'ENGLISH ELECTRIC' VALVES

ENGLISH ELECTRIC VALVE CO. LTD
CHELMSFORD ENGLAND

VALVE DATA BOOK

VOLUME TWO

GENERAL ITEMS

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March 1966

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Printed in England

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ENGLISH ELECTRIC VALVE CO. LTD.

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The following provides a complete list of the contents of Volume 2 and gives the correct sequence in which the sheets should be filed. It will be reissued periodically to incorporate any changes and may be used to check the contents of the volume. The page numbers refer to the front of each sheet only.

It should be noted that certain types listed herein may not be available from current production and their supply may be subject to a suitable quantity being ordered.

Any correspondence relating to the Valve Data Book should quote the serial numbers inside the front covers of the volumes and should be addressed to:

English Electric Valve Company Limited,
Technical Publications Department,
Chelmsford, Essex.

Divider Card: C.W. Magnetrons		**March 1968**
BM25L	Leaflet	March 1968
Divider Card: L-Band Magnetrons		**June 1968**
M554	Leaflet	June 1968
M565	Leaflet	June 1968
M586	Leaflet	June 1968
Divider Card: S-Band Magnetrons		**September 1968**
2J30–2J34	Leaflet	September 1968
4J31–4J35	Leaflet	September 1968
4J43–4J44	Leaflet	September 1968
4J53	Leaflet	September 1968
5586	Leaflet	September 1968
5657	Leaflet	September 1968
7182	Leaflet	September 1968
BM1003, BM1004, BM1005	Leaflet	September 1968
M525	Leaflet	September 1968
M561	Leaflet	September 1968
M566, M569, M570	Leaflet	September 1968
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M577B, M578B	Leaflet	September 1968
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M5028	Leaflet	September 1968
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M5058	Leaflet	September 1968
Divider Card: C-Band Magnetrons		**December 1968**
M5008, M5009	Leaflet	December 1968
M5032, M5033	Leaflet	December 1968
Divider Card: X-Band Magnetrons		**December 1968**
2J42	1	March 1967
	3,5,7	March 1964
2J42H	1,3,5,7	June 1966
2J55	1,3,5,7	June 1964
2J56	1,3,5,7	March 1960
4J50A	Leaflet	December 1968
4J52A	Leaflet	December 1968
6027	1,3,5,7	June 1964
6027H	1,3,5,7	September 1965

M5023, M5024, M5025	Leaflet	December 1968
M5043, M5044	Leaflet	December 1968

TABBED CARD: TRAVELLING WAVE TUBES **March 1964**

Tabulated Data:		
Travelling Wave Tubes	1	June 1967
6861	1	September 1962
	3,5,7,9	September 1960
N1001	1	September 1966
N1002	1	September 1966
N1004	1	September 1966
N1013	1	September 1966
N1016M	1	September 1962
	3,5,7,9	June 1961
N1017M	1	December 1963
	3,5,7,9	September 1960
N1024M	1	September 1966
N1025M	1	September 1966
N1029	1,3,5,7	June 1963
	9	March 1964
N1031	1	September 1966
N1032	1	September 1966
N1033	1	September 1962
	3,5	March 1961
	7	June 1962
	9	March 1967
	11	June 1962
N1038	1,3,5,7	June 1963
	9	March 1964
N1042M	1,3,5,7	September 1961
	9	March 1962
N1045M	1,3,5	June 1962
N1047M	1,3,5,7	September 1963
	9	March 1967
N1055	Leaflet	December 1967
N1056	1,3,5,7,9,11,13,15,17,19	June 1967
N1061	1,3,5,7	June 1967
N1062, N1063, N1064	1,3,5	June 1967
N4001	1,3	June 1961
N4003	1,3	June 1961
N4004	1,3	June 1961
N4006	1,3	June 1962

KLYSTRONS

Complete List of Types in this Section

Preamble

Data Sheets

March 1961

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

KLYSTRONS

TABULATED DATA

KLYSTRONS

AMPLIFIER KLYSTRONS — C.W. Operation, Television Service

EEV type	Tuning range (MHz)	Sat. output power‡ (kW)	Drive power (W)	Cooling (see below)	Circuit assembly
K365**	400–610	11	5.0	1,2	K4019A
K376 (4KM100LA)	470–610	28	2.0	1,2	K4054
K377 (4KM100LF)	590–720	28	2.0	1,2	K4055
K383	470–610	6.0	1.0	1	K4099
K384	590–720	6.0	1.0	1	K4100
K385	700–860	6.0	1.0	1	K4101
K3004	470–610	7.5	1.0	1,3	K4089
K3005	590–720	7.5	1.0	1,3	K4090
K3006	700–860	7.5	1.0	1,3	K4091
K3014	470–610	28	2.0	1,2,3	K4102
K3015	590–720	28	2.0	1,2,3	K4103
K3017	470–610	46	4.0	1,2,3	K4102
K3018	590–720	46	4.0	1,2,3	K4103

Perveance of K365 is 1×10^{-6}; perveance of other types in above table is 2×10^{-6}.

‡ At klystron output flange. Bandwidth 8MHz (K365 6MHz).

** Near equivalent of 4KM50,000LA3.

Cooling
1 Forced-air cooled.
2 Water cooled.
3 Vapour cooled.

AMPLIFIER KLYSTRONS – C.W. Operation, Tropospheric Scatter Service

EEV type	Tuning range (MHz)	Output power† (kW)	Drive power† (W)	Cooling (see below)	Circuit assembly
3K3000LQ	610–985	2.8	10	1	–
3KM3000LA	375–585	2.3	2.0	1	–
4KM50,000LA	400–610	10	0.02	1,2	K4019
4KM50,000LQ	610–985	10.5	0.05	1,2	–
4KM50,000LR	755–985	12	0.05	1,2	–

Perveance of types listed in above table is 1×10^{-6}.

AMPLIFIER KLYSTRONS – Pulse Operation

EEV type	Tuning range (MHz)	Output power (peak) (kW)	Gain (db)	Cooling (see below)	Focus mount
K211	2998 ± 5*	7000	32	1,2	Integral
K329	962–1213	6.5	29	1	–
K347A	580–615	600	33	1	–
K390	2998 ± 5*	8000	40	1,2	K4001

† Narrow band operation
* Fixed frequency

Cooling 1 Forced-air cooled
2 Water cooled

OSCILLATOR KLYSTRONS

EEV type	Mechanical tuning range (MHz)	Electronic tuning range (MHz)	Output power (mW)	Application
K300	9320–9500	30	30	Local oscillator
K302	9320–9500	30	30	Local oscillator
K305	9250–9500	35	25	Local oscillator
K308	8800–8900	40	40	Local oscillator
K311	8500–9500	30	45	Local oscillator
K324	9000–10 000	30	45	Local oscillator
K335	9555–9685	30	25	Local oscillator
K337*	9000–10 000	24	45	Local oscillator
K342*	8500–9000	35	45	Local oscillator
K343	12 000–14 500	50	80	Local oscillator
K346	14 500–17 000	75	45	Local oscillator
K350‡	8500–10 000	12	1.2W	Doppler
K351*	8500–9655	35	65	Local oscillator
K357	10 660–10 720	30	12	Doppler
K359*	8100–8750	55	90	Local oscillator
K361	10 700–10 725	20	27	Doppler
K361B	10 675–10 700	20	27	Doppler
K364	9295–9395	40	40	Local oscillator

Continued on page 4

* Rugged
‡ Forced-air cooled, two resonator type

OSCILLATOR KLYSTRONS (continued)

EEV type	Mechanical tuning range (MHz)	Electr-onic tuning range (MHz)	Output power (mW)	Application
K366† series	6125–7750	35	1.2W	Link transmitter
K367†† series	6125–7750	35	1.2W	Link transmitter
K391	9160–9340	30	40	Local oscillator
K391A*	8800–8900	40	60	Local oscillator
K397‡	8800 ± 5	12	1.2W	Local oscillator
K3003*	9350–9550	50	55	Local oscillator
K3007*	9295–9395	32	40	Local oscillator
K3020*	9350–9550	40	55	Local oscillator
KY366‡‡ series	6125–7750	35	1.2W	Link transmitter
KY367‡‡ series	6125–7750	35	1.2W	Link transmitter

* Rugged

‡ Forced-air cooled, two resonator type

† Forced-air cooled, equivalent to VA220 series

†† Equivalent to VA222 series

‡‡ Vapour cooled

INTRODUCTION—KLYSTRONS

For many years klystrons have been used almost exclusively for the one purpose of generating the local oscillator signal in superheterodyne microwave receivers. The klystron, however, is one of the most versatile of microwave valves and modern designs are meeting requirements in applications of increasing diversity.

The English Electric Valve Company has endeavoured to anticipate the changes in the demand for klystrons by its policy of research and development. As a result it can offer the comprehensive range of valves listed in this data book. New types will be added as they become available.

Reflex klystron oscillators are simple to use and provide reliable service as local oscillators and signal generators for test equipment. They are also suitable for use as medium power transmitting valves in a variety of applications which include microwave communication links and frequency modulated radars. This type of klystron may have its carrier frequency modulated over a limited range of up to about 0·3% by variation of the voltage applied to the reflector. Amplitude modulation may be achieved by changing either the reflector or the cathode voltage. In addition, mechanical adjustment of the frequency may be provided to give a tuning range of up to approximately 20% of the centre frequency.

The two-cavity klystron oscillator is generally more efficient than the reflex oscillator and, intrinsically, it is capable of a very much higher output. The electronic tuning range is somewhat less and is achieved by variation of the voltage between the cathode and the resonator. Mechanical tuning may be provided as for the reflex oscillator, but the adjustment is more complicated because the frequency of both resonators has to be changed.

Klystron amplifiers with two or more resonators now have achieved performance figures that compare favourably with other types of microwave valves. Their outstanding feature is the high power gain which may be obtained from a single valve; this may be as much as 55db for a design using four resonators. The power handling capacity in both pulsed and continuous wave operation is at least as great as for any other comparable type and the efficiency approaches the best obtained at frequencies for which klystrons are normally used.

These features make this class of valve eminently suited to many applications, amongst which may be mentioned tropospheric scatter transmission and radar using coherent pulse techniques for permanent echo cancellation. In the field of Nuclear Physics, klystrons serve to amplify R.F. power to energise high energy particle accelerators; this particular application indicates the stability of the phase of the output relative to the input because it has proved practicable to use a number of klystrons, operating individually, to feed separate sections of an accelerator. The stability is such that the correct relative phase of the R.F. field in each section of the machine can be maintained within the close limits required for efficient acceleration of the particles.

Each valve described in the following pages embodies, wherever possible, modern techniques adapted to meet the demands of the particular category to which it belongs. An improved grid construction now used in many of the reflex oscillators has resulted in higher stability and reduced microphony. Ceramics are being used more and more in the fabrication of vacuum envelopes and this, in the appropriate circumstances, enables designs of greater utility. Care exercised in the preparation and assembly of internal parts contributes to a long and trouble-free life.

The selection of the type of klystron best fitted to meet an individual requirement requires an appreciation of many aspects of the design of these valves. The following pages are intended to serve as a guide in making this choice and the English Electric Valve Company is always pleased to assist with the selection of valves for customers' requirements and to offer advice on the precautions that should be observed in the handling and use of their products.

GENERAL

Maximum and Minimum Ratings

All the ratings in this section are absolute ratings. The equipment designer is responsible for ensuring that valves are run within these ratings under any conditions of mains fluctuations, surges or component tolerances. (See British Standard Code of Practice CP 1005: Parts 1 & 2: 1954 'The Use of Electronic Valves'.)

Heater Voltage

For satisfactory life and performance, the heater voltage should be kept as close as possible to the nominal value. The heater voltage must be maintained within the limits specified under maximum and minimum ratings.

Heater Starting Current

The resistance of a heater when cold is only a small fraction of the resistance under steady running conditions and the initial heater current will be very high unless special precautions are taken to limit its value.

Small valves may have their heaters switched on directly—it is not usual to quote maximum heater starting current in such cases.

In large valves the magnitude of the forces involved could easily distort and damage the heater permanently. For this reason the maximum heater starting current is quoted in the valve data. Methods of limiting the initial heater current include the following:

(*a*) The inclusion of a resistor in the primary circuit of the heater transformer together with a delay switch for shorting out the resistor after steady conditions have been reached.

(*b*) The use of a specially designed heater transformer with high leakage reactance.

(*c*) Variac control of a normal heater transformer.

Typical Operating Conditions
The typical operating conditions given in this section are intended to serve as a guide to the general performance of the valve and should not be regarded as limiting conditions.

Electrode Voltages
All electrode voltages are given with respect to the cathode, unless otherwise stated.

Valve Life
Valve life is shortened by the use of incorrect heater voltage and excessive resonator, body or collector dissipation.

Forced-air Cooling
Forced-air cooling is used for three main purposes in connection with klystron valve operation:

1. To cool the radiators by forcing air through the channels formed by the fins or vanes and in its passage to cool the body of a klystron oscillator or the drift sections of a klystron amplifier.
2. To cool the collector in a similar manner.
3. To cool the gun end of the valve and the coaxial line output glass dome in the case of a high power klystron amplifier such as the K339 with its water-cooled collector and drift tubes.

It is essential to meet the minimum cooling requirements specified. It is preferable to exceed these minimum requirements. Failure to meet these requirements will lead to short valve life and will result in catastrophic failure in many cases.

The air flow specified in the data sheets should be delivered through the radiator before and during the application of any voltages. Heater power, H.T. and air may be removed simultaneously.

The pressure across the radiator may be checked in practice by the use of a U-tube manometer connected into the air duct close to the radiator on the fan or blower side. Water may be used in the tube and the pressure difference read in inches of water. If the valve is run under dead loss conditions, i.e., with no R.F. input, then all the input power appears as heat and if the temperatures of air entering and leaving the radiator are measured, the airflow can be calculated from the expression

$$\text{Airflow (cubic ft/min)} = \frac{T_{in} \times (\text{input power in watts})}{164 \times (\text{increase in air temperature})}$$

where T_{in} = absolute temperature of inlet air.
= inlet temperature $^\circ C + 273$.

The airflow-pressure characteristic can thus be corrected and the manometer may then be used as a monitor for the airflow. It should be recalibrated from time to time since dirt in the airstream may soon clog the radiator passages.

No supplies should be connected to the valve in the absence of air blast. Interlocking arrangements to this effect are desirable as is also cut-out protection against failure of the fan or fan motor.

Water Cooling

In some high power amplifier klystrons (e.g., K339) water cooling is required for both collector and drift tubes. An insulator (e.g., rubber hose) should be inserted in the water connections to the collector and drift tubes to permit monitoring of currents to these electrodes.

Soft water supplies should be used if scale deposits are to be minimised. One answer to this problem, and sometimes the cheapest, is to use demineralised or distilled water pumped round a circuit including a storage-cooling tank.

As with forced-air cooled valves, if the inlet and outlet temperatures of the coolant are measured, then either the flow of water or the total power dissipated can be derived if the other is known, using in this case the expression

$$P_d = \frac{G(t_o - t_i)}{3{\cdot}15} \text{ kW}$$

where t_i inlet temperature °C

t_o = outlet temperature °C

G = water flow in gallons per minute

P_d = total power dissipation in kW.

Data for water cooled valves normally include a recommended safe water flow and the actual flow should be kept above this value. The outlet temperature should not exceed 65°C and the temperature rise across any cooling jacket should not exceed 15°C.

Notes on the Protection of Large Klystrons

It is necessary to fit protective devices to guard against failure of the cooling system or the magnetic field or disconnection of the load and, in the event of failure of any of these, interlocks should operate to remove the applied H.T. The H.T. should also be removed if the collector becomes overheated. In addition, overload current relays are necessary to remove the applied H.T. should either the collector current or the body current exceed the specified limit.

KLYSTRON OSCILLATORS

The klystron oscillators described in this data book are divided into two distinct categories. These categories are:

1. Reflex klystron oscillators
2. Two resonator klystron oscillators.

All klystron oscillators are characterised by the fact that oscillations only occur within discrete regions of electrode voltage. Such regions are called 'modes of oscillation'. A further general feature is that within any given mode the frequency of oscillation varies continuously from one end of the mode to the other as the electrode voltage range for that mode is explored. This feature is termed 'Electronic Tuning'.

In many applications the choice between the two resonator oscillator and the reflex oscillator is fairly obvious. Sometimes, however, the choice is difficult. A brief description of both types is given below together with their advantages and disadvantages.

The Reflex Klystron Oscillator
The reflex klystron oscillator is shown schematically in Fig. 1 together with the recommended circuit for its satisfactory operation as a C.W. source. A loop output is shown for convenience of drawing; the majority of the reflex klystrons catalogued here in succeeding pages have waveguide outputs.

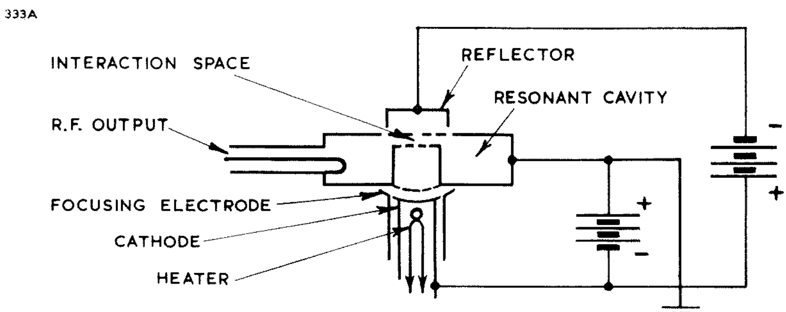

FIGURE 1

The relationship between resonator voltage and reflector voltage for the various modes of the reflex klystron oscillator is approximately

$$V_R = \frac{Cf\sqrt{V_0}}{N} - V_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where C is a constant for any given design
f is the oscillation frequency
V_R is the reflector voltage
V_0 is the resonator voltage
and N is a number identifying the mode.

←Indicates a change

For optimum power output

$$N = n + \tfrac{3}{4} \quad \text{where } n = 0, 1, 2, 3, 4 \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Fig. 2(*a*) shows an idealised plot of equation (1) in arbitrary units. The thick lines show the values of V_o against V_R for optimum power output, that is for values of $N = n + \frac{3}{4}$ at a fixed position of the mechanical tuner of the valve.

The shaded areas show the regions in which oscillations occur. As the figure shows there are certain regions of reflector and resonator voltages for which no oscillations occur, and there is a minimum value of resonator voltage for any given mode below which no oscillations occur whatever the value of the reflector voltage. This minimum value of resonator voltage is intimately connected with the starting current for the mode in question. In any well designed klystron the beam current varies with the resonator voltage according to the law

$$I_o = AV_o^{3/2} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

where A is a constant.

There is a minimum value of beam current, called the starting current, for any given mode below which the valve will not oscillate.

It is usual to operate a reflex klystron oscillator at a fixed resonator voltage. The variation of output power with reflector voltage under these conditions is shown in Fig. 2(*b*). Below this in Fig. 2(*c*) is shown the variation of frequency with reflector voltage, that is the electronic tuning of each mode. For practical purposes the electronic tuning range of any mode is defined as the frequency difference between the half-maximum-power-points of that mode.

The shape of the curves of 2(*c*) is essentially tangential in form with a substantial part of it reasonably linear. The slope of these curves at any given frequency δf from the mode centre is given by

$$\frac{\partial f}{\partial V_R} = \left(\frac{\partial f}{\partial V_R}\right)_o \left[1 + 4Q_L^2\left(\frac{\delta f}{f}\right)^2\right] \quad \ldots\ldots\ldots\ldots\ldots (4)$$

where Q_L is the loaded Q of the system

and $\left(\frac{\partial f}{\partial V_R}\right)_o$ the slope at the mode centre which is given by

$$\left(\frac{\partial f}{\partial V_R}\right)_o = \frac{\pi f_o N}{Q_L(V_o + V_R)} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

The slope of the electronic tuning varies therefore from mode to mode. As N increases, that is as V_R decreases, the slope increases.

Reverting to equation (1), this shows that for a fixed resonator voltage and constant mode number the reflector voltage for maximum power varies in a linear manner with mechanical tuning. This is useful in systems where remote wide band tuning is required: the reflector voltage control can be ganged to the mechanical tuning control.

The main advantages of the reflex klystron are:

(i) For frequency modulation or amplitude modulation applications, the modulating voltage can be applied to the reflector, a high impedance electrode drawing no current.

(ii) Ease of mechanical tuning, because there is only one cavity to be adjusted.

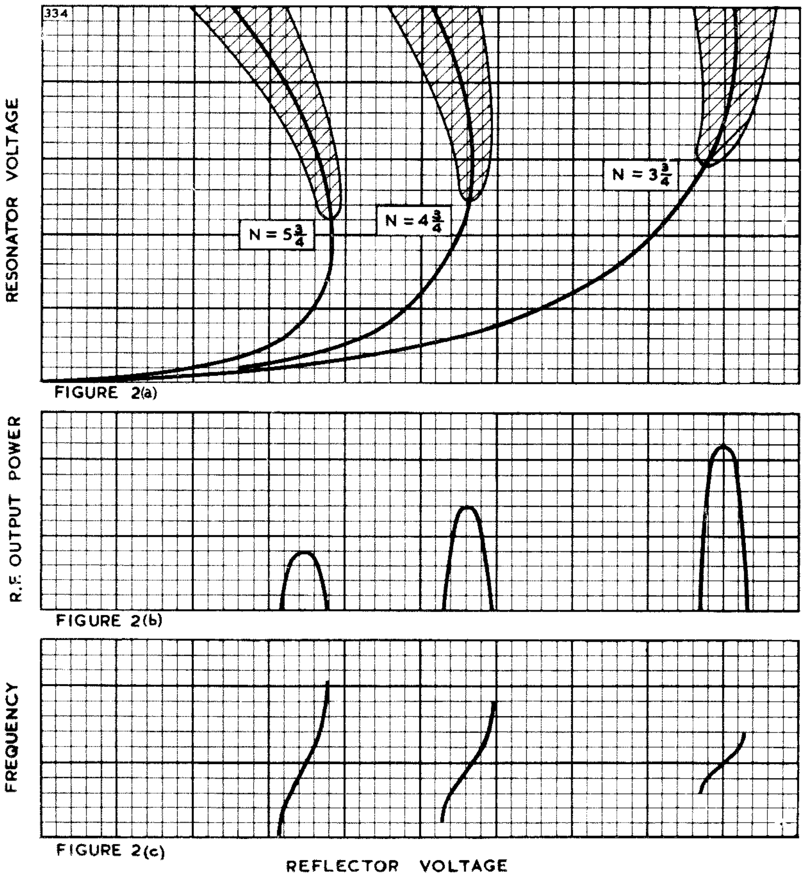

FIGURE 2

The main disadvantages of the reflex klystron are:

(i) Low efficiency. Most commercially available X-band, reflex klystrons work at about 1% efficiency. This increases slightly as the frequency decreases.

(ii) The power handling capacity is very limited—no commercially available X-band reflex klystrons deliver more than a few watts.

Typical operation of reflex klystrons is illustrated by the K324 and the K345.

The K324 was designed as a general purpose local oscillator for use in the band from 9000 to 10 000Mc/s. At 350V H.T. it delivers 50 to 100mW of power over the band at an efficiency of 0·5 to 1% and has an electronic tuning range of 30 to 40Mc/s.

The K345 was designed specifically for use in Microwave Link systems working in the 6000 to 8000Mc/s region. At 750V H.T. it delivers just over 1 watt of power at an efficiency of 2·25% in any 300Mc/s region of the band quoted. The electronic tuning range is about 30Mc/s with an average modulation sensitivity of 250kc/s/volt on the reflector.

All the reflex klystron oscillators catalogued here, except one, are supplied with the resonator integral with the valve. This is the result of a deliberate policy to provide the user with the least troublesome and most reliable product. Each valve supplied is tested rigorously to the specification as a complete component thus ensuring that the user will get the required performance.

Two Resonator Klystron Oscillators

The two resonator klystron oscillator is shown schematically in Fig. 3. Also shown is the recommended circuit for its satisfactory operation as a C.W. source. A loop output is again shown for convenience.

As with conventional triode oscillators some feedback is necessary from the output circuit to the input circuit. This may be provided either internally or externally to the valve as shown in Fig. 3. If the valve is provided with external feedback, it may readily be transformed into an amplifier.

The idealised variation of output power and frequency with beam voltage for the two resonator klystron are shown in Figs. 4(*a*) and 4(*b*). These curves illustrate the family of modes and the electronic tuning characteristiscs. For oscillations to occur, the beam voltage must be within the range of any mode.

The shapes of the curves in Figs. 4(*a*) and 4(*b*) depend markedly on the amount of feedback and also the difference frequency between the two cavities. As the amount of feedback is changed the output behaves very similarly to the response of two coupled circuits when the amount of coupling is changed. Usually the manufacturer fixes the coupling for the required performance before the valve leaves his hands, and therefore, from the user's point of view this is not important. The difference in frequency setting of the two cavities can be adjusted to give maximum output, maximum electronic tuning range or a compromise condition.

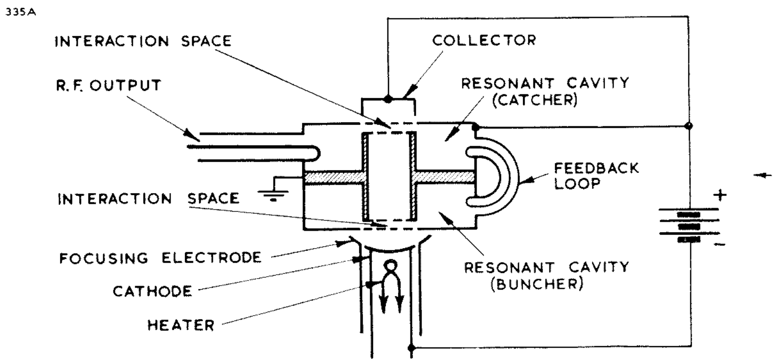

FIGURE 3

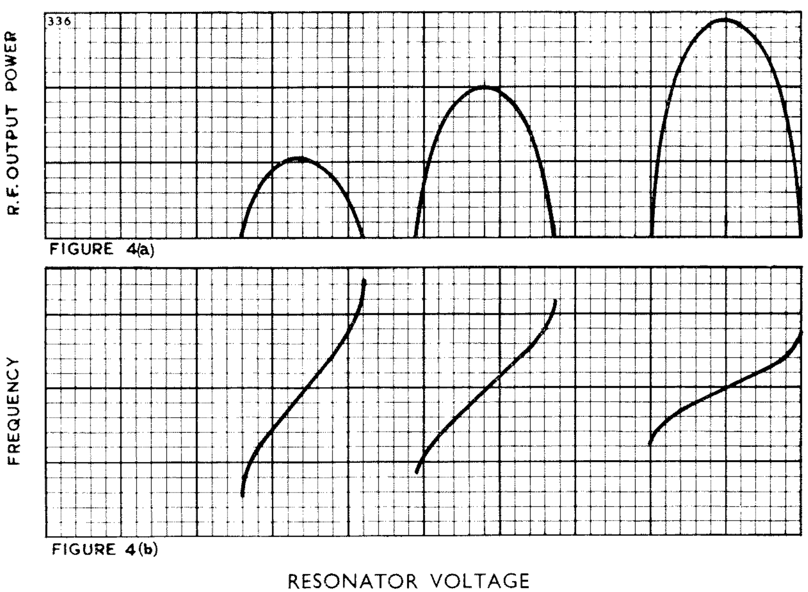

FIGURE 4

← Indicates a change

The main disadvantages of the two-resonator klystron are two-fold:

(i) Both circuits of this klystron possess an inherently high Q. The adjustment of both circuits to the same frequency and their simultaneous tracking in subsequent tuning may therefore present difficulties in tunable operation.

(ii) In frequency modulation applications the modulating voltage must be applied to a low-impedance electrode.

Opposed to these however the advantages are:

(i) An efficiency which is higher than that of the reflex klystron.

(ii) The inherent power handling capacity is much greater than that of the reflex klystron. Valves are made which give several hundreds of watts output.

Typical C.W. operation of the two-resonator klystron is illustrated by the K350. This valve was designed for use as a Transmitter in F.M.C.W. radar systems. At 700 volts beam voltage it delivers 1·5 watts with an efficiency of about 3% with an electronic tuning range of 15Mc/s. The modulation sensitivity (beam voltage) is approximately 250kc/s/volt.

KLYSTRON AMPLIFIERS

The klystron amplifier is best suited to applications requiring high gain with a relatively narrow bandwidth. Modern multi-cavity designs can provide a stable power gain up to about 100db depending on the number of cavities used, but the bandwidth under these conditions is usually a small fraction of one per cent. The bandwidth can be increased considerably by stagger tuning the cavities, although the power gain is appreciably less than that obtained with the cavities tuned identically. Furthermore, if the klystron has three or more cavities, stagger tuning improves the efficiency and it is unusual to operate a valve of this class with all the cavities tuned to the same frequency.

The usual frequency range of klystron amplifiers is from about 250Mc/s to upwards of 40 000Mc/s. They compare unfavourably in size and performance with triodes or tetrodes at frequencies lower than 250Mc/s and are difficult to manufacture for operation at frequencies above 40 000Mc/s.

Little attention has been paid to klystrons as low noise signal amplifiers although theoretically it is possible to design them to have a noise factor as low as that of any other electron beam type amplifier, e.g., the travelling wave tube. It is probable that the klystron has been disregarded for this type of service because it is basically a narrow band amplifier.

The klystron can be designed as a power amplifier capable of a high power handling capacity. Peak output powers of several megawatts are quite practicable in pulsed operation and in continuous wave conditions 10kW or more can be obtained in the U.H.F. band with an efficiency of some 30% to 40%.

Normally the most favourable performance is obtained from a klystron when the beam current to beam voltage ratio is made as high as possible. This ratio is restricted to be below a fairly well defined maximum value imposed by the physics of electron beam formation and focusing. It follows that the operating voltage is known approximately once the required output power is specified. The curves of Fig. 5 show the limits within which the operating voltage of most valves will fall when plotted against the output power.

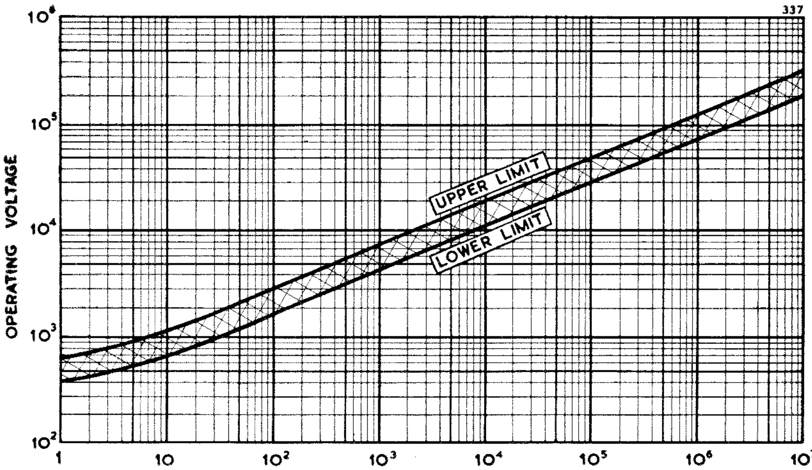

FIGURE 5

Klystron amplifiers employ two fundamentally different forms of construction for the resonant cavities. In one form, only the interaction gap is contained within the valve envelope and the vacuum is sealed from the remainder of the cavity by a low loss insulator made of glass or ceramic. The part of the cavity external to the valve includes input or output coupling circuits, R.F. monitor probes and the mechanical tuning arrangement. It is clamped to the vacuum envelope in a way that ensures a good R.F. connection between the internal and external elements of the resonant circuit. This construction is to be preferred whenever possible because it is more adaptable and valve replacement costs are lower. However the power handling capacity is usually lower than for the construction in which the resonant cavities are built wholly within the vacuum envelope as integral parts of the valve. The second type must therefore be used if the valve is to be designed to handle a power comparable with the maximum obtainable at any given frequency.

High performance klystrons require an axial magnetic field to focus and control the electron beam during its passage through the drift tubes. The improved performance generally justifies the complications involved in providing the magnetic field and in aligning the axes of the valve and the field. Damage to a valve will occur if the beam is not focused efficiently and it is essential to protect it against a failure in the focusing system causing a rise in the electron current which reaches the drift tubes. If a simpler installation with a reduced performance is acceptable it may be possible to use a klystron which has no external means for focusing the beam. This eliminates the need for a magnetic field and the power supply required to maintain it and the precautions on beam focusing are reduced simply to that of screening the electron beam from the influence of any stray magnetic fields present in the vicinity of the valve.

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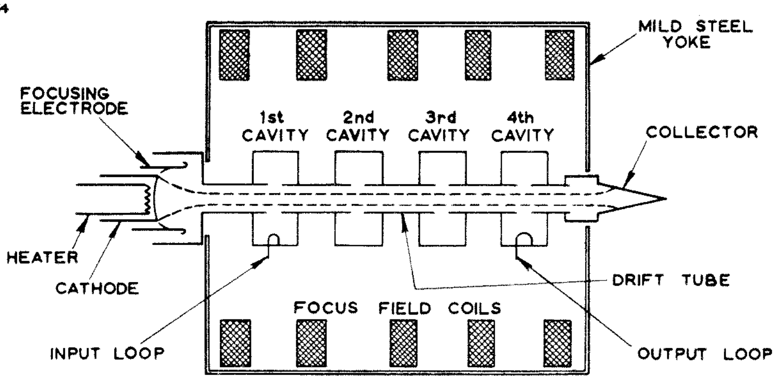

FIGURE 6

Figure 6 shows the arrangement, in schematic form, of a four cavity amplifier complete with the coils and mild steel yoke used to provide the axial magnetic field.

The cooling required by a klystron amplifier depends primarily on the power level at which the valve is to be operated; it is dependent to a lesser extent on the frequency of operation. As a rough guide, natural convection and conduction cooling by air at the normal ambient temperature is adequate for a rated output up to about one watt mean, forced-air cooling is satisfactory up to a few kilowatts mean and water cooling must be used at the higher levels. The cooling has to be applied to the collector where the major part of the internal heat dissipation takes place, but it is usually necessary to apply subsidiary cooling to the drift tubes and to the seals on the insulators of the electron gun.

The procedure for commissioning a new valve is straightforward provided the relevant safety precautions are observed. The cooling system must be functioning before any of the electrical supplies are switched on to the klystron and in most cases the cathode must be allowed adequate time to reach its normal running temperature before the high tension voltage is applied. It is permissible with low power valves to switch on the high tension voltage and the cathode heating voltage simultaneously although delayed switching of the H.T. supply is to be preferred. If the normal H.T. supply exceeds a few kilovolts a klystron must be conditioned after a prolonged storage period by raising the voltage gradually according to the schedule in the valve specification. The valve should be run without R.F. voltages during this conditioning period.

If the klystron beam is magnetically focused the beam transmission must be checked when a valve is newly fitted in its focusing mount. Adjustments must be made to the mechanical positioning of the valve and to the axial distribution of the magnetic field to ensure that a high proportion of the beam current reaches the collector. These adjustments must be carried out before the full rated voltage is applied to the valve and preferably without R.F. voltages across the interaction gaps. It is usual, however, to carry out a final trimming of the magnetic field when the full power is on and the R.F. voltages have their normal running values. The collector and body currents should be monitored, and the meter shunts used should have very heavy current carrying capacity to avoid damage under any possible valve fault conditions.

When the resonant cavities are set up, either at the commissioning of a valve or at a change of operating frequency, they should be adjusted to resonate at the frequencies given in the data sheets. If this information is not available it is usually satisfactory to set all the cavities to the same frequency with the exception that the penultimate cavity should be set to a frequency about 0·5% higher than the rest. Final adjustments are made when the valve is operating and delivering power to its load. Care must be taken during this final adjustment to avoid damage to the drift tubes which may result from excessive R.F. voltage appearing across any of the interaction gaps. In practice this is likely to occur only at the gaps of the penultimate and output cavities.

Further advice on the installation and maintenance or any other specific problems arising from the use of klystron amplifiers is available on request.

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Amplifier Klystrons

English Electric Valve Company Limited
Chelmsford, Essex, England

December 1968
Printed in England

ABRIDGED DATA

Three cavity, Electro-magnetically Focused, Forced-air Cooled Amplifier Klystron with separate tuning cavities, for U.H.F. c.w. service. The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency Range	610 to 985	MHz
Output Power (Narrow-band)	2·0	kW Min
Power Gain (Narrow-band)	25	db
Beam Voltage	9·0	kV Max

GENERAL

Electrical

Cathode	Indirectly Heated	
Heater Voltage	5·0	V
Heater Current	31	A
Heater Starting Current (Peak)	60	A Max
Cathode Heating Time (Minimum)	5	min

Mechanical

Overall Length	34·935 inches	(887·3 mm)	Max
Overall Diameter	5·132 inches	(130·4 mm)	Max
Mounting Position	Vertical, cathode end up		
Net Weight	32 pounds	(14·5 kg)	Approx

Cooling — Forced-air

Air Flow to collector	150 ft^3/min	(4·2 m^3/min)
Pressure Drop	1·6 inches W.G.	
Air Flow to output cavity	50 ft^3/min	(1·4 m^3/min)
Pressure Drop	1·0 inch W.G.	
Air Flow to cathode	5 ft^3/min	(0·14 m^3/min)
Pressure Drop	0·4 inch W.G.	
Inlet Air Temperature	20	°C

MAXIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

Beam Voltage	9·0 kV Max
Beam Current (Mean)	0·75 A Max
Body Current:	
continuous	75 mA Max
tuning	100 mA Max
Focus Electrode Voltage (negative)	500 V Max
Collector Dissipation	3·0 kW Max
Temperature of any external part of the valve	175 °C Max

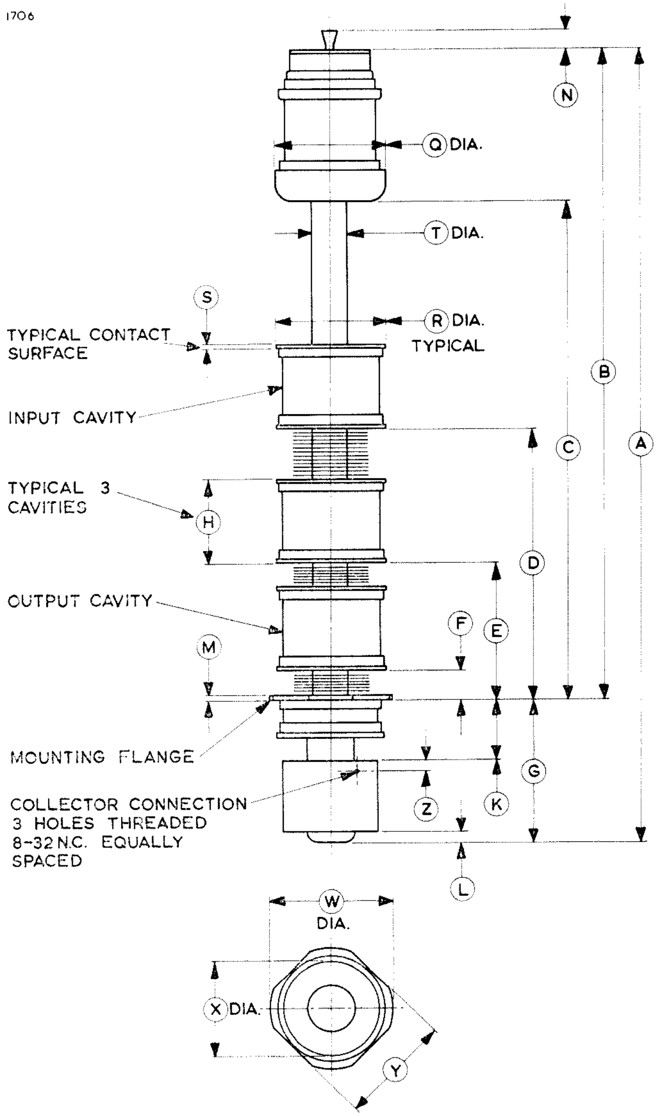
TYPICAL OPERATION
(Narrow-band c.w.)

Frequency	850	850	MHz
Beam Voltage	7·0	9·0	kV
Beam Current	375	580	mA
Focus Electrode Voltage	−200	−200	V
Body Current	30	30	mA
Driving Power	4·0	10	W
Output Power	1300	2790	W
Power Gain	25	24	db
Efficiency	50	54	%

Note A failure of the r.f. drive power while the valve is running may result in the collector dissipation rating being exceeded. A thermal trip should be fitted to the collector to cut off the beam if the collector temperature exceeds 175°C.

OUTLINE

(See page 4 for outline dimensions)



OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	33·187	842·9
B	27·312	693·7
C	20·812	528·6
D	11·312	287·3
E	5·812	147·6
F	1·312	33·32
G	5·875	149·2
H	3·500	88·90
K	2·500	63·50
L	0·375	9·53
M	0·250	6·35
N	0·750 Max	19·05 Max
Q	4·625	117·5
R	4·625	117·5
S	0·245	6·22
T	1·500	38·10
W	5·125	130·2
X	4·125	104·8
Y	4·625	117·5
Z	0·430	10·92

Millimetre dimensions have been derived from inches.

ABRIDGED DATA

Three Cavity, Electro-magnetically Focused, Forced-air Cooled Amplifier Klystron with separate tuning cavities, for U H.F. c.w. or pulse service. Second cavity loading is required to obtain the broad band performance. A modulating anode is fitted which may be used for pulse or amplitude modulation, or as a protective device.

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency Range	375 to 585	MHz
Output Power (Narrow-band)	2·3	kW
Power Gain (Narrow-band)	31	db
Beam Voltage	9·0	kV

GENERAL

Electrical

Cathode	Indirectly Heated	
Heater Voltage	5·0	V
Heater Current	31	A
Heater Starting Current (Peak)	62	A Max
Heater Cold Resistance	0·02 Ω	Approx
Cathode Heating Time (Minimum)	5·0	min

Mechanical

Overall Length	44·985 inches	(1143 mm)	Max
Overall Diameter	5·132 inches	(130·4 mm)	Max
Mounting Position	Vertical, cathode end up		
Net Weight	46 pounds	(20·9 kg)	Approx

Cooling

Air Flow to Collector	150 ft^3/min	(4·2 m^3/min)
Pressure Drop	1·6 inches W.G.	
Air Flow to Output Cavity	50 ft^3/min	(1·4 m^3/min)
Pressure Drop	1·0 inch W.G.	
Air Flow to Cathode	5 ft^3/min	(0·14 m^3/min)
Pressure Drop	0·4 inch W.G.	
Inlet Air Temperature	20	°C

MAXIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

Beam Voltage:		
c.w. operation	9·0 kV	Max
pulse operation	20 kV	Max
Beam Current:		
mean	0·75 A	Max
peak	2·8 A	Max
Body Current (c.w. operation)	75 mA	Max
Focus Electrode Voltage (negative)	500 V	Max
Collector Dissipation (*See Note on Page* 3)	3·0 kW	Max
Temperature of any external part of the valve	175 °C	Max

TYPICAL OPERATION

Narrow-band, Pulsed on Modulating Anode

Frequency Range	400 to 450	MHz
Beam Voltage	15	kV
Beam Current (Peak)	1·7	A
Duty Cycle	0·06	
Focus Electrode Voltage	0	V
Modulating Anode Voltage (Peak)	15	kV
Body Current (Peak)	100	mA
Driving Power (Peak)	10	W
Output Power (Peak)	12·3	kW
Power Gain	31	db
Efficiency	47	%

Narrow-band c.w.

