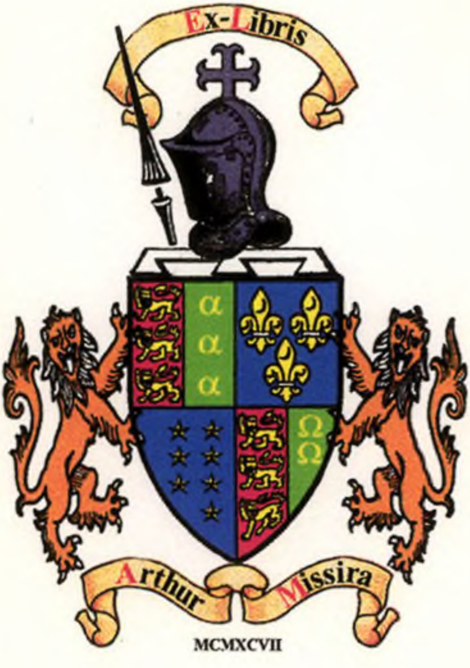
Mullard Book 1 Part 8 Microwave semiconductors and components January 1975

Mullard technical handbook

Book one
Semiconductor devices

Part eight
Microwave semiconductors and components

January 1975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MICROWAVE SEMICONDUCTORS AND COMPONENTS

CONTENTS

Book 1 comprises the following parts—

- Part 1 Transistors and accessories
- Part 2 Transistors and accessories
- Part 3 Diodes and opto-electronic devices
- Part 4 Rectifier diodes, rectifier diode stacks, medium and high-power voltage regulator diodes, transient suppressor diodes
- Part 5 Thyristors, triacs and accessories
- Part 6 Digital integrated circuits
- Part 7 Linear integrated circuits
- Part 8 Microwave semiconductors and components

Made and printed in England by Wightman & Co., Ltd.

BOOK 1 (Part 8)

SEMICONDUCTOR DEVICES

Microwave semiconductors
Microwave components

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LONDON, WC1E 7HD

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DATA HANDBOOK SYSTEM

The Mullard data handbook system is made up of three sets of books, each comprising several parts.

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

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

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

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

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

Requests for information on the data handbook system and for individual data sheets should be made to

Central Technical Services
Mullard Limited
New Road
Mitcham
Surrey CR4 4XY

Telephone: 01-648 3471 Telex: 22194

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

SELECTION GUIDE

ꞏECTION B—MICROWAVE DIODES

ꞏlicrowave Multiplier Varactor Diodes

Capacitance min. (pF)	Capacitance max. (pF)	at V_R (V)	Type No.	Description	V_R max. (V)	Typ. Cut-off Frequency (GHz)
0·5	1·0	6	BXY32	Silicon planar epitaxial step recovery. For high order frequency multiplier outputs in X-band	20	150
0·6	1·0	6	1N5157	Silicon planar epitaxial step recovery. For frequency multiplier outputs in X-band	20	200
0·8	1·5	6	BXY29		25	120
1·0	2·5	6	BXY28	Silicon planar epitaxial step recovery. For frequency multiplier outputs in C-band	45	120
1·0	3·0	6	1N5155		35	120
1·5	2·5	6	BXY56	High efficiency silicon types for multipliers with output frequencies in C and X-bands	60	160
2·5	3·5	6	BXY57		60	140
3·0	6·0	6	BXY27	Silicon planar epitaxial step recovery. For frequency multiplier outputs in S-band	55	100
5·0	7·5	6	1N5152 1N5153	Silicon planar epitaxial step recovery. For frequency multiplier outputs in S-band	75	100
28	39	6	BAY96	Silicon planar epitaxial. For high efficiency frequency multipliers	120	25

SECTION B (cont.)

Microwave Tuning Varactor Diodes

Capacitance min. (pF)	Capacitance max. (pF)	at V_R (V)	Type No.	Description	V_R max. (V)
0·8	1·2	4	**BXY53**	Silicon planar epitaxial tuning devices.	60
3·7	5·7	4	**BXY54**		60
12	18	4	**BXY55**		60

Microwave Special Purpose Varactor Diodes

Capacitance min. max. (pF)	at V_R (V)	Type No.	Description	V_R max. (V)	Typ. Cut-off Frequency (GHz)
0·2 typ.	0	**CXY10**	Gallium arsenide. For parametric amplifiers, frequency multipliers and switches	6	350
0·25 typ.	6	**CXY12**	Gallium arsenide. For frequency multiplier circuits up to Q-band output frequency	10	500
0·3 0·5	0	**CAY10**	Gallium arsenide diffused mesa type. For parametric amplifiers, frequency multipliers and switches	6	240

Mullard also supply other types of microwave diodes including varactor diodes to customers' specifications.

SECTION B (cont.)

Schottky Barrier Mixer Diodes

Max. Operating Frequency (GHz)	Type No.	Description	I.F. Impedance (Ω)	Max. Noise Figure (dB)
12	**BAT10**	Plastic package	250–500	7·5
12	**BAT11**	L.I.D.	280–380	7·0
12	**BAV22** **BAV22R**•	Rimmed coaxial	300–550	7·5
12	**BAV96A** **BAV96B** **BAV96C** **BAV96D**	M.Q.M.	250–450	7·5 7·0 6·5 6·0
12	**BAW95D** **BAW95E** **BAW95F** **BAW95G**	Reversible cartridge	250–500	8·2 7·5 7·0 6·5
40	**BAV71**	Mixer pill	900–1200	10
40	**BAV72**	M.Q.M.	850–1300	10

•Reverse polarity version.

Germanium Mixer Diodes

Max. Operating Frequency (GHz)	Type No.	Description	I.F. Impedance (Ω)	Max. Noise Figure (dB)
12	**AAY50** **AAY50R**•	Rimmed coaxial	300–500	6·8
18	**AAY51** **AAY51R**•	Rimless coaxial	220–320	7·5
18	**AAY52** **AAY52R**•	Rimless coaxial	220–320	8·5
18	**AAY39** **AAY39A**	Mixer pill	250–450	6·5 7·5
40	**AAY34**	Mixer pill	500–1000	10·5
40	**AAY59**	Mixer pill	700–1400	10

•Reverse polarity version.

SECTION B (cont.)

Schottky Barrier Detector Diodes

Frequency Range (GHz)	Type No.	Description	Typ. 1/f noise (dB)	Typ. Tangential Sensitivity (dBm)
8 to 12	**BAT10**	Plastic package	12	−52
8 to 12	**BAV46**	Reversible cartridge	10	−52
8 to 12	**BAV75**	Pill	10	−50
8 to 12	**BAV97**	M.Q.M.	10	−54

Backward Detector Diodes

Frequency Range (GHz)	Type No.	Description	Figure of merit (M)	Typ. Tangential Sensitivity (dBm)
1 to 18	**AEY17**	Mixer pill	120	−53
12 to 18	**AEY29** **AEY29R***	Rimless coaxial	50	−53
1 to 18	**AEY31**	M.Q.M.	120	−53
1 to 18	**AEY31A**	M.Q.M.	50	−50
18 to 40	**AEY32**	M.Q.M.	>50	2·0μA/μW†

*Reverse polarity version
†Zero bias current sensitivity

SECTION B (cont.)

Gunn Effect Devices

P_{out} min. (mW)	Type No.	Description	Operating Voltage (V)	P_{tot} max. (W)
5	CXY11A	Gallium arsenide bulk affect devices employing the Gunn effect to produce c.w. oscillations in X-band	7·0	1·0
10	CXY11B		7·0	1·0
15	CXY11C		7·0	1·0
100	CXY19		8 to 15	6·0
200	CXY19A		8 to 15	6·0
50	CXY21		9·5	2·5
5	CXY14A	Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in J-band	7·0	1·0
10	CXY14B		7·0	1·0
15	CXY14C		7·0	1·0

Impatt Diodes

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

SECTION C—GUNN EFFECT OSCILLATORS

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

Type No.	Nominal Centre Frequency (GHz)	Pout (mW)	Minimum Mechanical Tuning Range (MHz)	Minimum Electronic Tuning Range (MHz)	Output Coupling
CL8310	9·4	5	±50	200	WG16/WR90
CL8630 **CL8630S**	10·69	8	—	—	WG16/WR90
CL8632 **CL8632S**	9·35	8	—	—	WG16/WR90
CL8633 **CL8633S**	10·525	8	—	—	WG16/WR90
CL8441	9·4	5	±100	40	WG16/WR90
CL8640R*	10·49	6	±60	30	WG16/WR90
CL8640T†	10·56	6	±60	8	WG16/WR90

*Receiver local oscillator
†Transmitter

SECTION D—MIXERS

Mullard offers a large-scale production capability for custom-built and standard microwave integrated circuits on alumina, sapphire, quartz and ferrite substrates, integrating passive microwave components with unpackaged semiconductor devices in chip and beam lead form.

Type No.	Description	Typical Noise Figure (dB)	Frequency (GHz)	Terminals
CL7330 CL7331 CL7332	Miniature thin film balanced mixers using Schottky barrier diodes	7·0 7·0 7·0	9·0 to 10·0 10·7 to 11·7 11·7 to 12·7	50Ω S.M.A. 50Ω S.M.A. 50Ω S.M.A.
CL7500 CL7520	Wave guide single ended mixers/detectors	— —	10·687 9·35	WG16/WR90 WG16/WR90

SECTION E—SUBSYSTEMS

Doppler Modules

Type No.	Description	Centre Frequency (GHz)	Power Output (mW)	Typ. Output* Voltage (μV)
CL8960 CL8963	Doppler modules for volumetric presence detection, industrial process control, proximity switching and similar applications	10·687 10·525	8 8	40 40

*Output voltage for input power 100dB down on output power

$\left(\text{at 18dB min. } \frac{\text{signal + noise}}{\text{noise}}\right)$

Parametric Amplifiers

Type No.	Description	Gain (dB)	Noise Figure (dB)	Bandwidth (MHz)	Frequency (GHz)
CL9012G	Packaged parametric amplifier in temperature stabilised box	17	2·8	26	2·9 to 3·1
CL9070		17	1·8	23	1·09

SECTION F—CIRCULATORS

V.H.F. circulators for television band III

Frequency (MHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
150 to 160	0·30	20	1700	CL5361
160 to 178	0·35	20	500	CL5871
160 to 178	0·35	20	1000	CL5901
160 to 190	0·35	20	1000	CL5371
170 to 200	0·35	20	1000	CL5341
173 to 204	0·35	20	500	CL5861
173 to 204	0·35	20	1000	CL5891
190 to 220	0·35	20	1000	CL5381
195 to 230	0·35	20	1000	CL5351
200 to 230	0·35	20	500	CL5851
200 to 230	0·35	20	1000	CL5881
225 to 270	0·35	20	100	CL5931
225 to 270	0·35	20	500	CL5172
225 to 270	0·35	20	1000	CL5182

U.H.F. circulators for television bands IV and V

Frequency (MHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
270 to 330	0·35	20	100	CL5941
330 to 400	0·35	20	100	CL5951
400 to 470	0·35	20	300	CL5571
400 to 470	0·35	20	300	CL5621
470 to 600	0·50	20	100	CL5551
470 to 600	0·35	20	300	CL5631
470 to 600	0·35	20	300	CL5581
470 to 600	0·35	22	500	CL5027
470 to 600	0·35	20	2000	CL5261
590 to 720	0·35	20	500	CL5641
590 to 720	0·35	20	500	CL5591
590 to 720	0·35	22	—	CL5028
590 to 720	0·35	22	2000	CL5282
600 to 800	0·50	20	200	CL5561
600 to 800	0·35	20	500	CL5651
600 to 800	0·35	20	500	CL5601
600 to 800	0·35	20	—	CL5331
710 to 860	0·35	20	500	CL5611
710 to 860	0·35	20	500	CL5661
710 to 860	0·35	22	—	CL5029
710 to 860	0·35	22	—	CL5271
790 to 1000	0·50	20	170	CL5262

SECTION F (cont.)

Broadband microwave coaxial circulators (3 port)

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C. W. Power Rating (W)	Type No.
2·0 to 4·0	0·50	20	50	CL5501
2·0 to 4·0	0·50	20	50	CL5491
3·0 to 6·0	0·50	20	20	CL5511
3·8 to 4·2	0·25	25	10	CL5431
4·0 to 8·0	0·50	20	10	CL5811
4·4 to 5·0	0·25	25	10	CL5441
7·0 to 12·7	0·60	20	10	CL5821
12·0 to 18·0	0·50	20	5	CL5301

Broadband microwave coaxial circulators (4 port)

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)		C.W. Power Rating (W)	Type No.
		Opposite Ports	Adjacent Ports		
3·8 to 4·2	0·5	50	25	10	CL5032
4·4 to 5·0	0·5	50	25	10	CL5042

SECTION F (cont.)

3 port waveguide circulators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
5·925 to 6·425	0·2	30	100	CL5101
6·425 to 7·125	0·15	30	100	CL5281
7·125 to 7·750	0·2	30	100	CL5291

4 port cross junction waveguide circulators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)		C.W. Power Rating (W)	Type No.
		Opposite Ports	Adjacent Ports		
5·925 to 6·175	0·1	33	20	150	CL5081
6·125 to 6·425	0·1	30	20	150	CL5091
6·575 to 6·875	0·4	25	20	100	CL5053
6·825 to 7·125	0·4	25	18	100	CL5051
7·125 to 7·425	0·3	25	18	100	CL5050
7·425 to 7·725	0·4	30	20	100	CL5054
10·7 to 11·7	0·3	30	18	25	CL5056
12·5 to 13·5	0·3	25	20	25	CL5055

SECTION G—ISOLATORS

Coaxial isolators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
0·74 to 0·81	0·3	22	100	CL6001
0·89 to 0·97	0·3	22	100	CL6011
1·48 to 1·95	0·3	20	50	CL6041
1·70 to 2·3	0·3	20	50	CL6051
2·96 to 3·22	0·3	20	100	CL6021
2·0 to 4·0	0·5	20	50	CL6091
2·0 to 4·0	0·5	20	50	CL6101
3·0 to 6·0	0·5	20	20	CL6071
3·56 to 3·90	0·3	20	100	CL6031
4·0 to 8·0	0·5	20	10	CL6111
7·0 to 12·7	0·6	20	10	CL6122
12·0 to 18·0	0·5	20	5	CL6223

SECTION G (cont.)

Waveguide isolators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
3·8 to 4·2	0·5	30	10	CL6240
4·2 to 4·6	0·5	30	10	CL6202
4·6 to 5·0	0·8	30	10	CL6203
5·925 to 6·425	0·3	30	20	CL6206
6·425 to 7·150	0·3	30	20	CL6251
6·825 to 7·425	0·3	30	20	CL6231
7·125 to 7·750	0·3	30	20	CL6291
7·250 to 7·750	0·3	30	20	CL6241
7·7 to 8·5	0·5	30	10	CL6216
7·7 to 8·5	0·5	30	10	CL6214
8·5 to 9·6	0·5	30	10	CL6222
8·5 to 9·6	0·6	15	1	CL6221
8·5 to 9·6	1·2	55	10	CL6261
8·5 to 9·6	1·0	20	10	CL6271
10·7 to 11·7	0·8	30	5	CL6215
12·5 to 13·5	0·5	30	10	CL6217

SECTION H—ACCESSORIES

Horn Antenna

Type No.	Frequency Range (GHz)	Gain (dB)	Beam Angle (both planes) (deg)
ACX–01	9 to 11	16	30

GENERAL SECTION

A

A

TYPE NOMENCLATURE

Mullard semiconductor devices are registered by Pro Electron.
The type nomenclature of a discrete device or, in certain cases, of a range of devices, consists of two letters followed by a serial number. The serial number may consist of three figures or of one letter and two figures depending on the main application of the device.

The first letter indicates the semiconductor material used:

A — germanium

B — silicon

C — compound materials such as gallium arsenide

D — compound materials such as indium antimonide

R — compound materials such as cadmium sulphide

The second letter indicates the general function of the device:

A — detection diode, high speed diode, mixer diode.

B — variable capacitance diode

C — transistor for a.f. applications (not power types)

D — power transistor for a.f. applications

E — tunnel diode

F — transistor for r.f. applications (not power types)

G — multiple of dissimilar devices; miscellaneous devices

L — power transistor for r.f. applications

N — photo-coupler

P — radiation sensitive device such as photodiode, phototransistor, photoconductive cell, or radiation detector diode

Q — radiation generating device such as light-emitting diode

R — controlling and switching device (e.g. thyristor) having a specified breakdown characteristic (not power types)

S — transistor for switching applications (not power types)

T — controlling and switching power device (e.g. thyristor) having a specified breakdown characteristic

U — power transistor for switching applications

X — multiplier diode such as varactor or step recovery diode

Y — rectifier diode, booster diode, efficiency diode

Z — voltage reference or voltage regulator diode, transient suppressor diode

The remainder of the type number is a **serial number** indicating a particular design or development and is in one of the following two groups:

(a) Devices intended primarily for use in consumer applications (radio and television receivers, audio amplifiers, tape recorders, domestic appliances, etc.).
The serial number consists of three figures.

(b) Devices intended mainly for applications other than (a), e.g. industrial, professional and transmitting equipments.
The serial number consists of one letter (Z, Y, X, W, etc.) followed by two figures.

Range Numbers

Where there is a range of variants of a basic type of rectifier diode, thyristor or voltage regulator diode the type number as defined above is often used to identify the range; further letters and figures are added after a hyphen to identify individual types within the range. These additions are as follows:

Rectifier Diodes and Thyristors

The group of figures indicates the rated repetitive peak reverse voltage, V_{RRM}, or the rated repetitive peak off-state voltage, V_{DRM}, whichever value is lower, in volts for each type.

The final letter R is used to denote a reverse polarity version (stud anode) where applicable. The normal polarity version (stud cathode) has no special final letter.

Voltage Regulator Diodes, Transient Suppression Diodes

The first letter indicates the nominal percentage tolerance in the operating voltage V_Z.

A — ±1%
B — ±2%
C — ±5%
D — ±10%
E — ±15%

The letter is omitted on transient suppressor diodes.

The group of figures indicates the typical operating voltage V_Z for each type at the nominal operating current I_Z rating of the range. For transient suppressor diodes the figure indicates the maximum recommended standoff voltage V_R.

The letter V is used to denote a decimal sign.

The final letter R is used to denote a reverse polarity version (stud anode) where applicable. The normal polarity version (stud cathode) has no special final letter.

Examples:

BF362	Silicon r.f. transistor intended primarily for 'consumer' applications.
ACY17	Germanium a.f. transistor primarily for 'industrial' applications.
BTW24–800R	Silicon thyristor for 'industrial' applications. In BTW24 range with 800V maximum repetitive peak voltage, reverse polarity, stud connected to anode.
BZY88–C5V6	Silicon voltage regulator diode for 'industrial' applications. In BZY88 range with 5·6V operating voltage ±5% tolerance.
RPY71	Photoconductive cell for 'industrial' applications.

OLD SYSTEM

Some earlier semiconductor diodes and transistors have type numbers consisting of two or three letters followed by a group of one, two or three figures.

The first letter is always 'O', indicating a semiconductor device.

The second (and third) letter(s) indicate the general class of device:

A — diode or rectifier
AP — photodiode
AZ — voltage regulator diode
C — transistor
CP — phototransistor

The group of figures is a serial number indicating a particular design or development.

Section II

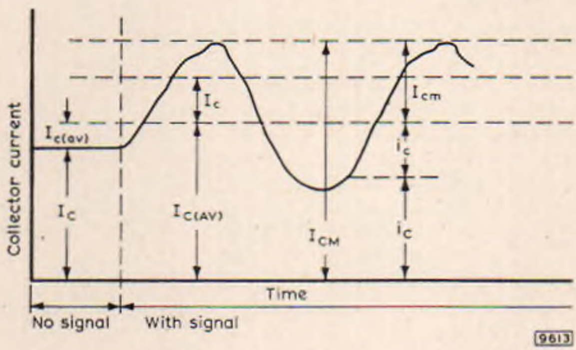
LIST OF SYMBOLS FOR SEMICONDUCTOR DEVICES

These symbols are based on British Standard Specification No. 3363: "Letter Symbols for Semiconductor Devices." A full description of the system is contained in this publication.

QUANTITY SYMBOLS

V	Voltage
I	Current
P	Power

i, v, p	with subscripts	e, b, c	instantaneous value of the varying component.
i, v, p	with subscripts	E, B, C	instantaneous total value.
I, V, P	with subscripts	e, b, c	the r.m.s. value of the varying component, or with appropriate additional subscript the peak (m) or average (d.c.) (av) value of the varying component.
I, V, P	with subscripts	E, B, C	the no-signal (d.c.) value or, with the appropriate additional subscripts the total average value (AV) with signal or the total peak value (M).



Examples:

I_E	d.c. emitter current no signal.
I_e	r.m.s. value of varying component of emitter current.
i_e	Instantaneous value of varying component of emitter current.
i_E	Instantaneous value of total emitter current.
$I_{E(AV)}$	Average (d.c.) value of total emitter current with signal applied.
$I_{e(av)}$	Average (d.c.) value of the varying component of the emitter current.
I_{em}	Peak value of the varying component of the emitter current.
I_{EM}	Peak value of the total emitter current.

Subscripts for quantity sumbols

A, a	Anode terminal
AV, av	Average
B, b	Base terminal
BO	Breakover
BR	Breakdown
C, c	Collector terminal, conversion, capacitive
D, d	Delay. Off-state (i.e. non trigger) drain terminal
E, e	Emitter terminal
F, f	Forward
G, g	Gate terminal
H, h	Holding
I, i	Input
J, j	Junction
K, k	Cathode terminal
M, m	Peak value
O, o	Open-circuit, output
OV	Average value of overload
R, r	Resistive, reverse, repetitive
S, s	Short-circuit, series, shield, source
T, t	On-state (i.e. triggered)
W, w	Working
X, x	Specified circuit, reactive
Z, z	Reference or regulator (i.e. Zener), impedance

The letter O is used with three terminal devices as a third subscript only to denote that the terminal not indicated in the subscript is open-circuited.

The letter S is also used with three terminal devices as a third subscript to denote that the terminal not indicated in the subscript is shorted to the reference terminal.

Sequence of subscripts

The first subscript denotes the terminal at which the current or terminal voltage is measured.

The second subscript denotes the reference terminal or circuit mode that the current or terminal voltage is measured.

Where the reference terminal or circuit is understood the second subscript may be omitted where its use is not required to preserve the meaning of the symbol.

The supply voltage shall be indicated by repeating the terminal subscript. The reference terminal may then be designated by the third subscript.

Examples V_{EE}, V_{CC}, V_{BB}, V_{EEB}

In devices having more than one terminal of the same type, the terminal subscripts shall be modified by adding a number following the subscript and on the same line.

Example B2

In multiple unit devices the terminal subscripts shall be modified by a number preceding the terminal subscript.

Example 2B

Where ambiguity might arise the complete terminal designations shall be separated by hyphens or commas.

Example $V_{1C1-2C1}$

the voltage at the first collector of the first unit referred to the voltage at the first collector of the second unit.

The first subscript in the matrix notation shall identify the element of the four pole matrix.

- i input
- o output
- f forward transfer
- r reverse transfer

A second subscript may be used to identify the circuit configuration.

- e common emitter
- b common base
- c common collector

Example $V_{ie} = h_{ie}.\ I_{ie} + h_{re}.V_{oe}$

When the common terminal is understood the second subscript may be omitted.

Static value of parameters shall be indicated by the upper case (capital) subscripts.

Example h_{IE}, h_{IB}

The four pole matrix parameters of the device are represented by lower case symbols with the appropriate subscripts

h_{ib}

The four pole matrix parameters of external circuits and of circuits in which the device forms only a small part are represented by upper case symbols with the appropriate subscripts.

H_i, Z_o

Symbols for the components of small-signal equivalent circuits used to represent devices are qualified by lower case symbols.

r_b, r_c, $r_{bb'}$

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
Distortion	D	
Frequency limits	f max. f min.	
Bandwidth	Δf	
Bandwidth (for associated circuits)		B
Noise factor		N

List of Symbols for Semiconductor Devices

C_d	diode capacitance (reverse bias)
C_f	diode capacitance (forward bias)
C_{ib}	transistor input capacitance (grounded base)
C_{ie}	transistor input capacitance (grounded emitter)
C_j	junction capacitance (of the intrinsic diode)
C_{min}	diode capacitance (at breakdown voltage)
C_o	diode capacitance (zero bias)
C_{ob}	transistor output capacitance (grounded base)
C_{oe}	transistor output capacitance (grounded emitter)
C_p	parasitic (parallel) capacitance
C_s	stray capacitance
C_{Te}	capacitance of the emitter depletion layer
C_{Tc}	capacitance of the collector depletion layer
f_{co}	varactor diode cut-off frequency
f_{hfb}, f_{hfe}	transistor cut-off frequency (the frequency at which the parameter indicated by the subscript is 0.7 times its low frequency value)
f_1	frequency of unity current transfer ratio modulus
f_{max}	maximum frequency of oscillations
f_r	tunnel diode resistive cut-off frequency
f_T	transition frequency (common emitter gain-bandwidth product)
g_j	tunnel diode negative conductance (of the intrinsic diode)
g_p	small signal power gain
G_p	large signal power gain
h_{IB}, h_{IE}, h_{IC}	the static value of the input resistance with the output voltage held constant
h_{ib} (h_{11}), h_{ie} (h_{11}), h_{ic}	The small-signal value of the input impedance with the output short-circuited to alternating current
h_{RB}, h_{RE}, h_{RC}	The static value of the reverse voltage transfer ratio with the input current held constant
h_{rb} (h_{12}), h_{re} (h_{12}), h_{rc}	The small-signal value of the reverse voltage transfer ratio with the output voltage held constant
h_{FB}, h_{FE}, h_{FC}	The static value of the forward current transfer ratio with the output voltage held constant
h_{fb} (h_{21}), h_{fe} (h_{21}), h_{fc}	The small-signal forward current transfer ratio with the output short-circuited to alternating current
h_{OB}, h_{OE}, h_{OC}	The static value of the output conductance with the input current held constant
h_{ob} (h_{22}), h_{oc} (h_{22}), h_{oc}	The small-signal value of the output admittance with the input open-circuited to alternating current
$h_{FE(sat)}$	transient forward current transfer ratio in saturation
h_{FEL}	inherent forward current transfer ratio $= \dfrac{I_C - I_{CBO}}{I_B + I_{CBO}}$

I_B, I_C, I_E	total d.c. current
$I_{B(AV)}$ $I_{C(AV)}$ $I_{E(AV)}$	average (d.c.) value of total current
I_{BBX}	base current (with both junctions reverse biased)
I_{BEX}, I_{CEX}	base (respectively collector) cut off current in a specified circuit
I_{BM}, I_{CM}, I_{EM}	peak value of total current
I_b, I_c, I_e	r.m.s. value of varying component of current
I_{bm}, I_{cm}, I_{em}	peak value of varying component of current
i_B, i_C, i_E	instantaneous total value of current
i_b, i_c, i_e	instantaneous value of varying component of current
$I_{(BO)}$	thyristor breakover current (d.c.)
I_{CBO}	collector cut-off current (emitter open-circuited)
I_{CBS}, I_{CES}	collector cut-off current (emitter short-circuited to base)
I_{CBX}	collector current with both junctions reverse biased with respect to base
I_{CEO}	collector cut-off current (base open-circuit)
I_{CER}	collector cut-off current (with specified resistance between base and emitter)
I_D	thyristor continuous (d.c.) off-state current, field effect transistor drain current
I_{EBO}	emitter cut-off current (collector open-circuit)
I_{EBX}	emitter current with both junctions reverse biased with respect to base
I_F	D.C. forward current
i_F	instantaneous forward current
$I_{F(AV)}$	average forward current
I_{FG}	thyristor forward gate current
I_{FGM}	thyristor peak forward gate current
I_{FM}	peak forward current
$I_{F(OV)}$, I_{FOM}	overload mean forward current
I_{FRM}	repetitive peak forward current
I_{FSM}	surge (non-repetitive) forward current
I_{GD}	thyristor gate non-trigger current
I_{GT}	thyristor gate trigger current
I_{GQ}	thyristor gate turn-off current
I_H	thyristor holding current (d.c.)
I_L	thyristor latching current
I_O	average output current
I_{ORM}	repetitive peak output current
I_P	tunnel diode peak point current
I_p/I_V	tunnel diode peak to valley point current ratio
I_R	continuous (d.c.) reverse leakage current
i_R	instantaneous reverse leakage current
I_{RG}	thyristor reverse gate current
I_{RRM}	repetitive peak reverse current
I_{RSM}	non-repetitive peak reverse current
I_S	source current
I_T	thyristor continuous (d.c.) on-state current
$I_{T(OV)}$	thyristor overload mean on-state current
$I_{T(AV)}$	thyristor average on-state current
I_{TRM}	thyristor repetitive peak on-state current
I_{TSM}	thyristor non-repetitive peak on-state current

I_V	tunnel diode valley point current
I_Z	voltage regulator (zener) diode continuous (d.c.) operating current
$I_{Z(AV)}$	voltage regulator (zener) diode average operating current
I_{ZM}	voltage regulator (zener) diode peak current
L_c	conversion loss
L_s	series inductance
N_f	flicker noise
N_{if}	noise figure at intermediate frequency
N_o	overall noise figure
N_r	noise temperature ratio
P_G	thyristor average gate power
P_{GM}	thyristor peak gate power
P_{tot}	total power dissipated within the device
Q_s	recovered (stored) charge
$r_{bb'}$	extrinsic base resistance
R_S	source resistance
r_S	series resistance
R_{th}	thermal resistance
r_Z	voltage regulator (zener) diode differential resistance
S_{ts}	tangential signal sensitivity
S_Z	voltage regulator (zener) diode temperature coefficient of the operating voltage
T_{amb}	ambient temperature
T_{case}	case temperature
T_j	junction temperature
T_{mb}	mounting base temperature
T_{stg}	storage temperature
t_d	delay time
t_f	fall time
t_{fr}	forward recovery time
t_{gt}	thyristor gate controlled turn-on time
t_{gq}	thyristor gate controlled turn-off time
t_p	pulse duration
t_q	thyristor circuit-commutated turn-off time
t_{on}	turn-on time
t_{off}	turn-off time
t_r	rise time
t_{rr}	reverse recovery time
t_s	storage time
θ_h	thermal resistance of heat sink
θ_i	contact thermal resistance
θ_{j-amb}	thermal resistance junction to ambient
θ_{j-case}	thermal resistance junction to case
θ_{j-mb}	thermal resistance junction to mounting base
τ_C	collector time coefficient of a switching transistor
τ_S	carrier storage time coefficient of a switching transistor
τ_F	fall time factor
τ_R	rise time factor

$V_{BE(sat)}$	base-emitter saturation voltage
$V_{(BO)}$	thyristor breakover voltage
$V_{(BR)}$	breakdown voltage
$V_{(BR)CBO}$	breakdown voltage collector to base (emitter open-circuited)
$V_{(BR)CBS}$	breakdown voltage collector to base (emitter and base short-circuited)
$V_{(BR)CEO}$	breakdown voltage collector to emitter (base open circuited)
$V_{(BR)CER}$	breakdown voltage collector to emitter (with specified resistance between base and emitter)
$V_{(BR)CES}$	breakdown voltage collector to emitter (emitter and base-short-circuited)
$V_{(BR)CEX}$	breakdown voltage collector to emitter (with specified circuit between base and emitter)
$V_{(BR)EBO}$	breakdown voltage emitter to base (collector open-circuited)
$V_{(BR)R}$	reverse breakdown voltage
V_{CB}	collector-base voltage (d.c.)
V_{CBO}	collector-base voltage (with emitter open-circuited)
V_{CBfl}	collector-base floating potential
V_{CC}	collector supply voltage (d.c.)
V_{CE}	collector to emitter voltage (d.c.)
V_{CEO}	collector to emitter voltage (with base open-circuited)
V_{ce}	collector to emitter r.m.s. voltage
$V_{CE(knee)}$	collector knee voltage.
$V_{CE(sat)}$	collector to emitter saturation voltage
$V_{CE(sust)}$	collector to emitter sustaining voltage
V_{D}	thyristor continuous (d.c.) off-state voltage
V_{DG}	drain to gate voltage
V_{DM}	thyristor peak off-state voltage
V_{DRM}	thyristor repetitive peak off-state voltage
V_{DS}	drain to source voltage
V_{DSM}	thyristor non-repetitive off-state voltage
V_{DWM}	thyristor crest (peak) working off-state voltage
V_{EB}	emitter-base voltage (d.c.)
V_{EBO}	emitter-base voltage (with collector open circuited)
V_{eb}	emitter-base r.m.s. voltage
V_{EBfl}	emitter-base floating potential
V_{ECfl}	emitter-collector floating potential
V_{F}	D.C. forward voltage
v_{F}	instantaneous total value of the forward voltage
V_{FG}	thyristor forward gate voltage
V_{FGM}	thyristor peak forward gate voltage
V_{fr}	signal diode forward recovery voltage
V_{GB}	gate to substrate voltage
V_{GD}	thyristor gate non-trigger voltage
V_{GS}	gate to source voltage
V_{GT}	thyristor gate trigger voltage
V_{I}	input voltage
V_{IRM}	repetitive peak input voltage
V_{ISM}	non-repetitive peak input voltage
V_{IWM}	crest working input voltage
V_{O}	output voltage

V_P	peak point voltage
V_{PP}	projected peak point voltage
V_R	D.C. reverse voltage
v_R	instantaneous total value of the reverse voltage
V_{RG}	thyristor reverse gate voltage
V_{RGM}	thyristor peak reverse gate voltage
V_{RM}	peak reverse voltage
V_{RRM}	repetitive peak reverse voltage
V_{RSM}	non-repetitive peak reverse voltage
V_{RWM}	crest (peak) working reverse voltage
V_T	thyristor continuous (d.c.) on-state voltage
$V_{T(TO)}$	thyristor threshold voltage
V_V	valley point voltage
V_Z	voltage regulator (zener) diode operating voltage
Z_{if}	intermediate frequency impedance
Z_v	video impedance

y-parameters

Common base	Common emitter		
y_{ib} (y_{11})	y_{ie} (y'_{11})	Input admittance	Output short-circuited
g_{ib} (g_{11})	g_{ie} (g'_{11})	Input conductance	
c_{ib} (c_{11})	c_{ie} (c'_{11})	Input capacitance	
ϕ_{ib}	ϕ_{ie}	Phase angle of input admittance	
y_{ob} (y_{22})	y_{oe} (y'_{22})	Output admittance	Input short-circuited
g_{ob} (g_{22})	g_{oe} (g'_{22})	Output conductance	
c_{obs} (c_{22})	c_{oes} (c'_{22})	Output capacitance	
ϕ_{ob}	ϕ_{oe}	Phase angle of output admittance	
$\lvert y_{fb}\rvert$ ($\lvert y_{21}\rvert$)	$\lvert y_{fe}\rvert$ ($\lvert y'_{21}\rvert$)	Transfer admittance	Output short-circuited
g_{fb}	g_{fe}	Transfer conductance	
c_{fb}	c_{fe}	Transfer capacitance	
ϕ_{fb} (ϕ_{21})	ϕ_{fe} (ϕ'_{21})	Phase angle of transfer admittance	
$\lvert y_{rb}\rvert$ (y_{12})	$\lvert y_{re}\rvert$ (y'_{12})	Feedback admittance	Input short-circuited
g_{rb}	g_{re}	Feedback conductance	
c_{rb}	c_{re}	Feedback capacitance	
ϕ_{rb} (ϕ_{12})	ϕ_{re} (ϕ'_{12})	Phase angle of feedback admittance	

Section III. Explanation of Handbook Data

1. FORM OF ISSUE

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

1.1 Types of Data

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

Tentative Data

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

Final Data

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

1.2 Presentation of Data

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

—description of basic application and physical characteristics of the device.
—quick reference data giving the most important ratings and characteristics.
—outline and dimensions. Reference to standard outline nomenclature if applicable and lead connections.
—Ratings. Voltage, current, power and thermal ratings.
—Characteristics.
—Application information or operating conditions.
—Mechanical and environmental data if applicable.
—Charts showing ratings and characteristics.

2. RATINGS

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

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

2.1 Rating Systems

Unless otherwise stated the ratings given in semiconductor data sheets follow the absolute maximum rating system.
The definitions of the three systems accepted by the International Electrotechnical Commission are as follows:

ABSOLUTE MAXIMUM RATING SYSTEM

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

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

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

DESIGN-CENTRE RATING SYSTEM

Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey device of a specified type as defined by its published data, and should not be exceeded under normal conditions. These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of all other devices in the equipment. The equipment manufacturer should design so that initially no design-centre value for the intended service is exceeded with a bogey device in equipment operating at the stated normal supply voltage.

DESIGN-MAXIMUM RATING SYSTEM

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

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

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

MICROWAVE DIODES

B

B

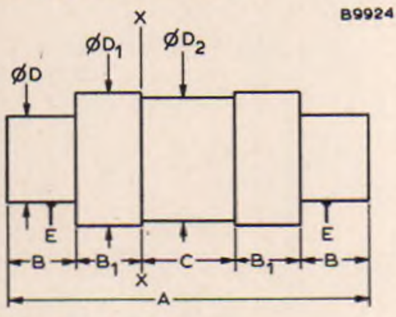
MICROWAVE MIXER DIODE

AAY34

A forward biased subminiature reversible point-contact diode for use in Q-band. Available in matched pairs as 2/AAY34/M.

QUICK REFERENCE DATA		
Frequency range	26 to 40	GHz
Typ. noise figure	8.5	dB

OUTLINE AND DIMENSIONS



	Millimetres	
	Min.	Max.
A	6.65	7.16
B	1.17	1.42
B_1	1.22	1.32
C	1.70	1.80
ØD	1.65	1.80
$ØD_1$	2.527	2.565
$ØD_2$	-	2.51

E, concentricity tolerance = ±0.15

TERMINAL IDENTIFICATION

The positive end (cathode) is marked red.

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

ACCESSORIES

Holders to fit these diodes are available in the U.K. from M.O.V. Co. Ltd., Brook Green Works, Hammersmith, London, W.6.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (r.f. spike)	0.03	erg
Max. burn-out pulse peak power (pulse duration 0.2μs)	0.5	W

Temperature

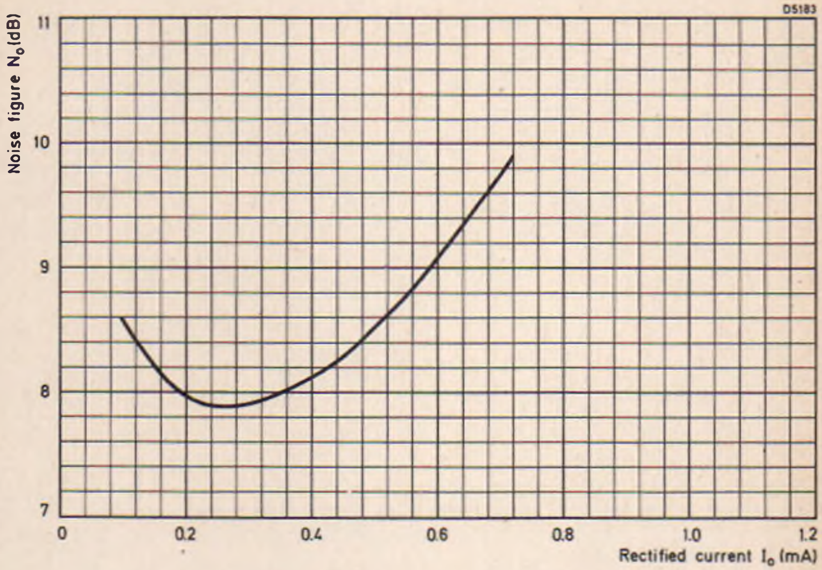
T_{stg} max.	100	^{o}C
T_{stg} min.	-55	^{o}C
T_{amb} max.	100	^{o}C
T_{amb} min.	-55	^{o}C

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

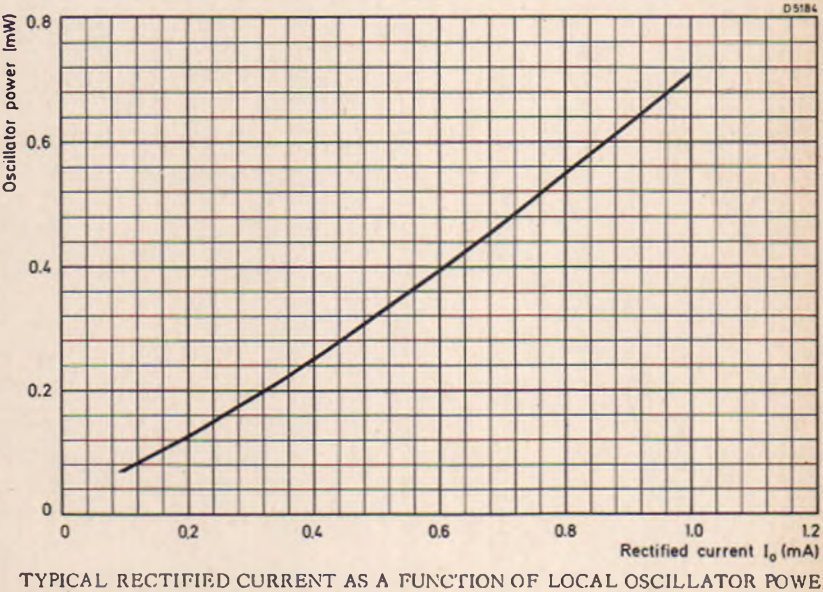
		Min.	Typ.	Max.	
Static					
I_R	Reverse current V_R=0.5V	-	10	-	μA
I_F	Forward current V_F=0.5V	-	2.0	-	mA
Dynamic					
N_o	Noise figure (see note 1)	-	8.5	10.5	dB
L_c	Conversion loss	-	5.5	-	dB
N_r	Noise temperature ratio (see note 2)	-	1.6	-	
v.s.w.r.	Voltage standing wave ratio (see note 3)	-	1.4	1.8	
z_{if}	Intermediate frequency impedance (see note 4)	500	750	1000	Ω
f	Operating frequency range	26	-	40	GHz

NOTES

1. Measured at 34.86GHz with V_{bias} =+150±10mV, 0.5mA total rectified current. N_o included N_{if} = 1.5dB and 45MHz i.f., R_L = 15Ω. BS9321/1406.
2. Intermediate frequency = 45MHz.
3. With respect to standard test holder. Measured at 34.86GHz. V_{bias} = +150±10mV, 0.5mA total rectified current, R_L = 15Ω. BS9321/1409
4. Measured at 34.86GHz, i.f. 45MHz, V_{bias} = +150±10mV, 0.5mA total rectified current, R_L = 15Ω. BS9321/1405



TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL RECTIFIED CURRENT AS A FUNCTION OF LOCAL OSCILLATOR POWER

MICROWAVE MIXER DIODES

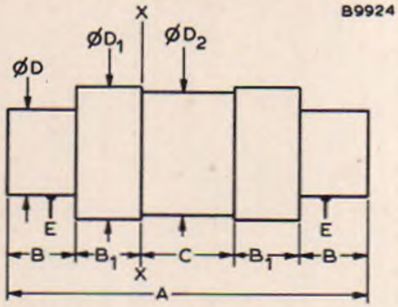
AAY39
AAY39A

Subminiature germanium reversible point-contact diodes primarily intended for low noise mixer applications in X-band. Available in matched pairs as 2/AAY39/M.

QUICK REFERENCE DATA			
Frequency range		1.0 to 18	GHz
Typ. noise figure at X-band	AAY39	6.0	dB
	AAY39A	7.0	dB

Unless otherwise stated data is applicable to both types

OUTLINE AND DIMENSIONS



XX = Reference plane

	Millimetres	
	Min.	Max.
A	6.65	7.16
B	1.17	1.42
B1	1.22	1.32
C	1.70	1.80
ØD	1.65	1.80
ØD1	2.527	2.565
ØD2	-	2.51

E concentricity tolerance = ± 0.15

Terminal identification

The positive end (cathode) is marked red.

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

ACCESSORIES

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (multiple d.c. spike)	0.1	erg
Max. burn-out (multiple r.f. spike)	0.05	erg
Max. burn-out pulse peak power (pulse duration 0.5μs)	0.5	W

Temperature

T_{stg} max.	100	^oC
T_{stg} min.	-55	^oC
T_{amb} max.	100	^oC
T_{amb} min.	-55	^oC

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

			Min.	Typ.	Max.	
Static						
I_R	Reverse current V_R =0.5V		-	3.0	-	μA
I_F	Forward current V_F =0.5V		-	5.0	-	mA
Dynamic						
N_o	Noise figure (see note 1)	AAY39	5.5	6.0	6.5	dB
		AAY39A	-	7.0	7.5	dB
L_c	Conversion loss	AAY39	-	4.2	-	dB
		AAY39A	-	5.0	-	dB
N_r	Noise temperature ratio (see note 2)	AAY39	-	1.1:1	-	
		AAY39A	-	1.2:1	-	
v.s.w.r.	Voltage standing wave ratio (see note 3)		-	-	1.43:1	
z_{if}	Intermediate frequency impedance (see note 4)		250	-	450	Ω
f	Operating frequency range		1.0	-	18	GHz

NOTES

1. Measured at 9.375GHz, 1.0mA total rectified current, R_L = 15Ω, N_o includes N_{if} = 1.5dB. BS9321/1406.
2. Intermediate frequency = 45MHz.
3. With respect to standard test holder measured at 9.375GHz and 1.0mA rectified current, R_L = 15Ω. BS9321/1409.
4. Measured at 9.375GHz, .i.f. 45MHz, 1.0mA total rectified current, R_L = 15Ω. BS9321/1405.

OPERATING NOTE

Optimum performance is obtained with AAY39 and AAY39A when the local oscillator drive is adjusted to give a diode rectified current of 1.0mA, and the load resistance is restricted to 100Ω max.

APPLICATION INFORMATION FOR AAY39

1. Mixer performance at other than Test Radio Frequency

		Typ.	
N_o	Measured overall noise figure $f=16.5GHz$, $N_{if}=1.5dB$, i.f. $=45MHz$	7.0	dB
	$f=3.0GHz$, $N_{if}=1.5dB$, i.f. $=45MHz$	5.5	dB
	$f=9.5GHz$, i.f. $=3.0kHz$	29	dB

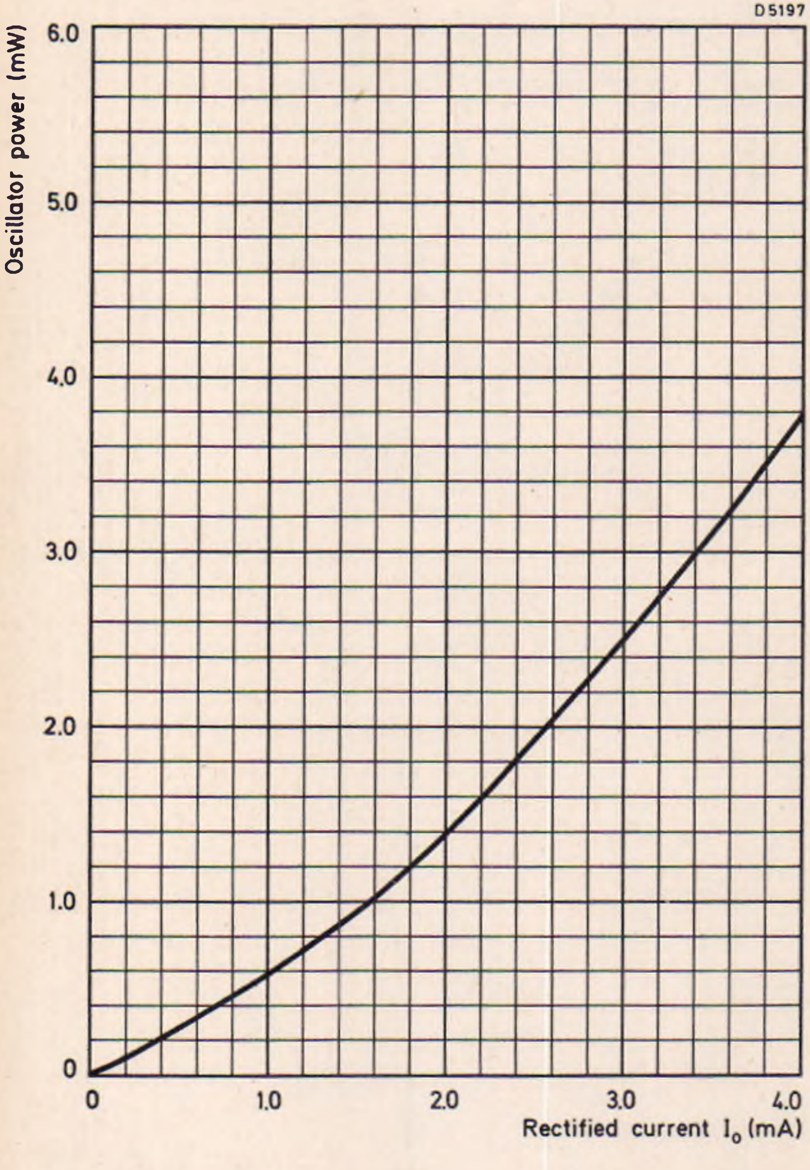
2. Signal/flicker noise ratio at 9.5GHz

	Measured at 2.0kHz from carrier in a 70Hz bandwidth	131	dB

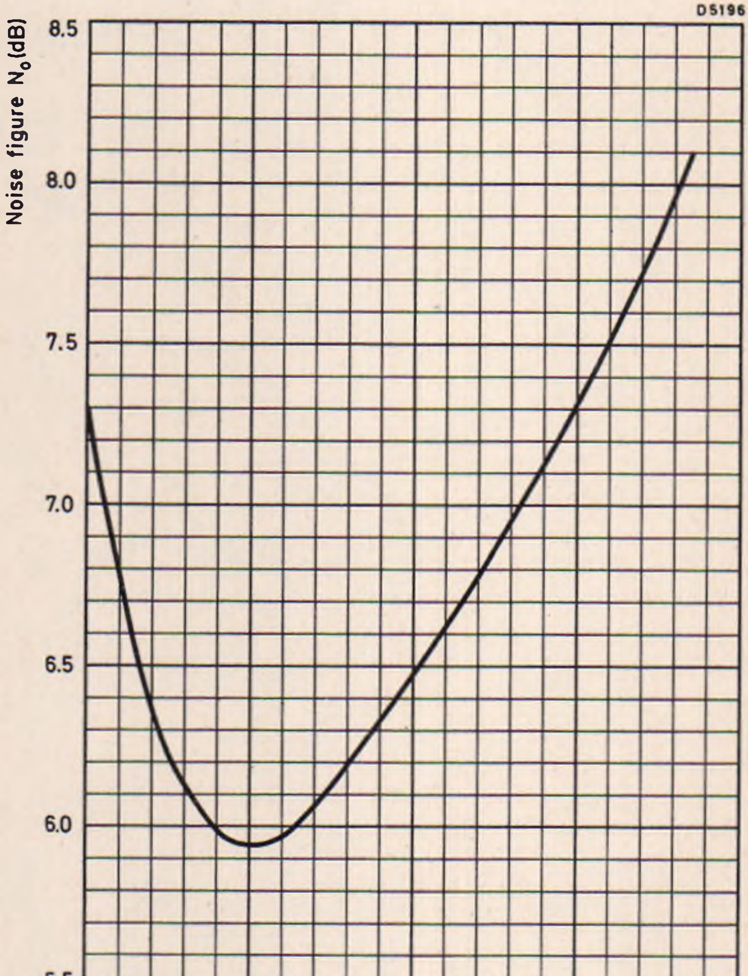
3. Detector performance

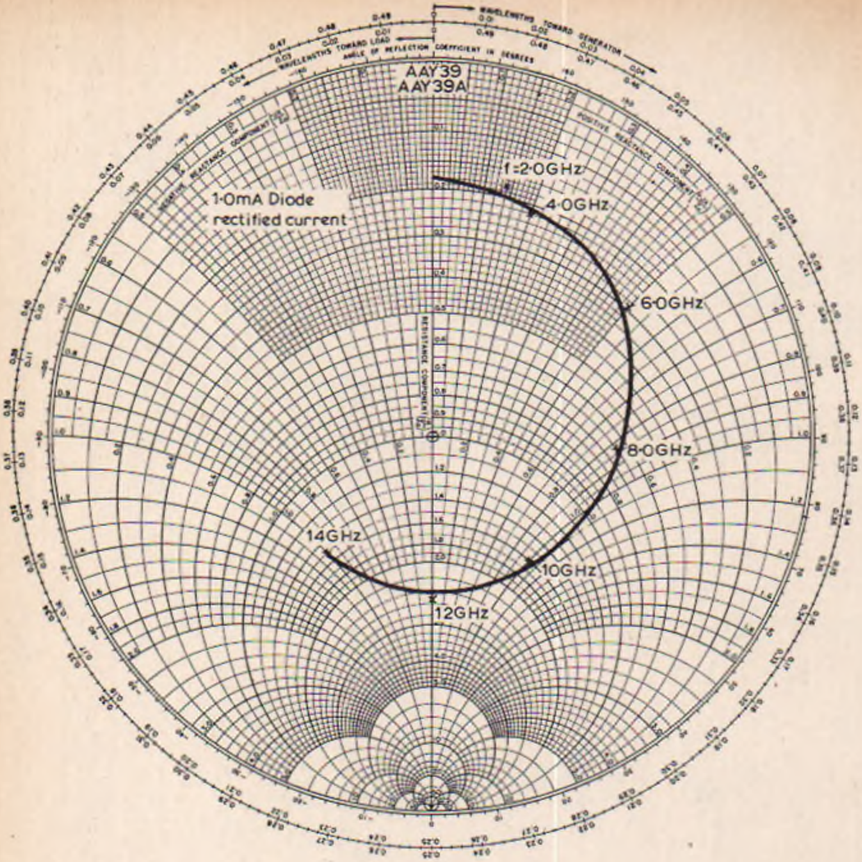
S_{ts}	Tangential sensitivity at 9.375GHz, 1kHz to 1MHz video bandwidth, I_F(bias) = 50μA. BS9322/1411	-52	dbm
Z_v	A.C. video impedance, I_F(bias) = 50μA. BS9322/1403	800	Ω

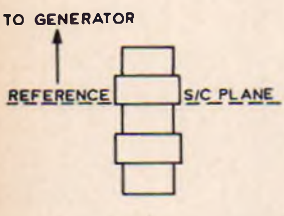
AAY39 TYPICAL RECTIFIED CURRENT
AS A FUNCTION OF LOCAL OSCILLATOR POWER



AAY39 TYPICAL NOISE FIGURE AS A FUNCTION
OF RECTIFIED CURRENT







TYPICAL R.F. ADMITTANCE AS A FUNCTION OF RADIO FREQUENCY

Admittance with respect to 1/50mho. Measured in 50Ω coaxial line.

MICROWAVE
MIXER DIODES

AAY50
AAY50R

TENTATIVE DATA

Coaxial germanium point-contact diodes for use in pre-tuned X-band low noise mixer circuits. The AAY50 and AAY50R are intended as low noise retrofits at X-band frequencies for coaxial mixer diodes, types SIM2/5, GEM3/4, etc. The two types have identical dimensions and characteristics, but the polarity is reversed. The pair are intended for use in balanced mixer circuits.

QUICK REFERENCE DATA		
Typ. noise figure at X-band	6.2	dB
Max. operating frequency	12	GHz

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-26

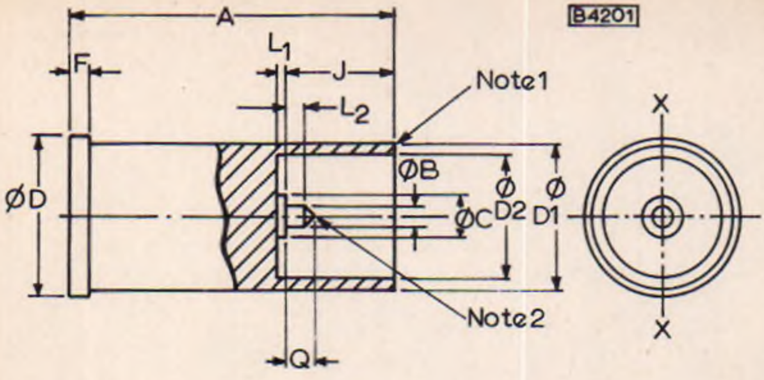
See page 2 for details

Terminal identification

AAY50	Pin	cathode
	Body (red spot)	anode
AAY50R	Pin	anode
	Body (green spot)	cathode

ACCESSORIES

Holders to fit these coaxial diodes are available in the U.K. from W.H.Sanders Ltd,. Stevenage, Herts



The millimetre dimensions are derived from the original inch dimensions

	Millimetres		Inches	
	Min.	Max.	Min.	Max.
A	18.80	19.30	0.740	0.760
ØB	1.270	1.320	0.050	0.052
ØC	3.023	3.073	0.119	0.121
ØD	9.28	9.52	0.365	0.375
ØD1	8.611	8.737	0.339	0.344
ØD2	7.163	7.264	0.282	0.285
F	1.15	1.39	0.045	0.055
J	6.300	6.477	0.248	0.255
L1	0.686	0.762	0.027	0.030
L2	1.02	1.27	0.040	0.050
Q	1.86	2.10	0.073	0.083

NOTES

1. The device is designed to make contact on this open face.
2. Cone tapers to a radius (0.13mm) 0.005in. nominal.

MICROWAVE MIXER DIODES

AAY50 AAY50R

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

Max. burn-out (r.f. spike)	0.2	erg
Max. burn-out pulse peak power (pulse duration=0.5μs)	2.0	W

Temperature

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

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

		Min.	Typ.	Max.	
Static					
I_R	Reverse current, $V_R=0.5V$	-	3.0	-	μA
I_F	Forward current, $V_F=0.5V$	-	9.0	-	mA
Dynamic					
F_o	Noise figure (see note 1)	-	6.2	6.8	dB
L_c	Conversion loss	-	4.4	-	dB
N_r	Noise temperature ratio (see note 2)	-	1.1	-	
v.s.w.r.	Voltage standing wave ratio (see note 3)	-	-	1.43	
Z_{if}	Intermediate frequency impedance	300	-	500	Ω
f	Operating frequency range	-	-	12	GHz

NOTES.

1. Measured at 9.375GHz, 1.0mA rectified current, $R_L=15\Omega$ in standard SIM2/5 holder. F_o includes F_{if}=1.5dB. K1007, Issue 3, Section 8B3.3.1/2.
2. Intermediate frequency = 45MHz.
3. Tested at 9375 ± 10MHz under conditions as in note 1. The nominal rectifier admittance at a plane 0.247in inside the body from the open end is:

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

OPERATING NOTE

The AAY50, 50R will exhibit their inherent improved noise figure performance over the frequency range 1.0 to 12GHz, but are not recommended for use as direct replacements in pre-tuned mounts designed for the SIM2/5 type coaxial diode, at other than X-band frequencies.

APPLICATION INFORMATION FOR AAY50, 50R

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

MICROWAVE MIXER DIODES

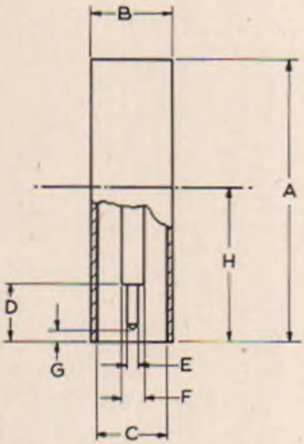
AAY51 AAY51R

The AAY51 and AAY51R form a reverse pair of mixer diodes for use in balanced mixer circuits at J-band (Ku band). The diodes give a good impedance match over the whole band. The AAY51 and AAY51R are packaged in the standard coaxial outline for the frequency, similar to 1N78 types. The encapsulation is hermetically sealed.

QUICK REFERENCE DATA		
Frequency range	12 to 18	GHz
Typ. noise figure at J-band	7.0	dB

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



	Millimetres	
	Min.	Max.
A	18.67	19.43
B dia.*	5.46	5.59
C dia.	4.67	4.80
D	3.73	-
E dia.	0.79	0.84
F dia.	1.60 nom.	
G	0.15	0.71
H	10.32 nom.	

*These tolerances apply over length H only

TERMINAL IDENTIFICATION

AAY51	Pin	cathode
	Body (red)	anode
AAY51R	Pin	anode
	Body (blue)	cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (multiple d.c. spike)	0.1	erg

Temperature

T_{stg} max.	100	^oC
T_{stg} min.	-55	^oC
T_{amb} max.	100	^oC
T_{amb} min.	-55	^oC

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

		Min.	Typ.	Max.	
Static					
I_R	Reverse current $V_R = 0.5V$	-	3.0	-	μA
I_F	Forward current $V_F = 0.5V$	-	9.0	-	mA
Dynamic					
$*N_o$	Overall noise figure	-	7.0	7.5	dB
L_c	Conversion loss	-	5.2	-	dB
$**N_r$	Noise temperature ratio	-	1.1:1	-	
v.s.w.r.	Voltage standing wave ratio				
	measured at 13.5GHz	-	-	1.5:1	
	measured in band 13-18GHz	-	-	2.5:1	
z_{if}	Intermediate frequency impedance	220	270	320	Ω
f	Operating frequency range	12	-	18	GHz

*Measured at 13.5GHz in JAN201 holder. N_o includes $N_{if} = 1.5$dB (K1007 Issue 3, Section 8B 3.3.1/2)

**Intermediate frequency = 45MHz

FINISH

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

MICROWAVE MIXER DIODES

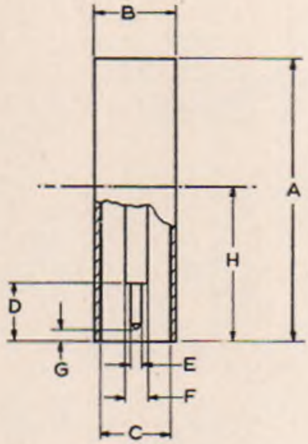
AAY52
AAY52R

The AAY52 and AAY52R form a reverse pair of mixer diodes for use in balanced mixer circuits at J-band (Ku band). The diodes give a good impedance match over the whole band. The AAY52 and AAY52R are packaged in the standard coaxial outline for the frequency, similar to 1N78 types. The encapsulation is hermetically sealed.

QUICK REFERENCE DATA		
Frequency range	12 to 18	GHz
Typ. noise figure at J-band	8.0	dB

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



	Millimetres Min.	Max.
A	18.67	19.43
B dia.*	5.46	5.59
C dia.	4.67	4.80
D	3.73	-
E dia.	0.79	0.84
F dia.	1.60 nom.	
G	0.15	0.71
H	10.32 nom.	

