PHILIPS

Data handbook

PHILIPS

Electronic components and materials

Electron tubes

Part 2b May 1978

Microwave semiconductors and components

ELECTRON TUBES

Part 2b **May 1978**

Index at the back.

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of three series of handbooks each comprising several parts.

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

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

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

ELECTRON TUBES (BLUE SERIES)

Part 1a	December 1975	ET1a 12-75	**Transmitting tubes for communication, tubes for r.f. heating** Types PE05/25 to TBW15/25
Part 1b	August 1977	ET1b 08-77	**Transmitting tubes for communication, tubes for r.f. heating, amplifier circuit assemblies**
Part 2a	November 1977	ET2a 11-77	**Microwave tubes** Communication magnetrons, magnetrons for microwave heating, klystrons, travelling-wave tubes, diodes, triodes T-R switches
Part 2b	May 1978	ET2b 05-78	**Microwave semiconductors and components** Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	January 1975	ET3 01-75	**Special Quality tubes, miscellaneous devices**
Part 4	March 1975	ET4 03-75	**Receiving tubes**
Part 5a	March 1978	ET5a 03-78	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 5b	May 1975	ET5b 05-75	**Camera tubes, image intensifier tubes**
Part 6	January 1977	ET6 01-77	**Products for nuclear technology** Channel electron multipliers, neutron tubes, Geiger-Müller tubes
Part 7a	March 1977	ET7a 03-77	**Gas-filled tubes** Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	March 1977	ET7b 03-77	**Gas-filled tubes** Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	May 1977	ET8 05-77	**TV picture tubes**
Part 9	March 1978	ET9 03-78	**Photomultiplier tubes; phototubes**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Part 1a	March 1976	SC1a 03-76	**Rectifier diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes (> 1,5 W), transient suppressor diodes, rectifier stacks, thyristors, triacs
Part 1b	May 1977	SC1b 05-77	**Diodes** Small signal germanium diodes, small signal silicon diodes, special diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes
Part 2	November 1977	SC2 11-77	**Low-frequency and dual transistors**
Part 3	January 1978	SC3 01-78	**High-frequency, switching and field-effect transistors**
Part 4a	June 1976	SC4a 06-76	**Special semiconductors** Transmitting transistors, field-effect transistors, dual transistors, microminiature devices for thick and thin-film circuits
Part 4b	July 1976	SC4b 07-76	**Devices for optoelectronics** Photosensitive diodes and transistors, light emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices
Part 5a	November 1976	SC5a 11-76	**Professional analogue integrated circuits**
Part 5b	March 1977	SC5b 03-77	**Consumer integrated circuits** Radio-audio, television
Part 6	October 1977	SC6 10-77	**Digital integrated circuits** LOCMOS HE4000B family
Signetics integrated circuits 1976			Logic, Memories, Interface, Analogue, Microprocessor, Milrel

COMPONENTS AND MATERIALS (GREEN SERIES)

Part 1	June 1977	CM1 06-77	**Assemblies for industrial use** High noise immunity logic FZ/30-series, counter modules 50-series, NORbits 60-series, 61-series, circuit blocks 90-series, circuit block CSA70(L), PLC modules, input/output devices, hybrid circuits, peripheral devices, ferrite core memory products
Part 2a	October 1977	CM2a 10-77	**Resistors** Fixed resistors, variable resistors, voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC), test switches
Part 2b	February 1978	CM2b 02-78	**Capacitors** Electrolytic and solid capacitors, film capacitors, ceramic capacitors, variable capacitors
Part 3	January 1977	CM3 01-77	**Radio, audio, television** FM tuners, loudspeakers, television tuners and aerial input assemblies, components for black and white television, components for colour television
Part 4a	October 1976	CM4a 10-76	**Soft ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	December 1976	CM4b 12-76	**Piezoelectric ceramics, permanent magnet materials**
Part 5	July 1975	CM5 07-75	**Ferrite core memory products** Ferroxcube memory cores, matrix planes and stacks, core memory systems
Part 6	April 1977	CM6 04-77	**Electric motors and accessories** Small synchronous motors, stepper motors, miniature direct current motors
Part 7	September 1971	CM7 09-71	**Circuit blocks** Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 8	February 1977	CM8 02-77	**Variable mains transformers**
Part 9	March 1976	CM9 03-76	**Piezoelectric quartz devices**
Part 10	April 1978	CM10 04-78	**Connectors**

General section A

Type nomenclature
List of symbols
Explanation
Rating system

TYPE NOMENCLATURE

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

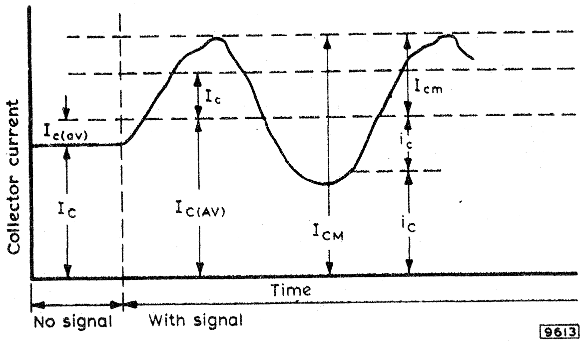
LIST OF SYMBOLS FOR SEMICONDUCTOR DEVICES

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

ii, 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_e, $r_{bb'}$

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_{oe} (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 $= \frac{I_C - I_{CBO}}{I_B + I_{CBO}}$

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	
$\|y_{fb}\|$($\|y_{21}\|$)	$\|y_{fe}\|$($\|y'_{21}\|$)	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	
$\|y_{rb}\|$ (y_{12})	$\|y_{re}\|$ (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.

Gunn, Impatt and noise diodes B

SILICON AVALANCHE NOISE DIODE

BAT31

Epitaxial, silicon planar, broadband noise generator. This is a current controlled device operated at avalanche breakdown and is effective from less than 10 Hz to above J-band. Applications include built-in test equipment (BITE) for surveillance, tracking and weather radars, microwave links, direction finding, p.c.m. systems and noise modulators for electronic countermeasures.
It conforms to the environmental requirements of BS9300 where applicable.

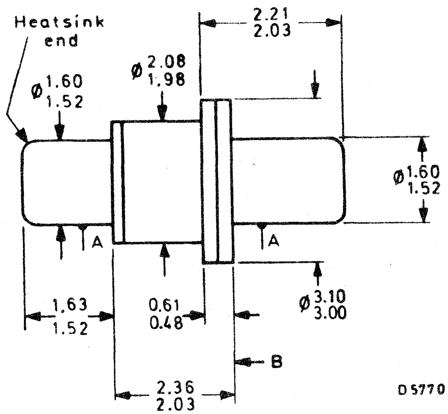
QUICK REFERENCE DATA

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

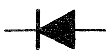
OUTLINE AND DIMENSIONS

Dimensions in mm

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ±0.13



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

LIMITING VALUES (Absolute max. rating system)

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

CHARACTERISTICS (T_{mb} = 25 ^oC)

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

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

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

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

R_{sp} is approximately 1 Ω

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

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

3) Other encapsulations may be made available on request.

APPLICATION INFORMATION

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

Temperature and excess noise relationship

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

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

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

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

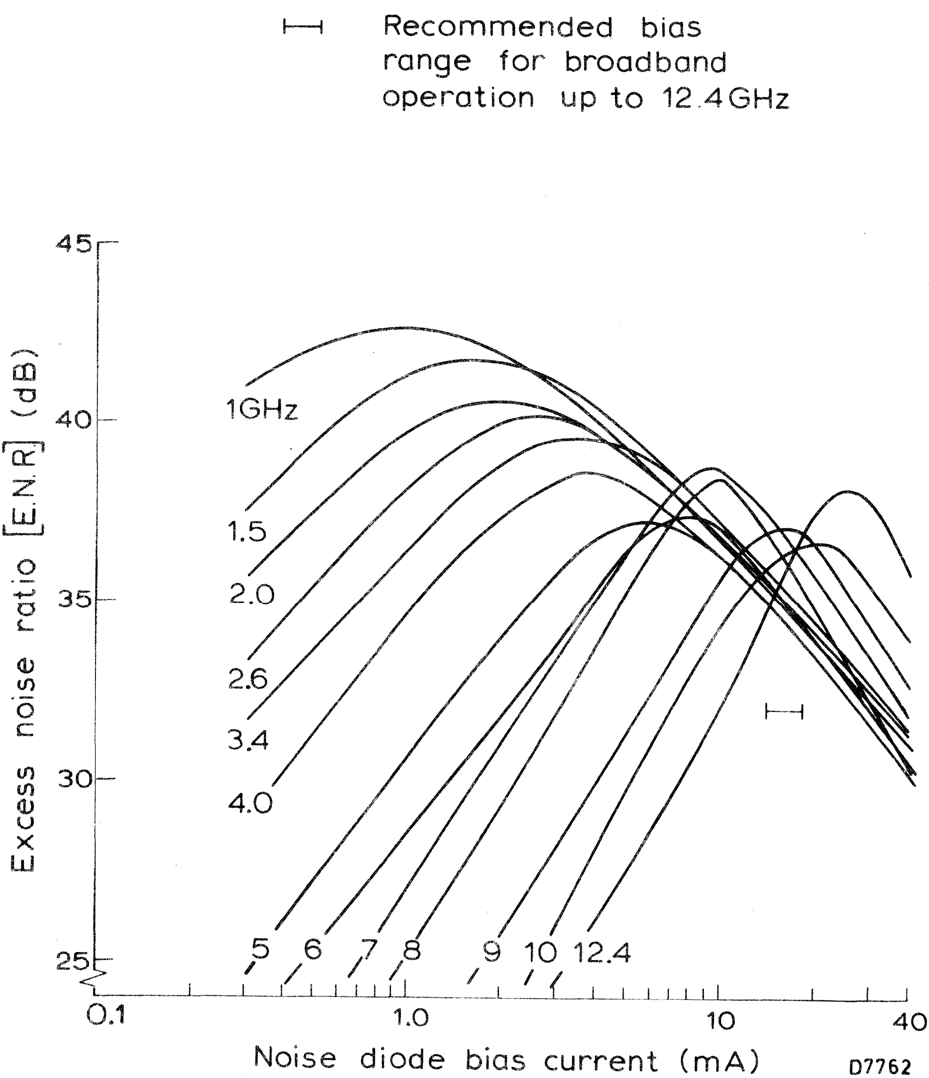


Fig. 1

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

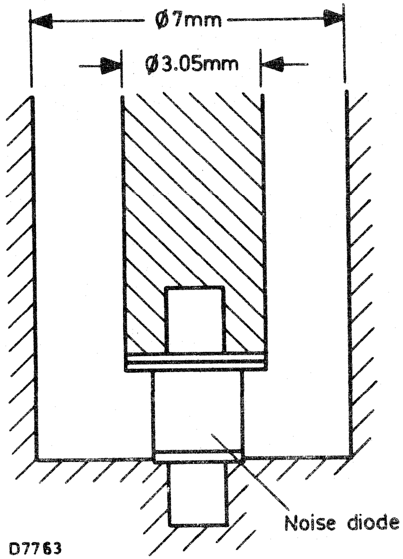


Fig. 2

Device mounted in a 50 Ω 7 mm coaxial line

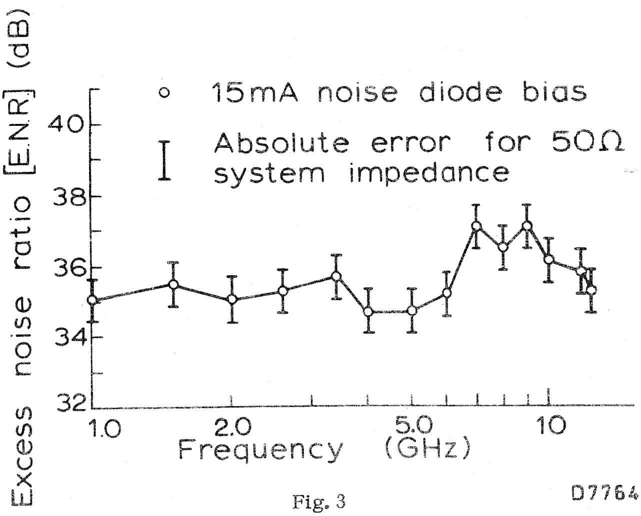


Fig. 3

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

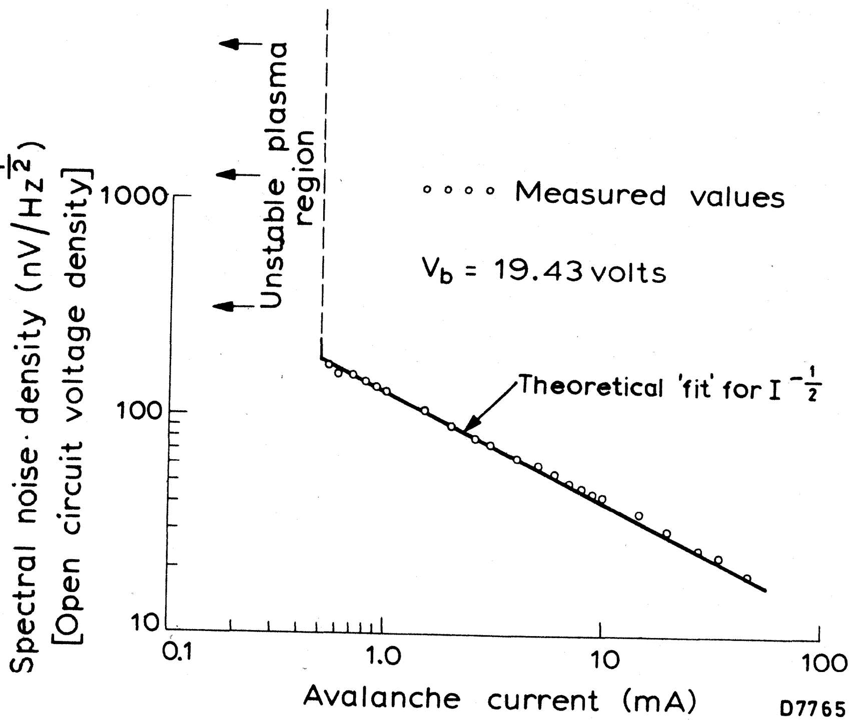


Fig. 4

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

SILICON IMPATT DIODE

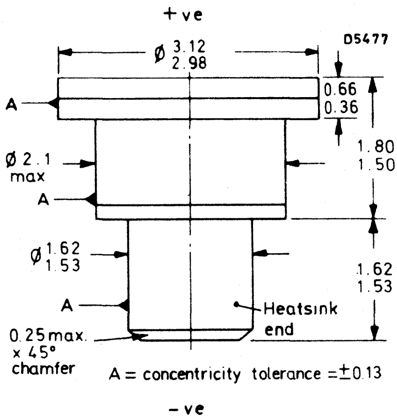
BXY50

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

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

TYPICAL OSCILLATOR PERFORMANCE

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

OPERATING NOTES

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

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

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

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

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

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

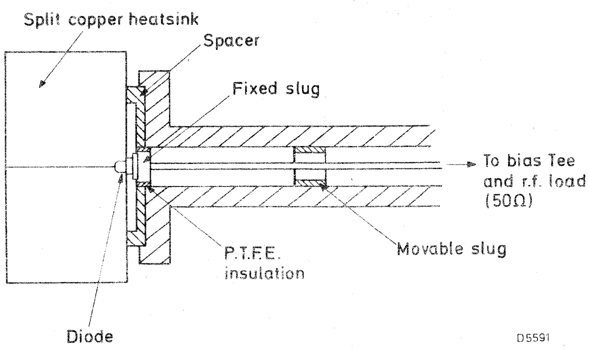
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

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

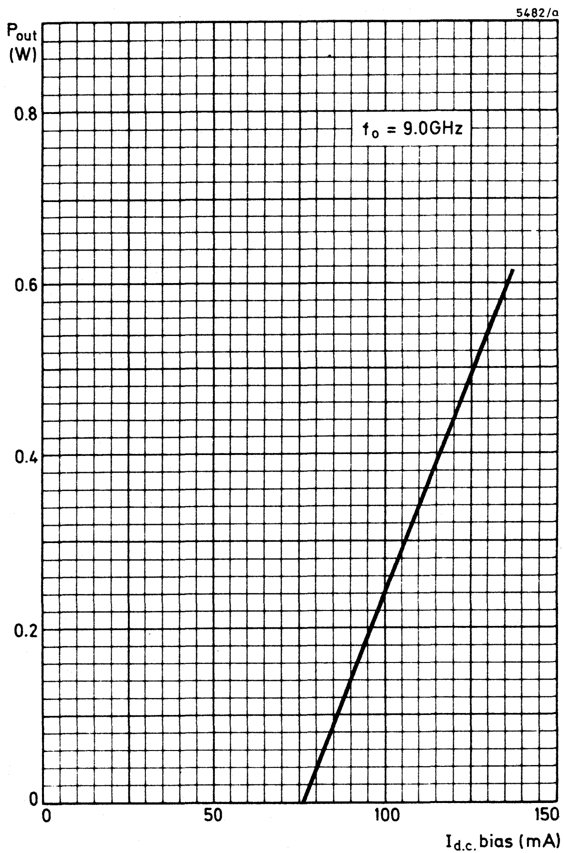
OPERATING NOTES (contd.)

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

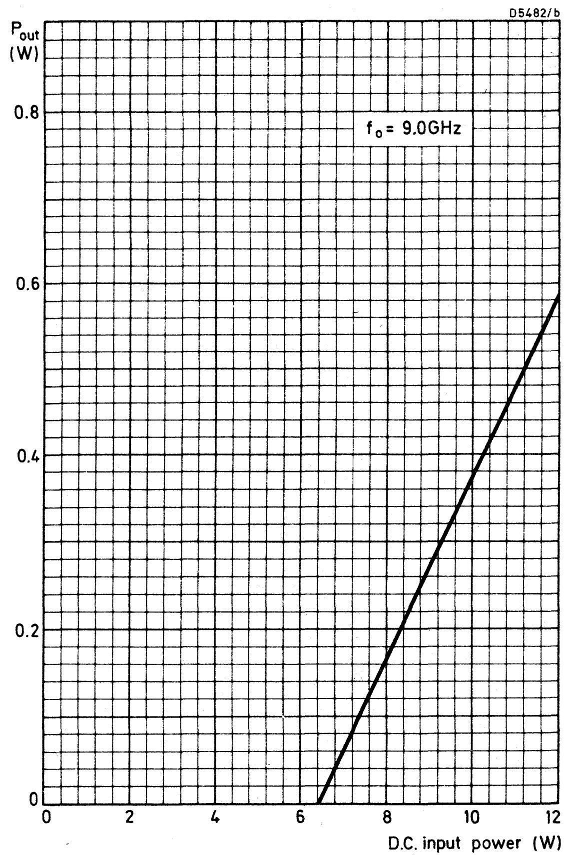
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



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

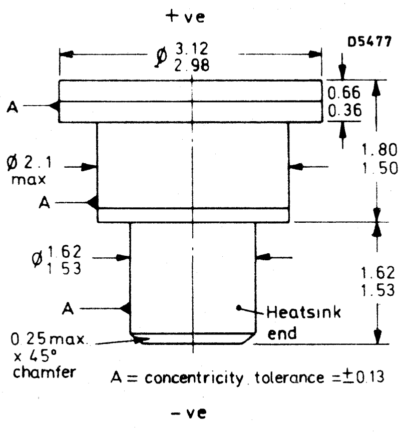
SILICON IMPATT DIODE

BXY51

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

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

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

		Min.	Typ.	Max.	
$V_{(BR)R}$	Reverse breakdown voltage (at I_R = 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^oC, 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.

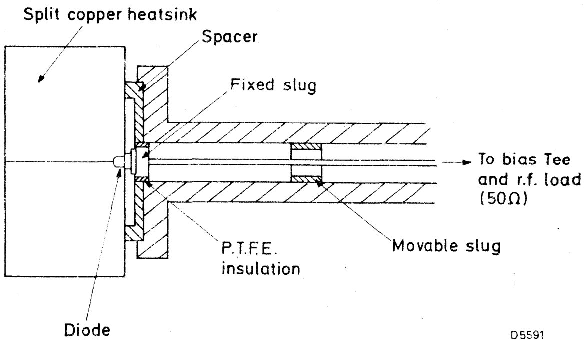
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

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

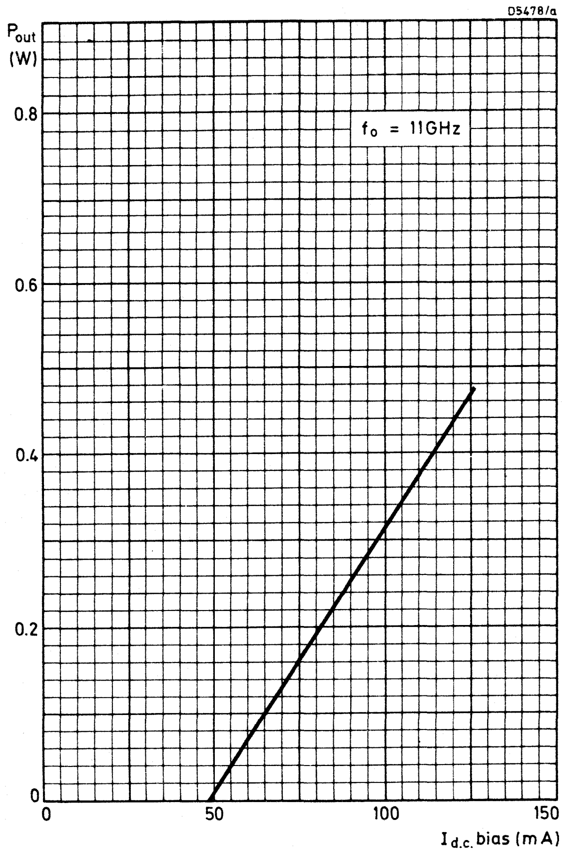
OPERATING NOTES (contd.)

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.

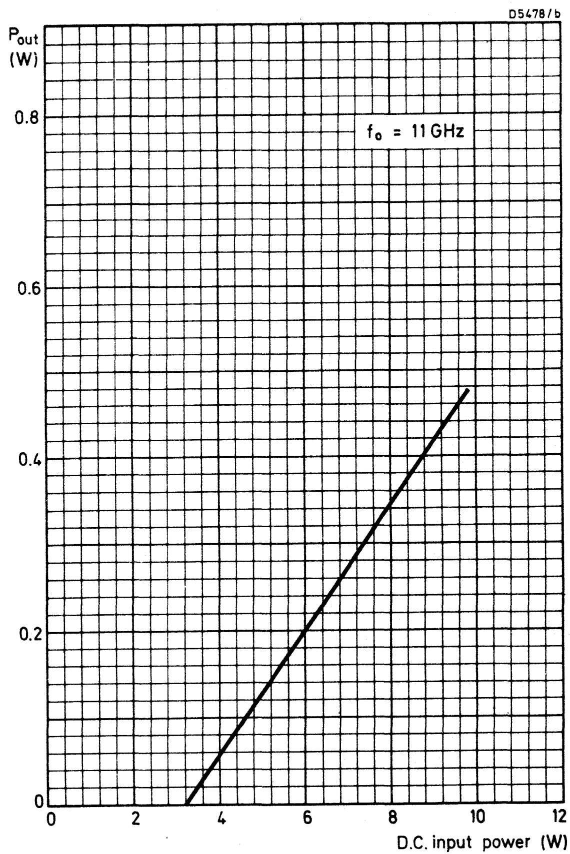
Devices may be selected to suit customers' specific requirements



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

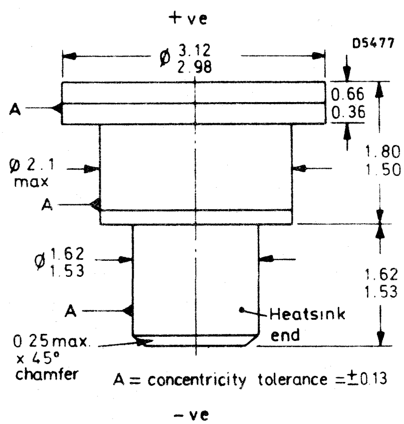
BXY52

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

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

TYPICAL OSCILLATOR PERFORMANCE

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

OPERATING NOTES

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

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

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

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

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

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

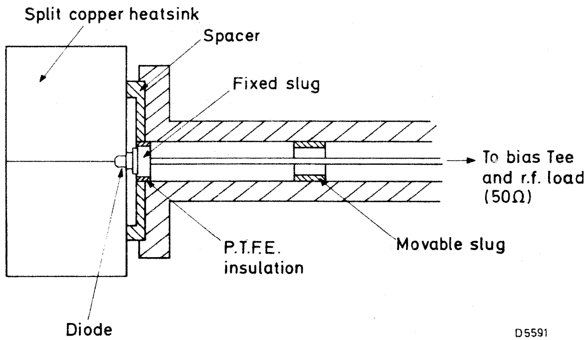
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).

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

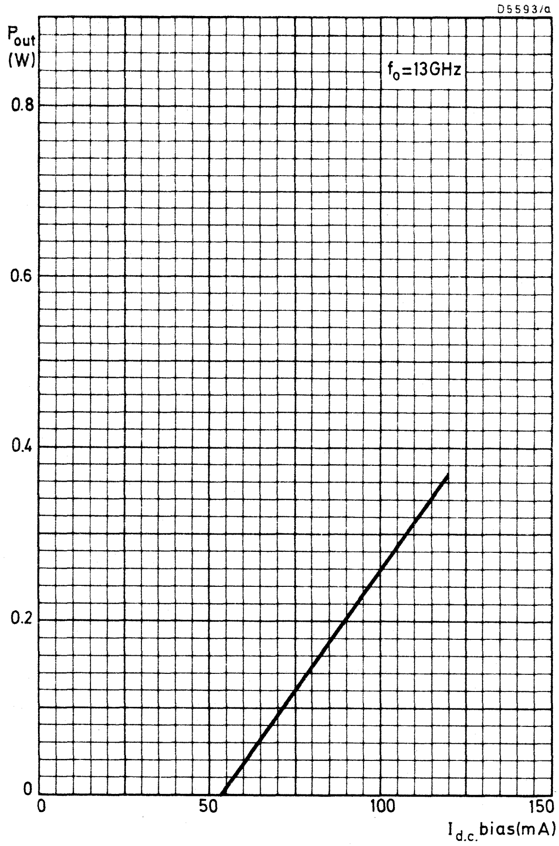
OPERATING NOTES (contd.)

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

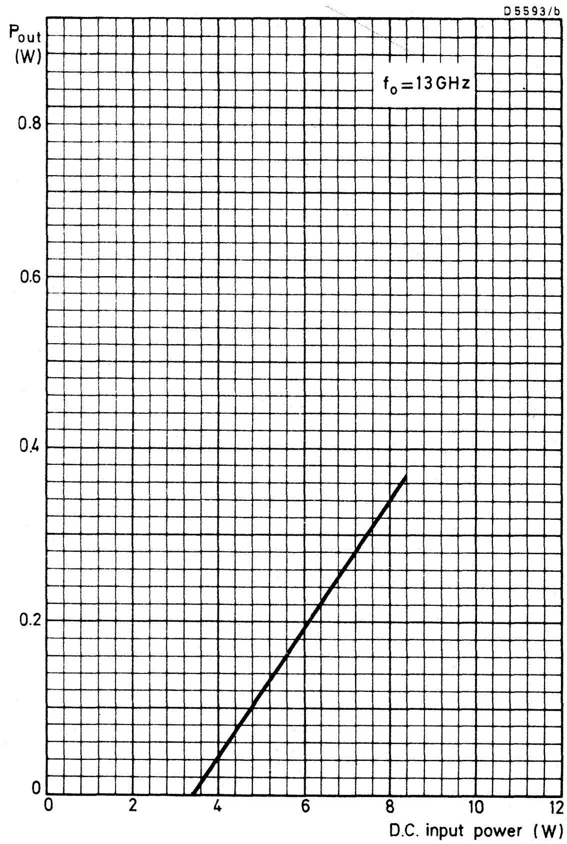
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT



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

SILICON IMPATT DIODE

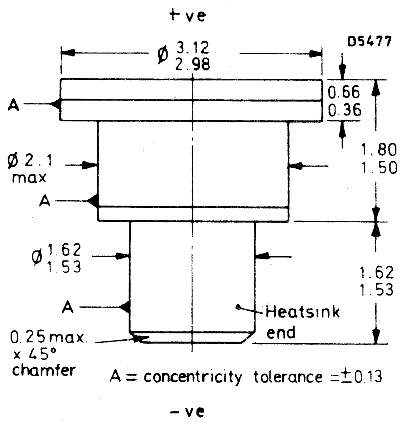
BXY60

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

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

P_{tot} max. (see note 1)	$\frac{200 - T_{hs}}{R_{th}\ (j - hs)}$	W
R_{th} (j - hs) max.	14	$^{o}C/W$
$T_j - T_{hs}$ 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 = 5.0mA)	85	100	115	V
I_R	Reverse current (at V_R = 70V)	-	-	10	μA
C_T	Total capacitance (at $V_{(BR)R}$ = 75V)	-	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. $\leq \frac{200 - T_{hs}}{R_{th}\ (j - hs)}$ W,

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

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

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

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

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

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

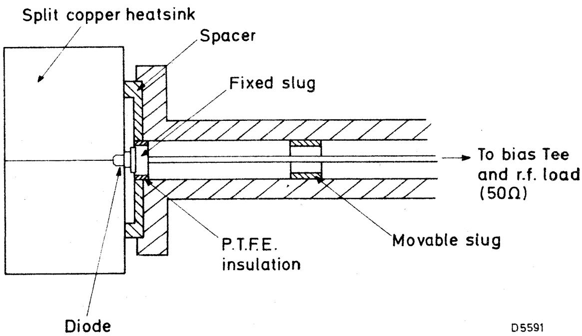
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

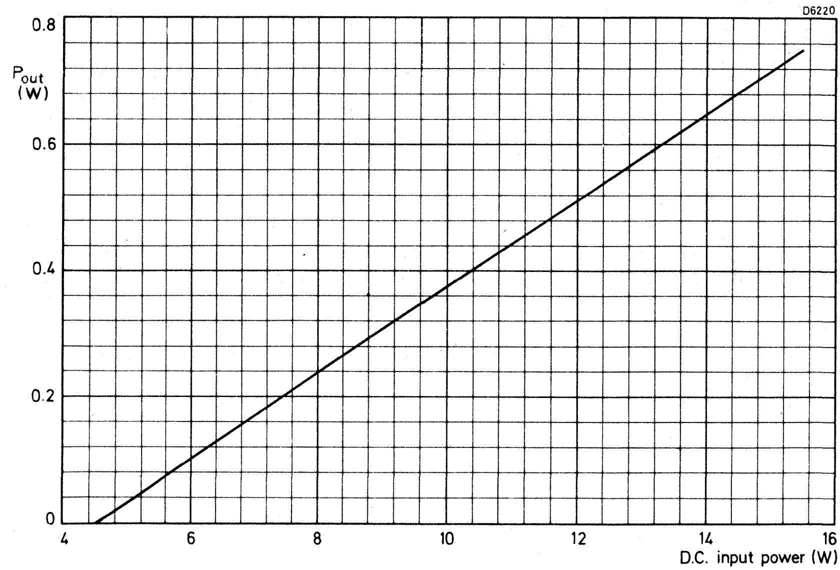
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically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

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

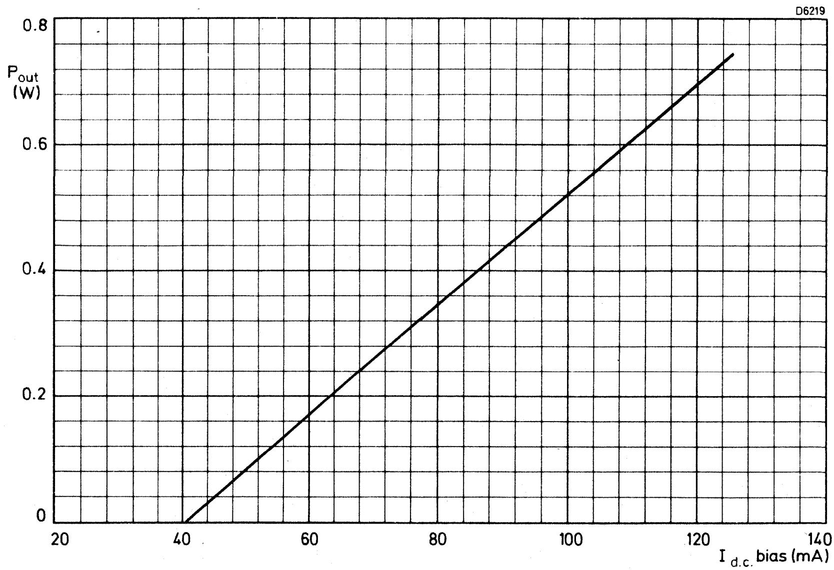
Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



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



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT

GUNN EFFECT DEVICES

CXY11A CXY11B CXY11C

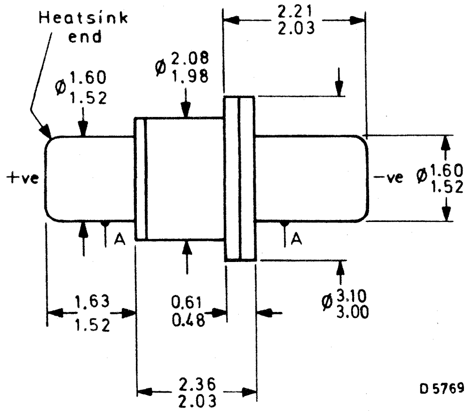
Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

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

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

OPERATING NOTES

1) Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients. An 8.2 V voltage regulator diode to shunt the power supply is recommended for this purpose.

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

3) The output power is normally measured in a coaxial cavity at a frequency of 9.5 GHz. Other centre frequencies may be supplied at 8.5, 10.5 and 11.5 GHz by suffixing the type number e.g. CXY11B/10.5 specifies a diode giving 10 mW min. at 10.5 GHz. See the table below.
Diodes with these other centre frequencies will not necessarily oscillate over the whole 8 to 12 GHz range.
The bias may be optimized to give maximum output power within the V max. and P_{tot} max. ratings.

4) A.M. noise is measured in a 1 Hz to 1 kHz bandwidth with the diode mounted in a CL8630 oscillator.

5) It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.

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

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

GUNN EFFECT DEVICES

CXY14A
CXY14B
CXY14C

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

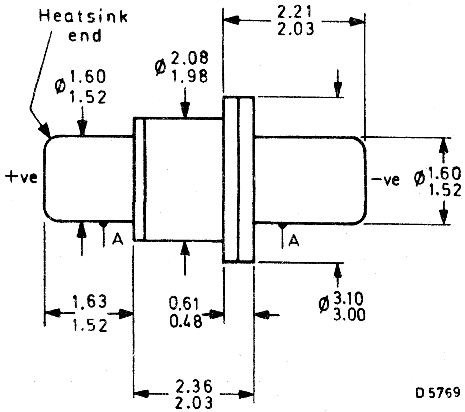
QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

Temperature

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

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

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

OPERATING NOTES

1) Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients. An 8.2 V voltage regulator diode to shunt the power supply is recommended for this purpose.

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

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

4) It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.

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

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

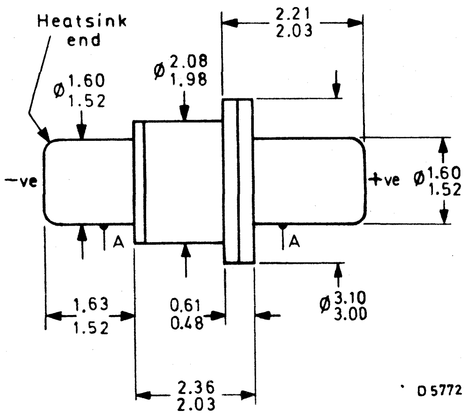
CXY19

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

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

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

OPERATING NOTES

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

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

CXY19A

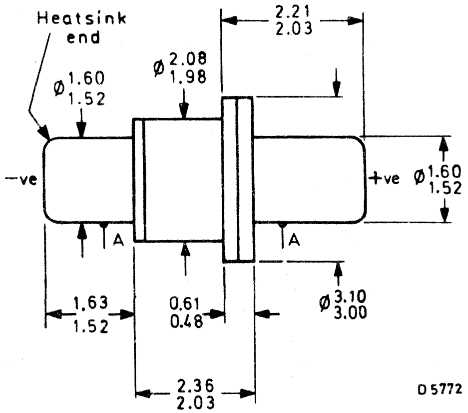
Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

OPERATING NOTES

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

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

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

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

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

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

CXY19B

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

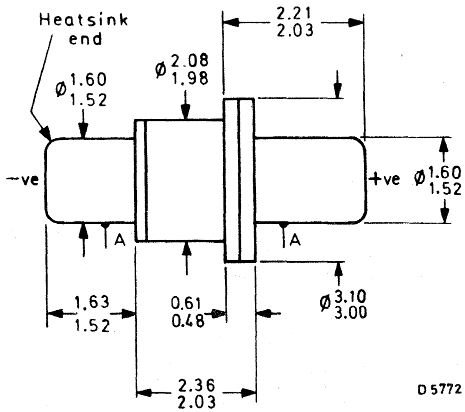
QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS

Dimensions in mm

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

<u>Temperature</u>

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

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

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

Devices may be selected to suit customers' specific requirements

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

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

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

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

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

GUNN EFFECT DEVICE

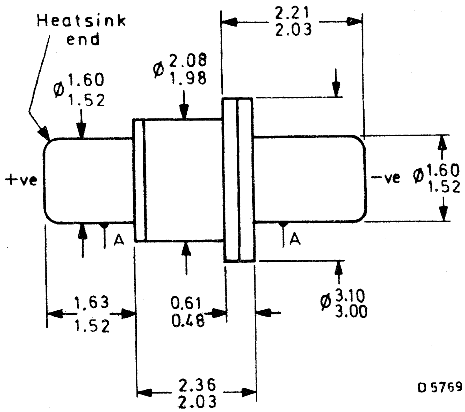
CXY 21

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

QUICK REFERENCE DATA		
Operating voltage	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 = 9.5 GHz)	60	mW

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

	Min.	Typ.	Max.	
Frequency range 2)	8.0	-	12	GHz
D.C. operating current (at V = 9.5 V)	-	210	265	mA
Power output 3)	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. An 11 V voltage regulator diode to shunt the power supply is recommended for this purpose.

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

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

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

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

Devices may be selected to suit customers' specific requirements.

