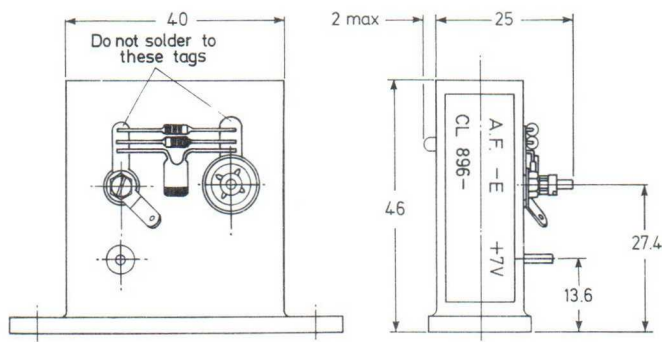
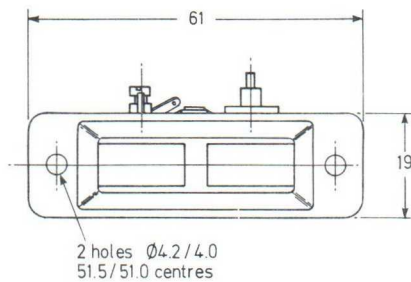
D8196B



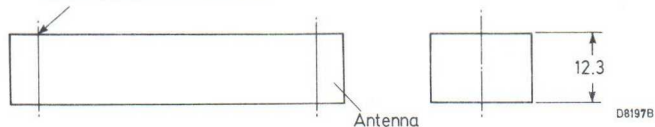
## MECHANICAL DATA

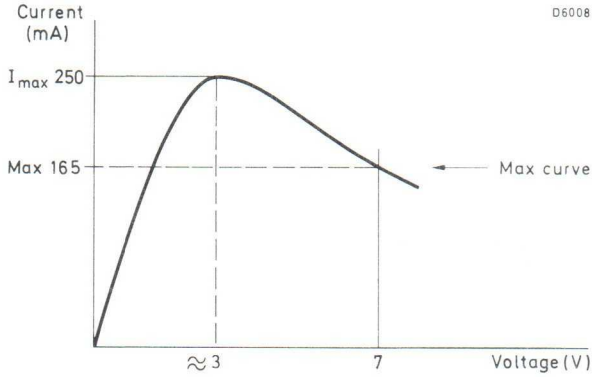
Dimensions in mm

CL8967

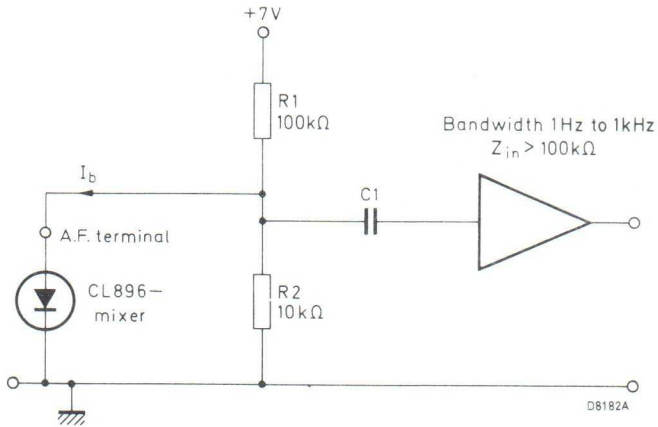


Recommended screws - M4





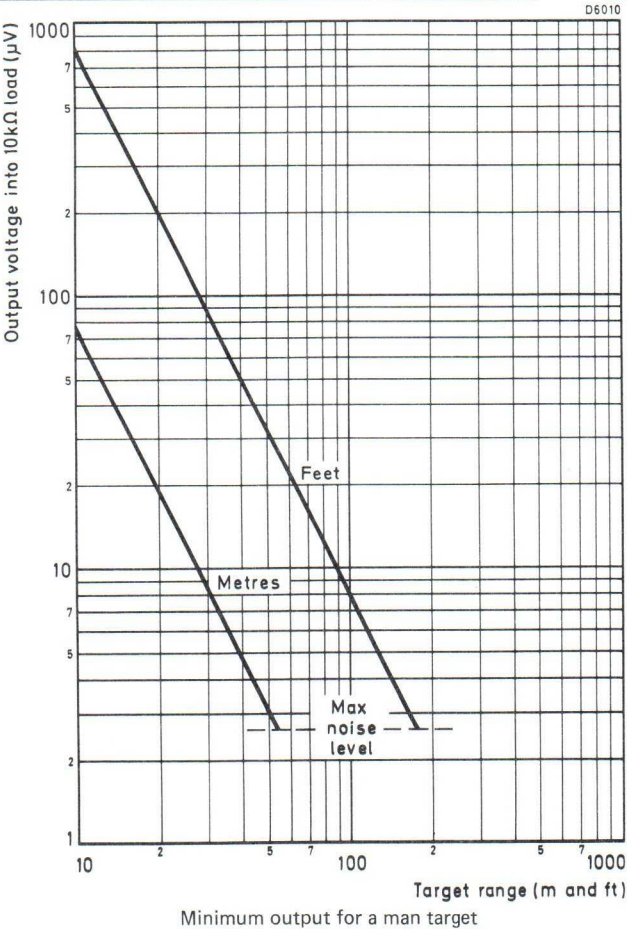
Typical Gunn device characteristic

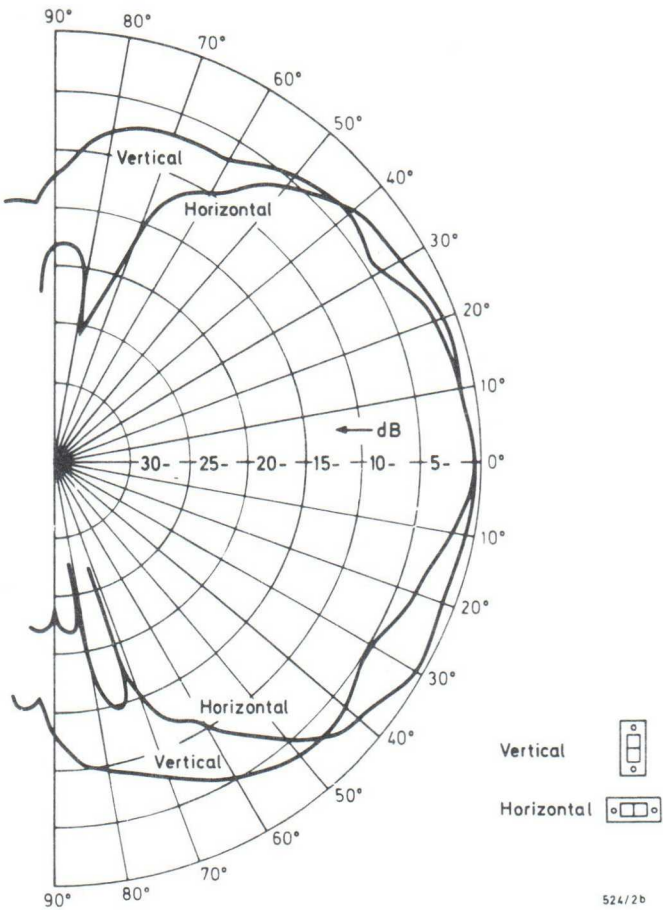


Circuit used to measure a.f. performance

#### Notes

1. The current  $I_b$  should be approximately 35  $\mu\text{A}$  with the Gunn device disconnected and approximately 42  $\mu\text{A}$  with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with  $Z_{in}$ .





Typical polar diagram for antenna supplied

## MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6 mm thick metal plate with aperture dimensions as shown on page 12.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained.

Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately 42  $\mu\text{A}$ . (35  $\mu\text{A}$  d.c. bias + 7  $\mu\text{A}$  from -19 dBm of coupled l.o. power).

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

In this case, the l.o. power coupled to the mixer will be -11 dBm, and the total mixer bias current will now be approximately 60  $\mu\text{A}$ .

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

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

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

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

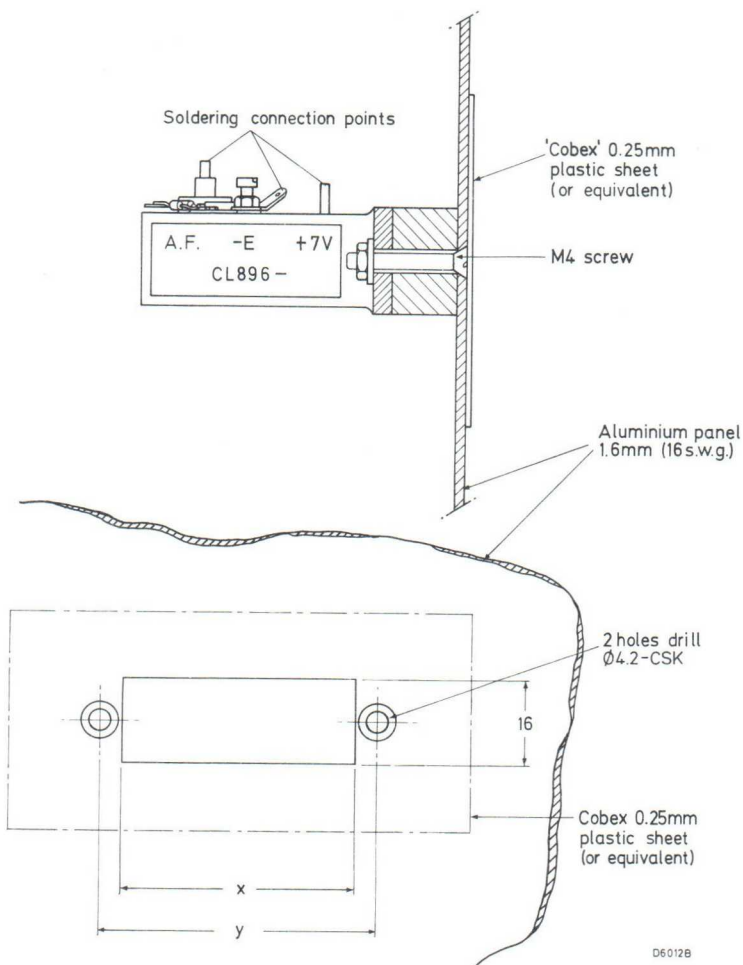
| L.O. coupling (dBm) | Mixer total bias ( $\mu\text{A}$ ) | Antenna covering material                   |
|---------------------|------------------------------------|---------------------------------------------|
| —                   | 35 (d.c. only)                     | —                                           |
| -19                 | 42                                 | No covering                                 |
| -15                 | 50                                 | 1 to 2 cm expanded polythene or polystyrene |
| -11                 | 61                                 | 0.25 mm Cobex plastic                       |
| -6                  | 70                                 | 0.5 mm Cobex plastic                        |

Cobex is a product of:

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

## PANEL MOUNTING DETAILS

Dimensions in mm



CL8960  
CL8963  
CL8964  
CL8965  
CL8967

x = 43  
y = 51.5/51.0

CL8961  
CL8962  
CL8968

x = 50  
y = 59.3/58.8

# **CIRCULATORS AND ISOLATORS**





## MICROSTRIP CIRCULATORS AND ISOLATORS

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

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

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

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

### TERMS AND DEFINITIONS

#### Frequency range

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

#### Isolation

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

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

#### Insertion loss

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

#### Maximum power

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

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

#### Temperature range

This is the ambient temperature range within which isolators and circulators function to specification. Circulators still function outside the temperature range but their electrical behaviour may be far outside the guaranteed specifications. Isolators can be stored at any temperature between  $-55$  and  $+125\ ^\circ\text{C}$ .

## MICROSTRIP CIRCULATORS

Electrical data (as measured in the related test jig)

Maximum power (c.w.) 10 W

Storage temperature -55 to +125 °C

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

MICROSTRIP CIRCULATORS

Dimensions in mm

Mechanical data

Tolerances  $\pm 0.05$  mm unless otherwise stated.

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

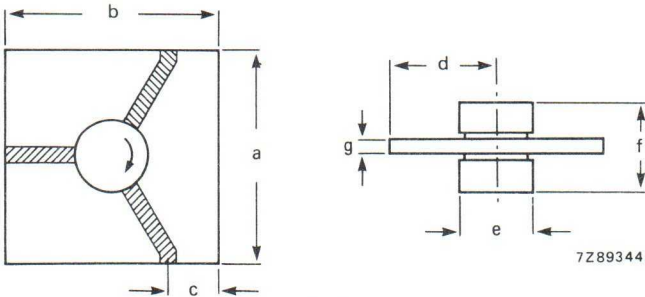


Fig.1

## MICROSTRIP ISOLATORS

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

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

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



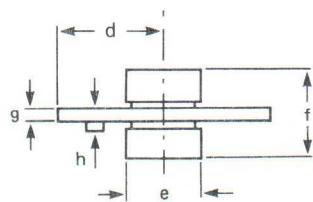
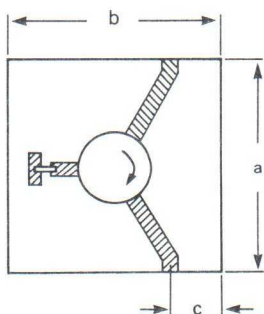
## MICROSTRIP ISOLATORS

Dimensions in mm

## Mechanical data

Tolerances  $\pm 0.05$  mm unless otherwise stated.

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



7289345

Fig.2

## MOUNTING AND INTERCONNECTION IN MIC HOUSINGS

Dimensions in mm

All devices are rectangular to facilitate insertion into associated circuitry.

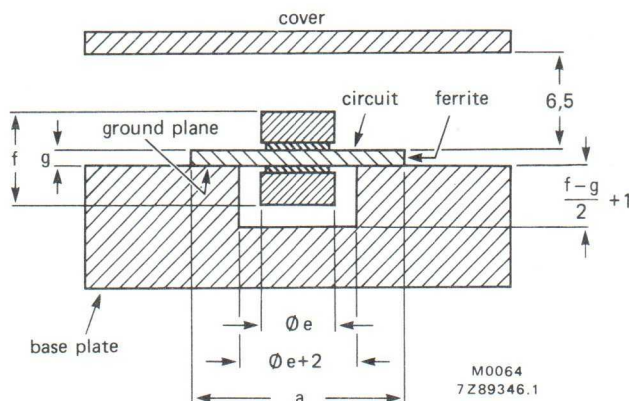


Fig. 3.

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

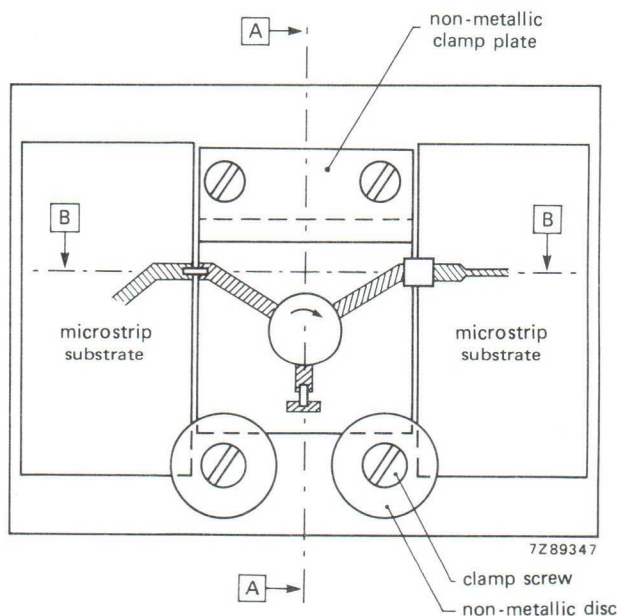


Fig. 4.

Two methods of mounting an isolator between MIC substrates:

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

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

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

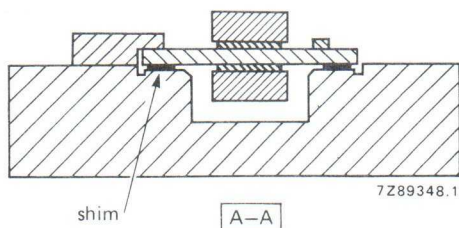


Fig. 5.

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

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

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

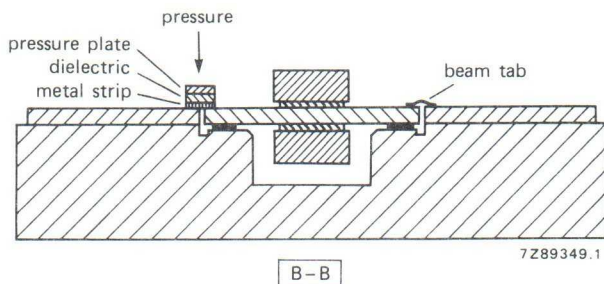


Fig.6

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

left: pressure contact

right: gold beam bond, which can be made ultrasonically or thermosonically, or by thermo-compression.

Careful milling is essential (rectangular and no burrs). Air gaps should be minimized but should not be less than 25  $\mu\text{m}$  at room temperature.

Note: the linear expansion coefficient of ferrite is about  $1 \times 10^{-5}/^{\circ}\text{C}$ .

**CAUTIONARY NOTE**

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

**NOTE ON ELECTRICAL PARAMETERS**

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

**→ ENVIRONMENTAL DATA**

Rapid change of temperature to BS2011: part N, 5 cycles,  $T_{\min} = -55^{\circ}\text{C}$ ,  $T_{\max} = +125^{\circ}\text{C}$ .

Dry heat to BS2011: part Ba,  $T_{\max} = +125^{\circ}\text{C}$ , duration = 72 hrs.

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



## CIRCULATORS AND ISOLATORS

### INTRODUCTION

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

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

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

### CIRCULATORS

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

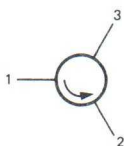


Fig. 1 Symbol for 3-port circulator.

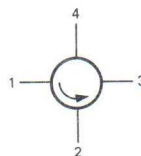


Fig. 2 Symbol for 4-port circulator.

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

### ISOLATORS

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



Fig. 3 Symbol for an isolator.

## TERMS AND DEFINITIONS

### Frequency range

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

### Isolation

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

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

### Insertion loss

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

### Maximum power

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

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

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

### Temperature range

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

## CAUTIONARY NOTES

Circulators and isolators have internal fields that are carefully adjusted for optimum operation; they should not, therefore, be subjected to strong external magnetic fields. During storage and transport a minimum distance of 10 mm to other circulators/isolators and ferromagnetic material is recommended. During operation this distance should be at least 20 mm.

Care must be taken that condensation of humidity, especially in water-cooled items, does not occur.

## QUALITY GUARANTEE

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

## STANDARD TEST SPECIFICATIONS

### Initial measurements

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

### Tropical test

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

### Vibration test

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

### Thermal shock test

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

### Mechanical shock test

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

### Drop test

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

### R.F. power test

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

### Final measurements

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

### Dimensions and visual appearance

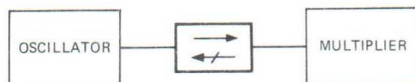
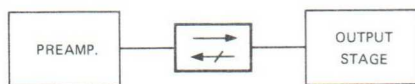
These have been checked in accordance with the published data.