*These tolerances apply over length H only

TERMINAL IDENTIFICATION

AAY52	Pin	cathode
	Body (red)	anode
AAY52R	Pin	anode
	Body (blue)	cathode

MATCHED PAIRS

Diodes are available in matched pairs to the following specification: -

Maximum unbalance conditions

1. $z_{if} = 25\Omega$
2. Rectified current = 0.1mA

Code number of matched pairs

2/AAY52/MR (comprising 1 AAY52 and 1 AAY52R)

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (multiple d.c. spike)	0.1	erg

Temperature

T_{stg} max.	100	^{o}C
T_{stg} min.	-55	^{o}C
T_{amb} max.	100	^{o}C
T_{amb} min.	-55	^{o}C

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

Static		Min.	Typ.	Max.	
I_R	Reverse current $V_R = 0.5V$	-	3.0	-	μA
I_F	Forward current $V_F = 0.5V$	-	9.0	-	mA
Dynamic					
$^*N_o$	Overall noise figure	-	8.0	8.5	dB
v.s.w.r.	Voltage standing wave ratio				
	measured at 13.5GHz	-	-	1.5:1	
	measured in band 13-18GHz	-	-	2.5:1	
z_{if}	Intermediate frequency impedance	220	270	320	Ω
f	Operating frequency range	12	-	18	GHz

*Measured at 13.5GHz in JAN201 holder. N_o includes $N_{if} = 1.5$dB (K1007 Issue 3, Section 8B 3.3.1/2)

FINISH

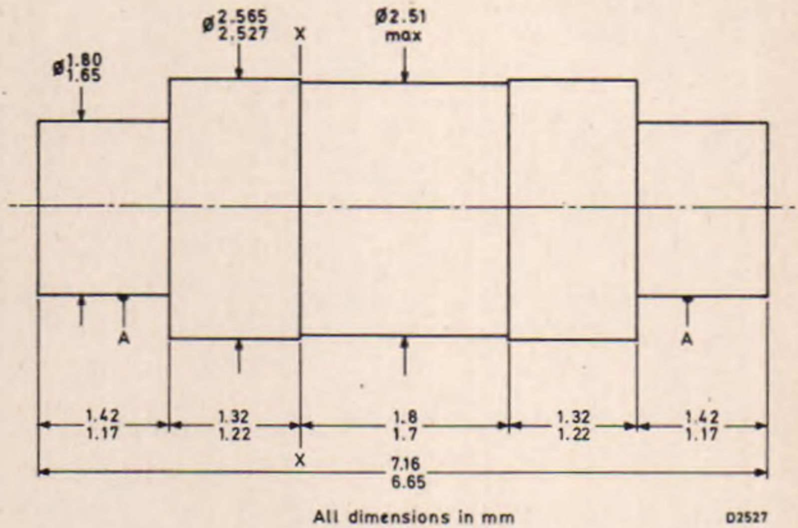
The bodies are cadmium plated in order to be compatible with an aluminium holder.

MICROWAVE MIXER DIODE

Subminiature germanium point-contact mixer diode for use at Q-band (Ka-band).

QUICK REFERENCE DATA		
Frequency range	26 to 40	GHz
Typ. noise figure	8.5	dB

OUTLINE AND DIMENSIONS



XX = Reference plane

A = Concentricity tolerance = ± 0.15

TERMINAL IDENTIFICATION

The positive end (cathode) is marked red.

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (r.f. spike)	0.03	erg
Max. burn-out pulse peak power (pulse duration 0.2μs)	0.5	W

Temperature

T_{stg} max.	100	^oC
T_{stg} min.	-55	^oC
T_{amb} max.	100	^oC
T_{amb} min.	-55	^oC

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

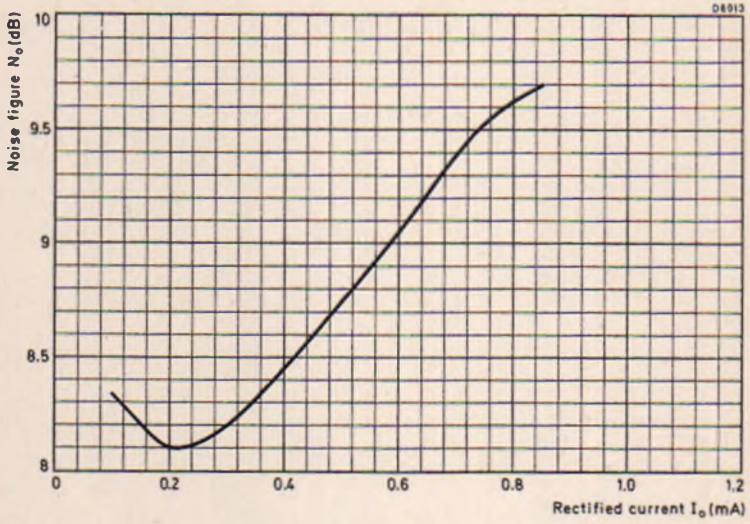
		Min.	Typ.	Max.	
Static					
I_R	Reverse current $V_R = 0.5V$	-	2.0	-	μA
I_F	Forward current $V_F = 0.5V$	-	2.0	-	mA
Dynamic					
N_o	Noise figure (note 1)	-	8.5	10	dB
L_c	Conversion loss	-	5.5	-	dB
N_r	Noise temperature ratio (note 2)	-	1.6:1	-	
v.s.w.r.	Voltage standing wave ratio (note 3)	-	1.4:1	1.8:1	
z_{if}	Intermediate frequency impedance (note 4)	700	1000	1400	Ω
f	Operating frequency range	26	-	40	GHz

→ NOTES

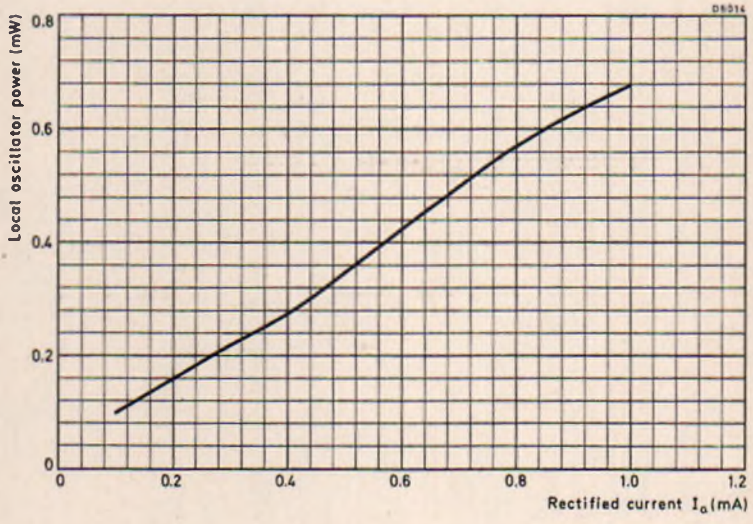
1. Measured at 34.86GHz, 0.5mA diode rectified current. N_o includes $N_{if} = 1.5$dB. BS9321/1406.
2. Intermediate frequency = 45MHz.
3. With respect to standard test holder, at 34.86GHz, 0.5mA rectified current, $R_L = 15\Omega$, BS9321/1409.
4. Measured at 34.86GHz, 0.5mA rectified current, i.f. = 45MHz, $R_L = 15\Omega$, BS9321/1405.

MATCHED PAIRS

The AAY59 can be supplied in matched pairs as 2/AAY59M. Diodes are matched to ± 10% on rectified current and within 150Ω i.f. impedance.



TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL LOCAL OSCILLATOR POWER AS A FUNCTION OF RECTIFIED CURRENT

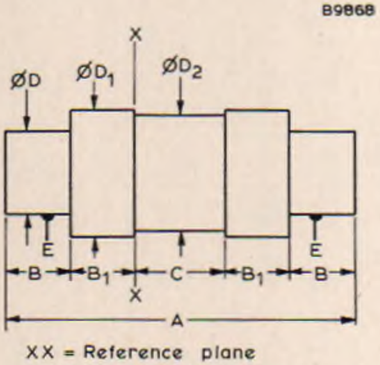
MICROWAVE DETECTOR DIODE

AEY17

Sub-miniature germanium bonded backward diode primarily intended for broadband low level detector applications at X-band.

QUICK REFERENCE DATA		
Frequency range	1 to 18	GHz
Typ. zero bias tangential sensitivity at X-band	-53	dbm

OUTLINE AND DIMENSIONS



Millimetres

	Min.	Max.
A	6.65	7.16
B	1.17	1.42
B1	1.22	1.32
C	1.70	1.80
Ø D	1.65	1.80
Ø D1	2.527	2.565
Ø D2	-	2.51

E, concentricity tolerance = ±0.15

TERMINAL IDENTIFICATION

The AEY17 is colour coded according to K1007 Issue 3, Section 1.3.4.4. That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.
The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

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

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

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

Notes:

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

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

APPLICATION INFORMATION FOR AEY17

1. Detector performance at other than Test Radio Frequency

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

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

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

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

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

MICROWAVE DETECTOR DIODES

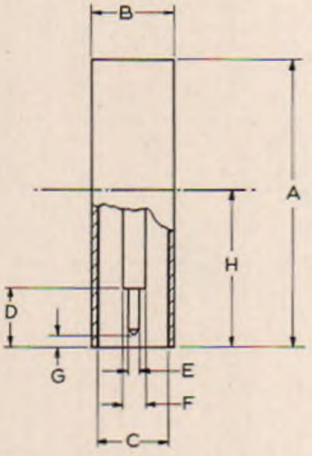
AEY29 AEY29R

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

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

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



	Millimetres	
	Min.	Max.
A	18.67	19.43
B dia.*	5.46	5.59
C dia.	4.67	4.80
D	3.73	-
E dia.	0.79	0.84
F dia.	1.60 nom.	
G	0.15	0.71
H	10.32 nom.	

*These tolerances apply over length H only

TERMINAL IDENTIFICATION

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

T_{stg} min.	-55	°C
T_{stg} max.	100	°C
T_{amb} min.	-55	°C
T_{amb} max.	100	°C

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

Static

		Min.	Typ.	Max.	
I_R	Reverse current $V_R = 0.3V$	-	100	-	μA
I_F	Forward current $V_F = 0.3V$	-	12	-	mA

Dynamic

		Min.	Typ.	Max.	
S_{ts}	Tangential sensitivity (see note 1)	-	-53	-	dbm
M	Figure of merit (see note 2)	50	-	-	
Z_v	Video impedance (see note 3)	-	300	-	Ω
v.s.w.r.	Voltage standing wave ratio (see note 4)	-	-	5:1	

Notes:

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

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

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

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

MICROWAVE DETECTOR DIODES

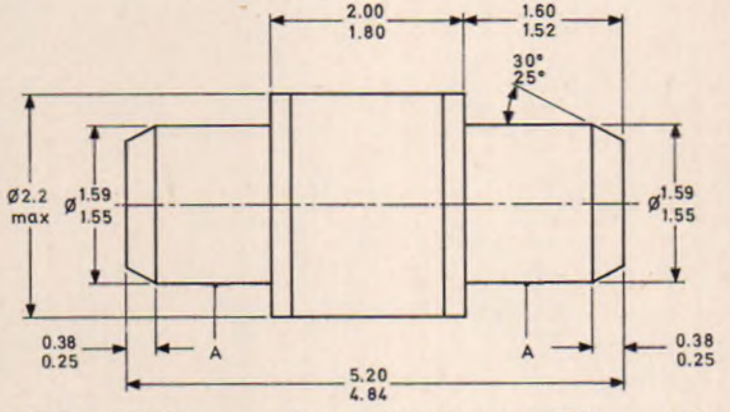
AEY31 AEY31A

Sub-miniature germanium bonded backward diodes primarily intended for broadband low level detector applications at X-band.

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

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



All dimensions in mm A = concentricity tolerance = ±0.15

TERMINAL IDENTIFICATION

The AEY31 and AEY31A are colour coded according to K1007 Issue 3, Section 1.3.4.4. That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

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

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

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

Notes:

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

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

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

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

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

APPLICATION INFORMATION FOR AEY31 AND AEY31A

1. Detector performance at other than Test Radio Frequency

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

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

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

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

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

MICROWAVE DETECTOR DIODE

AEY32

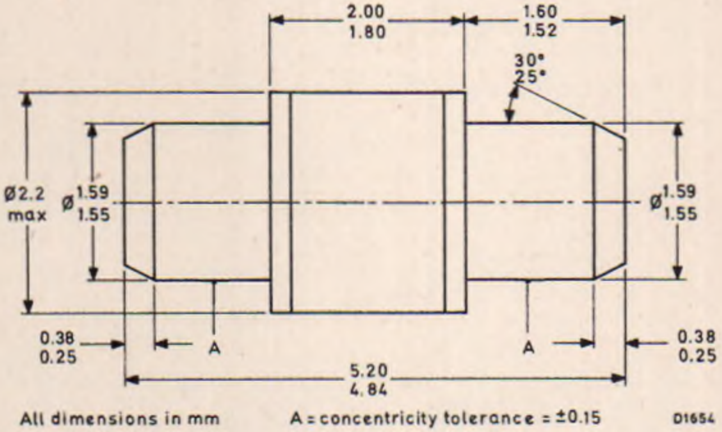
TENTATIVE DATA

Sub-miniature germanium bonded backward diode primarily intended for broadband low level detector applications in K-band and in Q-band (Ka-band).

QUICK REFERENCE DATA		
Frequency range	18 to 40	GHz
Zero bias current sensitivity in the band 18 to 40GHz (typ.)	2.0	μA/μW

OUTLINE AND DIMENSIONS

M.Q.M.



Terminal identification: red end indicates Cathode

POLARITY IDENTIFICATION

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

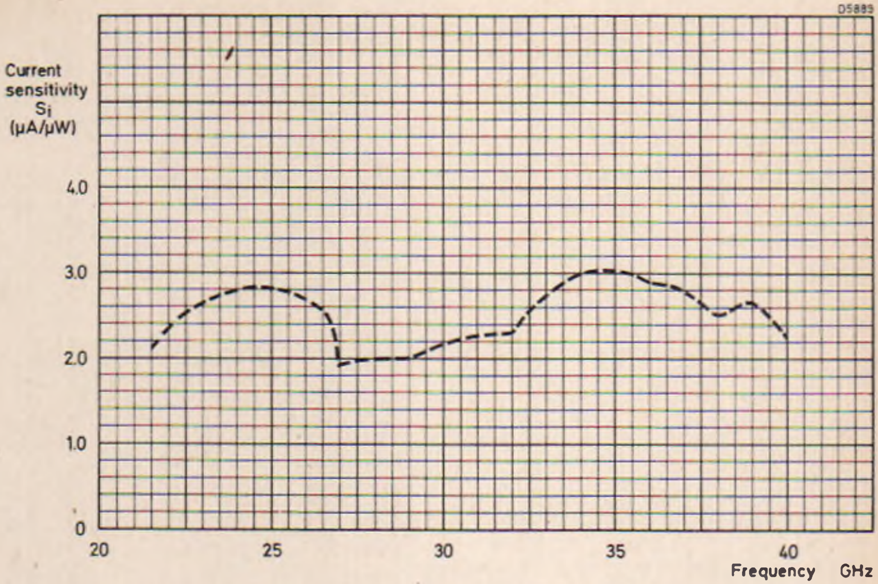
Max. pulsed r.f. input power (f = 9.375GHz, t_p = 0.5µs, p.r.f. = 2000 p.p.s.)	40	mW
T_{amb} range	-55 to +100	°C
T_{stg} range	-55 to +100	°C

ELECTRICAL CHARACTERISTICS

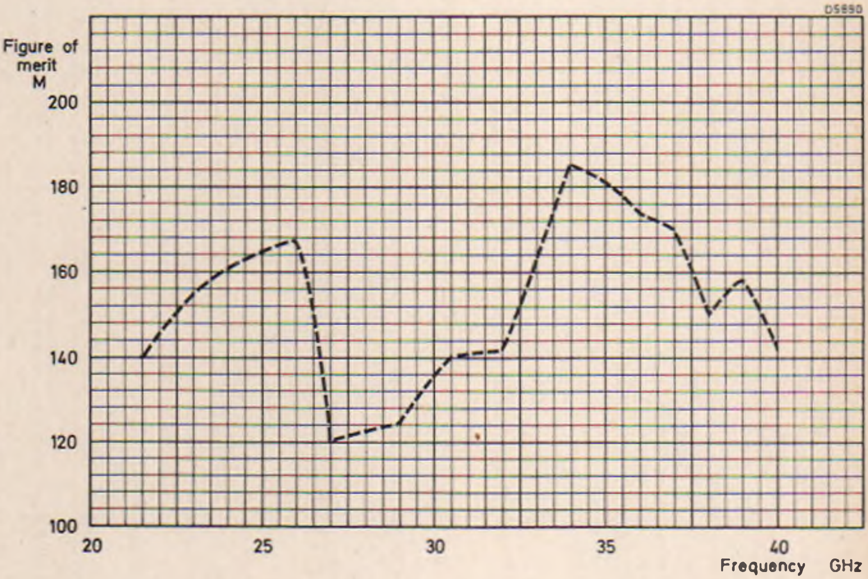
	Min.	Typ.	Max.	
1/f noise (see note 1)	-	-	7.0	dB
Swept v.s.w.r. (26.5 to 40GHz) (see note 2)	-	-	5:1	
Z_v video impedance (see note 3)	3.0	-	5.0	kΩ
S_i current sensitivity (see note 4)	-	2.0	-	µA/µW
M figure of merit (see note 5)	50	-	-	

NOTES

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



TYPICAL CURRENT SENSITIVITY AS A FUNCTION OF FREQUENCY



TYPICAL FIGURE OF MERIT AS A FUNCTION OF FREQUENCY

MICROWAVE MIXER/DETECTOR DIODE

BAT10

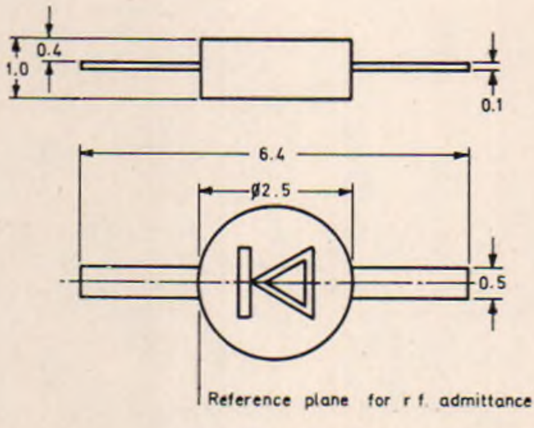
TENTATIVE DATA

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. Available as a matched pair 2/BAT10/M.

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



All dimensions in mm D3108

LIMITING VALUES (Absolute max. rating system)

Electrical

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

Temperature

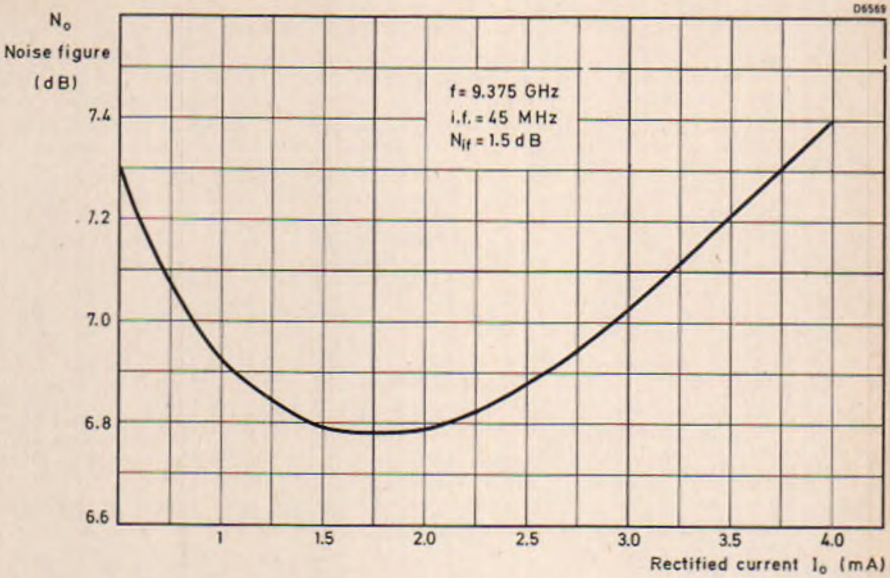
T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

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

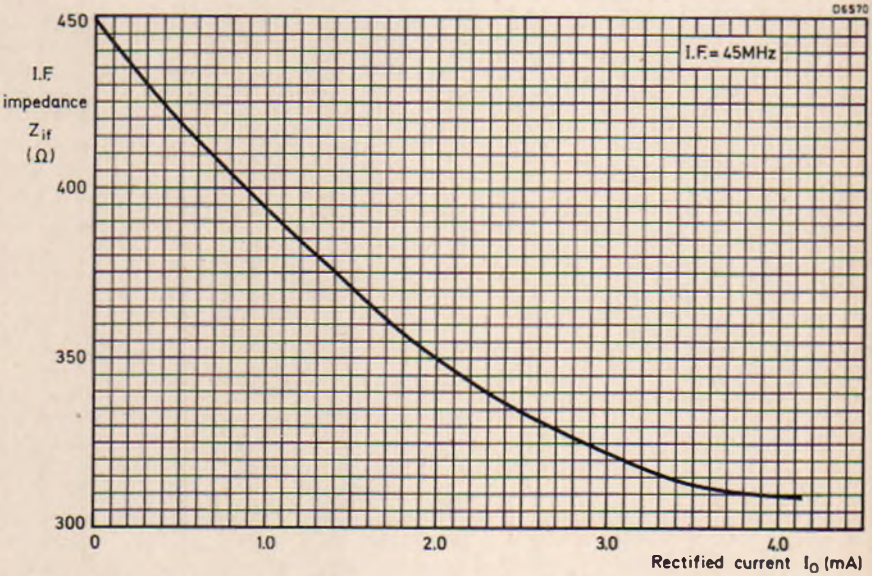
		Typ.	Max.	
Mixer				
N_o	Noise figure [1]	7.0	7.5	dB
v.s.w.r.	Voltage standing wave ratio [2]	-	2:1	
Z_{if}	Intermediate frequency impedance [3]	-	500	Ω
Detector				
S_{ts}	Tangential sensitivity [4]	-50	-	dBm
S_I	Current sensitivity [5]	5.0	-	μA/μW
v.s.w.r.	Voltage standing wave ratio [6]	-	5:1	
Z_v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

NOTES

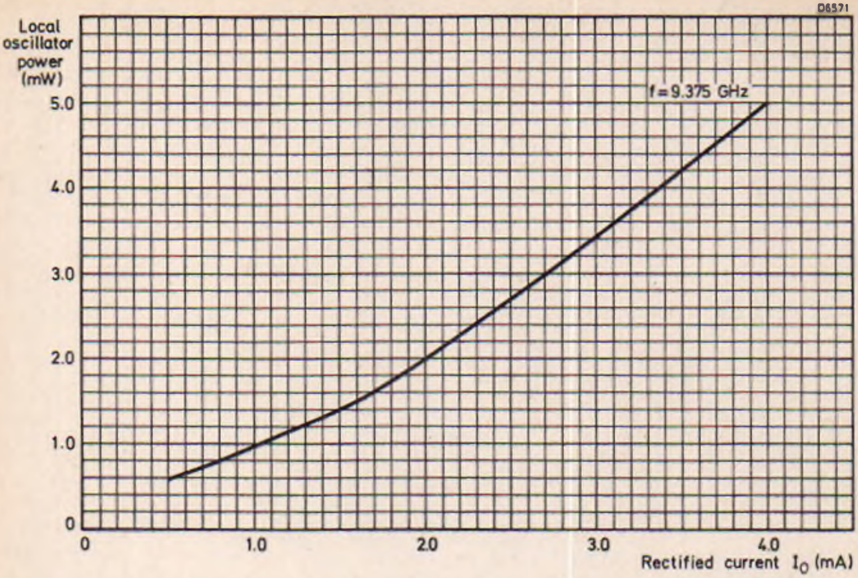
1. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω, i.f. = 45 MHz and i.f. noise figure = 1.5 dB. BS9300.
2. Measured with respect to 50 Ω at f = 9.375 GHz, rectified current = 2.0 mA, and load resistance = 10 Ω. BS9300.
3. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω and i.f. = 45 MHz. BS9300.
4. Measured at f = 9.375 GHz with 2.0 MHz bandwidth and 100 μA bias.
5. Measured at f = 9.375 GHz at an input power of 1.0 μW and 50 μA bias.
6. Measured with respect to 50 Ω at f = 9.375 GHz, 100 μA bias and c.w. input less than 2.0 μW. BS9300.
7. D.C. measurement with 1.0 mV max. and 50 μA bias.



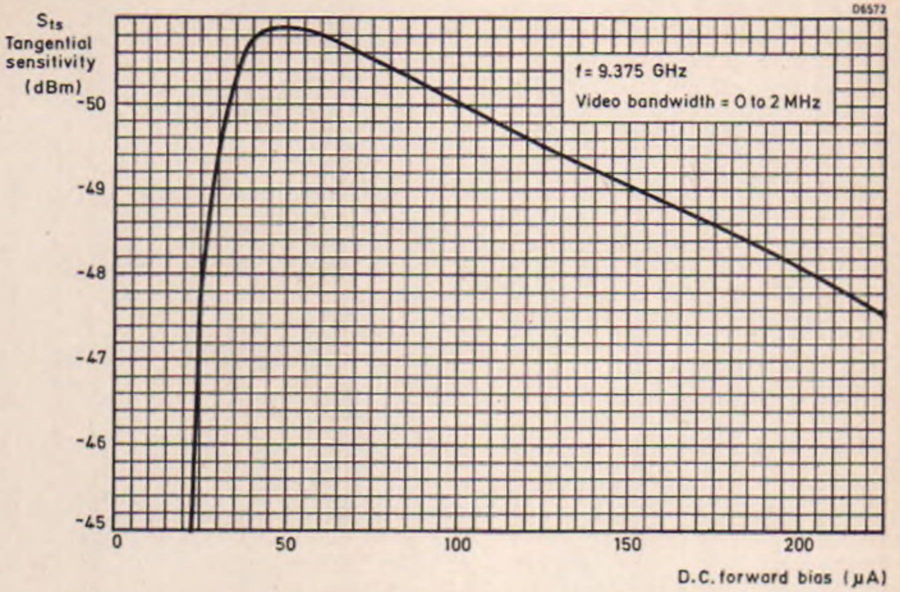
TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT (MIXER APPLICATION)



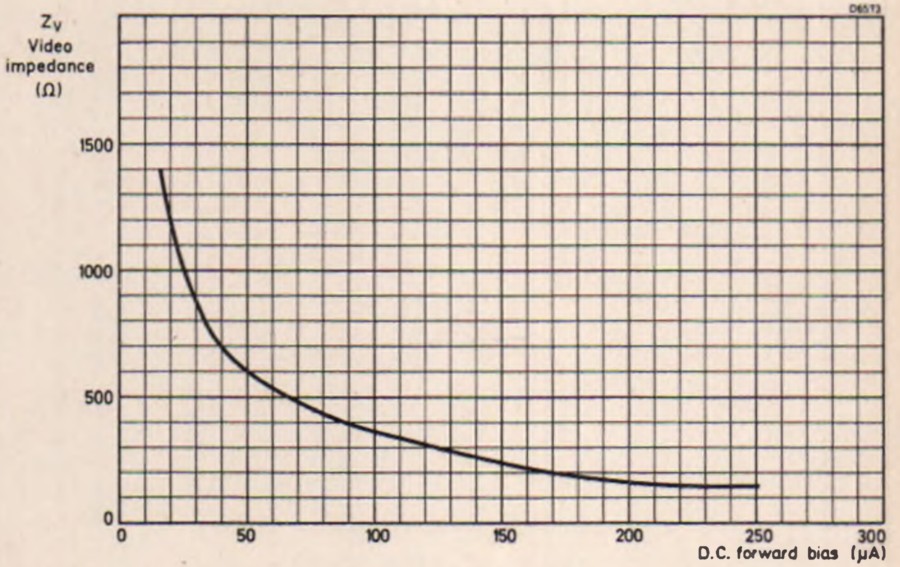
TYPICAL I.F. IMPEDANCE AS A FUNCTION OF RECTIFIED CURRENT (MIXER APPLICATION)



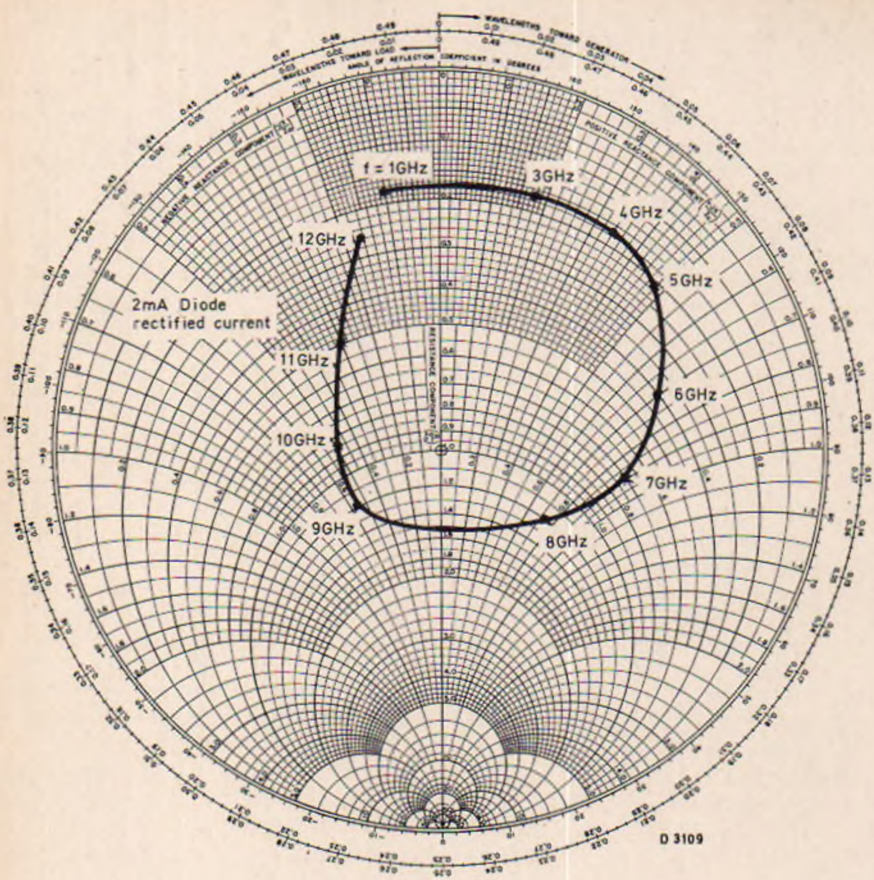
TYPICAL LOCAL OSCILLATOR POWER AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



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



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



TYPICAL ADMITTANCE AS A FUNCTION OF FREQUENCY

MICROWAVE MIXER DIODE

BAT11

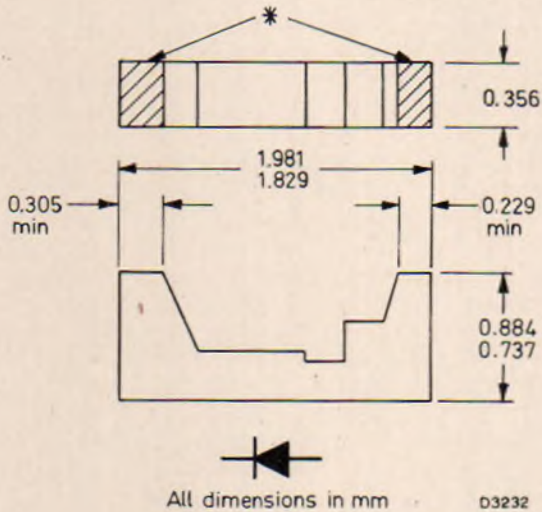
TENTATIVE DATA

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. Available as a matched pair 2/BAT11/M.

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

(Development No. 540BAY)

OUTLINE AND DIMENSIONS



*Gold plated, 5μm over 1.27μm of nickel.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

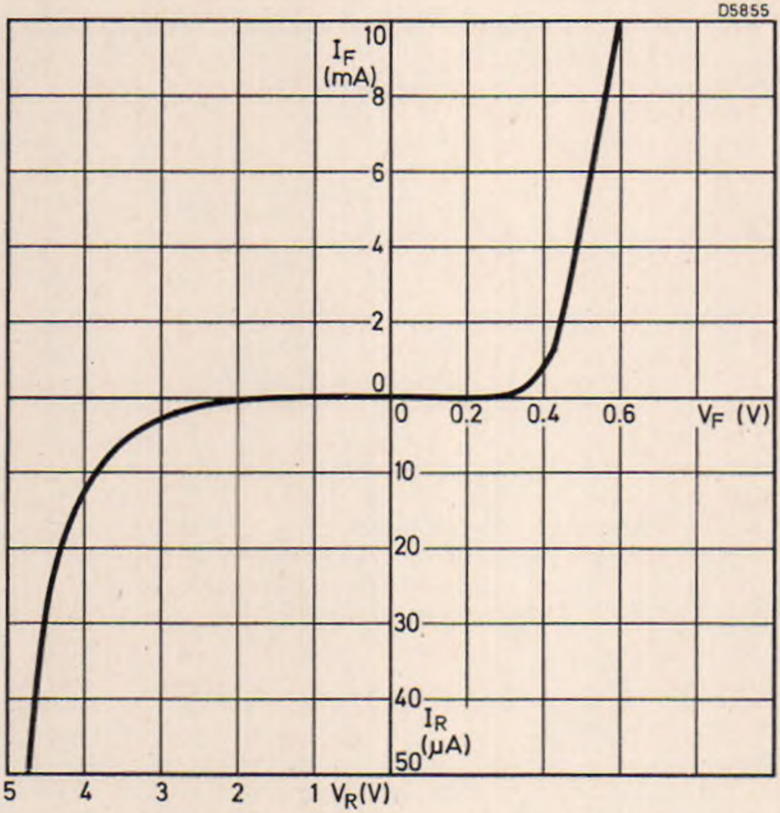
T_{stg} range	-55 to +150	^{o}C
T_{amb}	-55 to +150	^{o}C

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

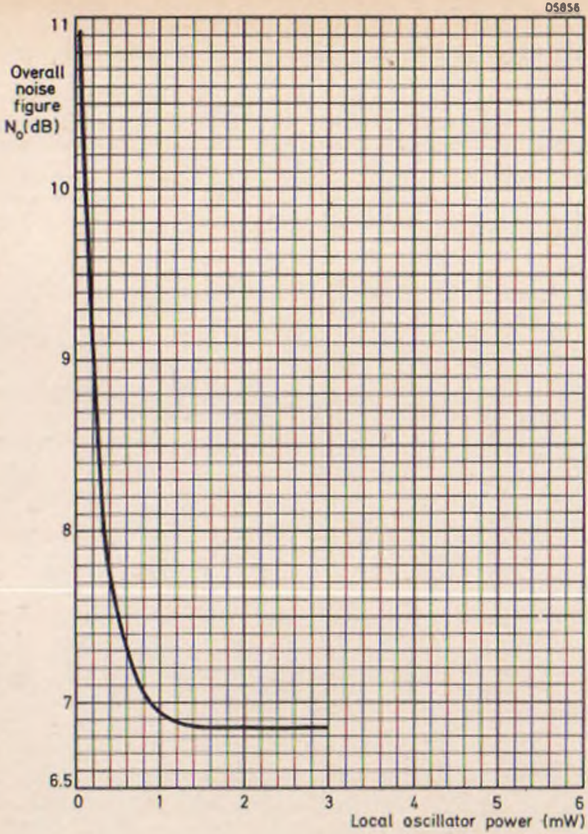
		Min.	Typ.	Max.	
Dynamic					
N_o	Noise figure (see note 1)	-	6.5	7.0	dB
Z_{rf}	R.F. impedance spread referred to 50Ω bounded by co-ordinates (see note 2).		0.6 - j0.3 0.6 + j0.3	0.4 - j0.3 0.4 + j0.3	
Z_{if}	Intermediate frequency impedance (see note 3)	280	320	380	Ω
f	Operating frequency range	-	-	12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

NOTES

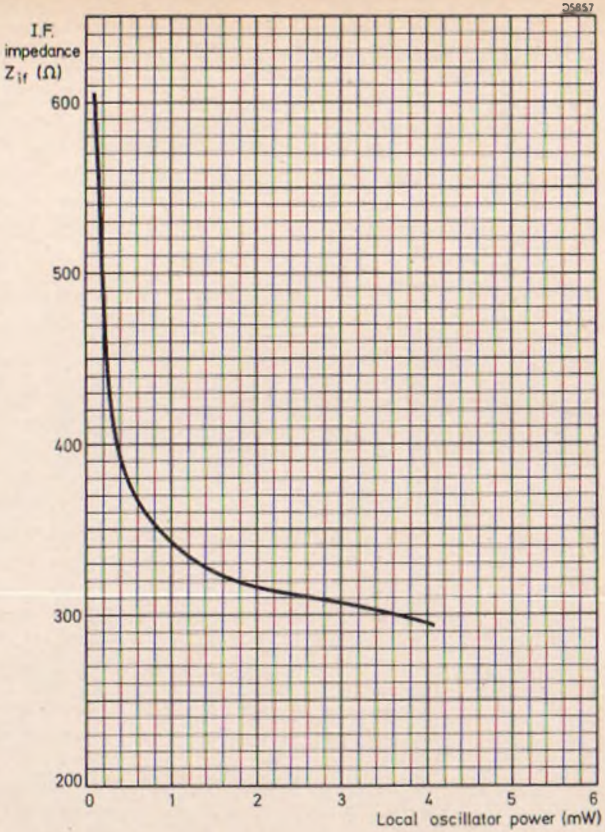
1. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω. N_o includes N_{if} = 1.5dB with 45MHz intermediate frequency. BS9321/1406.
2. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω. BS9321/1409.
3. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω, intermediate frequency 45MHz, BS9321/1405.
4. Maximum out of balance condition for a matched pair:
   a) 0.1mA rectified current.
   b) R.F. admittance 1.15:1 with other diode normalized to 50Ω.
5. The diode may be mounted on microstrip, using conventional thermocompression or micro-gap bonding techniques. Alternatively, the application of a single loaded epoxy, such as Epotek H40, may be used, followed by polymerisation at 150°C for 15 minutes. The force applied to the L.I.D. must not exceed 147mN (15gf).
6. Devices may be specially selected with the r.f. impedance measured at a customer's specific frequency in the range 8.4 to 12GHz.



TYPICAL D.C. CHARACTERISTIC



TYPICAL OVERALL NOISE FIGURE AS A FUNCTION OF LOCAL OSCILLATOR POWER



TYPICAL I.F. IMPEDANCE AS A FUNCTION
OF LOCAL OSCILLATOR POWER

TENTATIVE DATA

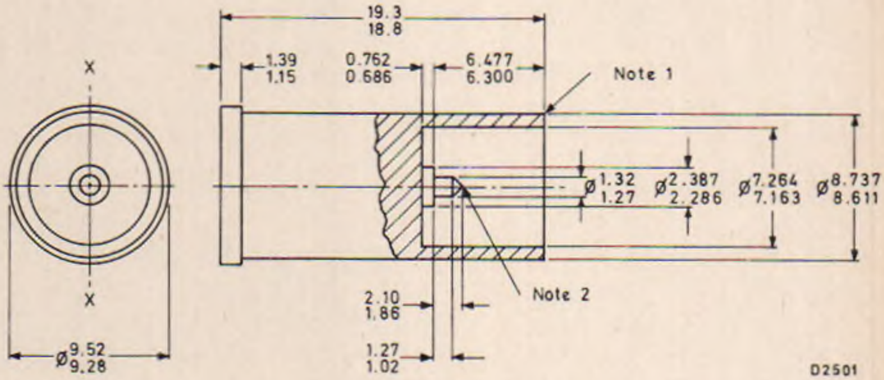
Coaxial Schottky barrier diodes for use in pre-tuned X-and S-band low noise mixer circuits. The diodes are suitable as replacements for most British coaxial point contact types in these bands, for example, GEM3, GEM4, CV7108, CV7109, CV2154 and CV2155. Available as matched pairs, 2/BAV22/MR.

QUICK REFERENCE DATA		
Typical noise figure at X-band	7.0	dB
at S-band	6.0	dB
Maximum operating frequency	12	GHz

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS

Conforming to B.S. 3934 SO-26



All dimensions in mm

Notes to outline drawing

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

Terminal identification

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

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

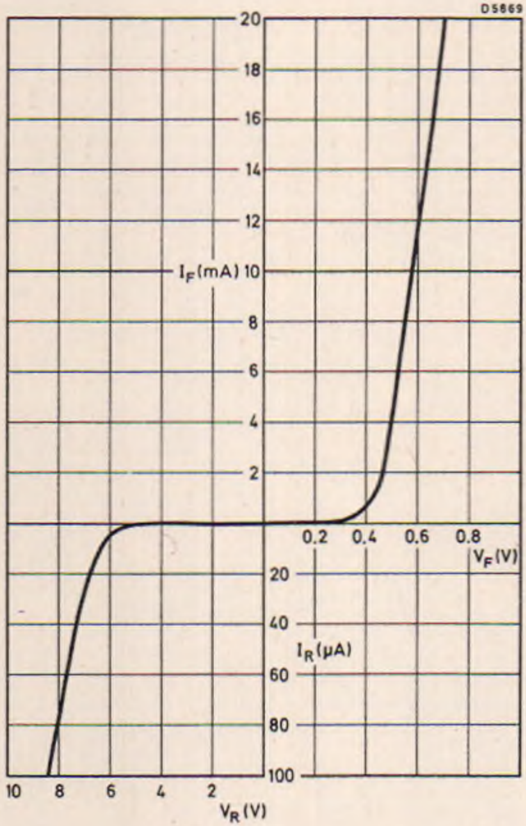
		Min.	Typ.	Max.	
N_o	Noise figure (see note 1)	-	7.0	7.5	dB
N_o	Noise figure (at 3GHz)	-	6.0	-	dB
v.s.w.r.	Voltage standing wave ratio (see note 2)	-	-	1.43:1	
v.s.w.r.	Voltage standing wave ratio (at 3GHz)	-	1.2:1	-	
Z_{if}	Intermediate frequency impedance (see note 3)	300	-	550	Ω

NOTES

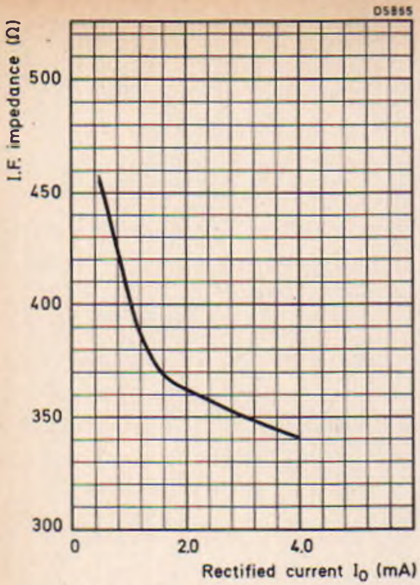
1. Measured at 9.375GHz, 1mA rectified current, R_L = 15Ω. N_o includes N_{if} = 1.5dB with 45MHz intermediate frequency. BS9321/1406.

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

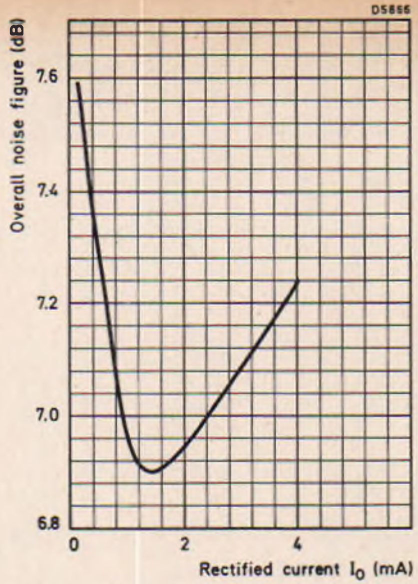
3. Measured at 9.375GHz, 1mA rectified current, R_L = 15Ω, i.f. = 45MHz. BS9321/1405.



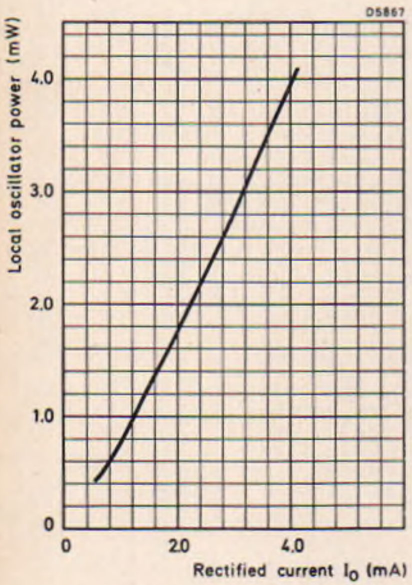
TYPICAL D.C. CHARACTERISTIC



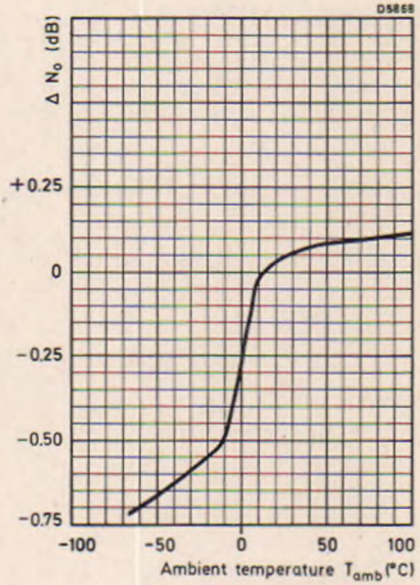
TYPICAL I.F. IMPEDANCE
AGAINST RECTIFIED CURRENT



TYPICAL OVERALL NOISE FIGURE
AGAINST RECTIFIED CURRENT



TYPICAL LOCAL OSCILLATOR POWER
AGAINST RECTIFIED CURRENT



TYPICAL CHANGE IN OVERALL NOISE
FIGURE AGAINST TEMPERATURE

MICROWAVE DETECTOR DIODE

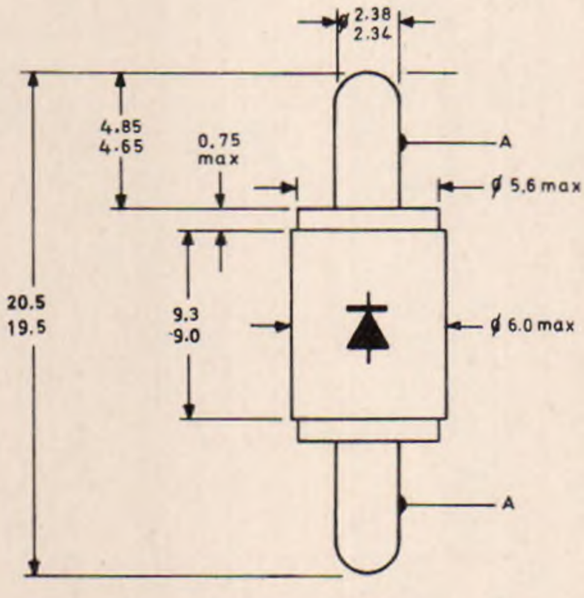
BAV46

Silicon Schottky barrier diode in DO-23 (1N23) outline specially designed for use in doppler radar systems and intruder alarms where low 1/f noise and high detector sensitivity is required.

QUICK REFERENCE DATA		
Sensitivity at X-band (typ.)	5.0	μA/μW
1/f noise at 1kHz (typ.)	10	dB

OUTLINE AND DIMENSIONS

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



D4867a

A = concentricity tolerance = ± 0.2
All dimensions in mm.

Terminal identification: Diode symbol indicates polarity

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

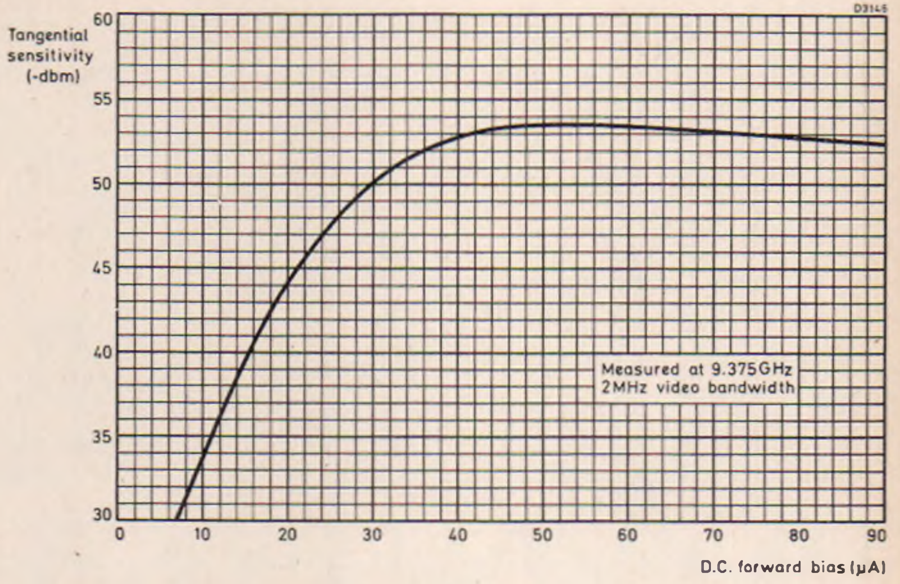
T_{stg} range	-20 to +150	^{o}C
T_{amb} range	-20 to +150	^{o}C

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

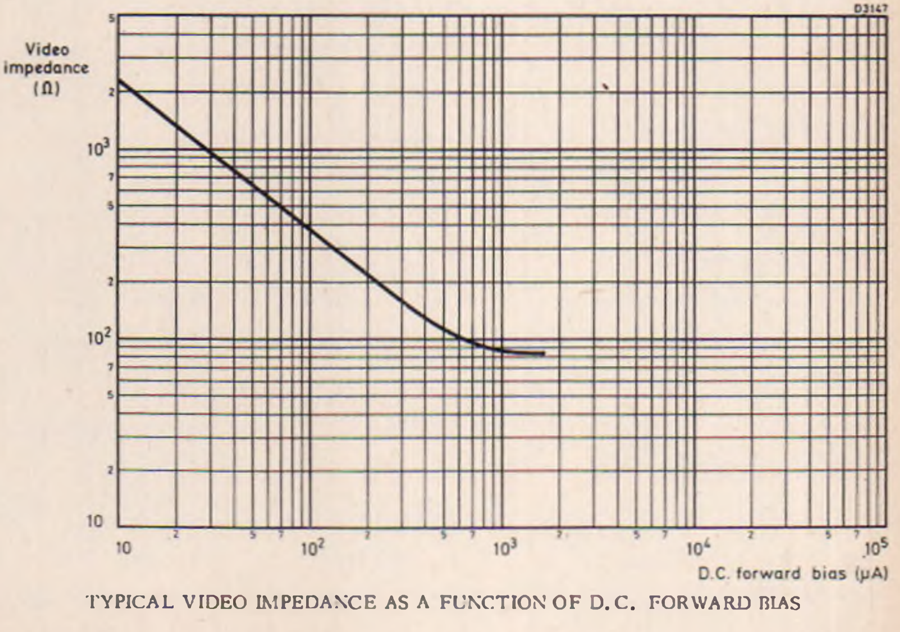
		Typ.	Max.	
	1/f Noise figure (see notes 1 and 2)	10	15	dB
S_i	Sensitivity (see notes 3 and 4)	5.0	-	μA
v.s.w.r.	Voltage standing wave ratio (see notes 3 and 5)	3:1	5:1	
Z_v	Video impedance (see note 2)	850		Ω
S_{ts}	Tangential sensitivity (see note 6)	-52		dbm
	(see note 7)	-54		dbm

NOTES

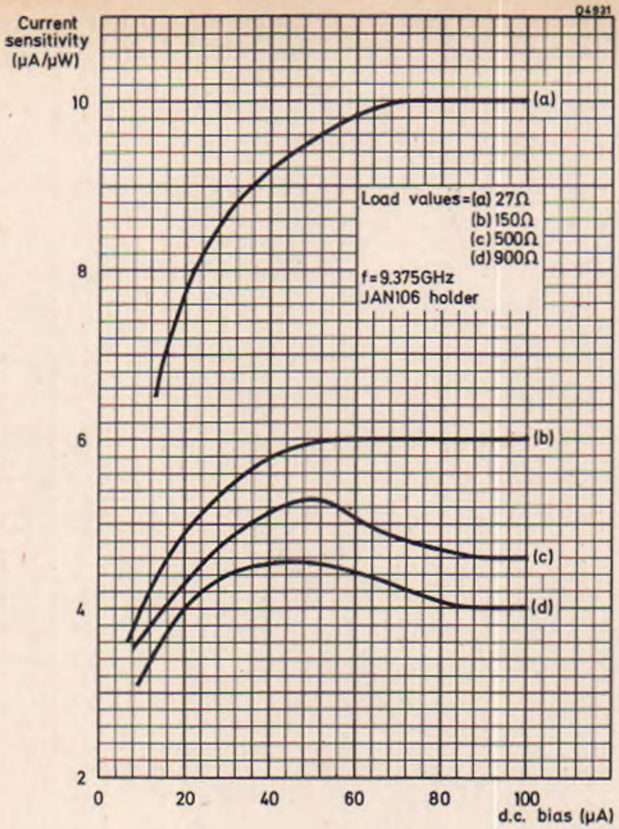
1. Measured at i.f. of 1kHz, bandwidth 50Hz.
2. Measured with forward bias of 30μA.
3. Measured with 30μA forward bias and 1μW local oscillator drive at 9.375GHz.
4. Measured in a JAN106 holder.
5. $R_L = 15\Omega$, JAN106 holder.
6. Measured with 0 to 2MHz bandwidth.
7. Measured with 1kHz to 1MHz bandwidth.



TYPICAL TANGENTIAL SENSITIVITY AS A FUNCTION OF D.C. FORWARD BIAS

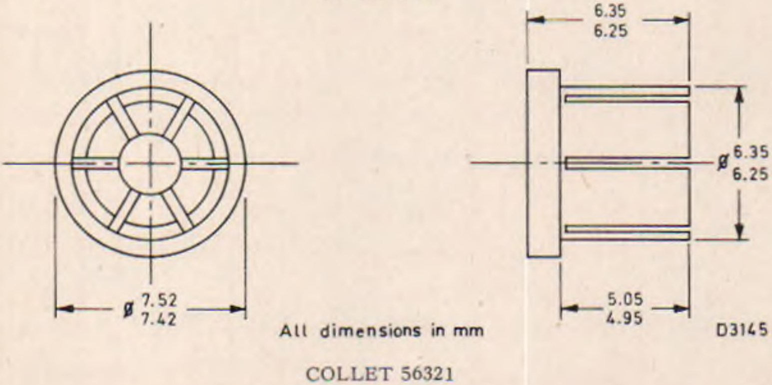


TYPICAL VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS



TYPICAL CURRENT SENSITIVITY AS A FUNCTION OF D.C. BIAS

ACCESSORY



All dimensions in mm

COLLET 56321

MICROWAVE MIXER DIODES

BAV71 BAV72

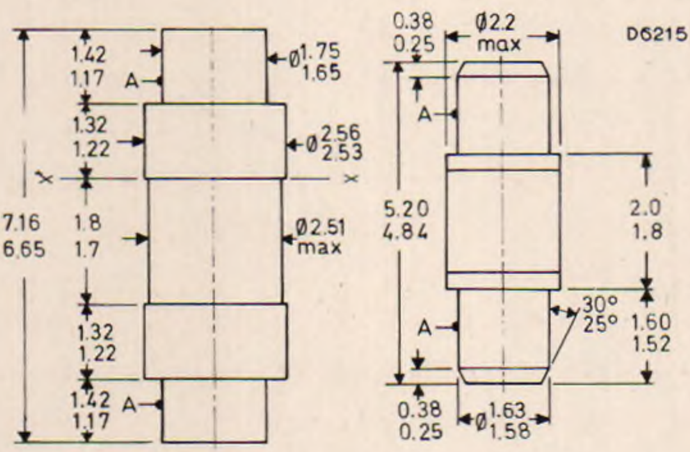
TENTATIVE DATA

Silicon Schottky barrier diodes for use in low noise mixer applications in Q-band.

QUICK REFERENCE DATA		
Frequency range	26 to 40	GHz
Noise figure (max.)	10	dB

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



XX = reference plane

all dimensions in mm

AA = concentricity tolerance = ±0.15

Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Max. burn-out (r.f. spike) (note 1)	0.04	erg
Max. burn-out pulse peak power	1.0	W

Temperature

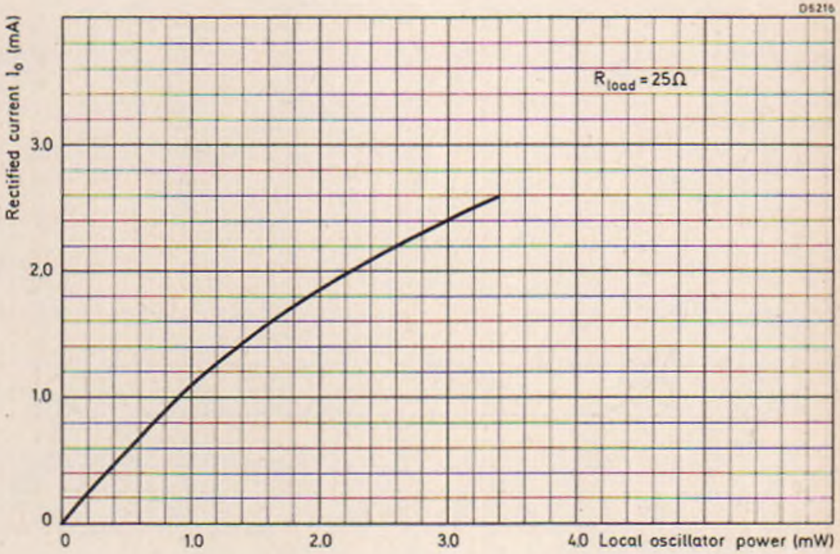
T_{stg} range	-55 to +150	^{o}C
T_{amb} range	-55 to +150	^{o}C

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

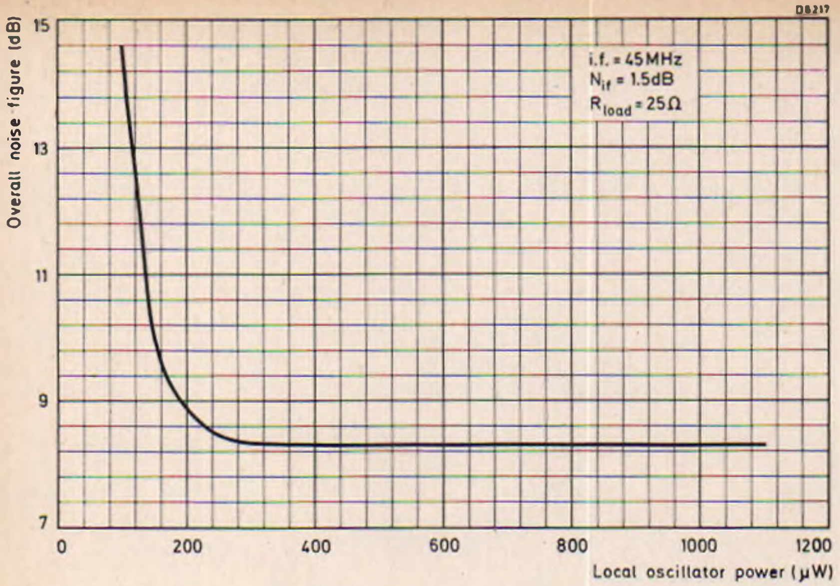
Static		Min.	Typ.	Max.	
I_R	reverse current (V_R = 0.5V)	-	-	0.2	μA
I_F	forward current (V_F = 0.5V)	0.5	-	-	mA
Dynamic					
N_o	noise figure (note 2)	-	-	10	dB
v.s.w.r.	voltage standing wave ratio (note 3)			1.8:1	
Z_{if}	intermediate frequency impedance (note 4)				
	BAV71	900	-	1200	Ω
	BAV72	850	-	1300	Ω
f	frequency range	26	-	40	GHz
L_c	conversion loss (note 5)	-	5.9	-	dB
N_r	noise temperature ratio (note 6)	-	1.4	-	

NOTES

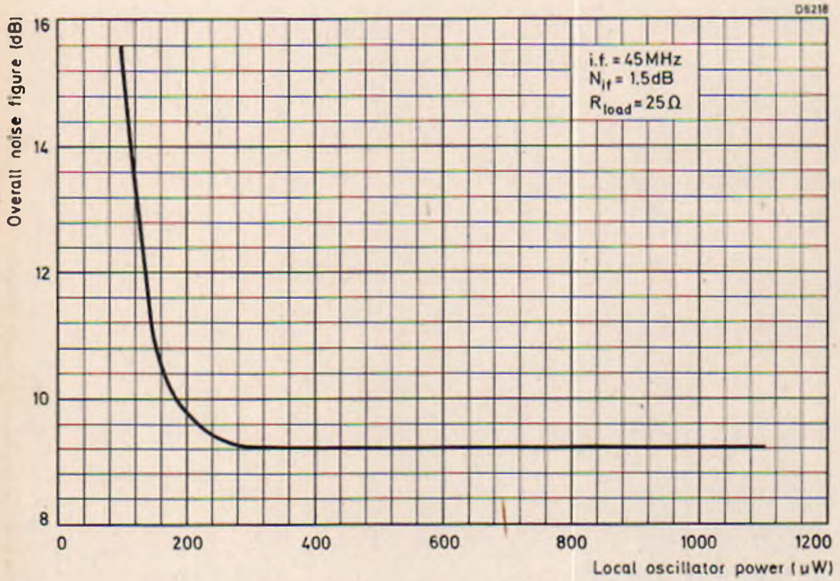
1. Local oscillator frequency = 9.375GHz, number of pulses = 6×10^5, pulse duration = 2ns at half peak energy, p.r.f. = 2000 p.p.s., load resistance = 0Ω. $T_{amb} = 25^oC$.
2. Measured with a local oscillator frequency of 34.86GHz, I_o = 0.5mA, load resistance = 15Ω, i.f. = 45MHz, BS 9300 No. 1406.
3. Measured with a local oscillator frequency of 34.86GHz, I_o = 0.5mA, load resistance = 15Ω, BS 9300 No. 1409.
4. Measured with a local oscillator frequency of 34.86GHz, I_o = 0.5mA, load resistance = 15Ω, i.f. = 45MHz, BS 9300 No. 1405.
5. Measured at 34.86GHz, 450μW local oscillator power level and load resistance = 1kΩ.
6. Measured at 34.86GHz and i.f = 45MHz.
7. The diodes are measured in fixed tuned Q-band waveguide mounts. Details may be obtained from Mullard Ltd.



TYPICAL RECTIFIED CURRENT AS A FUNCTION OF LOCAL OSCILLATOR POWER AT 34.86GHz



TYPICAL OVERALL NOISE FIGURE AS A FUNCTION OF LOCAL OSCILLATOR POWER (BAV71) AT 34.86GHz



TYPICAL OVERALL NOISE FIGURE AS A FUNCTION OF LOCAL OSCILLATOR POWER (BAV72) AT 34.86GHz.

MICROWAVE DETECTOR DIODE

BAV75

TENTATIVE DATA

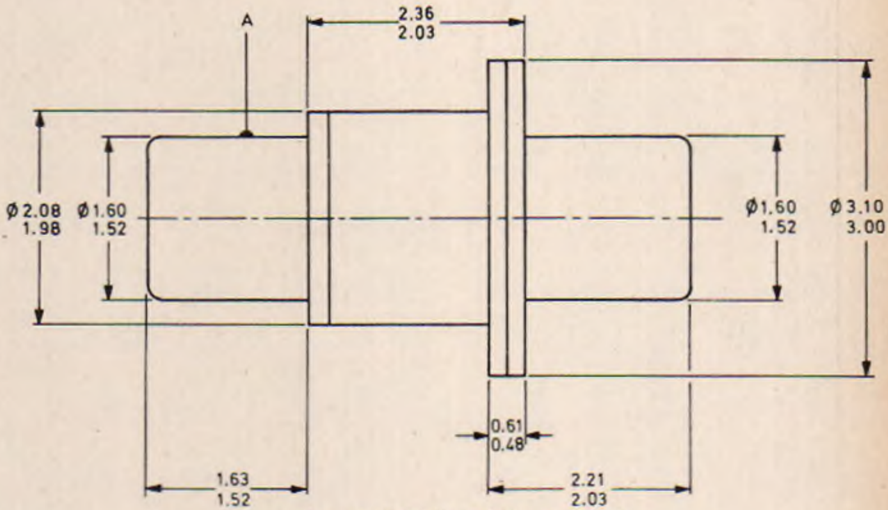
Silicon Schottky barrier diode in SO-86 outline, specially designed for use in doppler radars where high detector sensitivity is required.