Frequency	520	520	MHz
Bandwidth (to 3db points)	0·6	0·8	MHz
Beam Voltage	6·0	9·0	kV
Beam Current	370	590	mA
Focus Electrode Voltage	−200	−200	V
Body Current	25	40	mA
Driving Power	1·0	2·0	W
Output Power	900	2300	W
Power Gain	30	31	db
Efficiency	41	43	%

TYPICAL OPERATION *(continued)*

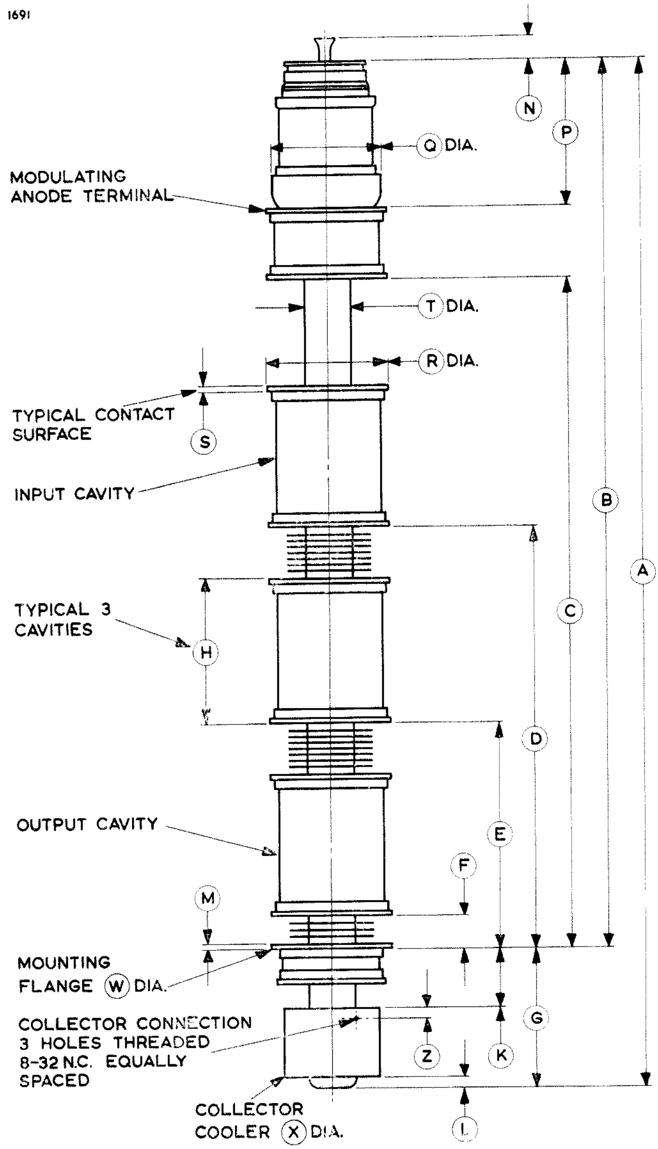
Broad-band c.w.

Frequency	400	MHz
Bandwidth (to 3db points)	3·5	MHz
Beam Voltage	7·5	kV
Beam Current	475	mA
Focus Electrode Voltage	−200	V
Body Current	18	mA
Driving Power	3·0	W
Output Power	1000	W
Power Gain	25	db
Efficiency	28	%

Note A failure of the r.f. drive power while the valve is running may result in the collector dissipation rating being exceeded. It is recommended that the collector be fitted with a thermal trip to cut off the beam if the collector temperature exceeds 175°C.

ENGLISH ELECTRIC

OUTLINE



OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	43·190	1097·0
B	37·312	947·7
C	28·085	713·4
D	17·588	446·7
E	9·456	240·2
F	1·324	33·63
G	5·875	149·2
H	6·000	152·4
K	2·433	61·80
L	0·375	9·53
M	0·250	6·35
N	1·500 Max	38·10 Max
P	6·275	159·4
Q	4·625	117·5
R	5·125	130·2
S	0·245	6·22
T	2·000	50·80
W	5·125	130·2
X	4·125	104·8
Z	0·375	9·53

Millimetre dimensions have been derived from inches.

American Equivalent 4KM50 000LA

INTRODUCTION

The 4KM50 000LA is a high power, forced-air and water cooled, four cavity, magnetically focused klystron amplifier for use under c.w. conditions, with mechanical tuning covering the frequency range from 400 to 610Mc/s. The valve will deliver a c.w. output power of not less than 10kW with a power gain of 50db.

The cavities are external to the vacuum envelope and are tuned by sliding plungers. This design affords a wide tuning range, facilitates adjustable loading for broadband operation and allows repeated tuning cycles without damage to the valve. A circuit assembly, comprising an electromagnetic frame and coils, external tuning cavities, adjustable load couplers for the second, third and output cavities, and an air distributing socket is available (see type K4019 in the Accessories Section, Volume 3). The operation of the valve is guaranteed only when it is used with the K4019 circuit assembly.

The 4KM50 000LA has a modulating anode which provides an effective method of amplitude or pulse modulating the output power without changing the beam voltage. It is also useful as a protective device, either in conjunction with external circuits or when connected to the beam supply through a high impedance.

The input coupling is coaxial (Type N connector) and the output is a 3·125 inch diameter 50 ohm line.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	7·5	V
Heater Current	40	A
Heater Starting Current:		
Peak Value, not to be exceeded	80	A
Operating Frequency (*See Note* 1)	400 to 610	Mc/s

Mechanical

Overall Length	67·30 inches (171cm)	Nom
Overall Diameter	5·125 inches (13cm)	Max
Net Weight	64 pounds (29kg)	Approx
Mounting Position	Vertical, cathode end up	

Cooling Water and Forced-air

At sea level and with an inlet air temperature of 20°C the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flow should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the valve but this practice is not recommended.

Air Flow to Cathode (using K4019 mount)	25 cu. ft. per minute	
Air Flow to Output Cavity	50 cu. ft. per minute	
Water Flow to Body (five drift-tube sections in series)	1 gallon per minute	
Water Flow to Collector	25 gallons per minute	
Outlet Water Temperature	70	°C Max

The temperature of any external part of the valve must not exceed 175°C.
See ' Notes on the Protection of Large Klystrons ' in the preamble to this section.

MAXIMUM RATINGS

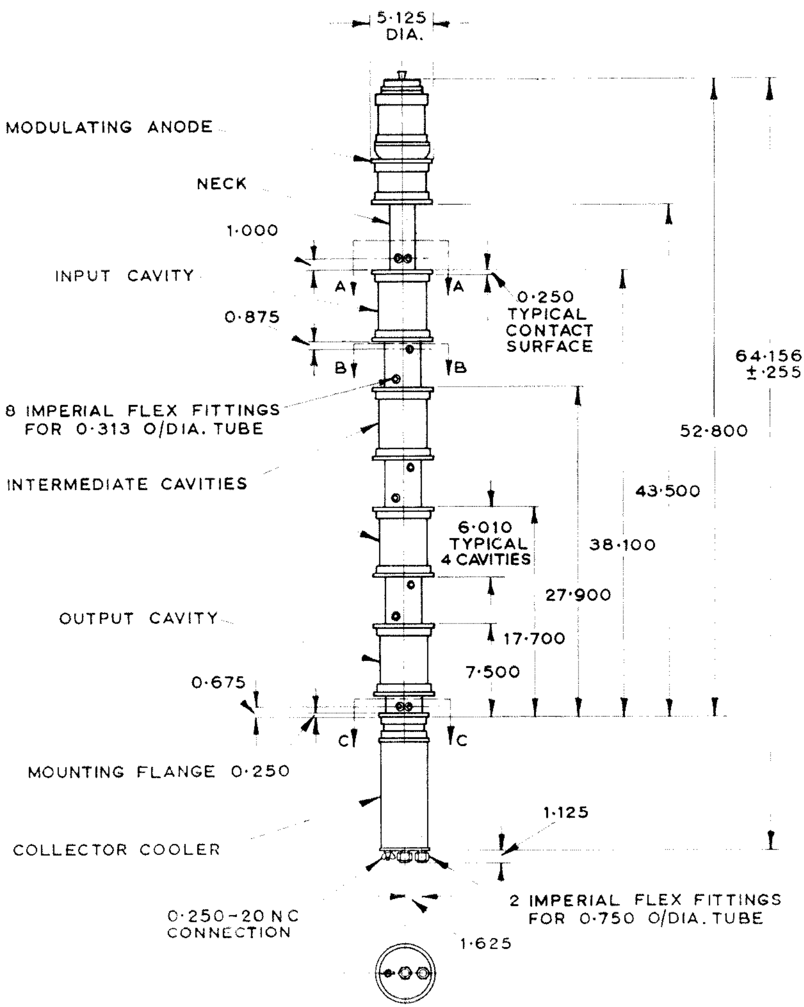
(Absolute Values) (*See Note* 2)

No individual rating should be exceeded

Beam Voltage	20	kV Max
Beam Current (Mean)	2·5	A Max
Body Current (Mean):		
for continuous operation	0·15	A Max
for tuning	0·25	A Max
Focus Electrode Voltage (negative value)	500	V Max
Collector Dissipation	50	kW Max

OUTLINE

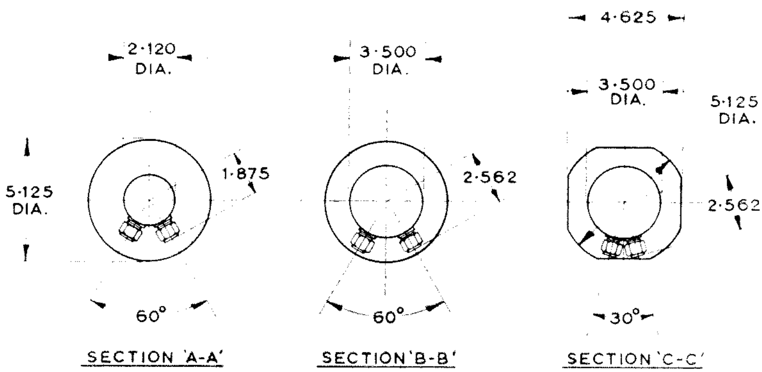
790

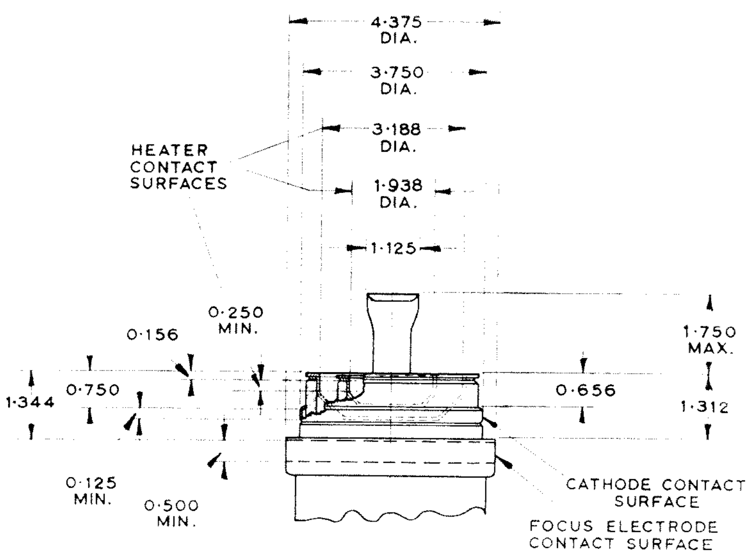


ALL DIMENSIONS IN INCHES

OUTLINE DETAILS

791





DETAIL OF HEADER

ALL DIMENSIONS IN INCHES

American Equivalent 4KM50,000LQ

INTRODUCTION

The 4KM50,000LQ is a high power, forced-air and water cooled, four cavity, magnetically focused klystron amplifier, with mechanical tuning covering the frequency range from 610 to 985Mc/s. The valve will deliver a c.w. output power of not less than 10kW with a minimum gain of 50db for narrow band operation and 33db with a typical bandwidth of 4Mc/s.

The cavities are external to the vacuum envelope and are tuned by sliding plungers. This design affords a wide tuning range, facilitates adjustable loading for broadband operation and allows repeated tuning cycles without damage to the valve. The 4KM50,000LQ has a modulating anode which provides an effective method of amplitude or pulse modulating the output power without changing the beam voltage. It is also useful as a protective device, either in conjunction with external circuits or when connected to the body through a resistor.

GENERAL DATA

Electrical

Cathode	Indirectly Heated	
Heater Voltage	7·5	V
Heater Current	40	A
Heater Starting Current:		
Peak Value, not to be exceeded	80	A
Power Gain (narrow band)	50	db
Output Power	10	kW
Operating Frequency (*See Note* 1)	610 to 985	Mc/s

Mechanical

Overall Length	47·75 inches	(121·3 cm)	Nom
Overall Diameter (excluding water fittings)	5·125 inches	(13·02 cm)	Nom
Net Weight	55 pounds	(25 kg)	Approx
Mounting Position	Vertical, cathode end up		

Cooling .. .. Water and Forced-air

At sea level and with an inlet air temperature of 20°C, the air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the valve, but this practice is not recommended.

Air Flow to Cathode Terminal	25	cu.ft/min
	0·71	cu.m/min
Air Flow to Output Cavity	50	cu.ft/min
	1·42	cu.m/min
Water Flow to Body (five drift-tube sections in series) ..	1	gal/min
	4·5	l.min
Water Flow to Collector	25	gal/min
	114	l.min
Outlet Water Temperature	70	°C Max

The temperature of any external part of the valve must not exceed 175°C. See 'Notes on the Protection of Large Klystrons' in the preamble to this section.

MAXIMUM RATINGS

(Absolute Values) (*See Note* 2)

No individual rating should be exceeded

Beam Voltage	20	kV Max
Beam Current (Mean)	2·5	A Max
Body Current (Mean):		
for continuous operation	100	mA Max
for tuning	150	mA Max
Focus Electrode Voltage (negative value)	500	V Max
Collector Dissipation	50	kW Max

TYPICAL OPERATION
(**C.W. Amplifier**) (*See Note* 2)

Frequency	900	Mc/s
Bandwidth	4·0	Mc/s
Beam Voltage	17	kV
Beam Current (Mean)	1·7	A
Focus Electrode Voltage	−250	V
Body Current (Mean) (*See Note* 3)	35	mA
Collector Current (Mean)	1·665	A
Driving Power (*See Note* 4)	1·0	W
Cavity No. 2 Power (*See Note* 5)	15	W
Cavity No. 3 Power (*See Note* 5)	150	W
Output Power	10·5	kW
Beam Efficiency	36·3	%

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(*See Note* 2)

Test Conditions

Heater Voltage	7·5	V
Beam Voltage	17·0	kV
Beam Current (Mean)	1·7	A
Driving Power	0·5	mW
Frequency	610 to 985	Mc/s
Modulating Anode Voltage (*See Note* 6)	0	V

Range of Characteristics

	Min	*Max*	
Heater Current	38	42	A
Focus Electrode Voltage (negative value)	100	300	V
Body Current (*See Note* 3)	—	100	mA
Output Power	10	—	kW

NOTES

1. The tuning range depends on the external cavities. The user is invited to consult the English Electric Valve Company Ltd. for other frequency ranges.
2. All voltages except the heater voltage are with respect to the cathode.
3. Correct focusing (i.e. minimum body current) can only be achieved when the valve is accurately aligned along the axis of the magnetic field.
4. The figure specified is the drive power which should be available.
5. For broad band operation it is normal to load the cavities externally. The powers specified are those dissipated in the loads.
6. During this test, the modulating anode is connected to the body of the valve by means of a 10 000 ohm resistor.

X-RAY WARNING

X-Rays are produced when the 4KM50,000LQ is operated with a beam voltage above 16kV (absolute value). These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the valve.

POWER
KLYSTR

September 1962

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MOUNTING

COLLECTC

ENGLISH

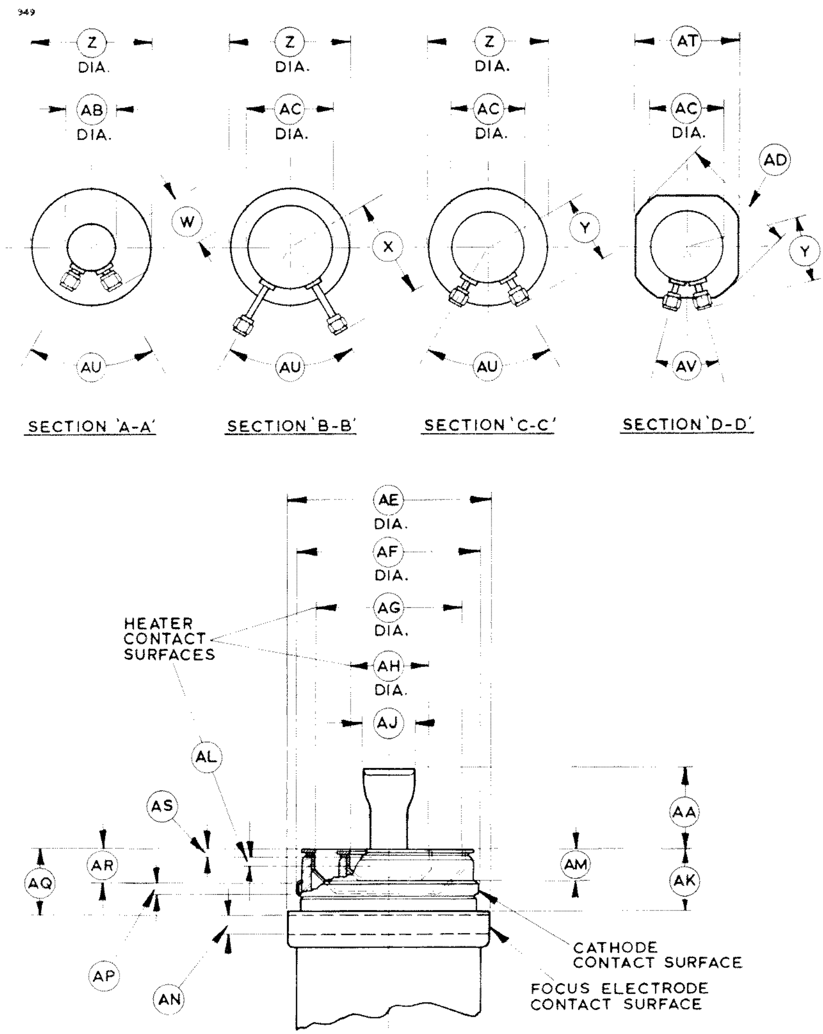
OUTLINE DETAIL DIMENSIONS
(Nominal)

Ref.	Inches	Millimetres
W	1·875	47·63
X	4·000	101·60
Y	2·563	65·10
Z	4·625	117·48
AA	1·750	44·45
AB	2·120	53·85
AC	3·250	82·55
AD	5·125	130·18
AE	4·375	111·13
AF	3·750	95·25
AG	3·188	80·98
AH	1·938	49·23
AJ	1·125	28·58
AK	1·312	33·32
AL	0·250 Min	6·35 Min
AM	0·656	16·66
AN	0·500 Min	12·7 Min
AP	0·125 Min	3·18 Min
AQ	1·344	34·14
AR	0·750	19·05
AS	0·156	3·96
AT	4·625	117·48
AU	60°	60°
AV	30°	30°

Millimetre dimensions have been derived from inches

ENGLISH ELECTRIC

OUTLINE DETAILS



ABRIDGED DATA

Four Cavity, Electro-magnetically Focused, Water and Forced-air Cooled Amplifier Klystron with separate tuning cavities, for U.H.F. c.w. service. Second and third cavity loading is required to obtain the specified broadband performance. A modulating anode is fitted which may be used for beam current control or as a protective device.

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency Range	755 to 985	MHz
Output Power (Narrow-band)	10	kW Min
Power Gain (Narrow-band)	53	db
Beam Voltage	17	kV

GENERAL

Electrical

Cathode	Indirectly Heated	
Heater Voltage	7·5	V
Heater Current	40	A
Heater Starting Current (Peak)	80	A Max
Cathode Heating Time (Minimum)	5	min

Mechanical

Overall Length	47·750 inches	(1213 mm)	Max
Overall Diameter	5·125 inches	(130·2 mm)	Max
Mounting Position	Vertical, cathode end up		
Net Weight	55 pounds	(25 kg)	Approx

Cooling — Water and Forced-air

Water Flow to collector	21 Imp.gal/min	(95·5 l./min)
Pressure Drop	28 lb/in²	(2 kg/cm²)
Water Flow to body	1 Imp.gal/min	(4·5 l./min)
Pressure Drop	28 lb/in²	(2 kg/cm²)
Air Flow to output cavity	50 ft³/min	(1·4 m³/min)
Pressure Drop	1·5 inches W.G.	
Air Flow to cathode	25 ft³/min	(0·7 m³/min)
Pressure Drop	1·0 inch W.G.	
Inlet Air Temperature for above air flow rates	20	°C

MAXIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

Beam Voltage	20	kV Max
Beam Current	2·5	A Max
Body Current:		
continuous	100	mA Max
tuning	150	mA Max
Focus Electrode Voltage (negative)	500	V Max
Collector Dissipation	50	kW Max
Inlet Water Pressure	50	lb/in² Max
	3·52	kg/cm² Max
Temperature of any external part of the valve	175	°C Max

TYPICAL OPERATION

Narrow-band c.w.

Frequency	755	985	MHz
Beam Voltage	17	17	kV
Beam Current	1·8	1·8	A
Focus Electrode Voltage	−200	−200	V
Body Current	30	40	mA
Driving Power	50	50	mW
Output Power	12·1	11·5	kW
Power Gain	53·8	53·6	db
Efficiency	39·5	37·6	%

Broad-band c.w.

Frequency	762	MHz
Bandwidth to 3db points	7·0	MHz
Beam Voltage	17	kV
Beam Current	1·8	A
Focus Electrode Voltage	−200	V
Body Current	50	mA
Driving Power	10	W
Output Power	10	kW
Power Gain	30	db
Efficiency	32·7	%

POWER
KLYSTR(

December 1966

1701

SEE DETA

MODULATI
TERMINAL

BODY WAT
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INPUT CAV

TYPICAL
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OUTPUT C.

MOUNTING

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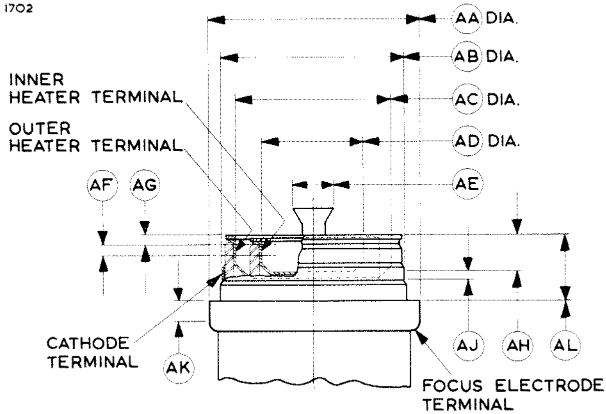
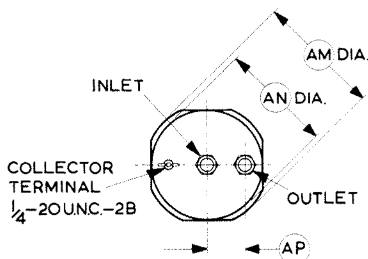


DETAIL OF CATHODE END



VIEW ON COLLECTOR END

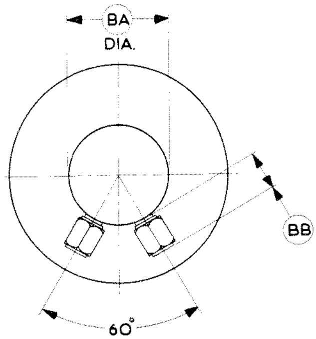
Ref.	Inches	Millimetres	Ref.
AA	4·375	111·1	AJ
AB	3·800	96·52	AK
AC	3·187	80·95	AL
AD	1·937	49·20	AM
AE	1·250	31·75	AN
AF	0·250	6·35	AP
AG	0·150	3·81	BA
AH	0·750	19·05	BB

Millimetre dir

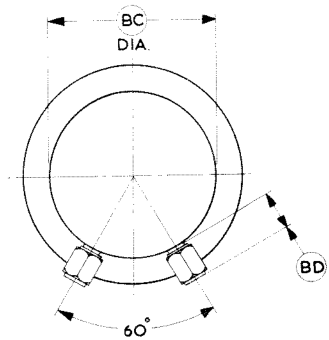
ENGLISH

OUTLINE DETAILS

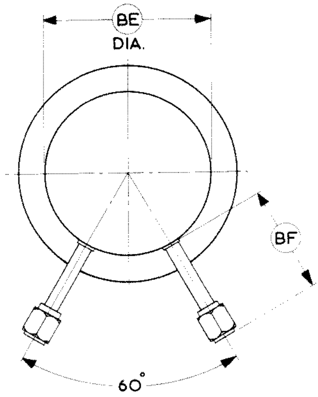
1705



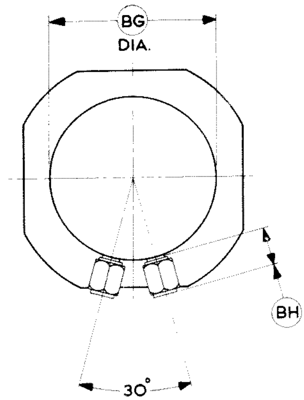
SECTION 'A'–'A'



SECTION 'B'–'B'



SECTION 'C'–'C'



SECTION 'D'–'D'

Inches	Millimetres	Ref.	Inches	Millimetres
0·125 Min	3·18 Min	BC	3·250	82·55
0·500 Min	12·70 Min	BD	0·850	21·59
1·312	33·32	BE	3·250	82·55
5·125	130·2	BF	2·250	57·15
4·625	117·5	BG	3·250	82·55
1·625	41·28	BH	0·850	21·59
2·120	53·85			
0·850	21·59			

ensions have been derived from inches.

POWER KLYSTRON

K211

ABRIDGED DATA

Pulse Amplifier Klystron for linear accelerators and long range radars.

Cavities (Three)	Integral
Frequency (*See Note* 1)	2998 MHz
Typical Peak Output Power	7·0 MW
Typical Power Gain	32 db
Focusing	Electro-magnetic focusing coils integral with valve
Output	No. 10 Waveguide
Coupler	UG–54A/U
Cooling	Water and Forced-air

GENERAL

Electrical

Cathode	Indirectly Heated	
Heater Voltage (*See Note* 2)	3·8	V
Heater Current	86	A
Heater Starting Current Peak Value, not to be exceeded	200	A

Mechanical

Overall Length	42·500 inches (108 cm) Nom
Overall Width	14·000 inches (35·56 cm) Max
R.F. Input Connection	Coaxial Socket, Transradio type CC2/5
R.F. Output Coupler	UG–54A/U
Net Weight	198 pounds (90 kg) Approx
Mounting Position	Vertical, cathode down
Socket	(*See Note* 3)

Cooling Requirements

Water Flow to Body (*See Note* 4)	0·8 Imp. gal/min (3·64 l./min) Min
Water Flow to Collector (*See Note* 4)	4·5 Imp.gal/min (20·5 l./min) Min
Air Flow to Output Window (N.T.P.) (*See Note* 5)	3 ft^3/min (0·085 m^3/min) Min
Cooling Air Excess Pressure	30 lb/in^2 (2·1 kg/cm^2) Min
Resistivity of Cooling Water	50 000 ohm-cm Min

The temperature of the cooling water at the outlet must not exceed 65°C.

All dissolved oxygen should be removed from the cooling water. The dew point of the cooling air must be at least 5°C below ambient and oil vapour or any other impurity harmful to satisfactory window operation must be reduced to a safe level by an approved means.

The air and water flows must be started before the heater and electro-magnet power is switched on and should be maintained for at least two minutes after these supplies have been switched off.

ENGLISH ELECTRIC VALVE CO. LTD. CHELMSFORD ENGLAND

Printed in England

MAXIMUM AND MINIMUM RATINGS (*See Note* 6)

(Pulsed Operation—Absolute Values)

(No individual rating should be exceeded)

	Min	*Max*	
Heater Voltage (*See Note* 2)	3·4	4·6	V
Heater Current	—	105	A
Collector and Body Voltage (Peak) (*See Note* 7)	—	210	kV
Beam Current (Peak)	—	105	A
Collector and Body Current (Mean)	—	180	mA
Collector and Body Dissipation	—	22·5	kW
Beam Input Power (Peak)	—	20	MW
R.F. Input Power (Peak)	—	7·5	kW
Output Power (Peak)	—	8·0	MW
Output Power (Mean) (*See Note* 5)	—	10·5	kW
Duty Cycle (*See Note* 5):			
Beam	—	0·00175	
R.F.	—	0·0015	
Pulse Length	—	3·0	μsec
V.S.W.R. of Load	—	1·2:1	
Electro-magnet Current	24	32	A

TYPICAL OPERATION

(*See Note* 6)

Operational Conditions

Frequency	2998	MHz
Heater Current	86	A
Collector and Body Voltage (Peak) (*See Note* 7)	197	kV
Pulse Length	2·5	μsec
Pulse Repetition Rate	600	p.p.s.
Electro-magnet Current (*See Note* 8)	27·5	A
R.F. Input Power (Peak)	4·0	kW

Typical Performance

Beam Current (Peak)	93	A
Collector and Body Current (Mean)	160	mA
Gain	32	db
Output Power:		
Peak	7·0	MW
Mean	10·5	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Pulsed Operation) (*See Note* 6)

Test Conditions

Frequency	2998	MHz
Pulse Length	2·5	μsec
Pulse Repetition Rate	600	p.p.s.
Output Power:		
Peak	7·0	MW
Mean	10·5	kW

Range of Characteristics

	Min	*Max*	
Heater Voltage	3·0	4·6	V
Collector and Body Voltage (Peak) (*See Note* 7)	—	210	kV
Beam Current (Peak)	—	105	A
Collector and Body Current (Mean)	—	180	mA
R.F. Input Power (Peak)	—	7·5	kW
Electro-magnet Current (*See Note* 8)	24	32	A

PROTECTION CIRCUITS

The equipment in which the valve is to operate must provide protection from damage caused by:

(*a*) Failure of the heater supply.

(*b*) A reduction below minimum in the flow of cooling water to the valve body or collector.

(*c*) A reduction below minimum in either the cooling air flow or pressure to the output window.

(*d*) A failure of the electro-magnet current.

(*e*) Excessive collector and body current.

(*f*) Voltage breakdown in the pressurised output waveguide system.

NOTES

1. The valve can be set before delivery to operate at any frequency within the range 2998±5MHz.

2. The heater power should be applied at least 5 minutes before the beam voltage is switched on. The heater must not be operated continuously for periods exceeding 1 hour without the beam voltage applied. The heater voltage quoted is the approximate value required to obtain the specified heater current.

3. The valve should be supported vertically from the mounting flange with the cathode end down. The base socket must allow for the complete immersion in oil of the cathode insulator and must incorporate corona flares designed to protect the insulator against electrical breakdown.

4. At this flow rate the pressure drop does not exceed 60lb/in^2 (4·2kg/cm^2).

5. The valve can be supplied without output window cooling nozzles for use in pressurised waveguide systems at r.f. duty cycles not exceeding 0·00015. Under these conditions, some reduction in collector cooling may also be tolerated.
   The customer is advised to consult the manufacturer before operation under reduced cooling conditions is attempted.

6. All voltages apart from the heater voltage are with respect to cathode.

7. When the valve is put into service after storage, it must be conditioned by increasing the beam voltage gradually until steady operation at the full rating is obtained. Valves held in store for long periods require conditioning at regular intervals; the procedure for this will be agreed from time to time with the user.

8. The hot resistance of the electro-magnet coils is approximately 2Ω. The electro-magnet current should be adjusted to give maximum r.f. output power. It should not be possible to apply h.t. in the absence of electro-magnet current.

X-RAY WARNING

The valve is supplied with lead shielding around the collector and output cavity, but this is not adequate to render it safe for personnel to work in the vicinity of the valve during normal operation.

The equipment designer is responsible for ensuring that sufficient additional shielding is provided to satisfy the safety requirements for any given installation.

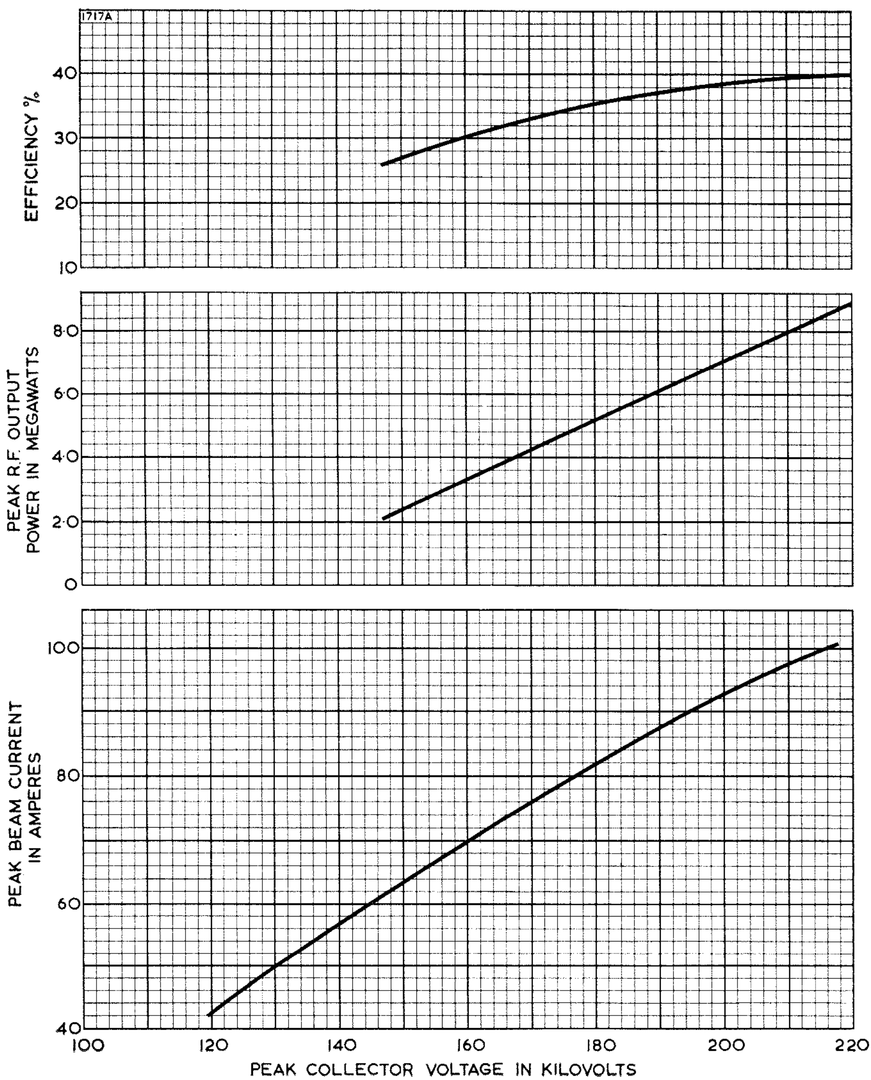
This radiation is entirely a function of high voltage devices and does not reflect on the design of the valve.

ENGLISH ELECTRIC VALVE CO. LTD.

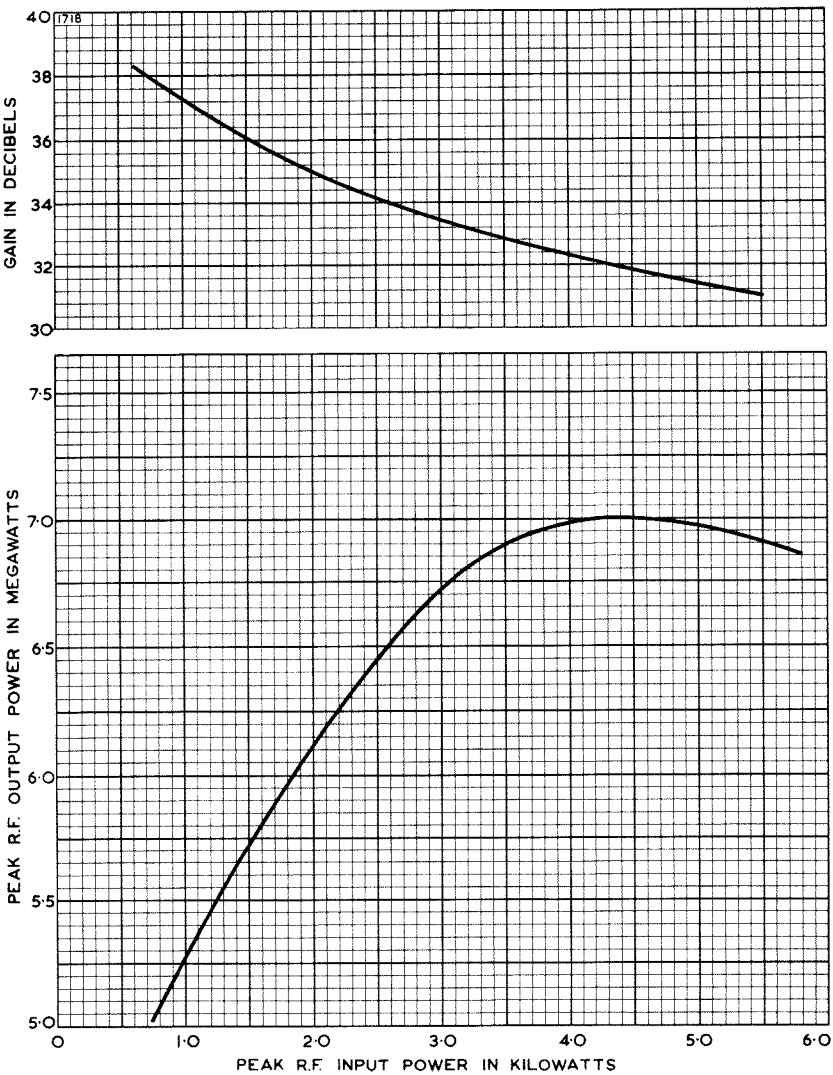
CHELMSFORD
ENGLAND

Printed in England

BEAM VOLTAGE CHARACTERISTICS

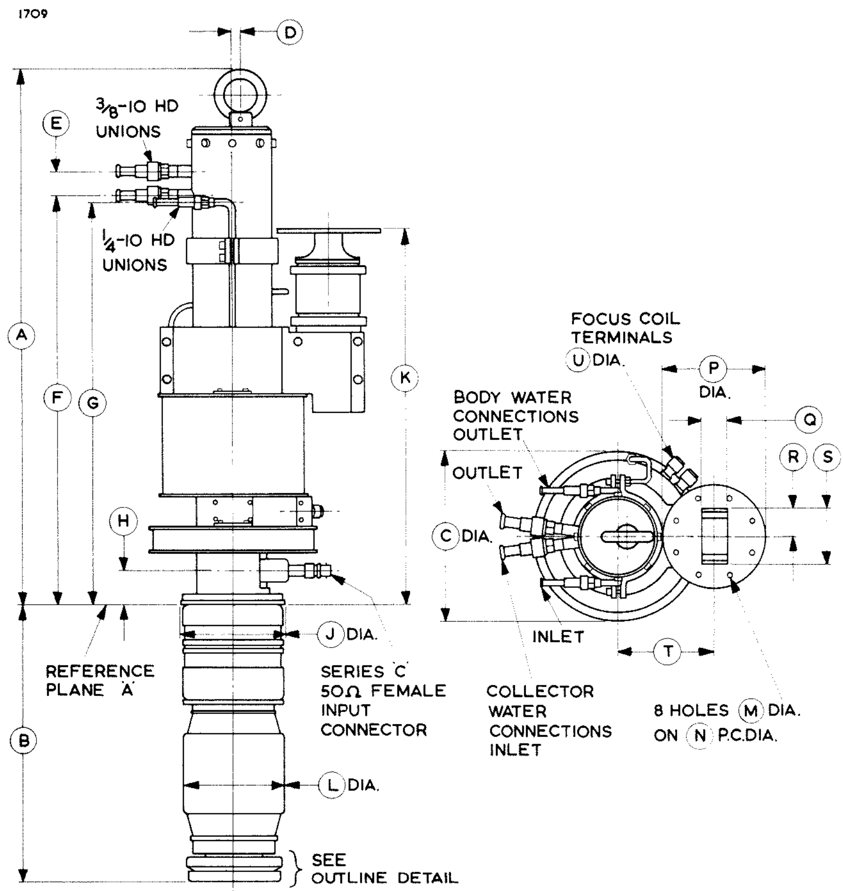


POWER AND GAIN CHARACTERISTICS



OUTLINE

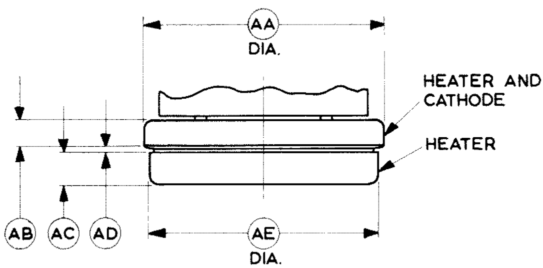
(See page 8 for Outline Detail and Outline Dimensions)



OUTLINE DETAIL

Detail of Heater and Cathode Connection Surfaces

1710



OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	27·875 Max	708·0 Max	N	4·750	120·7
B	14·677 ± 0·060	372·8 ± 1·52	P	5·312 ± 0·015	134·9 ± 0·38
C	8·812	223·8	Q	1·340	34·04
D	0·672	17·07	R	1·420	36·07
E	1·062	26·97	S	2·840	72·14
F	21·312	541·3	T	5·043 ± 0·015	128·1 ± 0·38
G	20·937	531·8	U	0·312	7·92
H	1·812	46·02	AA	5·062	128·6
J	5·745 ± 0·005	145·92 ± 0·13	AB	0·562	14·27
K	19·625 ± 0·060	498·5 ± 1·52	AC	0·719	18·26
L	5·118 Max	130·0 Max	AD	0·125	3·18
M	0·281	7·14	AE	4·812	122·2

Millimetre dimensions have been derived from inches.

POWER KLYSTRON

K329

Service Type CV2496

GENERAL

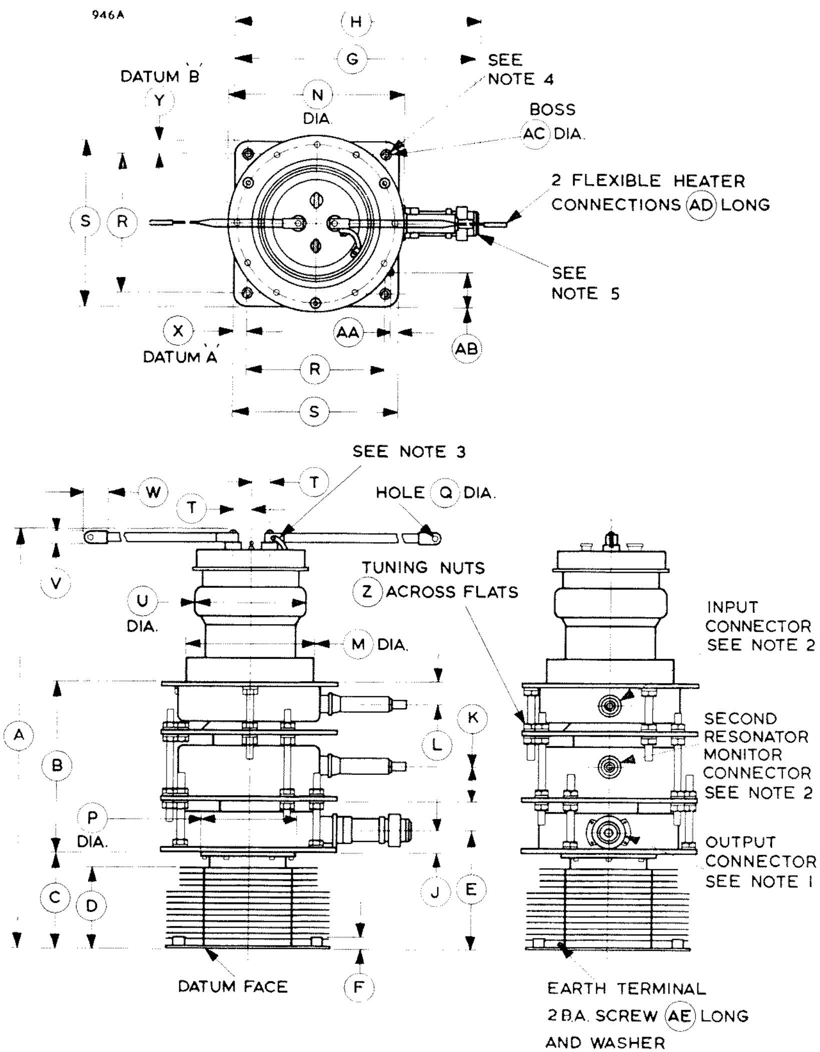
The K329 is a mechanically tuned, three cavity klystron amplifier of integral cavity construction, designed for pulsed operation. The valve was developed for use in TACAN ground beacons and is suitable as an intermediate amplifier in M.T.I. radar transmitters. It is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Typical Operation

Mechanical Tuning Range	962 to 1213	MHz
Output Power (Peak)	6·5	kW
Gain	29	db
Beam Voltage (Peak)	10	kV
Beam Current (Peak)	2·8	A
Pulse Length (pulses in pairs)	7·0	μs
Pulse Repetition Rate (pulse pairs)	3600	p.p.s.
Heater Voltage	5·0	V
Heater Current	40	A

Focus	Electrostatic. No focus mount required
Input Connector	BNC type bayonet to mate with jack type UG-88/U
Output Connector	Coaxial type UG-45/U to mate with jack type UG-1126/U
Net Weight	39 pounds (17·7 kg) Approx
Mounting Position	Any
Cooling	Forced-air

OUTLINE


946A
H
G
SEE NOTE 4
DATUM 'B'
Y
N DIA.
BOSS AC DIA.
2 FLEXIBLE HEATER CONNECTIONS AD LONG
S
R
SEE NOTE 5
AB
X
DATUM 'A'
AA
R
S
SEE NOTE 3
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W
T
HOLE Q DIA.
V
U DIA.
TUNING NUTS Z ACROSS FLATS
M DIA.
INPUT CONNECTOR SEE NOTE 2
A
B
K
L
SECOND RESONATOR MONITOR CONNECTOR SEE NOTE 2
P DIA.
OUTPUT CONNECTOR SEE NOTE 1
C
D
J
E
DATUM FACE
F
EARTH TERMINAL 2 B.A. SCREW AE LONG AND WASHER

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	18·500 Max	470 Max
B	6·950 ± 0·950	176·53 ± 24·13
C	3·900 Min	99·06 Min
D	3·500 Max	88·90 Max
E	5·000	127·00
F	0·450 Min	11·43 Min
G	10·000	254·00
H	10·200 Max	259·08 Max
J	0·950	24·13
K	1·400	35·56
L	0·950	24·13
M	5·375 ± 0·030	136·53 ± 0·76
N	7·300 Max	185·42 Max
P	4·250 Max	107·95 Max
Q	0·187	4·75
R	5·750	146·05
S	6·875 ± 0·030	174·63 ± 0·76
T	0·750	19·05
U	4·500 Max	114·30 Max
V	0·562	14·27
W	1·000	25·4
X	0·5625 ± 0·030	14·29 ± 0·76
Y	0·5625 ± 0·030	14·29 ± 0·76
Z	0·500	12·7
AA	0·350	8·89
AB	1·450	36·83
AC	0·563	14·30
AD	6·500	165·10
AE	0·250	6·35

Millimetre dimensions have been derived from inches

OUTLINE NOTES

1. The coaxial output connector type UG–45/U mates with jack type UG–1126/U.
2. The input and the second resonator monitor BNC type bayonet connectors will mate with jack type UG–88/U.
3. The cathode is connected externally to one heater terminal.
4. Four holes tapped $\frac{3}{8}$ A.N.C., 16 T.P.I. American thread. Positional tolerance 0·030 inch (0·76 mm) diameter, datum lines 'A' and 'B'.
5. Output nut tapped 1 – $\frac{1}{4}$ N.E.F., 18 T.P.I., class 2 fit American thread.