### Note

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

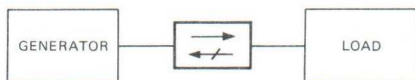
## APPLICATIONS

Decoupling of circuit stages



7Z88154

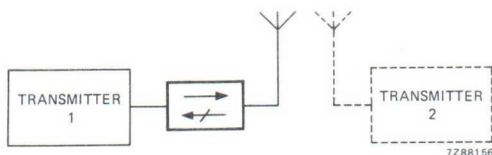
Reflection suppression in test chains



7Z88155

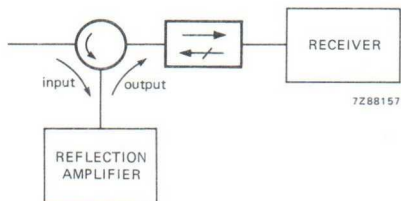
Suppression of reflections from

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



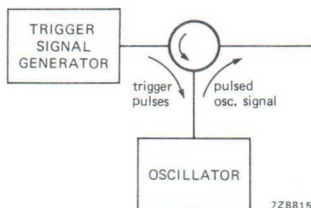
7Z88156

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



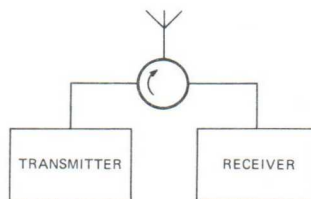
7Z88157

Feed trigger signals into an oscillator



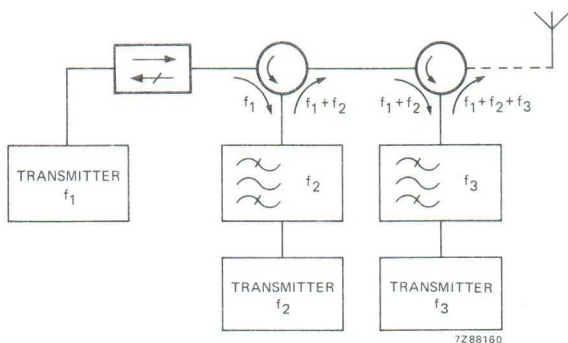
7Z88158

Avoid separate aerial for transmitter and receiver

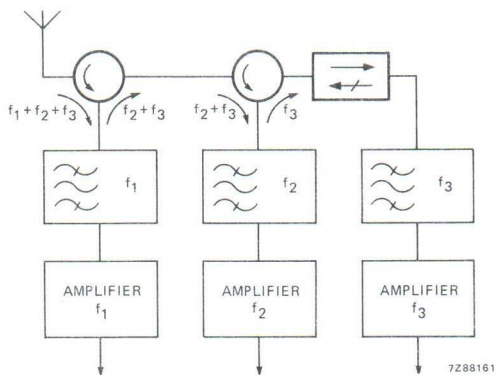


7Z88159

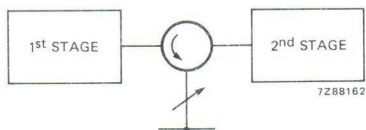
Connect different transmitters to a common aerial



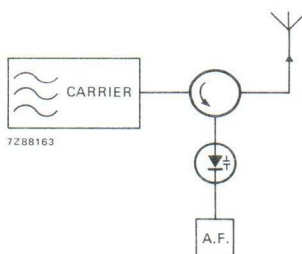
Separate a range of frequencies received by a common aerial

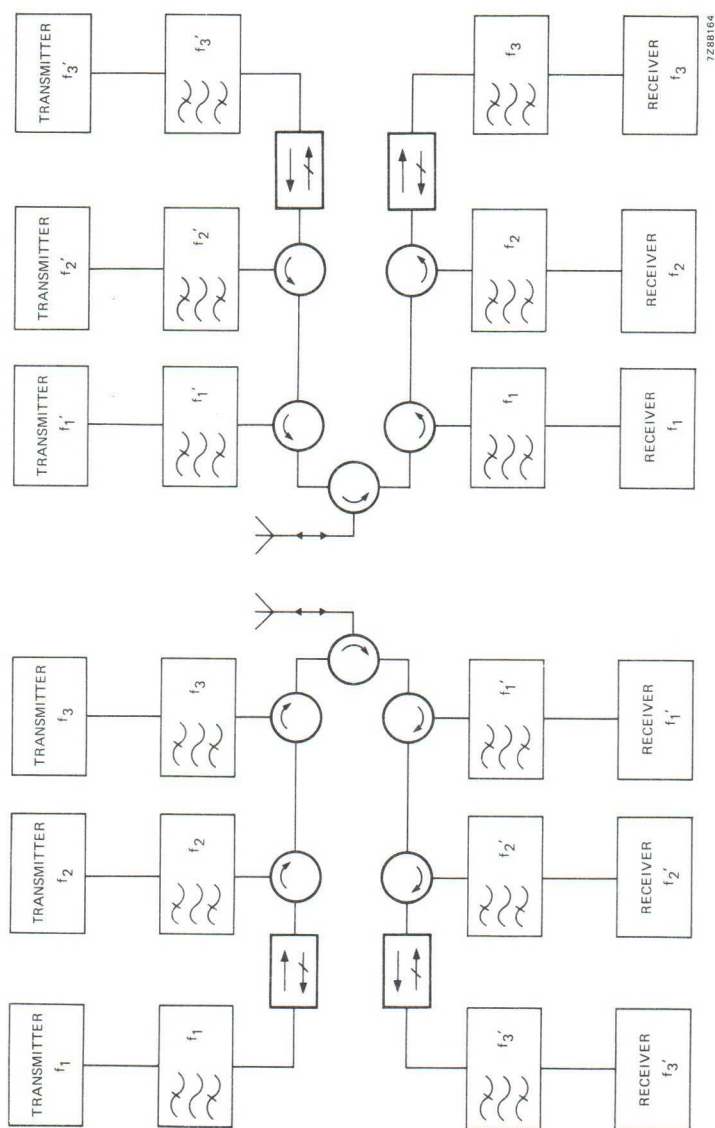


Variable phase shifters with a variable short-circuit



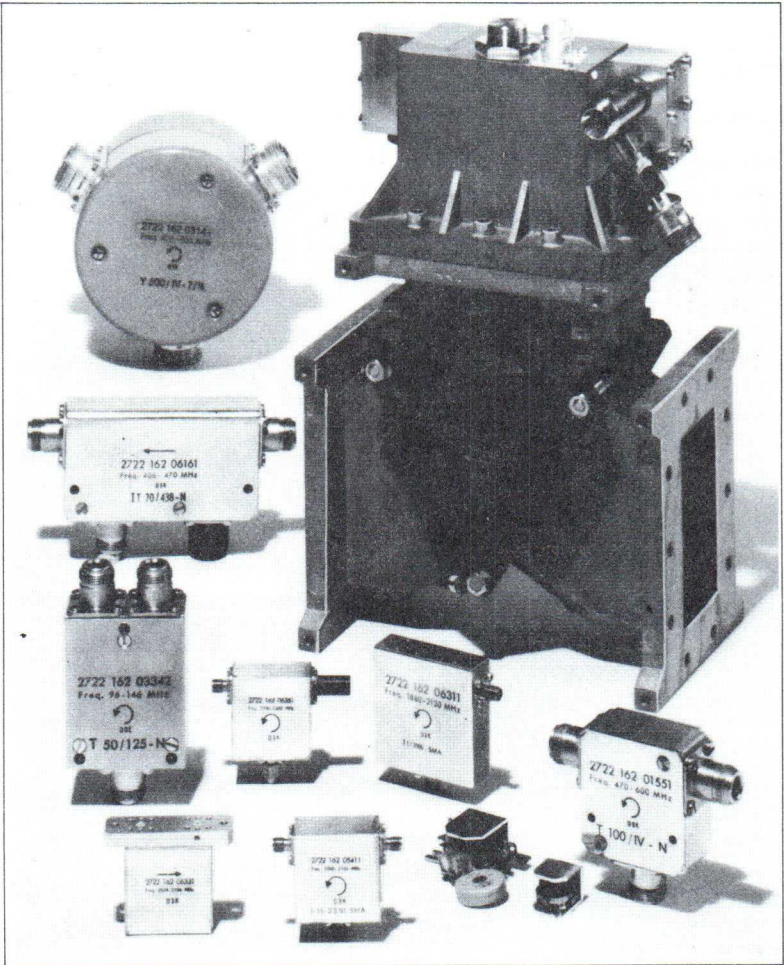
Phase modulation with a variable capacitance diode as a variable reactance





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





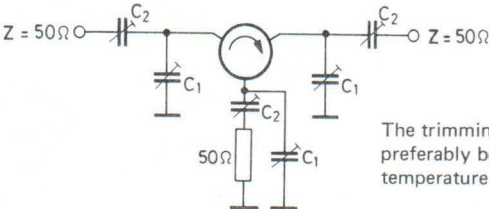


Preferred application: fixed and mobile communication.

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

\* For instantaneous bandwidth see diagram.

The technical characteristics have been measured in the following circuit:



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

VX712212EA

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

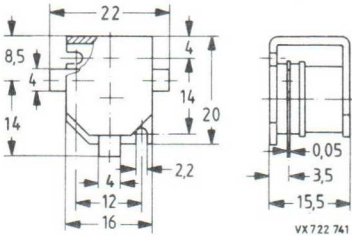


Fig. 1.

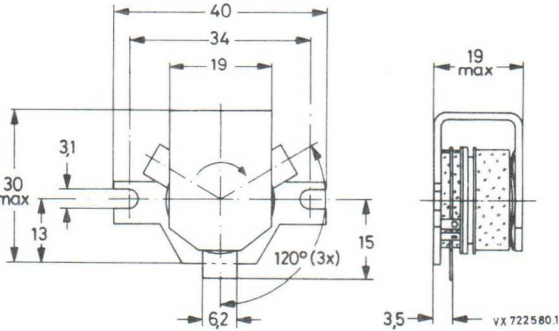
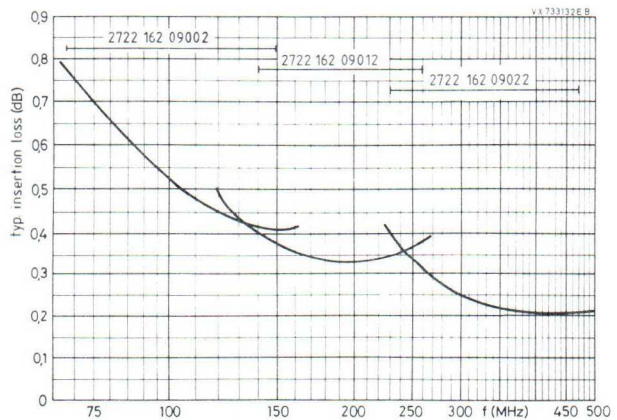
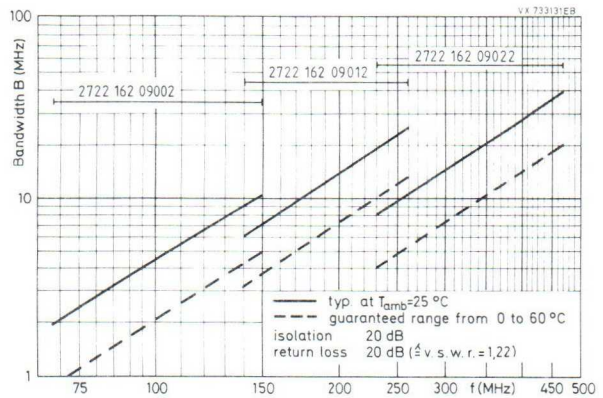


Fig. 2.

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



Preferred application: fixed and mobile communication

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

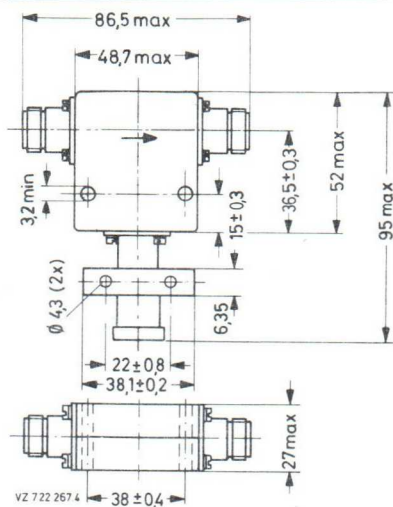


Fig. 3.

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

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

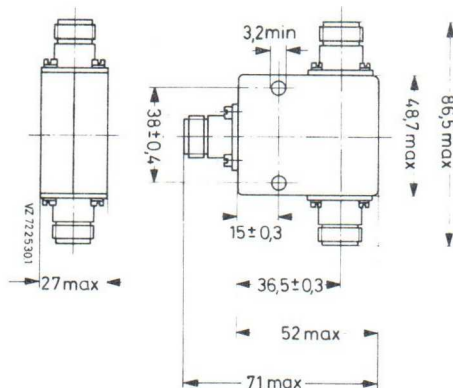


Fig. 4.

Preferred application: fixed and mobile communication

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

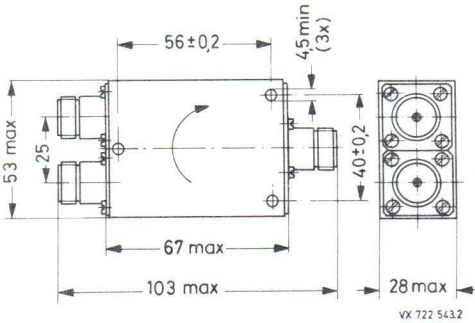


Fig. 5.

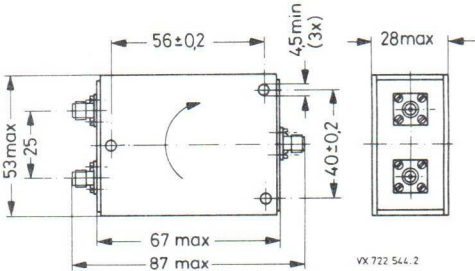


Fig. 6.

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

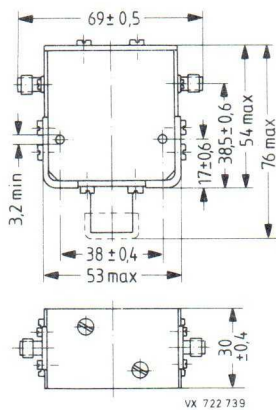


Fig. 7.

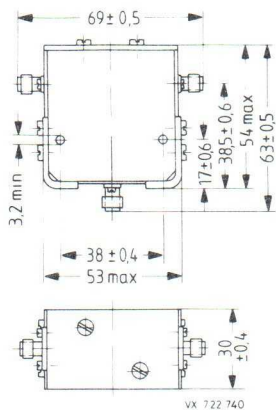


Fig. 8.

CIRCULATORS  
225 TO 400 MHz

Preferred application: fixed and mobile communication

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

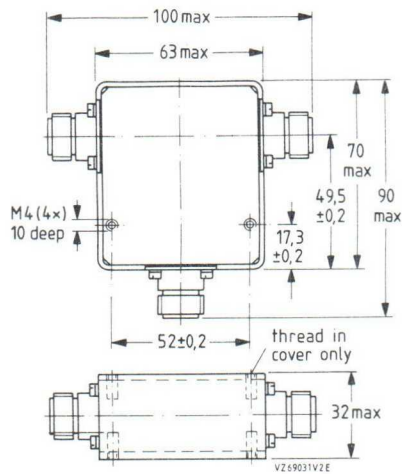


Fig. 9.



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

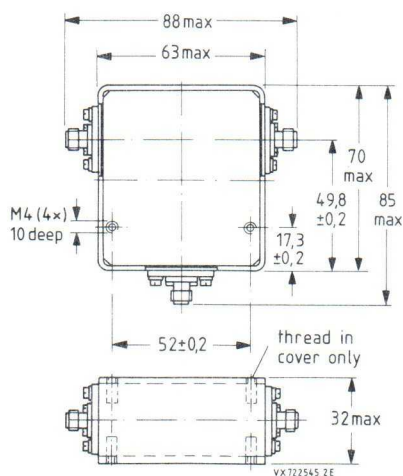


Fig. 10.

Preferred application: fixed and mobile communication

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

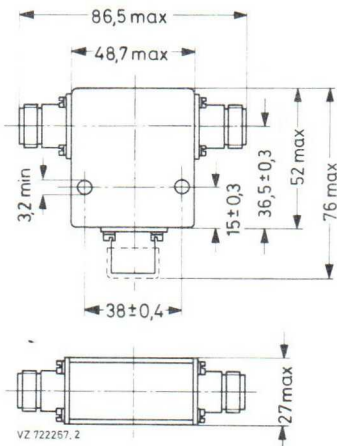


Fig. 11.

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

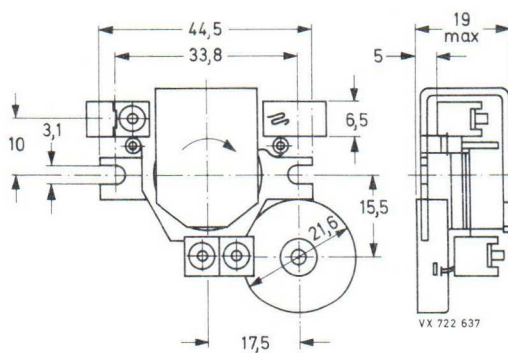


Fig. 12.

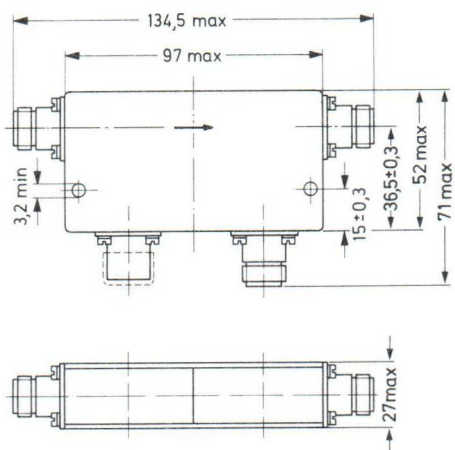


Fig. 13.

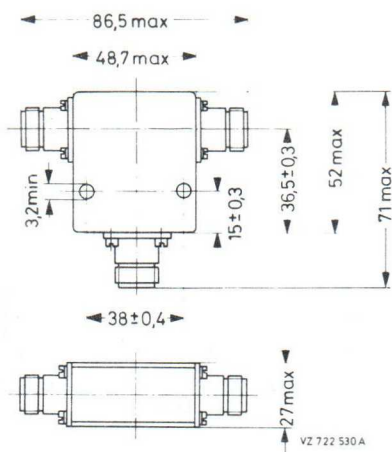


Fig. 14.

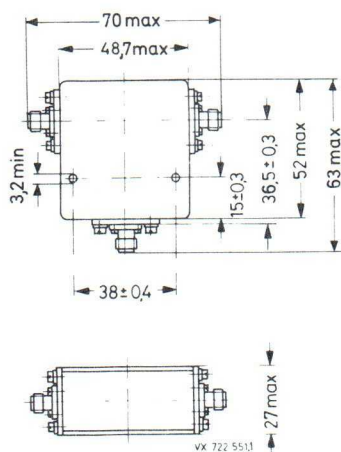


Fig. 15.

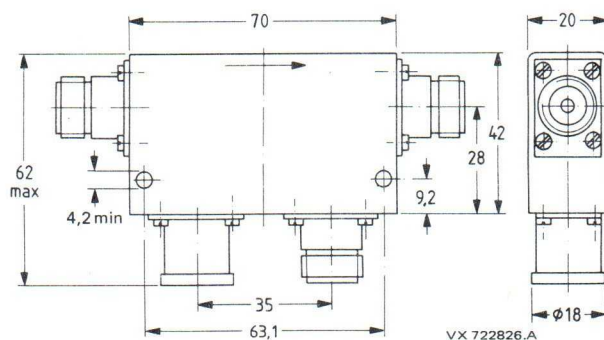


Fig. 16.

