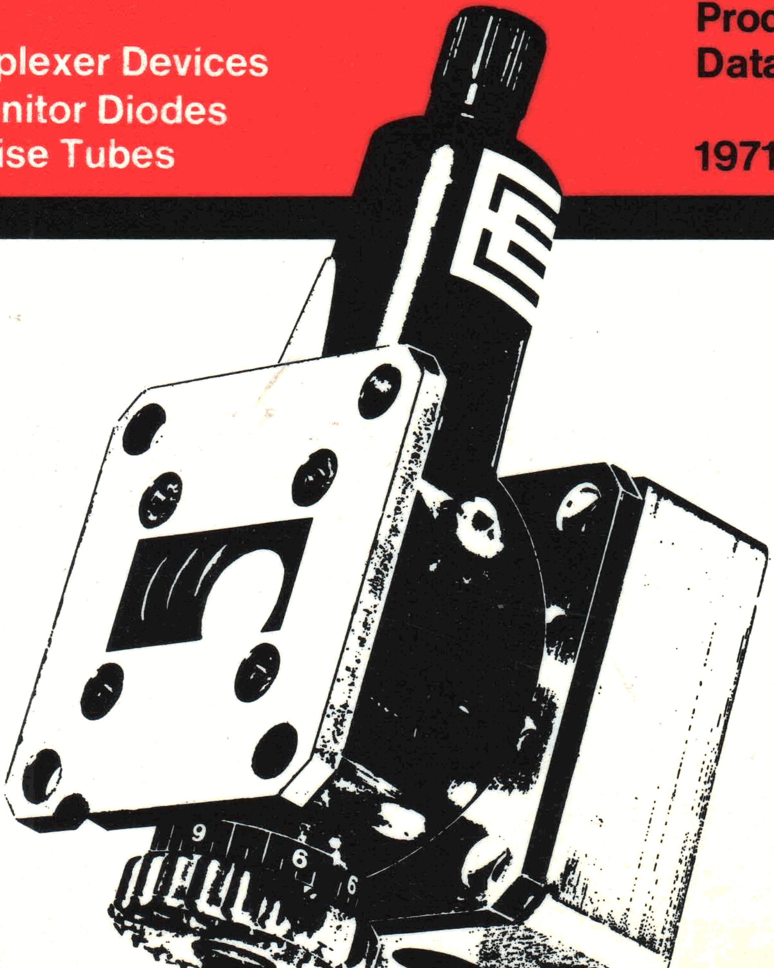
ENGLISH ELECTRIC VALVE CO LTD

Duplexer Devices
Monitor Diodes
Noise Tubes

Product Data

1971



DUPLEXER DEVICES
MONITOR DIODES
NOISE TUBES

The Valve Data Book comprises ten bound volumes, made up as follows:

- **IGNITRONS**
  RECTIFIERS
  INDUSTRIAL THYRATRONS
  VOLTAGE STABILIZERS
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- **TETRODES AND PENTODE**

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  MONITOR DIODES
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These bound volumes replace the previous loose-leaf books and will be re-issued at intervals. When the most recent data are required for equipment design purposes, the individual sheets should be obtained.

Duplexer Devices
Monitor Diodes
Noise Tubes

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June 1971

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EQUIVALENTS INDEX

Type to be replaced	EEV replacement
1B35A	BS412
1B63A	BS914
8NT5	BS386
30MD1	BS502
100MD1	BS510
100MD4	BS510
7381	BS918
BS48	BS48
BS52	BS52
BS82	BS82
BS84	BS84
BS92	BS92
BS104	BS104
BS114	BS114
BS116	BS116
BS118	BS118
BS148	BS148
BS156	BS156
BS158	BS158
BS200	BS200
BS202	BS202
BS204	BS204
BS248	BS248
BS286	BS286
BS310	BS310
BS324	BS324
BS332	BS810
BS338	BS338
BS384	BS384
BS386	BS386
BS390	BS390
BS392	BS392
BS402	BS402
BS412	BS412
BS426	BS426
BS430	BS430
BS440	BS440
BS450	BS450
BS452	BS452
BS456	BS456
BS460	BS460
BS462	BS462
BS466	BS466
BS502	BS502

Type to be replaced	EEV replacement
BS506	BS510
BS510	BS510
BS512	BS512
BS514	BS514
BS516	BS516
BS522	BS522
BS524	BS524
BS526	BS526
BS530	BS530
BS532	BS532
BS534	BS534
BS538	BS538
BS540	BS540
BS600	BS600
BS604	BS604
BS606	BS606
BS702	BS702
BS710	BS710
BS714	BS714
BS716	BS716
BS718	BS718
BS720	BS720
BS724	BS724
BS726	BS726
BS728	BS728
BS732	BS732
BS800	BS800

Type to be replaced	EEV replacement
BS802	BS802
BS804	BS804
BS806 Series	BS806 Series
BS810	BS810
BS812	BS812
BS814	BS814
BS816	BS816
BS818	BS818
BS822	BS822
BS824	BS824
BS826	BS826
BS832	BS832
BS834	BS834
BS836	BS836
BS838	BS838
BS846	BS846
BS848	BS848
BS852	BS852
BS856	BS856
BS858	BS858
BS860	BS860
BS864	BS864
BS870	BS870
BS872	BS872
BS876	BS876
BS882	BS882
BS886	BS886

Type to be replaced	EEV replacement
BS888	BS888
BS892	BS892
BS894	BS894
BS904	BS904
BS908	BS908
BS910	BS910
BS914	BS914
BS918	BS918
BS928	BS928
BS930	BS930
BS932	BS932
BS940	BS940
BS960	BS960
BS968	BS968
BS974	BS974
CV294	BS710
CV460	BS48
CV461	BS92
CV462	BS84
CV463	BS82
CV1841	BS52
CV1881	BS384
CV1923	BS810
CV2157	BS710
CV2181	BS104
CV2274	BS114
CV2285	BS702

Type to be replaced	EEV replacement
CV2306	BS156
CV2307	BS158
CV2308	BS116
CV2309	BS118
CV2311	BS200
CV2312	BS202
CV2351	BS456
CV2378	BS718
CV2379	BS720
CV2430	BS716
CV2481	BS932
CV2482	BS838
CV2488	BS724 Series
CV2826	BS914
CV3840	BS462
CV5398	BS732
CV5990	BS204
CV5991	BS286
CV6005	BS502
CV6028	BS834
CV6070	BS310
CV6086	BS836
CV6107	BS510
CV6129	BS714
CV6132	BS440
CV6178	BS816
CV6192	BS814

Type to be replaced	EEV replacement
CV6206 •	BS818
CV6207	BS826
CV8317	BS390
CV9442	BS390
CV9443	BS426
CV9444	BS430
JF20	BS824
JF20D	BS832
L2060	BS502
L2061	BS510
L2063	BS386
MA338/7381	BS918
MA3167A*	BS452
MD2901	BS452
N1067	BS386
PMDM3	BS512
QF34	BS894
QF41	BS810
QF41M	BS462
QF45	BS810
QF401	BS888
QF451	BS810
QF451L	BS908
QF451M	BS462

Type to be replaced	EEV replacement
TRN1	BS702
TRN2	BS710
TRN3	BS710
TRP3	BS716
TRP4	BS718
TRP5	BS720
TRP8	BS724 Series
TRP10	BS732
TRP14	BS714
TRW1	BS800
WF42	BS200
WF43	BS202
WF45	BS914
WF49A	BS914
WF402	BS158
WF402L	BS816
WF403	BS156
WF404L	BS814
WF405L	BS818
WF407L	BS814
WF409	BS452
WF412L	BS826
WF415	BS440

* Near equivalent

TABULATED DATA

DUPLEXER DEVICES
MONITOR DIODES
NOISE TUBES

PLUG-IN TR TUBES

EEV type	Frequency range (MHz)	Maximum peak power (kW)	Maximum breakdown power (kW)	Maximum recovery period (μs)
BS702†	S-band	2500	10	30**
BS710‡	2000–4000	2000	–	10**
BS714	2600–3950	5.0	–	30*
BS716‡	2600–3950	500	–	15**
BS718	2755–2915	5.0	–	25**
BS720⊕	2755–2915	3.0W	–	25**
BS724★ **BS726** **BS728**	2600–4100	15W	–	70**
BS732	2600–3950	5.0	–	16**
BS834‡	2000–12 000	2500	20	25*
BS836‡	2000–12 000	250	20	8.0*
BS838‡	2000–12 000	500	20	8.0*
BS940‡	2000–5500	1250	10	100*

÷ Used in batches of 20 tubes for polarization twist duplexers
‡ Pre-TR tube
⊕ Pulsed attenuator
★ Matched set of three protector tubes

* To –3db
** To –6db

PRE-TR AND PROTECTOR TUBES

EEV type	Frequency range (MHz)	Maximum peak power (kW)	Maximum V.S.W.R.	Maximum insertion loss (db)	Maximum recovery period (μs)
BS824	2700–3100	250	1.25:1	0.4	15*
BS832	2700–3100	250	1.25:1	0.4	15*
BS846	2700–3100	250	1.25:1	0.4	15*
BS848	2700–3200	250	1.25:1	0.4	15*
BS856	5300–5700	250	1.25:1	0.5	15*
BS858‡‡	5250–5710	1000	1.3:1	0.5	15*
BS870‡	1240–1370	1250	1.25:1	0.4	20*
BS872	1240–1365	10	1.25:1	0.3	20*
BS876	1230–1365	10	1.25:1	0.7	10*
BS904	2700–3100	10	1.25:1	0.7	10*
BS910‡‡	1250–1350	2500	1.3:1	0.5	20*
BS928	8500–10 000	200	1.4:1	0.8	2.0*
BS930‡‡	8500–10 000	200	1.4:1	0.8	2.0*

‡ Pre-TR tube
‡‡ Twin pre-TR tube

* To –3db

TR TUBES

EEV type	Frequency range (MHz)	Maximum peak power (kW)	Maximum V.S.W.R.	Maximum insertion loss (db)	Maximum recovery period (μs)
BS52	9320–9500	200	1.2:1	0.7	3.0*
BS104	2750–2860	1250	1.2:1	1.0	25*
BS156	9000–9600	200	1.2:1	0.8	3.0*
BS158	8500–9100	200	1.2:1	0.8	3.0*
BS200	9180–10 000	200	1.3:1	0.8	3.0*
BS202	8500–9300	200	1.3:1	0.8	3.0*
BS204	3000–3050	1250	1.2:1	1.0	25*
BS286	3055–3105	1250	1.2:1	1.0	25*
BS324	2700–2900	1250	1.2:1	1.0	25*
BS390	2925–3075	1250	1.33:1	1.0	25*
BS426	3600–3780	1250	1.33:1	1.0	25*
BS430	3230–3380	1250	1.33:1	1.0	25*
BS440	8500–9100	200	1.2:1	0.8	2.0*
BS450	9300–9500	100	1.3:1	0.8	3.0*
BS452	9310–9510	100	1.3:1	0.8	3.0*
BS456	2850–3050	1250	1.2:1	0.8	15*

* To –3db

Continued on page 4

TR TUBES – continued

EEV type	Frequency range (MHz)	Maximum peak power (kW)	Maximum V.S.W.R.	Maximum insertion loss (db)	Maximum recovery period (μs)
BS462♦	9000–9300	75	1.4:1	1.0	6.0*
BS466♦	9200–9600	75	1.4:1	1.0	6.0*
BS800	2840–3100	1250	1.2:1	0.8	15*
BS810♦	9245–9575	75	1.4:1	0.8	1.5**
BS822♦	9405–9690	75	1.4:1	0.8	1.5**
BS852■	2600–3960	1000	–	1.5	10*
BS860	8825–9225	100	1.3:1	0.8	1.5**
BS892	9340–9420	50	1.4:1	1.0	3.0*
BS894♦	3030–3070	1000	1.3:1	0.8	10*
BS914	8490–9578	200	1.4:1	0.7	4.0*
BS918††	8500–9600	250	1.3:1	1.0	3.0*
BS932	3490–3770	30	1.2:1	0.8	10**

♦ Tunable
■ Tunable TR-filter, 300MHz bandwidth
†† Twin TR tube

* To –3db
** To –6db

TR-LIMITER TUBES

EEV type ●	Frequency range (MHz)	Maximum peak power (kW)	Maximum V.S.W.R.	Maximum insertion loss (db)	Maximum recovery period (μs)
BS812	9320–9500	200	1.3:1	0.8	3.0*
BS814	9000–9700	200	1.3:1	0.8	3.0*
BS816	8500–9100	200	1.3:1	0.8	3.0*
BS818	9400–10 000	200	1.3:1	0.8	3.0*
BS826	9300–9900	200	1.3:1	0.8	3.0*
BS882	9300–9390	20	1.4:1	0.8	4.0*
BS886	8800–9250	200	1.4:1	1.0	3.0*
BS908◆	9250–9550	75	1.4:1	1.0	6.0*
BS960	8750–8850	200	1.2:1	0.8	0.25*
BS968	9000–9500	50	1.3:1	1.0	3.0*
BS974●	9000–9500	150	1.3:1	1.0	3.0*

◆ Tunable
● Twin TR-Limiter

* To –3db

TB TUBES

EEV type	Resonant frequency (MHz)	Operating power (kW)	Maximum V.S.W.R.	Maximum loaded Q	Maximum equivalent conductance
BS48	9410	4–50	1.1:1	6.0	0.045
BS82	9080	4–50	1.15:1	6.5	0.1
BS84	9240	4–50	1.1:1	6.5	0.1
BS92	9375	4–50	1.1:1	6.5	0.1
BS114	9600	4–50	1.1:1	6.5	0.05
BS116	9325	4–50	1.11:1	6.5	0.1
BS118	8775	4–50	1.11:1	6.5	0.1
BS148	9850	4–50	1.1:1	6.5	0.1
BS248	9025	4–50	1.1:1	6.5	0.1
BS310	9375	4–250	1.1:1	6.5	0.1
BS412	9300	4–250	1.1:1	6.5	0.1

MICROWAVE SWITCHES, LIMITERS AND FILTERS

EEV type	Description	Frequency range (MHz)	Bandwidth (MHz)	Maximum peak power (W)
BS338	PIN switch	S-band♣	200	500
BS392	PIN switch	2925–3075	150	500
BS402	Pulse generator for use with PIN switches			
BS460	PIN switch	X-band♣	100	500
BS802	PIN switch	3600–3770	170	500
BS804	PIN switch	3230–3380	150	500
BS806	Varactor limiter	X-band♣	200	50
BS864	PIN switch	2940–3060	120	500
BS888	Tunable filter	9255–9565	–	–

♣ Set to customers' requirements

MONITOR DIODES

EEV type	Mount type	Frequency range (GHz)	Maximum peak power (kW)	Maximum v.s.w.r.
BS502	BS512♦	8.5–10	20	1.3:1
BS510	BS514♦	2.6–3.2	20	1.3:1
	BS516	2.8–3.2		1.5:1
	BS522	2.8–3.2		1.5:1
	BS524♦	2.6–3.2		1.3:1
	BS530	2.7–2.95		1.3:1
	BS532	2.95–3.2		1.3:1
	BS534♦	2.6–3.2		1.3:1
BS540	BS526♦	5.4–5.9	20	1.3:1
	BS538	5.2–5.5		1.3:1
BS600	Power supply and indicator unit			

♦ Tunable

NOISE TUBES

EEV type	Mount type	Frequency range (GHz)	Excess noise ratio (db)
BS384	BS604	X-band	15.5 ± 0.5
	BS626	S-band	
	BS628	C-band	
BS386	BS606	Q-band	16.40 ± 0.36

PREAMBLE

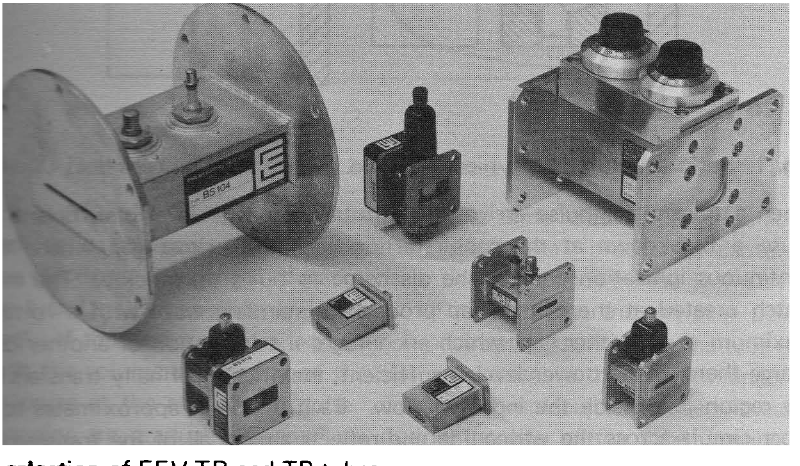
DUPLEXER DEVICES

INTRODUCTION

In a typical microwave pulse radar installation, a single aerial is used for both transmission and reception. The device which makes this possible is known as a duplexer, and although it may become quite complex it is preferable to the use of a second aerial. The basic function of the duplexer is to switch the aerial between transmitter and receiver. During the transmitter pulse it must provide sufficient isolation to protect the detector crystal of the receiver, and after the transmitter pulse it must switch back rapidly so that echos from objects nearby can be detected.

The switching speed required is such that mechanical switches cannot be used, and duplexers are constructed using various combinations of gas-filled tubes, semiconductors and ferrite devices. Ferrites can operate at higher power levels than semiconductors while gas tubes are suitable for the highest powers used in all of the centimetric bands.

Another important function which may be performed by the duplexer is passive protection of the receiver against high power signals reaching the aerial from other radars. Such signals can easily damage the detector crystal and this protection is equally necessary when the radar itself is switched off.



A selection of EEV TR and TB tubes.

GAS-FILLED DUPLEXER TUBES

TR Tubes

The switching element used in the earliest, and simplest, duplexers is a gas-filled device known as a TR (Transmit-Receive) tube; the internal structure of a typical TR tube is shown in Fig. 1. This tube is a sealed length of waveguide filled with a gas mixture, and having two resonant structures spaced $\lambda g/4$ apart. Each resonant structure consists of an iris, and a pair of cones forming an adjustable discharge gap. The gap nearest the receiver is provided with a primer electrode and this is connected to a high voltage supply during operation to provide a continuous source of ionization near the gap. Both gaps are adjusted during manufacture to give the required pass-band for low power signals, which pass through the tube with only slight attenuation.

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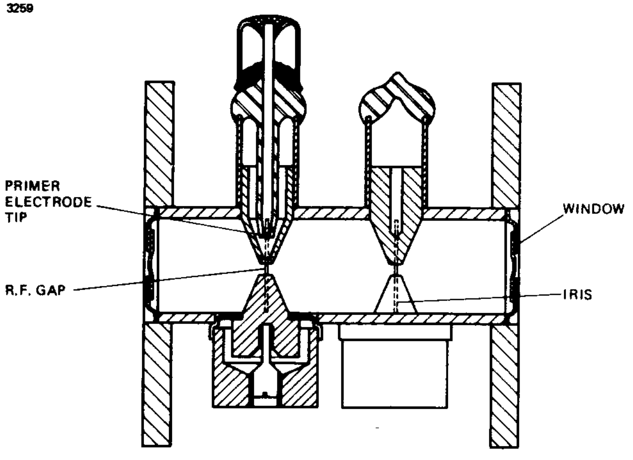


Fig. 1. Basic structure of a typical TR tube.

When a transmitter pulse arrives at the tube the power level is sufficient to cause a breakdown at the gaps, starting with the primer gap where the continuous ionization enables the discharge to build up quickly. The mismatch created at the primer gap produces a standing wave with a voltage maximum at the other gap, which encourages the formation of another discharge there; if the power level is sufficient, the discharge finally transfers to the region just inside the input window. Each discharge approximates to a short circuit across the waveguide and reflects almost all of the transmitter power, so that the establishment of a plasma discharge at the input window deprives the cones of r.f. power and they return to a quiescent state.

At the end of the transmitter pulse the plasma de-ionizes and the attenuation of the tube returns to the insertion loss value; the time taken to achieve this determines the minimum range of the radar. Fig. 2 shows how the attenuation of the tube varies during and after the transmitter pulse.

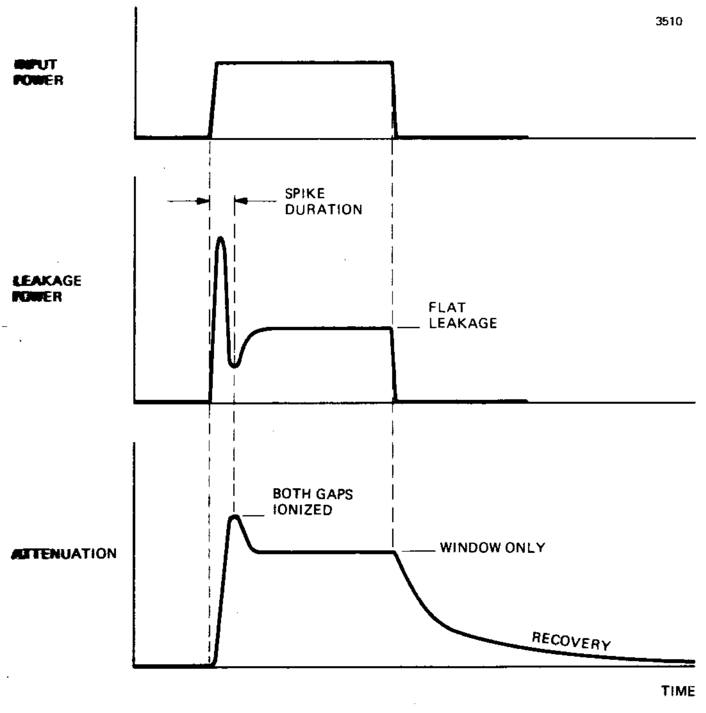


Fig. 2. Leakage characteristics of a single-primer TR tube.

The gas mixture in a TR tube usually includes some relatively large molecule such as water vapour, which speeds up this recovery process by capturing free electrons. The length of the recovery period depends on the geometry of the tube, the composition and pressure of its gas filling and the peak power level. If the peak power is increased, it penetrates further into the tube and both the volume and energy of the plasma increase, so that it takes longer to de-ionize at the end of the pulse. The heavy molecules included to assist recovery are gradually cleaned up during the life of the tube, leading to slower recovery as the tube ages until it no longer meets the recovery specification. The gas clean-up process is more rapid at high peak powers, so that the life of the tube varies with the peak power level used. The peak power ratings are chosen to give a tube life which is satisfactory in most applications and the ratings can often be substantially exceeded without damage if a reduced life is accepted. Conversely, the life of the tube can be increased by reducing the peak power.

TB Tubes

The TB (Transmitter Block) tube consists of a sealed length of waveguide with a window at one end and a short circuit $\lambda g/4$ from the window; there is no primer electrode and the gas filling differs from that used in TR tubes. The body of the tube is extended beyond the short circuit diaphragm to form a gas reservoir (see Fig. 3). The tube is mounted so that the window forms part of the side wall of the transmitter waveguide.

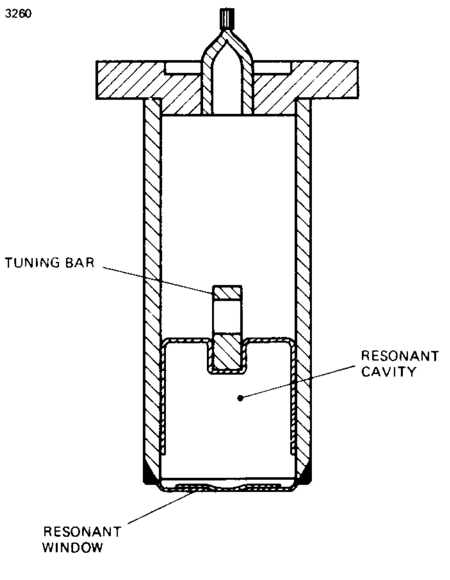


Fig. 3. Cross-section of an X-band TB tube

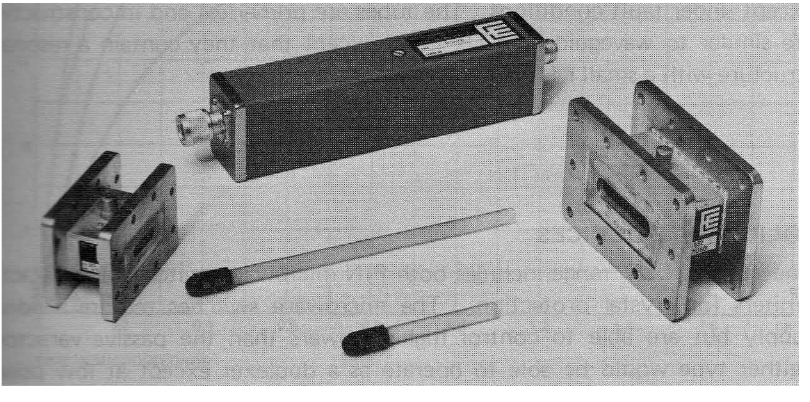
At low power levels the short circuit produces a standing wave in the tube; the position of the short circuit is adjusted during manufacture so that a voltage maximum appears at the window. At high power levels this results in breakdown of the gas inside the window, producing a plasma which effectively converts the window into a conductor and allows the transmitter pulse to proceed along the waveguide with only slight attenuation. At the end of the transmitter pulse the TB tube returns to the unfired state and presents a low admittance across the waveguide.

The TB tube may also be referred to as an ATR tube.

Pre-TR Tubes

The operation of a TR tube results in a small fraction of the transmitter power being dissipated near the input window of the tube. At high power levels this can become a limiting factor, and pre-TR tubes can be used to reduce the power reaching the main TR tube. The pre-TR tube reflects a proportion of the r.f. power in the waveguide; it is involved only in the duplexing function and plays no part in passive protection of the receiver.

Pre-TR tubes may be externally similar to a TR tube but with no primer electrode or internal resonant structures; alternatively they are often made as plug-in devices, basically a cylindrical envelope which locates in a suitable waveguide mount. The high powers encountered by pre-TR tubes would cause rapid clean-up of water vapour and this type of tube often contains quartz wool or chips to assist recovery.



Typical pre-TR and protector tubes from the EEV range.

In addition to their original application as attenuators to extend the power ratings of TR tubes, pre-TR tubes are often used as the main switching element in balanced duplexers. Tubes designed for this purpose are usually built as twin tubes with a common gas filling; this allows better control of differences between the two tubes and gives a corresponding improvement in the overall performance of the duplexer.

The characteristic features of a pre-TR tube are that it has no primer or internal resonators, and can operate at higher power levels than a TR tube of corresponding size. The twin tubes developed for balanced duplexers may therefore be known as pre-TR tubes even though they are not necessarily followed by a TR tube.

Protector Tubes

A balanced duplexer gives almost no protection of the receiver against signals received from other radars, and a separate tube can be installed next to the receiver for this purpose. These tubes are primerless and do not need high power ratings, since they deal only with signals weak enough to pass through the duplexer. The leakage requirements are determined by the nature of the receiver and some protector tubes are made with relatively large power transmission for the protection of travelling wave tubes and similar r.f. amplifiers.

The protector tubes were designed to limit the power leakage to r.f. amplifiers, such as parametric amplifiers, travelling wave tubes etc. and are generally used in circuits employing circulators or balanced duplexers. Because of this arrangement they are not subjected to full transmitter power except under fault conditions. The tubes are primerless and in construction are similar to waveguide pre-TR tubes except that they contain a resonant structure with a small r.f. discharge gap.

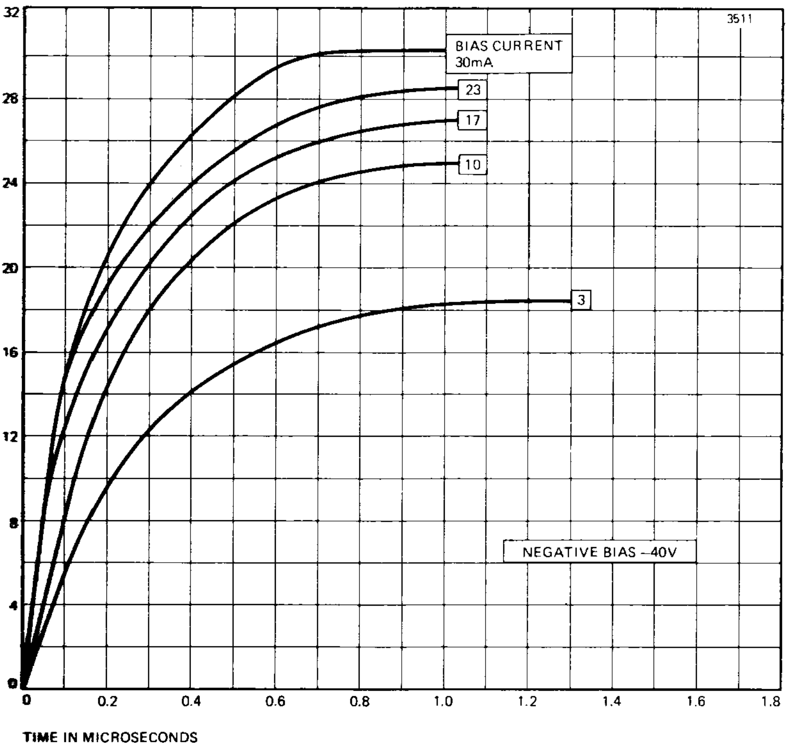
SOLID-STATE DEVICES

The current EEV range includes both PIN microwave switches and varactor limiters for crystal protection. The microwave switches require a power supply but are able to control higher powers than the passive varactors; neither type would be able to operate as a duplexer except at low power levels.

PIN Switches

These devices form a variable attenuator, controlled by a low voltage d.c. supply. The PIN diode is mounted in a short section of coaxial line coupled to a waveguide mount. As the diode bias current is increased, the r.f. impedance of the diode decreases and the attenuation in the waveguide increases, typically from 0.25db insertion loss to 25db maximum.

When used for crystal protection in a duplexer the switch is operated at a single value of bias current, which is pulsed in synchronism with the transmitter; the diode pulse actually starts before the transmitter pulse since it takes up to 1 microsecond to reach maximum attenuation (see Fig. 4). A similar time is required to recover to minimum attenuation at the end of the bias pulse, although this can be considerably reduced by applying negative



4. Typical PIN switch turn-on time characteristics.

bias of up to 40 volts between pulses (see Fig. 5) or using faster recovery diodes.

When the radar equipment is switched off, passive protection of the receiver can be provided by d.c. bias of the PIN switch, supplied from a small battery.

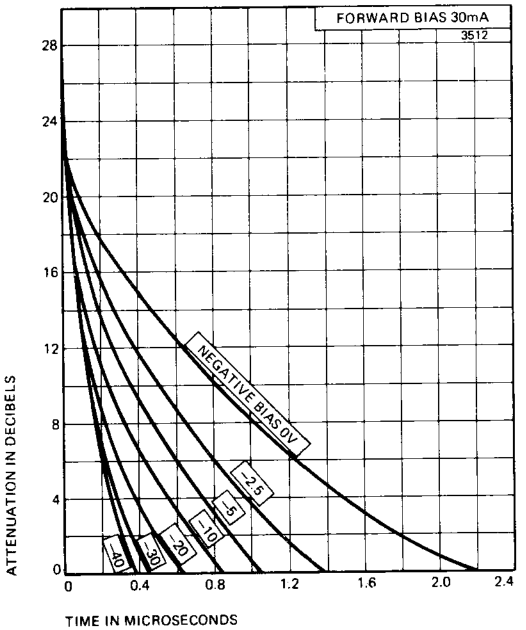


Fig. 5. Typical PIN switch recovery characteristics.

Varactor Limiters

It is a property of the varactor diode that its capacitance varies with changes in diode current, and this can be achieved by a self-biasing action when the diode is subjected to r.f. power. By fitting this type of diode in a waveguide mount with suitable tuning arrangements a device is produced which has a power limiting characteristic. At low power levels (up to a few milliwatts) the limiter transmits r.f. power with a small insertion loss, but as the power is increased it reflects an increasing proportion of the incident power (see Fig. 6). Varactor limiters have a very short response time but relatively low power handling capability, so that their usual application is to reduce the magnitude of the leakage pulse from a duplexer to the receiver. In particular they provide additional attenuation, in the region of 10db, against spike leakage energy. Since this leakage energy is mainly responsible for degradation or even burn-out of the mixer diode, its reduction is important. In this position the varactor also provides full passive protection of the receiver against random high power signals, at all times.

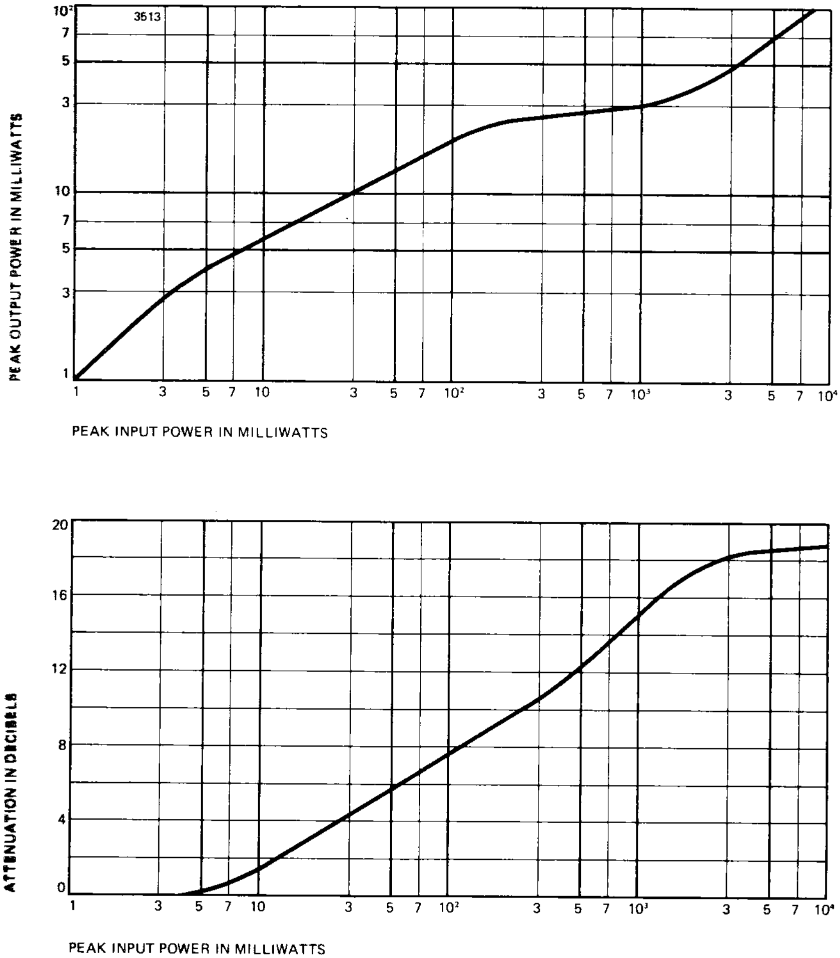


Fig. 6. Typical varactor limiter attenuation characteristics.

EEV varactor limiters are currently manufactured for operation in X-band, and there are several ways in which they can be applied.

a) The limiter can be tuned to a specified centre frequency and supplied as a discrete device for assembly to a balanced duplexer.

b) The limiter can be tuned to operate in conjunction with a specified type of TR tube in a branched duplexer.

c) A range of TR limiters is available, consisting of a TR tube and varactor limiter supplied as a single device, with characteristics matched for optimum performance. The insertion loss, v.s.w.r. and bandwidth of a TR limiter are superior to those of the same TR tube and limiter supplied separately and assembled by the user. The TR limiter arrangement introduces the possibility of using primerless TR tubes in cases where they could not otherwise be considered, because of excessive leakage. Primerless TR limiters require no power supplies, do not introduce primer noise and give full passive protection during an extended life.

Figs. 7 and 8 show how the insertion loss and bandwidth characteristics of a typical varactor limiter vary with the centre frequency to which it is tuned.

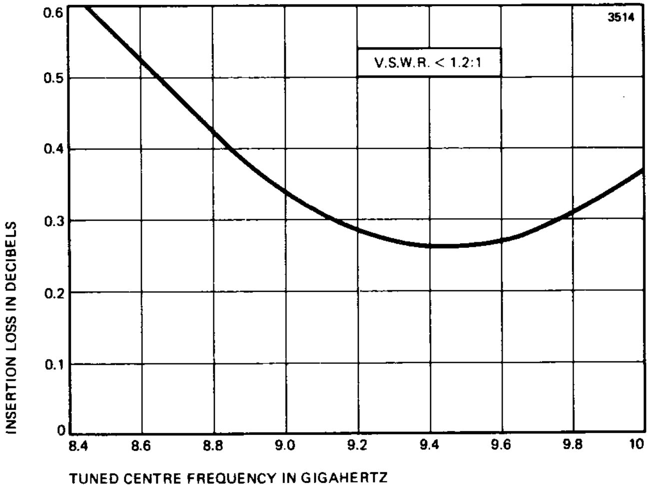


Fig. 7. Typical varactor limiter insertion loss characteristics.

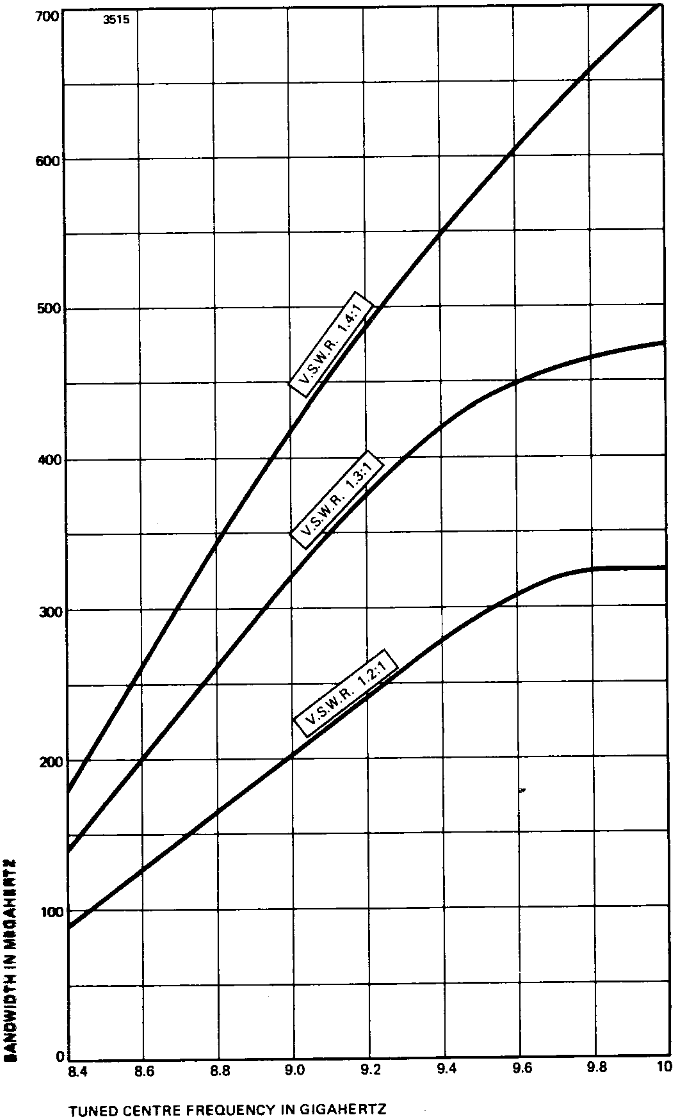


Fig. 8. Typical varactor limiter bandwidth characteristics.

PERFORMANCE CHARACTERISTICS

The duplexer devices described in this book are used almost exclusively in microwave pulse radar equipments – only the PIN switches and some of the protector tubes have other applications – and are specified and tested accordingly.

The basic frequency and power capabilities must be compatible with the transmitter or the equipment cannot operate at all, and the leakage performance of TR and protector tubes largely determines the life of the receiver crystal. Variations in the other electrical parameters will result in changes in the performance of the system, for example the minimum range is dependent on the recovery characteristics of gas-filled tubes while the sensitivity is directly affected by insertion loss, low level v.s.w.r. and arc loss values. Where low noise receivers are used, the noise output of primer electrodes can be an important factor in the signal/noise ratio. In balanced duplexers using twin tubes, imperfect matching of the phase-shift and leakage of the two channels also degrades the overall system performance.

The following brief notes describe the measurement of the various electrical parameters in general terms; detailed testing instructions can be found in BS9040:1970 or MIL-E-1D.

Frequency, Bandwidth and V.S.W.R.

Very few radar equipments operate at an accurately specified frequency; normally a frequency range of rather less than 1% is permitted. Duplexer devices must therefore have sufficient bandwidth to accommodate variations within the range allowed, or must be tunable over the range. When the transmitter is tunable the total range may exceed 5%. TR tubes contain resonant elements and have a relatively small bandwidth, but pre-TR tubes can be made to operate over a whole microwave band. The frequency range or bandwidth of a particular device is the range of frequencies over which the v.s.w.r., measured at a low power level, does not exceed the maximum value quoted for that device. The centre frequency of a broad-band type is generally defined as the geometric mean of the upper and lower frequency limits; for high Q types, the resonant frequency is that at which the low level v.s.w.r. is lowest (for TB tubes, the highest v.s.w.r. defines the resonant frequency).

It is a basic characteristic of TR tubes and related devices that the v.s.w.r. varies with the r.f. power, above a value which may be as low as a few milliwatts. The low level v.s.w.r. of each device must therefore be measured below this level, which is specified in the individual data sheets.

Insertion Loss

The insertion loss of a tube is defined as the difference in attenuation between the tube and the same length of plain waveguide. The windows, irises and primers all contribute to the insertion loss, which is minimized by careful design and choice of materials within the tube.

Measurements of insertion loss are made by substituting the tube for the same length of waveguide, and are normally carried out at the same frequency and power level as the v.s.w.r. tests.

Leakage of TR Tubes

The energy at the leading edge of the transmitter pulse which passes through a TR tube before an effective short-circuit is established is known as the spike energy (see Fig. 2). This spike can be very damaging to a sensitive crystal detector and a number of methods are used to minimize it, in particular the incorporation of a primer electrode. The lowest values of spike leakage are achieved by use of a semiconductor limiter in addition to the primed tube. Typical spike leakage values for combined TR-limiters are less than 2nJ per pulse, compared with 10 to 15nJ per pulse for similar tubes without limiters.

After the tube has reached a steady fired condition, with a single discharge at the input window, the receiver is still subject to a small amount of r.f. power which is known as the flat leakage power (see Fig. 2). This is composed partly of transmitter power leaking through the plasma discharge and partly of r.f. energy radiated by the discharge itself. The magnitude of the flat leakage power depends on the pressure and proportions of the gas filling.

In many cases, TR tube specifications quote spike energy and total power, rather than the flat leakage power. The total power is simply the average leakage power during the transmitter pulse, and therefore includes the spike leakage. Measurement of the spike energy can be achieved using a short transmitter pulse, which equals the duration of the spike; the energy which leaks through is considered to be the spike leakage.

The low power leakage of a TR tube is the highest power which can be transmitted through the tube without firing it, and can be measured using either a c.w. signal or pulses longer than the spike duration.

Arc Loss

Arc loss is the name given to the power dissipated in the discharge within the tube. For TR and TB tubes, it can be measured as the difference in output power at the aerial when the tube is replaced by a metallic short circuit located in the effective short circuit plane of the tube.

Recovery Period

With the tube operating under specified pulse conditions, an additional signal at the low power level is injected into the waveguide and the attenuation of this signal is measured using an oscilloscope coupled to a detector. If the low level signal is pulsed, it must be capable of a variable delay relative to the transmitter pulse. The low level attenuation during recovery is measured relative to the attenuation immediately before the transmitter pulse, which is assumed to be the insertion loss value. For TR tubes and TR limiters this measurement is made directly, but when the recovery period of a pre-TR or TB tube is tested it may be necessary to include a TR tube or pulsed attenuator in the circuit. In such cases the recovery characteristics of the extra tube must be checked and appropriate corrections applied.

Short Circuit Position

The position of the effective r.f. short circuit in a gas-filled tube, relative to the plane of the input flange, is measured as the change in position of standing-wave minimum when the tube is replaced by a metallic short circuit. This measurement is carried out at specified high power conditions.

Noise

The r.f. noise output of a TR tube is relatively small, despite the presence of the primer electrode. It is only in radar equipment using low noise receivers, such as parametric or tunnel diode amplifiers, that the TR tube noise can appreciably limit the performance of the system.

The noise figure F_{TR} of a TR tube during reception is given by

$$F_{TR} = 1 + \frac{T_p}{T_{in}}\left[L-1\right] + \frac{LT_k}{T_{in}}$$

where T_p = body temperature of TR tube

T_{in} = noise temperature at TR tube input

T_k = equivalent primer generated noise temperature

L = loss ratio of TR tube (greater than unity)

From the above, it can be seen that the noise contributed by the tube can be reduced by reductions of operating temperature, insertion loss and primer noise output. Dynamic noise radiated by the decaying r.f. discharge after a transmitter pulse is not a problem, since it falls to a low level during the recovery period while the tube is still blocking echo signals.

In a system with an overall noise figure of 4db, the contribution due to a tube body temperature of 100°C is approximately 0.25db and can be reduced by forced cooling of the tube, particularly in the region of the input window where the arc loss is dissipated.

The equivalent noise figure of the insertion loss is typically 0.6db in a 4db system; since some two-thirds of the insertion loss takes place in the windows, special low-loss windows of high density ceramic have been used to reduce noise levels.

So far as the primer is concerned, its noise output can be minimized by design refinements or it can be eliminated altogether by screening the discharge.

TB Tube Characteristics

The Q of a TB tube is largely determined by the dimensions of the resonant cavity and window; the lowest possible value is required in order to extend the frequency range of the tube and the duplexer. The equivalent conductance of a TB tube must also be held to a low value, to give a high v.s.w.r. during reception conditions.

The loaded Q is determined by a series of v.s.w.r. measurements at low power, over a range of frequencies. The normalized values of equivalent conductance and susceptance are derived from these measurements and the various properties are related by the expression

$$Q_L = \frac{fo\, \Delta b/\Delta f}{2\,(1+g)}$$

where Q_L = loaded Q

fo = resonant frequency

$\Delta b/\Delta f$ = rate of change of susceptance with frequency

g = normalized conductance

Full details of these tests, including alternative methods, are given in BS9040: 1970.

DUPLEXER SYSTEMS

The majority of radar installations rely on either branched or balanced duplexers, both of which are based on gas-filled tubes. The branched duplexer is simple and compact but offers very limited bandwidth and imposes restrictions on the cold impedance characteristics of the magnetron. It may also cause erratic starting of the magnetron. These disadvantages are avoided by use of the larger, more expensive balanced duplexer.

The Branched Duplexer

The simplest type of branched duplexer employs a single TR tube in the receiver arm (see Fig. 9). The TR tube is mounted at a distance $a = n\lambda g/2$ from the junction, where n is an integer (the tube may be mounted directly at the junction if required), and it reflects the transmitter pulse in phase to the aerial. The high mismatch of the magnetron between pulses is exploited by making the distance b such that the transmitter arm presents a low admittance at the junction during reception, so that the echo signal is reflected in phase to the receiver.

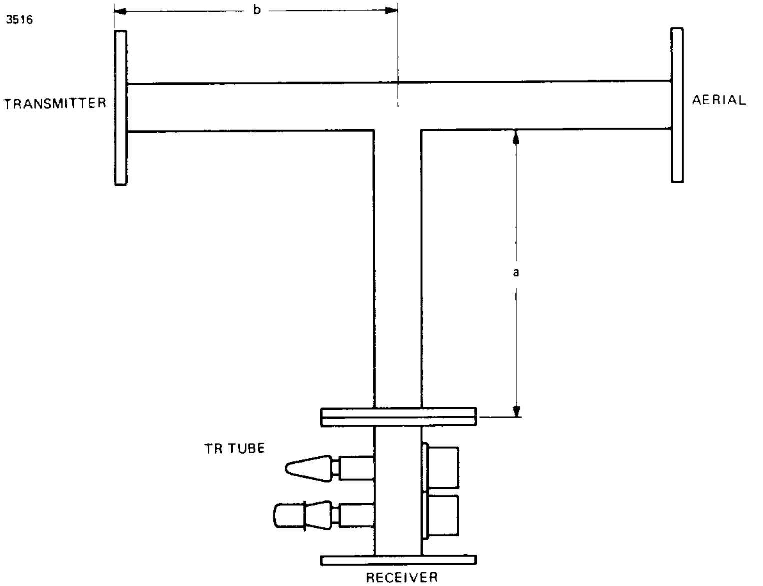


Fig. 9. Schematic of simple branched duplexer.