K347A

HIGH POWER KLYSTRON

ABRIDGED DATA

Three cavity, electro-magnetically focused amplifier klystron, with separate tuning cavities, for pulsed operation. The operation of the klystron is guaranteed only when used with approved tuning cavities and magnet assembly.

The K347A is similar to the K347 but has the focus electrode connected internally to the cathode.

Frequency range (see note 1)	580 to 615	MHz
Output power (peak)	600	kW
Beam voltage (peak)	75	kV
Efficiency	40	%
Power gain	33	db
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	7.0	V
Heater current range (see note 2)	32 to 39	A
Heater starting current (peak)	100	A
Magnetic focusing field	350	gauss

Mechanical

Overall length	63 inches (161cm) max
Overall diameter	8.01 inches (20.4cm) max
Net weight	65 pounds (29.6kg) approx
Mounting position	vertical

December 1968

Cooling

Air flow to collector and final drift tube	250	ft^3/min
	7.1	m^3/min
Inlet air temperature	55	°C max
Air pressure manometer reading	4.5	inches w.g.
Maximum temperature of any external parts of the klystron (see note 3)	180	°C

A supplementary air flow is required to cool the cathode end of the klystron.

The required airflows must be delivered before and during the application of h.t. voltage. H.T. power and air supplies may be removed simultaneously. See also Notes on the Protection of Large Klystrons in the preamble to this section.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

	Min	Max	
Heater voltage	6.5	7.3	V
Collector voltage (peak) (see note 4)	–	80	kV
Total current (collector + body) (peak) (see note 5)	–	23	A
Collector current (peak)	–	20	A
Collector dissipation	–	4.0	kW
Body voltage (peak) (see note 4)	–	80	kV
Body current (peak) with no r.f. drive (see note 6)	–	5.0	A
Pulse length	–	10	μs
V.S.W.R.	–	1.5:1	

TYPICAL OPERATION

Operating Conditions

Frequency	600	MHz
Load v.s.w.r.	1.1:1	max
Total current (collector + body) (peak)	20	A
Magnetic field	350	gauss
Pulse length	6.0	μs
Pulse repetition rate	400	p.p.s.

Typical Performance

Collector voltage (peak) (see note 4)	75	kV
Collector current (peak)	10	A
Body voltage (peak) (see note 4)	75	kV
Body current (peak)	10	A
Gain	33	db
Output power	600	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater voltage	7.0	V
Total current (collector + body) (peak)	20	A
Magnetic field	350	gauss
Duty cycle	0.0024	
Pulse length	4.0	μs
Pulse repetition rate	600	p.p.s.

Range of Characteristics

	Min	Max	
Heater current	32	39	A
Collector voltage (peak)	73	78	kV
Body voltage (peak)	73	78	kV
Body current (peak)	–	12	A
Mechanical tuning range (see note 1)	580	615	MHz
Gain for maximum efficiency	30	35	db
Interpulse noise (below output power)	180	–	db
Output power (peak)	500	–	kW

NOTES

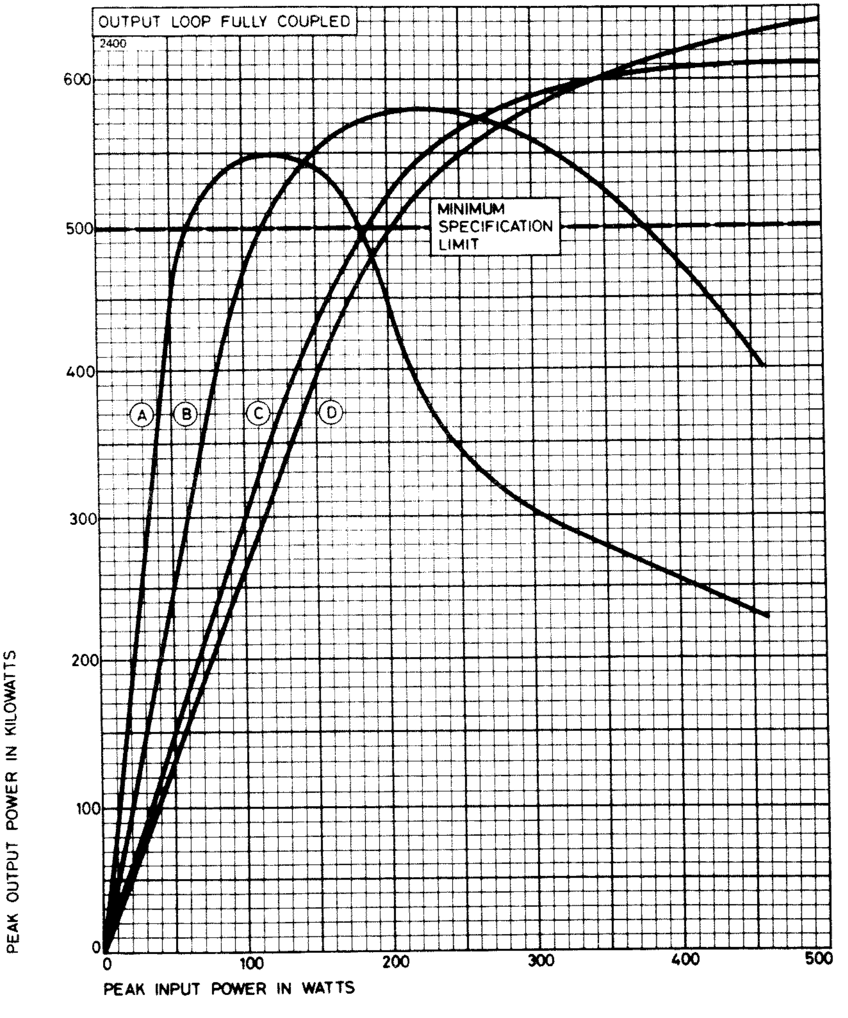
1. The tuning range depends on the external cavities.
2. An additional supply of 3V, 15A is required for the internal getter whilst the klystron is in use. It can be derived from the heater supply and is applied between the red painted heater terminal and the cathode.
3. The drift tube temperature may be measured by the copper-constantan thermocouple attached to the klystron. A temperature of 180°C corresponds to 5.5mV approx. with a cold junction temperature of 55°C.

4. When klystrons have been stored for long periods it is necessary to condition them by increasing the h.t. voltage gradually over a period which should not in general take longer than 2 hours to complete.
5. Provision should be made for monitoring both the body and collector currents; heavy duty shunts are advised. The body must be earthed.
6. With r.f. drive on, the body current may exceed 5A provided that the drift tube temperature is below 180°C.

X-RAY WARNING

X-rays are emitted by the K347A under normal operating conditions. These rays can constitute a health hazard unless the klystron is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the tube.

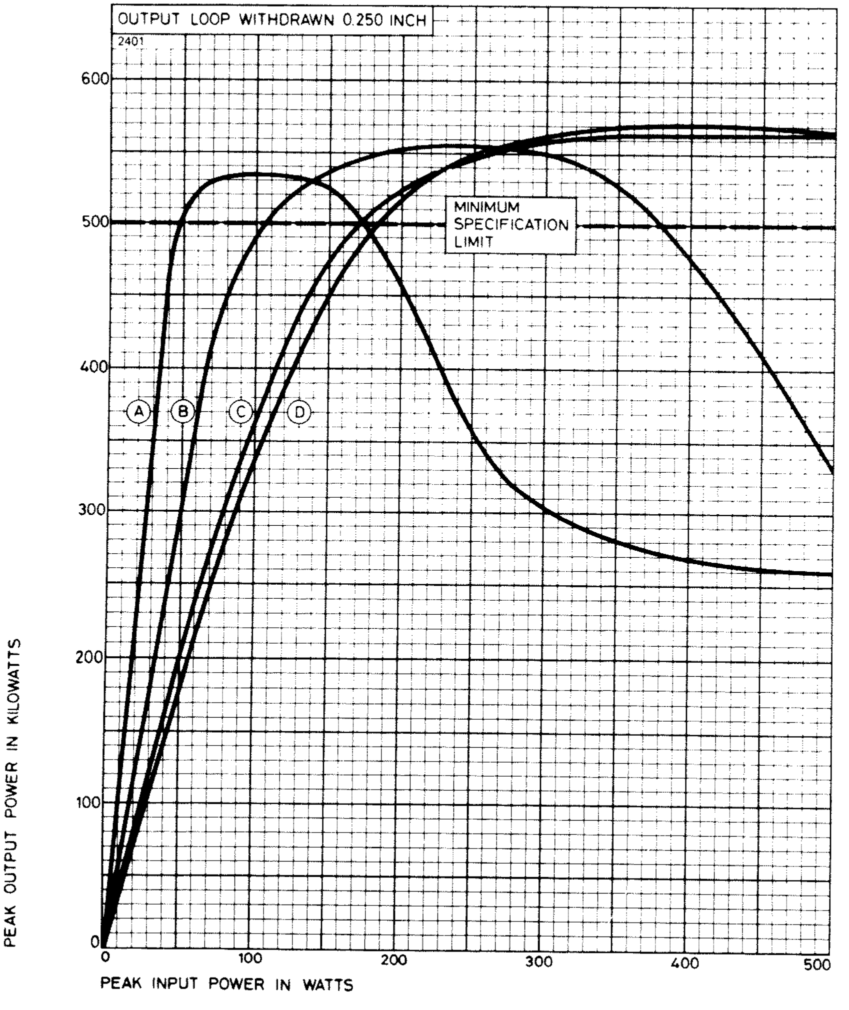
POWER CHARACTERISTICS



Measured with beam voltage 75kV, frequency 600MHz and magnetic field 350 gauss.
Cavities tuned for maximum output power at peak input powers of:

A	100W
B	200W
C	300W
D	400W

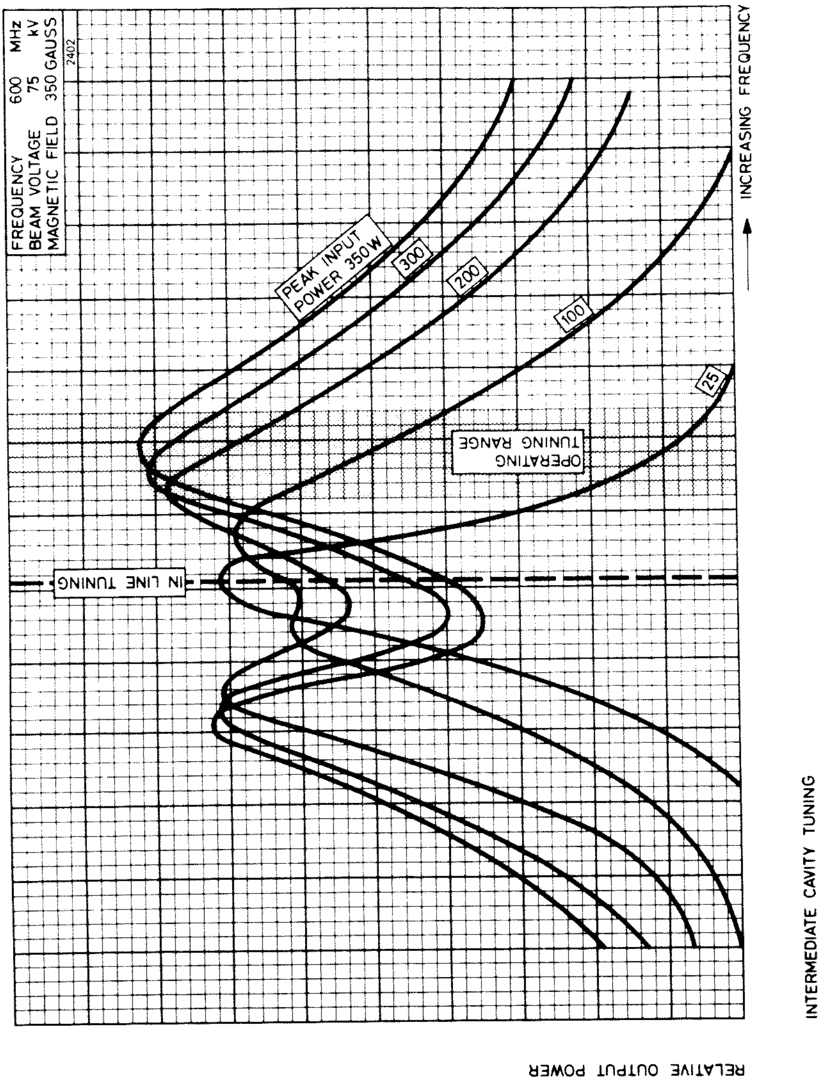
POWER CHARACTERISTICS



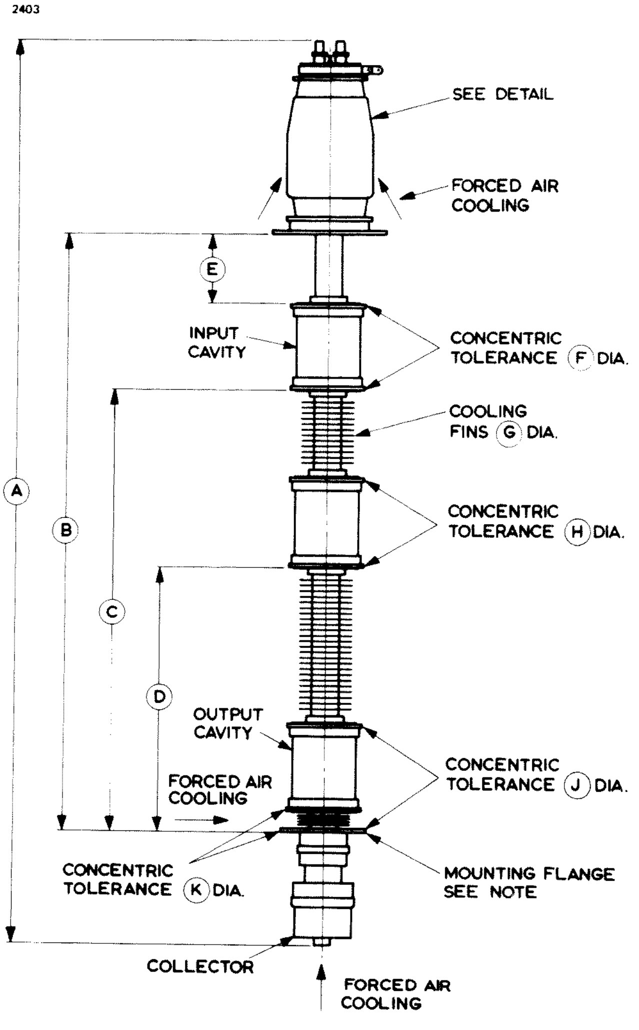
Measured with beam voltage 75kV, frequency 600MHz and magnetic field 350 gauss.
Cavities tuned for maximum output power at peak input powers of:

A 100W
B 200W
C 300W
D 400W

INTERMEDIATE CAVITY TUNING CHARACTERISTICS

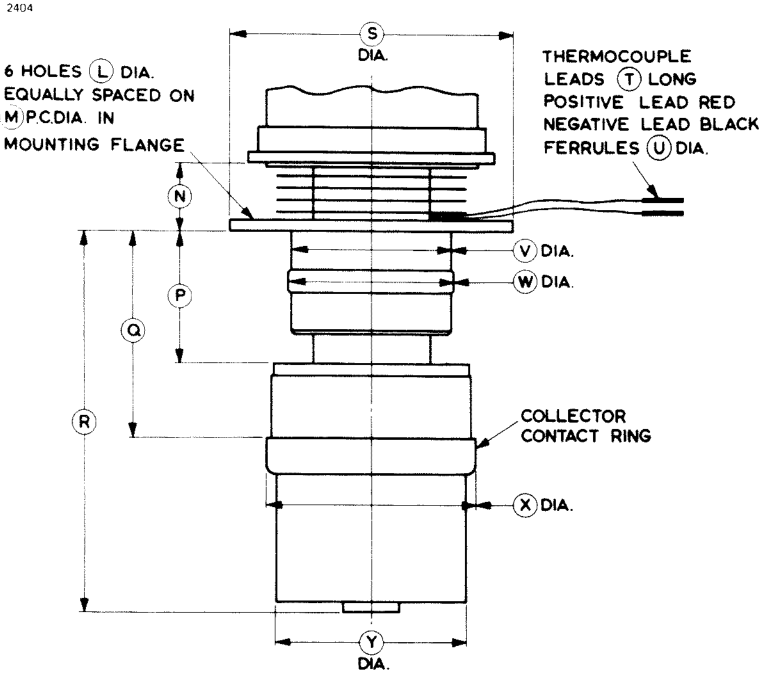


OUTLINE



Note Square tolerance of lower face at edge 0.010 inch (0.25mm) wide. Datum, centre line of lifting flange and mounting flange.

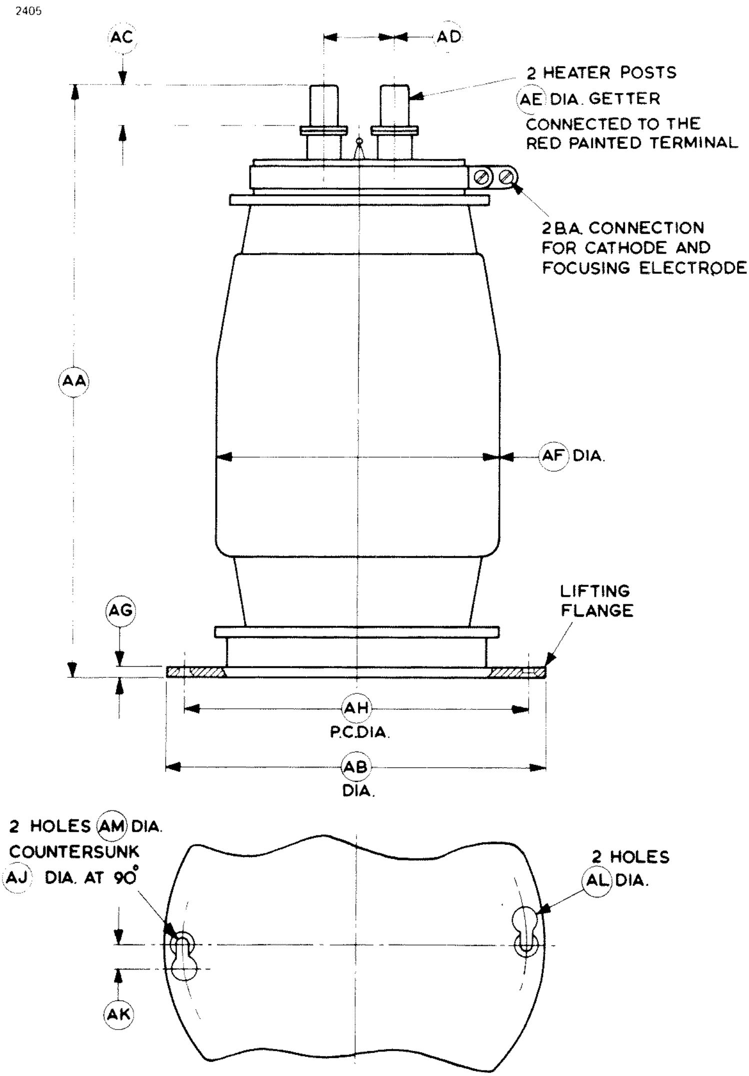
Detail of Collector



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	63.000 max	1600.2 max	N	1.438 ± 0.030	36.53 ± 0.76
B	41.250 ± 0.200	1047.8 ± 5.1	P	2.500 min	63.50 min
C	30.440 ± 0.100	773.2 ± 2.5	Q	4.560 ± 0.100	115.8 ± 2.5
D	18.440 ± 0.060	468.4 ± 1.5	R	8.375 max	212.7 max
E	4.812 ± 0.040	122.2 ± 1.0	S	5.994 ± 0.004	152.248 ± 0.102
F	0.031	0.79	T	14.000	355.6
G	3.980 max	101.1 max	U	0.156	3.96
H	0.031	0.79	V	3.500 max	88.90 max
J	0.020	0.51	W	3.700 max	93.98 max
K	0.008	0.20	X	4.437 ± 0.005	112.70 ± 0.13
L	0.264	6.71	Y	4.100 max	104.1 max
M	5.562 ± 0.010	141.27 ± 0.25			

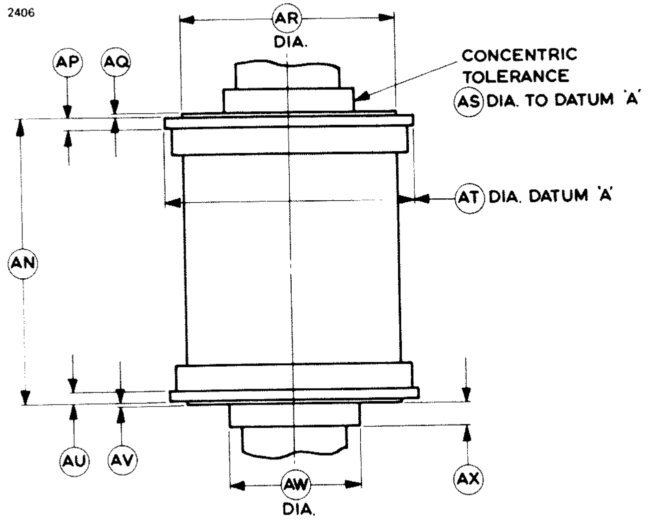
Millimetre dimensions have been derived from inches.

Details of Cathode Terminals and Lifting Flange



See page 11 for dimensions.

Details of Typical Cavity Assembly



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	12.500	317.5	AM	0.250	6.35
AB	8.000 $\pm$ 0.005	203.20 $\pm$ 0.13	AN	6.000 $\pm$ 0.030	152.40 $\pm$ 0.76
AC	0.885 min	22.48 min	AP	0.250	6.35
AD	1.500	38.10	AQ	0.050 max	1.27 max
AE	0.625	15.88	AR	4.600 max	116.8 max
AF	6.250 max	158.8 max	AS	0.010	0.25
AG	0.250	6.35	AT	5.250 $\pm$ 0.005	133.35 $\pm$ 0.13
AH	7.250	184.2	AU	0.250	6.35
AJ	0.500	12.70	AV	0.050 max	1.27 max
AK	0.500	12.70	AW	2.750 $\pm$ 0.005	69.85 $\pm$ 0.13
AL	0.516	13.11	AX	0.500	12.70

Millimetre dimensions have been derived from inches.

K365

HIGH POWER KLYSTRON

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystron, with separate tuning cavities, for u.h.f. television service. The collector is water cooled in an integral water jacket. A modulating anode is fitted which may be used for beam current control or as a protective device.

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range	400 to 610	MHz
Output power (peak sync.)	11	kW
Power gain (typical, 6.0MHz bandwidth)	30	db
Beam voltage	17	kV
Circuit assembly		K4019A
Output		$3^1/_8$ inch 50Ω coaxial line
Cooling (see page 2)		water and forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	7.5	V
Heater current range	38 to 42	A
Heater starting current (peak)	80	A max

Mechanical

Overall length	62.5 inches (159cm) nom
Overall diameter	5.125 inches (13cm) nom
Mounting position	vertical, cathode end up
Net weight of klystron	64 pounds (29kg) approx

December 1968

Circuit Assembly

Prefocus coil voltage	0 to 50	V
Prefocus coil current:		
maximum	1.5	A
typical	1.0	A
Body and collector coils voltage:		
range	0 to 600	V
typical	500	V
Body and collector coils current (typical)	2.6	A
R.F. input connector		UG-58/U
R.F. output	$3^1/_8$ inch 50Ω coaxial line	
Load couplers	$1^5/_8$ inch coaxial terminals	
Net weight with K365 klystron	831 pounds (378kg) approx	
Cavity tuning controls:		
total turns	55	
torque	1.67 lb-ft (0.231kg-m) max	
Output coupler control:		
total turns	25	
torque	0.83 lb-ft (0.115kg-m) max	

Cooling

At sea level and with an inlet air temperature of 20°C the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the klystron but this practice is not recommended.

Air flow to cathode	25	ft^3/min
	0.71	m^3/min
Air flow to output cavity	50	ft^3/min
	1.42	m^3/min
Water flow to klystron body	1.0	imp.gal/min
	4.5	l./min
Water flow to collector	25	imp.gal/min
	114	l./min
Outlet water temperature	70	°C max
The temperature of any external part of the klystron must not exceed	175	°C

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded

Beam voltage	20	kV max
Beam current (mean)	2.5	A max
Body current (mean):		
for continuous operation	0.15	A max
for tuning	0.25	A max
Focus electrode voltage (negative)	500	V max
Collector dissipation	50	kW max

TYPICAL OPERATION (Vision amplifier)

Frequency	500	MHz
Beam voltage	17	kV
Beam current	1.8	A
Bandwidth	6.0	MHz
Focus electrode voltage	−200	V
Body current (mean)	70	mA
Drive power (see note 1)	10	W
Second cavity power (see note 2)	25	W
Third cavity power (see note 2)	100	W
Output power (peak sync.)	11	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions (narrow-band operation)

Heater voltage	7.5	V
Beam voltage	17	kV
Frequency range	400 to 610	MHz
Modulating anode voltage (see note 3)	0	V
Drive power	25	mW

Range of Characteristics

	Min	Max	
Heater current	38	42	A
Focus electrode voltage (negative)	100	300	V
Body current	–	150	mA
Output power	10	–	kW

NOTES

1. The drive power specified should be available if required.
2. For broad-band operation the cavities are loaded externally; the power specified is that dissipated in the external load.
3. During the test the modulating anode is connected to the body of the klystron by a 10kΩ resistor.

X-RAYS

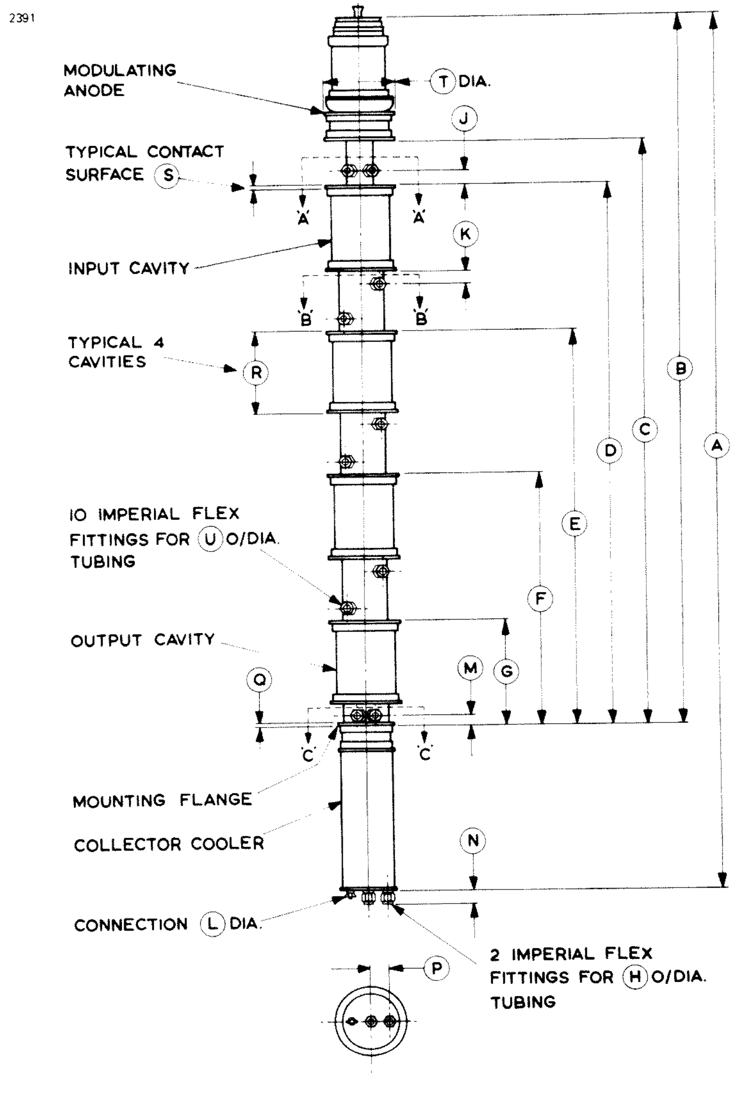
With the klystron operating under normal conditions, the stray X-ray radiation is below the minimum level which is hazardous to the health of operators.

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	61.410 ± 0.255	1559.8 ± 6.5
B	49.900	1267.5
C	41.160	1045.5
D	38.100	967.7
E	27.900	708.7
F	17.700	449.6
G	7.500	190.5
H	0.750	19.05
J	1.000	25.40
K	0.875	22.23
L	0.250	6.35
M	0.675	17.15
N	1.125	28.58
P	1.625	41.28
Q	0.250	6.35
R	6.010	152.65
S	0.250	6.35
T	5.125	130.18
U	0.312	7.92

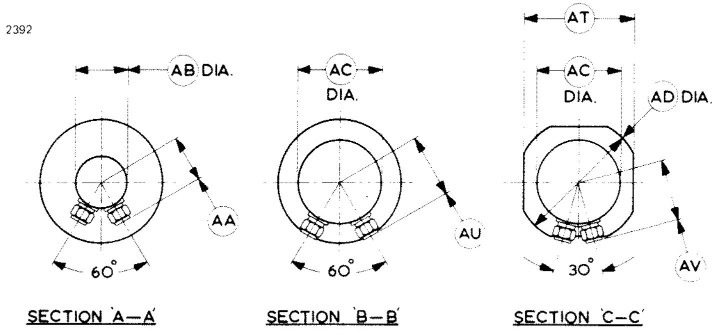
Millimetre dimensions have been derived from inches.

OUTLINE

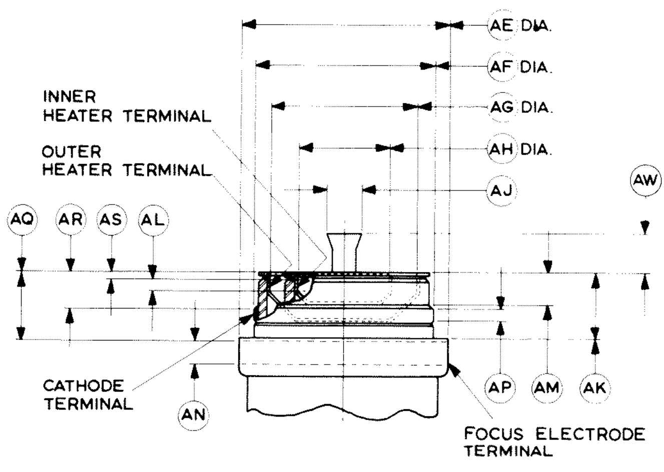

2391
MODULATING ANODE
T DIA.
J
TYPICAL CONTACT SURFACE S
A A
K
INPUT CAVITY
B B
TYPICAL 4 CAVITIES
R
B
C
D
A
10 IMPERIAL FLEX FITTINGS FOR U O/DIA. TUBING
E
F
OUTPUT CAVITY
M
G
Q
C C
MOUNTING FLANGE
COLLECTOR COOLER
N
CONNECTION L DIA.
2 IMPERIAL FLEX FITTINGS FOR H O/DIA. TUBING
P

OUTLINE DETAILS

Detail of Body Sections



Detail of Cathode Terminals



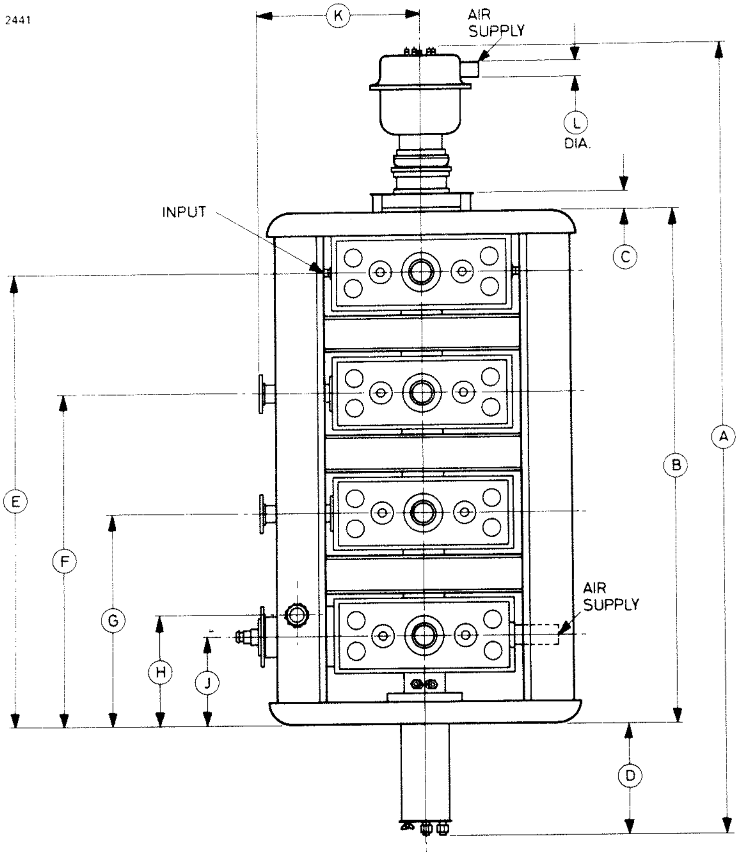
Outline Detail Dimensions

Ref	Inches	Millimetres
AA	1.875	47.63
AB	2.120	53.85
AC	3.500	88.90
AD	5.125	130.18
AE	4.375	111.13
AF	3.750	95.25
AG	3.188	80.98
AH	1.938	49.23
AJ	1.125	28.58
AK	1.312	33.32
AL	0.250	6.35
AM	0.656	16.66
AN	0.500 min	12.70 min
AP	0.125 min	3.18 min
AQ	1.344	34.14
AR	0.750	19.05
AS	0.156 min	3.96 min
AT	4.625	117.48
AU	2.562	65.07
AV	2.563	65.10
AW	0.750 max	19.05 max

Millimetre dimensions have been derived from inches.

OUTLINE OF K4019A

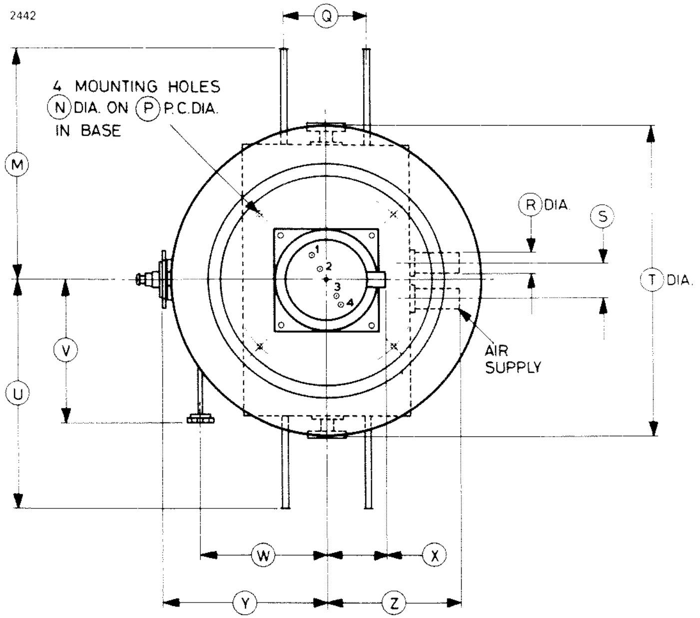
2441



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	66.500	1689	G	17.719	450.1
B	43.062	1094	H	9.312	236.5
C	1.625	41.27	J	7.500	190.5
D	9.625	244.5	K	13.688	347.7
E	38.125	968.4	L	1.500	38.10
F	27.906	708.8			

Millimetre dimensions have been derived from inches.

Top View of K4019A



Ref	Inches	Millimetres	Ref	Inches	Millimetres
M	19.250 max	489.0 max	U	19.250 max	489.0 max
N	0.438	11.12	V	12.000	304.8
P	16.250	412.8	W	10.625	269.9
Q	6.940	176.3	X	5.062	128.6
R	1.875	47.62	Y	13.656	346.9
S	3.000	76.20	Z	11.312	287.3
T	26.250	666.8			

Millimetre dimensions have been derived from inches.

Connections

1. Focus electrode, threaded 6–32 U.N.C.
2. Heater, threaded ¼–20 U.N.C.
3. Heater, threaded ¼–20 U.N.C.
4. Cathode, threaded 6–32 U.N.C.

K376 K377

HIGH POWER KLYSTRONS

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is water cooled in an integral water jacket. A modulating anode is fitted which may be used for beam current control or as a protective device.

Klystron	Frequency Range	Circuit Assembly
K376	470 to 610MHz	K4054
K377	590 to 720MHz	K4055

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	28	kW
Power gain (typical):		
K376	42	db
K377	44	db
Beam voltage	18	kV
Output	$3^1/_8$ inch 50Ω coaxial line	
Cooling (see page 2)	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	26	V
Heater current	11 to 13	A
Heater starting current (peak)	23	A max
Cathode heating time	15	minutes

Mechanical

Overall length (see note 1)	62 inches (158cm) nom
Overall diameter	10.00 inches (254mm) nom
Mounting position	vertical, cathode end up
Net weight of klystron	120 pounds (55kg) approx

Circuit Assembly

Electro-magnet current (see note 2)	9 ± 1	A
Electro-magnet resistance:		
cold (20°C)	9.5 ± 1	Ω
hot (20°C ambient)	12	Ω max
R.F. input connector		type N coaxial
R.F. output		$3^1/_8$ inch 50Ω coaxial line
Net weight of tuning cavities:		
for K376		120 pounds (54kg) approx
for K377		90 pounds (41kg) approx
Total lifting weight of klystron and cavities:		
K376		270 pounds (122kg) approx
K377		240 pounds (109kg) approx
Net weight of magnet assembly		1800 pounds (816kg) approx

COOLING

At sea level and with an inlet air temperature of 20°C the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the klystron but this practice is not recommended.

Air flow to cathode	5.0	ft^3/min
	0.14	m^3/min
Air flow to output and penultimate cavities		50ft^3/min (1.42m^3/min) each
Static pressure head (see note 4)		1 inch w.g.
Inlet air temperature	40	°C max
Water flow to body and electro-magnet in series (see note 3)	2.0	imp.gal/min
	9.0	l./min
Water flow to collector (see note 3)	25	imp.gal/min
	114	l./min
Collector pressure drop	7.5	lb/in^2 max
	0.53	kg/cm^2 max
Outlet water temperature	70	°C max
Inlet water pressure	100	lb/in^2 max
	7.0	kg/cm^2 max
The temperature of any external part of the klystron must not exceed	175	°C

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage:		
continuous	20	kV max
switch-on surge	24	kV max
Beam current (mean)	6.0	A max
Body current	150	mA max
Output power	30	kW max
Collector dissipation	100	kW max
Load v.s.w.r. (see note 5)	1.5:1	max

TYPICAL OPERATION (Vision amplifier)

Operating Conditions

Beam voltage	18.0	kV
Beam current	4.6	A
Electro-magnet current	9.0	A
Bandwidth (to 1db points)	8.0	MHz

K376 IN K4054 CIRCUIT

Frequency	500	MHz
Drive power for 28kW output	2.0	W

K377 IN K4055 CIRCUIT

Frequency	625	MHz
Drive power for 28kW output	1.0	W

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 6 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the modulating anode current may vary between 0 and 1.5mA. The potential divider network must be designed accordingly.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K376 IN K4054 CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	26	V
Electro-magnet current	8 to 10	A
Frequency range	470 to 610	MHz
Bandwidth (see note 6)	8.0	MHz
Output power (see note 7)	25	kW

Range of Characteristics

	Min	Max	
Heater current	11	13	A
Beam voltage	–	18	kV
Body current (see note 8)	–	150	mA
R.F. drive power (see note 9)	–	3.0	W

K377 IN K4055 CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	26	V
Electro-magnet current	8 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 6)	8.0	MHz
Output power (see note 7)	25	kW

Range of Characteristics

	Min	Max	
Heater current	11	13	A
Beam voltage	–	18	kV
Body current (see note 8)	–	150	mA
R.F. drive power (see note 9)	–	3.0	W

WARNING

English Electric Valve Company Ltd. should be consulted regarding the design of protection circuits. Inadequate protection may result in the destruction of the klystron.

X-RAYS

With the klystrons operating normally, the stray X-ray radiation is below the minimum level which is hazardous to the health of operators.

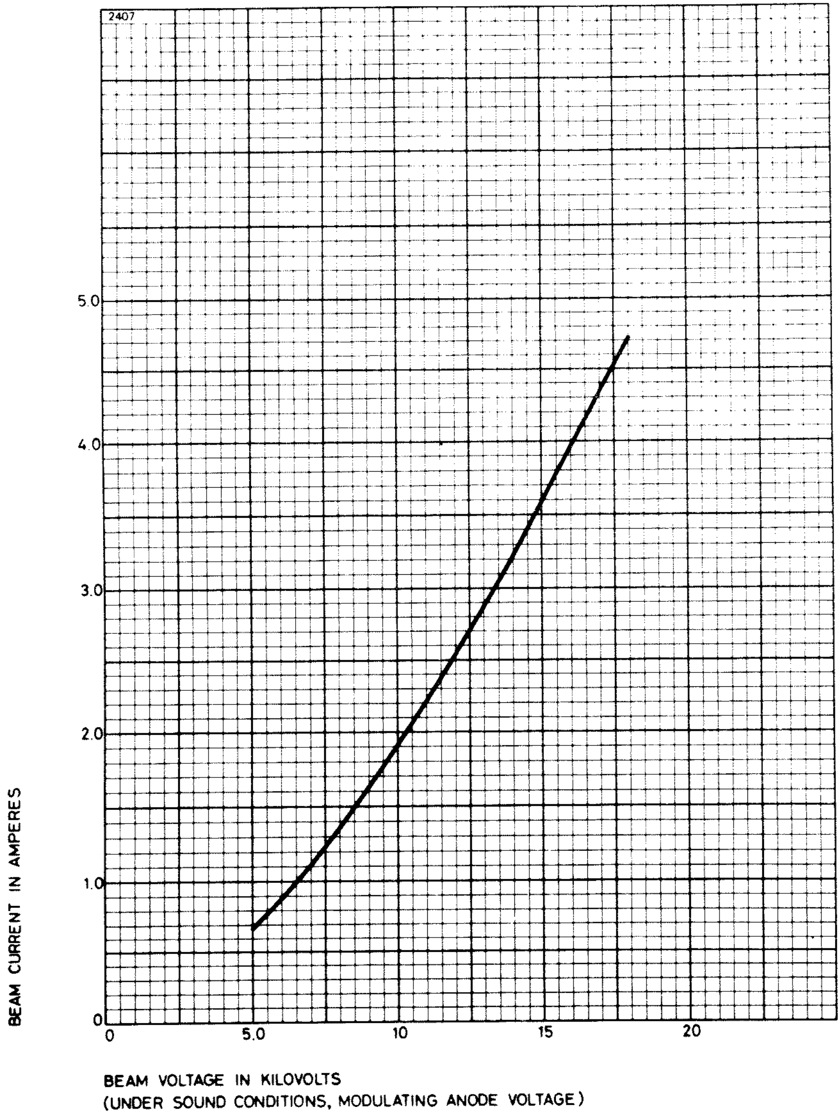
GAS CHECK

The internal gas pressure of the klystrons can be monitored during storage.