Mixer and detector diodes C

MICROWAVE MIXER/DETECTOR DIODE

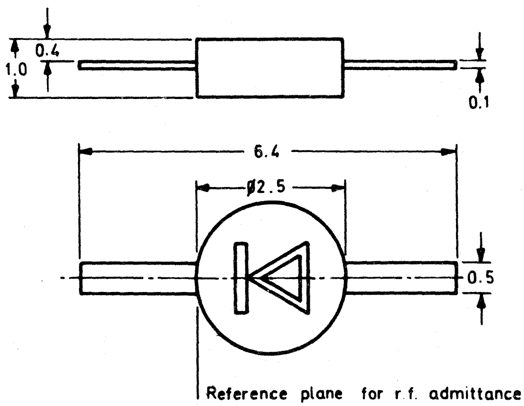
BAT10

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

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



All dimensions in mm D3108

LIMITING VALUES (Absolute max. rating system)

Electrical

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

Temperature

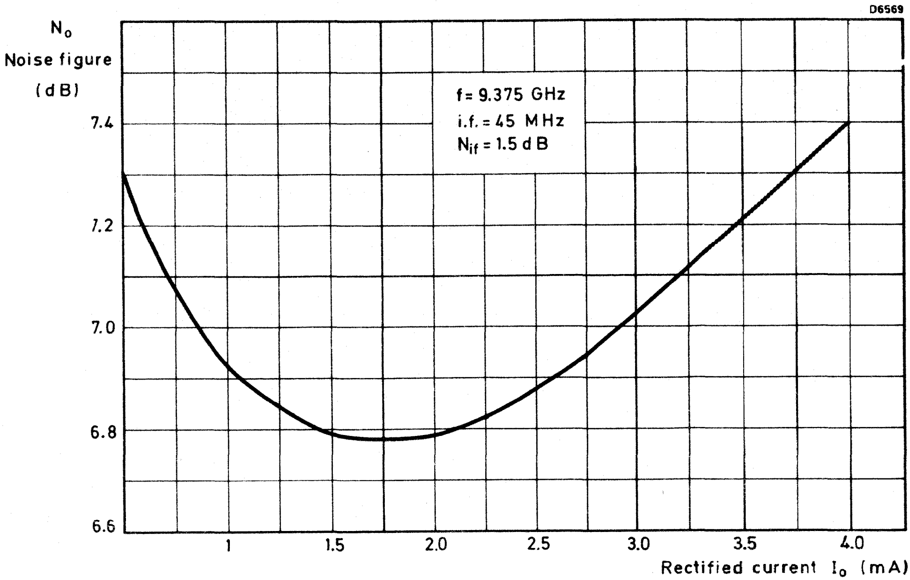
T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

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

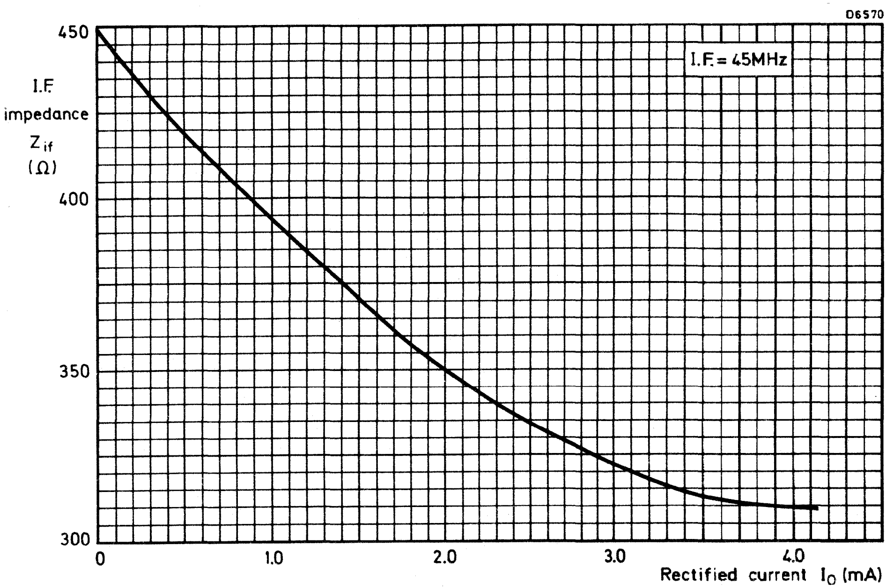
		Typ.	Max.	
Mixer				
N_o	Noise figure 1)	7.0	7.5	dB
v.s.w.r.	Voltage standing wave ratio 2)	-	2:1	
Z_{if}	Intermediate frequency impedance 3)	-	500	Ω
Detector				
S_{ts}	Tangential sensitivity 4)	-50	-	dBm
S_i	Current sensitivity 5)	5.0	-	μA/μW
v.s.w.r.	Voltage standing wave ratio 6)	-	5:1	
Z_v	Video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

NOTES

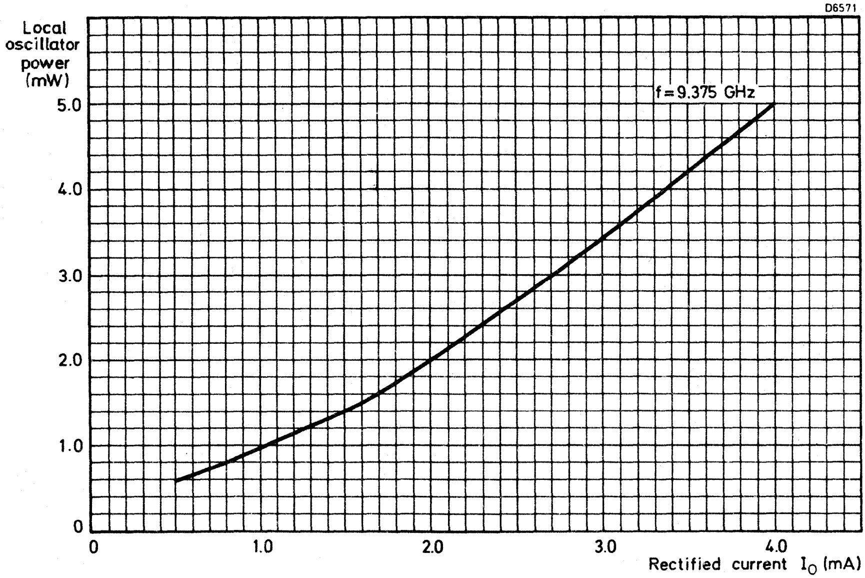
1. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω, i.f. = 45 MHz and i.f. noise figure = 1.5 dB. BS9300.
2. Measured with respect to 50 Ω at f = 9.375 GHz, rectified current = 2.0 mA, and load resistance = 10 Ω. BS9300.
3. Measured in a 50 Ω test mount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



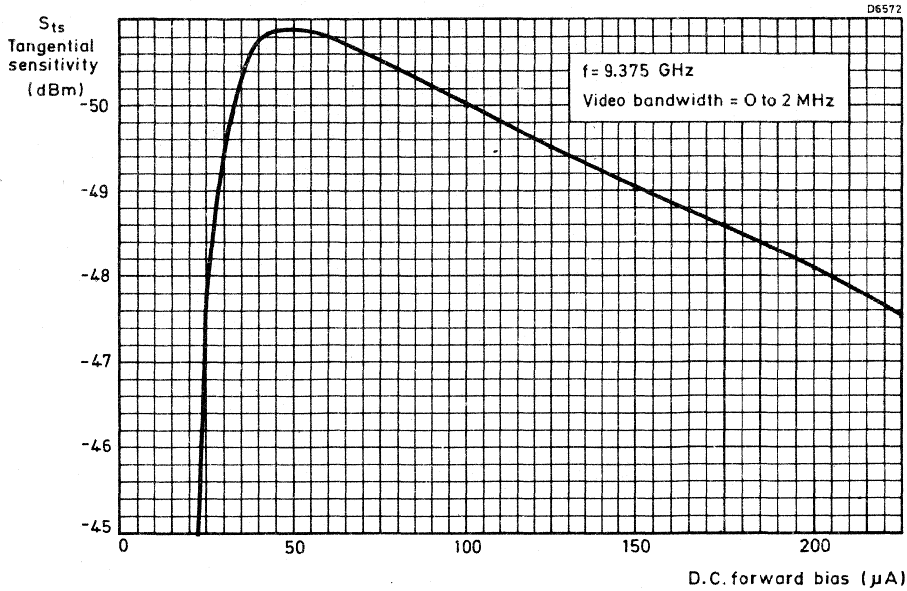
TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



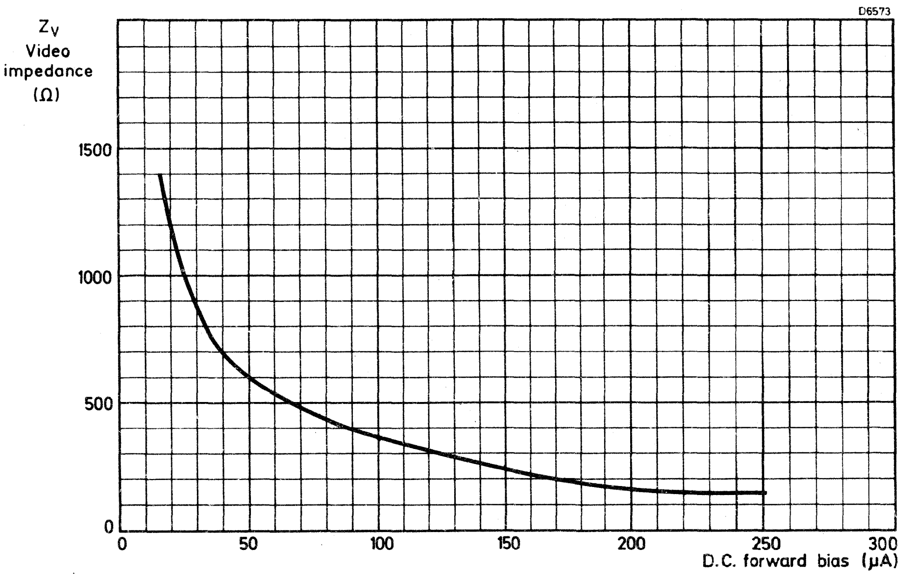
TYPICAL I.F. IMPEDANCE AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



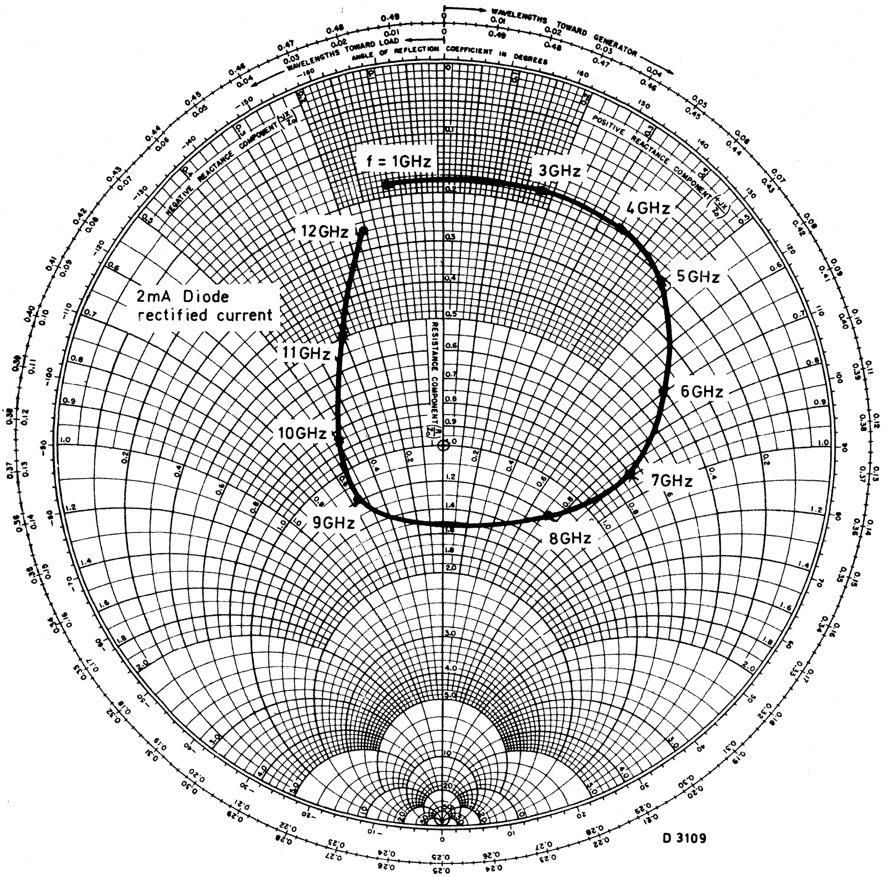
TYPICAL LOCAL OSCILLATOR POWER AS A FUNCTION OF RECTIFIED CURRENT (MIXER APPLICATION)



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

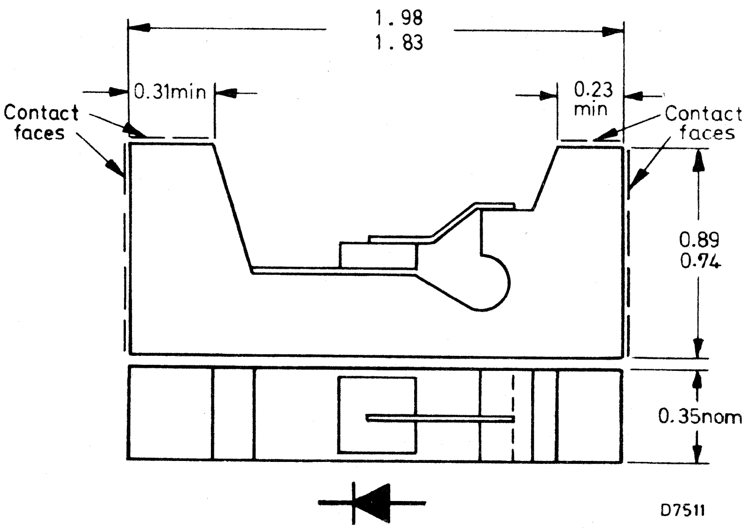
BAT11

Silicon Schottky barrier low noise mixer diode mounted in a L.I.D. type envelope. Primarily intended for hybrid integrated circuit applications in X-band. It conforms to the environmental requirements of BS9300 where applicable. Available as a matched pair 2/BAT11 M.

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

MECHANICAL DATA

Dimensions in mm



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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

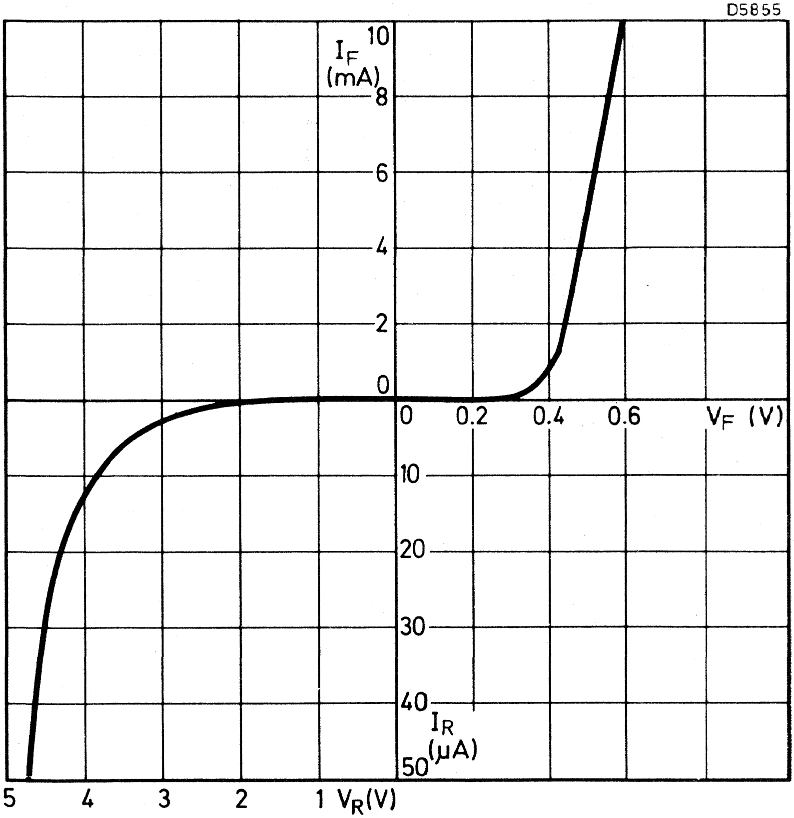
T_{stg} range	-55 to +150	^oC
T_{amb}	-55 to +150	^oC

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

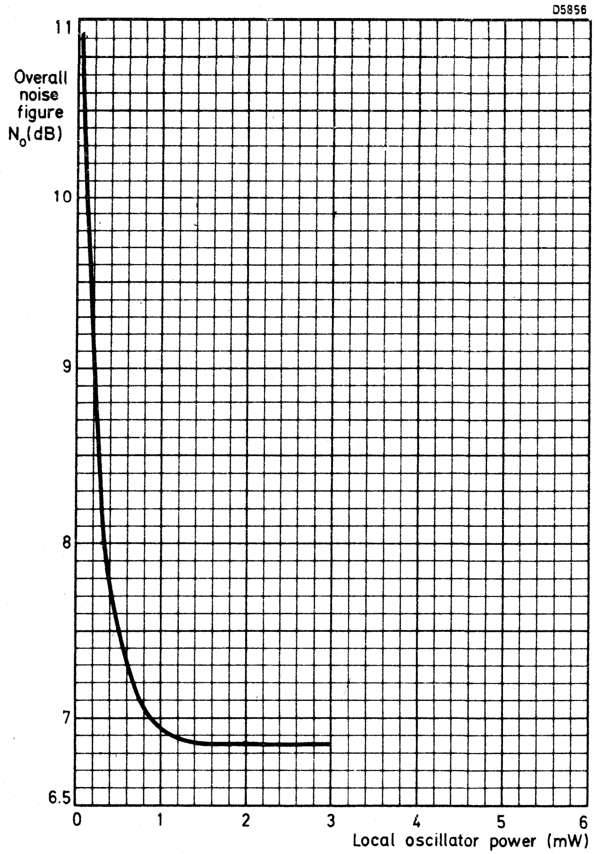
		Min.	Typ.	Max.	
Dynamic					
N_o	Noise figure (see note 1)	-	6.5	7.0	dB
Z_{rf}	R.F. impedance spread referred to 50Ω bounded by co-ordinates (see note 2).		0.6 - j0.3 0.6 + j0.3	0.4 - j0.3 0.4 + j0.3	
Z_{if}	Intermediate frequency impedance (see note 3)	280	320	380	Ω
f	Operating frequency range	-	-	12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

NOTES

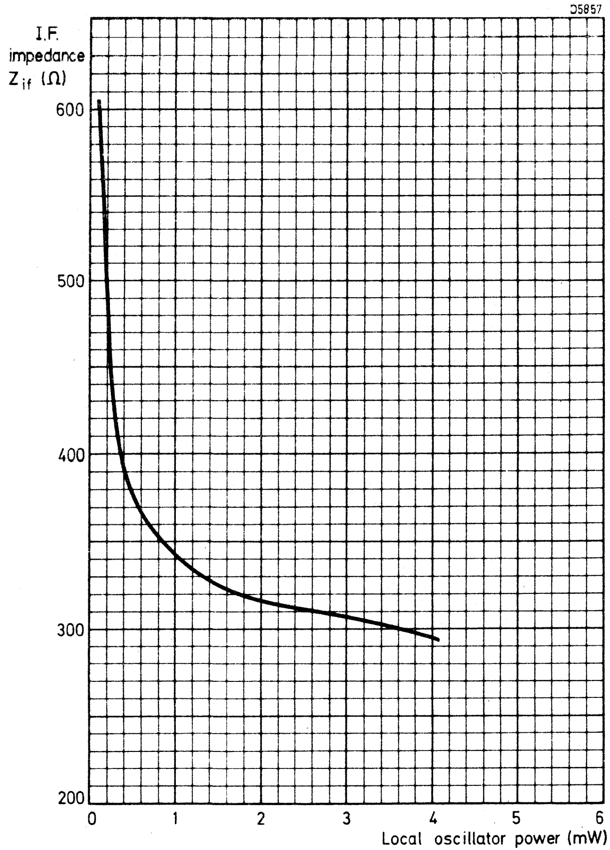
1. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω. N_O includes N_{if} = 1.5dB with 45MHz intermediate frequency. BS9321/1406.
2. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω. BS9321/1409.
3. Measured at 9.375GHz ± 0.1GHz, 1.5mA rectified current, R_L = 15Ω, intermediate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



TYPICAL D.C. CHARACTERISTIC



TYPICAL OVERALL NOISE FIGURE AS A FUNCTION OF LOCAL OSCILLATOR POWER



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

MICROWAVE MIXER DIODES

BAT39 BAT39A

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

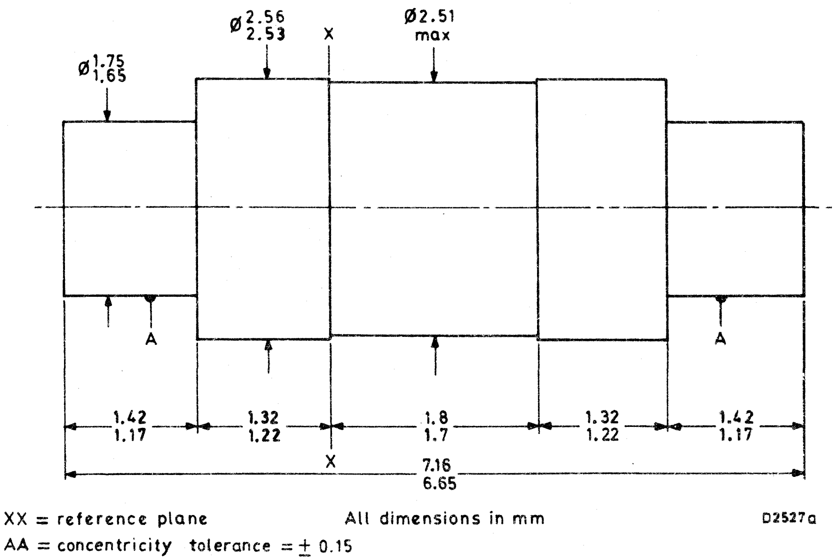
QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA

Dimensions in mm



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

ACCESSORIES

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

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

Burn-out f = 9.375 GHz

Multiple d.c. spike		max.	0.1	erg
Multiple r.f. spike (spike width at half peak power = 2 μs)		max.	0.05	erg
Peak pulse power				
f = 9.375 GHz, t_p = 1.0 μs		max.	0.5	W

Temperatures

Storage temperature	T_{stg}	-55 to +100	^oC
Ambient temperature	T_{amb}	-55 to +100	^oC

CHARACTERISTICS

T_{amb} = 25 ^oC

			Min.	Typ.	Max.	
Reverse current V_R = 0.5 V		I_R	-	-	2.0	μA
Forward current V_F = 0.5 V		I_F	-	7.0	-	mA
Overall noise figure						
f = 9.375 GHz, R_L = 15 Ω, rectified current = 1.0 mA	BAT39	N_o	5.5	6.0	6.5	dB
N_o includes N_{if} = 1.5 dB (BS9300/1406 Method B)	BAT39A	N_o	-	7.0	7.5	dB
Conversion loss	BAT39	L_c	-	4.2	-	dB
	BAT39A	L_c	-	5.0	-	dB
Noise temperature ratio						
I.F. = 45 MHz (BS9300/1407)	BAT39	N_r	-	1.1: 1	-	
	BAT39A	N_r	-	1.2: 1	-	
Voltage standing wave ratio						
f = 9.375 GHz, R_L = 15 Ω, rectified current = 1.0 mA (BS300/1409) Measured in standard test holder		v.s.w.r.	-	-	1.43: 1	
Intermediate frequency impedance						
f = 9.375 GHz, R_L = 15 Ω rectified current = 1.0 mA (BS9300/1405)		Z_{if}	250	-	450	Ω
Operating frequency range		f	1.0	-	18	GHz

OPERATING NOTE

Optimum performance is obtained with BAT39 and BAT39A when the local oscillator drive is adjusted to give a diode rectified current of 1.0 mA and the load resistance is restricted to 100 Ω max.

APPLICATION INFORMATION

Mixer performance at other than Test Radio Frequency

Measured overall noise figure

f = 16.5 GHz, N_{if} = 1.5 dB, i.f. = 45 MHz	N_o	typ.	7.0	dB
f = 3.0 GHz, N_{if} = 1.5 dB, i.f. = 45 MHz	N_o	typ.	5.5	dB
f = 9.5 GHz, i.f. = 3.0 kHz	N_o	typ.	29	dB

Signal/flicker noise at 9.5 GHz

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

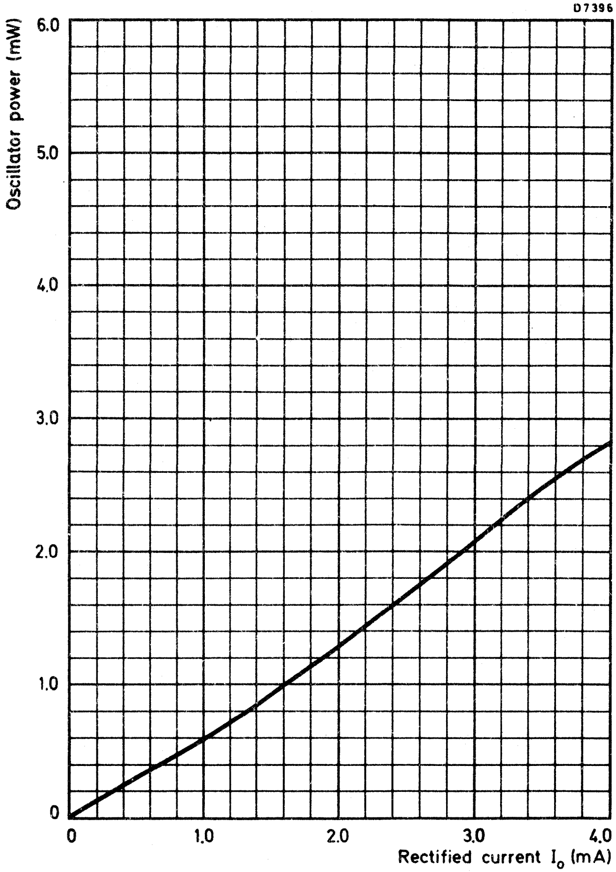
Detector performance

Tangential sensitivity at 9.375 GHz,

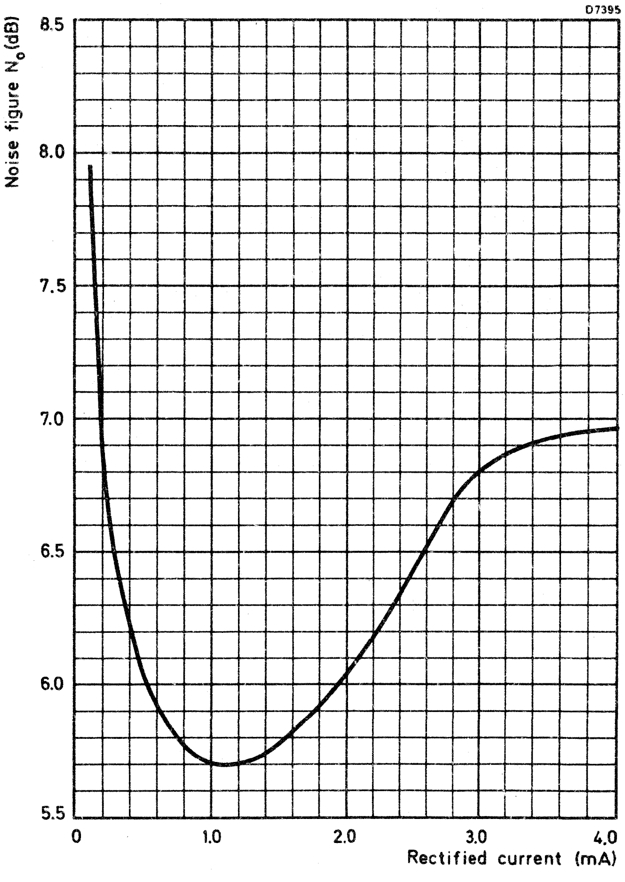
1 kHz to 1 MHz video bandwidth, I_F (bias) = 50 μA (BS9300/1411)	S_{ts}	typ.	-52	dbm

A.C. video impedance

I_F (bias) = 50 μA (BS9300/1403)	Z_r	typ.	800	Ω



Typical rectified current as a
function of local oscillator power



Typical noise figure as a function
of rectified current

MICROWAVE MIXER DIODES

BAT50 BAT50R

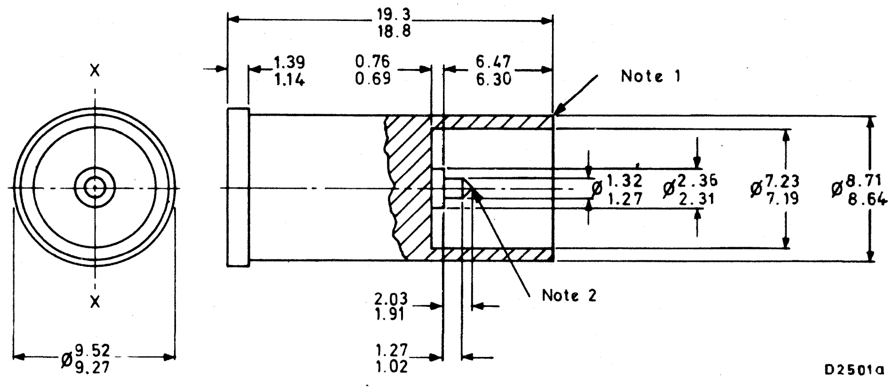
Coaxial silicon Schottky barrier diodes for use in pre-tuned X-band low noise mixer circuits. They are intended for use as low noise retrofits at X-band frequencies for coaxial mixer diodes types AAY50, AAY50R etc. The two types have identical dimensions and characteristics but the polarity is reversed.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

QUICK REFERENCE DATA

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

MECHANICAL DATA Dimensions in mm

Conforms to BS3934 SO-26



Terminal identification

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

ACCESSORIES

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

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

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

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

CHARACTERISTICS $T_{amb} = 25\ ^oC$

Reverse current $V_R = 0.5$ V	I_R		3.0	μA
Forward current $V_F = 0.5$ V	I_F		7.0	mA
Overall noise figure [1]				
f = 9.375 GHz, rectified current = 1.0 mA, $R_L = 15\ \Omega$, N_o includes $N_{if} = 1.5$ dB	N_o	typ. max.	6.2 6.8	dB dB
Conversion loss	L_c		4.4	dB
Noise temperature ratio				
I.F. = 45 MHz	N_r		1.1: 1	
Voltage standing wave ratio [1] [2]				
f = 9375 ± 10% MHz, rectified current 1.0 mA $R_L = 15\ \Omega$, N_o includes $N_{if} = 1.5$ dB	v.s.w.r.	max.	1.43: 1	
Intermediate frequency impedance	Z_{if}	min. max.	300 500	Ω Ω
Operating frequency range	f	max.	12	GHz

[1] Measured in standard holder (K1007, Issue 3, Section 8B3.3.1/2.)

[2] The nominal rectifier admittance at a plane 7.01 mm inside the body from the open end is

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

OPERATING NOTE

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

APPLICATION INFORMATION

Signal/Flicker noise ratio

f = 9.5 GHz. Measured at 2 kHz from carrier in 70 Hz bandwidth		typ.	131	dB

Detector performance

Tangential sensitivity, f = 9.375 GHz, video bandwidth = 1.0 MHz, I_F (bias) = 50 μA	S_t	typ.	-52	dBm
video impedance, I_F (bias) = 50 μA	Z_v	typ.	800	Ω

MICROWAVE MIXER DIODES

BAT51
BAT51R

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

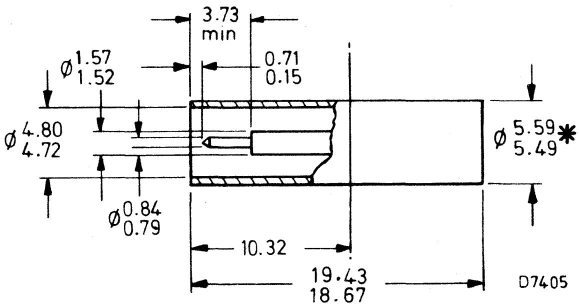
QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA Dimensions in mm

DO-37



*These limits apply only over 10. 32 dimension

Terminal identification

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

RATINGS In accordance with the Absolute Maximum System (IEC134)

Burn-out				
f = 9.375 GHz, multiple r.f. spike, spike width at half peak power = 2 ns		max.	0.05	erg
Peak pulse power				
f = 9.375 GHz, t_p = 1.0 μs		max.	0.5	W
Temperatures				
Storage temperature	T_{stg}		-55 to +100	°C
Ambient temperature	T_{amb}		-55 to +100	°C

CHARACTERISTICS T_{amb} = 25 °C

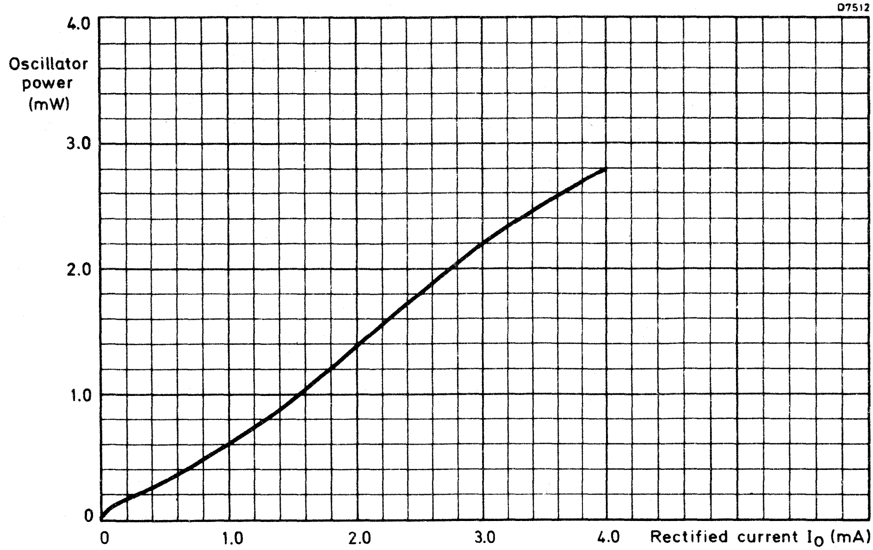
Reverse current V_R = 0.5 V	I_R	max.	0.2	μA
Forward current V_F = 0.5 V	I_F	typ.	7.0	mA
Overall noise figure				
f = 13.5 GHz, N_o includes N_{if} = 1.5 dB, Measured in JAN 201 holder (BS9300/1406 Method A)	N_o	typ. max.	7.0 7.5	dB dB
Conversion loss	L_C		5.2	dB
Noise temperature ratio				
I.F. = 45 MHz (BS9300/1407)	N_r		1.1: 1	
Voltage standing wave ratio				
f = 13.5 GHz, rectified current = 0.9 mA			1.5: 1	
Intermediate frequency impedance	Z_{if}	min. typ. max.	250 350 450	Ω Ω Ω
Operating frequency range	f		12 to 18	GHz

FINISH

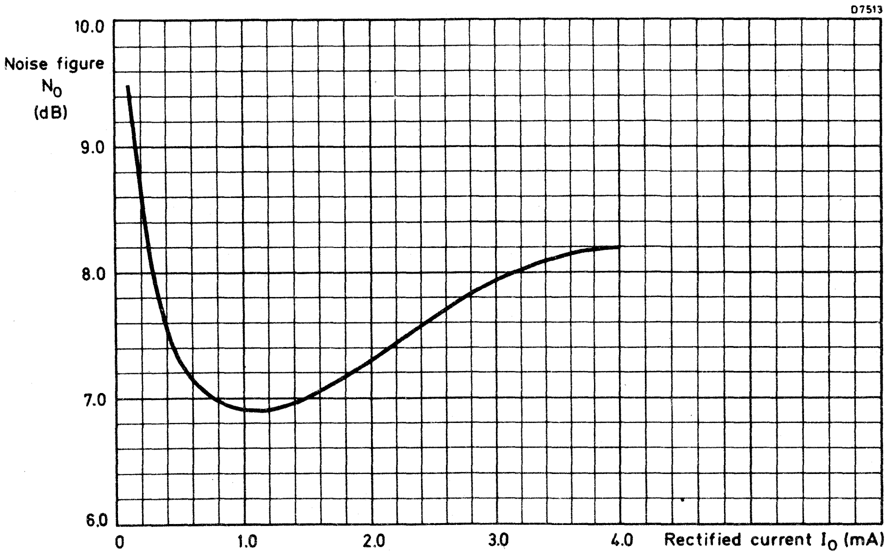
The bodies are cadmium plated in order to be compatible with an aluminium holder

MATCHED PAIR

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



Typical rectified current as a function of local oscillator power



Typical noise figure as a function of rectified current

MICROWAVE MIXER DIODES

BAT52 BAT52R

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

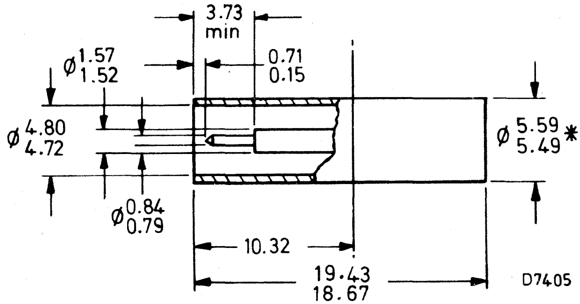
QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA Dimensions in mm

DO-37



*These limits apply only over 10.32 dimension

Terminal identification

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

RATINGS In accordance with the Absolute Maximum System (IEC134)

Burn-out

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

Temperatures

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

CHARACTERISTICS T_{amb} = 25 °C

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

FINISH

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

MATCHED PAIR

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

MICROWAVE MIXER DIODE

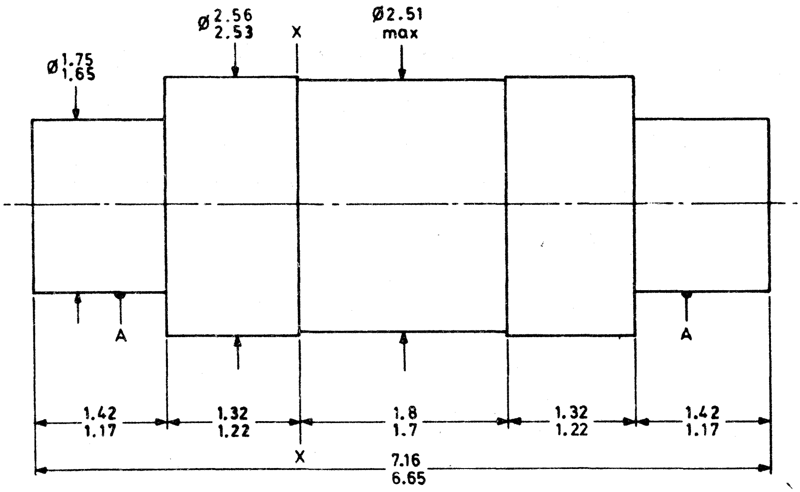
BAT59

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

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

MECHANICAL DATA

Dimensions in mm



XX = reference plane
AA = concentricity tolerance = ± 0.15

The cathode (positive) is marked red.

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

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

Burn-out				
R.F. spike		max.	0.04	erg
Peak pulse power (t_p = 0.2 μs)		max.	0.5	W
Temperature				
Storage temperature	T_{stg}		-55 to +100	°C
Ambient temperature	T_{amb}		-55 to +100	°C

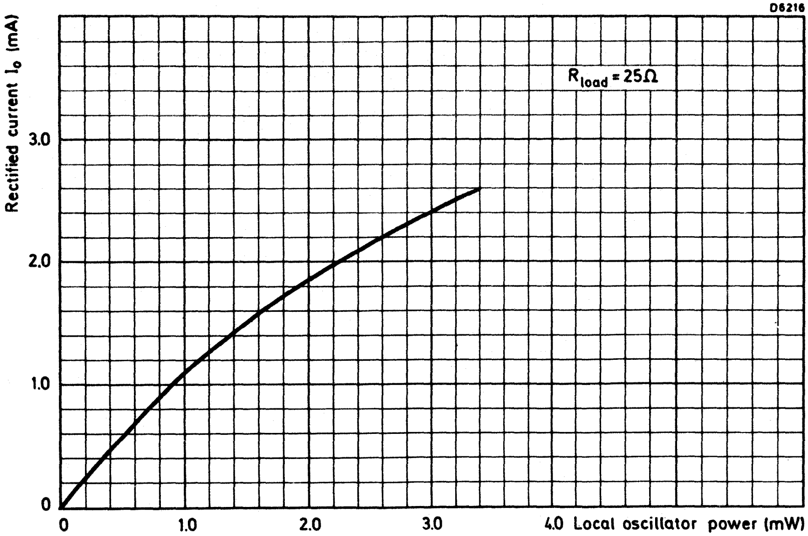
CHARACTERISTICS T_{amb} = 25 °C

Reverse current V_R = 0.5 V	I_R	typ.	2.0	μA
Forward current V_F = 0.5 V	I_F	typ.	2.0	mA
Overall noise figure				
f = 34.86 GHz, rectified current = 0.5 mA	N_o	typ.	8.5	dB
N_o includes N_{if} of 1.5 dB (BS9321/1406)		<	10	dB
Conversion loss	L_c	typ.	5.5	dB
Noise temperature ratio				
I.F. = 45 MHz	N_r		1.6:1	
Voltage standing wave ratio [1]				
f = 34.86 GHz, rectified current = 0.5 mA	v.s.w.r.	typ.	1.4:1	
R_L = 15 Ω (BS9321/1409)		<	1.8:1	
Intermediate frequency impedance				
f = 34.86 GHz, rectified current = 0.5 mA	Z_{if}	typ.	1000	Ω
R_L = 15 Ω, i.f. = 45 MHz (BS9321/1405)			700 to 1400	Ω
Operating frequency range	f		26 to 40	GHz

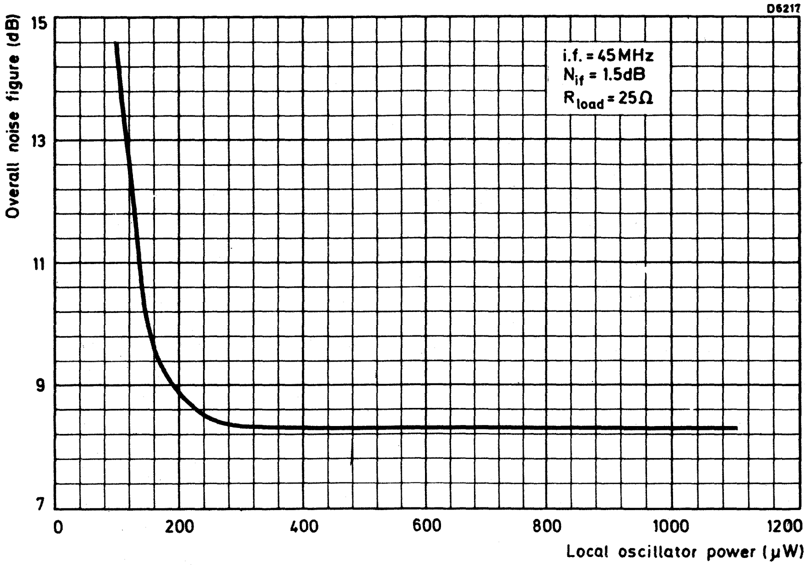
MATCHED PAIRS

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

[1]) Standard test holder.