A serious disadvantage of the simple branched duplexer described above is its dependence on the cold impedance characteristics of the magnetron. During the life of a magnetron, the frequency of oscillation and phase of cold impedance may both vary; when the magnetron is changed such variations are almost inevitable and can result in a serious loss of echo signal at the junction.

To overcome this problem another gas-filled tube known as a TB (Transmitter Block) or ATR (Anti–TR) tube can be placed in the transmitter arm (see Fig. 10). During the transmitter pulse, the ionized TB tube effectively forms part of the waveguide wall. The distance c is made equal to $\lambda g/4$, so that during reception, an echo signal arriving at the junction from the aerial finds the highest possible mismatch in the transmitter arm and is directed to the receiver. The major advantage of using the TB tube rather than the magnetron for this purpose is that the TB tube can be made with a low value of Q, giving the duplexer a much greater bandwidth. The control of magnetron admittance can also be relaxed and the position of the magnetron can be decided by other requirements.

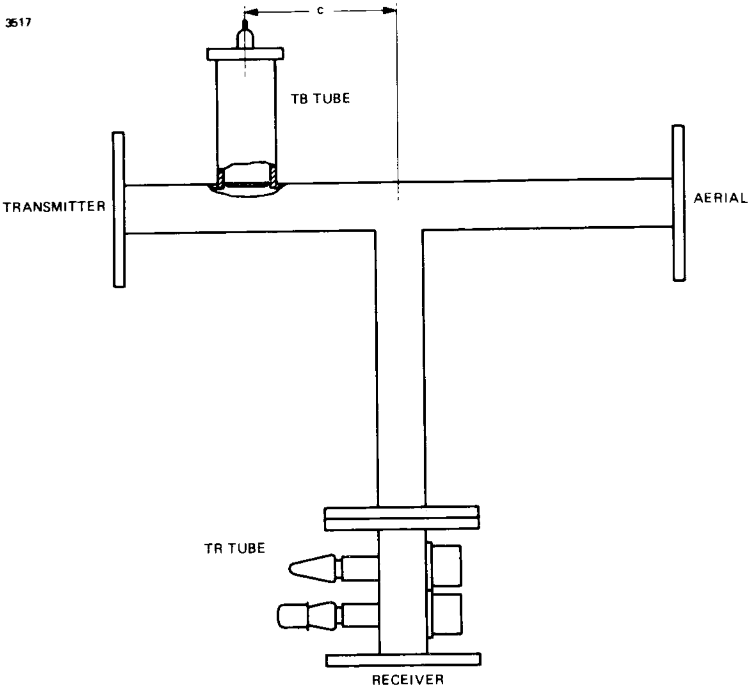


Fig. 10. Schematic of branched duplexer with TR and TB tubes.

The TB tube inevitably increases the losses during the transmitter pulse, although this may be more than offset by improved reception efficiency. It also increases the cost and complexity of the duplexer and the high mismatch which the unfired tube presents to the magnetron at the beginning of the transmitter pulse may lead to erratic starting. If the maximum possible bandwidth is required from this type of duplexer, then it may still be necessary to control the cold impedance and position of the magnetron. A bandwidth of 5% can then be achieved, and can be increased still more by using more than one TB tube, but it is difficult to obtain good performance over the whole band. In general, if a bandwidth greater than 5% is necessary the balanced duplexer is to be preferred.

The Balanced Duplexer

The operation of a balanced duplexer depends on the 3db hybrid coupler (this has superseded earlier, more complex methods of balanced duplexing). The hybrid coupler is a broadband device which couples power between two adjacent waveguides (see Fig. 11). A signal entering one port is divided equally between the two opposite ports, with negligible leakage to the fourth port; the two output signals are separated in phase by 90°. The hybrid is symmetrical and bi-directional, and typically has an isolation greater than 25db with both phase shift and coupling ratio very close to the nominal values.

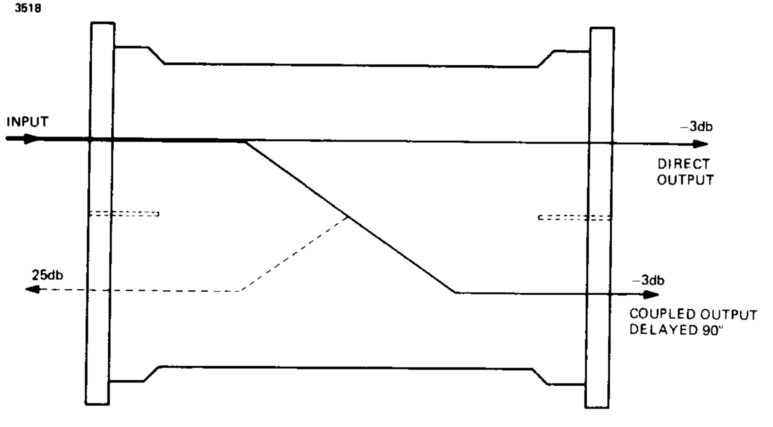


Fig. 11. Characteristics of the 3db hybrid coupler

Fig. 12 shows a typical balanced duplexer in diagrammatic form, during a transmitter pulse. The power reflected by the TR tubes combines in phase in the aerial port and cancels in the transmitter. The leakage power through the TR tubes combines in phase in the load and cancels in the receiver arm, so that the residual leakage is only that due to differences between the channels.

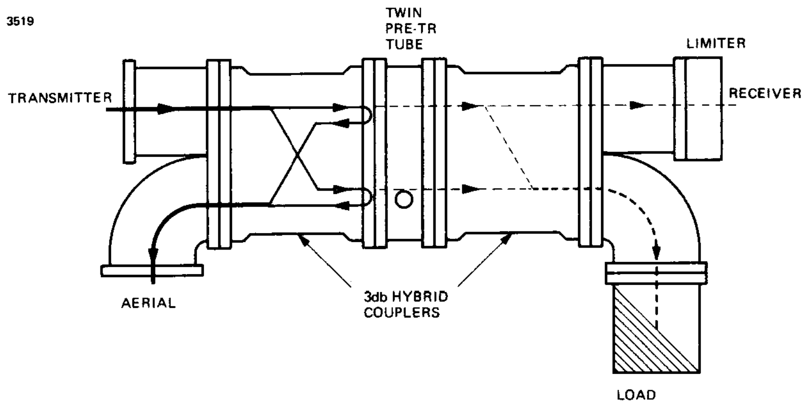


Fig. 12. Balanced duplexer during transmission

During reception, the signal is transmitted by both channels and combines in phase in the receiver port (see Fig. 13). The maximum low power transmission to the receiver is twice that of a single tube and some form of

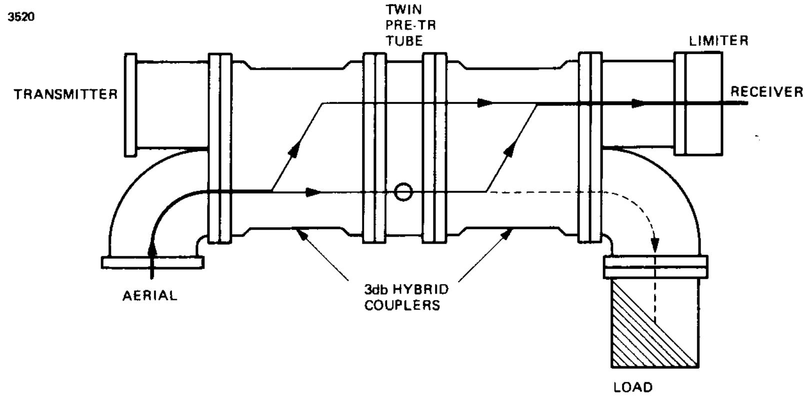
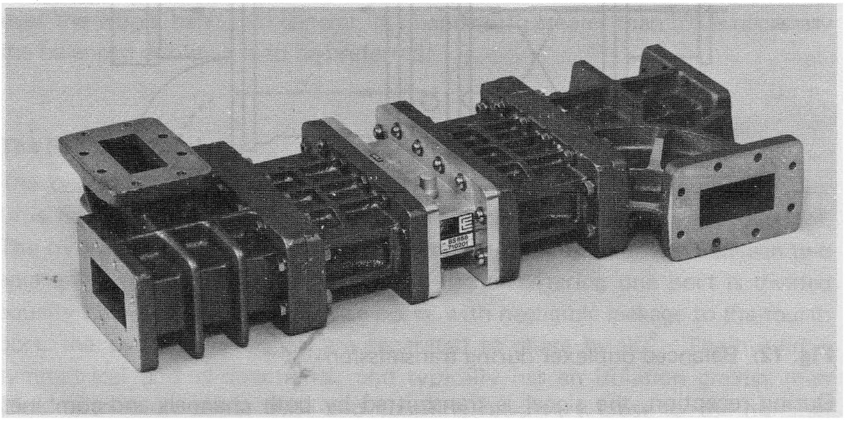


Fig. 13. Balanced duplexer during reception

passive protection is necessary, so that high power signals received from other radars in the same band will not destroy the receiver crystal.

The bandwidth of a balanced duplexer is generally limited by the TR tubes, but the leakage-cancelling characteristic permits the use of primerless tubes having relatively high individual leakage, and these can be made with a bandwidth covering the whole of a centimetric radar band. The current range of balanced duplexers available from EEV takes advantage of this feature and covers L, S, C and X-bands with four basic types.



An EEV balanced duplexer for C-band

OPERATING NOTES

Environmental Conditions

The duplexer devices manufactured by EEV are, in general, inherently rugged and unaffected by conditions of shock and vibration met in normal radar service. The data sheets do not specify tests of these properties, which are normally checked on a design test basis. Applications involving unusually severe mechanical conditions might call for additional testing but in most cases would not require design changes.

Any type of flange-coupled waveguide device can be subjected to considerable strains if bolted to mating flanges which are out of alignment; gas-filled tubes have windows of glass or ceramic materials which can be cracked by such treatment, especially when combined with thermal stresses.

The temperature ratings given in data sheets generally relate to storage conditions and cover a very wide range. Tubes are tested in free air at ambient temperatures within the 15 to 30°C range and operation outside this range should be avoided if possible. High ambient temperatures are likely to cause reduced life and possibly increased leakage, while very low temperatures lead to unreliable ignitor performance, and delayed recovery in tubes using water vapour in the filling.

Primer Supplies

Data sheets for tubes incorporating primers specify the supply voltage and impedance. It is essential that the requirement for a part of the impedance to be located at the tube terminal should be observed, otherwise parasitic oscillations are likely to arise in the primer circuit. Satisfactory operation of a TR tube is obtained over a relatively small range of primer current and the ratings given in data sheets are absolute limits. The voltage drop across the primer may vary from tube to tube and during life; in most cases its value is not important and need not be measured.

Any failure of a primer circuit during operation is likely to damage the receiver crystal but the effect may not be immediate, so that the radar display may not indicate the failure in any way unless the primer current is monitored.

VARIANT TYPES

Many of the duplexer devices in this book are variants of a basic type, usually frequency variants. Although the narrow-band tubes employ a number of resonant elements, it is usually possible to supply them for a wide range of centre frequencies to suit particular applications.

The peak power rating of most types is also relatively flexible, although a compromise must be accepted between power and tube life. Other electrical parameters usually represent an optimum compromise for a particular type of application.

Mechanical variants can also be arranged and many involve nothing more than a different waveguide coupler. More complex mechanical changes are possible but will generally increase the cost of the tube.

Plug-in TR Tubes

BS702

PLUG-IN
PRE-TR TUBE

Service Type CV2285

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Gas-filled tube for use, in batches of 20 tubes, in S-band polarization twist TR systems.

CHARACTERISTICS (for batch of 20 in twist section)

Frequency range		S-band
Breakdown power (peak) (see note 1)	10	kW max
Attenuation recovery period to −6db (see note 2)	30	μs max
Arc loss (see note 2)	0.5	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 3)	10	2500	kW
Ambient temperature (non-operating)	−40	+100	°C

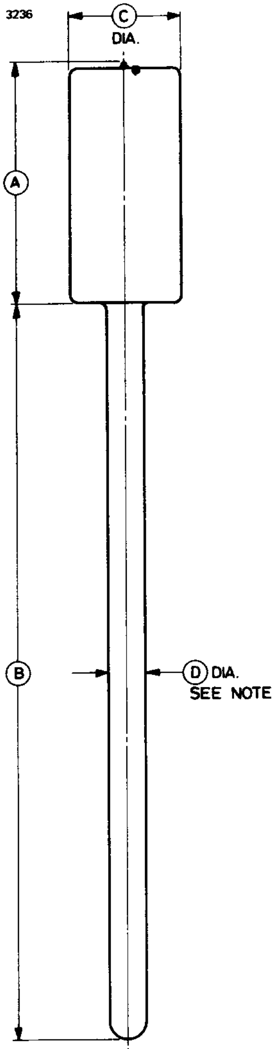
GENERAL

Overall dimensions	see Outline
Mounting position	stem down
Net weight	4.5g approx

NOTES

1. Measured at 1.0μs pulse length and 1000p.p.s., peak power increased from a low level until a glow discharge is established in all 20 tubes.
2. Measured at 1000kW peak input power, 1.0μs pulse length and 1000p.p.s.
3. The power handling capacity is measured at 2.0μs pulse length and 500p.p.s., peak power increased beyond 2500kW until sparking commences in the waveguide.

OUTLINE



Ref	Millimetres	Inches
A	35.0 max	1.378 max
	30.0 min	1.181 min
B	100.0 max	3.937 max
	98.0 min	3.858 min
C	15.0 max	0.591 max
	14.0 min	0.551 min
D	5.0 max	0.197 max
	4.5 min	0.177 min

Inch dimensions have been derived from millimetres.

Note Positional tolerance 1.00mm (0.039 inch) diameter, datum diameter C.

BS710

PLUG-IN PRE-TR TUBE

Service Types CV294, CV2157

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

All-glass pre-TR tube for S-band.

CHARACTERISTICS

Frequency range	2000 to 4000	MHz
Attenuation recovery period to −6db (see note 1)	10	μs max
Average life (see note 2)	500	hours min

MAXIMUM RATINGS

Transmitter power (peak)	2.0	MW max

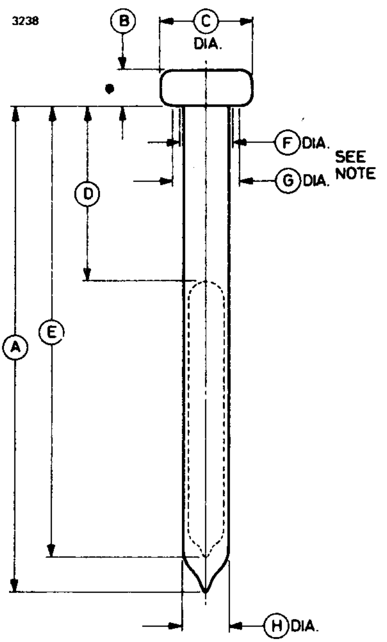
GENERAL

Overall dimensions	see Outline
Mounting position	any

NOTES

1. Measured at 1.0MW peak power, 1.0μs pulse length and 1000p.p.s.
2. Measured at 1.0MW peak; the end of life is defined as the point at which the recovery period to −6db exceeds 10μs.

OUTLINE



Ref	Millimetres	Inches
A	66.5 max	2.618 max
B	4.5 ± 0.5	0.177 ± 0.020
C	12.5 max	0.492 max
D	23.8 ± 1.5	0.937 ± 0.059
E	60.0 min	2.362 min
F	7.0 max	0.276 max
G	8.75 min	0.344 min
H	6.0 ± 0.5	0.236 ± 0.020

Inch dimensions have been derived from millimetres.

Note The annular area between dimensions F and G will be flat within 0.25mm (0.010 inch) and at right angles to the axis of the tube within 5°.

BS714

PLUG-IN
TR TUBE

Service Type CV6129

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Plug-in, primerless TR tube.

CHARACTERISTICS (See note 1)

Frequency range	2600 to 3950	MHz
Centre frequency (see note 2)	3600 to 3645	MHz
V.S.W.R. (see note 3)	1.12:1	max
Maximum leakage:		
spike energy (see note 4)	1.0	μJ/pulse
high power total (see note 5)	3.6	W
low power	10	W
Attenuation recovery period to −3db (see note 5)	30	μs max
Insertion loss (see note 3)	0.2	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.01	5.0	kW
Transmitter power (mean)	–	5.0	W
Ambient temperature (non-operating)	−40	+100	°C

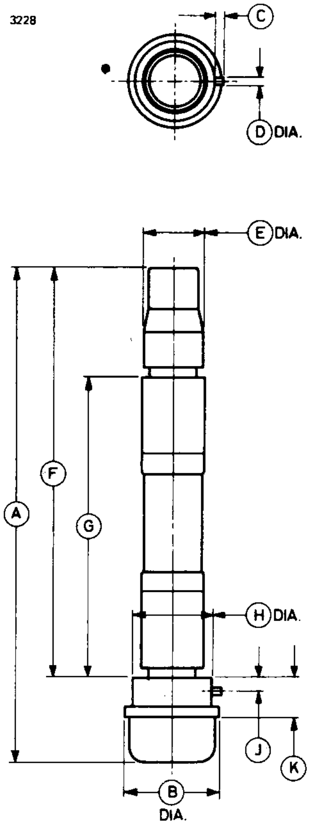
GENERAL

Overall dimensions	see Outline
Finish	metal parts silver or nickel plated
Mounting position	any
Net weight	120g (4.2 ounces) approx

NOTES

1. The tube is designed for use in a no. 10 or no. 11 waveguide mount. The frequency and performance characteristics depend on the design of the mount, which should have a loaded Q of 6.0 max, with the tube installed.
2. The geometric mean of the frequencies at which the v.s.w.r. is 1.33:1.
3. Measured at a low power level, at 3620MHz.
4. Measured at 5.0kW peak power, 0.1μs pulse length and 1000p.p.s.
5. Measured at 5.0kW peak power, 1.0μs pulse length and 1000p.p.s.

OUTLINE



Ref	Millimetres	Inches
A	132.0 ± 5.0	5.197 ± 0.197
B	25.40 max	1.000 max
C	1.40 ± 0.13	0.055 ± 0.005
D	1.40 ± 0.13	0.055 ± 0.005
E	15.85 max 15.77 min	0.624 max 0.621 min
F	112.0 max	4.409 max
G	82.4 ± 0.9	3.244 ± 0.035
H	21.50 ± 0.05	0.846 ± 0.002
J	3.95 ± 0.15	0.156 ± 0.006
K	11.0 ± 0.3	0.433 ± 0.012

Inch dimensions have been derived from millimetres.

BS716

PLUG-IN PRE-TR TUBE

Service Type CV2430

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Plug-in pre-TR tube

CHARACTERISTICS (See note 1)

Frequency range	2600 to 3950	MHz
Centre frequency (see note 2)	3288 to 3324	MHz
V.S.W.R. (see note 3)	1.08:1	max
Maximum leakage:		
spike energy (see note 4)	150	μJ/pulse
peak flat power (see note 5)	150	W
Attenuation recovery period to −6db (see note 5)	15	μs max
Insertion loss (see note 3)	0.2	db max
Arc loss (see note 6)	0.8	db max
Position of short circuit (see note 7)	0.085 ± 0.025 inch (2.16 ± 0.64mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	10	500	kW
Transmitter power (mean)	–	500	W
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	see Outline
Finish	metal parts silver or nickel plated
Mounting position	any
Net weight	110g (4 ounces) approx

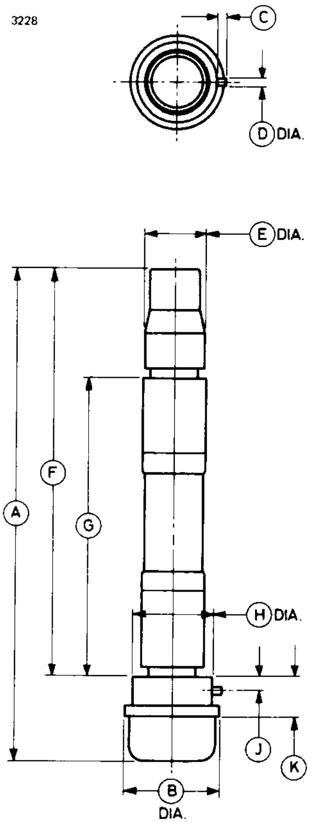
NOTES

1. The tube is designed for use in a no. 10 or no. 11 waveguide mount. The frequency and performance characteristics depend on the design of the mount, which should have a loaded Q of 1.0 max, with the tube installed.
2. The geometric mean of the frequencies at which the v.s.w.r. is 1.33:1.
3. Measured at a low power level, at 3305MHz.

4. Measured at 100kW peak power, 0.1μs pulse length and 1000p.p.s.
5. Measured at 100kW peak power, 1.0μs pulse length and 1000p.p.s.
6. Measured at 10kW peak power, 1.0μs pulse length and 1000p.p.s.
7. Measured from the axis of the tube towards the transmitter, with 50kW peak power, 1.0μs pulse length and 1000p.p.s.

OUTLINE

3228



Ref	Millimetres	Inches
A	132.0 ± 5.0	5.197 ± 0.197
B	25.40 max	1.000 max
C	2.4 ± 0.8	0.094 ± 0.031
D	2.9 ± 0.1	0.114 ± 0.004
E	15.85 max 15.77 min	0.624 max 0.621 min
F	112.0 max	4.409 max
G	82.4 ± 0.9	3.244 ± 0.035
H	21.50 ± 0.05	0.846 ± 0.002
J	3.95 ± 0.15	0.156 ± 0.006
K	11.0 ± 0.3	0.433 ± 0.012

Inch dimensions have been derived from millimetres.

BS718

PLUG-IN TR TUBE

Service Type CV2378

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Plug-in, primerless TR tube.

CHARACTERISTICS (See note 1)

Frequency range	2755 to 2915	MHz
V.S.W.R.:		
at 2825MHz	1.11:1	max
at 2755 and 2915MHz	1.82:1	max
Maximum leakage:		
spike energy (see note 2)	3.0	μJ/pulse
peak flat power (see note 3)	3.0	W
Attenuation recovery period to −6db (see note 3)	25	μs max
Insertion loss (see note 4)	0.2	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.1	5.0	kW
Duty cycle	–	0.00125	
Ambient temperature (non-operating)	−40	+100	°C

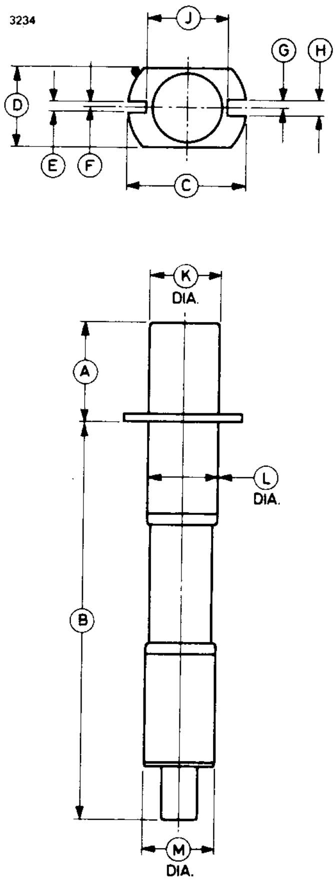
GENERAL

Overall dimensions	see Outline
Finish	metal parts silver or nickel plated
Mounting position	any
Net weight	150g (5.3 ounces) approx

NOTES

1. The tube is designed for use in a no. 10 waveguide mount. The frequency and performance characteristics depend on the design of the mount.
2. Measured at 5.0kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 5.0kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a low power level, at 2825MHz.

OUTLINE



Ref	Inches	Millimetres
A	1.640 max	41.66 max
B	4.180 ± 0.120	106.2 ± 3.0
C	1.250 ± 0.040	31.75 ± 1.02
D	0.850 ± 0.010	21.59 ± 0.25
E	0.094 ± 0.020	2.39 ± 0.51
F	0.047 ± 0.010	1.19 ± 0.25
G	0.078 ± 0.010	1.98 ± 0.25
H	0.156 ± 0.020	3.96 ± 0.51
J	0.850 ± 0.010	21.59 ± 0.25
K	0.744 ± 0.010	18.90 ± 0.25
L	0.740 min	18.80 min
M	0.740 min	18.80 min

Millimetre dimensions have been derived from inches.

BS720

S-BAND
PULSED ATTENUATOR

Service Type CV2379

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Plug-in pulsed attenuator

CHARACTERISTICS (See note 1)

Frequency range	2755 to 2915	MHz
V.S.W.R. at 2825MHz	1.11:1	max
V.S.W.R. at 2755MHz	1.82:1	max
V.S.W.R. at 2915MHz	1.82:1	max
Maximum leakage (see note 2):		
spike energy (primer current 50μA)	60	nJ/pulse
spike energy (primer current 700μA)	5.0	nJ/pulse
high power flat (primer current 700μA)	20	mW peak
Insertion loss at 2825MHz	0.2	db max
Recovery period to −6db (see note 2)	25	μs max
Excess noise (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	−	3.0	W
Primer supply voltage (negative) (see note 4)	900	1100	V
Primer current:			
standby	50	52	μA
pulsed (see note 4)	700	800	μA
Duration of primer pulse	33	40	μs
Transmitter duty cycle	−	0.00125	
Temperature range (non-operating)	−40	+100	°C

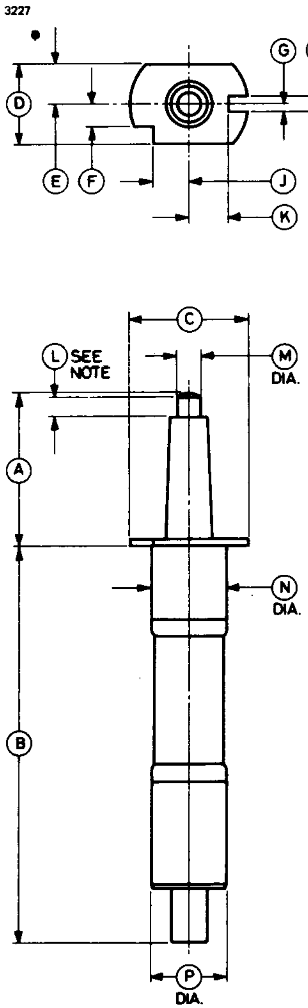
GENERAL

Overall dimensions	150.6 x 32.8 x 21.9mm max 5.930 x 1.291 x 0.860 inches max
Finish	metal parts silver or nickel plated
Mounting position	any
Net weight	150g (5 ounces) approx

NOTES

1. The tube is designed for use with a no. 10 waveguide mount. Operating performance depends upon the design of the mount.
2. Measured at 3.0W peak power, 1000p.p.s., 1.0μs pulse duration, at a frequency of 2.8GHz.
3. With the attenuator tested in noise measuring equipment at 2825MHz. The increase in generated noise is measured when a primer current of 50 $\pm$ 1μA is switched on.
4. Primer supply to be pulsed at 700μA for a period of 35μs, such that the high power r.f. pulse occurs during the final 5.0μs of the primer pulse.

OUTLINE



Ref	Millimetres	Inches
A	41.6 max	1.638 max
B	106.0 ± 3.0	4.173 ± 0.118
C	31.8 ± 1.0	1.252 ± 0.039
D	21.60 ± 0.25	0.850 ± 0.010
E	10.80 ± 0.12	0.425 ± 0.005
F	6.35 ± 0.50	0.250 ± 0.020
G	1.98 ± 0.25	0.078 ± 0.010
H	3.96 ± 0.50	0.156 ± 0.020
J	9.5 ± 0.5	0.374 ± 0.020
K	10.8 ± 0.25	0.425 ± 0.010
L	3.2 min	0.126 min
M	6.35 ± 0.25	0.250 ± 0.010
N	18.8 min	0.740 min
P	18.8 min	0.740 min

Inch dimensions have been derived from millimetres.

Note Parallel length

BS724 BS726 BS728

PLUG-IN TR PROTECTOR TUBES

Service Type CV2488

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Plug-in protector tubes, operated as a matched set of three in a broadband waveguide mount.

CHARACTERISTICS (See note 1)

Frequency range	2600 to 4100	MHz
Maximum leakage, total power (see note 2)	300	mW
Recovery period to −6db (see note 2)	70	μs max
Insertion loss:		
at 2500MHz	4.3	db max
at 4100MHz	4.0	db max
Primer firing time	5.0	s max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Operating power (peak)	–	15	W
Operating power (mean)	–	15	mW
Primer supply voltage (negative)	950	1100	V
Primer current (per tube)	45	65	μA
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

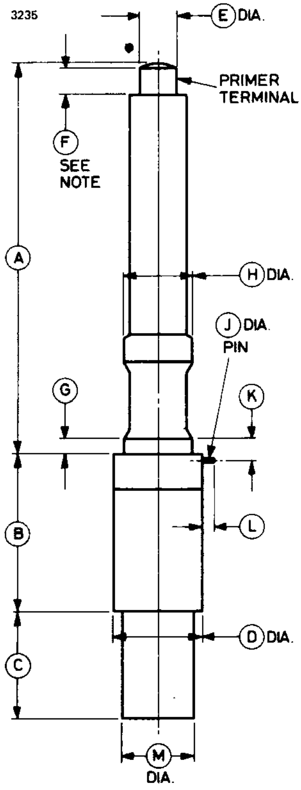
Overall dimensions	see Outline
Finish	any DEF 5000
Mounting position	any
Net weight	60g (2 ounces) approx

NOTES

1. For a set of three tubes operating in a standard mount, with primers energized at −1000V via an impedance of 13.6MΩ.
2. Measured at 10W peak power, 1.0μs pulse length and 1000p.p.s.

February 1971

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.750 ± 0.050	69.85 ± 1.27
B	1.115 ± 0.030	28.32 ± 0.76
C	0.750 max	19.05 max
D	0.633 max	16.08 max
	0.610 min	15.49 min
E	0.250	6.35
F	0.125 min	3.18 min
G	0.110 max	2.79 max
	0.103 min	2.62 min
H	0.484 min	12.29 min
J	0.042	1.07
K	0.141	3.58
L	0.078 ± 0.015	1.98 ± 0.38
M	0.520 max	13.21 max

Millimetre dimensions have been derived from inches.

Note Parallel length of top cap.

BS732

PLUG-IN
TR TUBE

Service Type CV5398

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Plug-in, primerless TR tube.

CHARACTERISTICS (See note 1)

Frequency range	2600 to 3950	MHz
Centre frequency (see note 2)	3600 to 3645	MHz
V.S.W.R. (see note 3)	1.12:1	
Maximum leakage:		
spike energy (see note 4)	1.6	μJ/pulse
total power (see note 5)	3.5	W
Recovery period to −6db (see note 5)	16	μs max
Insertion loss (see note 3)	0.2	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.5	5.0	kW
Ambient temperature (non-operating)	−40	+100	°C

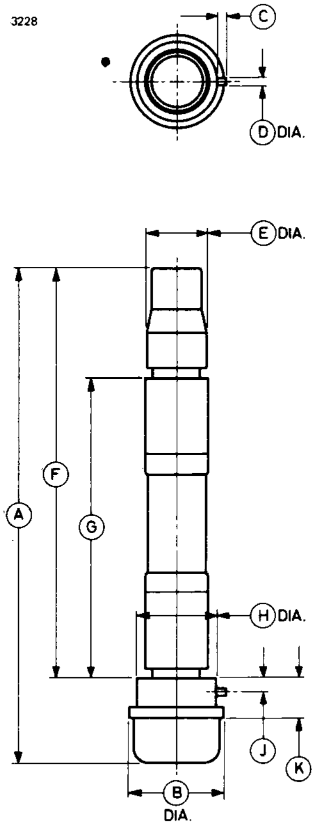
GENERAL

Overall dimensions	see Outline
Finish	metal parts silver or nickel plated
Mounting position	any
Net weight	120g (4.2 ounces) approx

NOTES

1. The tube is designed for use in a no. 10 or no. 11 waveguide mount. The frequency and performance characteristics depend on the design of the mount, which should have a loaded Q of 6.0 with the tube installed.
2. The mean of the frequencies at which the v.s.w.r. is 1.33:1.
3. Measured at a low power level, at 3620MHz.
4. Measured at 5.0kW peak power, 0.1μs pulse length and 1000p.p.s.
5. Measured at 5.0kW peak power, 1.0μs pulse length and 1000p.p.s.

OUTLINE



Ref	Millimetres	Inches
A	132.0 ± 5.0	5.197 ± 0.197
B	25.40 max	1.000 max
C	3.18 max	0.125 max
D	2.9 ± 0.1	0.114 ± 0.004
E	15.85 max	0.624 max
	15.77 min	0.621 min
F	112.0 max	4.409 max
G	82.4 ± 0.9	3.244 ± 0.035
H	21.50 ± 0.05	0.846 ± 0.002
J	3.95 ± 0.15	0.156 ± 0.006
K	11.0 ± 0.3	0.433 ± 0.012

Inch dimensions have been derived from millimetres.

BS834

PLUG-IN
PRE-TR TUBE

Service Type CV6028

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, low loss, plug-in pre-TR tube with no external connections.

CHARACTERISTICS (See note 1)

Frequency range (see note 2)	2.0 to 12	GHz
Breakdown power (see note 3)	20	kW max
Recovery period to −3db (see note 4)	25	µs max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (see note 5):			
peak	–	2.5	MW
mean	–	3.0	kW
Pulse length	–	2.5	µs
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature	−50	+100	°C

GENERAL

Overall dimensions	see Outline
Radio-active content (see note 6)	10 microcuries approx
Mounting position (see note 7)	any
Net weight	10g approx

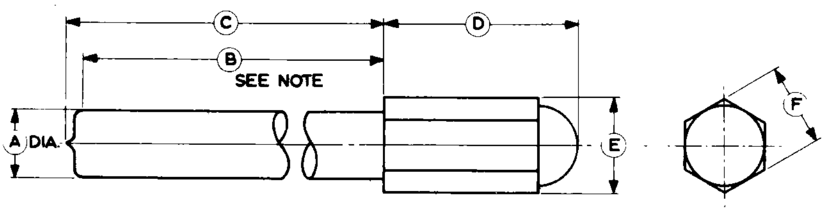
NOTES

1. The tube is tested at 9.5 ± 0.5GHz in a balanced duplexer in WG16 waveguide; the maximum v.s.w.r. looking outwards from the duplexer does not exceed 1.2:1 on any arm. A pulse length of 0.2µs ± 10% at a duty cycle of 0.0002 ± 10% is used.
2. The tube may be used in a suitable waveguide mount at any frequency within this range. The bandwidth and matching are determined by the design of the mount.

3. The power incident on a balanced duplexer.
4. Measured with peak input power 50kW ± 10%.
5. The power incident on a balanced duplexer where two tubes are each operating across both arms of the duplexer.
6. The radio-activity is low energy β emission, which is completely absorbed by the silica envelope of the tube.
7. The hole through which the tube passes should be 0.3576 ± 0.0005 inch (9.083 ± 0.013mm) diameter.

OUTLINE

2213



Ref	Inches	Millimetres
A	0.3568 ± 0.0002	9.063 ± 0.005
B	6.500 min	165.1 min
C	7.000 max	177.8 max
D	1.000 ± 0.010	25.40 ± 0.25
E	0.505 max	12.83 max
F	0.434 ± 0.003	11.024 ± 0.076

Millimetre dimensions have been derived from inches.

Outline Note Dimension B refers to the ground length.

BS836

PLUG-IN
PRE-TR TUBE

Service Type CV6086

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, low loss, plug-in pre-TR tube with no external connections.

CHARACTERISTICS (See note 1)

Frequency range (see note 2)	2.0 to 12	GHz
Breakdown power (see note 3)	20	kW max
Recovery period to −3db (see note 4)	8.0	μs max
	2.0	μs min

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (see note 5):			
peak	–	250	kW
mean	–	250	W
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature	−50	+100	°C

GENERAL

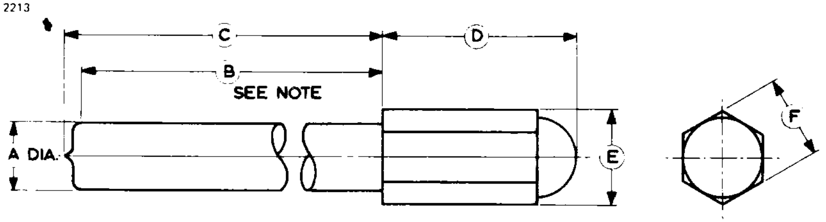
Overall dimensions	see Outline
Radio-active content (see note 6)	10 microcuries approx
Mounting position (see note 7)	any
Net weight	5g approx

NOTES

1. The tube is tested at 9.5 ± 0.5GHz in a balanced duplexer in WG16 waveguide; the maximum v.s.w.r. looking outwards from the duplexer does not exceed 1.2:1 on any arm. A pulse length of 0.2μs ± 10% at a duty cycle of 0.0002 ± 10% is used.
2. The tube may be used in a suitable waveguide mount at any frequency within this range. The bandwidth and matching are determined by the design of the mount.

3. The power incident on a balanced duplexer.
4. Measured with peak input power 50kW ± 10%.
5. The power incident on a balanced duplexer where two tubes are each operating across both arms of the duplexer.
6. The radio-activity is low energy β emission, which is completely absorbed by the silica envelope of the tube.
7. The hole through which the tube passes should be 0.3576 ± 0.0005 inch (9.083 ± 0.013mm) diameter.

OUTLINE



Ref	Inches	Millimetres
A	0.3568 ± 0.0002	9.063 ± 0.005
B	2.625 min	66.68 min
C	2.875 max	73.03 max
D	1.000 ± 0.010	25.40 ± 0.25
E	0.505 max	12.83 max
F	0.434 ± 0.003	11.024 ± 0.076

Millimetre dimensions have been derived from inches.

Outline Note Dimension B refers to the ground length.

BS838

PLUG-IN PRE-TR TUBE

Service Type CV2482

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, low loss, plug-in pre-TR tube with no external connections.

CHARACTERISTICS (See note 1)

Frequency range (see note 2)	2.0 to 12	GHz
Breakdown power (see note 3)	20	kW max
Recovery period to −3db (see note 4)	8.0	μs max
	2.0	μs min

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (see note 5):			
peak	–	500	kW
mean	–	500	W
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature	−50	+100	°C

GENERAL

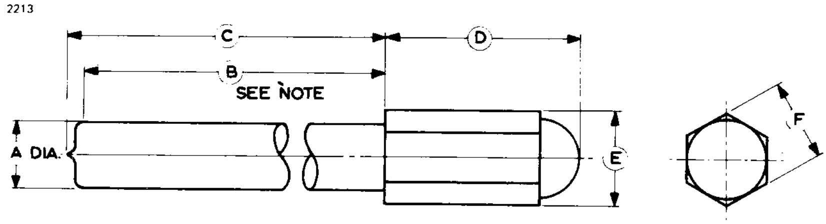
Overall dimensions	see Outline
Radio-active content (see note 6)	10 microcuries approx
Mounting position (see note 7)	any
Net weight	6.5g approx

NOTES

1. The tube is tested at 9.5 ± 0.5GHz in a balanced duplexer in WG16 waveguide; the maximum v.s.w.r. looking outwards from the duplexer does not exceed 1.2:1 on any arm. A pulse length of 0.2μs ± 10% at a duty cycle of 0.0002 ± 10% is used.
2. The tube may be used in a suitable waveguide mount at any frequency within this range. The bandwidth and matching are determined by the design of the mount.

3. The power incident on a balanced duplexer.
4. Measured with peak input power 50kW ± 10%.
5. The power incident on a balanced duplexer where two tubes are each operating across both arms of the duplexer.
6. The radio-activity is low energy β emission, which is completely absorbed by the silica envelope of the tube.
7. The hole through which the tube passes should be 0.3576 ± 0.0005 inch (9.083 ± 0.013mm) diameter.

OUTLINE



Ref	Inches	Millimetres
A	0.3568 ± 0.0002	9.063 ± 0.005
B	4.500 min	114.3 min
C	5.000 max	127 max
D	1.000 ± 0.010	25.40 ± 0.25
E	0.505 max	12.83 max
F	0.434 ± 0.003	11.024 ± 0.076

Millimetre dimensions have been derived from inches.

Outline Note Dimension B refers to the ground length.

BS940

PLUG-IN
PRE-TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, low loss, plug-in pre-TR tube with no external connections.

CHARACTERISTICS (See note 1)

Frequency range (see note 2)	2000 to 5500	MHz
Breakdown power (see note 3)	10	kW max
Recovery period to −3db (see note 4)	100	μs max
Insertion loss (see note 5)	1.0	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (see note 6):			
peak	–	1.25	MW
mean	–	1.5	kW
Pulse length	–	2.5	μs
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature	−50	+100	°C

GENERAL

Overall dimensions	see Outline
Mounting position (see note 7)	any
Net weight	33g (1.2 ounce) approx

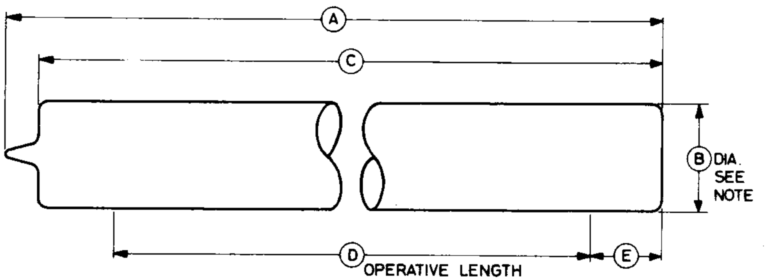
NOTES

1. The tube is tested within the band 2710 to 3180MHz in a balanced duplexer in WG10 waveguide; the maximum v.s.w.r. looking outwards from the duplexer does not exceed 1.2:1 on any arm. A pulse length of 1.0μs ± 10% at a duty cycle of 0.001 ± 10% is used.
2. The tube may be used in a suitable waveguide mount at any frequency within this range. The bandwidth and matching are determined by the design of the mount.

3. The power incident on a balanced duplexer.
4. Measured with peak input power 150kW.
5. Measured at 2715, 2945 and 3175MHz.
6. The power incident on a balanced duplexer where two tubes are each operating across both arms of the duplexer.
7. The hole through which the tube passes should be 0.5603 to 0.5606 inch (14.232 to 14.239mm) diameter.

OUTLINE

2854



Ref	Inches	Millimetres
A	9.250 max	235.0 max
B	0.5600 max	14.224 max
	0.5595 min	14.211 min
C	8.500 min	215.9 min
D	8.000 min	203.2 min
E	0.500 max	12.70 max

Millimetre dimensions have been derived from inches.

Outline Note The minimum dimension applies over the operative length only.

Pre-TR and Protector Tubes

BS824

S-BAND PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube, designed for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	2700 to 3100	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	600	nJ/pulse
total power (see notes 2 and 3)	0.9	W
low power	10	W
Recovery period to −3db (see note 2)	15	μs max
Insertion loss	0.4	db max
Position of short circuit (see notes 2 and 4)	0.080 inch (2.03mm)	nom

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	–	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

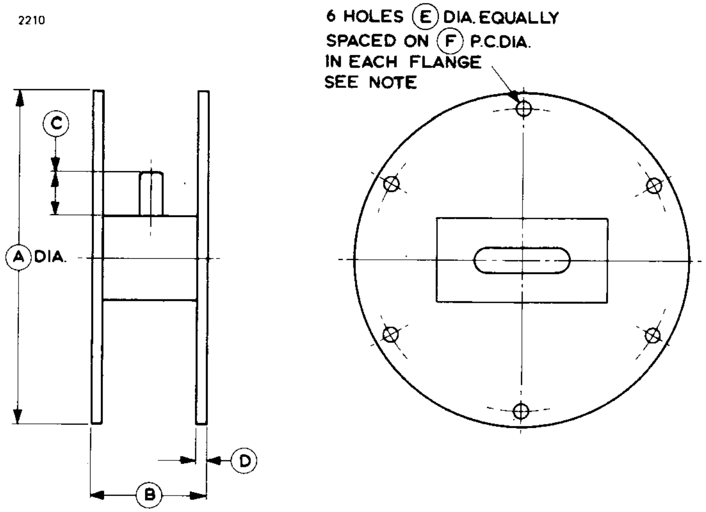
Overall dimensions	2.030 x 5.891 x 5.891 inches max 51.56 x 149.6 x 149.6mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	mates with NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	3¼ pounds (1.5kg) approx

February 1971

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 100kW peak power, 1.0μs pulse length and 1000p.p.s.
3. This is equivalent to 0.6W when tested at 2.0μs pulse length.
4. Distance of the effective r.f. short circuit behind the flange.
5. The tube will operate at 1.25MW peak power, with reduced life.

OUTLINE



Ref	Inches	Millimetres
A	5.875 ± 0.016	149.2 ± 0.4
B	2.020 ± 0.010	51.31 ± 0.25
C	1.000 max	25.40 max
D	0.203 max	5.16 max
E	0.260 ± 0.004	6.6 ± 0.1
F	5.375	136.5

Millimetre dimensions have been derived from inches except dimension E.

Note Holes in flanges are in alignment within 0.010 inch (0.25mm).

BS832

S-BAND PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube, designed for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	2700 to 3100	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	600	nJ/pulse
total power (see notes 2 and 3)	0.9	W
low power	10	W
Recovery period to −3db (see note 2)	15	μs max
Insertion loss	0.4	db max
Position of short circuit (see notes 2 and 4)	0.080 inch (2.03mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	–	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

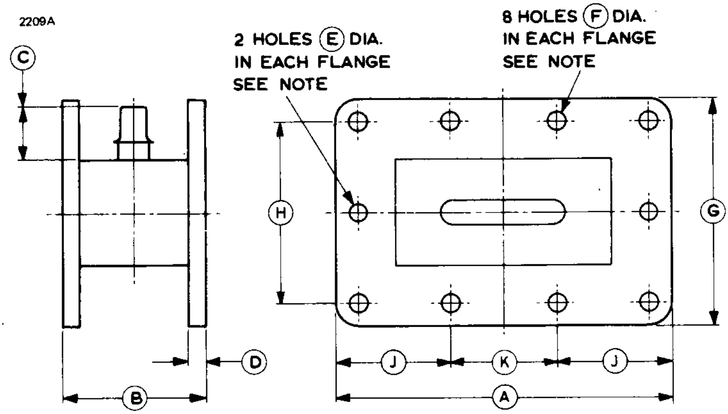
GENERAL

Overall dimensions	2.010 x 3.281 x 4.781 inches max 51.05 x 83.34 x 121.4mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	mates with NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	2¾ pounds (1.25kg) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 100kW peak power, 1.0μs pulse length and 1000p.p.s.
3. This is equivalent to 0.6W when tested at 2.0μs pulse length.
4. Distance of the effective r.f. short circuit behind the flange.
5. The tube will operate at 1.25MW peak power, with reduced life.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.766 ± 0.016	121.1 ± 0.4	F*	0.260 ± 0.004	6.6 ± 0.1
B	2.000 ± 0.010	50.80 ± 0.25	G	3.266 ± 0.016	82.96 ± 0.41
C	0.875 max	22.23 max	H	2.564	65.13
D	0.250 min	6.35 min	J	1.281	32.54
E*	0.252 max 0.250 min	6.40 max 6.35 min	K	1.500	38.10

Millimetre dimensions have been derived from inches except where indicated thus *

Note Holes in flanges are in alignment to within 0.010 inch (0.25mm).