QUICK REFERENCE DATA

Frequency range	8.0 to 12	GHz
Tangential sensitivity (typ.) with 100μA bias	-50	dbm

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ±0 13
All dimensions in mm

D5476

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

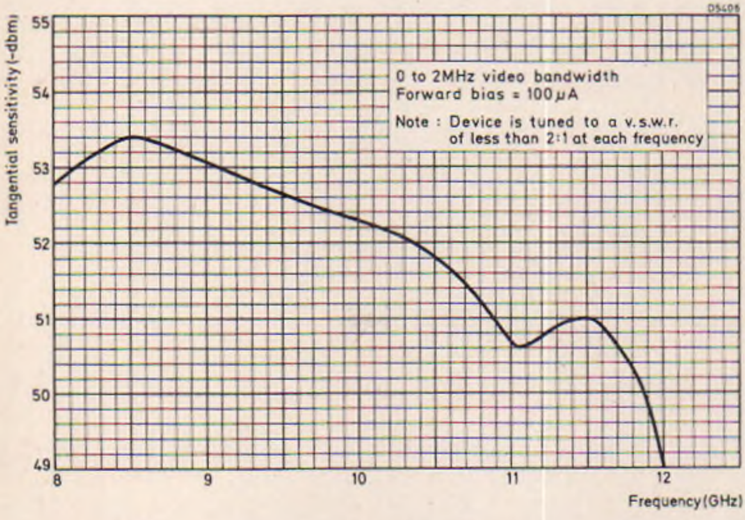
Peak pulse power (max.) at 9.375 GHz 0.5 μs pulse length	0.75	W
Temperature		
T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

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

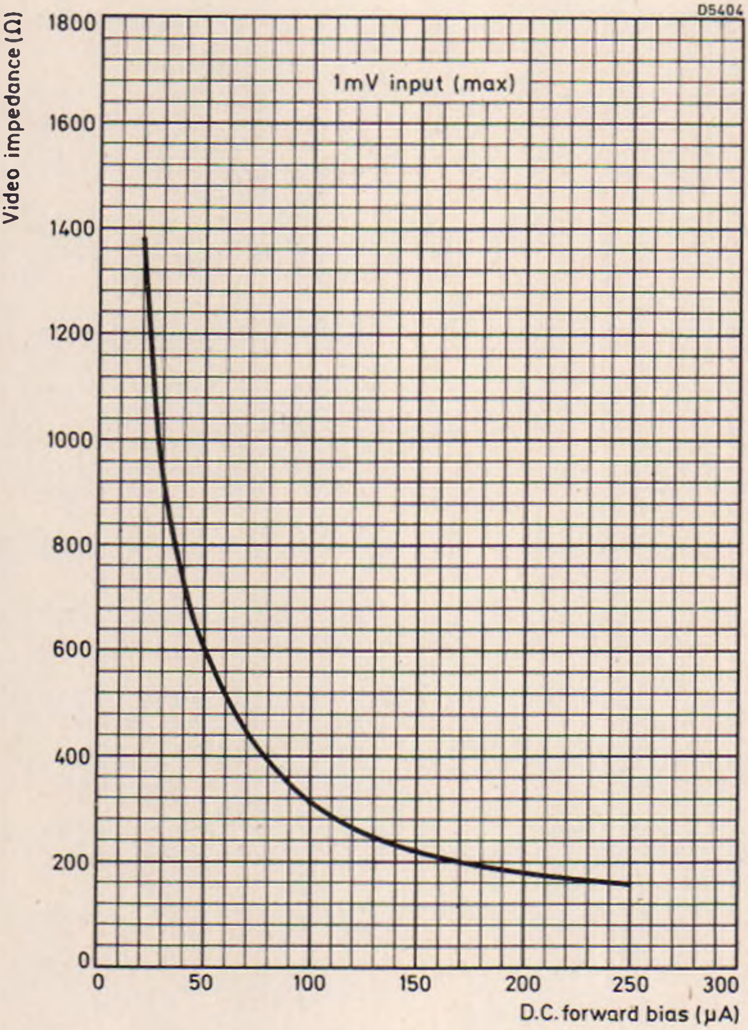
		min.	typ.	max.	
v.s.w.r.	Voltage standing wave ratio (see notes 1, 2, and 3)		2:1		
Z_v	Video impedance (see notes 4 and 5)		310		Ω
S_{ts}	Tangential sensitivity (see notes 1 and 2)	-49	-50		dbm
1/f	Flicker noise (see notes 4 and 6)		10	15	dB

NOTES

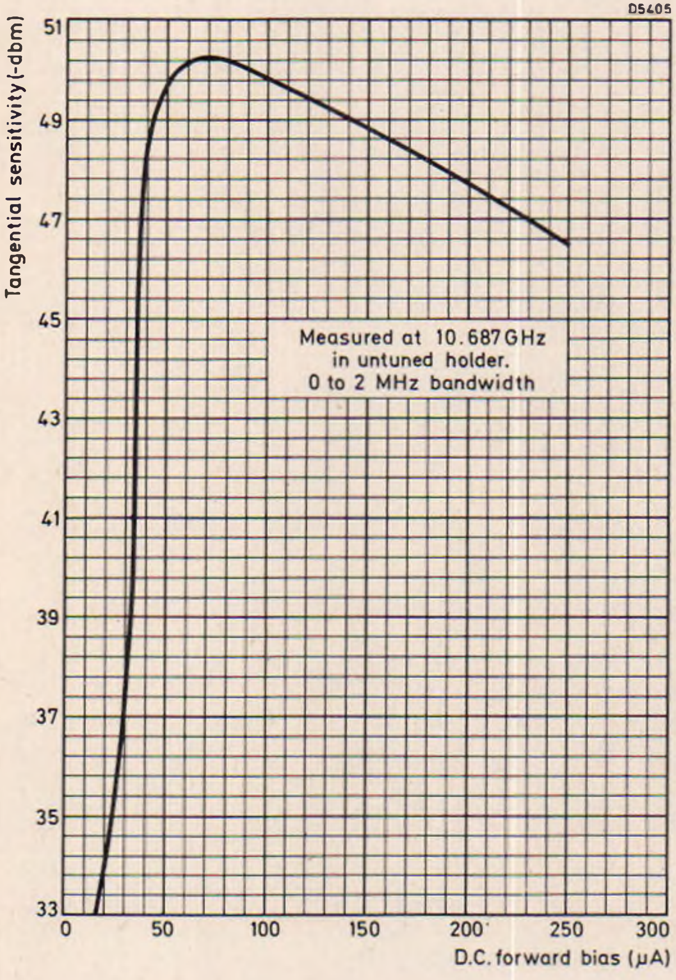
1. Measured at 10.687 GHz with 100μA forward bias.
2. Measured in a reduced height waveguide mount, (Sanders 6521, modified).
3. R.F. input power less than 5.0 μW.
4. Measured with 100 μA forward bias.
5. Maximum d.c. input voltage = 1.0mV.
6. a) Measured at an i.f. of 1kHz with 50Hz bandwidth.
   b) 1/f noise remains constant with a forward bias not exceeding 250 μA.



TANGENTIAL SENSITIVITY AS A FUNCTION OF FREQUENCY



VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS



TANGENTIAL SENSITIVITY AS A FUNCTION OF D.C. FORWARD BIAS

MICROWAVE MIXER DIODES

BAV96A
BAV96B
BAV96C
BAV96D

TENTATIVE DATA

A range of sub-miniature reversible low noise Schottky barrier mixer diodes. The planar technology employed imparts a high degree of reliability and reproducability. The metal-ceramic case is hermetically sealed.

QUICK REFERENCE DATA

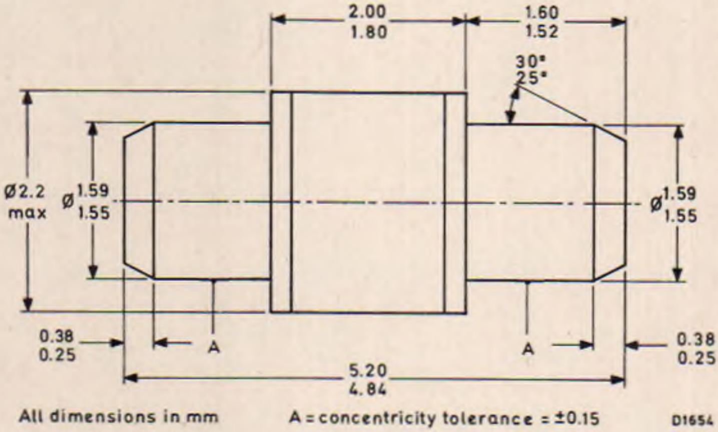
Maximum noise figure in X-band

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

Unless otherwise stated, data is applicable to all types
(Development nos. 195BAY/A, B, C and D)

OUTLINE AND DIMENSIONS

M.Q.M.



Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (Contd.)

Temperature

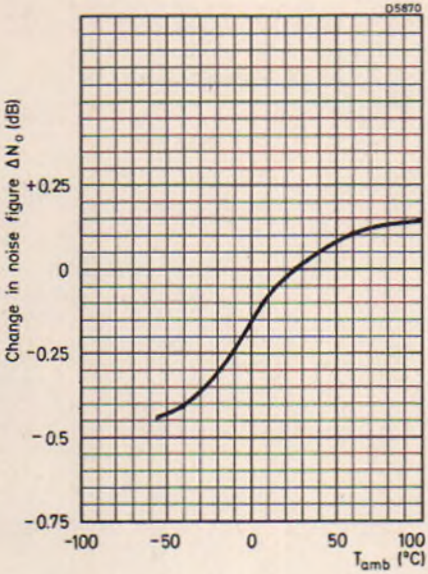
T_{stg} range	-55 to +150	^{o}C
T_{amb} range	-55 to +150	^{o}C

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

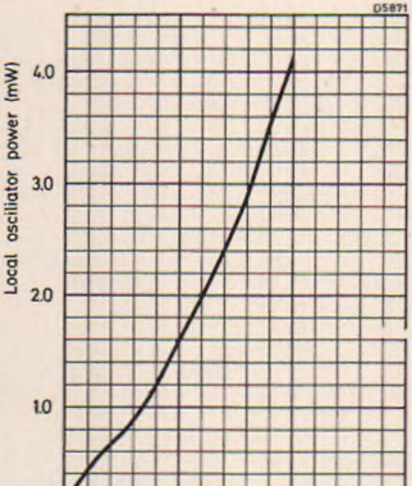
		Min.	Typ.	Max.	
N_o noise figure (see note 2)					
	BAV96A	-	7.0	7.5	dB
	BAV96B	-	6.5	7.0	dB
	BAV96C	-	6.0	6.5	dB
	BAV96D	-	5.5	6.0	dB
v.s.w.r. (see note 3)		-	1.33:1	1.43:1	
Z_{if}	i.f. impedance (see note 4)	250	-	450	Ω
S_{ts}	tangential sensitivity (see note 5)	-	-52	-	dbm
S_{ts} (see note 6)		-	-54	-	dbm

NOTES

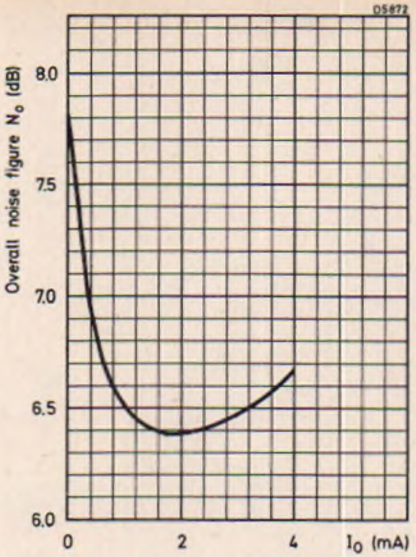
1. Burn out is defined as the r.f. pulse energy necessary to cause 1dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2ns width.
2. Measured at 9.375 ± 0.1GHz. The noise figure includes i.f. amplifier contribution of 1.5dB, i.f. 45MHz, d.c. return for diode 15Ω max., rectified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



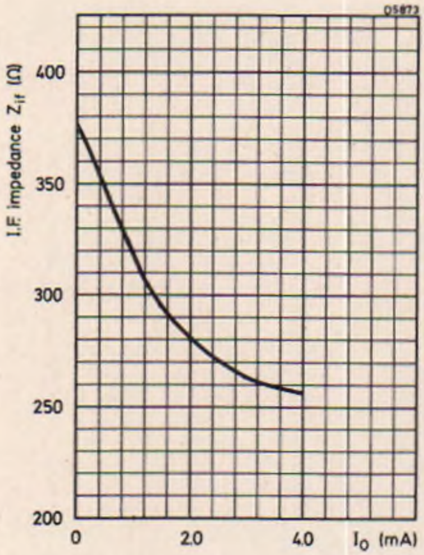
TYPICAL CHANGE IN OVERALL NOISE FIGURE
AS A FUNCTION OF TEMPERATURE



TYPICAL LOCAL OSCILLATOR POWER
AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL OVERALL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL I. F. IMPEDANCE AS A FUNCTION OF RECTIFIED CURRENT

MICROWAVE
DETECTOR DIODE

BAV97

TENTATIVE DATA

A reversible silicon Schottky barrier diode with excellent sensitivity and very low $\frac{1}{f}$ noise.

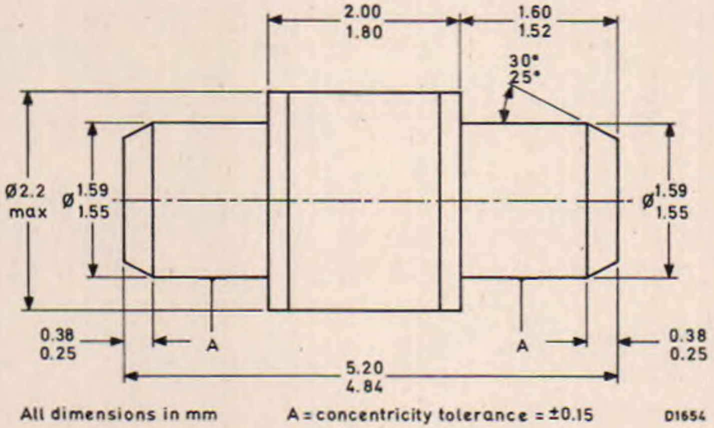
The metal-ceramic case is hermetically sealed.

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS

M.Q.M.



Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

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

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

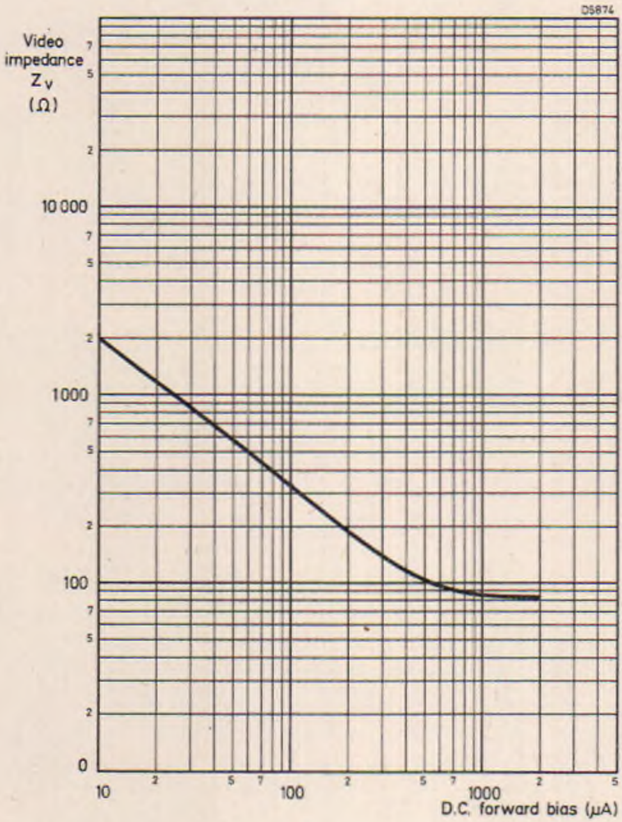
NOTES

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

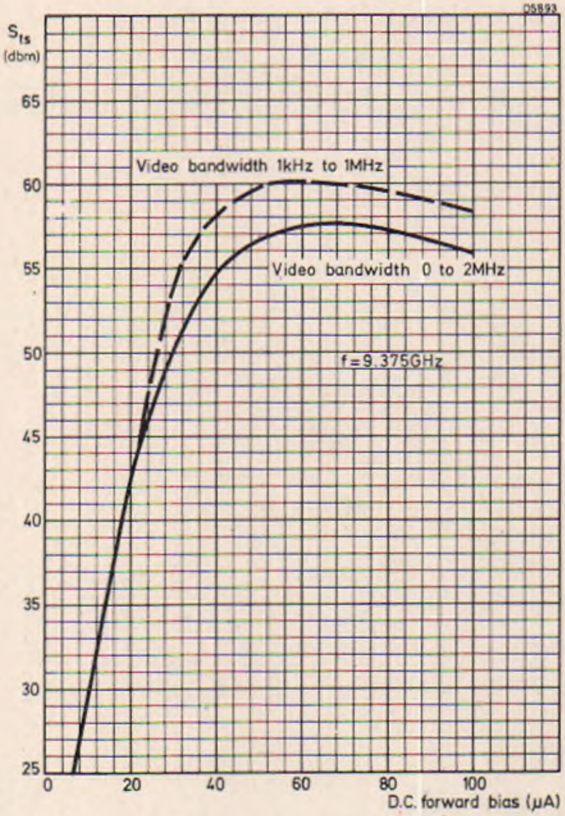
2. Video bandwidth 0 to 2MHz, 50μA bias, f = 9.375GHz. BS9322/1411. (A 2dbm improvement in tangential sensitivity may be obtained by limiting the bandwidth to 1kHz to 1MHz).

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

4. Measured at 50μA forward bias.



VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS



TANGENTIAL SENSITIVITY AS A FUNCTION OF D.C. FORWARD BIAS

MICROWAVE MIXER DIODES

BAW95D
BAW95E
BAW95F
BAW95G

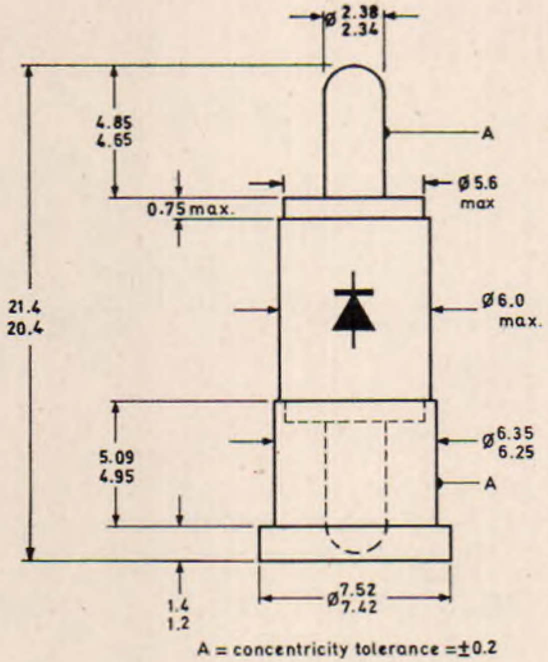
A range of silicon Schottky barrier mixer diodes in reversible cartridge outline. The diodes are suitable as replacements for the 1N23 and 1N415 series.

QUICK REFERENCE DATA		
Maximum noise figure at X-band		
BAW95D	8.2	dB
BAW95E	7.5	dB
BAW95F	7.0	dB
BAW95G	6.5	dB

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

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



All dimensions in mm. D4868

Terminal identification: Diode symbol indicates polarity.

LIMITING VALUES (Absolute max. rating system)

Electrical

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

Temperature

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

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

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

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

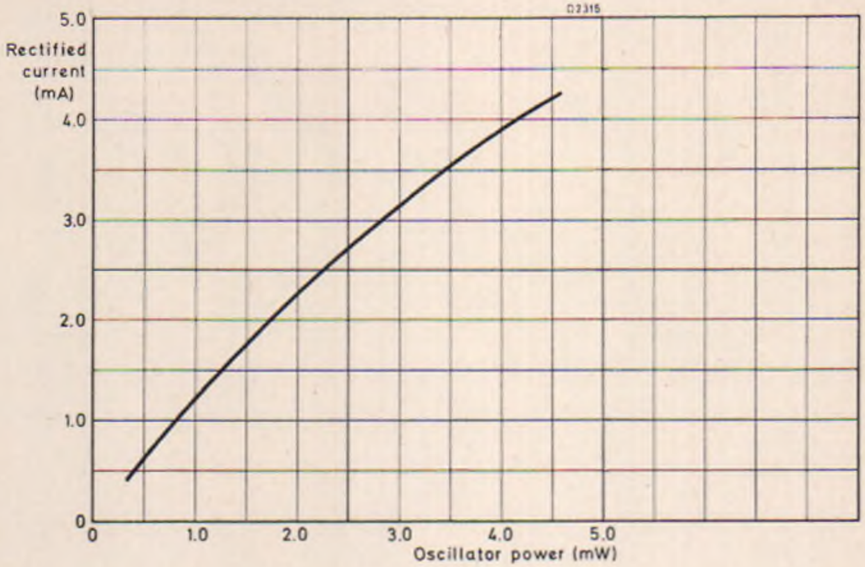
[2] Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. N_o includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9321/1406

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

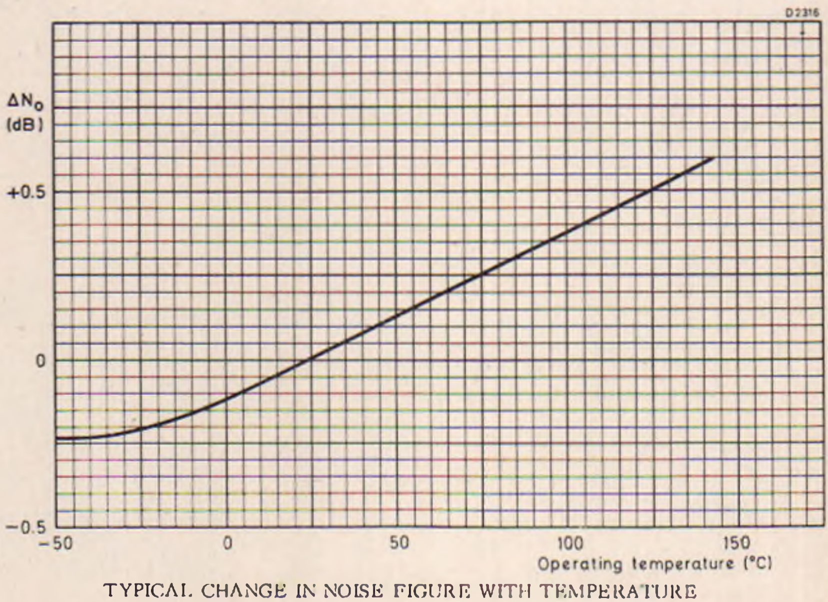
[4] Measured at 9.375 GHz. 1 mA rectified current, R_L = 15 Ω with 45 MHz intermediate frequency. BS9321/1405

MICROWAVE
MIXER DIODES

BAW95D
BAW95E
BAW95F
BAW95G

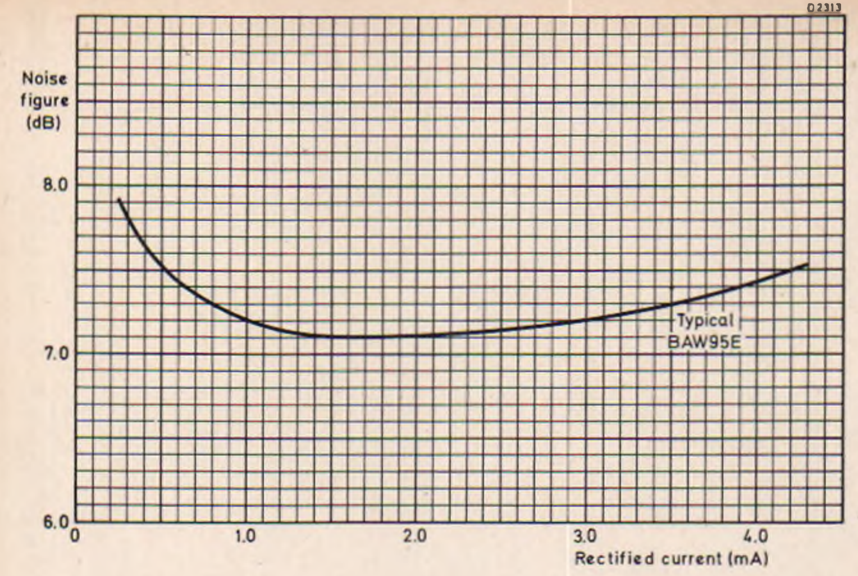


TYPICAL RECTIFIED CURRENT AS A FUNCTION OF LOCAL OSCILLATOR POWER

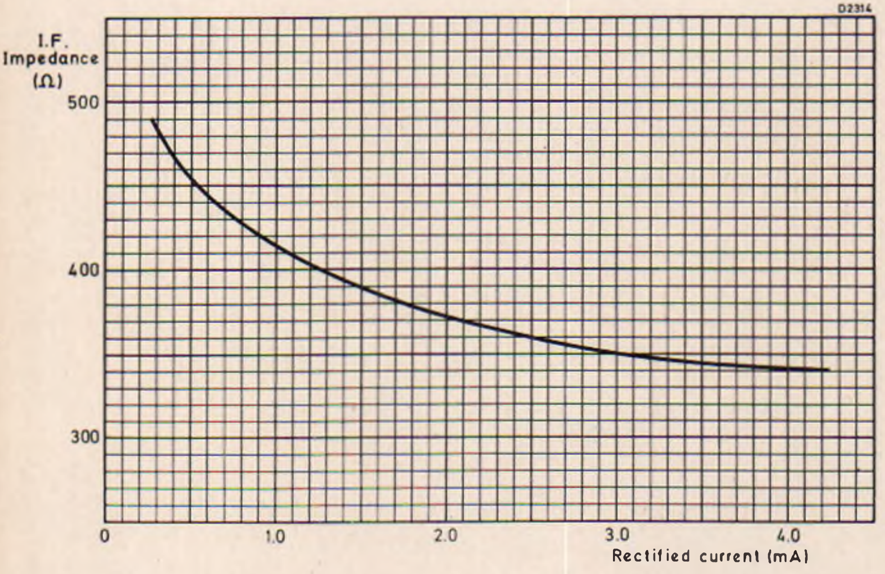


TYPICAL CHANGE IN NOISE FIGURE WITH TEMPERATURE

Mullard



TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL DEPENDENCE OF I. F. IMPEDANCE ON RECTIFIED CURRENT

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BAY96

TENTATIVE DATA

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 450Mc/s it has a typical efficiency of 64% and can handle inputs up to 40W. The BAY96 has a very low series resistance and is packaged in a low inductance, hermetically sealed, welded ceramic-metal envelope. DO-4 with stud cathode.

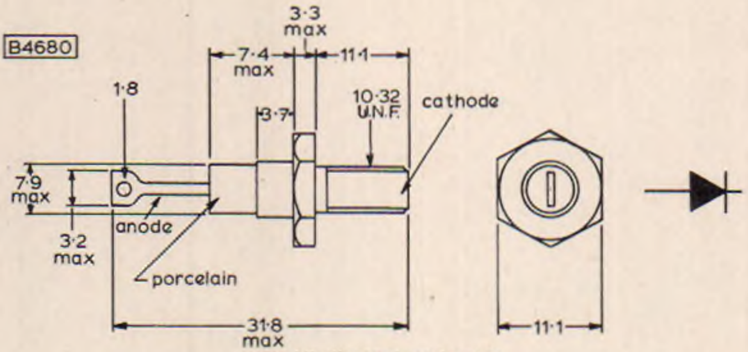
QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS

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

V.A.S.C.A. SO-10



All dimensions in mm

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

Θ_{j-mb}	7.5	deg C/W

ELECTRICAL CHARACTERISTICS

		Min.	Typ.	Max.	
c_d	Total capacitance				
	V_R = 6.0V, f = 1.0Mc/s	28	-	39	pF
R_s	Series resistance				
	V_R = 6.0V, f = 400Mc/s	-	0.9	1.2	Ω
f_{co}	Cut-off frequency				
	V_R = 120V				
	$\dfrac{1}{2\pi R_s \cdot c_d}$	-	25	-	Gc/s

APPLICATION INFORMATION

TYPICAL OPERATING CHARACTERISTICS AS A FREQUENCY TRIPLER

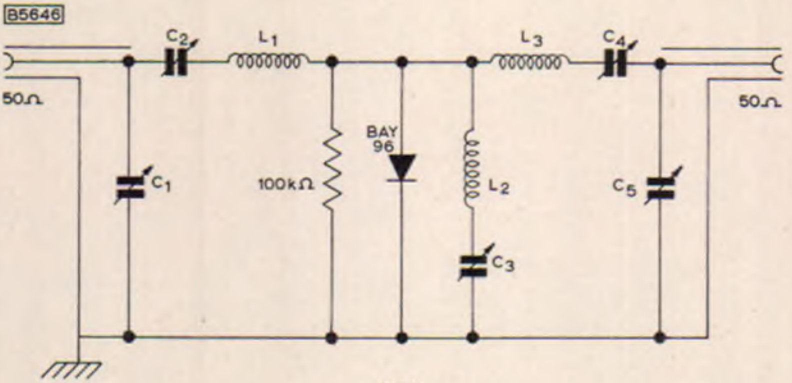


Fig.1

Frequency tripler circuit - 150 to 450Mc/s

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

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

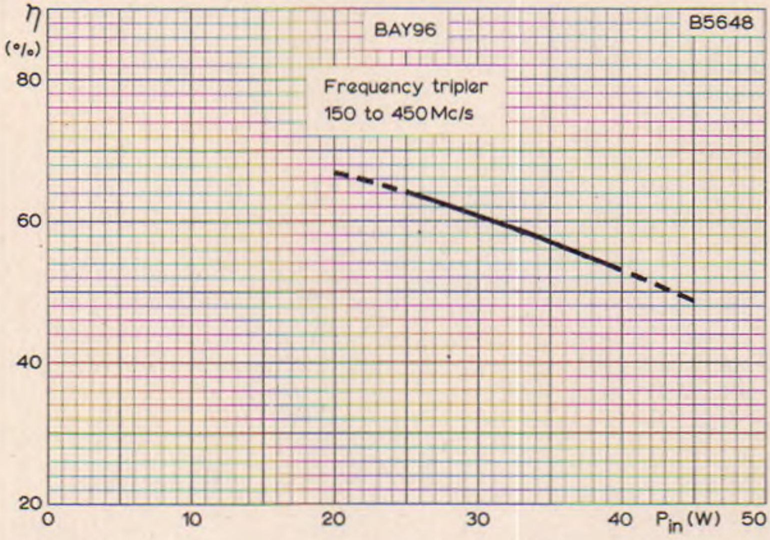
L_3 = 1" × 0.25" × 0.020" copper strip 0.562" from chassis

C_1 = 7.0 - 100pF variable

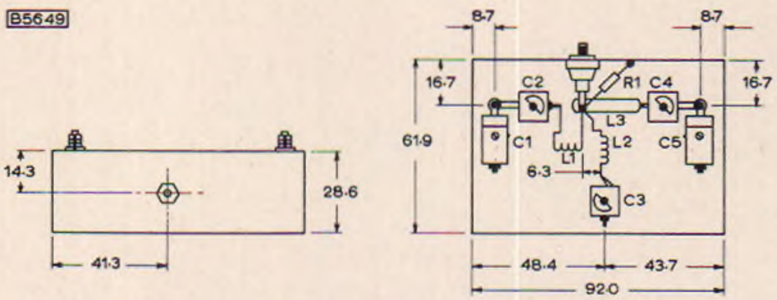
C_2, C_3, C_4 = 2.0 - 13pF variable

C_5 = 2.0 - 25pF variable

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

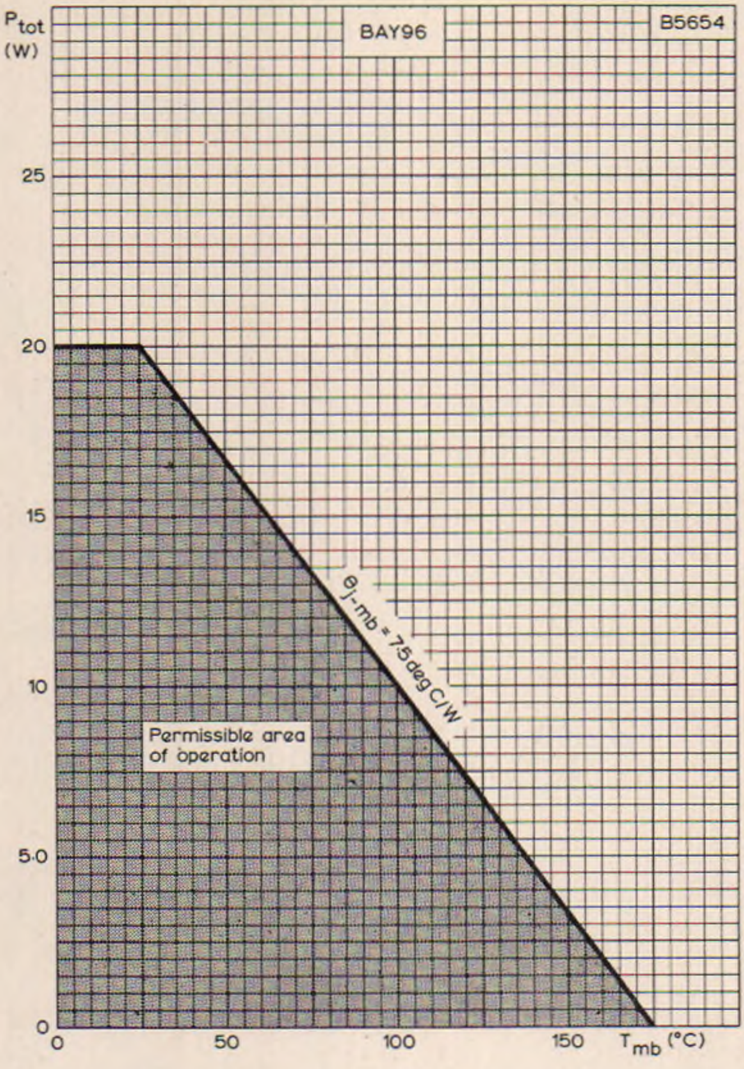


TYPICAL TRIPLER EFFICIENCY PLOTTED AGAINST INPUT POWER
See circuit on page 3

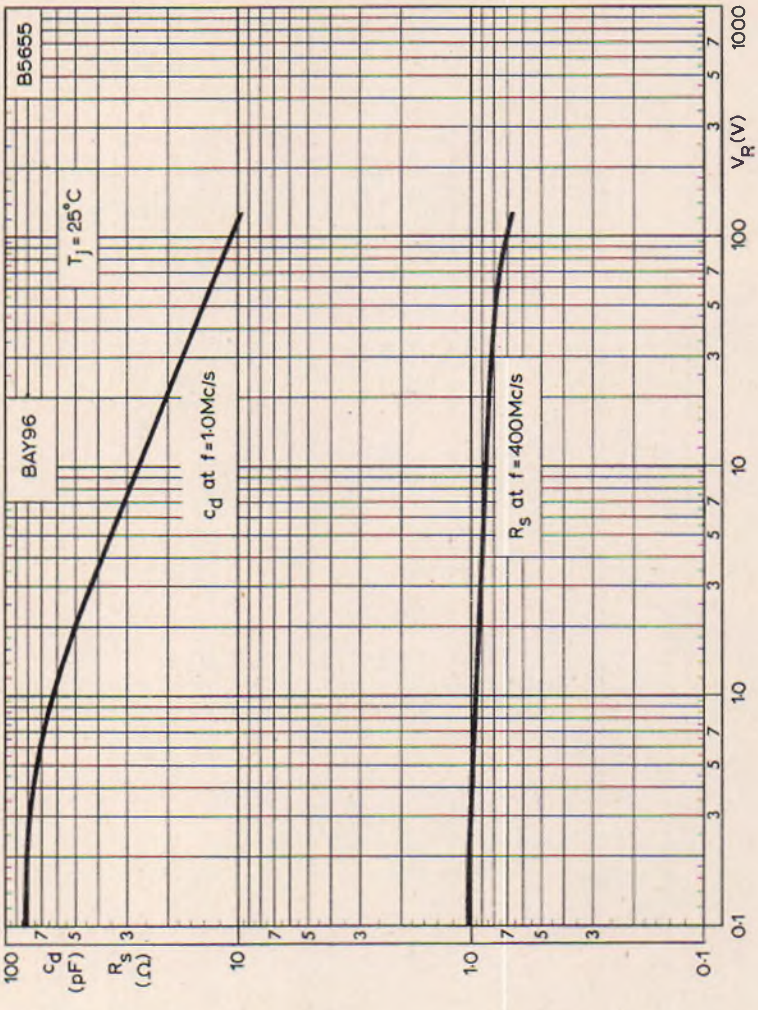


All dimensions in mm.

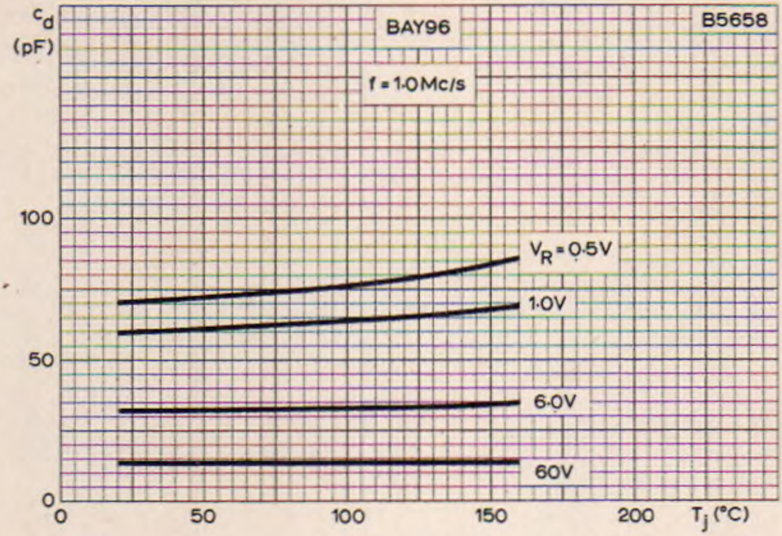
COMPONENT LAYOUT OF TRIPLER CIRCUIT

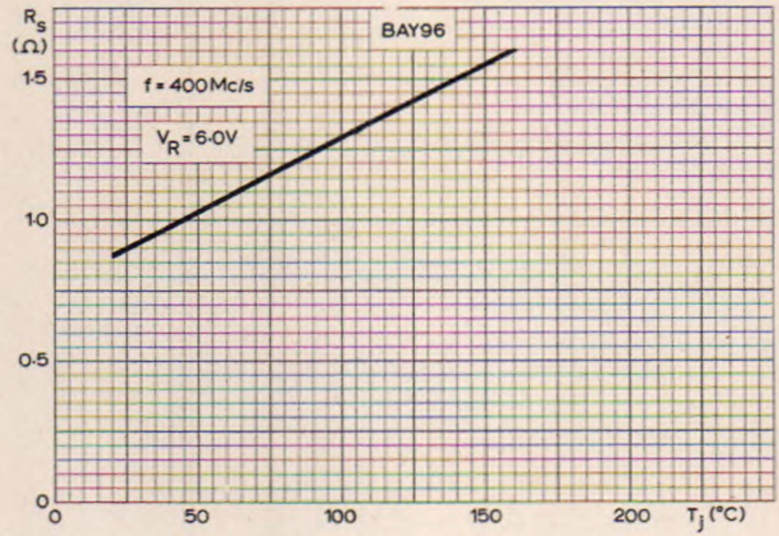


TOTAL DISSIPATION PLOTTED AGAINST MOUNTING BASE TEMPERATURE



TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED AGAINST REVERSE VOLTAGE





TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED AGAINST JUNCTION TEMPERATURE

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY27

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to 'S' band output frequency.

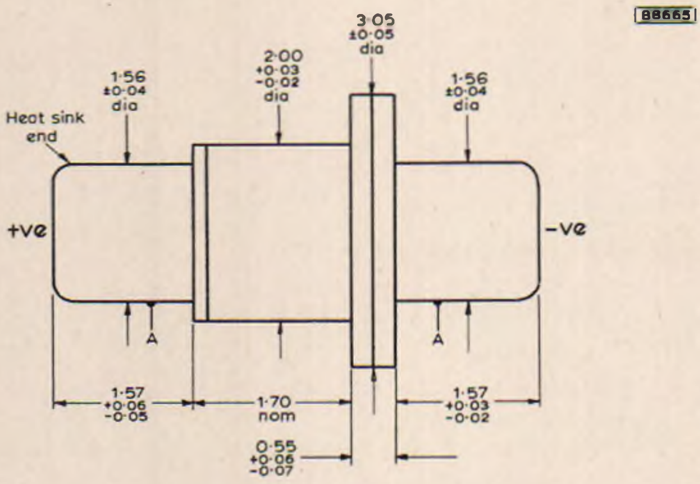
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal.

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

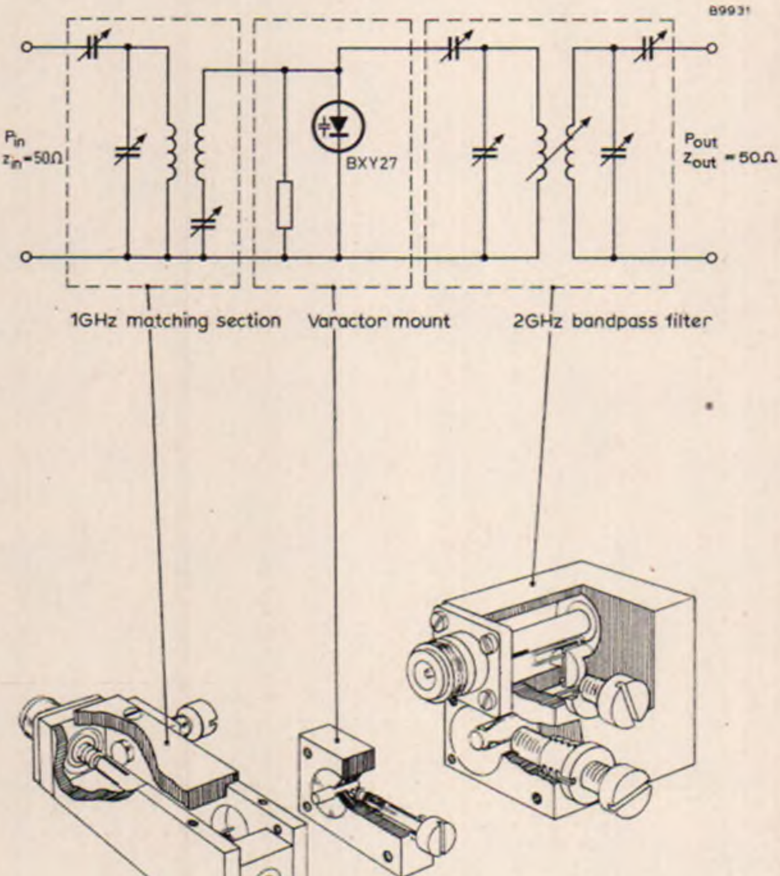
T_{stg} min.	-55	^oC
T_{stg} max.	150	^oC
T_j max.	150	^oC

THERMAL CHARACTERISTIC

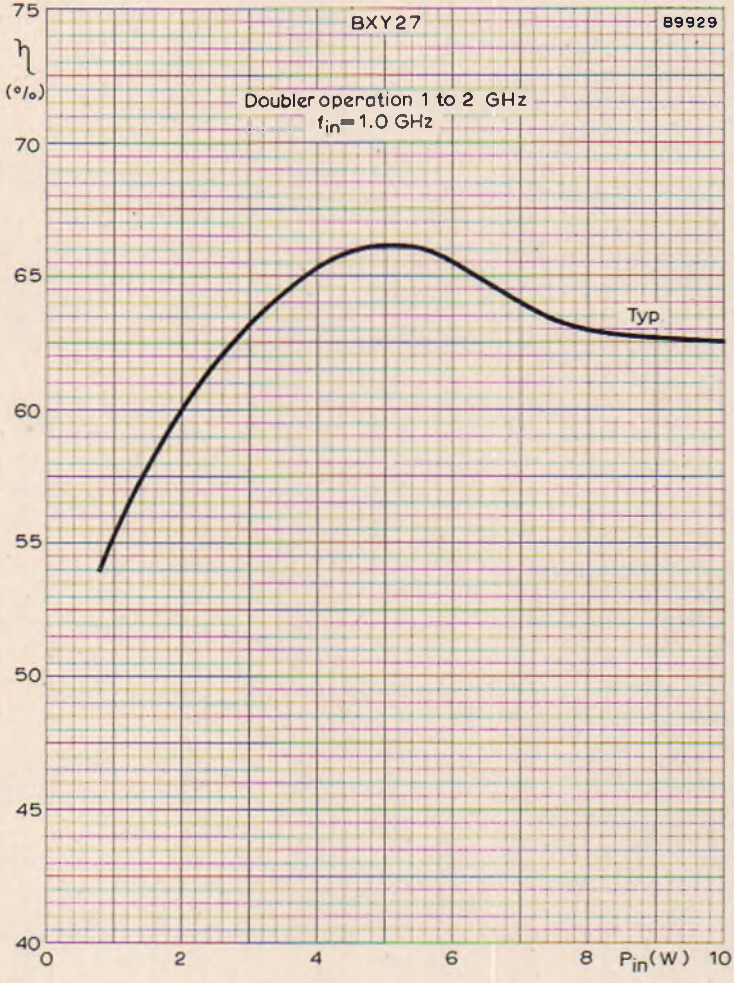
$R_{th(j-pin)}$ max.	20	degC/W

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

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



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (1 to 2GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

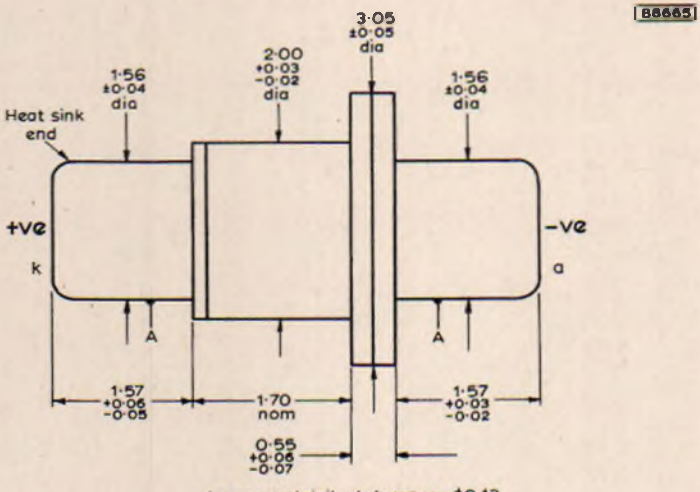
BXY28

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics especially suitable for use in frequency multiplier circuits up to C-band output frequency.

It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal.

QUICK REFERENCE DATA		
Operation as a frequency doubler 2 to 4GHz in a typical circuit.		
P_{in}	7.0	W
P_{out}	3.5	W
Resistive cut-off frequency typ. (V_R = 6.0V)	120	GHz
Total capacitance typ. (V_R = 6.0V)	1.5	pF
T_j max.	150	$^{\circ}$C

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

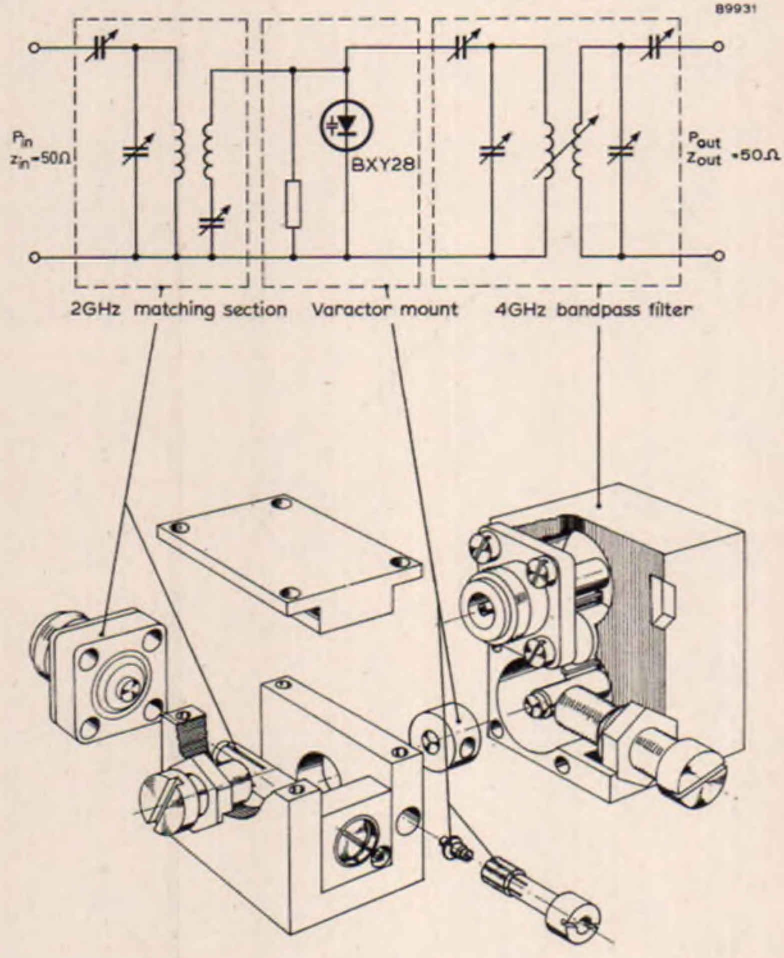
T_{stg} min.	-55	^{o}C
T_{stg} max.	150	^{o}C
T_j max.	150	^{o}C

THERMAL CHARACTERISTIC

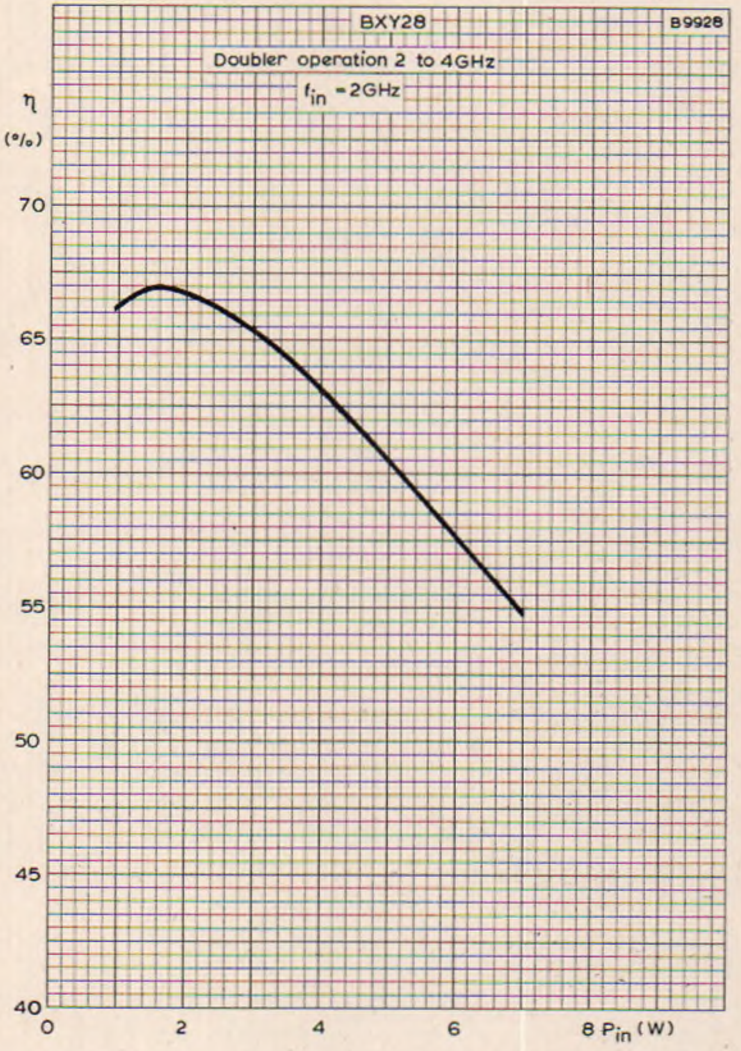
$R_{th(j-pin)}$ max.	30	degC/W

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

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



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (2 to 4GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY29

TENTATIVE DATA

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency.

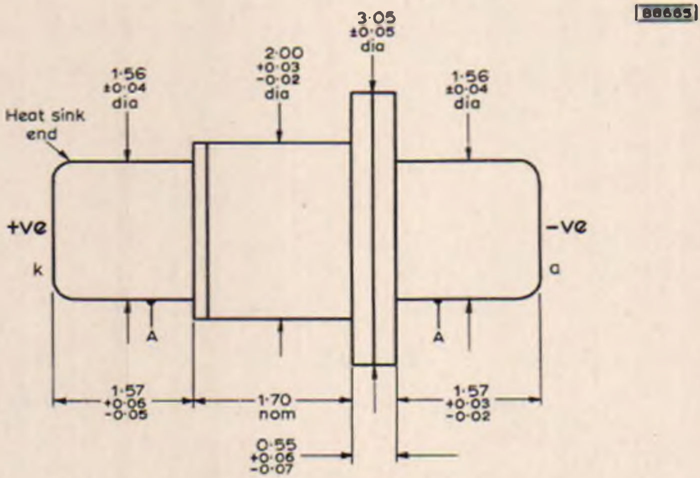
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal.

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	25	V
P_{tot} max. R.F. ($T_{pin} \leq 70^oC$)	2.0	W

Temperature

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

THERMAL CHARACTERISTIC

$R_{th(j-pin)}$ max.	40	degC/W

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

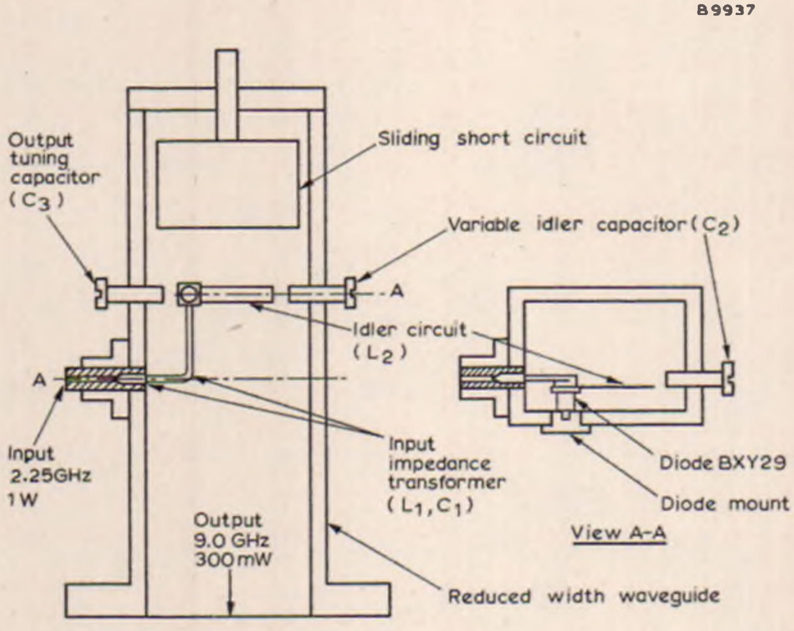
		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage ($I_R = 1.0$mA)	25	-	-	V
I_R	Reverse current ($V_R = 6.0$V)	-	0.001	1.0	μA
f_{co}	Cut-off frequency ($V_R = 6.0$V) (see note)	90	120	-	GHz
C_d	Total capacitance ($C_j + C_s$) ($V_R = 6.0$V, f = 1.0MHz)	0.8	1.0	1.5	pF
C_s	Stray capacitance	-	0.25	-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

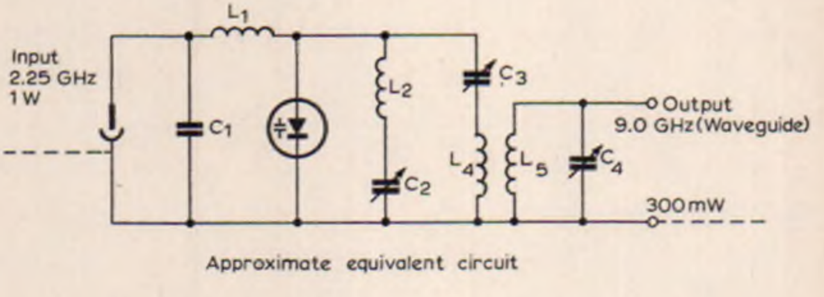
Note. The cut-off frequency f_{co} is defined as:

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

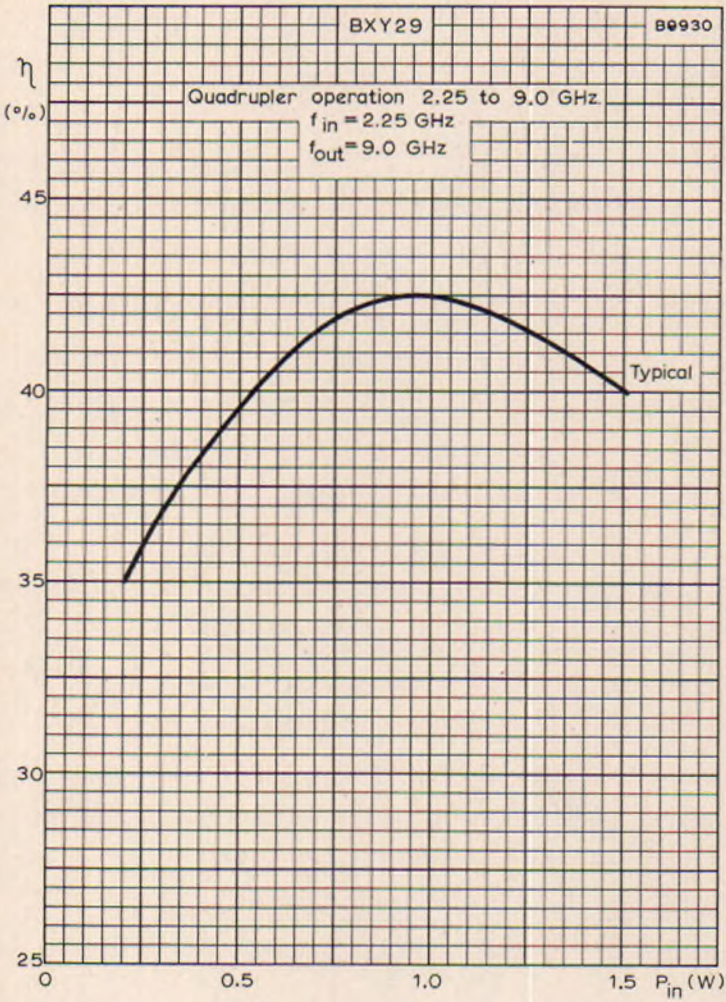
Where, C_j is the junction capacitance and is measured at 1.0MHz
r_s is measured on a slotted line at 2.0GHz.

S–X BAND QUADRUPLER





Approximate equivalent circuit



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR QUADRUPLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY32

TENTATIVE DATA

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency.

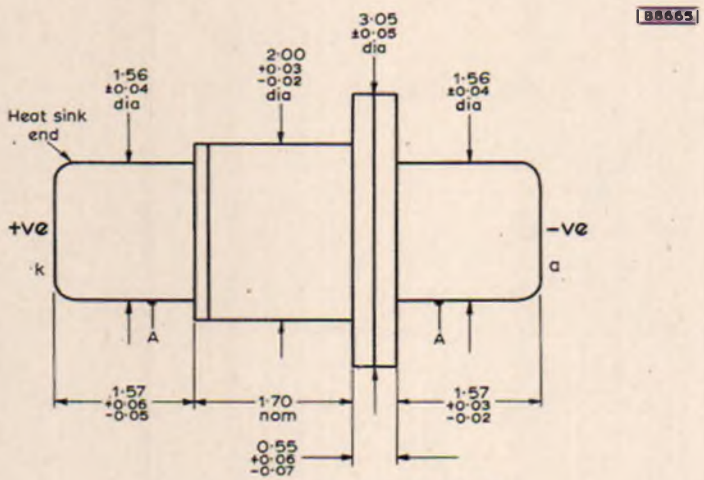
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal.