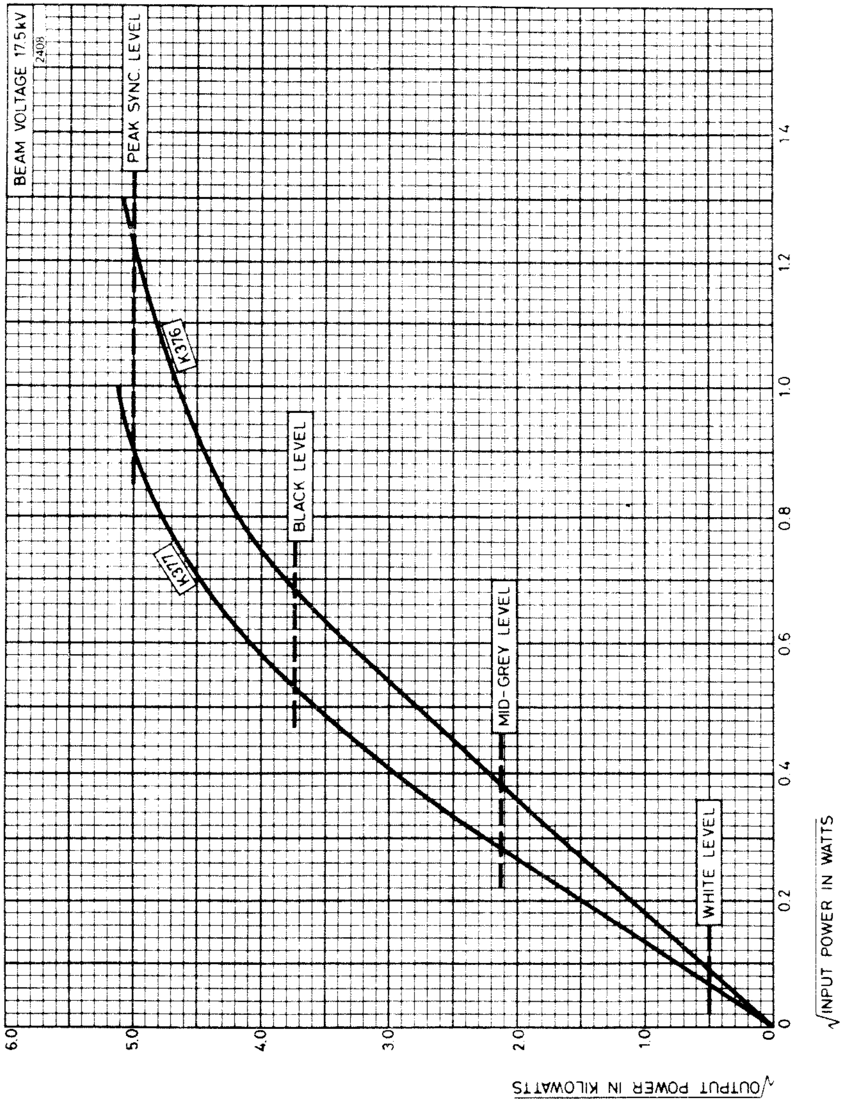
NOTES

1. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 126 inches (3.2m) is required. This is measured to the top of the lifting harness and does not include the hoist.
2. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily over the current range stated.
3. These values apply when the coolant used is distilled water with the dissolved oxygen removed. English Electric Valve Company Ltd. should be consulted if it is intended to use alternative coolants.
4. Measured at the input pipes to the circuit assembly.
5. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
6. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.
7. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
8. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
9. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.

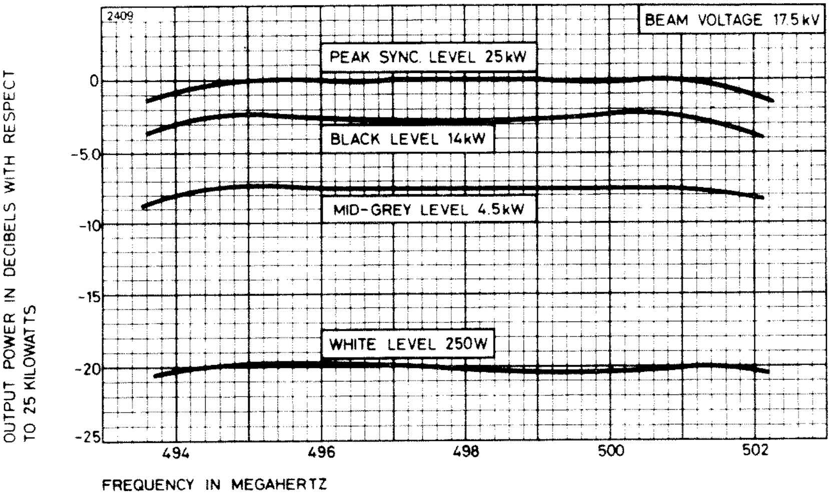
TYPICAL BEAM CHARACTERISTIC



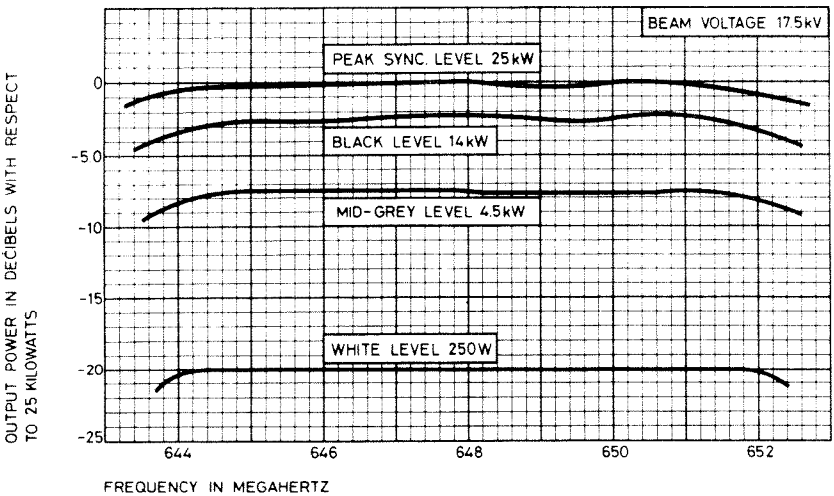
TYPICAL GAIN CHARACTERISTICS



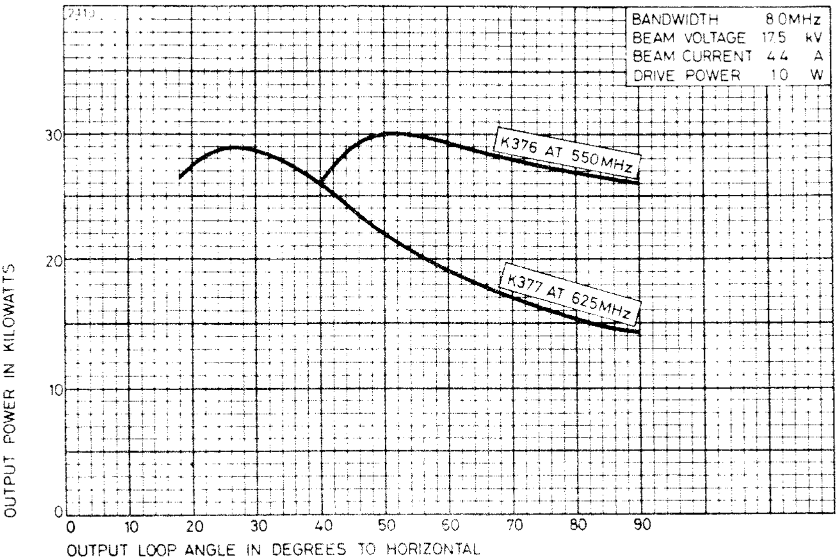
TYPICAL BANDWIDTH CHARACTERISTICS FOR K376



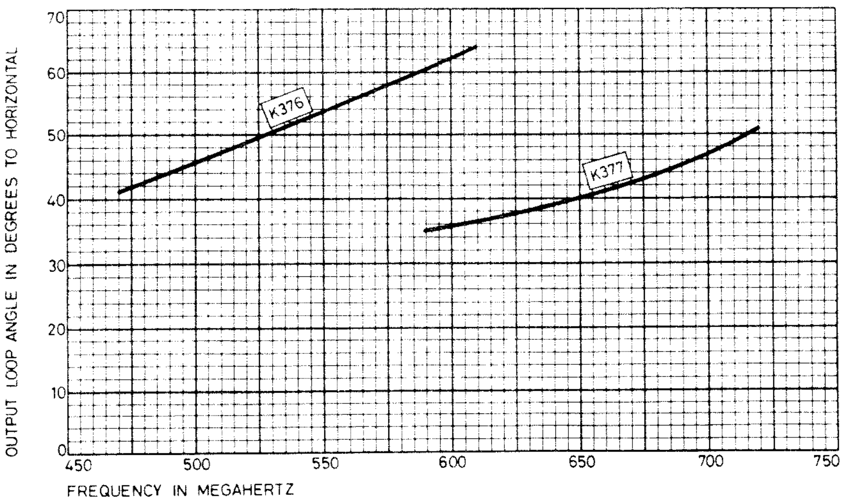
TYPICAL BANDWIDTH CHARACTERISTICS FOR K377



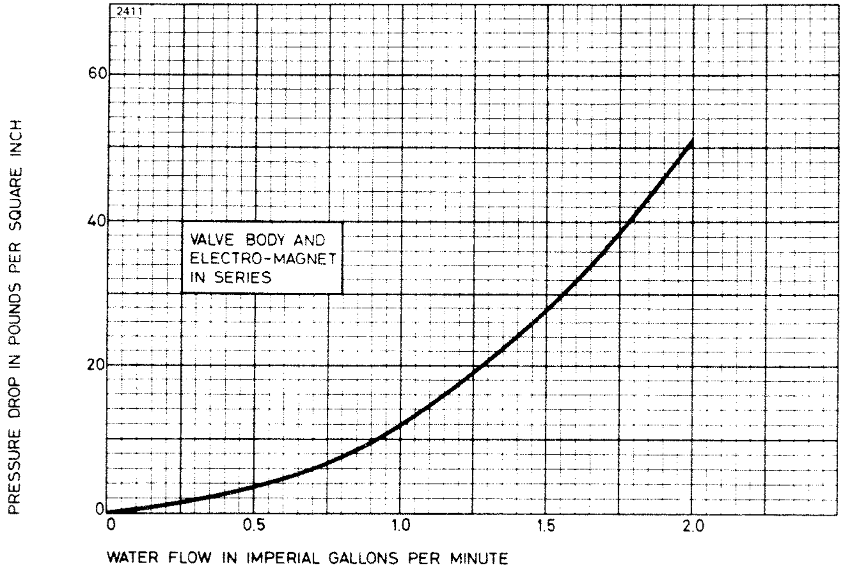
OUTPUT POWER – LOOP ANGLE CHARACTERISTICS

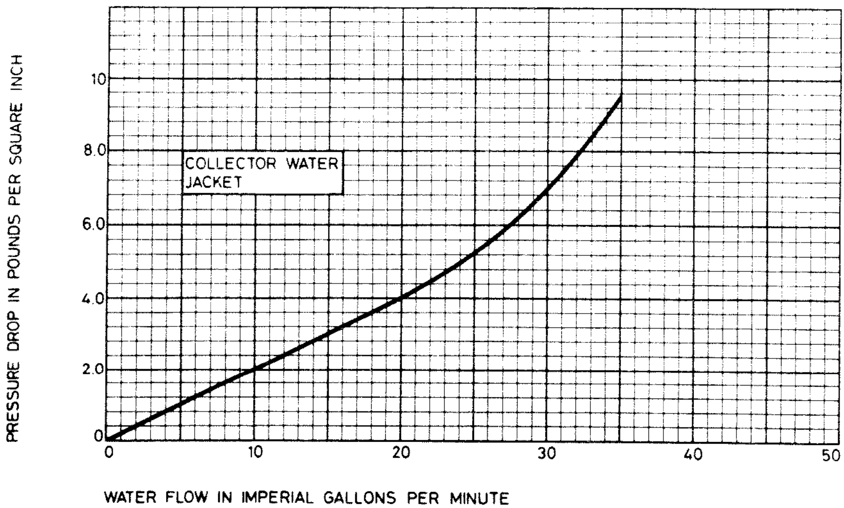


LOOP ANGLE – FREQUENCY CHARACTERISTICS
(Recommended loop angle for initial setting-up)

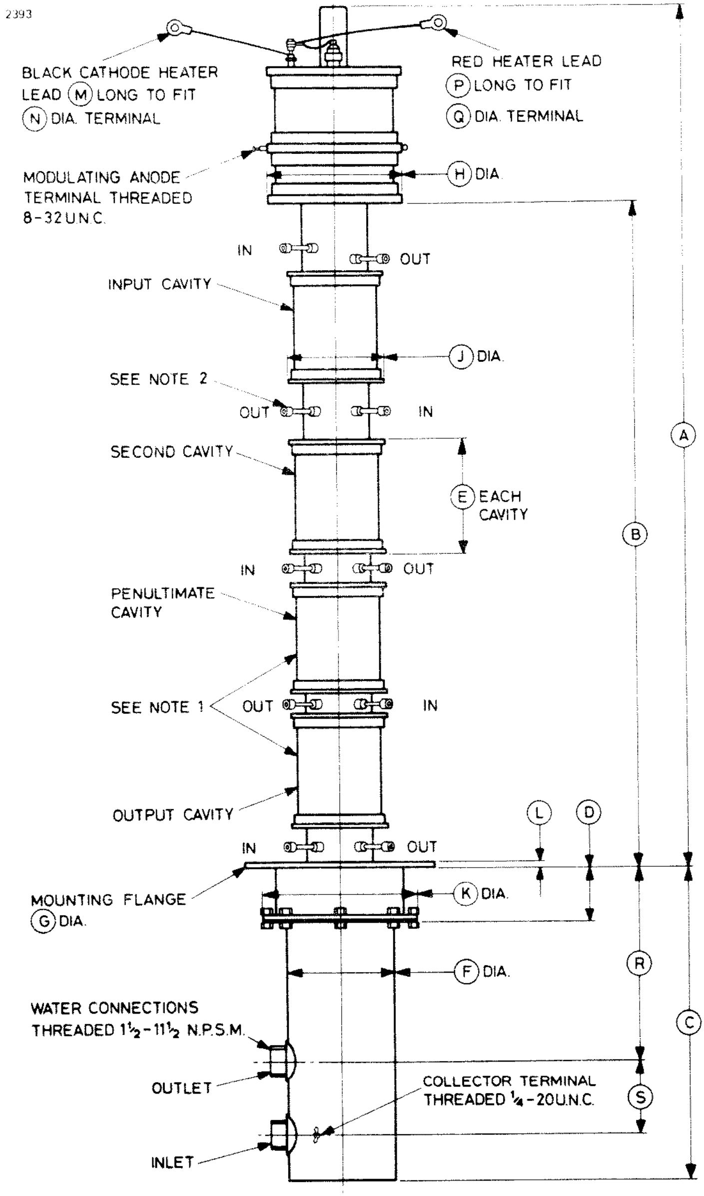


WATER FLOW CHARACTERISTICS

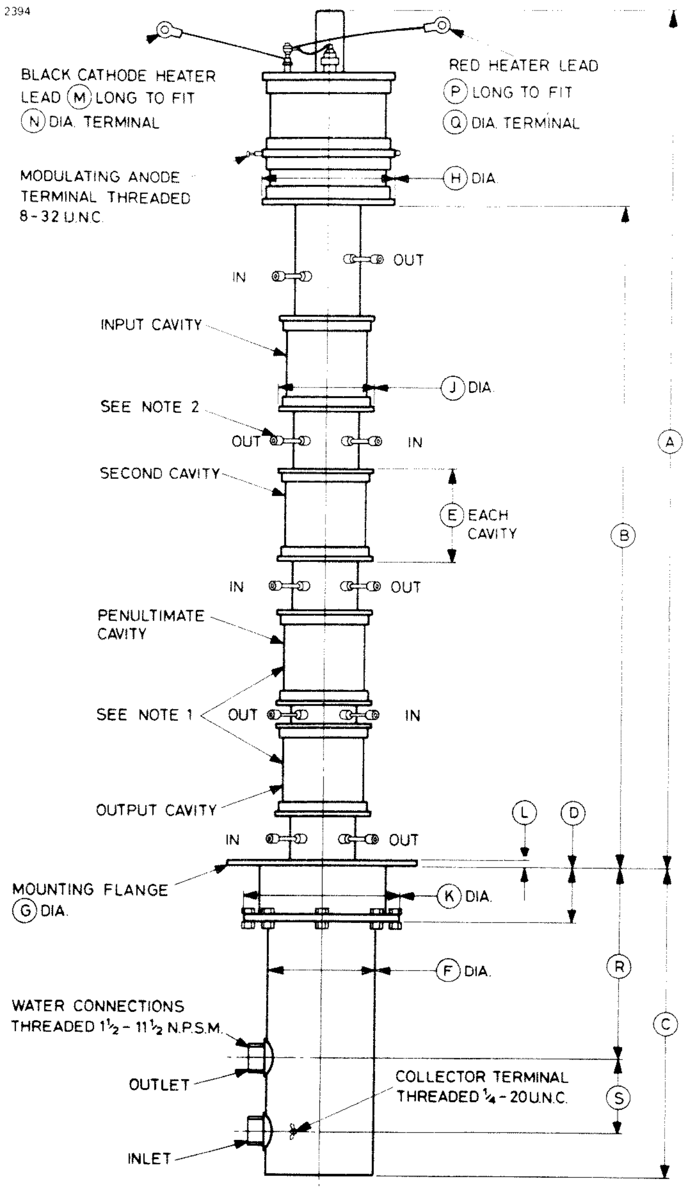




OUTLINE FOR K376



OUTLINE FOR K377



Outline Dimensions for K376

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	45.19	1148	K	8.125	206.4
B	34.47	875.5	L	0.375	9.53
C	16.48	418.6	M	15.000	381.0
D	2.912	73.96	N	0.312	7.92
E	6.000	152.4	P	15.000	381.0
F	5.500	139.7	Q	0.250	6.35
G	10.000	254.0	R	10.35	262.9
H	7.125	181.0	S	4.000	101.6
J	5.125	130.2			

Millimetre dimensions have been derived from inches.

Outline Dimensions for K377

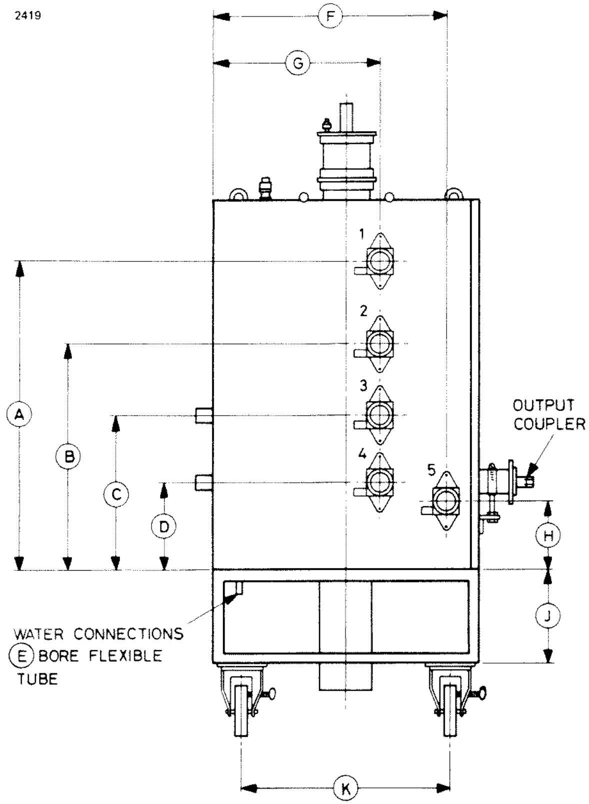
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	45.19	1148	K	8.125	206.4
B	34.47	875.5	L	0.375	9.53
C	16.48	418.6	M	15.000	381.0
D	2.912	73.96	N	0.312	7.92
E	5.000	127.0	P	15.000	381.0
F	5.500	139.7	Q	0.250	6.35
G	10.000	254.0	R	10.35	262.9
H	7.125	181.0	S	4.000	101.6
J	5.125	130.2			

Millimetre dimensions have been derived from inches.

Outline Notes

1. The penultimate and output cavity ceramics are beryllium oxide.
2. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.

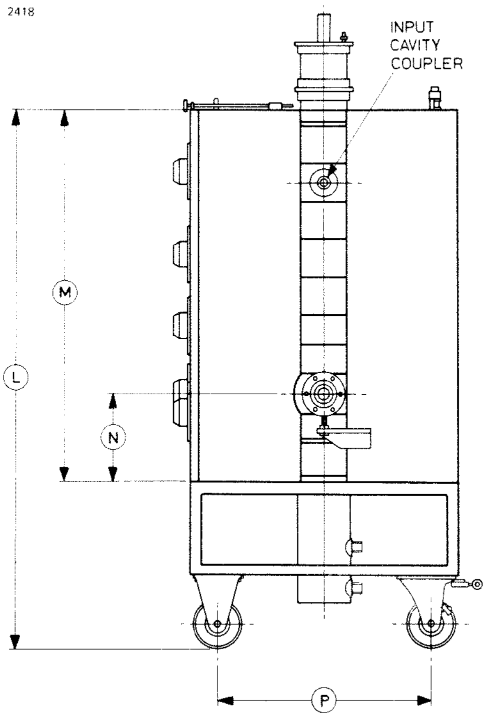
OUTLINE OF K4054 AND K4055



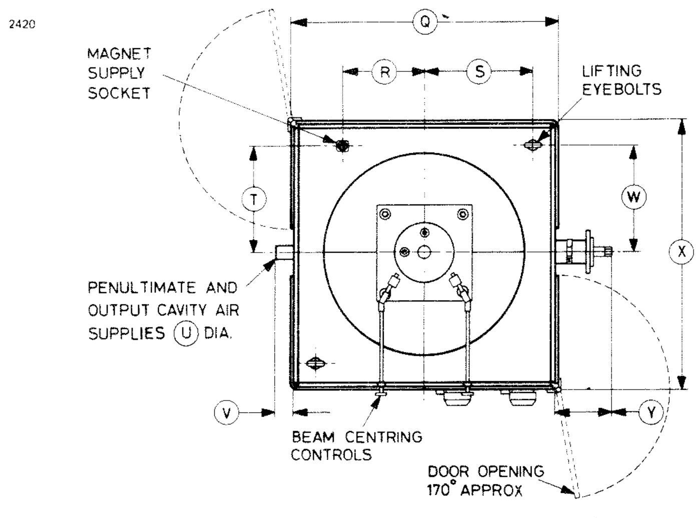
Controls

1 Input cavity tuning
2 Second cavity tuning
3 Penultimate cavity tuning
4 Output cavity tuning
5 Output coupling

OUTLINE OF K4054 AND K4055



OUTLINE OF K4054 AND K4055



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	32.312	820.7	N	9.125	231.8
B	23.500	596.9	P	22.25	565.2
C	16.000	406.4	Q	28.000 ± 0.125	711.2 ± 3.2
D	9.125	231.8	R	8.500 ± 0.125	215.9 ± 3.2
E	0.500	12.70	S	11.250	285.8
F	24.531	623.1	T	11.500 ± 0.125	292.1 ± 3.2
G	17.500	444.5	U	1.750	44.45
H	7.250	184.2	V	2.000	50.80
J	9.875	250.8	W	11.250	285.8
K	21.875	555.6	X	28.000 ± 0.125	711.2 ± 3.2
L	56.375	1432	Y	5.625	142.9
M	38.875	987.5			

Millimetre dimensions have been derived from inches.

K383 K384 K385

HIGH POWER KLYSTRONS

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons, with separate tuning cavities, for u.h.f. television service. A modulating anode is fitted which may be used for beam current control or as a protective device.

Klystron	Frequency Range	Circuit Assembly
K383	470 to 610MHz	K4099B
K384	590 to 720MHz	K4100B
K385	700 to 860MHz	K4101B

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	5.5	kW
Power gain (typical)	38	db
Beam voltage	9.5	kV
Output	$1^5/_8$ inch 50Ω coaxial line	
Cooling (see page 2)	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	5.5	V
Heater current range	40 to 44	A
Heater starting current (peak)	84	A max
Cathode heating time (minimum)	5	min

Mechanical

Overall length:	
K383	44.742 inches (113.6cm) max
K384, K385	40.717 inches (103.4cm) max
Overall diameter	8.015 inches (20.4cm) max
Mounting position	vertical, cathode end up
Net weight of klystron:	
K383	60 pounds (27kg) approx
K384, K385	55 pounds (25kg) approx

Circuit Assembly

Electromagnet current:		
K383	10.5 ± 1.0	A
K384, K385	9.0 ± 1.0	A
Electromagnet resistance:		
cold (20°C)	5.7	Ω
hot (20°C ambient)	7.3	Ω max
R.F. input connector		type N coaxial
R.F. output		$1^5/_8$ inch 50Ω coaxial line
Net weight of tuning cavities:		
for K383		102 pounds (46kg) approx
for K384		83 pounds (38kg) approx
for K385		64 pounds (29kg) approx
Net weight of magnet assembly		784 pounds (356kg) approx

Cooling

The collector and output cavity require forced-air cooling. Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

Air flow to collector	560	ft^3/min
	15.9	m^3/min
Pressure drop	8	inches w.g.
Air flow to output cavity (see note 1)	60	ft^3/min
	1.7	m^3/min
Static pressure head (see note 2)	1.5	inches w.g. min
Inlet air temperature	40	°C max
Temperature of any external parts of the klystron must not exceed	175	°C max

The collector is fitted with a thermostat having contacts normally closed. This should be used to remove beam power from the klystron in the event of overheating. A thermocouple is supplied so that the collector temperature may be monitored during initial setting up. See page 9 for calibration curve.

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage	12	kV max
Beam current (mean)	2.5	A max
Body current:		
with no input power	50	mA max
at saturated output power	150	mA max
Collector dissipation	25	kW max
Load v.s.w.r. (see note 3)	1.5:1	max

TYPICAL OPERATION

The operating conditions and performance figures given are for operation in a television transmitter giving a peak synchronous output power of 5.0kW. The klystrons are also suitable for transposer service.

Operating Conditions

Beam voltage	9.5	kV
Beam current	1.9	A
Electromagnet current:		
K383 in K4099B circuit	10.5	A
K384 in K4100B circuit	9.0	A
K385 in K4101B circuit	9.0	A
Bandwidth (to 1db points)	8.0	MHz

K383 in K4099B Circuit

Frequency	470 to 478 (channel 21)	526 to 534 (channel 28)	598 to 606 (channel 37)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (5.0kW)	25	25	30	mA
at 6.0kW c.w. output, vision frequency	45	40	45	mA
Drive power:				
at 5.0kW output	0.75	0.3	0.15	W
at 6.0kW output	0.9	0.4	0.4	W
Saturated output power	6.2	6.4	6.4	kW

K384 in K4100B Circuit

Frequency	590 to 598 (channel 36)	654 to 662 (channel 44)	710 to 718 (channel 51)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (5.0kW)	25	20	26	mA
at 6.0kW c.w. output, vision frequency	46	43	52	mA
Drive power:				
at 5.0kW output	0.5	0.4	0.2	W
at 6.0kW output	1.0	0.7	0.4	W
Saturated output power	6.5	6.1	6.2	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 8 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the modulating anode current may vary between 0 and 1.5mA. If a potential divider network is used to supply the modulating anode it must allow for this variation.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K383 IN K4099B CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current	9.5 to 11.5	A
Frequency range	470 to 610	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	5.5	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Beam voltage (see note 7)	–	10	kV
Body current (see note 8)	–	150	mA
Modulating anode current	–	5.0	mA
R.F. drive power (see note 9)	–	1.5	W
Efficiency (see note 10)	30	–	%

K383 IN K4099B CIRCUIT, TRANSPOSER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current		see note 11
Beam voltage		see note 12
Frequency range	470 to 610	MHz
Bandwidth (see note 5)	8.0	MHz
Peak synchronous power (see note 13)	1.0	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Electromagnet current	9.5	11.5	A
Beam voltage	8.5	10	kV
Intermodulation level (see note 14)	–	–52	db
R.F. drive power (see note 9)	–	200	mW

K384 IN K4100B CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current	8.0 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	5.5	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Beam voltage (see note 7)	–	10	kV
Body current (see note 8)	–	150	mA
Modulating anode current	–	5.0	mA
R.F. drive power (see note 9)	–	1.5	W
Efficiency (see note 10)	30	–	%

K384 IN K4100B CIRCUIT, TRANSPOSER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current		see note 11
Beam voltage		see note 12
Frequency range	590 to 720	MHz
Bandwidth (see note 5)	8.0	MHz
Peak synchronous power (see note 13)	1.0	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Electromagnet current	9.5	11.5	A
Beam voltage	8.5	10	kV
Intermodulation level (see note 14)	–	–52	db
R.F. drive power (see note 9)	–	200	mW

K385 IN K4101B CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current	8.0 to 10	A
Frequency range	700 to 860	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	5.5	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Beam voltage (see note 7)	–	10	kV
Body current (see note 8)	–	150	mA
Modulating anode current	–	5.0	mA
R.F. drive power (see note 9)	–	1.5	W
Efficiency (see note 10)	30	–	%

K385 IN K4101B CIRCUIT, TRANSPOSER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current		see note 11
Beam voltage		see note 12
Frequency range	700 to 860	MHz
Bandwidth (see note 5)	8.0	MHz
Peak synchronous power (see note 13)	1.0	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Electromagnet current	9.5	11.5	A
Beam voltage	8.5	10	kV
Intermodulation level (see note 14)	–	–52	db
R.F. drive power (see note 9)	–	200	mW

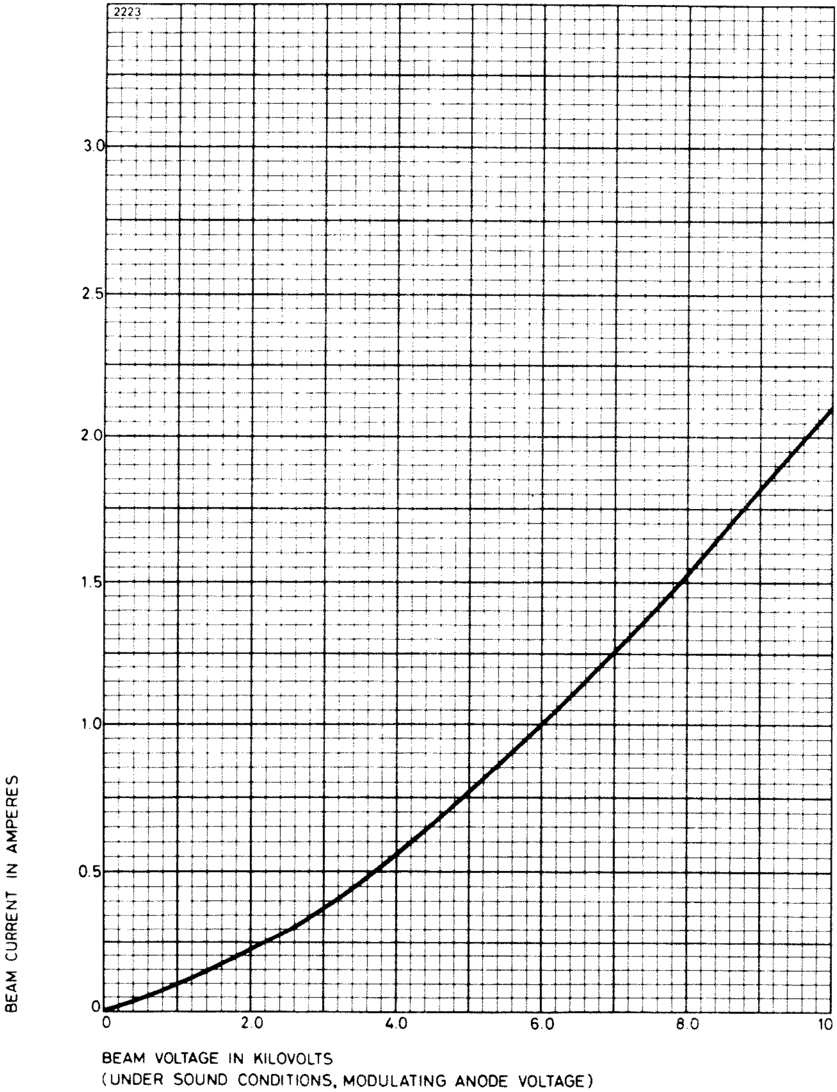
NOTES

1. An airpipe is provided which divides the incoming air approximately equally between the final drift tube and the output cavity. A minimum flow trip is incorporated in the branch supplying the output cavity.
2. Measured at the input to the circuit assembly.
3. This value applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
4. This supply must be stabilized to within ± 3%.
5. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.
6. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output power.
7. With the modulating anode connected to the body via a 10kΩ resistor the beam current will be within ±5% of the value given by the graph on page 8.
8. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
9. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
10. The efficiency will not fall below the specified limit for any beam power in the range 15 to 20kW.
11. Adjusted for minimum intermodulation product. This supply must be stabilized to within ±2%.
12. Adjusted for minimum intermodulation product. This supply must be stabilized to within ±1%.
13. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power adjusted to give the specified output.
14. The intermodulation is measured by driving the klystron with three signals as follows:

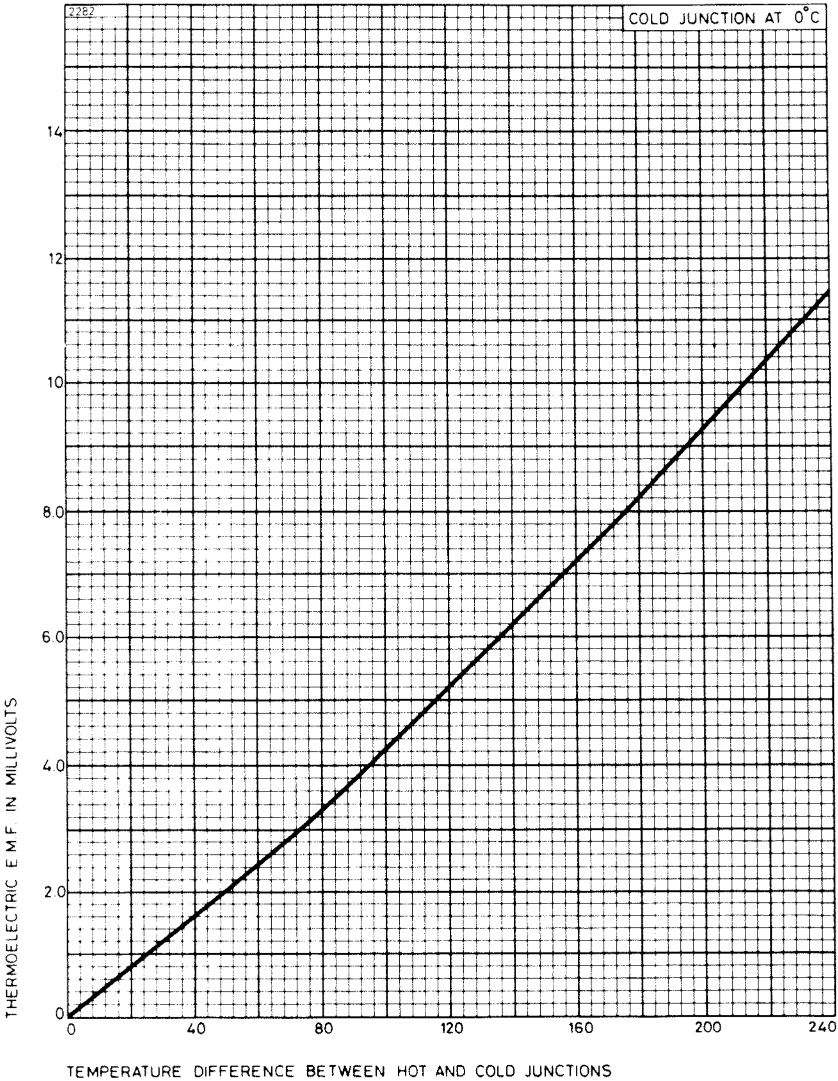
2.25MHz below channel centre	−8db
2.20MHz above channel centre	−17db
3.75MHz above channel centre	−7db

The drive levels are measured with respect to the drive power for 1kW output. The intermodulation level is measured with respect to 1kW.

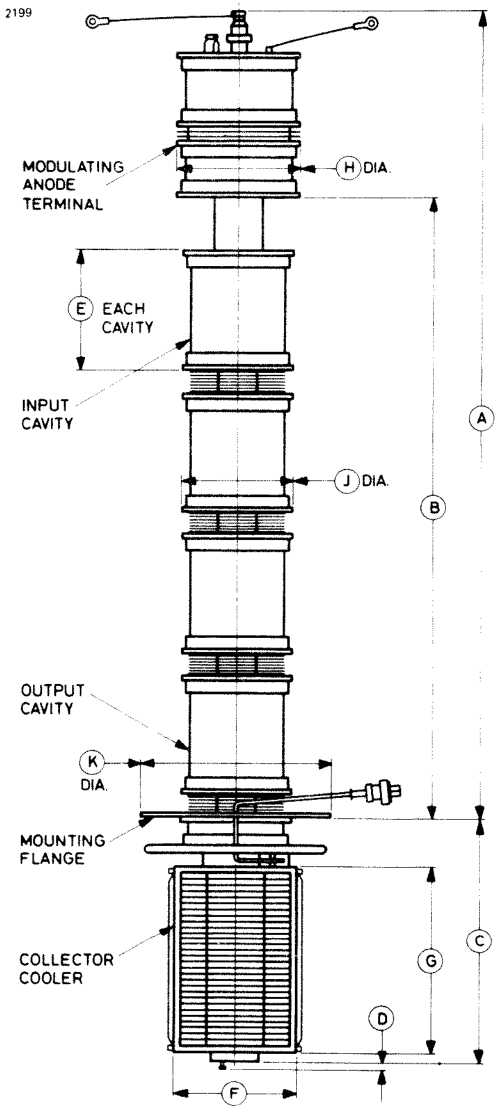
BEAM CHARACTERISTIC



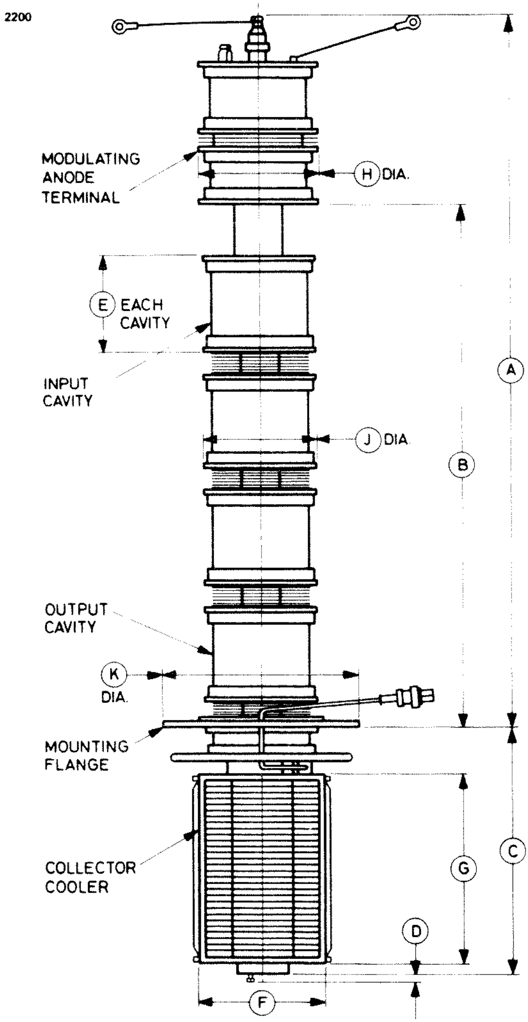
THERMOCOUPLE CALIBRATION CURVE



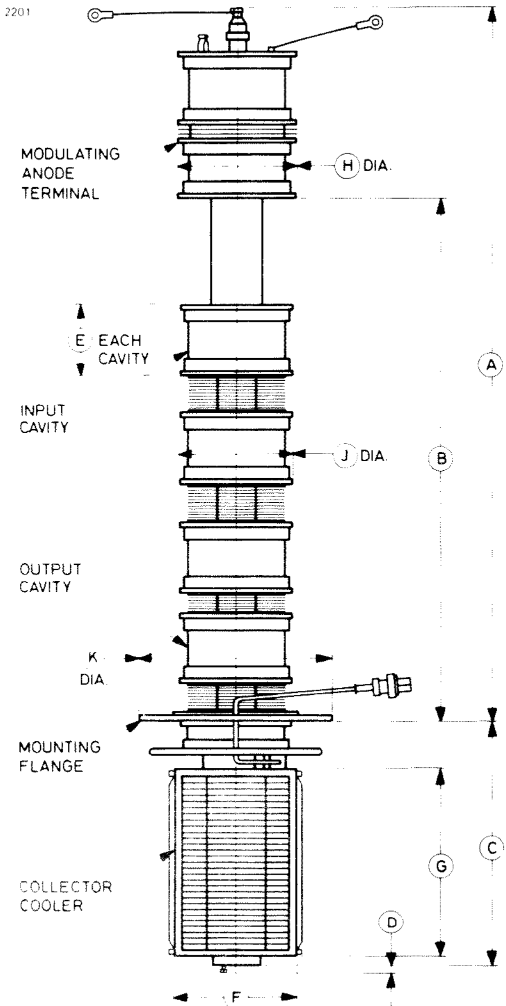
OUTLINE FOR K383 (See page 13 for dimensions)



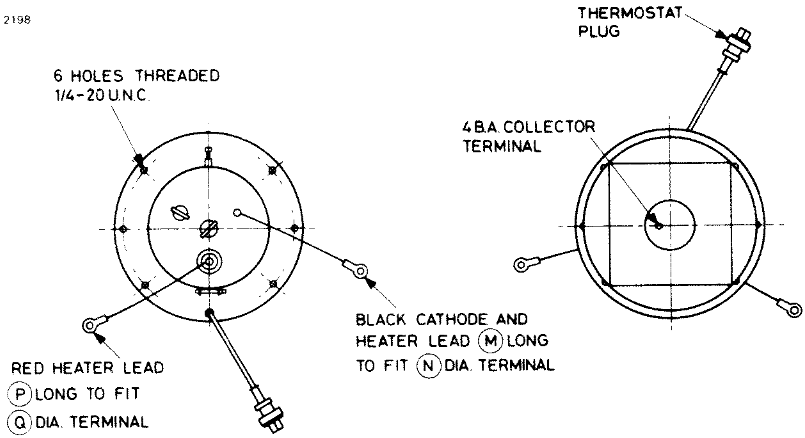
OUTLINE FOR K384 (See page 14 for dimensions)



OUTLINE FOR K385 (See page 14 for dimensions)



OUTLINE DETAILS FOR K383, K384 AND K385



View on gun end **View on collector end**

OUTLINE DIMENSIONS FOR K383

Ref	Inches	Millimetres
A	34.125 max	866.8 max
B	25.800	655.3
C	10.367 max	263.3 max
D	0.250 max	6.35 max
E	5.000	127.0
F	5.185 max	131.7 max
G	8.125 max	206.4 max
H	5.125	130.2
J	4.625	117.5
K	8.015 max	203.6 max
M	15.000 min	381.0 min
N	0.312	7.92
P	15.000 min	381.0 min
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

OUTLINE DIMENSIONS FOR K384

Ref	Inches	Millimetres
A	30.100 max	764.5 max
B	21.775	553.1
C	10.367 max	263.3 max
D	0.250 max	6.35 max
E	4.000	101.6
F	5.185 max	131.7 max
G	8.125 max	206.4 max
H	5.125	130.2
J	4.625	117.5
K	8.015 max	203.6 max
M	15.000 min	381.0 min
N	0.312	7.92
P	15.000 min	381.0 min
Q	0.250	6.35

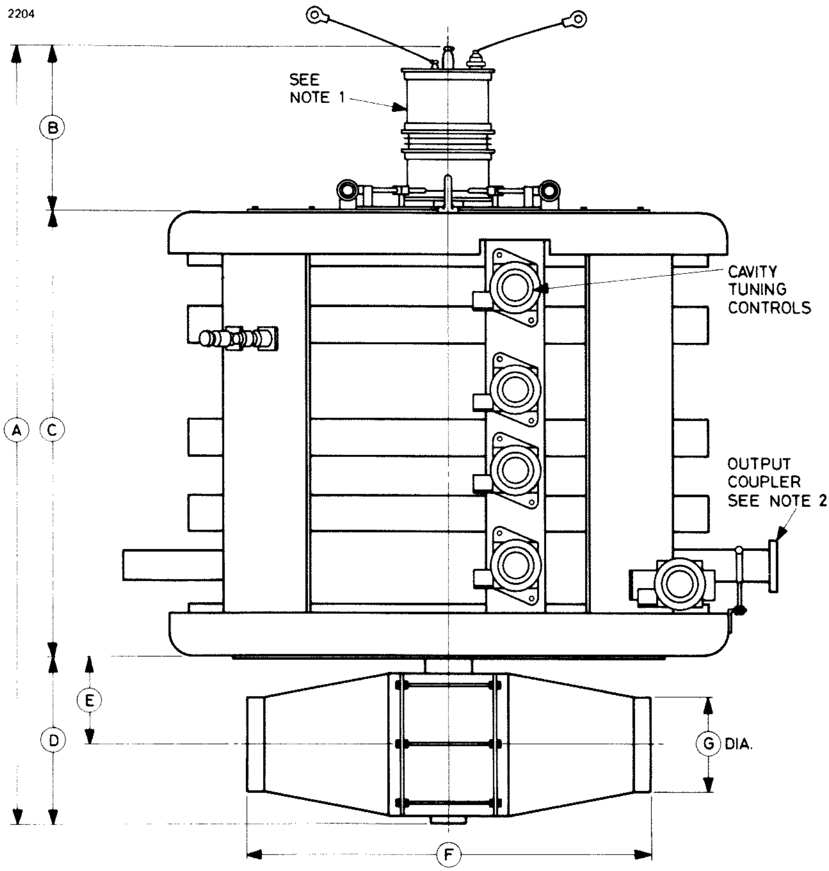
Millimetre dimensions have been derived from inches.