BS846

S-BAND PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube, designed for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	2700 to 3100	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	600	nJ/pulse
total power (see notes 2 and 3)	0.9	W
low power	10	W
Recovery period to −3db (see note 2)	15	µs max
Insertion loss	0.4	db max
Position of short circuit (see notes 2 and 4)	0.080 inch (2.03mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	–	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

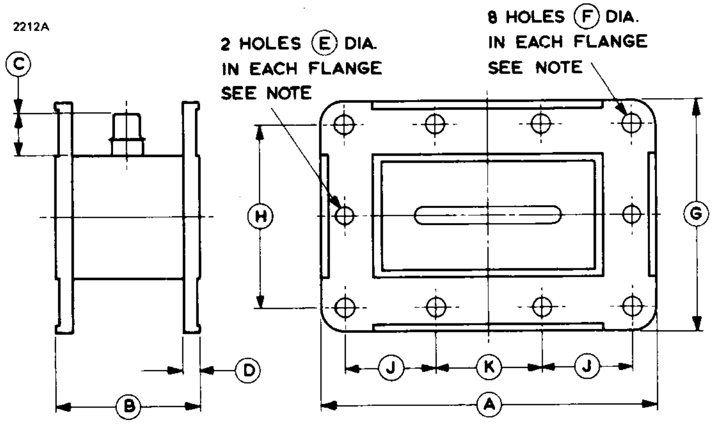
Overall dimensions	2.030 x 3.281 x 4.781 inches max 51.56 x 83.34 x 121.4mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	mates with NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	2¾ pounds (1.25kg) approx

March 1971

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 100kW peak power, 1.0μs pulse length and 1000p.p.s.
3. This is equivalent to 0.6W when tested at 2.0μs pulse length.
4. Distance of the effective r.f. short circuit behind the flange.
5. The tube will operate at 1.25MW peak power, with reduced life.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.766 ± 0.016	121.1 ± 0.4	F*	0.260 ± 0.004	6.6 ± 0.1
B	2.020 ± 0.010	51.31 ± 0.25	G	3.266 ± 0.016	82.96 ± 0.41
C	0.625 max	15.88 max	H	2.564	65.13
D	0.250 min	6.35 min	J	1.281	32.54
E*	0.252 max	6.40 max	K	1.500	38.10
	0.250 min	6.35 min			

Millimetre dimensions have been derived from inches except where indicated thus *.

Note Holes in flanges are in alignment to within 0.010 inch (0.25mm).

BS848

S-BAND PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube, designed for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	2700 to 3200	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	600	nJ/pulse
total power (see notes 2 and 3)	0.9	W
low power	10	W
Recovery period to −3db (see note 2)	15	μs max
Insertion loss	0.4	db max
Position of short circuit (see notes 2 and 4)	0.080 inch (2.03mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	–	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

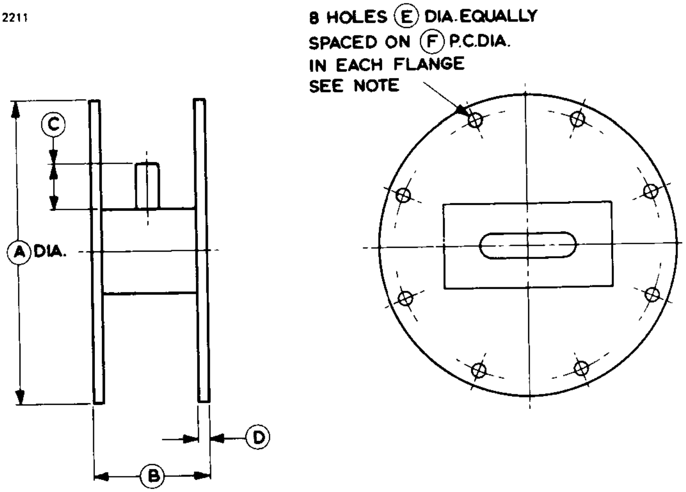
GENERAL

Overall dimensions	2.010 x 5.329 x 5.329 inches max 51.05 x 135.4 x 135.4mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	mates with NATO S.N. 5985-99-083-0010 (UG-53/U, 154 IEC–PAR32)
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	3¼ pounds (1.5kg) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 100kW peak power, 1.0μs pulse length and 1000p.p.s.
3. This is equivalent to 0.6W when tested at 2.0μs pulse length.
4. Distance of the effective r.f. short circuit behind the flange.
5. The tube will operate at 1.25MW peak power, with reduced life.

OUTLINE



Ref	Inches	Millimetres
A	5.313 ± 0.016	135.0 ± 0.4
B	2.000 ± 0.010	50.80 ± 0.25
C	1.000 max	25.40 max
D	0.203 max	5.16 max
E	0.260 ± 0.004	6.6 ± 0.1
F	4.750	120.7

Millimetre dimensions have been derived from inches except dimension E.

Note Holes in flanges are in alignment within 0.010 inch (0.25mm).

BS856

C-BAND PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube, designed for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	5300 to 5700	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	400	nJ/pulse
flat power (see note 2)	0.6	W
low power	6.0	W
Recovery period to −3db (see note 2)	15	μs max
Insertion loss	0.5	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 3)	–	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

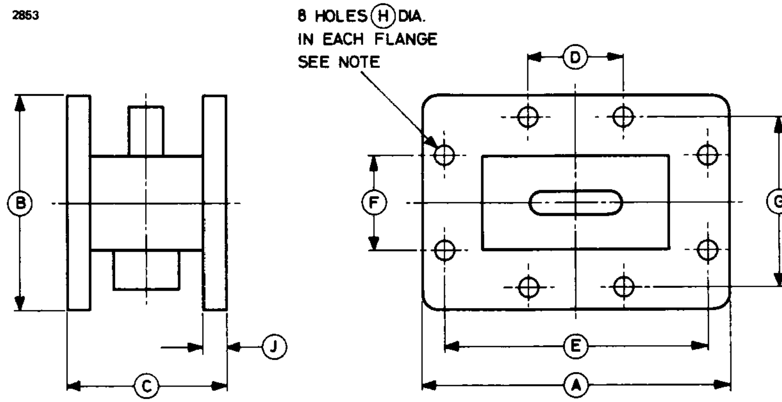
Overall dimensions	1.700 x 2.266 x 3.266 inches max 43.18 x 57.56 x 82.96mm max
Waveguide size	no. 12 (1.872 x 0.872 inches internal)
Coupler	see Outline
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	1.1 pounds (0.5kg) approx

March 1971

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 100kW peak power, 2.5μs pulse length and 600p.p.s.
3. The tube will operate at 1.25MW peak power, with reduced life.

OUTLINE



Ref	Inches	Millimetres
A	3.250 ± 0.015	82.55 ± 0.38
B	2.250 ± 0.015	57.15 ± 0.38
C	1.693 ± 0.008	43.00 ± 0.20
D	1.000 ± 0.005	25.40 ± 0.13
E	2.787 ± 0.007	70.79 ± 0.18
F	1.000 ± 0.005	25.40 ± 0.13
G	1.790 ± 0.005	45.47 ± 0.13
H	0.205 ± 0.005	5.20 ± 0.13
J	0.250 min	6.35 min

Millimetre dimensions have been derived from inches except dimension H.

Note Holes in flanges are in alignment to within 0.010 inch (0.25mm).

BS858

C-BAND
TWIN PRE-TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broadband primerless twin pre-TR tube for the protection of the r.f. amplifiers and mixer diodes in a balanced duplexer.

CHARACTERISTICS (See Note 1)

Frequency range	5250 to 5710	MHz
V.S.W.R. (see note 2)	1.3:1	max
Maximum leakage:		
spike energy (see note 3)	25	nJ/pulse
flat (peak) (see note 3)	50	mW
low power (peak) (see note 4)	6	W
Recovery period to −3db (see note 3)	15	μs max
Insertion loss (see note 2)	0.5	db max
Arc loss (see note 3)	0.6	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 1)	–	1.0	MW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

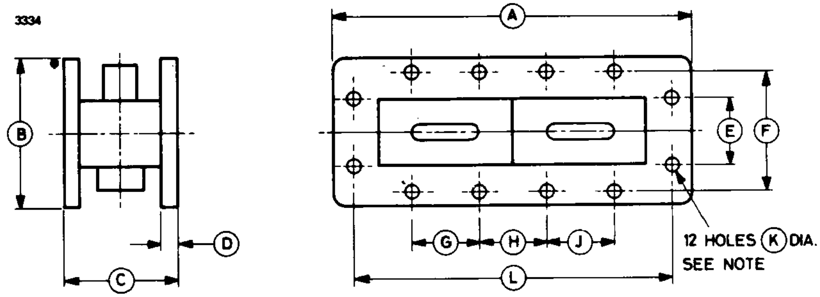
GENERAL

Overall dimensions	5.265 x 2.265 x 1.701 inches max 133.7 x 57.53 x 43.21mm max
Waveguide size	2 x no. 12 (1.872 x 0.872 inches internal)
Finish	tin plated
Mounting position	any
Net weight	1.9 pounds (850g) approx

NOTES

1. All electrical tests performed with the tube mounted between sidewall 3db couplers of minimum isolation 25db and v.s.w.r. into matched loads of better than 1.1:1 over the specified frequency range.
2. Measured at a power level below 10mW over the frequency range, between aerial and receiver ports with a variable short circuit on the transmitter port.
3. Measured at 400kW peak power input, 2.5μs pulse length and 600p.p.s.
4. Measured at 2.5μs pulse length and 600p.p.s. by increasing the incident power from zero until the tube fires.

OUTLINE



Ref	Inches	Millimetres
A	5.250 ± 0.015	133.4 ± 0.4
B	2.250 ± 0.015	57.15 ± 0.4
C*	1.693 ± 0.008	43.00 ± 0.20
D	0.250	6.35
E	1.000 ± 0.005	25.40 ± 0.13
F	1.790 ± 0.005	45.47 ± 0.13
G	1.000 ± 0.005	25.40 ± 0.13
H	1.000 ± 0.005	25.40 ± 0.13
J	1.000 ± 0.005	25.40 ± 0.13
K*	0.205 ± 0.005	5.20 ± 0.13
L	4.787 ± 0.007	121.6 ± 0.18

Millimetre dimensions have been derived from inches except where marked *.

Note The corresponding holes of both flanges are in alignment within 0.010 inch (0.25mm). Positional tolerance 0.006 inch (0.15mm).

BS870

L-BAND
PRE-TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless pre-TR tube for balanced or T junction duplexers.

CHARACTERISTICS

Frequency range	1240 to 1370	MHz
V.S.W.R. (see note 1)	1.25:1	max
Recovery period to −3db (see note 2)	20	μs max
Insertion loss (see note 1)	0.4	db max
Arc loss (see note 2)	0.2	db max
Position of short circuit (see note 3)	0.106 ± 0.040 inch (2.7 ± 1.0mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 4)	–	2.5	MW
Waveguide pressure	–	150	kN/m²
	–	22	lb/in²
Ambient temperature:			
non-operating	−40	+100	°C
operating	0	+60	°C

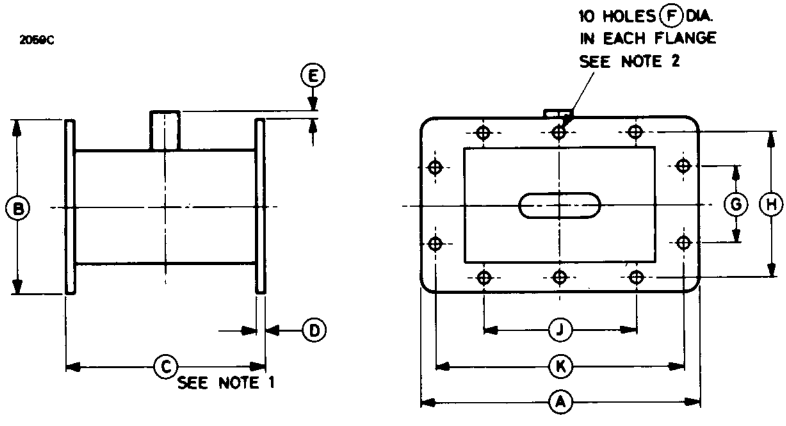
GENERAL

Overall dimensions	222.5 x 160.0 x 140.0mm nom 8.760 x 6.299 x 5.512 inches nom
Waveguide size	no. 6 (6.500 x 3.250 inches internal)
Coupler	mates with 154 I.E.C.-PDR14 or NATO S.N. 5985-99-083-1573
Finish	tin plated
Mounting position	any
Net weight	8¼ pounds (3.7kg) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 500p.p.s.
3. Distance of the effective r.f. short circuit behind input flange.
4. On the duplexer; the power incident on each tube is half this value.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	222.5 ± 0.5	8.760 ± 0.020	F	9.1 ± 0.1	0.358 ± 0.004
B	140.0 ± 0.5	5.512 ± 0.020	G	63.50	2.500
C	160.0 ± 0.05	6.299 ± 0.002	H	117.4	4.624
D	7.0 min	0.276 min	J	120.7	4.750
E	10.0 max	0.394 max	K	200.0	7.875

Inch dimensions have been derived from millimetres.

Outline Notes

1. The two flange faces are flat and parallel within 0.1mm (0.004 inch).
2. The corresponding holes in both flanges are in alignment within 0.5mm (0.020 inch).

BS872

L-BAND
TR PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad band primerless TR tube for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	1240 to 1365	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	700	nJ/pulse
total power (see note 3)	1.0	W
low power	10	W
Recovery period to −3db (see note 3)	20	μs max
Insertion loss (see note 1)	0.3	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	10	kW
Waveguide pressure	–	150	kN/m^2
	–	22	lb/in^2
Ambient temperature:			
non-operating	−40	+100	°C
operating	0	+60	°C

GENERAL

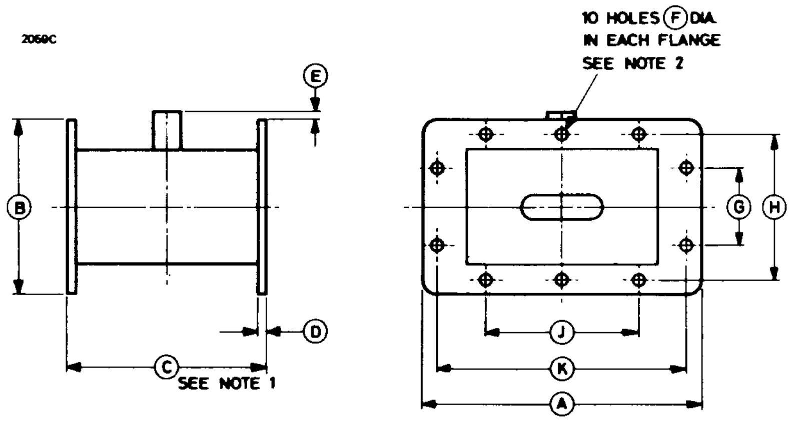
Overall dimensions	222.5 x 160.0 x 140.0mm nom 8.760 x 6.299 x 5.512 inches nom
Waveguide size	no. 6 (6.500 x 3.250 inches internal)
Coupler	mates with 154 I.E.C.-PDR14 or NATO S.N. 5985-99-083-1573
Finish	tin plated
Mounting position	any
Net weight	8¼ pounds (3.7kg) approx

March 1971

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0kW peak power, 0.1μs pulse length and 500p.p.s.
3. Measured at 1.0kW peak power, 1.0μs pulse length and 500p.p.s.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	222.5 ± 0.5	8.760 ± 0.020	F	9.1 ± 0.1	0.358 ± 0.004
B	140.0 ± 0.5	5.512 ± 0.020	G	63.5	2.500
C	160.0 ± 0.05	6.299 ± 0.002	H	117.4	4.624
D	7.0 min	0.276 min	J	120.7	4.750
E	10.0 max	0.394 max	K	200.0	7.875

Inch dimensions have been derived from millimetres.

Outline Notes

1. The two flange faces are flat and parallel within 0.1mm (0.004 inch).
2. The corresponding holes in both flanges are in alignment within 0.5mm (0.020 inch).

BS876

L-BAND COAXIAL PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	1230 to 1365	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	23	μJ/pulse
total power (see note 2)	30	μJ/pulse
low power	50	W
Recovery period to −3db (see note 2)	10	μs max
Insertion loss (see note 1)	0.7	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 3)	–	10	kW
Pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

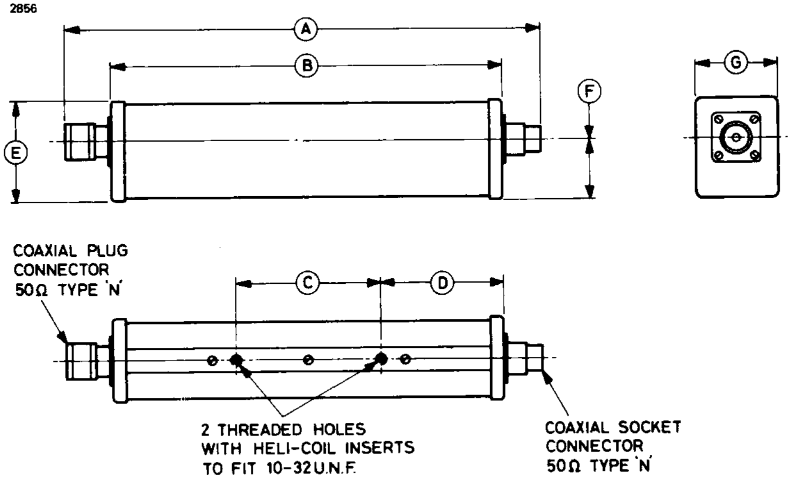
Overall dimensions	254.0 x 54.5 x 45.0mm max 10.000 x 2.146 x 1.772 inches max
R.F. connections	50Ω type N coaxial
Finish	plastic coated steel and chromium plate
Mounting position (see note 4)	any
Net weight	1kg (2.2 pounds) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0kW peak power, 1.4μs pulse length, and 500p.p.s.
3. Determined by the breakdown of the coaxial connector.
4. If the tapped holes in the base are used for mounting, the two washers supplied (0.040 inch thick x 1.25 inches diameter) must be placed between the base and the equipment frame to prevent bending strain on the tube.

OUTLINE

2856



Ref	Millimetres	Inches
A	253.0 ± 1.0	9.960 ± 0.040
B	209.5 ± 1.5	8.245 ± 0.060
C	76.2 ± 0.2	3.000 ± 0.008
D	66.5 ± 1.0	2.619 ± 0.040
E	54.0 ± 0.5	2.126 ± 0.020
F	31.5 ± 0.5	1.240 ± 0.020
G	44.5 ± 0.5	1.752 ± 0.020

Inch dimensions have been derived from millimetres.

N.B. Before mounting see note 4 above.

BS904

S-BAND COAXIAL PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	2700 to 3100	MHz
V.S.W.R. (see note 1)	1.25:1	max
Maximum leakage:		
spike energy (see note 2)	4.0	μJ/pulse
total power (see note 2)	6.0	μJ/pulse
low power	30	W
Recovery period to −3db (see note 2)	10	μs max
Insertion loss (see note 1)	0.7	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 3)	–	10	kW
Pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

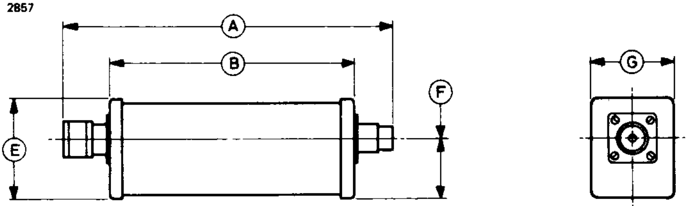
Overall dimensions	6.940 x 2.130 x 1.765 inches max 176.3 x 54.10 x 44.83mm max
R.F. connections	50Ω type N coaxial
Finish	plastic coated steel and chromium plate
Mounting position (see note 4)	any
Net weight	1.5 pounds (0.7kg) approx

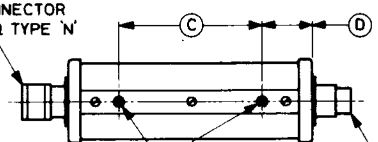
NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 3.0kW peak power, 1.0μs pulse length and 1000p.p.s.
3. Determined by the breakdown of the coaxial connector.
4. If the tapped holes in the base are used for mounting, the two washers supplied (0.040 inch thick x 1.25 inches diameter) must be placed between the base and the equipment frame to prevent bending strain on the tube.

OUTLINE

2857





Ref	Inches	Millimetres
A	6.910 ± 0.030	175.5 ± 0.8
B	5.125 ± 0.030	130.2 ± 0.8
C	3.000 ± 0.005	76.20 ± 0.13
D	1.060 ± 0.020	26.92 ± 0.51
E	2.120 ± 0.010	53.85 ± 0.25
F	1.250 ± 0.010	31.75 ± 0.25
G	1.755 ± 0.010	44.58 ± 0.25

Millimetre dimensions have been derived from inches.

N.B. Before mounting see note 4 above.

BS910

L-BAND TWIN PRE-TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless twin pre-TR tube for use in balanced duplexers.

CHARACTERISTICS

Frequency range	1250 to 1350	MHz
V.S.W.R. (see note 1):		
1250 to 1350MHz	1.3:1	max
1100 to 1650MHz	2.0:1	max
Maximum leakage:		
spike energy (see note 2)	100	nJ/pulse
flat power (see note 2)	200	mW
Recovery period to −3db (see note 2)	20	μs max
Insertion loss (see notes 1 and 3)	0.5	db max
Arc loss (see note 2)	0.3	db max
Differential electrical length (see notes 1 and 4)	±5	degrees
Differential position of short (see notes 2 and 5)	±0.5	mm

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	–	2.5	MW
Transmitter power (mean)	–	2.5	kW

GENERAL

Overall dimensions	15.375 x 6.299 x 5.250 inches nom 390.5 x 160.0 x 133.4mm nom
Waveguide size	no. 6 (6.500 x 3.250 inches internal)
Coupler	mates with coupler to Marconi drawing no. E/RAD/D 42442/2
Finish	tin plated
Mounting position	any
Net weight	7.5kg (16.5 pounds) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured in a balanced duplexer, where the power incident on the duplexer is 1MW peak with 1.0μs pulse length at 500p.p.s.
3. The insertion loss of each tube.
4. The absolute electrical length of each tube is not important when used in a balanced duplexer, but the differential electrical length increases the insertion loss of the duplexer system. A differential electrical length of $\pm 5^\circ$ results in an increase of less than 0.05db insertion loss.
5. The absolute distance of the effective r.f. short circuit behind the input flange is not important when used in a balanced duplexer, but the differential position of short results in the reflection of power back to the source. A differential position of short of ±0.5mm results in less than 0.03db transmission loss or a v.s.w.r. of less than 1.2:1.
6. The operating power is the power incident on the duplexer; the power incident on each tube is half this value.

Outline Dimensions (All dimensions without limits are nominal)

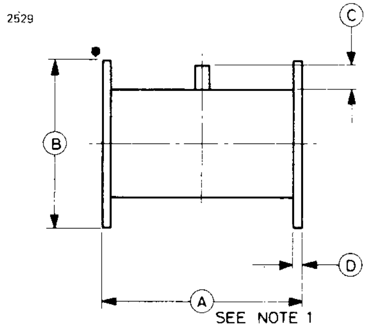
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	6.299	160	K*	0.358 ± 0.004	9.1 ± 0.1
B	5.250	133.4	L	4.500	114.3
C*	1.378 max	35.0 max	M	2.000	50.80
D*	0.276 min	7.0 min	N	9.656	245.3
E	8.156	207.2	P	11.406	289.7
F	6.250	158.8	Q	12.906	327.8
G	4.750	120.7	R	14.406	365.9
H	3.000	76.20	S	15.375	390.5
J	1.500	38.10			

Millimetre dimensions have been derived from inches except where indicated thus *.

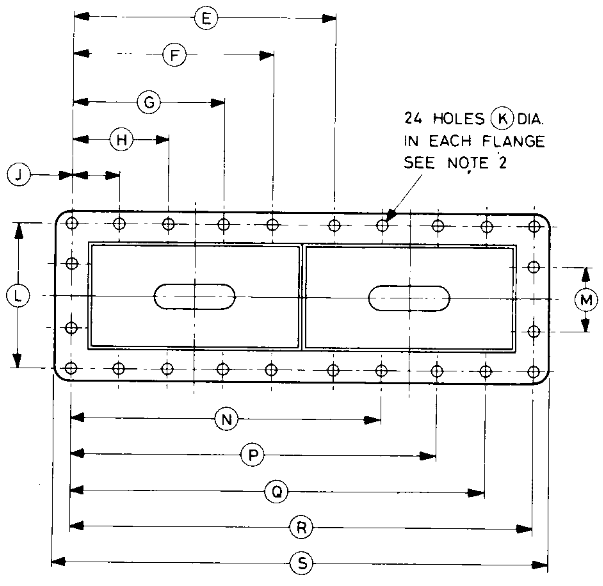
Outline Notes

1. The two flanges are flat and parallel within 0.1mm (0.004 inch).
2. The corresponding holes in both flanges are in alignment within 0.5mm (0.020 inch).

OUTLINE



View on Flange Face



BS928

X-BAND PROTECTOR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR tube, designed for the protection of r.f. amplifiers.

CHARACTERISTICS

Frequency range	8500 to 10 000	MHz
V.S.W.R. (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	600	nJ/pulse
total power (see note 3)	1.0	W
low power	10	W
Recovery period to −3db (see note 3)	2.0	μs max
Insertion loss (see note 1)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 2 and 4)	1.0 ± 0.2mm (0.040 ± 0.008 inch)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	1.0	200	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

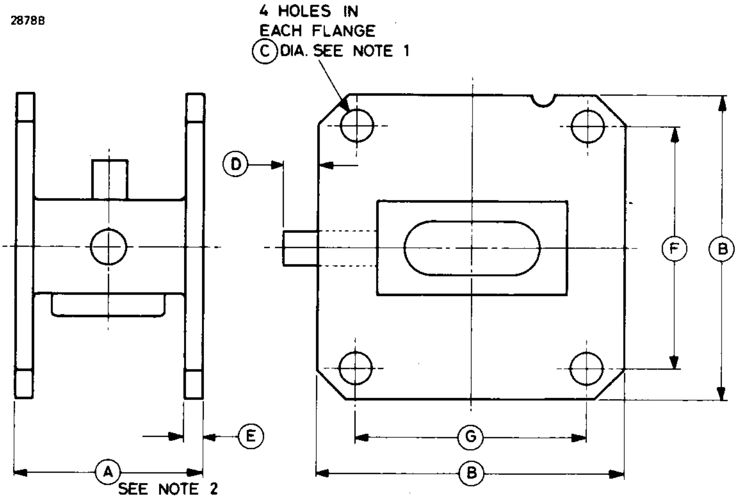
GENERAL

Overall dimensions	25 x 41 x 41mm nom 0.984 x 1.614 x 1.614 inches nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	NATO S.N. 5985-99-083-0051 or 5985-99-083-0052
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Distance of the effective r.f. short circuit behind plane of input flange.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	25.0 ± 0.1	0.984 ± 0.004	E	2.3 min	0.901 min
B	41.0	1.614	F	32.5 ± 0.1	1.280 ± 0.004
C	4.3 ± 0.1	0.169 ± 0.004	G	31.0 ± 0.1	1.220 ± 0.004
D	5.0 max	0.197 max			

Inch dimensions have been derived from millimetres.

Outline Notes

1. The corresponding holes in both flanges will be coaxial within 0.1mm (0.004 inch).
2. The two flanges are flat and parallel within 0.1mm (0.004 inch).

BS930

X-BAND TWIN PRE-TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless twin pre-TR tube, designed for the protection of r.f. amplifiers and mixer diodes in a balanced duplexer.

CHARACTERISTICS (See note 1)

Frequency range	8500 to 10 000	MHz
V.S.W.R. (see note 2)	1.4:1	max
Maximum leakage into receiver:		
spike energy (see note 3)	5.0	nJ/pulse
total power (see note 4)	5.0	mW
low power (see note 5)	20	W
Recovery period to −3db (see note 4)	2.0	μs max
Insertion loss (see note 2)	0.8	db max
Arc loss (see note 4)	0.8	db max
Position of short circuit (see notes 4 and 6)	1.0 ± 0.2mm (0.040 ± 0.008 inch)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	4.0	200	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

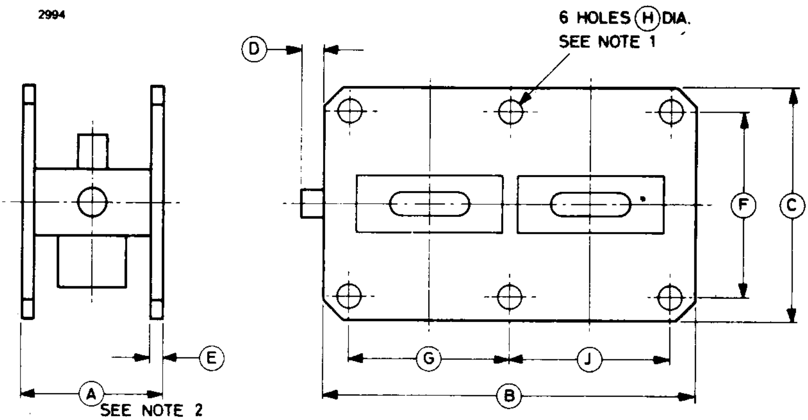
GENERAL

Overall dimensions	25.0 x 41.0 x 71.0mm nom 0.984 x 1.614 x 2.795 inches nom
Waveguide size	2 x no. 16 (0.900 x 0.400 inch internal)
Coupler	see Outline
Finish	flanges tin plated
Mounting position	any
Net weight	150g (5.5 ounces) approx

NOTES

1. All electrical tests are performed with the tube mounted between side-wall 3db hybrid couplers of minimum isolation 25db and v.s.w.r. into matched loads of better than 1.1:1, over the specified frequency range.
2. Measured at a power level below 10mW over the frequency range.
3. Measured at 40kW peak power input, 0.1μs pulse length and 3000p.p.s.
4. Measured at 40kW peak power input, 1.0μs pulse length and 1000p.p.s.
5. Measured at 1.0μs pulse length and 1000p.p.s., by increasing the incident power level from zero until breakdown occurs.
6. Distance of the effective r.f. short circuit behind the flange.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	25.0 ± 0.1	0.984 ± 0.004	F	32.5	1.280
B	66.0	2.598	G	28.2	1.110
C	41.0	1.614	H	4.3 ± 0.1	0.169 ± 0.004
D	5.0 max	0.197 max	J	28.2	1.110
E	2.3 min	0.091 min			

Inch dimensions have been derived from millimetres.

Outline Notes

1. Holes in both flanges are in alignment to within 0.1mm (0.004 inch). Positional tolerance 0.2mm (0.008 inch) diameter, datum dimensions B and C.
2. Flange faces flat and parallel within 0.1mm (0.004 inch).

TR Tubes

BS52

X-BAND TR TUBE

Service Type CV1841

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	9320 to 9500	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 3)	100	mW
low power	500	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.7	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	5.0	200	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

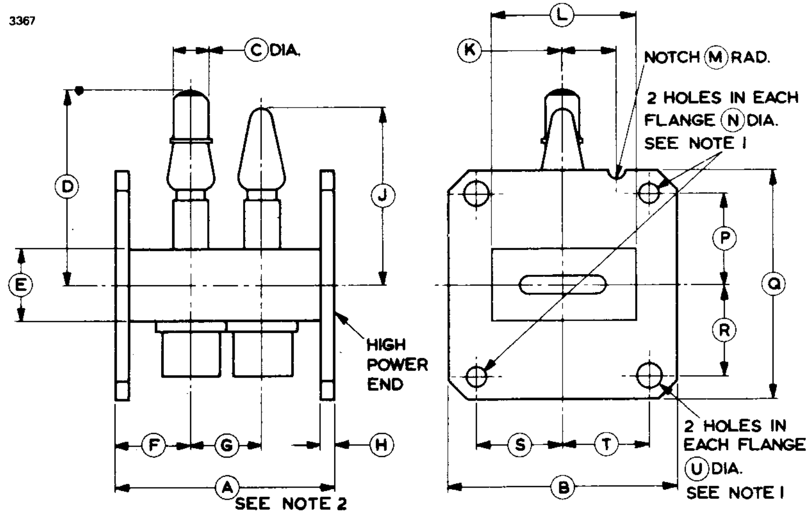
1. Measured at a power level below 10mW over the frequency range 9320 to 9500MHz.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051
B	1.625	41.28
C	0.250	6.35
D	1.375 max	34.93 max
E	0.500	12.70
F	0.531	13.49
G	0.500	12.70
H	0.094 min	2.39 min
J	1.250 max	31.75 max
K	0.375 ± 0.005	9.53 ± 0.13
L	1.000	25.40
M	0.062 ± 0.031	1.57 ± 0.79
N	0.147	3.73
P	0.640 ± 0.002	16.256 ± 0.051
Q	1.625	41.28
R	0.640 ± 0.002	16.256 ± 0.051
S	0.610 ± 0.002	15.494 ± 0.051
T	0.610 ± 0.002	15.494 ± 0.051
U	0.1695 ± 0.004	4.305 ± 0.102

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS104

S-BAND
TR TUBE

Service Type CV2181

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	2750 to 2860	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.906 x 5.906 x 5.083 inches max 150.0 x 150.0 x 129.1mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

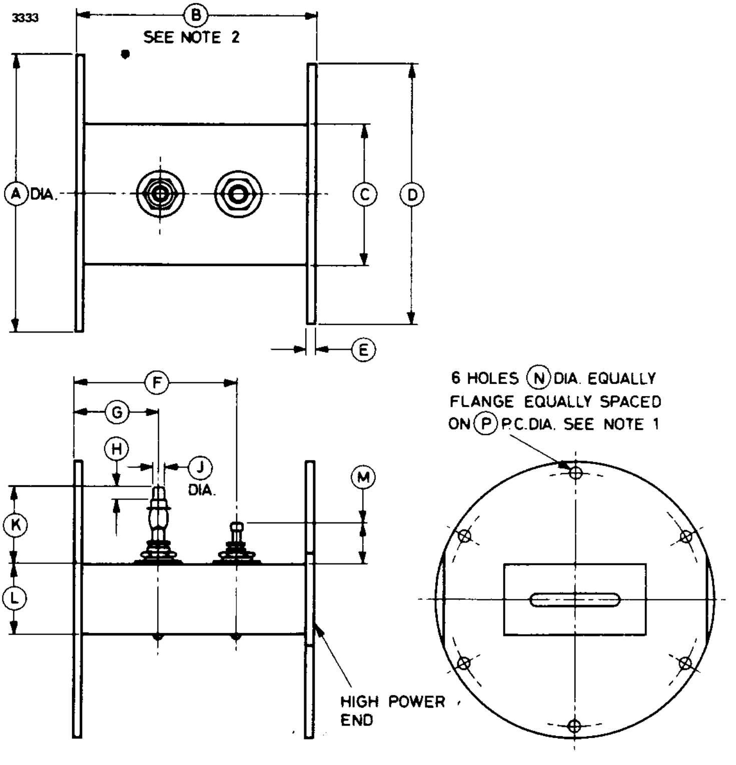
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 0.001 duty factor.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.016	149.2 ± 0.4
B	5.073 ± 0.010	128.9 ± 0.3
C	3.000 ± 0.031	76.20 ± 0.79
D	5.500 ± 0.031	139.7 ± 0.8
E	0.156 ± 0.031	3.96 ± 0.79
F	3.400	86.36
G	1.750	44.45
H	0.250	6.35
J	0.250	6.35
K	1.625 max	41.28 max
L	1.500 ± 0.031	38.10 ± 0.79
M	0.875 max	22.23 max
N	0.264 max	6.70 max
	0.257 min	6.53 min
P	5.375	136.5

Millimetre dimensions have been derived from inches except dimension N.

OUTLINE



Outline Notes

1. The flange holes fit a gauge with six parallel pegs, each 0.250 inch (6.35mm) diameter, equally spaced on 5.375 inch (136.5mm) pitch circle diameter. The corresponding holes of the flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm) within a circle of 5.125 inch (130.2mm) diameter concentric with the pitch circle of the flange holes.

BS156

X-BAND
TR TUBE

Service Type CV2306

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	9000 to 9600	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	20	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.007 inch (0.53 ± 0.18mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	5.0	200	kW
Primer supply voltage (negative) (see note 6)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

1. Measured at a power level below 10mW over the frequency range 9000 to 9600MHz.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap.

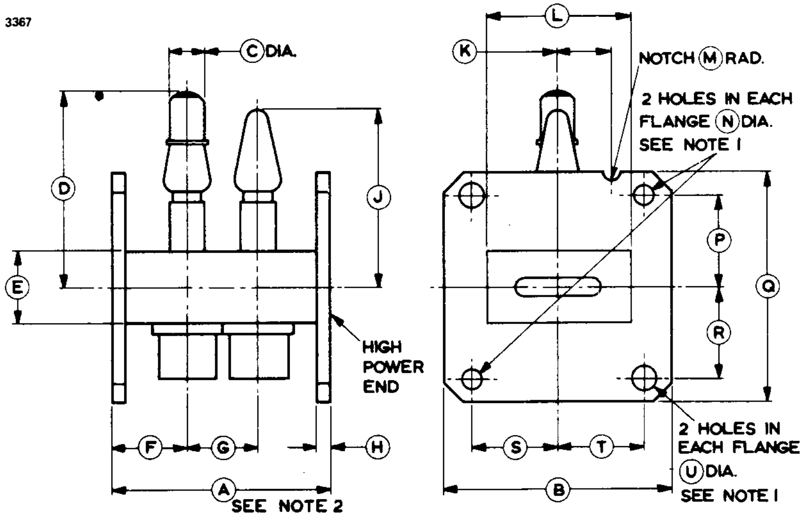
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051
B	1.625	41.28
C	0.250	6.35
D	1.375 max	34.93 max
E	0.500	12.70
F	0.531	13.49
G	0.500	12.70
H	0.094 min	2.39 min
J	1.250 max	31.75 max
K	0.375 ± 0.005	9.53 ± 0.13
L	1.000	25.40
M	0.062 ± 0.031	1.57 ± 0.79
N	0.147	3.73
P	0.640 ± 0.002	16.256 ± 0.051
Q	1.625	41.28
R	0.640 ± 0.002	16.256 ± 0.051
S	0.610 ± 0.002	15.494 ± 0.051
T	0.610 ± 0.002	15.494 ± 0.051
U	0.1695 ± 0.004	4.305 ± 0.102

Millimetre dimensions have been derived from inches.

OUTLINE

3367



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS158

X-BAND
TR TUBE

Service Type CV2307

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	8500 to 9100	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	20	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.007 inch (0.53 ± 0.18mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	5.0	200	kW
Primer supply voltage (negative) (see note 6)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

February 1971

NOTES

1. Measured at a power level below 10mW over the frequency range 8500 to 9100MHz.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap.

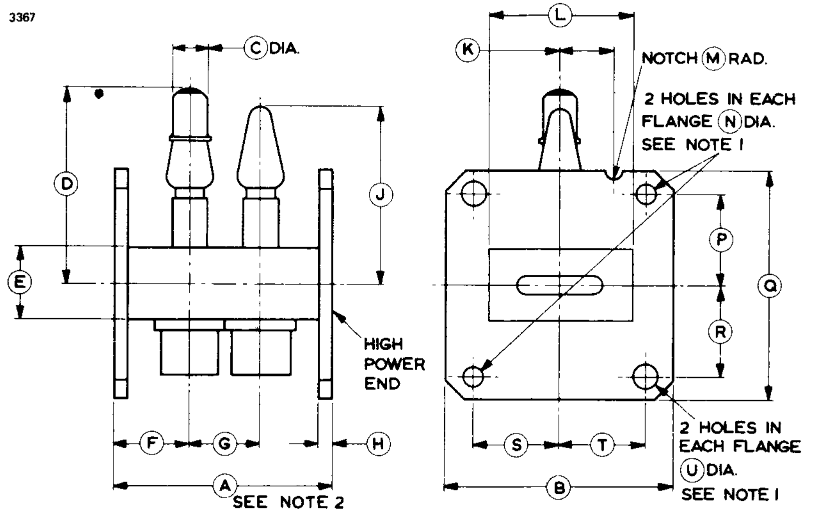
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051
B	1.625	41.28
C	0.250	6.35
D	1.375 max	34.93 max
E	0.500	12.70
F	0.531	13.49
G	0.500	12.70
H	0.094 min	2.39 min
J	1.250 max	31.75 max
K	0.375 ± 0.005	9.53 ± 0.13
L	1.000	25.40
M	0.062 ± 0.031	1.57 ± 0.79
N	0.147	3.73
P	0.640 ± 0.002	16.256 ± 0.051
Q	1.625	41.28
R	0.640 ± 0.002	16.256 ± 0.051
S	0.610 ± 0.002	15.494 ± 0.051
T	0.610 ± 0.002	15.494 ± 0.051
U	0.1695 ± 0.004	4.305 ± 0.102

Millimetre dimensions have been derived from inches.

OUTLINE

3367



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS200

X-BAND
TR TUBE

Service Type CV2311

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band twin primer TR tube.

CHARACTERISTICS

Frequency range	9180 to 10 000	MHz
V.S.W.R. (see note 1):		
at 9400, 9600 and 9800MHz	1.2:1	max
at 9180 and 10 000MHz	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	30	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.007 inch (0.53 ± 0.18mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	1.0	200	kW
Primer supply voltage (negative) (see note 7)	900	1100	V
Main primer current	70	185	μA
Auxiliary primer current	8.0	50	μA
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

February 1971

NOTES

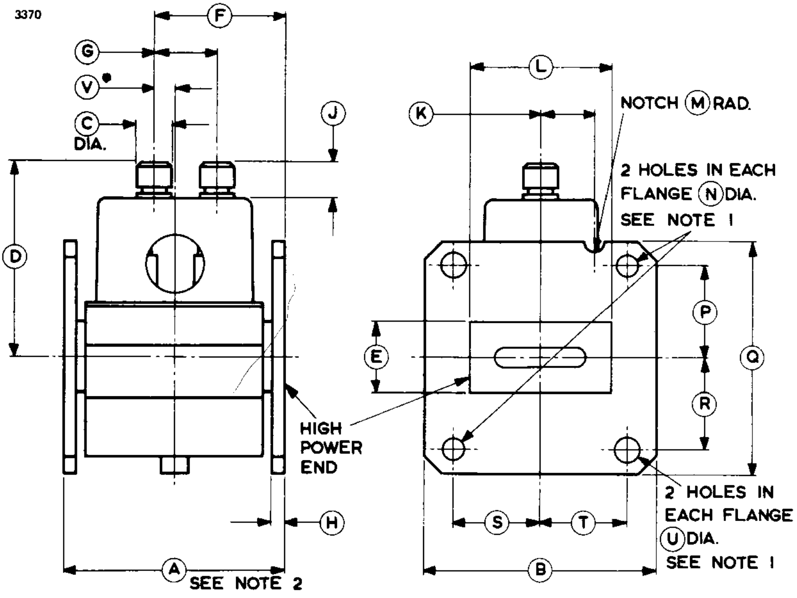
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051
B	1.625	41.28
C	0.250	6.35
D	1.366 max	34.70 max
E	0.500	12.70
F	0.922	23.42
G	0.440	11.18
H	0.094 min	2.39 min
J	0.250	6.35
K	0.375	9.53
L	1.000	25.40
M	0.062	1.57
N	0.147	3.73
P	0.640 ± 0.002	16.256 ± 0.051
Q	1.625	41.28
R	0.640 ± 0.002	16.256 ± 0.051
S	0.610 ± 0.002	15.494 ± 0.051
T	0.610 ± 0.002	15.494 ± 0.051
U	0.1695 ± 0.004	4.305 ± 0.102
V	0.140	3.56

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS202

X-BAND
TR TUBE

Service Type CV2312

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band twin primer TR tube.

CHARACTERISTICS

Frequency range	8500 to 9300	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	30	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.007 inch (0.53 ± 0.18mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	1.0	200	kW
Primer supply voltage (negative) (see note 7)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

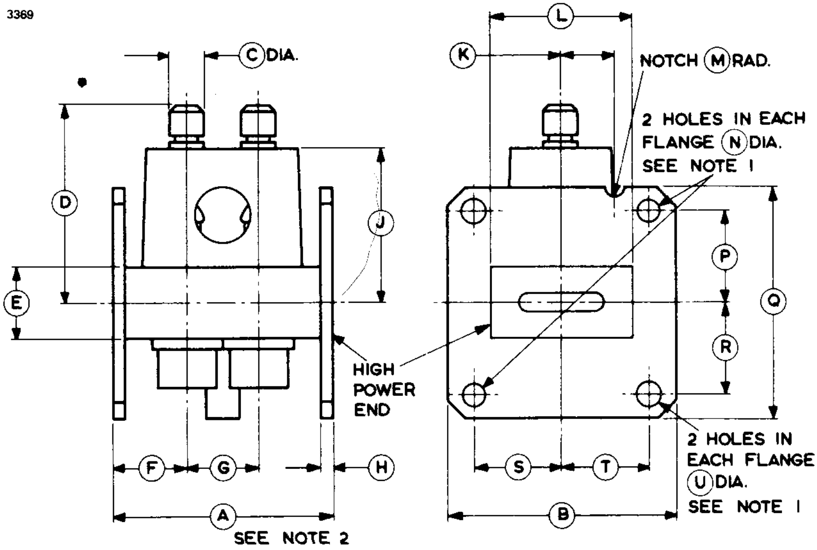
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. Operation at peak power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051
B	1.625	41.28
C	0.250	6.35
D	1.375 max	34.93 max
E	0.500	12.70
F	0.531	13.49
G	0.500	12.70
H	0.094 min	2.39 min
J	1.078 ± 0.031	27.38 ± 0.79
K	0.375 ± 0.005	9.53 ± 0.13
L	1.000	25.40
M	0.062	1.57
N	0.147	3.73
P	0.640 ± 0.002	16.256 ± 0.051
Q	1.625	41.28
R	0.640 ± 0.002	16.256 ± 0.051
S	0.610 ± 0.002	15.494 ± 0.051
T	0.610 ± 0.002	15.494 ± 0.051
U	0.1695 ± 0.004	4.305 ± 0.102

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS204

S-BAND
TR TUBE

Service Type CV5990

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3000 to 3050	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	−	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	−	300	kN/m^2
	−	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.906 x 5.906 x 5.083 inches max 150.0 x 150.0 x 129.1mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

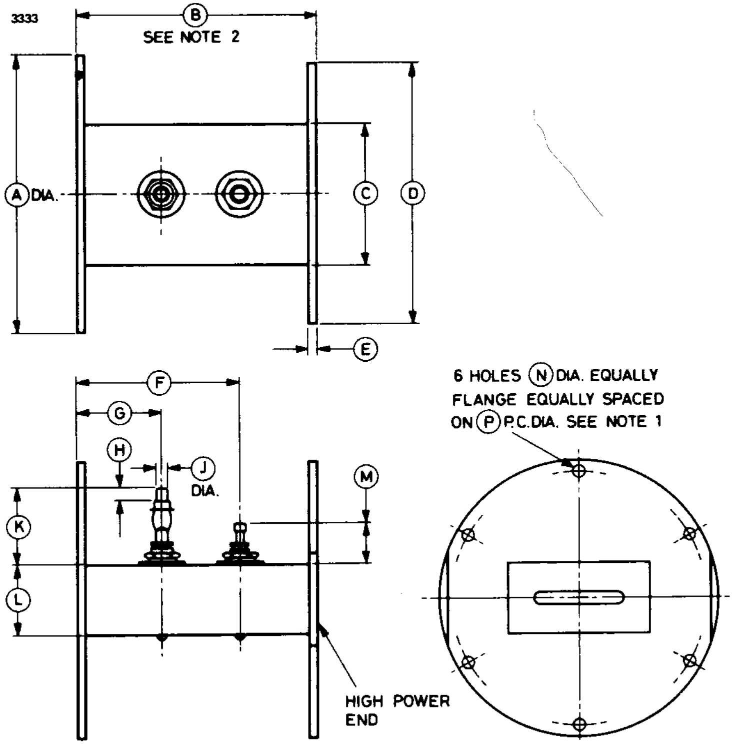
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 0.001 duty factor.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.016	149.2 ± 0.4
B	5.073 ± 0.010	128.9 ± 0.3
C	3.000 ± 0.031	76.20 ± 0.79
D	5.500 ± 0.031	139.7 ± 0.8
E	0.156 ± 0.031	3.96 ± 0.79
F	3.400	86.36
G	1.750	44.45
H	0.250	6.35
J	0.250	6.35
K	1.625 max	41.28 max
L	1.500 ± 0.031	38.10 ± 0.79
M	0.875 max	22.23 max
N	0.264 max 0.257 min	6.70 max 6.53 min
P	5.375	136.5

Millimetre dimensions have been derived from inches except dimension N.

OUTLINE



Outline Notes

1. The flange holes fit a gauge with six parallel pegs, each 0.250 inch (6.35mm) diameter, equally spaced on 5.375 inch (136.5mm) pitch circle diameter. The corresponding holes of the flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm) within a circle of 5.125 inch (130.2mm) diameter concentric with the pitch circle of the flange holes.