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	20	V
P_{tot} max. R.F. ($T_{pin} \leq 70^oC$)	1.6	W

Temperature

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

THERMAL CHARACTERISTIC

$R_{th(j-pin)}$ max.	50	degC/W

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

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

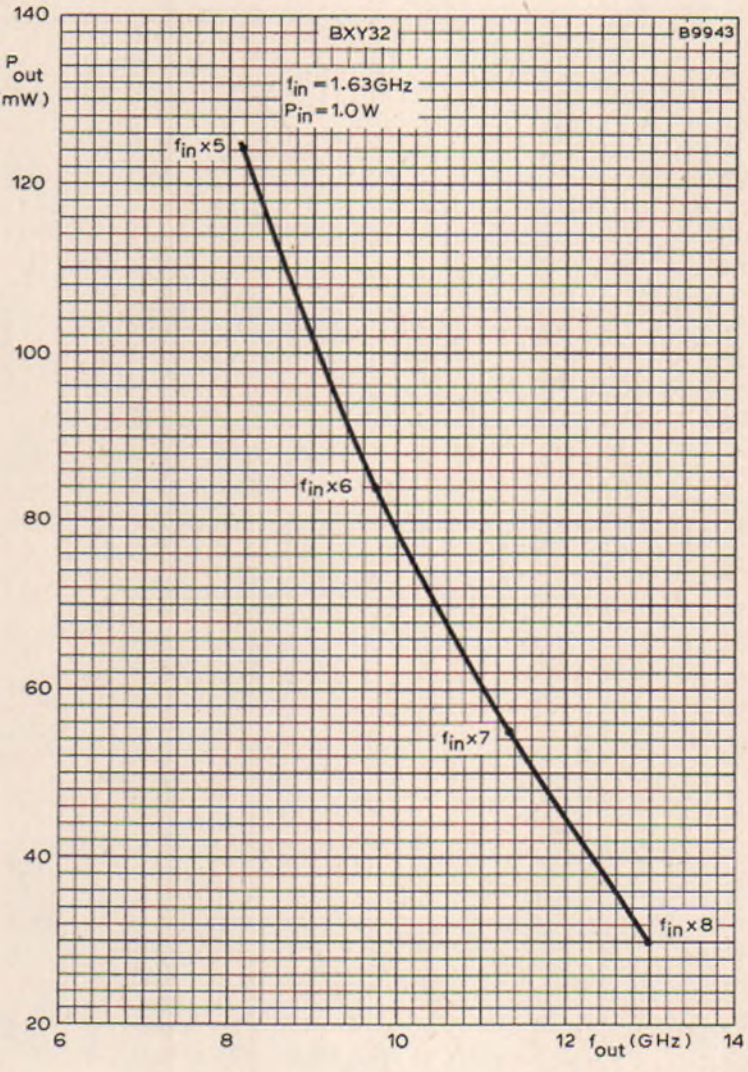
Note. The cut-off frequency f_{co} is defined as:

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

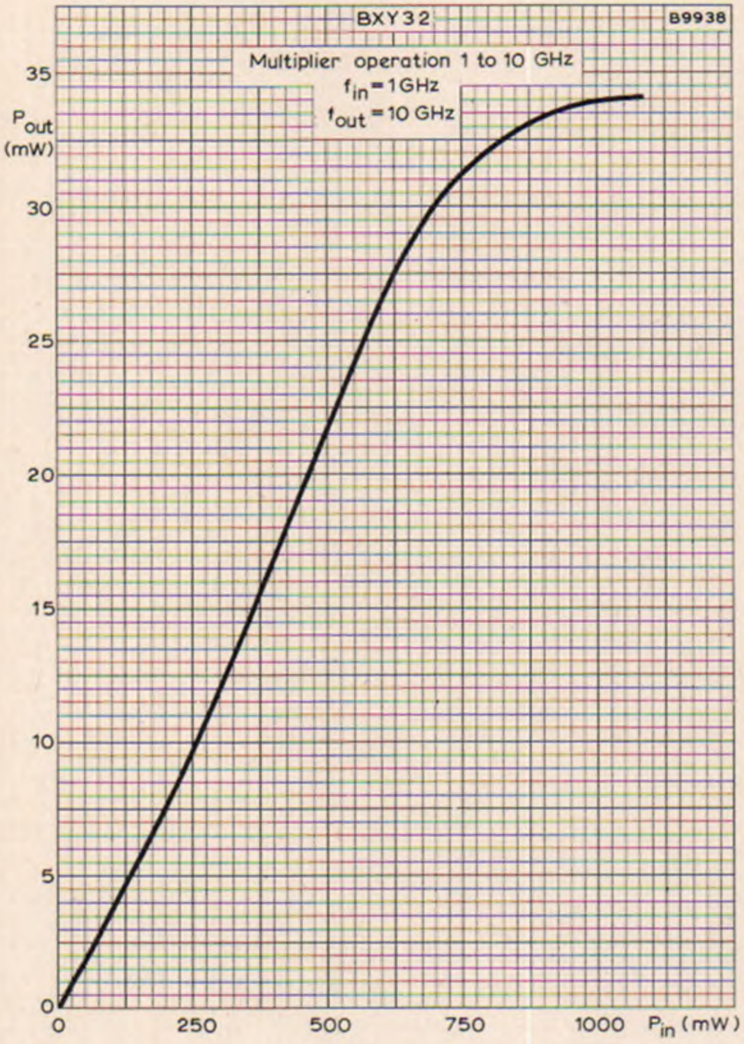
Where, C_j is the junction capacitance and is measured at 1.0MHz
r_s is measured on a slotted line at 8.0GHz

MULTIPLIER PERFORMANCE

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



TYPICAL PERFORMANCE IN HIGH ORDER MULTIPLIERS



TYPICAL PERFORMANCE AS A FREQUENCY MULTIPLIER

SILICON IMPATT DIODE

BXY50

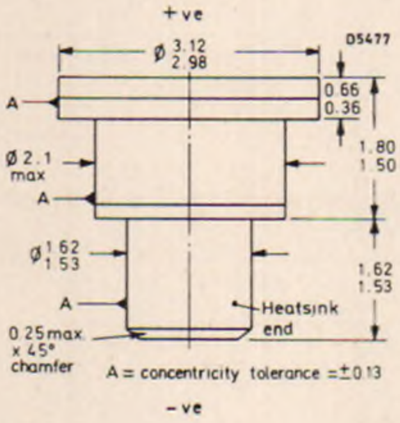
TENTATIVE DATA

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

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

(Development No. 194BAY/9)

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

TYPICAL OSCILLATOR PERFORMANCE

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

OPERATING NOTES

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

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

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

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

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

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

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

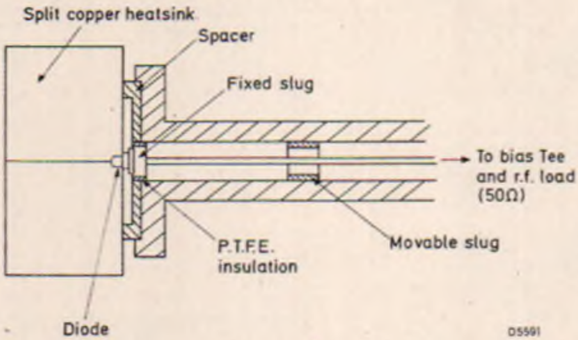
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

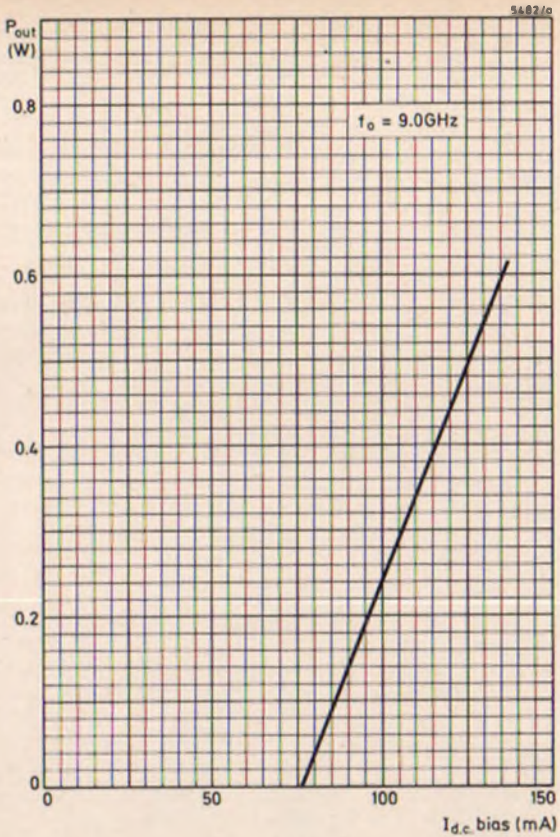
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

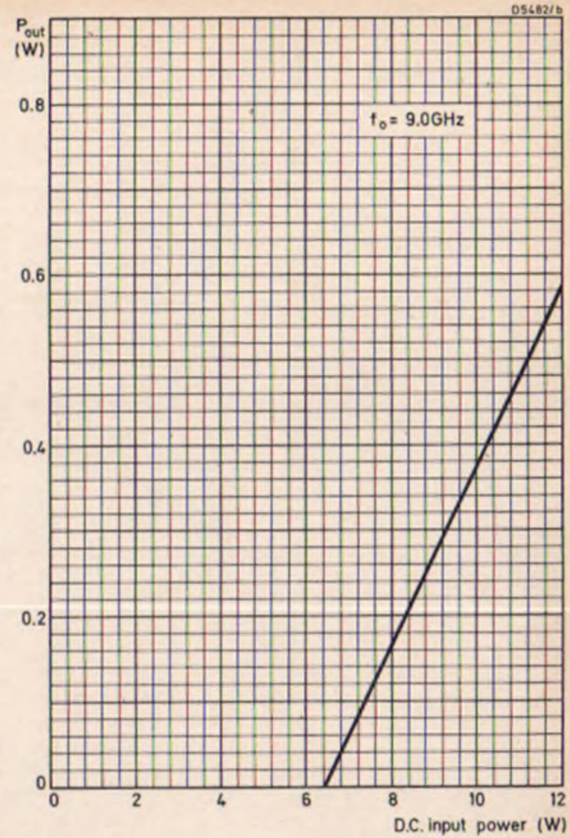
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



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

SILICON IMPATT DIODE

BXY51

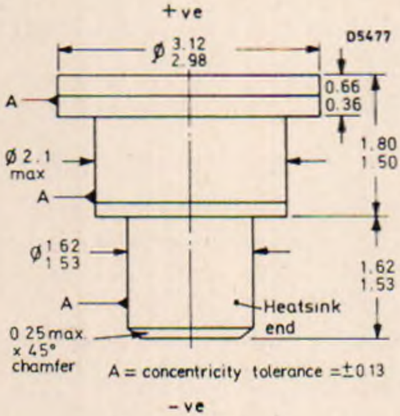
TENTATIVE DATA

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

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

(Development No. 194BAY/11)

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

TYPICAL OSCILLATOR PERFORMANCE

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

OPERATING NOTES

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

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

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

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

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

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

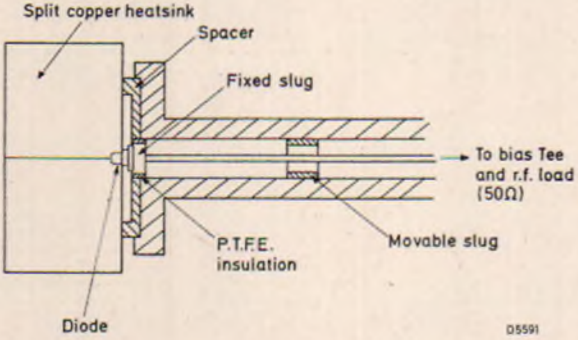
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

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

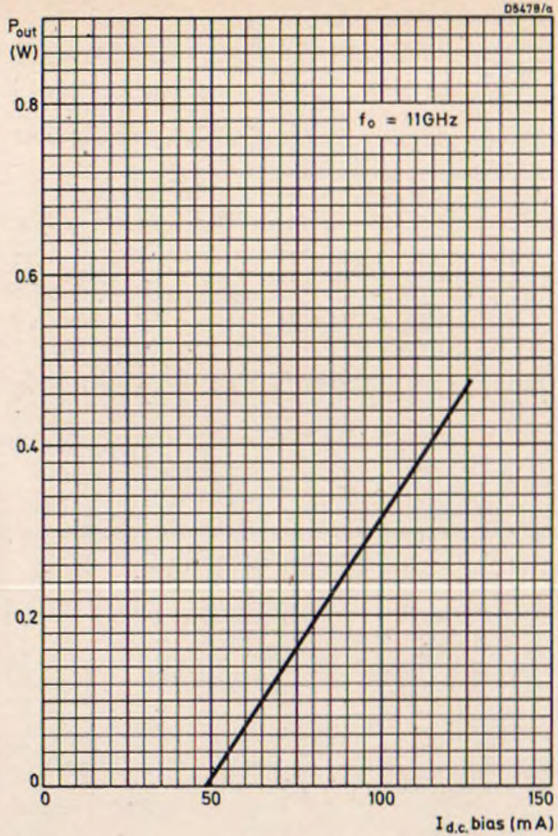
OPERATING NOTES (contd.)

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

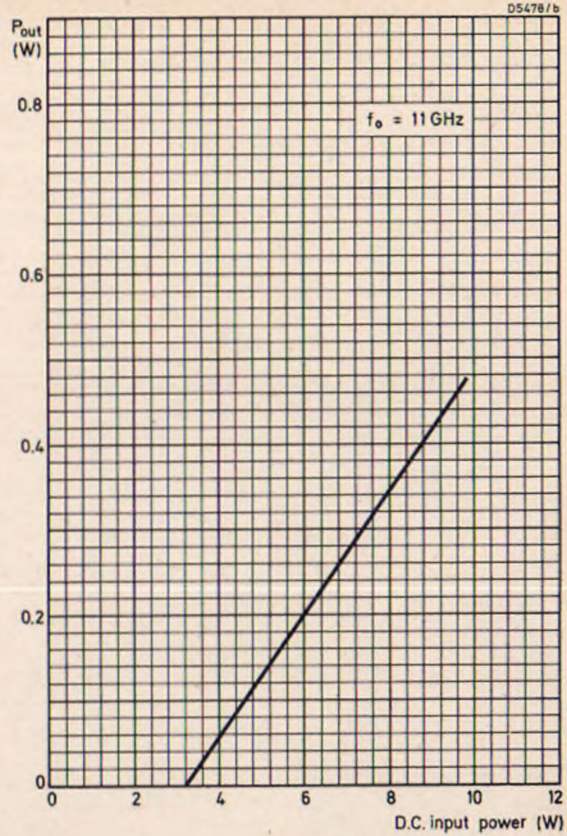
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



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

SILICON IMPATT DIODE

BXY52

TENTATIVE DATA

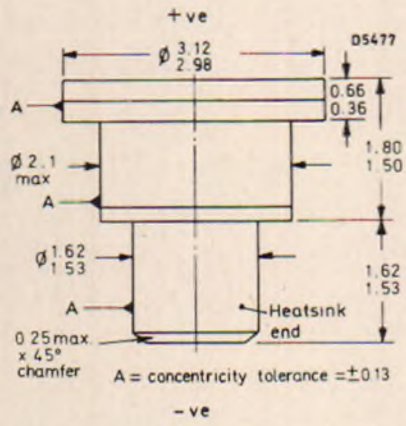
A high efficiency silicon Impatt diode for the generation of c.w. power at microwave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA

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

(Development No. 194BAY/13)

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

TYPICAL OSCILLATOR PERFORMANCE

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

OPERATING NOTES

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

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

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

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

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

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

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

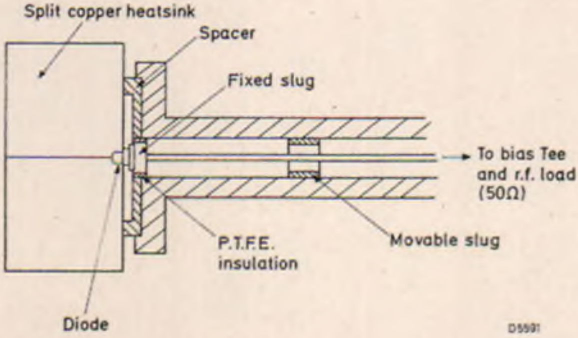
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

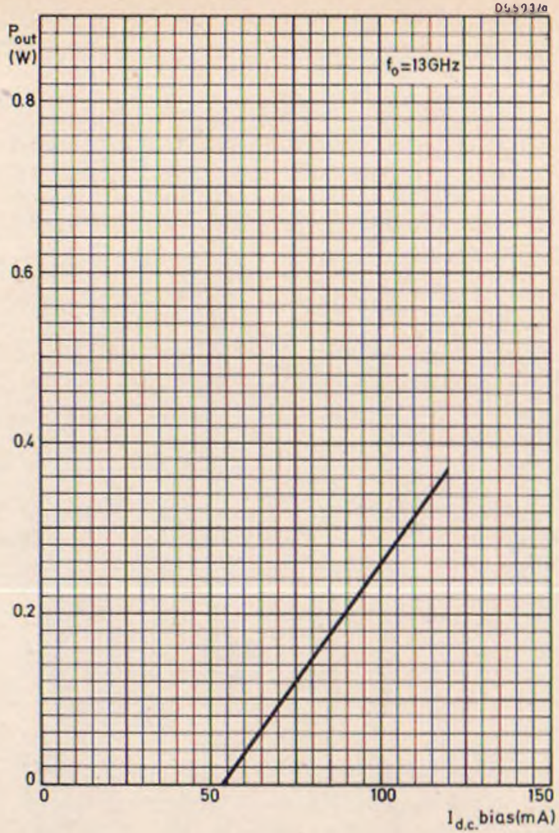
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

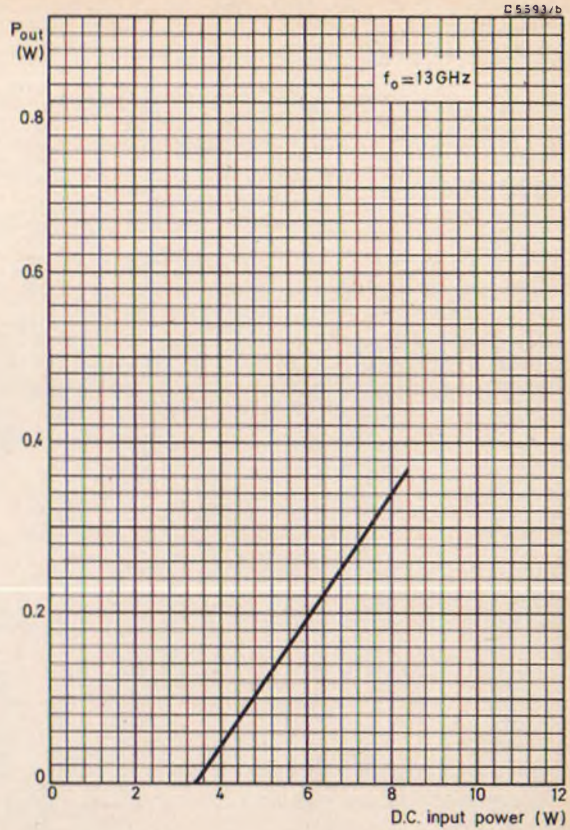
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



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

SILICON VARACTOR TUNING DIODES

BXY53
BXY54
BXY55

TENTATIVE DATA

Epitaxial silicon varactor tuning diodes supplied in a standard microwave package.

QUICK REFERENCE DATA

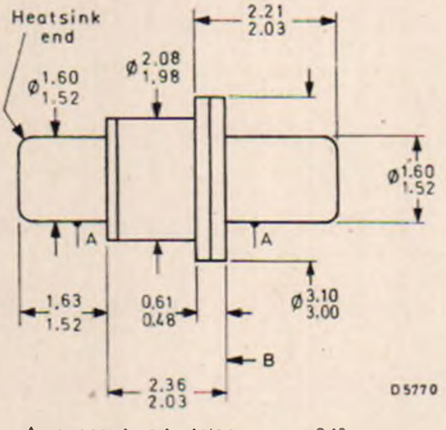
	BXY53	BXY54	BXY55	
V_R max.		60		V
C_T at -4V typ.	1.0	4.7	15	pF
$\frac{C_{TO}}{C_{T60V}}$ min.	4.0	6.5	7.0	pF

Unless otherwise shown, data is applicable to all types

Development Nos. 206 BXY/1
206BXY/4.7
206BXY/15

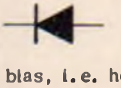
OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm



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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

NOTES

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

APPLICATION NOTE

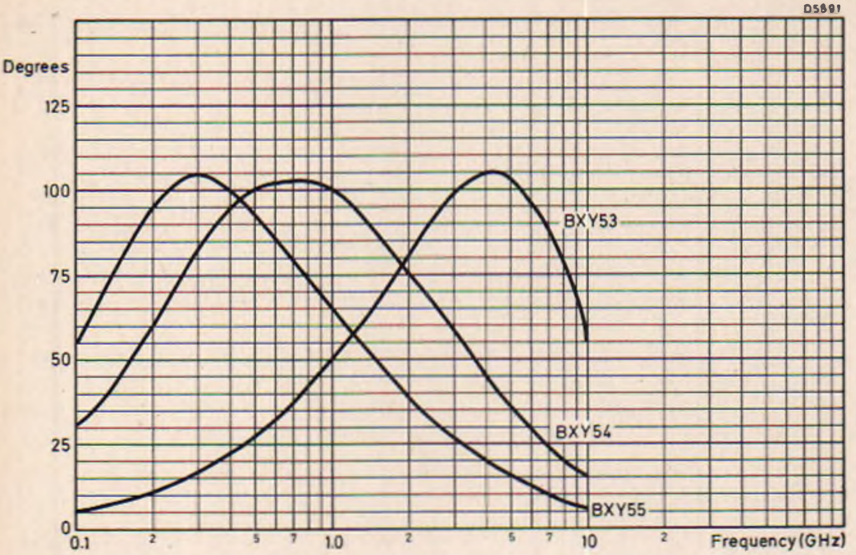
When designing tuning circuits at high frequencies it is not sufficient to specify a capacitance swing and loss resistance in the tuning varactor. The parasitic reactances of the microwave package have a significant effect on the terminal impedance of the device. Although strictly speaking one must consider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

APPLICATION NOTE (contd.)

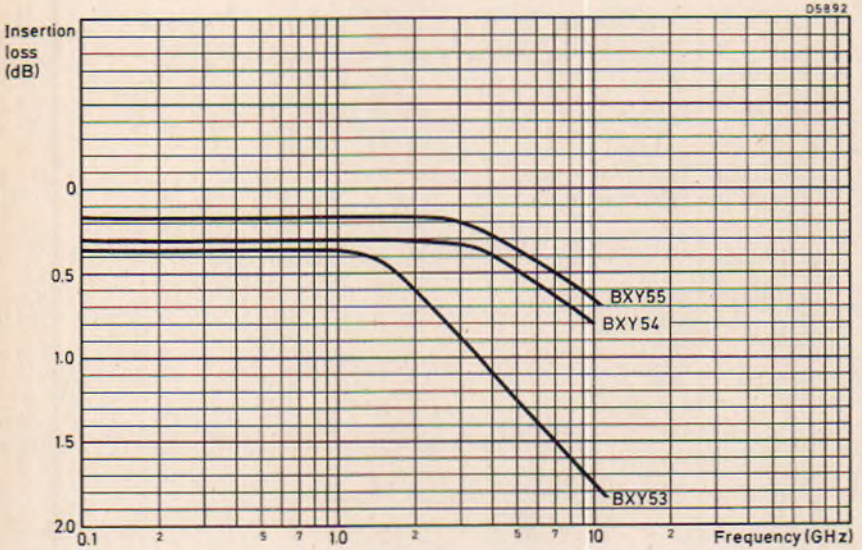
One may simply take the measurements as giving values of r.f. impedance as a function of bias for small signal conditions or they can be used as a more fundamental design aid. This is because the significant factors for the design of a microwave varactor tuned circuit are the available phase swing in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

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

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



TYPICAL PHASE SWING AS A FUNCTION OF FREQUENCY



TYPICAL INSERTION LOSS AS A FUNCTION OF FREQUENCY

SILICON VARACTOR DIODES

BXY56 BXY57

TENTATIVE DATA

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

QUICK REFERENCE DATA

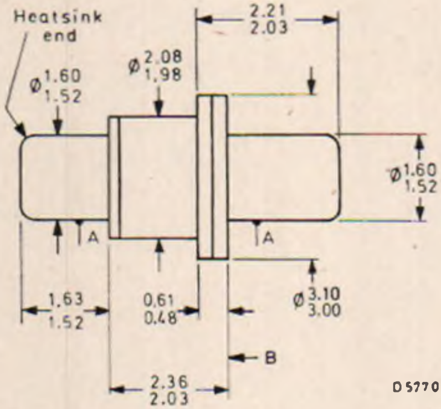
		BXY56	BXY57	
$V_{BR(R)}$ min. (I_R = 10μA min.)			60	V
C_j (V_R = 6V)	min.	1.5	2.5	pF
	max.	2.5	3.5	pF
f_c (V_R = 6V min.)		160	140	GHz

Unless otherwise shown, data is applicable to both types

Development Nos. 205BXY/2
205BXY/3

OUTLINE AND DIMENSIONS

Conforms to BS 3934 SO-86



A: concentricity tolerance = ±0.13

All dimensions in mm

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

CHARACTERISTICS (T_{pin} = 25°C)

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

MULTIPLIER PERFORMANCE (see note 4)

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

NOTES

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

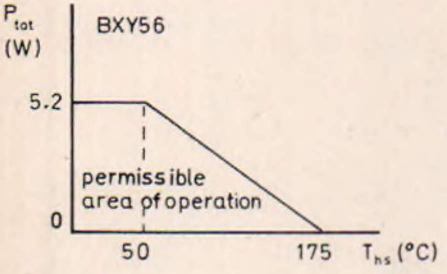


Fig. 1

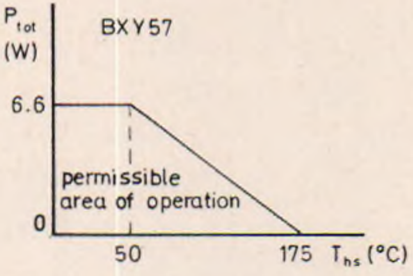


Fig. 2

NOTES (contd.)

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

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

4. For high power applications it is essential that the heatsink end of the devices is gripped by a collet or equivalent clamping system to ensure the best possible thermal conductivity, this in turn should be coupled to an adequate heatsink. Care must be taken to avoid unnecessary deformation of this diode pin, as this may cause cracking of the metal-ceramic hermetic seal.

The location of the top cap should be a hole of diameter 1.8 to 2.2mm. bearing on flange B with a force not exceeding 10 newton (1kgf).

SILICON IMPATT DIODE

BXY60

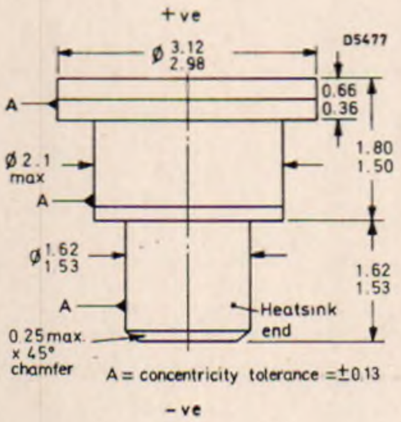
TENTATIVE DATA

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

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

OPERATING NOTES

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

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

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

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

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burnout. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 140V and 180mA.

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

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

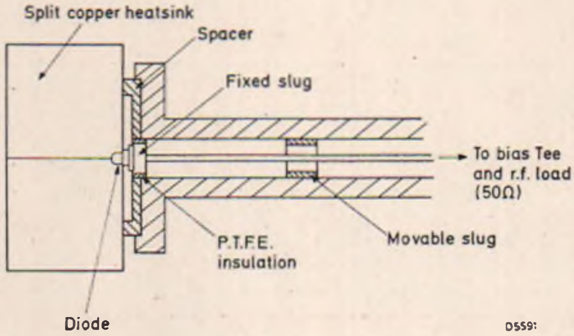
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

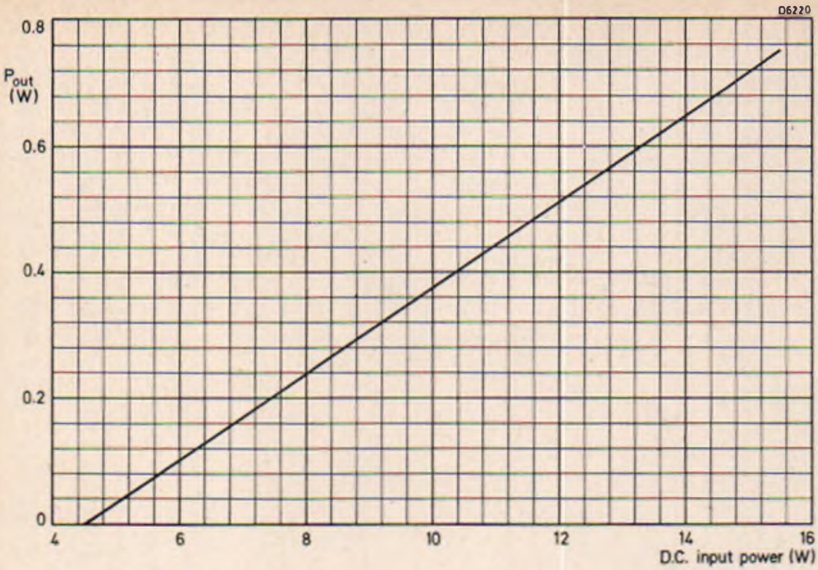
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

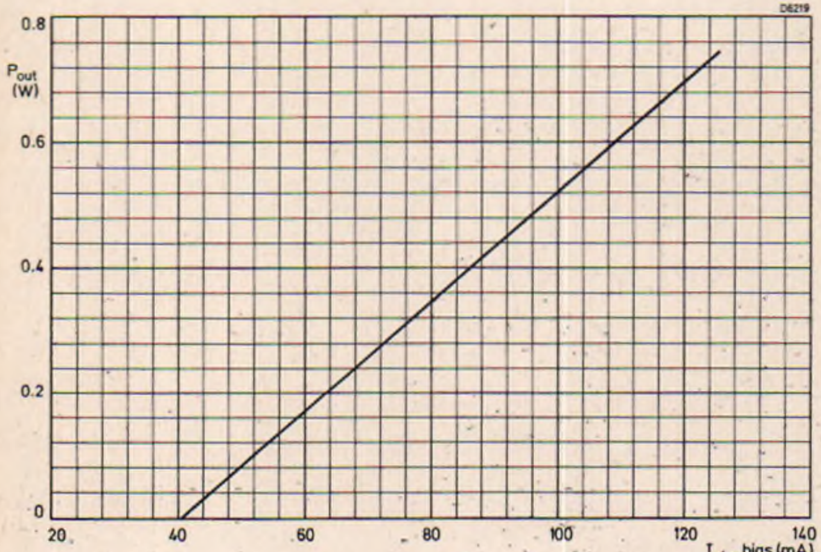
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



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



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT

GALLIUM ARSENIDE VARACTOR DIODE

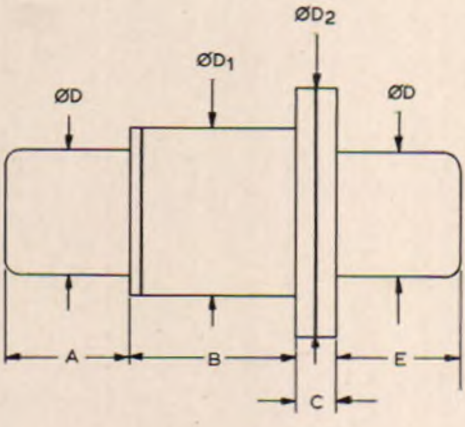
CAY10

TENTATIVE DATA

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 and are mounted in a small ceramic-metal case with a welded hermetic seal.

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

OUTLINE AND DIMENSIONS



Millimetres	Min.	Max.
A	1.52	1.63
B	1.70 nom.	
C	0.48	0.61
ØD	1.52	1.60
$ØD_1$	1.98	2.03
$ØD_2$	3.00	3.10
E	1.55	1.60

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

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

Temperature

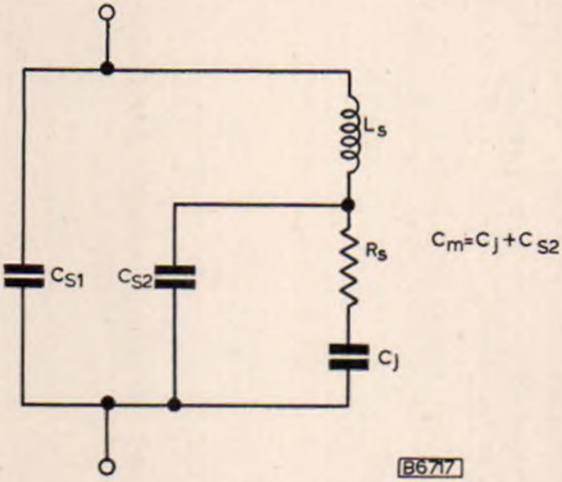
T_{stg} min.	-196	^{o}C
T_{stg} max.	+150	^{o}C
T_j (operating range)	-196 to +150	^{o}C

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

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

Notes

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



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

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

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

3. The capacitance variation coefficient γ is defined as

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

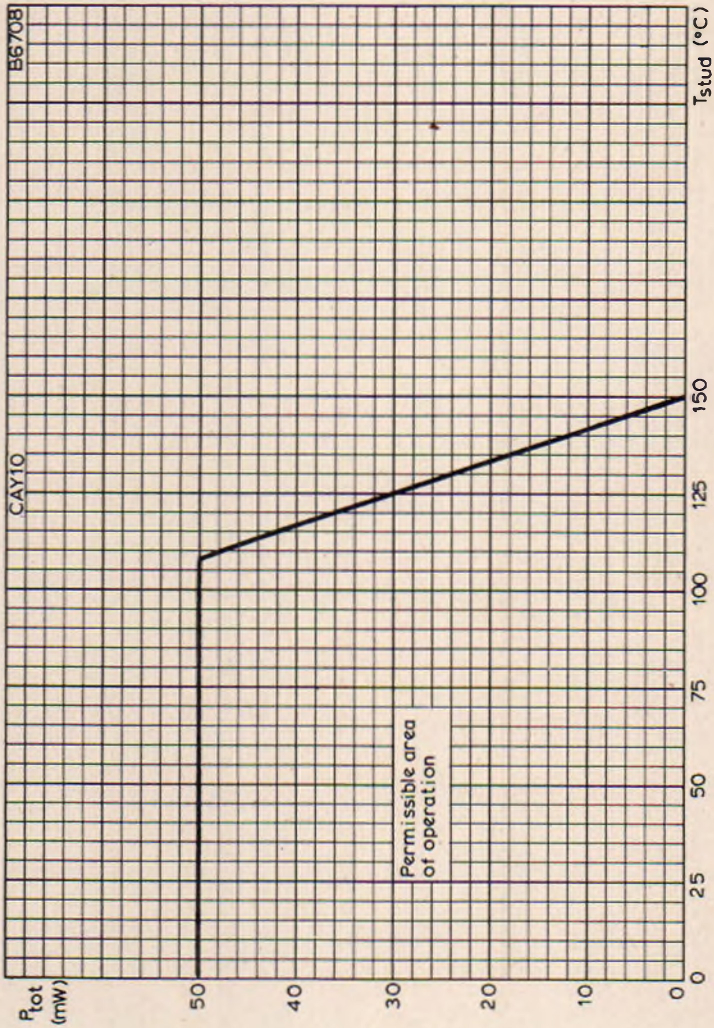
where C_m min. = effective capacitance at $V_R = 1.0\text{V}$
C_m max. = effective capacitance at $I_F = 1.0\mu\text{A}$

This can be re-written in the form

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

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

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



TOTAL DISSIPATION PLOTTED AGAINST STUD TEMPERATURE

GALLIUM ARSENIDE VARACTOR DIODE

CXY10

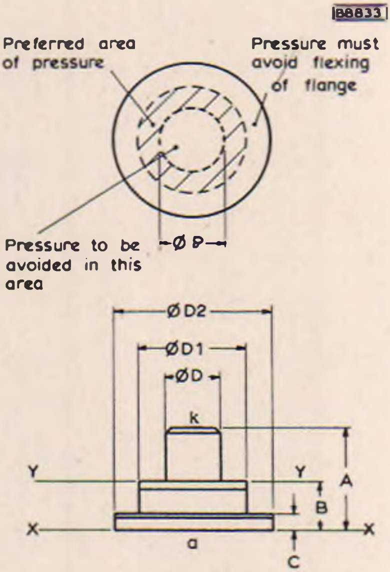
TENTATIVE DATA

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 and are mounted in a small ceramic-metal case with a hermetic welded seal.

QUICK REFERENCE DATA

V_R max.	6.0	V
P_{tot} max. $T_{pin} \leq 25^oC$	50	mW
Operating temperature range	-196 to +135	^oC
f_{co} typ. (V_R = 0V)	350	GHz

OUTLINE AND DIMENSIONS



Millimetres

	Min.	Max.
A	1.15	1.60
B	0.56	0.87
C	0.19	0.32
ØD	0.61	0.66
ØD1	1.19	1.35
ØD2	1.75	1.80
ØP	0.71	0.81

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

V_R max.	6.0	V
P_{tot} max. T_{pin} ≤25°C	50	mW

Temperature

T_{stg} min.	-196	°C
T_{stg} max.	+175	°C
T_j (operating range)	-196 to +135	°C

THERMAL CHARACTERISTIC

$R_{th(j-pin)}$ max.	0.9	degC/mW

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

		Min.	Typ.	Max.	
I_R	Reverse current V_R = 6.0V	-	0.1	1.0	μA
f_{res}	Series resonant frequency V_R = 0 (see note 1)	27	30	34	GHz
f_{co}	Cut-off frequency V_R = 0 (see note 1)	200	350	-	GHz
γf_{co}	Product of capacitance variation coefficient and cut-off frequency at V_R = 0V (see note 2)	35	40	-	GHz
R_m	Microwave value of effective device series resistance (see notes 1, 4)	1.0	2.25	3.0	Ω
C_m	Microwave value of effective device capacitance V_R = 0V (see notes 3, 4)	-	0.2	-	pF
C_s	Stray capacitance (L.F. measurement)	-	0.3	-	pF
L_s	Microwave value of effective device series inductance (see note 3)	-	140	-	pH

Notes

1. Measurements on semiconductor devices at microwave frequencies are very much dependent upon the kind of holder used. The above dynamic parameters are quoted using a holder which takes the form of a double four-section, wide band, low v.s.w.r. Q-band (ka-band) 26 to 40GHz waveguide transformer to a reduced height of 0.25mm. The transformer is step down followed by step up in order to use standard Q-band components on either side. A d.c. isolated coaxial choke system allows the diode to be inserted across the 0.25mm reduced height section and to be biased.

   Using a sweep frequency transmission loss measuring system the series resonant frequency can be measured, the Q of the diode/holder system (hence the frequency cut-off $Q \times f_{res}$), the effective capacitance variation coefficient, and separately, by measuring the transmission loss past the diode at resonance, the effective diode series resistance.

2. The capacitance variation coefficient, γ, is defined as follows:-

$$\gamma = \frac{C_m\,(\max) - C_m\,(\min)}{2\left[C_m\,(\max) + C_m\,(\min)\right]} = \frac{f_{res}^{-2}\,(\min) - f_{res}^{-2}\,(\max)}{2\left[f_{res}^{-2}\,(\min) + f_{res}^{-2}\,(\max)\right]}$$

where C_m (min) = capacitance at $V_R = 1.0\text{V}$

C_m (max) = capacitance at $I_F = 1.0\mu\text{A}$

and f_{res} (max) and f_{res} (min) are the corresponding resonant frequencies, assuming a constant inductance. Hence it is directly measurable in the transmission loss system.

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

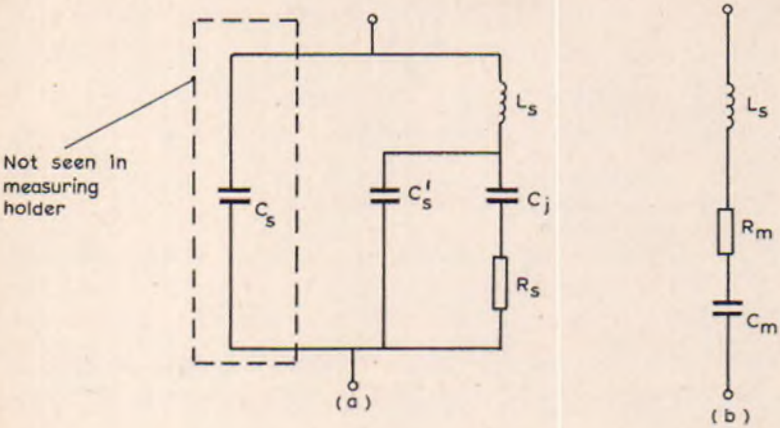
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

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

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

4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.



Operating note

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

For instance, at a signal frequency of 8.5GHz in an amplifier having an over-coupled ratio of 4dB to 5dB with a pump frequency at 35GHz and an idler frequency of 26.5GHz, 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. In cooled paramps, due to its low temperature working capability, the device would give appropriately lower effective input noise temperatures.

GUNN EFFECT DEVICES

CXY11A
CXY11B
CXY11C

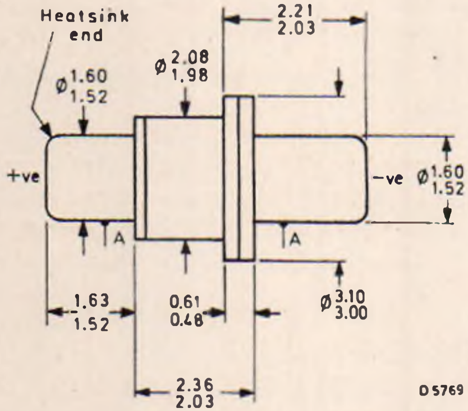
Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

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

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. (see note 1)	7.5	V
P_{tot} max. ($T_{mb} = 70^{o}C$)	1.0	W
Temperature		
T_{mb} range	-40 to +70	
T_{stg} range	-55 to +150	^{o}C

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

		Min.	Typ.	Max.	
I_{dc} (at V = 7.0V) (see note 1)		-	120	145	mA
Frequency (see note 2)		8.0	9.5	12	GHz
P_{out} (at V = 7.0V) (see note 3)	CXY11A	5.0	8.0	-	mW
	CXY11B	10	12	-	mW
	CXY11C	15	20	-	mW

OPERATING NOTES

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
2. The frequency is governed by the choice of cavity to which the device is coupled.
3. The output power is normally measured in a coaxial cavity at a frequency of 9.5GHz. Other centre frequencies may be supplied at 8.5, 10.5 and 11.5GHz by suffixing the type number e.g. CXY11B/10.5 specifies a diode giving 10mW min. at 10.5GHz. See the table below.
   Diodes with these other centre frequencies will not necessarily oscillate over the whole 8 to 12GHz 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. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

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

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

GALLIUM ARSENIDE VARACTOR DIODE

CXY12

TENTATIVE DATA

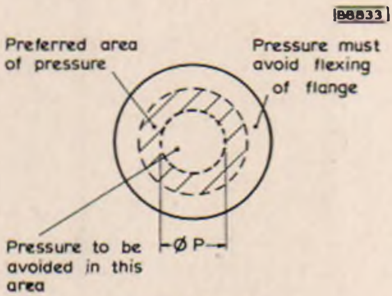
Gallium arsenide varactor diode suitable for use in frequency multiplier circuits up to Q-band output frequency. The diodes are of the diffused mesa type and are mounted in a small ceramic-metal case with hermetic welded seal.

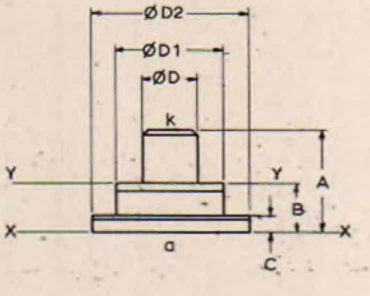
QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS





Millimetres

	Min.	Max.
A	1.15	1.60
B	0.56	0.87
C	0.19	0.32
ØD	0.61	0.66
ØD1	1.19	1.35
ØD2	1.75	1.80
ØP	0.71	0.81

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

Notes

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

2. Measurements on semiconductor devices at microwave frequencies are very much dependent upon the kind of holder used. The dynamic parameters are quoted using a holder which takes the form of a double four section Q-band (Ka-band) 26 to 40GHz waveguide wide band low v.s.w.r. transformer to a reduced height of 0.25mm. The transformer is step down followed by step up in order to use standard Q-band components on either side. A d.c. isolated coaxial choke system allows the diode to be inserted across the 0.25mm reduced height section and to be biased.

   Using a swept frequency transmission loss measurement system, the series resonant frequency and the Q of the diode holder system can be measured. Hence the resistive cut-off frequency which is defined as $Q \times f_{res}$.

   Separately, by measuring the transmission loss past the diode at resonance, the effective diode series resistance can be found.

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

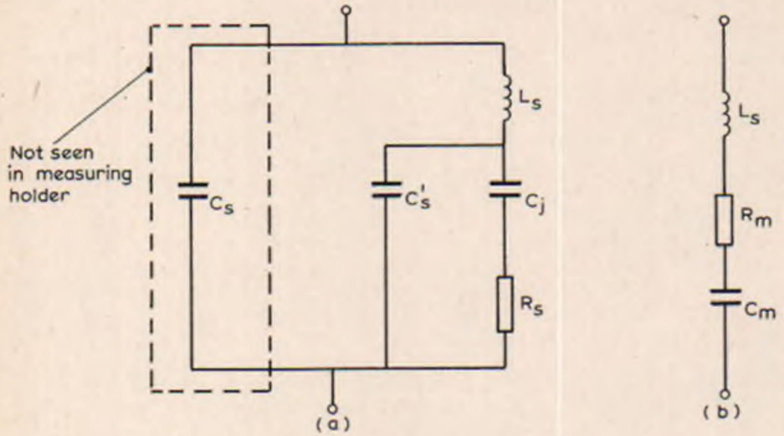
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

   L_s is also calculated using f_{res} and C_m

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

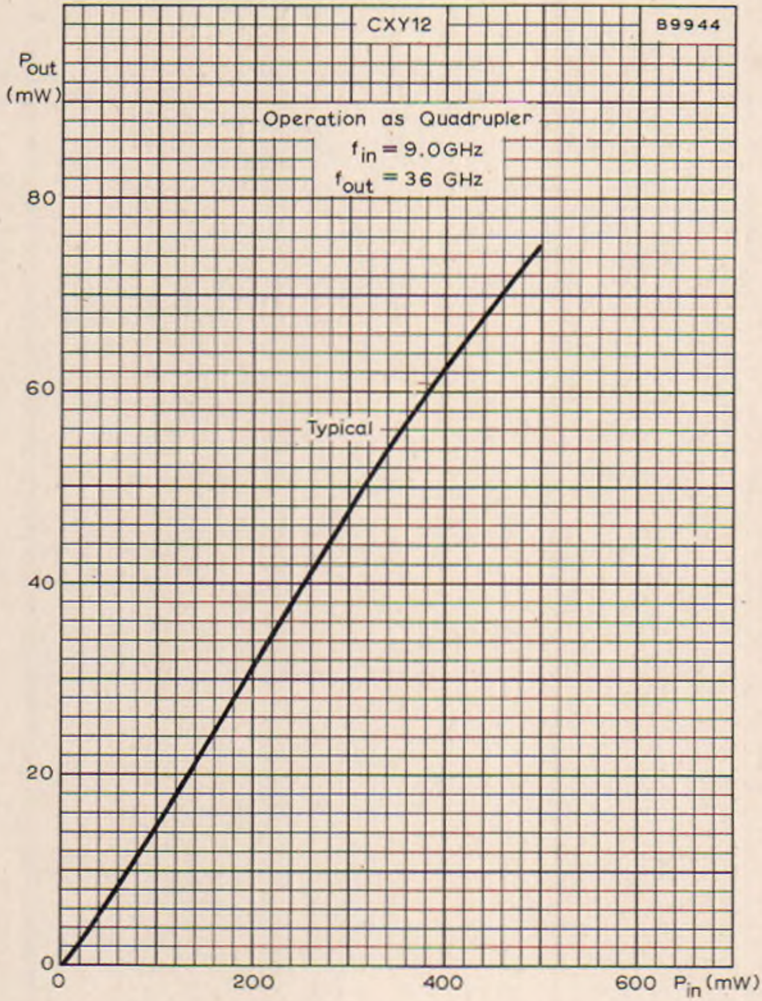
4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.



Application note

In a suitable frequency quadrupler CL8700 this device is capable of producing 50mW at 36GHz for an input power of 500mW at 9.0GHz.



OUTPUT POWER AGAINST INPUT POWER
QUADRUPLER OPERATION

GUNN EFFECT DEVICES

CXY14A CXY14B CXY14C

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.

QUICK REFERENCE DATA

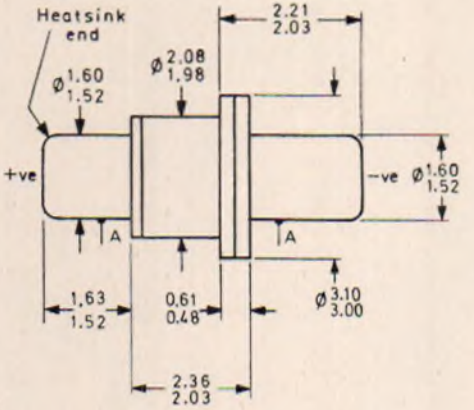
Operating voltage		7.0	V
P_{tot} max. (T_{mb} = 70^{o}C)		1.0	W
Operating frequency		12 to 18	GHz
P_{out} min.	CXY14A	5.0	mW
	CXY14B	10.0	mW
	CXY14C	15.0	mW

(Development Nos. 803CXY/A
803CXY/B
803CXY/C)

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A: concentricity tolerance = ±0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. (see note 1)	7.5	V
P_{tot} max. (T_{mb} = 70°C)	1.0	W
Temperature		
- T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

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

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

OPERATING NOTES

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
2. The frequency is governed by the choice of cavity to which the device is coupled.
3. The output power is normally measured in a coaxial cavity at approximately centre band frequency. The bias may be optimized to give maximum output power within the V max. and P_{tot} max. ratings.
4. It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.
5. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers specific requirements.

GUNN EFFECT DEVICE

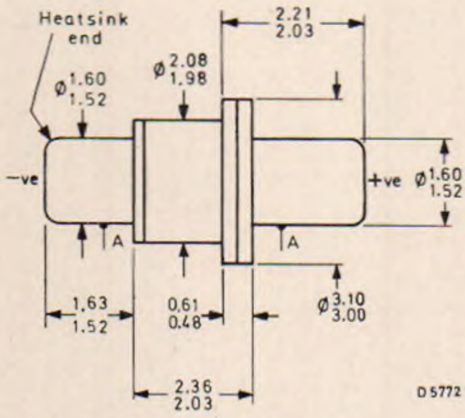
CXY19

Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package.

QUICK REFERENCE DATA		
Operating voltage	8 to 15	V
P_{tot} max. (T_{mb} = 70°C)	6.0	W
Operating frequency	8 to 12	GHz
P_{out} min. (f = 9.5GHz)	100	mW

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

OPERATING NOTES

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
2. Each device is measured for maximum output power at 9.5GHz in a coaxial test cavity. The bias is optimized for this maximum within the V max. and P_{tot} max. ratings. The operating voltage and corresponding current are quoted for this condition on a test record supplied with each device.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
5. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

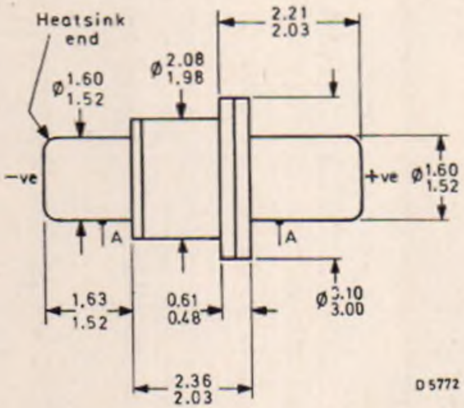
CXY19A

Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package.

QUICK REFERENCE DATA		
Operating voltage	8 to 15	V
P_{tot} max. (T_{mb} = 70°C)	6.0	W
Operating frequency	8 to 12	GHz
P_{out} min. (f = 9.5GHz)	200	mW

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

OPERATING NOTES

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.

2. Each device is measured for maximum output power at 9.5GHz in a coaxial test cavity. The bias is optimized for this maximum within the V max. and P_{tot} max. ratings. The operating voltage and corresponding current are quoted for this condition on a test record supplied with each device.

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

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

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

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

CXY 21

TENTATIVE DATA

Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. oscillations at microwave frequencies. It is encapsulated in a standard microwave package.

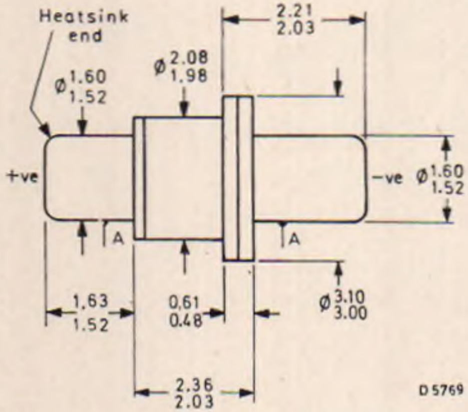
QUICK REFERENCE DATA

Operating voltage	9.5	V
P_{tot} max. (T_{mb} = 70°C)	2.5	W
Operating frequency range	8.0 to 12	GHz
P_{out} typ. (at f_o = 9.5GHz)	60	mW

(Development No. 820CXY/A)

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V max. (see note 1)	10	V
P_{tot} max. (T_{mb} = 70°C)	2.5	W
T_{mb} range	-40 to +70	°C
T_{stg} range	-55 to +150	°C

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

	Min.	Typ.	Max.	
Frequency range (see note 2)	8.0	-	12	GHz
D.C. operating current (at V = 9.5V)	-	210	265	mA
Power output (see note 3)	50	60	-	mW

OPERATING NOTES

1. The heatsink end is positive. Bias must be applied in such a way that the mounting base end of the device is always positive. Reversal of the bias will cause permanent damage. Care should be taken to prevent the device from transients.

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

3. The power output is normally measured in a coaxial cavity at approximately mid-band frequency. The bias may be optimized to give maximum power output within the limits of V max. and P_{tot} max.

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

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

Devices may be selected to suit customers specific requirements.

SILICON PLANAR EPITAXIAL VARACTOR DIODES

1N5152
1N5153

TENTATIVE DATA

Silicon planar epitaxial varactor diodes exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to S-band output frequency.

QUICK REFERENCE DATA

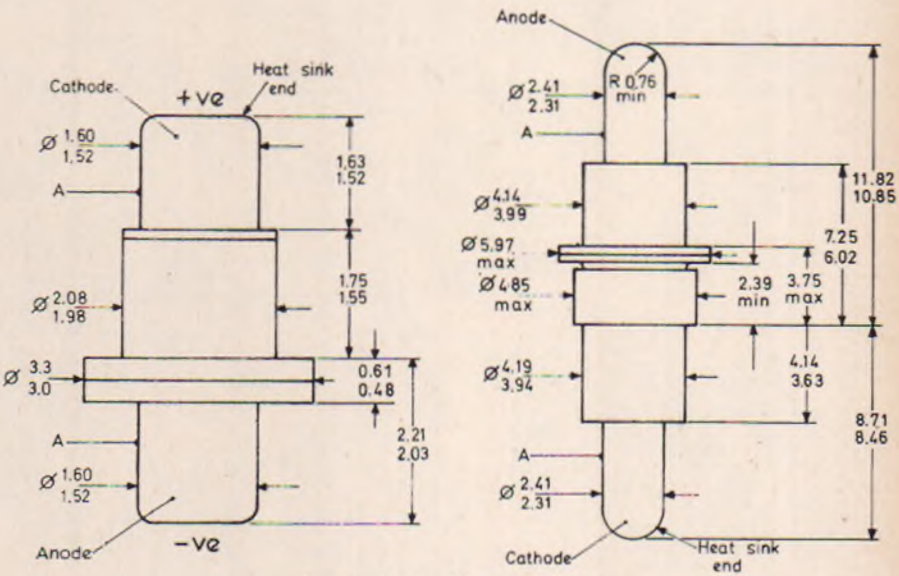
Operation as a frequency doubler 1.0 to 2.0GHz in a typical circuit.

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

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS

OUTLINE DRAWING OF 1N5152 OUTLINE DRAWING OF 1N5153



A= concentricity tolerance = ± 0.13

All dimensions in mm

D 1652

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

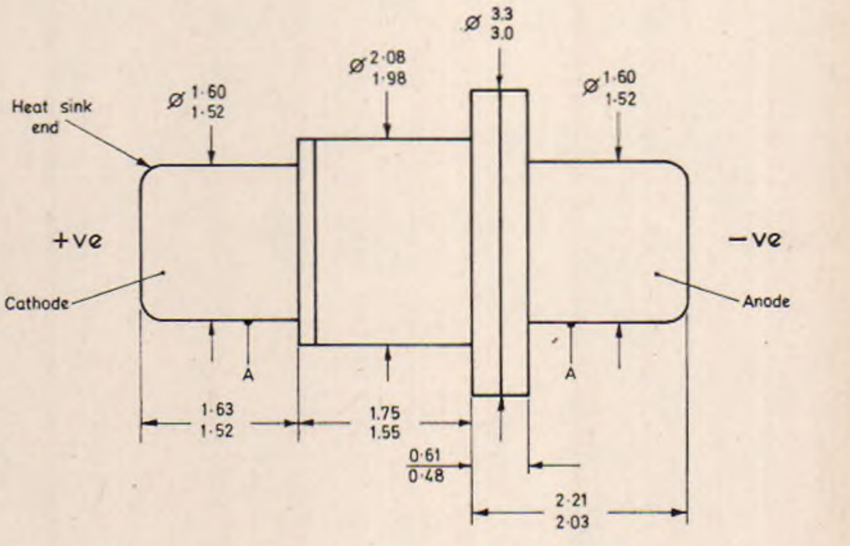
1N5155

TENTATIVE DATA

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency.

QUICK REFERENCE DATA		
Operation as a frequency tripler 2.0 to 6.0GHz in a typical circuit.		
P_{in}	5.0	W
P_{out}	2.0	W
Typical resistive cut-off frequency ($V_R = 6.0V$)	120	GHz
Typical total capacitance ($V_R = 6.0V$)	2.0	pF

OUTLINE AND DIMENSIONS



A= concentricity tolerance = ± 0·13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

1N5157

TENTATIVE DATA

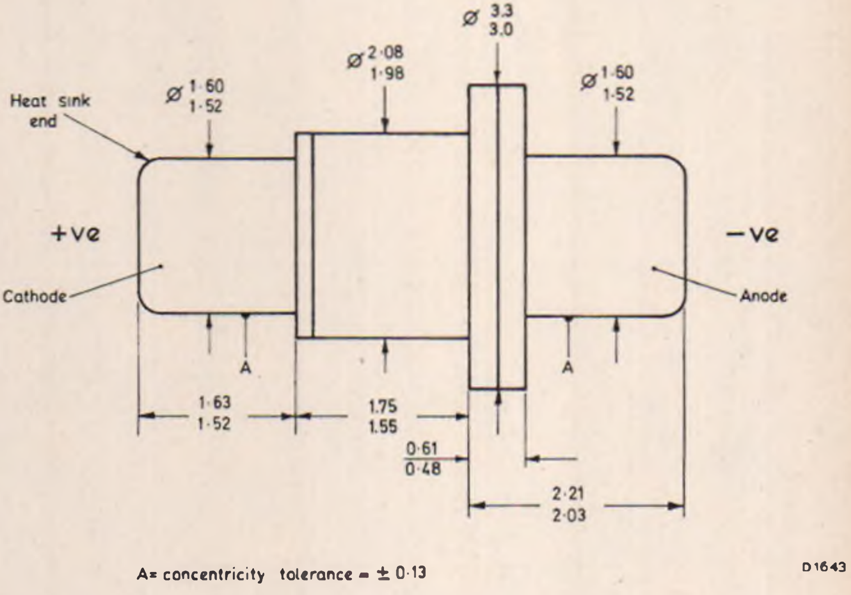
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplior circuits up to X-band output frequency.

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0·13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

T_{stg} min.	-55	$^{\circ}C$
T_{stg} max.	+175	$^{\circ}C$
T_j max.	+175	$^{\circ}C$

THERMAL CHARACTERISTIC

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

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

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

GUNN EFFECT OSCILLATORS

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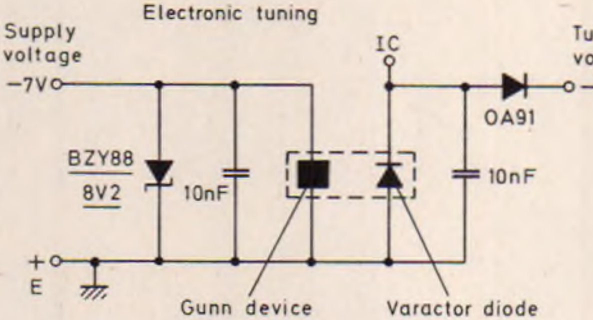
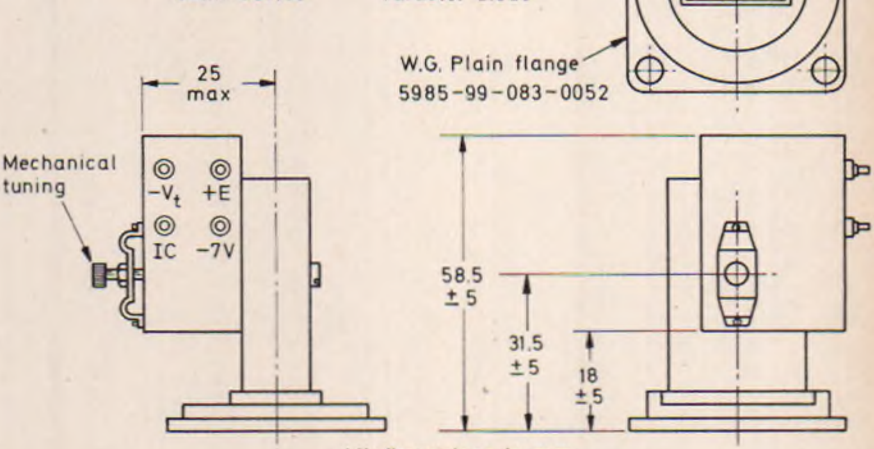
X-BAND GUNN OSCILLATOR

CL8310

TENTATIVE DATA

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





All dimensions in mm

OPERATING CONDITIONS

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency		9.4		GHz
Mechanical tuning range	±50	-	-	MHz
Electronic tuning range	200	250	-	MHz
*P_{out}	3.0	5.0	-	mW
Variation in P_{out} over electronic tuning range	-	1.5	-	dB
Electronic tuning sensitivity	-	25	-	MHz/V
Frequency temperature coefficient	-	-1.0	-	MHz/degC
Frequency pushing	-	30	-	MHz/V

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

TEMPERATURE

Range max.	-30 to +70	°C

OPERATING NOTE

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

X-BAND GUNN OSCILLATOR

CL8441

TENTATIVE DATA

This unit is an electronically tuned oscillator suitable for use as a solid-state replacement for reflex klystrons. CL8441 may be used as a local oscillator in marine radars employing a single balanced mixer and no a.f.c. system.

QUICK REFERENCE DATA		
Output connector	WG16	
Centre frequency	9.4	GHz
Mechanical tuning range (min.)	±100	MHz
Electronic tuning range (min.)	40	MHz
Power output (min.)	5	mW
Operating voltage	-7.5	V

TYPICAL OPERATING CONDITIONS

Supply voltage (see note 1)	-7.5	V
Supply current	150	mA
Tuning voltage (see notes 1 and 2)	0 to -10	V
Tuning current	10	μA

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max.	-8	V
Supply current max.	200	mA
Tuning voltage max.	-12	V
Tuning current max.	100	μA

CHARACTERISTICS at 25°C

Centre frequency			9.4	GHz
	Min.	Typ.	Max.	
Mechanical tuning range	±100	±150	-	MHz
Electronic tuning range	40	60	-	MHz
P_{out} (see note 3)	5	8	-	mW
Electronic tuning sensitivity (see note 4)	-	10	-	MHz/V
Frequency deviation over temperature range	-	-	±15	MHz
Frequency pushing	-	15	-	MHz/V
Frequency pulling (see note 5)	-	±10	-	MHz

TEMPERATURE

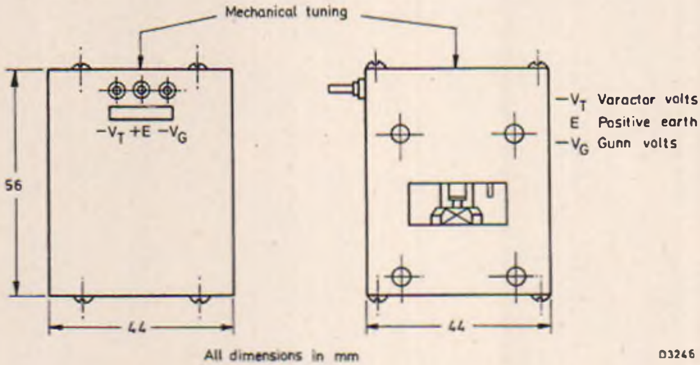
Range max.	-30 to +70	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients as far as possible.
2. The voltage supply should have a source impedance of less than 1kΩ.
3. Output power measured under all conditions of tuning and temperature.
4. The electronic tuning characteristic is essentially non-linear, giving greatest slope at low tuning voltages. The figure quoted is the typical figure for chord slope between 0 and 3 volts tuning bias.
5. Load v.s.w.r. 1.5 maximum. The sign depending upon the phase of mismatch.