OUTLINE DIMENSIONS FOR K385

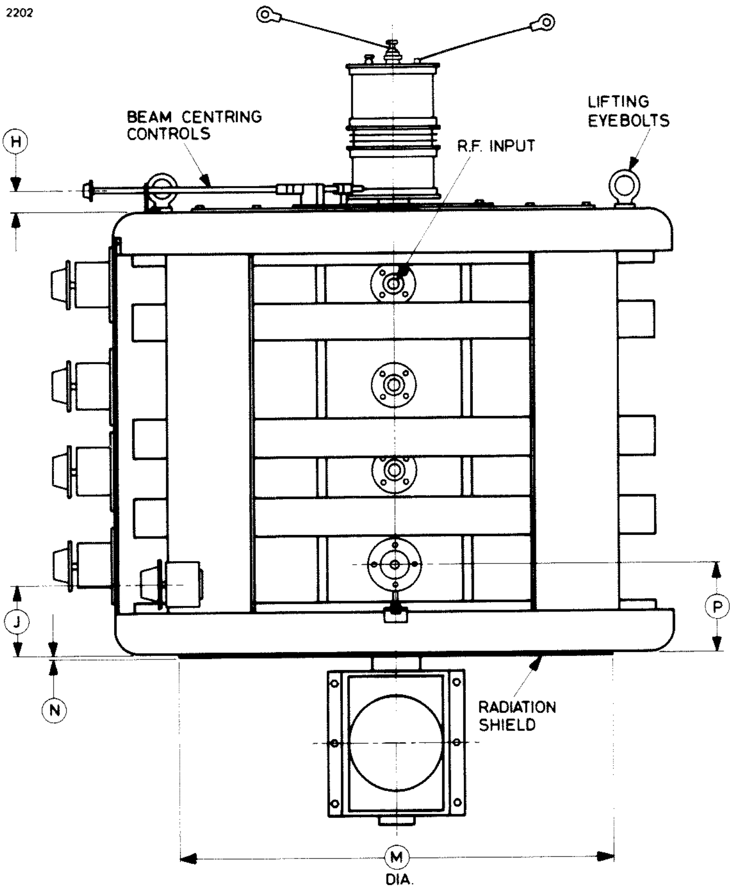
Ref	Inches	Millimetres
A	30.100 max	764.5 max
B	21.775	553.1
C	10.367 max	263.3 max
D	0.250 max	6.35 max
E	3.000	76.2
F	5.185 max	131.7 max
G	8.125 max	206.4 max
H	5.125	130.2
J	4.625	117.5
K	8.015 max	203.6 max
M	15.000 min	381.0 min
N	0.312	7.92
P	15.000 min	381.0 min
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

OUTLINE FOR K4099B, K4100B AND K4101B

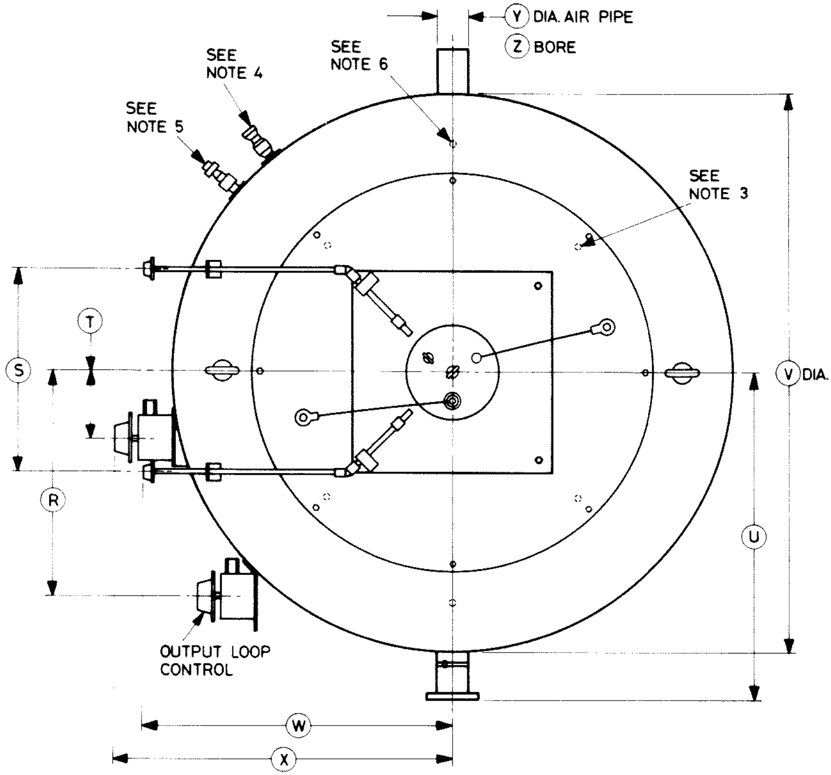


OUTLINE FOR K4099B, K4100B AND K4101B



OUTLINE FOR K4099B, K4100B AND K4101B

2203



OUTLINE NOTES FOR K4099B, K4100B AND K4101B

1. The klystron is shown installed for clarity.
2. Output coupler mates with $1^5/_8$ inch E.I.A. flange.
3. Four mounting holes in base, $^3/_8$ inch (9.53mm) diameter equally spaced on 18.500 inch (470mm) P.C.D.
4. Two pin focus supply socket, see page 20.
5. Ten pin interlock socket, see page 20.
6. Four mounting holes in base threaded $^3/_8$–16 U.N.C. equally spaced on 24 inch (609.6mm) P.C.D.

OUTLINE DIMENSIONS FOR K4099B

Ref	Inches	Millimetres
A	44.500 max	1130.3 max
B	8.750 max	222.3 max
C	27.000 max	685.8 max
D	8.750 max	222.3 max
E	4.625	117.5
F	21.000	533.4
G	5.000	127.0
H	1.062	26.97
J	3.700	93.98
M	22.750	577.9
N	0.207	5.26
P	4.625 ± 0.062	117.5 ± 1.6
R	12.000	304.8
S	10.500	266.7
T	3.500	88.90
U	17.000 ± 0.100	431.8 ± 2.5
V	29.250 max	743.0 max
W	16.000	406.4
X	17.500	444.5
Y	1.600	40.64
Z	1.500	38.10

Millimetre dimensions have been derived from inches.

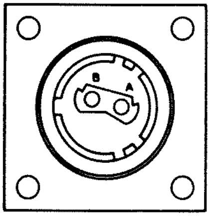
OUTLINE DIMENSIONS FOR K4100B AND K4101B

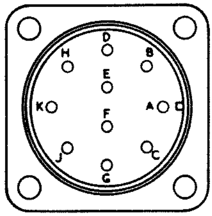
Ref	Inches	Millimetres
A	40.500 max	1028.7 max
B	8.750 max	222.3 max
C	23.000 max	584.2 max
D	8.750 max	222.3 max
E	4.625	117.5
F	21.000	533.4
G	5.000	127.0
H	1.062	26.97
J	3.700	93.98
M	22.750	577.9
N	0.207	5.26
P	4.625 $\pm$ 0.062	117.5 $\pm$ 1.6
R	12.000	304.8
S	10.500	266.7
T	3.500	88.90
U	17.000 $\pm$ 0.100	431.8 $\pm$ 2.5
V	29.250 max	743.0 max
W	16.000	406.4
X	17.500	444.5
Y	1.600	40.64
Z	1.500	38.10

Millimetre dimensions have been derived from inches.

SOCKET CONNECTIONS

2110





Connections to two-pin socket

Pin	Connection
A	Electromagnet supply
B	Electromagnet supply

Connections to ten-pin socket

Pin	Connection
A	–
B	Collector thermostat
C	Collector thermostat
D	Spare
E	–
F	–
G	Spare
H	Airflow trip
J	Airflow trip
K	–

K386

POWER KLYSTRON

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystron with separate tuning cavities, for tropospheric scatter service. The collector is vapour cooled in a separate boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device. The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range (in circuit assembly K4108)	755 to 985	MHz
Bandwidth to 3db	6.0	MHz
Output power	11	kW min
Power gain at 11kW output	40	db min
Beam voltage for 11kW output	12.5	kV max
Output	$3^1/_8$ inch 50Ω coaxial line	
Cooling (see page 2)	vapour and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	5.5 ± 1%	V
Heater current	42	A
Heater starting current (peak)	84	A max
Cathode heating time	5	minutes

Mechanical

Overall length	39.6 inches (100.6cm) nom
Overall diameter	8 inches (20.3cm) nom
Mounting position	vertical, cathode end up
Net weight of valve	55 pounds (25kg) approx

Circuit Assembly K4108

Electromagnet current	11 ± 1 A
Electromagnet resistance:	
cold	5.7 Ω
hot	7.3 Ω max
R.F. input connector	type N coaxial
R.F. output	$3^1/_8$ inch 50Ω coaxial line
Net weight of magnet assembly	770 pounds (349kg) approx
Weight of cavities	60 pounds (27kg) approx

Cooling

The valve collector is vapour cooled. The boiler, which is part of the circuit assembly, is of the upward steam exit type and intended for use with a separate condenser. The final drift tube and output cavity require forced air cooling. In order to achieve maximum thermal stability, air should be blown between the cavities across the drift tubes.

Volume of steam produced by collector dissipation	$1.5ft^3$/min/kW ($0.043m^3$/min/kW)
Volume of water converted to steam	0.006 Imp.gal/min/kW (0.027 litre/min/kW)
Air flow to output cavity (see note 1)	$60ft^3$/min ($1.7m^3$/min)
Static pressure head (see note 2)	1.5 inches w.g. min
Inlet air temperature	55 °C max
Temperature of any external parts of the valve must not exceed	175 °C max

Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage	14	kV max
Beam current (mean)	3.5	A max
Body current:		
with no input power	50	mA max
at saturated output power	150	mA max
Output power	12	kW max
Collector dissipation	45	kW max
Load v.s.w.r.	1.3:1	max

TYPICAL OPERATION

The values given are for operation in a 10kW tropospheric-scatter transmitter.

Beam voltage			12	kV
Beam current			2.7	A
Electromagnet current			11	A
Bandwidth to 3db			6.0	MHz
Centre frequency	760	870	980	MHz
Body current:				
with no input power	15	15	15	mA
at saturation	70	50	35	mA
Drive power	0.8	0.5	0.2	W
Saturated output power	11.4	11.5	11.0	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater voltage	5.5	V
Electromagnet current	10 to 12	A
Frequency range	755 to 985	MHz
Bandwidth (see note 3)	6.0	MHz
Output power (see note 4)	11	kW

Range of Characteristics

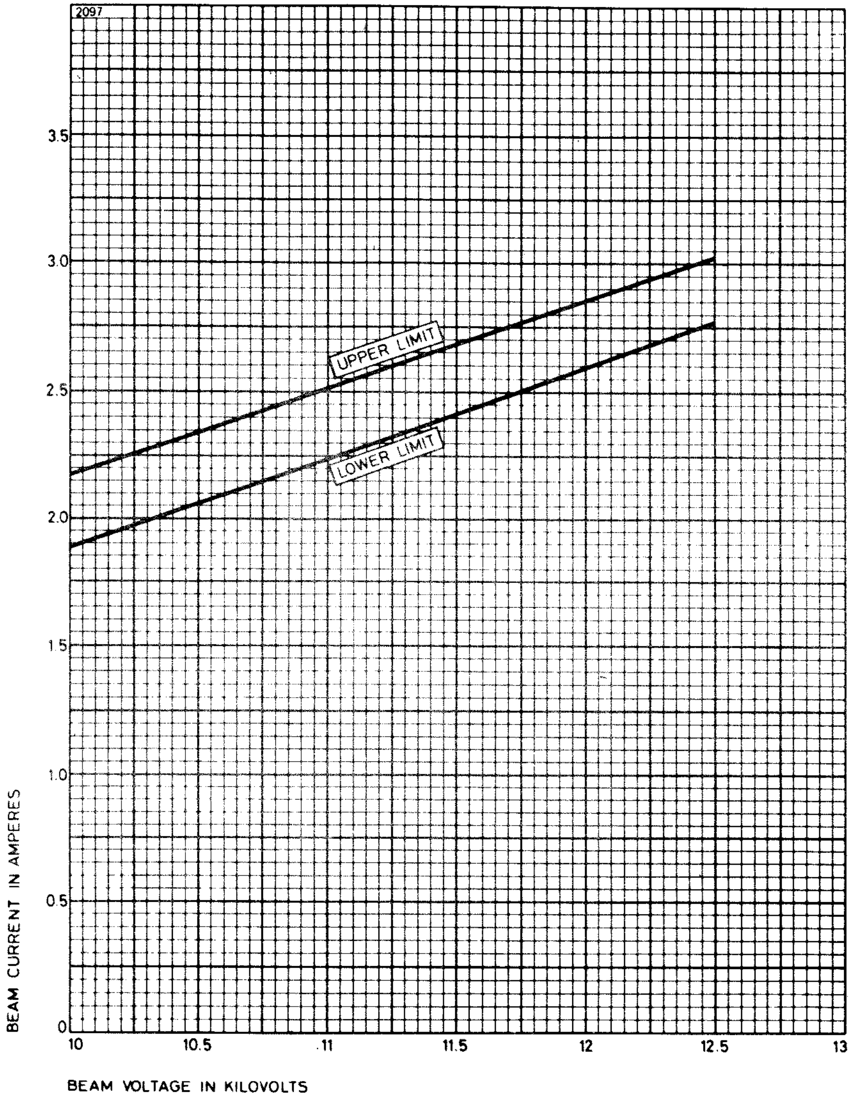
	Min	Max	
Heater current	40	44	A
Beam voltage (see note 5)	–	12.5	kV
Body current	–	150	mA
R.F. drive power (see note 6)	–	1.1	W
Efficiency (see note 7)	32	–	%

NOTES

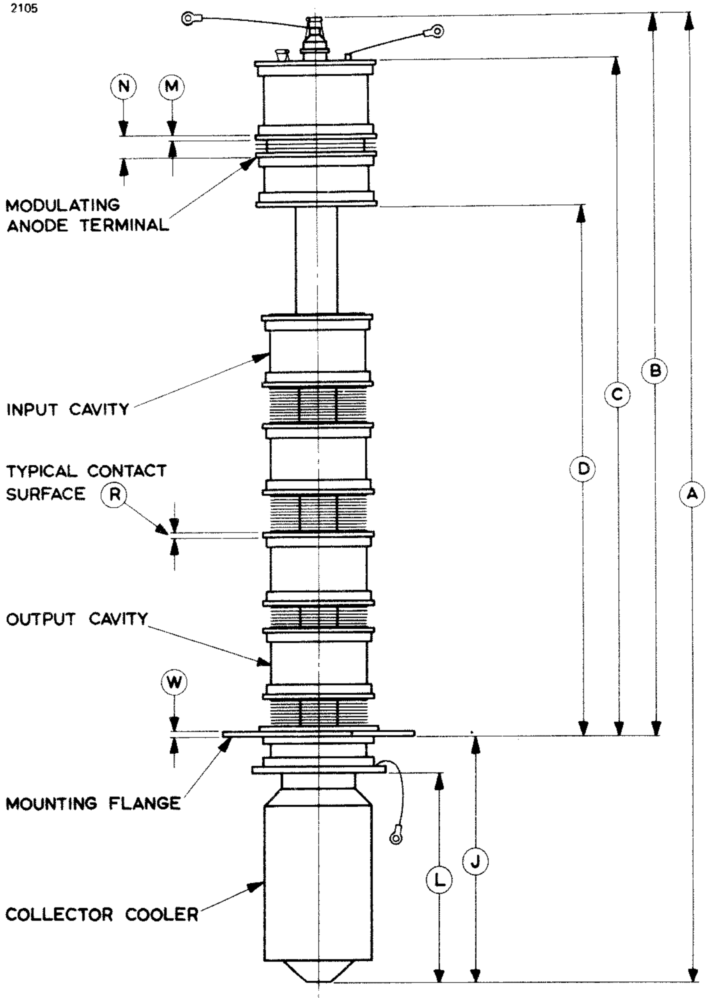
1. An airpipe is provided which divides the incoming air approximately equally between the final drift tube and the output cavity. A minimum flow trip is incorporated in the branch of this pipe which feeds the output cavity.
2. Measured at the input to the circuit assembly.
3. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 3db over the specified bandwidth.

4. Input frequency set to band centre.
5. With the modulating anode connected to the body via a 10kΩ resistor the beam current limits are given by the graph on page 5. For any valve the graph of beam current over the range of beam voltage shown will be approximately linear with a slope between the slopes of the two limiting curves.
6. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
7. The efficiency will not fall below the specified limit for any beam power in the range 30 to 37.5kW.

BEAM CURRENT LIMITS

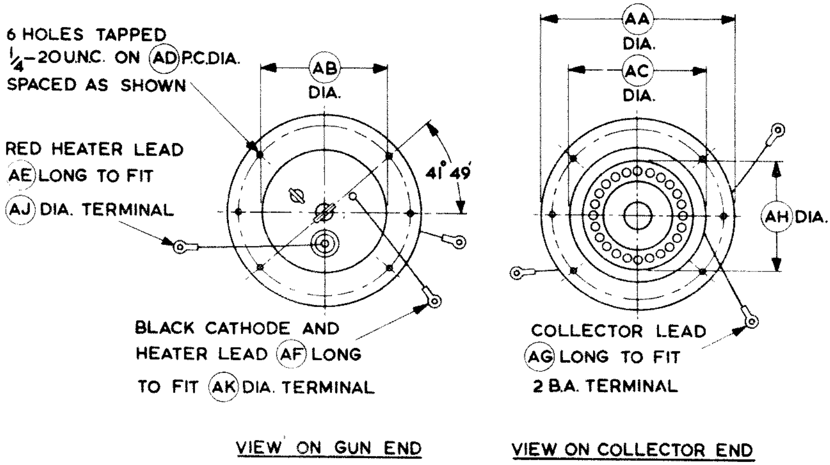


OUTLINE


2105
N
M
MODULATING
ANODE TERMINAL
INPUT CAVITY
TYPICAL CONTACT
SURFACE R
OUTPUT CAVITY
W
MOUNTING FLANGE
COLLECTOR COOLER
A
B
C
D
J
L

OUTLINE DETAILS

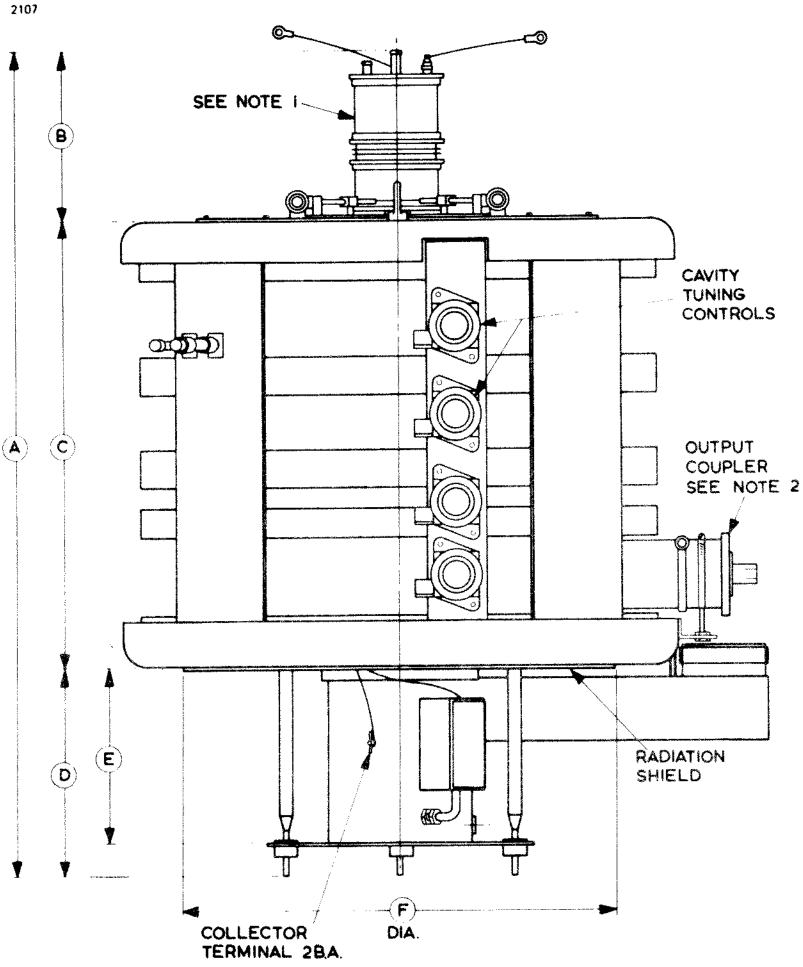
2106



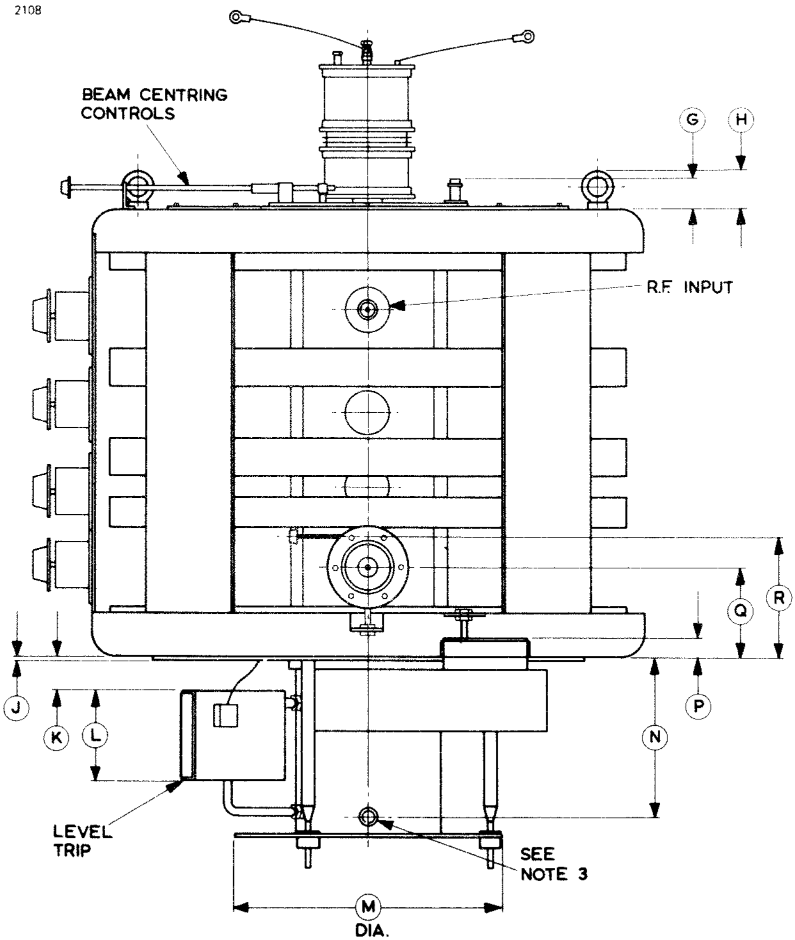
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	39.600	1005.8	AA	8.000	203.2
B	29.600	751.8	AB	5.125	130.2
C	27.860	707.6	AC	5.625	142.9
D	21.780	553.2	AD	7.125	181.0
J	10.000	254.0	AE	15.000 min	381.0 min
L	8.500	215.9	AF	15.000 min	381.0 min
M	0.245	6.22	AG	12.000 min	304.8 min
N	0.950	24.13	AH	4.437	112.7
R	0.245	6.22	AJ	0.250	6.35
W	0.250	6.35	AK	0.312	7.92

Millimetre dimensions have been derived from inches.

OUTLINE OF CIRCUIT ASSEMBLY K4108

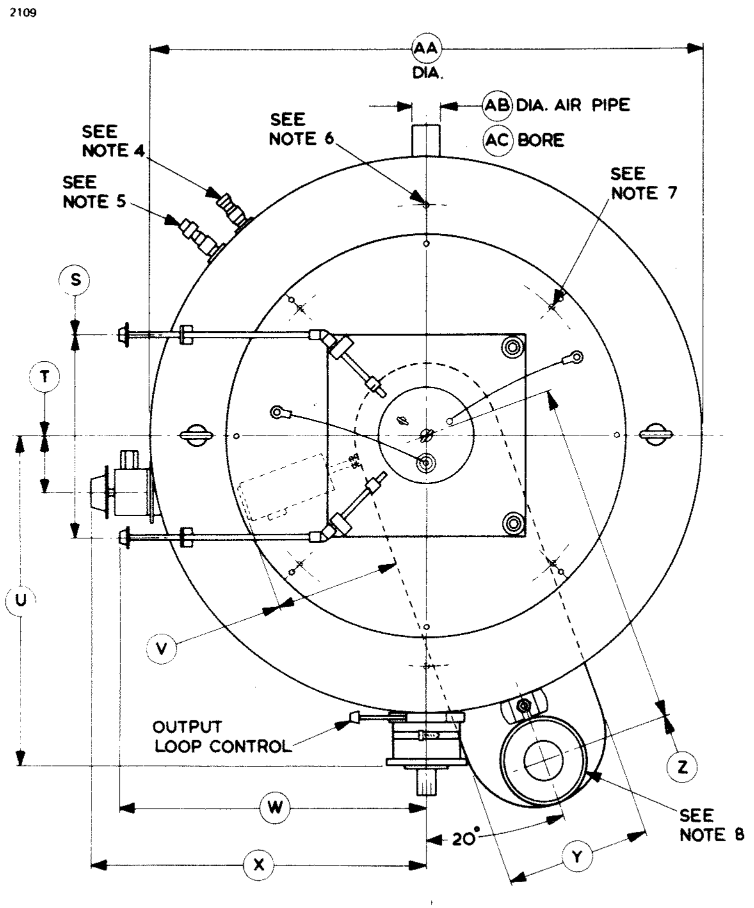


OUTLINE OF CIRCUIT ASSEMBLY K4108



See page 11 for dimensions and notes.

OUTLINE OF CIRCUIT ASSEMBLY K4108



K4108 OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	42.500 max	1079.5 max	Q	4.650 ± 0.100	118.1 ± 2.5
B	8.750 max	222.3 max	R	6.293	159.8
C	23.000 max	584.2 max	S	10.500 nom	266.7 nom
D	10.750 max	273.1 max	T	3.500 nom	88.90 nom
E	9.062 max	230.2 max	U	17.125 ± 0.100	435.0 ± 2.5
F	22.750	577.9	V	7.000 max	177.8 max
G	1.625	41.28	W	16.000	406.4
H	2.000	50.80	X	17.500	444.5
J	0.207	5.26	Y	7.500	190.5
K	1.500	38.10	Z	18.000	457.2
L	4.750	120.7	AA	29.250 max	743.0 max
M	14.000	355.6	AB	1.600	40.64
N	8.125	206.4	AC	1.500	38.10
P	1.000 ± 0.125	25.40 ± 3.18			

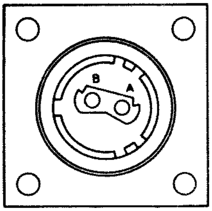
Millimetre dimensions have been derived from inches.

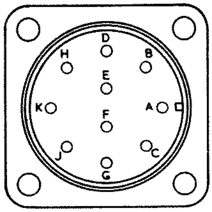
OUTLINE NOTES

1. The klystron is shown installed for clarity.
2. Output coupler, mates with 3$^1/_8$ inch EIA flange.
3. Water inlet $^3/_4$ inch B.S.P.F. thread.
4. Two pin focus supply socket, see page 12.
5. Ten pin interlock socket, see page 12.
6. Four mounting holes in base, threaded $^3/_8$-16 U.N.C. equally spaced on 24 inch P.C.D.
7. Four mounting holes in base, $^3/_8$ inch diameter equally spaced on 18½ inch P.C.D.
8. Steam outlet 4½ inch diameter, 4 U.N. class 2A thread.

SOCKET CONNECTIONS

2110





Connections to two-pin socket

Pin	Connection
A	Electromagnet supply
B	Electromagnet supply

Connections to ten-pin socket

Pin	Connection
A	—
B	Spare
C	Spare
D	Airflow trip switch
E	—
F	—
G	Airflow trip switch
H	Water level trip switch
J	Water level trip switch
K	—

K390

HIGH POWER KLYSTRON

ABRIDGED DATA

Pulse amplifier klystron for linear accelerators and long range radars.

Cavities (four)		integral
Frequency (see note 1)	2998	MHz
Typical peak output power	8.0	MW
Typical power gain	42	db
Focusing	electro-magnet focus mount type K4001	
Output	no. 10 waveguide	
Coupler	UG-54A/U	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 2)	3.4	V
Heater current	86	A
Heater starting current, peak value, not to be exceeded	200	A

Mechanical

Overall length	48.25 inches (122.6cm) max
Overall width	13.41 inches (34.1cm) max
R.F. input connection	coaxial socket, Amphenol type 82-815
R.F. output coupler	UG-54A/U
Net weight	75 pounds (34kg) approx
Mounting position	vertical, cathode down
Socket	see note 3

Cooling Requirements

Water flow to body (see note 4)	1 imp.gal/min (4.55 l./min) min
Water flow to collector (see note 4)	7.5 imp.gal/min (34.1 l./min) min
Air flow to output window (N.T.P.)	$3ft^3$/min ($0.085m^3$/min) min
Cooling air excess pressure	30 lb/in^2 ($2.1kg/cm^2$) min
Resistivity of cooling water	50 000 ohm-cm min

Continued on page 2

The temperature of the cooling water at the outlet must not exceed 65°C. All dissolved oxygen should be removed from the cooling water. The dew point of the cooling air must be at least 5°C below ambient and oil vapour or any other impurity harmful to satisfactory window operation must be reduced to a safe level by an approved means.

The air and water flows must be started before the heater power is switched on and should be maintained for at least two minutes after the heater power has been switched off.

Focus Mount

The K4001 is a water cooled electro-magnet focus mount. It operates from a single variable voltage d.c. supply, connection being made to the terminals marked 'D.C. Supply'. A bucking coil is connected internally to the d.c. supply terminals and requires a controlling potentiometer and ammeter; these must be connected in series to the terminals marked 'B Coil'.

Overall length (see note 5)	18.25 inches (46.4cm) approx
Overall diameter	23.00 inches (58.4cm) approx
Net weight	400 pounds (182kg) approx
Minimum cooling water flow	1 imp.gal/min (4.55 l./min)
Maximum pressure drop at 1 imp.gal/min flow	25 lb/in^2 (1.76kg/cm^2)
Maximum cooling water inlet temperature	30 °C max

Protection against water supply failure must be provided.

	Min	Max	
Bucking coil resistance	52	65	Ω
Main coil resistance:			
cold	1.375	1.625	Ω
hot (see note 6)	1.75	2.00	Ω

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

K4001

	Min	Max	
D.C. supply voltage	30	80	V
D.C. supply current	20	40	A
D.C. bucking coil current	–	1.0	A

Continued on page 3

MAXIMUM AND MINIMUM RATINGS – Continued
(Pulsed operation, see note 7)

K390

	Min	Max	
Heater voltage (see note 2)	3.2	4.2	V
Heater current	–	105	A
Collector voltage (peak) (see note 8)	–	205	kV
Beam current (peak)	–	105	A
Collector current (mean)	–	175	mA
Collector dissipation	–	35	kW
Body voltage (peak) (see note 8)	–	205	kV
Body current (mean)	–	40	mA
Beam input power (peak)	–	20	MW
R.F. input power (peak)	–	5.0	kW
Output power (peak)	–	8.8	MW
Output power (mean)	–	10.5	kW
Duty cycle:			
beam	–	0.00175	
r.f.	–	0.0015	
Pulse length	–	3.0	μs
V.S.W.R. of load	–	1.2:1	

TYPICAL OPERATION (See note 7)

Operational Conditions (in focus mount K4001)

Frequency	2998	MHz
Heater voltage (see note 2)	3.4	V
Collector voltage (peak) (see note 8)	196	kV
Body voltage (peak) (see note 8)	196	kV
Pulse length:		
beam	3.0	μs
r.f.	2.5	μs
Duty cycle:		
beam	0.0015	
r.f.	0.00125	
Electro-magnet current (see note 9):		
main coil	38	A
bucking coil	0.6	A

Typical Performance

Beam current (peak)	96	A
Collector current (mean)	144	mA
Body current (mean)	25	mA
R.F. input power (peak)	700	W
Output power:		
peak	8.0	MW
mean	10	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Pulsed Operation) (See Note 7)

Test Conditions (in focus mount K4001)

Frequency	2998	MHz
Pulse length (r.f.)	2.5	μs
Duty cycle (r.f.)	0.00125	
Output power:		
peak	8.0	MW
mean	10	kW

Range of Characteristics

	Min	Max	
Heater voltage	3.0	4.6	V
Collector voltage (peak) (see note 8)	–	200	kV
Beam current (peak)	–	100	A
Collector current (mean)	–	175	mA
Body voltage (peak) (see note 8)	–	200	kV
Body current (mean)	–	40	mA
R.F. input power (peak)	–	5	kW
Electro-magnet current:			
main coil	25	45	A
bucking coil	–	1.0	A

PROTECTION CIRCUITS

The equipment in which the valve is to operate must provide protection from damage caused by:

(a) Failure of the heater supply.

(b) A reduction below minimum in the flow of cooling water to the valve body or collector.

(c) A reduction below minimum in either the cooling air flow or pressure to the output window.

(d) A failure of the focusing coil currents.

(e) Excessive collector current.

(f) Excessive body current.

(g) Voltage breakdown in the pressurised output waveguide system.

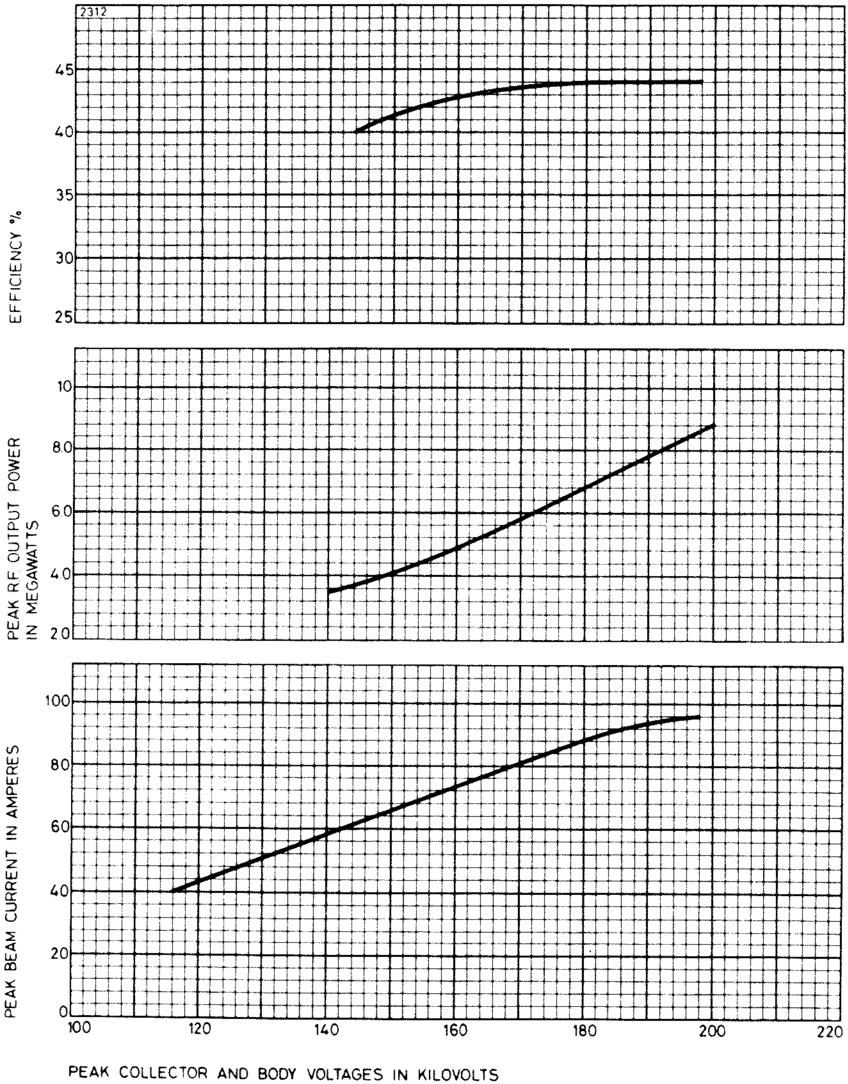
NOTES

1. The valve can be set before delivery to operate at any frequency within the range 2993 to 3003MHz.
2. The heater power should be applied at least 5 minutes before the beam voltage is switched on. The heater must not be operated continuously for periods exceeding 1 hour without the beam voltage applied.
3. The valve should be supported vertically from the mounting flange with the cathode end down. The base socket must allow for the complete immersion in oil of the cathode insulator and must incorporate corona flares designed to protect the insulator against electrical breakdown.
4. At this flow the pressure drop does not exceed 25 lb/in^2 ($1.76 kg/cm^2$).
5. The overall length will depend upon the valve socket details.
6. Measured after 3 hours operation at 40A, with cooling water flow at rated minimum value.
7. All voltages apart from the heater voltage are with respect to cathode.
8. When the valve is put into service after storage, it must be conditioned by increasing the beam voltage gradually until steady operation at the full rating is obtained. Valves held in store for long periods require conditioning at regular intervals; the procedure for this will be agreed from time to time with the user.
9. Optimum focusing is obtained by independent adjustment of the main and bucking coil currents and no mechanical adjustments are necessary. Recommended current settings for operation in K4001 are quoted on the test sheet supplied with each valve.
10. Routine inspection of the collector is required, the collector water jacket being removable for this purpose. The procedure for this will be agreed from time to time with the user.
11. The valve is fitted with an appendage pump which should be used whenever the valve is operated. Further details may be obtained from English Electric Valve Company Ltd.

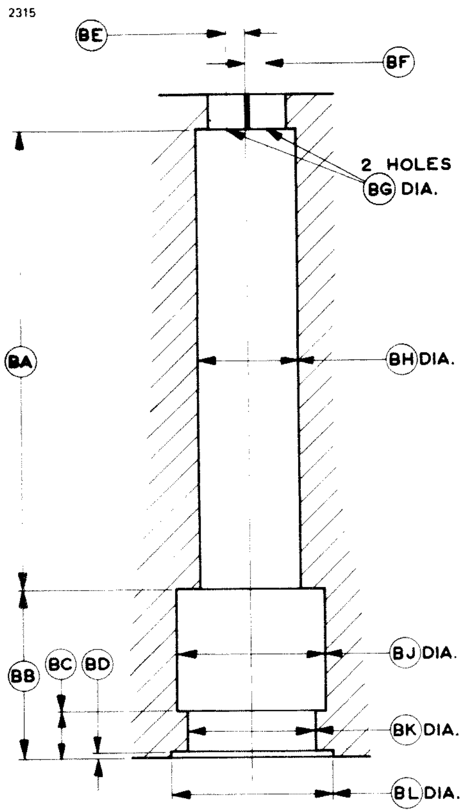
X-RAY WARNING

X-rays are produced by the valve under normal operating conditions. These rays can constitute a health hazard unless the valve is adequately shielded for X-radiation (the collector gauge drawing will assist in the design of the collector shielding). X-radiation is emitted by all high voltage devices and its presence does not reflect on the design of the valve.

BEAM VOLTAGE CHARACTERISTICS



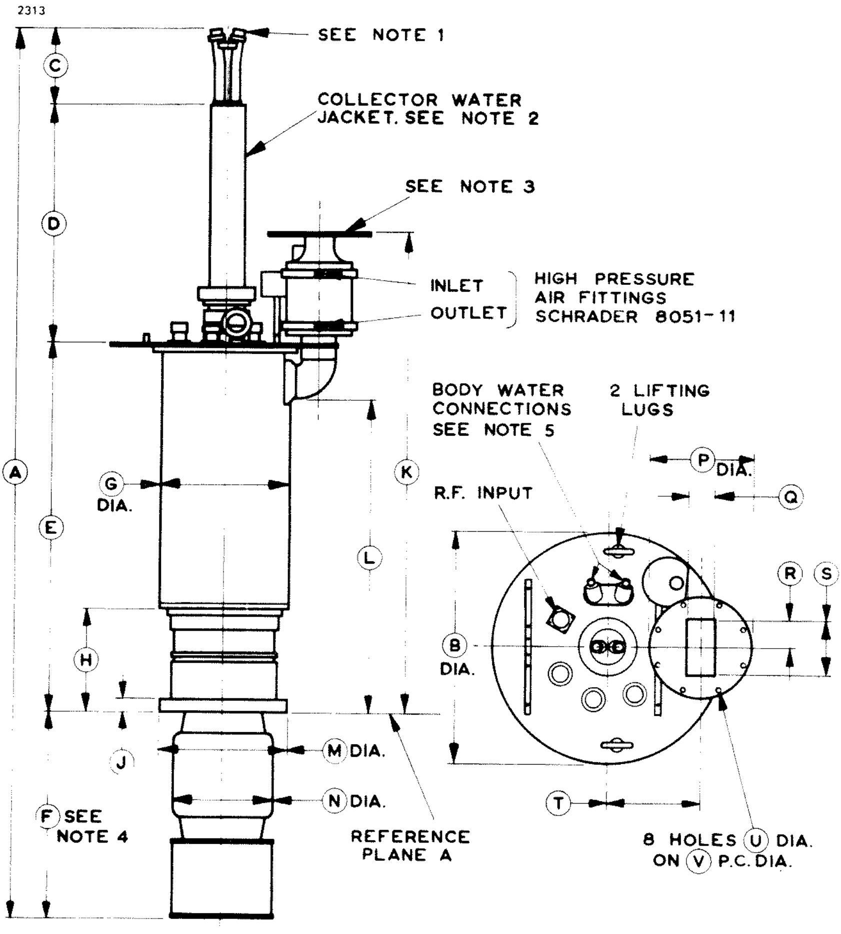
COLLECTOR GAUGE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	9.500	241.3	BG	0.750	19.05
BB	3.500	88.90	BH	2.010	51.05
BC	1.000	25.40	BJ	3.015	76.58
BD	0.125	3.18	BK	2.600	66.04
BE	0.375	9.53	BL	3.312	84.12
BF	0.437	11.10			

Millimetre dimensions have been derived from inches.