BS286

S-BAND
TR TUBE

Service Type CV5991

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3055 to 3105	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.906 x 5.906 x 5.083 inches max 150.0 x 150.0 x 129.1mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

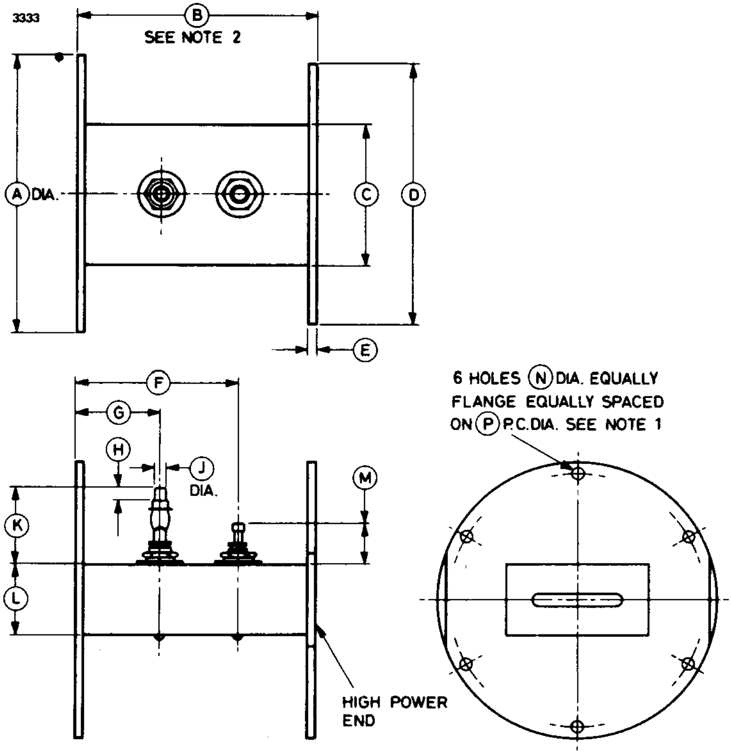
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 0.001 duty factor.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.016	149.2 ± 0.4
B	5.073 ± 0.010	128.9 ± 0.3
C	3.000 ± 0.031	76.20 ± 0.79
D	5.500 ± 0.031	139.7 ± 0.8
E	0.156 ± 0.031	3.96 ± 0.79
F	3.400	86.36
G	1.750	44.45
H	0.250	6.35
J	0.250	6.35
K	1.625 max	41.28 max
L	1.500 ± 0.031	38.10 ± 0.79
M	0.875 max	22.23 max
N	0.264 max	6.70 max
	0.257 min	6.53 min
P	5.375	136.5

Millimetre dimensions have been derived from inches except dimension N.

OUTLINE



Outline Notes

1. The flange holes fit a gauge with six parallel pegs, each 0.250 inch (6.35mm) diameter, equally spaced on 5.375 inch (136.5mm) pitch circle diameter. The corresponding holes of the flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm) within a circle of 5.125 inch (130.2mm) diameter concentric with the pitch circle of the flange holes.

BS324

S-BAND TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	2700 to 2900	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm)	nom

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.906 x 5.906 x 5.083 inches max 150.0 x 150.0 x 129.1mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

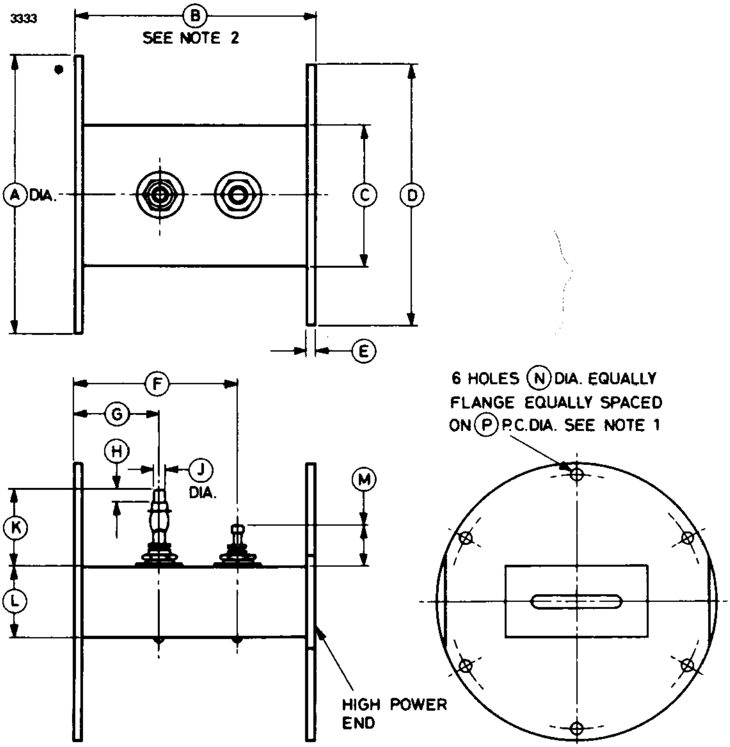
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 0.001 duty factor.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.016	149.2 ± 0.4
B	5.073 ± 0.010	128.9 ± 0.3
C	3.000 ± 0.031	76.20 ± 0.79
D	5.500 ± 0.031	139.7 ± 0.8
E	0.156 ± 0.031	3.96 ± 0.79
F	3.400	86.36
G	1.750	44.45
H	0.250	6.35
J	0.250	6.35
K	1.625 max	41.28 max
L	1.500 ± 0.031	38.10 ± 0.79
M	0.875 max	22.23 max
N	0.264 max	6.70 max
	0.257 min	6.53 min
P	5.375	136.5

Millimetre dimensions have been derived from inches except dimension N.

OUTLINE



Outline Notes

1. The flange holes fit a gauge with six parallel pegs, each 0.250 inch (6.35mm) diameter, equally spaced on 5.375 inch (136.5mm) pitch circle diameter. The corresponding holes of the flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm) within a circle of 5.125 inch (130.2mm) diameter concentric with the pitch circle of the flange holes.

BS390

S-BAND TR TUBE

Service Type CV9442

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	2925 to 3075	MHz
V.S.W.R. (see note 1)	1.33:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm)	nom

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	4.470 x 4.760 x 3.880 inches nom 113.5 x 120.9 x 98.55mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

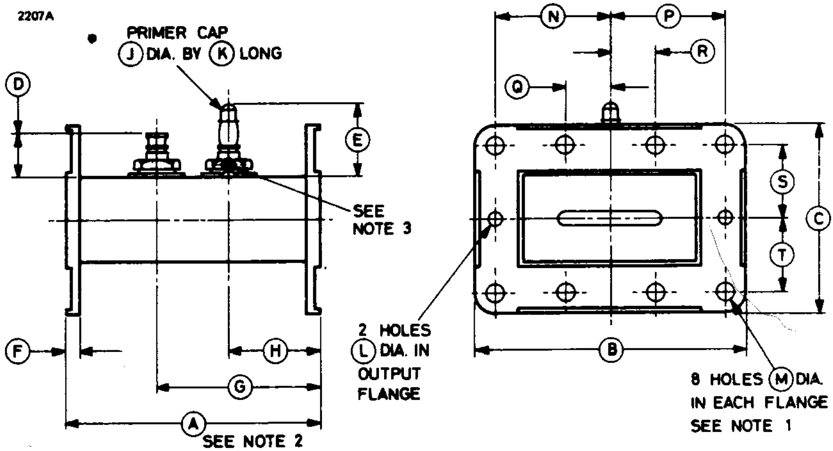
1. Measured at a power level below 10mW over the frequency range on a matched T junction.
2. Measured at 1.0MW peak power 1.0μs pulse length and 500p.p.s.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.470	113.5	L	$0.250^{+0.002}_{-0.000}$	$6.350^{+0.051}_{-0.000}$
B	4.760 ± 0.010	120.9 ± 0.25			
C	3.260 ± 0.010	82.80 ± 0.25	M	0.260 ± 0.004	6.6 ± 0.1
D	0.875 max	22.23 max	N	2.031	51.59
E	1.250 ± 0.125	31.75 ± 3.18	P	2.031	51.59
F	0.250 min	6.35 min	Q	0.750	19.05
G	3.062 ± 0.062	77.77 ± 1.57	R	0.750	19.05
H	1.500 ± 0.062	38.10 ± 1.57	S	1.281	32.54
J	0.250	6.35	T	1.281	32.54
K	0.250	6.35			

Millimetre dimensions have been derived from inches except dimension M.

OUTLINE



Outline Notes

1. The corresponding holes of both flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm). The flanges mate with coupler NATO S.N. 5985-99-083-0058.
3. Hole each side, 3.8mm diameter, to accept primer cap spring.

BS426

S-BAND
TR TUBE

Service Type CV9443

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3600 to 3780	MHz
V.S.W.R. (see note 1)	1.33:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm)	nom

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	−	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	−	300	kN/m^2
	−	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	3.600 x 4.760 x 3.630 inches nom 91.44 x 120.9 x 92.20mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

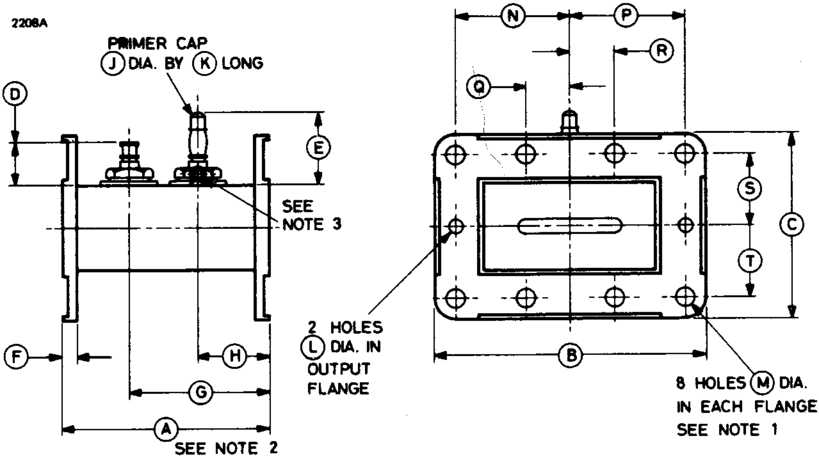
1. Measured at a power level below 10mW over the frequency range on a matched T junction.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 500p.p.s.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.600	91.44	L	$0.250^{+0.002}_{-0.000}$	$6.350^{+0.051}_{-0.000}$
B	4.760 ± 0.010	120.9 ± 0.25			
C	3.260 ± 0.010	82.80 ± 0.25	M	0.260 ± 0.004	6.6 ± 0.1
D	0.875 max	22.23 max	N	2.031	51.59
E	1.250 ± 0.125	31.75 ± 3.18	P	2.031	51.59
F	0.250 min	6.35 min	Q	0.750	19.05
G	2.375 ± 0.062	60.33 ± 1.57	R	0.750	19.05
H	1.250 ± 0.062	31.75 ± 1.57	S	1.281	32.54
J	0.250	6.35	T	1.281	32.54
K	0.250	6.35			

Millimetre dimensions have been derived from inches except dimension M.

OUTLINE



Outline Notes

1. The corresponding holes of both flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm). The flanges mate with coupler NATO S.N. 5985-99-083-0058.
3. Hole each side, 3.8mm diameter, to accept primer cap spring.

BS430

S-BAND
TR TUBE

Service Type CV9444

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3230 to 3380	MHz
V.S.W.R. (see note 1)	1.33:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	4.470 x 4.760 x 3.630 inches nom 113.5 x 120.9 x 98.55mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

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NOTES

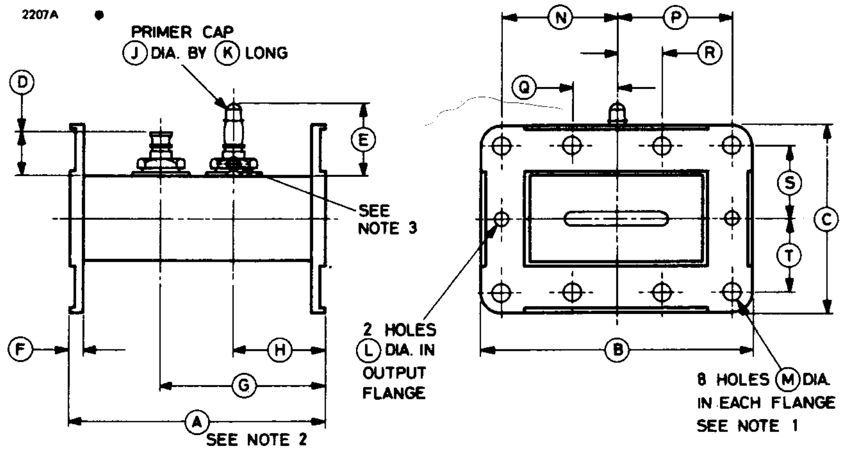
1. Measured at a power level below 10mW over the frequency range on a matched T junction.
2. Measured at 1.0MW peak power 1.0μs pulse length and 500p.p.s.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.470	113.5	L	$0.250^{+0.002}_{-0.000}$	$6.350^{+0.051}_{-0.000}$
B	4.760 ± 0.010	120.9 ± 0.25			
C	3.260 ± 0.010	82.80 ± 0.25	M	0.260 ± 0.004	6.6 ± 0.1
D	0.875 max	22.23 max	N	2.031	51.59
E	1.250 ± 0.125	31.75 ± 3.18	P	2.031	51.59
F	0.250 min	6.35 min	Q	0.750	19.05
G	2.875 ± 0.062	73.01 ± 1.57	R	0.750	19.05
H	1.625 ± 0.062	41.28 ± 1.57	S	1.281	32.54
J	0.250	6.35	T	1.281	32.54
K	0.250	6.35			

Millimetre dimensions have been derived from inches except dimension M.

OUTLINE



Outline Notes

1. The corresponding holes of both flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm). The flanges mate with coupler NATO S.N. 5985-99-083-0058.
3. Hole each side, 3.8mm diameter, to accept primer cap spring.

BS440

X-BAND
TR TUBE

Service Type CV6132

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	8500 to 9100	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	20	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	2.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.007 inch (0.53 ± 0.18mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	1.0	200	kW
Primer supply voltage (negative) (see note 7)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

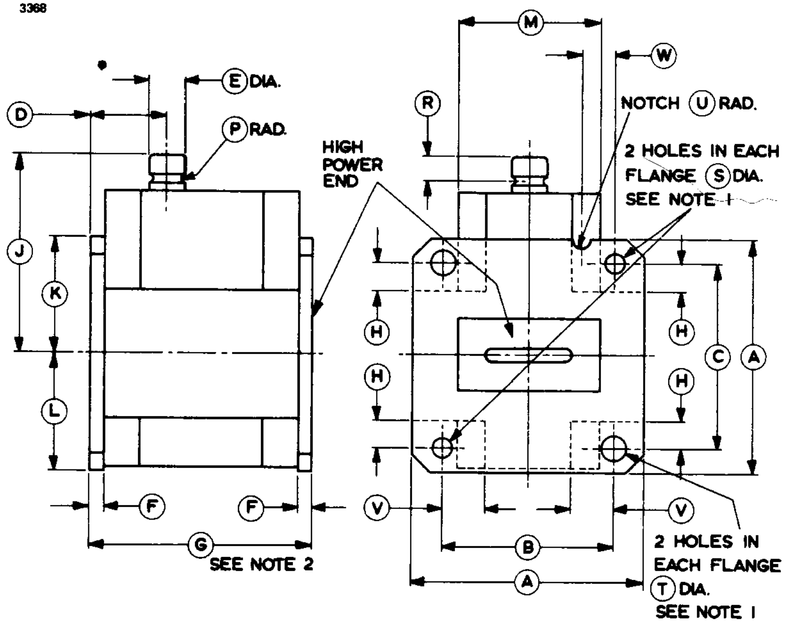
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.625	41.28
B	1.220 ± 0.004	30.988 ± 0.102
C	1.280 ± 0.004	32.512 ± 0.102
D	0.531	13.49
E	0.250	6.35
F	0.109 ± 0.016	2.77 ± 0.41
G	1.555 ± 0.002	39.497 ± 0.051
H	0.187 min	4.75 min
J	1.375 ± 0.031	34.93 ± 0.79
K	1.125 max	28.58 max
L	0.828 max	21.03 max
M	1.000 max	25.40 max
P	0.030	0.76
R	0.170	4.32
S*	0.150 ± 0.004	3.8 ± 0.1
T*	0.169 ± 0.004	4.3 ± 0.1
U	0.062 ± 0.031	1.57 ± 0.79
V	0.219 min	5.56 min
W	0.235 ± 0.010	5.97 ± 0.52

Millimetre dimensions have been derived from inches except where indicated thus *.

OUTLINE

3368



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS450

X-BAND TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	9300 to 9500	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	15	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.010 inch (0.53 ± 0.25mm)	
Primer firing time	5.0	s max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	1.0	100	kW
Primer supply voltage (negative) (see note 6)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.002 x 1.635 x 2.563 inches max 25.45 x 41.53 x 65.10mm max
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

March 1971

NOTES

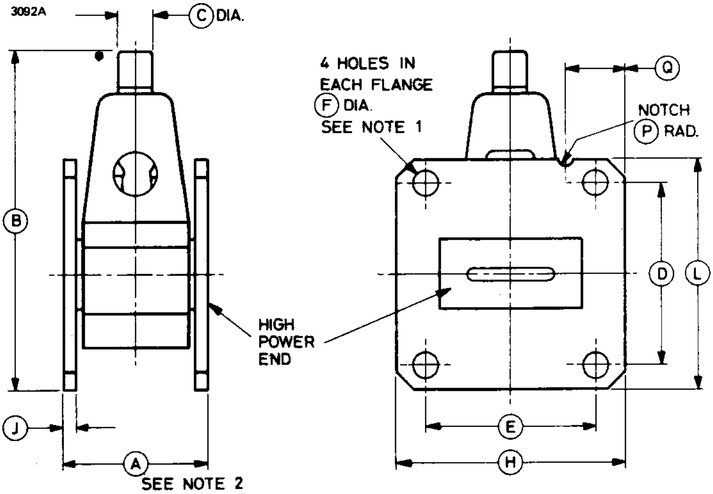
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 4.0kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.000 ± 0.002	25.400 ± 0.051
B	2.563 max	65.10 max
C	0.250 ± 0.005	6.35 ± 0.13
D	1.280	32.51
E	1.220	30.99
F	0.169 ± 0.004	4.3 ± 0.1
H	1.635 max	41.53 max
J	0.093 min	2.36 min
L	1.635 max	41.53 max
P	0.062 ± 0.031	1.57 ± 0.79
Q	0.437 ± 0.005	11.10 ± 0.13

Millimetre dimensions have been derived from inches except dimension F.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.005 inch (0.13mm).

BS452

X-BAND
TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	9310 to 9510	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	15	nJ/pulse
flat power (see note 3)	85	mW
low power	250	mW
Recovery period		see note 4
Insertion loss (see note 1)	0.8	db max
Position of short circuit (see note 5)	5.1 to 6.6mm (0.201 to 0.260 inch)	
Primer firing time	5.0	s max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	1.0	100	kW
Duty cycle	–	0.001	
Primer supply voltage (negative) (see note 7)	700	1500	V
Primer current	70	200	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating) (see note 8)	–30	+70	°C

GENERAL

Overall dimensions	1.000 x 1.625 x 2.437 inches nom 25.40 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

1. Measured at a low power level over the frequency band.
2. Measured at a pulse length of 0.1μs.
3. The average leakage power during a pulse length of 1.0μs, after subtracting the energy in the spike leakage. It is defined by

$$P_f = \frac{P_2 - P_1}{prr\ (t_2 - t_1)} \times 10^3\,\text{mW}$$

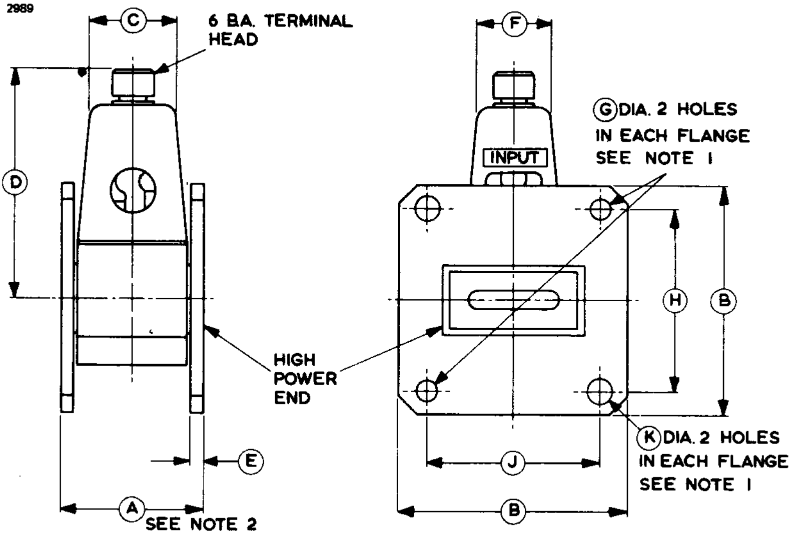
   where P_2 and P_1 are the average leakage power in microwatts with pulse lengths of t_2 and t_1 microseconds respectively and prr is the pulse repetition rate in pulses per second.

4. The recovery characteristic is determined by measuring the transmission of a low level c.w. signal at 9400 ± 50MHz, following a pulse of 0.1μs at 2.5kW.

Time after end of pulse μs	Maximum attenuation db
0.1	40
0.2	30
0.4	20
0.6	15
0.9	10
1.4	6

5. Measured at 20kW transmitter power, 1.0μs pulse length and 1000p.p.s. to determine the lower limit, and at 2.5kW transmitter power, 0.1μs pulse length and 1000p.p.s. to determine the upper limit.
6. For operation in a simple T junction duplexer where the power incident on the TR tube is half the transmitter power.
7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ of which at least 0.5MΩ must be adjacent to the primer terminal.
8. The recovery characteristic will be initially degraded if the tube is at a temperature below 0°C when the transmitter is switched on, but will return to normal as the tube warms up.
9. Tubes are tested at least 7 days after completion, and with the primer energized as specified in note 7.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.000 ± 0.005	25.40 ± 0.13	F	0.531	13.49
B	1.625	41.28	G*	0.150 ± 0.004	3.8 ± 0.1
C	0.625	15.88	H	1.280 ± 0.004	32.512 ± 0.102
D	1.750 max	44.45 max	J	1.220 ± 0.004	30.988 ± 0.102
E	0.094 min	2.39 min	K*	0.169 ± 0.004	4.3 ± 0.1

Millimetre dimensions have been derived from inches except those marked *.

Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.005 inch (0.13mm).

BS456

S-BAND
TR TUBE

Service Type CV2351

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR cell.

CHARACTERISTICS

Frequency range	2850 to 3050	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 3)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	15	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 5)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 6)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.890 x 5.890 x 4.469 inches nom 149.6 x 149.6 x 113.5mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or nickel plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

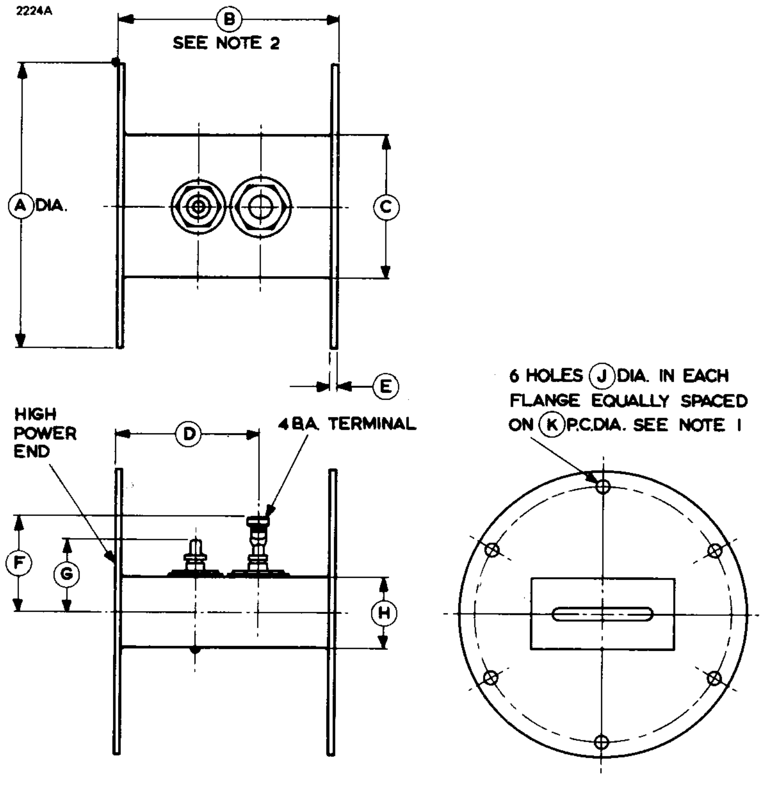
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 250kW peak power, 1.0μs pulse length and 0.001 duty factor.
3. For 1.0μs pulse.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.015	149.2 ± 0.38
B	4.469 ± 0.004	113.5 ± 0.1
C	3.000	76.20
D	3.000 ± 0.094	76.20 ± 2.39
E	0.156	3.96
F	2.500 max	63.50 max
G	1.500 max	38.10 max
H	1.500	38.10
J	0.260 ± 0.004	6.60 ± 0.10
K	5.375	136.5

Millimetre dimensions have been derived from inches except dimension J.

OUTLINE



Outline Notes

1. The holes are equally spaced on the pitch circle diameter within 0.006 inch (0.15mm) positional tolerance zone diameter with respect to each other. The holes in each flange will be within 1° of twist and 0.020 inch (0.51mm) of lateral displacement.

   The flanges mate with NATO S.N. 5985-99-083-1560.

2. The two flange faces are flat and parallel within 0.004 inch (0.10mm).

BS462

X-BAND TR TUBE

Service Type CV3840

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable high Q TR tube, intended for marine radar.

CHARACTERISTICS

Frequency range	9000 to 9300	MHz
V.S.W.R. at resonance (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	8.0	nJ/pulse
total power (see note 3)	30	mW
low power	250	mW
Recovery period to −3db (see note 3)	6.0	μs max
Insertion loss at resonance (see note 1)	1.0	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	75	kW
Primer supply voltage (negative) (see note 4)	700	1500	V
Primer current	100	200	μA
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.000 x 1.625 x 3.813 inches nom 25.40 x 41.28 x 96.85mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	brass flanges
Mounting position	any
Net weight	6 ounces (170g) approx

January 1971

NOTES

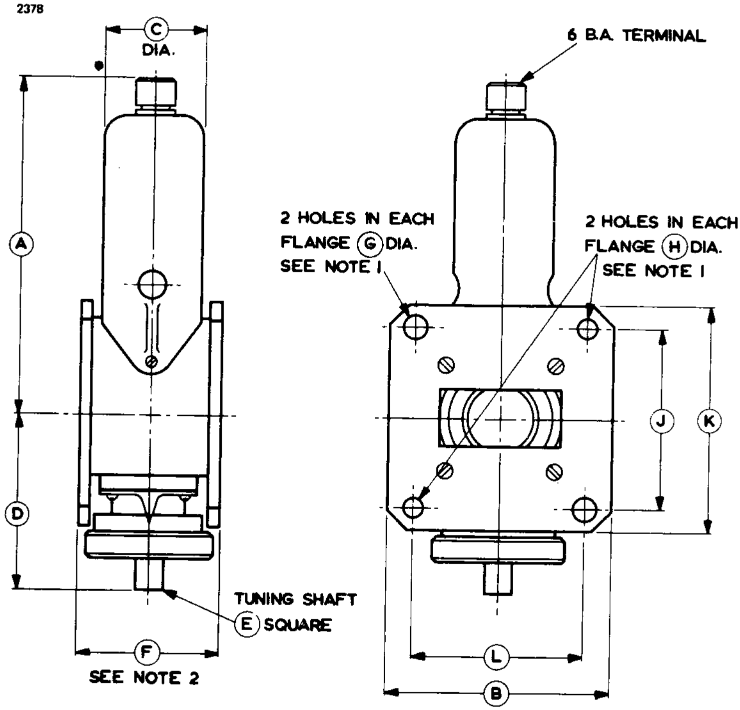
1. Measured at a power level below 10mW.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	2.375 max	60.33 max
B	1.625	41.28
C	0.722 max	18.34 max
D	1.437 max	36.50 max
E	0.187	4.75
F	1.000 ± 0.005	25.40 ± 0.13
G	0.170 ± 0.002	4.318 ± 0.051
H	0.150 ± 0.002	3.810 ± 0.051
J	1.280 ± 0.003	32.512 ± 0.076
K	1.625	41.28
L	1.220 ± 0.003	30.988 ± 0.076

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.010 inch (0.25mm).

BS466

X-BAND
TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable high Q TR tube, intended for marine radar.

CHARACTERISTICS

Frequency range	9200 to 9600	MHz
V.S.W.R. at resonance (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	8.0	nJ/pulse
total power (see note 3)	30	mW
low power	250	mW
Recovery period to −3db (see note 3)	6.0	μs max
Insertion loss at resonance (see note 1)	1.0	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	75	kW
Primer supply voltage (negative) (see note 4)	700	1500	V
Primer current	100	200	μA
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.000 x 1.625 x 3.813 inches nom 25.40 x 41.28 x 96.85mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	tin plated flanges
Mounting position	any
Net weight	6 ounces (170g) approx

NOTES

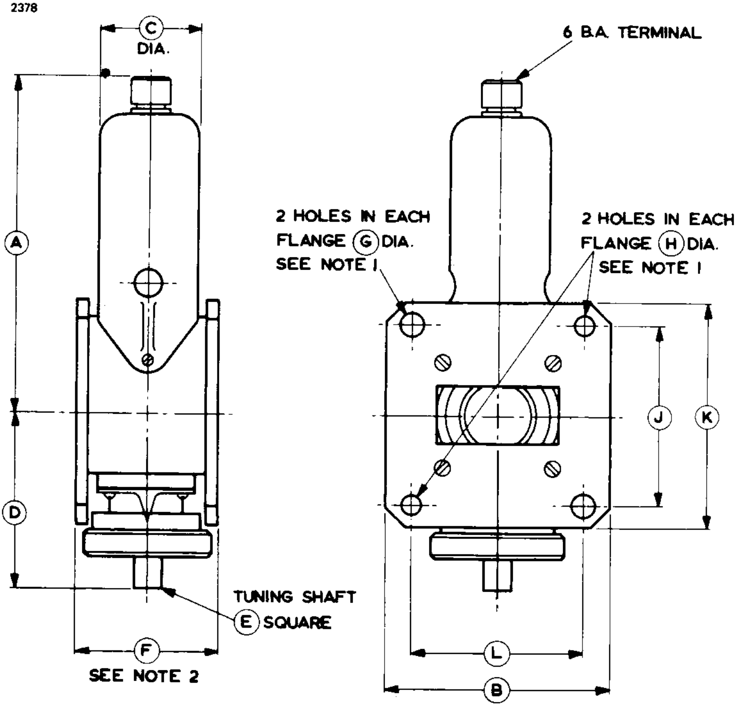
1. Measured at a power level below 10mW.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	2.375 max	60.33 max
B	1.625	41.28
C	0.722 max	18.34 max
D	1.437 max	36.50 max
E	0.187	4.75
F	1.000 ± 0.005	25.40 ± 0.13
G	0.170 ± 0.002	4.318 ± 0.051
H	0.150 ± 0.002	3.810 ± 0.051
J	1.280 ± 0.003	32.512 ± 0.076
K	1.625	41.28
L	1.220 ± 0.003	30.988 ± 0.076

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.010 inch (0.25mm).

BS800

S-BAND
TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	2840 to 3100	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	750	mW
Recovery period to −3db (see note 2)	15	μs max
Insertion loss:		
at 2950MHz	0.6	db max
over the range	0.8	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 3)	0.062 inch (1.6mm) nom	
Electrical length	4.095 inches (104mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 4)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.890 x 5.890 x 4.473 inches nom 149.6 x 149.6 x 113.6mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or nickel plated
Mounting position	any
Net weight	3¾ pounds (1.7kg) approx

NOTES

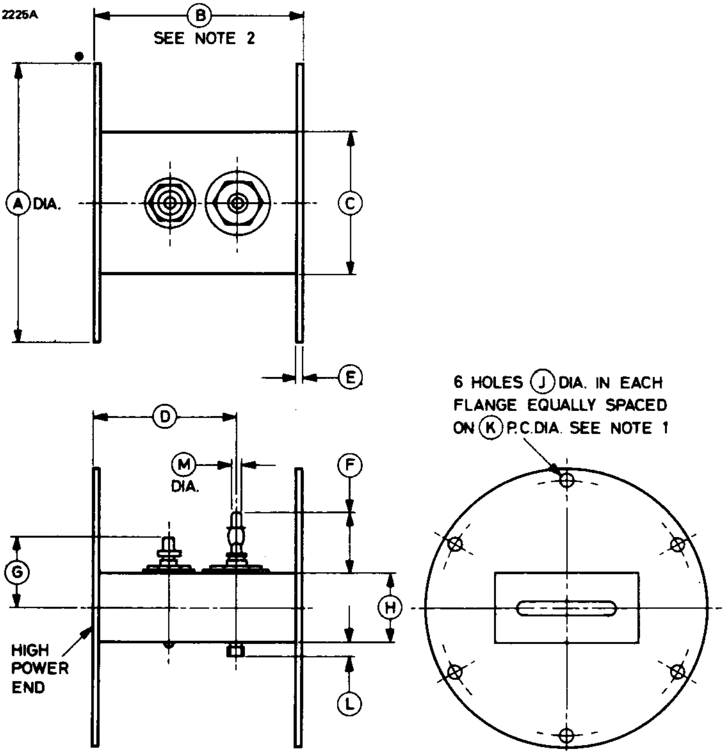
1. Measured at a power level below 10mW over the frequency range 2840 to 3100MHz.
2. Measured at 250kW peak power, 1.0μs pulse length and 0.001 duty factor.
3. Distance of the effective r.f. short circuit behind front flange.
4. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.015	149.2 ± 0.38
B	4.469 ± 0.004	113.5 ± 0.1
C	3.000	76.20
D	3.000 ± 0.094	76.20 ± 2.39
E	0.156	3.96
F	1.625 max	41.28 max
G	1.500 max	38.10 max
H	1.500	38.10
J	0.260 ± 0.004	6.60 ± 0.10
K	5.375	136.5
L	0.250	6.35
M	0.250	6.35

Millimetre dimensions have been derived from inches except dimension J.

OUTLINE



Outline Notes

1. Positional tolerance 0.006 inch (0.15mm) diameter.

   The corresponding holes in the flanges will be aligned within 1° of twist and 0.020 inch (0.5mm) of lateral displacement.
2. The flange faces are flat and parallel to within 0.004 inch (0.102mm). The flanges mate with NATO S.N. 5985-99-083-1560.

BS810

X-BAND TR TUBE

Service Type CV1923

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable high Q TR tube, intended for marine radar.

CHARACTERISTICS

Frequency range (see note 1)	9245 to 9575	MHz
V.S.W.R. at resonance (see note 2)	1.4:1	max
Maximum leakage:		
spike energy (see note 3)	8.0	nJ/pulse
total power (see note 4)	30	mW
low power, primed (see note 5)	100	mW
low power, unprimed (see note 5)	250	mW
Recovery period to −6db:		
at 2.5kW peak power		see note 6
at 25kW peak, 0.1μs pulse length, 1000p.p.s.	1.5	μs max
Insertion loss at resonance (see note 2)	0.8	db max
Arc loss (see note 7)	0.15	db max
Position of short circuit (see note 8):		
with gap discharge	0.240 ± 0.020 inch (6.10 ± 0.51mm)	
with window discharge	0.189 ± 0.020 inch (4.80 ± 0.51mm)	
Loaded Q	125 to 170	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.001	75	kW
Primer supply voltage (negative) (see note 9)	700	1500	V
Primer current	100	200	μA
Primer operating voltage	250	450	V
Temperature range:			
non-operating	−40	+100	°C
operating	−25	+80	°C

February 1971

GENERAL

Overall dimensions	1.000 x 1.625 x 3.813 inches nom 25.40 x 41.28 x 96.85mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flanges brass
Mounting position	any
Net weight	7 ounces (200g) approx

NOTES

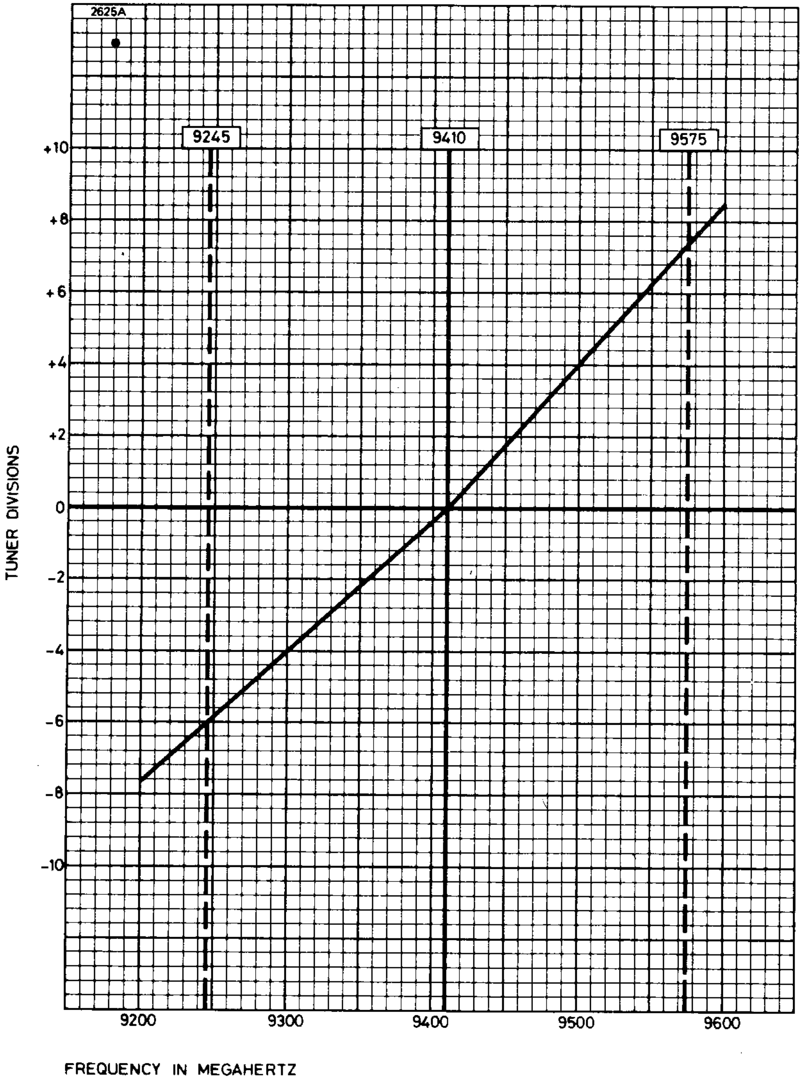
1. Tuning knob set to 9410MHz against pointer on leaving factory. Approximate frequency corresponding to knob scale is given on page 3.
2. Measured at power level below 10mW at centre frequency of 9410MHz.
3. Measured at 25kW peak power, 0.1μs pulse length and 1000p.p.s. Primer current set to 150μA.
4. Measured at 25kW peak power, 1.0μs pulse length and 1000p.p.s. Primer current set to 150μA.
5. Primed and unprimed low power breakthrough are measured by increasing the incident r.f. power at 1.0μs pulse length and 1000p.p.s. from zero until breakdown occurs inside the TR tube.
6. The recovery characteristic is determined by measuring the transmission through a peak response tuned TR tube of a low level c.w. signal at the transmitter frequency, which will be within the range 9410 $\pm$ 65MHz, following a transmitter pulse of 0.1μs duration at 3000p.p.s.

Time after end of pulse, μs	**Maximum attenuation, db**
0.1	40
0.2	30
0.4	20
0.6	15
0.9	10
1.4	6

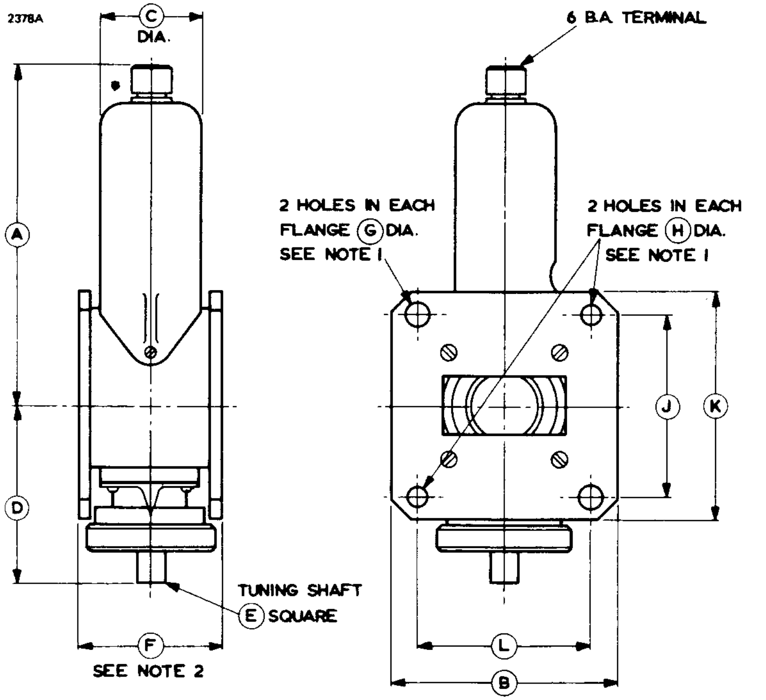
7. Measured at 1.5kW peak power, 0.1μs pulse length and 3000p.p.s. at a TR tube frequency of 9410MHz. Sample test only.
8. Transition of v.s.w. minimum from cone gap to windows occurs at following conditions approximately.

   9kW peak power, 1.0μs pulse length and 1000p.p.s.
   10.5kW peak power, 1.0μs pulse length and 500p.p.s.
   17.5kW peak power, 0.5μs pulse length and 1000p.p.s.
9. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current should be adjusted to 150μA by means of series resistance, around the value of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap terminal.

TYPICAL TUNER CHARACTERISTIC



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.375 max	60.33 max	G*	0.169 ± 0.004	4.3 ± 0.1
B	1.625	41.28	H*	0.150 ± 0.004	3.8 ± 0.1
C	0.750	19.05	J	1.280 ± 0.003	32.512 ± 0.076
D	1.437 max	36.50 max	K	1.625	41.28
E	0.187	4.75	L	1.220 ± 0.003	30.988 ± 0.076
F	1.000 ± 0.005	25.40 ± 0.13			

Millimetre dimensions have been derived from inches except where indicated thus *.

Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.008 inch (0.20mm).

BS822

X-BAND
TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable high Q TR tube, intended for marine radar.

CHARACTERISTICS

Frequency range (see note 1)	9405 to 9690	MHz
V.S.W.R. at resonance (see note 2)	1.4:1	max
Maximum leakage:		
spike energy (see note 3)	8.0	nJ/pulse
total power (see note 4)	30	mW
low power, primed (see note 5)	100	mW
low power, unprimed (see note 5)	250	mW
Recovery period to −6db:		
at 2.5kW peak power		see note 6
at 25kW peak, 0.1μs pulse length, 1000p.p.s.	1.5	μs max
Insertion loss at resonance (see note 2)	0.8	db max
Arc loss (see note 7)	0.15	db max
Position of short circuit (see note 8):		
with gap discharge	0.240 ± 0.020 inch (6.10 ± 0.51mm)	
with window discharge	0.189 ± 0.020 inch (4.80 ± 0.51mm)	
Loaded Q	125 to 170	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.001	75	kW
Primer supply voltage (negative) (see note 9)	700	1500	V
Primer current	100	200	μA
Primer operating voltage	250	450	V
Temperature range:			
non-operating	−40	+100	°C
operating	−25	+80	°C

March 1971

GENERAL

Overall dimensions	1.000 x 1.625 x 3.813 inches nom 25.40 x 41.28 x 96.85mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler •	UG-39/U
Finish	flanges brass
Mounting position	any
Net weight	7 ounces (200g) approx

NOTES

1. Tuning knob set to 9548MHz against pointer on leaving factory. Approximate frequency corresponding to knob scale is given on page 3.
2. Measured at power level below 10mW at centre frequency of 9548MHz.
3. Measured at 25kW peak power, 0.1μs pulse length and 1000p.p.s. Primer current set to 150μA.
4. Measured at 25kW peak power, 1.0μs pulse length and 1000p.p.s. Primer current set to 150μA.
5. Primed and unprimed low power breakthrough are measured by increasing the incident r.f. power at 1.0μs pulse length and 1000p.p.s. from zero until breakdown occurs inside the TR tube.
6. The recovery characteristic is determined by measuring the transmission through a peak response tuned TR tube of a low level c.w. signal at the transmitter frequency, which will be within the range 9548 ± 65MHz, following a transmitter pulse of 0.1μs duration at 3000p.p.s.

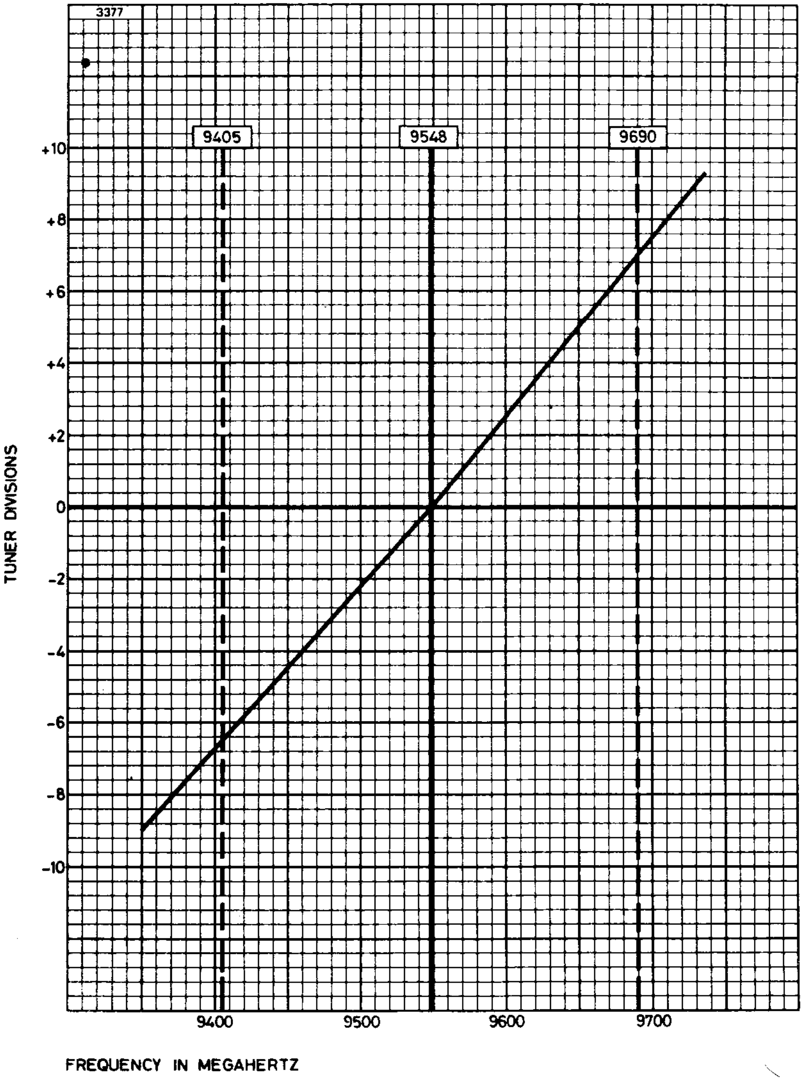
Time after end of pulse, μs	**Maximum attenuation, db**
0.1	40
0.2	30
0.4	20
0.6	15
0.9	10
1.4	6

7. Measured at 1.5kW peak power, 0.1μs pulse length and 3000p.p.s. at a TR tube frequency of 9548MHz. Sample test only.
8. Transition of v.s.w. minimum from cone gap to windows occurs at following conditions approximately.