Preferred application: VHF television

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

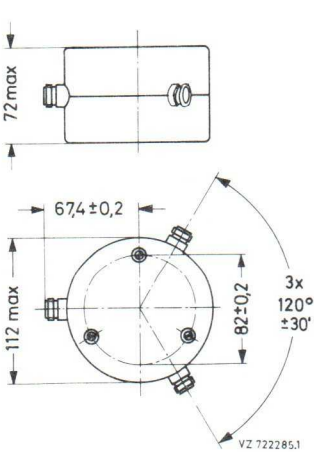


Fig. 17.

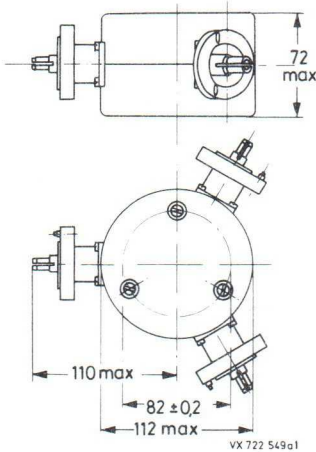


Fig. 18.

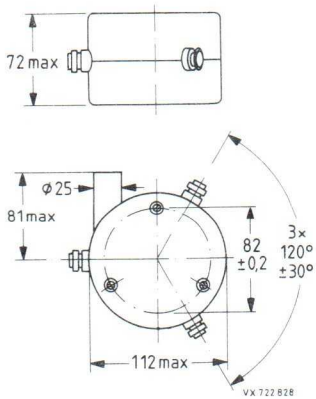


Fig. 19.

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

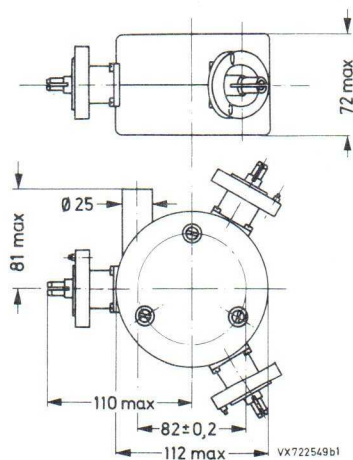


Fig. 20.

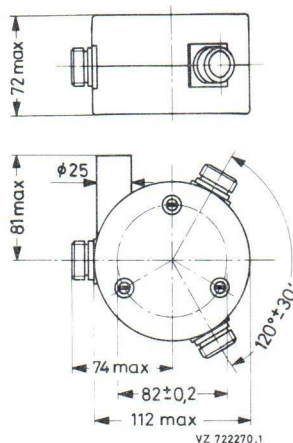


Fig. 21.

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



Preferred application: UHF television

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

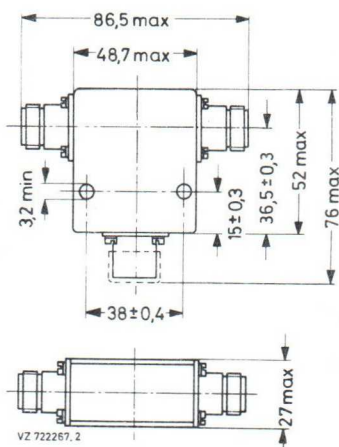


Fig. 22.

\* Low noise.

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

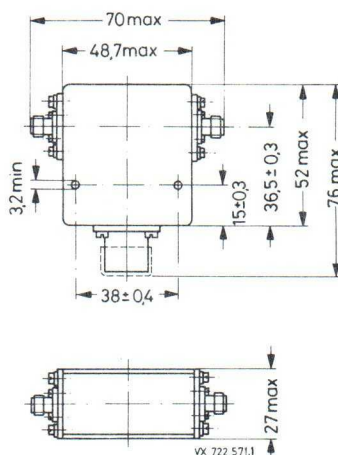


Fig. 23.

\*\* Other connectors on request.

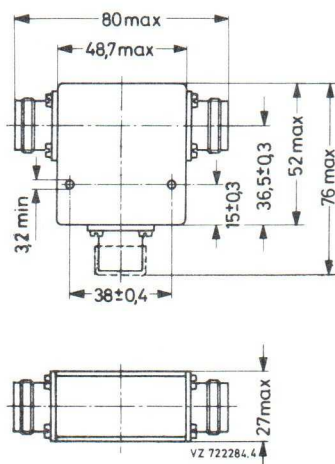


Fig. 24.

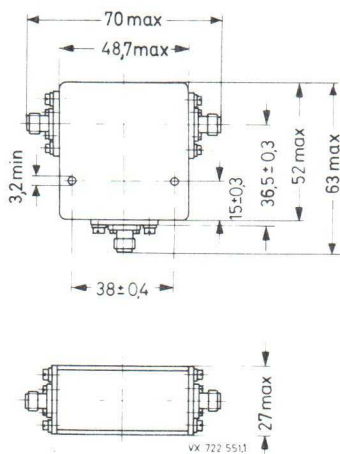


Fig. 25.

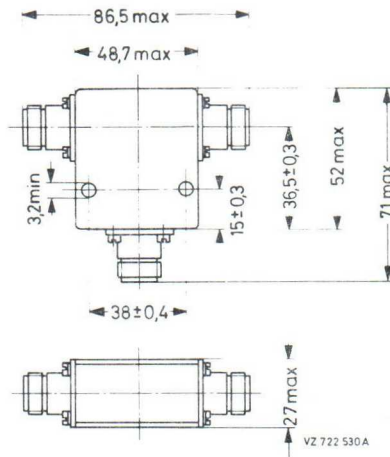


Fig. 26.

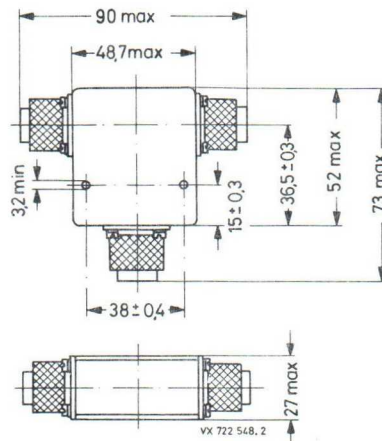


Fig. 27.

Preferred application: UHF television

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

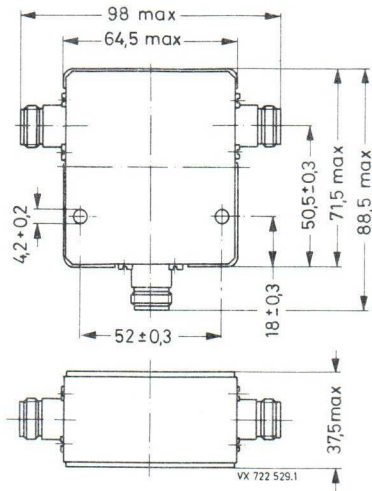


Fig. 28.

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

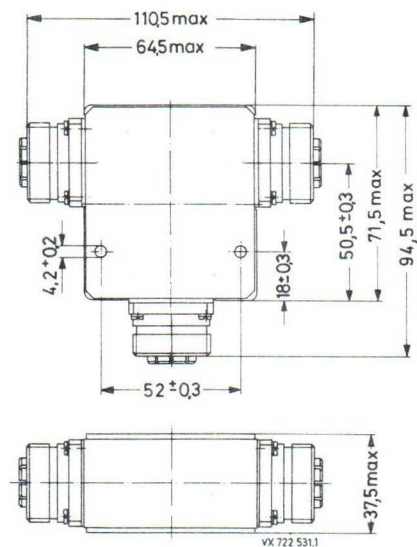


Fig. 29.

Preferred application: UHF television

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

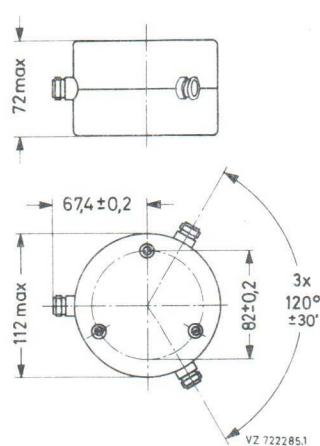


Fig. 30.

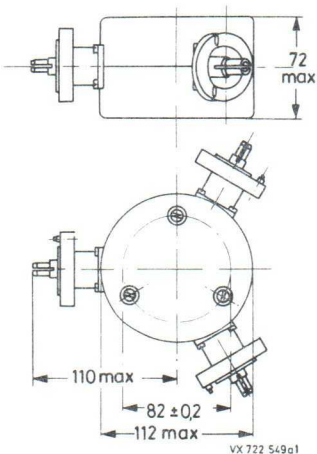


Fig. 31.



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

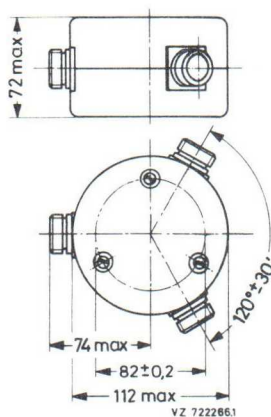


Fig. 32

Preferred application: UHF television

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

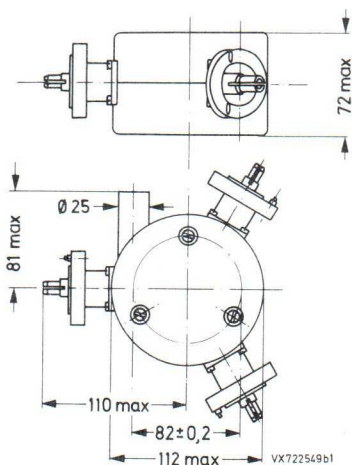


Fig. 33.

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

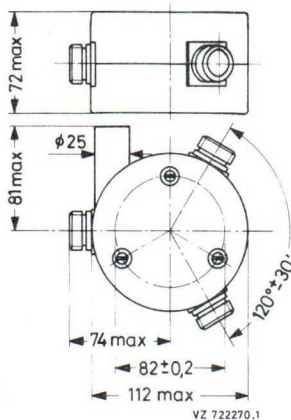


Fig. 34.

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

**BAND IV/V**  
**CIRCULATORS**  
 2/8 kW

Preferred application: UHF television

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

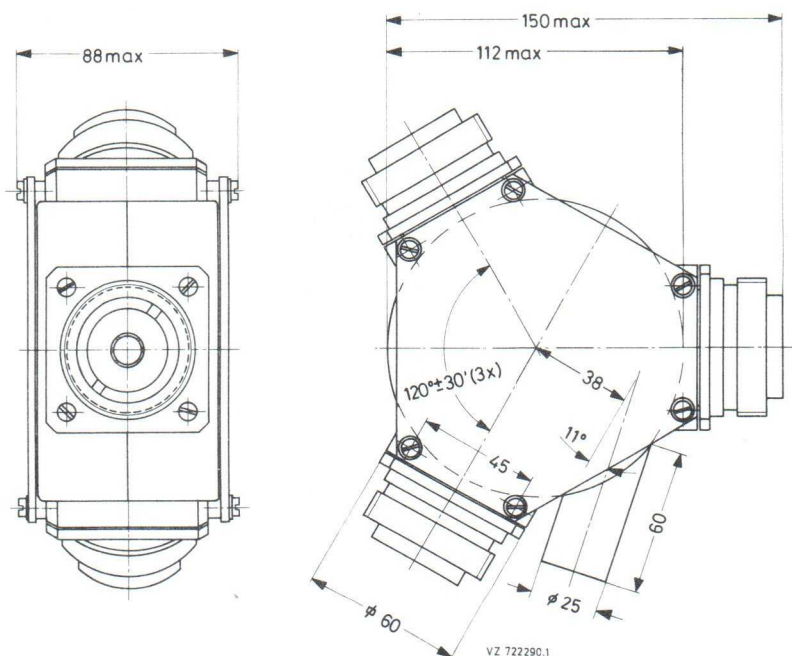


Fig. 35.

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

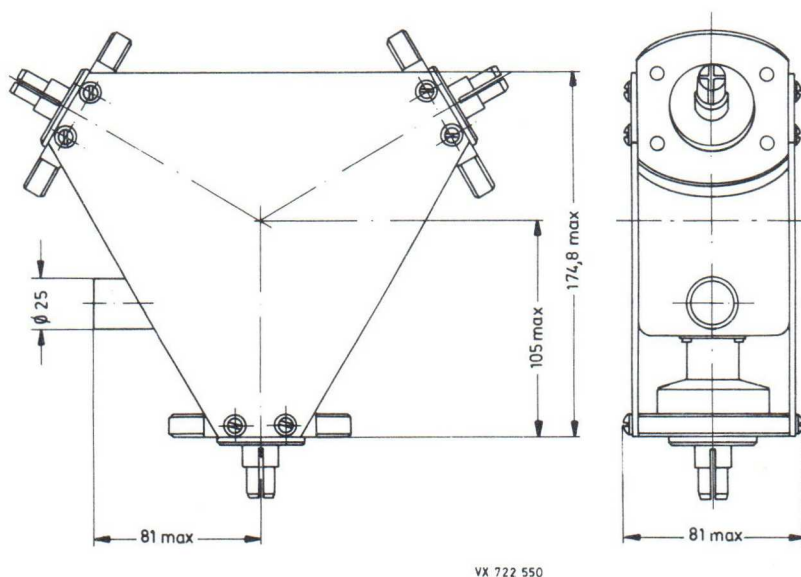


Fig. 36.

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

Preferred application: radio links and navigation

| type                    | dimensions<br>Fig. | frequency range<br>MHz | maximum power |                |
|-------------------------|--------------------|------------------------|---------------|----------------|
|                         |                    |                        | CW<br>W       | reflected<br>W |
| 2722 162 02492<br>03802 | 37<br>38           | 1427 to 1535           | 10            |                |
| 2722 162 05331          | 39                 | 1350 to 1700           | 10            |                |
| 2722 162 05571<br>06701 | 39<br>40           | 1350 to 2100           | 10            |                |
| 2722 162 03591          | 38                 | 960 to 1225            | 100           |                |

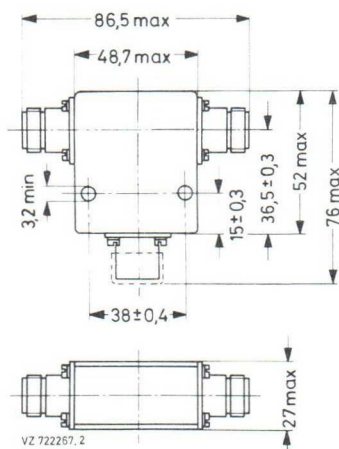


Fig. 37.

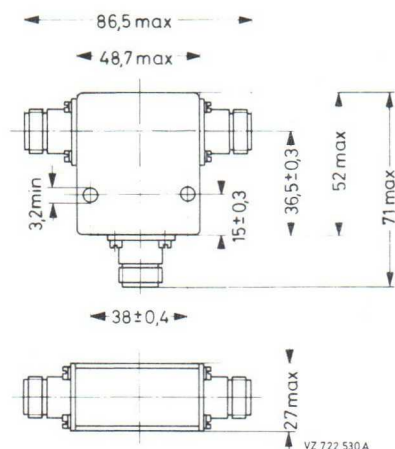


Fig. 38.

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C | connector  | mass |
|------------|------------|----------------|------------|------|------|-------------------|------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                   |            |      |
| 20         | 24         | 0,4            | 0,3        | 1,15 | 1,12 | 0 to 55           | N female   | 400  |
| 20         | 23         | 0,4            | 0,3        | 1,2  | 1,15 | 0 to 45           | SMA female | 120  |
| 17         |            | 0,5            |            | 1,35 |      | -15 to + 65       | SMA female | 120  |
| 20         | 22         | 0,5            | 0,35       | 1,25 | 1,20 | -10 to + 60       | N female   | 460  |

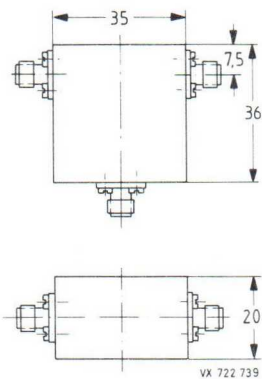


Fig. 39.

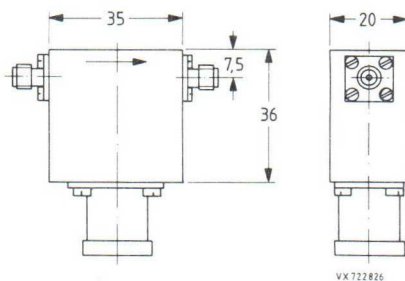


Fig. 40.



**CIRCULATORS/  
ISOLATORS**  
2 GHz

Preferred application: radio links

| type                                                        | dimensions<br>Fig. | frequency range<br>MHz                                                                       | maximum power |                |
|-------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------------|---------------|----------------|
|                                                             |                    |                                                                                              | CW<br>W       | reflected<br>W |
| 2722 162 02521<br>02531<br>02541<br>02551                   | 43                 | 1470 to 1620<br>1590 to 1800<br>1760 to 1940<br>1890 to 2110                                 | 1             | 1              |
| 2722 162 02631<br>02641<br>02651<br>02661                   | 44                 | 1470 to 1620<br>1590 to 1800<br>1760 to 1940<br>1890 to 2110                                 | 15            | 15             |
| 2722 162 05241<br>05251<br>05231                            | 45                 | 1700 to 2100                                                                                 | 30            |                |
| 2722 162 05261<br>05271                                     | 45                 | 1900 to 2300                                                                                 | 30            |                |
| 2722 162 02571<br>02581<br>02591<br>02601                   | 41                 | 1700 to 2100<br>1700 to 2100<br>1900 to 2300<br>1900 to 2300                                 | 15            | 15             |
| 2722 162 05311<br>05341<br>05351<br>05361<br>05401<br>05411 | 41                 | 1700 to 2100<br>1900 to 2300<br>2100 to 2500<br>2300 to 2700<br>2450 to 2850<br>2000 to 2700 | 10            |                |
| 2722 162 05471                                              | 42                 | 1900 to 2300                                                                                 | 15            |                |

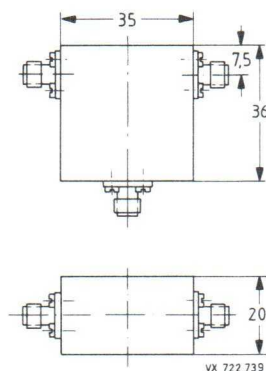


Fig. 41.

| isolation      |            | insertion loss |            | VSWR                 |      | temp. range<br>°C | connector                      | mass |
|----------------|------------|----------------|------------|----------------------|------|-------------------|--------------------------------|------|
| min.<br>dB     | typ.<br>dB | max.<br>dB     | typ.<br>dB | max.                 | typ. |                   |                                |      |
| 20             | 23         | 0,4            | 0,3        | 1,22                 | 1,15 | 0 to 55           | solder pins                    | 100  |
| 20             | 23         | 0,4            | 0,3        | 1,22                 | 1,15 | 0 to 55           | SMA<br>female                  | 150  |
| 26<br>26<br>20 |            | 0,3            |            | 1,11<br>1,11<br>1,25 |      | 0 to 55           | SMA<br>2 x female<br>1 x male  | 120  |
| 26             |            | 0,3            |            | 1,11                 |      | 0 to 55           | SMA<br>2 x female<br>1 x male  |      |
| 26             |            | 0,25           |            | 1,11                 |      | 0 to 55           | SMA<br>2 x female<br>1 x male  | 140  |
| 20             |            | 0,4            |            | 1,2                  |      | -20 to + 55       | SMA<br>female                  | 120  |
| 23             |            | 0,3            |            | 1,1                  |      | - 10 to + 70      | 1 x N female<br>2 x SMA female | 150  |

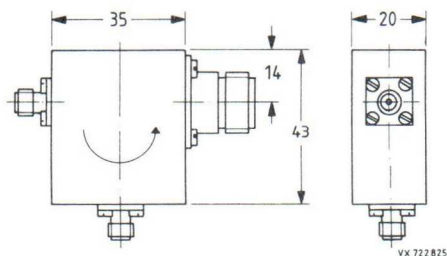


Fig. 42.