WEIGHT	250	g

OUTLINE DRAWING



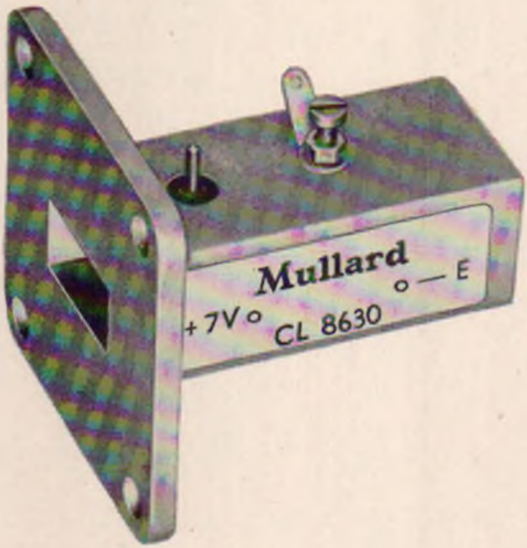
X-BAND GUNN OSCILLATOR

CL8630

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

OPERATING CONDITIONS

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



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

Centre frequency		10.687		GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.675	10.687	10.7	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	1.5	-	MHz/V
A.M. noise to carrier ratio (1Hz to 100Hz bandwidth)		-94		dB
Second harmonic		-35		dbm

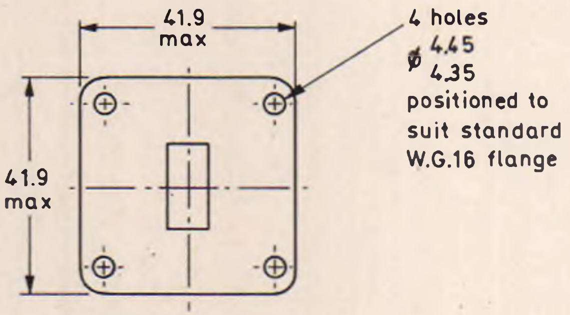
TEMPERATURE

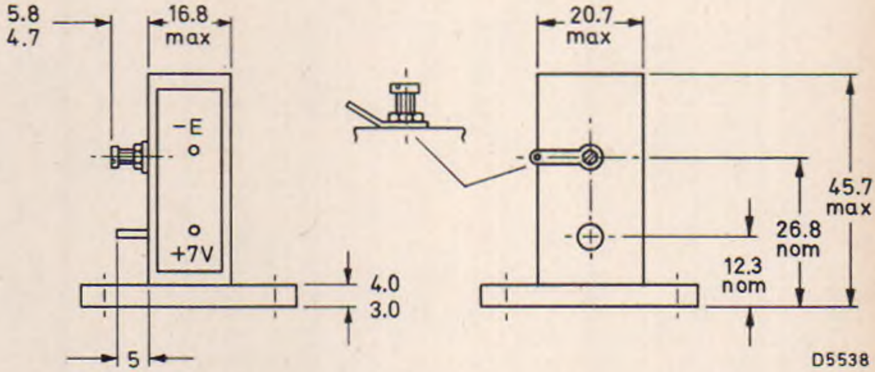
Range max.	0 to +40	°C

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. Modulation of the supply voltage within the 1Hz to 100Hz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components. The f.m. component may be demodulated by the non-linear response characteristic of the associated detecting element.

OUTLINE DRAWING





X-BAND GUNN OSCILLATOR

CL8630S

TENTATIVE DATA

QUICK REFERENCE DATA

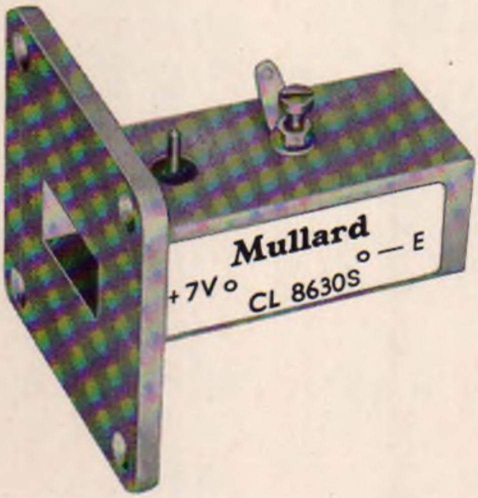
Fixed frequency Gunn oscillator for operation in the 10.7GHz band as a self-oscillating mixer (auto detector).

Centre frequency	10.687	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/^{o}C

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

OPERATING CONDITIONS

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



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency		10.687		GHz
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.675	10.687	10.7	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Output voltage for input 66dB down on output power (at 6dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	24	40	-	μV
Second harmonic	-	-35	-	dbm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

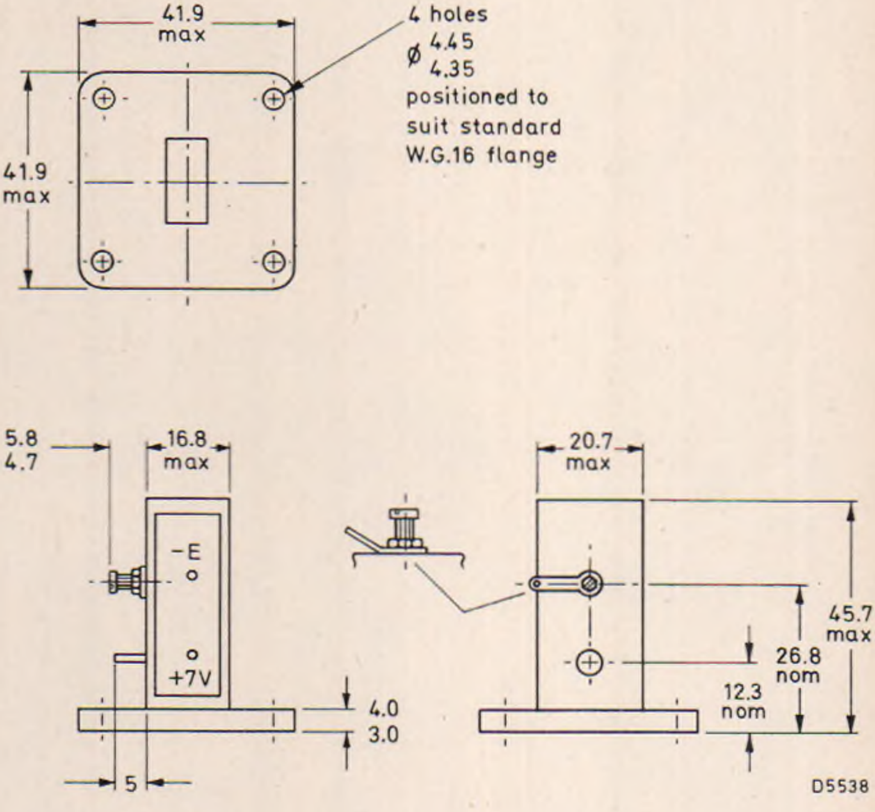
TEMPERATURE

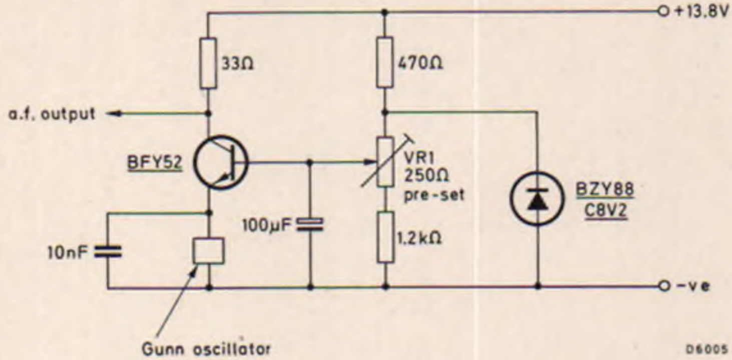
Range max.	0 to +40	°C

OPERATING NOTES

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

OUTLINE DRAWING





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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

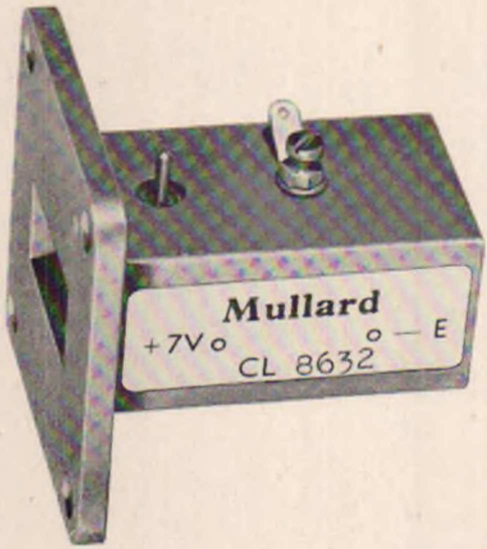
X-BAND GUNN OSCILLATOR

CL8632

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 9.35GHz band. Applications include all forms of miniature radar systems.		
Centre frequency	9.35	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/°C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

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



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

Centre frequency			9.35	GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	9.33	9.35	9.37	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/degC
Frequency pushing	-	1.5	-	MHz/V
A.M. noise to carrier ratio (1Hz to 100Hz bandwidth)		-94		dB
Second harmonic		-25		dbm

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

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

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

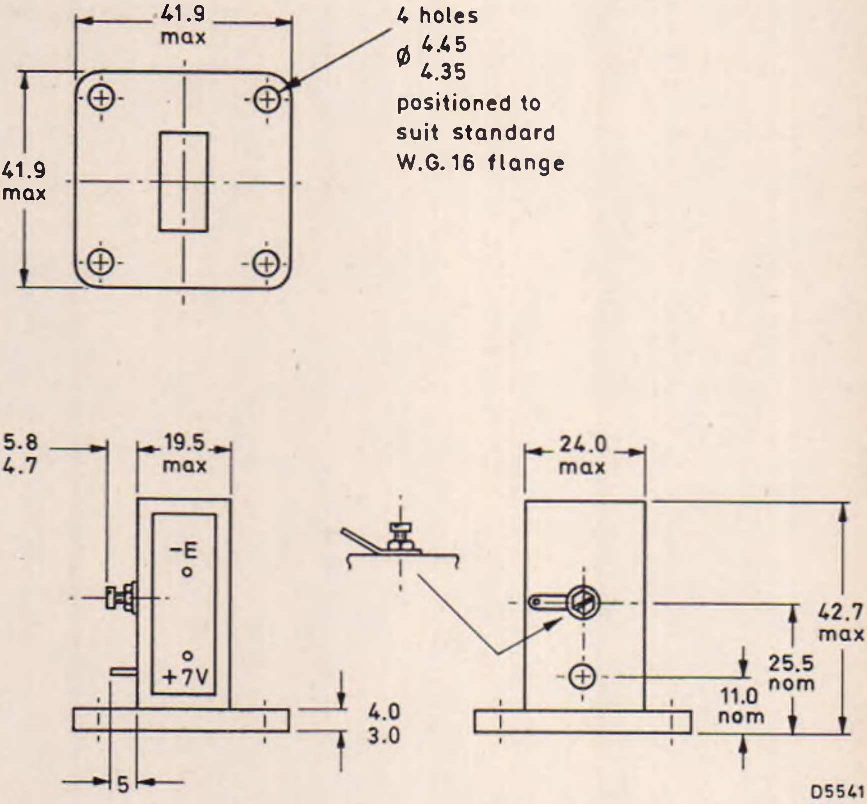
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

4. Modulation of the supply voltage within the 1Hz to 100Hz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components.

X-BAND GUNN OSCILLATOR

CL8632

OUTLINE DRAWING



X-BAND GUNN OSCILLATOR

CL8632S

TENTATIVE DATA

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 9.35GHz band as a self-oscillating mixer (auto detector).		
Centre frequency	9.35	GHz
Power output (at 7V) typical	8.0	mW
Frequency temperature coefficient	-0.25	MHz/^{o}C
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency		9.35		GHz
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	9.33	9.35	9.37	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Output voltage for input 66dB down on output power (at 6dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	24	40	-	μV
Second harmonic	-	-25	-	dbm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

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

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

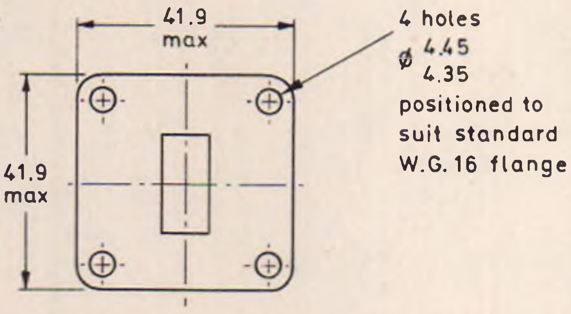
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

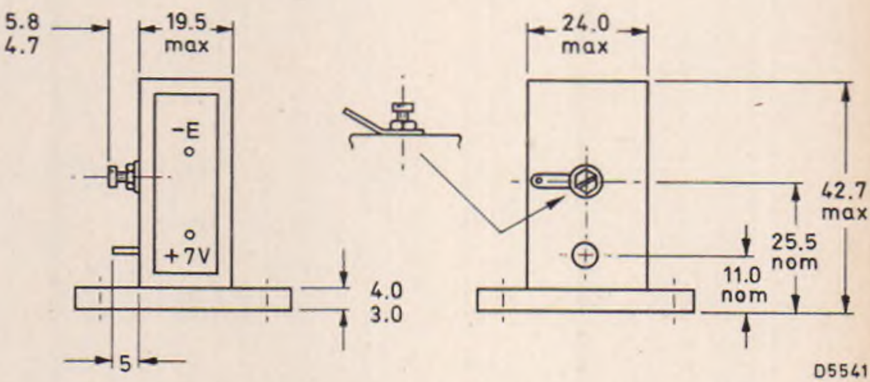
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 12m, when operating with an antenna gain of 20dB.

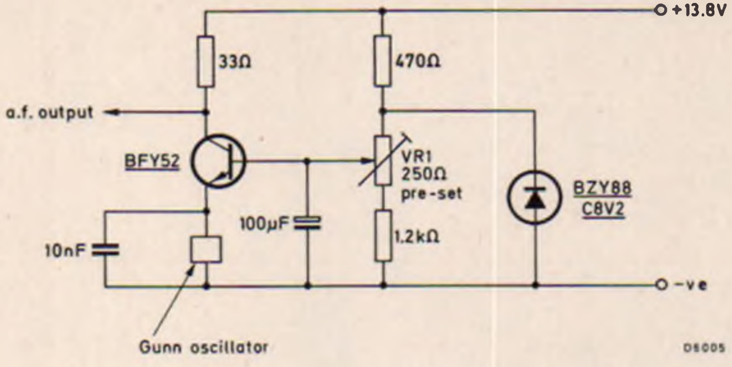
5. System bandwidth 1Hz to 1kHz.

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

OUTLINE DRAWING







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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

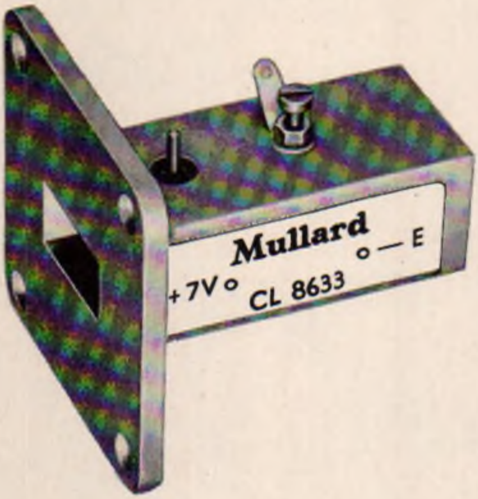
X-BAND GUNN OSCILLATOR

CL8633

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

OPERATING CONDITIONS

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



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency		10.525		GHz
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.500	10.525	10.550	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
A.M. noise to carrier ratio (1Hz to 100Hz bandwidth)		-94		dB
Second harmonic		-35		dbm

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

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

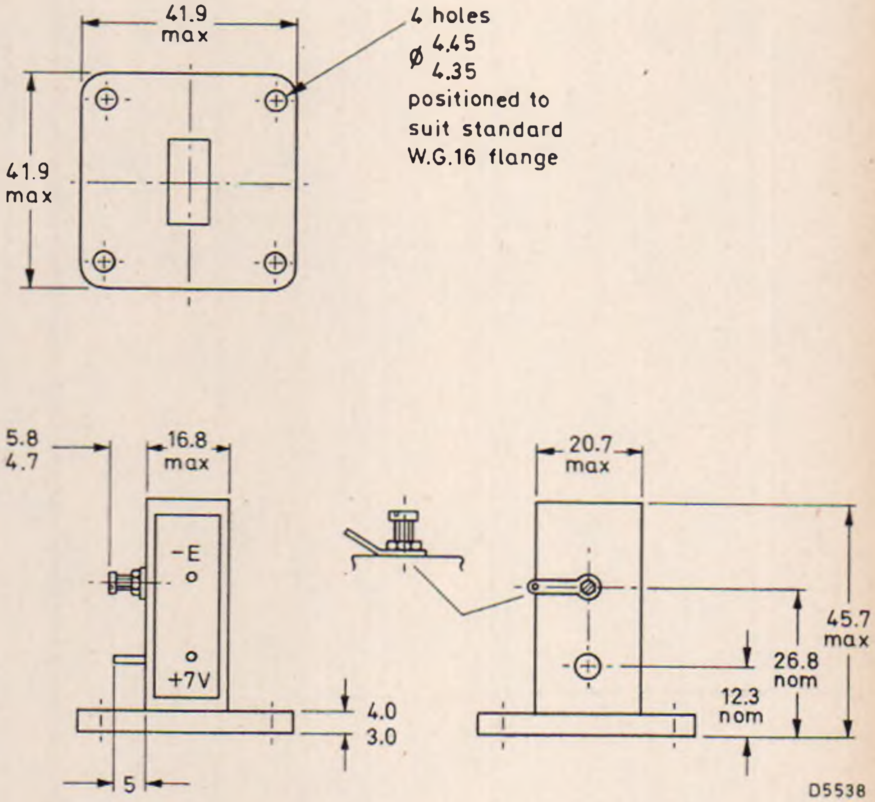
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.

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

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

5. Second harmonic level is measured into a W.G.16 load with a v.s.w.r. <1.1:1 at fundamental frequency. The level is equivalent to that radiated from a low v.s.w.r. X-band antenna, for example, Mullard ACX-01.

OUTLINE DRAWING



X-BAND GUNN OSCILLATOR

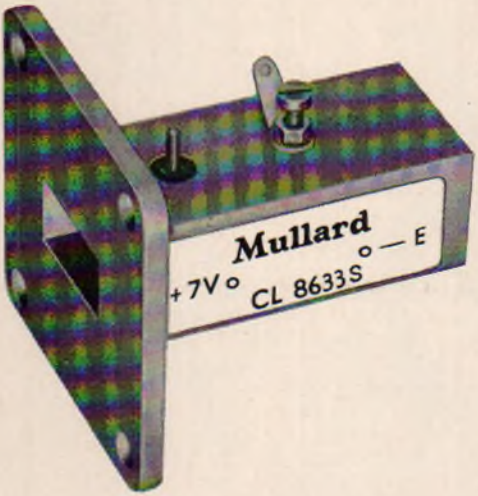
CL8633S

TENTATIVE DATA

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

OPERATING CONDITIONS

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



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

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

CHARACTERISTICS at 25°C

Centre frequency			10.525	GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.500	10.525	10.550	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/°C
Frequency pushing	-	1.5	-	MHz/V
Output voltage for input 66dB down on output power (at 6dB min. $\frac{\text{signal + noise}}{\text{noise}}$)	24	40	-	µV
Second harmonic	-	-35	-	dbm
Threshold current	-	-	200	mA
Operating current	-	120	160	mA

TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTES

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

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

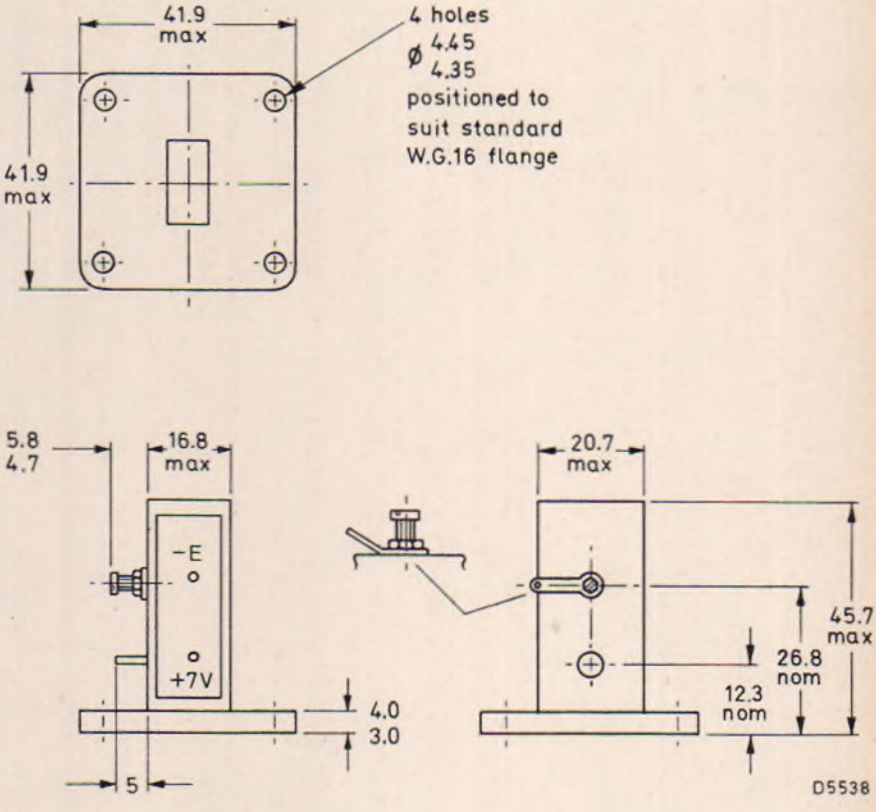
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.

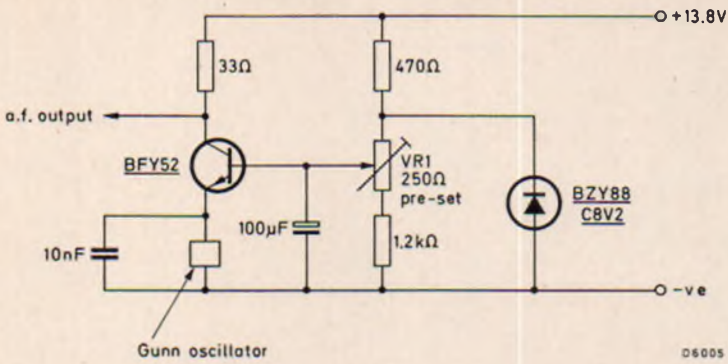
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 12m, when operating with an antenna gain of 20dB.

5. System bandwidth 1Hz to 1kHz.

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

OUTLINE DRAWING





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

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8640R
CL8640T

TENTATIVE DATA

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

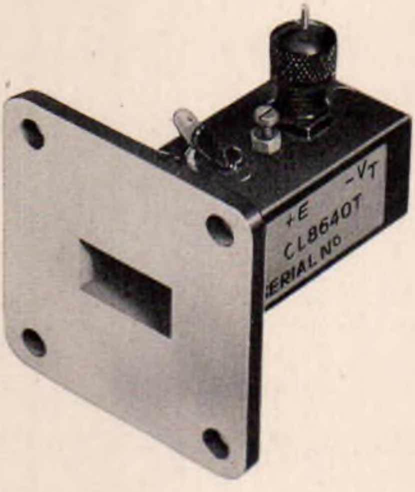
QUICK REFERENCE DATA

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

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

CL8640R - receiver local oscillator

CL8640T - transmitter



TYPICAL OPERATING CONDITIONS

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

CHARACTERISTICS (at 25°C)

Centre frequency	CL8640R	10.49	GHz
	CL8640T	10.56	GHz

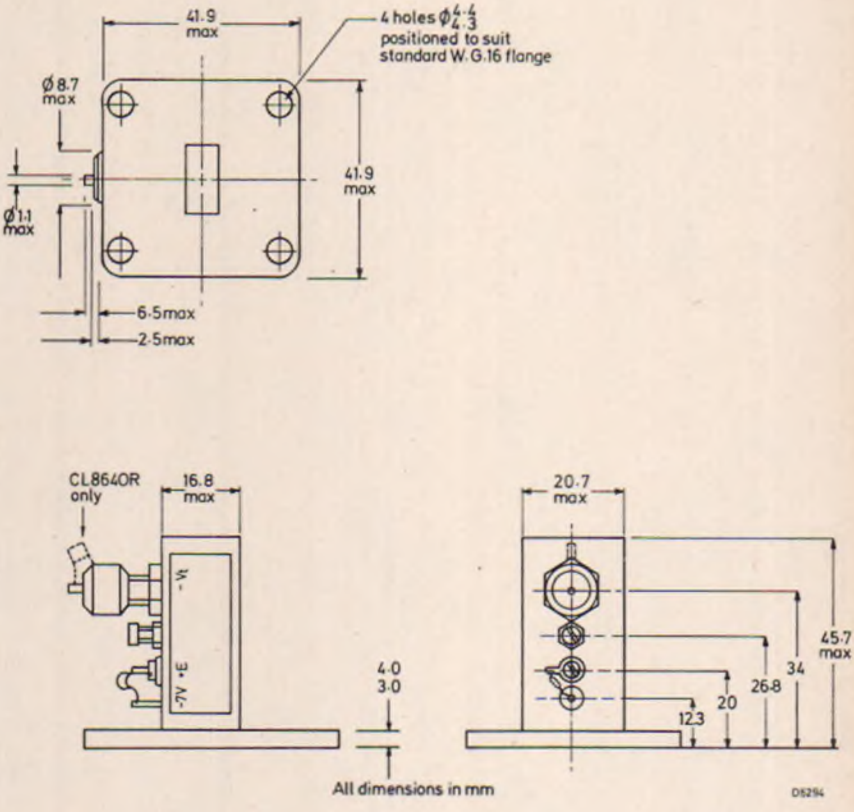
		Min.	Typ.	Max.	
Mechanical tuning range		±60	-	-	MHz
Electronic tuning range	CL8640R	±15	-	-	MHz
(notes 2 and 3)	CL8640T	±4.0	-	-	MHz
Power output at -7.0V		4.0	6.0	-	mW
Frequency pushing		-	3.0	-	MHz/V
Frequency pulling (note 4)		-	1.5	-	MHz
Frequency temperature coefficient		-	-0.25	-0.3	MHz/°C
Tuning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

TEMPERATURE

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

OPERATING NOTES

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



OUTLINE DRAWING

MIXERS

D

D

X-BAND COAXIAL BALANCED MIXERS

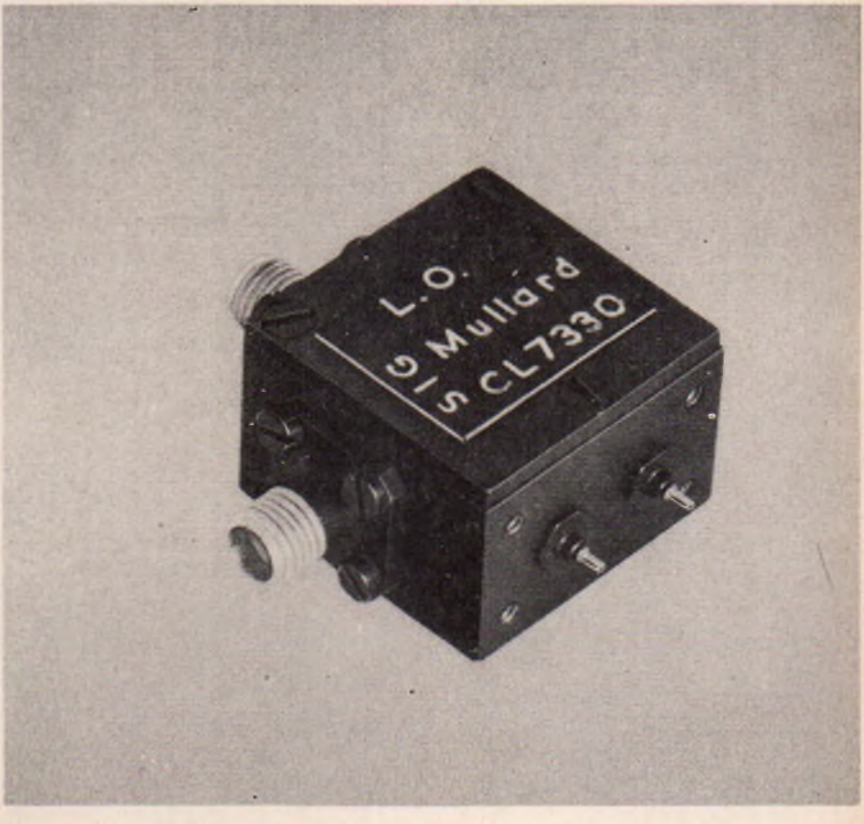
CL7330
CL7331
CL7332

QUICK REFERENCE DATA

Miniature, thin film microstrip balanced mixers using bonded non-replaceable Schottky barrier diodes. The mixers are suitable for radar and communications receivers particularly where size and weight are critical.

Frequency range		
CL7330	9 to 10	GHz
CL7331	10.7 to 11.7	GHz
CL7332	11.7 to 12.7	GHz
Noise figure, typical	7.0	dB
Input connectors	O.S.M.204	

Unless otherwise stated, data is applicable to all types



ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C) (see note 1)

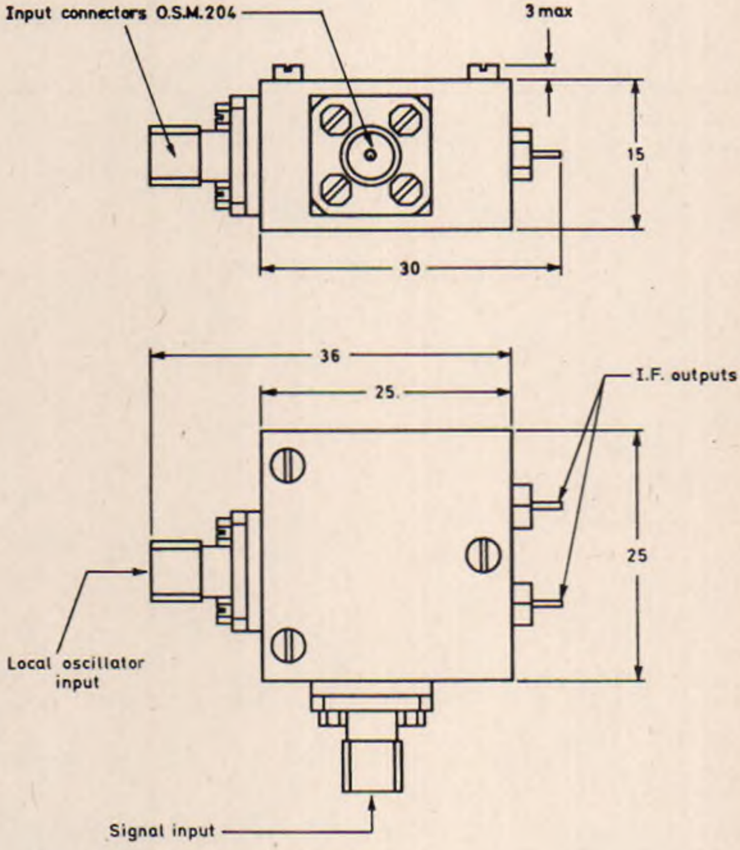
	Min.	Typ.	Max.	
Centre frequency				
CL7330		9.5		GHz
CL7331		11.2		GHz
CL7332		12.2		GHz
Bandwidth	±500	-	-	MHz
Isolation (see note 2)	15	20	-	dB
v.s.w.r. (see notes 2 and 3)	-	2.0:1	3.0:1	
Noise figure (see notes 2 and 4)	-	7.0	7.5	dB
Out of balance (see note 5)	-	0.5	1.5	dB
I.F. impedance (see note 2)	-	135	-	Ω
Output capacitance	-	4.0	-	pF
Local oscillator power (see note 2)	-	2.0	2.5	mW
Input impedance (nominal)		50		Ω

NOTES

1. Characteristics apply to the whole 1GHz frequency range of each mixer.
2. The local oscillator power level is adjusted to give 1.5mA rectified current on the most efficient diode, that is, i.f. output terminal indicating the higher current of the two.
3. Characteristics applicable to both signal and local oscillator inputs.
4. The noise figure is the overall value including a 1.5dB i.f. amplifier noise figure at 45MHz.
5. The power level is adjusted to give 1.5mA rectified current from the most efficient diode. If this level is P_1, the power is increased to P_2 to give 1.5mA rectified current from the other diode. Out of balance is defined as $10 \log_{10} \frac{P_1}{P_2}$ dB.

WEIGHT 32 g

OUTLINE DRAWING OF CL7330, CL7331 AND CL7332



All dimensions in mm

D2528

X-BAND MIXER/DETECTOR

CL7500

TENTATIVE DATA

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

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

LIMITING VALUES (Absolute max. rating system)

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

TYPICAL OPERATING CONDITIONS

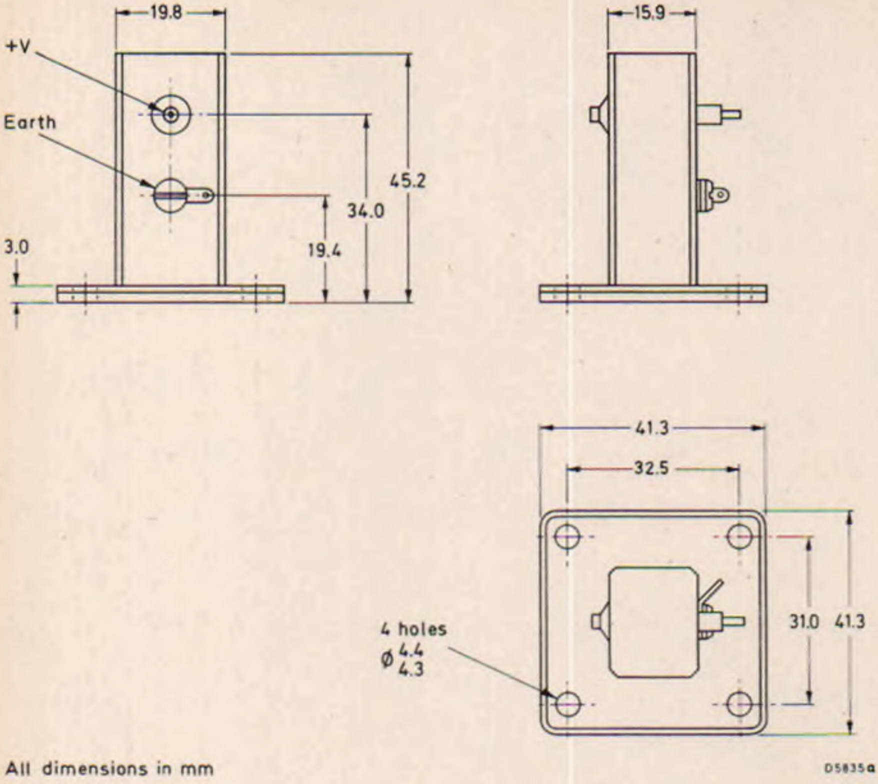
T_{amb} range	-10 to +50	°C
Local oscillator level	-18	dBm
D.C. bias	32	µA
Total load (d.c. and i.f.)	10	kΩ

ELECTRICAL CHARACTERISTICS (at 25 °C)

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

Notes see page 2

OUTLINE DRAWING



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

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

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

4) The mixer diode will be damaged by forward current in excess of 10 mA. The module is supplied with a shorting strap connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the shorting strap is not removed until all wiring has been completed.

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

X-BAND MIXER/DETECTOR

CL7520

TENTATIVE DATA

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

QUICK REFERENCE DATA

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

LIMITING VALUES (Absolute max. rating system)

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

TYPICAL OPERATING CONDITIONS

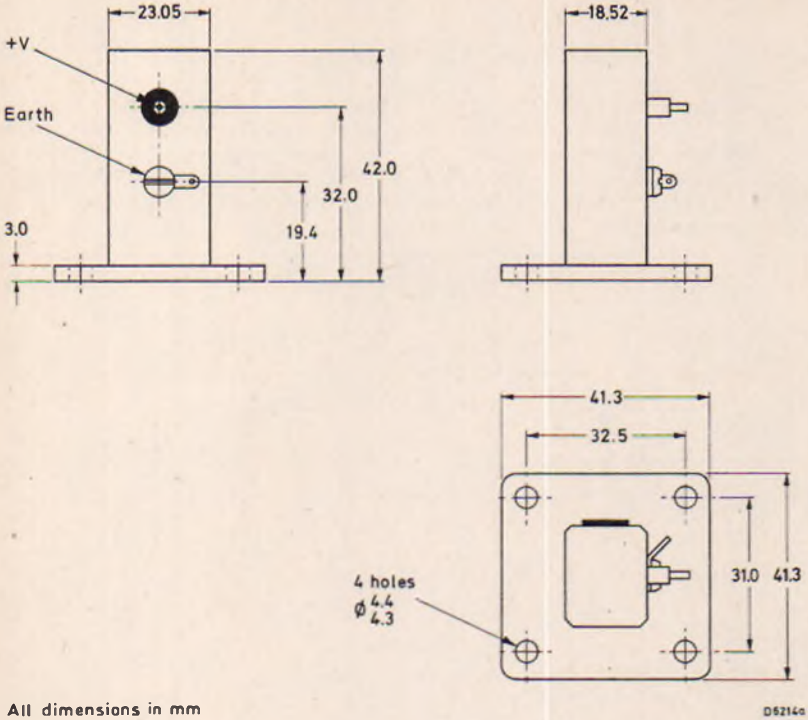
T_{amb} range	-10 to +50	°C
Local oscillator level	-18	dBm
D.C. bias	32	μA
Total load (d.c. and i.f.)	10	kΩ

ELECTRICAL CHARACTERISTICS (at 25 °C)

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

Notes see page 2

OUTLINE DRAWING



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

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

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

4) The mixer diode will be damaged by forward current in excess of 10 mA. The module is supplied with a shorting strap connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from main supplies and that the shorting strap is not removed until all wiring has been completed.

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

SUBSYSTEMS
Doppler modules
Parametric amplifiers

E

E

X-BAND DOPPLER RADAR MODULE

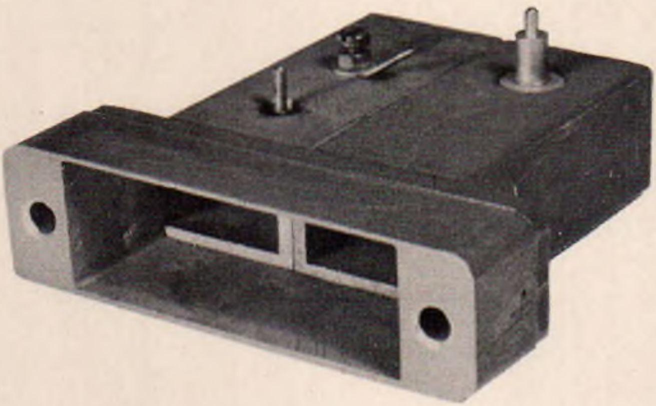
CL8960

TENTATIVE DATA

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.7GHz band. Applications include all forms of Doppler radar systems.

Centre frequency	10.687	GHz
Power output (at 7.0V) typ.	8.0	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



OPERATING CONDITIONS

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency	-	10.687	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) (see notes 1 and 4 and page 6)	20	40	-	μV
Output power at 7.0V	-	8.0	-	mW
Frequency fixed	10.675	10.687	10.700	GHz
Frequency temperature coefficient	-	−0.2	−0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	−35	-	dbm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

WEIGHT	170	g

OPERATING NOTES

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

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

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

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

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

4. Noise measured in a 1Hz to 1kHz bandwidth.

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

6. The mixer diode will be damaged by forward current in excess of 10mA. The module is supplied with a shorting strap connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the shorting strap is not removed until all wiring has been completed.

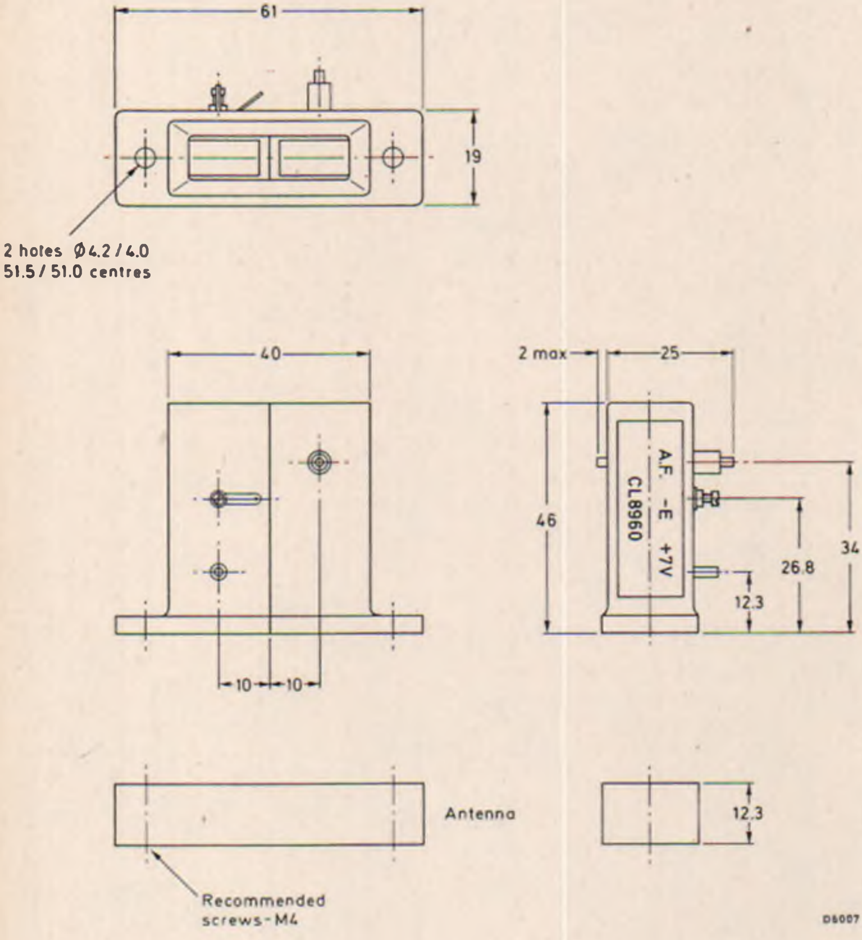
7. The above conditions apply when operated into the antenna supplied with the CL8960 module.

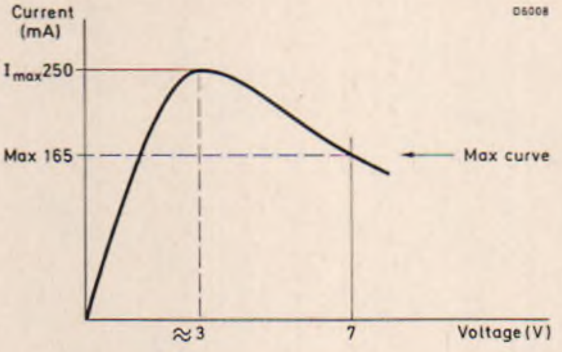
8. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.

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

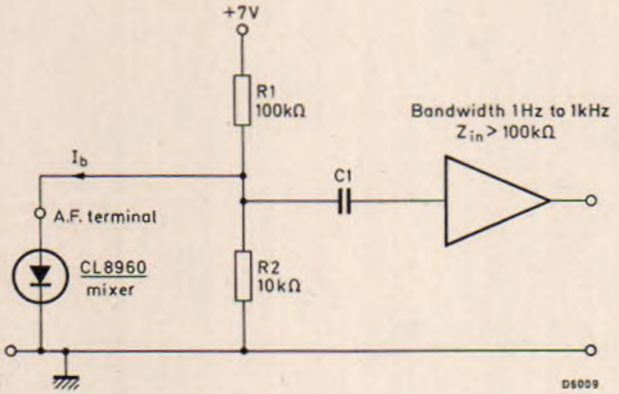
Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OUTLINE DRAWING





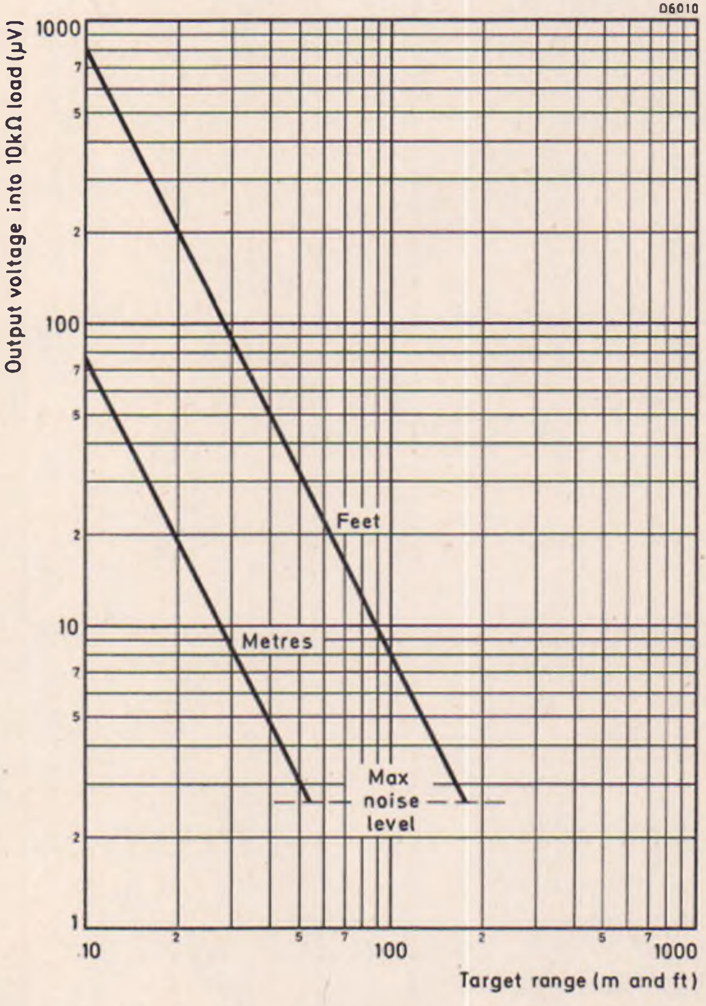
GUNN DEVICE CHARACTERISTIC



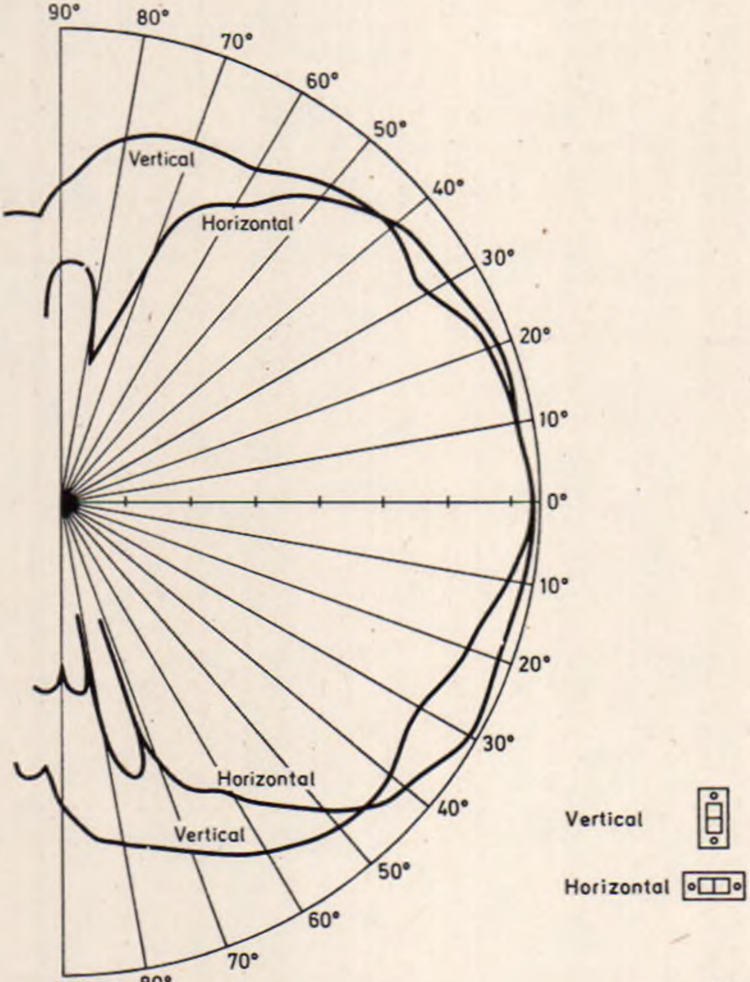
CIRCUIT USED TO MEASURE A.F. PERFORMANCE

NOTES

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



MINIMUM OUTPUT FOR A MAN TARGET



POLAR DIAGRAM FOR ANTENNA SUPPLIED

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

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

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

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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

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

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

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

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

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

Cobex is a product of: British Industrial Plastics,
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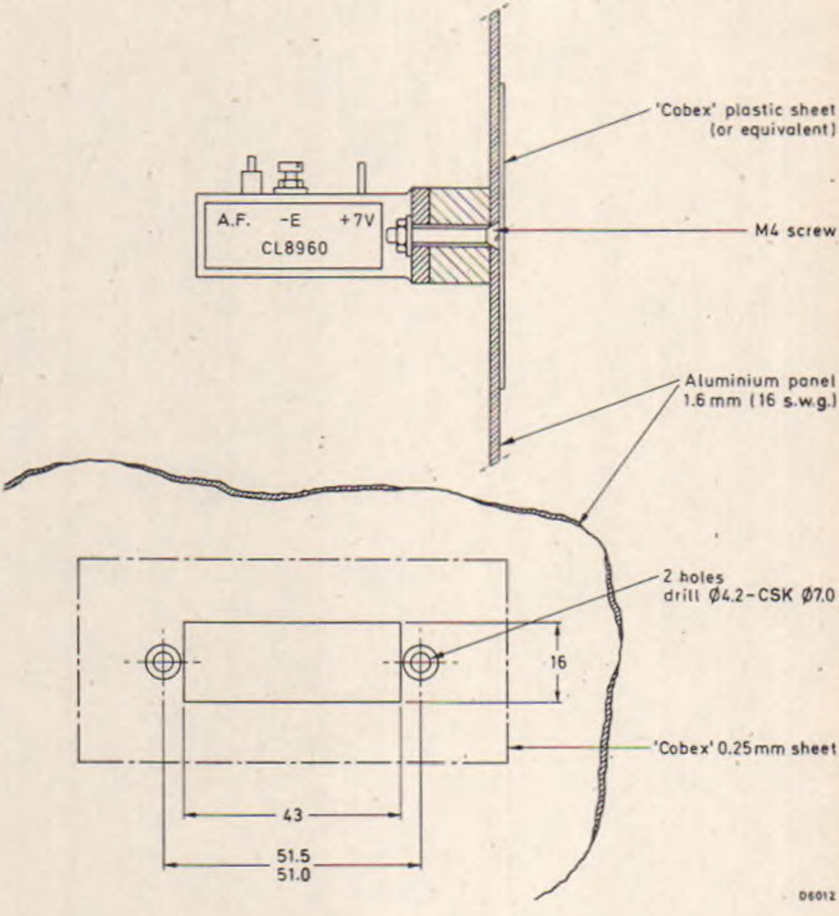
Brantham,
Manningtree, Essex CO11 1NJ



PANEL MOUNTING DETAILS

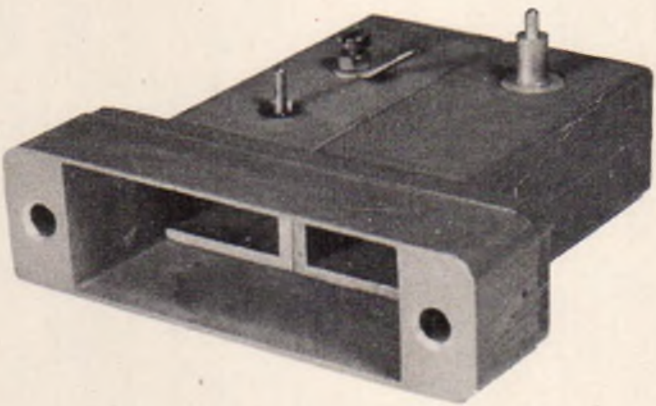
X-BAND DOPPLER RADAR MODULE

CL8963

TENTATIVE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.5GHz band. Applications include all forms of Doppler radar systems.

QUICK REFERENCE DATA		
Centre frequency	10.525	GHz
Power output (at 7.0V) typ.	8.0	mW
Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$ (see page 6 and note 1)	40	μV
Supply voltage	7.0	V



OPERATING CONDITIONS

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

CHARACTERISTICS at 25°C

	Min.	Typ.	Max.	
Centre frequency	-	10.525	-	GHz
Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal + noise}}{\text{noise}}$) see notes 1 and 4 and page 6	20	40	-	μV
Output power at 7.0V	-	8.0	-	mW
Frequency fixed	10.500	10.525	10.550	GHz
Frequency temperature coefficient	-	-0.2	-0.3	MHz/°C
Frequency pushing	-	4.0	-	MHz/V
Second harmonic	-	-35	-	dbm
Diode current (see note 3)	-	130	165	mA
Polar diagram		see page 7		

WEIGHT 170 g

OPERATING NOTES

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

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

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

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

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

4. Noise measured in a 1Hz to 1kHz bandwidth.

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

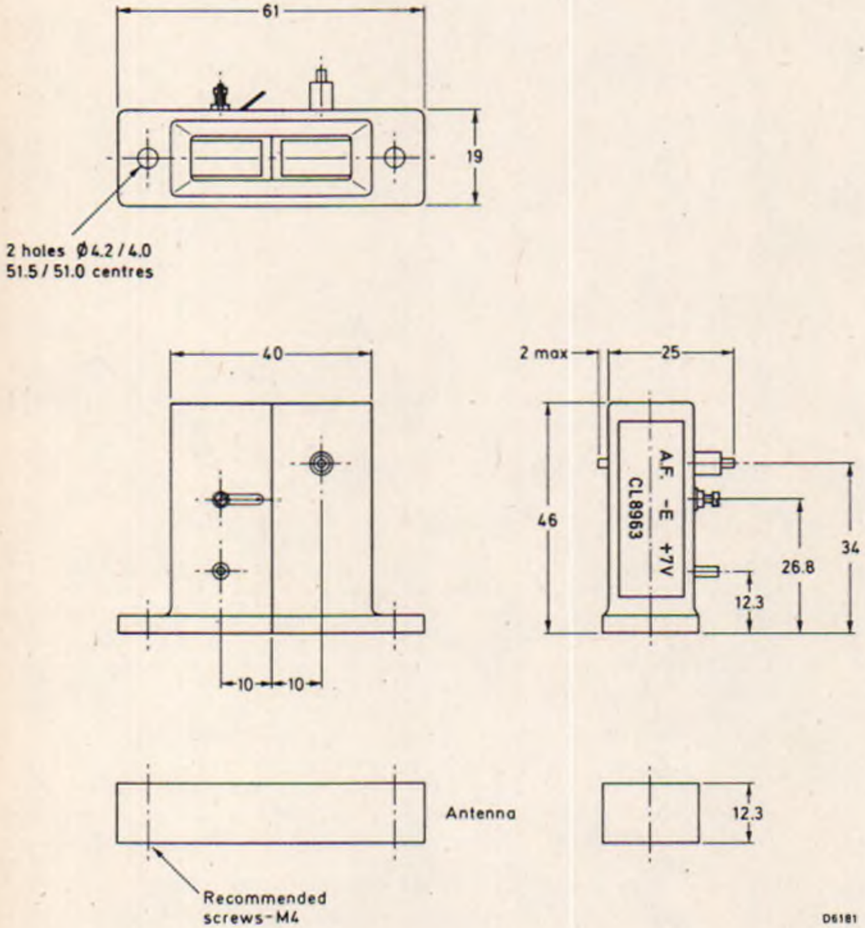
6. The mixer diode will be damaged by forward current in excess of 10mA. The module is supplied with a shorting strap connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from main supplies and that the shorting strap is not removed until all wiring has been completed.

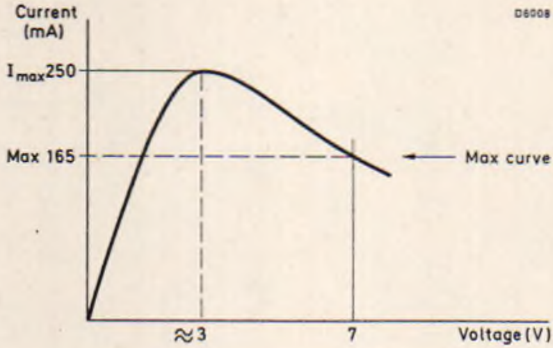
7. The above conditions apply when operated into the antenna supplied with the CL8963 module.

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

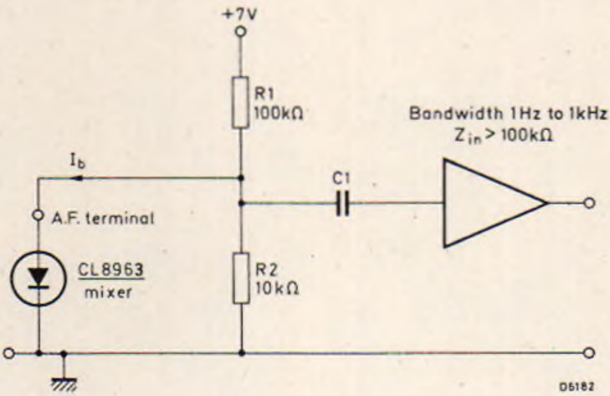
9. $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

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


61
19
2 holes Ø4.2 / 4.0
51.5 / 51.0 centres
40
10
10
2 max
25
46
A.F. -E +7V
CL8963
34
26.8
12.3
Antenna
12.3
Recommended
screws-M4
D6181



GUNN DEVICE CHARACTERISTIC



CIRCUIT USED TO MEASURE A. F. PERFORMANCE

NOTES

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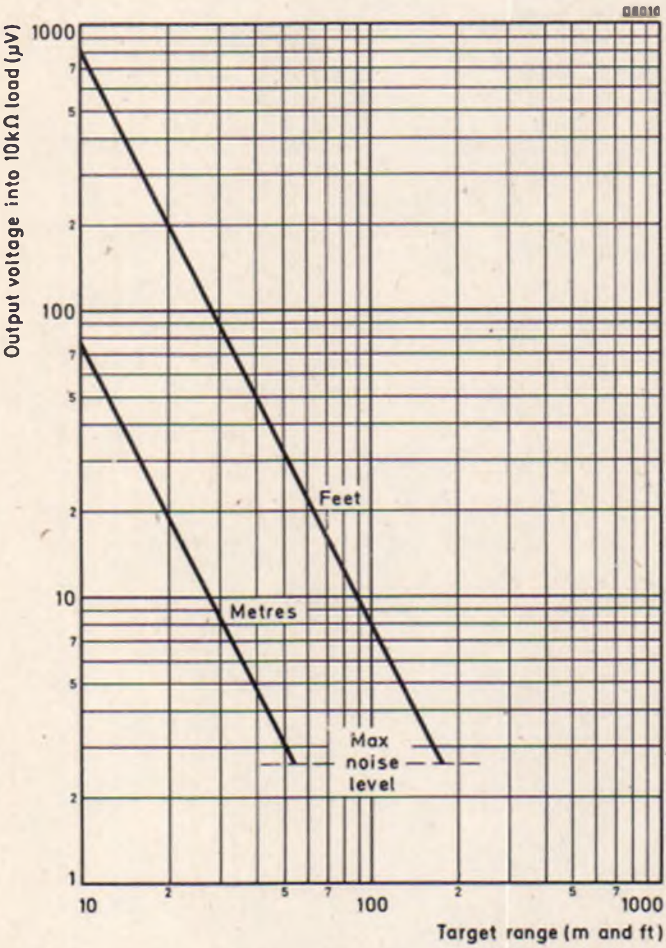
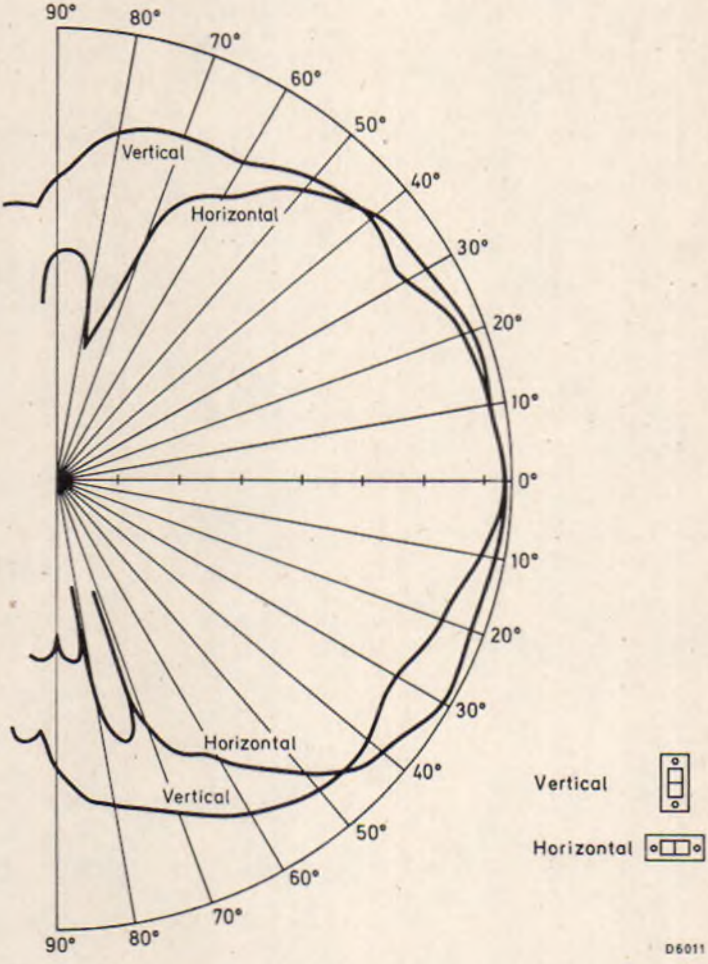
2. The coupling capacitor should have a small impedance compared with Z_{in}.