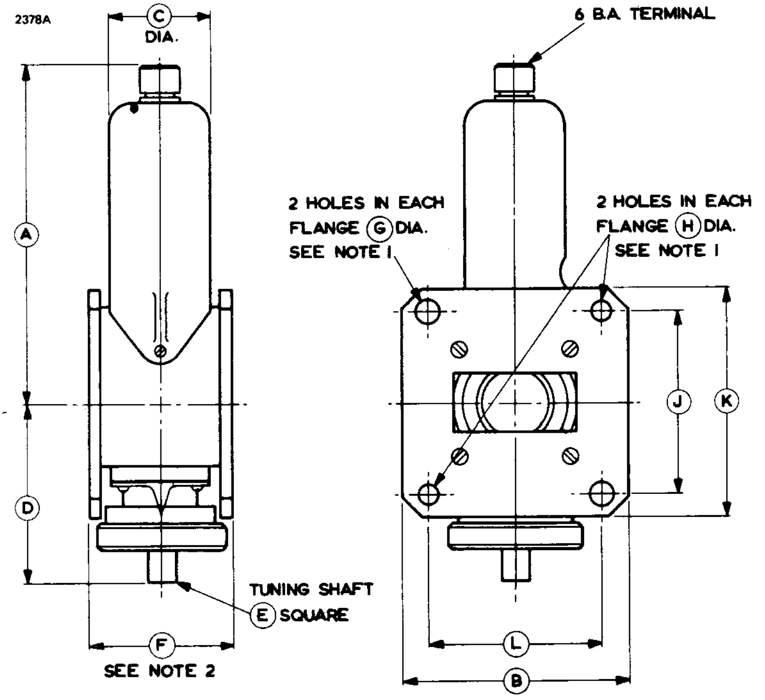
   9kW peak power, 1.0μs pulse length and 1000p.p.s.
   10.5kW peak power, 1.0μs pulse length and 500p.p.s.
   17.5kW peak power, 0.5μs pulse length and 1000p.p.s.

9. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current should be adjusted to 150μA by means of series resistance, around the value of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap terminal.

TYPICAL TUNER CHARACTERISTIC



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.375 max	60.33 max	G*	0.169 ± 0.004	4.3 ± 0.1
B	1.625	41.28	H*	0.150 ± 0.004	3.8 ± 0.1
C	0.750	19.05	J	1.280 ± 0.003	32.512 ± 0.076
D	1.437 max	36.50 max	K	1.625	41.28
E	0.187	4.75	L	1.220 ± 0.003	30.988 ± 0.076
F	1.000 ± 0.005	25.40 ± 0.13			

Millimetre dimensions have been derived from inches except where indicated thus *.

Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.008 inch (0.20mm).

BS852

S-BAND
TR TUBE-FILTER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Primerless, tunable, double cavity TR tube-filter.

CHARACTERISTICS

Frequency range	any 300MHz within the band 2.60 to 3.96GHz	
Maximum leakage (see note):		
total power	50	mW
low power	100	mW
Recovery period to −3db (see note)	10	μs max
Insertion loss (over operating temperature range)	1.5	db max
Rejection at ±30MHz	30	db min

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1.0	MW
Transmitter power (mean)	–	2.0	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (operating)	−30	+70	°C

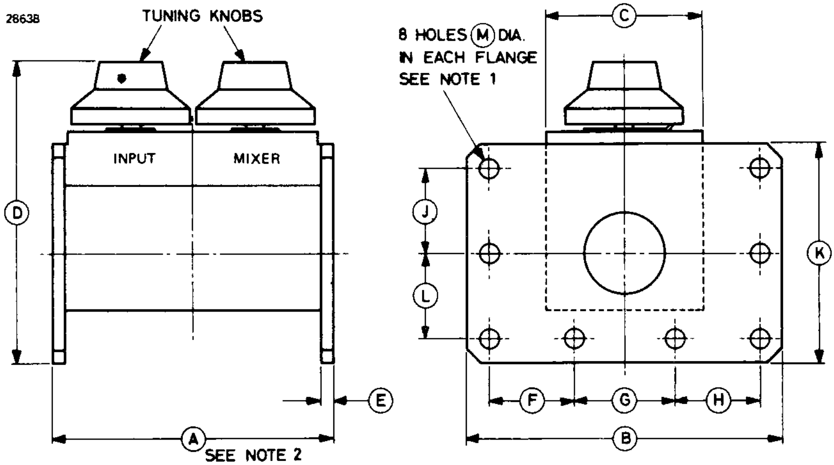
GENERAL

Overall dimensions	121.5 x 120.0 x 107.5mm max 4.783 x 4.724 x 4.232 inches max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	mates with NATO S.N. 5985-99-083-0058
Finish	flange faces aluminium alloy
Mounting position	any
Net weight	1.75kg (3.8 pounds) approx

NOTE

Measured at 100W peak power, 10μs pulse length at 10kHz. Power levels above this value may affect some of the performance and life characteristics of the tube. Recovery is substantially improved at shorter pulse lengths.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	107.0 ± 0.5	4.213 ± 0.020	G	38.10	1.500
B	121.0 ± 0.5	4.764 ± 0.020	H	32.54	1.281
C	60.0 max	2.362 max	J	32.54	1.281
D	120.0 max	4.724 max	K	83.0 ± 0.5	3.268 ± 0.020
E	5.0 min	0.197 min	L	32.54	1.281
F	32.54	1.281	M	7.3 ± 0.2	0.287 ± 0.008

Inch dimensions have been derived from millimetres.

Outline Notes

1. Minimum effective diameter of holes on their true position, including concentricity from flange to flange, 6.6mm (0.260 inch).
2. The two flange faces are flat and parallel within 0.25mm (0.010 inch).

BS860

X-BAND TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	8825 to 9225	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	15	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period		see note 4
Insertion loss (see note 1)	0.8	db max
Position of short circuit (see note 5)	5.1 to 6.6mm (0.201 to 0.260 inch)	
Primer firing time	5.0	s max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	1.0	100	kW
Duty cycle	–	0.001	
Primer supply voltage (negative) (see note 7)	700	1500	V
Primer current	100	200	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating) (see note 8)	–30	+70	°C

GENERAL

Overall dimensions	1.000 x 1.625 x 2.437 inches nom 25.40 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

January 1971

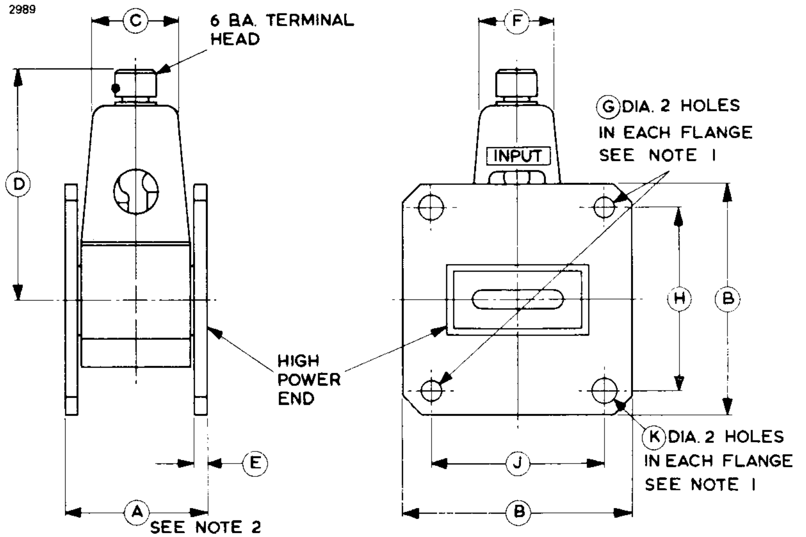
NOTES

1. Measured at a low power level over the frequency band.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. The recovery characteristic is determined by measuring the transmission of a low level c.w. signal at 9025 ± 50MHz, following a power pulse of 0.1μs at 2.5kW peak.

Time after end of pulse	Maximum attenuation
μs	db
0.1	40
0.2	30
0.4	20
0.6	15
0.9	10
1.4	6

5. Measured at 20kW transmitter power, 1.0μs pulse length and 1000p.p.s. to determine the lower limit, and at 2.5kW transmitter power, 0.1μs pulse length and 1000p.p.s. to determine the upper limit.
6. For operation in a simple T junction duplexer where the power incident on the tube is half the transmitter power.
7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ of which at least 0.5MΩ must be adjacent to the primer terminal.
8. The recovery characteristic will be initially degraded if the tube is at a temperature below 0°C when the transmitter is switched on, but will return to normal as the tube warms up.
9. Tubes are tested at least 7 days after completion, and with the primer energized as specified in note 7.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.000 ± 0.005	25.40 ± 0.13	F	0.531	13.49
B	1.625	41.28	G*	0.150 ± 0.004	3.8 ± 0.1
C	0.625	15.88	H	1.280 ± 0.004	32.512 ± 0.102
D	1.750 max	44.45 max	J	1.220 ± 0.004	30.988 ± 0.102
E	0.094 min	2.39 min	K*	0.169 ± 0.004	4.3 ± 0.1

Millimetre dimensions have been derived from inches except where indicated thus *.

Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.005 inch (0.13mm).

BS892

X-BAND TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	9340 to 9420	MHz
V.S.W.R. (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	15	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	1.0	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit • (see notes 3 and 5)	0.062 ± 0.010 inch (1.57 ± 0.25mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	1.0	50	kW
Primer supply voltage (negative) (see note 6)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

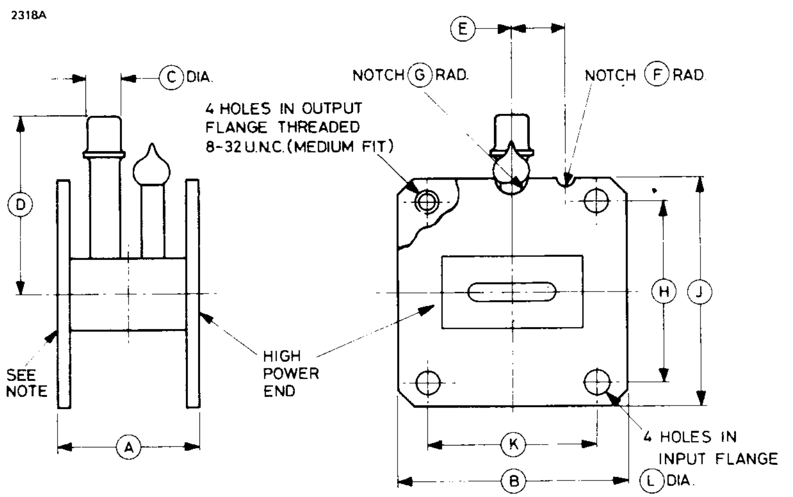
Overall dimensions	1.000 x 1.625 x 2.437 inches nom 25.40 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	see Outline
Finish	flange faces copper, tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

January 1971

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.000 ± 0.092	25.40 ± 2.34	G	0.250 max	6.35 max
B	1.625	41.28	H	1.280 ± 0.004	32.512 ± 0.102
C	0.250	6.35	J	1.625	41.28
D	1.250 min	31.75 min	K	1.220 ± 0.004	30.988 ± 0.102
E	0.375 ± 0.005	9.53 ± 0.13	L	0.173 ± 0.012	4.4 ± 0.3
F	0.062 ± 0.031	1.57 ± 0.79			

Millimetre dimensions have been derived from inches except dimension L.

Outline Note Surface roughness of output flange may be left as pressed.

BS894

S-BAND
TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

High Q, primerless, tunable TR tube

CHARACTERISTICS

Frequency range	3030 to 3070	MHz
V.S.W.R.	1.3:1	max
Maximum leakage:		
spike energy (see note)	15	nJ/pulse
total power (see note)	60	mW
low power	150	mW
Recovery period to −3db (see note)	10	μs max
Insertion loss	0.8	db max
Position of short circuit (see note)	5.6mm (0.220 inch) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1.0	MW
Transmitter power (mean)	–	2.0	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (operating)	−15	+75	°C

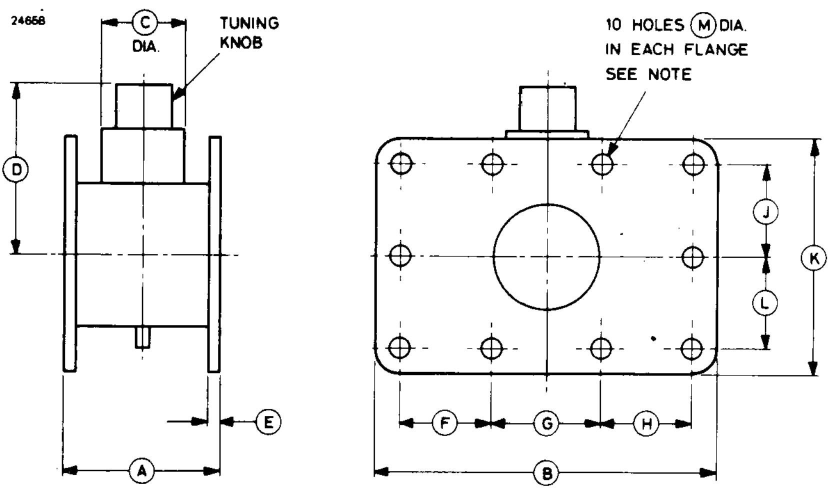
GENERAL

Overall dimensions	122 x 102 x 55.5mm max 4.803 x 4.016 x 2.185 inches max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces aluminium
Mounting position	any
Net weight	900g (2 pounds) approx

NOTE

Measured at 20kW peak power, 1.0µs pulse length and 1000p.p.s. Operation at considerably higher power levels will affect some of the performance characteristics of the tube, and the user is invited to consult English Electric Valve Company Ltd. on such applications.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	55.0 ± 0.5	2.165 ± 0.020	G	38.10	1.500
B	121.0 ± 0.5	4.764 ± 0.020	H	32.54	1.281
C	38.0 max	1.496 max	J	32.54	1.281
D	60.0 max	2.362 max	K	83.0 ± 0.5	3.268 ± 0.020
E	5.0 min	0.197 min	L	32.54	1.281
F	32.54	1.281	M	7.3 ± 0.2	0.287 ± 0.008

Inch dimensions have been derived from millimetres.

Outline Note

The minimum effective diameter of the holes on true positions, including concentricity from flange to flange, is 6.6mm (0.260 inch).

BS914

X-BAND
TR TUBE

Equivalent to 1B63A

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	8490 to 9578	MHz
V.S.W.R. (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	20	nJ/pulse
flat power (see note 3)	50	mW
low power	250	mW
Recovery period to −3db (see note 3)	4.0	μs max
Insertion loss (see note 4)	0.7	db max
Arc loss (see note 5)	0.8	db max
Interaction loss (see note 4)	0.2	db max
Position of short circuit (see notes 3 and 6)	0.065 ± 0.007 inch (1.65 ± 0.18mm)	
Primer firing time at −700V	5.0	s max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	4.0	200	kW
Primer supply voltage (negative) (see note 7)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler mates with	NATO S.N. 5985-99-083-0051 and 5985-99-083-0052
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power input, 0.1μs pulse length and 1000p.p.s., frequency 9400 $\pm$ 50MHz.
3. Measured at 40kW peak power input, 1.0μs pulse length and 1000p.p.s., frequency 9400 $\pm$ 50MHz.
4. Measured at a power level below 10mW at 9000MHz.
5. Measured at 4kW peak power input, 1.0μs pulse length and 1000p.p.s., frequency 9400 $\pm$ 50MHz.
6. Distance of the effective r.f. short circuit behind front flange.
7. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

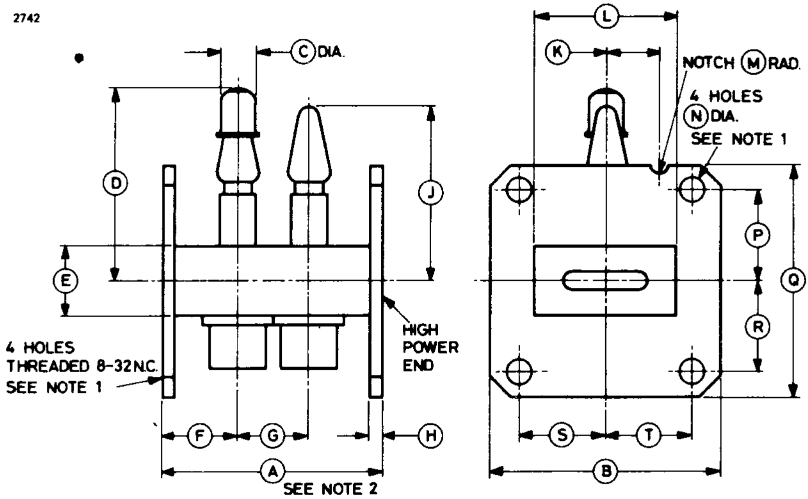
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 $\pm$ 0.002	39.497 $\pm$ 0.051	K	0.375 $\pm$ 0.005	9.53 $\pm$ 0.13
B	1.625	41.28	L	1.000	25.40
C	0.250	6.35	M	0.062 $\pm$ 0.031	1.57 $\pm$ 0.79
D	1.375 max	34.93 max	N	0.169	4.30
E	0.500	12.70	P	0.640 $\pm$ 0.002	16.256 $\pm$ 0.051
F	0.531	13.49	Q	1.625	41.28
G	0.500	12.70	R	0.640 $\pm$ 0.002	16.256 $\pm$ 0.051
H	0.094 min	2.39 min	S	0.610 $\pm$ 0.002	15.494 $\pm$ 0.051
J	1.250 max	31.75 max	T	0.610 $\pm$ 0.002	15.494 $\pm$ 0.051

Millimetre dimensions have been derived from inches except dimension N.

OUTLINE

2742



Outline Notes

1. The corresponding holes in both flanges will be coaxial. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS918

X-BAND
TWIN TR TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, H-plane twin TR tube with one primer per tube.

CHARACTERISTICS (See note 1)

Frequency range	8500 to 9600	MHz
V.S.W.R. (see note 2)	1.3:1	max
Maximum leakage to receiver:		
high power spike (see note 3)	10	nJ/pulse
high power total (see note 4)	15	mW
low power (see note 5)	500	mW
Recovery period to −3db (see note 4)	3.0	μs max
Insertion loss (see note 1)	1.0	db max
Arc loss (see note 4)	0.6	db max
Phase control (see note 6)	±5	degrees
Primer firing time (see note 7)	5.0	s max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0	250	kW
Primer supply voltage (negative) (see note 7)	900	1100	V
Primer current	70	150	μA
Primer voltage drop	200	400	V
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−55	+125	°C

GENERAL

Overall dimensions	39.5 x 46.0 x 66.0mm nom 1.555 x 1.811 x 2.598 inches nom
Waveguide size	2 x no. 16 (0.900 x 0.400 inch internal)
Coupler	see Outline
Finish	flanges tin or silver plated
Mounting position	any
Net weight	200g (7 ounces) approx

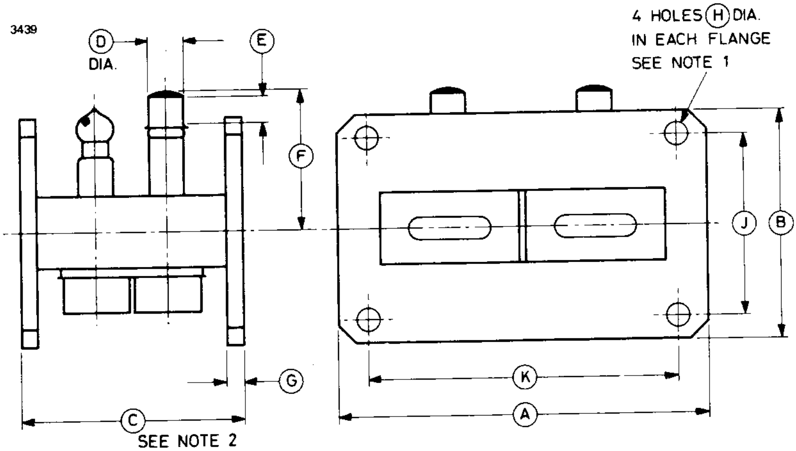
NOTES

1. All tests are performed with the tube mounted between short-slot hybrid couplers of directivity 25db minimum over the frequency range and the primers energized at 100μA each.
2. Measured through either tube at a power level below 10mW.
3. Measured at 40kW peak power, 0.25μs pulse length, and 3000p.p.s.
4. Measured at 40kW peak power, 1.0μs pulse length, and 1000p.p.s.
5. Measured at 1.0μs pulse length and 1000p.p.s., increasing power until the tube fires.
6. The electrical lengths of the tubes will not differ by more than 5 degrees, and will be within the limits given below:

Frequency MHz	Electrical Length degrees
8500	147 to 187
9000	234 to 274
9500	350 to 390

7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	66.0 ± 0.5	2.598 ± 0.020
B	41.0 ± 0.5	1.614 ± 0.020
C	39.50 ± 0.25	1.555 ± 0.010
D	6.35	0.250
E	6.5	0.256
F	25.0 max	0.984 max
G	2.6 min	0.102 min
H	4.4 max	0.173 max
	4.3 min	0.169 min
J	32.5	1.280
K	55.1	2.169

Inch dimensions have been derived from millimetres.

Outline Notes

1. Positional tolerance 0.2mm (0.008 inch) datum dimensions A and B. The corresponding holes of both flanges are in alignment within 0.25mm (0.010 inch).
2. The two flange faces are flat and parallel within 0.1mm (0.004 inch).

BS932

S-BAND TR TUBE

Service Type CV2481

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band double primer TR tube.

CHARACTERISTICS

Frequency range	3490 to 3770	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
high power spike (see note 2)	25	nJ/pulse
low power (see note 3)	1.0	mW min
	150	mW max
Recovery time to −6db (see note 2)	10	μs max
Insertion loss (see note 4)	0.8	db max
Primer firing time	15	s max
Primer voltage drop (see note 5)	200	V min
	400	V max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	30	kW
Transmitter power (average)	–	45	W
Primer supply voltage (negative)	1.0	2.0	kV
Primer current (each primer)	100	200	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	90.5 x 104.0 x 106.5mm max 3.563 x 4.094 x 4.193 inches max
Waveguide size	no. 11a (2.290 x 1.145 inches internal)
Coupler	NATO S.N. 5985-99-083-1563
Primer terminal	Plessey plug CZ63958 with coarse thread adaptor and locking spring
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	1.0kg (2.2 pounds) approx

NOTES

1. Measured over the frequency range 3490 to 3770MHz.
2. Measured at a frequency of 3630MHz.
3. Measured at 100kW peak power, frequency within the range 3490 to 3770MHz, 1000p.p.s. and 1.0μs pulse length.
4. Measured at 1000p.p.s. and 1.0μs pulse length with the power increased from a low level until breakdown occurs within the tube.
5. Measured at pins A and C of the primer plug, with a primer current of 150μA.

Outline Dimensions (All dimensions without limits are nominal)

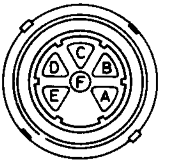
Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	103.0 ± 1.0	4.055 ± 0.039	N	63.5 max	2.500 max
B	90.2 ± 0.3	3.551 ± 0.012	P	1.6 min	0.063 min
C	13.0 max	0.512 max	Q	14.30 ± 0.13	0.563 ± 0.005
D	71.5 ± 1.0	2.815 ± 0.039	R	51.0 max	2.008 max
E	21.0 max	0.827 max	S	38.10 ± 0.25	1.500 ± 0.010
F	8.0 ± 0.8	0.315 ± 0.032	T	20.6 ± 0.4	0.811 ± 0.016
G	1.14 ± 0.13	0.045 ± 0.005	U	3.6 ± 0.4	0.142 ± 0.016
H	38.0 max	1.496 max	V	50.8	2.000
J	44.5 max	1.752 max	W	27.0	1.063
K	69.85 ± 0.25	2.750 ± 0.010	X	28.6	1.126
L	1.6 min	0.063 min	Y	27.0	1.063
M	14.30 ± 0.13	0.563 ± 0.005			

Inch dimensions have been derived from millimetres.

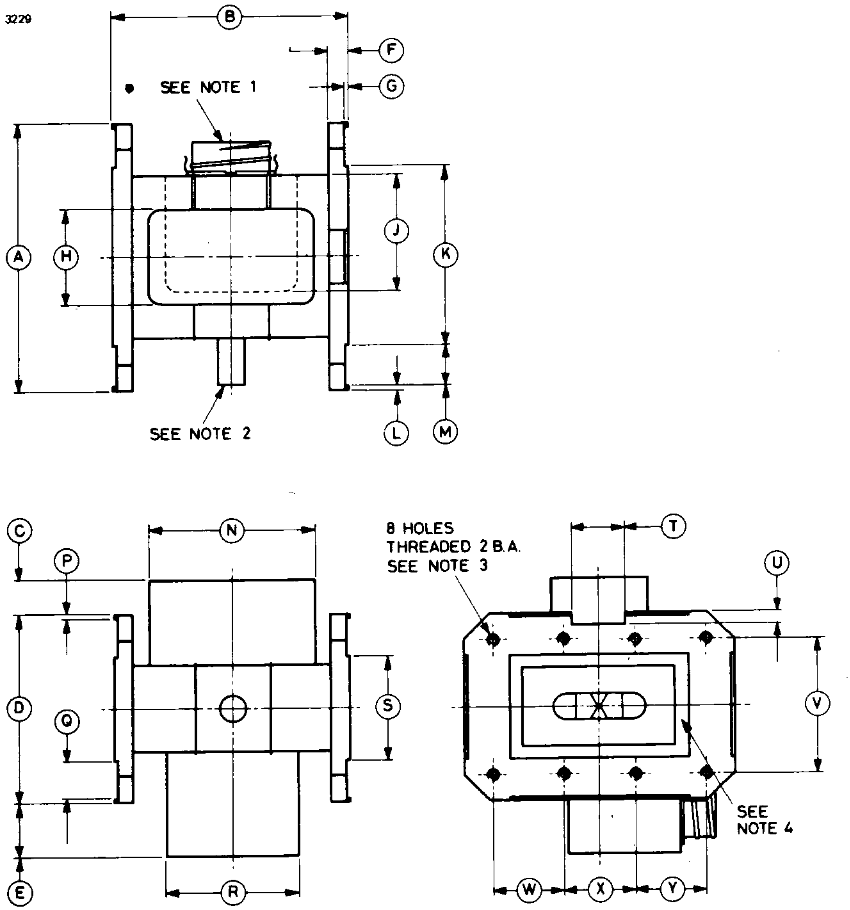
Outline Detail of Plug Connections

Ref	Element
A	Primer 1
B*	Primer 2
C	Primer 1
D*	Primer 2
E	Case
F	–

* Pins B and D have a series resistor of 2.2MΩ connected inside tube.



OUTLINE



Outline Notes

1. Plessey plug type CZ63958 with locking spring and coarse thread adaptor. See page 2 for detail showing plug connections.
2. The seal-off will not project beyond the flange.
3. Positional tolerance 0.15mm (0.006 inch), symmetrical tolerance 0.25mm (0.010 inch) datum dimensions K and S.
4. Flat tolerance 0.08mm (0.003 inch).

TR Limiter Tubes

BS812

X-BAND
TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9320 to 9500	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	µs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	µA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

GENERAL

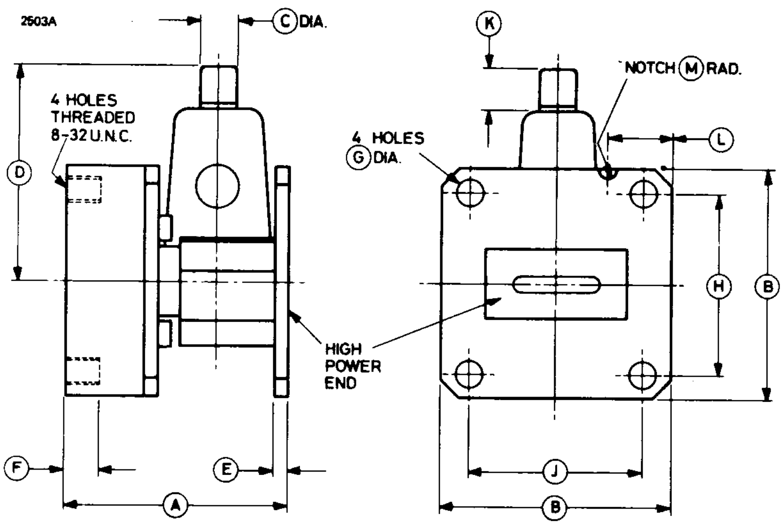
Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

February 1971

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13
B	1.625	41.28
C	0.250	6.35
D	1.625 max	41.28 max
E	0.094 min	2.39 min
F	0.250	6.35

Ref	Inches	Millimetres
G	0.173 ± 0.004	4.4 ± 0.1
H	1.280	32.51
J	1.220	30.99
K	0.250 min	6.35 min
L	0.437	11.10
M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS814

X-BAND
TR LIMITER

Service Type CV6192

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9000 to 9700	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

GENERAL

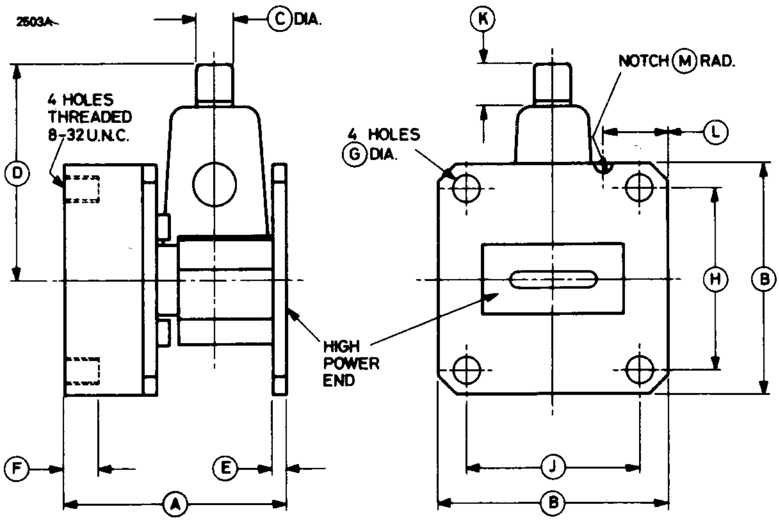
Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

February 1971

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.35	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS816

X-BAND
TR LIMITER

Service Type CV6178

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	8500 to 9100	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

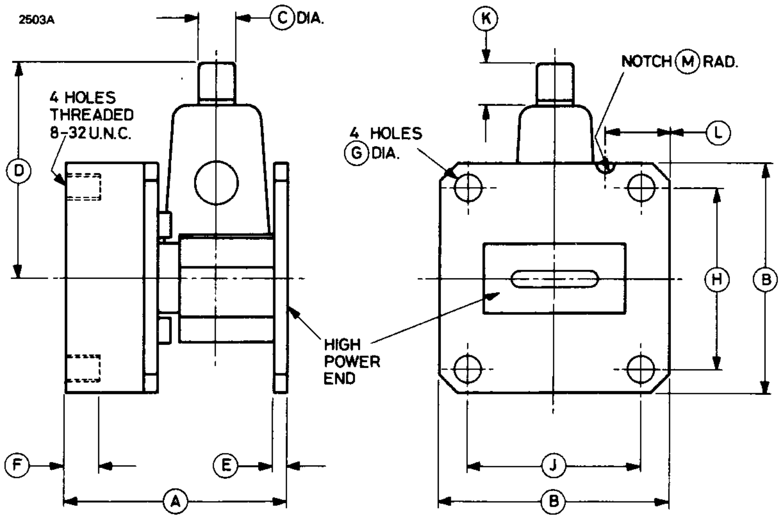
GENERAL

Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.35	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS818

X-BAND
TR LIMITER

Service Type CV6206

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9400 to 10 000	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

GENERAL

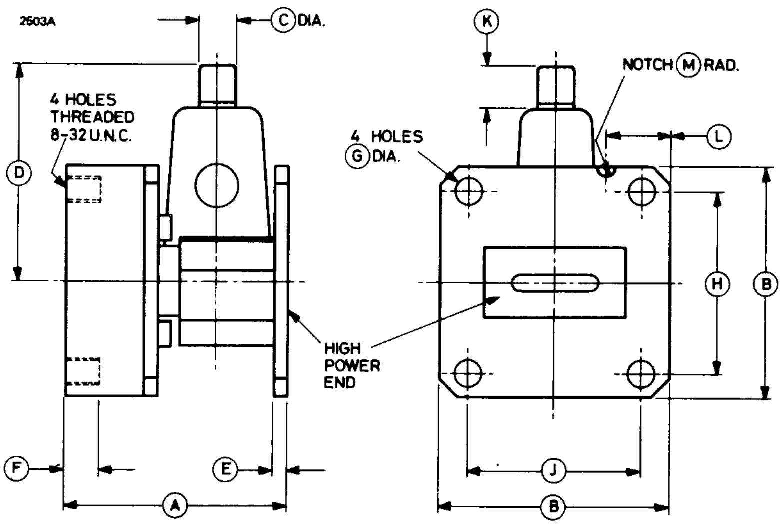
Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

February 1971

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.35	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS826

X-BAND
TR LIMITER

Service Type CV6207

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9300 to 9900	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

GENERAL

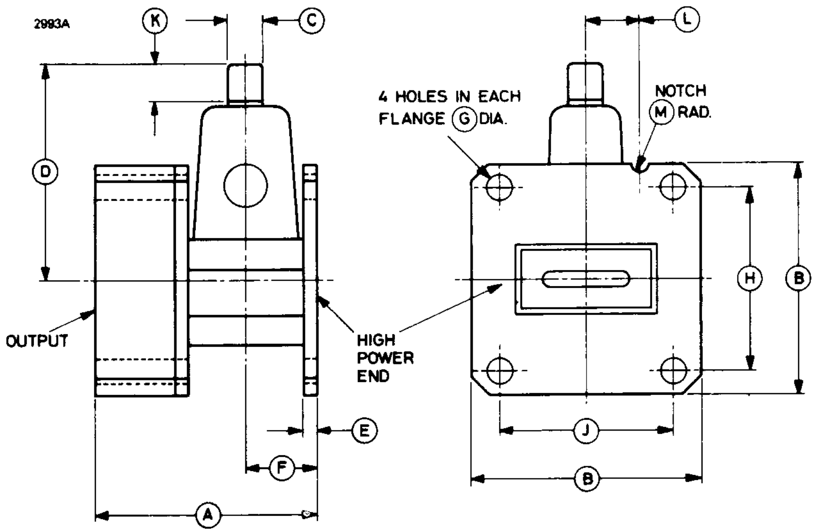
Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

February 1971

NOTES

1. Measured at a power level below 1.0mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at 9300, 9600 and 9900MHz.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.177 ± 0.004	4.5 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.375 ± 0.005	9.53 ± 0.13
F	0.500	12.70	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS882

X-BAND
TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

ABRIDGED DATA

Single primer TR limiter

Frequency range	9345 ± 45	MHz
Operating power (peak)	1.0 to 20	kW
Waveguide size	no. 16 (0.900 x 0.400 inches internal)	

GENERAL

Electrical

V.S.W.R. (see note 1)	1.4:1	max
Insertion loss at resonance (see note 2)	0.8	db max
Recovery time to 3db (see notes 3 and 4)	6.0	μs max
Maximum leakage:		
high power spike (see notes 4 and 5)	0.05	erg/pulse
high power total (see notes 3 and 4)	50	mW
Primer excess noise ratio	1.1	max

Mechanical

Overall dimensions	1.565 x 1.640 x 3.250 inches max
	39.75 x 41.66 x 82.55mm max
Finish	flange faces tin plated
Mounting position	any
Net weight	250g (9 ounces) approx

MAXIMUM AND MINIMUM RATINGS

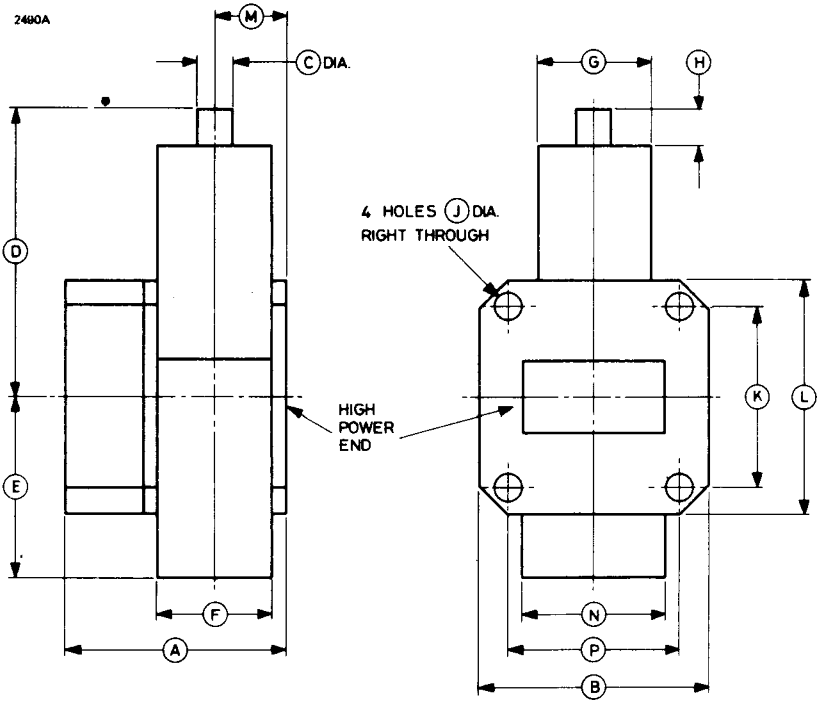
	Min	Max	
Frequency	9300	9390	MHz
Transmitter power (peak)	1.0	20	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	90	150	μA
Ambient temperature:			
storage	−50	+90	°C
operating	−40	+85	°C

November 1970

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at a power level below 10mW at 9345MHz.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. The cell will also meet the limits given at 20kW peak power, 6.0μs pulse length and 200p.p.s.
5. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
6. The primer supply voltage must be applied at least 5 seconds before the cell is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.010	39.50 ± 0.25	H	0.250 min	6.35 min
B	1.625 ± 0.015	41.28 ± 0.38	J*	0.177 ± 0.004	4.5 + 0.1
C	0.250 ± 0.005	6.35 ± 0.13	K	1.280 ± 0.005	32.51 ± 0.13
D	2.000 max	50.80 max	L	1.625 ± 0.015	41.28 ± 0.38
E	1.250 max	31.75 max	M	0.500 ± 0.093	12.70 ± 2.36
F	0.800 max	20.32 max	N	1.130 max	28.70 max
G	0.800 max	20.32 max	P	1.220 ± 0.005	30.99 ± 0.13

Millimetre dimensions have been derived from inches except where marked *.

BS886

X-BAND TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	8800 to 9250	MHz
V.S.W.R. (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	40	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	1.0	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

GENERAL

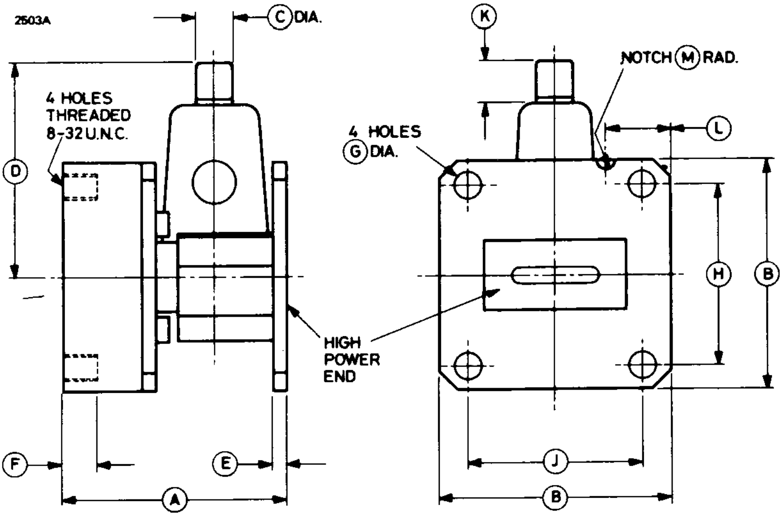
Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	5.6 ounces (160g) approx

February 1971

NOTES

1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at 8800, 9025 and 9250MHz.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.35	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS908

X-BAND
TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable, high Q TR limiter for marine radar.

CHARACTERISTICS

Frequency range	9250 to 9550	MHz
V.S.W.R. at resonance (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	20	mW
low power	50	mW
Recovery period to −3db (see note 3)	6.0	μs max
Insertion loss at resonance (see note 1)	1.0	db max
Arc loss (see note 4)	0.15	db max
Position of short circuit (see note 5):		
with gap discharge	0.240 ± 0.020 inch (6.10 ± 0.51mm)	
with window discharge	0.220 ± 0.020 inch (5.59 ± 0.51mm)	
Loaded Q	125 to 160	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	1.0	75	kW
Primer supply voltage (negative) (see note 6)	700	1500	V
Primer current	70	200	μA
Temperature range:			
non-operating	−40	+100	°C
operating	−20	+70	°C

April 1971

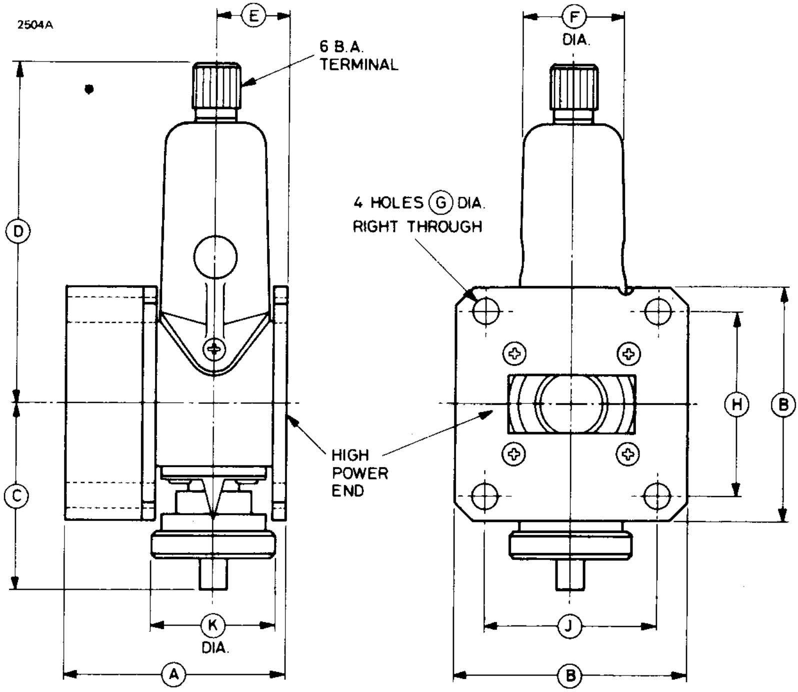
GENERAL

Overall dimensions	1.565 x 1.640 x 3.813 inches max 39.75 x 41.66 x 96.85mm max
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flanges tin plated
Mounting position	any
Net weight	9 ounces (250g) approx

NOTES

1. Measured at a power level below 10mW.
2. Measured at 50kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 50kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 1.5kW peak power, 0.1μs pulse length and 1000p.p.s.
5. Transition of voltage minimum from gap to window occurs at the following conditions approximately:
   9kW peak power, 1.0μs pulse length and 1000p.p.s.
   10.5kW peak power, 1.0μs pulse length and 500p.p.s.
   17kW peak power, 0.5μs pulse length and 1000p.p.s.
6. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

OUTLINE



Ref	Inches	Millimetres
A	1.555 ± 0.010	39.50 ± 0.25
B	1.625 ± 0.015	41.28 ± 0.38
C	1.437 max	36.50 max
D	2.375 max	60.33 max
E	0.500 ± 0.094	12.70 ± 2.39
F	0.800 max	20.32 max
G	0.177 ± 0.004	4.5 ± 0.1
H	1.280 ± 0.005	32.51 ± 0.13
J	1.220 ± 0.005	30.99 ± 0.13
K	0.900 max	22.86 max

Millimetre dimensions have been derived from inches except dimension G.

BS960

X-BAND
TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	8750 to 8850	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	10	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	0.25	μs max
Insertion loss (see note 4)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	200	kW
Primer supply voltage (negative) (see note 5)	950	1100	V
Primer current	50	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.200 inches nom 39.50 x 41.28 x 55.88mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	6 ounces (170g) approx

February 1971

NOTES

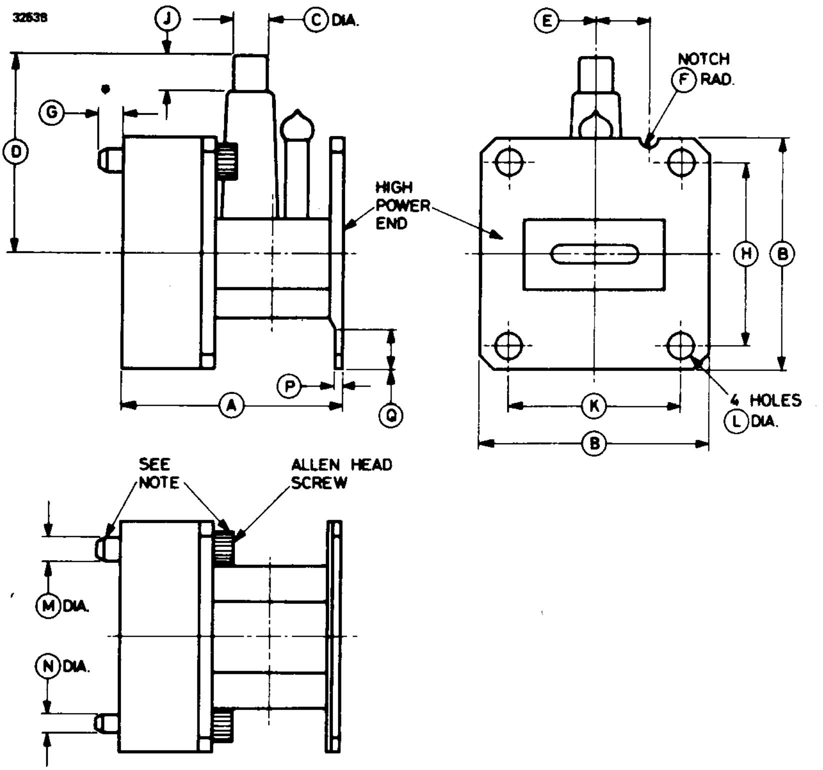
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0W peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 1.0W peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 12.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051	J	0.250 min	6.35 min
B	1.625	41.28	K	1.220 ± 0.004	30.988 ± 0.102
C	0.250	6.35	L	0.173 ± 0.012	4.4 ± 0.3
D	1.375 ± 0.031	34.93 ± 0.79	M	0.165	4.19
E	0.375 ± 0.005	9.53 ± 0.13	N	0.145	3.68
F	0.062 ± 0.031	1.57 ± 0.79	P	0.062	1.57
G	0.125 min	3.18 min	Q	0.300 min	7.62 min
H	1.280 ± 0.004	32.512 ± 0.102			

Millimetre dimensions have been derived from inches except dimension L.

OUTLINE



Outline Note The Allen screws may be used to retract the two locating pins when installing the BS960 under limited space conditions.

BS968

X-BAND TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band primerless TR limiter. In monopulse radars this tube is used in the difference channel and BS974 is used in the sum channel.

CHARACTERISTICS

Frequency range	9000 to 9500	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
high power spike (see note 2)	5.0	nJ/pulse
high power total (see note 3)	30	mW
low power	50	mW
Recovery time to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	1.0	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+90	°C

GENERAL

Overall dimensions	78.5 x 41.5 x 41.5mm max 3.091 x 1.634 x 1.634 inches max
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	350g (12 ounces) approx

February 1971

NOTES

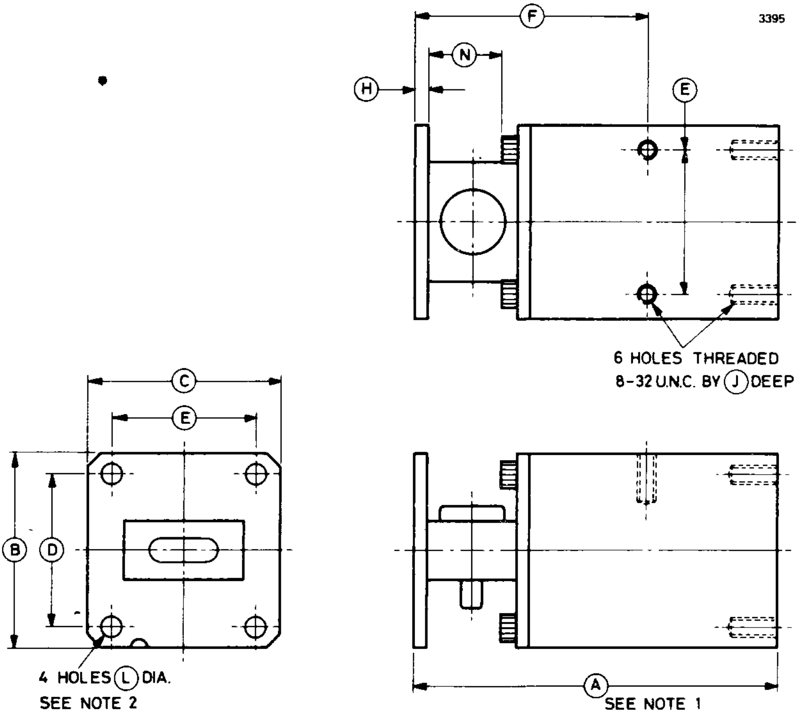
1. Measured at a power level below 1.0mW over the frequency range.
2. Measured at 40kW peak power, 0.25μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 1.0mW at 9000, 9250 and 9500MHz.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Millimetres	Inches
A	78.0 ± 0.5	3.071 ± 0.020
B	41.5 max	1.634 max
C	41.5 max	1.634 max
D	32.5	1.280
E	31.0	1.220
F	50.0 ± 0.5	1.969 ± 0.020
H	3.0 ± 0.5	0.118 ± 0.020
J	10.0 min	0.394 min
L	4.3 ± 0.1	0.169 ± 0.004
N	13.5 min	0.532 min

Inch dimensions have been derived from millimetres.