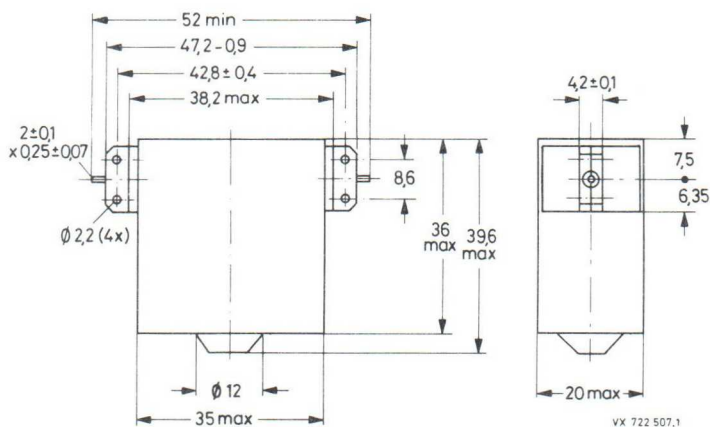


Fig. 43.

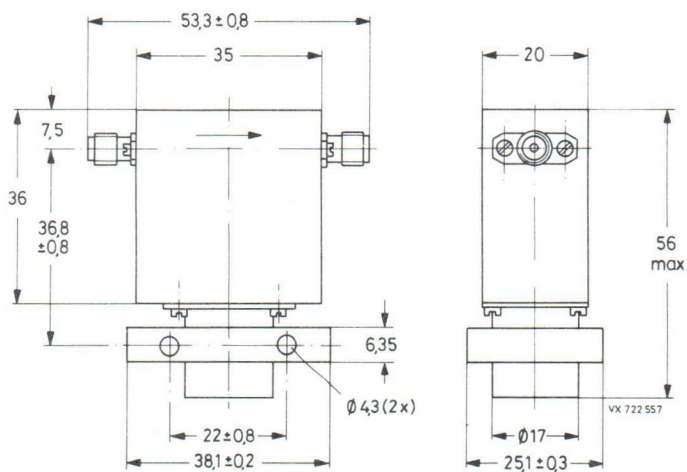


Fig. 44.

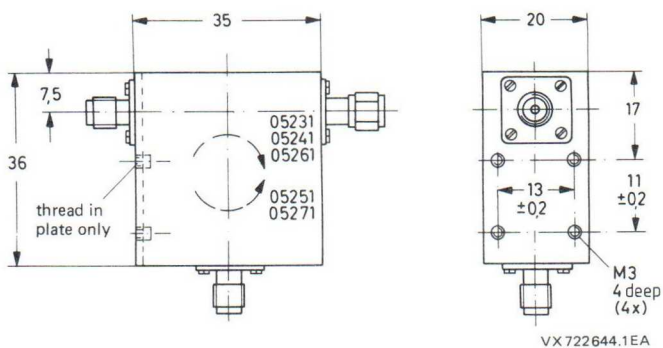


Fig. 45.

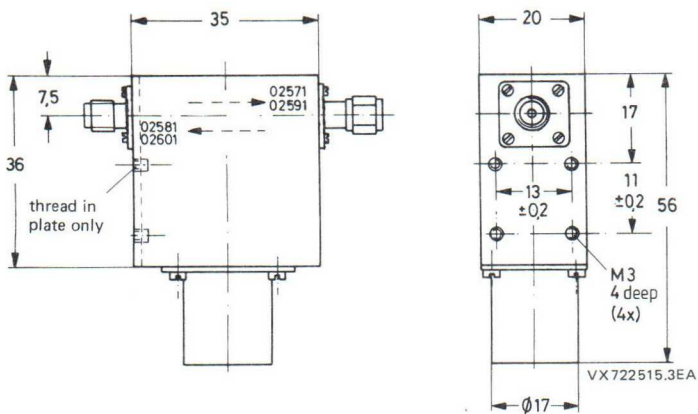


Fig. 46.

Preferred application: radio links

| type                             | dimensions<br>Fig. | frequency range<br>MHz                       | maximum power |                |
|----------------------------------|--------------------|----------------------------------------------|---------------|----------------|
|                                  |                    |                                              | CW<br>W       | reflected<br>W |
| 2722 162 03881<br>03891<br>03901 | 47                 | 1680 to 1920<br>1880 to 2120<br>2080 to 2320 | 20            |                |
| 2722 162 03911<br>03921<br>03931 | 48                 | 1680 to 1920<br>1880 to 2120<br>2080 to 2320 | 50            |                |
| 2722 162 03951<br>03941          | 47<br>48           | 1700 to 2300                                 | 20<br>50      |                |
| 2722 162 02191<br>02511          | 49<br>50           | 1700 to 2300                                 | 20            | 5              |

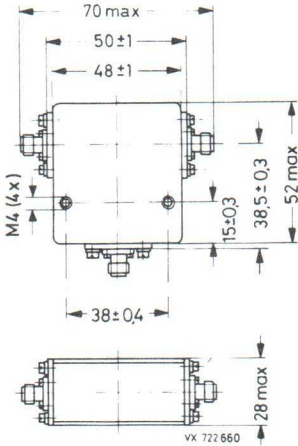


Fig. 47.

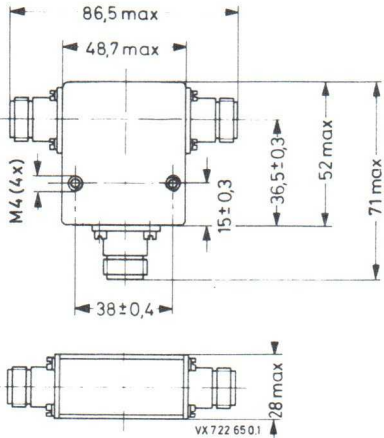


Fig. 48.

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C | connector              | mass |
|------------|------------|----------------|------------|------|------|-------------------|------------------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                   |                        |      |
| 25         |            | 0,35           |            | 1,12 |      | 0 to + 50         | SMA female             | 400  |
| 23         |            | 0,40           |            | 1,15 |      | −20 to + 60       | N female               | 400  |
| 20         |            | 0,3            |            | 1,25 |      | 0 to + 55         | SMA female<br>N female | 400  |
| 20         |            | 0,3            |            | 1,25 |      | 0 to + 55         | N m + f<br>SMA m + f   | 400  |

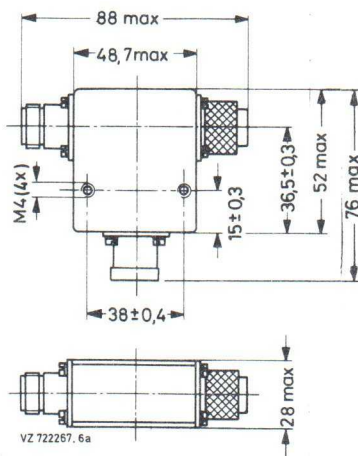


Fig. 49.

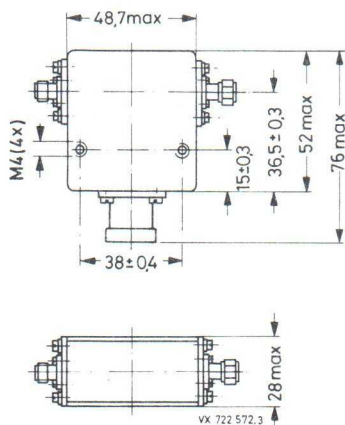


Fig. 50.

Preferred application: radio links

| type                                                        | dimensions<br>Fig. | frequency range<br>MHz                                                                               | maximum power |                |
|-------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------|---------------|----------------|
|                                                             |                    |                                                                                                      | CW<br>W       | reflected<br>W |
| 2722 162 06031<br>06321<br>06041<br>06051<br>06331<br>06061 | 51                 | 1630 to 1780<br>1815 to 1925<br>1890 to 1990<br>2038,5 to 2108,5<br>2074 to 2184<br>2297,5 to 2367,5 | 1             | 1              |

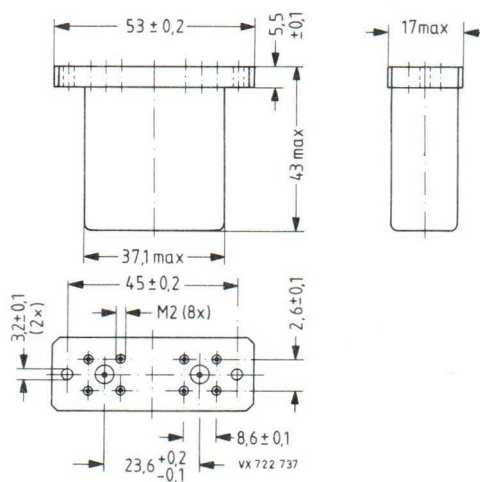


Fig. 51.



ISOLATORS 2 GHz  
FOR  
P.C. BOARD MOUNTING

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C | connector                  | mass |
|------------|------------|----------------|------------|------|------|-------------------|----------------------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                   |                            |      |
| 20         |            | 0,4            |            | 1,25 |      | -20 to + 60       | SMA<br>female,<br>modified | 110  |

4-PORT  
CIRCULATORS  
2 GHz

Preferred application: television

| type                    | dimensions<br>Fig. | frequency range<br>MHz       | maximum power |                |
|-------------------------|--------------------|------------------------------|---------------|----------------|
|                         |                    |                              | CW<br>W       | reflected<br>W |
| 2722 162 04051<br>04061 | 52                 | 1700 to 2100<br>1900 to 2300 | 30            | 15             |
| 2722 162 04091<br>04101 | 52                 | 1700 to 2100<br>1900 to 2300 | 30            |                |

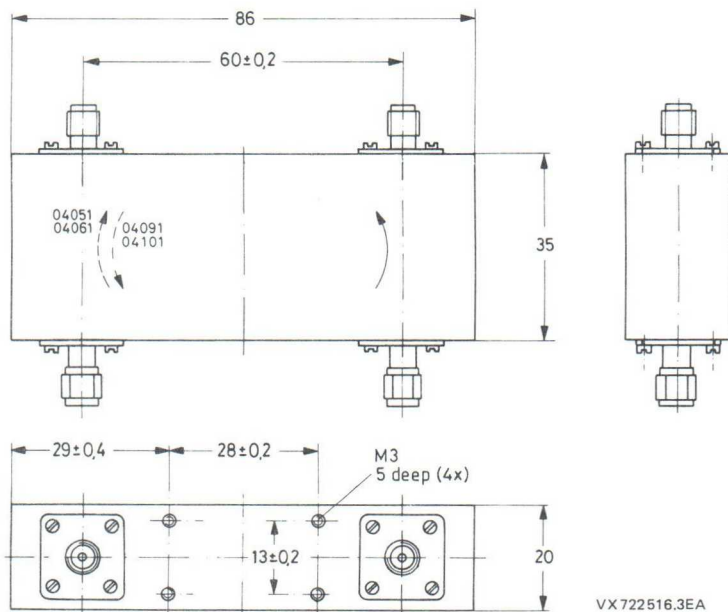


Fig. 52.

**4-PORT  
CIRCULATORS  
2 GHz**

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C | connector                     | mass |
|------------|------------|----------------|------------|------|------|-------------------|-------------------------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                   |                               |      |
| 26         |            | 0,25           |            | 1,11 |      | 0 to + 55         | SMA<br>male 2 x<br>female 2 x | 220  |
| 26         |            | 0,25           |            | 1,11 |      | 0 to + 55         | SMA<br>male 2 x<br>female 2 x | 220  |

Preferred application: radio links and navigation

| type                    | dimensions<br>Fig. | frequency range<br>MHz       | maximum power |                |
|-------------------------|--------------------|------------------------------|---------------|----------------|
|                         |                    |                              | CW<br>W       | reflected<br>W |
| 2722 162 02471          | 53                 | 4200 to 4400                 | 10            | 1,5            |
| 2722 162 03431<br>03441 | 54                 | 3800 to 4200<br>4400 to 5000 | 10            |                |
| 2722 162 04031<br>04041 | 55                 | 3800 to 4200<br>4400 to 5000 | 10            |                |

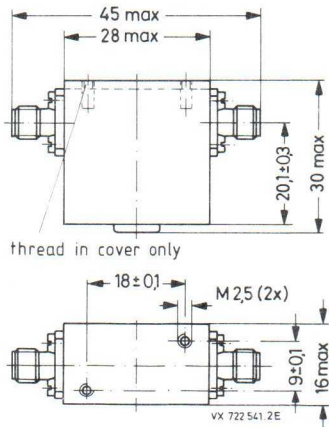


Fig. 53.

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C | connector  | mass |
|------------|------------|----------------|------------|------|------|-------------------|------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                   |            |      |
| 23         | 25         | 0,3            | 0,25       | 1,2  | 1,12 | -55 to + 90       | SMA female | 60   |
| 25         | 27         | 0,25           | 0,2        | 1,12 | 1,10 | -10 to + 70       | SMA female | 110  |
| 25         | 27         | 0,25           | 0,2        | 1,12 | 1,10 | -10 to + 70       | SMA female | 220  |

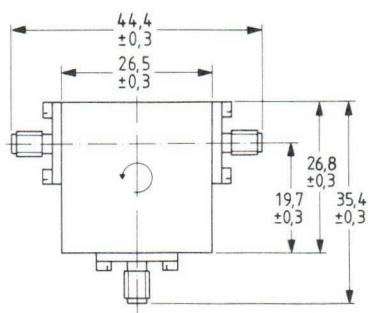


Fig. 54.

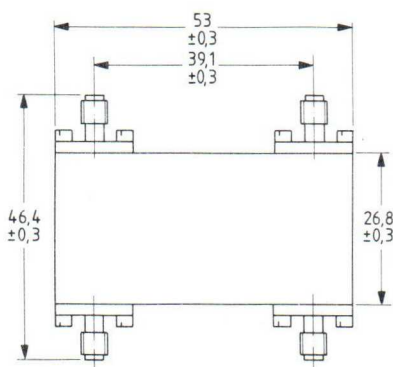
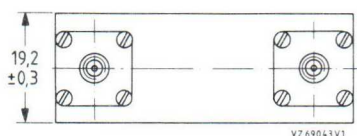
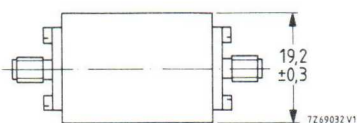


Fig. 55.



Preferred application: radio links

| type                             | dimensions<br>Fig. | frequency range<br>MHz                       | maximum power |                |
|----------------------------------|--------------------|----------------------------------------------|---------------|----------------|
|                                  |                    |                                              | CW<br>W       | reflected<br>W |
| 2722 161 04001<br>04051<br>04061 | 56                 | 5925 to 6425<br>6425 to 7125<br>7125 to 7750 | 200           | 3              |
| 2722 161 02211<br>02311<br>02321 | 57                 | 5925 to 6425<br>6425 to 7125<br>7125 to 7750 | 200           |                |

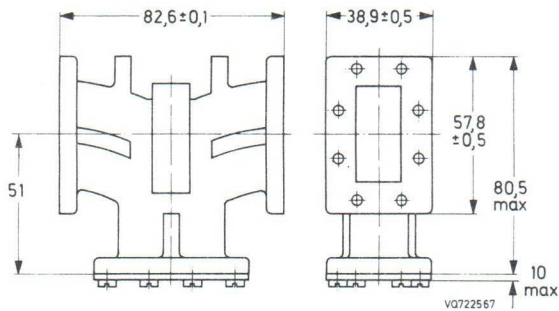


Fig. 56.

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C | connector  | mass |
|------------|------------|----------------|------------|------|------|-------------------|------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                   |            |      |
| 28         |            | 0,2            |            | 1,08 |      | 0 to + 50         | IEC-UER 70 | 230  |
| 28         |            | 0,2            |            | 1,08 |      | 0 to + 50         | IEC-UER 70 | 230  |

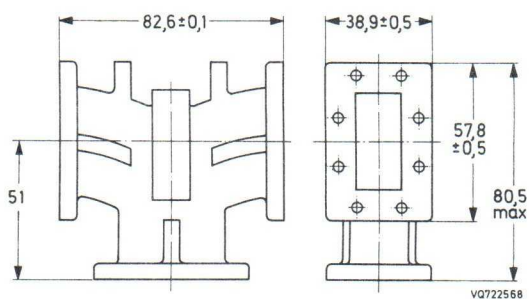


Fig. 57.



Preferred application: microwave measurements

| type                    | dimensions<br>Fig. | frequency range<br>MHz        | maximum power |                |
|-------------------------|--------------------|-------------------------------|---------------|----------------|
|                         |                    |                               | CW<br>W       | reflected<br>W |
| 2722 162 02091<br>01491 | 58<br>59           | 2000 to 4000                  | 50            |                |
| 2722 162 02101<br>01501 | 60<br>61           | 2000 to 4000                  | 50            |                |
| 2722 162 02071<br>01511 | 62<br>63           | 3000 to 6000                  | 20            |                |
| 2722 162 02111<br>01811 | 64<br>65           | 4000 to 8000                  | 10            |                |
| 2722 162 02122<br>01822 | 66<br>67           | 7000 to 12400                 | 10            |                |
| 2722 162 02221<br>03301 | 68<br>69           | 12000 to 18000                | 5             |                |
| 2722 162 02231<br>02501 | 70<br>71           | 7900 to 10400<br>8900 to 9600 | 5             |                |
| 2722 161 02071          | 72                 | 8200 to 11200                 | 50            |                |

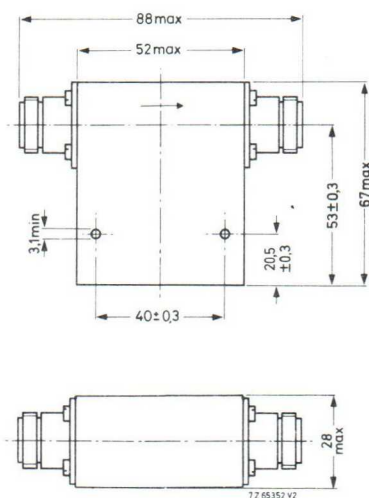


Fig. 58.