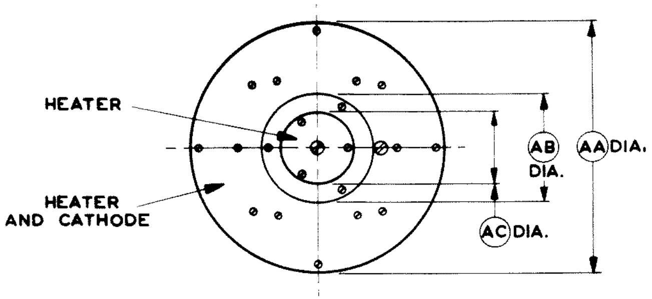
OUTLINE (See page 10 for outline notes)



OUTLINE DETAIL

Heater and Cathode Connection Surfaces

2314



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	48.250 max	1225.6 max	N	5.500 max	139.7 max
B	11.980 ± 0.015	304.29 ± 0.38	P	5.312 ± 0.015	134.92 ± 0.38
C	4.000	101.6	Q	1.340	34.04
D	12.156 ± 0.219	308.76 ± 5.56	R	1.420	36.07
E	19.140 ± 0.130	486.16 ± 3.30	S	2.840	72.14
F	10.640 ± 0.078	270.26 ± 1.98	T	4.750	120.65
G	6.800	172.7	U	0.281	7.14
H	5.265 ± 0.065	133.73 ± 1.65	V	4.750	120.65
J	0.750 ± 0.010	19.05 ± 0.25	AA	5.375	136.5
K	25.000 ± 0.125	635.00 ± 3.18	AB	2.250	57.15
L	15.750 min	400.0 min	AC	1.500	38.10
M	6.625 ± 0.025	168.28 ± 0.64			

Millimetre dimensions have been derived from inches.

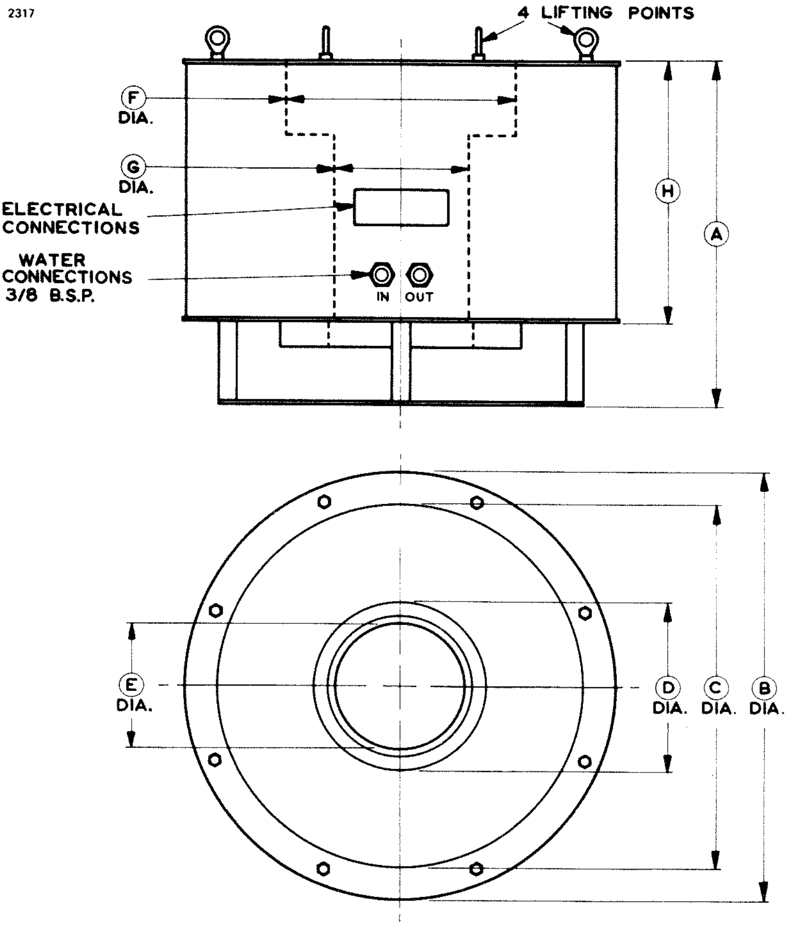
OUTLINE NOTES

1. Collector water connections. $^3/_8$-inch 'Yorkshire' fittings with male ½-inch B.S.P. parallel thread suitable for use with $^3/_8$-inch 'Yorkshire' cup and leather connector and 'O' Ring type No. OS.10 (B.S.1806:1951).

   The collector water jacket seats on to 'O' Ring type No. OS.32 (B.S.1806: 1951) 0.210 inch (5.33mm) thick.

2. Concentricity and length of collector are such that it will fit into collector gauge shown on page 7.
3. Parallel tolerance 0.040 inch (1.02mm) wide. Datum-Reference Plane A (B.S.308:1953).
4. No diameter over this length will exceed the diameter of the cathode insulator.
5. Body water connections. ¼-inch 'Yorkshire' cone fitting with male $^3/_8$-inch B.S.P. parallel thread.

OUTLINE FOR FOCUS MOUNT K4001



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	18.250	463.6	E	6.765	171.8
B	23.000	584.2	F	12.000	304.8
C	19.250	489.0	G	7.000	177.8
D	9.030	229.4	H	13.870	352.3

Millimetre dimensions have been derived from inches.

K3004 K3005 K3006

HIGH POWER KLYSTRONS

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is vapour cooled in a boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.

Klystron	Frequency Range	Circuit Assembly
K3004	470 to 610MHz	K4089B
K3005	590 to 720MHz	K4090B
K3006	700 to 860MHz	K4091B

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	7.0	kW
Power gain (typical)	39	db
Beam voltage	10.5	kV
Output	$1^5/_8$ inch 50Ω coaxial line	
Cooling (see page 2)	vapour and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	5.5	V
Heater current range	40 to 44	A
Heater starting current (peak)	84	A max
Cathode heating time (minimum)	5	min

Mechanical

Overall length:	
K3004	44.187 inches (112.2cm) max
K3005, K3006	40.162 inches (102.0cm) max
Overall diameter	8 inches (20.3cm) max
Mounting position	vertical, cathode end up
Net weight of klystron:	
K3004	60 pounds (27kg) approx
K3005, K3006	55 pounds (25kg) approx

September 1968

Circuit Assembly

Electromagnet current:		
K3004	10.5 ± 1.0	A
K3005, K3006	9.0 ± 1.0	A
Electromagnet resistance:		
cold (20°C)	5.7	Ω
hot (20°C ambient)	7.3	Ω max
R.F. input connector		type N coaxial
R.F. output		1⅝ inch 50Ω coaxial line
Net weight of tuning cavities:		
for K3004		102 pounds (46kg) approx
for K3005		83 pounds (38kg) approx
for K3006		64 pounds (29kg) approx
Net weight of magnet assembly		784 pounds (356kg) approx

Cooling

The klystron collector is vapour cooled. The boiler, which is part of the circuit assembly, is of the upward steam exit type and intended for use with a separate condenser.

The final drift tube and output cavity require forced-air cooling. Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

Volume of steam produced by collector dissipation	1.5	ft^3/min/kW
	0.043	m^3/min/kW
Volume of water converted to steam	0.006	imp.gal/min/kW
	0.027	litre/min/kW
Air flow to output cavity (see note 1)	60	ft^3/min
	1.7	m^3/min
Static pressure head (see note 2)	1.5	inches w.g. min
Inlet air temperature	40	°C max
Temperature of any external parts of the klystron must not exceed	175	°C max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage	12.5	kV max
Beam current (mean)	3.0	A max
Body current:		
with no input power	50	mA max
at saturated output power	150	mA max
Output power	8.0	kW max
Collector dissipation	35	kW max
Load v.s.w.r. (see note 3)	1.5:1	max

TYPICAL OPERATION

The operating conditions and performance figures given are for operation in a television transmitter giving a peak synchronous output power of 6.25kW. The klystrons are also suitable for transposer service.

Operating Conditions

Beam voltage	10.5	kV
Beam current	2.3	A
Electromagnet current:		
K3004 in K4089B circuit	10.5	A
K3005 in K4090B circuit	9.0	A
K3006 in K4091B circuit	9.0	A
Bandwidth (to 1db points)	8.0	MHz

K3004 in K4089B Circuit

Frequency	470 to 478 (channel 21)	526 to 534 (channel 28)	598 to 606 (channel 37)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (6.25kW)	30	27	29	mA
at 7.0kW c.w. output, vision frequency	48	43	48	mA
Drive power:				
at 6.25kW output	1.0	0.6	0.4	W
at 7.0kW output	1.2	0.7	0.5	W
Saturated output power	7.2	7.3	7.2	kW

K3005 in K4090B Circuit

Frequency	590 to 598 (channel 36)	654 to 662 (channel 44)	710 to 718 (channel 51)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (6.25kW)	28	24	30	mA
at 7.0kW c.w. output, vision frequency	46	45	50	mA
Drive power:				
at 6.25kW output	0.65	0.35	0.13	W
at 7.5kW output	1.0	0.6	0.25	W
Saturated output power	7.5	7.7	7.8	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 6 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the modulating anode current may vary between 0 and 1.5mA. If a potential divider network is used to supply the modulating anode it must allow for this variation.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K3004 IN K4089B CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current	9.5 to 11.5	A
Frequency range	470 to 610	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	7.0	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Beam voltage (see note 7)	–	11	kV
Body current (see note 8)	–	150	mA
Modulating anode current	–	5.0	mA
R.F. drive power (see note 9)	–	1.5	W
Efficiency (see note 10)	30	–	%

K3005 IN K4090B CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current	8.0 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	7.0	kW

Range of Characteristics

	Min	Max	
Heater current	40	44	A
Beam voltage (see note 7)	–	11	kV
Body current (see note 8)	–	150	mA
Modulating anode current	–	5.0	mA
R.F. drive power (see note 9)	–	1.5	W
Efficiency (see note 10)	30	–	%

K3006 IN K4091B CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 4)	5.5	V
Electromagnet current	8.0 to 10	A
Frequency range	700 to 860	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	7.0	kW

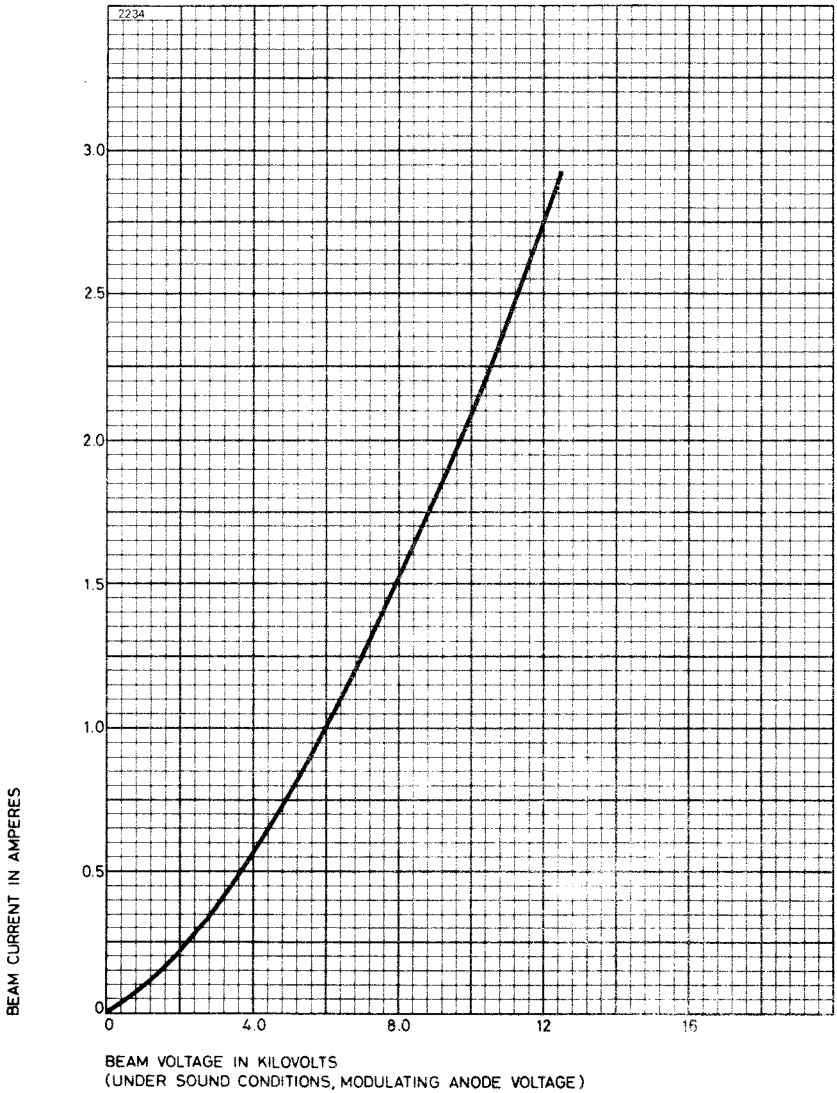
Range of Characteristics

	Min	Max	
Heater current	40	44	A
Beam voltage (see note 7)	–	11	kV
Body current (see note 8)	–	150	mA
Modulating anode current	–	5.0	mA
R.F. drive power (see note 9)	–	1.5	W
Efficiency (see note 10)	30	–	%

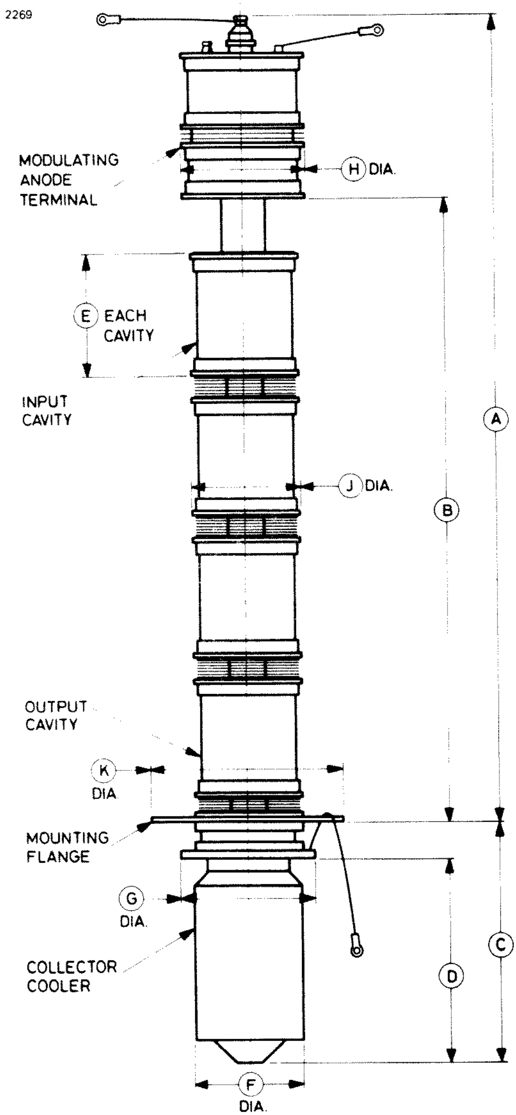
NOTES

1. An airpipe is provided which divides the incoming air approximately equally between the final drift tube and the output cavity. A minimum flow trip is incorporated in the branch supplying the output cavity.
2. Measured at the input to the circuit assembly.
3. This value applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
4. This supply must be stabilized to within ± 3%.
5. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.
6. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
7. With the modulating anode connected to the body via a 10kΩ resistor the beam current will be within ±5% of the value given by the graph on page 6.
8. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
9. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
10. The efficiency will not fall below the specified limit for any beam power in the range 20 to 26kW.

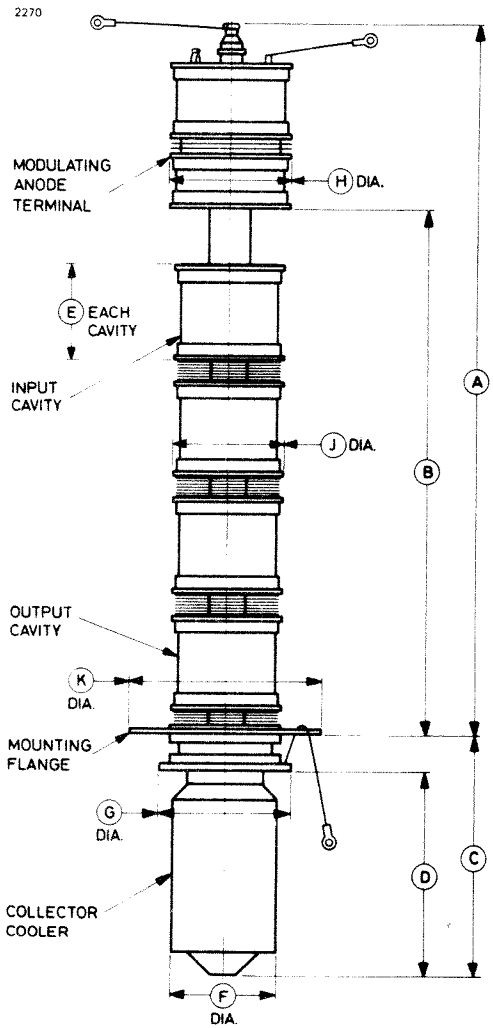
BEAM CHARACTERISTIC



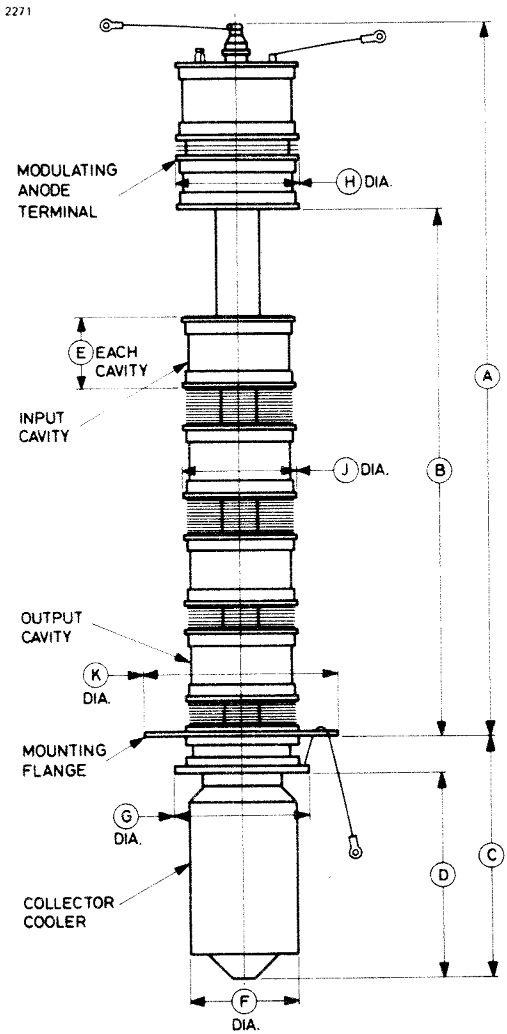
OUTLINE FOR K3004 (See page 10 for dimensions)



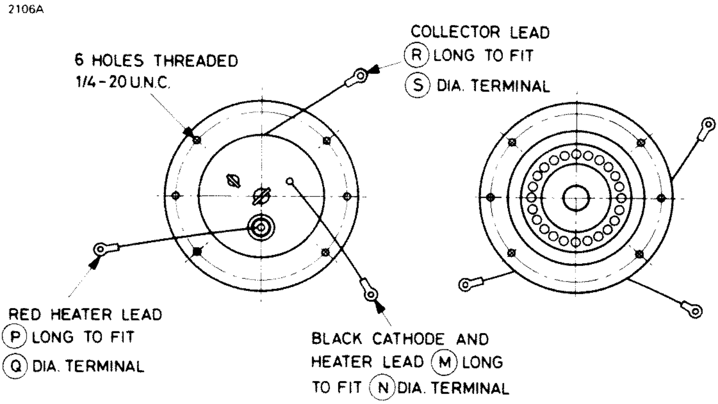
OUTLINE FOR K3005 (See page 11 for dimensions)



OUTLINE FOR K3006 (See page 11 for dimensions)



OUTLINE DETAILS FOR K3004, K3005 AND K3006



View on gun end **View on collector end**

OUTLINE DIMENSIONS FOR K3004

Ref	Inches	Millimetres
A	34.125 max	866.8 max
B	25.800	655.3
C	10.062 max	255.6 max
D	8.500	215.9
E	5.000	127.0
F	4.375	111.1
G	5.625	142.9
H	5.125	130.2
J	4.625	117.5
K	8.000 max	203.2 max
M	15.000 min	381.0 min
N	0.312	7.92
P	15.000 min	381.0 min
Q	0.250	6.35
R	36.000 min	914.4 min
S	0.196	4.98

Millimetre dimensions have been derived from inches.

OUTLINE DIMENSIONS FOR K3005

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	30.100 max	764.5 max	J	4.625	117.5
B	21.775	553.1	K	8.000 max	203.2 max
C	10.062 max	255.6 max	M	15.000 min	381.0 min
D	8.500	215.9	N	0.312	7.92
E	4.000	101.6	P	15.000 min	381.0 min
F	4.375	111.1	Q	0.250	6.35
G	5.625	142.9	R	36.000 min	914.4 min
H	5.125	130.2	S	0.196	4.98

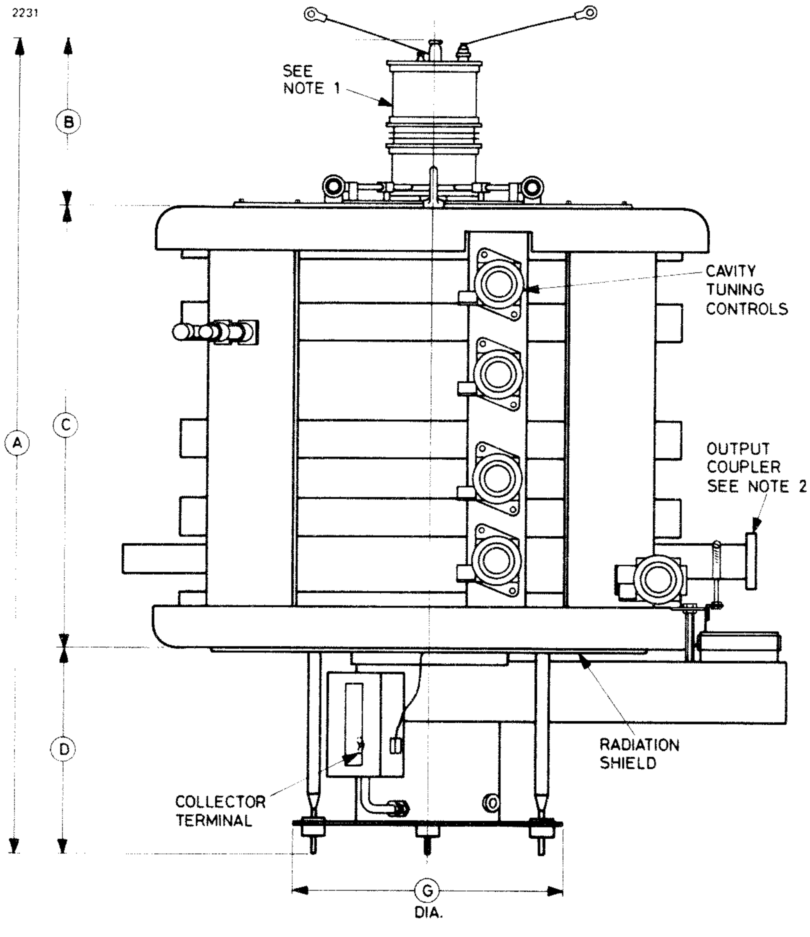
Millimetre dimensions have been derived from inches.

OUTLINE DIMENSIONS FOR K3006

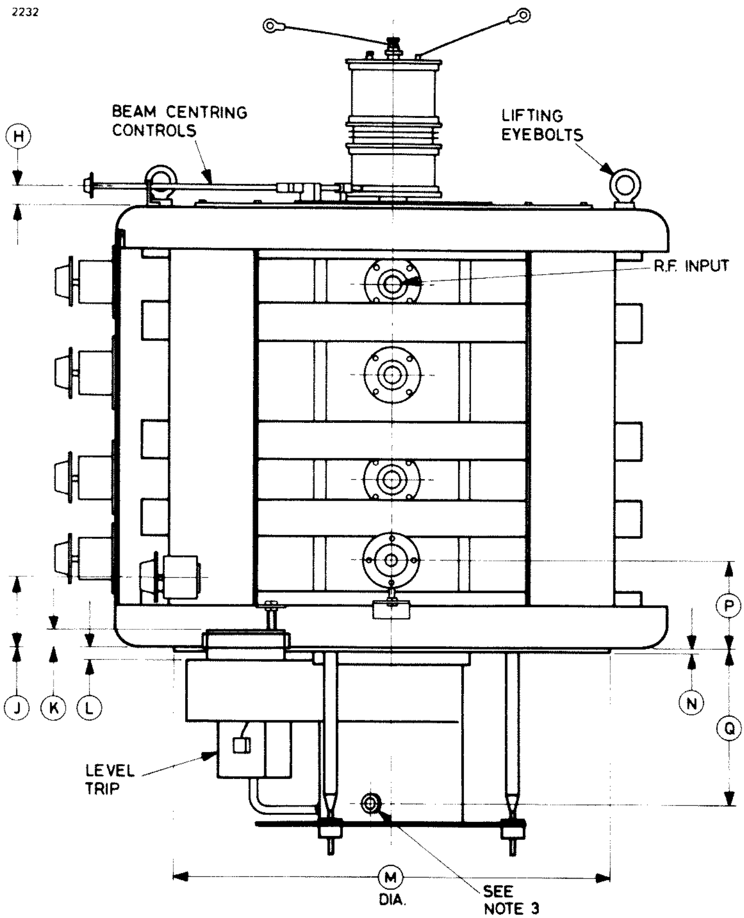
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	30.100 max	764.5 max	J	4.625	117.5
B	21.775	553.1	K	8.000 max	203.2 max
C	10.062 max	255.6 max	M	15.000 min	381.0 min
D	8.500	215.9	N	0.312	7.92
E	3.000	76.20	P	15.000 min	381.0 min
F	4.375	111.1	Q	0.250	6.35
G	5.625	142.9	R	36.000 min	914.4 min
H	5.125	130.2	S	0.196	4.98

Millimetre dimensions have been derived from inches.

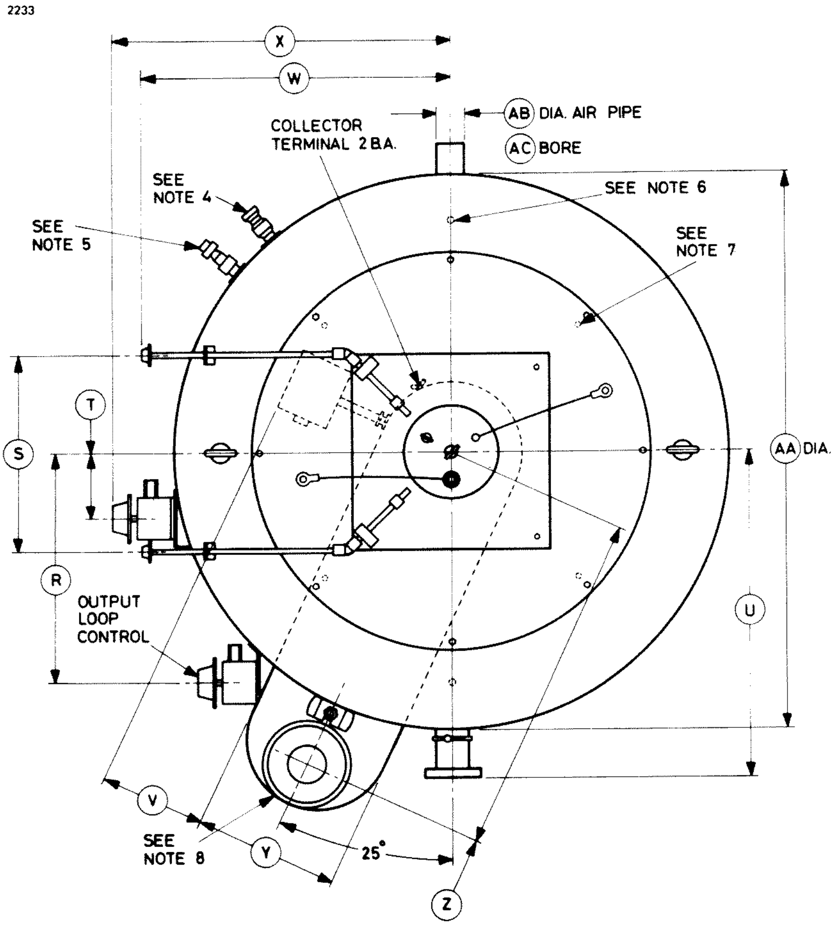
OUTLINE FOR K4089B, K4090B AND K4091B



OUTLINE FOR K4089B, K4090B AND K4091B



OUTLINE FOR K4089B, K4090B AND K4091B



OUTLINE NOTES FOR K4089B, K4090B AND K4091B

1. The klystron is shown installed for clarity.
2. Output coupler mates with $1^5/_8$ inch E.I.A. flange.
3. Water inlet $^3/_4$ inch B.S.P.F. thread.
4. Two pin focus supply socket, see page 16.
5. Ten pin interlock socket, see page 16.
6. Four mounting holes in base threaded $^3/_8$—16 U.N.C. equally spaced on 24 inch (609.6mm) P.C.D.
7. Four mounting holes in base, $^3/_8$ inch (9.53mm) diameter equally spaced on 18.500 inch (470mm) P.C.D.
8. Steam outlet $4^1/_2$ inch diameter, 4 U.N. class 2A thread.

OUTLINE DIMENSIONS FOR K4089B

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	46.500 max	1181.1 max	R	12.000	304.8
B	8.750 max	222.3 max	S	10.500	266.7
C	27.000 max	685.8 max	T	3.500	88.90
D	10.750 max	273.1 max	U	17.000 ± 0.100	431.8 ± 2.5
G	14.000	355.6	V	6.000 max	152.4 max
H	1.062	26.97	W	16.000	406.4
J	3.700	93.98	X	17.500	444.5
K	1.000 ± 0.125	25.40 ± 3.18	Y	7.500	190.5
L	0.625 min	15.88 min	Z	18.000	457.2
M	22.750	577.9	AA	29.250 max	743.0 max
N	0.207	5.26	AB	1.600	40.64
P	4.625 ± 0.062	117.5 ± 1.6	AC	1.500	38.10
Q	8.125	206.4			

Millimetre dimensions have been derived from inches.

OUTLINE DIMENSIONS FOR K4090B AND K4091B

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	42.500 max	1079.5 max	R	12.000	304.8
B	8.750 max	222.3 max	S	10.500	266.7
C	23.000 max	584.2 max	T	3.500	88.90
D	10.750 max	273.1 max	U	17.000 ± 0.100	431.8 ± 2.5
G	14.000	355.6	V	6.000 max	152.4 max
H	1.062	26.97	W	16.000	406.4
J	3.700	93.98	X	17.500	444.5
K	1.000 ± 0.125	25.40 ± 3.18	Y	7.500	190.5
L	0.625 min	15.88 min	Z	18.000	457.2
M	22.750	577.9	AA	29.250 max	743.0 max
N	0.207	5.26	AB	1.600	40.64
P	4.625 ± 0.062	117.5 ± 1.6	AC	1.500	38.10
Q	8.125	206.4			

Millimetre dimensions have been derived from inches.

SOCKET CONNECTIONS

2110

Connections to two-pin socket

Pin	Connection
A	Electromagnet supply
B	Electromagnet supply

Connections to ten-pin socket

Pin	Connection
A	–
B	Water level trip switch
C	Water level trip switch
D	Spare
E	–
F	–
G	Spare
H	Airflow trip
J	Airflow trip
K	–

K3014 K3015 K3016

HIGH POWER KLYSTRONS

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is vapour cooled in a boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.

Klystron	Frequency Range	Circuit Assembly
K3014	470 to 610MHz	K4102BD
K3015	590 to 720MHz	K4103BD
K3016	700 to 860MHz	K4104BD

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	28	kW
Power gain (typical):		
K3014	41	db
K3015	44	db
K3016	44	db
Beam voltage	18	kV
Output	$3^1/_8$ inch 50Ω coaxial line	
Cooling (see page 2)	water, vapour and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	8.5 ± 3%	V
Heater current	37 to 46	A
Heater starting current (peak)	200	A max
Cathode heating time (see note 1)	5	minutes

Mechanical

Overall length (see note 2):	
K3014, K3015	63.75 inches (161.9cm) max
K3016	59.5 inches (151.1cm) max
Overall diameter	11.125 inches (283mm) nom
Mounting position	vertical, collector end up
Net weight of klystron:	
K3014, K3015	210 pounds (95kg) approx
K3016	155 pounds (70kg) approx

Circuit Assembly

Electro-magnet current (see note 3)	9 ± 1	A
Electro-magnet resistance:		
cold (20°C)	9.5 ± 1	Ω
hot (20°C ambient)	12	Ω max
R.F. input connector		type N coaxial
R.F. output		$3^1/_8$ inch 50Ω coaxial line
Net weight of tuning cavities:		
for K3014		120 pounds (54kg) approx
for K3015		90 pounds (41kg) approx
for K3016		70 pounds (32kg) approx
Total lifting weight of klystron, cavities, boiler and mounting collar:		
K3014		440 pounds (200kg) approx
K3015		410 pounds (186kg) approx
K3016		335 pounds (152kg) approx
Net weight of magnet assembly		1800 pounds (816kg) approx

EEV arc detector type MA257 is fitted to the output cavity. See pages 22 to 24 for connection details and suggested operating circuit.

Cooling

The klystron collector is vapour cooled in a boiler with an upward steam exit, intended for use with a separate condenser. The klystron body is water cooled; the gun and the output and penultimate cavities require forced air cooling.

Volume of steam produced by collector dissipation	1.5	ft^3/min/kW ($0.043m^3$/min/kW)
Volume of water converted to steam	0.006	imp.gal/min/kW (0.027 litre/min/kW)
Inlet water flow to body and collector in series		2.0imp.gal/min (9 litres/min)
Body pressure drop at 2.0imp.gal/min	28	lb/in^2 ($2.0kg/cm^2$)
Inlet water temperature	80	°C max
Air flow to penultimate and output cavities		$50ft^3$/min ($1.42m^3$/min) each
Static pressure head (see note 4)		1 inch w.g.
Air flow to cathode		$5.0ft^3$/min ($0.142m^3$/min)
Inlet air temperature	40	°C max
Temperature of any external part of the klystron must not exceed	175	°C max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage:		
continuous	20	kV max
switch-on surge	24	kV max
Beam current (mean)	6.0	A max
Body current	150	mA max
Output power	30	kW max
Collector dissipation	100	kW max
Load v.s.w.r. (see note 5)	1.5:1	max
Thermocouple e.m.f. (see note 6)	11.5	mV max

TYPICAL OPERATION (Vision amplifier)

Operating Conditions

Beam voltage	18	kV
Beam current	4.6	A
Electro-magnet current	9.0	A
Bandwidth (to 1db points)	8.0	MHz

K3014 IN K4102BD CIRCUIT

Frequency	486 to 494 (channel 23)	542 to 550 (channel 30)	MHz
Body current:			
with no input power	15	15	mA
at 28kW c.w. output, vision frequency	60	55	mA
Drive power for 28kW output	2.0	2.0	W
Saturated output power	28	28	kW

K3015 IN K4103BD CIRCUIT

Frequency	590 to 598 (channel 36)	710 to 718 (channel 51)	MHz
Body current:			
with no input power	15	15	mA
at 28kW c.w. output, vision frequency	55	60	mA
Drive power for 28kW output	1.0	1.2	W
Saturated output power	28	28	kW

K3016 IN K4104BD CIRCUIT

Frequency	702 to 710 (channel 50)	846 to 854 (channel 68)	MHz
Body current:			
with no input power	15	15	mA
at 28kW c.w. output, vision frequency	75	80	mA
Drive power for 28kW output	0.8	1.5	W
Saturated output power	28	28	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 7 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the maximum value of the modulating anode current is 1.5mA. The potential divider network must be designed accordingly.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K3014 IN K4102BD CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	470 to 610	MHz
Bandwidth (see note 7)	8.0	MHz
Output power (see note 8)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 9)	–	18.5	kV
Body current (see note 10)	–	150	mA
Modulating anode current	–	6.0	mA
R.F. drive power (see note 11)	–	3.0	W
Efficiency (see note 12)	32	–	%

K3015 IN K4103BD CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 7)	8.0	MHz
Output power (see note 8)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 9)	–	18.5	kV
Body current (see note 10)	–	150	mA
Modulating anode current	–	6.0	mA
R.F. drive power (see note 11)	–	3.0	W
Efficiency (see note 12)	32	–	%

K3016 IN K4104BD CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	700 to 860	MHz
Bandwidth (see note 7)	8.0	MHz
Output power (see note 8)	28	kW

Range of Characteristics

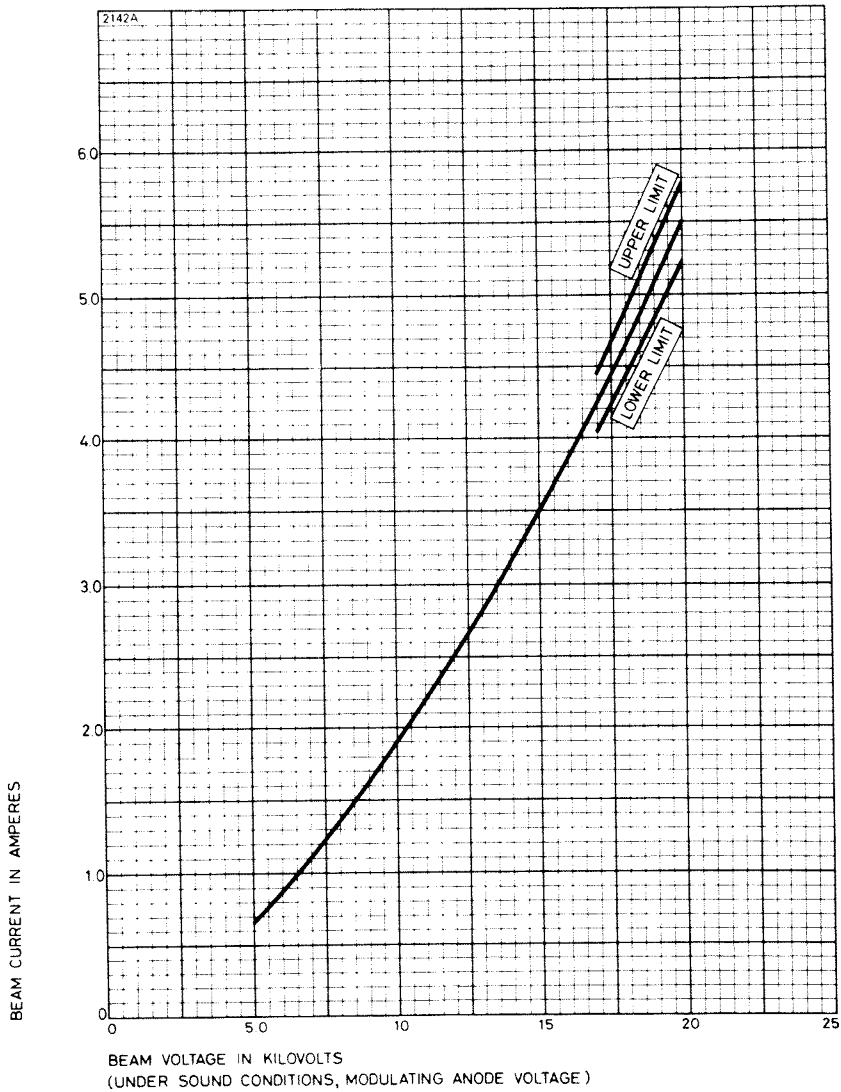
	Min	Max	
Heater current	37	46	A
Beam voltage (see note 9)	–	19	kV
Body current (see note 10)	–	150	mA
Modulating anode current	–	6.0	mA
R.F. drive power (see note 11)	–	2.0	W
Efficiency (see note 12)	30	–	%

NOTES

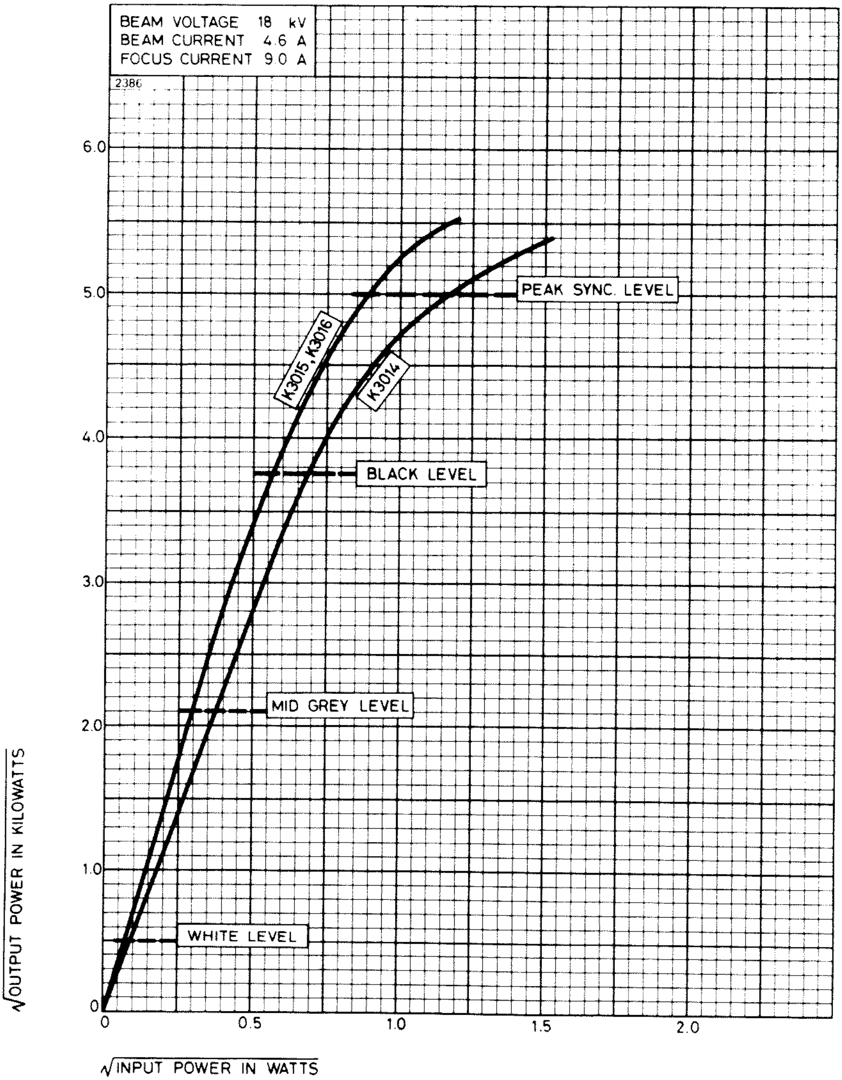
1. For fast warm-up using a 'hot shot' technique, consult English Electric Valve Company Ltd.
2. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 135 inches (3.43m) is required. This is measured to the top of the lifting harness and does not include the hoist.
3. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily over the current range stated.
4. Measured at the input pipes to the circuit assembly.
5. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
6. The klystron is provided with three copper-constantan thermocouples fitted to the collector. On commissioning a new klystron the output of each must be monitored and the one reading the highest temperature used as a control for future monitoring.
7. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.

8. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
9. With the modulating anode connected to the body via a 10kΩ resistor the beam current will be within ±5% of the value given by the graph on page 7.
10. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
11. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
12. The efficiency will not fall below the specified limit for any beam power in the range 75 to 95kW.

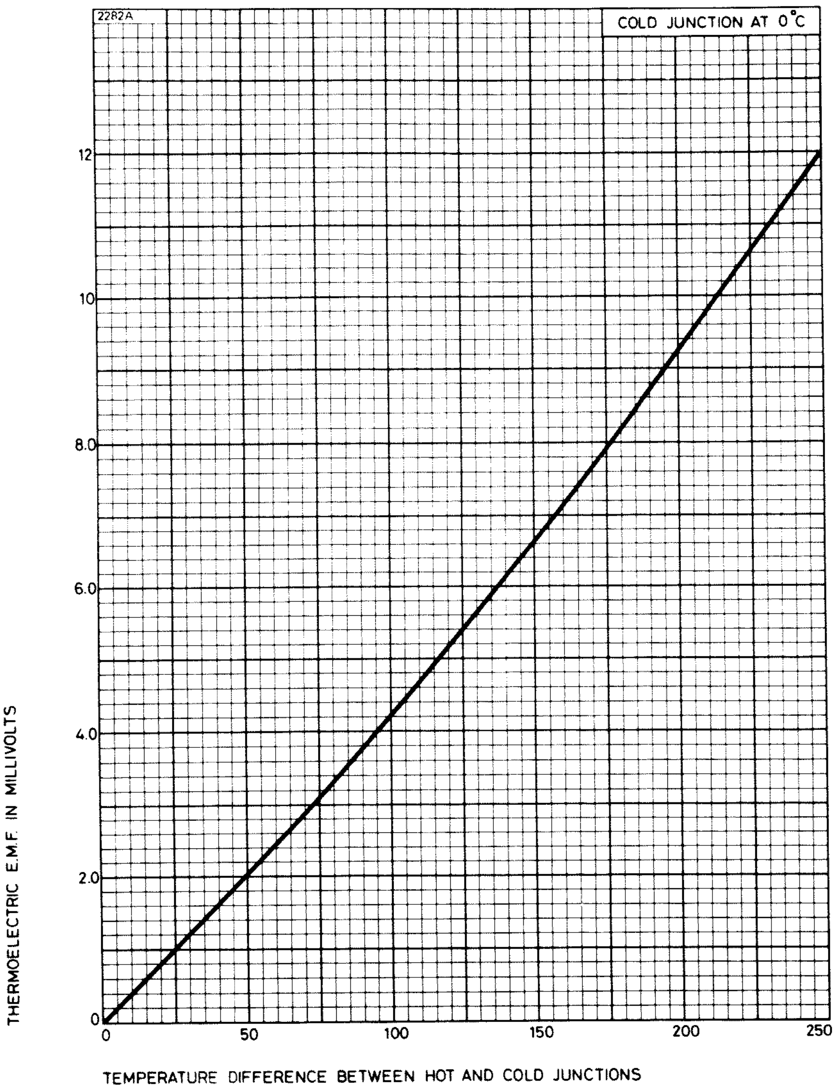
TYPICAL BEAM CHARACTERISTIC



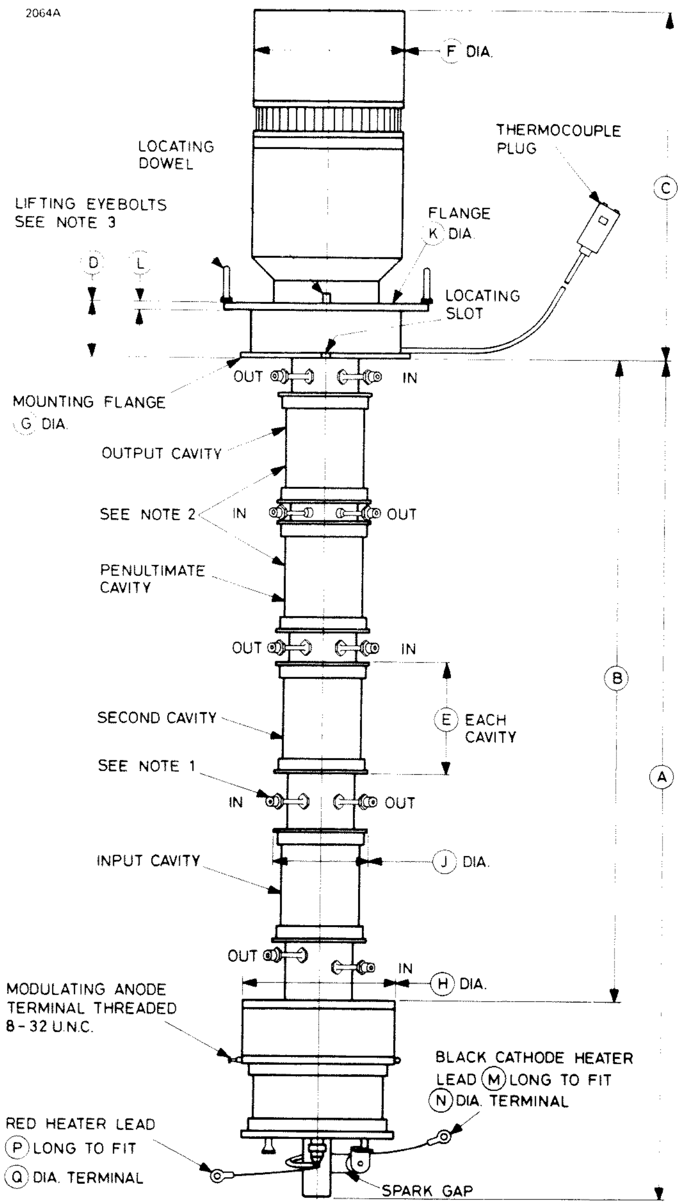
TYPICAL GAIN CHARACTERISTICS



THERMOCOUPLE CALIBRATION CURVE



OUTLINE FOR K3014



Outline Dimensions

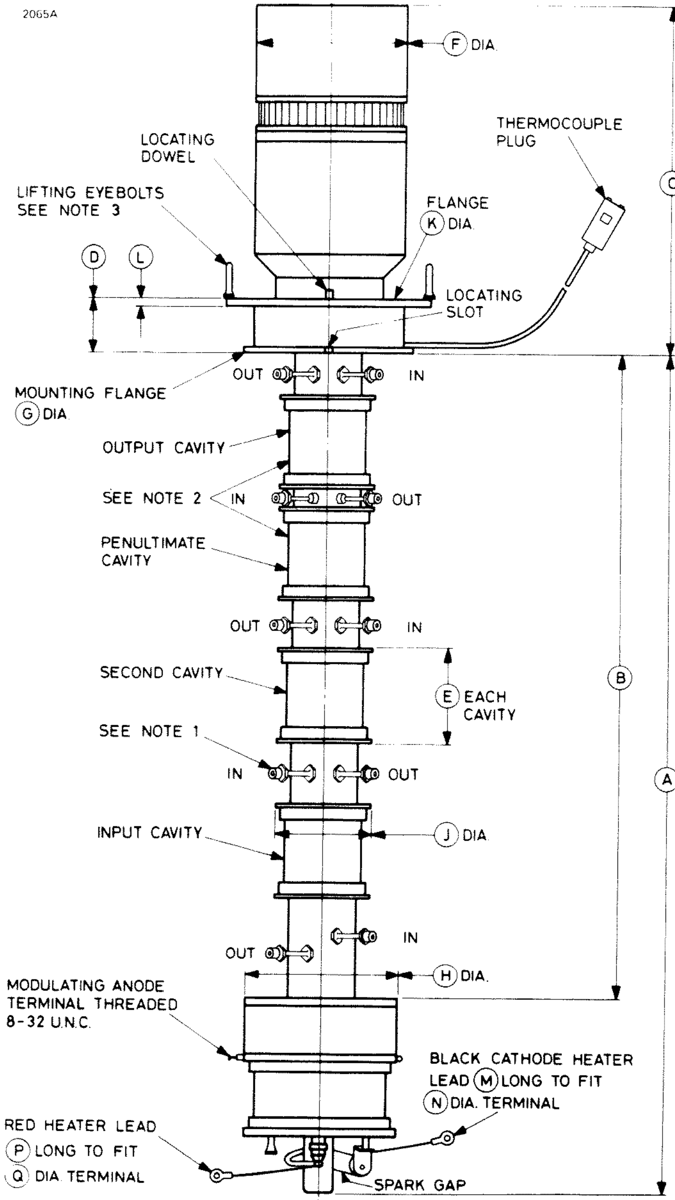
Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	6.000	152.4
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.

OUTLINE FOR K3015



Outline Dimensions

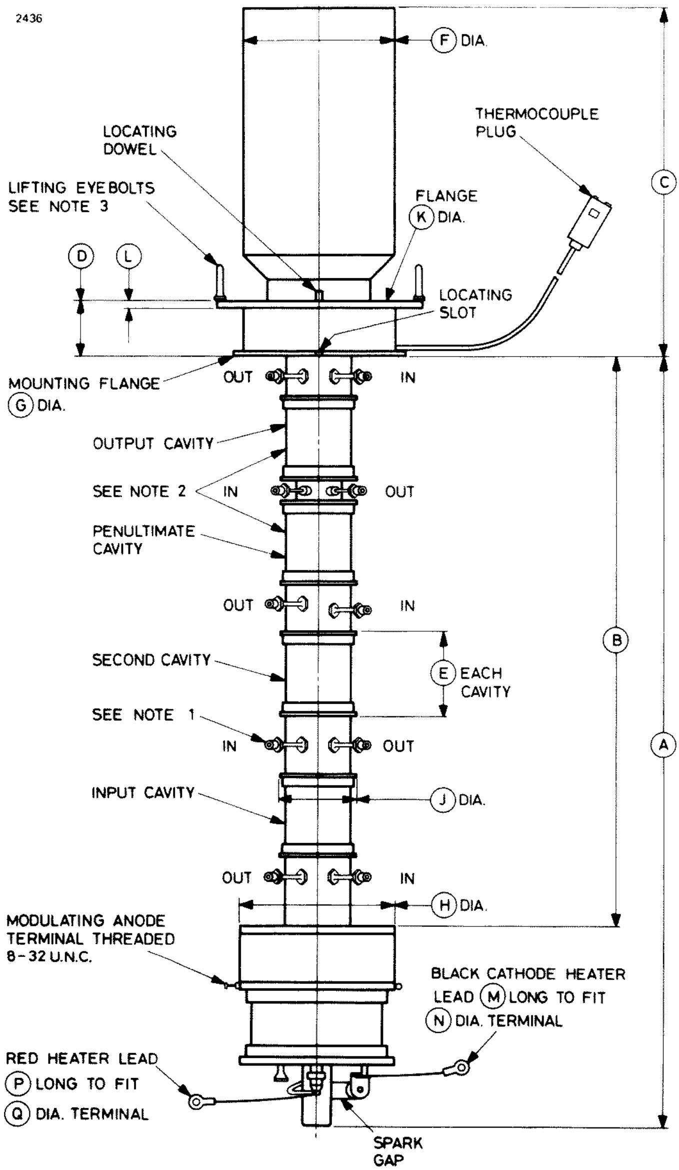
Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	5.000	127.0
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.

OUTLINE FOR K3016



Outline Dimensions

Ref	Inches	Millimetres
A	40.600	1031.2
B	29.875	758.8
C	18.500	469.9
D	3.000	76.20
E	4.500	114.3
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	4.125	104.8
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

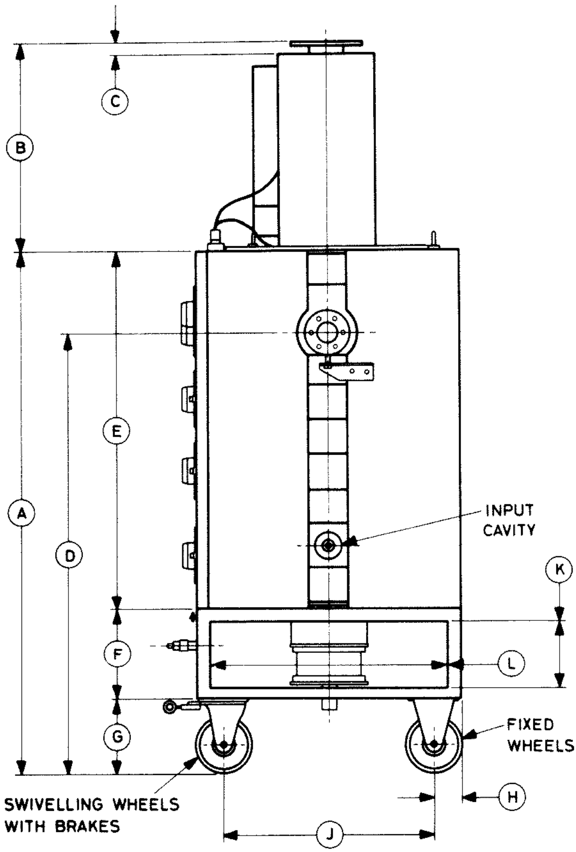
Millimetre dimensions have been derived from inches.

Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.

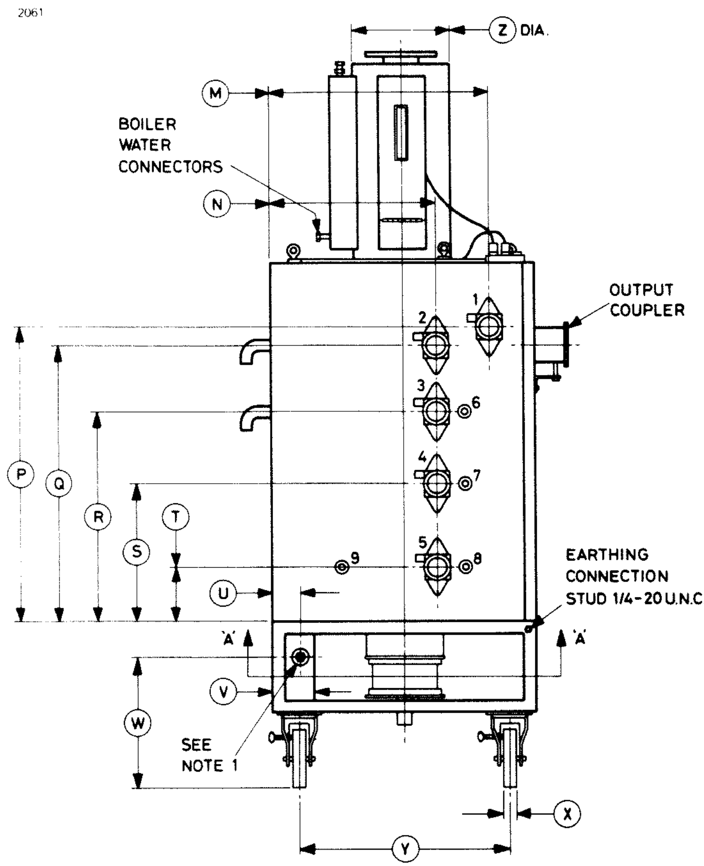
OUTLINE FOR CIRCUIT ASSEMBLIES

2062



Note This drawing is not to scale for the K4104BD.

OUTLINE FOR CIRCUIT ASSEMBLIES



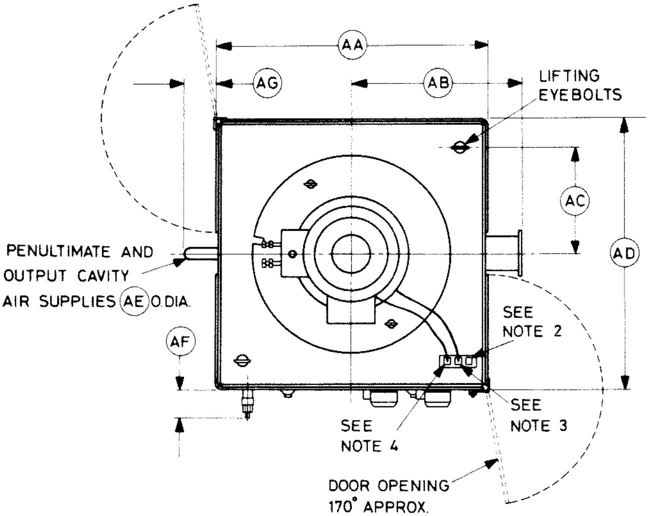
Controls

1	Output coupling	6	Penultimate cavity loading
2	Output cavity tuning	7	Second cavity loading
3	Penultimate cavity tuning	8	Input cavity coupling
4	Second cavity tuning	9	Input cavity loading
5	Input cavity tuning		

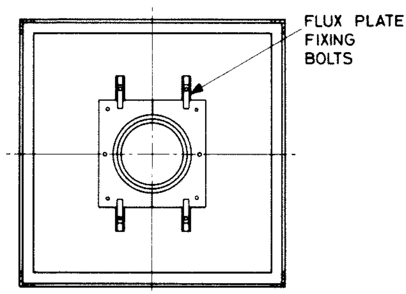
Note This drawing is not to scale for the K4104BD.

OUTLINE FOR CIRCUIT ASSEMBLIES

2063



VIEW FROM ABOVE



SECTION 'A'—'A' SHOWING
CENTRING PLATE

OUTLINE NOTES

1. Water inlet connection Hitemp Minilock Self Sealing Coupling, threaded ½-inch B.S.P.
2. Connections to external circuits; see page 22.
3. Thermocouple socket, accepts plug wired to klystron.
4. Collector and level trip socket, accepts plug wired to boiler.

OUTLINE DIMENSIONS FOR K4102BD AND K4103BD

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	55.125 ± 0.125	1400.2 ± 3.2	S	14.562	369.9
B	22.000 ± 0.125	558.8 ± 3.2	T	5.750	146.1
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	37.813 ± 0.062	960.5 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	9.688 ± 0.062	246.1 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.062	555.6 ± 1.57
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.000 ± 0.125	711.2 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.750 max	400.1 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.000 ± 0.125	711.2 ± 3.2
N	17.500	444.5	AE	1.750	44.45
P	30.813	782.7	AF	4.250	108.0
Q	28.937	735.0	AG	2.500	63.50
R	22.062	560.4			

Millimetre dimensions have been derived from inches.

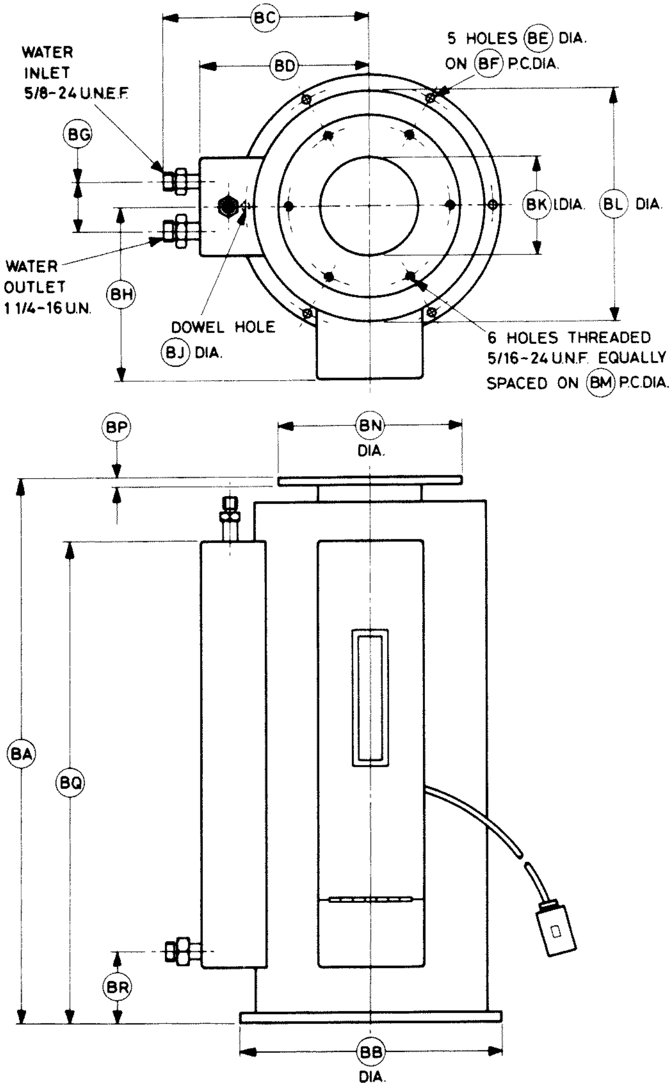
OUTLINE DIMENSIONS FOR K4104BD

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	54.562 ± 0.125	1385.9 ± 3.2	S	12.625	320.7
B	22.000 ± 0.125	558.8 ± 3.2	T	5.125	130.2
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	33.375 ± 0.062	847.7 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	13.562 ± 0.062	344.5 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.062	555.6 ± 1.57
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.000 ± 0.125	711.2 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.5 max	393.7 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.000 ± 0.125	711.2 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	26.938	684.2	AF	4.250	108.0
Q	25.062	636.6	AG	2.750	69.85
R	19.562	496.9			

Millimetre dimensions have been derived from inches.

BOILER UNIT

2060



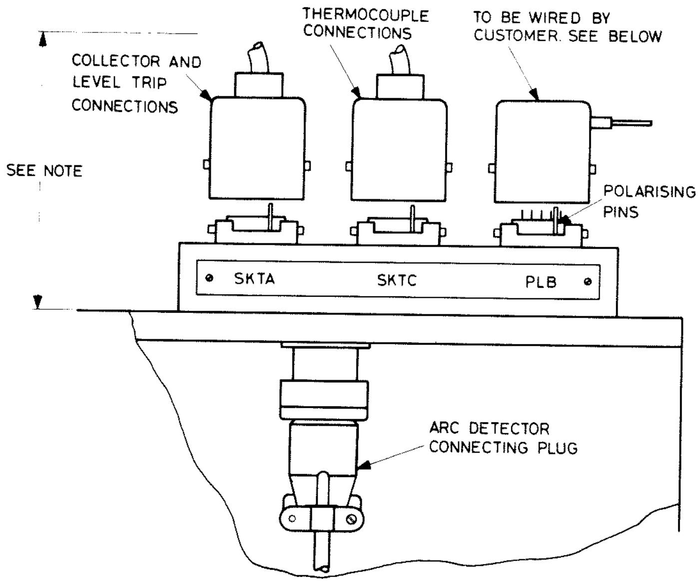
DIMENSIONS FOR BOILER UNIT

Ref	Inches	Millimetres
BA	23.125 ± 0.125	587.4 ± 3.2
BB	11.125 ± 0.125	282.6 ± 3.2
BC	8.250 ± 0.125	209.6 ± 3.2
BD	7.125 ± 0.125	181.0 ± 3.2
BE	0.312	7.92
BF	10.500	266.7
BG	2.000 ± 0.062	50.80 ± 1.57
BH	7.375 ± 0.125	187.3 ± 3.2
BJ*	0.394	10.0
BK	4.000	101.6
BL	9.750	247.7
BM	7.000	177.8
BN	7.750 ± 0.016	196.9 ± 0.4
BP	0.375	9.53
BQ	20.562	522.3
BR	2.938 ± 0.062	74.63 ± 1.57

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

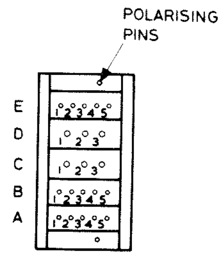
PLUG AND SOCKET CONNECTIONS

2115



Input Socket Connections (to be wired by customer)

Water level trip circuit	B1, B2
Collector connection	C1
Thermocouple circuit:	
copper	B3
constantan 1	C2
constantan 2	D2
constantan 3	D1
Arc detector circuit:	
photo resistor	E4, E5
bulb	E2, E3
screen and earth	E1
link	B4, B5
Focus coils:	
positive	C3
negative	D3



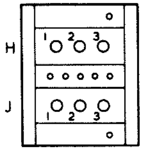
Input socket

View on solder connections with cover removed

Note Clearance for connector removal 5.750 inches (146mm) minimum.

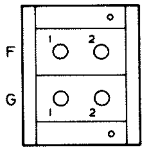
Collector Plug

2116



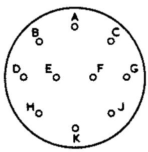
Pin	Element
H1	Collector
H2	—
H3	—
J1	Water level trip
J2	Water level trip
J3	—

Thermocouple Plug



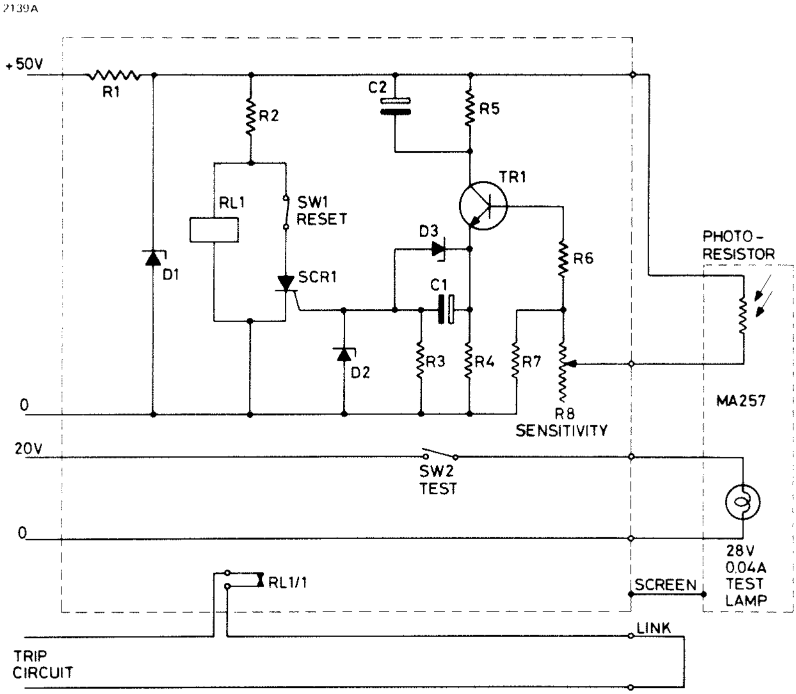
Pin	Element
F1	Copper
F2	Constantan 3
G1	Constantan 1
G2	Constantan 2

Arc Detector Plug



Pin	Element
A	Photo resistor
B	Photo resistor
C	Bulb
D	Link
E	Screen and earth
F	Screen and earth
G	Bulb
H	Link
J	No connection
K	No connection

SUGGESTED CIRCUIT FOR ARC DETECTOR



K3017 K3018 K3019

HIGH POWER KLYSTRONS

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is vapour cooled in a boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.

Klystron	Frequency Range	Circuit Assembly
K3017	470 to 610MHz	K4102BD
K3018	590 to 720MHz	K4103BD
K3019	700 to 860MHz	K4104BD

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	45	kW
Power gain (typical):		
K3017	40	db
K3018	44	db
K3019	46	db
Beam voltage	21.5	kV
Output	$3^1/_8$ inch 50Ω coaxial line	
Cooling (see page 2)	water, vapour and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	$8.5 \pm 3\%$	V
Heater current range	37 to 46	A
Heater starting current (peak)	200	A max
Cathode heating time (see note 1)	5	minutes

Mechanical

Overall length (see note 2):	
K3017, K3018	63.75 inches (161.9cm) max
K3019	59.5 inches (151.1cm) max
Overall diameter	11.125 inches (283mm) nom
Mounting position	vertical, collector end up
Net weight of klystron:	
K3017, K3018	210 pounds (95kg) approx
K3019	155 pounds (70kg) approx

Circuit Assembly

Electro-magnet current (see note 3)	11 ± 1	A
Electro-magnet resistance:		
cold (20°C)	9.5 ± 1	Ω
hot (20°C ambient)	12	Ω max
R.F. input connector		type N coaxial
R.F. output		$3^1/_8$ inch 50Ω coaxial line
Net weight of tuning cavities:		
for K3017		120 pounds (54kg) approx
for K3018		90 pounds (41kg) approx
for K3019		70 pounds (32kg) approx
Total lifting weight of klystron, cavities, boiler and mounting collar:		
K3017		440 pounds (200kg) approx
K3018		410 pounds (186kg) approx
K3019		335 pounds (152kg) approx
Net weight of magnet assembly		1800 pounds (816kg) approx

EEV arc detector type MA257 is fitted to the output cavity. See pages 22 to 24 for connection details and suggested operating circuit.

Cooling

The klystron collector is vapour cooled in a boiler with an upward steam exit, intended for use with a separate condenser. The klystron body is water cooled; the gun and the output and penultimate cavities require forced air cooling.

Volume of steam produced by collector dissipation	1.5	ft^3/min/kW ($0.043m^3$/min/kW)
Volume of water converted to steam	0.006	imp.gal/min/kW (0.027 litre/min/kW)
Inlet water flow to body and collector in series		2.0imp.gal/min (9 litres/min)
Body pressure drop at 2.0imp.gal/min	28	lb/in^2 ($2.0kg/cm^2$)
Inlet water temperature	80	°C max
Air flow to penultimate and output cavities		$50ft^3$/min ($1.42m^3$/min) each
Static pressure head (see note 4)		1 inch w.g.
Air flow to cathode		$5.0ft^3$/min ($0.142m^3$/min)
Inlet air temperature	40	°C max
Temperature of any external part of the klystron must not exceed	175	°C max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage:		
continuous	23	kV max
switch-on surge	27	kV max
Beam current (mean)	7.0	A max
Body current	150	mA max
Output power	50	kW max
Collector dissipation	150	kW max
Load v.s.w.r. (see note 5)	1.5:1	max
Thermocouple e.m.f. (see note 6)	11.5	mV max

TYPICAL OPERATION (Vision amplifier)

Beam voltage	21.5	kV
Beam current	6.2	A
Electro-magnet current	11	A
Bandwidth (to 1db points)	8.0	MHz

K3017 in K4102BD Circuit

Frequency	470 to 478 (channel 21)	598 to 606 (channel 37)	MHz
Body current:			
with no input power	15	15	mA
at 45kW c.w. output, vision frequency	78	85	mA
Drive power for 45kW output	4.0	4.0	W
Saturated output power	45	47	kW

K3018 in K4103BD Circuit

Frequency	590 to 598 (channel 36)	710 to 718 (channel 51)	MHz
Body current:			
with no input power	15	15	mA
at 45kW c.w. output, vision frequency	65	55	mA
Drive power for 45kW output	1.5	1.5	W
Saturated output power	45	47	kW

K3019 in K4104BD Circuit

Frequency	702 to 710 (channel 50)	846 to 854 (channel 68)	MHz
Body current:			
with no input power	15	15	mA
at 45kW c.w. output, vision frequency	90	100	mA
Drive power for 45kW output	0.8	1.2	W
Saturated output power	47	45	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 7 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the maximum value of the modulating anode current is 1.5mA. The potential divider network must be designed accordingly.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K3017 IN K4102BD CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	10 to 12	A
Frequency range	470 to 610	MHz
Bandwidth (see note 7)	8.0	MHz
Output power (see note 8)	45	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 9)	–	22.5	kV
Body current (see note 10)	–	150	mA
Modulating anode current	–	6.0	mA
R.F. drive power (see note 11)	–	5.0	W
Efficiency (see note 12)	32	–	%

K3018 IN K4103BD CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	10 to 12	A
Frequency range	590 to 720	MHz
Bandwidth (see note 7)	8.0	MHz
Output power (see note 8)	45	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 9)	–	22.5	kV
Body current (see note 10)	–	150	mA
Modulating anode current	–	6.0	mA
R.F. drive power (see note 11)	–	3.0	W
Efficiency (see note 12)	32	–	%

K3019 IN K4104BD CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	10 to 12	A
Frequency range	700 to 860	MHz
Bandwidth (see note 7)	8.0	MHz
Output power (see note 8)	45	kW

Range of Characteristics

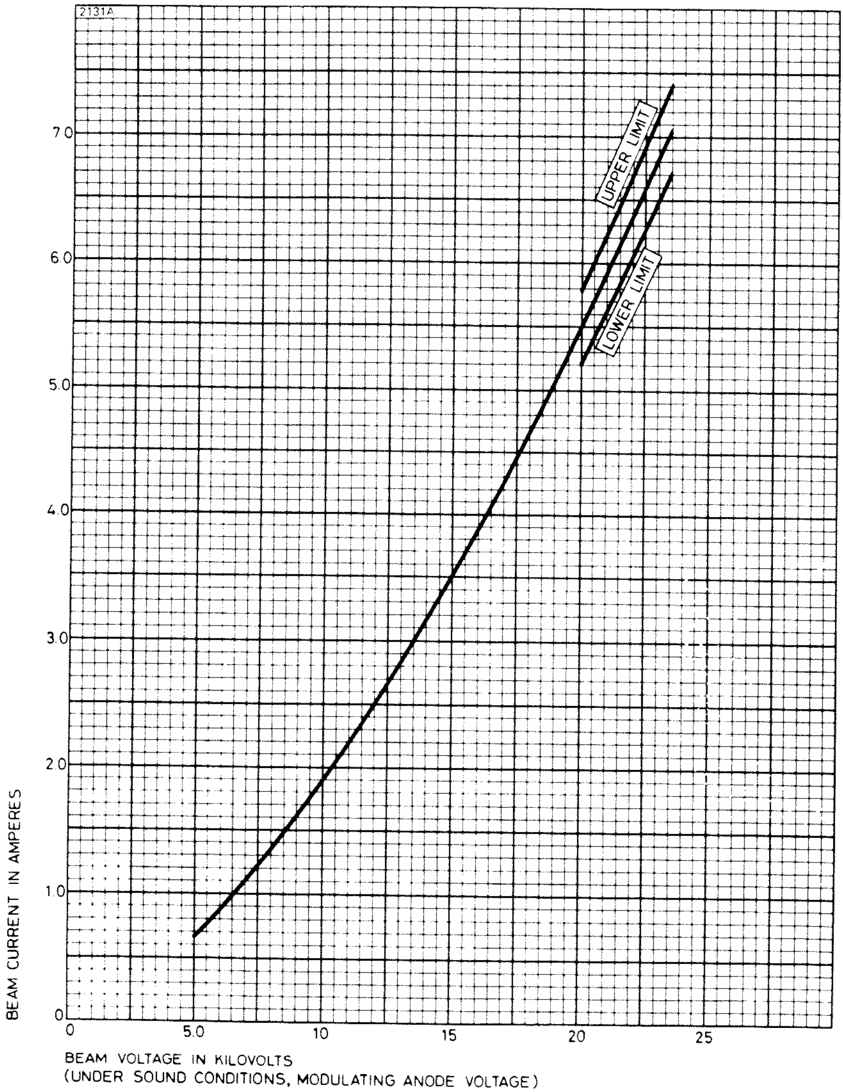
	Min	Max	
Heater current	37	46	A
Beam voltage (see note 9)	–	22.5	kV
Body current (see note 10)	–	150	mA
Modulating anode current	–	6.0	mA
R.F. drive power (see note 11)	–	3.0	W
Efficiency (see note 12)	32	–	%

NOTES

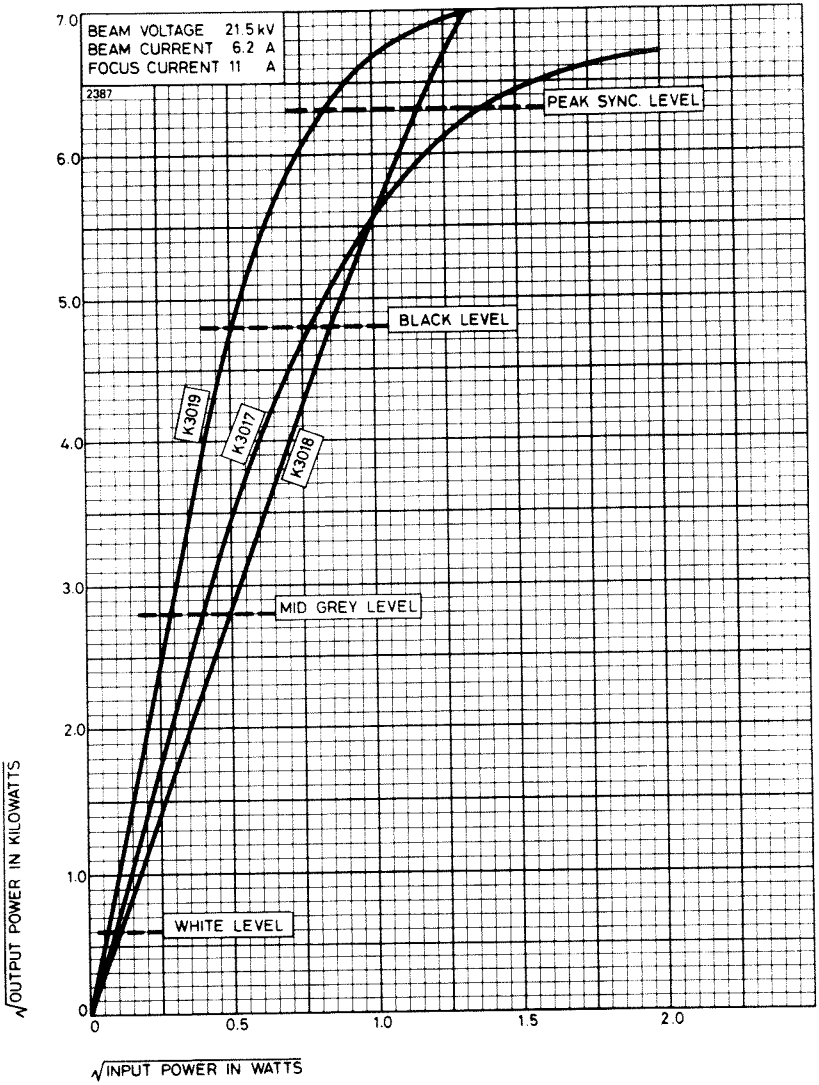
1. For fast warm-up using a 'hot shot' technique, consult English Electric Valve Company Ltd.
2. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 135 inches (3.43m) is required. This is measured to the top of the lifting harness and does not include the hoist.
3. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily over the current range stated.
4. Measured at the input pipes to the circuit assembly.
5. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
6. The klystron is provided with three copper-constantan thermocouples fitted to the collector. On commissioning a new klystron the output of each must be monitored and the one reading the highest temperature used as a control for future monitoring.
7. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.

8. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
9. With the modulating anode connected to the body via a 10kΩ resistor the beam current will be within $\pm$5% of the value given by the graph on page 7.
10. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
11. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
12. The efficiency will not fall below the specified limit for any beam power in the range 120 to 150kW.

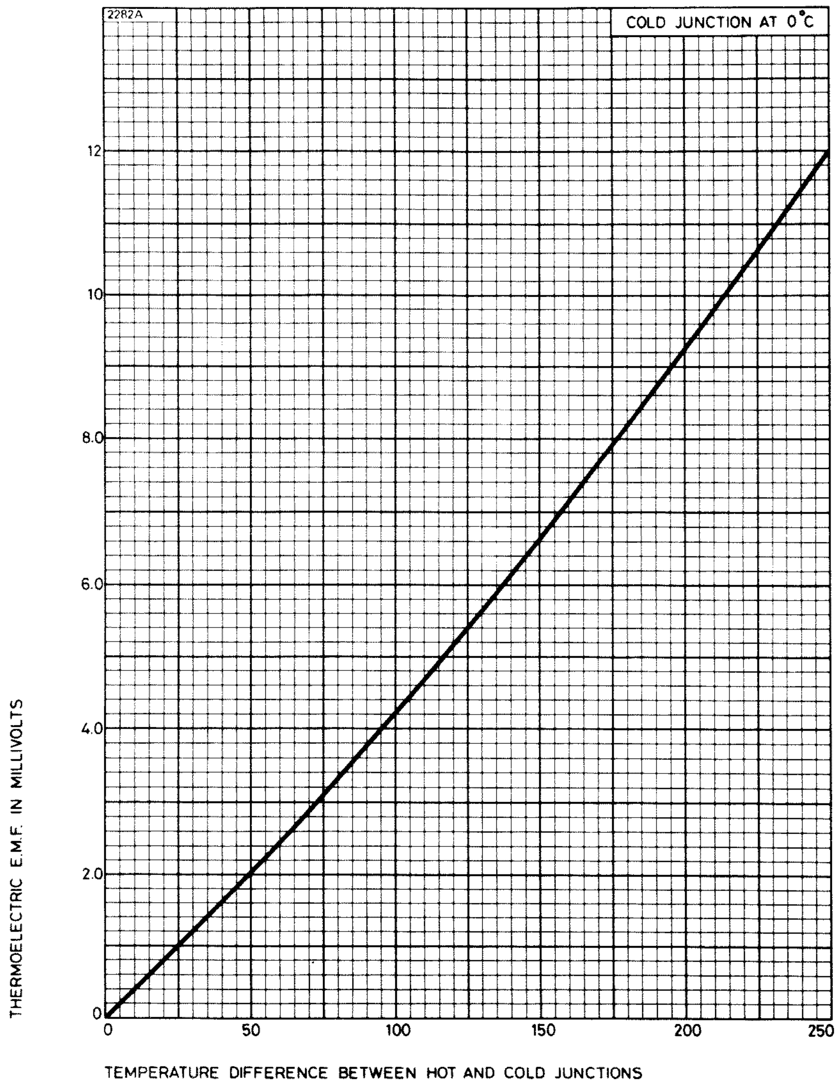
TYPICAL BEAM CHARACTERISTIC



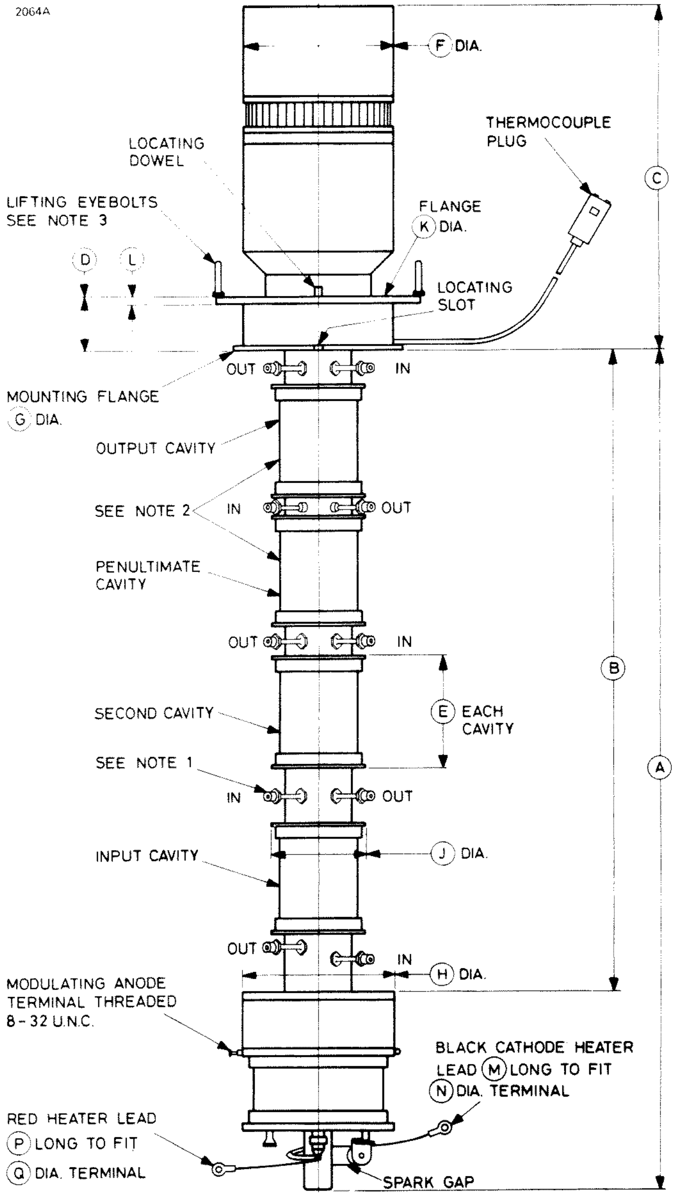
TYPICAL GAIN CHARACTERISTICS



THERMOCOUPLE CALIBRATION CURVE



OUTLINE FOR K3017



Outline Dimensions

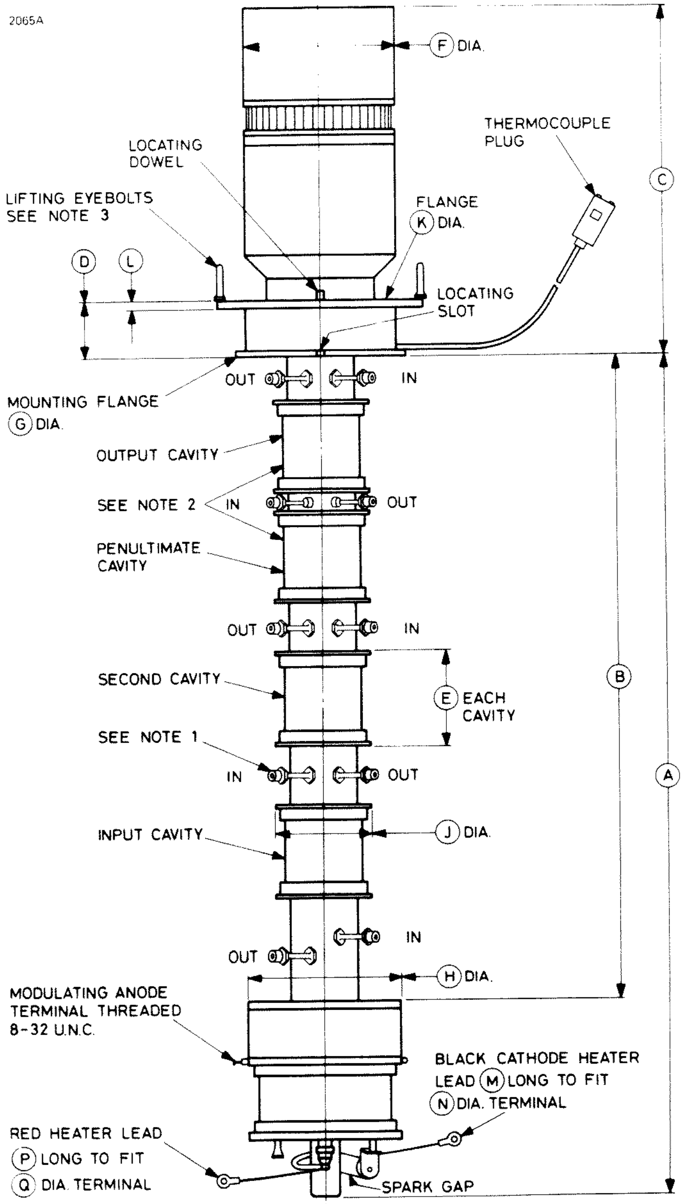
Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	6.000	152.4
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.