OUTLINE



Outline Notes

1. The two end faces will be flat within 0.05mm (0.002 inch) and parallel within 0.1mm (0.004 inch).
2. Positional tolerance 0.05mm (0.002 inch) diameter.

BS974

X-BAND
TWIN TR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, primerless, E-plane twin TR limiter. In monopulse radars this tube is used in the sum channel and BS968 is used in the difference channel.

CHARACTERISTICS (Mounted between 3db couplers)

Frequency range		9000 to 9500	MHz
V.S.W.R. (see note 1)		1.3:1	max
Attenuation recovery period to −3db (see note 2)		3.0	μs max
Insertion loss (see note 3)		1.0	db max
Arc loss (see note 2)		0.8	db max
Maximum leakage:	**Receiver**	**Load**	
high power spike (see note 4)	5.0	30	nJ/pulse
high power total (see note 2)	30	300	mW
low power	400		mW

MAXIMUM AND MINIMUM RATINGS

	Min	**Max**	
Transmitter power (peak) (see note 5)	1.0	150	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+90	°C

GENERAL

Overall dimensions	41.5 x 50.5 x 60.5mm max
	1.634 x 1.988 x 2.382 inches max
Waveguide size	2 x no. 16 (0.900 x 0.400 inch internal)
Coupler	see Outline
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	300g (10.5 ounces) approx

February 1971

NOTES

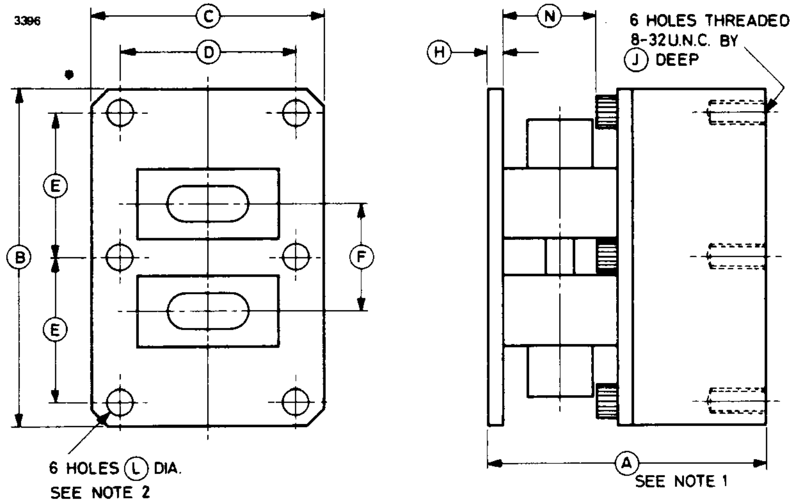
1. Measured at a power level below 1.0mW over the frequency range.
2. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
3. Measured at a power level below 2.0mW at 9000, 9250 and 9500MHz.
4. Measured at 40kW peak power, 0.25μs pulse length and 3000p.p.s.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Millimetres	Inches
A	50.0 ± 0.5	1.969 ± 0.020
B	60.5 max	2.382 max
C	41.5 max	1.634 max
D	31.0	1.220
E	25.75	1.014
F	19.0 ± 0.2	0.748 ± 0.008
H	3.0 ± 0.5	0.118 ± 0.020
J	10.0 min	0.394 min
L	4.3 ± 0.1	0.169 ± 0.004
N	13.5 min	0.532 min

Inch dimensions have been derived from millimetres

OUTLINE



Outline Notes

1. The two end faces will be flat within 0.05mm (0.002 inch) and parallel within 0.1mm (0.004 inch).
2. Positional tolerance 0.05mm (0.002 inch) diameter.

TB Tubes

BS48

X-BAND
TB TUBE

Service Type CV460

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9410	MHz
Loaded Q	6.0	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.045	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

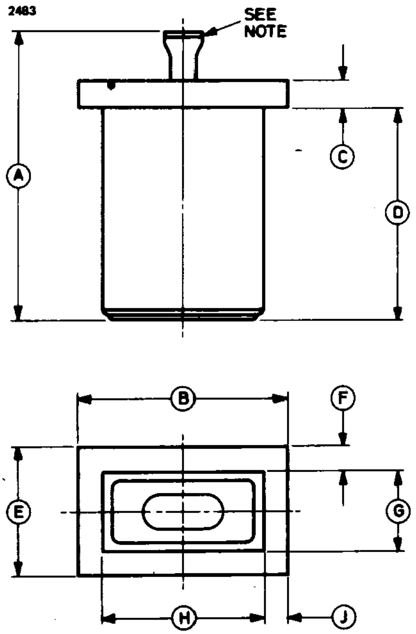
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS82

X-BAND
TB TUBE

Service Type CV463

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9080	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1:15:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

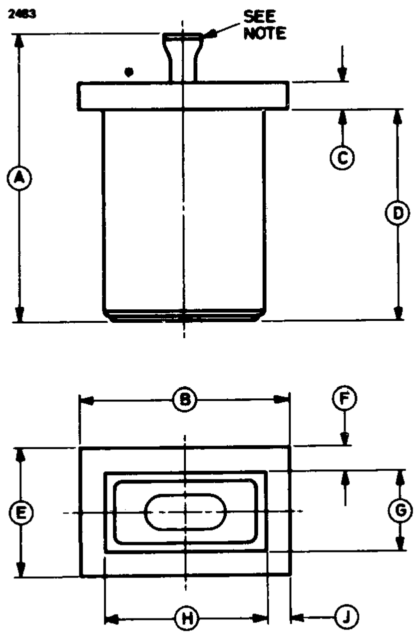
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS84

X-BAND
TB TUBE

Service Type CV462

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9240	MHz
Loaded Q	6.5	max
Equivalent susceptance	$\pm$0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

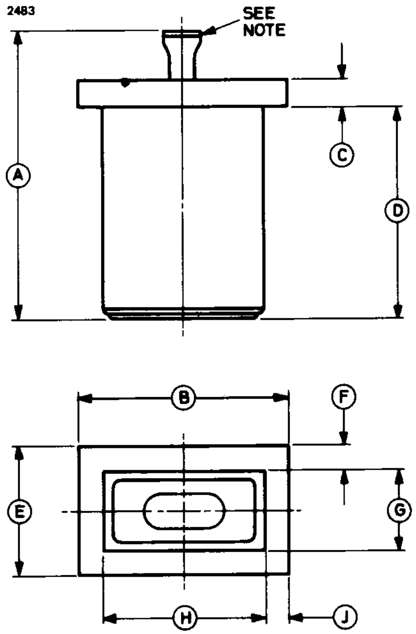
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres
A	1.813 max	46.05 max
B	1.303 $^{+0.000}_{-0.006}$	33.10 $^{+0.00}_{-0.15}$
C	0.133 $^{+0.000}_{-0.016}$	3.38 $^{+0.00}_{-0.41}$
D	1.299 ± 0.005	32.99 ± 0.13
E	0.803 $^{+0.000}_{-0.006}$	20.40 $^{+0.00}_{-0.15}$

Ref	Inches	Millimetres
F	0.142 min	3.61 min
G	0.510 $^{+0.000}_{-0.020}$	12.95 $^{+0.00}_{-0.51}$
H	1.010 $^{+0.000}_{-0.020}$	25.65 $^{+0.00}_{-0.51}$
J	0.142 min	3.61 min

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS92

X-BAND
TB TUBE

Service Type CV461

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9375	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

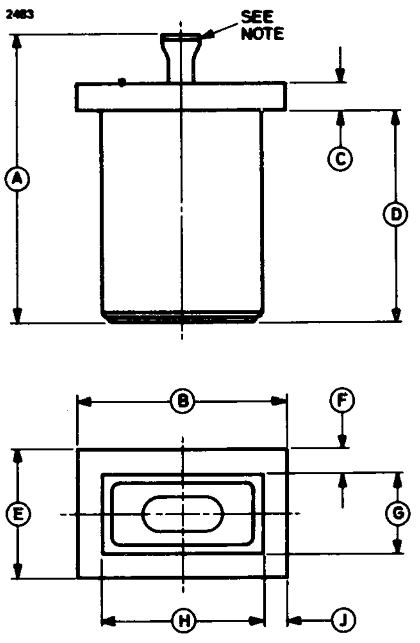
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS114

X-BAND
TB TUBE

Service Type CV2274

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9600	MHz
Loaded Q	6.5	max
Equivalent susceptance	$\pm$0.06	max
Equivalent conductance	0.05	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

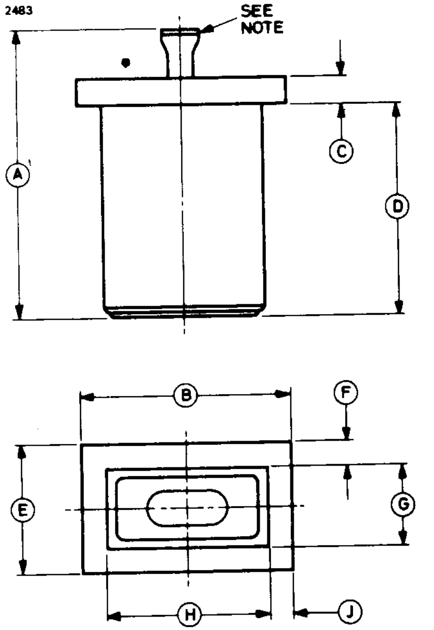
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres
A	1.813 max	46.05 max
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$
D	1.299 ± 0.005	32.99 ± 0.13
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$

Ref	Inches	Millimetres
F	0.142 min	3.61 min
G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
J	0.142 min	3.61 min

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS116

X-BAND
TB TUBE

Service Type CV2308

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9325	MHz
Loaded Q	6.5	max
Equivalent susceptance	± 0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.11 : 1	max
Recovery loss at $2\mu s$ (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

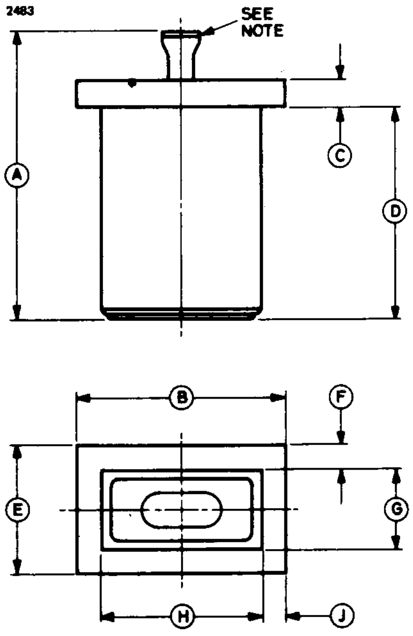
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, $1.0\mu s$ pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, $1.0\mu s$ pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), $1.0\mu s$ pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS118

X-BAND
TB TUBE

Service Type CV2309

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	8775	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.11:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

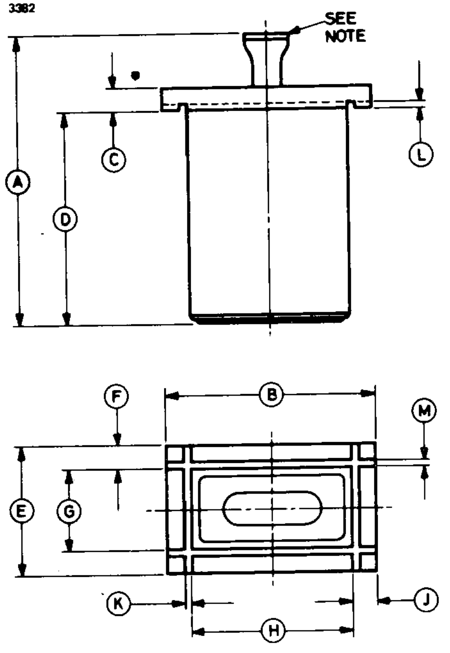
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres
A	1.813 max	46.05 max
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$
D	1.299 ± 0.005	32.99 ± 0.13
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$
F	0.142 min	3.61 min
G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
J	0.142 min	3.61 min
K	0.040 max 0.030 min	1.02 max 0.76 min
L	0.040 ± 0.005	1.02 ± 0.13
M	0.040 max 0.030 min	1.02 max 0.76 min

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS148

X-BAND TB TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9850	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

GENERAL

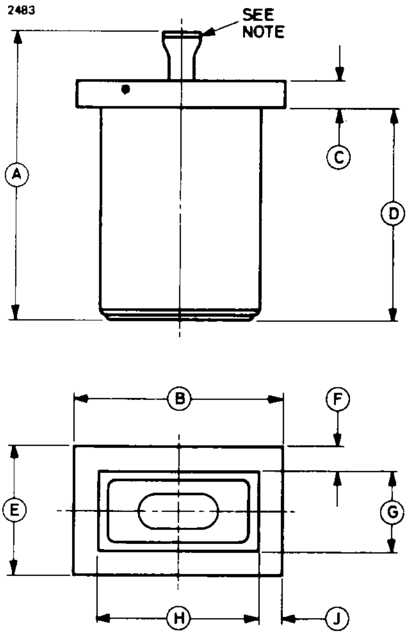
Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

February 1971

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS248

X-BAND
TB TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9025	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	–40	+100	°C

GENERAL

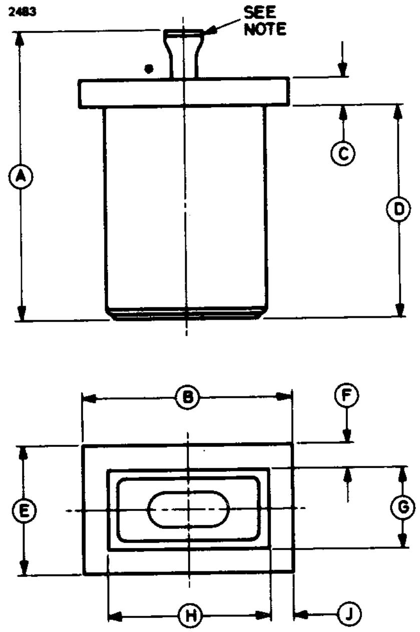
Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

February 1971

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS310

X-BAND
TB TUBE

Service Type CV6070

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9375	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	4.0	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

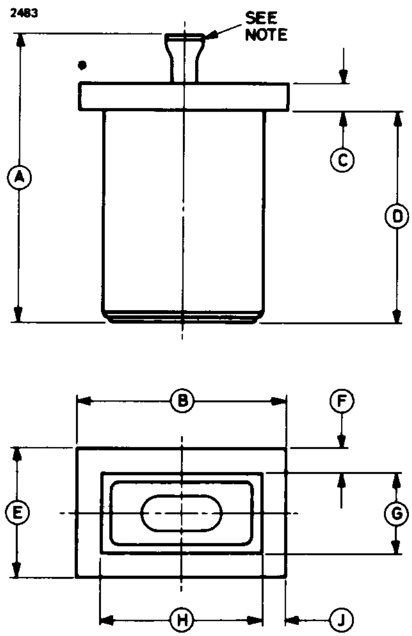
Overall dimensions	1.813 x 1.303 x 0.803 inches max
	46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.

February 1971

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS412

X-BAND TB TUBE

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9300	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	4.0	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

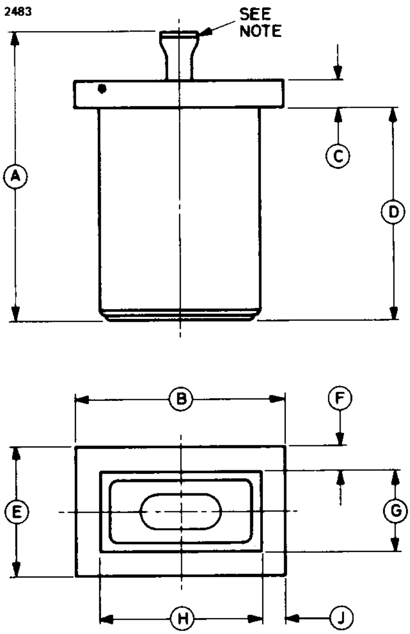
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.

OUTLINE



Ref	Inches	Millimetres
A	1.813 max	46.05 max
B	1.303 $^{+0.000}_{-0.006}$	33.10 $^{+0.00}_{-0.15}$
C	0.133 $^{+0.000}_{-0.016}$	3.38 $^{+0.00}_{-0.41}$
D	1.299 ± 0.005	32.99 ± 0.13
E	0.803 $^{+0.000}_{-0.006}$	20.40 $^{+0.00}_{-0.15}$
F	0.142 min	3.61 min
G	0.510 $^{+0.000}_{-0.020}$	12.95 $^{+0.00}_{-0.51}$
H	1.010 $^{+0.000}_{-0.020}$	25.65 $^{+0.00}_{-0.51}$
J	0.142 min	3.61 min

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

Microwave Switches, Limiters and Filters

BS338

MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed tuned, S-band microwave switch. The resonant frequency is preset to customers' requirements.

CHARACTERISTICS

Frequency range		S-band
Bandwidth	200	MHz
V.S.W.R. at resonance	1.1:1	max
Attenuation range (see note 1)	1.0 to 25	db
Insertion loss	0.25	db

MAXIMUM RATINGS

Input power (peak)	500	W max
Input power (mean)	10	W max
Forward bias voltage	1.0	V max
Bias current	30	mA max

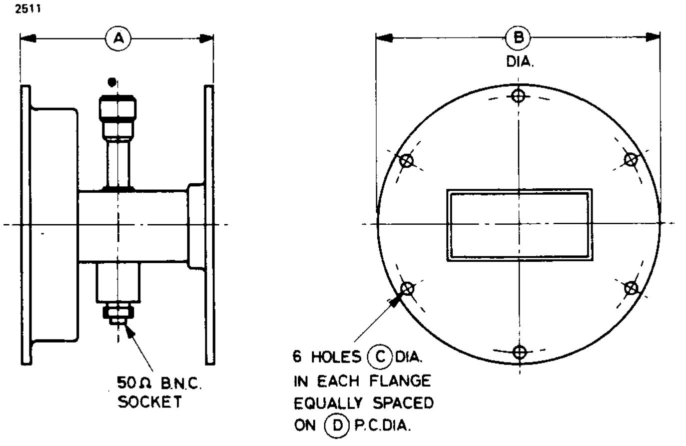
GENERAL

Overall dimensions	5.875 x 5.875 x 4.000 inches nom 149.2 x 149.2 x 101.6mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler (see note 2):	
input	NATO S.N. 5985-99-083-1558
output	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	6 pounds (2.7kg) approx

NOTES

1. This attenuation range corresponds to a bias current range of 0 to 30mA.
2. Other flanges can be supplied as required.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	4.000	101.6
B	5.875	149.2
C	0.260 ± 0.004	6.6 ± 0.1
D	5.375	136.5

Millimetre dimensions have been derived from inches.

BS392

S-BAND MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Microwave switch intended for use with TR tube BS390.

CHARACTERISTICS

Resonant frequency	3000	MHz
Bandwidth	2925 to 3075	MHz
V.S.W.R. over the band	1.4:1	max
Attenuation at 30mA bias:		
at 3000MHz	20	db min
2925 to 3075MHz	10	db min
Insertion loss	0.25	db max

MAXIMUM RATINGS

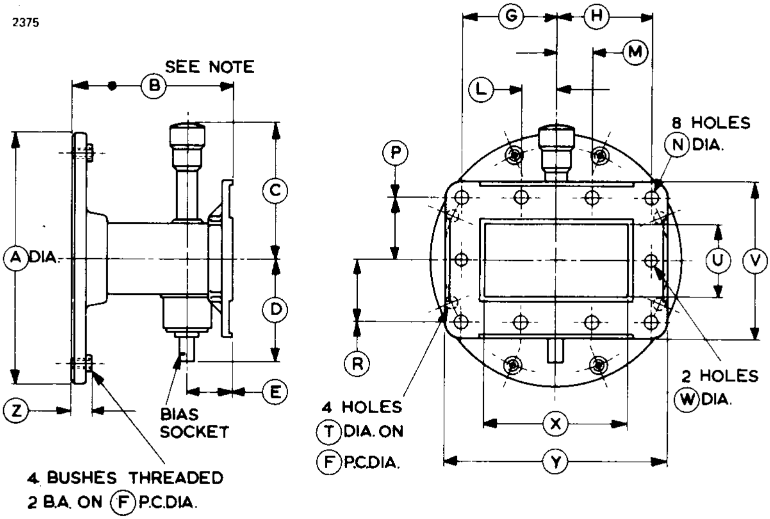
Input power (peak)	500	W max
Input power (mean)	10	W max
Forward bias voltage	1.0	V max
Bias current	30	mA max

GENERAL

Overall dimensions	5.656 x 5.313 x 3.420 inches max 143.7 x 135.0 x 86.87mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler:	
input	NATO S.N. 5985-99-083-0058
output	NATO S.N. 5985-99-083-0010
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 pounds (1.8kg) approx

April 1971

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.313	135.0	P	1.281	32.54
B	3.415 ± 0.005	86.74 ± 0.13	R	1.281	32.54
C	3.000 max	76.20 max	T	0.258 max	6.553 max
D	2.125 max	53.98 max		0.255 min	6.477 min
E	1.187 ± 0.031	30.15 ± 0.79	U	1.500	38.10
F	4.750	120.7	V	3.313	84.15
G	2.031	51.59	W	0.250 ± 0.002	6.350 ± 0.051
H	2.031	51.59	X	3.000	76.20
L	0.750	19.05	Y	4.813	122.3
M	0.750	19.05	Z	0.437	11.10
N	0.284 max	7.214 max			
	0.281 min	7.137 min			

Millimetre dimensions have been derived from inches.

Note The two flange faces are flat and parallel to within 0.005 inch (0.13mm) and at right angles to the waveguide within 1°.

BS402

DRIVE UNIT FOR MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

The BS402 is designed to drive PIN microwave switches used in radar equipments to suppress leakage into the receiver. When triggered by a suitable input pulse, it provides a current pulse of optimum amplitude and duration for the PIN switch. When the equipment is switched off, the BS402 connects a stand-by battery bias supply to provide passive protection of the receiver. The circuit can operate at up to 7500 pulses per second.

INPUT REQUIREMENTS

Supply voltage for pulse operation (d.c.)	12 (±5%)		V
Stand-by battery voltage	1.35 (+0, −10%)		V
	Pulse Operation	**Stand-by**	
Current drain from 12V supply	25	0	mA
Current drain from stand-by battery	0.1	25	mA
Trigger pulse requirements:			
amplitude	15 (±10%)		V
pulse length	1.2 (±10%)		μs
rise time	0.05		μs max
fall time	1.0		μs max

TYPICAL PERFORMANCE

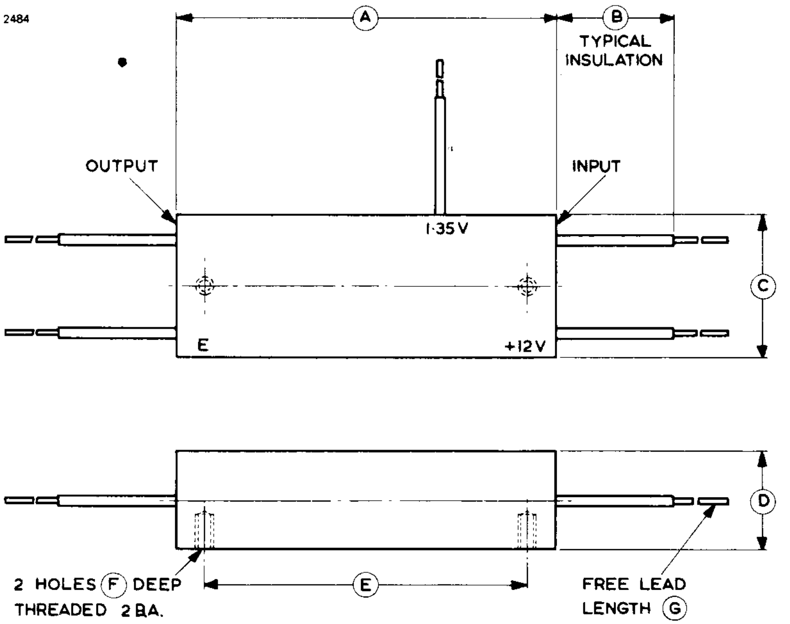
Output pulse characteristics:		
amplitude	30 to 36	mA
pulse length	7 to 9	μs
rise time	0.5	μs max
fall time	0.25	μs max
Output current on stand-by	18 to 25	mA

GENERAL

Overall dimensions	see Outline
Net weight	3.5 ounces (100g) approx

April 1971

OUTLINE (All dimensions nominal)



Ref	Inches	Millimetres
A	3.250	82.55
B	1.000	25.4
C	1.250	31.75
D	0.875	22.23
E	2.750	69.85
F	0.312	7.93
G	2.125	54

Millimetre dimensions have been derived from inches.

BS460

X-BAND MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed-tuned, X-band microwave switch. The resonant frequency is preset to customers' requirements.

CHARACTERISTICS

Frequency range		X-band
Bandwidth	100	MHz
V.S.W.R. at resonance	1.2:1	max
Attenuation range (see note)	1.0 to 25	db
Insertion loss	1.0	db max

MAXIMUM RATINGS

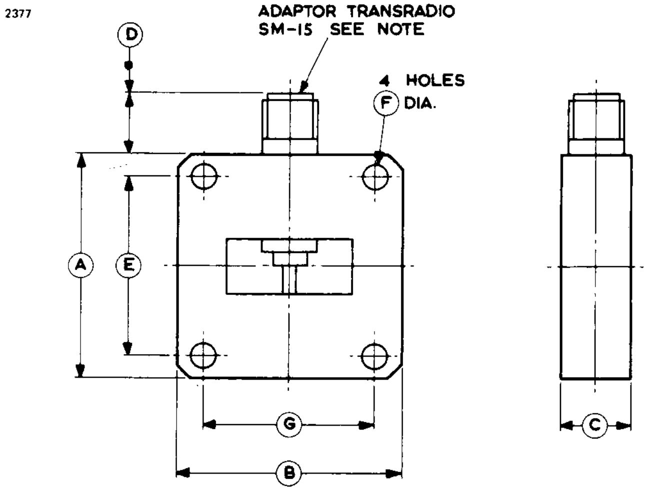
Input power (peak)	500	W max
Input power (mean)	10	W max
Forward bias voltage	1.0	V max
Bias current	30	mA max

GENERAL

Overall dimensions	2.062 x 1.625 x 0.500 inches nom 52.37 x 41.28 x 12.70mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	tin or silver plated
Mounting position	any
Net weight	5 ounces (140g) approx

Note This corresponds to a bias current range of 0 to 30mA.

OUTLINE (All dimensions nominal)



Ref	Inches	Millimetres
A	1.625	41.28
B	1.625	41.28
C	0.500	12.70
D	0.437	11.10
E	1.280	32.51
F	0.170	4.32
G	1.220	30.99

Millimetre dimensions have been derived from inches.

Note The adaptor mates with plug SM5 or SM7 (5935-99-911-6882).

BS802

S-BAND MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed tuned S-band microwave switch.

CHARACTERISTICS

Resonant frequency	3690	MHz
Bandwidth	3600 to 3770	MHz
V.S.W.R. over the band	1.4:1	max
Attenuation at 30mA bias:		
at centre frequency	25	db typical
over the band	10	db min
Insertion loss	0.25	db max

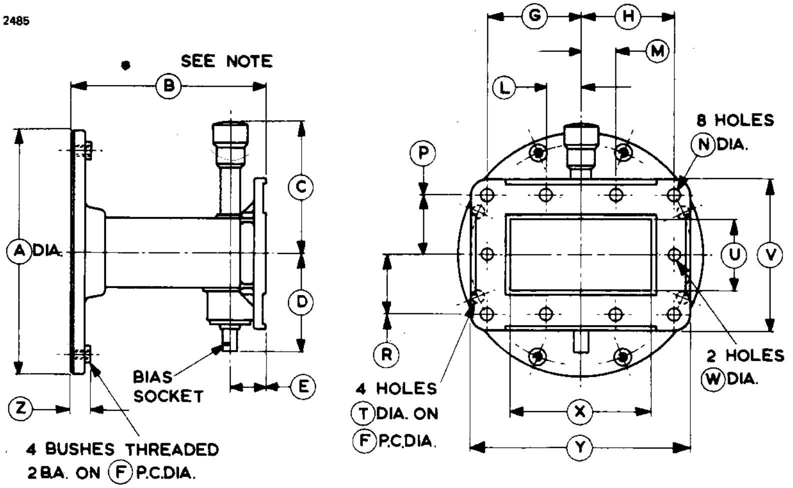
MAXIMUM RATINGS

Input power (peak)	500	W max
Input power (mean)	10	W max
Forward bias voltage	1.0	V max
Bias current	30	mA max

GENERAL

Overall dimensions	5.656 x 5.313 x 4.285 inches nom 143.7 x 135.0 x 108.8mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler:	
input	NATO S.N. 5985-99-083-0058
output	NATO S.N. 5985-99-083-0010
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 pounds (1.8kg) approx

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.313	135.0	N	0.282	7.16
B	4.285	108.8	P	1.281	32.54
C	3.000 max	76.20 max	R	1.281	32.54
D	2.125 max	53.98 max	T	0.250	6.35
E	0.781	19.84	U	1.500	38.10
F	4.750	120.7	V	3.312 ± 0.031	84.12 ± 0.79
G	2.031	51.59	W	0.250 ± 0.002	6.350 ± 0.051
H	2.031	51.59	X	3.000	76.20
L	0.750	19.05	Y	4.812 ± 0.031	122.22 ± 0.79
M	0.750	19.05	Z	0.437	11.10

Millimetre dimensions have been derived from inches.

Note The two flange faces are flat and parallel within 0.005 inch (0.13mm) and at right angles to waveguide within 1°.

BS804

S-BAND MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed tuned S-band microwave switch.

CHARACTERISTICS

Resonant frequency	3305	MHz
Bandwidth	3230 to 3380	MHz
V.S.W.R. over the band	1.4:1	max
Attenuation at 30mA bias:		
at centre frequency	25	db typical
over the band	10	db min
Insertion loss	0.25	db max

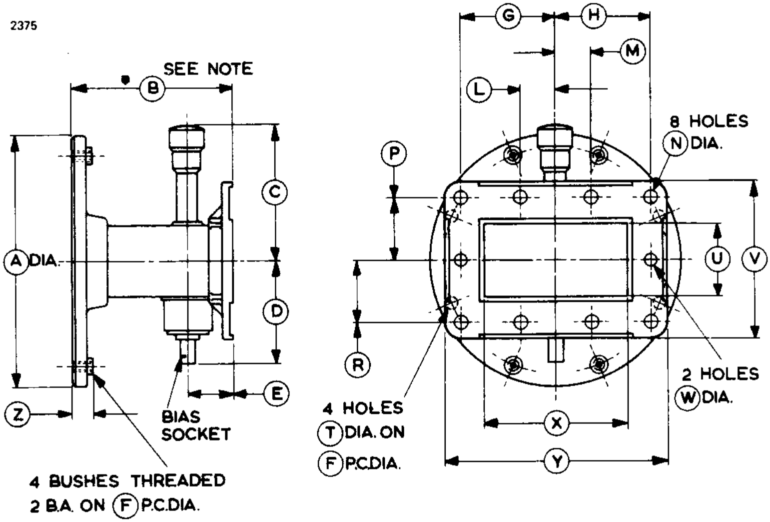
MAXIMUM RATINGS

Input power (peak)	500	W max
Input power (mean)	10	W max
Forward bias voltage	1.0	V max
Bias current	30	mA max

GENERAL

Overall dimensions	5.656 x 5.313 x 3.415 inches nom 143.7 x 135.0 x 86.74mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	
input	NATO S.N. 5985-99-083-0058
output	NATO S.N. 5985-99-083-0010
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 pounds (1.8kg) approx

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.313	135.0	N	0.282	7.16
B	3.415	86.74	P	1.281	32.54
C	3.000 max	76.20 max	R	1.281	32.54
D	2.125 max	53.98 max	T	0.250	6.35
E	0.969	24.61	U	1.500	38.10
F	4.750	120.7	V	3.312 ± 0.031	84.12 ± 0.79
G	2.031	51.59	W	0.250 ± 0.002	6.350 ± 0.051
H	2.031	51.59	X	3.000	76.20
L	0.750	19.05	Y	4.812 ± 0.031	122.22 ± 0.79
M	0.750	19.05	Z	0.437	11.10

Millimetre dimensions have been derived from inches.

Note The two flange faces are flat and parallel to within 0.005 inch (0.13mm) and at right angles to waveguide within 1°.

BS806A

X-BAND
VARACTOR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed-tuned varactor limiter for use with the broadband TR tube BS450. The BS806A is tuned directly behind a standard BS450.

CHARACTERISTICS

Centre frequency		see note 1
Bandwidth (see note 2):		
to 1.2:1 v.s.w.r.	200	MHz
to 1.3:1 v.s.w.r.	350	MHz
to 1.4:1 v.s.w.r.	500	MHz
Attenuation (see note 3)	0 to 16	db
Insertion loss (see notes 2 and 4)	0.5	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Peak input power	–	50	W
Temperature range	–40	+100	°C

GENERAL

Overall dimensions	1.625 x 1.625 x 0.591 inches nom 41.28 x 41.28 x 15.0mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	aluminium or Alochrome
Mounting position	any
Net weight	70g (2.5 ounces) approx

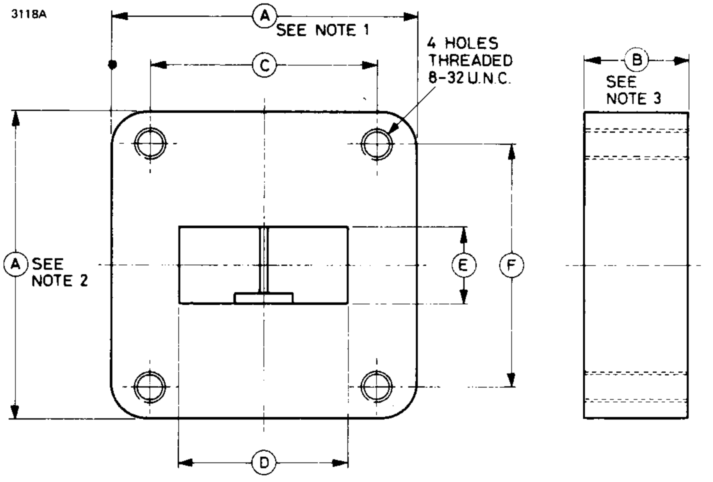
CHARACTERISTICS (BS806A with typical BS450)

Frequency range	9300 to 9500	MHz
V.S.W.R. (see note 2)	1.3:1	max
Maximum leakage:		
spike energy (see note 5)	2.0	nJ/pulse
total power (see note 6)	30	mW
low power	50	mW
Recovery period to −3db (see note 6)	3.0	μs max
Insertion loss (see note 2)	0.8	db max
Arc loss (see note 6)	0.8	db max
Position of short circuit (see notes 6 and 7)	0.021 + 0.010 inch 0.53 ± 0.25mm	

NOTES

1. Tuned to operate with a typical BS450.
2. Measured at a power level below 2mW.
3. Attenuation varies with input power.
4. Measured over the frequency range for which v.s.w.r. is less than 1.2:1.
5. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
6. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
7. Distance of the effective r.f. short circuit behind front flange.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	1.625	41.28
B	0.591 ± 0.002	15.00 ± 0.05
C	1.220	30.99
D	0.900 ± 0.002	22.860 ± 0.051
E	0.400 ± 0.002	10.160 ± 0.051
F	1.280	32.51

Millimetre dimensions have been derived from inches except dimension B.

Outline Notes

1. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension D.
2. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension E.
3. Parallel tolerance 0.005 inch (0.13mm) wide.

BS806B

X-BAND VARACTOR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed-tuned varactor limiter.

CHARACTERISTICS

Centre frequency (see note 1)	9300 ± 10	MHz
Bandwidth (see note 2):		
to 1.2:1 v.s.w.r.	200	MHz
to 1.3:1 v.s.w.r.	350	MHz
to 1.4:1 v.s.w.r.	500	MHz
Attenuation range (see note 3)	0 to 16	db
Insertion loss (see notes 2 and 4)	0.5	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Peak input power	–	50	W
Temperature range	−40	+100	°C

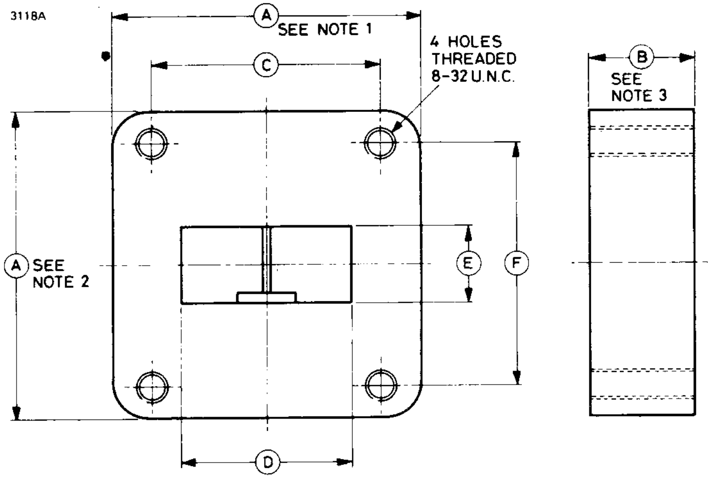
GENERAL

Overall dimensions	0.555 x 1.625 x 1.625 inches nom 14.10 x 41.28 x 41.28mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	aluminium or Alochrome
Mounting position	any
Net weight	70g (2.5 ounces) approx

NOTES

1. Any frequency in the range 8.5 to 10GHz can be supplied on request.
2. Measured at a power level below 2mW.
3. Attenuation varies with input power.
4. Measured over the frequency range for which v.s.w.r. is less than 1.2:1.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	1.625	41.28
B	0.591 ± 0.002	15.00 ± 0.05
C	1.220	30.99
D	0.900 ± 0.002	22.860 ± 0.051
E	0.400 ± 0.002	10.160 ± 0.051
F	1.280	32.51

Millimetre dimensions have been derived from inches except dimension B.

Outline Notes

1. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension D.
2. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension E.
3. Parallel tolerance 0.005 inch (0.13mm) wide.

BS806C

X-BAND VARACTOR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed-tuned varactor limiter for use with the broadband TR tube BS452. The BS806C is tuned directly behind a standard BS452.

CHARACTERISTICS

Centre frequency		see note 1
Bandwidth (see note 2):		
to 1.2:1 v.s.w.r.	200	MHz
to 1.3:1 v.s.w.r.	350	MHz
to 1.4:1 v.s.w.r.	500	MHz
Attenuation (see note 3)	0 to 16	db
Insertion loss (see notes 2 and 4)	0.5	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Peak input power	–	50	W
Temperature range	–40	+100	°C

GENERAL

Overall dimensions	1.625 x 1.625 x 0.591 inches nom 41.28 x 41.28 x 15.0mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	aluminium or Alochrome
Mounting position	any
Net weight	70g (2.5 ounces) approx

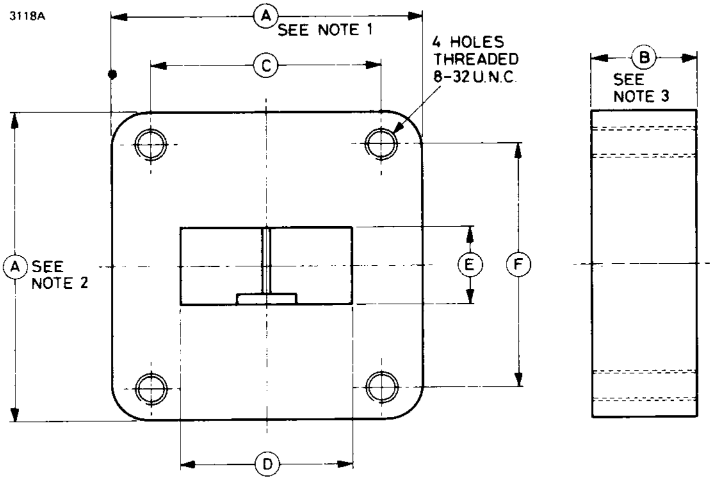
CHARACTERISTICS (BS806C with typical BS452)

Frequency range	9310 to 9510	MHz
V.S.W.R. (see note 2)	1.3:1	max
Maximum leakage:		
spike energy (see note 5)	2.0	nJ/pulse
total power (see note 6)	30	mW
low power	50	mW
Recovery period to −3db (see note 6)	4.0	μs max
Insertion loss (see note 2)	0.8	db max
Position of short circuit (see note 6)	5.1 to 6.6mm (0.201 to 0.260 inch)	

NOTES

1. Tuned to operate with a typical BS452.
2. Measured at a power level below 2mW.
3. Attenuation varies with input power.
4. Measured over the frequency range for which v.s.w.r. is less than 1.2:1.
5. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
6. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	1.625	41.28
B	0.591 ± 0.002	15.00 ± 0.05
C	1.220	30.99
D	0.900 ± 0.002	22.860 ± 0.051
E	0.400 ± 0.002	10.160 ± 0.051
F	1.280	32.51

Millimetre dimensions have been derived from inches except dimension B.

Outline Notes

1. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension D.
2. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension E.
3. Parallel tolerance 0.005 inch (0.13mm) wide.

BS806D

X-BAND VARACTOR LIMITER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Fixed-tuned varactor limiter for use with the tunable TR tube BS810. The BS806D is tuned directly behind a standard BS810.

CHARACTERISTICS

Centre frequency		see note 1
Bandwidth (see note 2):		
to 1.2:1 v.s.w.r.	200	MHz
to 1.3:1 v.s.w.r.	350	MHz
to 1.4:1 v.s.w.r.	500	MHz
Attenuation (see note 3)	0 to 16	db
Insertion loss (see notes 2 and 4)	0.5	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Peak input power	–	50	W
Temperature range	–40	+100	°C

GENERAL

Overall dimensions	1.625 x 1.625 x 0.591 inches nom 41.28 x 41.28 x 15.0mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	aluminium or Alochrome
Mounting position	any
Net weight	70g (2.5 ounces) approx

CHARACTERISTICS (BS806D with typical BS810)

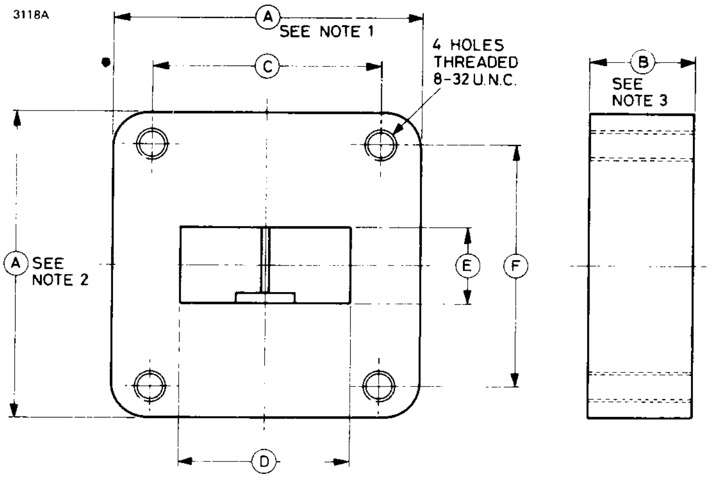
Frequency range	9245 to 9575	MHz
V.S.W.R. at resonance (see note 2)	1.4:1	max
Maximum leakage:		
spike energy (see note 5)	2.0	nJ/pulse
total power (see note 6)	30	mW
low power	50	mW
Recovery period to −3db (see note 6)	4.0	μs max
Insertion loss at resonance (see note 2)	1.0	db max
Arc loss (see note 6)	0.15	db max
Position of short circuit (see note 7):		
with gap discharge	0.240 ± 0.020 inch (6.10 ± 0.51mm)	
with window discharge	0.189 ± 0.020 inch (4.80 ± 0.51mm)	
Loaded Q	125 to 170	

NOTES

1. Tuned to operate with a typical BS810.
2. Measured at a power level below 2mW.
3. Attenuation varies with input power.
4. Measured over the frequency range for which v.s.w.r. is less than 1.2:1.
5. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
6. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
7. Transition of v.s.w. minimum from cone gap to window occurs at the following conditions approximately:

   9kW peak power, 1.0μs pulse length and 1000p.p.s.
   10.5kW peak power, 1.0μs pulse length and 500p.p.s.
   17.5kW peak power, 0.5μs pulse length and 1000p.p.s.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	1.625	41.28
B	0.591 ± 0.002	15.00 ± 0.05
C	1.220	30.99
D	0.900 ± 0.002	22.860 ± 0.051
E	0.400 ± 0.002	10.160 ± 0.051
F	1.280	32.51

Millimetre dimensions have been derived from inches except dimension B.

Outline Notes

1. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension D.
2. Symmetrical tolerance 0.010 inch (0.25mm) wide, datum dimension E.
3. Parallel tolerance 0.005 inch (0.13mm) wide.

BS864

S-BAND MICROWAVE SWITCH

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Microwave switch intended for use with TR tube BS832.

CHARACTERISTICS

Resonant frequency	3000	MHz
Bandwidth	2940 to 3060	MHz
V.S.W.R. over the band	1.25:1	max
Attenuation over the band:		
minimum	6.0	db
maximum	10	db
Insertion loss	0.25	db max

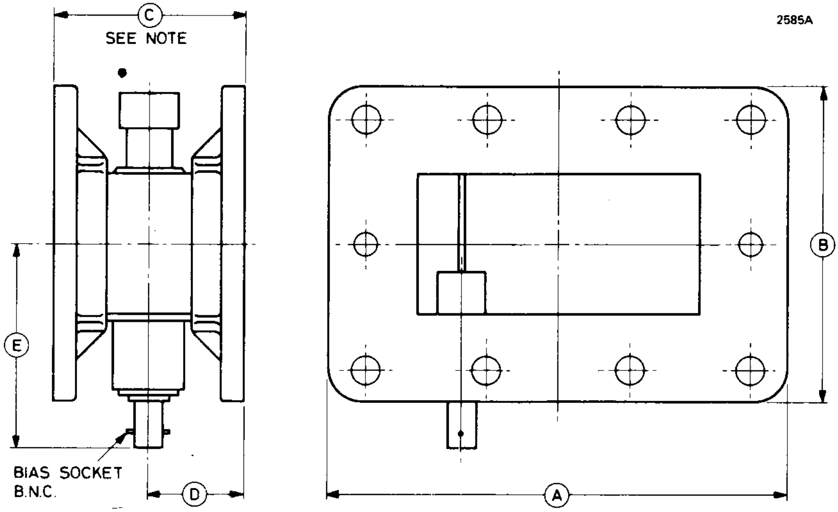
MAXIMUM RATINGS

Input power (peak)	500	W max
Input power (mean)	10	W max
Forward bias voltage	1.0	V max
Bias current	50	mA max

GENERAL

Overall dimensions	4.843 x 3.797 x 2.005 inches max 123.0 x 96.44 x 50.93mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	2½ pounds (1.1kg) approx

OUTLINE



Ref	Inches	Millimetres
A	4.812 ± 0.031	122.2 ± 0.79
B	3.312 ± 0.031	84.12 ± 0.79
C	2.000 ± 0.005	50.80 ± 0.13
D	1.000 ± 0.031	25.40 ± 0.79
E	2.125 max	53.98 max

Millimetre dimensions have been derived from inches.

Note The two flange faces are flat and parallel to within 0.005 inch (0.13mm) and at right angles to waveguide within 1°.

BS888

X-BAND FILTER

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable, high Q cavity designed for use as a filter in conjunction with the high Q marine radar TR tube BS810. The filter will bolt directly to the TR tube and no. 16 waveguide.