MINIMUM OUTPUT FOR A MAN TARGET



POLAR DIAGRAM FOR ANTENNA SUPPLIED

MODULE MOUNTING

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

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

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

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

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

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

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

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

L.O. coupling (dbm)	Mixer total bias (μA)	Antenna covering material
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-15	50	1 to 2cm expanded polythene or polystyrene
-11	61	0.25mm Cobex plastic
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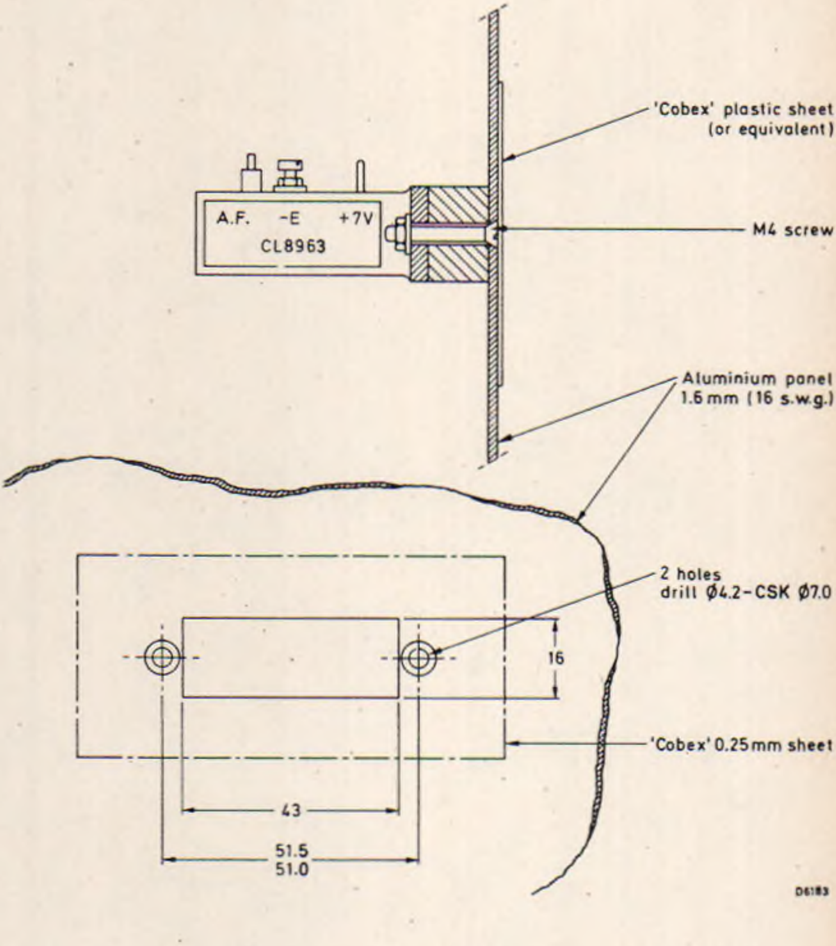


PANEL MOUNTING DETAILS

PARAMETRIC AMPLIFIER CL9012G

TENTATIVE DATA

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

QUICK REFERENCE DATA		
Power gain	17	dB
Tuning range (min.)	2.9 to 3.1	GHz
Noise figure (max.)	3.0	dB
Input and output impedance	50	Ω
Mains supply voltage (50 Hz)	240 ± 10%	V

ELECTRICAL CHARACTERISTICS [1]

	Min.	Typ.	Max.	
Power gain (recommended setting) [2]	-	17	-	dB
Operating frequency	2.9	-	3.1	GHz
Noise figure (at 3.1 GHz) [3]	-	2.9	3.0	dB
(at 2.9 GHz) [3]	-	2.7	2.8	dB
Bandwidth [4]	22	-	30	MHz
Input saturation level (referred to 1 mW) [5]	-32	-30	-	dBm
Gain stability: long term	-	±0.5	-	dB/day
short term	-	±0.1	-	dB/h

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (T_{amb} = 25 °C)

Maximum continuous r.f. input power	100	mW
Maximum input spike energy	500	nJ
Mains supply (max.)	260	V
T_{amb} operating range	-20 to +35	°C
T_{stg} range	-30 to +50	°C

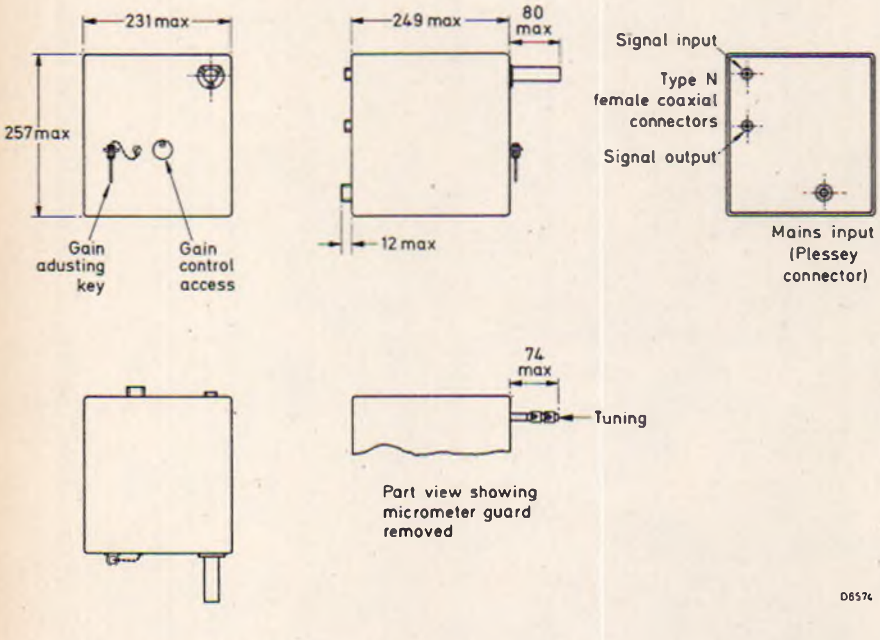
MASS	5.4	kg

Notes see page 2

NOTES

1. These are given for matched conditions.
2. The gain is set mechanically in the first place by adjusting the internal attenuator, using the hexagonal key supplied. Small variations may be made by using the potentiometer on the front panel.
3. The amplifier noise figure includes a contribution from the internal circulator, but excludes that from the following receiver.
4. The bandwidth is measured to the -3 dB points with the gain being set at 17 dB.
5. This is the input level at which the gain is compressed by 1 dB, the gain being set at 17 dB.
6. Internal temperature of unit is automatically stabilized at 35 °C. Alternative internally stabilized temperatures may be provided on request. The unit may be supplied without the temperature controlled enclosure for operation under controlled environment conditions.

Active consideration will be given to custom built parametric amplifiers to suit customers' specific requirements.



OUTLINE DRAWING

PARAMETRIC AMPLIFIER CL9070

TENTATIVE DATA

A single diode non-degenerate parametric amplifier designed for use as a low noise pre-amplifier in microwave applications. Mounted on a single temperature stabilized baseplate with its solid state Gunn-effect oscillator pump and integral power supply fully enclosed. An external fine gain control is included.

QUICK REFERENCE DATA

Operating frequency	1.090	GHz
Power gain	17	dB
Tuning adjustment (min.)	±20	MHz
Noise figure (max.)	2.0	dB
Input and output impedance	50	Ω
Mains supply voltage (50Hz)	240 ± 10%	V

ELECTRICAL CHARACTERISTICS

		Min.	Typ.	Max.	
Power gain (recommended setting) (see note 1)		-	17	-	dB
Operating frequency		-	1.09	-	GHz
Noise figure (see note 2)		-	1.8	2.0	dB
Bandwidth (see note 3)		-	23	-	MHz
Input saturation level (referred to 1mW) (see note 4)		-	-32	-	dbm
Gain stability:	long term	-	±0.5	-	dB/day
	short term	-	±0.1	-	dB/h
Gain adjustment:	coarse mechanical	+10 -17	-	-	dB
	fine electrical	±2.0	-	-	dB

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (T_{amb} = 25°C)

Maximum continuous r.f. input power	100	mW
Maximum input spike energy	500	nJ
	5	erg
Mains supply (max.)	264	V
T_{amb} operating range	-20 to +60	°C
T_{stg} range	-30 to +80	°C

Mullard

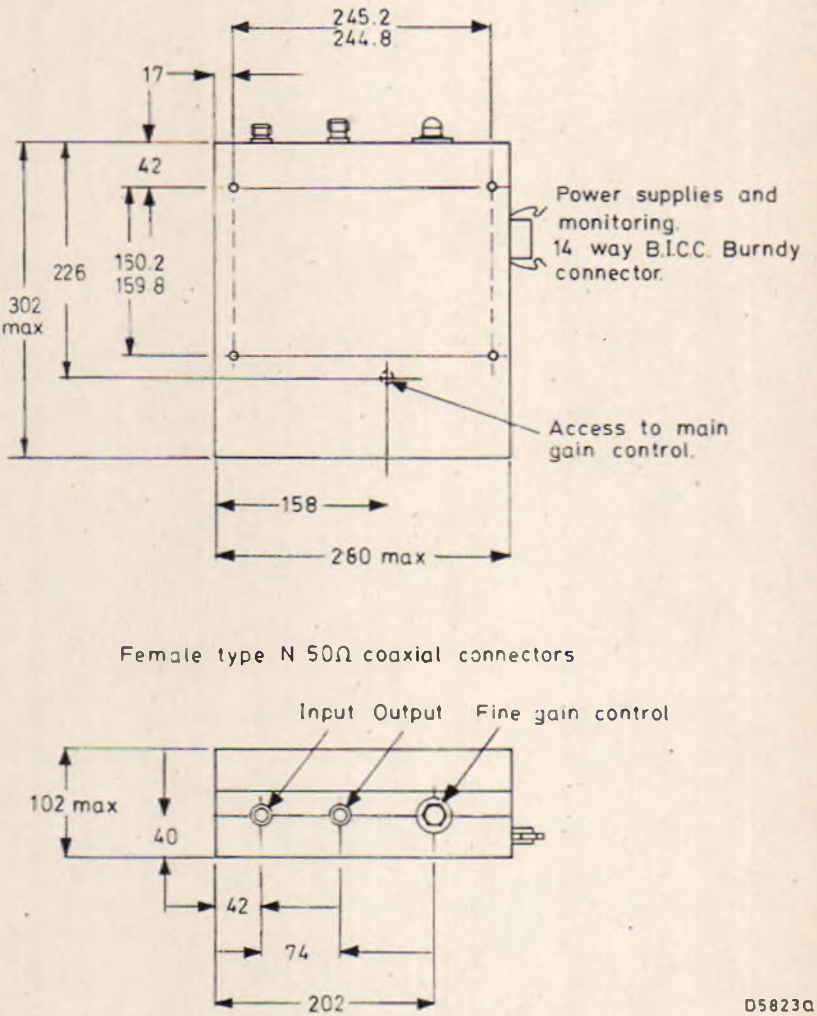
WEIGHT	5.4	kg

NOTES

1. The gain is set mechanically in the first place by adjusting the internal attenuator, using the hexagonal key supplied. Small variations may be made by using the potentiometer on the front panel.
2. The amplifier noise figure includes a contribution from the internal circulator, but excludes that from the following receiver.
3. The bandwidth is measured to the -3dB points with the gain set at 17dB.
4. This is the input level at which the gain is compressed by 1dB, the gain being set at 17dB.

> Active consideration will be given to custom built parametic amplifiers to suit customers' specific requirements.

OUTLINE DRAWING



CIRCULATORS

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CIRCULATORS

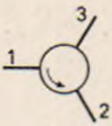
GENERAL EXPLANATORY NOTES

INTRODUCTION

A circulator is a passive non-reciprocal device with three or more ports. It contains a core of ferrite material in which energy introduced into one port is transferred to an adjacent port, the other ports being isolated.

Although circulators can be made with any number of ports, the most commonly used are 3 ports and 4 ports, the symbols of which are given in Fig.1 and 2.

symbols



3 port circulator
Fig.1

4 port circulator
Fig.2

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

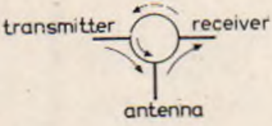
In an ideal circulator no energy would flow in the direction opposite to the circulation direction. Again in practice this isolation is in the order of 20 to 30 dB, in very narrow bands even higher.

The non-reciprocal behaviour of circulators is the result of gyromagnetic effects in the ferrite when this is biased with a magnetic field.

APPLICATION

The main application of circulators is duplexing of systems for simultaneous transmission and reception in low and medium power telecommunication equipment as illustrated in Fig.3 and 4.

a.



b.

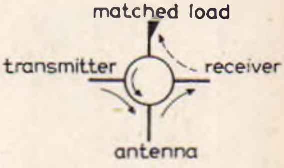


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Fig.3
Duplexing of one receiver
and one transmitter

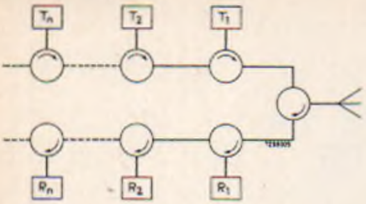


Fig.4
Duplexing of a number of transmitters and receivers

R = receiver; T = transmitter

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

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

A 3 port circulator can also be used as an isolator by putting a matched load on one port, Fig.5. Particularly at lower frequencies the characteristics of a circulator as to decoupling of functions are superior to those of an isolator. Decoupling can be increased by cascading circulators, see Fig.6. The decoupling is directly proportional to the number of circulators; so is the insertion loss.

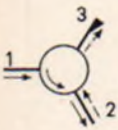


fig.5

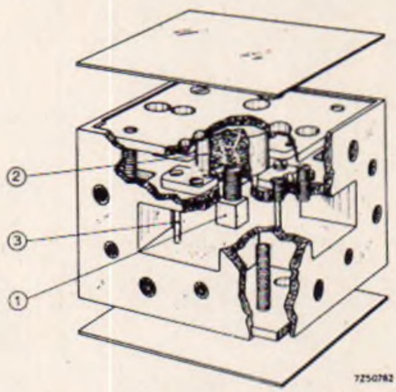
fig.6

CONSTRUCTION

As for the construction of the circulators two types may be distinguished, the waveguide circulators and the coaxial circulators. Both are junction types.

<u>Waveguide circulators</u>

Construction of a waveguide circulator
Fig.7



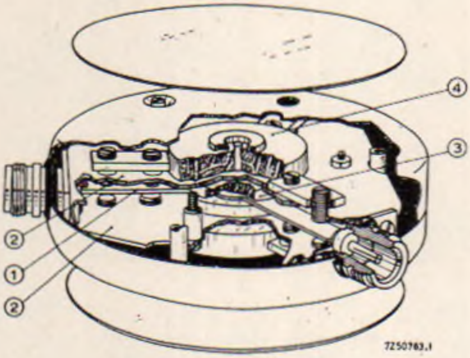
Mullard

In this type three or four waveguides intersect each other at 120° or 90° angles. In Fig.7 a 4-port waveguide circulator of the junction type is shown. Exactly in the centre of the intersection a piece of ferrite (1) is located between two magnets (2).

In the waveguide some posts (3) are placed which are required to achieve a good match.

Coaxial circulators

In Fig.8 a coaxial circulator of the junction type is shown. Three copper strips (1) intersect at an angle of 120° in the centre of the circulator, thus forming a Y-arrangement [1]). These strips are mounted between two earth plates (2), in this way forming a matched high frequency conductor. In the exact centre of the circulator two ferrite discs (3) and magnets (4) are mounted.



Construction of a coaxial circulator
Fig.8

Mounting

Mounting of a coaxial circulator can be done by removing the three screws in the cover plates. The screw size is 3 x 10 mm metric. The circulator can then be placed directly against a metal support and be secured by the three screws.

TERMS AND DEFINITIONS

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

1) A T-arrangement can be made on request.

Isolation is the ratio, expressed in dB, of the energy entering into a port to the energy scattered into the adjacent port on the side opposite to normal circulation. It is measured with a matched source and all other ports correctly terminated. The isolation α_{1-3}, i.e. the isolation between ports 1 and 3, is equal to α_{3-2} and α_{2-1}. (See Fig. 1).

Insertion loss is the attenuation which results from including a circulator in the transmission system. It is given as a ratio expressed in dB which compares the situation before and after the insertion of the circulator, i.e., the power delivered to a matched load is compared with the power delivered to the same load after the insertion of a circulator (which has the isolated port terminated with a matched load).

Voltage standing wave ratio (VSWR) is the ratio of the maximum to the minimum voltages along a lossless line attached to the circulator. It is measured with all other ports terminated by a matched load. The coaxial circulators are designed with a characteristic impedance of 50 ohms.

Maximum power is the largest power that a circulator can handle at sea level when one port is terminated with a mismatch of VSWR = 2, whilst the next port is matched with VSWR $\leq$ 1.2. This power value should under no circumstances be exceeded.
For coaxial circulators the maximum power is the maximum continuous wave power unless a maximum peak power is separately stated. These power levels should not be exceeded.

The peak power is the maximum peak sync power as defined by the CCIR signal standard. This value is given for circulators in the VHF and UHF television frequencies. If this value is exceeded the circulator can be damaged by arcing in the internal transmission structure of the circulator.

Temperature range is the ambient temperature range within which the circulators will function to specification. (When necessary special temperature compensation is built in.) Outside this temperature range the circulator still functions but the electrical behaviour may be far outside the guaranteed specifications. However, no permanent damage can be expected unless a large temperature rise is caused by excessive power handling.

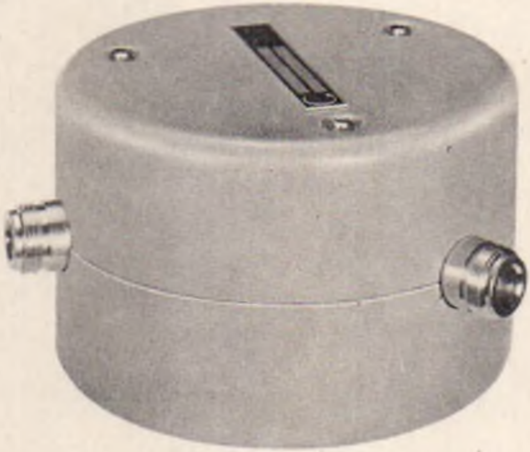
CAUTION

a. The circulators have rather strong internal magnetic fields which are carefully adjusted for optimal operation.

b. They are not to be subjected to strong external magnetic fields.

CIRCULATOR
(2722 162 01121)

CL5027



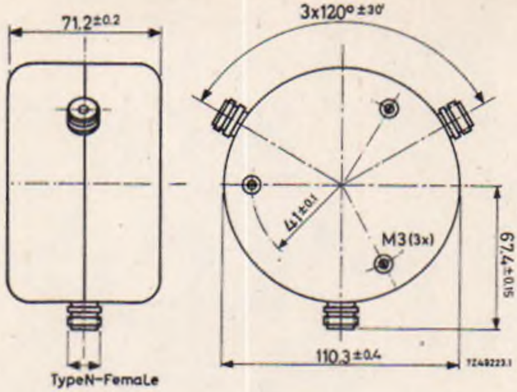
ELECTRICAL DATA

Frequency range	0.47-0.60 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 °C

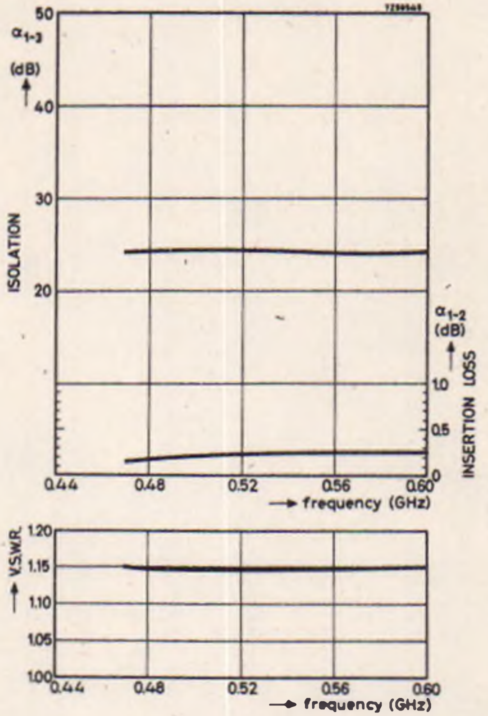
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female*)
Finish	connectors silverplated, outside enamelled grey
Weight	2080 g

*) Also available with connectors HF 7/16 (according to DIN 47223) and EIA 7/8



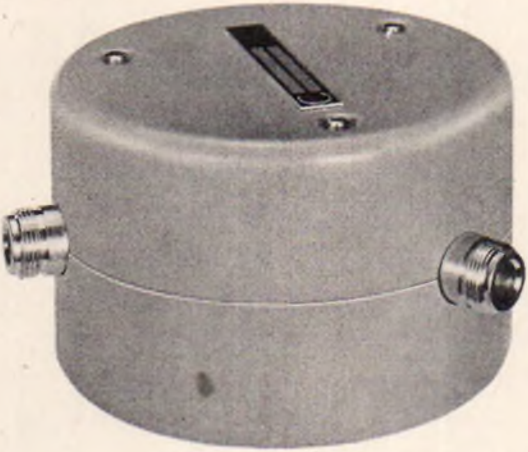
Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR
(2722 162 01131)

CL5028



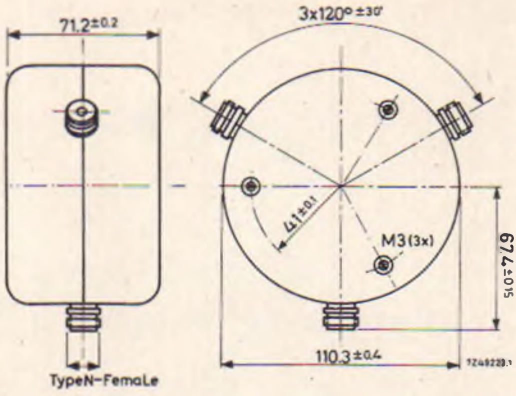
ELECTRICAL DATA

Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 ^{o}C

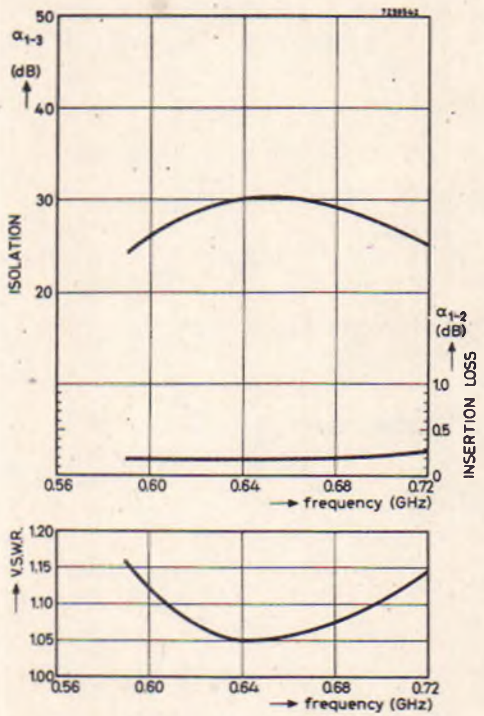
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female*)
Finish	connectors silverplated, outside enamelled grey
Weight	2080 g

*) Also available with connectors HF 7/16 (according to DIN 47223) and EIA 7/8



Dimensions in mm

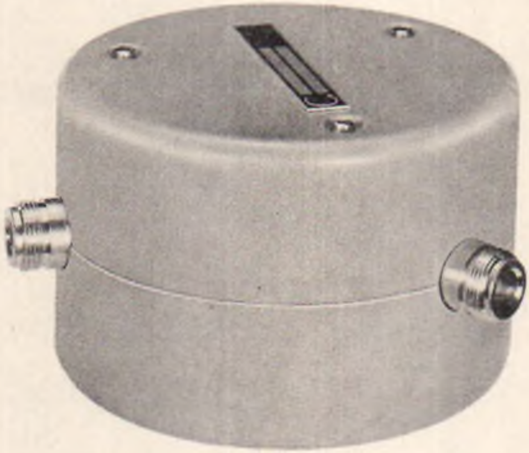


Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5029

(2722 162 01141)



ELECTRICAL DATA

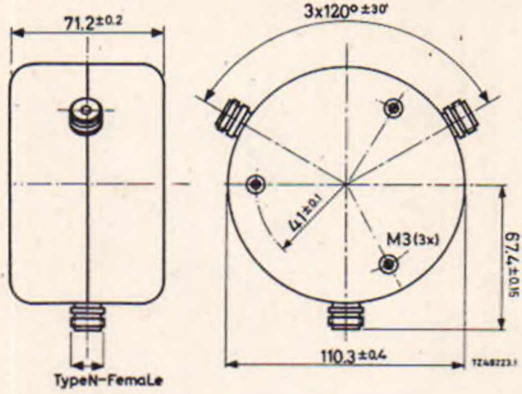
Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 ^{o}C

MECHANICAL DATA

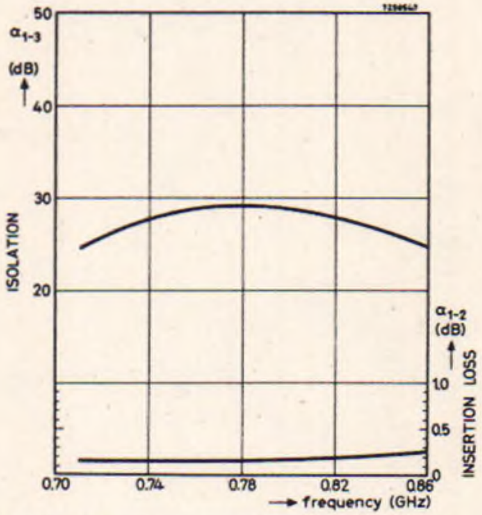
Construction	coaxial 3 port
Terminations	type N-female*)
Finish	connectors silverplated, outside enamelled grey
Weight	2080 g

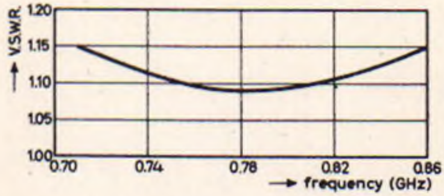
*) Also available with connectors HF 7/16 (according to DIN 47223) and EIA 7/8

Mullard



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

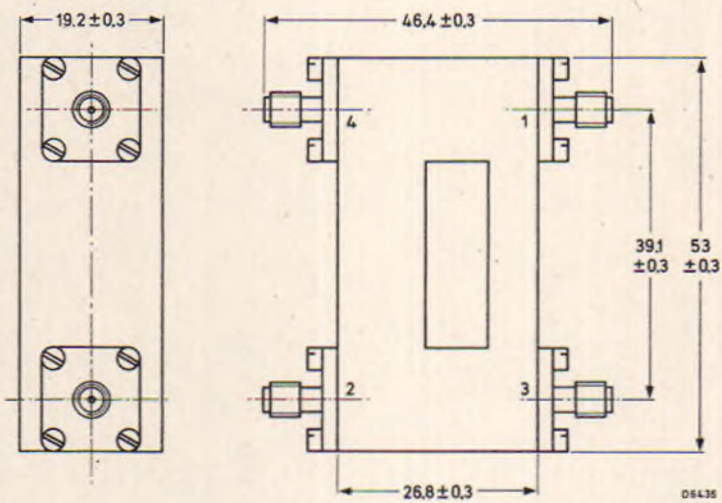
(2722 162 04031)

CL5032

COAXIAL 4-PORT CIRCULATOR

Frequency 3.8 to 4.2 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	3.8 to 4.2 GHz	-
Isolation α_{1-4}, α_{3-2}	≥ 25 dB	27 dB
α_{2-1}, α_{4-3}	≥ 50 dB	52 dB
Insertion loss α_{4-1}, α_{2-3}	≤ 0.25 dB	0.2 dB
α_{1-2}, α_{3-4}	≤ 0.5 dB	0.4 dB
V.S.W.R.	≤ 1.12	1.1
Maximum power (c.w.)	10 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012)
Finish of connectors	gold plated
Weight	220 g

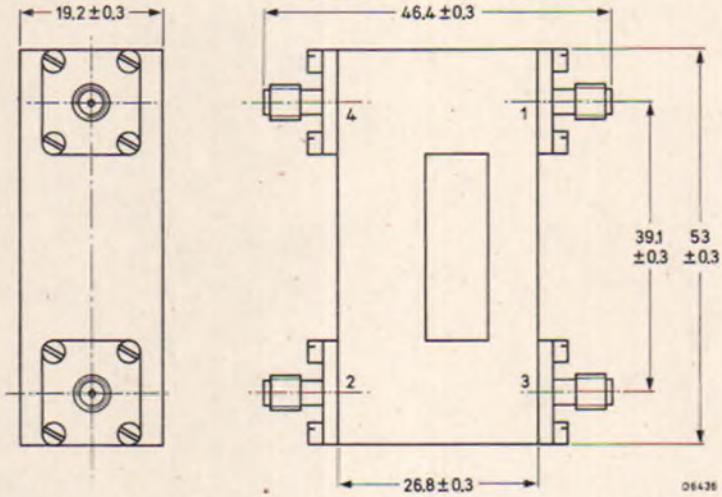
CIRCULATOR
(2722 162 04041)

CL5042

COAXIAL 4-PORT CIRCULATOR

Frequency 4.4 to 5 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

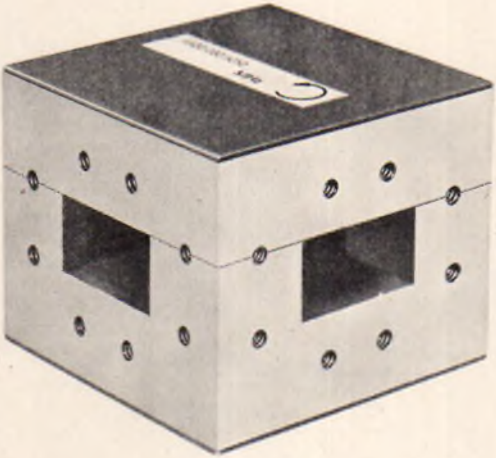
	guaranteed values	typical values
Frequency range	4.4 to 5 GHz	-
Isolation α_{1-4}, α_{3-2}	≥ 25 dB	27 dB
α_{2-1}, α_{3-4}	≥ 50 dB	52 dB
Insertion loss α_{4-1}, α_{2-3}	≤ 0.25 dB	0.2 dB
α_{1-2}, α_{3-4}	≤ 0.5 dB	0.4 dB
V.S.W.R.	≤ 1.12	1.1
Maximum power (c.w.)	10 W	
Temperature range	-10 to +70 ^{o}C	at 25 ^{o}C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012)
Finish of connectors	gold plated
Weight	220 g

CIRCULATOR
(2722 161 03001)

CL5050

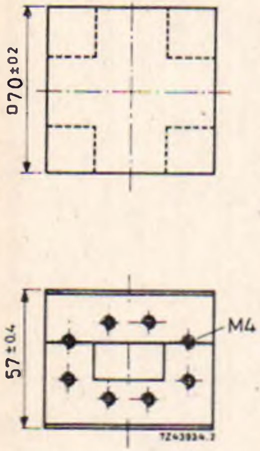


ELECTRICAL DATA

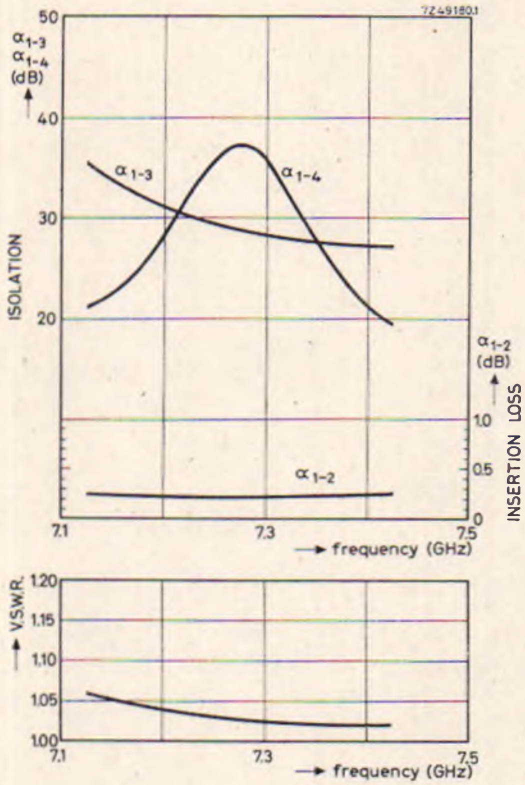
Frequency range	7.125-7.425 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 ^{0}C
	For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



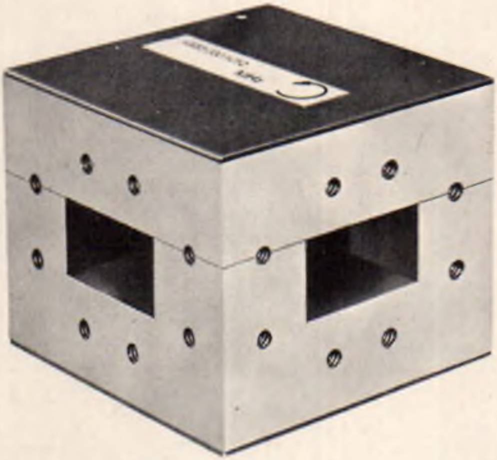
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR
(2722 161 03011)

CL5051



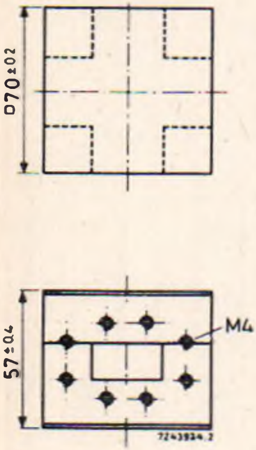
ELECTRICAL DATA

Frequency range	6.825-7.125 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.4
V.S.W.R.	< 1.08
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

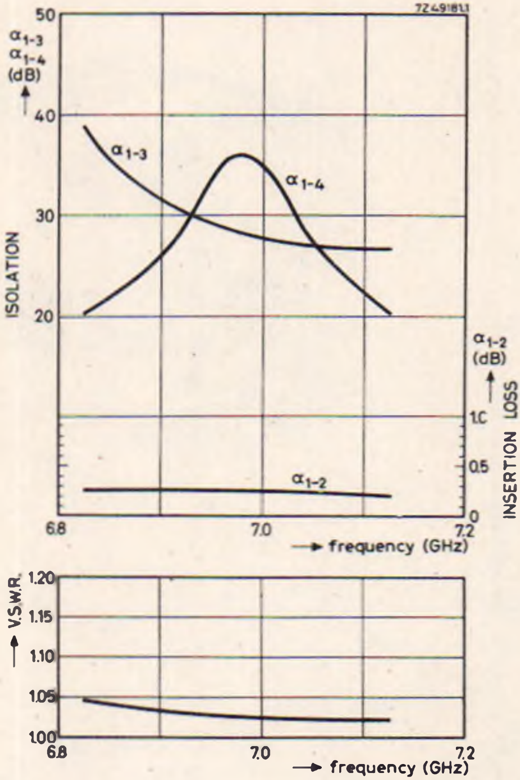
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g

Mullard



Dimensions in mm.

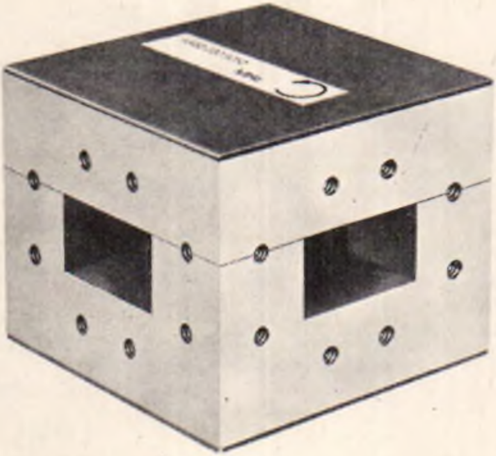


Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

(2722 161 03031)

CL5053

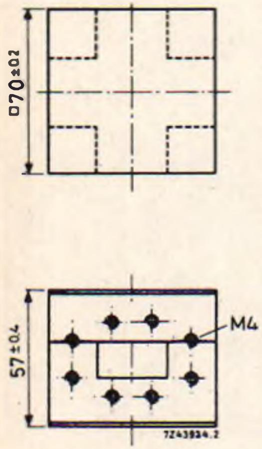


ELECTRICAL DATA

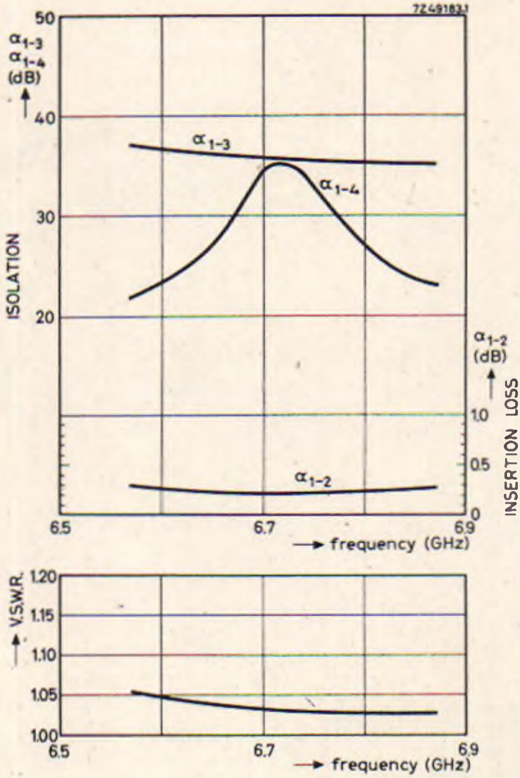
Frequency range	6.575-6.875 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C
	For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



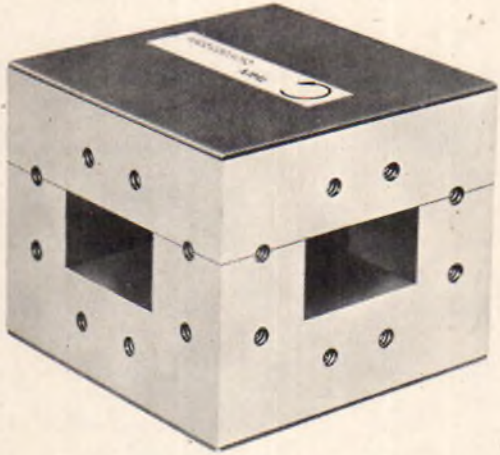
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR
(2722 161 03041)

CL5054

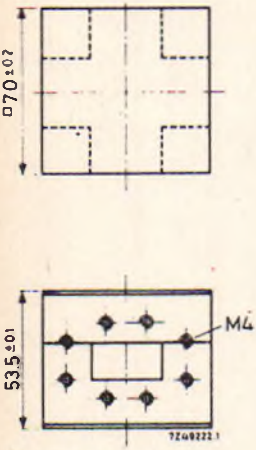


ELECTRICAL DATA

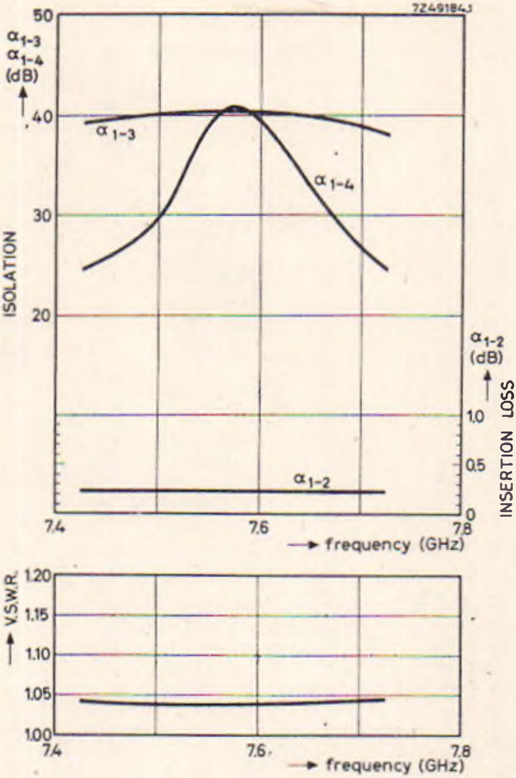
Frequency range	7.425-7.725 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



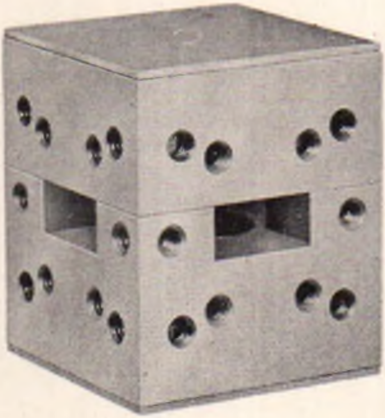
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR
(2722 161 03051)

CL5055

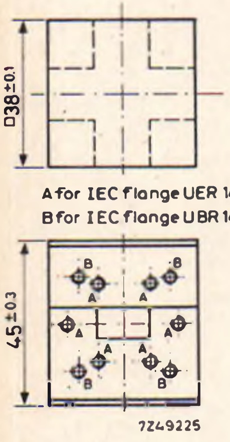


ELECTRICAL DATA

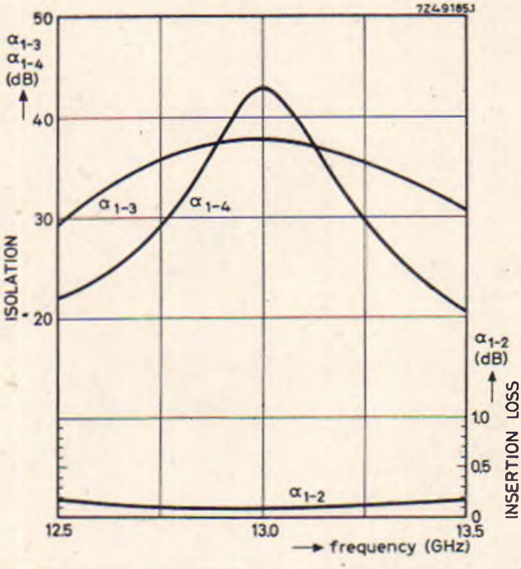
Frequency range	12.5 – 13.5 GHz
Isolation a_{1-3}	> 25 dB
a_{1-4}	> 20 dB
Insertion loss a_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	25 W
Temperature range	+ 10 to + 60 °C For other temperature ranges please inquire

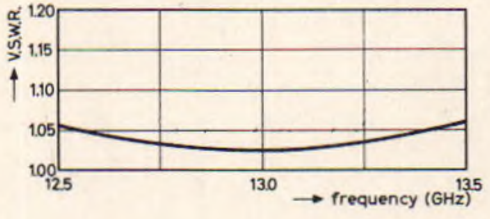
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER140 and UBR140 (I.E.C.)
Finish	goldplated upon silverplated outside enamelled grey
Weight	320 g



Dimensions in mm.

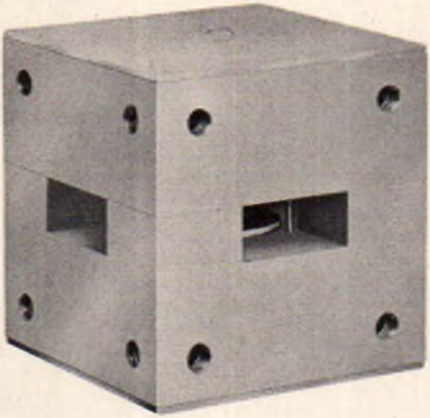




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR
(2722 161 03061)

CL5056

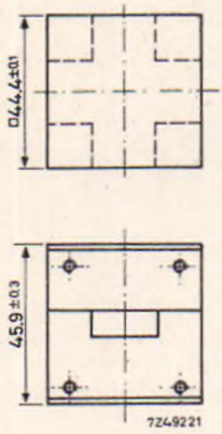


ELECTRICAL DATA

Frequency range	10.7-11.7 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	25 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

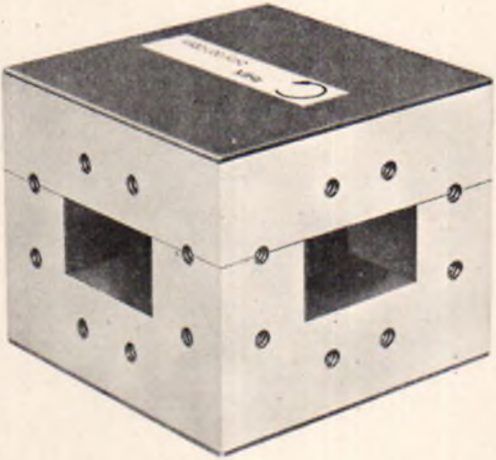
Construction	waveguide 4 port
Material	brass
Flange type	UBR 100 (I.E.C.)
Finish	goldplated upon silverplated outside enamelled grey
Weight	390 g



Dimensions in mm.

CIRCULATOR
(2722 161 03081)

CL5081

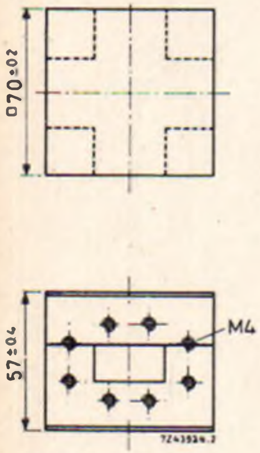


ELECTRICAL DATA

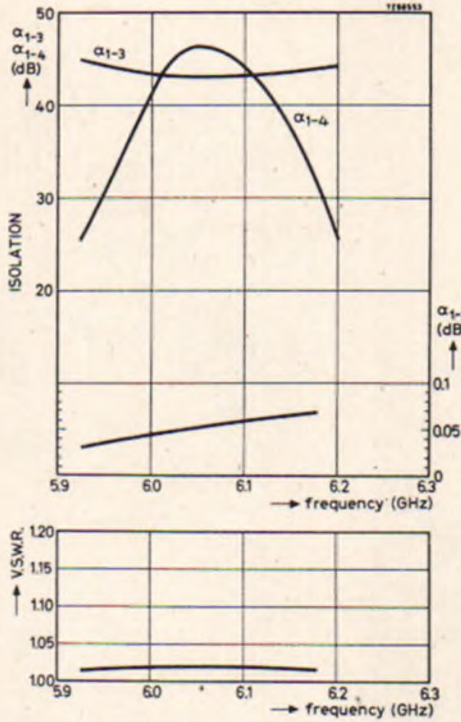
Frequency range	5.925–6.175 GHz
Isolation α_{1-3}	> 33 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.1 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	150 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



Dimensions in mm

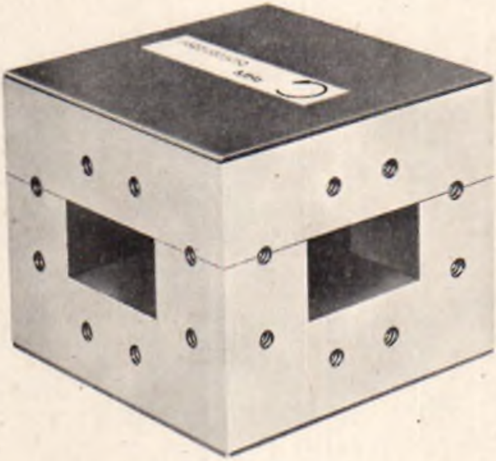


Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5091

(2722 161 03091)

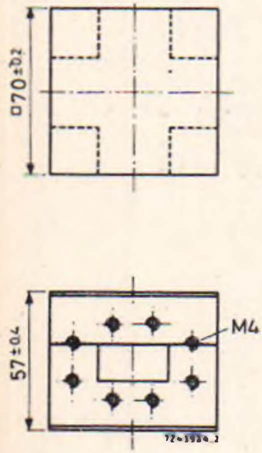


ELECTRICAL DATA

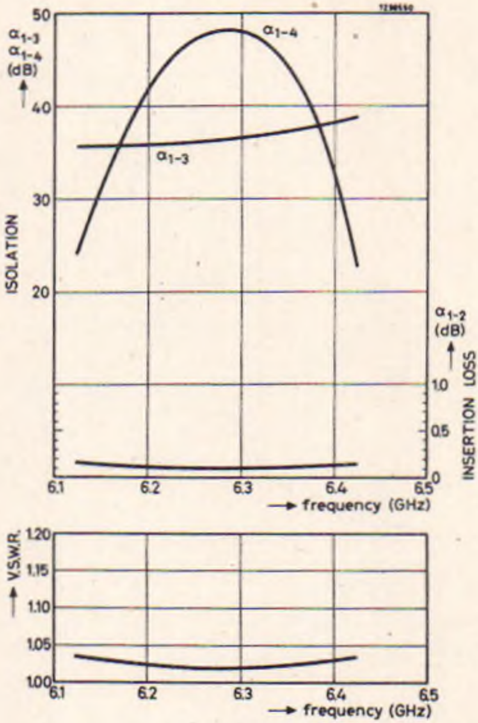
Frequency range	6.125–6.425 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.1 dB
V.S.W.R.	< 1.06
Nominal power (c.w.)	150 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

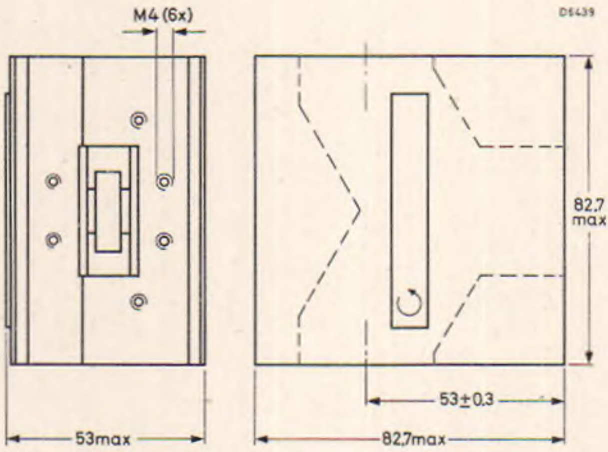
(2722 161 02101)

CL5101

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 5.925 to 6.425 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

Frequency range	5.925 to 6.425 GHz
Isolation α_{1-3}	> 30 dB
Insertion loss α_{1-2}	< 0.2 dB
V.S.W.R.	< 1.06
Maximum power	100 W
Temperature range	-10 °C to +70 °C For other temperature ranges please enquire

MECHANICAL DATA

Material of waveguide and flanges	Aluminium
Mating flange type	154 IEC-UER 70
Finish of flanges	alodine
Colour of top and bottom face	black
Weight	approx. 950 g

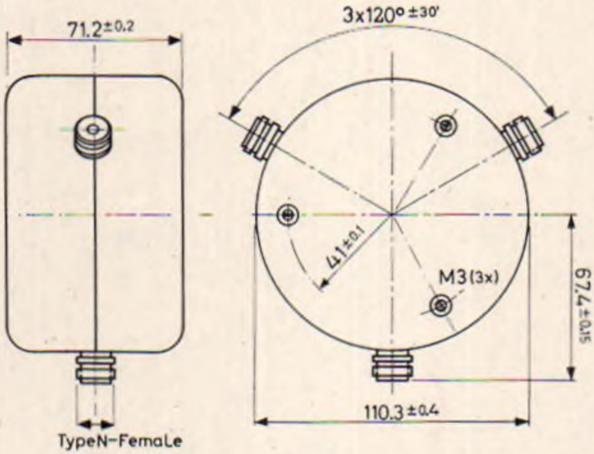
CIRCULATOR
(2722 162 03171)

CL5172

COAXIAL 3-PORT CIRCULATOR

Frequency 225 to 270 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	225 to 270 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	500 W	
Maximum power (peak sync.)	850 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	2100 g

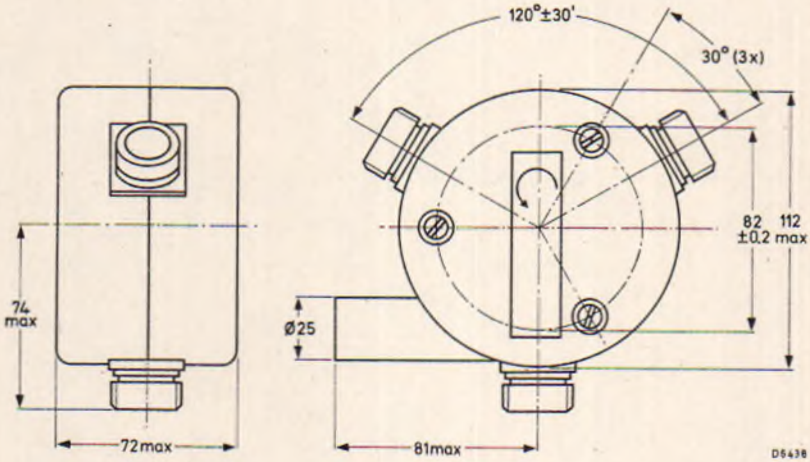
CIRCULATOR
(2722 162 03181)

CL5182

COAXIAL 3-PORT CIRCULATOR

Frequency 225 to 270 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	225 to 270 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	1000 W	
Maximum power (peak sync.)	1800 W	
Temperature range	-10 to +40 °C	at 25 °C

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

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	Silver plated
Weight	2100 g

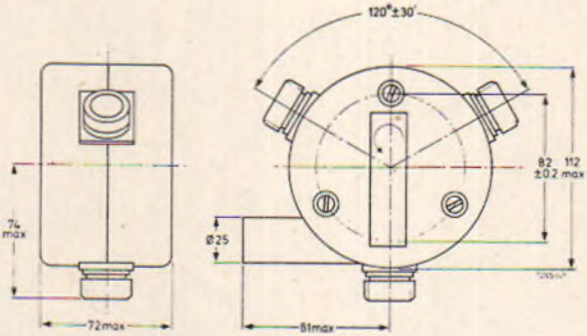
CIRCULATOR
(2722 162 01261)

CL5261

COAXIAL 3-PORT CIRCULATOR

Frequency 470 to 600 MHz

DIMENSIONS (in mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	470 to 600 MHz	-
Isolation	> 20 dB	24 dB
Insertion loss	< 0,35 dB	0,17 dB
V.S.W.R.	< 1,25	1,12
Maximum power (continuous wave and peak sync.)	2000 W	
Temperature range	-10 to + 40 °C	at 25 °C

With aircooling (filtered) at a pressure of 15 mm water column and max 40 °C intake temperature, the permissible connector temperature is + 60 °C.

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	silver plated
Weight	2000 g approx.

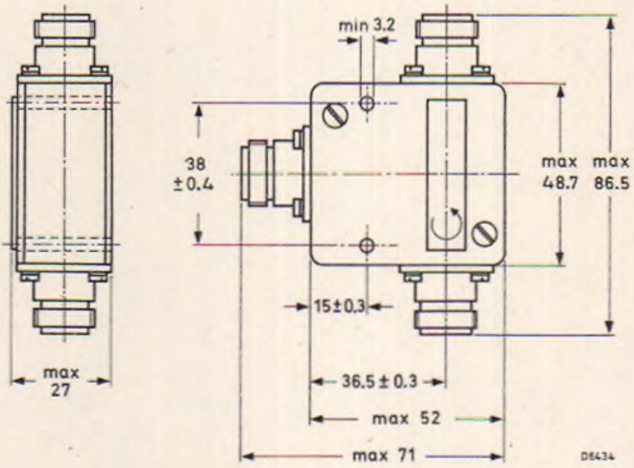
CIRCULATOR
(2722 162 03261)

CL5262

COAXIAL 3-PORT CIRCULATOR

Frequency 790 to 1000 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	790 to 1000 MHz	-
Isolation	>20 dB	25 dB
Insertion loss	<0.5 dB	0.3 dB
V.S.W.R.	<1.25	1.14
Maximum power (c.w.)	100 W	
Maximum power (peak sync.)	170 W	
Temperature range	-10 to 60 °C	at 25 °C

MECHANICAL DATA

Connector type	Type N female, 50 Ω
Finish of connectors	Nickel plated
Weight	400 g

Mullard

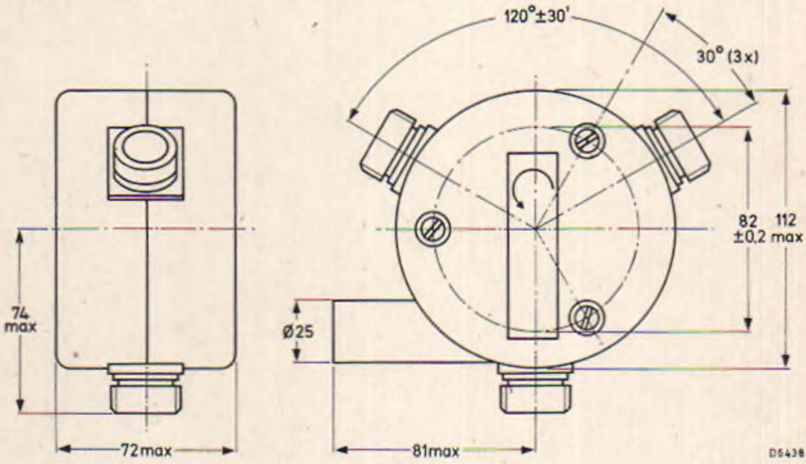
CIRCULATOR
(2722 162 01271)

CL5271

COAXIAL 3-PORT CIRCULATOR

Frequency 710 to 860 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	710 to 860 MHz	-
Isolation	> 22 dB	26 dB
Insertion loss	< 0.35 dB	0.16 dB
V.S.W.R.	< 1.2	1.15
Maximum power (continuous wave and peak sync.)	2000 W	
Temperature range	-10 to +40 °C	at 25 °C

With aircooling (filtered) at a pressure of 15 mm water column and max. 40 °C intake temperature, the permissible connector temperature is +60 °C.

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	silver plated
Weight	2000 g approx.

Mullard

CIRCULATOR
(2722 161 02081)

CL5281

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 6.425 to 7.125 GHz

DIMENSIONS (mm)

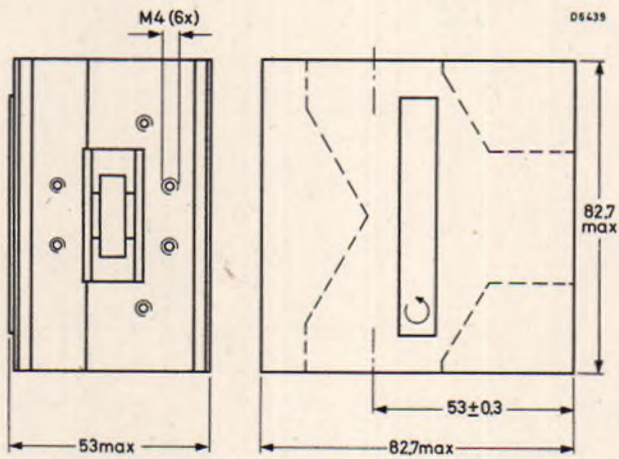


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	6.425 to 7.125 GHz
Isolation α_{1-3}	> 30 dB
Insertion loss α_{1-2}	< 0.15 dB
V.S.W.R.	< 1.07
Maximum power	100 W
Temperature range	-10 to +70 ^{o}C For other temperature ranges please enquire

MECHANICAL DATA

Material of waveguide and flanges	aluminium
Mating flange type	154 IEC-UER 70
Finish of flanges	alodine
Colour of top and bottom face	black
Weight	950 g

Typical performance as a function of frequency at an operating temperature of 20 °C

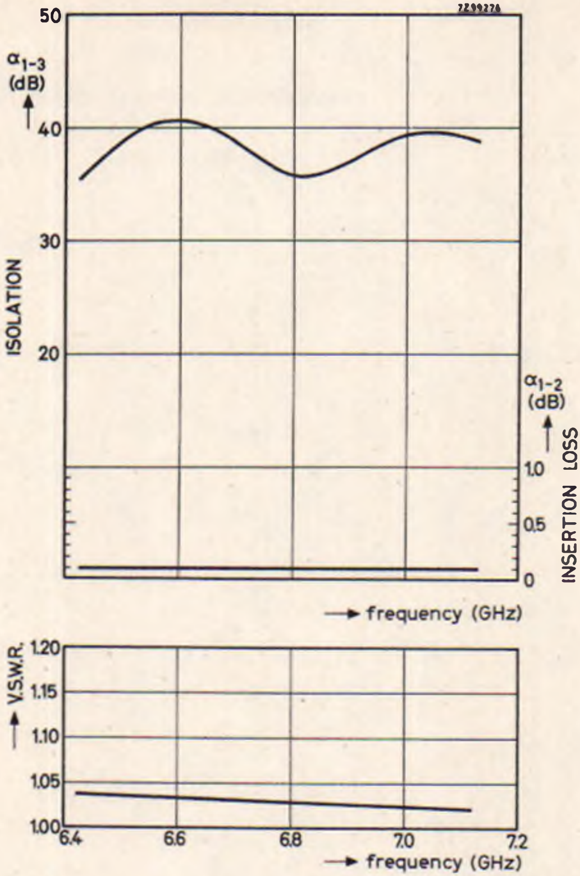


Fig. 2

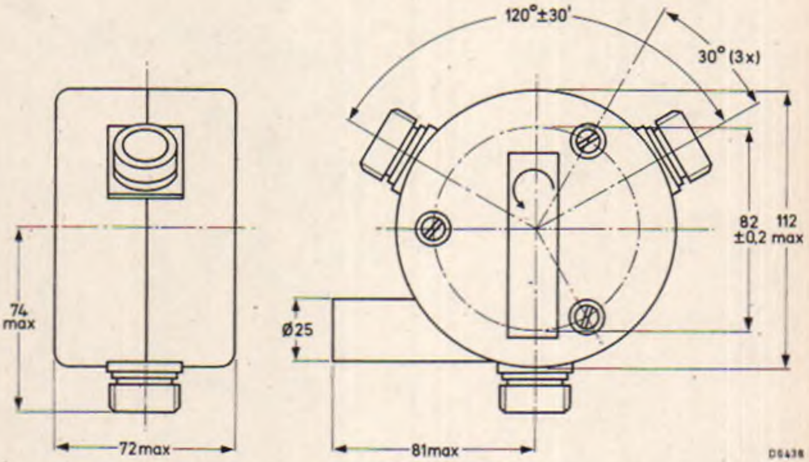
CIRCULATOR
(2722 162 01281)

CL5282

COAXIAL 3-PORT CIRCULATOR

Frequency 590 to 720 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	590 to 720 MHz	-
Isolation	> 22 dB	27 dB
Insertion loss	< 0.35 dB	0.15 dB
V.S.W.R.	< 1.2	1.1
Maximum power		
(continuous wave and peak sync.)	2000 W	
Temperature range	-10 to +40 °C	at 25 °C

With aircooling (filtered) at a pressure of 15 mm water column and max 40 °C intake temperature, the permissible connector temperature is +60 °C.

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	silver plated
Weight	2000 g approx.