Typical rectified current as a function of local oscillator power at 34. 86 GHz



Typical overall noise figure as a function of local oscillator power at 34. 86 GHz

MICROWAVE MIXER DIODES

BAV22 BAV22R

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

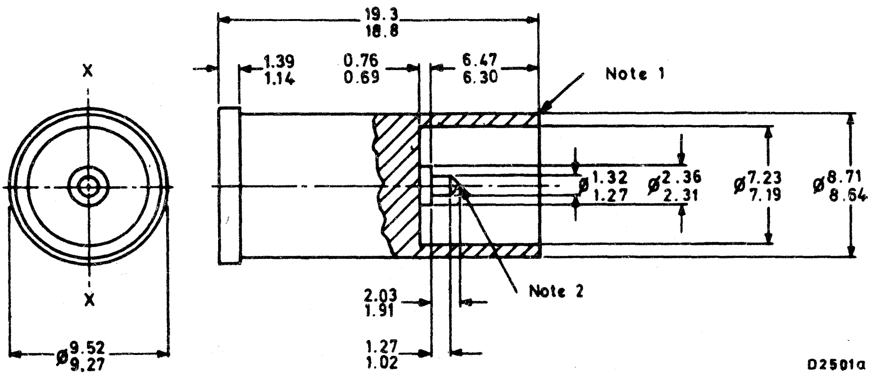
QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA Dimensions in mm

Conforms to BS3934 SO-26



Terminal identification

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

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

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

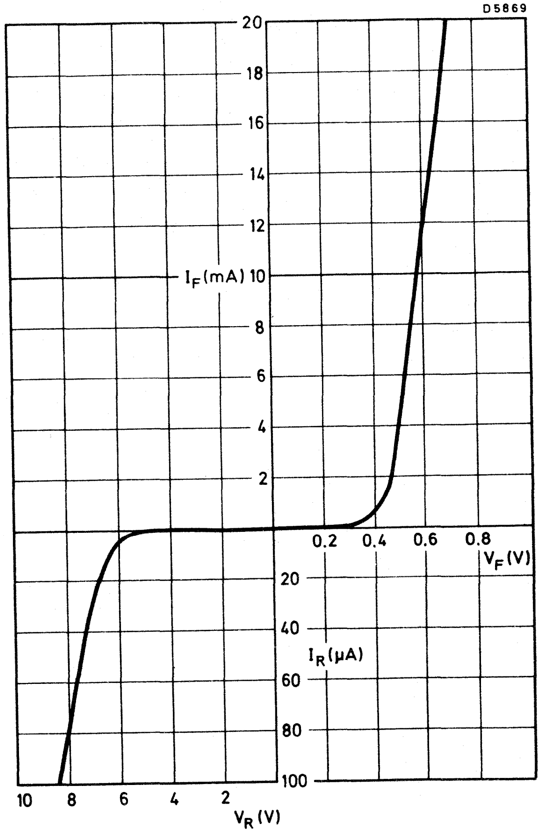
		Min.	Typ.	Max.	
N_o	Noise figure (see note 1)	-	7.0	7.5	dB
N_o	Noise figure (at 3GHz)	-	6.0	-	dB
v.s.w.r.	Voltage standing wave ratio (see note 2)	-	-	1.43:1	
v.s.w.r.	Voltage standing wave ratio (at 3GHz)	-	1.2:1	-	
Z_{if}	Intermediate frequency impedance (see note 3)	300	-	550	Ω

NOTES

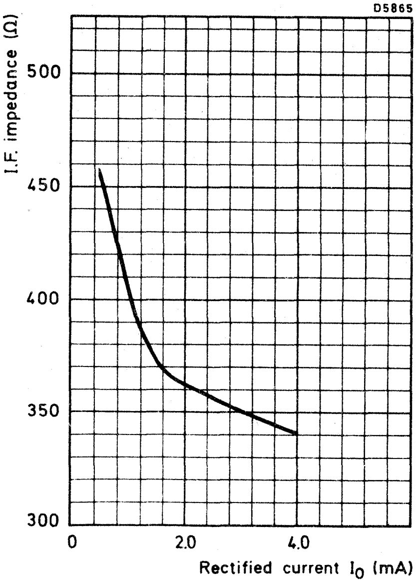
1. Measured at 9.375GHz, 1mA rectified current, R_L = 15Ω. N_o includes N_{if} = 1.5dB with 45MHz intermediate frequency. BS9321/1406.

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

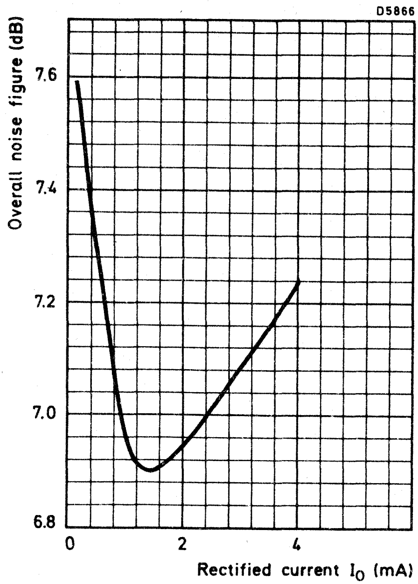
3. Measured at 9.375GHz, 1mA rectified current, R_L = 15Ω, i.f. = 45MHz. BS9321/1405.



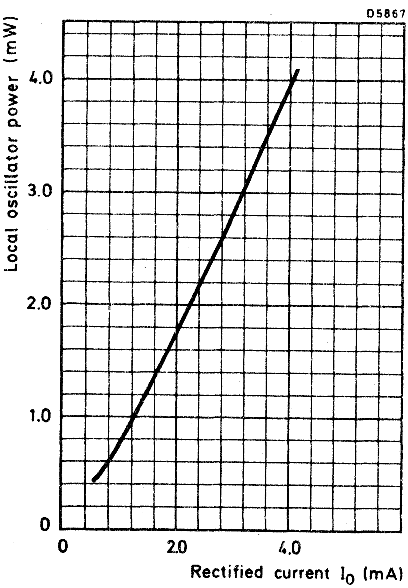
TYPICAL D.C. CHARACTERISTIC



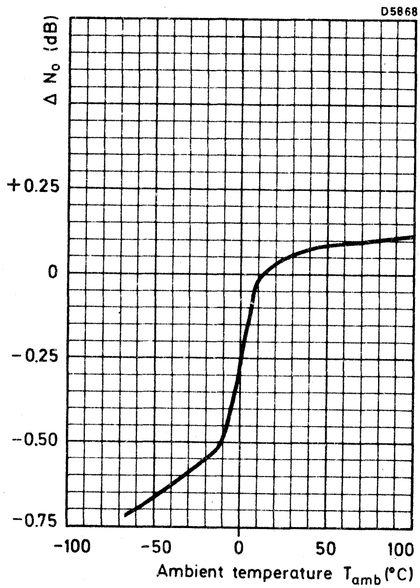
TYPICAL I.F. IMPEDANCE AGAINST RECTIFIED CURRENT



TYPICAL OVERALL NOISE FIGURE AGAINST RECTIFIED CURRENT



TYPICAL LOCAL OSCILLATOR POWER AGAINST RECTIFIED CURRENT



TYPICAL CHANGE IN OVERALL NOISE FIGURE AGAINST TEMPERATURE

MICROWAVE DETECTOR DIODE

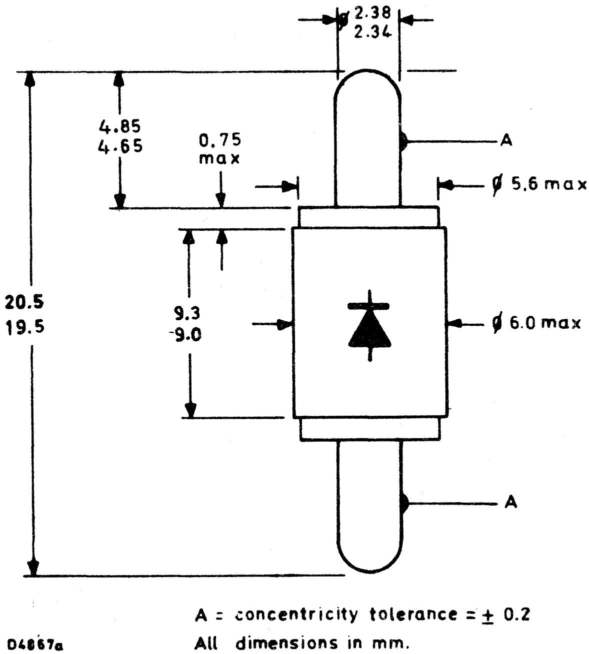
BAV46

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



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

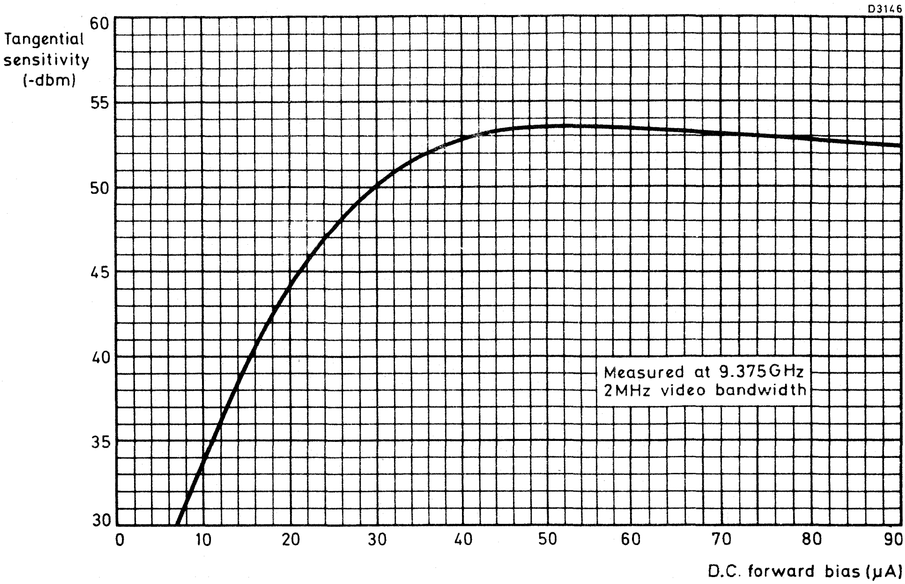
T_{stg} range	-20 to +150	^oC
T_{amb} range	-20 to +150	^oC

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

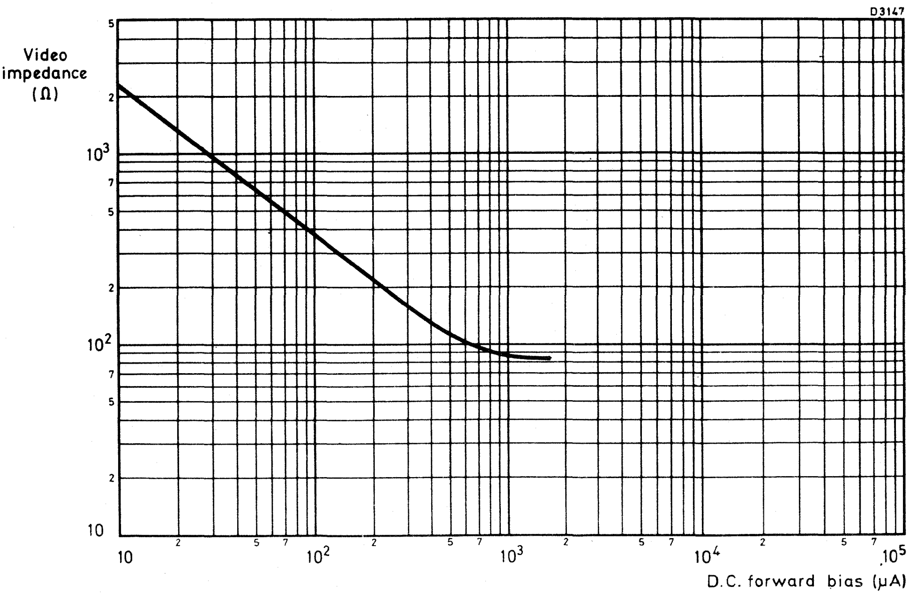
		Typ.	Max.	
	1/f Noise figure (see notes 1 and 2)	10	15	dB
S_i	Sensitivity (see notes 3 and 4)	5.0	-	μA
v.s.w.r.	Voltage standing wave ratio (see notes 3 and 5)	3:1	5:1	
Z_v	Video impedance (see note 2)	850		Ω
S_{ts},	Tangential sensitivity (see note 6)	-52		dbm
	(see note 7)	-54		dbm

NOTES

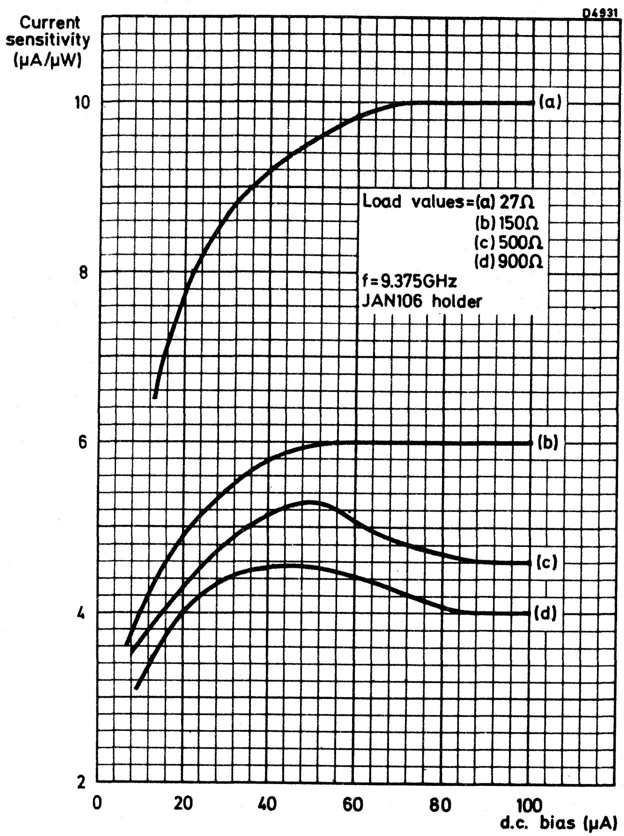
1. Measured at i.f. of 1kHz, bandwidth 50Hz.
2. Measured with forward bias of 30μA.
3. Measured with 30μA forward bias and 1μW local oscillator drive at 9.375GHz.
4. Measured in a JAN106 holder.
5. $R_L = 15\Omega$, JAN106 holder.
6. Measured with 0 to 2MHz bandwidth.
7. Measured with 1kHz to 1MHz bandwidth.



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

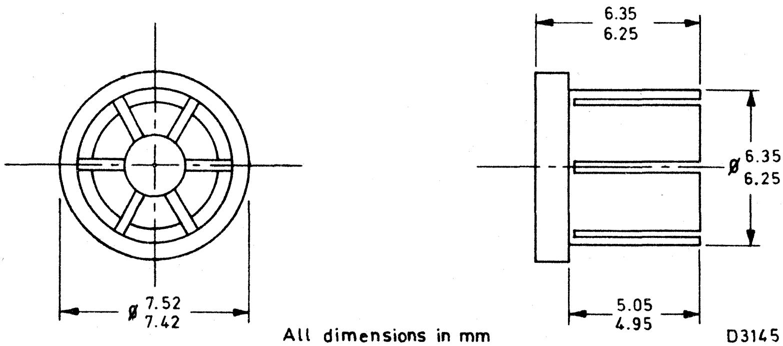


TYPICAL VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS



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

ACCESSORY



COLLET 56321

MICROWAVE DETECTOR DIODE

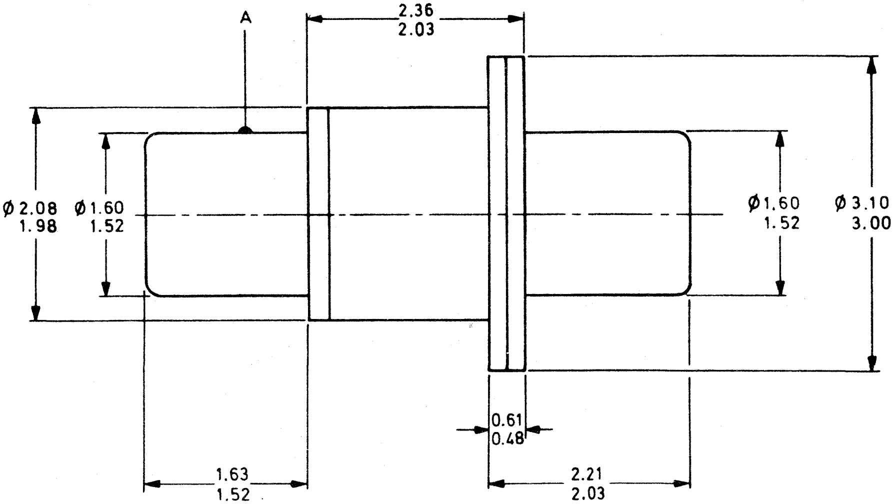
BAV75

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

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

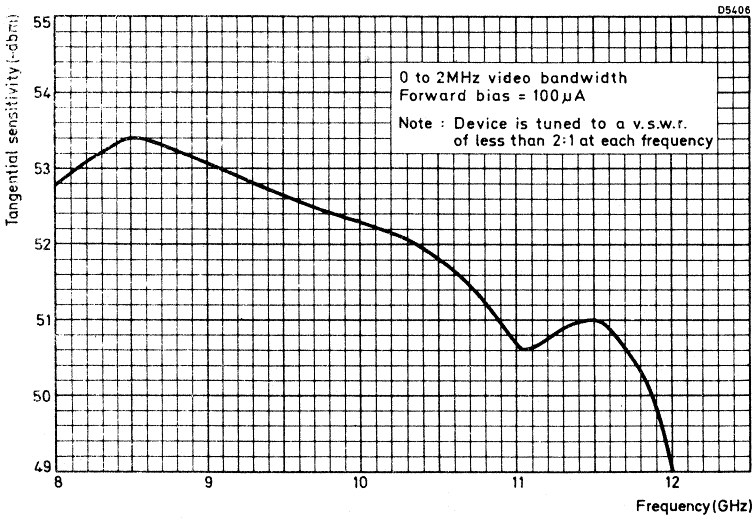
T_{stg} range	-55 to +150	°C
T_{amb} range	-55 to +150	°C

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

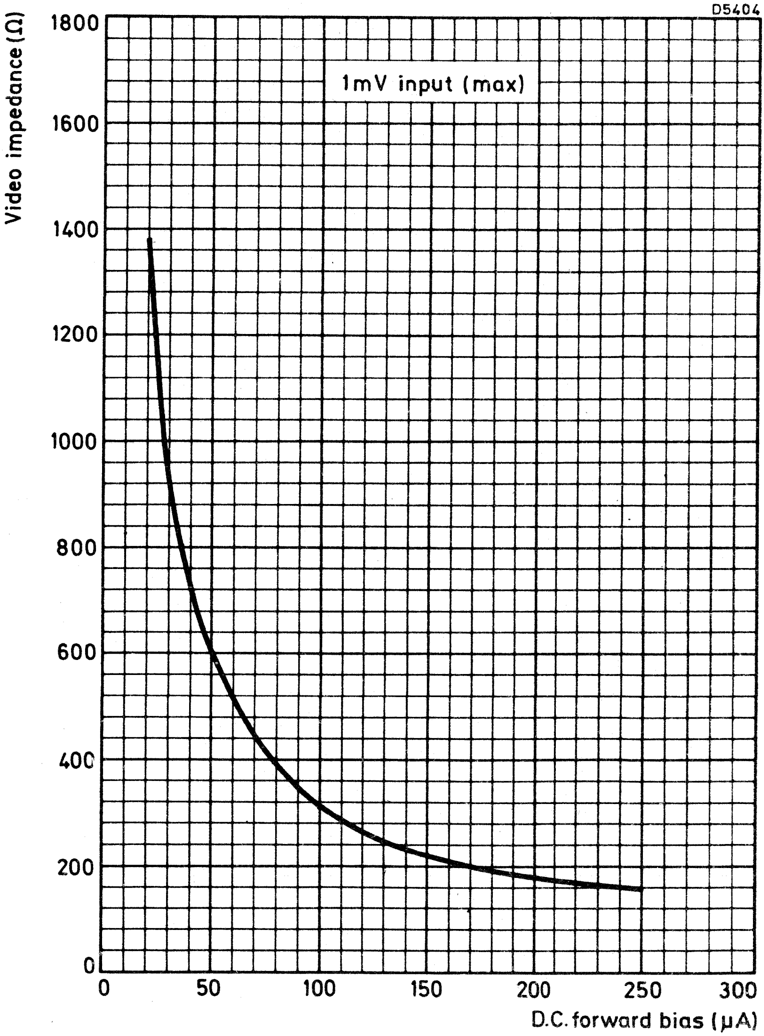
		min.	typ.	max.	
v.s.w.r.	Voltage standing wave ratio (see notes 1, 2, and 3)		2:1		
Z_v	Video impedance (see notes 4 and 5)		310		Ω
S_{ts}	Tangential sensitivity (see notes 1 and 2)	-49	-50		dbm
1/f	Flicker noise (see notes 4 and 6)		10	15	dB

NOTES

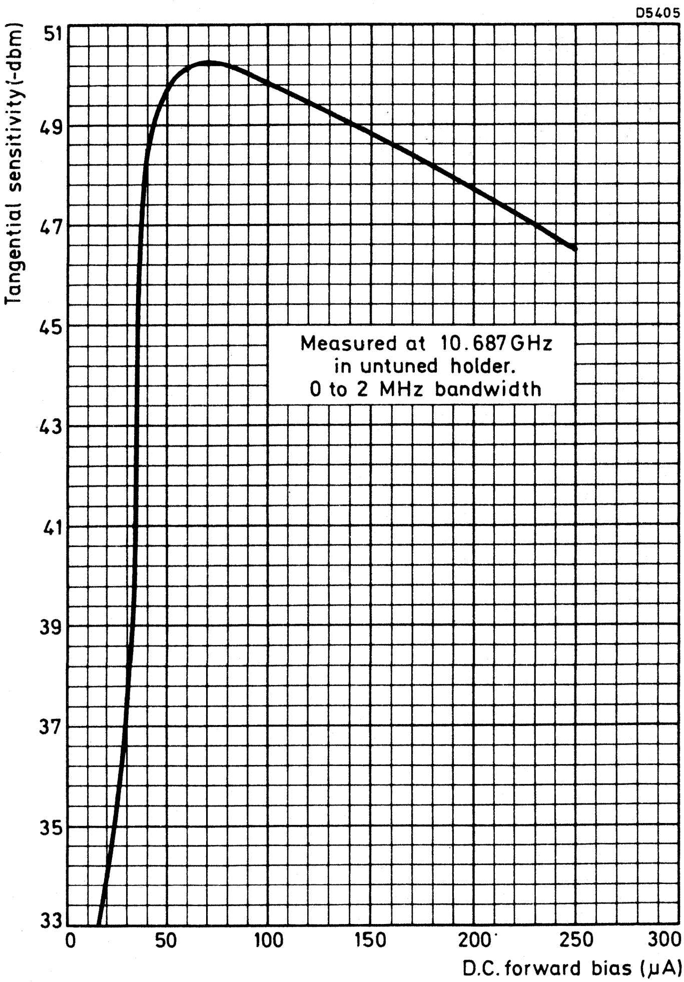
1. Measured at 10.687 GHz with 100µA forward bias.
2. Measured in a reduced height waveguide mount, (Sanders 6521, modified).
3. R.F. input power less than 5.0 µW.
4. Measured with 100 µA forward bias.
5. Maximum d.c. input voltage = 1.0mV.
6. a) Measured at an i.f. of 1kHz with 50Hz bandwidth.
   b)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

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

QUICK REFERENCE DATA

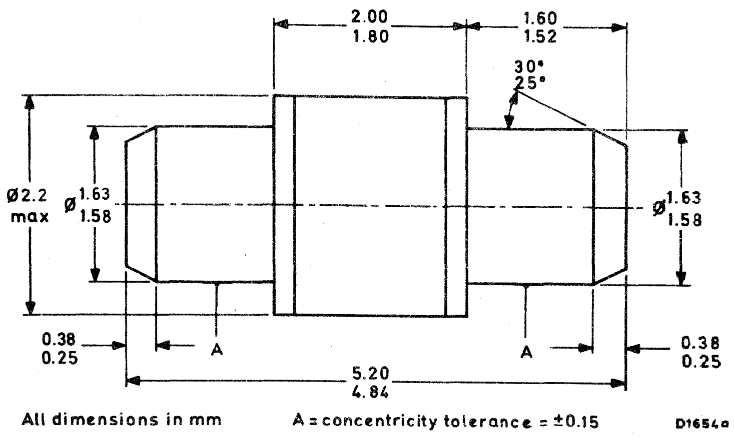
Maximum noise figure in X-band

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

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

M.Q.M.



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

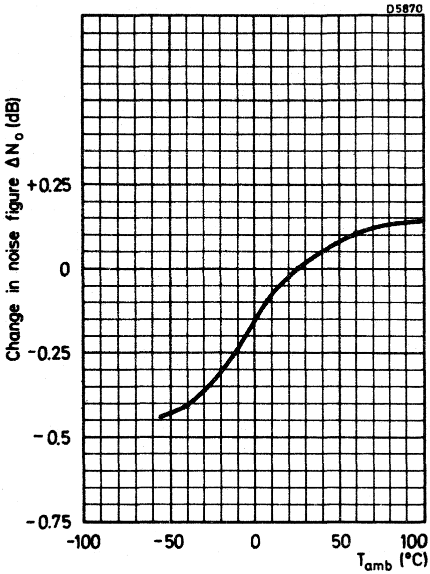
T_{stg} range	-55 to +150	^oC
T_{amb} range	-55 to +150	^oC

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

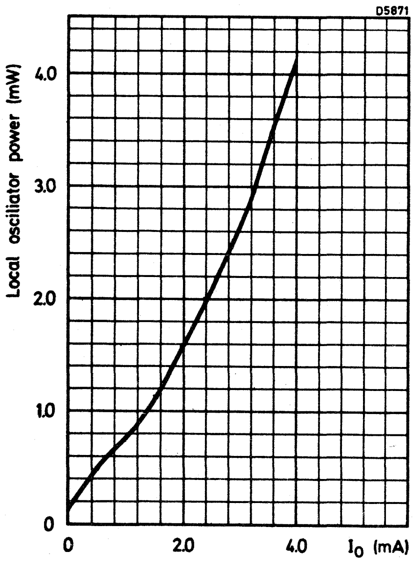
	Min.	Typ.	Max.	
N_o noise figure (see note 2)				
BAV96A	-	7.0	7.5	dB
BAV96B	-	6.5	7.0	dB
BAV96C	-	6.0	6.5	dB
BAV96D	-	5.5	6.0	dB
v.s.w.r. (see note 3)	-	1.33:1	1.43:1	
Z_{if} i.f. impedance (see note 4)	250	-	450	Ω
S_{ts} tangential sensitivity (see note 5)	-	-52	-	dbm
S_{ts} (see note 6)	-	-54	-	dbm

NOTES

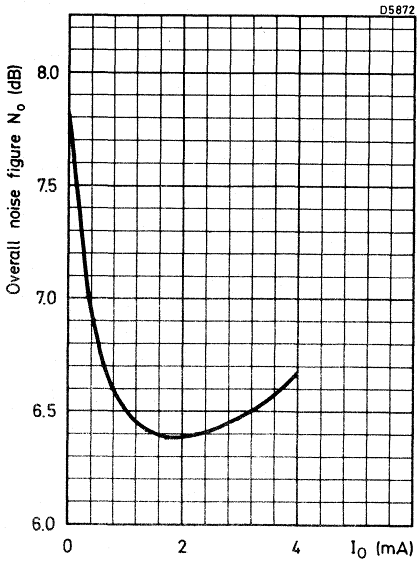
1. Burn out is defined as the r.f. pulse energy necessary to cause 1dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2ns width.
2. Measured at 9.375 ± 0.1GHz. The noise figure includes i.f. amplifier contribution of 1.5dB, i.f. 45MHz, d.c. return for diode 15Ω max., rectified 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.



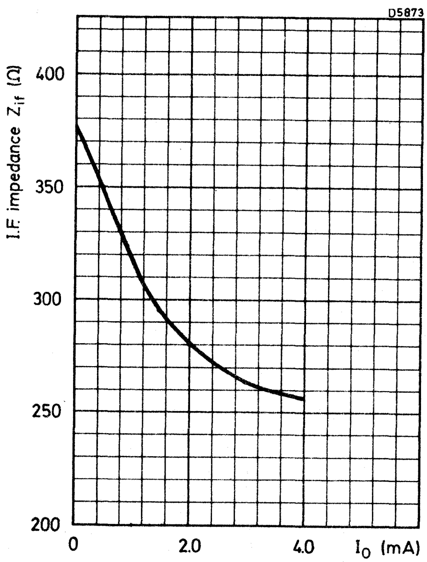
TYPICAL CHANGE IN OVERALL NOISE FIGURE
AS A FUNCTION OF TEMPERATURE



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

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

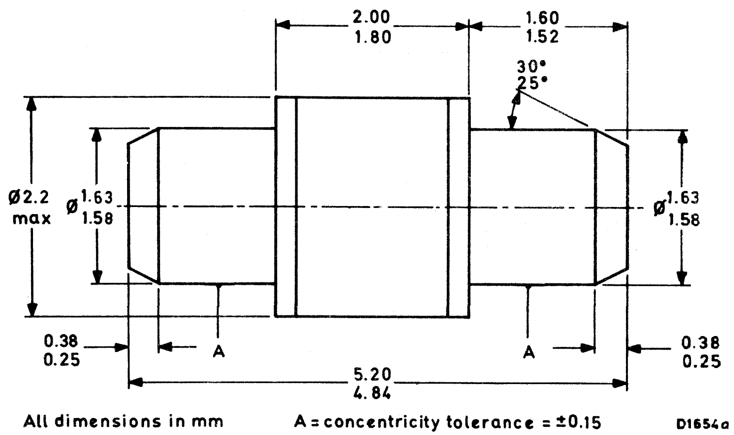
The metal ceramic case is hermetically sealed.

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS

M.Q.M.



Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

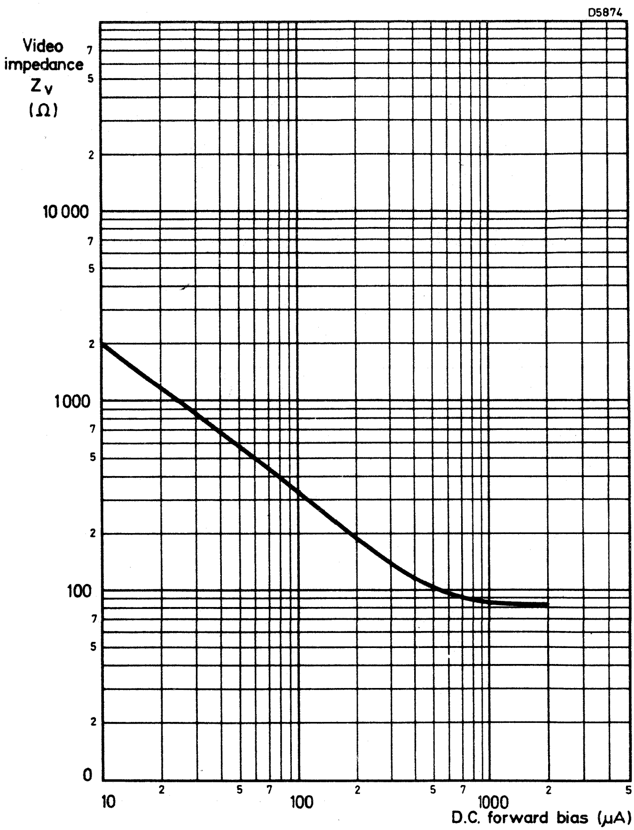
NOTES

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.

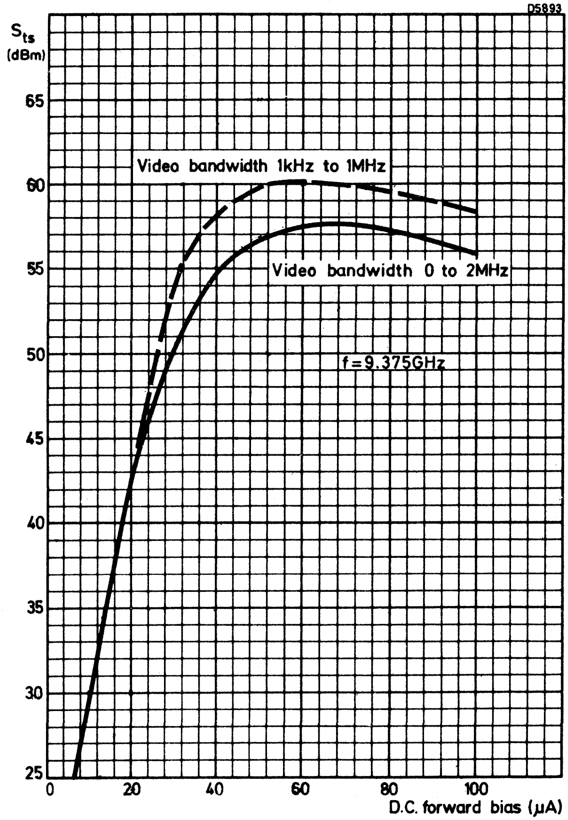
2. Video bandwidth 0 to 2MHz, 50μA bias, f = 9.375GHz. BS9322/1411. (A2dBm improvement in tangential sensitivity may be obtained by limiting the bandwidth to 1kHz to 1MHz).

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

4. Measured at 50μA forward bias.



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



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

MICROWAVE MIXER DIODES

BAW95D
BAW95E
BAW95F
BAW95G

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

QUICK REFERENCE DATA

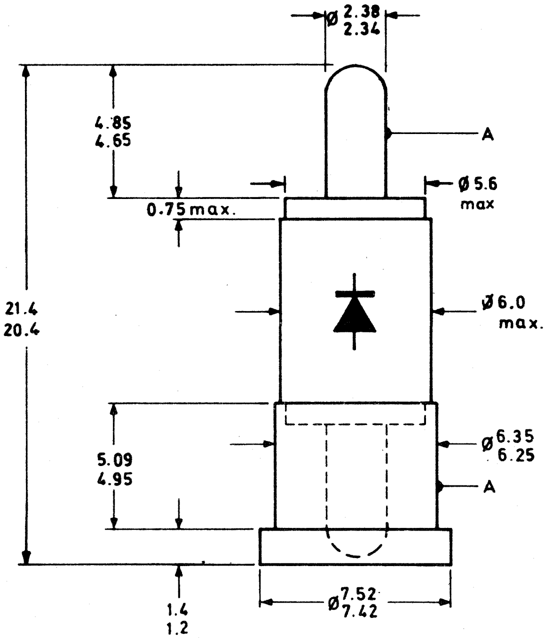
Maximum noise figure at X-band

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

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

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



A = concentricity tolerance = ±0.2

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	°C
T_{amb} range	-55 to +150	°C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C

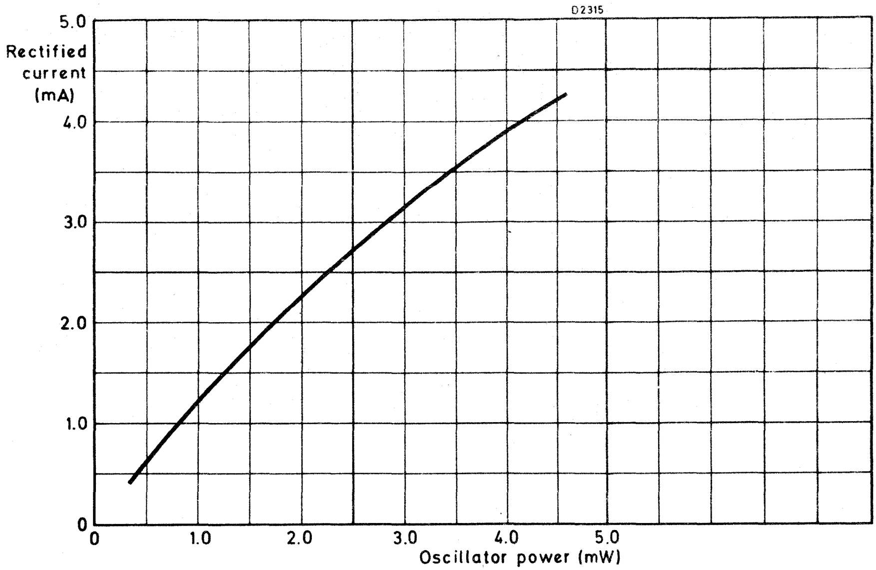
		Min.	Typ.	Max.	
N_o	Noise figure [2]				
	BAW95D	-	7.8	8.2	dB
	BAW95E	-	7.2	7.5	dB
	BAW95F	-	6.8	7.0	dB
	BAW95G	-	6.3	6.5	dB
v.s.w.r.	Voltage standing wave ratio [3]	-	-	1.3:1	
z_{if}	Intermediate frequency impedance [4]	250	415	500	Ω

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

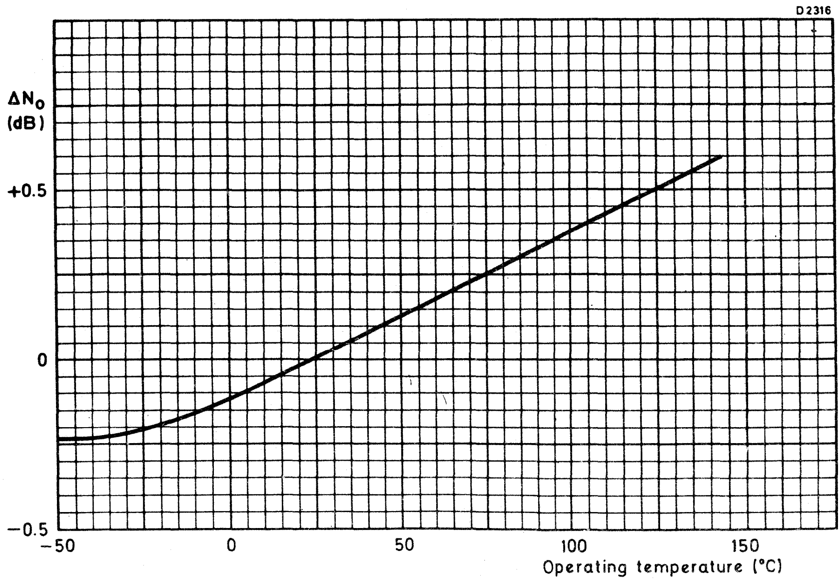
2) Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω. N_o includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9321/1406

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

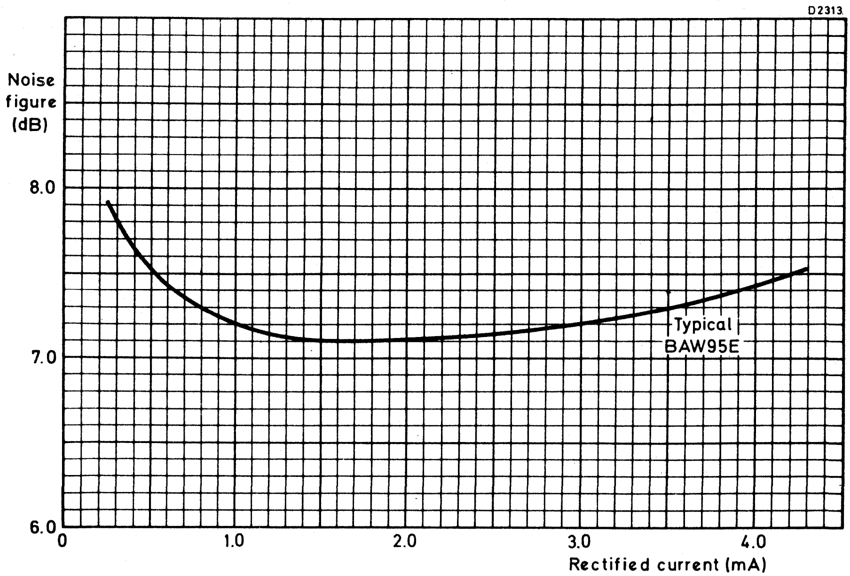
4) Measured at 9.375 GHz. 1 mA rectified current, R_L = 15 Ω with 45 MHz intermediate frequency. BS9321/1405