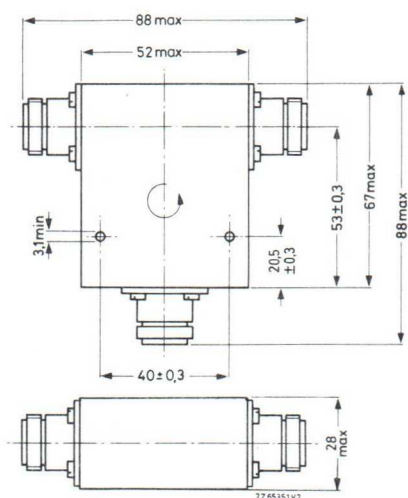


Fig. 59.

| isolation  |            | insertion loss |             | VSWR        |      | temp. range<br>°C | connector   | mass |
|------------|------------|----------------|-------------|-------------|------|-------------------|-------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB  | max.        | typ. |                   |             |      |
| 20         | 24         | 0,5            | 0,35        | 1,25        | 1,15 | -10 to + 70       | N female    | 300  |
| 20         | 24         | 0,5            | 0,35        | 1,25        | 1,15 | -10 to + 70       | SMA female  | 300  |
| 20         | 24         | 0,5            | 0,3         | 1,25        | 1,15 | -10 to + 70       | SMA female  | 120  |
| 20         | 24         | 0,5            | 0,3         | 1,25        | 1,15 | -10 to + 70       | SMA female  | 100  |
| 20         | 24         | 0,6            | 0,35<br>0,4 | 1,25        | 1,15 | -10 to + 70       | SMA female  | 60   |
| 18         | 22         | 0,6            | 0,35        | 1,25<br>1,3 | 1,2  | -10 to + 70       | SMA female  | 20   |
| 20         | 22         | 0,4            | 0,35        | 1,25        | 1,23 | -10 to + 70       | SMA female  | 30   |
| 22         | 30         | 0,5            | 0,3         | 1,18        | 1,15 | + 10 to + 40      | IEC-UBR 100 | 500  |

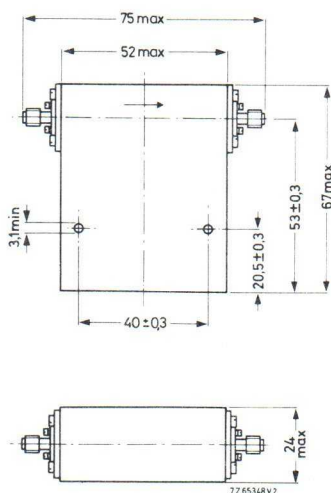


Fig. 60.

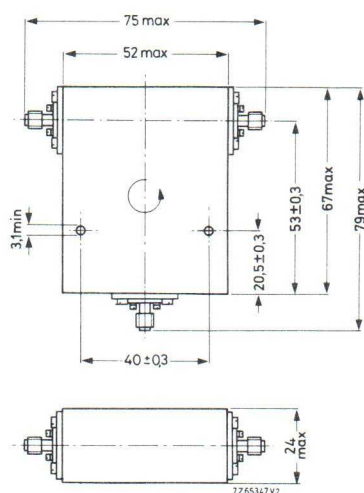


Fig. 61.

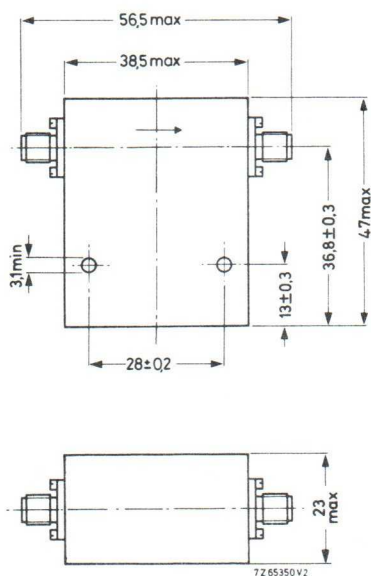


Fig. 62.

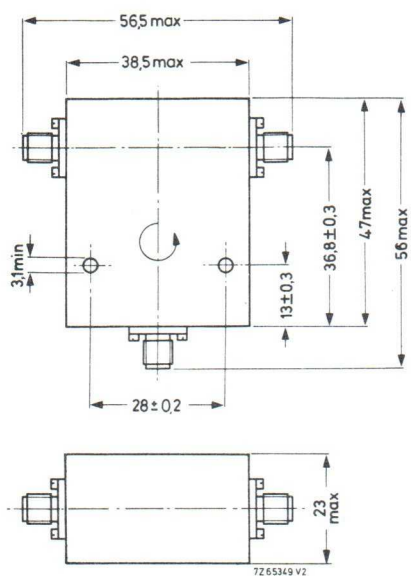


Fig. 63.

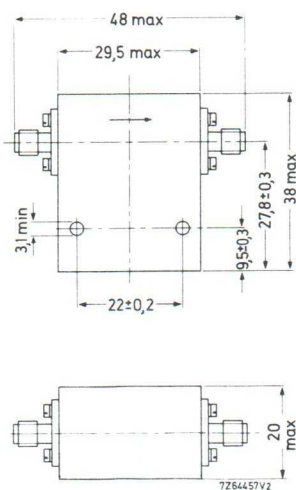


Fig. 64.

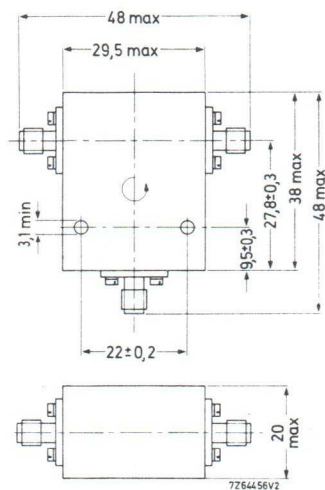


Fig. 65.

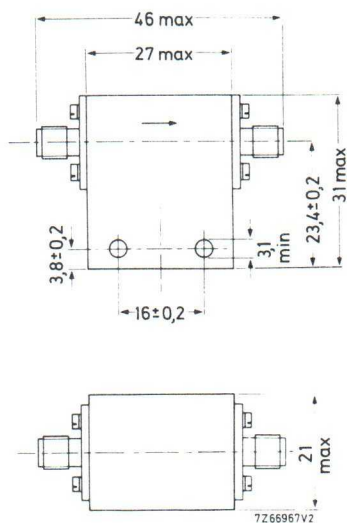


Fig. 66.

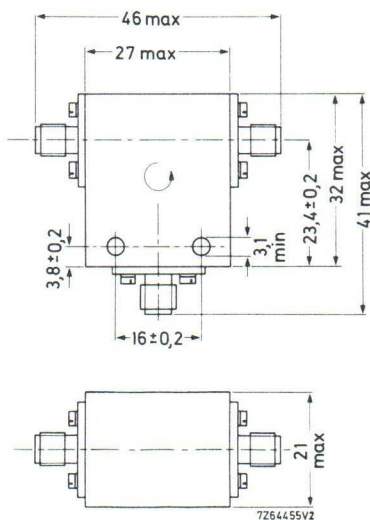


Fig. 67.

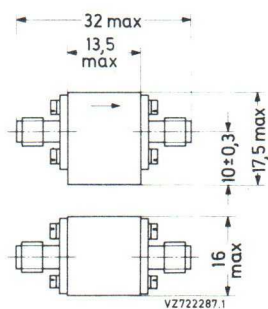


Fig. 68.

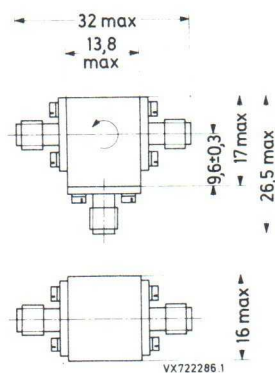


Fig. 69.

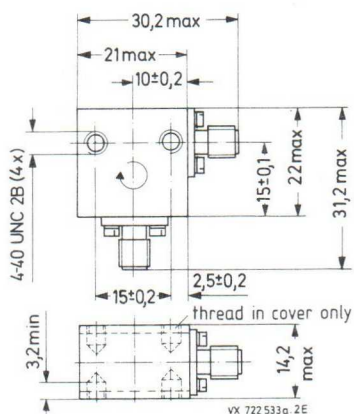


Fig. 70.

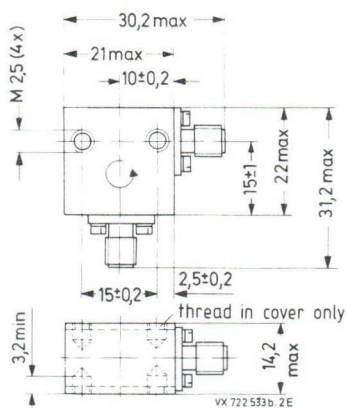


Fig. 71.

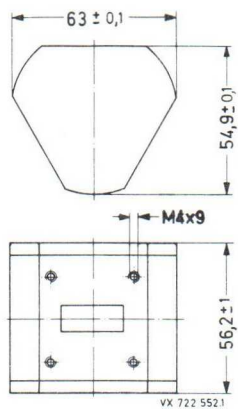


Fig. 72.

Preferred application: radar

| type                     | dimensions<br>Fig. | frequency range<br>MHz | maximum power |                |
|--------------------------|--------------------|------------------------|---------------|----------------|
|                          |                    |                        | CW<br>W       | reflected<br>W |
| 2722 161 01221<br>01222* | 73                 | 8500 to 9600           | 1             |                |
| 2722 161 01361           | 74                 | 8500 to 9600           | 5             |                |
| 2722 161 01211<br>01261  | 75<br>76           | 8500 to 9600           | 10            |                |
| 2722 161 01531           | 77                 | 10025 to 10325         | 1             |                |

\* With M4-Helicoil.

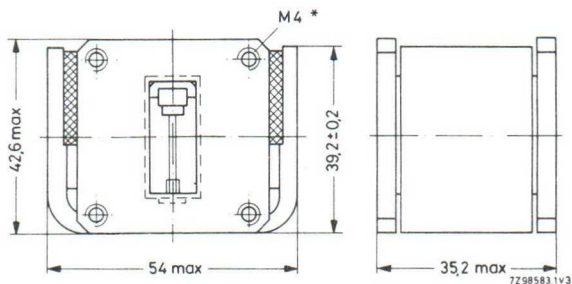


Fig. 73.

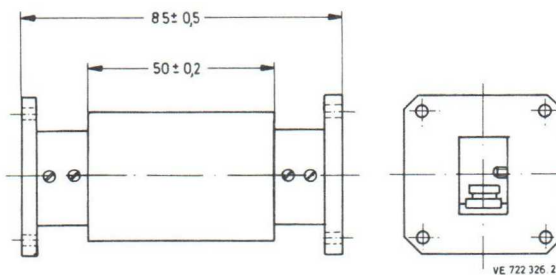


Fig. 74.

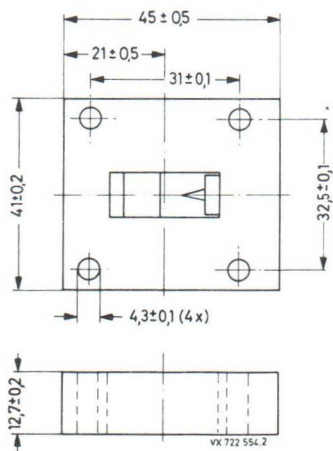


Fig. 77.

| isolation  |            | insertion loss |            | VSWR         |      | temp. range<br>°C | connector   | mass       |
|------------|------------|----------------|------------|--------------|------|-------------------|-------------|------------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max.         | typ. |                   |             |            |
| 15         |            | 0,6            |            | 1,15         |      | + 10 to + 70      | IEC-UBR 100 | 400        |
| 30         |            | 0,5            |            | 1,05         |      | -10 to + 70       | IEC-UBR 100 | 600        |
| 30<br>55   |            | 0,5<br>1,2     |            | 1,05<br>1,20 |      | -10 to + 70       | IEC-UBR 100 | 420<br>600 |
| 20         |            | 0,4            |            | 1,25         |      | -40 to + 85       | IEC-UBR 100 | 50         |

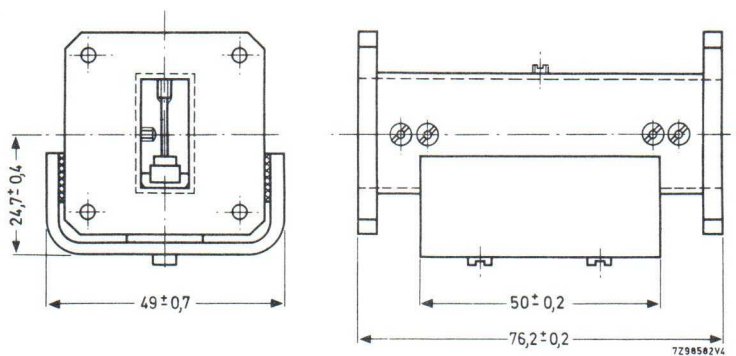


Fig. 75.

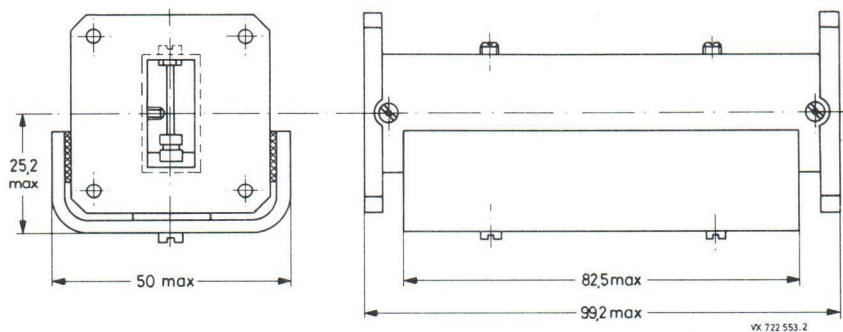


Fig. 76.



Preferred application: microwave heating

| type                    | dimensions<br>Fig. | frequency range<br>MHz | maximum power |                |
|-------------------------|--------------------|------------------------|---------------|----------------|
|                         |                    |                        | CW<br>W       | reflected<br>W |
| 2722 163 02091<br>02081 | 78<br>79           | 2350 to 2400           | 3000          | 3000           |
| 2722 163 02071<br>02061 | 78<br>79           | 2425 to 2475           | 3000          | 3000           |

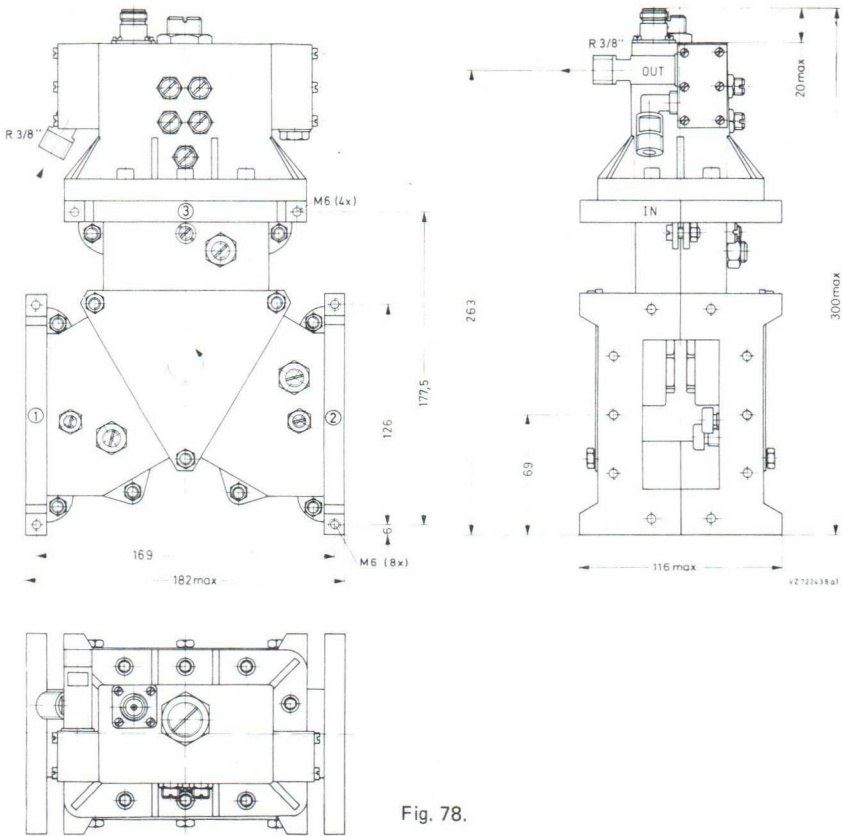


Fig. 78.

| isolation  |            | insertion loss |            | VSWR  |      | temp. range<br>°C                                | connector                                      | mass |
|------------|------------|----------------|------------|-------|------|--------------------------------------------------|------------------------------------------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max.  | typ. |                                                  |                                                |      |
| 20         | 26         | 0,3            | 0,2        | 1,25* |      | $\theta_1$ : max. + 40<br>$\theta_2$ : max. + 50 | IEC-PDR 26,<br>monitor-<br>output:<br>N female | 4500 |
| 20         | 26         | 0,3            | 0,2        | 1,25* |      | $\theta_1$ : max. + 40<br>$\theta_2$ : max. + 50 |                                                | 4500 |

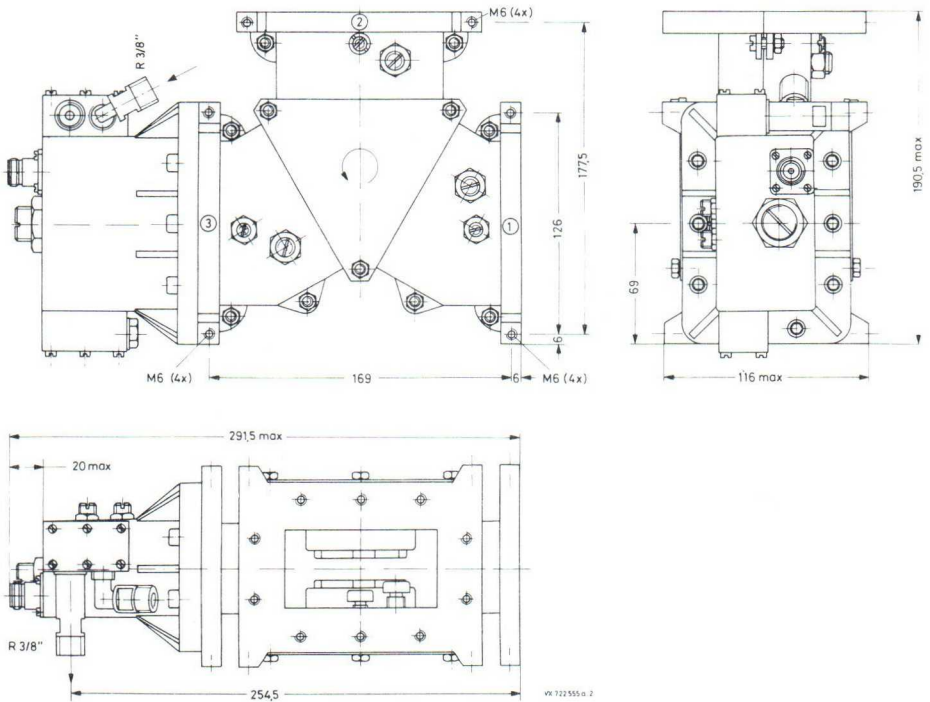


Fig. 79.

\* With output short-circuited:  $S \leq 1,5$ .