CIRCULATOR
(2722 161 02091)

CL5291

WAVEGUIDE 3-PORT CIRCULATOR

Frequency 7.125 to 7.750 GHz

DIMENSIONS (mm)

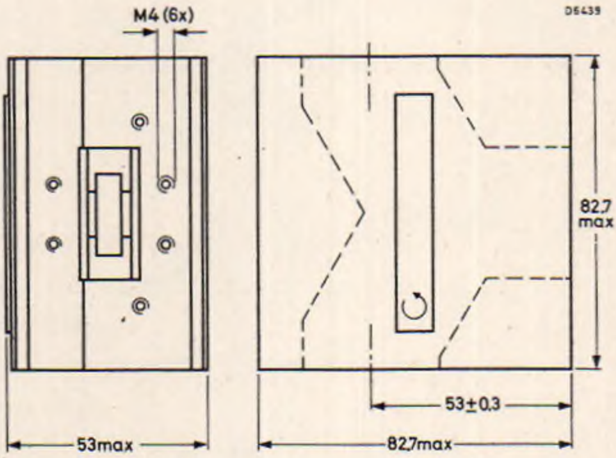


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	7.125 to 7.750 GHz
Isolation α_{1-3}	> 30 dB
Insertion loss α_{1-2}	< 0.2 dB
V.S.W.R.	< 1.06
Maximum power	100 W
Temperature range	-10 to +70 ^{o}C For other temperature ranges please enquire

MECHANICAL DATA

Material of waveguide and flanges	aluminium
Mating flange type	154 IEC-UER 70
Finish of flanges	alodine
Colour of top and bottom face	black
Weight	950 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

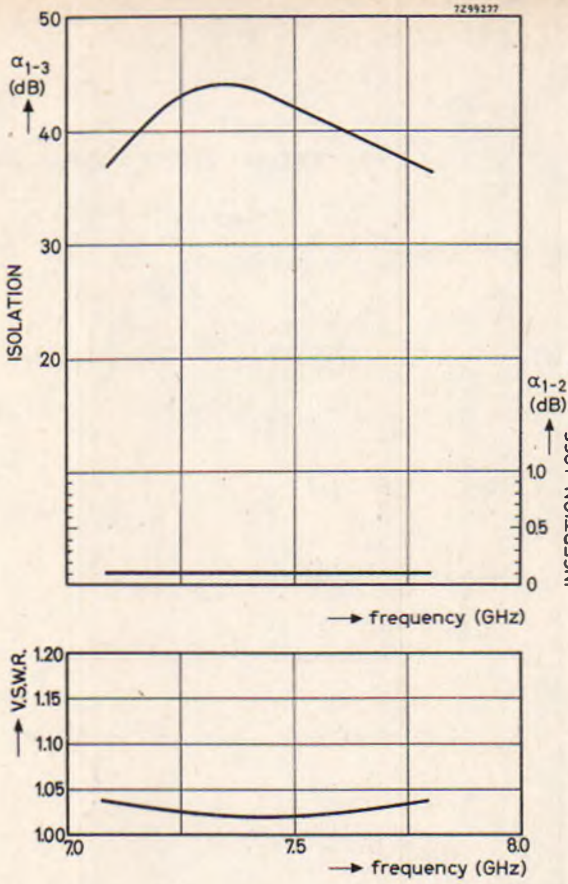


Fig. 2

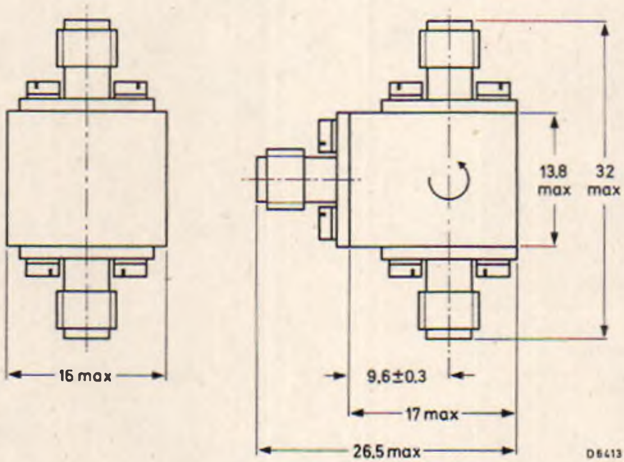
CIRCULATOR
(2722 162 03301)

CL5301

COAXIAL 3-PORT CIRCULATOR

Frequency 12 to 18 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	12 to 18 GHz	-
Isolation	≥ 20 dB	22 dB
Insertion loss	≤ 0.5 dB	0.35 dB
V.S.W.R.	≤ 1.30	1.20
Maximum power (c.w.)	5 W	
Temperature range	-10 to +70 °C	at +25 °C

MECHANICAL DATA

Connector type	SMA (MIL - C - 39012/60)
Finish of connectors	Gold plated
Weight	20 g

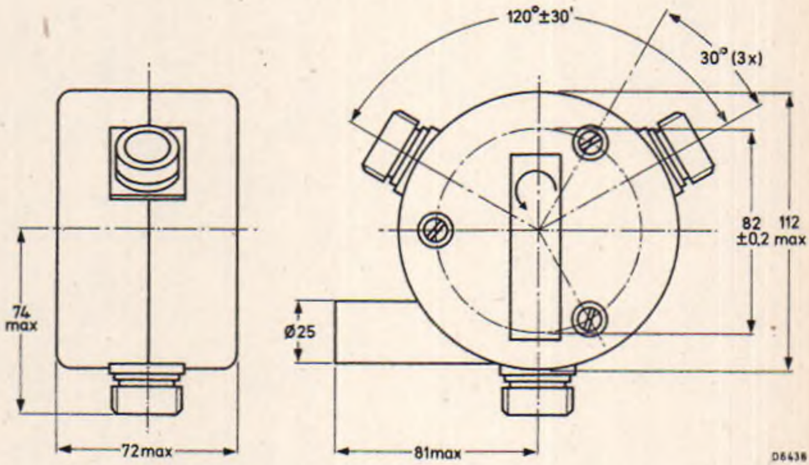
CIRCULATOR
(2722 162 01331)

CL5331

COAXIAL 3-PORT CIRCULATOR

Frequency 600 to 800 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	600 to 800 MHz	-
Isolation	> 20 dB	24 dB
Insertion loss	< 0.35 dB	0.17 dB
V.S.W.R.	< 1.25	1.13
Maximum power		
(continuous wave and peak sync.)	2000 W	
Temperature range	-10 to +40 °C	at 25 °C

With aircooling (filtered) at a pressure of 15 mm water column and max. 40 °C intake temperature, the permissible connector temperature is +60 °C.

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	silver plated
Weight	2000 g approx.

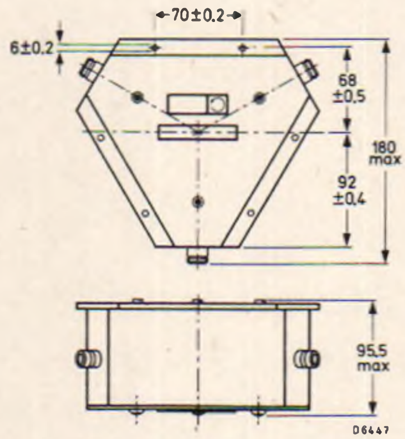
CIRCULATOR
(2722 162 01341)

CL5341

COAXIAL 3-PORT CIRCULATOR

Frequency 170 to 200 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	170 to 200 MHz	-
Isolation	> 20 dB	22 dB
Insertion loss	< 0.35 dB	0.25 dB
V.S.W.R.	< 1.25	1.1
Maximum power (continuous wave)	1000 W	
(peak sync.)	1700 W	
Temperature range	+10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	6400 g approx.

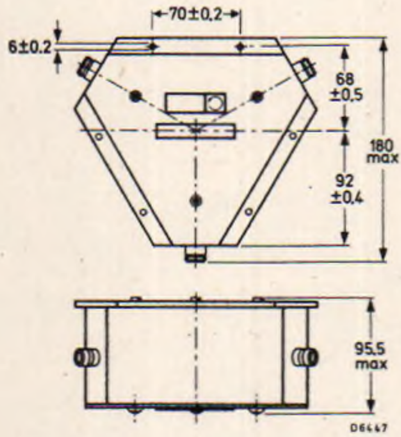
CIRCULATOR
(2722 162 01351)

CL5351

COAXIAL 3-PORT CIRCULATOR

Frequency 195 to 230 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	195 to 230 MHz	-
Isolation	> 20 dB	22 dB
Insertion loss	< 0.35 dB	0.25 dB
V.S.W.R.	< 1.25	1.1
Maximum power (continuous wave)	1000 W	
(peak sync.)	1700 W	
Temperature range	+10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	6400 g approx.

Mullard

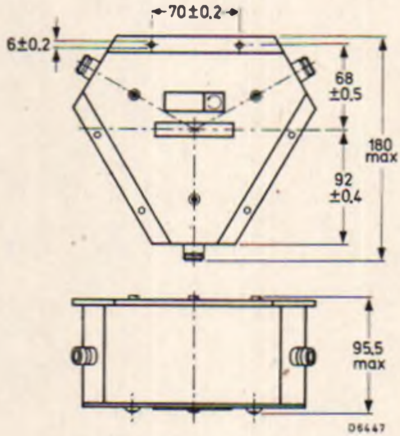
CIRCULATOR
(2722 162 01361)

CL5361

COAXIAL 3-PORT CIRCULATOR

Frequency 150 to 160 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	150 to 160 MHz	-
Isolation loss	> 20 dB	22 dB
Insertion loss	< 0.30 dB	0.25 dB
V.S.W.R.	< 1.25	1.1
Maximum power (continuous wave)	1000 W	
(peak sync.)	1700 W	
Temperature range	+10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	6400 g approx.

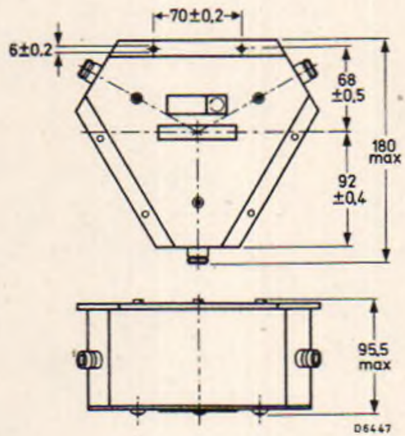
CIRCULATOR
(2722 162 01371)

CL5371

COAXIAL 3-PORT CIRCULATOR

Frequency 160 to 190 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	160 to 190 MHz	-
Isolation	> 20 dB	22 dB
Insertion loss	< 0.35 dB	0.25 dB
V.S.W.R.	< 1.25	1.1
Maximum power (continuous wave)	1000 W	
(peak sync.)	1700 W	
Temperature range	+10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	6400 g approx.

CIRCULATOR

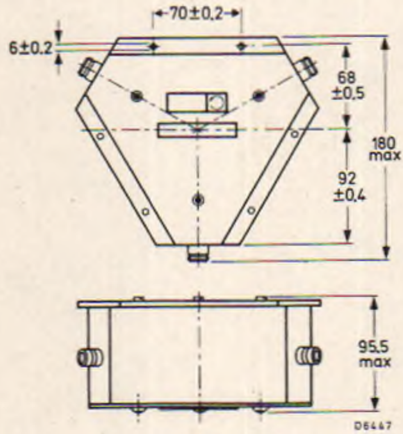
(2722 162 01381)

CL5381

COAXIAL 3-PORT CIRCULATOR

Frequency 190 to 220 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	190 to 220 MHz	-
Isolation	> 20 dB	22 dB
Insertion loss	< 0.35 dB	0.25 dB
V.S.W.R.	< 1.25	1.1
Maximum power (continuous wave)	1000 W	
(peak sync.)	1700 W	
Temperature range	+10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	6400 g approx.

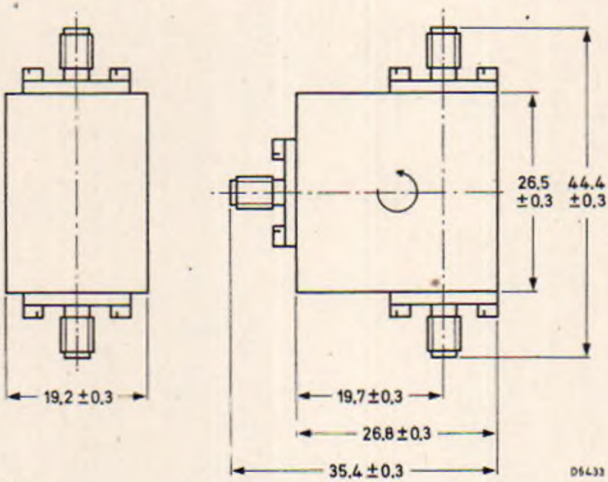
CIRCULATOR
(2722 162 03431)

CL5431

COAXIAL 3-PORT CIRCULATOR

Frequency 3.8 to 4.2 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	3.8 to 4.2 GHz	-
Isolation	≥ 25 dB	27 dB
Insertion loss	≤ 0.25 dB	0.2 dB
V.S.W.R.	≤ 1.12	1.1
Maximum power (c.w.)	10 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	110 g

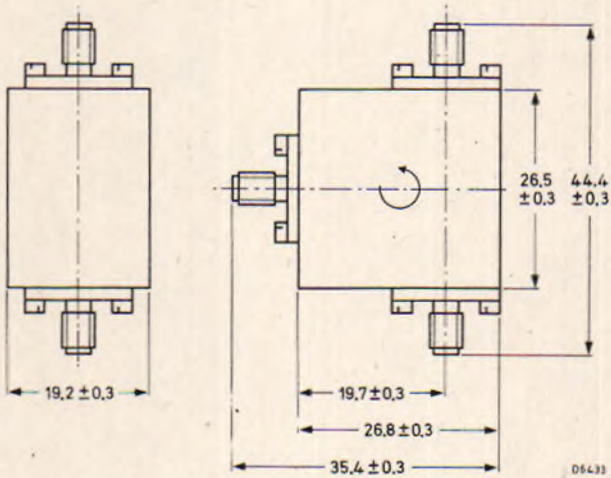
CIRCULATOR
(2722 162 03441)

CL5441

COAXIAL 3-PORT CIRCULATOR

Frequency 4.4 to 5 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	4.4 to 5 GHz	-
Isolation	≥ 25 dB	27 dB
Insertion loss	≤ 0.25 dB	0.2 dB
V.S.W.R.	≤ 1.12	1.1
Maximum power (c.w.)	10 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	110 g

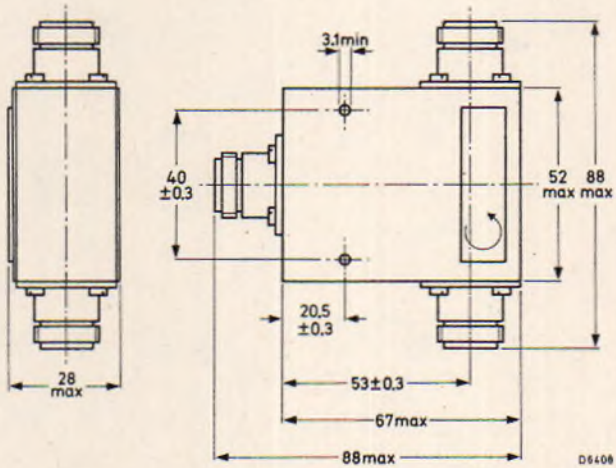
Mullard

CIRCULATOR
(2722 162 01491)

COAXIAL 3-PORT CIRCULATOR

Frequency 2 to 4 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	2 to 4 GHz	-
Isolation	> 20 dB	24 dB
Insertion loss	< 0.5 dB	0.35 dB
V.S.W.R.	< 1.25	1.15
Maximum power	50 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

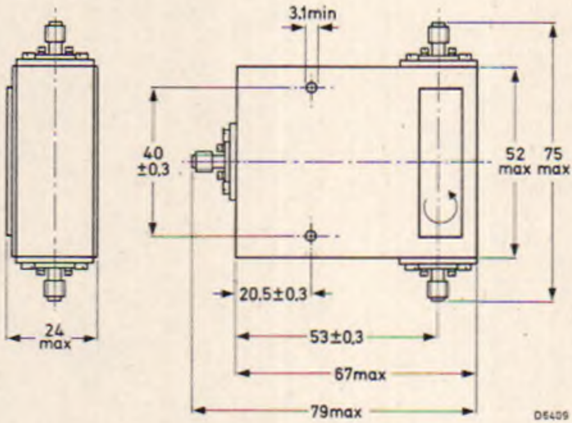
Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	300 g approx.

CIRCULATOR
(2722 162 01501)

COAXIAL 3-PORT CIRCULATOR

Frequency 2 to 4 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	2 to 4 GHz	-
Isolation	> 20 dB	24 dB
Insertion loss	< 0.5 dB	0.35 dB
V.S.W.R.	< 1.25	1.15
Maximum power	50 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	300 g approx.

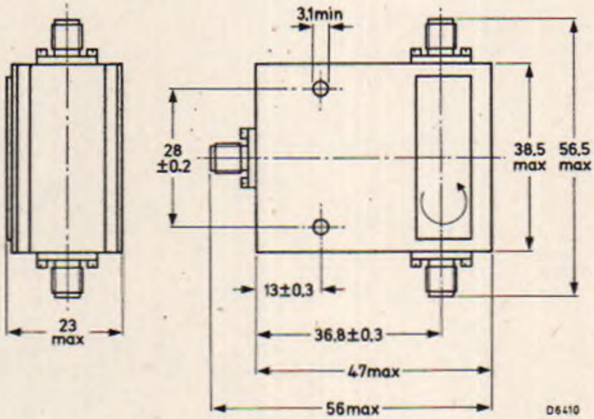
CIRCULATOR
(2722 162 01511)

CL5511

COAXIAL 3-PORT CIRCULATOR

Frequency 3 to 6 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	3 to 6 GHz	-
Isolation	> 20 dB	27 dB
Insertion loss	< 0.5 dB	0.3 dB
V.S.W.R.	< 1.25	1.1
Maximum power	20 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	120 g approx.

Mullard

CIRCULATOR

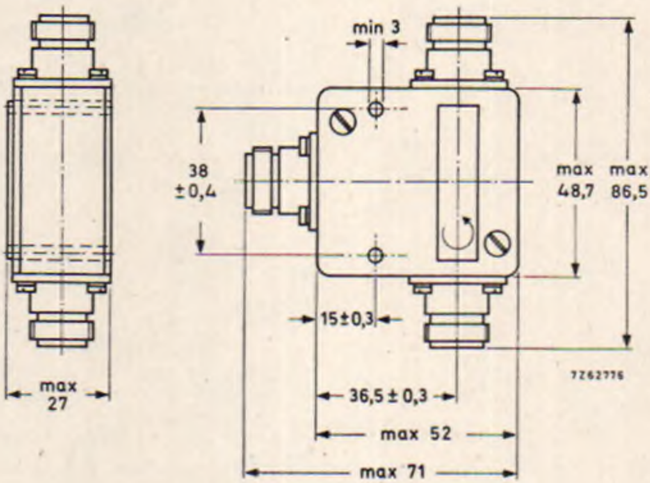
CL5551

(2722 162 01551)

COAXIAL 3-PORT CIRCULATOR

Frequency 470 to 600 MHz

DIMENSIONS (in mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	470 to 600 MHz	–
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0,5 dB	0,35 dB
V.S.W.R.	≤ 1,25	1,15
Maximum power (c.w.)	100 W	
Maximum power (peak sync.)	200 W	
Temperature range	−10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	400 g

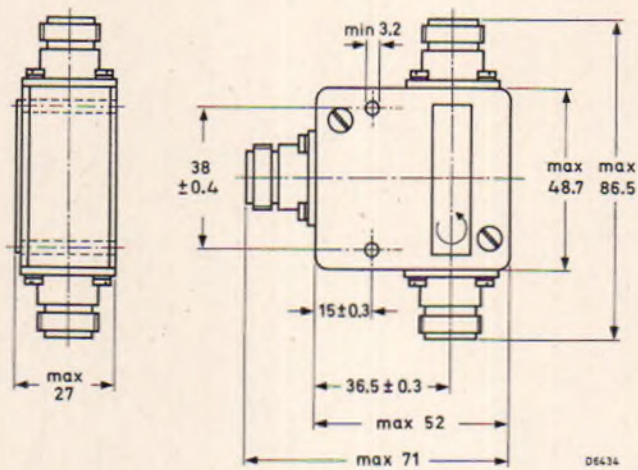
CIRCULATOR
(2722 162 01561)

CL5561

COAXIAL 3-PORT CIRCULATOR

Frequency 600 to 800 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	600 to 800 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.5 dB	0.35 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	100 W	
Maximum power (peak sync.)	200 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	400 g

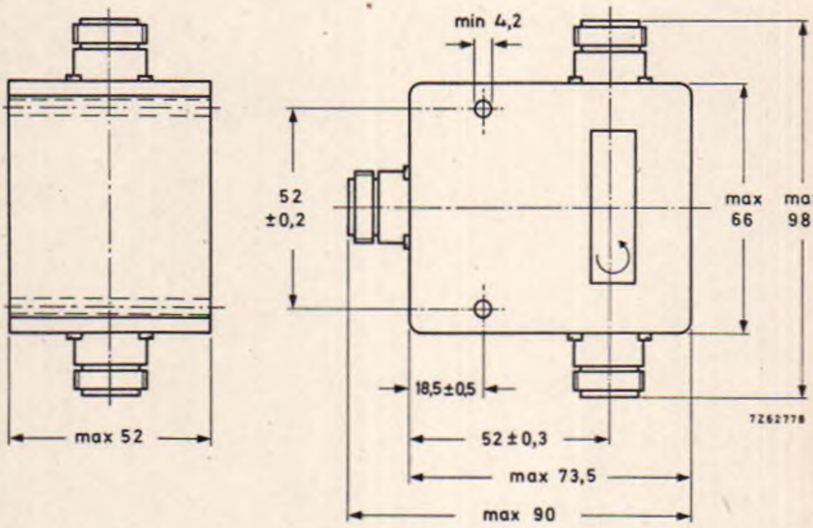
CIRCULATOR
(2722 162 01571)

CL5571

COAXIAL 3-PORT CIRCULATOR

Frequency 400 to 470 MHz

DIMENSIONS (in mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	400 to 470 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0,35 dB	0,20 dB
V.S.W.R.	≤ 1,25	1,15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	−10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	1200 g

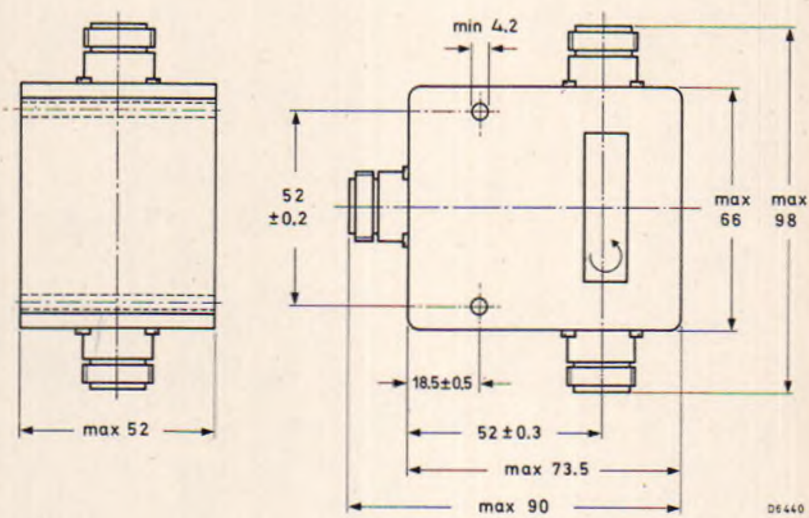
CIRCULATOR
(2722 162 01581)

CL5581

COAXIAL 3-PORT CIRCULATOR

Frequency 470 to 600 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	470 to 600 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	1200 g

Mullard

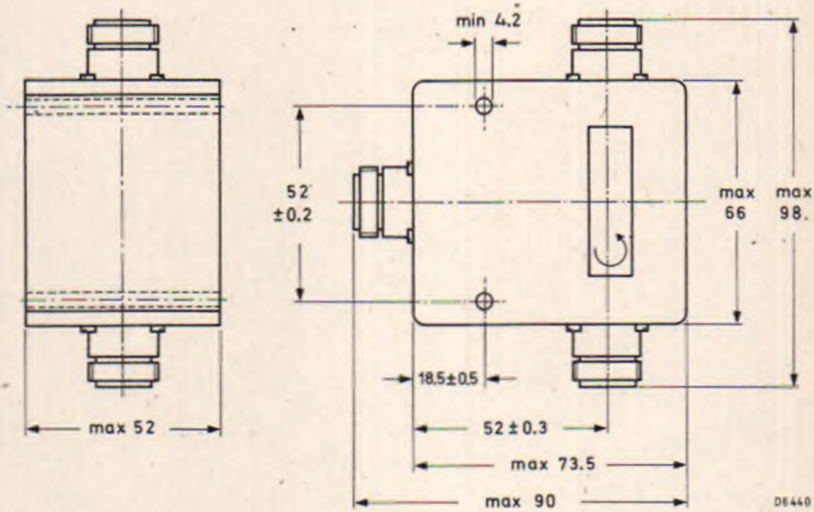
CIRCULATOR
(2722 162 01591)

CL5591

COAXIAL 3-PORT CIRCULATOR

Frequency 590 to 720 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	590 to 720 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	1200 g

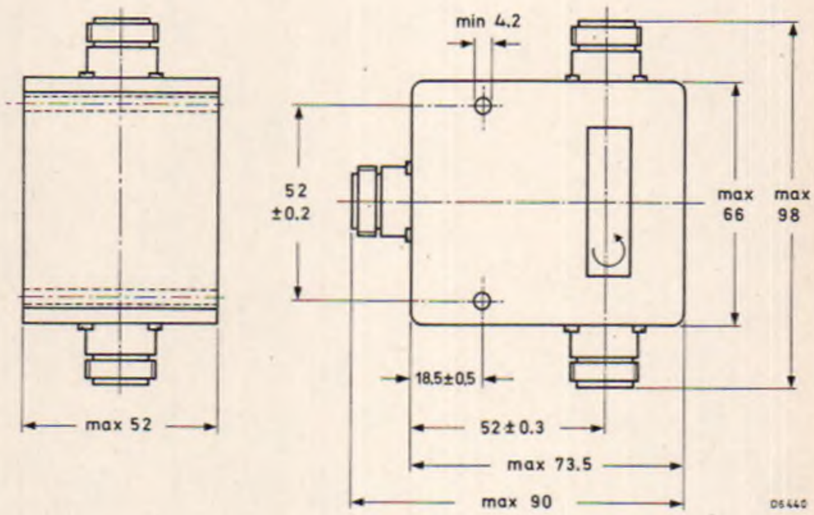
CIRCULATOR
(2722 162 01601)

CL5601

COAXIAL 3-PORT CIRCULATOR

Frequency 600 to 800 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	600 to 800 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	1200 g

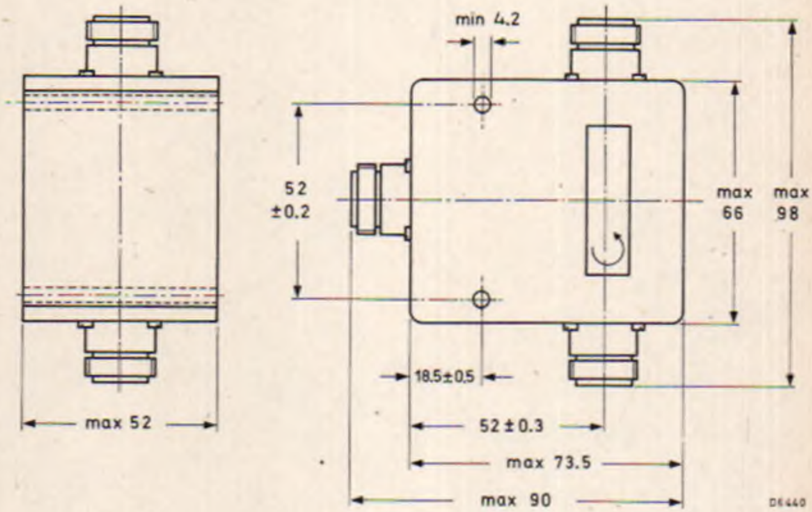
CIRCULATOR
(2722 162 01611)

CL5611

COAXIAL 3-PORT CIRCULATOR

Frequency 710 to 860 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	710 to 860 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	1200 g

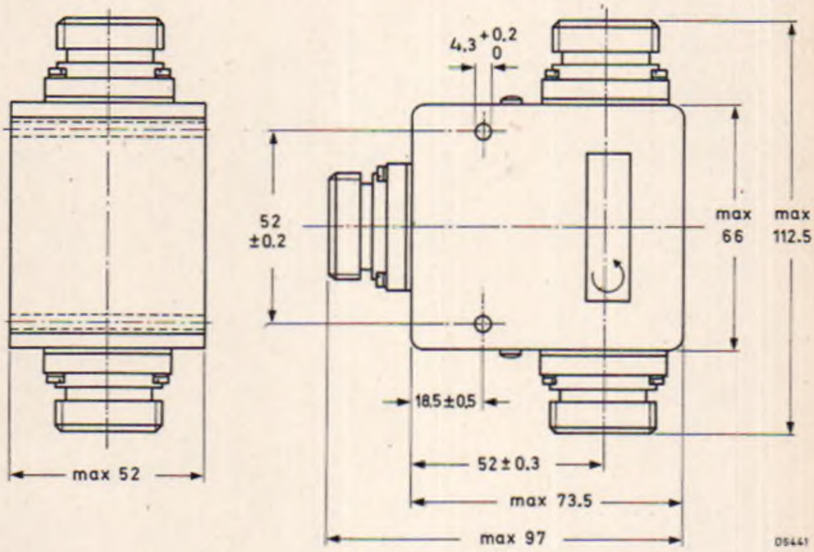
CIRCULATOR
(2722 162 01621)

CL5621

COAXIAL 3-PORT CIRCULATOR

Frequency 400 to 470 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	400 to 470 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 dB

MECHANICAL DATA

Connector type	HF7/16 DIN 47223
Finish of connectors	Silver plated
Weight	1200 g

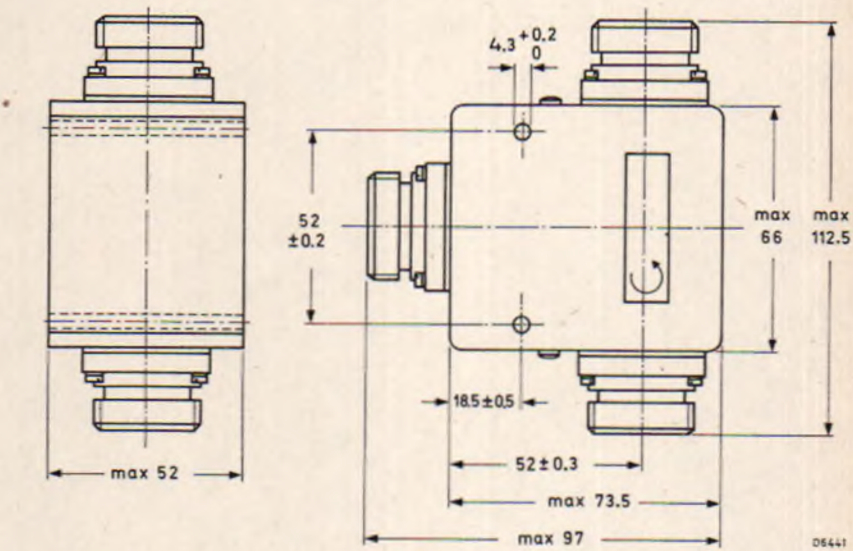
CIRCULATOR
(2722 162 01631)

CL5631

COAXIAL 3-PORT CIRCULATOR

Frequency 470 to 600 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	470 to 600 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 dB

MECHANICAL DATA

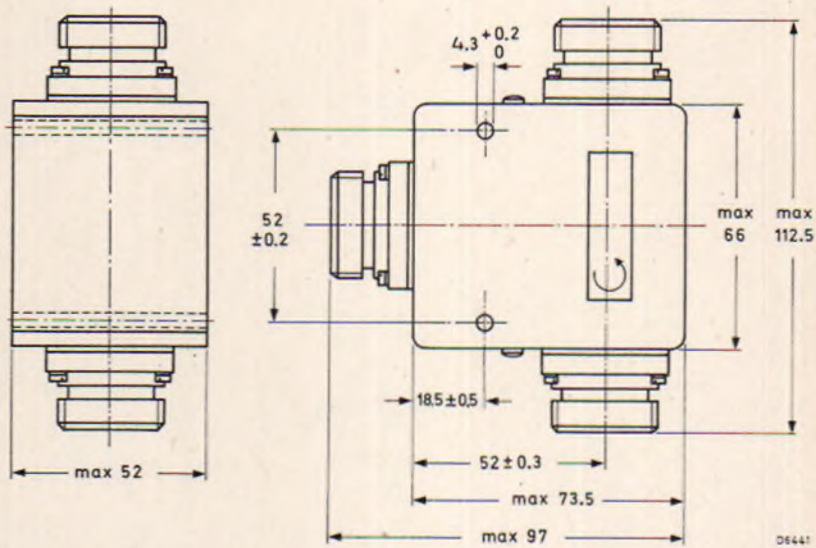
Connector type	HF7/16 DIN 47223
Finish of connectors	Silver plated
Weight	1200 g

CIRCULATOR
(2722 162 01641)

COAXIAL 3-PORT CIRCULATOR

Frequency 590 to 720 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	590 to 720 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25 dB	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	HF7/16 DIN 47223
Finish of connectors	Silver plated
Weight	1200 g

CIRCULATOR

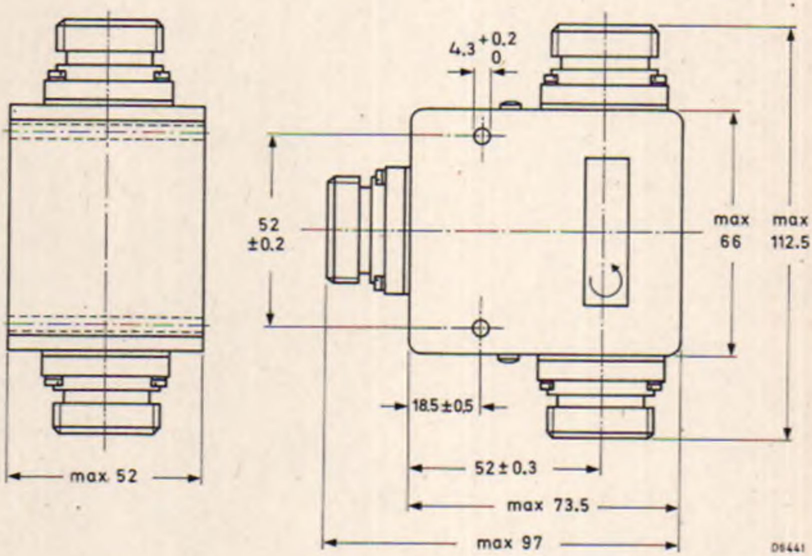
CL5651

(2722 162 01651)

COAXIAL 3-PORT CIRCULATOR

Frequency 600 to 800 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	600 to 800 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	HF7/16 DIN 47223
Finish of connectors	Silver plated
Weight	1200 g

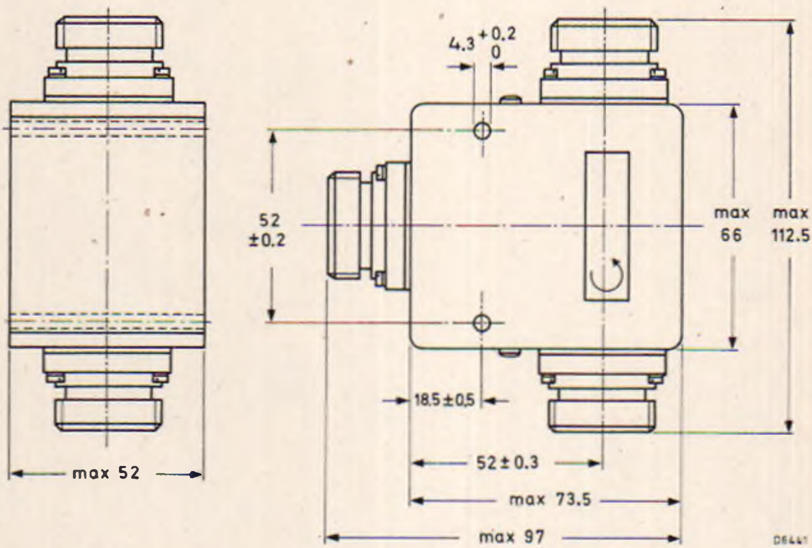
CIRCULATOR
(2722 162 01661)

CL5661

COAXIAL 3-PORT CIRCULATOR

Frequency 710 to 860 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	710 to 860 MHz	-
Isolation	≥ 20 dB	25 dB
Insertion loss	≤ 0.35 dB	0.20 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	300 W	
Maximum power (peak sync.)	500 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

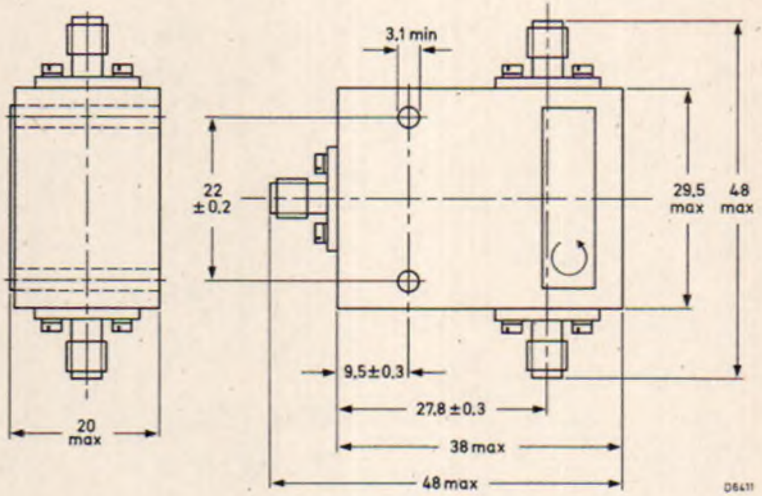
Connector type	HF7/16 DIN 47223
Finish of connectors	Silver plated
Weight	1200 g

CIRCULATOR
(2722 162 01811)

COAXIAL 3-PORT CIRCULATOR

Frequency 4 to 8 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	4 to 8 GHz	-
Isolation	≥ 20 dB	23 dB
Insertion loss	≤ 0.5 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15 dB
Maximum power (c.w.)	10 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	100 g

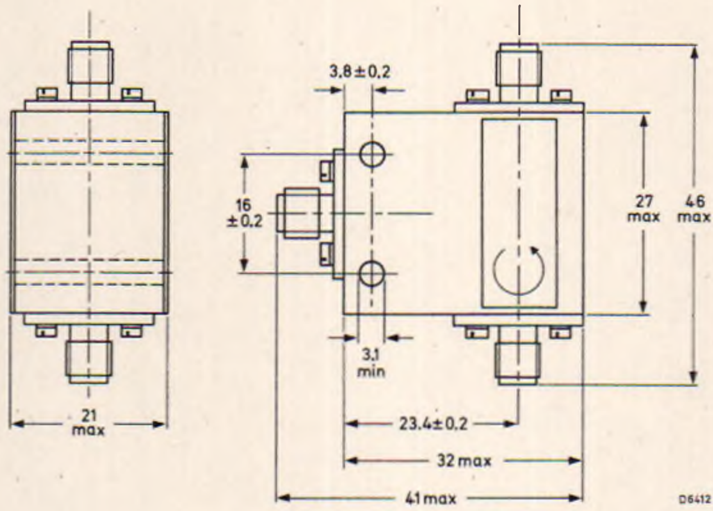
CIRCULATOR
(2722 162 01821)

CL5821

COAXIAL 3-PORT CIRCULATOR

Frequency 7 to 12.7 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	7 to 12.7 GHz	-
Isolation	≥ 20 dB	23 dB
Insertion loss	≤ 0.6 dB	0.4 dB
V.S.W.R.	≤ 1.25	1.15 dB
Maximum power (c.w.)	10 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	60 g

Mullard

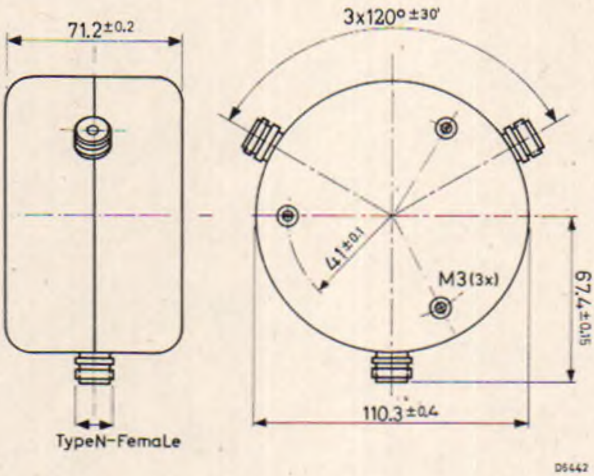
CIRCULATOR
(2722 162 01851)

CL5851

COAXIAL 3-PORT CIRCULATOR

Frequency 200 to 230 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	200 to 230 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	500 W	
Maximum power (peak sync.)	850 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	2100 g

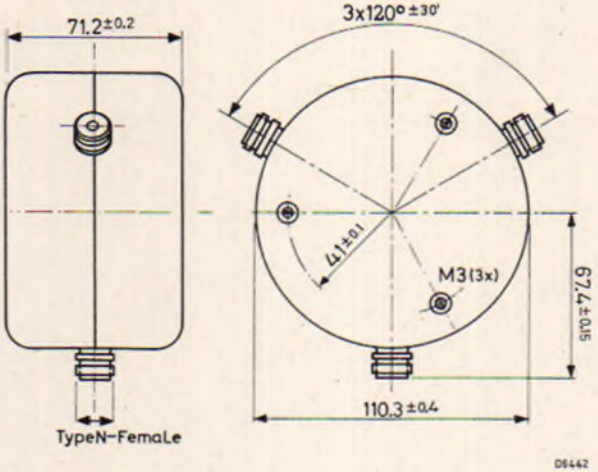
CIRCULATOR
(2722 162 01861)

CL5861

COAXIAL 3-PORT CIRCULATOR

Frequency 173 to 204 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	173 to 204 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	500 W	
Maximum power (peak sync.)	850 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	2100 g

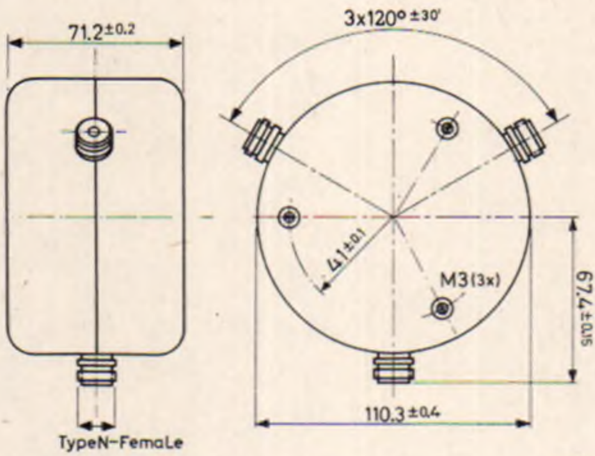
CIRCULATOR
(2722 162 01871)

CL5871

COAXIAL 3-PORT CIRCULATOR

Frequency 160 to 178 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	160 to 178 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	500 W	
Maximum power (peak sync.)	850 W	
Temperature range	-10 to +60 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	Nickel plated
Weight	2100 g

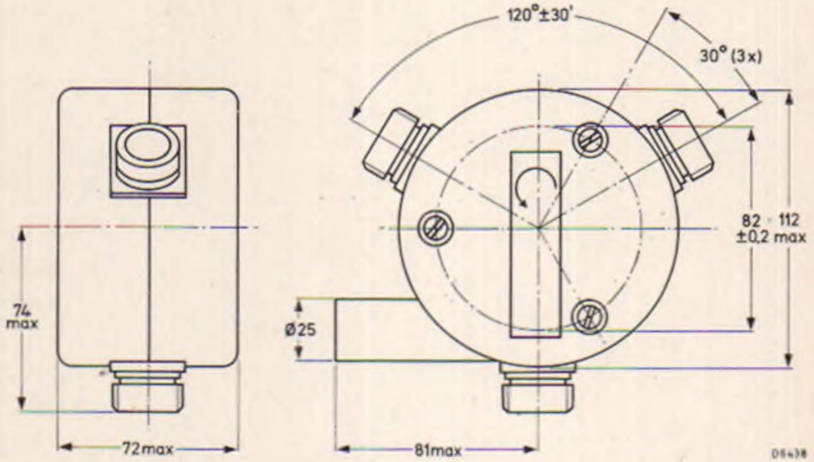
CIRCULATOR
(2722 162 01881)

CL5881

COAXIAL 3-PORT CIRCULATOR

Frequency 200 to 230 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	200 to 230 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	1000 W	
Maximum power (peak sync.)	1800 W	
Temperature range	-10 to +40 °C	at 25 °C

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

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	Silver plated
Weight	2100 g

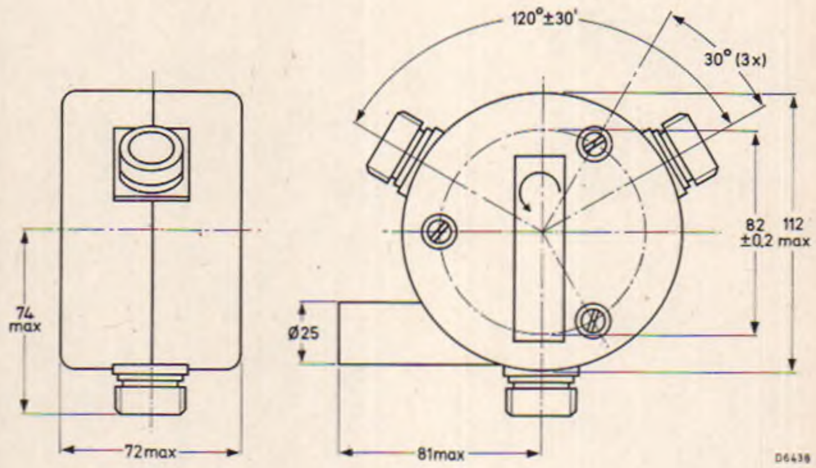
CIRCULATOR
(2722 162 01891)

CL5891

COAXIAL 3-PORT CIRCULATOR

Frequency 173 to 204 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	173 to 204 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	1000 W	
Maximum power (peak sync.)	1800 W	
Temperature range .	-10 to +40 °C	at 25 °C

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

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	Silver plated
Weight	2100 g

Mullard

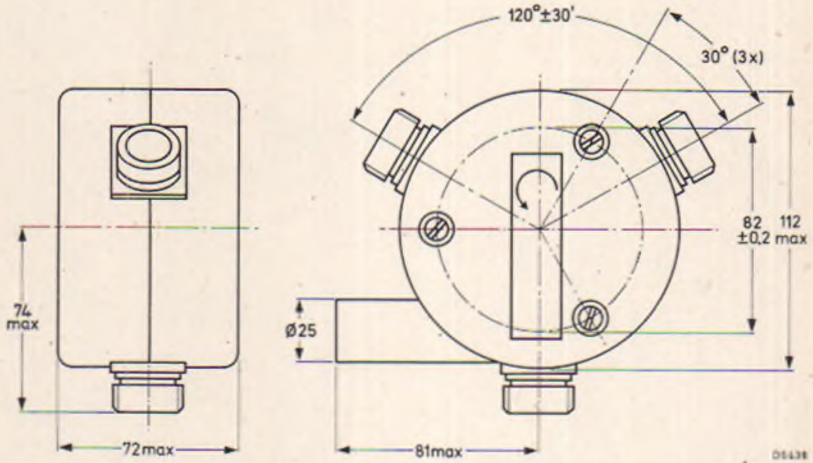
CIRCULATOR
(2722 162 01901)

CL5901

COAXIAL 3-PORT CIRCULATOR

Frequency 160 to 178 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	160 to 178 MHz	-
Isolation	≥ 20 dB	24 dB
Insertion loss	≤ 0.35 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	1000 W	
Maximum power (peak sync.)	1800 W	
Temperature range	-10 to +40 °C	at 25 °C

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

MECHANICAL DATA

Connector type	DIN 47223 HF 7/16
Finish of connectors	Silver plated
Weight	2100 g

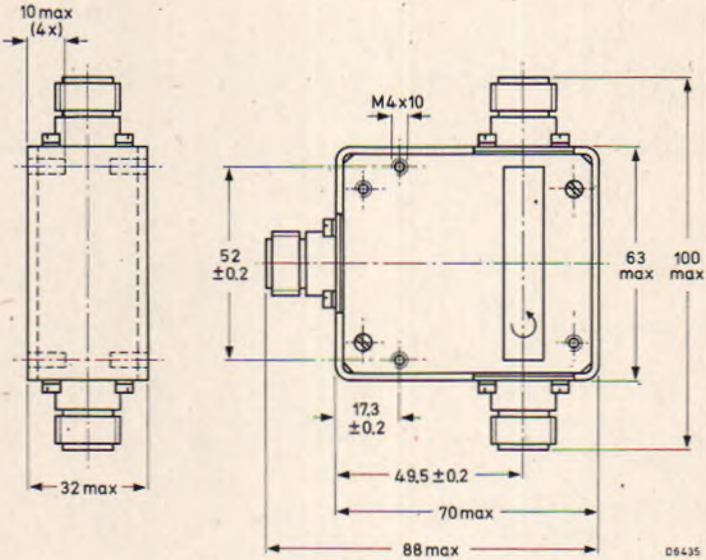
CIRCULATOR
(2722 162 01931)

CL5931

COAXIAL 3-PORT CIRCULATOR

Frequency 225 to 270 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	225 to 270 MHz	-
Isolation	> 18 dB	21 dB
Insertion loss	< 0.35 dB	0.2 dB
V.S.W.R.	< 1.35	1.25
Maximum power (c.w.)	150 W	
Temperature range	0 to 70 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	725 g

*) Maximum insertion depth for screws in order to avoid damage of the print.

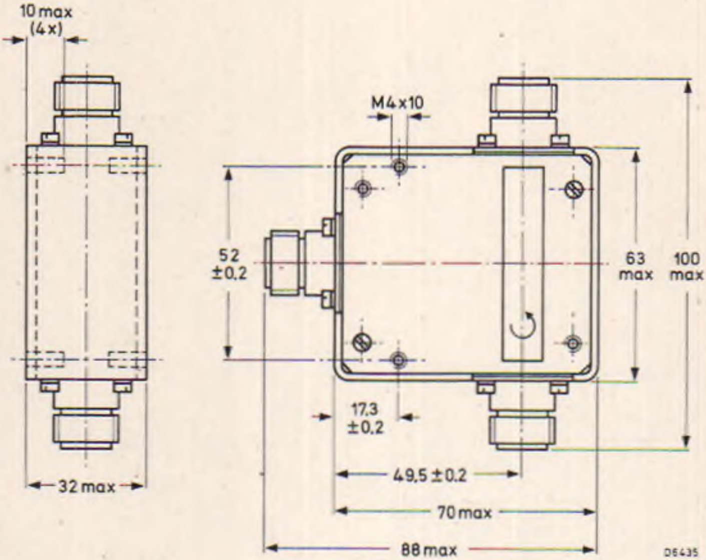
CIRCULATOR
(2722 162 01941)

CL5941

COAXIAL 3-PORT CIRCULATOR

Frequency 270 to 330 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	270 to 330 MHz	-
Isolation	> 18 dB	21 dB
Insertion loss	< 0.35 dB	0.2 dB
V.S.W.R.	< 1.35	1.25
Maximum power (c.w.)	150 W	
Temperature range	0 to 70 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	725 g

*) Maximum insertion depth for screws in order to avoid damage of the print.

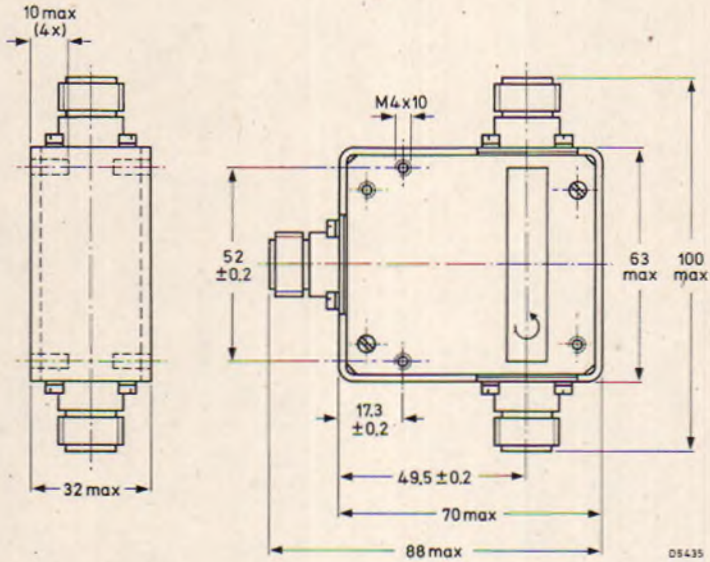
CIRCULATOR
(2722 162 01951)

CL5951

COAXIAL 3-PORT CIRCULATOR

Frequency 330 to 400 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	330 to 400 MHz	-
Isolation	> 18 dB	21 dB
Insertion loss	< 0.35 dB	0.3 dB
V.S.W.R.	< 1.35	1.25
Maximum power (c.w.)	150 W	
Temperature range	0 to 70 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	725 g

*) Maximum insertion depth for screws in order to avoid damage of the print.

ISOLATORS

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ISOLATORS — GENERAL EXPLANATORY NOTES

INTRODUCTION

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

In the forward direction, that is the direction in which the energy is passed, the insertion loss is usually 0.3 to 0.5 dB in the frequency range for which the isolator has been designed. In the opposite direction the isolation is normally 30 dB but for certain applications isolation can be made as high as 55 to 60 dB.

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

For the coaxial isolators in this section, which are coaxial 3-port circulators with a matched load on one port, see section "Circulators, general".

APPLICATION

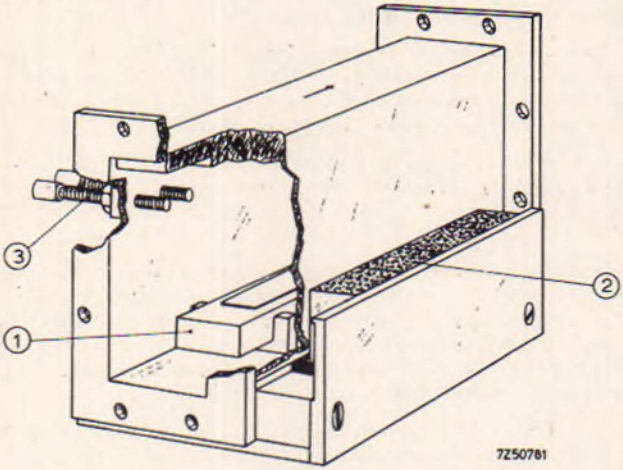
The main application of an isolator is to improve the behaviour of klystrons, magnetrons or travelling wave tubes by isolating the source from the load. The main factor is that an antenna or amplifier can not be ideally matched to the preceding function over the required frequency range so that energy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

The isolators, provided with matching screws, offer the possibility to match the isolator so that over a certain frequency range the VSWR is minimum. It is therefore possible to optimise the efficiency of waveguide runs by matching the isolator to minimum reflection. This means that long line effects can be drastically reduced.

CONSTRUCTION

Waveguide isolator

In the fig. below a field displacement isolator is shown. In the waveguide the ferrite bar (1) can be seen, flanked by two sets of magnets (2) outside the waveguide. These magnets bias the ferrite bar.



Field displacement type of isolator

The screws (3) protruding into the waveguide are used to match the isolator for minimum voltage standing wave ratio.

Coaxial isolator

For construction and mounting see section "Circulators", at Fig. 8.

TERMS AND DEFINITIONS

Frequency range is the range within which the isolator meets the guaranteed specification.
Outside this range the electrical properties deteriorate rapidly.

Isolation is the ratio, expressed in dB, of the input power to the output power in the reverse direction, measured with matched source and matched load.

Insertion loss is the attenuation which results from including an isolator in the transmission system. It is given as a ratio expressed in dB which compares the situation before and after the insertion of the isolator, i.e., the power delivered to a matched load is compared with the power delivered to the same load after the insertion of an isolator (which has the isolated port terminated with a matched load).

Voltage standing wave ratio (VSWR) is the ratio of the maximum to the minimum voltages along a lossless line.

Maximum power is the largest power that may be passed through the isolator in forward direction into a load with a VSWR of 2. This power value should under no circumstances be exceeded.

Temperature range is the ambient temperature range within which the isolators function to specification.
The isolator will continue to function outside the given temperature range, but some of its characteristics may change.
The storage temperature of the isolators may be from -40 to +125 ^{o}C.

CAUTION

The isolators have rather strong internal magnetic fields which are carefully adjusted for optimal operation. They are not to be subjected to strong external magnetic fields.

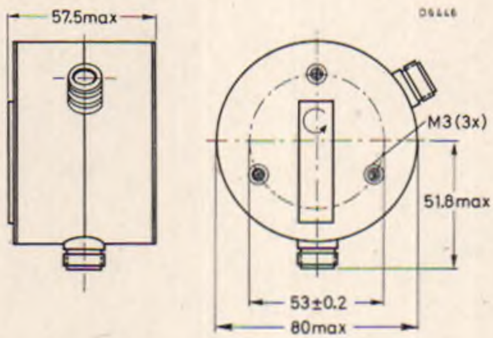
ISOLATOR
(2722 162 02001)

CL6001

COAXIAL ISOLATOR

Frequency 740 to 810 MHz

DIMENSIONS (mm)



ELECTRICAL DATA

Frequency range	740 to 810 MHz
Isolation	> 22 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please enquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	1200 g

ISOLATOR CL6011
(2722 162 02011)

COAXIAL ISOLATOR

Frequency 890 to 970 MHz

DIMENSIONS (mm)

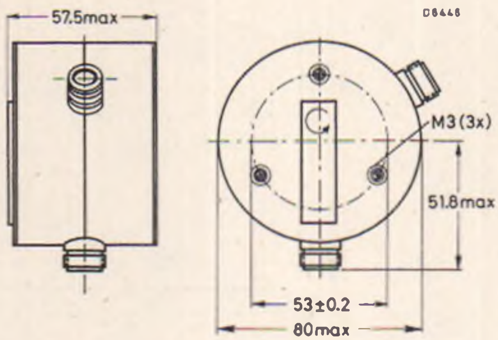


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	890 to 970 MHz
Isolation	> 22 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please enquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver coloured
top and bottom face	black
Weight	1200 g

Typical performance as a function of frequency at an operating temperature of 20 °C

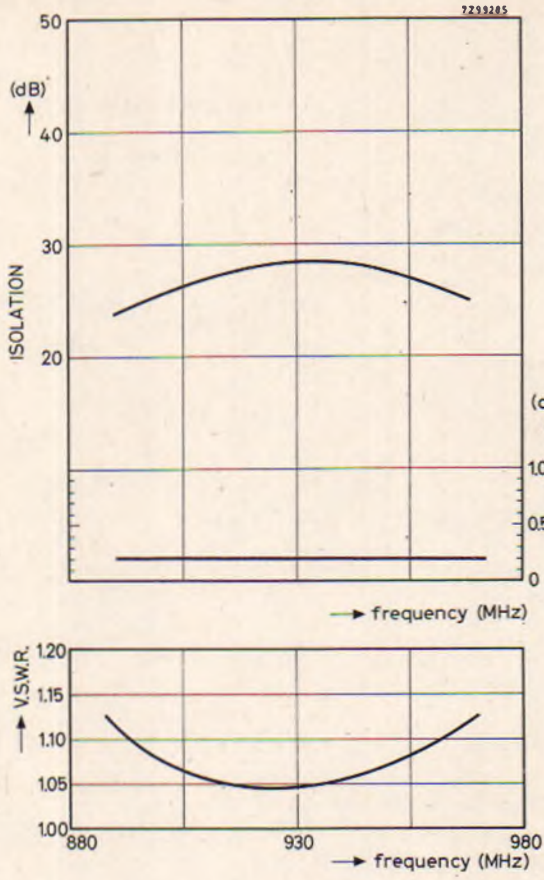


Fig. 2

ISOLATOR
(2722 162 02021)

CL6021

COAXIAL ISOLATOR

Frequency 2.96 to 3.22 GHz

DIMENSIONS (mm)

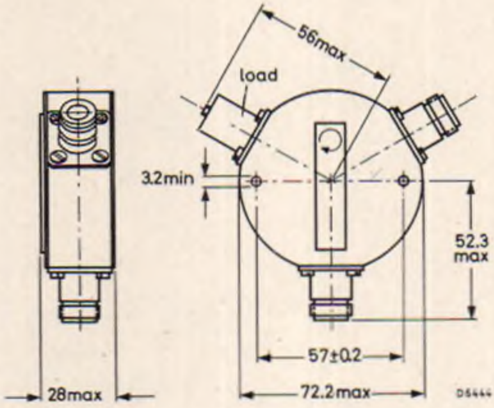


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	2.96 to 3.22 GHz
Isolation	> 20 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please enquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	
top and bottom face	black
Weight	550 g

Typical performance as a function of frequency at an operating temperature of 20 °C

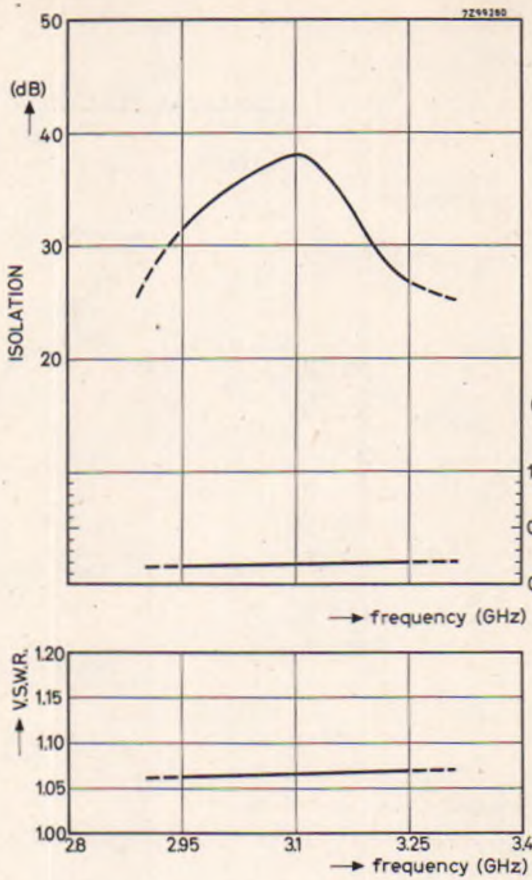


Fig. 2

ISOLATOR
(2722 162 02031)

CL6031

COAXIAL ISOLATOR

Frequency 3.56 to 3.90 GHz

DIMENSIONS (mm)

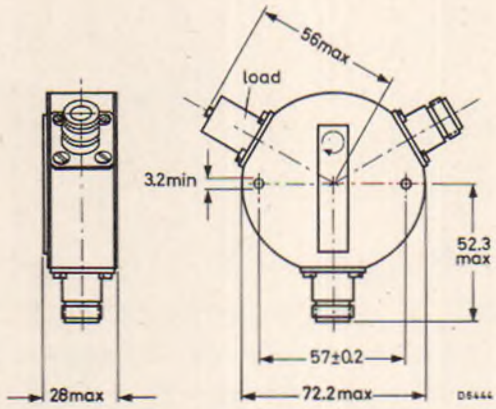


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	3.56 to 3.90 GHz
Isolation	> 20 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	100 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please enquire

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	silver
top and bottom face	black
Weight	550 g

Typical performance as a function of frequencyat an operating temperature of 20 ^{o}C

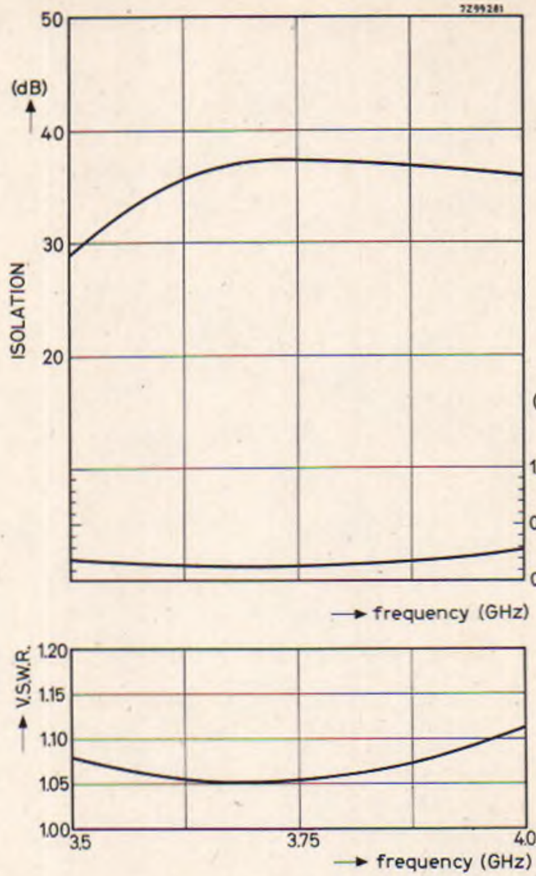


Fig. 2

ISOLATOR
(2722 162 02041)

CL6041

COAXIAL ISOLATOR

Frequency 1.48 to 1.95 GHz

DIMENSIONS (mm)

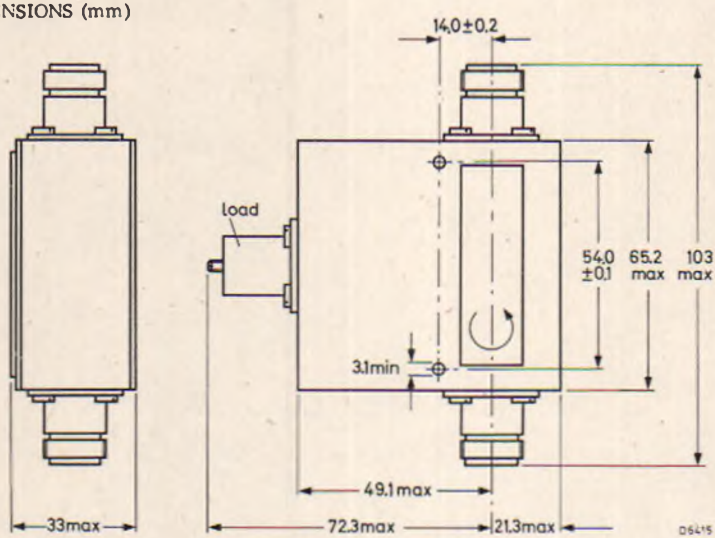


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	1.48 to 1.95 GHz
Isolation	> 20 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.2
Maximum power	50 W
Maximum permissible reflected power	2 W
Temperature range	-10 to +70 °C For other temperature ranges please enquire.