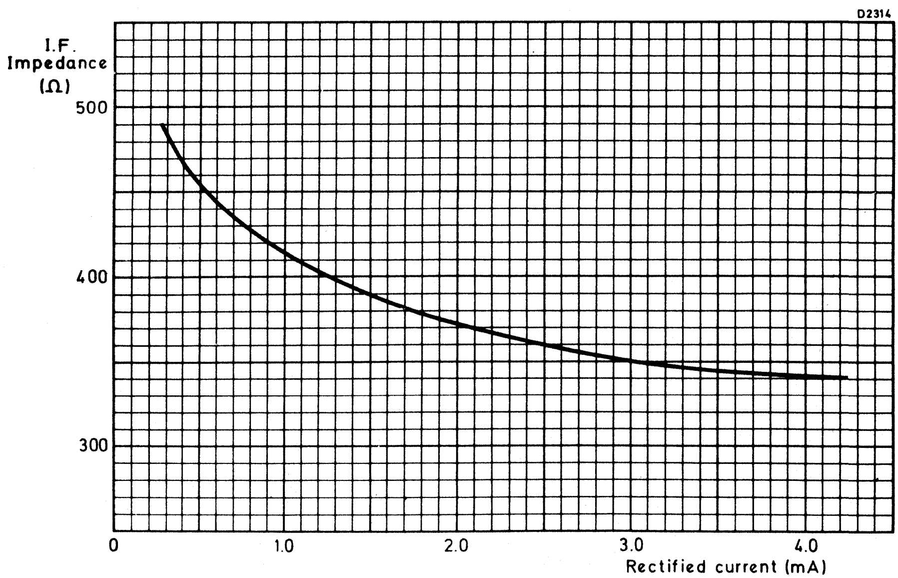
TYPICAL RECTIFIED CURRENT AS A FUNCTION OF LOCAL OSCILLATOR POWER



TYPICAL CHANGE IN NOISE FIGURE WITH TEMPERATURE



TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



TYPICAL DEPENDENCE OF I. F. IMPEDANCE ON RECTIFIED CURRENT

Backward diodes D

MICROWAVE DETECTOR DIODE

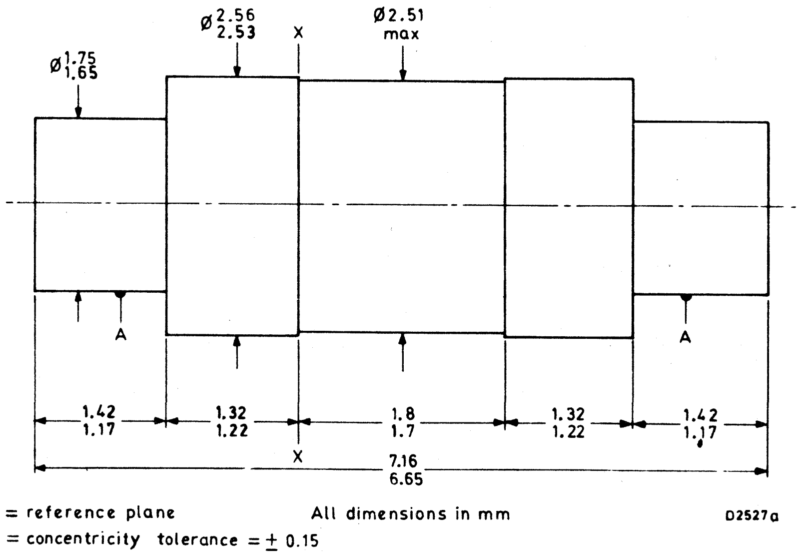
AEY17

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

QUICK REFERENCE DATA

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

OUTLINE AND DIMENSIONS



TERMINAL IDENTIFICATION

The AEY17 is colour coded according to K1007 Issue 3, Section 1. 3. 4. 4.
That is: the positive end (cathode) is marked red and the negative end (anode is marked blue.
The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

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

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

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

Notes:

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

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

APPLICATION INFORMATION FOR AEY17

1. Detector performance at other than Test Radio Frequency

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

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

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

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

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

MICROWAVE DETECTOR DIODES

AEY29 AEY29R

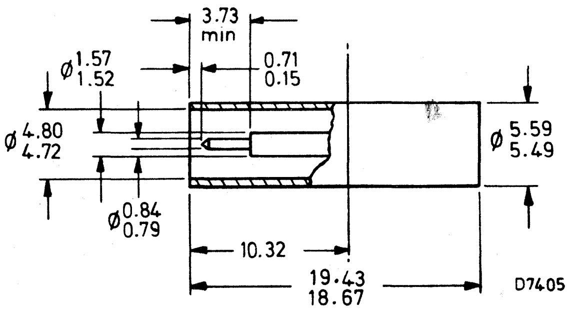
Germanium bonded backward diodes primarily intended for low level detector applications at J-band (Ku band). The AEY29 and AEY29R are packaged in the standard coaxial outline for this frequency band, similar to 1N78 types. The encapsulation is hermetically sealed and the devices conform to the environmental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

QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



Dimensions in mm

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°C)

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

Notes:

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

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

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

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

MICROWAVE DETECTOR DIODES

AEY31 AEY31A

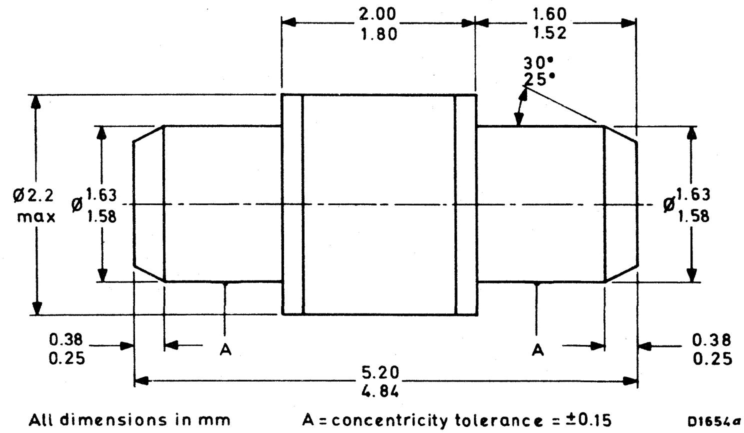
Sub-miniature germanium bonded backward diodes primarily intended for broad-band low level detector applications at X-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

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

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



TERMINAL IDENTIFICATION

The AEY31 and AEY31A are colour coded according to K1007 Issue 3, Section 1.3.4.4. That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.
The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

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

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

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

Notes:

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

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

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

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

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

APPLICATION INFORMATION FOR AEY31 AND AEY31A

1. Detector performance at other than Test Radio Frequency

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

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

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

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

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

MICROWAVE DETECTOR DIODE

AEY32

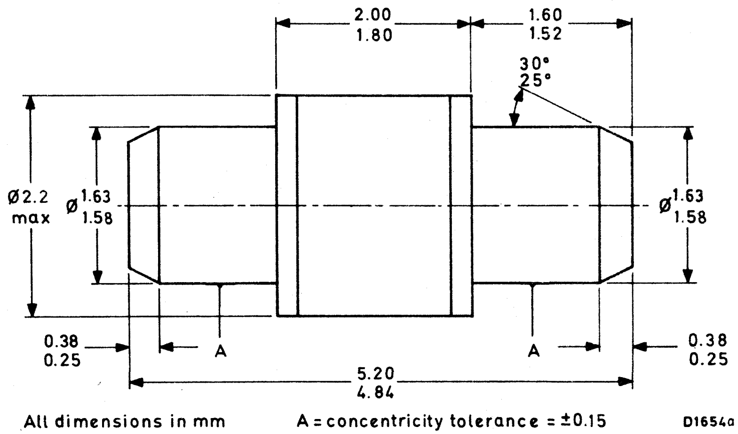
Sub-miniature germanium bonded backward diode primarily intended for broadband low level detector applications in K-band and in Q-band (Ka-band). It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Frequency range	18 to 40	GHz
Zero bias current sensitivity in the band 18 to 40 GHz (typ.)	2.0	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.

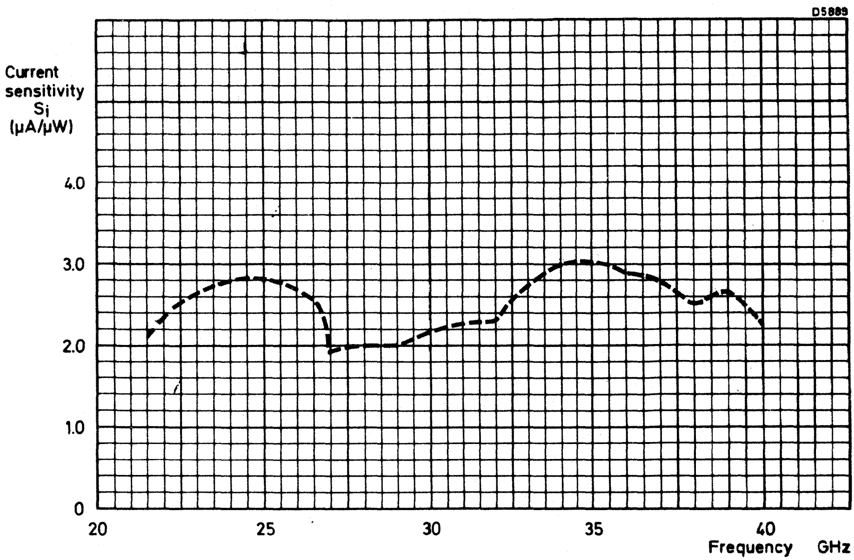
RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

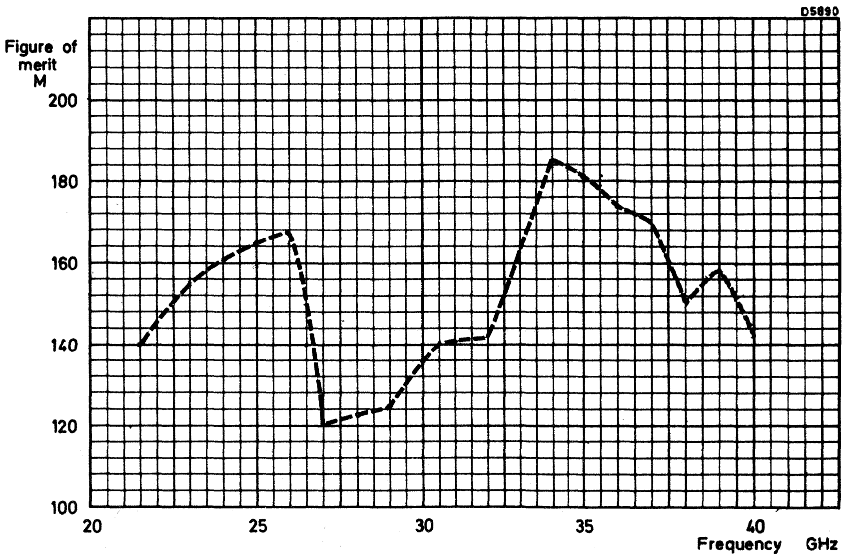
ELECTRICAL CHARACTERISTICS	Min.	Typ.	Max.	
1/f noise (see note 1)	-	-	7.0	dB
Swept v.s.w.r. (26.5 to 40GHz) (see note 2)	-	-	5:1	
Z_v video impedance (see note 3)	3.0	-	5.0	kΩ
S_i current sensitivity (see note 4)	-	2.0	-	μA/μW
M figure of merit (see note 5)	50	-	-	

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

Varactor diodes E

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BAY96

Silicon planar epitaxial varactor diode for use as a high efficiency frequency multiplier in the v.h.f. and u.h.f. bands. As a tripler from 150 to 450 MHz it has a typical efficiency of 64% and can handle inputs up to 40 W. The BAY96 has a very low series resistance and is packaged in a low inductance, hermetically sealed, welded ceramic-metal envelope, DO-4 with stud cathode. It conforms to the environmental requirements of BS9300 where applicable.

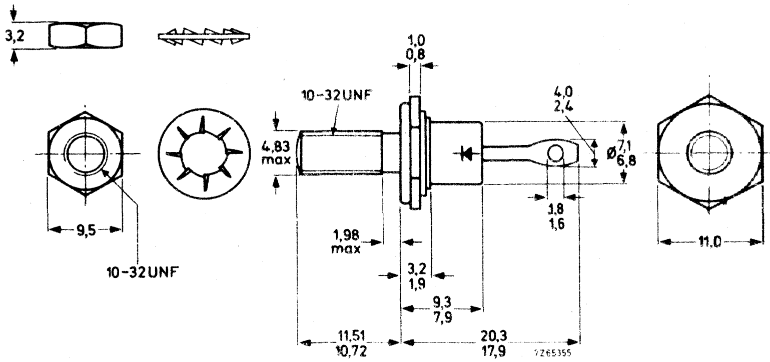
QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm

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



RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

$R_{th\ j-mb}$	7.5	°C/W

ELECTRICAL CHARACTERISTICS

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

APPLICATION INFORMATION

TYPICAL OPERATING CHARACTERISTICS AS A FREQUENCY TRIPLER

B5646

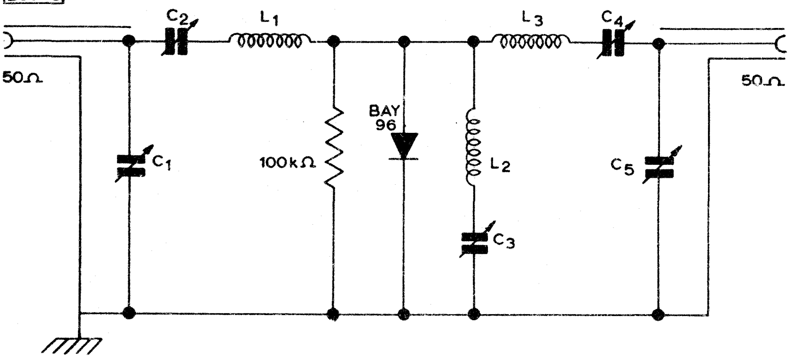


Fig.1

Frequency tripler circuit - 150 to 450 MHz

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

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

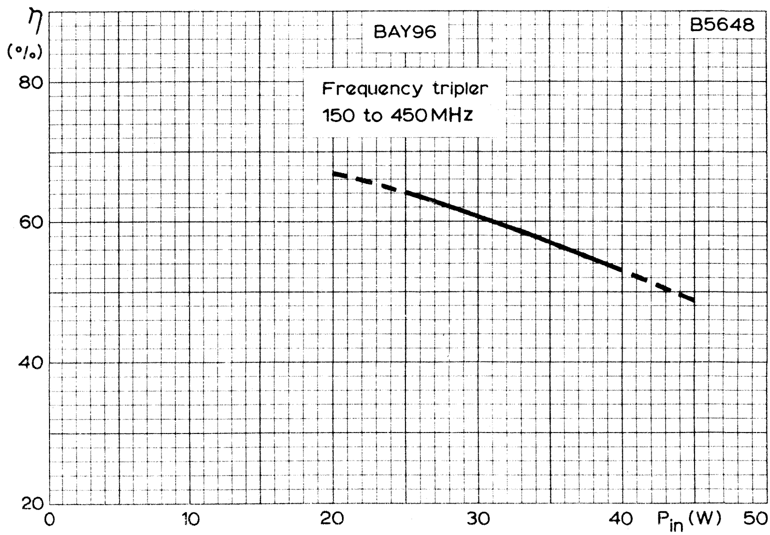
L_3 = 1" × 0.25" × 0.020" copper strip 0.562" from chassis

C_1 = 7.0 - 100pF variable

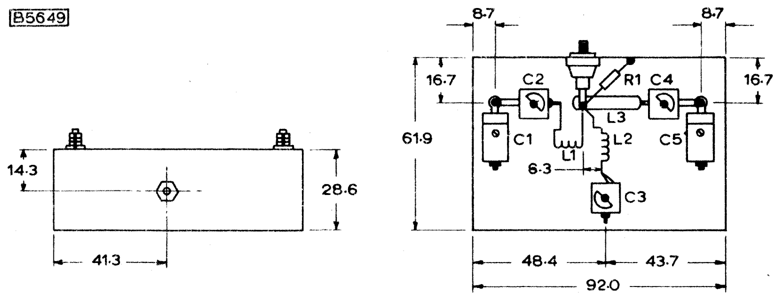
C_2, C_3, C_4 = 2.0 - 13pF variable

C_5 = 2.0 - 25pF variable

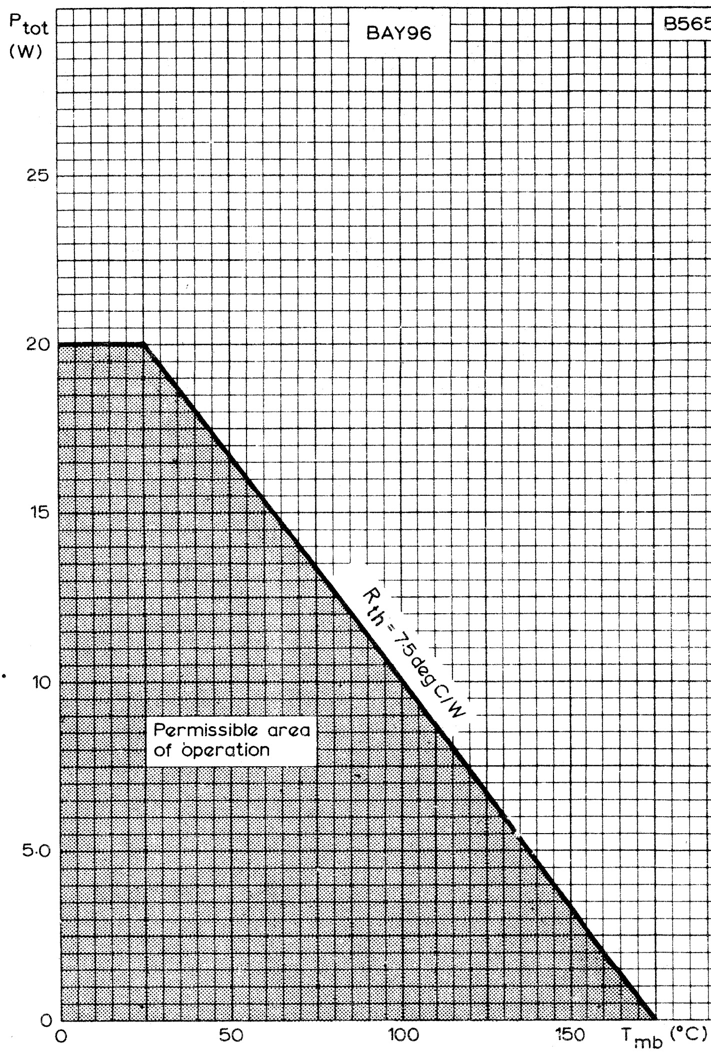
		Min.	Typ.	
η	Efficiency			
	P_{in} = 25W, f_{in} = 150 MHz	60	64	%



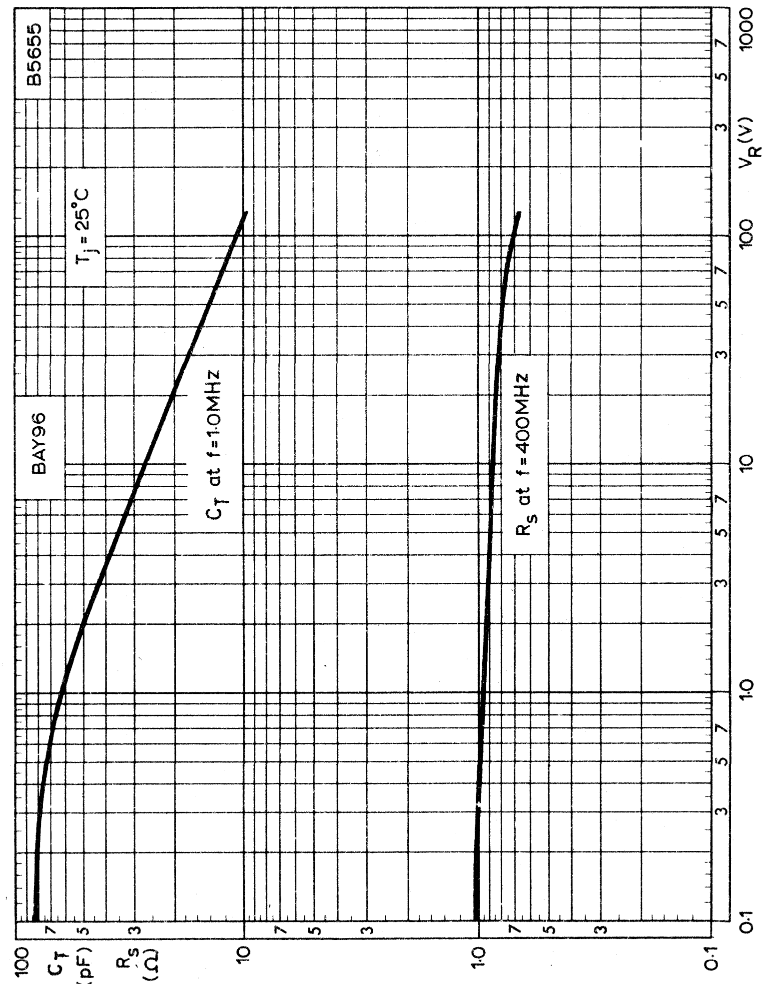
TYPICAL TRIPLER EFFICIENCY PLOTTED AGAINST INPUT POWER
See circuit on page 3



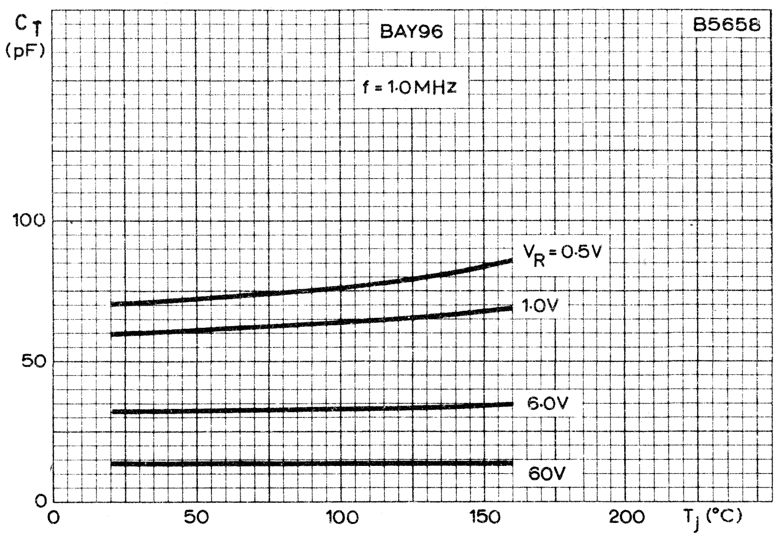
COMPONENT LAYOUT OF TRIPLER CIRCUIT

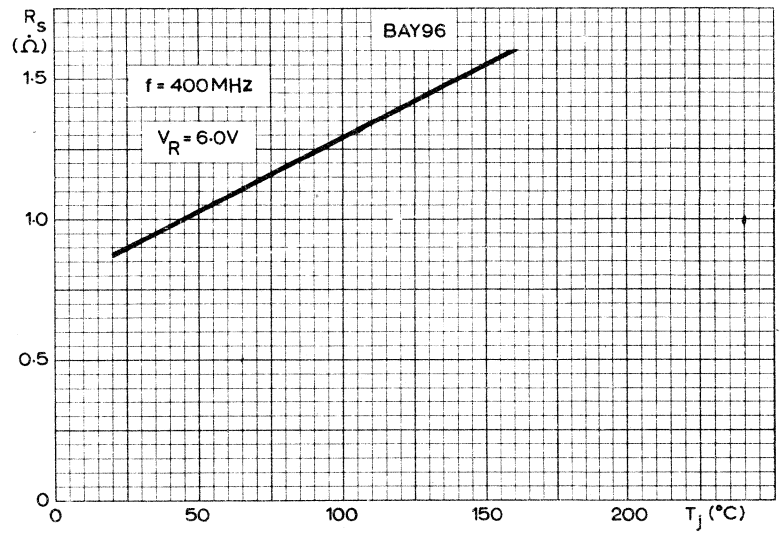


TOTAL DISSIPATION PLOTTED AGAINST MOUNTING BASE TEMPERATURE



TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED AGAINST REVERSE VOLTAGE





TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED AGAINST JUNCTION TEMPERATURE

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY27

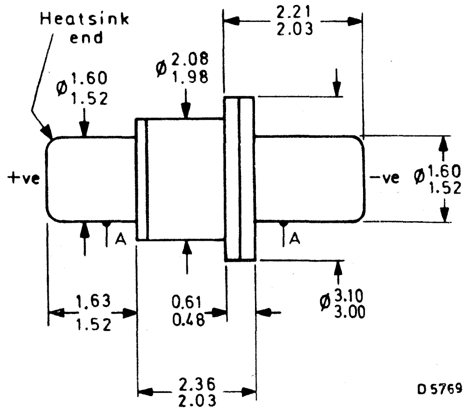
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to 'S' band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to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

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

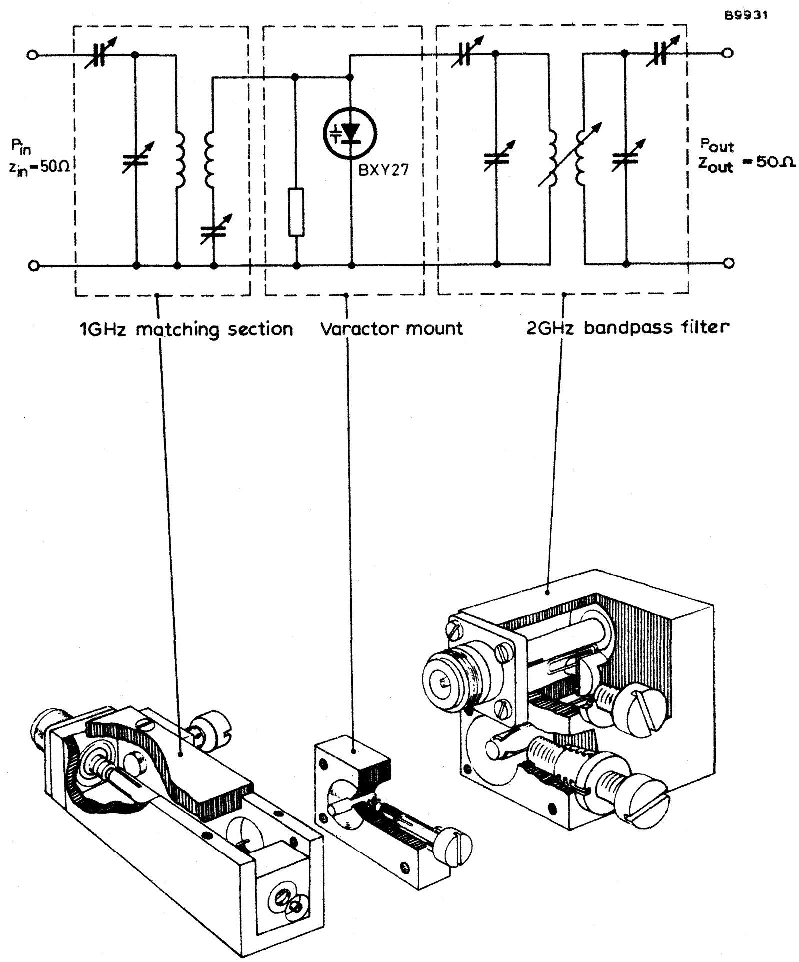
$R_{th\ j\text{-}pin}$ max.	20	degC/W

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

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY27



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (1 to 2GHz)

OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY28

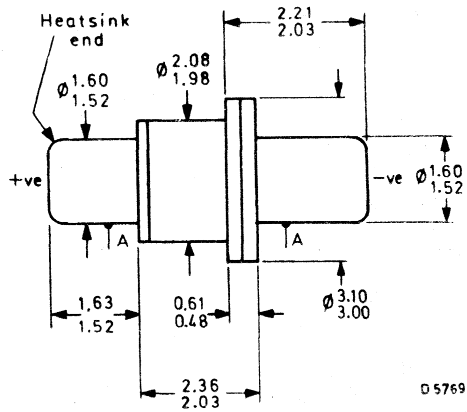
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the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

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

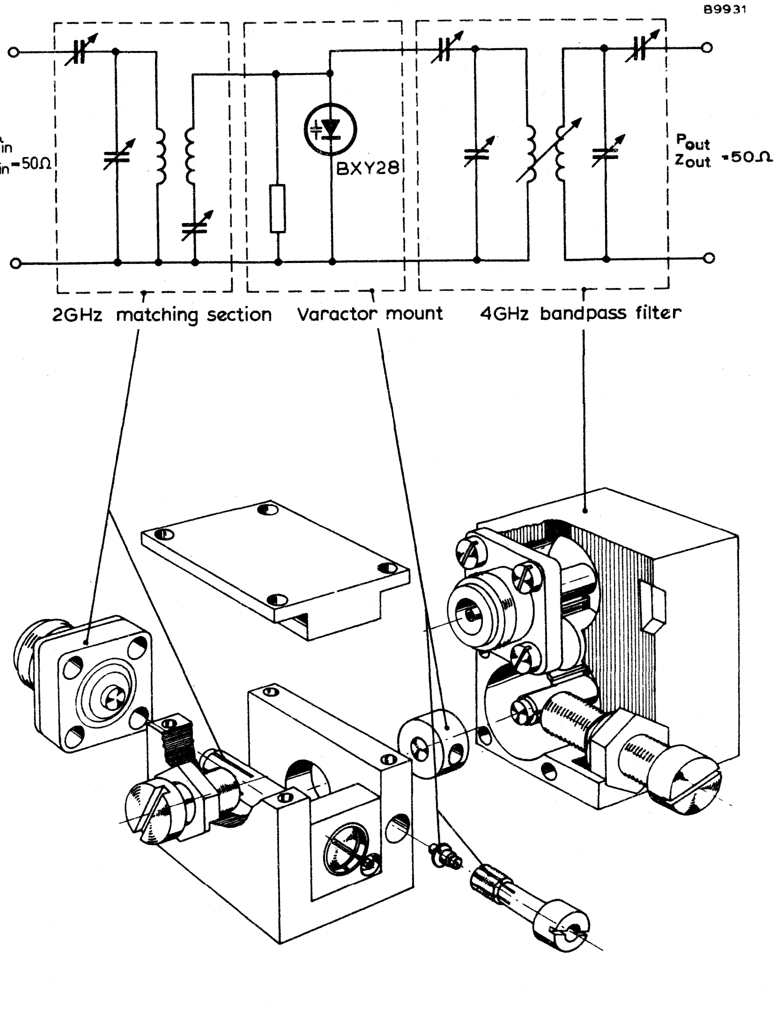
T_{stg} min.	-55	^oC
T_{stg} max.	150	^oC
T_j max.	150	^oC

THERMAL CHARACTERISTIC

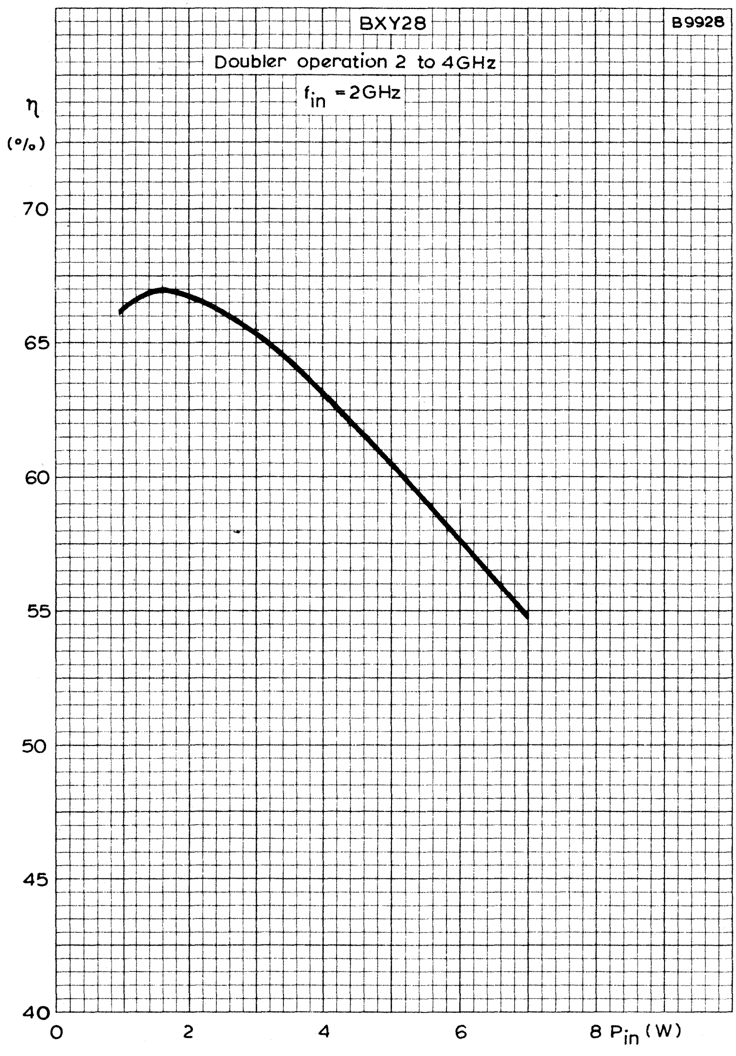
$R_{th\ j\text{-}pin}$ max.	30	degC/W

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

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



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (2 to 4GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY29

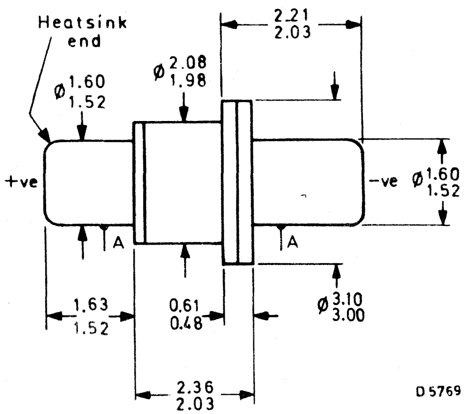
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to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

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

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

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

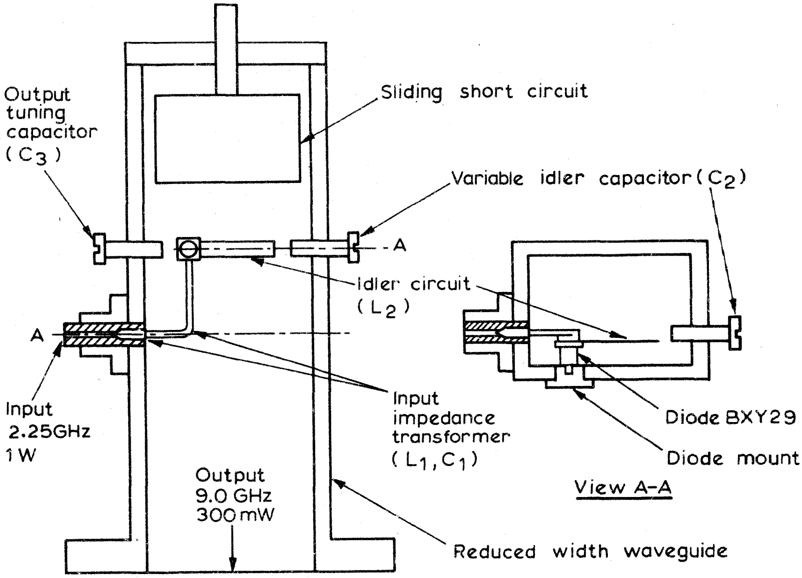
Where, C_j is the junction capacitance and is measured at 1.0MHz
r_s is measured on a slotted line at 2.0GHz.