CHARACTERISTICS

Filter Alone

Frequency range (see page 3)	9255 to 9565	MHz
Q	200	min
V.S.W.R.	3.5:1	max
Insertion loss	1.5	db max
Position of voltage minimum in front of input flange	18.5 ± 1.0	mm
Presetting accuracy of label tuning scale (see note 1):		
at scale zero	9410 ± 2	MHz
at −4 on scale	9300 ± 4	MHz
at +4 on scale	9500 ± 4	MHz

BS888 and BS810 combined (see note 2)

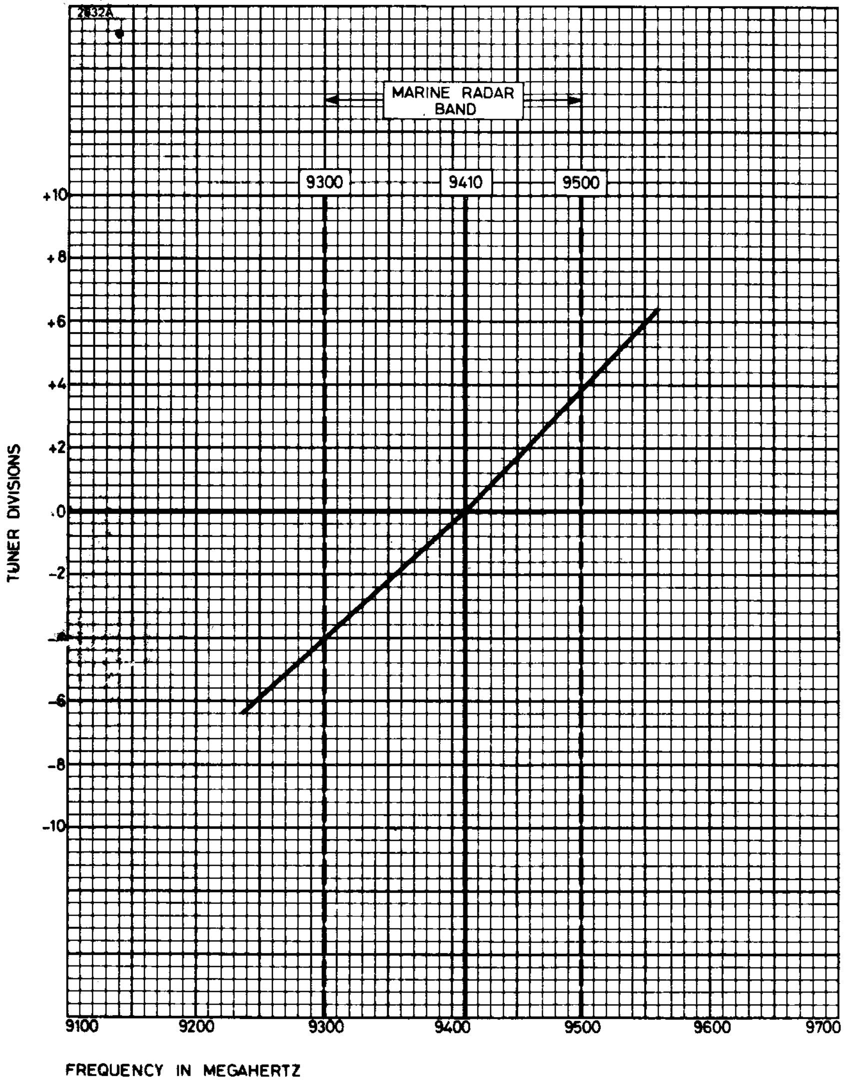
V.S.W.R. (see note 3)	1.4:1	max
Insertion loss (see note 3)	1.3	db max
Typical leakage:		
spike energy (see note 4)	2.5	nJ/pulse
total power (see note 5)	15	mW
Recovery period to −6db		see note 6
Position of voltage minimum behind input flange face:		
with gap discharge	0.240 ± 0.020 inch (6.1 ± 0.5mm)	
with window discharge	0.189 ± 0.020 inch (4.8 ± 0.5mm)	

NOTES

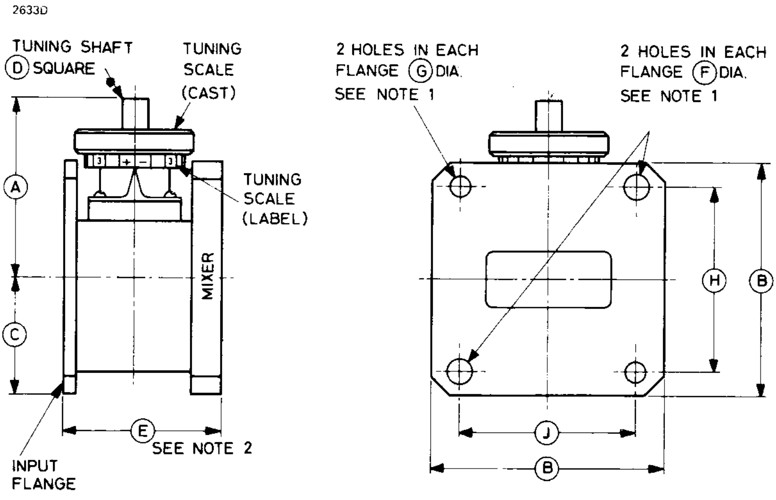
1. The zero of the label tuning scale is set to 9410 ± 2MHz against the pointer on leaving the factory; the scale cast on the tuning knob is for guidance only. To eliminate hysteresis, approach the frequency setting by turning the tuning knob clockwise.
2. The TR tube and filter are tuned to the same frequency as the test signals.
3. Measured at a power level below 10mW at 9410MHz. Due to interaction of evanescent modes the performance of the TR tube and filter combined is better than that of the filter alone.
4. Measured at 25kW peak power, 0.1μs pulse length and 1000p.p.s.
5. Measured at 25kW peak power, 1.0μs pulse length and 1000p.p.s.
6. The recovery characteristic is determined by measuring the transmission of a low-level c.w. signal, following a pulse of 2.5kW peak power, 0.1μs pulse length and 3000p.p.s. The test is carried out within the frequency range 9410 ± 65MHz.

Time after end of pulse μs	Maximum attenuation db
0.1	40
0.2	30
0.4	20
0.6	15
0.9	10
1.4	6

TYPICAL TUNER CHARACTERISTIC



OUTLINE (All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	36.5 max	1.437 max
B	42.0 max	1.654 max
C	20.5	0.807
D	4.75	0.187
E	28.0 ± 0.2	1.102 ± 0.008
F	4.3 ± 0.1	0.169 ± 0.004
G	3.8 ± 0.1	0.150 ± 0.004
H	32.5 ± 0.1	1.280 ± 0.004
J	31.0 ± 0.1	1.220 ± 0.004

Inch dimensions have been derived from millimetres.

Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.20mm (0.008 inch).

Monitor Diodes

PREAMBLE

MONITOR DIODES

INTRODUCTION

The monitor diode is a thermionic rectifier made in the form of a coaxial line (see Fig. 1), with an indirectly heated central electrode (the cathode) and an outer conductor (the anode). Electro-magnetic waves can be propagated along the monitor diode and the microwave energy interacts with the electron space charge of the diode, inducing an electron flow from cathode to anode. A potential difference is developed across an external load resistor connected between anode and cathode, the voltage being dependent upon the instantaneous microwave power level in the diode.

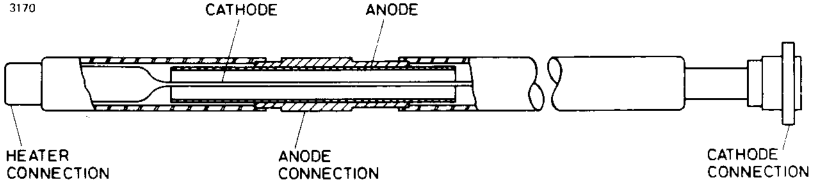


Fig. 1. Schematic diagram of monitor diode

The diode is used in a waveguide mount, and together they form a well matched waveguide to coaxial transition. The mount contains a high power matched load, made of iron loaded epoxy resin, to absorb the microwave power passing through the diode.

Applications of the monitor diode include:

- Direct viewing of microwave power pulse envelopes
- Observation of irregularities in magnetron or modulator performance
- Continuous monitoring of microwave power
- Detection of reflected power to protect systems from waveguide arcs

The diode has high power handling capacity, large output and very short response time. The output of the diode can be applied directly to the deflection plates of a display tube, eliminating the need for a high gain amplifier and fully exploiting the high resolution of the device. The monitor diode measures peak power and no knowledge of duty cycle is required.

PERFORMANCE CHARACTERISTICS

Frequency Range and V.S.W.R.

Monitor diodes and mounts are currently available for operation in S, C and X-bands; units for other bands are being developed. Fig. 2 and Fig. 3 show typical v.s.w.r. curves for S-band and X-band diodes in tunable mounts. The v.s.w.r. curves shown are for one setting only; by suitable adjustment of the position of the short circuit behind the diode, a v.s.w.r. better than 1.2:1 can be achieved at any frequency in the range of the diode and mount.

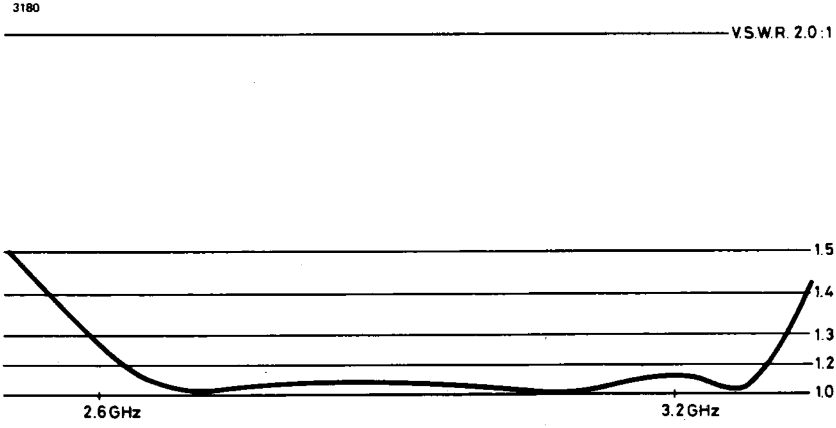


Fig. 2. Typical v.s.w.r. – frequency characteristic for S-band monitor diode type BS510 in tunable mount type BS514

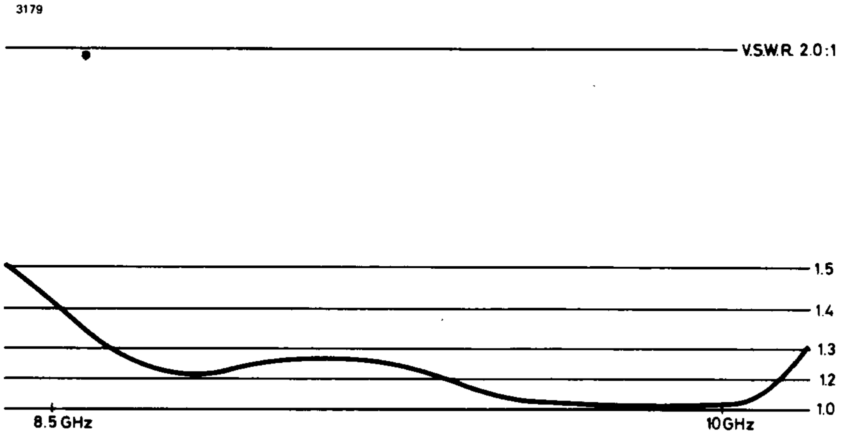


Fig. 3. Typical v.s.w.r. – frequency characteristic for X-band monitor diode type BS502 in tunable mount type BS512

Sensitivity

Each monitor diode is tested for sensitivity in a standard mount at a single frequency and power level as specified in the data sheets. Individual diodes and mounts can be calibrated at other power levels and frequencies and English Electric Valve Company Ltd. can provide this service if required. Calibration errors are estimated to be within ±7% for a particular diode and mount combination. Alternatively, a diode can be calibrated by the user, and the procedure described under Sensitivity Calibration below is recommended. Once calibrated, a diode can be used to measure peak powers in pulses of irregular shape and without any knowledge of repetition rate. A diode is rugged with a life of thousands of hours, but if accurate peak power measurements are required the diode should be recalibrated every 500 hours.

Fig. 4 shows typical curves of the output voltage across a load of 68Ω, as a function of r.f. peak power for diodes at three frequencies in the S, C and X-bands. It should be noted that the sensitivity is frequency dependent and the curves shown in Fig. 4 are not to be regarded as calibration curves.

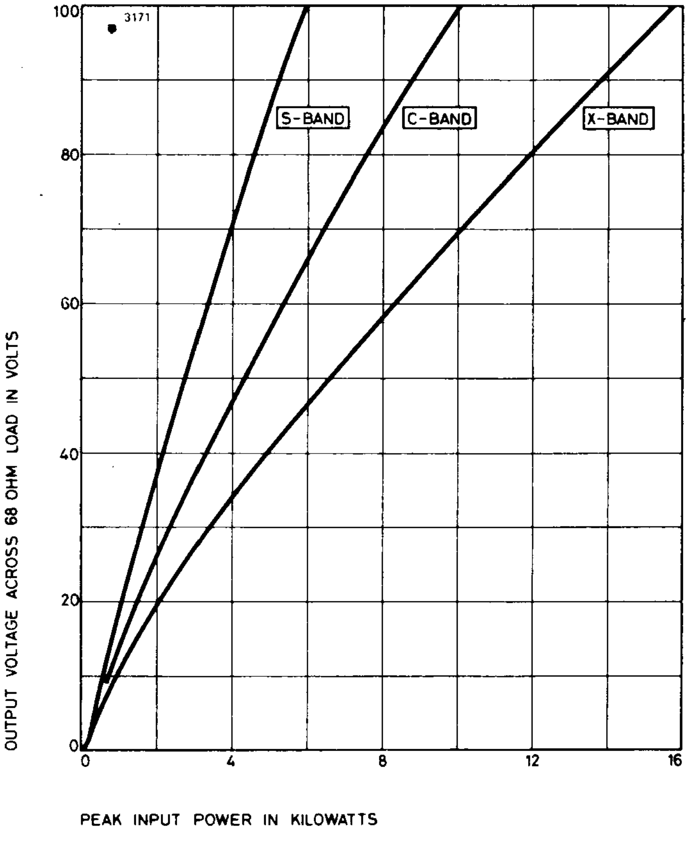


Fig. 4. Typical sensitivity of monitor diodes at S, C and X-band frequencies

From Fig. 4 it can be seen that the diodes have high power handling capacity and large output which can be applied directly to the deflection plates of modern high sensitivity cathode ray tubes. The sensitivity of the diodes is sufficient to enable their use at peak powers down to about 1kW. Diodes and mounts are interchangeable with sensitivity variation within ±10%.

Speed of response

The rise time of the diode is of the order of nanoseconds. Resolutions of better than 10 nanoseconds can be achieved by applying the output of the diode directly to the deflection plates of a high sensitivity cathode ray tube.

SENSITIVITY CALIBRATION

Calibration Procedure

Monitor diodes should be calibrated as shown in Fig. 5 or Fig. 6. The high power oscillator is modulated to produce pulses of accurately known shape and repetition rate so that the peak power into the monitor diode can be calculated from the measured mean power. Thus peak power is given by:

$$\text{Peak power} = \frac{\text{mean power}}{\text{pulse width x p.r.r.}}$$

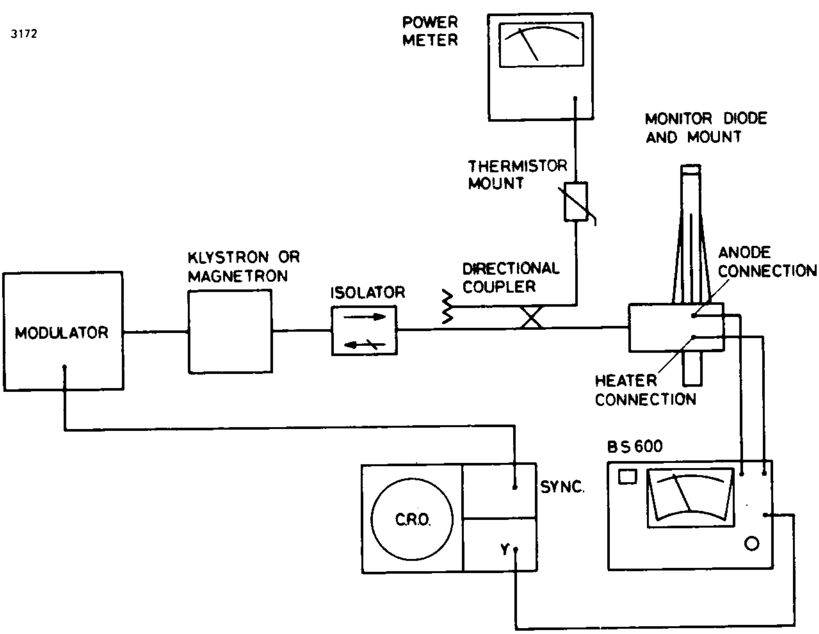


Fig. 5. Calibration of a monitor diode using a thermistor mount and power meter (a suitable meter is Hewlett Packard model 432A).

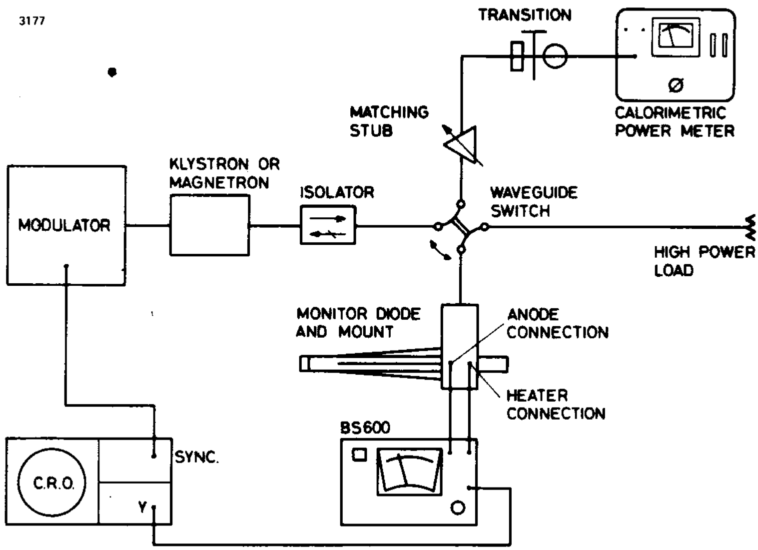


Fig. 6. Calibration of a monitor diode using a calorimetric power meter (a suitable meter is Hewlett Packard model 434)

The output of the monitor diode is displayed on a cathode ray tube from which the peak voltage is measured; the input power should preferably be adjusted to give convenient values of output voltage. Thus the peak input power and output voltage are obtained and a calibration curve can be drawn.

Sources of Error

The sensitivity calibration is subject to a number of errors which can be minimized by careful calibration of the measurement equipment, and by a few simple precautions. The sources of error are listed below together with some comments which may be self evident.

(a) V.S.W.R. Care must be taken to ensure that the waveguide is well matched in both directions to reduce the mismatch uncertainty. Since high power oscillators in general have a high output v.s.w.r., it is advisable to use an isolator as shown in Fig. 5 and Fig. 6 to avoid excessive errors. For instance, if the generator mismatch were 2.0:1 and the monitor diode mismatch were 1.2:1, there would be a mismatch uncertainty of approximately ±6% and a mismatch loss at the diode of 0.8%.

The same comments apply to the power meter used to measure the mean power level. If the power is switched between the monitor diode and a calorimetric power meter as shown in Fig. 6 the isolator is also required to ensure that any change in the load does not change the generator output power level.

The recommended specification for the isolator is as follows:

Peak power	20	kW max
Mean power	20	W max
Isolation	30	db min
Input and output v.s.w.r.	1.05:1	max

Thus with a monitor diode mismatch of 1.2:1 the mismatch uncertainty would be reduced to ±0.4% with 0.8% mismatch loss at the diode. With a typical monitor diode mismatch of 1.1:1 the mismatch uncertainty would be reduced further to 0.23%, with a diode mismatch loss of 0.23%.

The above figures emphasize the importance of the waveguide match to the accuracy of the calibration. If a high power oscillator can be used such that the monitor diode is connected via a directional coupler of 13db or more, then it should be possible to dispense with an isolator because the generator mismatch would be sufficiently small.

(b) MEAN POWER The power meter reading is also subject to mismatch uncertainty and mismatch loss as noted above, but the meter itself is subject to errors which can be minimized by careful calibration. For instance, calibration by d.c. substitution with either the Hewlett Packard Model 432A Power Meter or Model 434 Calorimetric Power Meter can result in mean power measurement accuracy within ±0.5%.

(c) PULSE WIDTH The accuracy of the pulse width measurement depends on the calibration of the oscilloscope used to observe the diode output pulse. The oscilloscope timebase can be calibrated by means of an accurate time mark generator so that the voltage pulse width can be measured to within ±1%.

(d) PULSE SHAPE It should be remembered that since the diode sensitivity is not linear, the pulse width measured from the voltage output pulse will differ from the width of the input pulse if the pulse shape is trapezoidal. This point can be ignored if the rise and fall times are less than 10% of the pulse width. It is also essential that any oscillations or droop on the pulse top be less than ±5% of the pulse height.

(e) PULSE REPETITION RATE Pulse repetition rate should be measured by means of electronic counters which are accurate to ±1 count. The use of an oscilloscope to measure pulse repetition rate is not recommended.

(f) VOLTAGE The accuracy of the peak voltage measurement again depends on the calibration of the oscilloscope used to observe the diode output pulse. The oscilloscope vertical deflection can be calibrated by means of an accurate pulse amplitude calibrator, and it is recommended that the calibrator setting be equal to the diode output pulse to be measured. Thus any non-linearity in the oscilloscope is eliminated and if the output pulse produces a full scale deflection of the oscilloscope trace, the peak voltage can be measured to within ±2%.

The peak voltage can also be measured by 'backing-off' the pulse and reading the voltage on a grade 1 d.c. voltmeter. Again, any non-linearity in the oscilloscope is eliminated and the peak voltage can be measured to within ±2%.

OPERATING CONDITIONS

Mounting Position

The diode and mount may be mounted in any position provided there is free convection of the surrounding air.

Heater Voltage

(a) PRE-HEAT The heater voltage should be set at 6.3 ± 0.5V for at least one minute before the r.f. power is applied to the diode.

(b) OPERATING Back bombardment of the cathode occurs when r.f. power is applied to the diode and the applied heater voltage must be reduced to prevent overheating of the cathode. The amount of reduction is dependent upon the mean r.f. input power but the actual value of heater voltage is not very critical. For optimum life it is recommended that the heater voltage should be set between 10% and 20% above the value at which the diode output starts to fall. This corresponds to two increments of the heater voltage range switch on BS600 Monitor Diode Power Supply and Indicator Unit.

Load Resistance

The sensitivity of monitor diodes is a function of the external load resistance connected across the anode and cathode. The load resistance used for most sensitivity calibrations made by English Electric Valve Company Ltd. is 68Ω ± 1%. BS600 Monitor Diode Power Supply and Indicator Unit incorporates a 68Ω ± 1% resistor shunted across the 'Pulse' output socket.

It is, of course, possible to use a 50Ω coaxial cable with 50Ω termination at the deflection plates of the cathode ray tube, to eliminate any reflections and thus take full advantage of the resolution of the diode at the expense of only a slight loss of sensitivity. Monitor diodes BS536 and BS542 are calibrated for sensitivity with 50Ω load resistance at several frequencies across the frequency range.

Waveguide Match

The importance of the waveguide match in determining the accuracy of the monitor diode calibration has been emphasized already, but the match is no less important when the monitor diode is used to measure peak power in an equipment. It is recommended that the mismatch 'seen' by both the monitor diode and the high power source be less than 1.05:1. Thus either an isolator with the specification given above or a directional coupler of 13db or more should be used.

Maximum Ratings

The maximum power that can be passed through a monitor diode is determined by the power that both the centre and outer conductors can dissipate. The following maximum ratings should be observed to ensure the life of the diode, but they may be exceeded for short periods.

Input power (peak)	20	kW
Input power (mean)	18	W
Pulse length	15	μs

English Electric Valve Company Ltd. should be consulted if operation at pulse lengths exceeding 15μs is required.

APPLICATIONS

Monitor diodes have many applications and further uses for them will be found as their capabilities become more widely known. Such quantities as peak and mean power output, pulse length, pulse amplitude uniformity and pulse rise and decay times can be readily measured using only a fast time base, zero amplification oscilloscope. Present applications may be divided into two main categories as given below.

(1) Measuring device to give information required for the further development of pulsed oscillators or their modulators.

Much time is saved in the inspection departments of both magnetron tube and radar equipment manufacturers by using monitor diodes to check performance. Magnetron faults such as moding and ringing are clearly seen and identified, and peak output power measured independently of the duty cycle, while very short time phenomena such as leading edge jitter and spurious noise modulation can be seen and measured (see Fig. 7). Oscilloscope amplifiers are not required and so the need for assumptions about their bandwidth and phase characteristics is eliminated. The present availability of cathode ray tubes with both high writing speed and high deflection sensitivity allows displays of several centimetres amplitude from peak powers of only a few hundred watts applied to the diode. However, improved accuracy may result from applying as much r.f. power as the diode will tolerate reliably, since the coupling factor of the waveguide directional couplers used to extract the monitoring signal from the main waveguide can then be greater and, therefore, more accurately known. In the case of smaller radar transmitters it is possible to couple the whole of the output power straight into the monitor diode. Under these conditions, or where a directional coupler of less than 13db is fitted, an isolator should be used as explained in the section on waveguide match.

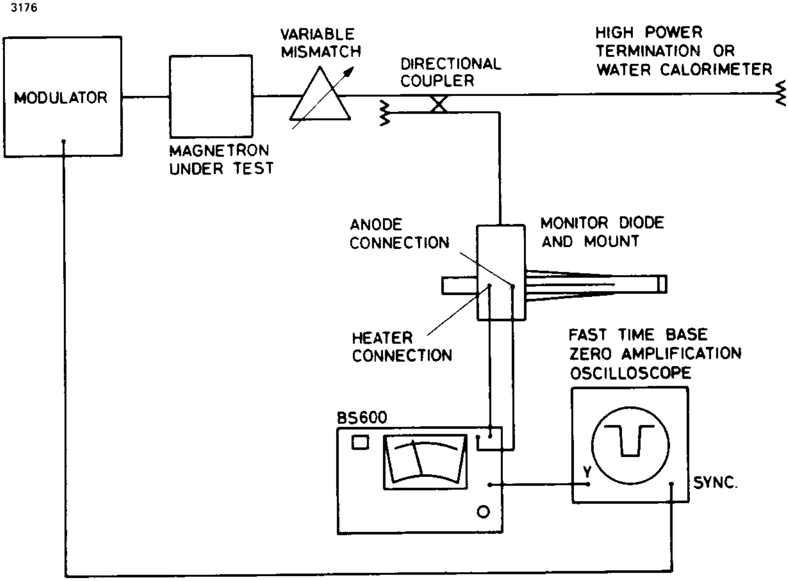


Fig. 7. Use of a monitor diode for magnetron testing.

(2) The continuous monitoring of pulsed microwave transmitter performance.

The monitor diode is used for this purpose mainly in the larger types of ground or shipborne equipment where size and the loss of perhaps one kilowatt of radiated peak power is of no consequence. It is usually in this type of equipment that detailed and accurate monitoring of transmitter performance is most needed. In the more complex frequency scan radars an accurate knowledge of klystron output pulse shapes, which is essential, can be provided by the monitor diode.

Another application is the measurement of instantaneous power output in transmitters where the repetition rate or pulse length is constantly varied. The usual method of determining peak power is based upon measurement of mean power and duty cycle and therefore presents difficulties in this instance, which are readily solved by use of a monitor diode. Since the monitor diode measures peak power directly, it provides a convenient solution to the problem.

At the very high peak r.f. powers commonplace in long range surveillance radars there is always the risk of waveguide breakdown occurring under certain fault conditions. Many of the higher power klystrons and magnetrons in use today can be damaged beyond repair in a fraction of a second by a severe waveguide breakdown, and it has been necessary to build into equipments complex waveguide arcing and reflected power detection systems which rapidly remove the high voltage supply from the output amplifier. The monitor diode has been utilized with great success as a reflected power detector by connecting it to the main waveguide run via a directional coupler, as shown in Fig. 8. In this role the diode can produce a signal to shut off the d.c. power to a klystron after less than 5 milliseconds, thus ensuring that in general a klystron so protected never experiences more than a single pulse of more than a known amount of power.

In certain types of radar there is a need for the measurement of the range to a very high degree of accuracy. The accuracy which can be achieved in practice is largely controlled by the stability of the timing reference pulse available, and monitor diodes have been widely used for providing this pulse. The response time of the diode is only a very few nanoseconds and the leading edge of the output pulse of the monitor diode, sampled from the main transmitter pulse, provides a very convenient and accurate reference signal. The same diode can be used simultaneously to monitor the transmitted power.

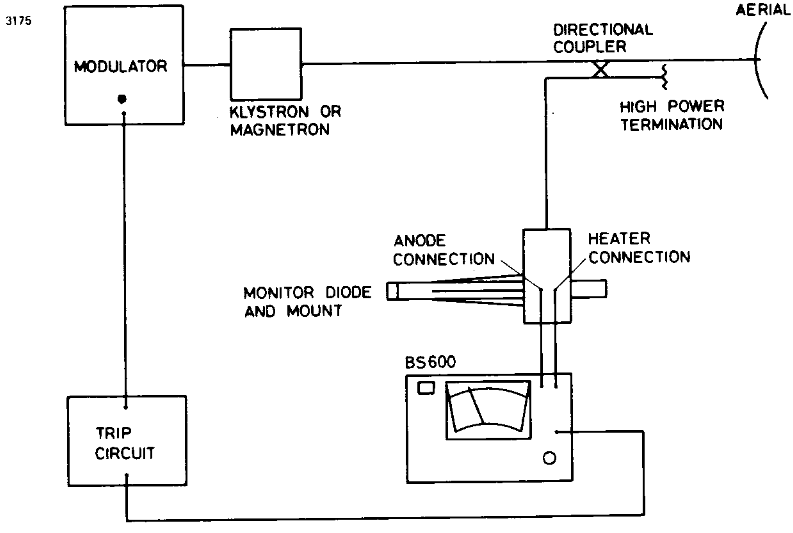


Fig. 8. Use of a monitor diode for system protection

APPENDIX – Theory of Operation

The operation of the monitor diode is based on a discovery at the Services Electronics Research Laboratory, Baldock in 1952, during experiments on gas filled coaxial attenuators. If the central conductor of the attenuator was coated with the usual cathode coating mixture, the coaxial structure evacuated and the cathode processed, then it was found that a potential difference was developed across the two electrodes when microwave power was transmitted through the tube. This occurred even though the transit time of any electron leaving the cathode might be more than one r.f. cycle.

The efficiency of a planar diode as a rectifier decreases rapidly as the transit time of an electron moving from cathode to anode becomes comparable to one half cycle of the alternating field. However, in the case of a coaxial diode with an electro-magnetic wave propagating in the T.E.M. mode, the electric field is not uniform and is given by:

$$E_r = \frac{v}{r \log (r_a/r_c)}$$

where E_r is the field at radius r, v is the instantaneous voltage between anode and cathode, and r_a and r_c are the radii of anode and cathode respectively. It is assumed initially that $v = V_0 \sin \omega t$ is only the r.f. voltage developed. If the effects of space charge and the thermal velocities of the electrons are ignored, the microwave field can be assumed to act entirely radially and only the radial components of motion need be considered. Thus the equation of motion can be written as:

$$\frac{d^2 r}{dt^2} = -\frac{e}{m} \times \frac{V_0 \sin(\omega t + a)}{r \log(r_a/r_c)}$$

where a denotes the phase of entry of an electron into the alternating field. The equation has been solved for several sets of conditions and Fig. 9 shows the calculated trajectories of three electrons leaving with different phases of entry with respect to the r.f. cycle. As can be seen, the electron leaving early in the cycle appears to travel quickly to the anode while the electron leaving

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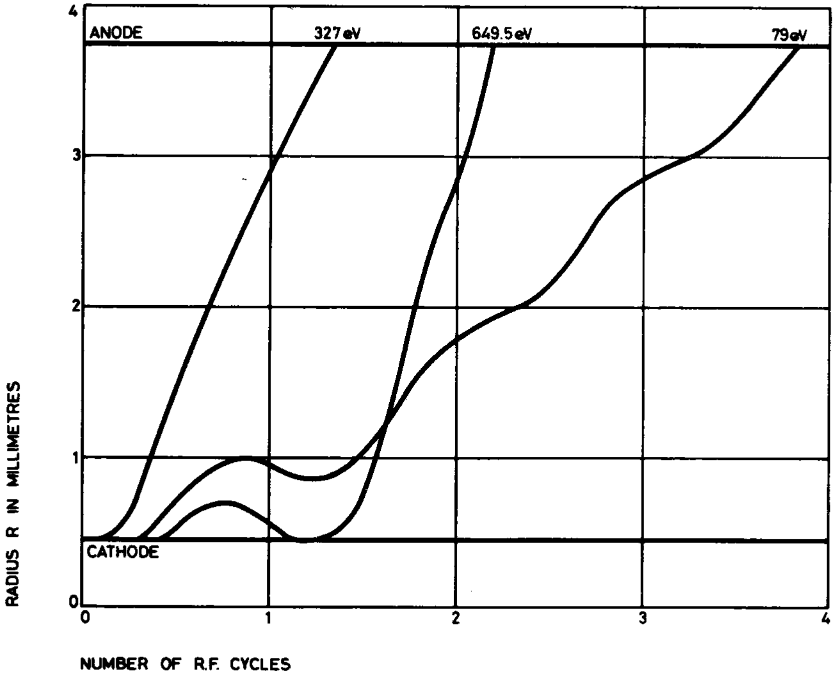


Fig. 9. Calculated trajectories of three electrons ($f = 3670MHz$, $V_0 = 1300V$)

later takes several cycles to cover the distance. An electron which leaves still later in the cycle returns to the cathode with considerable kinetic energy. If it is assumed that a secondary electron is emitted with the same initial energy as that with which the primary electron bombards the cathode, the trajectory of this secondary electron will be as shown. The transit time of this electron is less than that of any primary electron. It is also seen that this secondary electron arrives at the anode with considerably greater energy than any primary electron.

It has been assumed that it is the energy of the secondary electrons which determines the maximum potential difference between anode and cathode, and the calculated output due to these electrons is in good agreement with experimental results. A more accurate analysis of tube operation has been made where it is assumed that the anode carries a negative bias equal to the charge attained by the anode under open-circuit conditions. These calculations agree closely with test results.

Other effects which can be predicted from this theory are shown to occur in practice. For example, the diode output is found to be completely independent of cathode temperature above that necessary to initiate the starting primary electrons. The rise time of the diode theoretically is of the order of 1 nanosecond and this has also been observed in practice. The cathode back-bombardment heating forms the main upper limit to the power level at which the diode can operate.

BS502

X-BAND
MONITOR DIODE

Service Type CV6005

The data should be read in conjunction with the Monitor Diode Preamble.

DESCRIPTION

The BS502 is a monitor diode operating in the frequency range 8.5 to 10GHz. It is used with monitor diode mount type BS512 and power supply and indicator unit type BS600.

GENERAL DATA

Mechanical

Overall dimensions		see Outline
Mounting position		see note 1
Ambient temperature	70	°C max

Electrical

Frequency range (see note 2)	8.5 to 10	GHz
V.S.W.R. (see note 2)	1.3:1	max
Heater voltage (pre-heat)	6.3 ± 0.5	V
Heater voltage (operating)		see note 3
Heater current at 6.3V	1.2 ± 0.1	A
Load resistance	$68 \pm 1\%$	Ω
Power sensitivity (see note 4)	14.1 to 17.3	kW

MAXIMUM RATINGS

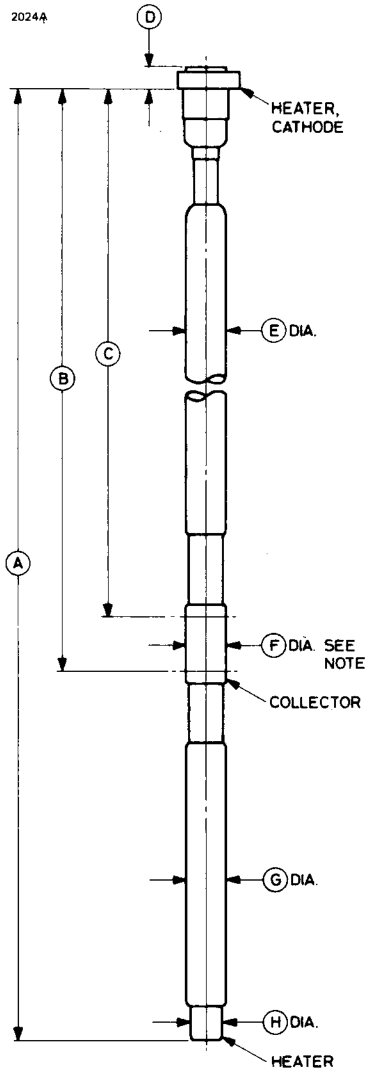
Input power (peak)	20	kW
Input power (mean)	18	W
Pulse length	2	μs

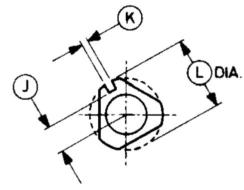
NOTES

1. The diode and mount may be mounted in any position provided there is free convection of the surrounding air.
2. In a standard mount type BS512. By adjustment of the position of the matching piston in the mount it is possible to obtain a v.s.w.r. of less than 1.3:1 at any frequency in the range.
3. The maximum diode life will be obtained if the heater voltage is reduced when the diode is operating with r.f. power input. The reduced voltage should be 10% to 20% above the value at which the amplitude of the diode output voltage begins to decrease.

4. The diode is tested in a standard mount at a pulse repetition rate of 1000p.p.s. and pulse length of 1μs $\pm$ 1%. Sensitivity is measured by setting the pulse output to 100V $\pm$ 1V across a 68Ω $\pm$ 1% load resistance.

OUTLINE





VIEW ON TOP

Ref	Inches	Millimetres
A	10.700 $\pm$ 0.150	271.8 $\pm$ 3.8
B	6.800 min	172.7 min
C	6.375 max	161.9 max
D	0.250 max 0.187 min	6.35 max 4.75 min
E	0.428 max	10.87 max
F	$0.435^{+0.001}_{-0.004}$	$11.049^{+0.025}_{-0.102}$
G	0.428 max	10.87 max
H	0.364	9.25
J	0.280 max	7.11 max
K	0.063 $\pm$ 0.003	1.600 $\pm$ 0.076
L	0.750 $\pm$ 0.005	19.05 $\pm$ 0.13

Millimetre dimensions have been derived from inches.

Note Diameter F will be maintained between dimensions B and C.

BS510

S-BAND
MONITOR DIODE

Service Type CV6107

The data should be read in conjunction with the Monitor Diode Preamble.

DESCRIPTION

The BS510 is a monitor diode operating in the frequency range 2.5 to 6.5GHz. The diode may be used in a suitable mount at any frequency within this range, the bandwidth and v.s.w.r. depending on the design of the mount. The following table gives brief details of the range of mounts currently available for use with the BS510; full data on each are available separately.

Type	Frequency Range (GHz)	V.S.W.R. (max)	Waveguide Flange NATO Stock No.	Notes
BS514	2.6 to 3.2	1.3:1	5985-99-083-0010	Tunable
BS524			-0009	
BS534			-0058	
BS516	2.8 to 3.2	1.5:1	5985-99-083-0009	Fixed-tuned,
BS522			-0058	screened load
BS530	2.7 to 2.95	1.3:1	5985-99-083-0058	Fixed-tuned
BS532	2.95 to 3.2	1.3:1	5985-99-083-0058	Fixed-tuned

GENERAL DATA

Mechanical

Overall dimensions	see outline drawing	
Mounting position	see note 1	
Ambient temperature	70	°C max

Electrical

Frequency range	2.5 to 6.5	GHz
V.S.W.R.	1.5:1	max
Heater voltage (pre-heat)	6.3 ± 0.5	V
Heater voltage (operating)	see note 2	
Heater current at 6.3V	1.2 ± 0.1	A
Load resistance	$68 \pm 1\%$	Ω
Power sensitivity	see note 3	

MAXIMUM RATINGS

Input power (peak)	20	kW
Input power (mean)	18	W
Pulse length (see note 4)	15	μs

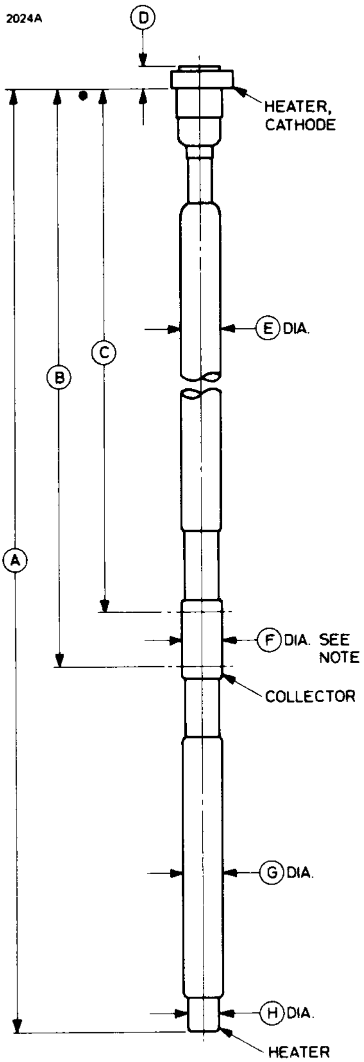
NOTES

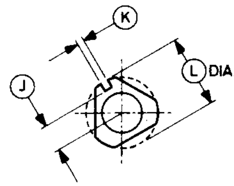
1. The diode and mount may be mounted in any position provided there is free convection of the surrounding air.
2. The maximum diode life will be obtained if the heater voltage is reduced when the diode is operating with r.f. power input. The reduced voltage should be 10% to 20% above the value at which the amplitude of the diode output voltage begins to decrease.
3. The diode is tested for sensitivity under the following conditions:

Pulse length	10 ± 1		μs
Pulse repetition rate	250		p.p.s.
Load resistance	$68 \pm 1\%$		Ω
Output voltage (peak)	$9 \pm 1\%$		V
Mount type	BS530	BS532	
Frequency	2.8	3.1	GHz
Input power (peak)	235 to 290	250 to 305	W

4. English Electric Valve Company Ltd. should be consulted if operation at pulse lengths exceeding 15μs is required.

OUTLINE





VIEW ON TOP

Ref	Inches	Millimetres
A	15.600 ± 0.150	396.2 ± 3.8
B	11.400 min	289.6 min
C	10.750 max	273.1 max
D	0.250 max 0.187 min	6.35 max 4.75 min
E	0.428 max	10.87 max
F	$0.435^{+0.001}_{-0.004}$	$11.049^{+0.025}_{-0.102}$
G	0.428 max	10.87 max
H	0.364	9.25
J	0.280 max	7.11 max
K	0.063 ± 0.003	1.600 ± 0.076
L	0.750 ± 0.005	19.05 ± 0.13

Millimetre dimensions have been derived from inches.

Note Diameter F will be maintained between dimensions B and C.

BS512

MONITOR DIODE MOUNT

DESCRIPTION

The BS512 is a tunable waveguide mount, incorporating a coaxial load, designed for use with the X-band monitor diode BS502.

GENERAL DATA

Electrical

Frequency range (see note 1)	8.5 to 10	GHz
V.S.W.R. (see note 1)	1.3:1	max

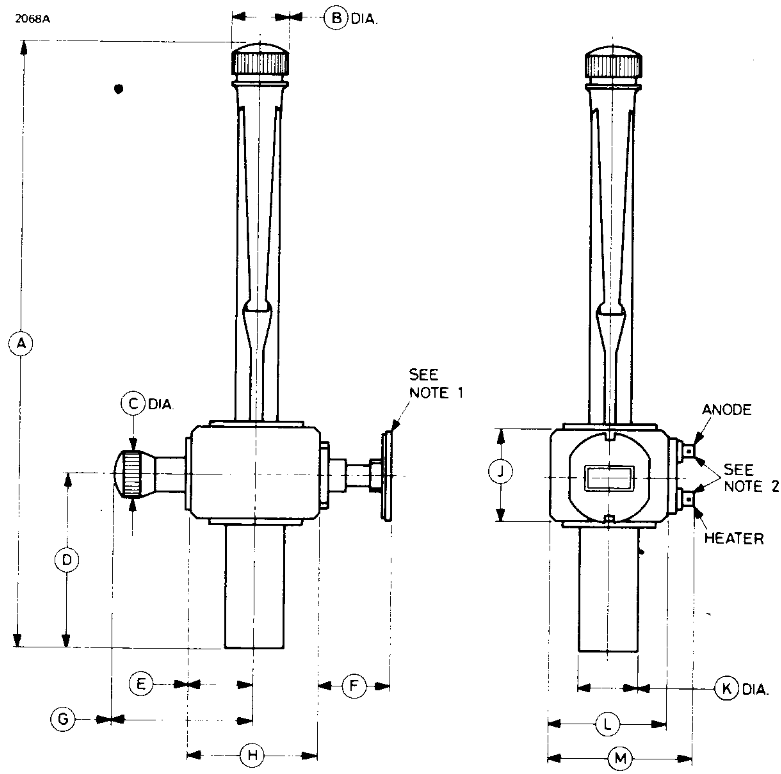
Mechanical

Overall dimensions	see Outline
Net weight	2¾ pounds (1.2kg) approx
Mounting position	see note 2
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	NATO S.N. 5985-99-083-0004
Heater and anode connectors	B.N.C. sockets (NATO S.N. 5985-99-911-6872)

NOTES

1. With reference diode type BS502. By adjustment of the matching piston behind the diode it is possible to obtain a v.s.w.r. much better than 1.3:1 at any frequency in the range.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	12.750 max	323.9 max
B	1.187	30.15
C	1.000	25.40
D	3.656	92.86
E	1.375	34.93
F	1.500	38.10

Ref	Inches	Millimetres
G	3.125 max	79.38 max
H	2.750	69.85
J	1.937	49.20
K	1.250	31.75
L	2.500	63.50
M	3.500 max	88.90 max

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0004.
2. B.N.C. socket type UG-447/U.

BS514

MONITOR DIODE MOUNT

DESCRIPTION

The BS514 is a tunable waveguide mount, incorporating a coaxial load, designed for use with the S-band monitor diode BS510.

GENERAL DATA

Electrical

Frequency range (see note 1)	2.6 to 3.2	GHz
V.S.W.R. (see note 1)	1.3:1	max

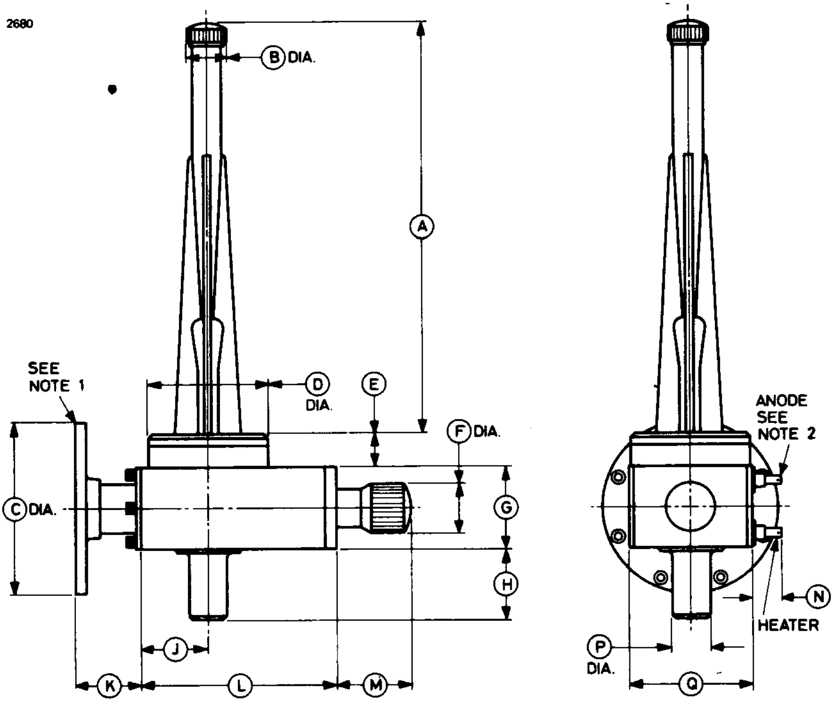
Mechanical

Overall dimensions	see Outline
Net weight	10 pounds (4.5kg) approx
Mounting position	see note 2
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0010
Heater and anode connectors	B.N.C. sockets (NATO S.N. 5985-99-911-6872)

NOTES

1. With reference diode type BS510. By adjustment of the matching piston behind the diode it is possible to obtain a v.s.w.r. much better than 1.3:1 at any frequency in the range.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.875 max	301.6 max	J	2.000	50.80
B	1.250 max	31.75 max	K	2.062 max	52.37 max
C	5.312	134.9	L	6.000 max	152.4 max
D	3.625	92.08	M	2.500 max	63.50 max
E	1.000 max	25.40 max	N	0.875 max	22.23 max
F	1.500	38.10	P	1.312 max	33.32 max
G	2.500	63.50	Q	3.750	95.25
H	2.187 max	55.55 max			

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0010.
2. Heater and anode connectors B.N.C. type UG-447/U (5985-99-911-6872).