Preferred application: microwave heating

| type                    | dimensions<br>Fig. | frequency range<br>MHz | maximum power |                |
|-------------------------|--------------------|------------------------|---------------|----------------|
|                         |                    |                        | CW<br>W       | reflected<br>W |
| 2722 163 02024<br>02025 | 80<br>81           | 2350 to 2400           | 6500          | 6500           |
| 2722 163 02004<br>02005 | 80<br>81           | 2425 to 2475           | 6500          | 6500           |

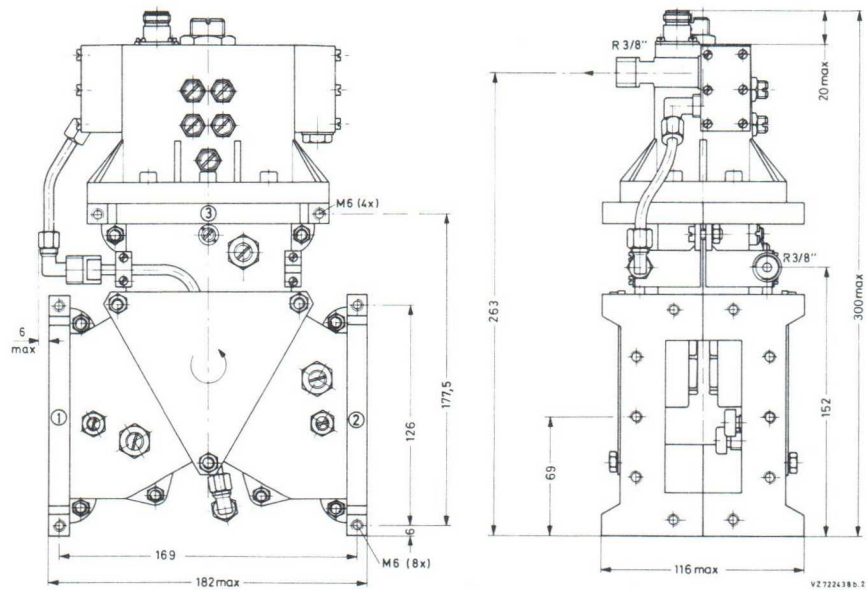


Fig. 80.

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C                                | connector                                      | mass |
|------------|------------|----------------|------------|------|------|--------------------------------------------------|------------------------------------------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                                                  |                                                |      |
| 20         | 26         | 0,3            | 0,2        | 1,2* | 1,1  | $\theta_1$ : max. + 40<br>$\theta_2$ : max. + 50 | IEC-PDR 26,<br>monitor-<br>output:<br>N female | 4700 |
| 20         | 26         | 0,3            | 0,2        | 1,2* | 1,1  | $\theta_1$ : max. + 40<br>$\theta_2$ : max. + 50 |                                                | 4700 |

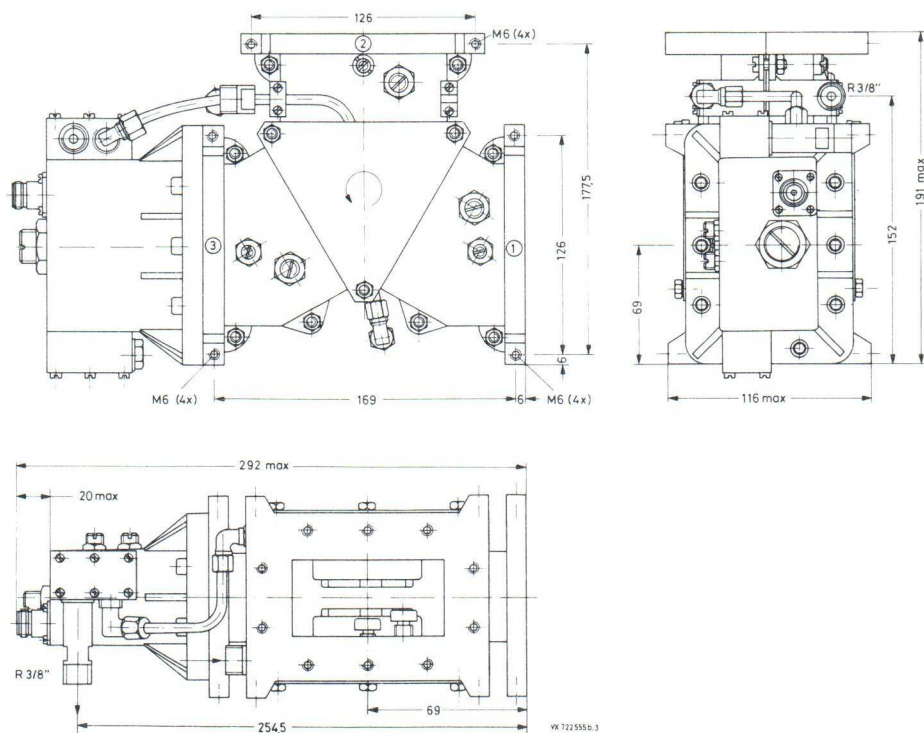


Fig. 81.

\* With output short-circuited:  $S \leq 1,5$ .

Preferred application: microwave heating

| type           | dimensions<br>Fig. | frequency range<br>MHz | maximum power |   |
|----------------|--------------------|------------------------|---------------|---|
|                |                    |                        | CW<br>W       | W |
| 2722 163 01021 | 82                 | 2425 to 2475           | 6500          |   |

Water load; type 2722 163 02051; dimensions Fig. 83;  $\theta_1$ : max. + 40 °C;  $\theta_2$ : max. 50 °C;  
connector: IEC-PDR26, monitor output: N female.

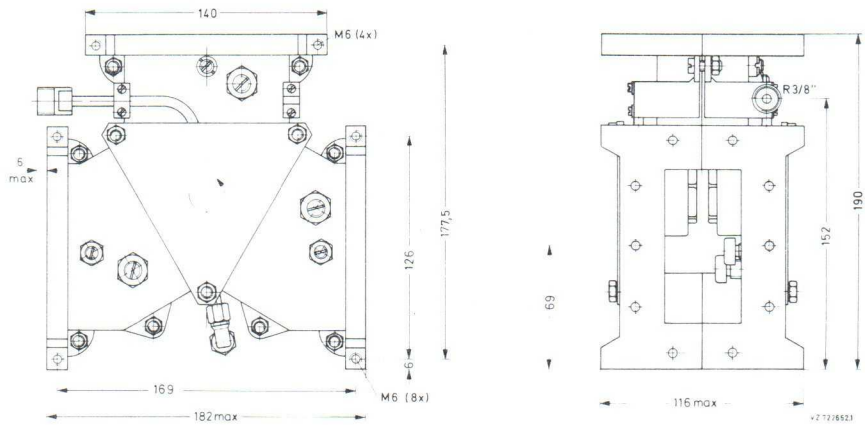


Fig. 82.

| isolation  |            | insertion loss |            | VSWR |      | temp. range<br>°C                                | connector  | mass |
|------------|------------|----------------|------------|------|------|--------------------------------------------------|------------|------|
| min.<br>dB | typ.<br>dB | max.<br>dB     | typ.<br>dB | max. | typ. |                                                  |            |      |
| 20         |            | 0,3            |            | 1,2* |      | $\theta_1$ : max. + 40<br>$\theta_2$ : max. + 50 | IEC-PDR 26 |      |

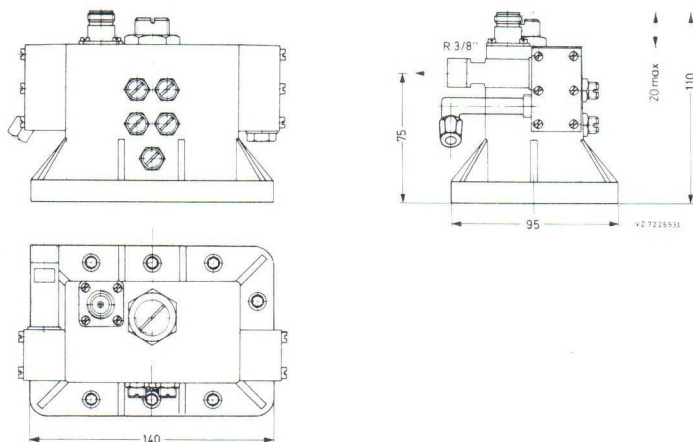


Fig. 83.

\* With output short-circuited:  $S \leq 1,5$ .



# MISCELLANEOUS





## MICROWAVE HORN ANTENNA

A general purpose X-band antenna for miniature radar systems.

The unit gives a low v.s.w.r. and is of a strong cast construction.

**QUICK REFERENCE DATA****CHARACTERISTICS**

|                          |           |     |
|--------------------------|-----------|-----|
| Frequency range          | 9.0 to 11 | GHz |
| Gain                     | 16        | dB  |
| Beam angle (both planes) | 30        | deg |
| v.s.w.r. max.            | 1.2       |     |

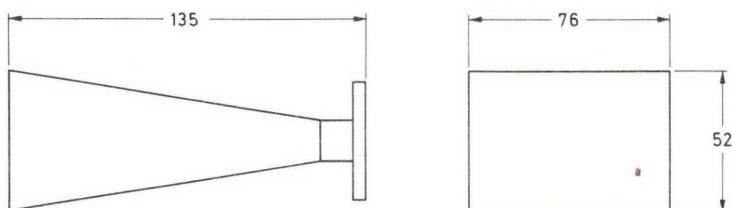
**MECHANICAL DATA**

|        |                  |   |
|--------|------------------|---|
| Weight | 160              | g |
| Flange | UBR100 (UG135/U) |   |

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

**MECHANICAL DATA**

Dimensions in mm



All dimensions in mm

D6006



## DEVELOPMENT DATA

This data sheet contains advance information and specifications are subject to change without notice.

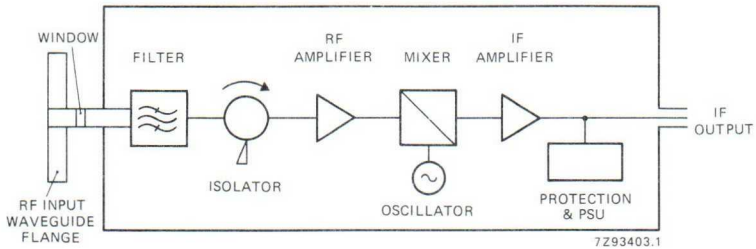
JM1201

### 12 GHz DOWN CONVERTER

This down converter is designed for use with the direct broadcast satellites in Western Europe. It converts the 11,7 to 12,5 GHz signal from a satellite to a frequency of 950 to 1750 MHz.

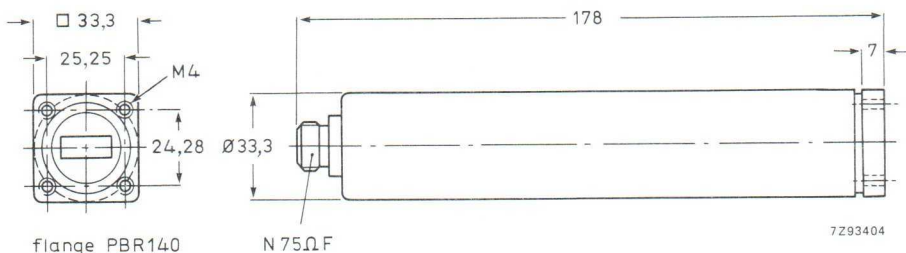
The down converter consists of the following:

- Waveguide filter
- Isolator
- R.F. amplifier
- Mixer
- Oscillator
- I.F. amplifier
- Power supply and d.c. protection circuits
- Hermetic housing



**ELECTRICAL DATA** (temperature range  $-25^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ )

|                                              |                       |
|----------------------------------------------|-----------------------|
| R.F. band                                    | 11,7 to 12,5 GHz      |
| Input noise figure                           | max. 5 dB             |
| V.S.W.R. at r.f. input                       | $\leq 1,5$            |
| L.O. frequency                               | $10,75 \pm 0,005$ GHz |
| Conversion gain                              | $37,5 \pm 2,5$ dB     |
| Gain variation in:                           |                       |
| i.f. 800 MHz band                            | $\leq 5$ dB           |
| 27 MHz band                                  | $\leq 0,5$ dB         |
| Local oscillator radiation                   | $\leq -86$ dBm        |
| Image rejection                              | $\geq 90$ dB          |
| I.F. output                                  | 950 to 1750 MHz       |
| I.F. output v.s.w.r.                         | $\leq 1,5$            |
| 1 dB compression                             | $\geq 5$ dBm          |
| Third harmonic intercept                     | $\geq 15$ dBm         |
| D.C. power supply, centre conductor positive | 13 to 16,5 V          |
| D.C. consumption                             | $\leq 150$ mA         |

**MECHANICAL DATA**

|                                             |                                  |
|---------------------------------------------|----------------------------------|
| R.F. input                                  | PBR-140, Ni-plated               |
| I.F. output                                 | N-female 75 $\Omega$ , Ni-plated |
| Housing                                     | Aluminium, enamel finish white   |
| Hermetic seal                               | Laser welds                      |
| R.F. input closed with special glass window |                                  |
| D.C. power positive on centre conductor     |                                  |
| Mass                                        | $\leq 250$ g                     |

**ENVIRONMENTAL DATA**, limiting values

|                       |                                |
|-----------------------|--------------------------------|
| Operating temperature | $-25$ to $+55^{\circ}\text{C}$ |
| Operating mode        | continuous                     |
| Relative humidity     | 100%                           |
| Vibration             | IEC 68-2-6                     |
| Shock                 | IEC 68-2-29                    |

**CATALOGUE NUMBER**

9360 046 30112

## YIG-TUNED OSCILLATORS

These oscillators consist of a Gunn diode, a microstrip impedance transformer, a YIG sphere and electromagnetic coils. They are intended for use in wideband equipment for civil and military applications in frequency bands from 8 to 18 GHz.

## QUICK REFERENCE DATA

| type   | frequency range<br>GHz | guaranteed minimum output<br>power over tuning range<br>mW |
|--------|------------------------|------------------------------------------------------------|
| YG1103 | 8 - 12.4               | 40                                                         |
| YG1104 | 10 - 15                | 20                                                         |
| YG1105 | 12 - 18                | 20                                                         |

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

## POTENTIAL HAZARD-BERYLLIUM OXIDE

This device contains beryllium oxide, the dust of which is toxic. The device is entirely safe, provided that the beryllium oxide disc is not damaged. Care should be taken to ensure that all those who may handle, use or dispose of this device are aware of its nature and of the necessary safety precautions. In particular, it should never be thrown out with general industrial or domestic waste.

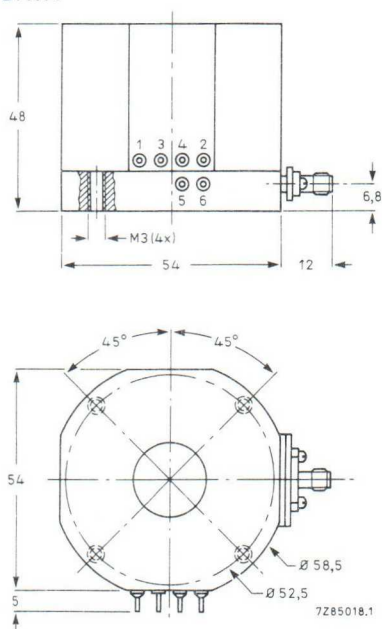
## DISPOSAL SERVICE

In the United Kingdom, devices requiring disposal may be returned to the Mullard Service Department at the address below. They must be separately and securely packed and clearly identified. If they are damaged or broken, they must not be sent through the post.

Mullard Service Department,  
Mullard Ltd,  
P.O. Box No. 142,  
Beddington Lane,  
CROYDON,  
Surrey,  
CR9 9EL

## MECHANICAL DATA

Dimensions in mm



## Connections:

- 1-2 Main coil
- 3-4 Fast coil
- 5 -V Gunn earth
- 6 +V Gunn

Fig. 1.

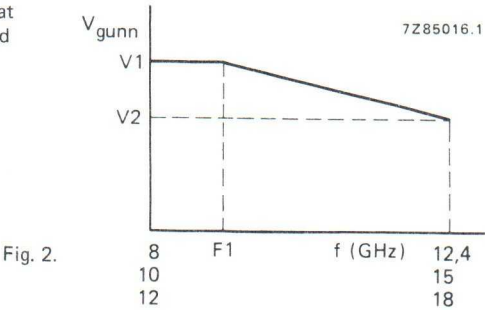
## ELECTRICAL DATA

|                                                                  | YG1103       | YG1104   | YG1105                              |
|------------------------------------------------------------------|--------------|----------|-------------------------------------|
| Frequency range                                                  | 8 to 12.4    | 10 to 15 | 12 to 18 GHz                        |
| Linearity                                                        | typ. $\pm 2$ | $\pm 3$  | $\pm 3$ ‰                           |
| Output power over tuning range,<br>see Figs 5, 6 and 7, at 25 °C | min. 40      | 20       | 20 mW                               |
| Power variation in band,<br>at 25 °C                             | max. 5       | 5        | 5 dB                                |
| Pulling (VSWR 1,5 : 1)                                           | max. 15      | 15       | 15 MHz                              |
| Pushing                                                          | max. 20      | 20       | 20 MHz/V                            |
| Phase noise<br>at 3 dBc                                          | max. 50      | 50       | 50 kHz                              |
| Other parasitics                                                 | typ. -40     | -40      | -40 dBc                             |
| Second harmonic                                                  | typ. -20     | -20      | -20 dBc                             |
| Frequency drift from<br>0 to +50 °C                              | typ. 50      | 50       | $50 \cdot 10^{-6}/^{\circ}\text{C}$ |
| Sensitivity to external<br>magnetic field                        | typ. 15      | 15       | 15 GHz/T                            |
| Hysteresis                                                       | typ. 10      | 12       | 15 MHz                              |

OPERATING CONDITIONS

|                                                                |      |             |     |     |    |
|----------------------------------------------------------------|------|-------------|-----|-----|----|
| Supply voltage of Gunn diode                                   | max. | 15          | 14  | 12  | V  |
| Supply current of Gunn diode                                   | max. | 1.0         | 0.8 | 1.2 | A  |
| Storage temperature                                            |      | -55 to +125 |     |     | °C |
| Operating temperature, measured on<br>base plate of oscillator |      | 0 to +50    |     |     | °C |

To obtain optimum characteristics over the whole band, the supply voltage to the Gunn diode must be adjusted with the frequency at the value indicated on the test sheet supplied with the product.



A curve giving measured data is supplied with each oscillator. The Gunn diode will be damaged if its polarity is reversed. Maximum supply voltages of the Gunn diode must not be exceeded. The oscillator must be bolted to a heatsink. To ensure good thermal contact, the oscillator has an unpainted machined flat baseplate.



## Typical coil data

Main coil:

Tuning sensitivity up to 100 Hz

Current

Resistance

Inductance at 1 kHz

see Fig. 3.

17,5 MHz/mA

< 1,2 A

7  $\Omega$

165  $\pm$  15 mH

Fast coil:

Tuning sensitivity at 100 Hz, Fig. 4

Tuning sensitivity at 1 MHz, Fig. 4

Resistance

Inductance

Current

typ. 320 kHz/mA

typ. 90 kHz/mA

< 1  $\Omega$

< 10  $\mu$ H

< 1 A

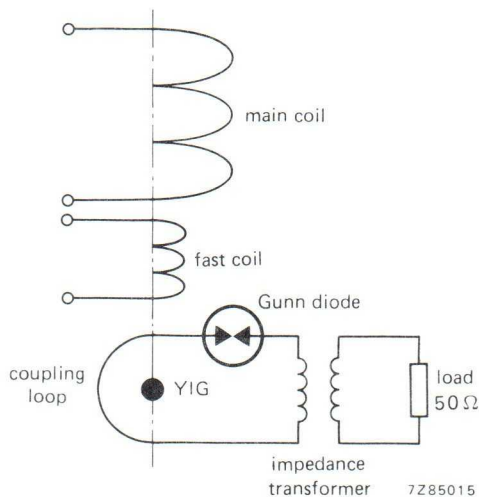


Fig. 3.