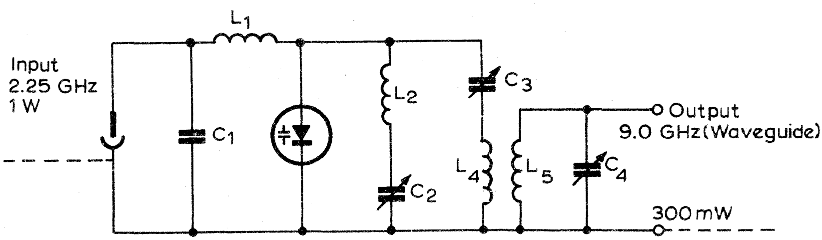
SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY29

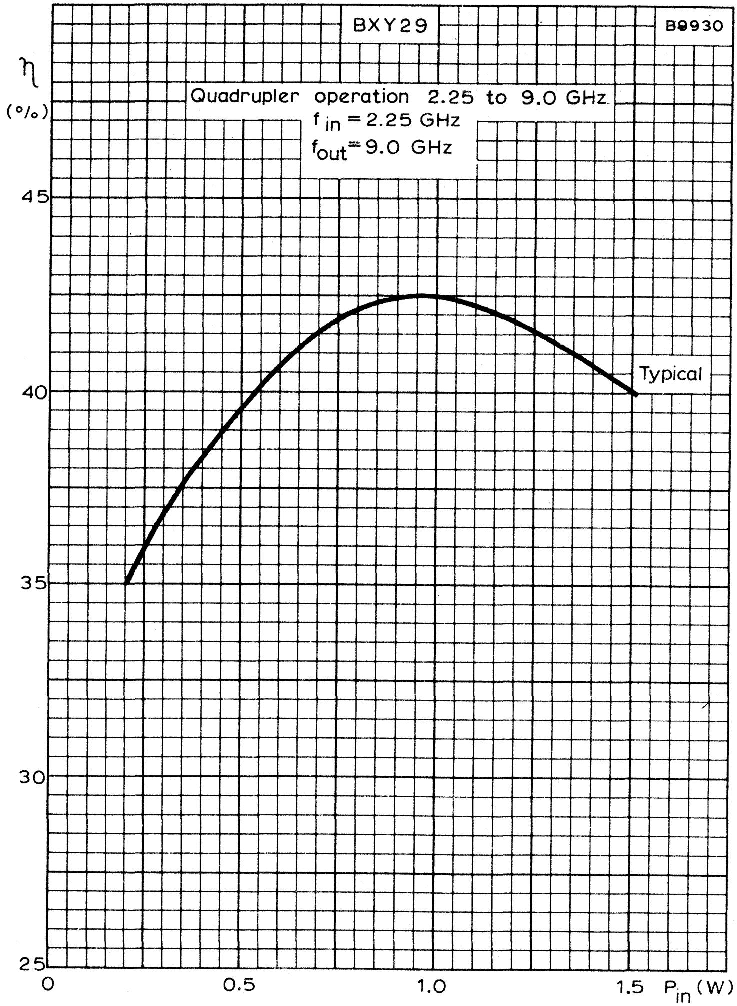
S-X BAND QUADRUPLER

B9937





Approximate equivalent circuit



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR QUADRUPLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY32

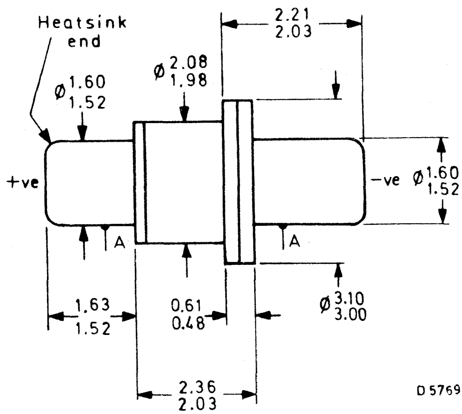
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency.
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to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

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

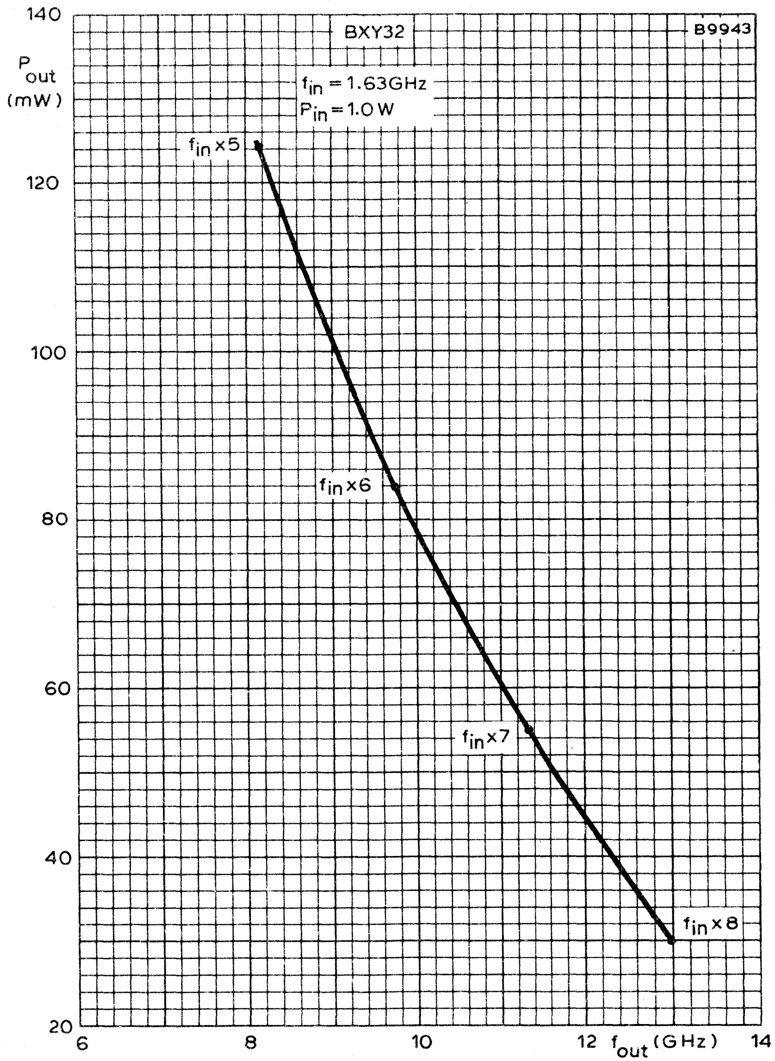
Note. The cut-off frequency f_{co} is defined as:

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

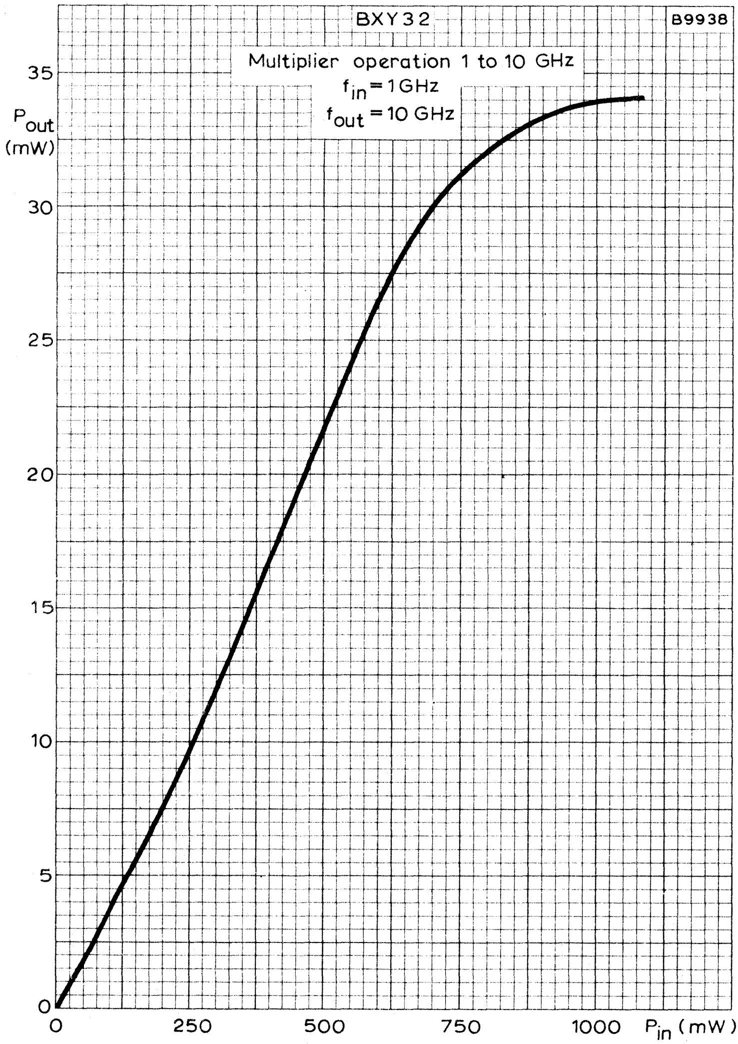
Where, C_j is the junction capacitance and is measured at 1.0MHz
r_s is measured on a slotted line at 8.0GHz

MULTIPLIER PERFORMANCE

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



TYPICAL PERFORMANCE IN HIGH ORDER MULTIPLIERS



TYPICAL PERFORMANCE AS A FREQUENCY MULTIPLIER

SILICON VARACTOR TUNING DIODES

BXY53 BXY54 BXY55

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

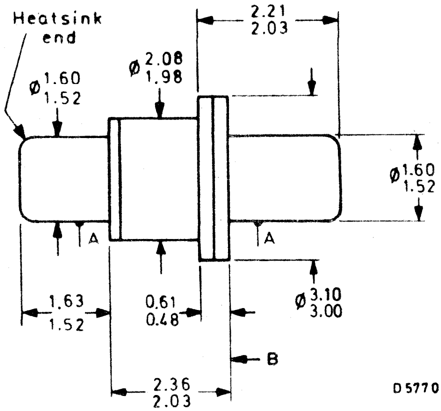
QUICK REFERENCE DATA

	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

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

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

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

NOTES

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

APPLICATION NOTE

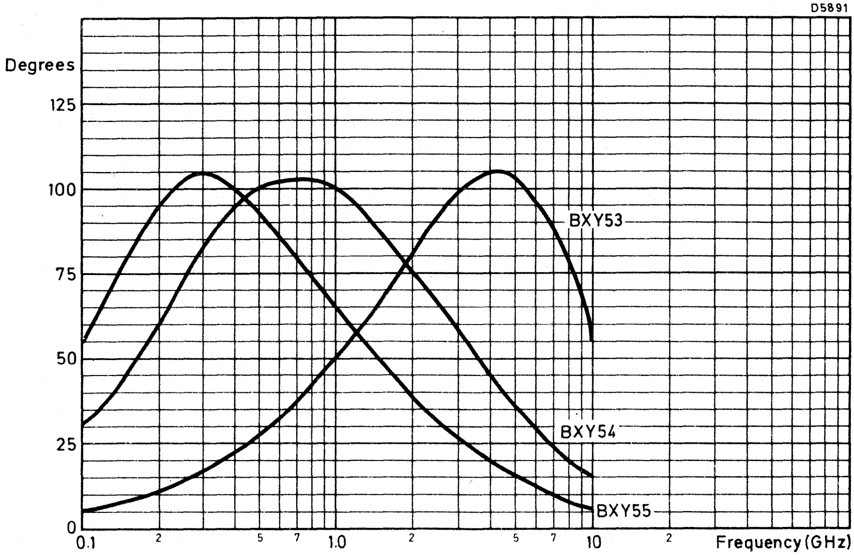
When designing tuning circuits at high frequencies it is not sufficient to specify a capacitance swing and loss resistance in the tuning varactor. The parasitic reactances of the microwave package have a significant effect on the terminal impedance of the device. Although strictly speaking one must consider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

APPLICATION NOTE (contd.)

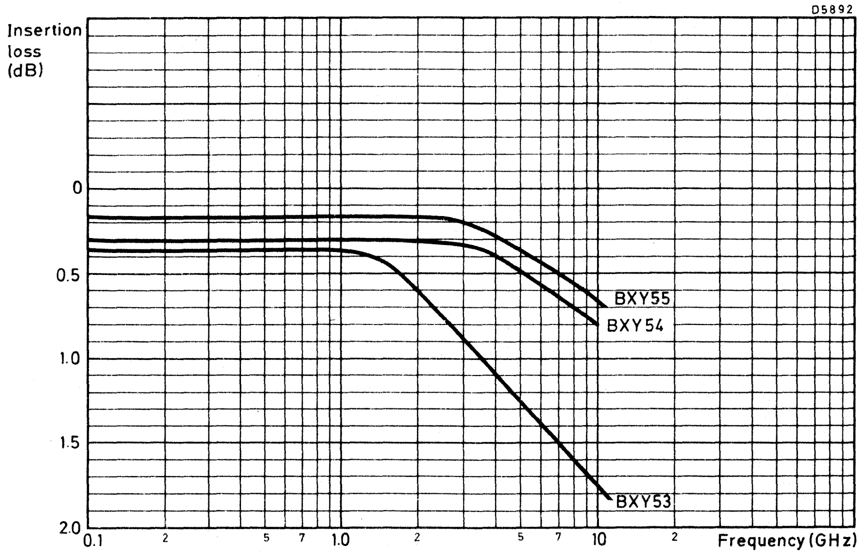
One may simply take the measurements as giving values of r.f. impedance as a function of bias for small signal conditions or they can be used as a more fundamental design aid. This is because the significant factors for the design of a microwave varactor tuned circuit are the available phase swing in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

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

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



TYPICAL PHASE SWING AS A FUNCTION
OF FREQUENCY



TYPICAL INSERTION LOSS AS A
FUNCTION OF FREQUENCY

SILICON VARACTOR DIODES

BXY56 BXY57

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

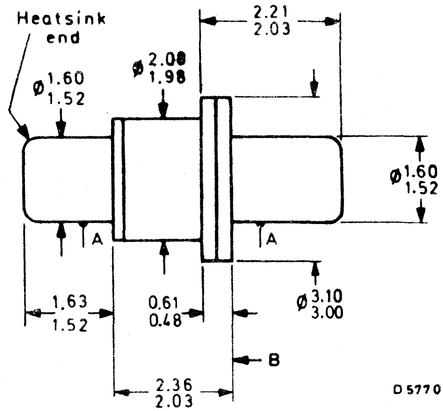
QUICK REFERENCE DATA

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

Unless otherwise shown, data is applicable to both types

OUTLINE AND DIMENSIONS

Conforms to BS3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	BXY56	BXY57	
V_R max.	60	60	V
P_{tot} max. (T_{hs} max. 50°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)

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

MULTIPLIER PERFORMANCE (see note 4)

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

NOTES

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

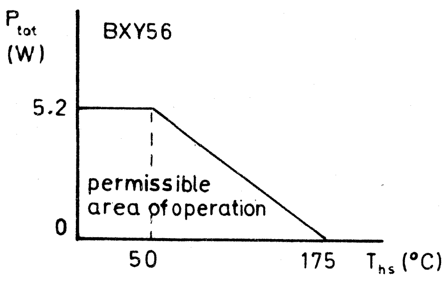


Fig. 1

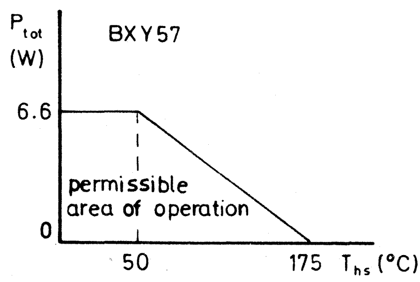


Fig. 2

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 the supplier in the customer's circuit.

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

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

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

GALLIUM ARSENIDE VARACTOR DIODE

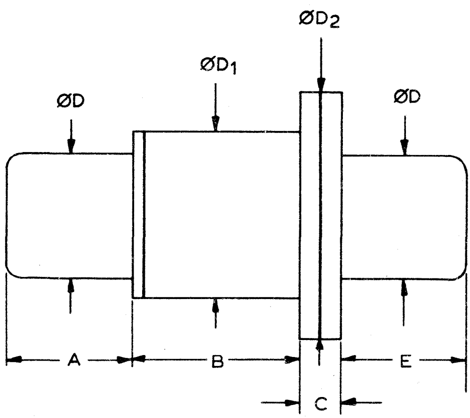
CAY10

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 °C	50	mW
for higher temperatures see derating curve		
Operating temperature range	-196 to +150	°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. ($T_{stud} \leq 107^oC$)	50	mW

Temperature

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

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

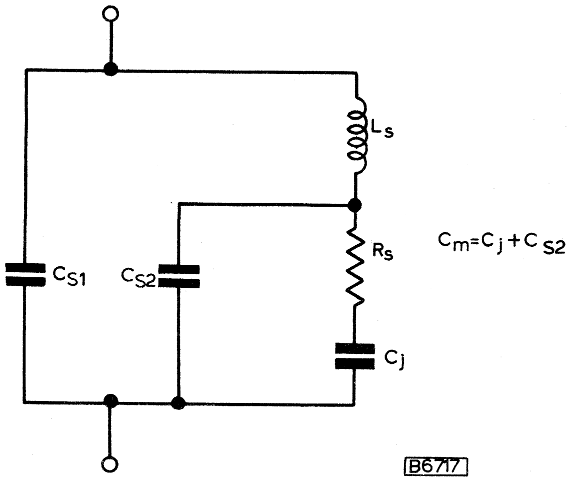
		Min.	Typ.	Max.	
Static					
I_R	Reverse current $V_R = 6.0V$	-	0.1	1.0	μA
V_F	Forward voltage drop $I_F = 1.0\mu A$ (see note 3.)	-	0.9	-	V
Dynamic					
f_o	Series resonant frequency Zero bias (see notes 1, 2.)	8.9	10	11.6	GHz
f_{co}	Cut-off frequency Zero bias (see note 2.)	125	150	-	GHz
f_c	Cut-off 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

GALLIUM ARSENIDE VARACTOR DIODE

CAY10

Notes

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



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

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

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

3. The capacitance variation coefficient γ is defined as

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

where C_m min. = effective capacitance at $V_R = 1.0V$

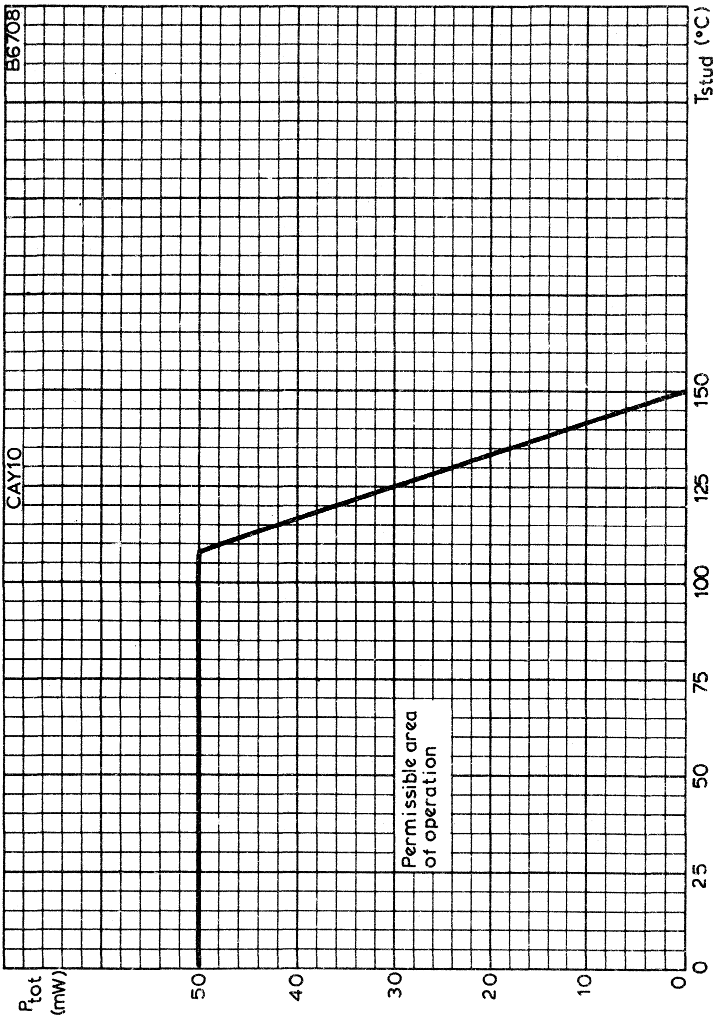
C_m max. = effective capacitance at $I_F = 1.0\mu A$

This can be re-written in the form

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

where $V = V_F$ at 1.0µA

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



TOTAL DISSIPATION PLOTTED AGAINST STUD TEMPERATURE

GALLIUM ARSENIDE VARACTOR DIODE

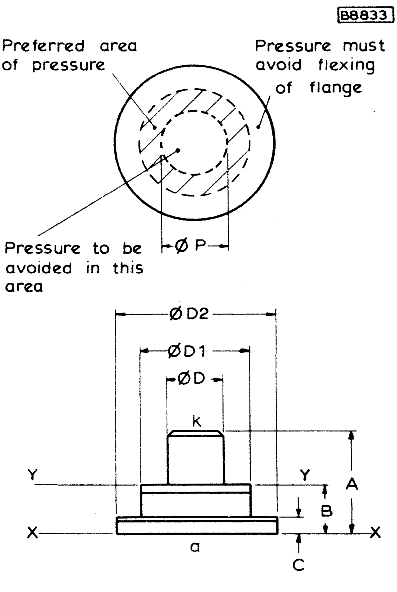
CXY10

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. $T_{pin} \leq 25^oC$	50	mW

Temperature

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

THERMAL CHARACTERISTIC

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

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^oC$ 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 $V_R = 1.0V$

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

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:-

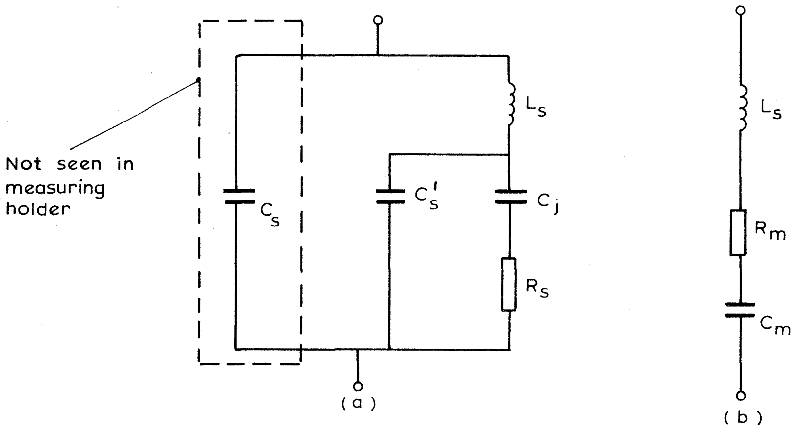
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

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.

GALLIUM ARSENIDE VARACTOR DIODE

CXY12

TENTATIVE DATA

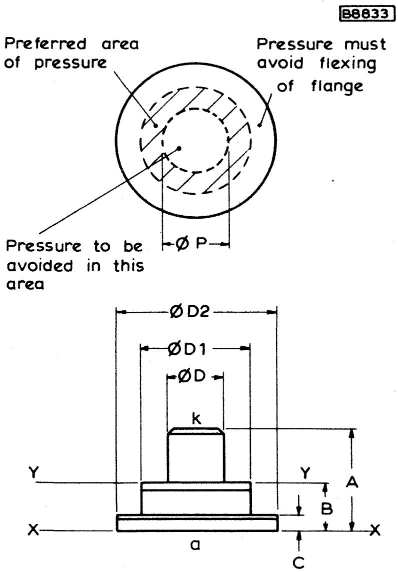
Gallium arsenide varactor diode suitable for use in frequency multiplier circuits up to Q-band output frequency. The diodes are of the diffused mesa type and are mounted in a small ceramic-metal case with hermetic welded seal.

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	^oC

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. ($T_{pin} = 25^oC$) (see note 1)	300	mW
P_{in} R.F. max.	500	mW

Temperature

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

THERMAL CHARACTERISTIC

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

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

		Min.	Typ.	Max.	
$V_{(BR)R}$	Breakdown voltage $I_R = 100\mu A$	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

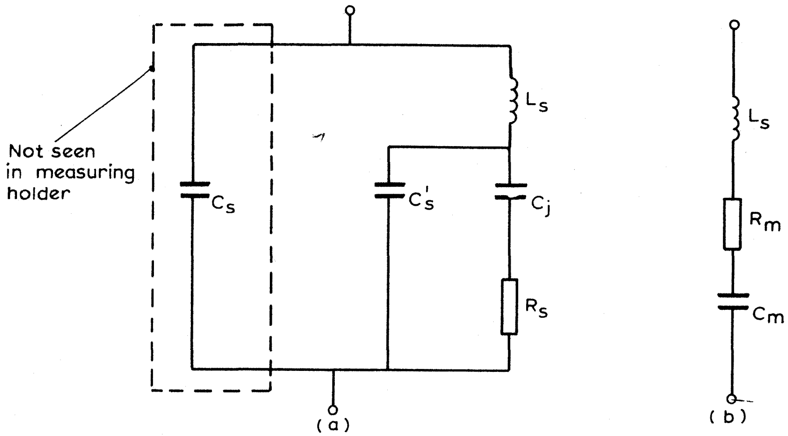
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

   L_s is also calculated using f_{res} and C_m

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

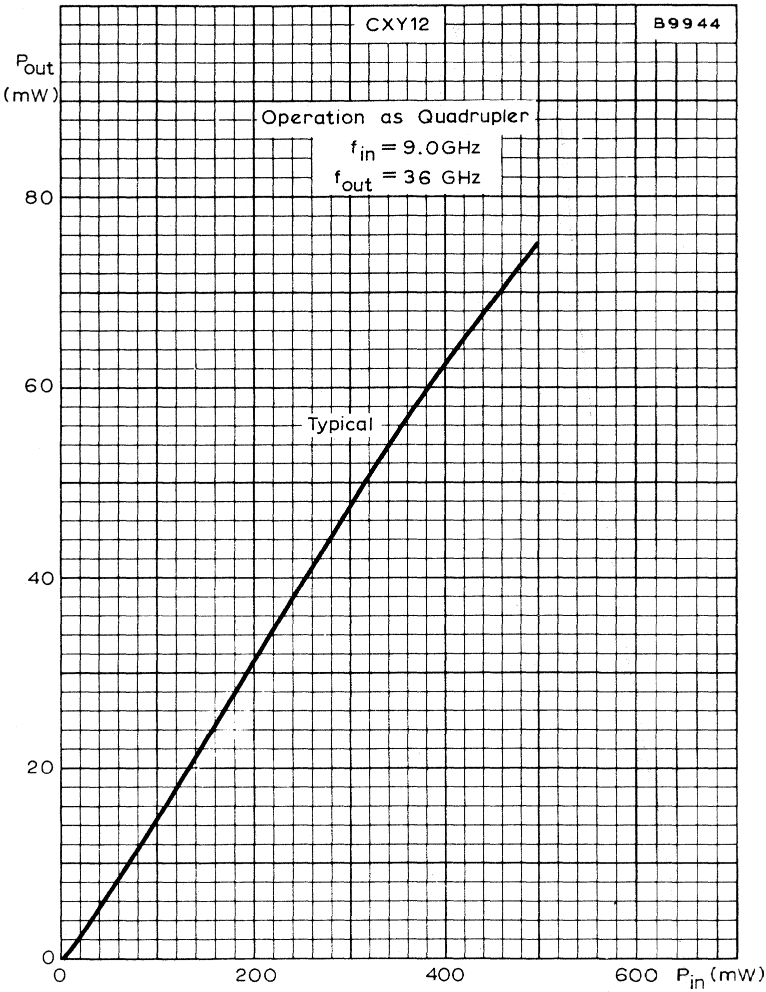
4. (a) Diode circuit model.

(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

GALLIUM ARSENIDE LIMITER DIODES

CXY22A CXY22B

DEVELOPMENT SAMPLE DATA

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

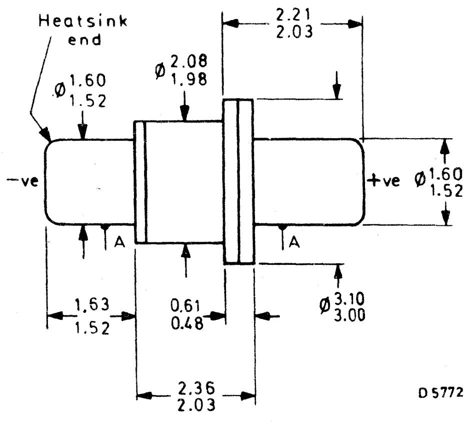
QUICK REFERENCE DATA

	CXY22A	CXY22B	
Operating frequency range	2.0 to 7.0	7.0 to 12	GHz
C_T at 0V (typ.)	0.85	0.55	pF
Insertion loss (typ.)	0.2	0.3	dB
High power attenuation (typ.)	30	16	dB

Unless otherwise shown, data is applicable to both types.

OUTLINE AND DIMENSIONS

Dimensions in mm



A = concentricity tolerance = ± 0.13

LIMITING VALUES (Absolute max. rating system)

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

CHARACTERISTICS

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

SILICON PLANAR EPITAXIAL VARACTOR DIODES

1N5152
1N5153

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

QUICK REFERENCE DATA

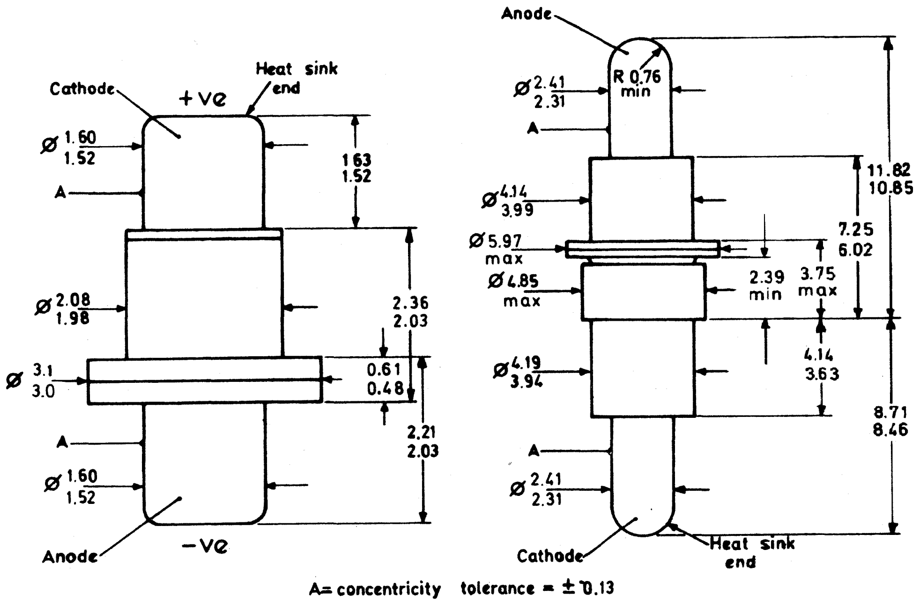
Operation as a frequency doubler 1.0 to 2.0 GHz in a typical circuit.

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

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS

OUTLINE DRAWING OF 1N5152 OUTLINE DRAWING OF 1N5153



A= concentricity tolerance = ± 0.13

All dimensions in mm

D7840

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

IN5155

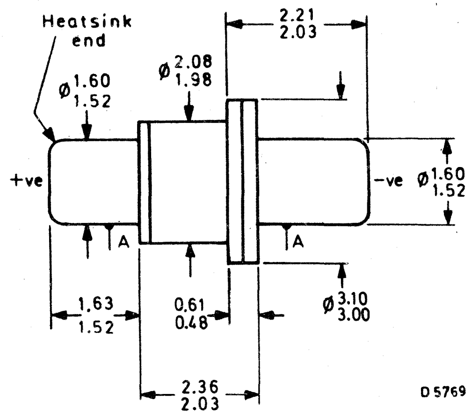
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

SILICON PLANAR EPITAXIAL VARACTOR DIODE

1N5157

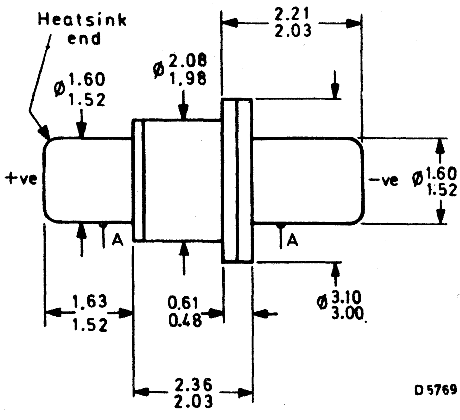
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to X-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

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

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

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ±0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

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

Temperature

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

THERMAL CHARACTERISTIC

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

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

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

Gunn oscillators F

X-BAND GUNN OSCILLATOR

Fixed frequency Gunn oscillator for operation in the 10,7 GHz band.
Applications include all forms of miniature radar systems.

QUICK REFERENCE DATA		
Centre frequency	10,687	GHz
Output power	8	mW
Supply voltage	7	V
Output flange	154 IEC-UBR 100 (WG16/WR90)	

OPERATING CONDITIONS [1][2]

Supply voltage		7	V
Supply current	≤	160	mA
Output power		8	mW

CHARACTERISTICS at 25 ^{o}C

	min.	typ.	max.	
Centre frequency		10,687		GHz
Output power	5	8		mW
Frequency (fixed)	10,675	10,687	10,700	GHz
Temperature coefficient of frequency		-0,25	-0,40	MHz/K
Pushing figure		1,5		MHz/V
A.M. noise to carrier ratio (1 Hz to 100 Hz bandwidth)		-94		dB
Second harmonic		-35		dBm [3]

LIMITING VALUES (Absolute max. rating system)

Supply voltage	max.	7,5	V
	min.	6,5	V
Supply current, running	max.	160	mA
starting	max.	200	mA
Voltage standing wave ratio	max.	1,5	

Notes see page 2.

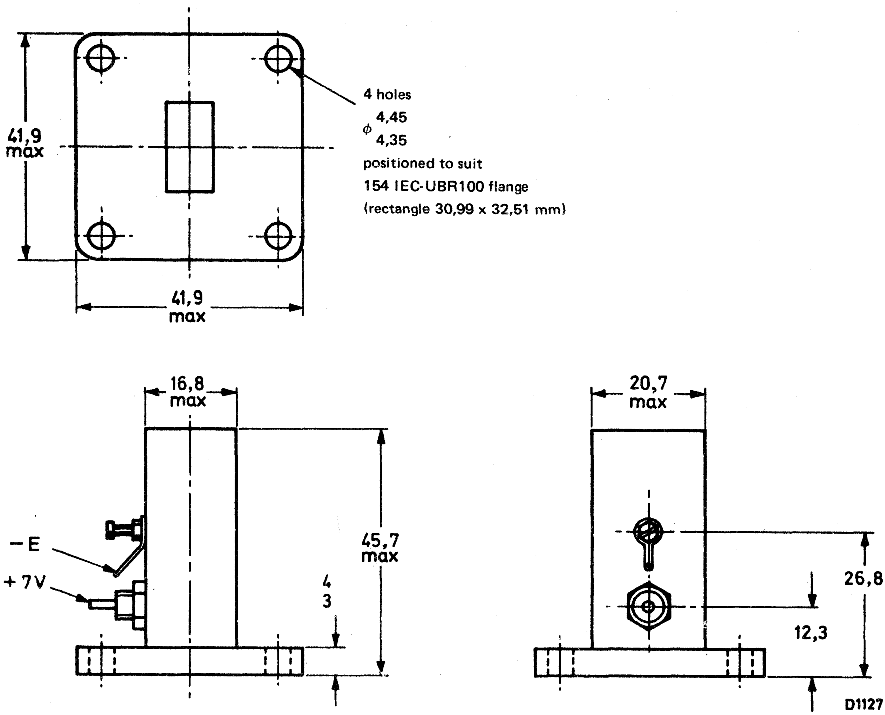
Data based on pre-production devices.

TEMPERATURE LIMITS

Ambient temperature	max.	+40	°C
	min.	0	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm



Soldering: The use of low melting point solder is recommended.

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 V. A voltage regulator diode to shunt the power supply is recommended for this purpose.

2) A 10 nF capacitor between the $+V_G$ terminal and earth (E) is recommended to suppress any tendency to low frequency oscillations in the supply leads.

3) Modulation of the supply voltage within the 1 to 100 Hz 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.

X-BAND GUNN OSCILLATOR/DETECTOR

Fixed frequency Gunn oscillator for operation in the 10,7 GHz band as a self-oscillating mixer (auto detector).

QUICK REFERENCE DATA		
Frequency	10,687	GHz
Output power at supply voltage = 7 V	8	mW
Frequency temperature coefficient	−0,25	MHz/K
Supply voltage, d.c.	7	V
Output flange	154 IEC-UBR100 (WG16/WR90)	

OPERATING CONDITIONS

Supply voltage, d.c. (see operating notes)		7	V
Voltage standing wave ratio of the load	max.	1,5	
Threshold current	⩽	200	mA
Operating current	⩽	160	mA

CHARACTERISTICS at 25 °C

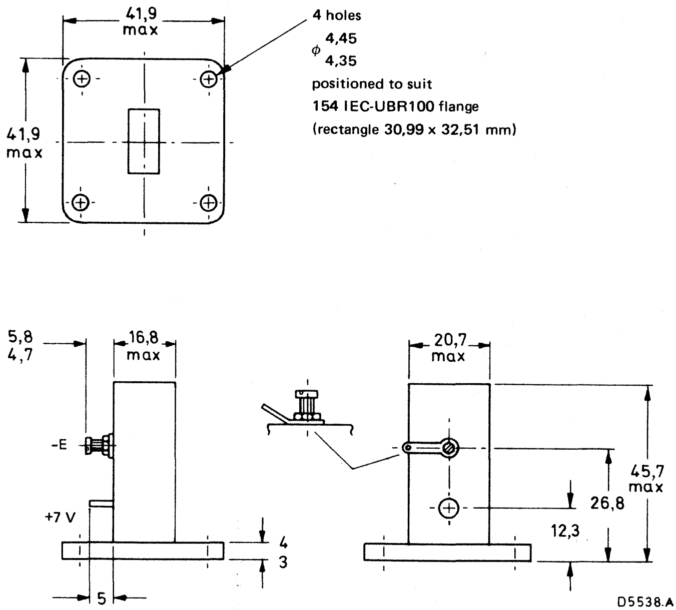
Centre frequency		10,687	GHz
Output power		8	mW
	>	5	mW
Frequency, fixed	>	10,687	GHz
	<	10,700	GHz
Frequency temperature coefficient		−0,25	MHz/K
	<	−0,40	MHz/K
Frequency pushing		4	MHz/V
Output voltage for an input power 66 dB down on output power at $\frac{\text{signal + noise}}{\text{noise}}$ = 6 dB		40	μV
	>	24	μV
Second harmonic		−35	dBm
Threshold current	<	200	mA
Operating current		120	mA
	<	160	mA

Data based on pre-production devices.

LIMITING VALUES (absolute max. rating system) at 25 °C

Supply voltage, d.c.	max.	7,5	V
	min.	6,5	V
transient, T_{imp} = max. 1 ms	max.	9,0	V
Temperature, operating	max.	+40	°C
	min.	0	°C

DIMENSIONS AND CONNECTIONS Dimensions in mm



Soldering: The use of low melting point solder is recommended.

OPERATING NOTES

1) The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8, 2 V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

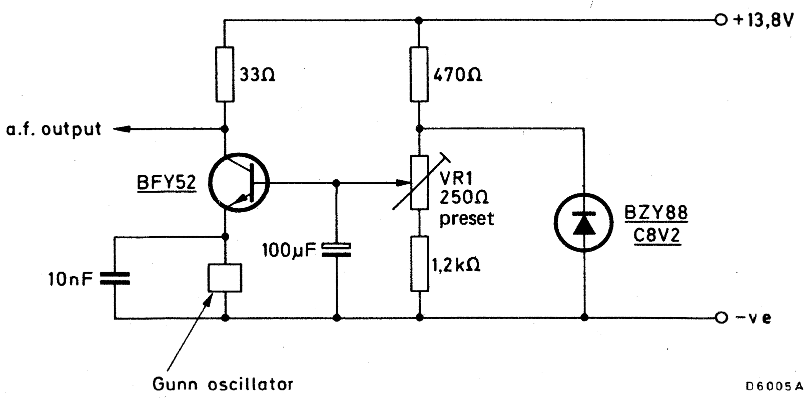
2) The minimum supply voltage is 6, 5 V for the frequency of oscillation to remain within the characteristic limits.

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

4) A return signal 66 dB down on radiated power will be achieved from a man target of radar cross-section 1 m^2 at a range of 12 m, when operating with an antenna gain of 20 dB.

5) System bandwidth 1 Hz to 1 kHz.

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



VR_1 is used to set voltage at 7 V across Gunn oscillator.

Circuit for sensitivity measurements

X-BAND GUNN OSCILLATOR

Fixed frequency Gunn oscillator for operation in the 9,35 GHz band.

QUICK REFERENCE DATA		
Frequency	9,35	GHz
Output power at supply voltage = 7 V	8	mW
Frequency temperature coefficient	−0,25	MHz/K
Supply voltage, d.c.	7	V
Output flange	154 IEC-UBR100 (WG16/WR90)	

OPERATING CONDITIONS

Supply voltage, d.c. (see operating notes)		7	V
Voltage standing wave ratio of the load	max.	1,5	
Threshold current	≤	200	mA
Operating current	≤	160	mA

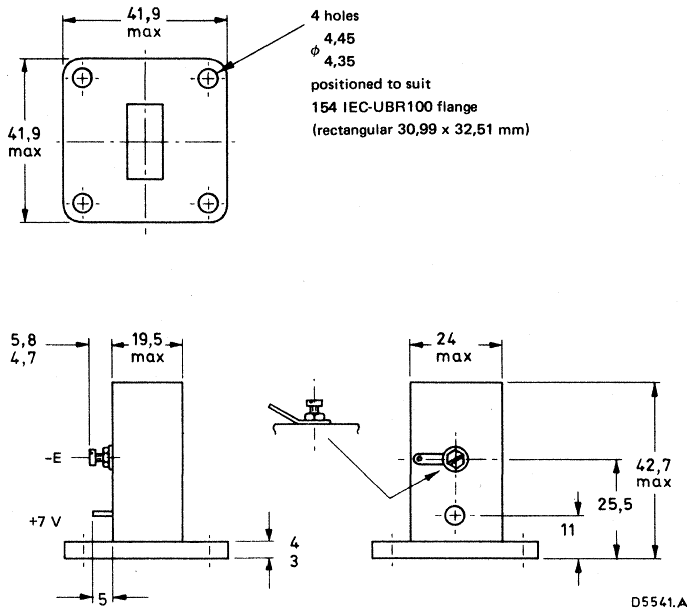
CHARACTERISTICS at 25 °C

Centre frequency		9,35	GHz
Output power		8	mW
	>	5	mW
Frequency, fixed	>	9,33	GHz
	<	9,37	GHz
Frequency temperature coefficient		−0,25	MHz/K
	<	−0,40	MHz/K
Frequency pushing		1,5	MHz/V
A.M. noise to carrier ratio (1 Hz to 100 Hz bandwidth)		−94	dB
Second harmonic		−25	dBm
Threshold current	<	200	mA
Operating current		120	mA
	<	160	mA

LIMITING VALUES (absolute max. rating system) at 25 °C

Supply voltage, d.c.	max.	7,5	V
	min.	6,5	V
transient, T_{imp} = max. 1 ms	max.	8	V
Temperature, operating	max.	40	°C
	min.	0	°C

DIMENSIONS AND CONNECTIONS Dimensions in mm



Soldering: The use of low melting point solder is recommended.

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, 2 V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

2) The minimum supply voltage is 6, 5 V for the frequency of oscillation to remain within the characteristic limits.

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

4) Modulation of the supply voltage within the 1 Hz to 100 Hz 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/DETECTOR

Fixed frequency Gunn oscillator for operation in the 9, 35 GHz band as a self-oscillating mixer (auto detector).

QUICK REFERENCE DATA		
Frequency	9, 35	GHz
Output power at supply voltage = 7 V	8	mW
Frequency temperature coefficient	−0, 25	MHz/K
Supply voltage, d.c.	7	V
Output flange	154 IEC-UBR100 (WG16/WR90)	

OPERATING CONDITIONS

Supply voltage, d.c. (see operating notes)		7	V
Voltage standing wave ratio of the load	max.	1, 5	
Threshold current	⩽	200	mA
Operating current	⩽	160	mA

CHARACTERISTICS at 25 °C

Centre frequency		9, 35	GHz
Output power		8	mW
	>	5	mW
Frequency, fixed	>	9, 33	GHz
	<	9, 37	GHz
Frequency temperature coefficient		−0, 25	MHz/K
	<	−0, 40	MHz/K
Frequency pushing		4	MHz/V
Output voltage for an input power 66 dB down on output power at $\frac{\text{signal + noise}}{\text{noise}} = 6$ dB		40	µV
	>	24	µV
Second harmonic		−25	dBm
Threshold current	<	200	mA
Operating current		120	mA
	<	160	mA

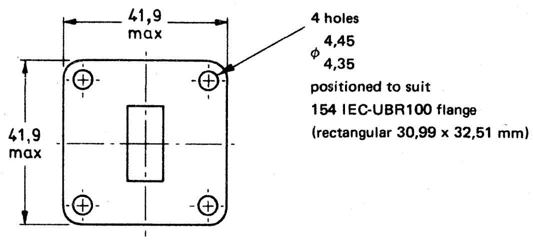
Data based on pre-production devices.