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connector	silver plated
Colour of housing	grey
top and bottom face	black
Weight	500 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

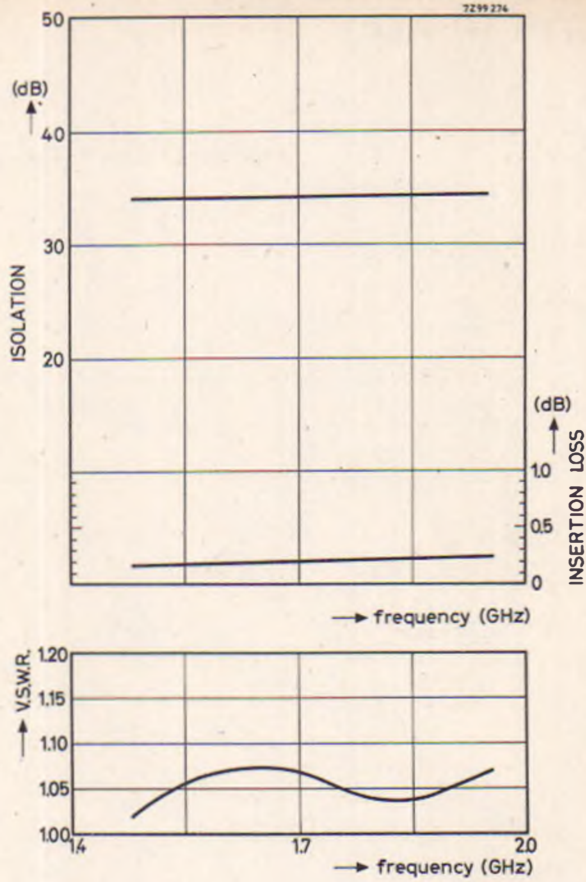


Fig. 2

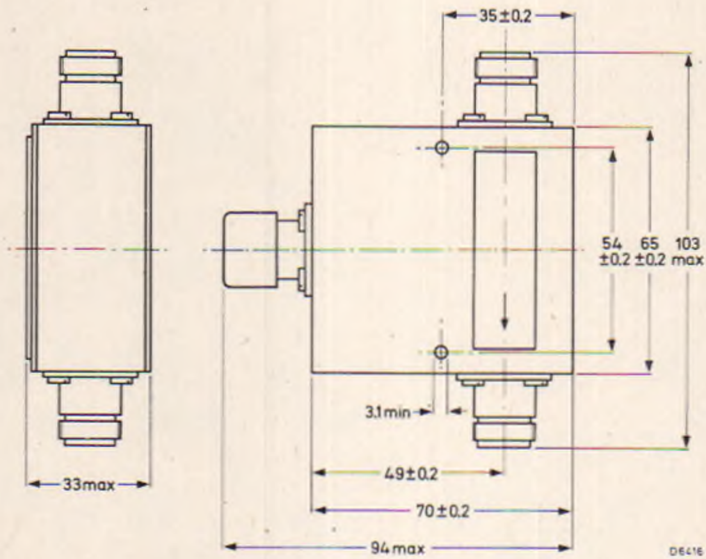
ISOLATOR
(2722 162 02051)

CL6051

COAXIAL ISOLATOR

Frequency 1.7 to 2.3 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	1.7 to 2.3 GHz	-
Isolation	> 20 dB	28 dB
Insertion loss	< 0.3 dB	0.2 dB
V.S.W.R.	< 1.25 dB	1.1
Maximum power (c.w.)	50 W	-
Max. permissible reflected power into port 2	2 W	-
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	500 g approx.

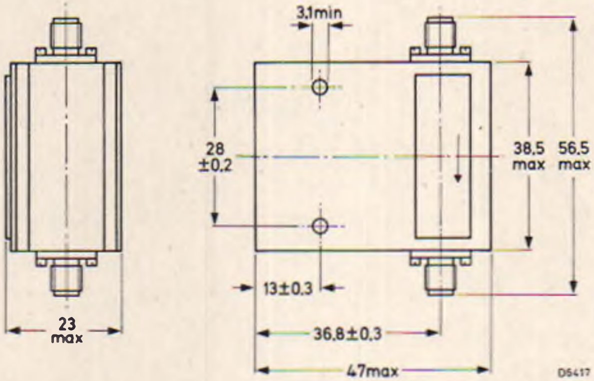
ISOLATOR
(2722 162 02071)

CL6071

COAXIAL ISOLATOR

Frequency 3 to 6 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	3 to 6 GHz	-
Isolation	> 20 dB	27 dB
Insertion loss	< 0.5 dB	0.3 dB
V.S.W.R.	< 1.25 dB	1.1
Maximum power (c.w.)	20 W	
Max. permissible reflected power	5 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	120 g approx.

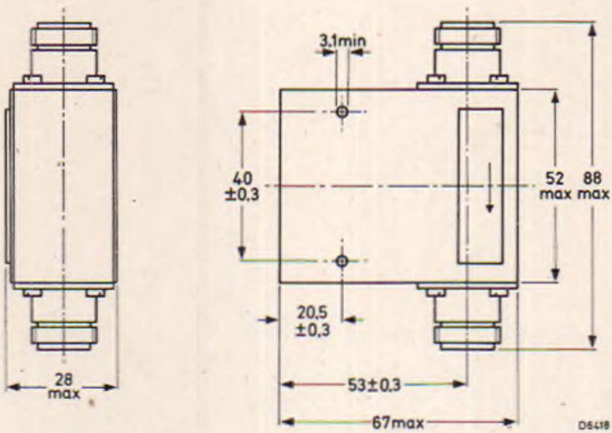
ISOLATOR
(2722 162 02091)

CL6091

COAXIAL ISOLATOR

Frequency 2 to 4 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	2 to 4 GHz	-
Isolation	> 20 dB	24 dB
Insertion loss	< 0.5 dB	0.35 dB
V.S.W.R.	< 1.25	1.1
Maximum power (c.w.)	50 W	
Max. permissible reflected power	5 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	N female 50 Ω
Finish of connectors	nickel plated
Weight	300 g approx.

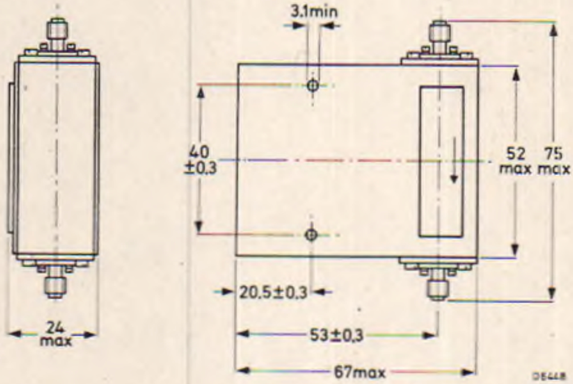
ISOLATOR
(2722 162 02101)

CL6101

COAXIAL ISOLATOR

Frequency 2 to 4 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	2 to 4 GHz	-
Isolation	> 20 dB	24 dB
Insertion loss	< 0.5 dB	0.35 dB
V.S.W.R.	< 1.25	1.1
Maximum power (c.w.)	50 W	
Max. permissible reflected power	5 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	300 g approx.

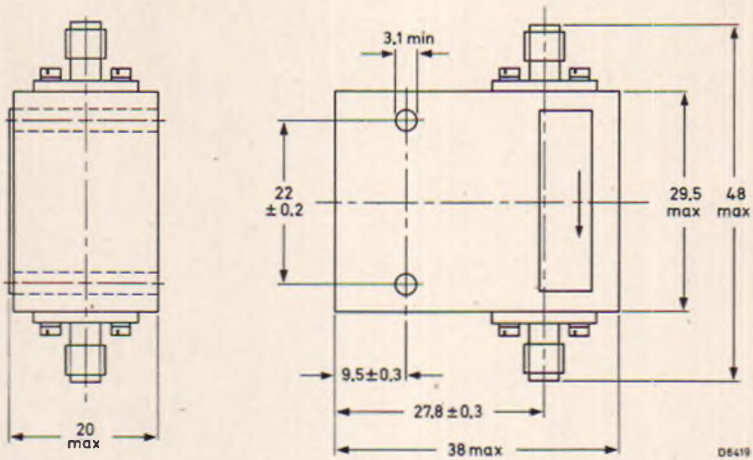
ISOLATOR
(2722 162 02111)

CL6111

COAXIAL ISOLATOR

Frequency 4 to 8 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

	guaranteed values	typical values
Frequency range	4 to 8 GHz	-
Isolation	≥ 20 dB	27 dB
Insertion loss	≤ 0.5 dB	0.3 dB
V.S.W.R.	≤ 1.25	1.15
Maximum power (c.w.)	10 W	
Maximum permissible reflected power into port 2 (c.w.)	5 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	100 g

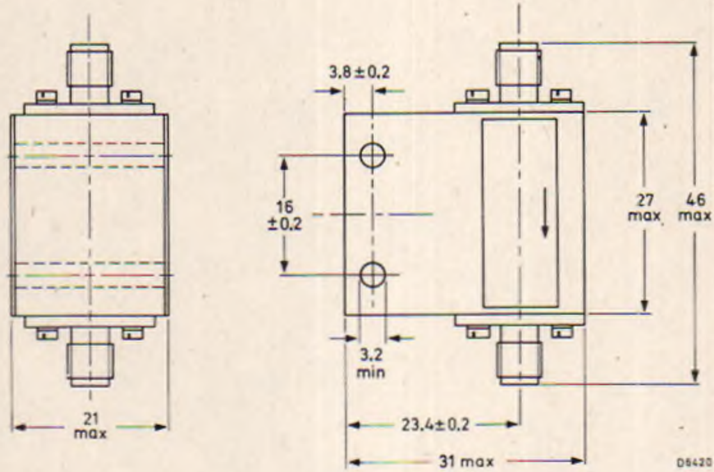
ISOLATOR
(2722 162 02121)

CL6122

COAXIAL ISOLATOR

Frequency 7 to 12.7 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

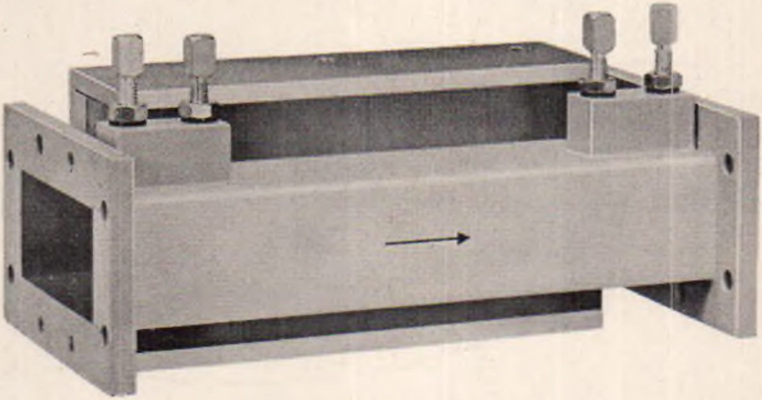
	guaranteed values	typical values
Frequency range	7 to 12.7 GHz	-
Isolation	> 20 dB	25 dB
Insertion loss	< 0.6 dB	0.35 dB
V.S.W.R.	< 1.25	1.12
Maximum power	10 W	
Maximum permissible reflected power in to port 2	2 W	
Temperature range	-10 to +70 °C	at 25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	gold plated
Weight	100 g approx.

ISOLATOR
(2722 161 01091)

CL6202

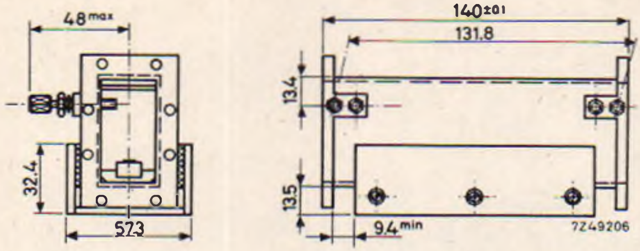


ELECTRICAL DATA

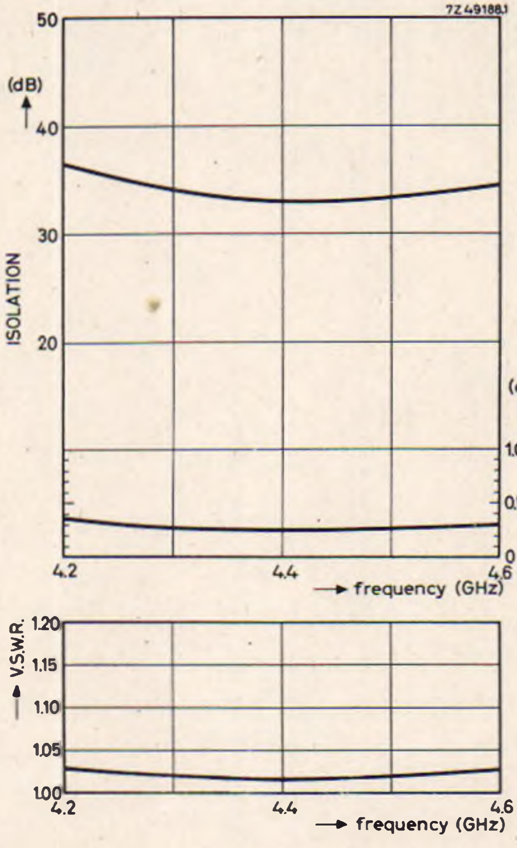
Frequency range	4.2 – 4.6 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1680 g



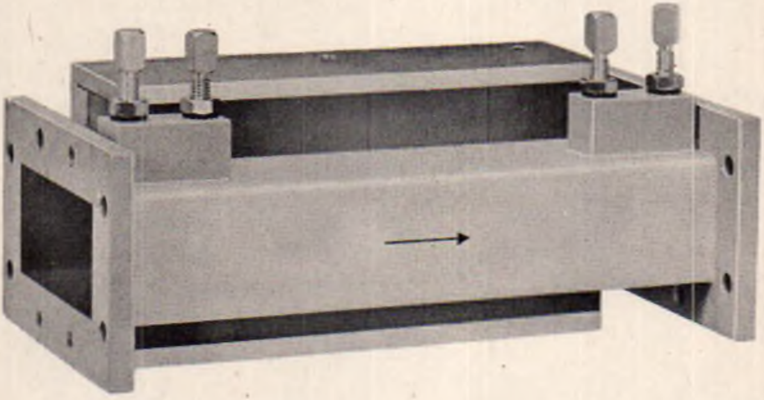
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR
(2722 161 01101)

CL6203



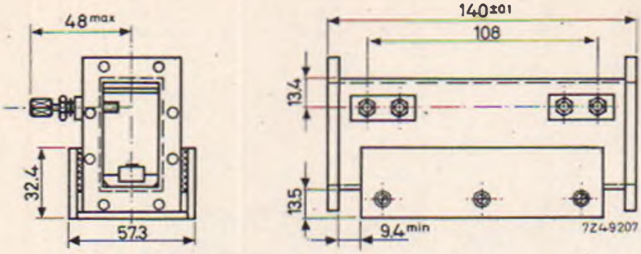
ELECTRICAL DATA

Frequency range	4.6 - 5.0 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C
	For other temperature ranges please inquire

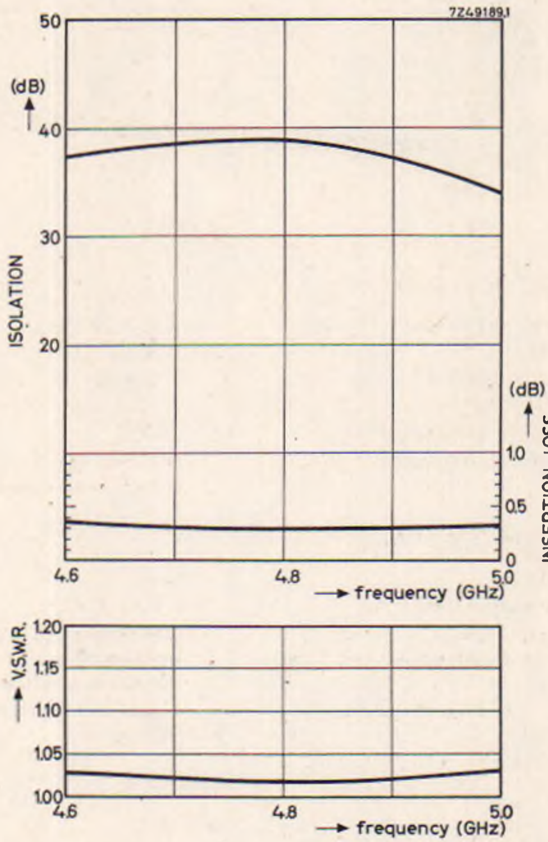
MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated
	outside enamelled grey
of magnet system	nickel standard mat
Weight	1680 g

Mullard



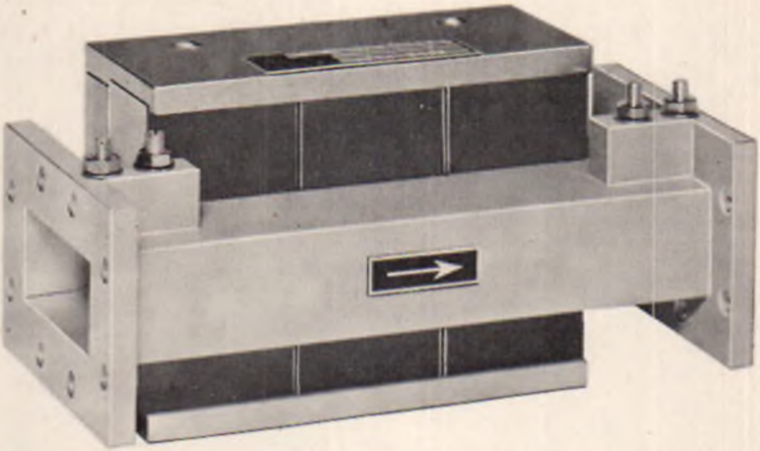
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR
(2722 161 01191)

CL6206

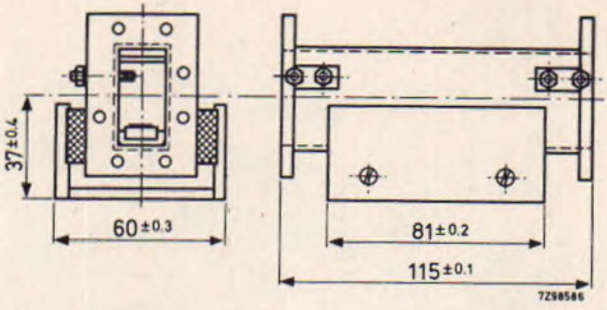


ELECTRICAL DATA

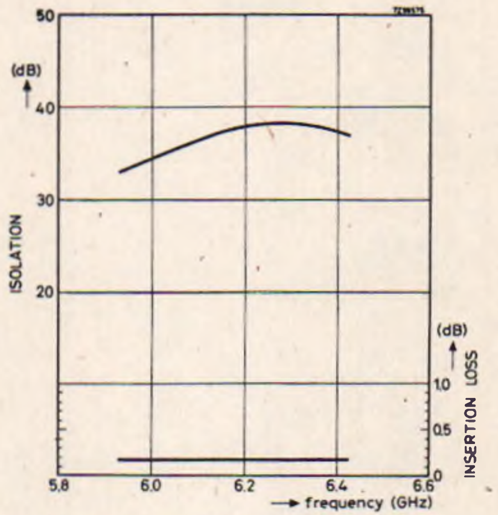
Frequency range	5.925-6.425 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

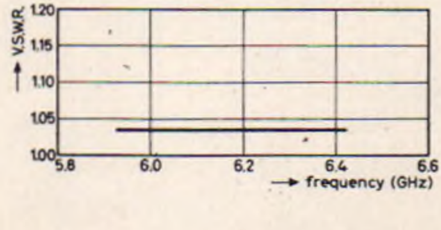
MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR
(2722 161 01161)

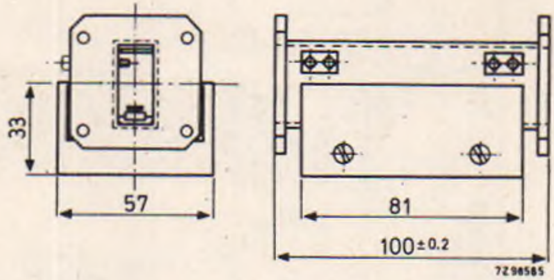
CL6214

ELECTRICAL DATA

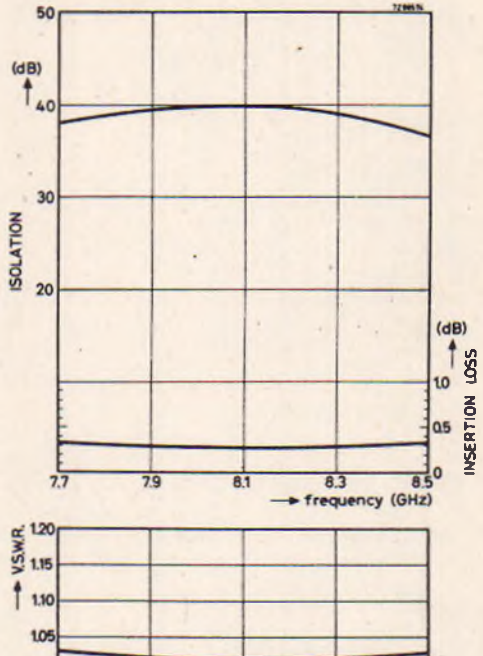
Frequency range	7.7-8.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R84 (I.E.C.)
Flange type	UBR84 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1260 g



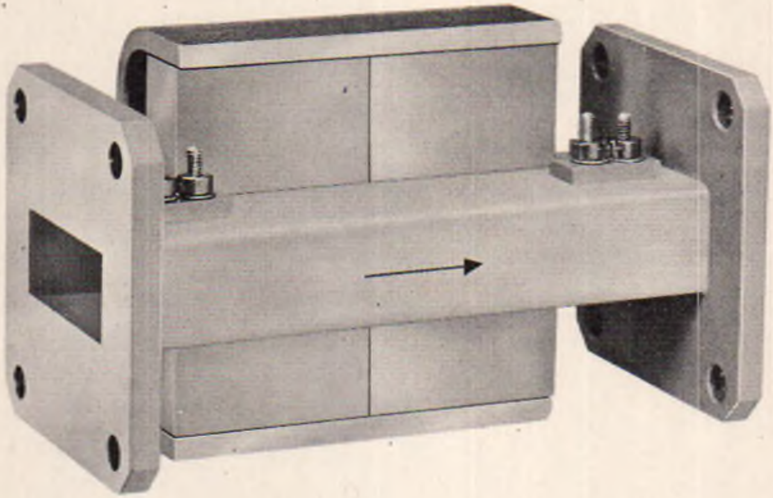
Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR
(2722 161 01171)

CL6215

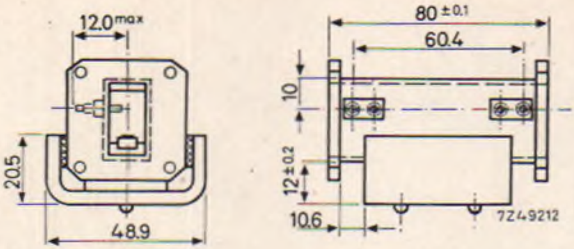


ELECTRICAL DATA

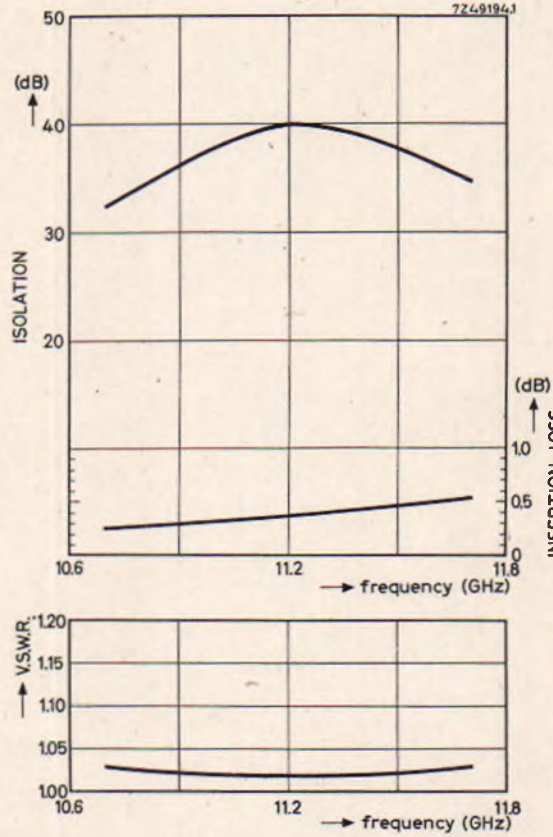
Frequency range	10.7 - 11.7 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	5 W
Temperature range	+ 10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 100 (I.E.C.)
Flange type	UBR 100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated
	outside enamelled grey
of magnet system	nickel standard mat
Weight	430 g



Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR
(2722 161 01051)

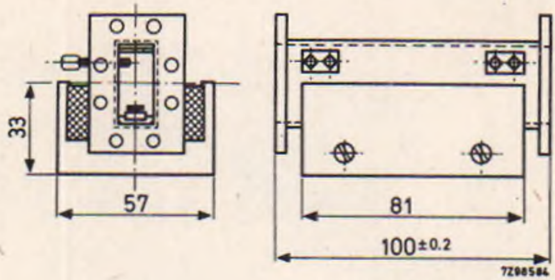
CL6216

ELECTRICAL DATA

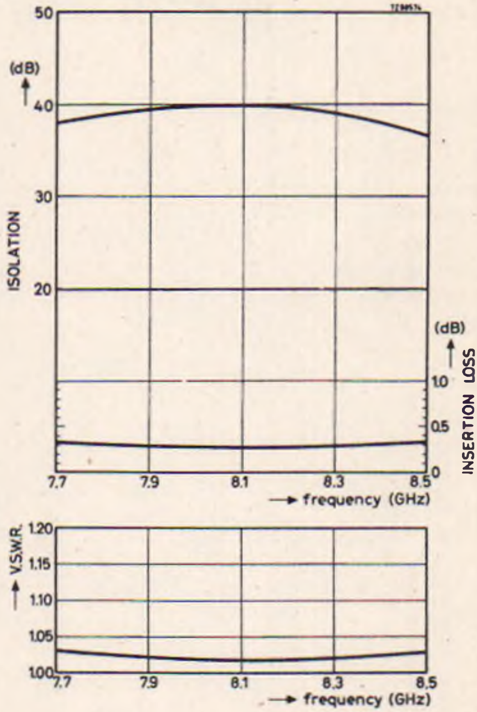
Frequency range	7.7-8.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R84 (I.E.C.)
Flange type	UER84 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1260 g



Dimensions in mm

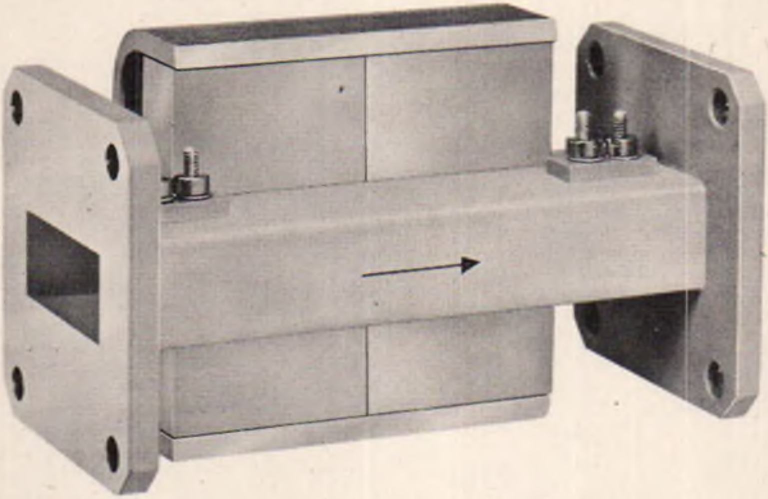


Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

CL6217

(2722 161 01181)

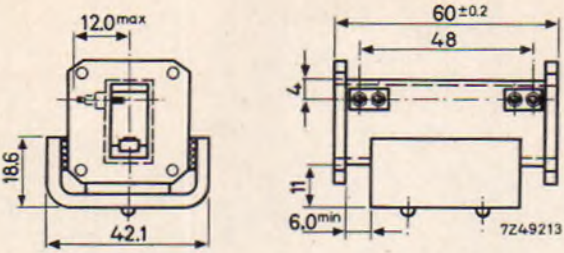


ELECTRICAL DATA

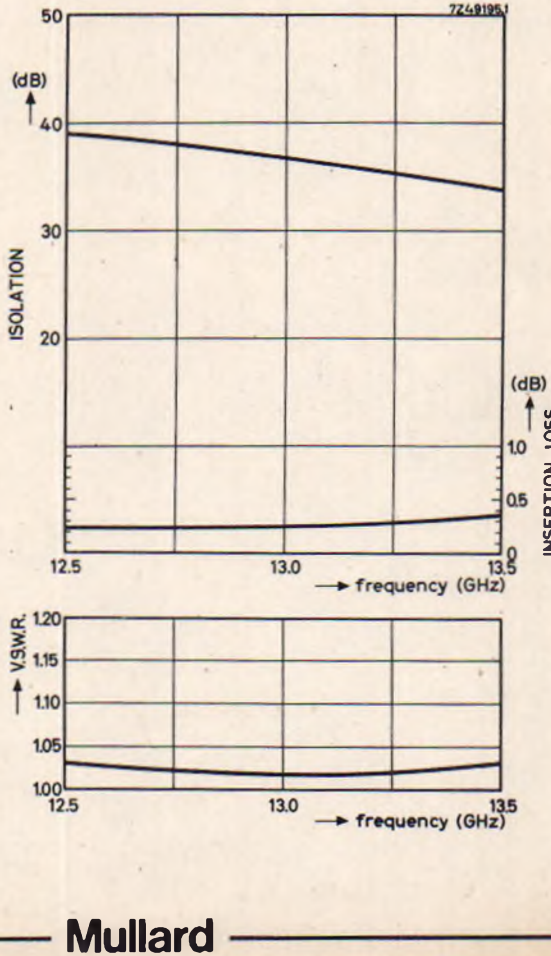
Frequency range	12.5 - 13.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 140 (I.E.C.)
Flange type	UBR 140 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	220 g



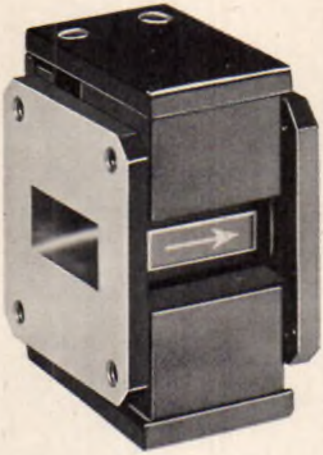
Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR
(2722 161 01221)

CL6221

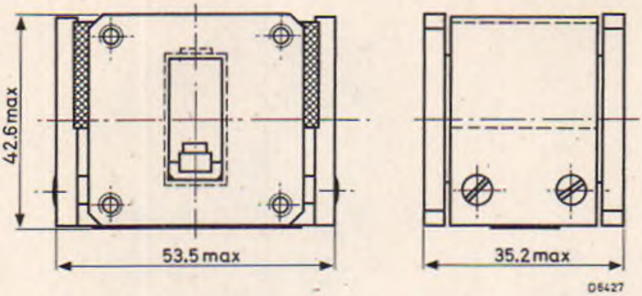


ELECTRICAL DATA

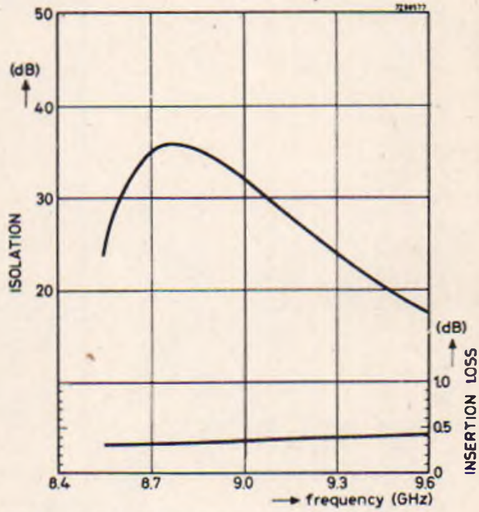
Frequency range	8.5-9.6 GHz
Isolation	> 15 dB
Insertion loss	< 0.6 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	1 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

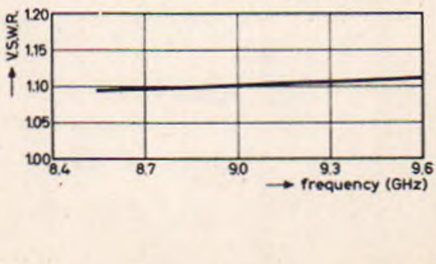
MECHANICAL DATA

Material	brass
Waveguide type	R100 (I.E.C.)
Flange type	UBR100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	nickelplated outside enamelled black
of magnet system	nickel standard mat
Weight	400 g



Dimensions in mm



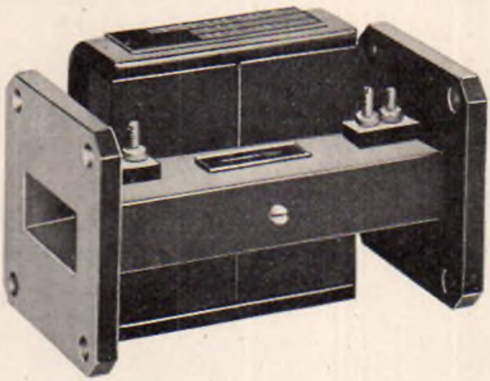


Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

CL6222

(2722 161 01211)

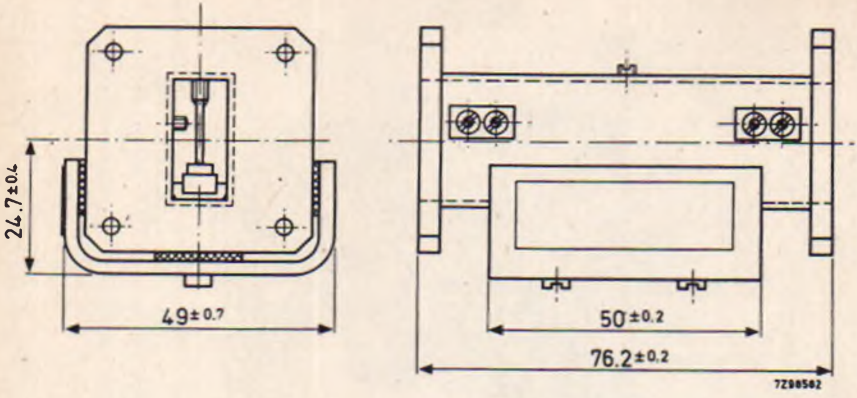


ELECTRICAL DATA

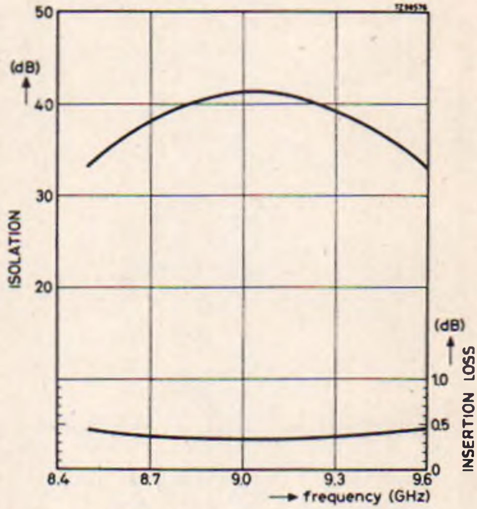
Frequency range	8.5-9.6 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

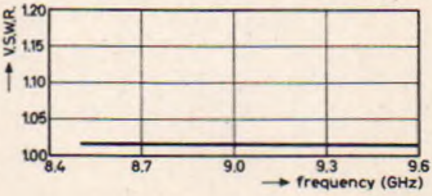
MECHANICAL DATA

Material	brass
Waveguide type	R100 (I.E.C.)
Flange type	UBR100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	nickelplated outside enamelled black
of magnet system	nickel standard mat
Weight	420 g



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

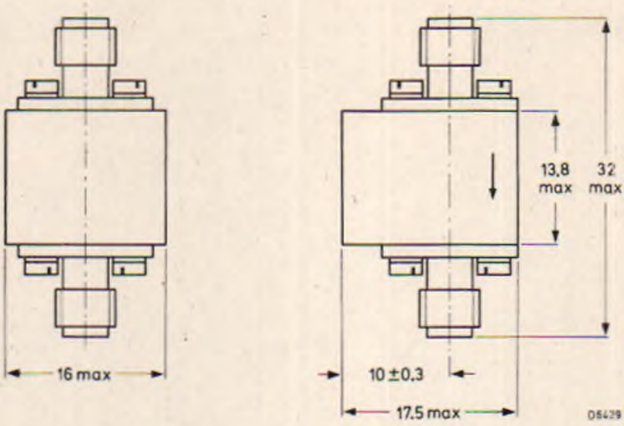
ISOLATOR
(2722 162 02221)

CL6223

COAXIAL ISOLATOR

Frequency 12 to 18 GHz

DIMENSIONS (mm)



ELECTRICAL DATA

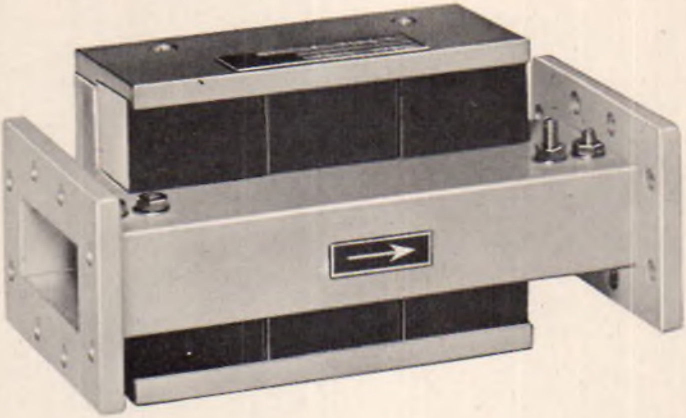
	guaranteed values	typical values
Frequency range	12 to 18 GHz	-
Isolation	≥ 20 dB	22 dB
Insertion loss	≤ 0.5 dB	0.35 dB
V.S.W.R.	≤ 1.25	1.20
Maximum power (c.w.)	5 W	
Maximum permissible reflected power in to port 2	1 W	
Temperature range	-10 to +70 °C	at +25 °C

MECHANICAL DATA

Connector type	SMA (MIL-C-39012/60)
Finish of connectors	Gold plated
Weight	20 g

ISOLATOR
(2722 161 01231)

CL6231

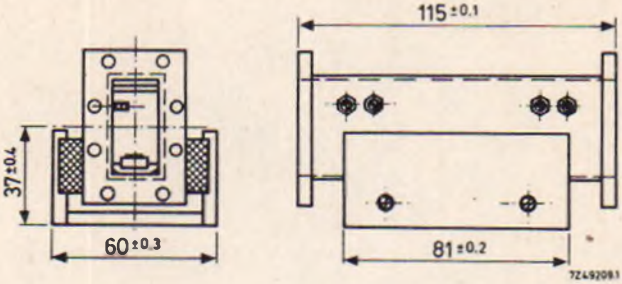


ELECTRICAL DATA

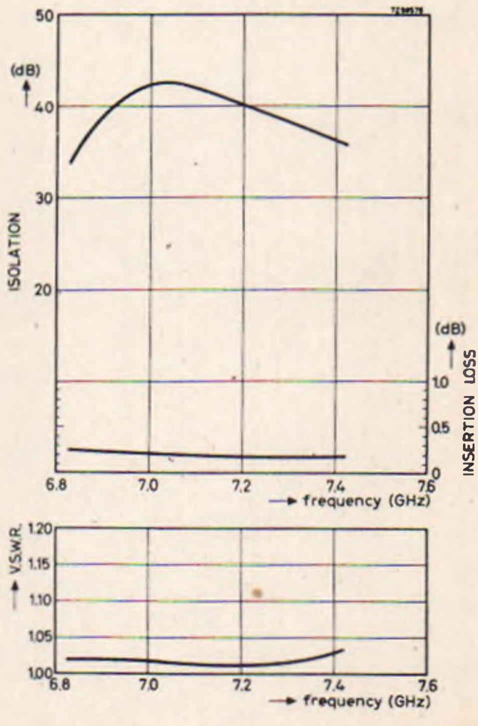
Frequency range	6.825-7.425 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm

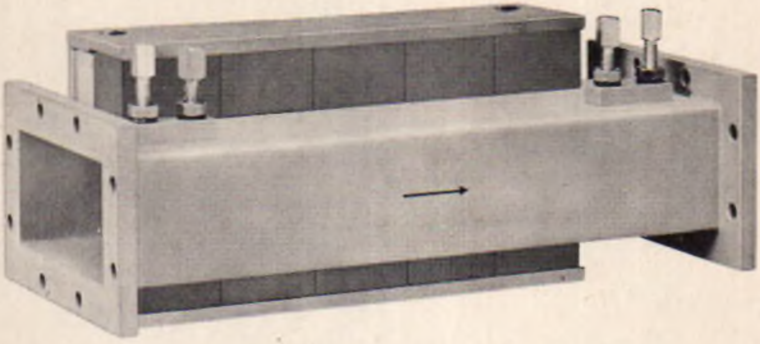


Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

CL6240

(2722 161 01081)

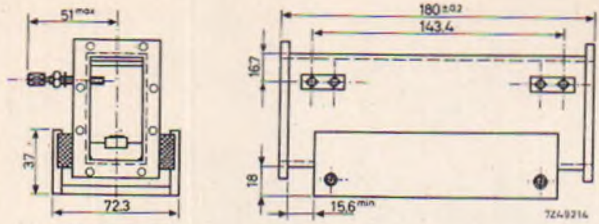


ELECTRICAL DATA

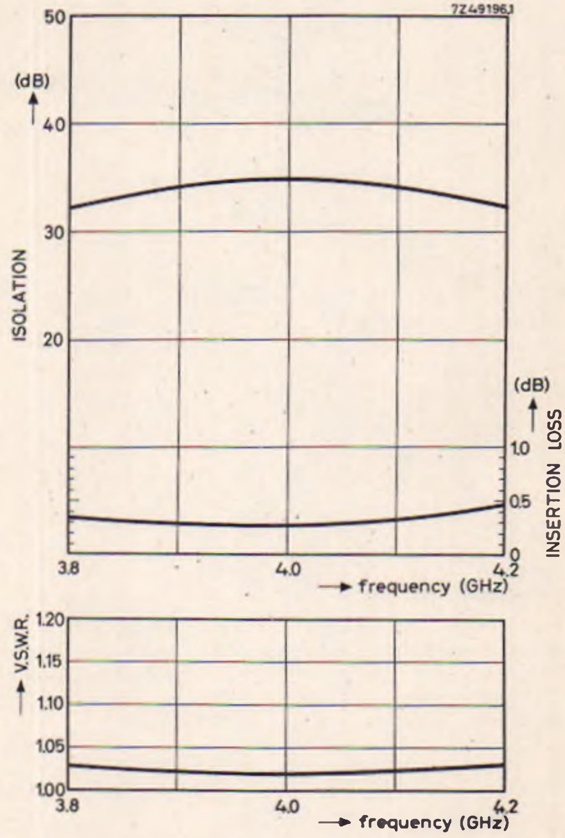
Frequency range	3.8 – 4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 80 °C
	For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 40 (I.E.C.)
Flange type	UER 40 (I.E.C.); other flanges to orde-
Finish of waveguide and flanges	goldplated upon silverplated
	outside enamelled grey
of magnet system	nickel standard mat
Weight	2450 g



Dimensions in mm.

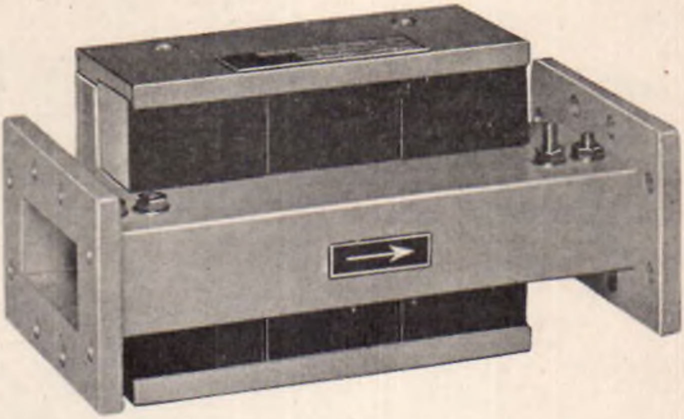


Typical performance as a function of frequency at a working temperature of 20 °C.

Mullard

ISOLATOR
(2722 161 01241)

CL6241

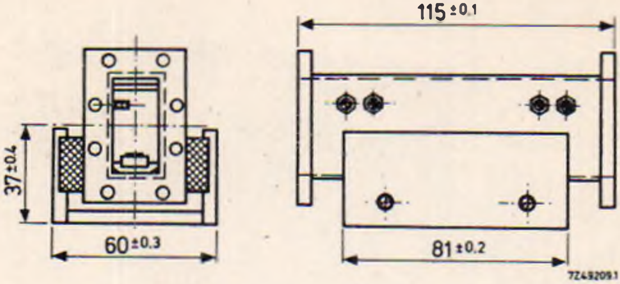


ELECTRICAL DATA

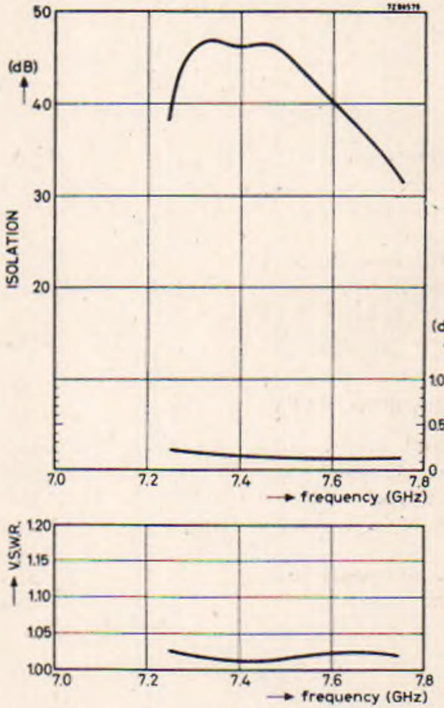
Frequency range	7.25-7.75 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm

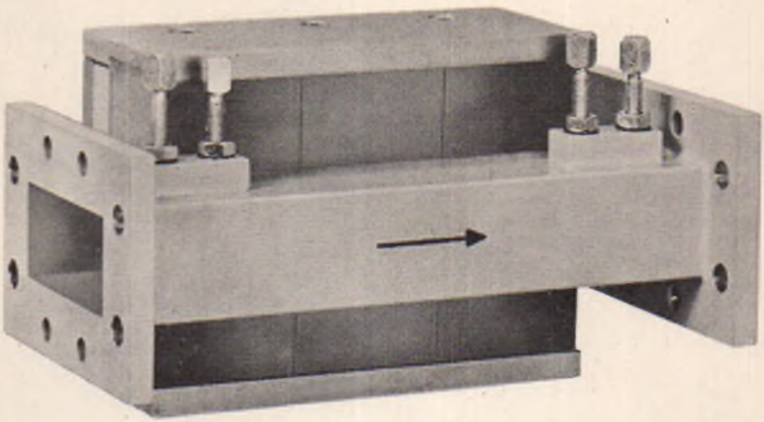


Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR

(2722 161 01251)

CL6251

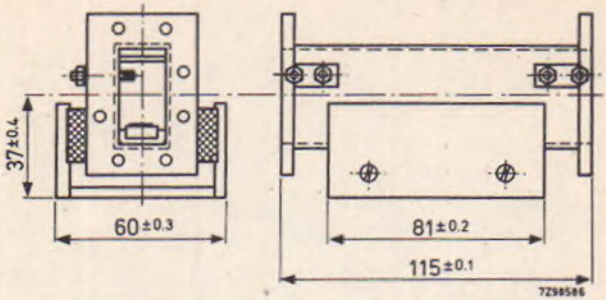


ELECTRICAL DATA

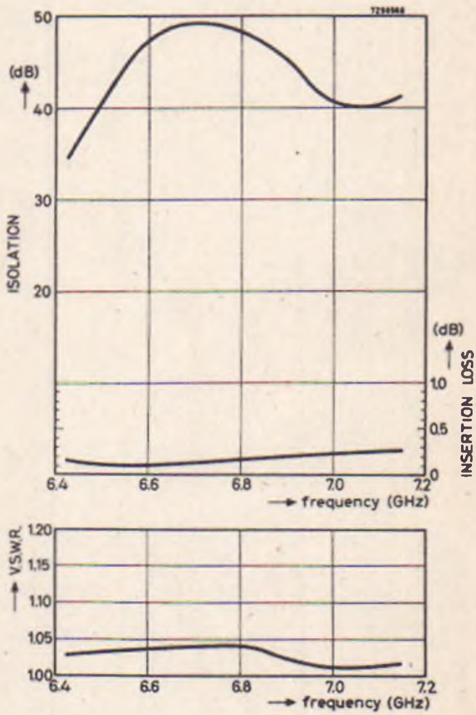
Frequency range	6.425-7.150 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.

ISOLATOR (2722 161 01261)

CL6261

WAVEGUIDE ISOLATOR

Frequency 8.5 to 9.6 GHz

DIMENSIONS (mm)

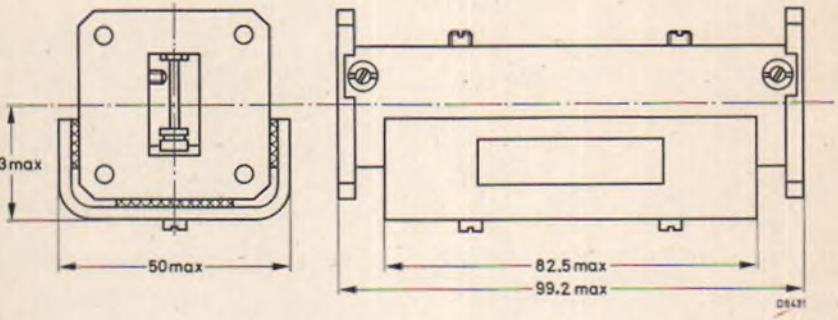


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	8.5 to 9.6 GHz
Isolation	> 55 dB
Insertion loss	< 1.2 dB
V.S.W.R.	< 1.2
Maximum power	10 W
Temperature range	-10 to +70 °C For other temperature ranges please enquire

MECHANICAL DATA

Material of waveguide and flange	brass
Mating flange type	154 IEC-UER 100
Finish of flanges	nickel plated
Colour	black
Weight	600 g

Typical performance as a function of frequency at an operating temperature of 20 °C.

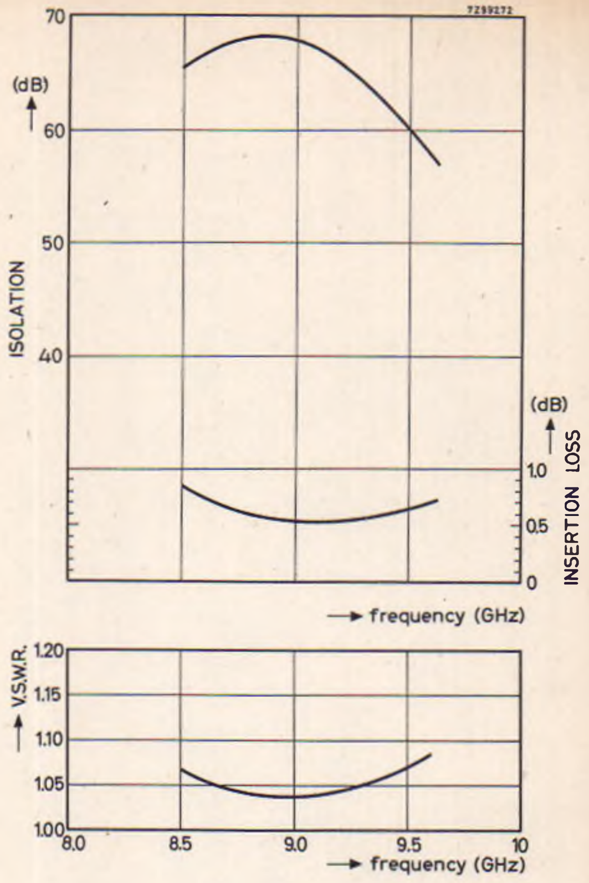


Fig. 2

ENVIRONMENTAL TESTS

The isolator withstands the following environmental tests of MIL-STD-202C

Moisture resistance, method 106B
Temperature cycling, method 102A, condition D
Thermal shock, method 107B, condition A
Vibration, method 201A
Shock, method 202B

ISOLATOR
(2722 161 01271)

CL6271

WAVEGUIDE ISOLATOR

Frequency 8.5 to 9.6 GHz

DIMENSIONS (mm)

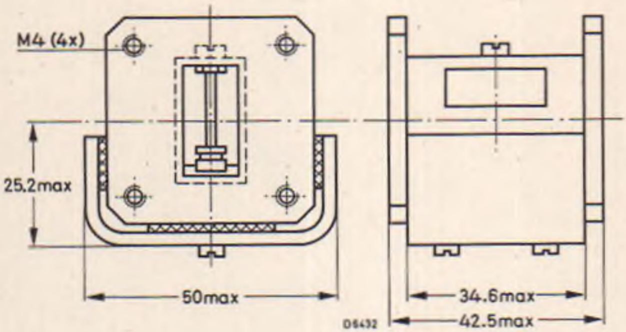


Fig. 1

ELECTRICAL DATA (see also Fig. 2)

Frequency range	8.5 to 9.6 GHz
Isolation	> 20 dB
Insertion loss	< 1 dB
V.S.W.R.	< 1.15
Maximum power	10 W
Temperature range	-10 to +70 °C For other temperatures please enquire

MECHANICAL DATA

Material of waveguide and flange	brass
Mating flange type	154 IEC-UBR 100
Finish of flanges	nickel plated
Colour	black
Weight	300 g

Typical performance as a function of frequency at an operating temperature of 20 °C

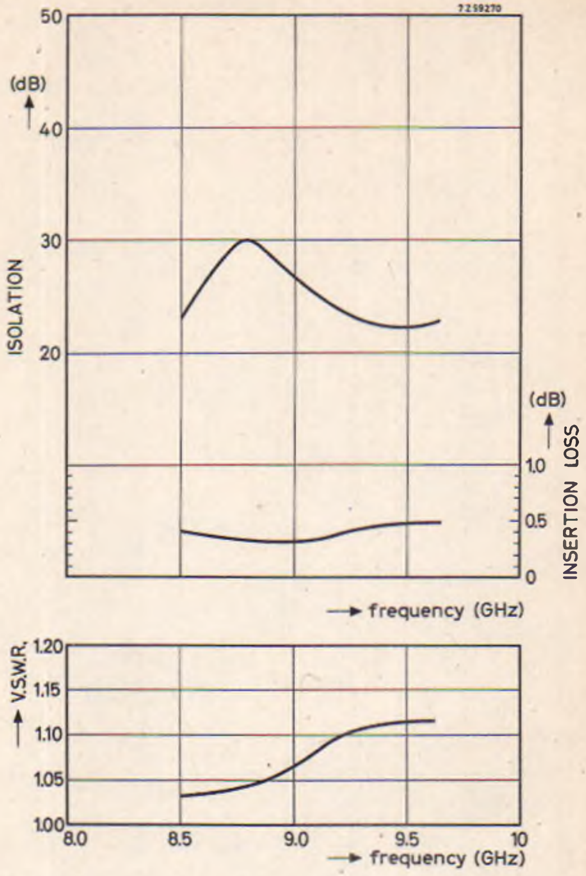


Fig. 2

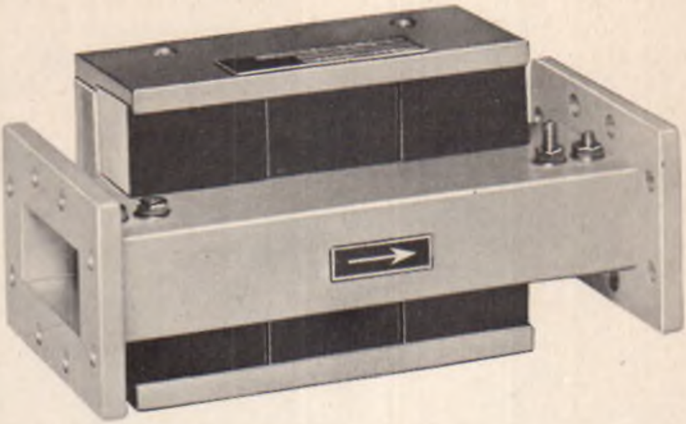
ENVIRONMENTAL TESTS

The isolator withstands the following environmental tests of MIL-STD-202C

Moisture resistance, method 106B
Temperature cycling, method 102A, condition D
Thermal shock, method 107B, condition A
Vibration, method 201A
Shock, method 202B

ISOLATOR
(2722 161 01291)

CL6291

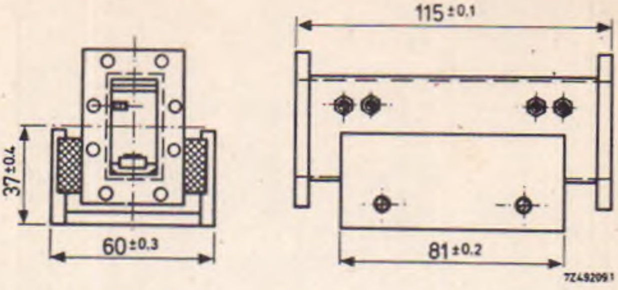


ELECTRICAL DATA

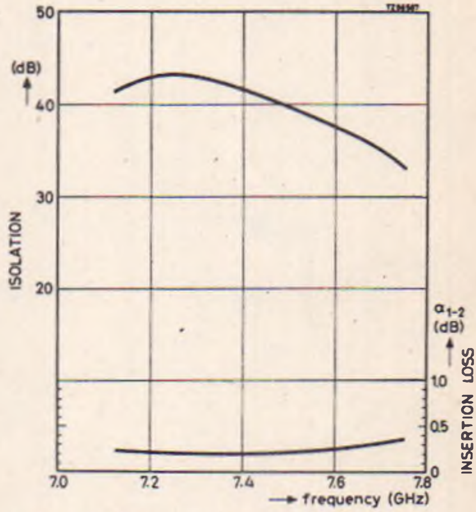
Frequency range	7.125-7.750 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

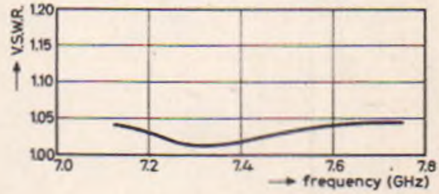
MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



Dimensions in mm





Typical performance as a function of frequency at a working temperature of 20 °C.

ACCESSORIES

H

MICROWAVE HORN ANTENNA

ACX-01

TENTATIVE DATA

A general purpose X-band antenna for miniature radar systems. The unit gives a low v.s.w.r. and is of a strong cast construction.

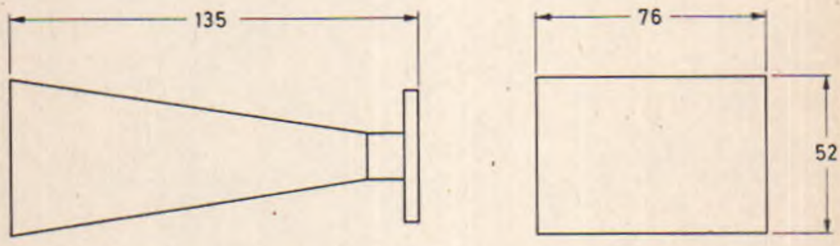
CHARACTERISTICS

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

MECHANICAL DATA

Weight	160	g
Flange	UBR100 (UG135/U)	

OUTLINE DRAWING



All dimensions in mm

D6306

INDEX

INDEX TO BOOK 1, PART 8

Type Number	Section	Type Number	Section
CL5851	F	CL8310	C
CL5861	F	CL8441	C
CL5871	F	CL8630	C
CL5881	F	CL8630S	C
CL5891	F	CL8632	C
CL5901	F	CL8632S	C
CL5931	F	CL8633	C
CL5941	F	CL8633S	C
CL5951	F	CL8640R/T	C
CL6001	G	CL8960	E
CL6011	G	CL8963	E
CL6021	G	CL9012G	E
CL6031	G	CL9070	E
CL6041	G	CXY10	B
CL6051	G	CXY11A/B/C	B
CL6071	G	CXY12	B
CL6091	G	CXY14A/B/C	B
CL6101	G	CXY19/19A	B
CL6111	G	CXY21	B
CL6122	G	GEM1/2	See BAV22/22R
CL6202	G	GEM3/4	See BAV22/22R
CL6203	G	SIM2/5	See BAV22/22R
CL6206	G	1N23D/23DR	See BAW95D
CL6214	G	1N23E/23ER	See BAW95E
CL6215	G	1N23F	See BAW95F
CL6216	G	1N23G/23GR	See BAW95G
CL6217	G	1N23WE	See BAW95E
CL6221	G	1N78D	See AAY52
CL6222	G	1N78DR	See AAY52R
CL6223	G	1N78E	See AAY51
CL6231	G	1N78ER	See AAY51R
CL6240	G	1N415D	See BAW95D
CL6241	G	1N415E	See BAW95E
CL6251	G	1N415F	See BAW95F
CL6261	G	1N415G	See BAW95G
CL6271	G	1N5152	B
CL6291	G	1N5153	B
CL7330/1/2	D	1N5155	B
CL7500	D	1N5157	B
CL7520	D		

MICROWAVE SEMICONDUCTORS AND COMPONENTS

CONTENTS

Mullard

Book 1 Part 8

Microwave semiconductors
and components

January 1975

Mullard Limited
Mullard House, Torrington Place, London, WC1E 7HD

Printed in England
TP 1518