BS516

MONITOR DIODE MOUNT

DESCRIPTION

The BS516 is a fixed-tuned waveguide mount, incorporating a screened coaxial load, designed for use with the S-band monitor diode BS510.

GENERAL DATA

Electrical

Frequency range (see note 1)	2.8 to 3.2	GHz
V.S.W.R. (see note 1)	1.5:1	max

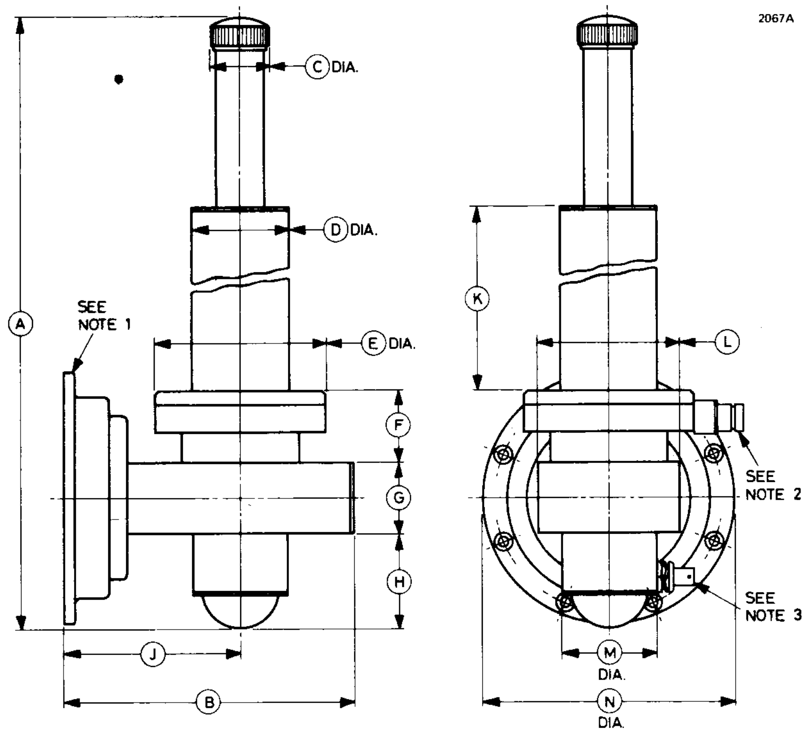
Mechanical

Overall dimensions	see Outline
Net weight	11 pounds (4.9kg) approx
Mounting position	see note 2
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0009
Heater connector	B.N.C. socket
Anode connector	type N socket

NOTES

1. With reference diode type BS510.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	16.750 max	425.5 max	H	2.125 max	53.98 max
B	6.125 max	155.6 max	J	3.719	94.46
C	1.250 max	31.75 max	K	7.625 max	193.7 max
D	2.062 max	52.37 max	L	3.000	76.20
E	3.625	92.08	M	2.000	50.80
F	1.500	38.10	N	5.312	134.9
G	1.500	38.10			

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0009.
2. Anode connector type UG-680/U.
3. Heater socket NATO S.N. 5935-99-012-0235.

BS522

MONITOR DIODE MOUNT

DESCRIPTION

The BS522 is a fixed-tuned waveguide mount, incorporating a screened coaxial load, designed for use with the S-band monitor diode BS510.

GENERAL DATA

Electrical

Frequency range (see note 1)	2.8 to 3.2	GHz
V.S.W.R. (see note 1)	1.5:1	max

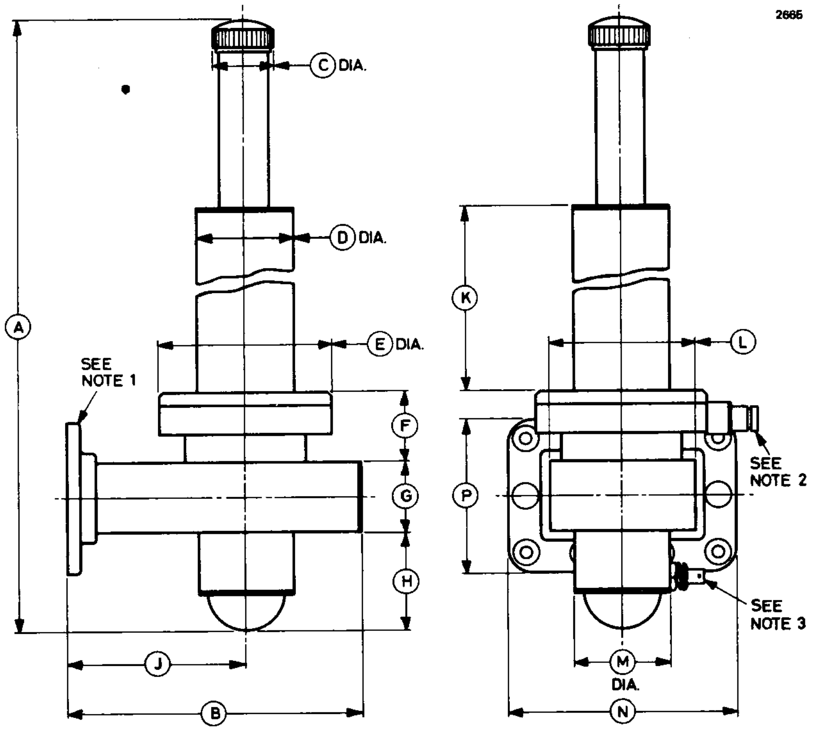
Mechanical

Overall dimensions	see Outline
Net weight	9 pounds (4kg) approx
Mounting position	see note 2
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Heater connector	B.N.C. socket
Anode connector	type N socket

NOTES

1. With reference diode type BS510.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	16.750 max	425.5 max
B	6.125 max	155.6 max
C	1.250 max	31.75 max
D	2.062 max	52.37 max
E	3.625	92.08
F	1.500	38.10
G	1.500	38.10
H	2.125 max	53.98 max
J	3.719	94.46
K	7.625 max	193.7 max
L	3.000	76.20
M	2.000	50.80
N	4.750	120.7
P	3.250	82.55

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0058.
2. Anode connector type UG-680/U.
3. Heater socket NATO S.N. 5935-99-012-0235.

BS524

MONITOR DIODE MOUNT

DESCRIPTION

The BS524 is a tunable waveguide mount, incorporating a coaxial load, designed for use with the S-band monitor diode BS510.

GENERAL DATA

Electrical

Frequency range (see note 1)	2.6 to 3.2	GHz
V.S.W.R. (see note 1)	1.3:1	max

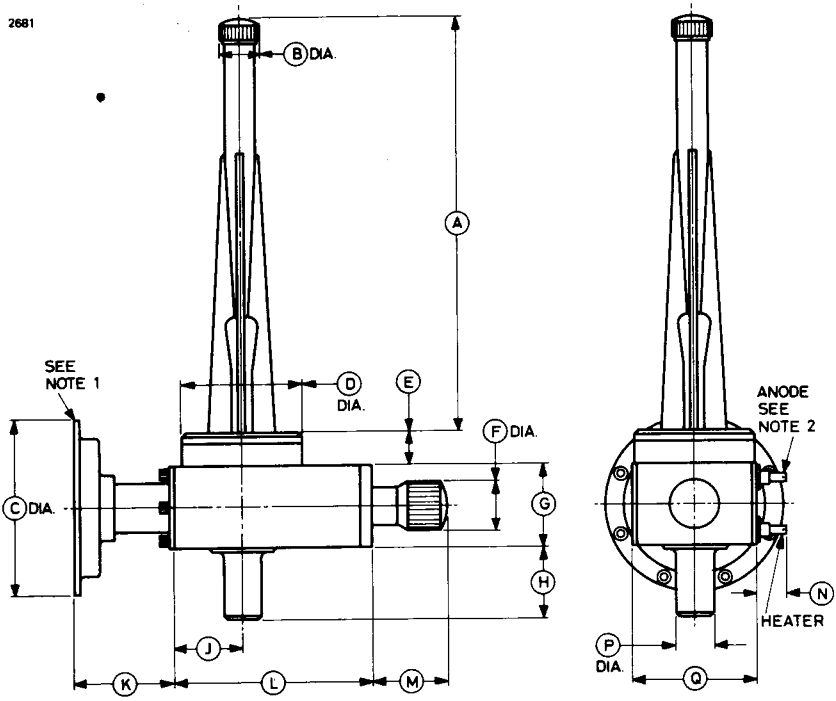
Mechanical

Overall dimensions	see Outline
Net weight	12¾ pounds (5.7kg) approx
Mounting position	see note 2
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0009
Heater and anode connectors	B.N.C. sockets (NATO S.N. 5985-99-911-6872)

NOTES

1. With reference diode type BS510. By adjustment of the matching piston behind the diode it is possible to obtain a v.s.w.r. much better than 1.3:1 at any frequency in the range.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	11.875 max	301.6 max
B	1.250 max	31.75 max
C	5.375	136.5
D	3.625	92.08
E	1.000 max	25.40 max
F	1.500	38.10
G	2.500	63.50
H	2.187 max	55.55 max

Ref	Inches	Millimetres
J	2.000	50.80
K	3.062 max	77.77 max
L	6.000 max	152.4 max
M	2.500 max	63.50 max
N	0.875 max	22.23 max
P	1.312 max	33.32 max
Q	3.750	95.25

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0009.
2. Heater and anode connectors B.N.C. type UG-447/U (5985-99-911-6872).

BS526

MONITOR DIODE MOUNT

DESCRIPTION

The BS526 is a tunable waveguide mount, incorporating a coaxial load, designed for use in C-band with the monitor diode BS510.

GENERAL DATA

Electrical

Frequency range (see note 1)	5.39 to 5.9	GHz
V.S.W.R. (see note 1)	1.3:1	max

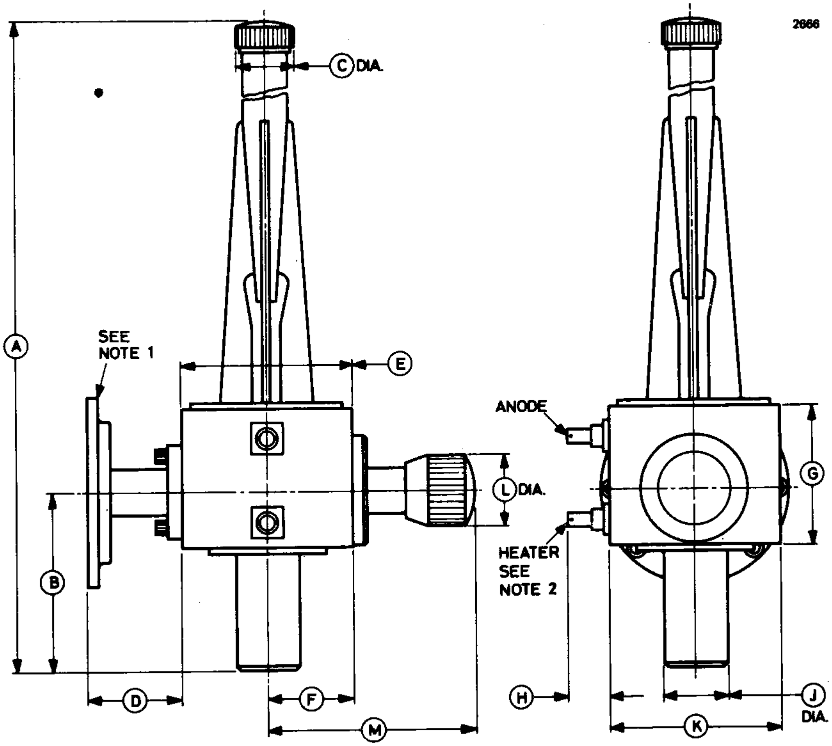
Mechanical

Overall dimensions	see Outline
Net weight	7 pounds (3.1kg) approx
Mounting position	see note 2
Waveguide size	no. 12 (1.872 x 0.872 inches internal)
Coupler	NATO S.N. 5985-99-083-0042
Heater and anode connectors	B.N.C. sockets (NATO S.N. 5985-99-911-6872)

NOTES

1. With reference diode type BS510. By adjustment of the matching piston behind the diode it is possible to obtain a v.s.w.r. much better than 1.3:1 at any frequency in the range.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	18.000 max	457.2 max
B	3.812 max	96.82 max
C	1.250 max	31.75 max
D	2.062 max	52.37 max
E	3.625	92.08
F	1.812	46.02

Ref	Inches	Millimetres
G	2.937	74.60
H	0.875 max	22.23 max
J	1.375	34.93
K	3.625	92.08
L	1.500	38.10
M	4.625 max	117.5 max

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0042.
2. Heater and anode connectors B.N.C. type UG-447/U (5985-99-911-6872).

BS530 BS532

MONITOR DIODE MOUNTS

DESCRIPTION

The BS530 and BS532 are fixed-tuned waveguide mounts, incorporating coaxial loads, designed for use with the S-band monitor diode BS510. They are identical apart from the frequency range.

GENERAL DATA

Electrical

Frequency range (see note 1):

BS530	2.7 to 2.95	GHz
BS532	2.95 to 3.2	GHz
V.S.W.R. (see note 1)	1.3:1	max

Mechanical

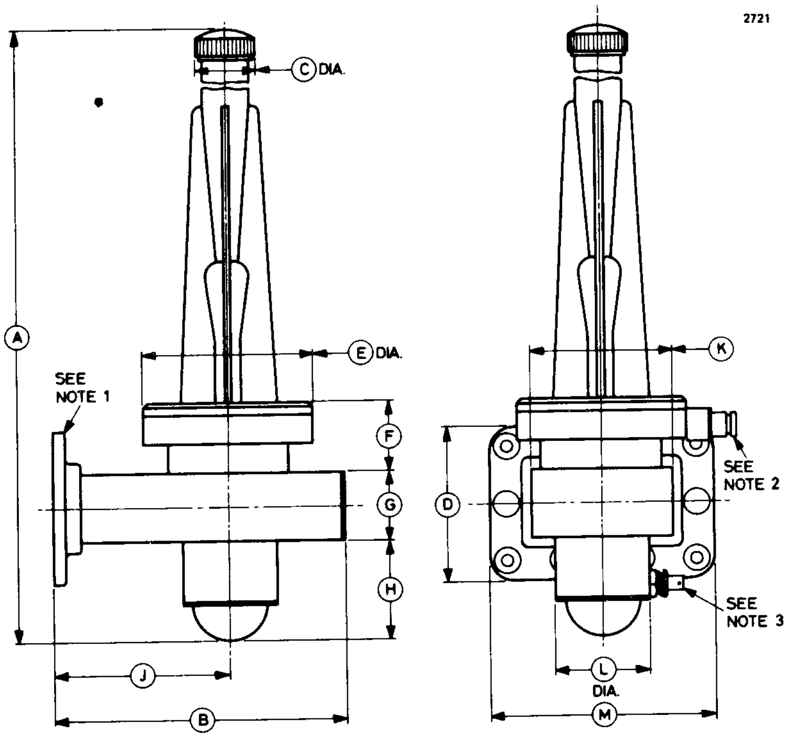
Overall dimensions	see Outline
Net weight	9 pounds (4kg) approx
Mounting position	see note 2
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Heater connector	B.N.C. socket
Anode connector	type N socket

NOTES

1. With diode type BS510.

2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	17.000 max	431.8 max	G	1.500	38.10
B	6.125 max	155.6 max	H	2.125 max	53.98 max
C	1.250 max	31.75 max	J	3.719	94.46
D	3.250	82.55	K	3.000	76.20
E	3.625	92.08	L	2.000	50.80
F	1.500	38.10	M	4.750	120.7

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0058.
2. Anode connector type UG-680/U.
3. Heater socket NATO S.N. 5935-99-012-0235.

BS534

MONITOR DIODE MOUNT

DESCRIPTION

The BS534 is a tunable waveguide mount, incorporating a coaxial load, designed for use with the S-band monitor diode BS510.

GENERAL DATA

Electrical

Frequency range (see note 1)	2.6 to 3.2	GHz
V.S.W.R. (see note 1)	1.3:1	max

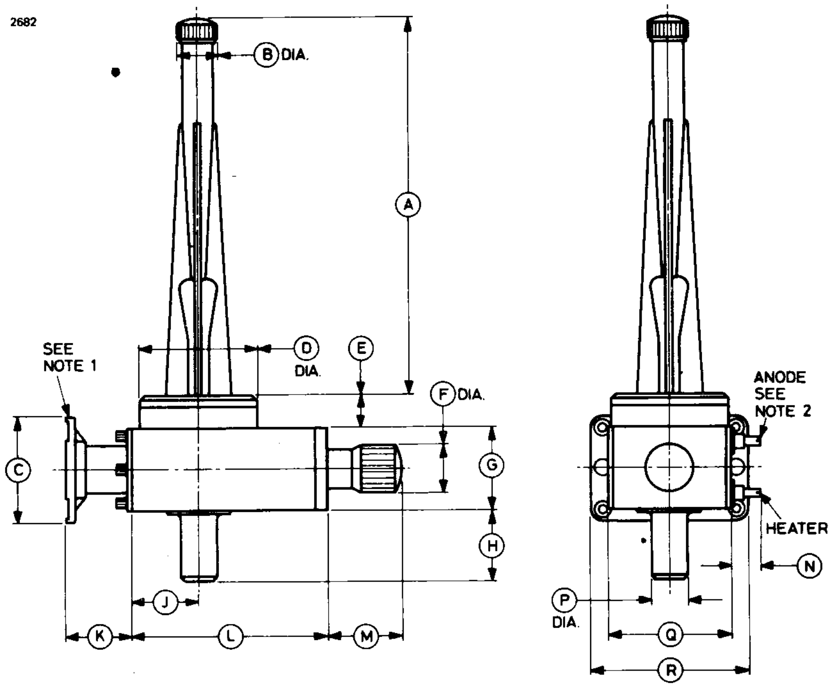
Mechanical

Overall dimensions	see Outline
Net weight	10½ pounds (4.7kg) approx
Mounting position	see note 2
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Heater and anode connectors	B.N.C. sockets (NATO S.N. 5985-99-911-6872)

NOTES

1. With reference diode type BS510. By adjustment of the matching piston behind the diode it is possible to obtain a v.s.w.r. much better than 1.3:1 at any frequency in the range.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.875 max	301.6 max	J	2.000	50.80
B	1.250 max	31.75 max	K	2.062 max	52.37 max
C	3.250	82.55	L	6.000 max	152.4 max
D	3.625	92.08	M	2.500 max	63.50 max
E	1.000 max	25.40 max	N	0.875 max	22.23 max
F	1.500	38.10	P	1.312 max	33.32 max
G	2.500	63.50	Q	3.750	95.25
H	2.187 max	55.55 max	R	4.750	120.7

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0058.
2. Heater and anode connectors B.N.C. type UG-447/U (5985-99-911-6872).

BS538

MONITOR DIODE MOUNT

DESCRIPTION

The BS538 is a fixed-tuned waveguide mount, incorporating a coaxial load, designed for use with the C-band monitor diode BS540.

GENERAL DATA

Electrical

Frequency range (see note 1)	5.2 to 5.5	GHz
V.S.W.R. (see note 1)	1.3:1	max

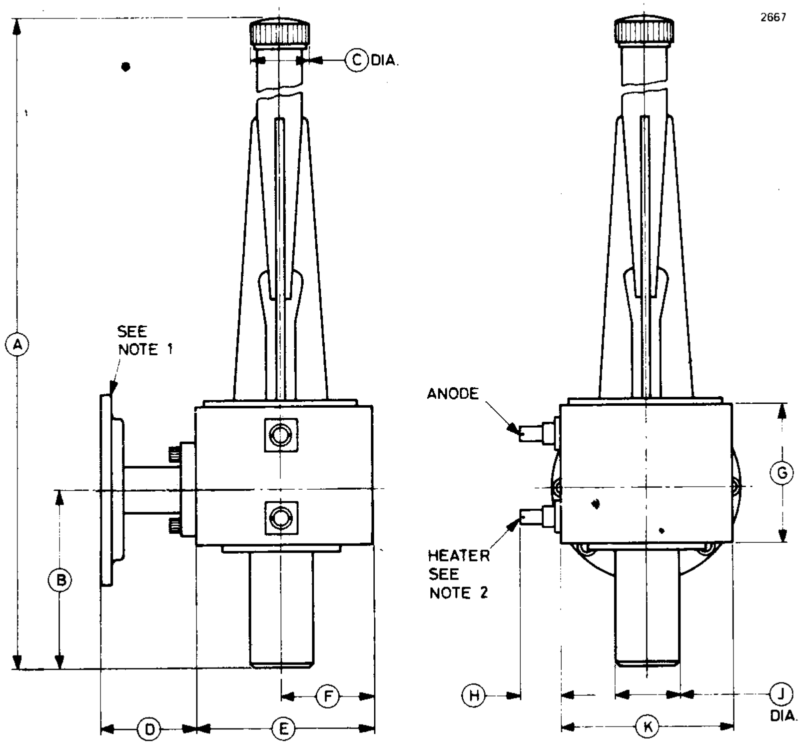
Mechanical

Overall dimensions	see Outline
Net weight	6¾ pounds (3kg) approx
Mounting position	see note 2
Waveguide size	no. 12 (1.872 x 0.872 inches internal)
Coupler	NATO S.N. 5985-99-083-0042
Heater and anode connectors	B.N.C. sockets (NATO S.N. 5985-99-911-6872)

NOTES

1. With reference diode type BS540.
2. The diode and mount may be mounted in any position provided there is free convection of the air surrounding the load.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	18.000 max	457.2 max
B	3.812 max	96.82 max
C	1.250 max	31.75 max
D	2.062 max	52.37 max
E	3.750	95.25
F	1.937	49.20
G	2.937	74.60
H	0.875 max	22.23 max
J	1.375	34.93
K	3.625	92.08

Millimetre dimensions have been derived from inches.

Outline Notes

1. To suit coupler NATO S.N. 5985-99-083-0042.
2. Heater and anode connectors B.N.C. type UG-447/U.

BS540

C-BAND
MONITOR DIODE

The data should be read in conjunction with the Monitor Diode Preamble.

DESCRIPTION

The BS540 is a monitor diode operating in the frequency range 5.2 to 5.5GHz. It is used with a monitor diode mount type BS538 or BS526 and power supply and indicator unit type BS600.

GENERAL DATA

Mechanical

Overall dimensions		see Outline
Mounting position		see note 1
Ambient temperature	70	°C max

Electrical

Frequency range (see note 2)	5.2 to 5.5	GHz
V.S.W.R. (see note 2)	1.3:1	max
Heater voltage (pre-heat)	6.3 ± 0.5	V
Heater voltage (operating)		see note 3
Heater current at 6.3V	1.2 ± 0.1	A
Load resistance	$68 \pm 1\%$	Ω

MAXIMUM RATINGS

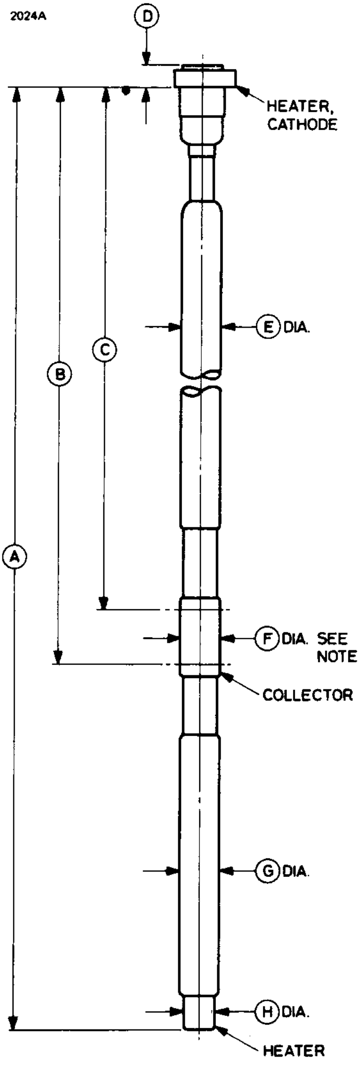
Input power (peak)	20	kW
Input power (mean)	18	W
Pulse length (see note 4)	15	μs

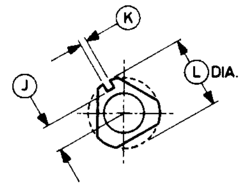
NOTES

1. The diode and mount may be mounted in any position provided there is free convection of the surrounding air.
2. In a standard mount type BS538.
3. The maximum diode life will be obtained if the heater voltage is reduced when the diode is operating with r.f. power input. The reduced voltage should be 10% to 20% above the value at which the amplitude of the diode output voltage begins to decrease.
4. English Electric Valve Company Ltd. should be consulted if operation at pulse lengths exceeding 15μs is required.

March 1971

OUTLINE





VIEW ON TOP

Ref	Inches	Millimetres
A	15.600 ± 0.150	396.2 ± 3.8
B	11.400 min	289.6 min
C	10.750 max	273.1 max
D	0.250 max 0.187 min	6.35 max 4.75 min
E	0.428 max	10.87 max
F	0.435 $^{+0.001}_{-0.004}$	11.049 $^{+0.025}_{-0.102}$
G	0.428 max	10.87 max
H	0.364	9.25
J	0.280 max	7.11 max
K	0.063 ± 0.003	1.600 ± 0.076
L	0.750 ± 0.005	19.05 ± 0.13

Millimetre dimensions have been derived from inches.

Note Diameter F will be maintained between dimensions B and C.

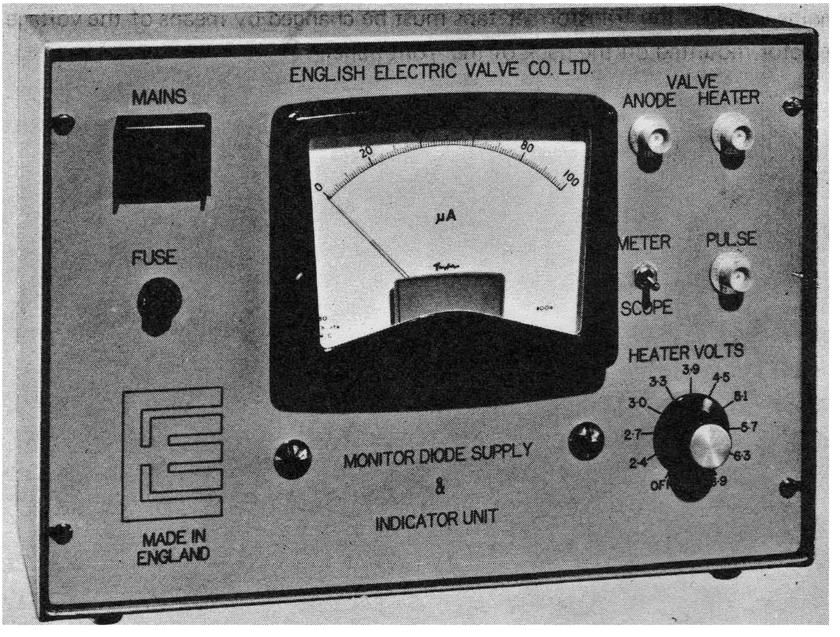
BS600

MONITOR DIODE SUPPLY AND INDICATOR UNIT

The BS600 is a power supply and indicator unit for use with the EEV range of monitor diodes.

A front panel control, calibrated in volts, allows adjustment of the diode heater voltage for all conditions of r.f. input.

The unit has sockets for connection to the diode heater and anode, and the correct diode load resistance is built in. The diode output can be switched to either a built-in meter or an oscilloscope output socket; the output to an oscilloscope is the demodulated r.f. pulse envelope and the meter reading is proportional to the mean r.f. power input to the diode. The response time of a monitor diode is such that the pulse shape can be accurately displayed.



GENERAL DATA

Mechanical

Overall dimensions (nominal)	11¼ x 7¾ x 4 inches
	286 x 197 x 102mm
Net weight	7 pounds (3.2kg) approx
Heater and anode connectors	B.N.C. sockets
Oscilloscope output	B.N.C. socket

Electrical

Mains voltage (see note)	230–250Va.c.
	or 110–120Va.c.
Heater voltage settings	2.4 to 6.9V in 0.3V increments
Internal diode load resistance	68 ± 1% Ω
Meter range	0 to 100 μA

Note The unit is delivered set for use on 230–250Va.c. For use at other mains voltages the transformer taps must be changed by means of the voltage selector mounted on the back of the front panel.

Noise Tubes

BS384

NOISE TUBE

Service Type CV1881

ABRIDGED DATA

Gas discharge noise source for noise figure measurements. The BS384 is a broad-band device operating from 3 to 12GHz; it should be used in an approved mount.

Mount Type	Frequency Range
BS604	X-band
BS626	S-band
BS628	C-band

Excess noise ratio (see note 1)	15.5 ± 0.5	db

GENERAL

Electrical

Filament voltage	6.3	V
Filament current at 6.3V	0.4	A
Breakdown voltage (see note 2)	1500	V

Mechanical

Overall length	8.918 inches (226.5mm) max
Overall diameter	0.570 inch (14.5mm) max
Net weight	20g approx
Mounting position	any

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Filament voltage	5.5	7.0	V
Anode current (see note 3)	160	250	mA

TYPICAL OPERATION

Operating Conditions (in mount BS604)

Heater voltage	6.3	V
Anode current	180	mA
Ambient temperature	23	°C
Warm up period (see note 4)	5	min

Typical Performance

Anode voltage	55	V
Mount temperature (see note 5)	28	°C
Excess noise ratio	15.5 ± 0.5	db
Equivalent noise temperature	10 580	°K
Noise variation with current (max)	–0.005	db/mA
Noise variation with mount temperature (max)	–0.0025	db/°C
V.S.W.R. (see note 6)	1.3:1	max

TEST CONDITIONS AND LIMITS (in mount BS604)

The tube is tested to comply with the following electrical specification.

Test Conditions

Heater voltage	6.3	V
Anode current	180	mA
Ambient temperature	23	°C
Warm up period (see note 4)	5	min

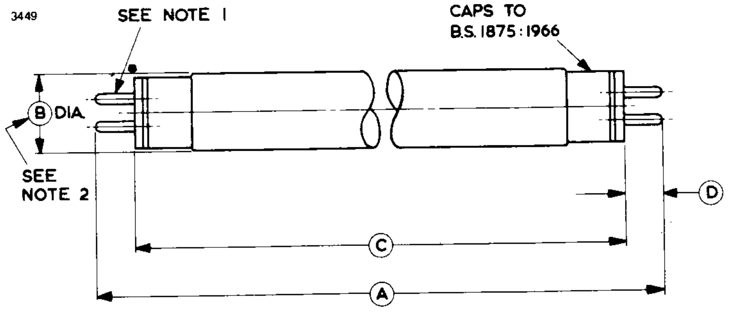
Limits

	Min	Max	
Critical current (see note 7)	–	160	mA
V.S.W.R. (fired) at 9375 ± 5MHz	–	1.05:1	
Excess noise ratio at 9375 ± 5MHz	15.0	16.0	db

NOTES

1. Excess noise above 290°K at a frequency of 9375MHz in mount BS604, with anode current of 180mA, at an ambient temperature of 23°C.
2. With earthed metal shield and voltage applied for a minimum of 100μs.
3. No damage is likely to result from operating the tube below the minimum anode current rating, but parasitic oscillations will occur, which modulate the v.s.w.r. and seriously affect the excess noise ratio.
4. Since the excess noise ratio is dependent on the tube and mount temperature, a warm up period should be allowed to ensure reproducible noise measurements.
5. Steady state temperature after warm-up period, in still air at ambient temperature of 23°C.
6. A better v.s.w.r. can be obtained at a specified frequency or reduced bandwidth by tuning the mount.
7. The critical current is determined by the anode current at which parasitic oscillations can be observed on the swept frequency reflectometer display.

OUTLINE



Ref	Inches	Millimetres
A	8.918 max	226.5 max
B	0.550 ± 0.020	13.97 ± 0.51
C	8.344 max	211.9 max
D	0.276 ± 0.011	7.01 ± 0.28

Millimetre dimensions have been derived from inches.

Connections

The tube has a filament at each end connected across the two pins. Either filament may be used as the cathode; the other is used as the anode and requires no heater supply.

Outline Notes

1. The pins will enter a gauge having two holes 0.110 inch (2.794mm) diameter at 0.1875 inch (4.763mm) centres.
2. The tube will pass through a tubular gauge, 0.610 inch (15.494mm) internal diameter by 8.000 inches (203.2mm) long.

BS386

Q-BAND NOISE TUBE

ABRIDGED DATA

Gas discharge noise source for accurate noise figure measurements. The BS386 should be used in conjunction with mount type BS606.

Frequency range (see note 1)	33 to 36	GHz
Excess noise ratio (see notes 1 and 2)	16.40 ± 0.36	db

GENERAL

Electrical

Heater voltage	3.5	V
Heater current at 3.5V	0.4	A
Breakdown voltage	600	V

Mechanical

Overall dimensions	165.8 x 25.5 x 25.5mm max	
Net weight	46	g approx
Mounting position		any

MAXIMUM AND MINIMUM RATINGS

No rating should be exceeded

	Min	Max	
Heater voltage	3.0	4.0	V
Anode current (see note 3)	85	150	mA

TYPICAL OPERATION

Operating Conditions (in mount BS606)

Heater voltage	3.5	V
Anode current	100	mA
Ambient temperature	23	°C
Warm up period (see note 4)	5	min

Typical Performance

Anode voltage	55	V
Mount temperature (see note 5)	28	°C
Excess noise ratio (see note 6)	16.40 ± 0.36	db
Equivalent noise temperature	12 950	°K
Noise variation with current (max)	−0.003	db/mA
Noise variation with mount temperature (max)	−0.0015	db/°C
V.S.W.R. (fired)	1.15	max
V.S.W.R. (unfired)	1.25	max

TEST CONDITIONS AND LIMITS (in mount BS606)

The tube is tested to comply with the following electrical specification.

Test Conditions

Heater voltage	3.5	V
Anode current	100	mA
Ambient temperature	23	°C
Warm up period (see note 4)	5	min
Frequency range for v.s.w.r. measurement	33.0 to 36.0	GHz
Frequency of excess noise ratio measurement	35.0	GHz
Excess noise ratio of standard (see note 7)	16.36 ± 0.24	db

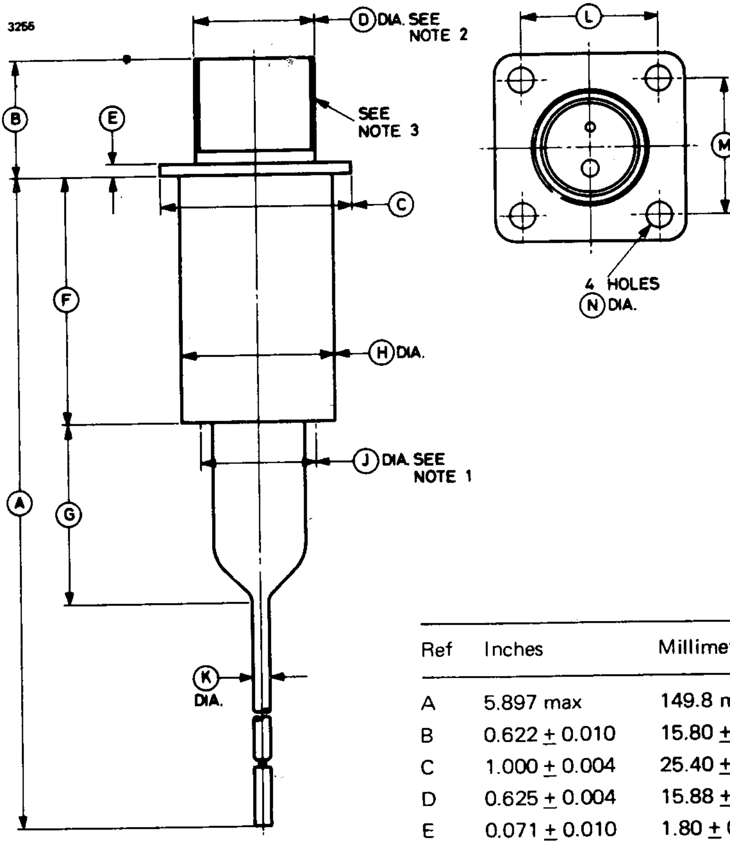
Limits

	Min	Max	
V.S.W.R. (unfired) across frequency range	–	1.25	
V.S.W.R. (fired) across frequency range	–	1.15	
Critical current (see note 8)	–	85	mA
V.S.W.R. (fired) at 35.0GHz	–	1.10	
Excess noise ratio relative to standard	−0.06	+0.14	db

NOTES

1. In mount BS606.
2. Excess noise above 290°K at a frequency of 35GHz, with anode current of 100mA, at an ambient temperature 23°C.
3. No damage is likely to result from operating the tube below the minimum anode current rating, but parasitic oscillations will occur, which modulate the v.s.w.r. and seriously affect the excess noise ratio.
4. Since the excess noise ratio is dependent on the tube and mount temperature, a warm up period should be allowed to ensure noise measurement accuracy.
5. Steady state temperature after warm-up period, in still air at ambient temperature of 23°C.
6. At a frequency of 35.0GHz. The spread of excess noise ratio is within ±0.1db for any tube in any mount. The tolerance quoted is mainly due to the uncertainty of the calibration of the standard (see note 7).
7. Calibrated against a cross-band standard. The cross-band standard has been calibrated against thermal standards at several frequencies, and the excess noise ratio has been estimated by extrapolation, with an estimated uncertainty of ±0.2db. The calibration of the measurement standard against the cross-band standard introduced a further ±0.04db uncertainty.
8. The critical current is determined by the anode current at which parasitic oscillations can be observed on the swept frequency reflectometer display.

OUTLINE



Ref	Inches	Millimetres
A	5.897 max	149.8 max
B	0.622 ± 0.010	15.80 ± 0.25
C	1.000 ± 0.004	25.40 ± 0.10
D	0.625 ± 0.004	15.88 ± 0.10
E	0.071 ± 0.010	1.80 ± 0.25
F	1.287 ± 0.010	32.70 ± 0.25
G	1.173 max	29.79 max
H	0.809 ± 0.001	20.55 ± 0.02
J	0.520 min	13.20 min
K	0.095 max	2.41 max
L	0.718 ± 0.004	18.24 ± 0.10
M	0.718 ± 0.004	18.24 ± 0.10
N	0.134 ± 0.002	3.40 ± 0.05

Millimetre dimensions have been derived from inches.

Notes

1. Minimum clearance hole, concentric with base.
2. Threaded 5/8-inch S.A.E. 24 TPI.
3. U.H.F. polarized receptacle.

BS604

X-BAND NOISE TUBE MOUNT

DESCRIPTION

X-band waveguide mount for use with noise tube BS384 and power supply BS610.

TYPICAL OPERATION (with tube BS384)

Frequency range	8.5 to 10	GHz
Tube filament voltage	6.3	V
Warm-up period (see note 1)	5.0	minutes
Maximum tube voltage (see note 2)	2.0	kV
Tube operating current	180	mA
V.S.W.R. (see note 3)	1.3:1	max
Excess noise ratio	15.5 ± 0.5	db
Equivalent noise temperature	10 580	°K

GENERAL

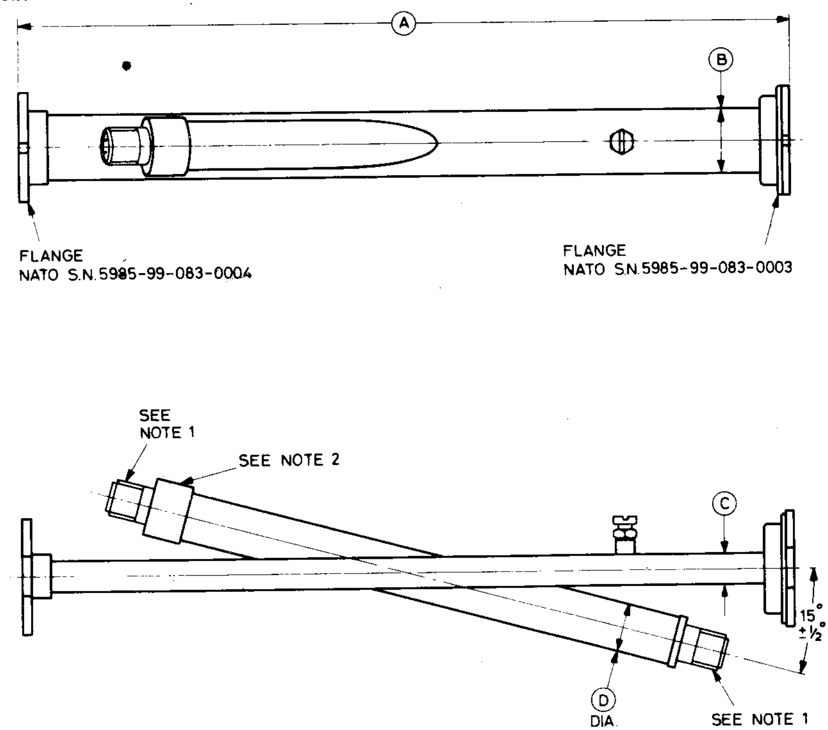
Overall dimensions	50 x 85 x 305mm max 1.969 x 3.346 x 12.008 inches max
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Couplers	see Outline
Tube connectors	u.h.f. twin
Mounting position	any
Net weight	550g (1.2 pounds) approx

NOTES

1. The excess noise ratio depends on the tube and mount temperatures, and a warm up period is necessary for accurate reproducible measurements.
2. Absolute maximum rating for voltage spikes applied to anode connector.
3. The mount can be tuned to a better v.s.w.r. for a specified frequency or reduced bandwidth; such requirements should be stated when ordering.

OUTLINE (All dimensions without limits are nominal)

3456



Ref	Millimetres	Inches
A	304.8	12.000
B	25.40	1.000
C	12.70	0.500
D	19.25 max 19.00 min	0.758 max 0.748 min

Inch dimensions have been derived from millimetres.

Outline Notes

1. Threaded $^5/_8 - 24$ U.N.E.F.
2. This end unscrews for tube insertion.

BS606

Q-BAND
NOISE TUBE MOUNT

ABRIDGED DATA

The BS606 is a waveguide mount for use with the Q-band noise tube BS386.

Frequency range (see note 1)	33 to 36	GHz
Waveguide size	no. 22 (0.280 x 0.140 inches internal)	
Coupler	mates with 154 IEC-(UBR 320) or NATO S.N. 5985-99-012-4834	
Anode connector	high voltage connector type HNC	

GENERAL

Mechanical

Overall dimensions	37.9 x 49.1 x 177.2mm max	
Finish	plastic coated steel and chromium plate	
Net weight	900	g approx
Mounting position (see note 2)		any

MAXIMUM RATING (Absolute value)

Anode voltage (see note 3)	2.0	kV

TYPICAL OPERATION

Operating Conditions (with tube BS386)

Tube anode current	100	mA
Ambient temperature	23	°C
Warm up period (see note 4)	5	min

Typical Performance

Anode voltage	55	V
Mount temperature (see note 5)	28	°C
Excess noise ratio (see note 6)	16.40 ± 0.36	db
Equivalent noise temperature	12 950	°K
Noise variation with mount temperature	−0.0015	db/°C max
V.S.W.R. (tube fired)	1.15	max
V.S.W.R. (tube unfired)	1.25	max

October 1970

TEST CONDITIONS AND LIMITS (with tube BS386)

The mount is tested to comply with the following electrical specification.

Test Conditions

Heater voltage	3.5	V
Anode current	100	mA
Ambient temperature	23	°C
Warm up period (see note 4)	5	min
Frequency range for v.s.w.r. measurements	33.0 to 36.0	GHz
Frequency of excess noise ratio measurement	35.0	GHz
Excess noise ratio of standard (see note 7)	16.36 ± 0.24	db

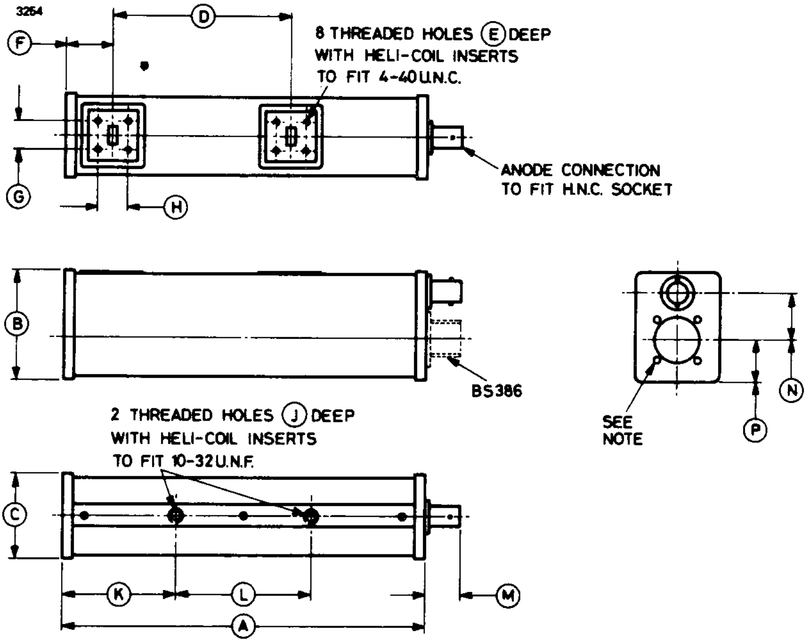
Limits

	Min	Max	
V.S.W.R. across frequency range (tube unfired)	–	1.25	
V.S.W.R. across frequency range (tube fired)	–	1.15	
V.S.W.R. at 35.0GHz (tube fired)	–	1.10	
Excess noise ratio relative to standard	–0.06	+0.14	db

NOTES

1. With tube type BS386.
2. If the tapped holes in the base are used for mounting, the two washers supplied (1mm thick x 32mm diameter) must be placed between the mount and the equipment frame.
3. If a high voltage spike is used to initiate the discharge in the noise tube, the voltage applied to the anode connector must not exceed the specified rating.
4. Since the excess noise ratio is dependent on the tube and mount temperature, a warm up period should be allowed to ensure noise measurement accuracy.
5. Steady state temperature after warm up period, in still air at ambient temperature of 23°C.
6. At a frequency of 35.0GHz. The spread of excess noise ratio is within ±0.1db for any tube in any mount. The tolerance quoted is mainly due to the uncertainty of the calibration of the standard (see note 7).
7. Calibrated against a cross-band standard. The cross-band standard has been calibrated against thermal standards at several frequencies, and the excess noise ratio has been estimated by extrapolation, with an estimated uncertainty of ±0.2db. The calibration of the measurement standard against the cross-band standard introduced a further ±0.04db uncertainty.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	6.338 ± 0.008	161.0 ± 0.2	H	0.530 ± 0.002	13.46 ± 0.05
B*	1.929 ± 0.004	49.0 ± 0.1	J	0.250	6.35
C	1.488 ± 0.004	37.8 ± 0.1	K*	1.988 ± 0.008	50.5 ± 0.2
D	3.135 ± 0.004	79.6 ± 0.1	L*	2.362 ± 0.008	60.0 ± 0.2
E	0.250	6.35	M*	0.630 max	16.00 max
F	0.814 ± 0.004	20.68 ± 0.10	N	0.815 ± 0.008	20.7 ± 0.2
G	0.500 ± 0.002	12.70 ± 0.05	P	0.744 ± 0.004	18.9 ± 0.1

Millimetre dimensions have been derived from inches except where marked *.

Note 4 holes threaded 5–40 U.N.C. by 0.250 inch (6.35mm) deep to suit flange on BS386.