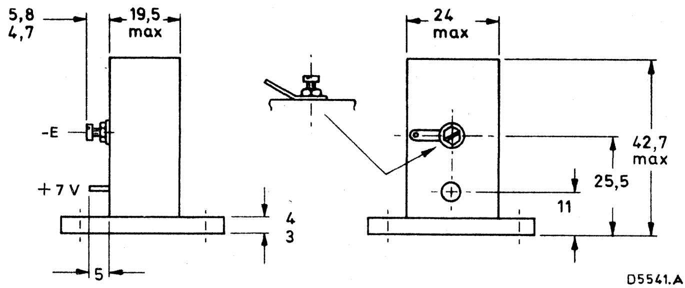
LIMITING VALUES (absolute max. rating system) at 25 °C

Supply voltage, d.c.	min.	6,5	V
	max.	7,5	V
transient, T_{imp} = max. 1 ms	max.	9,0	V
Temperature, operating	min.	0	°C
	max.	40	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm





Soldering: The use of low melting point solder is recommended.

OPERATING NOTES

1) The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8, 2 V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

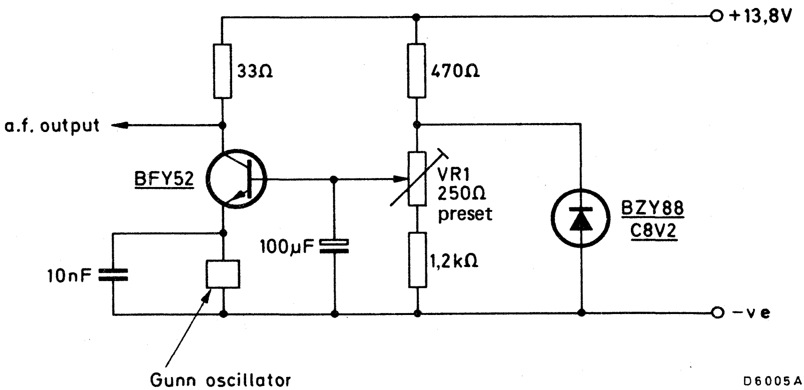
2) The minimum supply voltage is 6, 5 V for the frequency of oscillation to remain within the characteristic limits.

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

4) A return signal 66 dB down on radiated power will be achieved from a man target of radar cross-section 1 m^2 at a range of 12 m, when operating with an antenna gain of 20 dB.

5) System bandwidth 1 Hz to 1 kHz.

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



VR_1 is used to set voltage at 7 V across Gunn oscillator.

Circuit for sensitivity measurements

X-BAND GUNN OSCILLATOR

Fixed frequency Gunn oscillator in the 10,5 GHz band. Applications include all forms of miniature radar systems.

QUICK REFERENCE DATA		
Frequency	10,525	GHz
Output power at supply voltage = 7 V	8	mW
Frequency temperature coefficient	−0,25	MHz/K
Supply voltage, d.c.	7	V
Output flange	154 IEC-UBR100 (WG16/WR90)	

OPERATING CONDITIONS

Supply voltage, d.c. (see operating notes)		7	V
Voltage standing wave ratio of the load	max.	1,5	
Threshold current	⩽	200	mA
Operating current	⩽	160	mA

CHARACTERISTICS at 25 °C

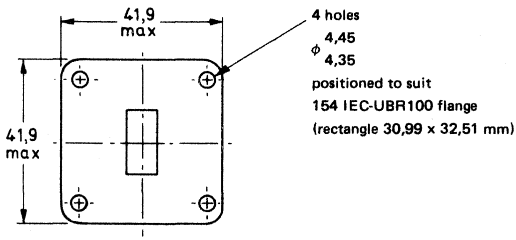
Centre frequency		10,525	GHz
Output power		8	mW
	>	5	mW
Frequency, fixed	>	10,500	GHz
	<	10,550	GHz
Frequency temperature coefficient		−0,25	MHz/K
	<	−0,40	MHz/K
Frequency pushing		4	MHz/V
A.M. noise to carrier ratio (1 Hz to 100 Hz bandwidth)		−94	dB
Second harmonic		−35	dBm
Threshold current	<	200	mA
Operating current	≤	160	mA

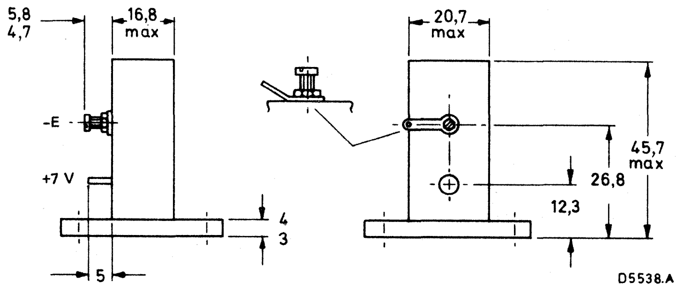
LIMITING VALUES (absolute max. rating system) at 25 °C

Supply voltage, d.c.	min.	6,5	V
	max.	7,5	V
transient, T_{imp} = max. 1 ms	max.	9,0	V
Temperature, operating	min.	0	°C
	max.	40	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm





Soldering: The use of low melting point solder is recommended.

OPERATING NOTES

1) The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8, 2 V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

2) The minimum supply voltage is 6, 5 V for the frequency of oscillation to remain within the characteristic limits.

3) It is recommended that a small capacitor (e.g. 10 nF) is connected across the oscillator 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 load with a VSWR < 1, 1 at fundamental frequency. The level is equivalent to that radiated from a low VSWR X-band antenna, for example, ACX-01.

X-BAND GUNN OSCILLATOR/DETECTOR

Fixed frequency Gunn oscillator for operation in the 10,525 GHz band as a self-oscillating mixer (auto detector).

QUICK REFERENCE DATA		
Frequency	10,525	GHz
Output power at supply voltage = 7 V	8	mW
Frequency temperature coefficient	−0,25	MHz/K
Supply voltage, d.c.	7	V
Output flange	154 IEC-UBR100 (WG16/WR90)	

OPERATING CONDITIONS

Supply voltage, d.c. (see operating notes)		7	V
Voltage standing wave ratio of the load	max.	1,5	
Threshold current	⩽	200	mA
Operating current	⩽	160	mA

CHARACTERISTICS at 25 °C

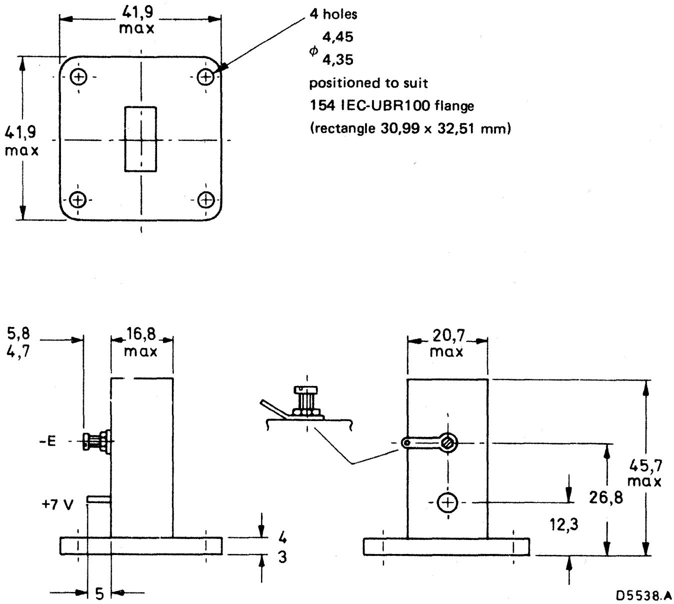
Centre frequency		10,525	GHz
Output power		8	mW
	>	5	mW
Frequency, fixed	>	10,500	GHz
	<	10,550	GHz
Frequency temperature coefficient		0,25	MHz/K
	<	0,40	MHz/K
Frequency pushing		1,5	MHz/V
Output voltage for an input power 66 dB down on output power at $\frac{\text{signal + noise}}{\text{noise}} = 6$ dB		40	µV
	>	24	µV
Second harmonic		−35	dBm
Threshold current	<	200	mA
Operating current		120	mA
	<	160	mA

Data based on pre-production devices.

LIMITING VALUES (absolute max. rating system) at 25 ^{o}C

Supply voltage, d.c.	min.	6,5	V
	max.	7,5	V
transient, T_{imp} = max. 1 ms	max.	9,0	V
Temperature, operating	min.	0	^{o}C
	max.	40	^{o}C

DIMENSIONS AND CONNECTIONS Dimensions in mm



Soldering: The use of low melting point solder is recommended.

OPERATING NOTES

1) The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8, 2 V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.

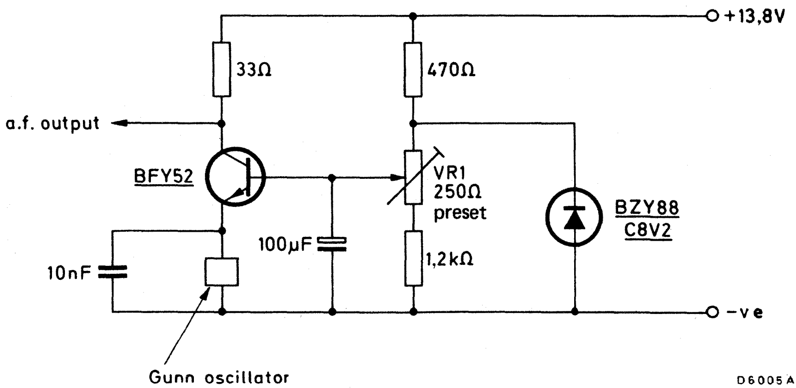
2) The minimum supply voltage is 6, 5 V for the frequency of oscillation to remain within the characteristic limits.

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

4) A return signal 66 dB down on radiated power will be achieved from a man target of radar cross-section 1 m^2 at a range of 12 m, when operating with an antenna gain of 20 dB.

5) System bandwidth 1 Hz to 1 kHz.

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



VR_1 is used to set voltage at 7 V across Gunn oscillator.

Circuit for sensitivity measurements

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.

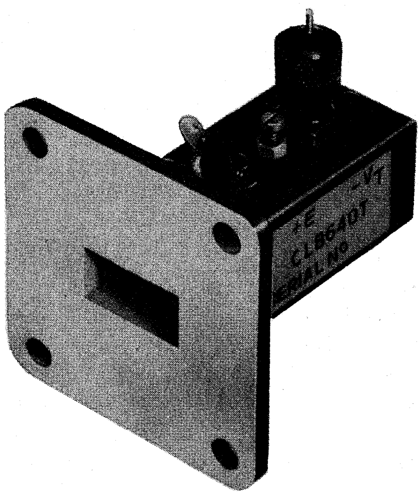
QUICK REFERENCE DATA

	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

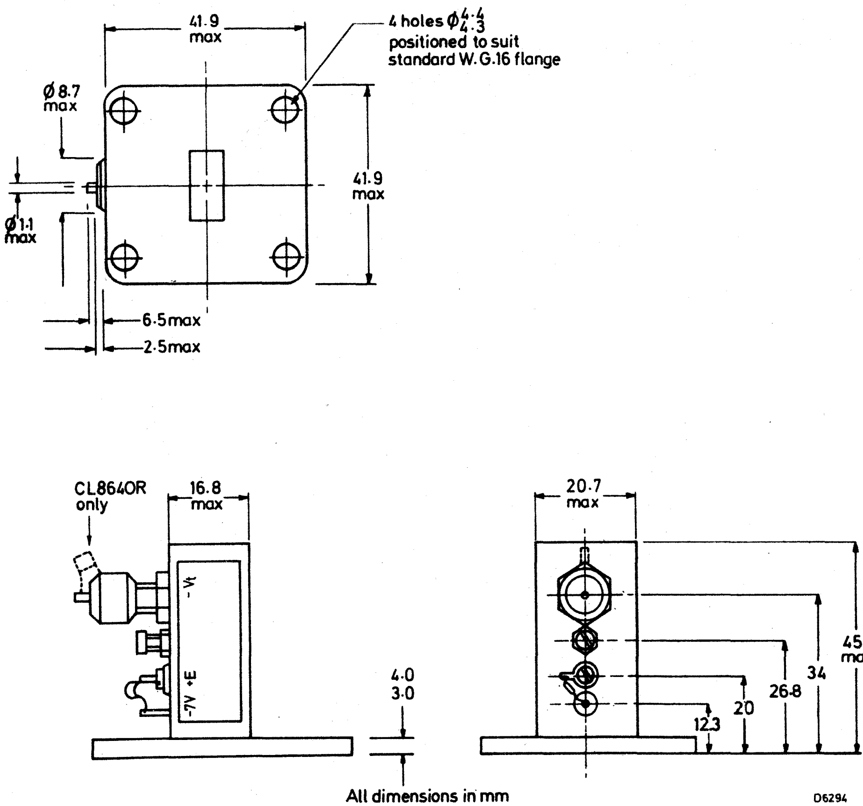
		Min.	Typ.	Max.	
Mechanical tuning range		±60	-	-	MHz
Electronic tuning range	CL8640R	±15	-	-	MHz
(notes 2 and 3)	CL8640T	±4.0	-	-	MHz
Power output at -7.0V		4.0	6.0	-	mW
Frequency pushing		-	3.0	-	MHz/V
Frequency pulling (note 4)		-	1.5	-	MHz
Frequency temperature coefficient		-	-0.25	-0.3	MHz/°C
Tuning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

Sub-assemblies G

MICROWAVE HORN ANTENNA

A general purpose X-band antenna for miniature radar systems. The unit gives a low VSWR and is of a strong cast construction.

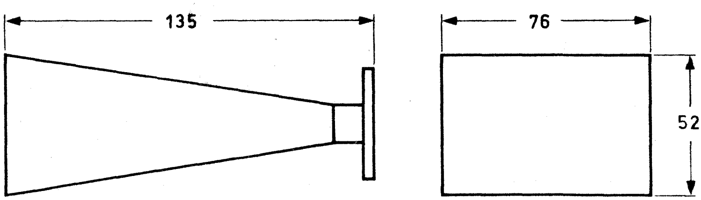
CHARACTERISTICS

Frequency range		9 to 11	GHz
Gain		16	dB
Beam angle (both planes)		30	deg
Voltage standing wave ratio	max.	1,2	

MECHANICAL DATA

Dimensions in mm

Weight	160 g
Dimensions	See outline drawing
Flange	UBR100 (UG135/U)



7Z62715

X-BAND MIXER/DETECTOR

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 the 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.

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	μV

TYPICAL OPERATING CONDITIONS

Ambient temperature	−10 to +50	°C
Local oscillator level	−18	dBm
D.C. bias [3], [4]	32	μA
Total load (d.c. and i.f.)	10	kΩ

CHARACTERISTICS at 25 °C

	min.	typ.	max.	
Centre frequency			10,687	GHz
Mixer				
Sensitivity for −95 dBm input	10	15		μV
Noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) [1]		1	2	μV
Detector				
Tangential sensitivity at centre frequency [2]		−50		dBm
Tangential sensitivity from 10,1 to 11,0 GHz [2]		−49		dBm

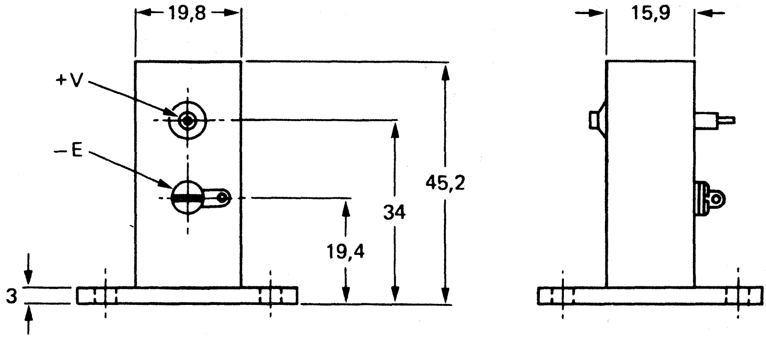
Notes see page 2.

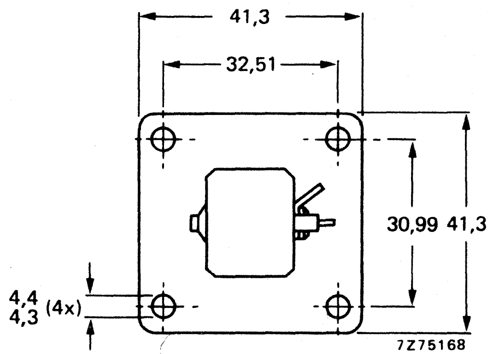
LIMITING VALUES (Absolute max. rating system)

Reverse current	max.	5	mA
Forward current, peak	max.	10	mA
Storage temperature	max.	+100	°C
	min.	−10	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm





Soldering: The use of low melting point solder is recommended.

1) When the local oscillator power is derived from a Gunn source with an a.m. noise-to-carrier ratio of 94 dB (e.g. 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.

X-BAND MIXER/DETECTOR

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 the 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-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	μV

TYPICAL OPERATING CONDITIONS

Ambient temperature range	−10 to +50	°C
Local oscillator level	−18	dBm
D.C. bias 3), 4)	32	μA
Total load (d.c. and i.f.)	10	kΩ

CHARACTERISTICS at 25 °C

Centre frequency				9,35	GHz
		min.	typ.	max.	
Mixer					
Sensitivity for −95 dBm input		10	15		μV
Noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth)	1)		1	2	μV
Detector					
Tangential sensitivity	2)		−50		dBm

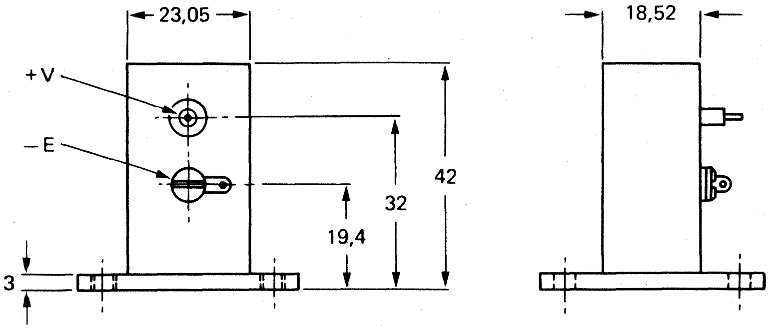
Notes see page 2.

LIMITING VALUES (Absolute max. rating system)

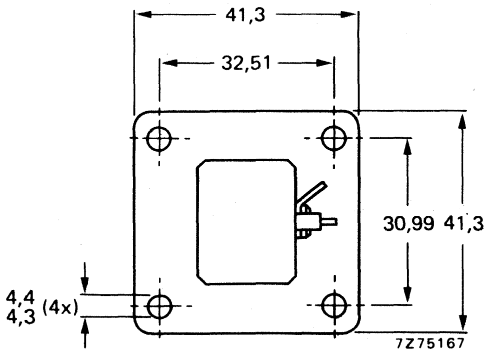
Reverse current	max.	5	mA
Forward current, peak	max.		
Ambient temperature, storage	max.	+100	°C
	min.	−10	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm



Soldering: The use of low melting point solder is recommended.



[1]) When the local oscillator power is derived from a Gunn source with an a.m. noise-to-carrier ratio of 94 dB (e.g. 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.

X-BAND DOPPLER RADAR MODULE

Fixed frequency Gunn oscillator and mixer cavity for operation in the X-band (approx. 3 cm wavelength) intended for use in all forms of Doppler radar systems.

QUICK REFERENCE DATA		
Frequency	10,687	GHz
Output power at supply voltage = 7 V	8	mW
Output voltage for an input power 100 dB down on input power at $\frac{\text{signal + noise}}{\text{noise}}$ = 18 dB	40	μV
Supply voltage, d.c.	7	V

OPERATING CONDITIONS

Supply voltage	2)	7,0 ± 0,1	V
Supply current	3)	140	mA
D.C. mixer bias current (into a.f. terminal with respect to earth)		30 to 35	μA
A.F. load	see page 4	10	kΩ

CHARACTERISTICS at 25 °C

Centre frequency		10,687	GHz
Output voltage for an input power 100 dB down on input power at $\frac{\text{signal + noise}}{\text{noise}}$ = 18 dB	1), 4), and page 5	40 > 20	μV μV
Output power at supply voltage = 7 V		8	mW
Frequency, fixed		> 10,675 < 10,700	GHz GHz
Frequency temperature coefficient		-0,2 < -0,3	MHz/K MHz/K
Frequency pushing		4	MHz/V
Second harmonic		-35	dBm
Diode current	3)	130 < 165	mA mA
Polar diagram		see page 5	

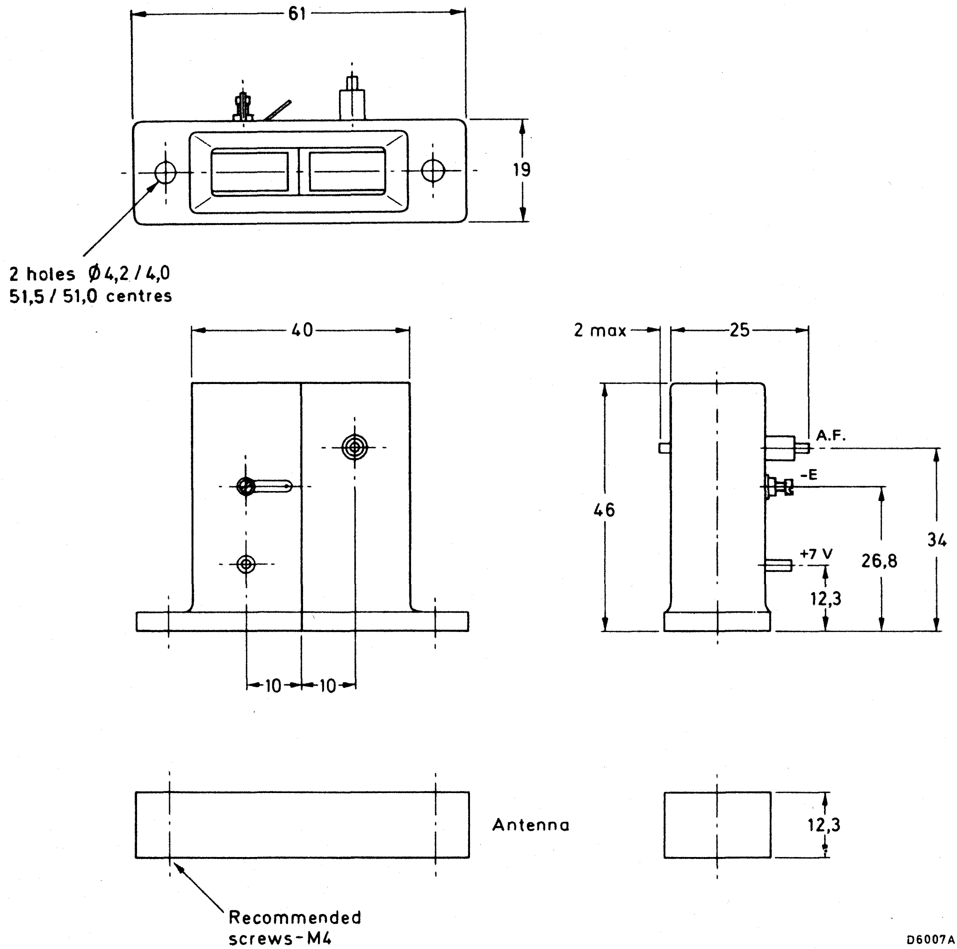
Notes see page 3.

LIMITING VALUES (Absolute max. rating system)

Supply voltage, d.c.	max.	7,5	V
transient, T_{imp} = max. 1 ms	max.	9	V
Temperature, storage	max.	+70	°C
	min.	−10	°C
operating ambient	max.	+40	°C
	min.	0	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm



Soldering: The use of low melting point solder is recommended.

OPERATING NOTES

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

Extended range may be obtained for a reduced $\frac{\text{signal + noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110 dB path loss is obtained from a man target of radar cross-section 1 m^2 at a range of 25 m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15 dB with an output voltage of 16 μV min.
Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to the supplier.

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

3) The Gunn effect device has a voltage/current characteristic as shown on page 4. The power supply should have a low source impedance and be capable of supplying up to 250 mA at approximately 3 V during the switch-on phase.

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

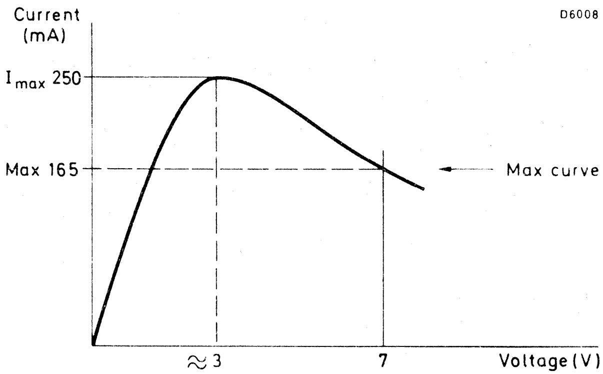
5) The Gunn device will be damaged if the supply is reversed.

6) The mixer diode will be damaged by forward current in excess of 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.

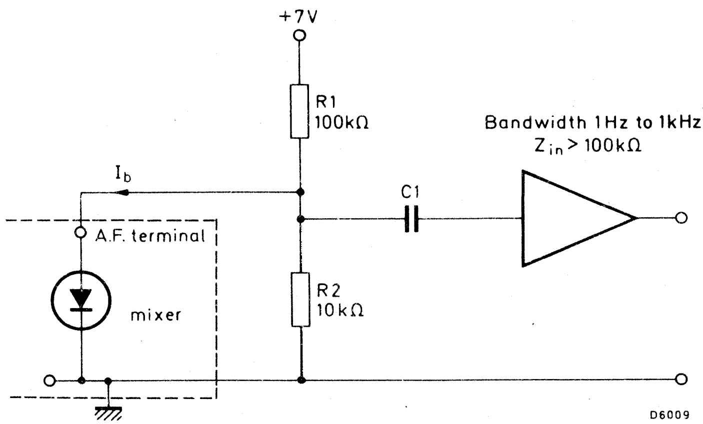
7) The above conditions apply when operated into the antenna supplied with the CL8960 module.

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

9) $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 6 describes the preferred arrangement.



Gunn device characteristic



Circuit used to measure a.f. performance

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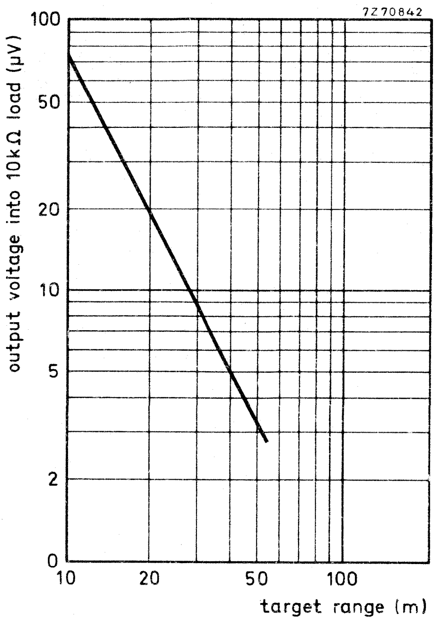
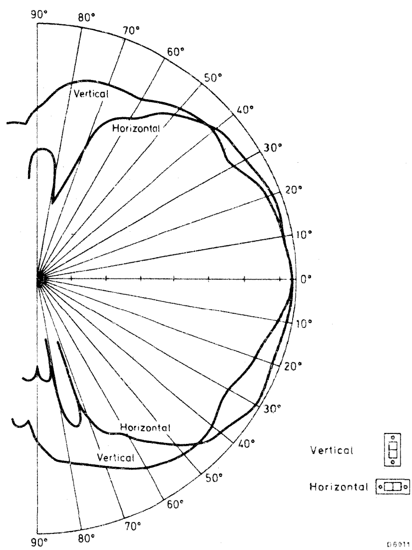
1) The current I_b should be approximately 35 μA with the Gunn device disconnected and approximately 42 μA with the Gunn device operational and the antenna operating into free space.

2) The impedance of the coupling capacitor should be low compared with Z_{in}.



Minimum output for a man target



Polar diagram for antenna supplied

MOUNTING

For optimum signal to noise ratio it is recommended that the module and antenna are mounted, using M4 screws, to a 1, 6 mm thick metal plate with aperture dimensions as shown on page 7.
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 completely contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

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

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic meterial (approximately 0, 25 mm thick) is fixed to the metal plate with adhesive.

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

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

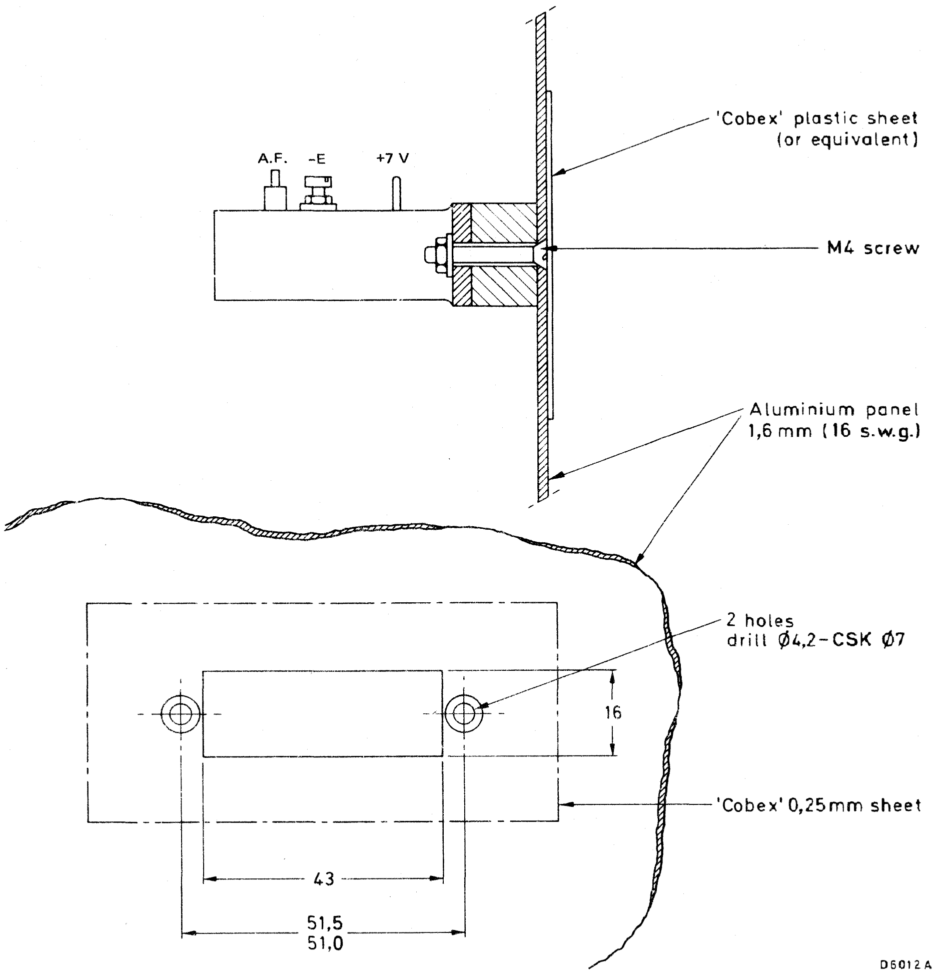
However, further increase in the level of coupled l.o. power, arising from the use of thick or microwave reflective covering materials, will:

a. continue to increase the a.f. power output voltage from the mixer but, at the same time, degrade the signal to noise ratio. Note that the increase in a.f. output voltage will not be the same for each module.
b. present a mismatch to the Gunn oscillator which may impair the switching and running performance and may "pull" the frequency outside the allocated operating frequency band.

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

L.O. coupling (dBm)	Mixer total bias (μA)	Antenna covering material
-	35 (d.c. only)	-
-19	42	No covering
-15	50	1 to 2 cm expanded polythene or polystyrene
-11	61	0, 25 mm Cobex plastic
-6	70	0, 5 mm Cobex plastic

Cobex is a product of British Industrial Plastics.


'Cobex' plastic sheet
(or equivalent)
A.F.
-E
+7 V
M4 screw
Aluminium panel
1,6 mm (16 s.w.g.)
2 holes
drill Ø4,2-CSK Ø7
16
'Cobex' 0,25mm sheet
43
51,5
51,0
D6012 A

X-BAND DOPPLER RADAR MODULE

Fixed frequency Gunn oscillator and mixer cavity for operation in the X-band (approx. 3 cm wavelength) intended for use in all forms of Doppler radar systems.

QUICK REFERENCE DATA		
Frequency	10,525	GHz
Output power at supply voltage = 7 V	8	mW
Output voltage for an input power 100 dB down on output power at $\frac{\text{signal + noise}}{\text{noise}} = 18$ dB	40	μV
Supply voltage, d.c.	7	V

OPERATING CONDITIONS

Supply voltage	2)		7,0 ± 0,1	V
Supply current	3)		140	mA
D.C. mixer bias current (into a.f. terminal with respect to earth)			30 to 50	μA
A.F. load	see page 4		10	kΩ

CHARACTERISTICS at 25 °C

Centre frequency			10,525	GHz
Output voltage for an input power 100 dB down on output power at $\frac{\text{signal + noise}}{\text{noise}} = 18$ dB	1), 4), page 5		40	μV
		>	20	μV
Output power at supply voltage = 7 V			8	mW
Frequency, fixed		>	10,500	GHz
		<	10,550	GHz
Frequency temperature coefficient			−0,2	MHz/K
		<	−0,3	MHz/K
Frequency pushing			4	MHz/V
Second harmonic			−35	dBm
Diode current	3)		130	mA
		<	165	mA
Polar diagram			see page 5	

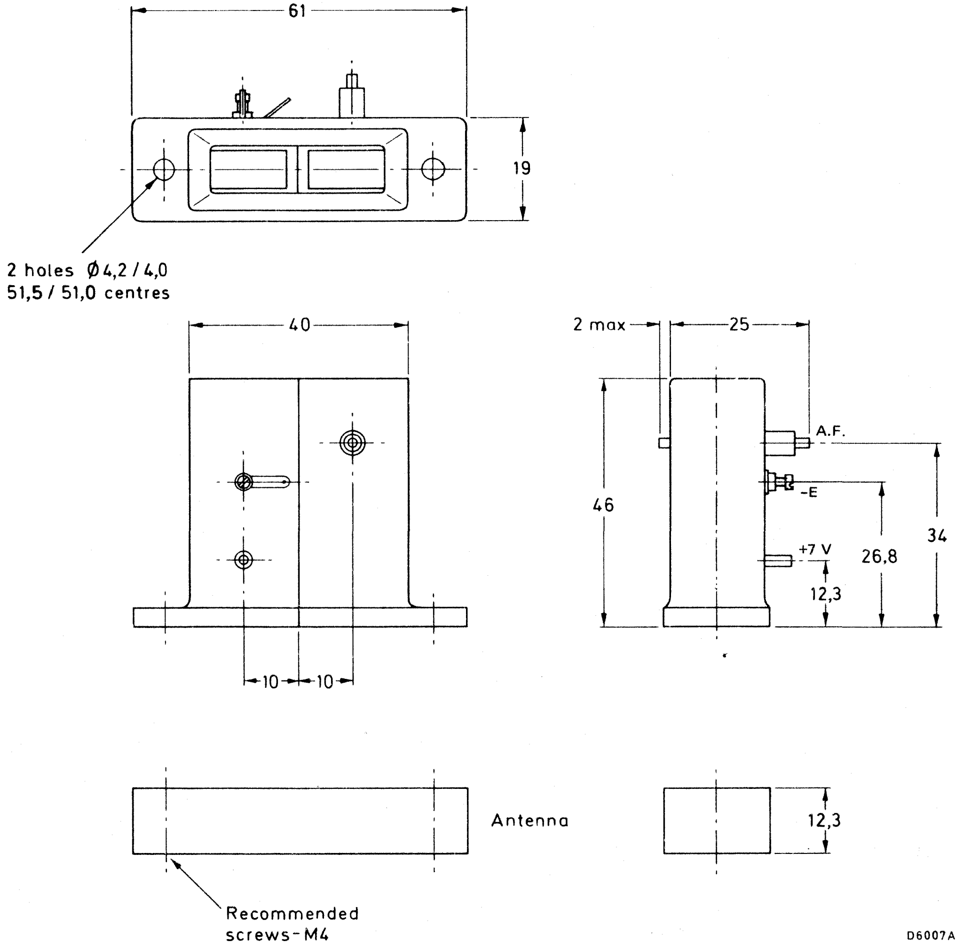
Notes see page 3.
Data based on pre-production devices.

LIMITING VALUES (Absolute max. rating system)

Supply voltage, d.c.	max.	7,5	V
transient, T_{imp} = max. 1 ms	max.	9,0	V
Temperature, storage	min.	−10	°C
	max.	+70	°C
operating	min.	0	°C
	max.	+40	°C

DIMENSIONS AND CONNECTIONS

Dimensions in mm



Soldering: The use of low melting point solder is recommended.

OPERATING NOTES

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

Extended range may be obtained for a reduced $\frac{\text{signal + noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110 dB path loss is obtained from a man target of radar cross-section 1 m^2 at a range of 25 m and the $\frac{\text{signal + noise}}{\text{noise}}$ is reduced to 15 dB with an output voltage of 16 μV min.

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

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

3) The Gunn effect device has a voltage/current characteristic as shown on page 4. The power supply should have a low source impedance and be capable of supplying up to 250 mA at approximately 3 V during the switch-on phase.

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

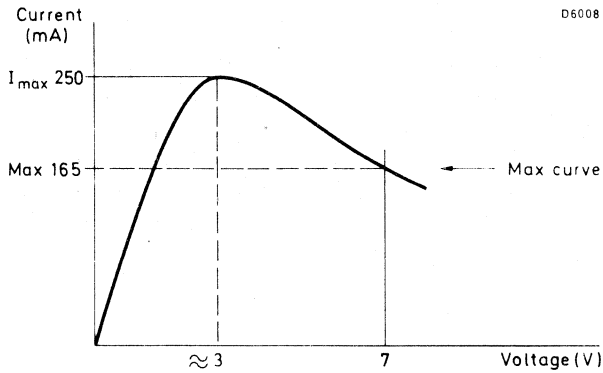
5) The Gunn device will be damaged if the supply is reversed.

6) The mixer diode will be damaged by forward current in excess of 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.

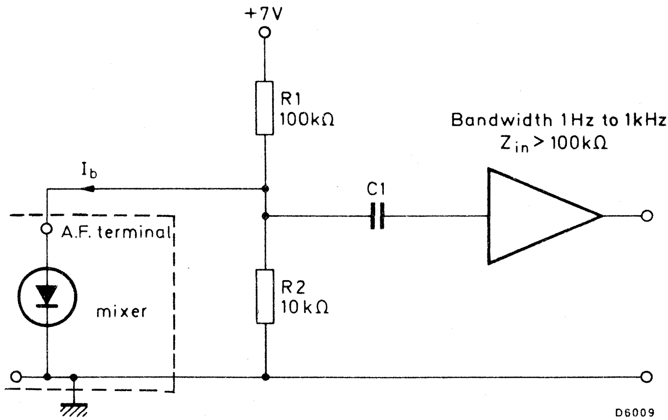
7) The above conditions apply when operated into the antenna supplied with the CL8963 module.

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

9) $\frac{\text{Signal + noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 6 describes the preferred arrangement.