## PERFORMANCE CURVES

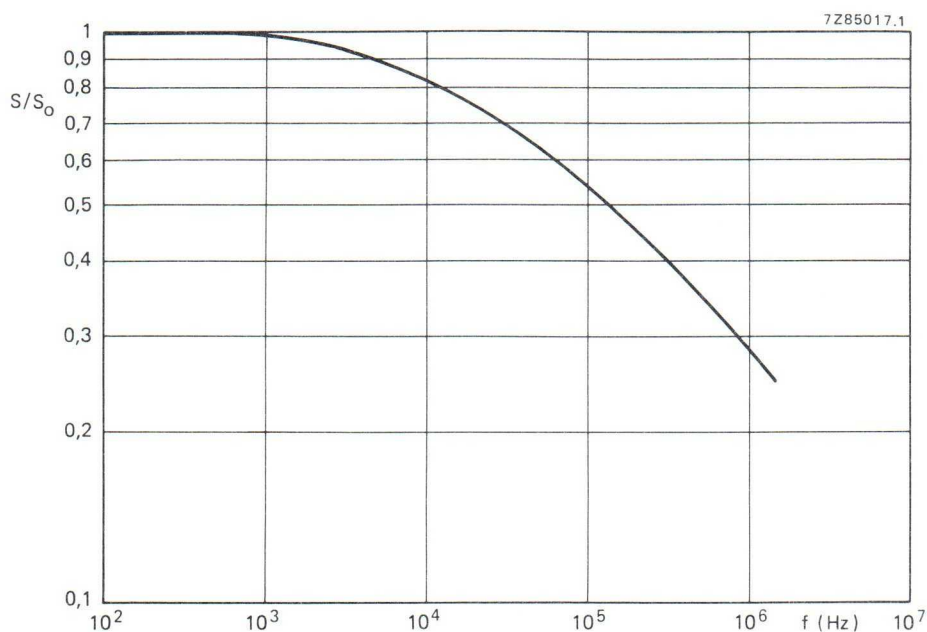


Fig. 4 Typical sensitivity variation of the fast coil versus the sweeping frequency  
 $S_0 = 320 \text{ kHz/mA}$ .

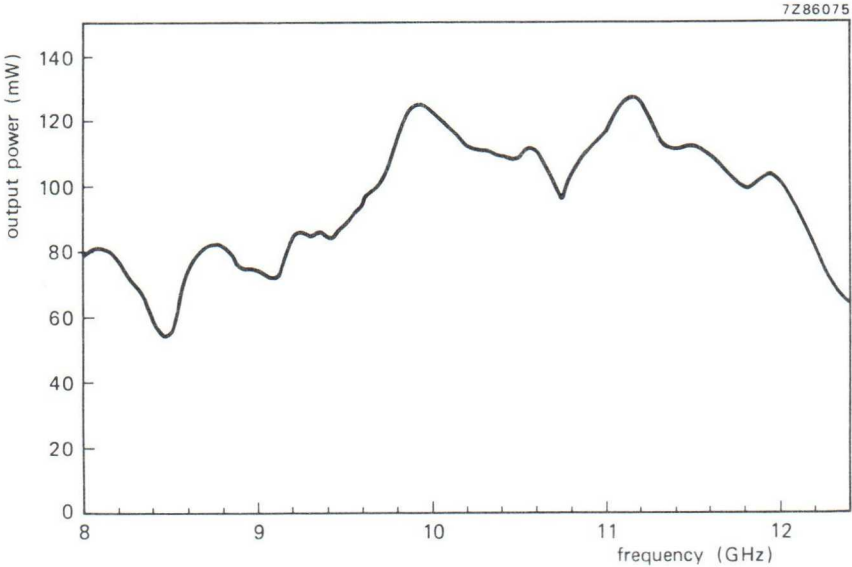


Fig. 5 Typical test curve of YG1103.

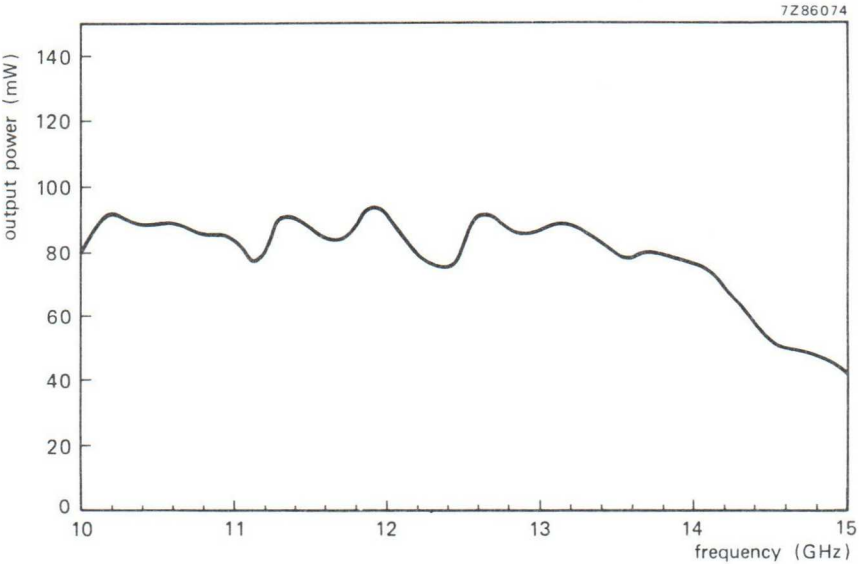


Fig. 6 Typical test curve of YG1104.

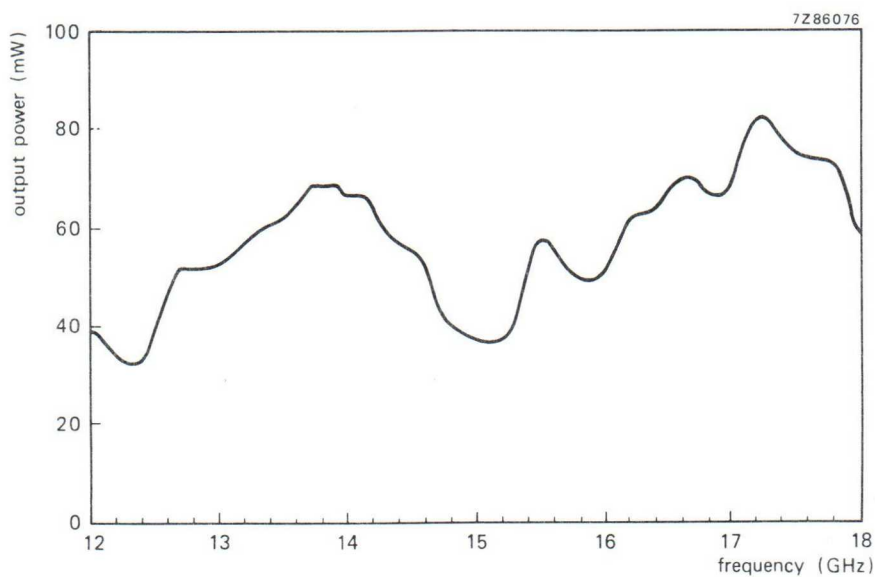


Fig. 7 Typical test curve of YG1105.



## YIG TUNED-OSCILLATOR

This hermetically sealed, very linear and temperature stabilized YIG tuned-oscillator consists of a Gunn diode, a microstrip impedance transformer, a YIG sphere and electromagnetic coils. It is intended for use in wideband equipment for military applications in the frequency band from 12 to 18 GHz and features an operating temperature range from  $-40$  to  $+85$  °C.

### QUICK REFERENCE DATA

|                                                                        |      |           |     |
|------------------------------------------------------------------------|------|-----------|-----|
| Frequency range                                                        |      | 12 to 18  | GHz |
| Frequency drift with temperature $-40$ to $85$ °C                      | max. | $\pm 25$  | MHz |
| Overall linearity, over total operating temperature range              |      | $<\pm 50$ | MHz |
| Output power, over total tuning range and over total temperature range | typ. | 20        | mW  |

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

### POTENTIAL HAZARD-BERYLLIUM OXIDE

This device contains beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the beryllium oxide disc is not damaged. Care should be taken to ensure that all those who may handle, use or dispose of this device are aware of its nature and of the necessary safety precautions. In particular, it should never be thrown out with general industrial or domestic waste.

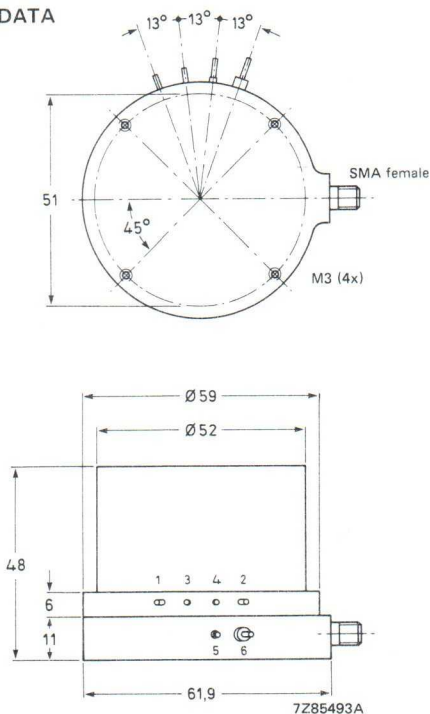
### DISPOSAL SERVICE

In the United Kingdom, devices requiring disposal may be returned to the Mullard Service Department at the address below. They must be separately and securely packed and clearly identified. If they are damaged or broken, they must not be sent through the post.

Mullard Service Department,  
Mullard Ltd,  
P.O. Box No. 142,  
Beddington Lane,  
CROYDON,  
Surrey,  
CR9 9EL

# MECHANICAL DATA

Dimensions in mm



## Connections:

- 1-2 Main coil
- 3-4 Fast coil
- 5 -V Gunn earth
- 6 + V Gunn

# ELECTRICAL DATA

Frequency range

Linearity

Output power over tuning range (Fig. 5)

Power variation in band

Pulling (VSWR 1,4 : 1)

Pushing

Phase noise at 3 dBc

Other parasitics

Second harmonic

Frequency drift as a function of temperature

Sensitivity to external magnetic field at 50 Hz

Hysteresis

12 to 18 GHz

see Figs 4 and 6

min. 15 mW

max. 8 dB

max.  $\pm 5$  MHz

max. 12 MHz/V

max. 50 kHz

max. -50 dBc

max. -15 dBc

see Fig. 4

max. 10 GHz/T

typ. 15 MHz

**OPERATING CONDITIONS**

Supply voltage of Gunn diode

typ. 4 to 10 V

Supply current of Gunn diode

typ. 1 A

Storage temperature

-55 to 110 °C

Operating temperature, measured on  
base plate of oscillator

-40 to 85 °C

To obtain optimum characteristics over the whole band, the supply voltage to the Gunn diode must be adjusted with the frequency at the value indicated on the test sheet supplied with the product.

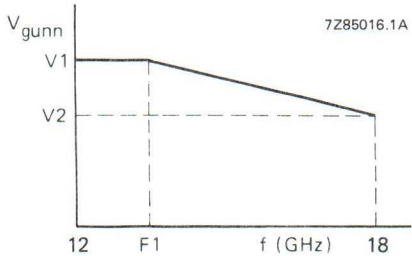


Fig. 2.

A curve giving measured data is supplied with each oscillator. The Gunn diode will be damaged if its polarity is reversed. Maximum supply voltages of the Gunn diode must not be exceeded. The oscillator must be bolted to a heatsink. To ensure good thermal contact, the oscillator has an unpainted machined flat baseplate.



### Typical coil data

see Fig. 3

#### Main coil:

Tuning sensitivity up to 100 Hz

17,5 MHz/mA

Current (d.c.)

&lt; 1,2 A

Resistance

 $\leq 10 \Omega$ 

Inductance at 1 kHz

170 mH

#### Fast coil:

Tuning sensitivity at 3 MHz, at  $I_{p-p} \leq 2,2$  A

200 MHz

Resistance

typ.  $1 \Omega$ 

Inductance

<  $2,5 \mu\text{H}$ 

Current (d.c.)

&lt; 0,7 A

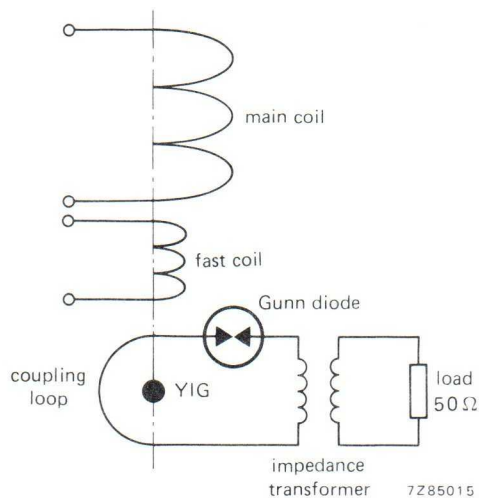


Fig. 3.

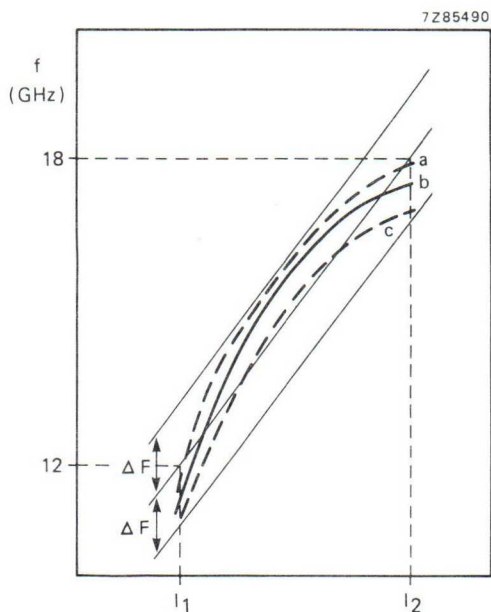


Fig. 4 Linear relation of frequency as a function of current in main coil; typical values, curve a at  $-40^{\circ}\text{C}$ ; curve b at  $+25^{\circ}\text{C}$  and curve c at  $+85^{\circ}\text{C}$ .

Deviation  $\Delta F$  max.  $\pm 50$  MHz over the whole frequency range and operating temperature range.

Frequency drift with temperature ( $-40$  to  $85^{\circ}\text{C}$ ) at fixed current: max.  $\pm 25$  MHz.

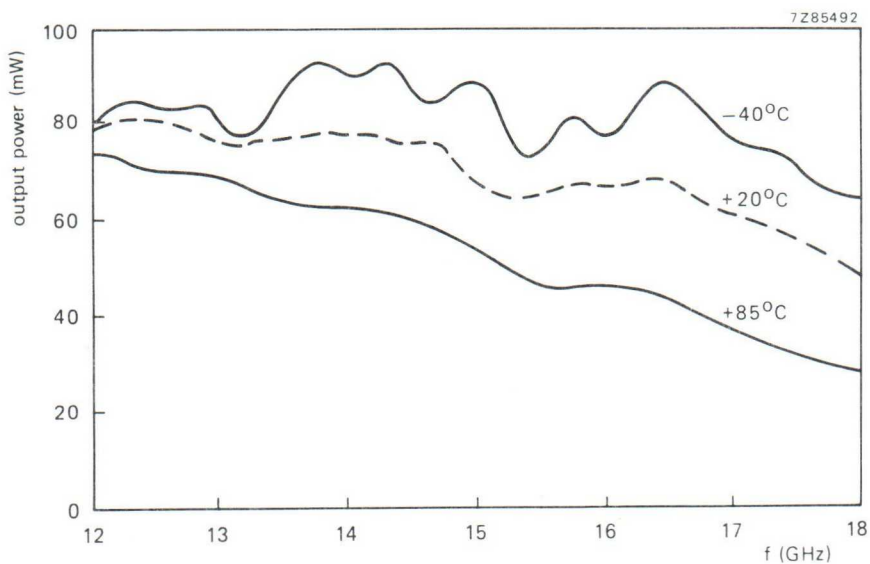
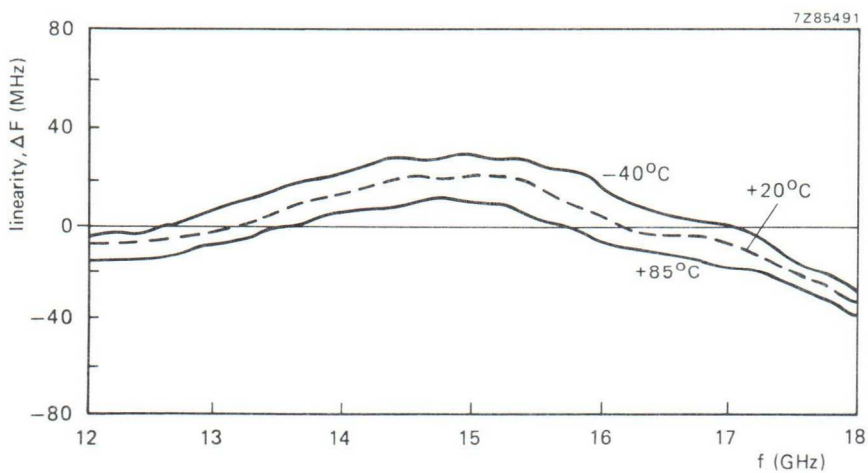


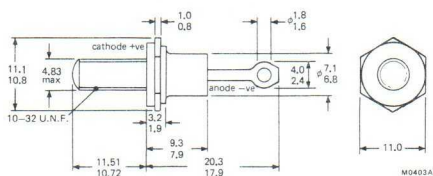
Fig. 5 Typical test curves, output power over tuning range.