Gunn device characteristic



Circuit used to measure a.f. performance

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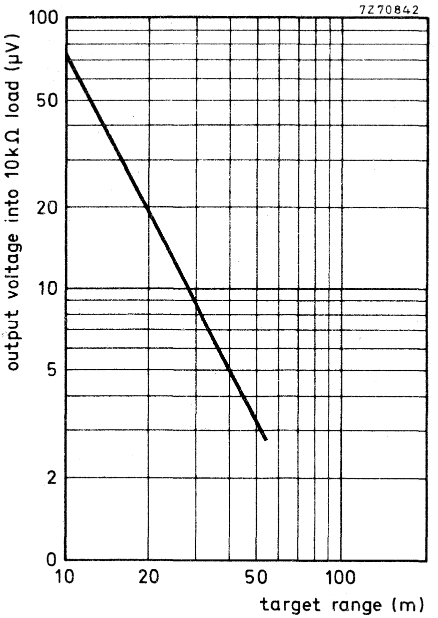
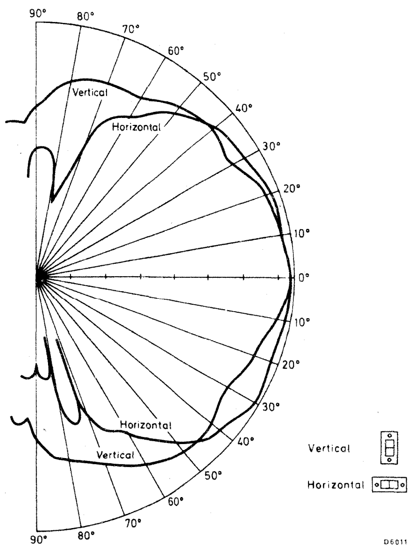
1) The current I_b should be approximately 35 μA with the Gunn device disconnected and approximately 42 μA with the Gunn device operational and the antenna operating into free space.

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



Minimum output for a man target



Polar diagram for antenna supplied

MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1,6 mm thick metal plate with aperture dimensions as shown on page 7.

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 and mounting plate.

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

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0,25 mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 7.

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

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

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

a. continue to increase the a.f. output voltage from the mixer but, at the same time, degrade the signal to noise ratio. Note that the increase in a.f. output voltage will not be the same for each module.

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

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

L.O. coupling (dBm)	Mixer total bias (μA)	Antenna covering material
-	35 (d.c. only)	-
−19	42	No covering
−15	50	1 to 2 cm expanded polythene or polystyrene
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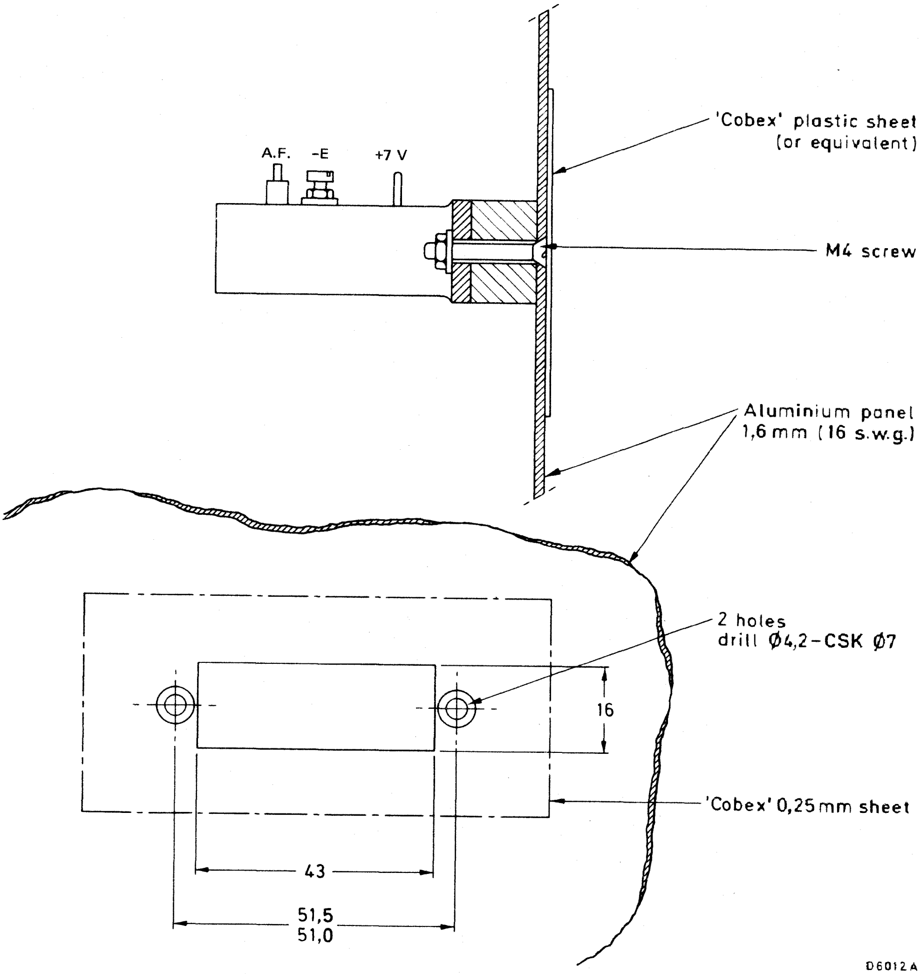
−6	70	0,5 mm Cobex plastic

Cobex is a product of British Industrial Plastics.


'Cobex' plastic sheet
(or equivalent)
A.F.
-E
+7 V
M4 screw
Aluminium panel
1,6 mm (16 s.w.g.)
2 holes
drill Ø4,2-CSK Ø7
16
'Cobex' 0,25 mm sheet
43
51,5
51,0
D6012 A

MICROWAVE ANTENNA

The MAC0102 is a general purpose X-band antenna with SMA socket, for use with 50 Ω coaxial cables provided with a 50 Ω plug. The MAC0103 is fitted with an SMA plug for use with 50 Ω socket.

CHARACTERISTICS

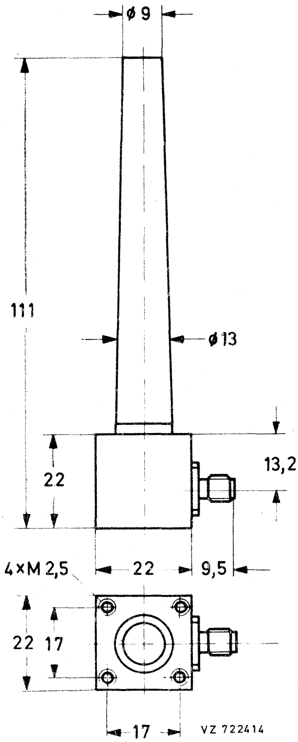
Frequency range	9 to 10 GHz
Gain at 9,35 GHz	12 to 13 dB
Beam angle, both planes, 3 dB at 9,35 GHz	30 deg
VSWR	max. 1,2

MECHANICAL DATA

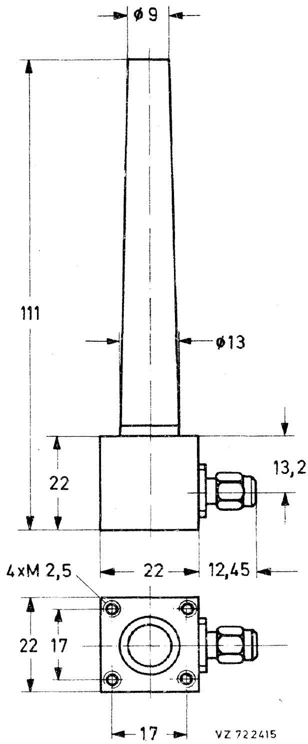
Dimensions in mm

Conical body made in polypropylene

Mass 35 g nominal



MAC0102.



MAC0103.

X-BAND DOPPLER RADAR MODULE

The MDX0520 is a compact oscillator/detector type Doppler radar module comprising a cavity stabilized Gunn-oscillator as transmitter, a diode mixer, and a planar transmitter and receiver antenna; it is intended for use in motion detectors. (Application information on request.)
The oscillator, the diode mixer and antenna are one unit.

QUICK REFERENCE DATA

Frequency	9,350	GHz
Detection range (human target)	≈ 15	m
Antenna beam angle		
horizontal	≈ 50	deg
vertical	≈ 30	deg
Supply voltage, d.c.	10,5 to 14,0	V
Dimensions	70 dia x 25	mm
Mass	≈ 80	g

CHARACTERISTICS AND LIMITING VALUES

Detection range (human target); see page 3	≈ 15	m*
Antenna beam angle (−3 dB)		
horizontal	≈ 50	deg
vertical	≈ 30	deg
Antenna gain	≈ 9	dB
Operating frequency	9,350	GHz**
Temperature coefficient of frequency	−0,5	MHz/K
Radiated power	≈ 10	mW
Second harmonic radiated power	$< 10^{-2}$	mW

* For detection of a human target (target gain 40 dB, or radar cross-section 1 m^2). Noise voltage (5 to 100 Hz) $\leqslant 3\ \mu V$. The range depends on the electrical characteristics of the low frequency amplifier and the signal processing system connected to the unit.

** Other frequencies in the X-band on request.

CHARACTERISTICS AND LIMITING VALUES (continued)

Power supply requirements

Caution: Negative to case — reversal of polarity will destroy module

voltage d.c., operating	max.	14,0	V
	min.	10,5	V
ripple voltage (peak-to-peak)		1	V*
absolute maximum	max.	15	V
current	≈	150	mA
Temperature	max.	+70	°C
operating	min.	−30	°C
	max.	+80	°C
storage	min.	−30	°C

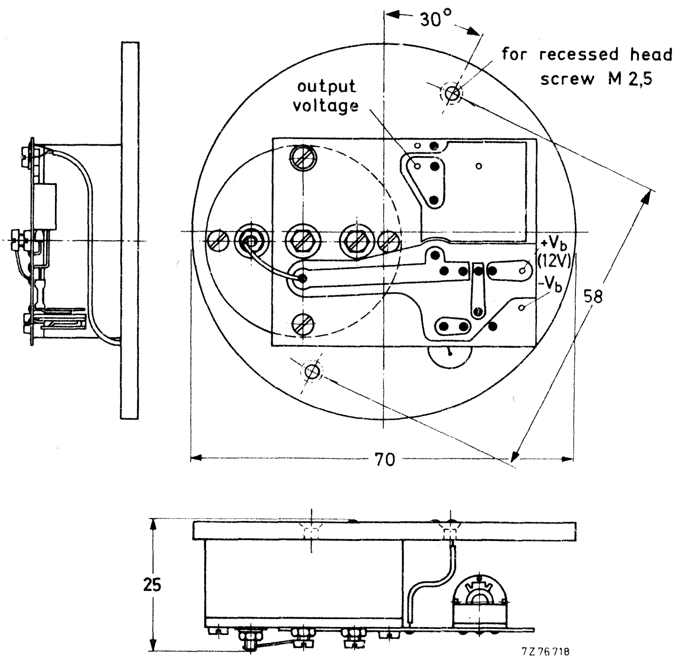
CONNECTIONS

Soldering terminals

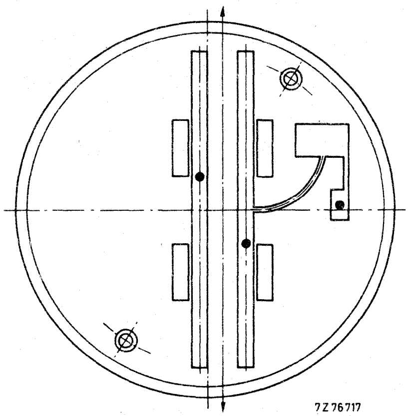
The signal processing circuitry (or, at least, the signal amplifier) shall be connected directly to the module.

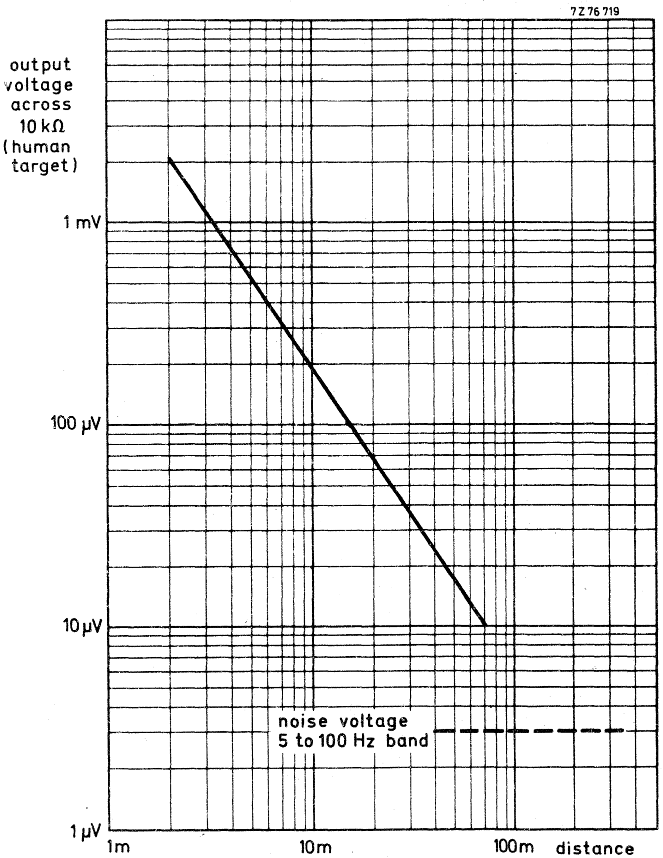
MECHANICAL DATA

Dimensions in mm

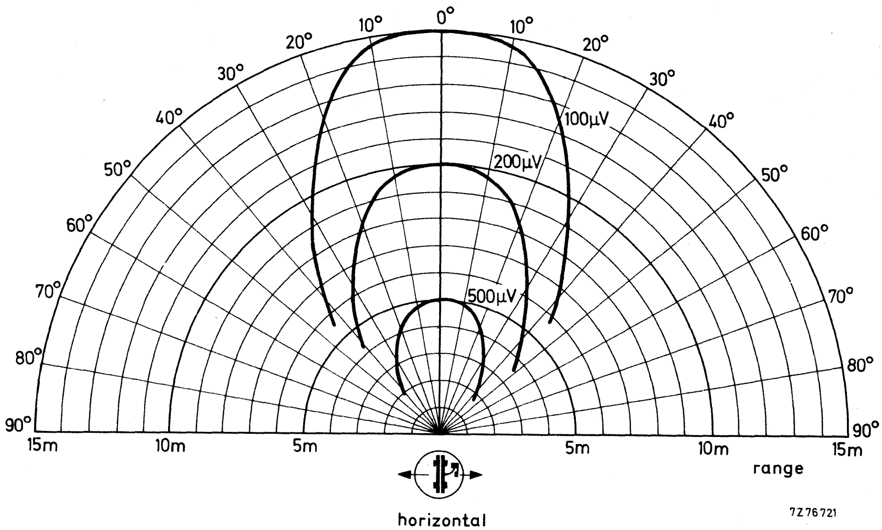


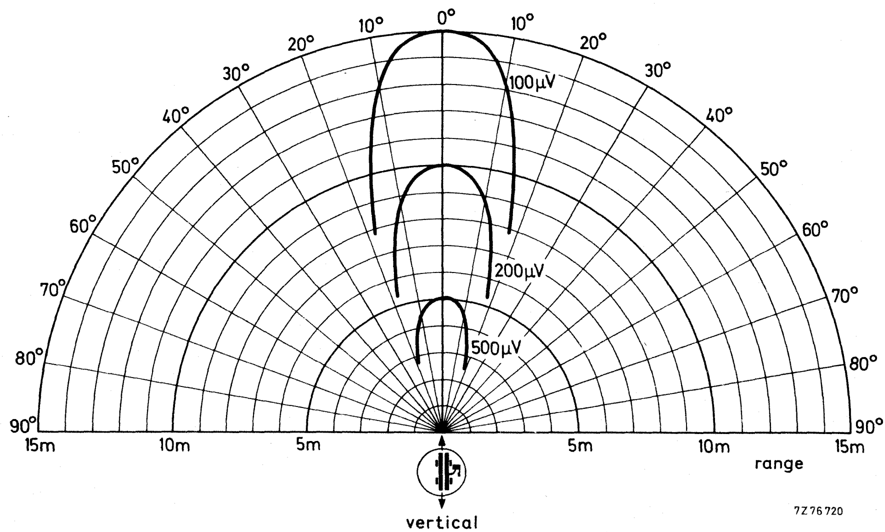
* The instantaneous value of the supply voltage shall not be below 10,5 V.


vertical mounting axis
7Z76717


7Z76719
output voltage across 10 kΩ (human target)
1 mV
100 µV
10 µV
1 µV
noise voltage
5 to 100 Hz band
1m
10m
100m
distance

Output voltage across 10 kΩ (human target)





MICROWAVE DOPPLER RADAR MODULE

The MDX1021 is an oscillator/detector type Doppler radar module operating in the X-band (approximately 3 cm wavelength). It has been designed for slow-motion detection and its main application is in intruder alarm systems. The module features a built-in self-testing circuit that detects certain fault conditions such as improper functioning or attempts to sabotage the module.

QUICK REFERENCE DATA		
Detection range, adjustable (human target)	≥ 1 to ≥ 12	m
Velocity range	0,25 to 3,5	km/h
Antenna beam angle (horizontal and vertical)	≈ 150	deg
Supply voltage, d.c.	12	V
Overall dimensions	max. 195 x 180 x 162	mm
Mass	≈ 2	kg

DESCRIPTION

The MDX1021 contains a special waveguide cavity Gunn oscillator and a Schottky diode mixer cavity (twin cavity module). Both use the same antenna, which forms an integral part of the cavities. Microwave energy is transmitted and received via this antenna. When the transmitted energy is reflected by a moving object the frequency will be changed due to the Doppler effect. In the receiving part of the module only those signals are amplified and processed that differ in frequency from that of the radiated frequency.
When Doppler signals of sufficient strength (e.g. from intruders) are detected, a positive security relay is operated - normally closed relay contacts are opened - and an alarm can be initiated via these contacts.
A separate built-in self-testing circuit continuously checks the proper functioning of both transmitter and receiver. When the module is at fault this will result in the operation of a relay with normally closed contacts that can be incorporated in a monitoring circuit. Furthermore, when an attempt is made to sabotage the module by placing a metal screen in front of the antenna to make the MDX1021 "blind" the same relay is operated to indicate that the module is not functioning properly.

In the module and in the wall bracket three normally closed microswitches protect the module against tampering.
The only adjustment to be made after mounting the module is the setting of the range by means of a variable potentiometer, situated behind a microswitch-protected panel.

To avoid unnecessary alarms the MDX1021 has three circuits:

-1 A low-pass filter to ensure that only slow movements are detected, and interference signals with frequencies of 100 Hz and higher are suppressed.

-2 An A.G.C.: Automatic Gain Control.
A circuit in the amplifier section ensures that repetitive interference signals will be inversely and proportionally amplified so that only those Doppler signals will lead to an alarm whose nature and level differ from repetitive interference signals. As soon as the interference signals have disappeared the gain of the amplifier is progressively restored to the originally set nominal value.

-3 A signal analyser.
As soon as Doppler signals are received they are stored in a memory. After approximately one second they are compared with the output signals of the amplifier. If these are still present the alarm circuit is triggered.

CHARACTERISTICS AND LIMITING VALUES

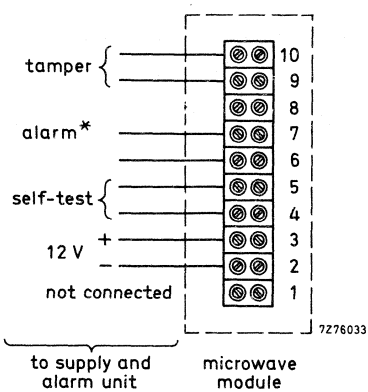
Detection range, adjustable (human target)		≥ 1 to ≥ 12	m
Antenna beam angle (horizontal and vertical)	≈	150	deg
Operating frequency		10, 670	GHz 1)
Radiated power (Gunn diode)		15	mW
Second harmonic radiation	>	−20	dBm
Amplifier gain	≤	50 000	
Amplifier pass-band (−6 dB points)		5 to 70	Hz
Power supply requirements			
Voltage, d.c.	nom.	12	V
	min.	11	V
	max.	15	V
Ripple voltage (peak-to-peak)	max.	50	mV
Current	nom.	180	mA
	≤	250	mA

1) Modules with operating frequencies of 9, 350 GHz or 9, 900 GHz can be supplied.

Output terminals:

Alarm	relay [1]		max. 200 mA
Self-test circuit	relay		max. 200 V
Tamper	microswitches		max. 10 VA
Temperature range			−10 to +55 °C
Overall dimensions			max. 195 x 180 x 162 mm
Mass			≈ 2 kg

CONNECTIONS

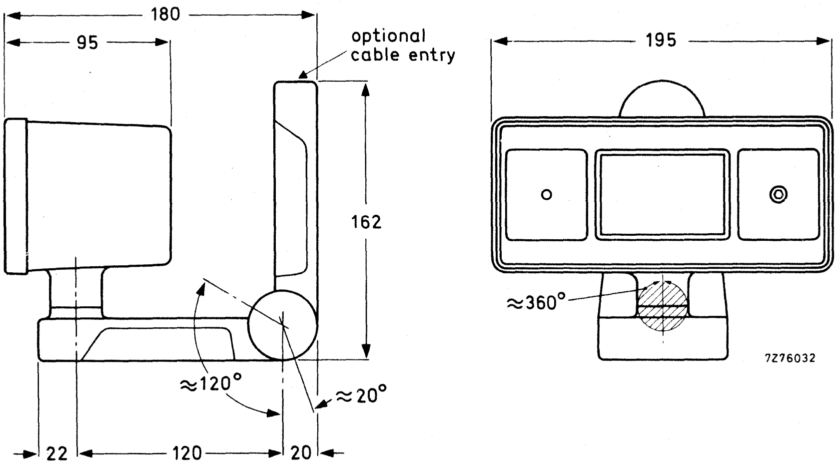


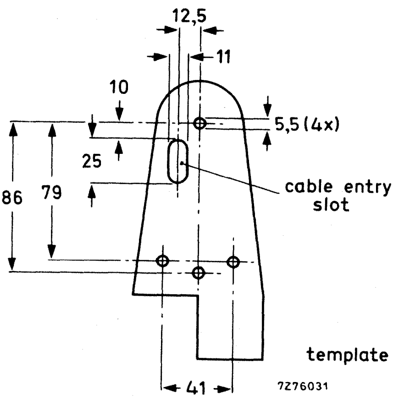
* Terminals 6 and 7 "normally closed" with power on.

[1]) To protect the relay contacts:
a) for inductive d.c. load (relay) connect a diode (BYX36/400 or equivalent) across the load coil (cathode connected to +supply):
b) for a.c. load connect a 0,1 μF (400 V) capacitor across the load.

MECHANICAL DATA

Dimensions in mm





MICROWAVE DOPPLER RADAR MODULE

The MDX1033 is an oscillator/detector type Doppler radar module operating in the X-band (approximately 3 cm wavelength). It has been designed for slow-motion detection (0,25 to 4 km/h) and its main application is in automatic door openers.
The module is built in a sturdy, drip-proof housing, with a mounting bracket which can be orientated.

QUICK REFERENCE DATA

Detection range, adjustable (human target)	⩽ 1	to	⩾ 12	m
Velocity range	0,25	to	4	km/h
Antenna beam angle (horizontal and vertical) at maximum gain			≈ 150	deg
Supply voltage, d.c.			12	V
Overall dimensions			max 195 x 180 x 162	mm
Mass			≈ 2	kg

DESCRIPTION

The MDX1033 contains a special twin cavity with separate Gunn oscillator and Schottky diode mixer cavity, and an integral common antenna. When the transmitted microwave energy is reflected by a moving object the frequency will be changed due to the Doppler effect. In the mixer this frequency shift is detected. The "difference frequency signal" is amplified and filtered to avoid parasitic operation of the positive security output relay (in case of failure the contacts are closed).
The only adjustment to be made is the **setting of the range** by means of a potentiometer situated behind a small front panel. Operation is monitored by a small LED indicator ("on" during standby).

The electronic subassembly is separately available. Please ask your supplier.

CHARACTERISTICS AND LIMITING VALUES

Detection range, adjustable (human target)		⩽ 1 to ⩾ 12	m
Antenna beam angle (horizontal and vertical) at maximum gain	≈	150	deg
Operating frequency		10 670	MHz †
Radiated power (Gunn diode)		15	mW
Second harmonic radiation	<	−20	dBm
Amplifier pass band		5 to 80	Hz
Power supply requirements			
Voltage, d.c.	nom	12	V
	min	11	V
	max	15	V
Ripple voltage, peak to peak	max	30	mV
Current	nom	180	mA
	max	220	mA
Output relay	S.P.D.T. (form C)		
Switched power	max	550	VA
Switched voltage	max		V
Switched current	max		mA
Overall dimensions	max	195 x 180 x 162	mm
Mass	≈	2	kg

CONNECTIONS

terminal	colour	connection	function
10	–	–	
9	–	–	
8	yellow	normally closed	output relay
7	blue	normally open	output relay
6	green	common	output relay
5	white	–	
4	grey	–	
3	red	+12 V	supply
2	black	mass	supply
1	–	–	

† Other frequencies such as 9350 MHz and 9900 MHz can be supplied.

INSTALLATION AND POSITIONING

All connections are hidden inside the mounting bracket and accessible after taking off its front cover.

Direction setting

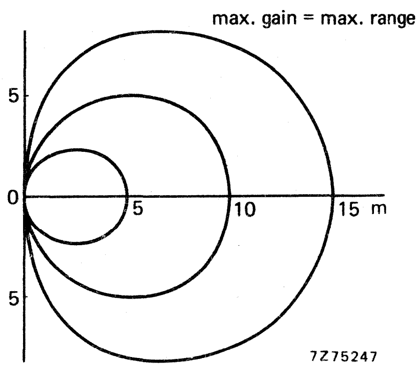
a) **Elevation** (in steps of 10^o)
The elevation is set by means of the hinge in the mounting bracket. The hinge can be unlocked and locked in position with the screw in it (use no.5 Allen key).

b) **Azimuth** (in steps of 10^o)
The housing may be turned around the vertical axis. The locking screw is accessible after removing the bottom plate of the mounting bracket.

Position the module so that the lobe of the radiation pattern (see below) skims the door to be opened.

Range setting (see radiation pattern below)

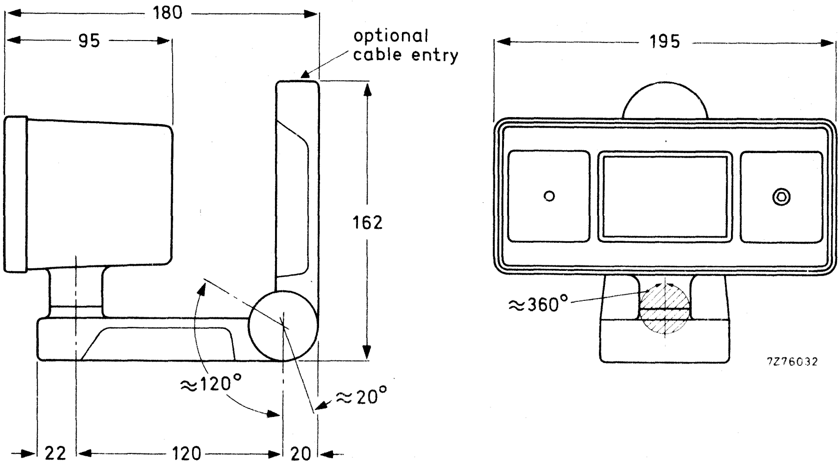
The range (= gain) setting potentiometer is accessible after removing the small front panel of the module.
After switching on the power, set the range (gain) at minimum by turning the potentiometer clockwise and allow a few minutes for the detector to become active: LED indicator lights up (in absence of moving bodies at close range). Any detection of movement within the set range activates the output relay (hold position maintained for about 1 s) and de-activates the LED indicator. If necessary increase the range (gain) by turning the potentiometer anti-clockwise.
Do not set the gain higher than strictly necessary to avoid unwanted activation: the range is a function of the cross-section of the moving body. Microwave radiation can "see" through thin walls as well as being reflected by thicker walls or metal surfaces.
Note that the beam width is reduced with lower gain.
The complete electronic subassembly can be removed from the housing for servicing without affecting the direction setting. Unscrew the 4 corner screws in the front panel, take out the subassembly and disconnect the internal connector.

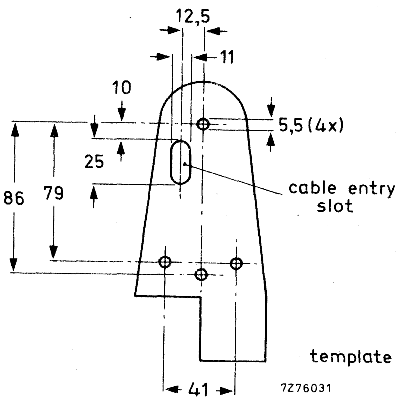


Radiation pattern

MECHANICAL DATA

Dimensions in mm





BALANCED MIXER

Balanced mixer in microstrip technique with integrated Schottky-barrier diodes intended for transformation of signals from the X-band to intermediate frequencies up to 2 GHz, e.g. TV converter band VI to band IV/V.

OPERATING CONDITIONS AND CHARACTERISTICS (at 25 °C)

Signal frequency range		11,4 to	12,2	GHz*
Oscillator frequency		11,33 to	11,41	GHz
Local oscillator power			6	mW
Noise figure, measured with broad-band amplifier with a noise contribution of 1,5 dB; i.f. frequency 70 MHz			8	dB
Conversion loss			4	dB
	min.	typ.	max.	
L.O. isolation	15	20		dB
VSWR (with respect to 50 Ω)				
at the signal input terminal		2	3	
at the oscillator input terminal		2	3	

LIMITING VALUES (Absolute maximum rating system)

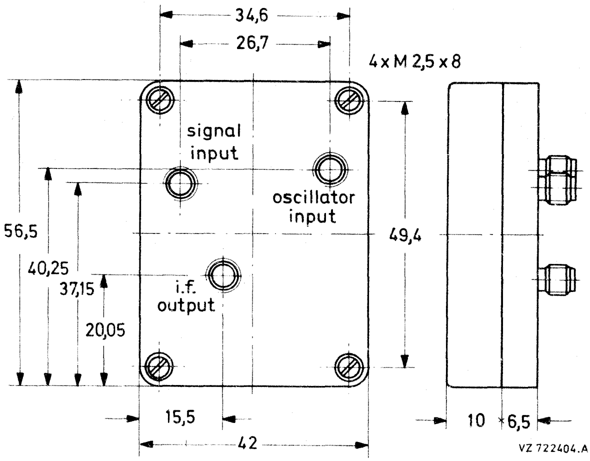
Input power at signal terminal	max.	100	mW
Input power at oscillator terminal	max.	100	mW
Ambient temperature	max.	75	°C

* Other frequency ranges within the X-band on request.

MECHANICAL DATA

Dimensions in mm

Terminals SMA 50 Ω



The SHF inputs may be interchanged without damaging the mixer and without significant changes in performance. The values given in these data are based on the connections indicated in the drawing.

BALANCED MIXER

Balanced mixer in microstrip technique with integrated Schottky-barrier diodes, intended for transformation of signals from the X-band to intermediate frequencies of 10 to 70 MHz.

OPERATING CONDITIONS AND CHARACTERISTICS (at 25 °C)

Signal frequency range			8,5 to 9,6	GHz*
Oscillator frequency			8,4 to 9,7	GHz
Intermediate frequency			10 to 70	MHz
Local oscillator power			10	mW
	min.	typ.	max.	
Noise figure, measured with broad-band amplifier with a noise contribution of 1,5 dB; i.f. frequency 30 and 70 MHz		8	9	dB
Conversion loss			6,5	dB
L.O. isolation	15			dB
VSWR (with respect to 50 Ω)				
at the signal input terminal		max.	3	
at the oscillator input terminal		max.	3	

LIMITING VALUES (Absolute maximum rating system)

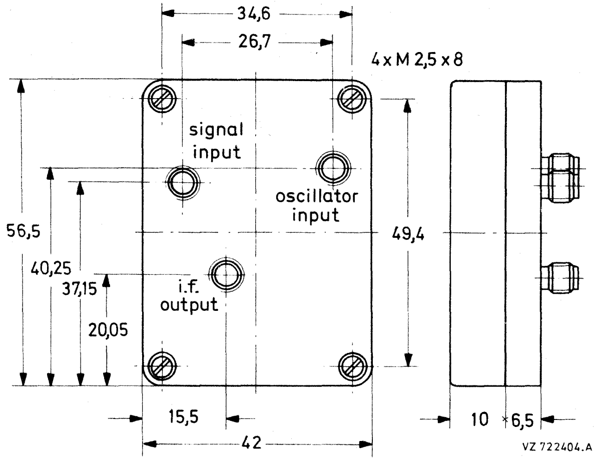
Input power at signal terminal	max.	100	mW
Input power at oscillator terminal	max.	100	mW
Ambient temperature	max.	75	°C

* Other frequency ranges within the X-band on request.

MECHANICAL DATA

Terminals SMA 50 Ω

Dimensions in mm



The SHF inputs may be interchanged without damaging the mixer and without significant changes in performance. The values given in these data are based on the connections indicated in the drawing.

BROAD-BAND BALANCED MIXER

Broad-band balanced mixer in microstrip and microslot technique with integrated Schottky-barrier diodes intended for transformation of signals from the X-band to the intermediate frequencies from 10 to 70 MHz.

OPERATING CONDITIONS AND CHARACTERISTICS (at 25 °C)

Signal frequency range	8,13 to	12,47	GHz
Oscillator frequency	8,2 to	12,4	GHz
Intermediate frequency	10 to	70	MHz
Local oscillator power		8	mW

	typ.	max.	
Noise figure*	8,5	10	dB
VSWR (with respect to 50 Ω)			
at the signal input terminal	2	3	
at the oscillator input terminal	2	3	

LIMITING VALUES (Absolute maximum rating system)

Input power signal terminal	max.	100	mW
Input power oscillator terminal	max.	100	mW
Ambient temperature	max.	75	°C

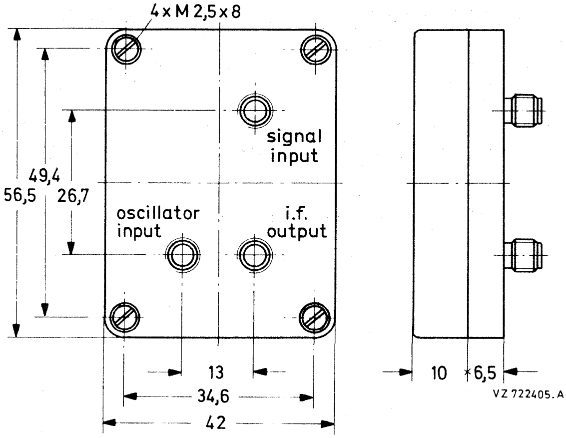
MECHANICAL DATA

Terminals: SMA 50 Ω female

* Measured with an i.f. amplifier with a noise contribution of 1,8 dB.

MECHANICAL DATA (continued)

Dimensions in mm



The SHF inputs may be interchanged without damaging the mixer and without significant changes in performance. The values given in these data are based on the connections indicated in the drawing.

Circulators and isolators H

Contents

ISOLATORS AND CIRCULATORS

INTRODUCTION

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

Isolators

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

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

Circulators

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

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

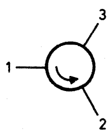


Fig. 1 Symbol for 3-port circulator.

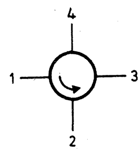


Fig. 2 Symbol for 4-port circulator.

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

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

APPLICATIONS

Isolators

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

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

Circulators

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

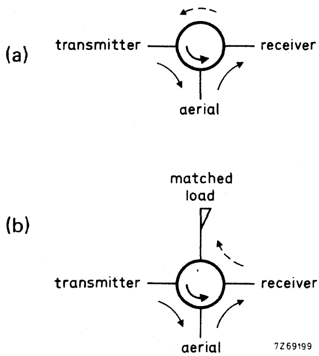


Fig. 3 Duplexing one receiver and one transmitter with (a) a 3-port circulator and (b) a 4-port.

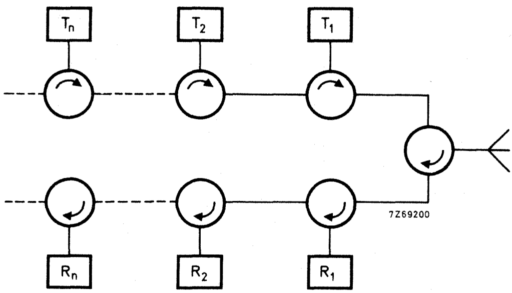


Fig. 4 Duplexing of a number of transmitters (T) and receivers (R).

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

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

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

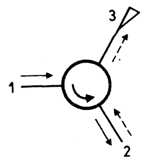


Fig. 5 A 3-port circulator used as an isolator.

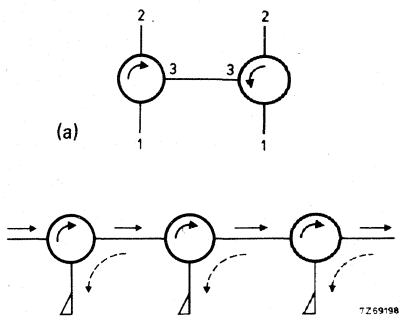


Fig. 6 Cascaded circulators (a) in H-configuration, (b) π-configuration.

CONSTRUCTION

Waveguide isolators

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

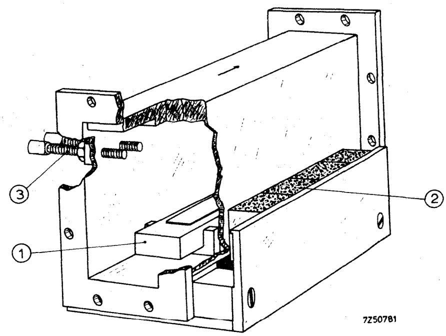


Fig. 7 Field displacement isolator.

Waveguide circulators

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

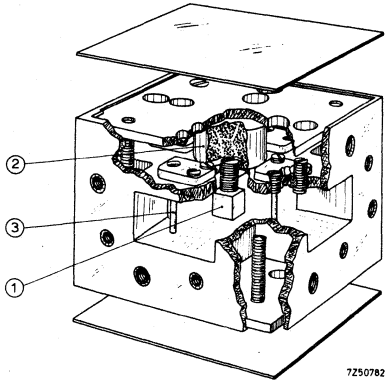


Fig. 8 Construction of a junction type waveguide circulator.

Coaxial circulators

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

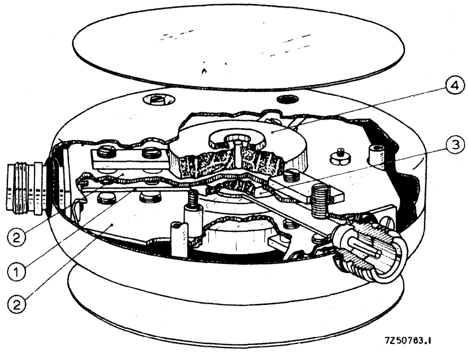


Fig. 9 Construction of a junction type coaxial circulator.

TERMS AND DEFINITIONS

Frequency range

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

Isolation

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

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

Insertion loss

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

Voltage standing wave ratio

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

Maximum power

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

In an *isolator,* the maximum power is the largest power that may be passed through it in the forward direction into a load with a v.s.w.r. of 2.

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

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

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

Peak power values are valid for one signal passage only.

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

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

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

Temperature range

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

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

CAUTIONARY NOTES

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

QUALITY GUARANTEE

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

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

STANDARD TEST SPECIFICATIONS

Initial measurements

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

Tropical test

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

Vibration test

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

Thermal shock test

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

Mechanical shock test

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

Drop test

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

R.F. power test

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

Final measurements

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

Dimensions and visual appearance

These have been checked in accordance with the published data.

Note

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

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

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

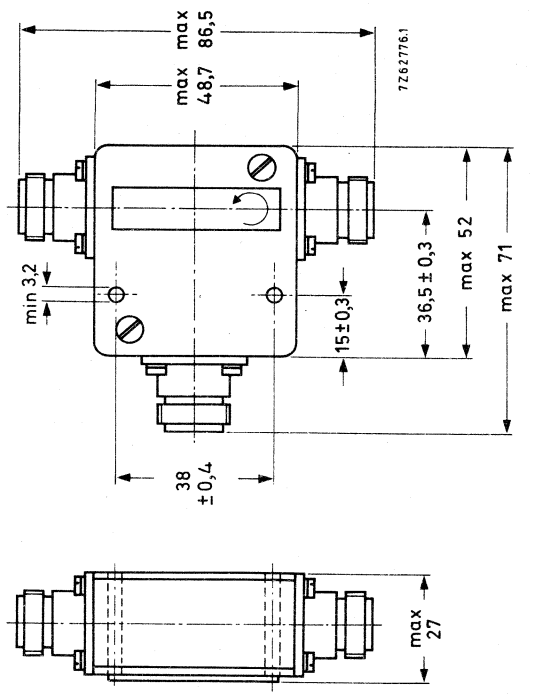
Notes

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

Isolator versions of these circulators are available.

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

Dimensions in mm



2722 162 03411
01551
01561
03261

OUTLINES

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

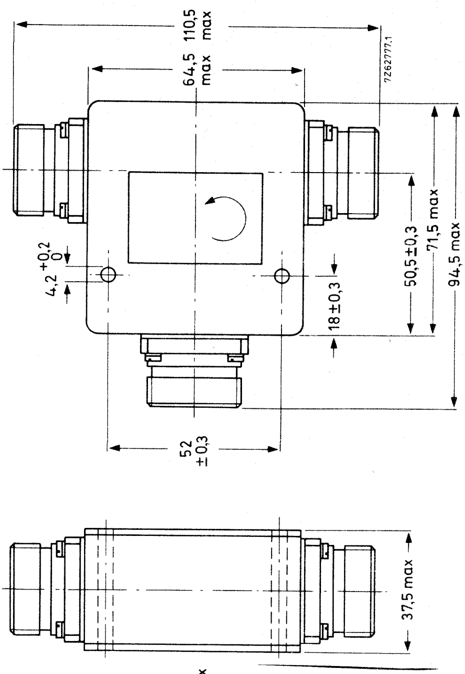
frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
MHz	guaran-teed	typ	guaran-teed	typ	guaran-teed	typ	c.w.	peak sync	°C	*	g	
400–470	> 20	25	< 0,35	0,20	< 1,25	1,15	300	500	–10 to + 60	N-female	1200	2722 162 01572
400–470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

Note

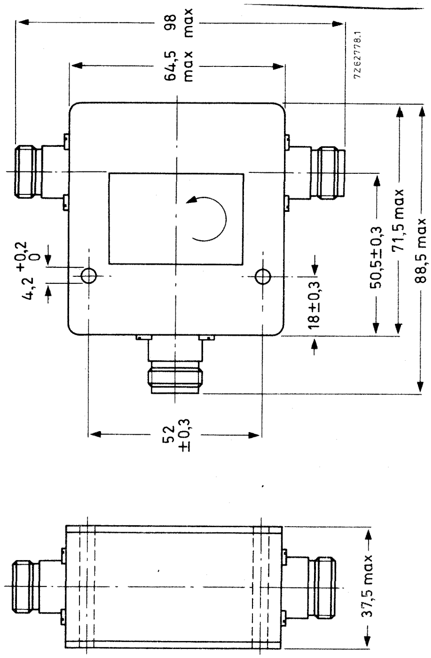
Isolator versions of these circulators are available.

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

Dimensions in mm



2722 162 01622
01632
01642
01662



2722 162 01572
01582
01592
01612

OUTLINES

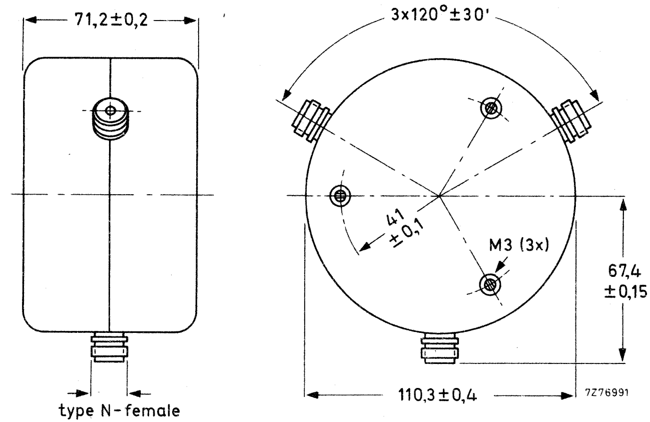
COAXIAL CIRCULATOR SERIES, 500 W/1 kW, V.H.F., TV

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

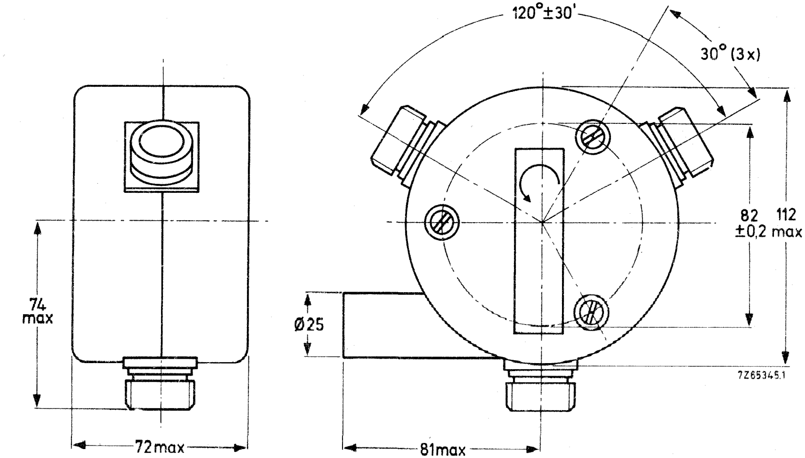
* With air cooling (filtered) at a pressure of 25 mm water column and maximum 40 °C intake temperature, the permissible connector temperature is + 55 °C.

OUTLINES

Dimensions in mm



2722 162 01851
01861
01871
03171



2722 162 01881
01891
01901
03181

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

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

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

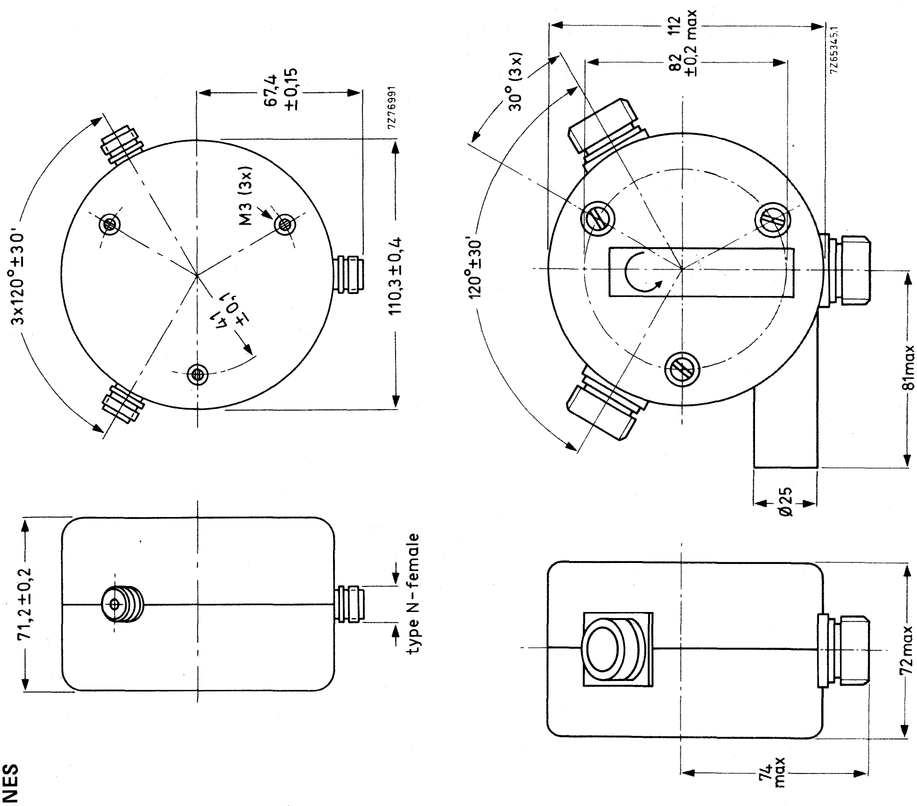
** Also available with connector HF 7/16 (to DIN 47223), EIA 7/8, and EIA 1 5/8.

OUTLINES

Dimensions in mm

2722 162 01121
01131
01141

2722 162 01261
01271
01281
01331



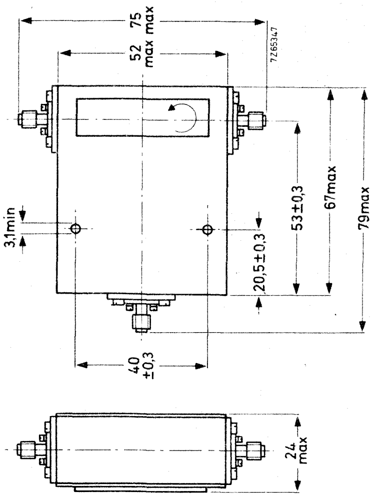
COAXIAL CIRCULATOR/ISOLATOR SERIES, OCTAVE BANDWIDTH

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

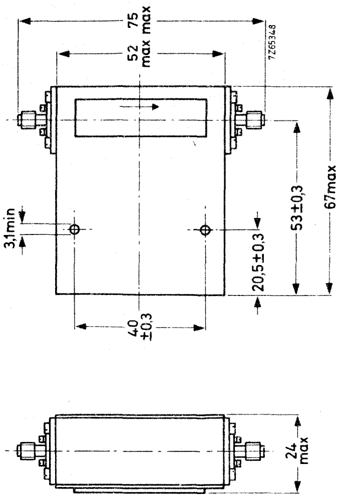
Note

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

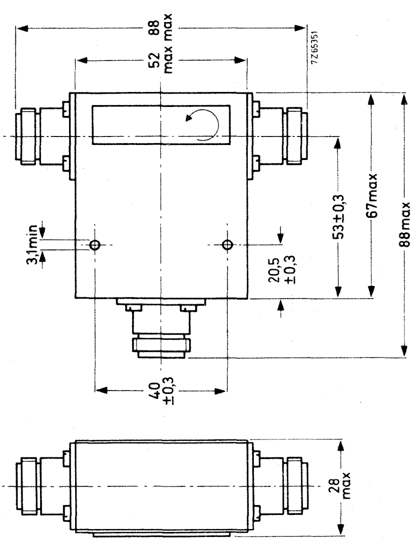
Dimensions in mm



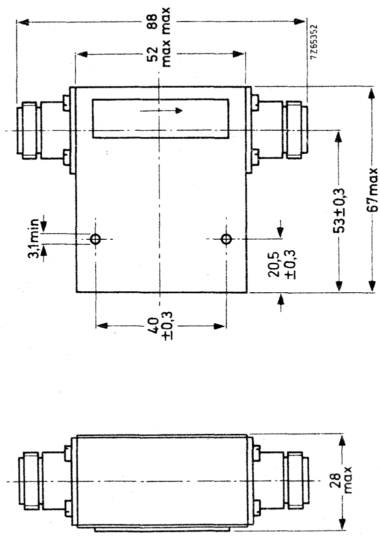
2722 162 01501



2722 162 02101

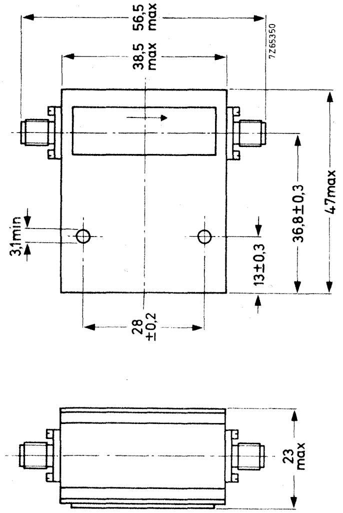


2722 162 01491

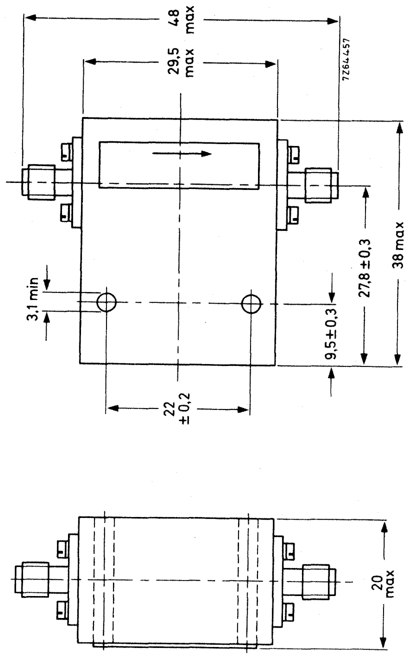


2722 162 02091

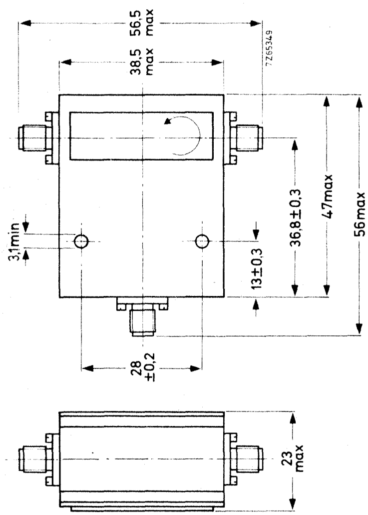
OUTLINES



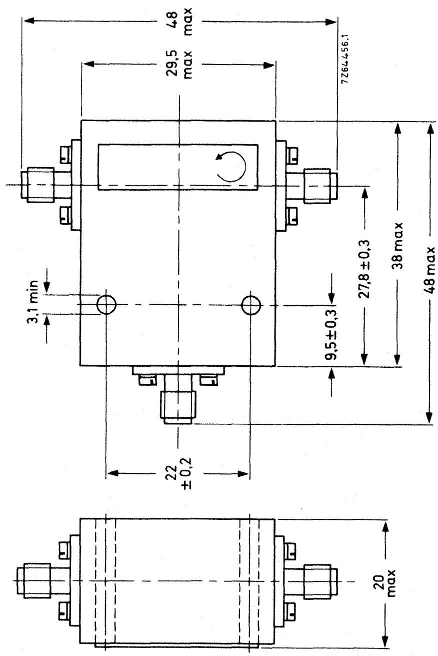
2722 162 02071



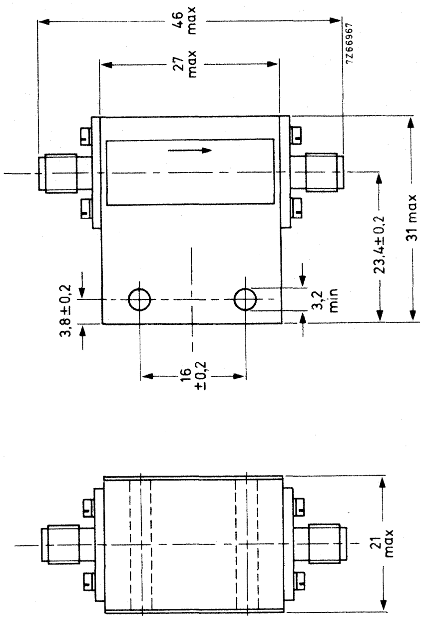
2722 162 02111



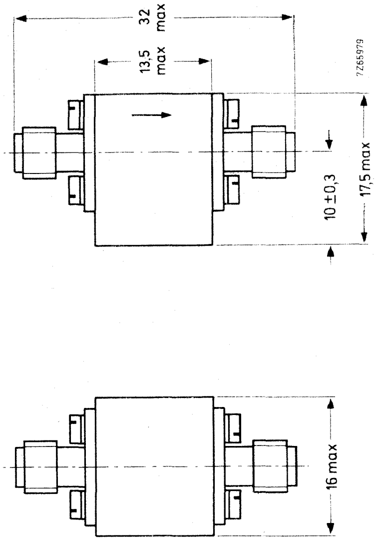
2722 162 01511



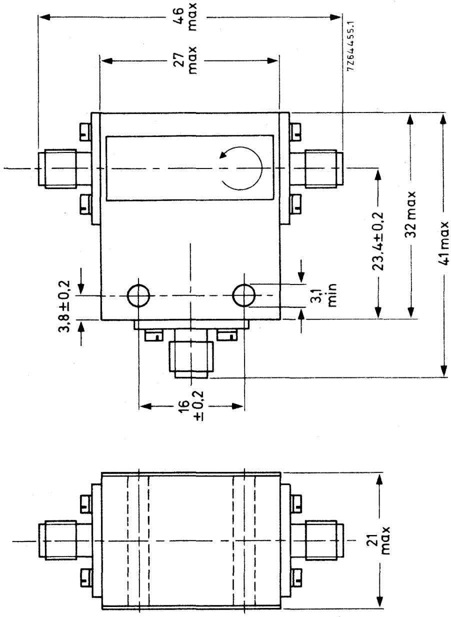
2722 162 01811



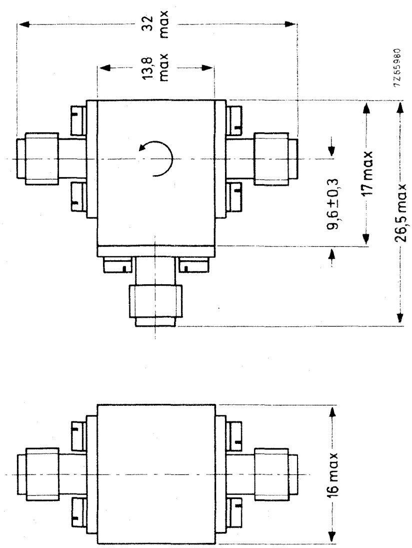
2722 162 02121



2722 162 02221



2722 162 01821



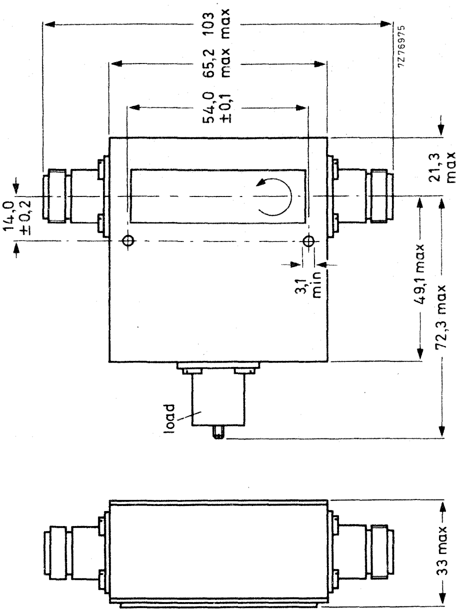
2722 162 03301

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

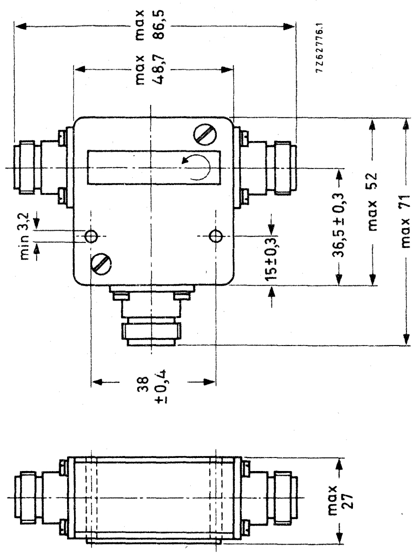
frequency range	isolation dB		insertion loss dB		v.s.w.r.		max. power W		temperature range	connector type	mass approx	catalogue number
GHz	guaranteed	typ	guaranteed	typ	guaranteed	typ	forward	reverse	°C		g	
0,225–0,27	> 18	21	< 0,35	0,2	< 1,35	1,25	150	–	0 to + 70	N-female	725	2722 162 01931
0,27 –0,33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

OUTLINES

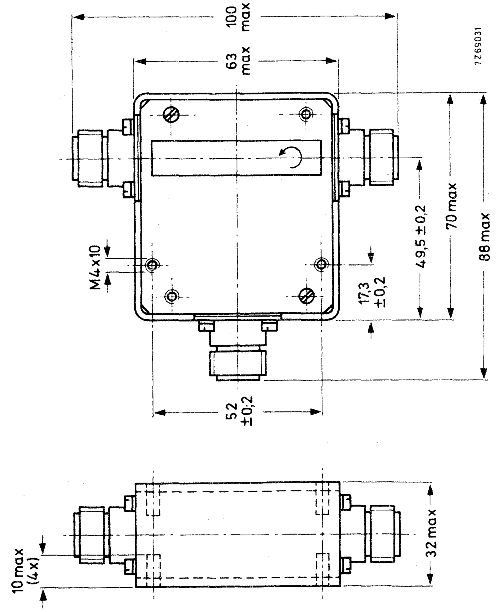
Dimensions in mm



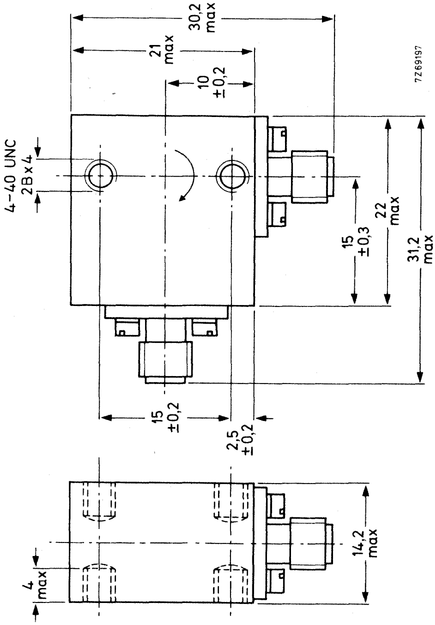
2722 162 02041



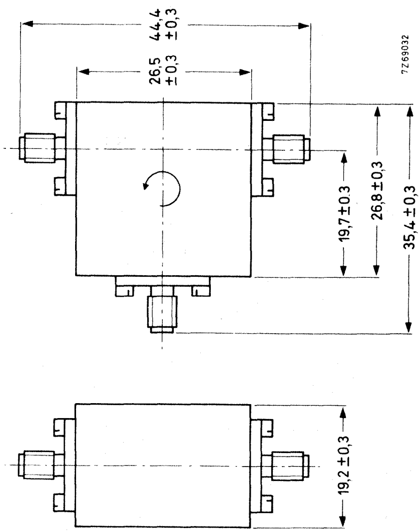
2722 162 03261



2722 162 01931
01941
01951
03591



2722 162 02231



2722 162 03431
03441

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

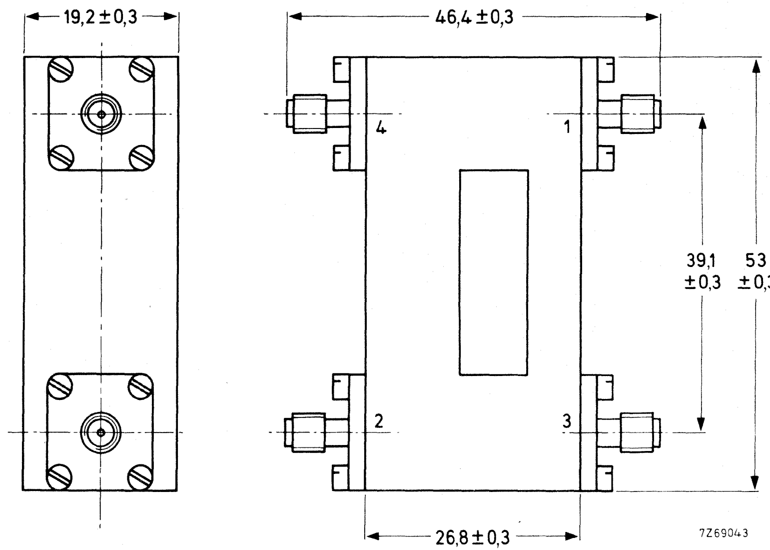
frequency range	isolation (dB)				insertion loss (dB)				v.s.w.r.		max. (c.w.) power	temperature range	connector type	catalogue number
	guaranteed		typical		guaranteed		typical		guaranteed	typ				
GHz	α_{1-4} α_{3-2}	α_{2-1} α_{4-2}	α_{1-4} α_{3-2}	α_{2-1} α_{4-3}	α_{4-1} α_{2-3}	α_{1-2} α_{3-4}	α_{4-1}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

Mass of circulators: 220 g approx.

OUTLINES

Dimensions in mm

2722 162 04031
04041



WAVEGUIDE CIRCULATOR SERIES (3—PORT VERSIONS)

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

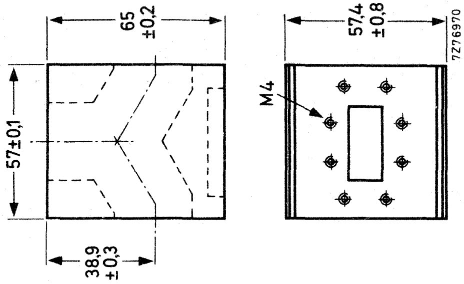
Note

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

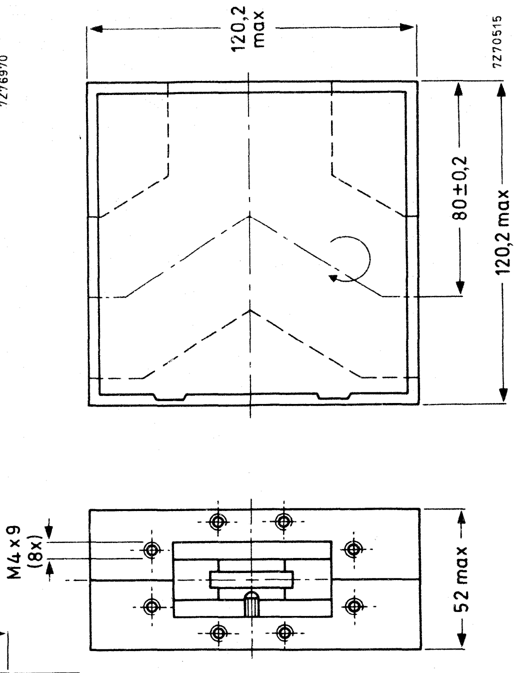
* Material of flanges: aluminium. Finish of flanges: alodine.

OUTLINES

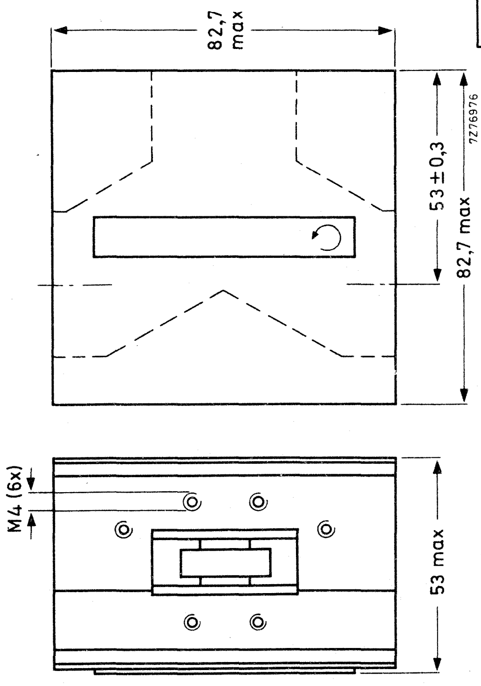
Dimensions in mm



2722 161 02191
02271
02281



2722 161 02231
02261



2722 161 02081
02091
02101

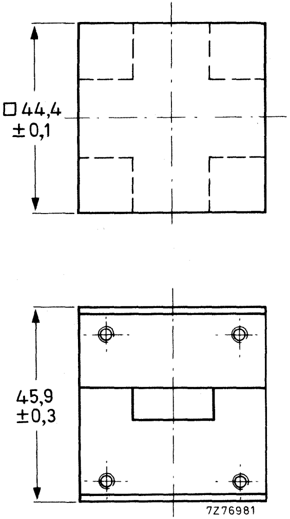
WAVEGUIDE CIRCULATOR SERIES (4–PORT VERSIONS)

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

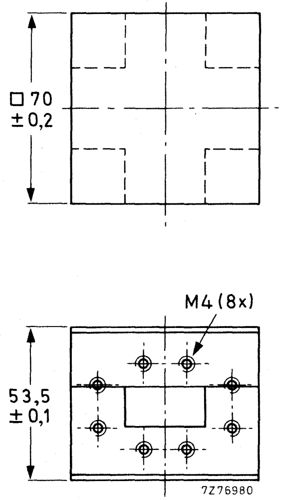
* Material of flange: brass. Finish of flange: gold on silver plate.

OUTLINES

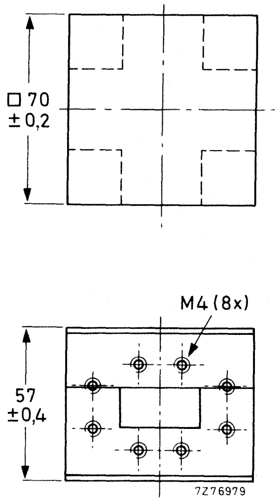
Dimensions in mm



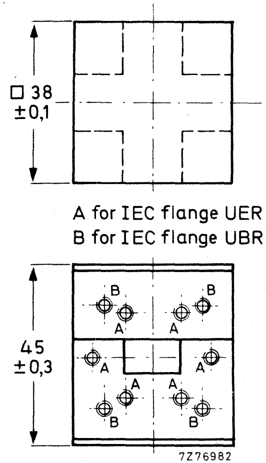
2722 161 03061



2722 161 03041



2722 161 03001
03011
03031
03081
03091



2722 161 03051

INDUSTRIAL HEATING ISOLATORS

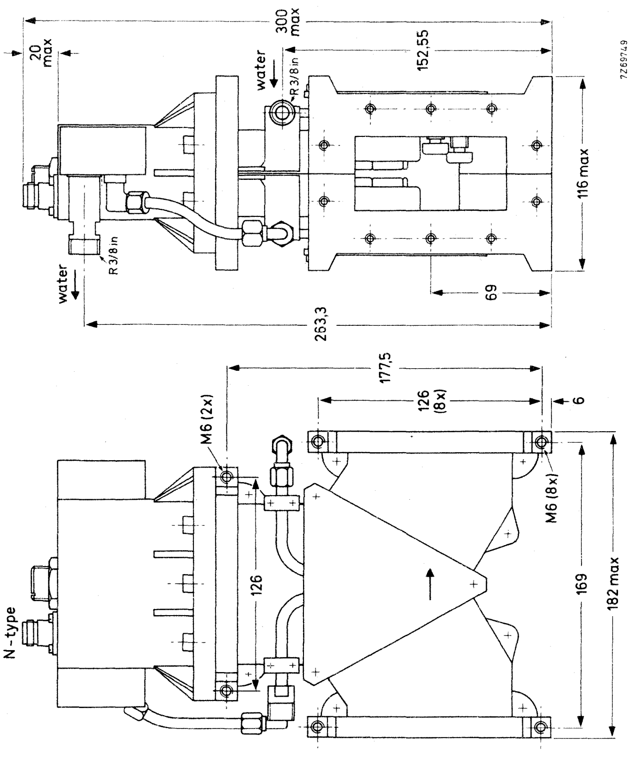
frequency range GHz	isolation dB		insertion loss dB		v.s.w.r.		max. c.w. power forward/reverse W	cooling water temp. (°C) (water pressure 600 kPa abs)		flange type (IEC) *	h.f. monitoring terminal	mass approx kg	catalogue number
	guaranteed	typ	guaranteed	typ	guaranteed	typ		inlet	outlet				
2,425–2,475	> 20	26	< 0,3	0,2	< 1,2	1,1	6500	40	50	PDR26	N-female	4,7	2722 163 02004
2,350–2,400	> 20	26	< 0,3	0,2	< 1,2	1,1	6500	40	50	PDR26	N-female	4,7	2722 163 02024

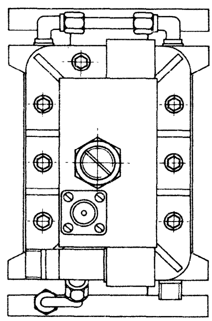
Note

Minimum storage temperature, −10 °C.

* Finish of flange/housing: alodine.

Dimensions in mm





2722 163 02004
02024

OUTLINES

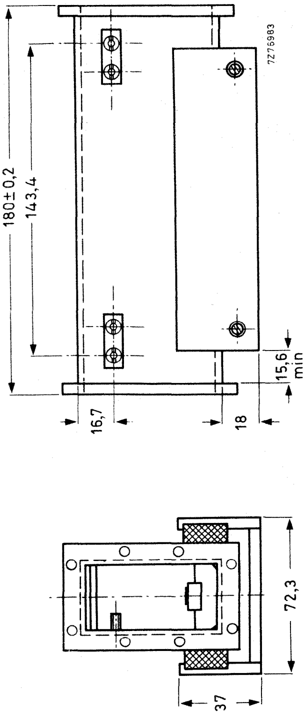
WAVEGUIDE ISOLATOR SERIES

frequency range GHz	isolation dB	insertion loss dB	v.s.w.r.	power (c.w.) W	temperature range °C	waveguide type (IEC)	flange type (IEC) *	mass approx g	catalogue number
3,8 –4,2	> 30	< 0,8	< 1,05	10	+ 10 to + 40	R48	UER48	1700	2722 161 01071
3,8 –4,2	> 30	< 0,5	< 1,05	10	+ 10 to + 80	R40	UER40	2450	2722 161 01081
4,2 –4,6	> 30	< 0,5	< 1,05	10	+ 10 to + 40	R48	UER48	1680	2722 161 01091
4,6 –5,0	> 30	< 0,8	< 1,05	10	+ 10 to + 40	R48	UER48	1680	2722 161 01101
5,925–6,425	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01191
6,425–7,150	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01251
6,825–7,425	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01231
7,125–7,750	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01291
7,250–7,750	> 30	< 0,3	< 1,05	20	–10 to + 70	R70	UER70	1450	2722 161 01241
7,4 –8,025	> 30	< 0,5	< 1,05	10	–10 to + 70	R70	UER70	1450	2722 161 01151
7,7 –8,5	> 30	< 0,5	< 1,05	10	+ 10 to + 70	R84	UBR84	1260	2722 161 01161
8,5 –9,6	> 30	< 0,5	< 1,05	10	–10 to + 70	R100	UBR100	420	2722 161 01211
8,5 –9,6	> 15	< 0,6	< 1,15	1	+ 10 to + 70	R100	UBR100	400	2722 161 01221
8,5 –9,6	> 55	< 1,2	< 1,2	10	–10 to + 70	R100	154-UER100**	600	2722 161 01261
8,5 –9,6	> 20	< 1	< 1,15	10	–10 to + 70	R100	154-UBR100**	300	2722 161 01271
10,7 –11,7	> 30	< 0,8	< 1,05	5	+ 10 to + 70	R100	UBR100	430	2722 161 01171
12,5 –13,5	> 30	< 0,5	< 1,05	10	+ 10 to + 70	R140	UBR100	220	2722 161 01181

* Other flanges to order. Finish of waveguide and flanges: gold plate.
** Finish of flanges: nickel plate.

OUTLINES

Dimensions in mm



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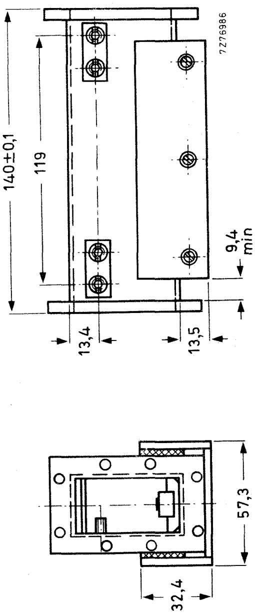

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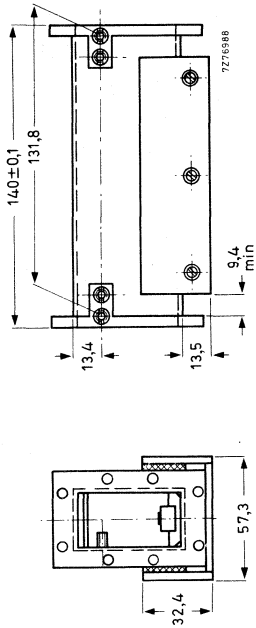

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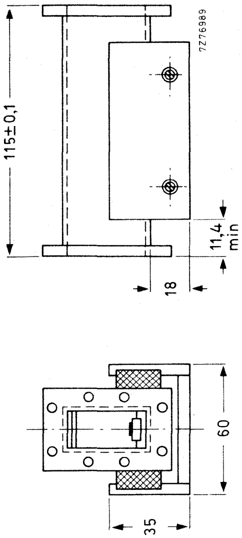

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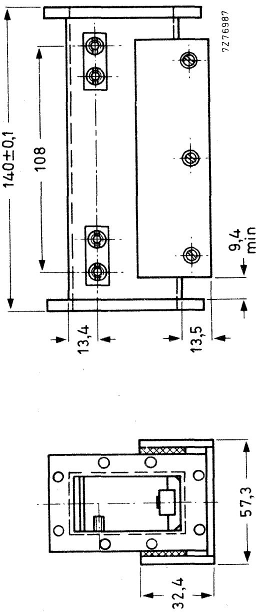

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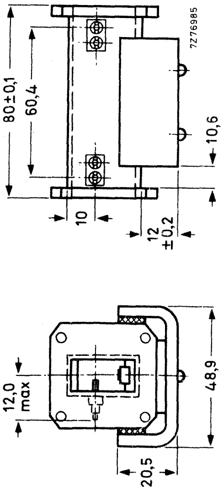

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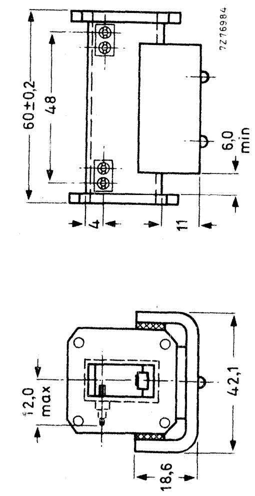

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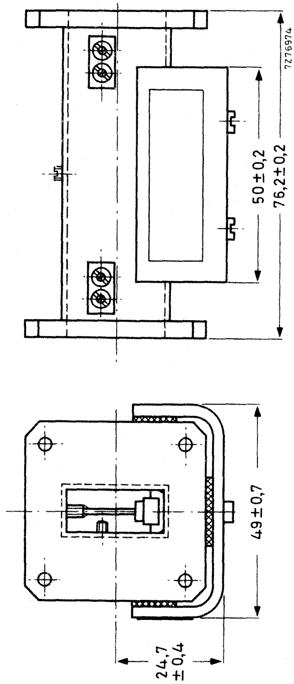

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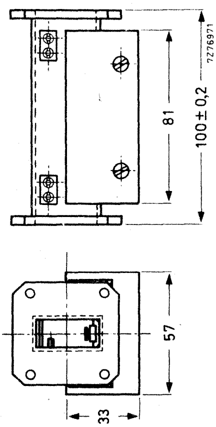

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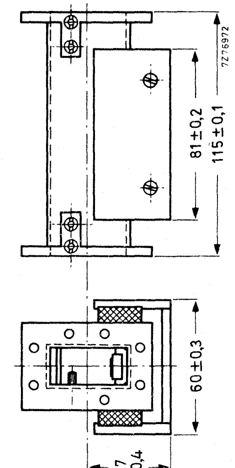

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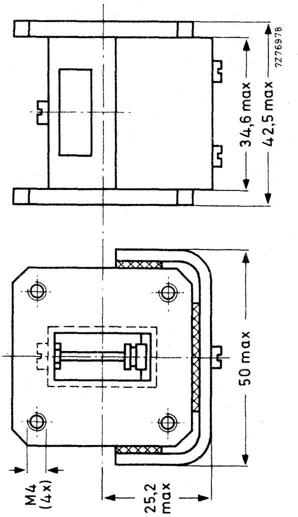

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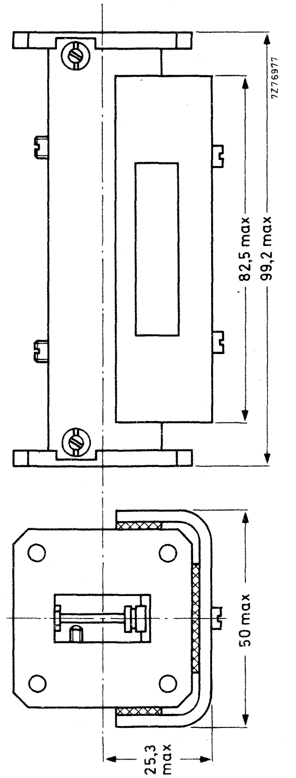

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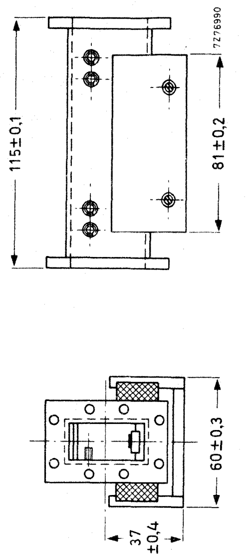

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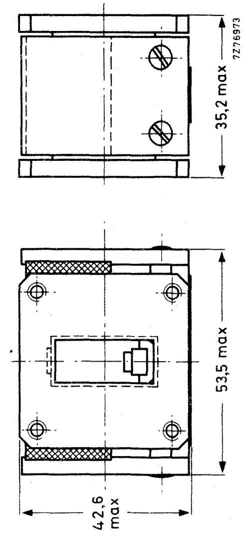

2722 161 01221

CONTENTS

INDEX OF TYPE NUMBERS

A = General
B = Gunn, Impatt and noise diodes
C = Mixer and detector diodes
D = Backward diodes
E = Varactor diodes
F = Gunn oscillators
G = Sub-assemblies
H = Circulators and isolators.

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