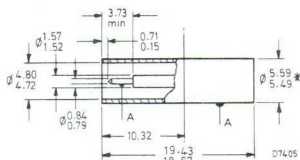
## **PACKAGE STYLES**

# PACKAGE STYLES

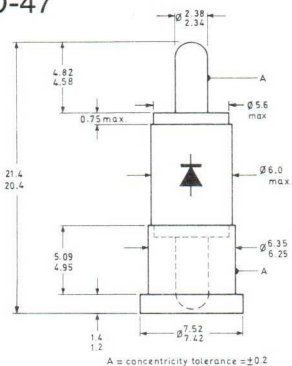
## DO-4 SO-10 SOD-4/8



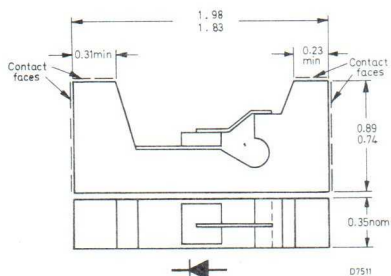
## DO-37 SOD-49



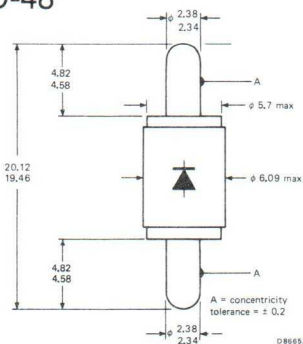
## DO-22 SOD-47



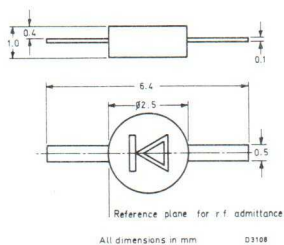
## MO-27



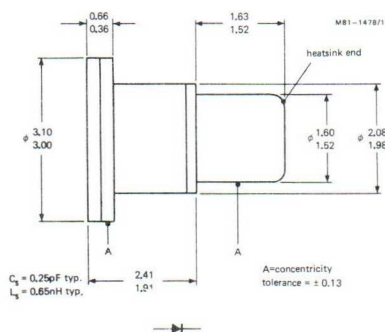
## DO-23 SOD-48



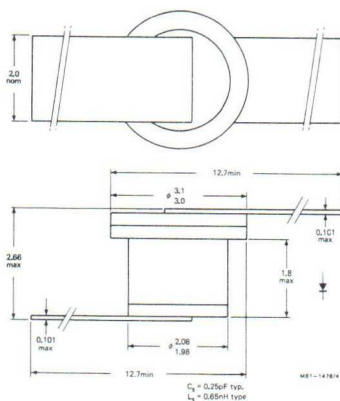
## MO-28



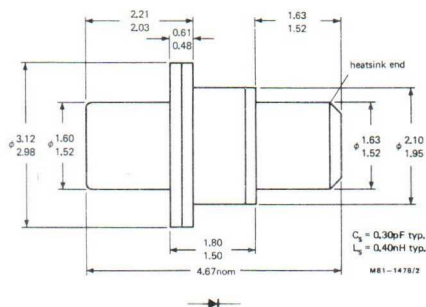
## MO-63



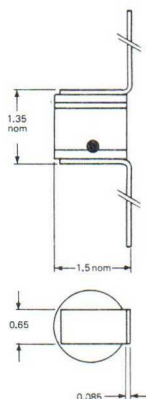
## MO-66



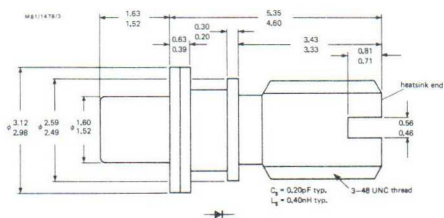
## MO-64



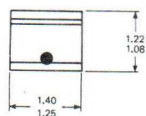
## MO-67



## MO-65

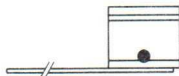


## MO-68

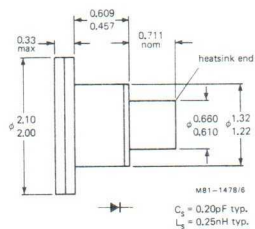


# PACKAGE STYLES

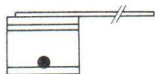
MO-69



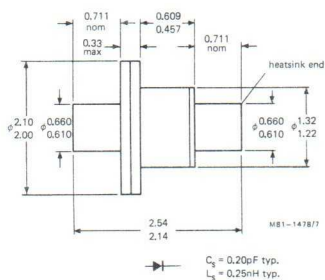
MO-72



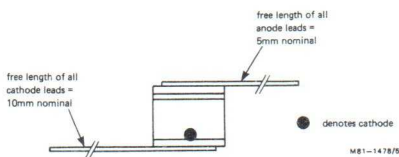
MO-70



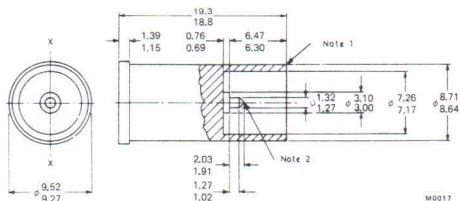
MO-73



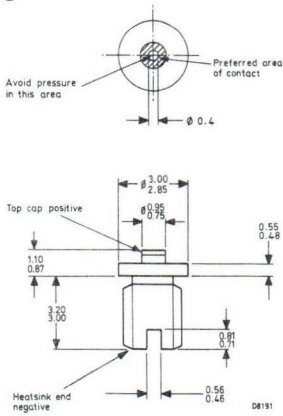
MO-71



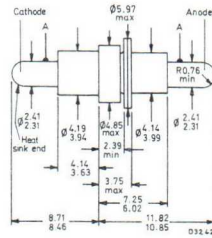
MO-74



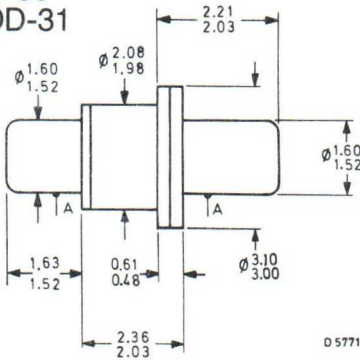
## MO-75



SOD-43

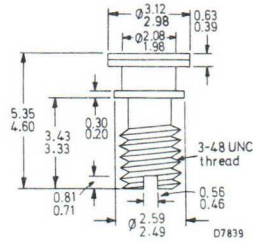


SO-86  
SOD-31

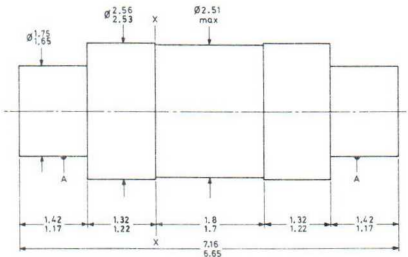


A = concentricity tolerance =  $\pm 0.13$

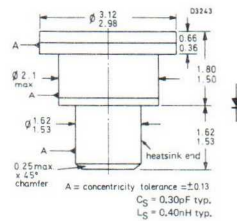
SOD-44



SOD-42



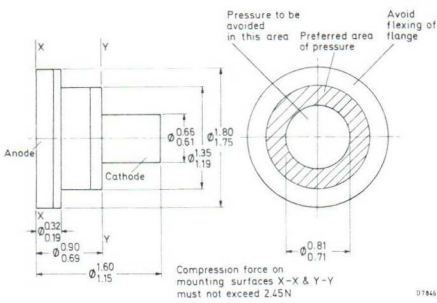
SOD-45



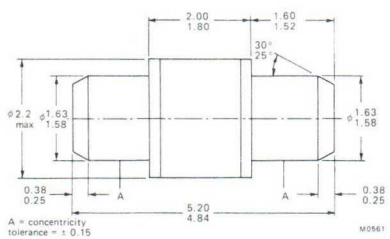


PACKAGE  
STYLES

SOD-46



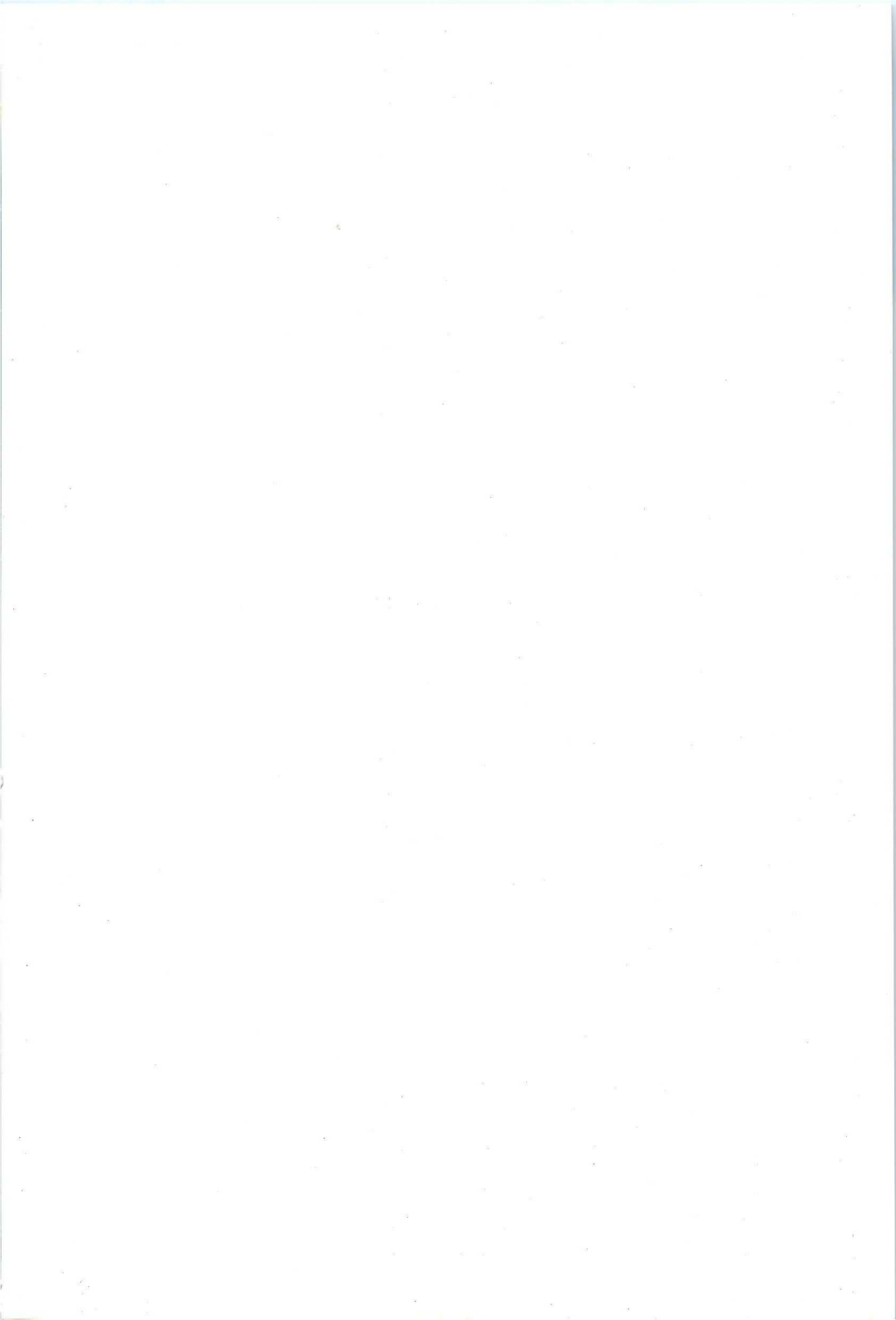
SOD-50



## INDEX OF TYPE NUMBERS

| type number  | page | type number   | page |
|--------------|------|---------------|------|
| ACX-01A      | 315  | BXY60         | 29   |
| AEY33        | 115  | CAY10         | 149  |
| BAS46        | 45   | CAY18         | 105  |
| BAT10        | 51   | CAY19         | 109  |
| BAT11        | 57   | CL7500 series | 203  |
| BAT31        | 11   | CL8030 series | 211  |
| BAT38        | 61   | CL8060 series | 217  |
| BAT39        | 65   | CL8630 series | 195  |
| BAT50,R      | 71   | CL8960 series | 227  |
| BAT51,R      | 75   | CXY10         | 153  |
| BAT52,R      | 79   | CXY11A to C   | 33   |
| BAV72        | 81   | CXY12         | 157  |
| BAV75        | 85   | CXY14A,B      | 35   |
| BAV96A to D  | 89   | CXY19,A,B     | 37   |
| BAV97        | 93   | CXY21,A       | 39   |
| BAW95D to G  | 97   | CXY22A,B      | 191  |
| BAY96        | 119  | CXY23 series  | 177  |
| BXY27        | 125  | CXY24A,B      | 41   |
| BXY28        | 129  | CXY26 series  | 183  |
| BXY29        | 133  | JM1201        | 317  |
| BXY32        | 137  | YG1100 series | 319  |
| BXY35 to 41  | 141  | YG1301E       | 327  |
| BXY48 series | 169  | 1N415E        | 101  |
| BXY50        | 17   | 1N5152,3      | 161  |
| BXY51        | 21   | 1N5155        | 163  |
| BXY52        | 25   | 1N5157        | 165  |
| BXY56,7      | 145  |               |      |





# Electronic components and materials for professional, industrial and consumer uses from the world-wide Philips Group of Companies

**Argentina:** PHILIPS ARGENTINA S.A., Div. Elcoma, Vedia 3892, 1430 BUENOS AIRES, Tel. 541-7141/7242/7343/7444/7545.  
**Australia:** PHILIPS INDUSTRIES HOLDINGS LTD., Elcoma Division, 11 Waltham Street, ARTARMON, N.S.W. 2064, Tel. (02) 439 3322.  
**Austria:** ÖSTERREICHISCHE PHILIPS BAUELEMENTE INDUSTRIE G.m.b.H., Triester Str. 64, A-1101 WIEN, Tel. 62 91 11.  
**Belgium:** N.V. PHILIPS & MBLE ASSOCIATED, 9 rue du Pavillon, B-1030 BRUXELLES, Tel. (02) 242 7400.  
**Brazil:** IBRAPE, Caixa Postal 7383, Av. Brigadeiro Faria Lima, 1735 SAO PAULO, SP, Tel. (011) 211-2600.  
**Canada:** PHILIPS ELECTRONICS LTD., Elcoma Division, 601 Milner Ave., SCARBOROUGH, Ontario, M1B 1M8, Tel. 292-5161.  
**Chile:** PHILIPS CHILENA S.A., Av. Santa Maria 0760, SANTIAGO, Tel. 39-4001.  
**Colombia:** IND. PHILIPS DE COLOMBIA S.A., c/o IPRELENSO LTD., Cra. 21, No. 56-17, BOGOTA, D.E., Tel. 249 7624.  
**Denmark:** MINIWATT A/S, Strandlodsvej 2, P.O. Box 1919, DK 2300 COPENHAGEN S, Tel. (01) 54 11 33.  
**Finland:** OY PHILIPS AB, Elcoma Division, Kaivokatu 8, SF-00100 HELSINKI 10, Tel. 172 71.  
**France:** R.T.C. LA RADIOTECHNIQUE-COMPELEC, 130 Avenue Ledru Rollin, F-75540 PARIS 11, Tel. 338 80-00.  
**Germany (Fed. Republic):** VALVO, UB Bauelemente der Philips G.m.b.H., Valvo Haus, Burchardstrasse 19, D-2 HAMBURG 1, Tel. (040) 3296-0.  
**Greece:** PHILIPS S.A. HELLENIQUE, Elcoma Division, 52, Av. Syngrou, ATHENS, Tel. 9215111.  
**Hong Kong:** PHILIPS HONG KONG LTD., Elcoma Div., 15/F Philips Ind. Bldg., 24-28 Kung Yip St., KWAI CHUNG, Tel. (0)-24 51 21.  
**India:** PEICO ELECTRONICS & ELECTRICALS LTD., Elcoma Dept., Band Box Building, 254-D Dr. Annie Besant Rd., BOMBAY - 400 025, Tel. 4220387/4220311.  
**Indonesia:** P.T. PHILIPS-RALIN ELECTRONICS, Elcoma Div., Setiabudi II Building, 6th Fl., Jalan H.R. Rasuna Said (P.O. Box 223/KBY) Kuningan, JAKARTA - Selatan, Tel. 512 572.  
**Ireland:** PHILIPS ELECTRICAL (IRELAND) LTD., Newstead, Clonskeagh, DUBLIN 14, Tel. 693355.  
**Italy:** PHILIPS S.p.A., Sezione Elcoma, Piazza IV Novembre 3, I-20124 MILANO, Tel. 2-6752.1.  
**Japan:** NIKON PHILIPS CORP., Shuwa Shinagawa Bldg., 26-33 Takanawa 3-chome, Minato-ku, TOKYO (108), Tel. 448-5611.  
 (IC Products) SIGNETICS JAPAN LTD., 8-7 Sanbancho Chiyoda-ku, TOKYO 102, Tel. (03) 2310-1521.  
**Korea (Republic of):** PHILIPS ELECTRONICS (KOREA) LTD., Elcoma Div., Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL, Tel. 794-5011.  
**Malaysia:** PHILIPS MALAYSIA SDN. BERHAD, No. 4 Persiaran Barat, Petaling Jaya, P.O.B. 2163, KUALA LUMPUR, Selangor, Tel. 77 44 11.  
**Mexico:** ELECTRONICA, S.A. de C.V., Carr. México-Toluca km. 62.5, TOLUCA, Edo. de México 50140, Tel. Toluca 91 (721) 613-00.  
**Netherlands:** PHILIPS NEDERLAND, Marktgroep Elconco, Postbus 90050, 5600 PB EINDHOVEN, Tel. (040) 793333.  
**New Zealand:** PHILIPS NEW ZEALAND LTD., Elcoma Division, 110 Mt. Eden Road, C.P.O. Box 1041, AUCKLAND, Tel. 605-914.  
**Norway:** NORSK A/S PHILIPS, Electronica Dept., Sandstuveien 70, OSLO 6, Tel. 68 02 00.  
**Peru:** CADESA, Av. Alfonso Ugarte 1268, LIMA 5, Tel. 326070.  
**Philippines:** PHILIPS INDUSTRIAL DEV. INC., 2246 Pasong Tamo, P.O. Box 911, Makati Comm. Centre, MAKATI-RIZAL 3116, Tel. 86-89-51 to 59.  
**Portugal:** PHILIPS PORTUGUESA S.A.R.L., Av. Eng. Duarte Pacheco 6, 1009 LISBOA Codex, Tel. 683121.  
**Singapore:** PHILIPS PROJECT DEV. (Singapore) PTE LTD., Elcoma Div., Lorong 1, Toa Payoh, SINGAPORE 1231, Tel. 3502 000.  
**South Africa:** EDAC (PTY) LTD., 3rd Floor Rainer House, Upper Railway Rd. & Ove St., New Doornfontein, JOHANNESBURG 2001, Tel. 614-2362/9.  
**Spain:** MINIWATT S.A., Balmes 22, BARCELONA 7, Tel. 301 63 12.  
**Sweden:** PHILIPS KOMPLEMENTER A.B., Lidingsvägen 50, S-11584 STOCKHOLM 27, Tel. 08/7821000.  
**Switzerland:** PHILIPS A.G., Elcoma Dept., Allmendstrasse 140-142, CH-8027 ZÜRICH, Tel. 01-488 22 11.  
**Taiwan:** PHILIPS TAIWAN LTD., 150 Tun Hua North Road, P.O. Box 22978, TAIPEI, Taiwan, Tel. 7120500.  
**Thailand:** PHILIPS ELECTRICAL CO. OF THAILAND LTD., 283 Silom Road, P.O. Box 961, BANGKOK, Tel. 233-6330-9.  
**Turkey:** TÜRK PHILIPS TICARET A.Ş., Elcoma Department, İnönü Cad. No. 78-80, P.K. 504, 80074 İSTANBUL, Tel. 4359 10.  
**United Kingdom:** MULLARD LTD., Mullard House, Torrington Place, LONDON WC1E 7HD, Tel. 01-580 6633.  
**United States:** (Active Devices & Materials) AMPEREX SALES CORP., Providence Pike, SLATERSVILLE, R.I. 02876, Tel. (401) 762-9000.  
 (Passive Devices) MEPCO/ELECTRA INC., Columbia Rd., MORRISTOWN, N.J. 07960, Tel. (201) 539-2000.  
 (Passive Devices & Electromechanical Devices) CENTRALAB INC., 5855 N. Glen Park Rd., MILWAUKEE, WI 53201, Tel. (414) 228-7380.  
 (IC Products) SIGNETICS CORPORATION, 811 East Arques Avenue, SUNNYVALE, California 94086, Tel. (408) 991-2000.  
**Uruguay:** LUZIELECTRON S.A., Avda Uruguay 1287, P.O. Box 907, MONTEVIDEO, Tel. 91 43 21.  
**Venezuela:** IND. VENEZOLANAS PHILIPS S.A., c/o MAGNETICA S.A., Calle 6, Ed. Las Tres Jotas, App. Post. 78117, CARACAS, Tel. (02) 239 3931.

**For all other countries apply to:** Philips Electronic Components and Materials Division, International Business Relations, Building BAE, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Tel. +31 40 72 33 04, Telex 35000 phtcnl

AS50

© Philips Export B.V 1986

This information is furnished for guidance, and with no guarantee as to its accuracy or completeness; its publication conveys no licence under any patent or other right, nor does the publisher assume liability for any consequence of its use; specifications and availability of goods mentioned in it are subject to change without notice; it is not to be reproduced in any way, in whole or in part, without the written consent of the publisher.

Printed in England

9398 133 80011