OUTLINE FOR K3018



Outline Dimensions

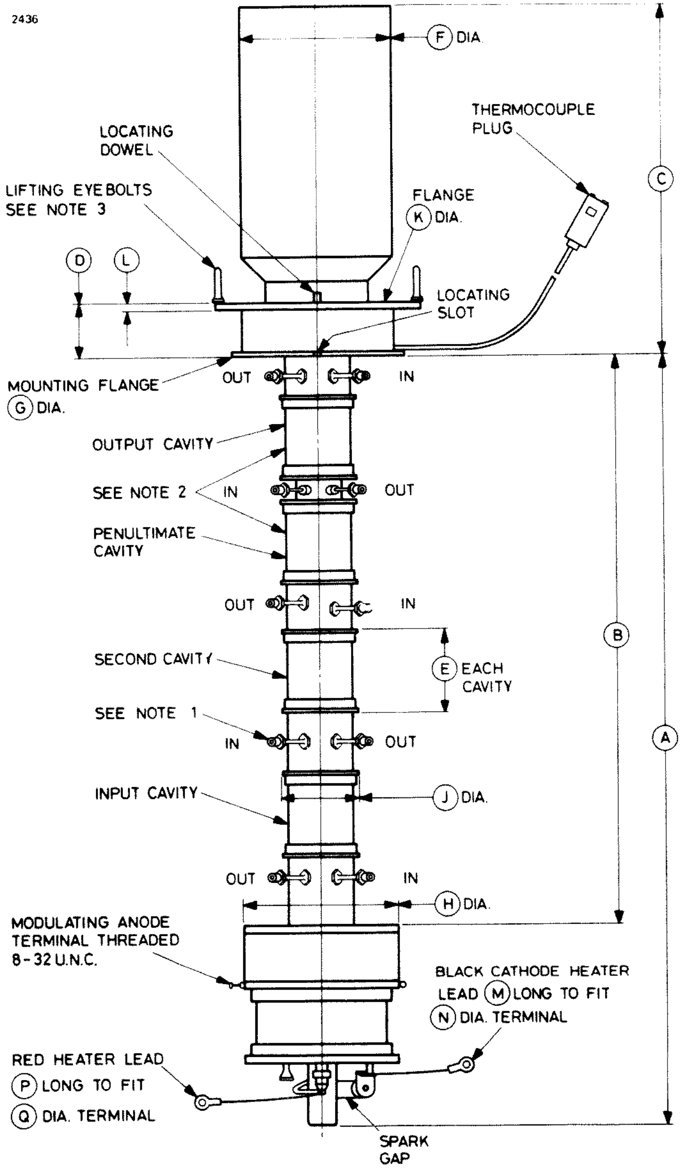
Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	5.000	127.0
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.

OUTLINE FOR K3019



Outline Dimensions

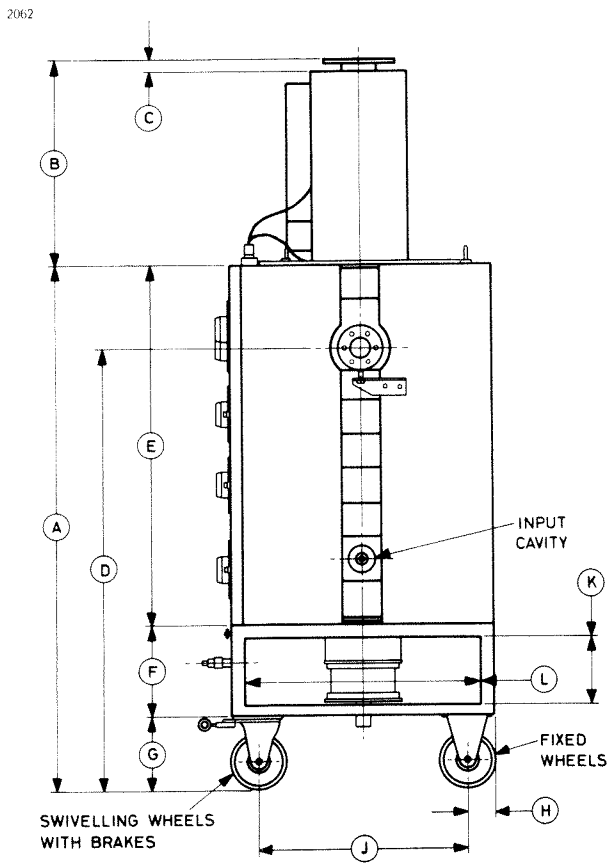
Ref	Inches	Millimetres
A	40.600	1031.2
B	29.875	758.8
C	18.500	469.9
D	3.000	76.20
E	4.500	114.3
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	4.125	104.8
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

Outline Notes

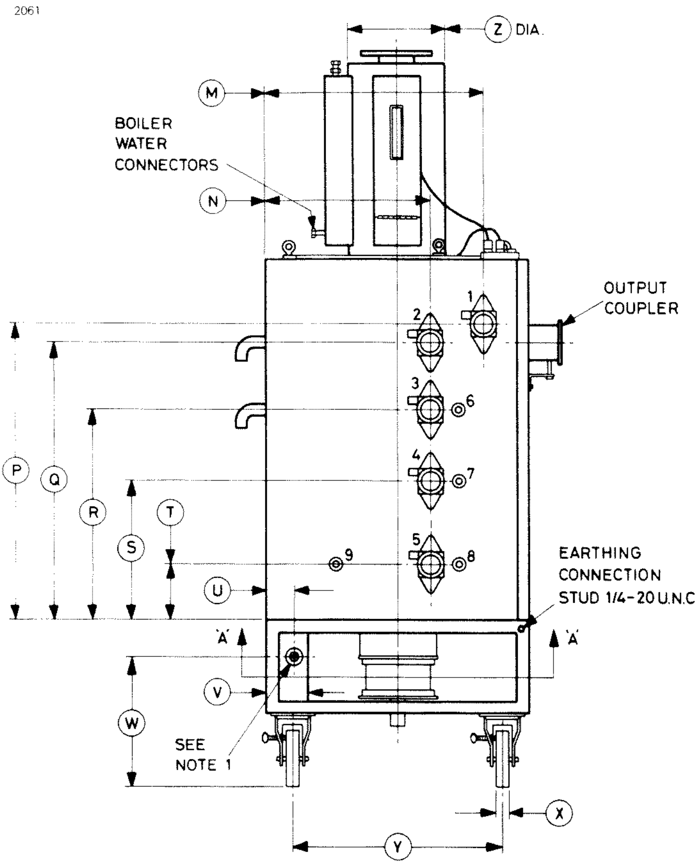
1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $^5/_8$ U.N.E.F. and a set of connecting pipes is included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.

OUTLINE FOR CIRCUIT ASSEMBLIES



Note This drawing is not to scale for the K4104BD.

OUTLINE FOR CIRCUIT ASSEMBLIES

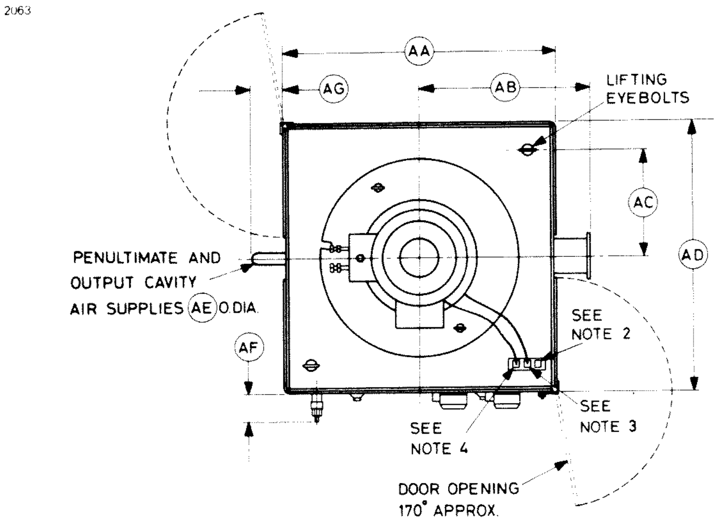


Controls

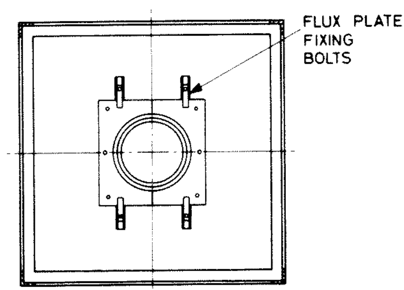
1	Output coupling	6	Penultimate cavity loading
2	Output cavity tuning	7	Second cavity loading
3	Penultimate cavity tuning	8	Input cavity coupling
4	Second cavity tuning	9	Input cavity loading
5	Input cavity tuning		

Note This drawing is not to scale for the K4104BD.

OUTLINE FOR CIRCUIT ASSEMBLIES



VIEW FROM ABOVE



SECTION 'A'—'A' SHOWING
CENTRING PLATE

OUTLINE NOTES

1. Water inlet connection Hitemp Minilock Self Sealing Coupling, threaded ½-inch B.S.P.
2. Connections to external circuits; see page 22.
3. Thermocouple socket, accepts plug wired to klystron.
4. Collector and level trip socket, accepts plug wired to boiler.

OUTLINE DIMENSIONS FOR K4102BD AND K4103BD

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	55.125 ± 0.125	1400.2 ± 3.2	S	14.562	369.9
B	22.000 ± 0.125	558.8 ± 3.2	T	5.750	146.1
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	37.813 ± 0.062	960.5 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	9.688 ± 0.062	246.1 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.062	555.6 ± 1.57
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.000 ± 0.125	711.2 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.750 max	400.1 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.000 ± 0.125	711.2 ± 3.2
N	17.500	444.5	AE	1.750	44.45
P	30.813	782.7	AF	4.250	108.0
Q	28.937	735.0	AG	2.500	63.50
R	22.062	560.4			

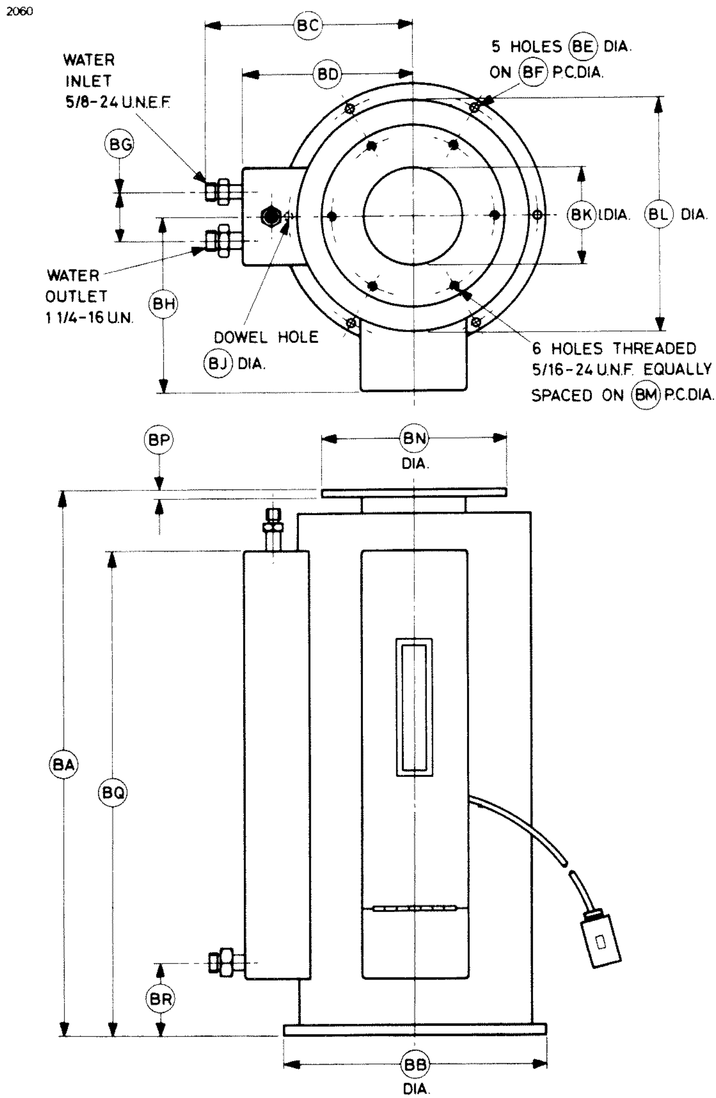
Millimetre dimensions have been derived from inches.

OUTLINE DIMENSIONS FOR K4104BD

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	54.562 ± 0.125	1385.9 ± 3.2	S	12.625	320.7
B	22.000 ± 0.125	558.8 ± 3.2	T	5.125	130.2
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	33.375 ± 0.062	847.7 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	13.562 ± 0.062	344.5 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.062	555.6 ± 1.57
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.000 ± 0.125	711.2 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.5 max	393.7 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.000 ± 0.125	711.2 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	26.938	684.2	AF	4.250	108.0
Q	25.062	636.6	AG	2.750	69.85
R	19.562	496.9			

Millimetre dimensions have been derived from inches.

BOILER UNIT



2060
BC
BD
WATER
INLET
5/8-24 U.N.E.F.
5 HOLES BE DIA.
ON BF P.C.DIA.
BG
BK DIA.
BL DIA.
WATER
OUTLET
1 1/4-16 U.N.
BH
DOWEL HOLE
BJ DIA.
6 HOLES THREADED
5/16-24 U.N.F. EQUALLY
SPACED ON BM P.C.DIA.
BP
BN
DIA.
BA
BQ
BR
BB
DIA.

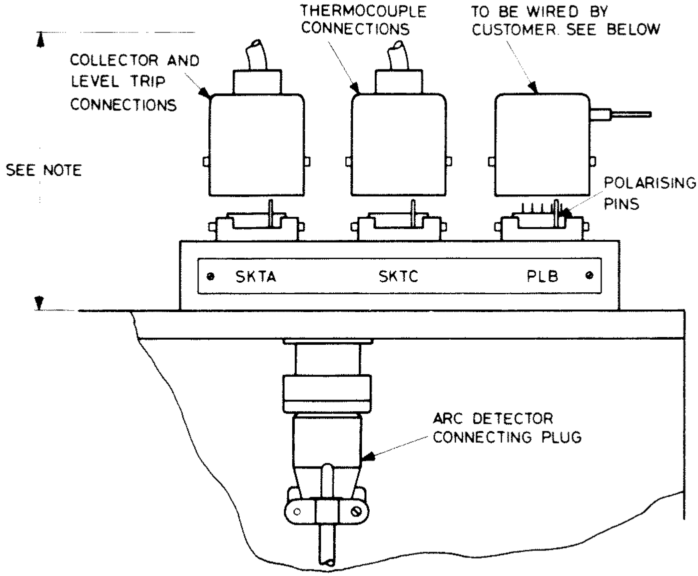
DIMENSIONS FOR BOILER UNIT

Ref	Inches	Millimetres
BA	23.125 ± 0.125	587.4 ± 3.2
BB	11.125 ± 0.125	282.6 ± 3.2
BC	8.250 ± 0.125	209.6 ± 3.2
BD	7.125 ± 0.125	181.0 ± 3.2
BE	0.312	7.92
BF	10.500	266.7
BG	2.000 ± 0.062	50.80 ± 1.57
BH	7.375 ± 0.125	187.3 ± 3.2
BJ*	0.394	10.0
BK	4.000	101.6
BL	9.750	247.7
BM	7.000	177.8
BN	7.750 ± 0.016	196.9 ± 0.4
BP	0.375	9.53
BQ	20.562	522.3
BR	2.938 ± 0.062	74.63 ± 1.57

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

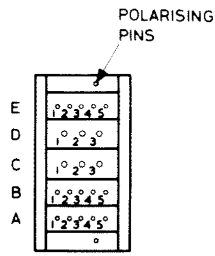
PLUG AND SOCKET CONNECTIONS

2115



Input Socket Connections (to be wired by customer)

Water level trip circuit	B1, B2
Collector connection	C1
Thermocouple circuit:	
copper	B3
constantan 1	C2
constantan 2	D2
constantan 3	D1
Arc detector circuit:	
photo resistor	E4, E5
bulb	E2, E3
screen and earth	E1
link	B4, B5
Focus coils:	
positive	C3
negative	D3



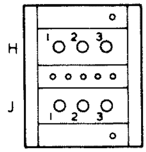
Input socket

View on solder connections with cover removed

Note Clearance for connector removal 5.750 inches (146mm) minimum.

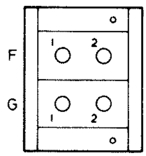
Collector Plug

2116



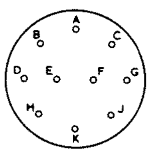
Pin	Element
H1	Collector
H2	—
H3	—
J1	Water level trip
J2	Water level trip
J3	—

Thermocouple Plug



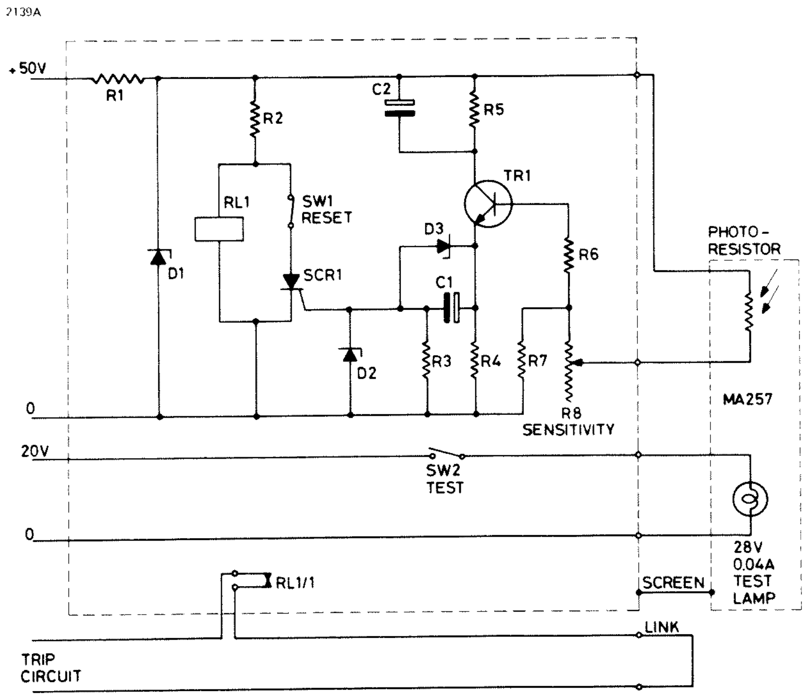
Pin	Element
F1	Copper
F2	Constantan 3
G1	Constantan 1
G2	Constantan 2

Arc Detector Plug



Pin	Element
A	Photo resistor
B	Photo resistor
C	Bulb
D	Link
E	Screen and earth
F	Screen and earth
G	Bulb
H	Link
J	No connection
K	No connection

SUGGESTED CIRCUIT FOR ARC DETECTOR



INTRODUCTION

The K4019 is a complete klystron amplifier circuit designed for use with the 4KM50,000LA klystron. The circuit comprises a magnetic frame, coils for prefocus, body and collector, tuning boxes for the four cavities and other accessories as listed below. Provision should be made for mounting the circuit on a suitable trolley (supplied as an extra if required) fitted with wheels for moving the complete assembly into or out of the equipment.

The amplifier circuit comprises the following items:—

One magnetic frame	(part number MF—117)
One prefocus coil	(part number MC—201)
One upper body coil	(part number MC—239)
One middle body coil	(part number MC—240)
One lower body coil	(part number MC—241)
One collector coil	(part number MC—242)
One klystron socket	(part number SK—110)
One modulating anode connector	(part number SK—111)
One input tuning cavity	(part number RF—451)
One second tuning cavity	(part number RF—452)
One penultimate tuning cavity	(part number RF—450)
One output tuning cavity	(part number RF—453)
One output load coupler	(part number LC—316)
Two load couplers for second and penultimate tuning cavities	(part number LC—313)
One extension wrench (hexagonal type)	(part number HT—100)
Miscellaneous spare fastenings	(part number SP—100)

Any of these parts can be supplied separately for replacement purposes.

GENERAL DATA

Electrical

Prefocus Coil Supply Voltage	0 to 50	V
Prefocus Coil Current:		
Maximum Value	1·5	A
Typical Value	1·0	A
Three Body Coils and Collector Coil in Series:		
Supply Voltage	0 to 600	V
Typical Voltage	500	V
Typical Current	2·6	A

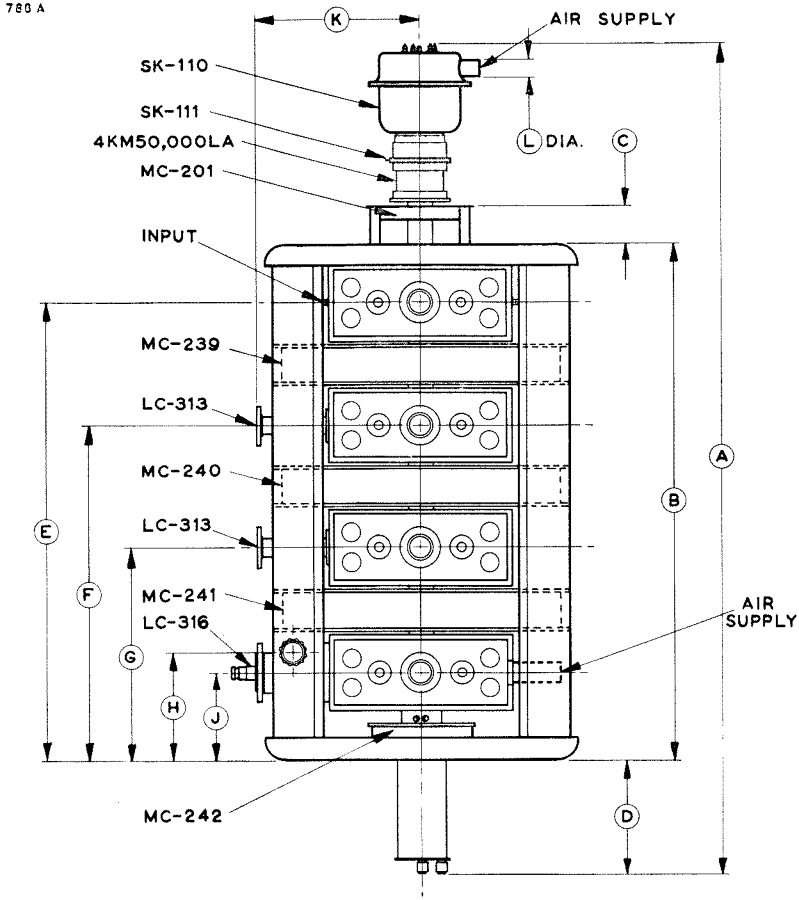
Mechanical

Overall Length (with 4KM50,000LA in position)	69·812 inches	(177·3cm)	Nom
Overall Diameter (excluding output load coupler)	26·25 inches	(66·68cm)	Nom
Net Weight:			
with 4KM50,000LA	831 pounds	(378kg)	Approx
without 4KM50,000LA	767 pounds	(348kg)	Approx
Cavity Tuning Knobs:			
Total Turns	55		
Torque	1·67 lb-ft	(0·231kg-m)	Max
Output Coupler Knob:			
Total Turns	25		
Torque	0·83 lb-ft	(0·115kg-m)	Max

Connections on K4019

R.F. Input	UG-58/U
R.F. Output	3·125 inch (79·38mm) diameter coaxial terminal 5·187 inch (131·7mm) diameter flange
Load Couplers	1·625 inch (41·28mm) diameter coaxial terminals 3·500 inch (88·90mm) diameter flanges
Heater	Posts threaded ¼-20 UNC-2A with lock nuts
Cathode and Focus Electrode	Posts threaded 6-32 UNC-2A with lock nuts
Pre-focus Coil	0·156 inch (3·96mm) spade lugs
Modulating Anode	8-32 UNC screw to accept spade terminal
Collector Coil and Body Coils	10-32 UNF screws to accept spade terminals

OUTLINE



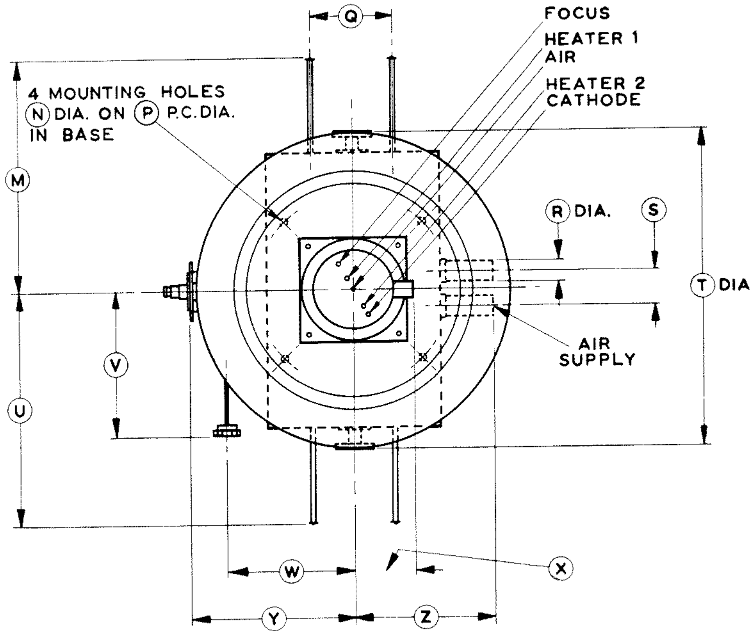
Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	69·812	1773	G	17·719	450·1
B	43·062	1094	H	9·312	236·5
C	3·187	80·95	J	7·500	190·5
D	9·625	244·5	K	13·688	347·7
E	38·125	968·4	L	1·500	38·10
F	27·906	708·8			

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC

OUTLINE
(Top View)

789 A



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
M	19·250 Max	489·0 Max	U	19·250 Max	489·0 Max
N	0·438	11·12	V	12·000	304·8
P	16·250	412·8	W	10·625	269·9
Q	6·940	176·3	X	5·062	128·6
R	1·875	47·62	Y	13·656	346·9
S	3·000	76·20	Z	11·312	287·3
T	26·250	666·8			

Millimetre dimensions have been derived from inches.

Oscillator Klystrons

English Electric Valve Company Limited
Chelmsford, Essex, England

December 1968
Printed in England

KLYSTRON

INTRODUCTION

The K300 is a low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9320 to 9500Mc/s.

The waveguide output flange is designed for coupling directly to waveguide with internal dimensions 1·000 inch × 0·500 inch by means of a coupler to Admiralty Pattern AP 54989.

Mechanical tuning is achieved by means of a reactive stub intruding into the waveguide. This stub may be operated directly by means of the micrometer provided or remotely by means of a shaft engaging a 1/16-in. diameter pin mounted across the diameter of a ¼-in. hole recessed in the micrometer.

The electronic tuning range is typically 30Mc/s obtained by a voltage sweep of 20 volts.

Each valve is marked with the reflector voltage at which the valve will oscillate and give an output power of at least 12mW over the specified Mechanical Tuning Range.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·85 × 3·00 × 1·75 inches	Max
	123·2 × 76·2 × 44·5 mm	Max
Net Weight	10 ounces (270 gm)	Approx
Mounting Position		Any
Top Cap		B.S. 448/CT1
Base		5-pin International Octal

Cooling (*See Note* 1) .. .. Natural

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure a safe body temperature.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9410 ± 20Mc/s under typical operating conditions.

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

No individual rating should be exceeded.

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

	Min	*Max*	
Heater Current at heater voltage 6·3V	0·52	0·61	A
Resonator Current*	20	44	mA
Reflector Voltage* (negative) (*See Note* 2)	90	150	V
Output Power* (Load V.S.W.R. ≯ 1·1 : 1)	15	—	mW
Mechanical Tuning Range	9320	9500	Mc/s
Electronic Tuning Range between 3db points*	20	—	Mc/s
Frequency Drift (*See Note* 3)	—	5	Mc/s

**Resonator Voltage* 350*V; Heater* 6·3*V*

TYPICAL OPERATION

(with load V.S.W.R. ≯ 1·1 : 1)

Resonator Voltage	350	V
Resonator Current	35	mA
Reflector Voltage Range	—100 to —140	V
Output Power	30	mW
Mechanical Tuning Range	9320 to 9500	Mc/s
Electronic Tuning Range	30	Mc/s
Nominal Reflector Voltage change to give 30Mc/s electronic tuning	20	V
Frequency Drift	3	Mc/s

OUTLINE

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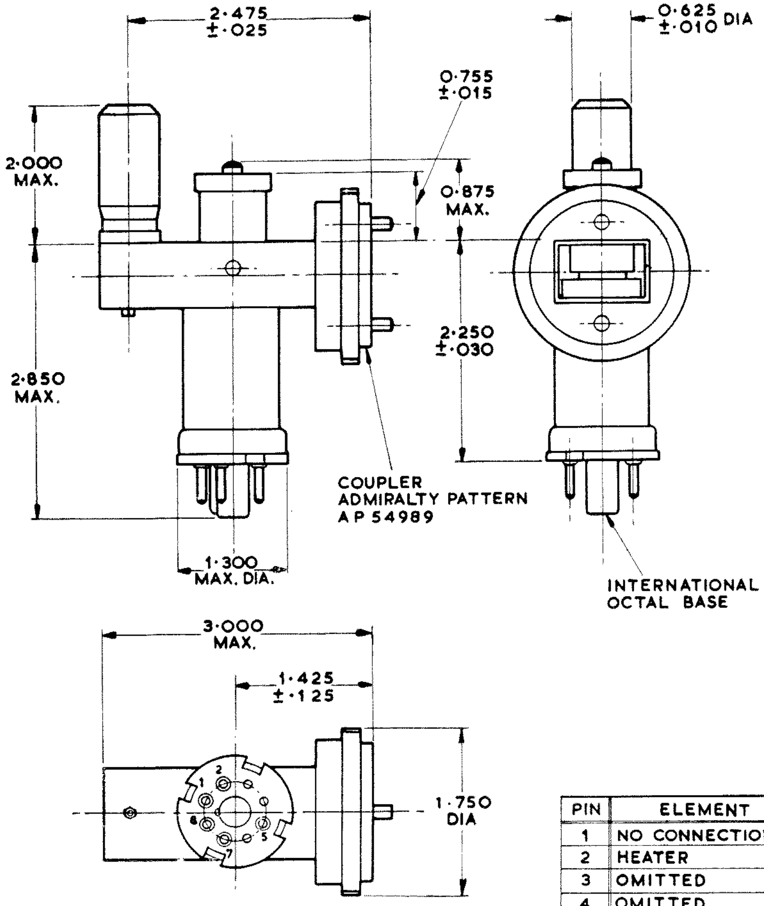

PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

ALL DIMENSIONS IN INCHES

KLYSTRON

Service Type CV2164

INTRODUCTION

The K302 is a low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9320 to 9500Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions).

Mechanical tuning is achieved by means of a reactive stub intruding into the waveguide. This stub may be operated directly by means of the micrometer provided or remotely by means of a shaft engaging 1/16-in. diameter pin mounted across the diameter of a ¼-in. hole recessed in the micrometer.

The electronic tuning range is typically 30Mc/s obtained by a voltage sweep of 20 volts.

Each valve is marked with the reflector voltage at which the valve will oscillate and give an output of at least 12mW over the specified Mechanical Tuning Range.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·60 × 2·75 × 1·63 inches	Max
	116·9 × 69·9 × 41·5 mm	Max
Net Weight	9 ounces (240 gm)	Approx
Mounting Position		Any
Top Cap		B.S. 448/CT1
Base		5-pin International Octal

Cooling (*See Note* 1) .. .. Natural

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure a safe body temperature.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9410$\pm$20Mc/s under typical operating conditions.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

	Min	*Max*	
Heater Current at heater voltage 6·3V	0·52	0·61	A
Resonator Current*	20	44	mA
Reflector Voltage* (negative) (*See Note* 2)	80	165	V
Output Power* (Load V.S.W.R. ≯ 1·1 : 1)	15	—	mW
Mechanical Tuning Range	9320	9500	Mc/s
Electronic Tuning Range between 3db points*	20	—	Mc/s
Frequency Drift (*See Note* 3)	—	5	Mc/s

* *Resonator Voltage* 350*V*; *Heater* 6·3*V*

TYPICAL OPERATION
(with load V.S.W.R. ≯ 1·1 : 1)

Resonator Voltage	350	V
Resonator Current	35	mA
Reflector Voltage Range	—90 to —155	V
Output Power	30	mW
Mechanical Tuning Range	9320 to 9500	Mc/s
Electronic Tuning Range	30	Mc/s
Nominal Reflector Voltage change to give 30Mc/s electronic tuning	20	V
Frequency Drift	3	Mc/s

KLYSTRON

OUTLINE

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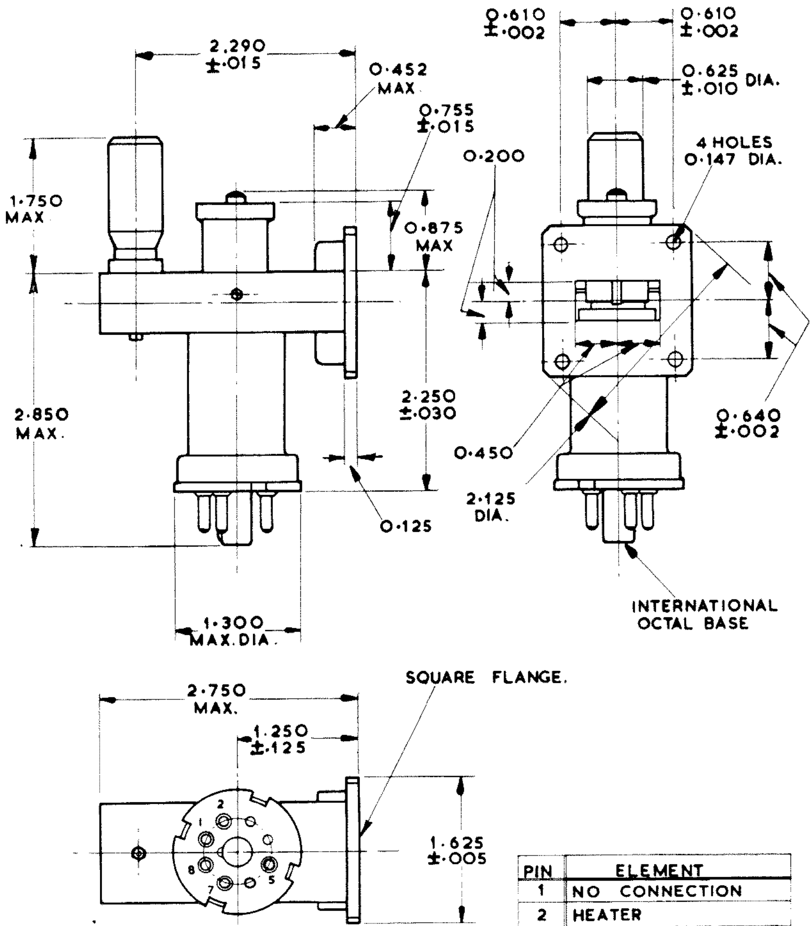


PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

ALL DIMENSIONS IN INCHES

KLYSTRON

Service Type CV2263

INTRODUCTION

The K305 is a low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9250 to 9500Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions).

The K305 is designed to accommodate a solenoid-operated tuning plunger. A screwed boss is provided to attach the plunger to the valve. A 2mm diameter tuning pin is recommended.

The electronic tuning range is typically 35Mc/s obtained by a voltage sweep of 20 volts.

Each valve is marked with the reflector voltage at which the valve will oscillate and give an output power of at least 10mW over the specified Mechanical Tuning Range.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	3·74 × 2·75 × 1·63 inches	Max
	95·0 × 69·9 × 41·5 mm	Max
Net Weight	7 ounces (200 gm)	Approx
Mounting Position		Any
Top Cap		B.S.448/CT1
Base		5-pin International Octal

Cooling (*See Note* 1) .. .. Natural

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure a safe body temperature.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9375 ± 20Mc/s under typical operating conditions.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

	Min	*Max*	
Heater Current at heater voltage 6·3V	0·52	0·61	A
Resonator Current*	—	44	mA
Reflector Voltage* (negative) (*See Note* 2)	80	170	V
Output Power* (Load V.S.W.R. $\ngtr$ 1·1 : 1)	15	—	mW
Mechanical Tuning Range	9250	9500	Mc/s
Electronic Tuning Range between 3db points*	30	—	Mc/s
Frequency Drift (*See Note* 3)	—	5	Mc/s

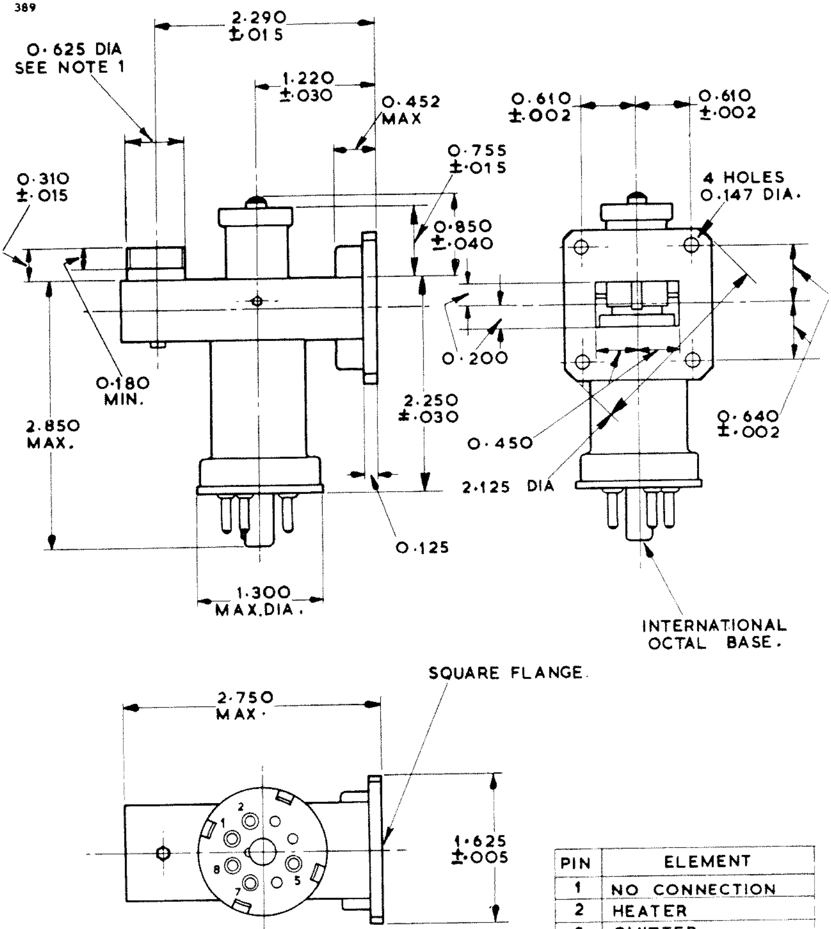
**Resonator Voltage* 350*V*; *Heater* 6·3*V*

TYPICAL OPERATION
(with load V.S.W.R. $\ngtr$ 1·1 : 1)

Resonator Voltage	350	V
Resonator Current	35	mA
Reflector Voltage Range	—90 to —160	V
Output Power	25	mW
Mechanical Tuning Range	9250 to 9500	Mc/s
Electronic Tuning Range	35	Mc/s
Nominal Reflector Voltage change to give 35Mc/s electronic tuning	20	V
Frequency Drift	3	Mc/s

KLYSTRON

OUTLINE



NOTE 1. THREADED 40 T.P.I. WHITWORTH FORM, MEDIUM FIT. MAX. DIA OF UNSCREWED PART TO BE 0·640 DIA.

NOTE 2 ℄ OF VALVE BASE TO COINCIDE WITH ℄ OF VALVE TO WITHIN ±0·125

ALL DIMENSIONS IN INCHES

PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

Service Type CV2282

INTRODUCTION

The K308 is a low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 8800 to 8900Mc/s. The valve is one of a series of frequency variants which can be supplied to oscillate over any 100Mc/s band in the range from 8800 to 10 000Mc/s. This series is specifically designed for use with systems requiring the magnetron and local oscillator to track in frequency over relatively large temperature variations without any adjustment of the mechanical tuner being necessary.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG–40A/U (Z830051).

Mechanical tuning is achieved by means of a reactive stub intruding into the waveguide. This stub may be operated directly by means of the micrometer provided or remotely by means of a shaft engaging a 1/16th inch diameter pin mounted across the diameter of a ¼-inch hole recessed in the micrometer.

The electronic tuning range is typically 40Mc/s obtained by a voltage sweep of 40 volts.

Each valve is marked with the reflector voltage at which the valve will oscillate and give an output power of at least 10mW over the specified mechanical tuning range. The expected reflector voltage variations are shown on page 4.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	3·96 × 3·15 × 1·50 inches	Max
	100·6 × 80·1 × 38·1 mm	Max
Net Weight	7 ounces (210 gm)	Approx
Mounting Position		Any
Top Cap		B.S.448/CT1
Base	B.S.448/B8-0 5-pin International Octal	

Cooling (*See Note* 1) .. .. Natural

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage Range	−150 to −210	V
Load V.S.W.R. not greater than	1·1:1	

Typical Performance

Resonator Current	35	mA
Output Power	40	mW
Mechanical Tuning Range	8800 to 8900	Mc/s
Electronic Tuning Range	40	Mc/s
Nominal Reflector Voltage Change to give 30Mc/s electronic tuning	40	V
Frequency Change with resonator body temperature	−0·18Mc/s/°C	

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

Range of Characteristics

	Min	*Max*	
Heater Current..	0·52	0·61	A
Resonator Current	—	44	mA
Reflector Voltage (Negative) (*See Note* 2) ..	140	220	V
Output Power	25	—	mW
Mechanical Tuning Range	8800	8900	Mc/s
Electronic Tuning Range between 3db points (*See Note* 3)	25	—	Mc/s
Frequency Change with resonator body temperature	(*See Notes* 3 *and* 4)		

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature of 140°C is not exceeded.

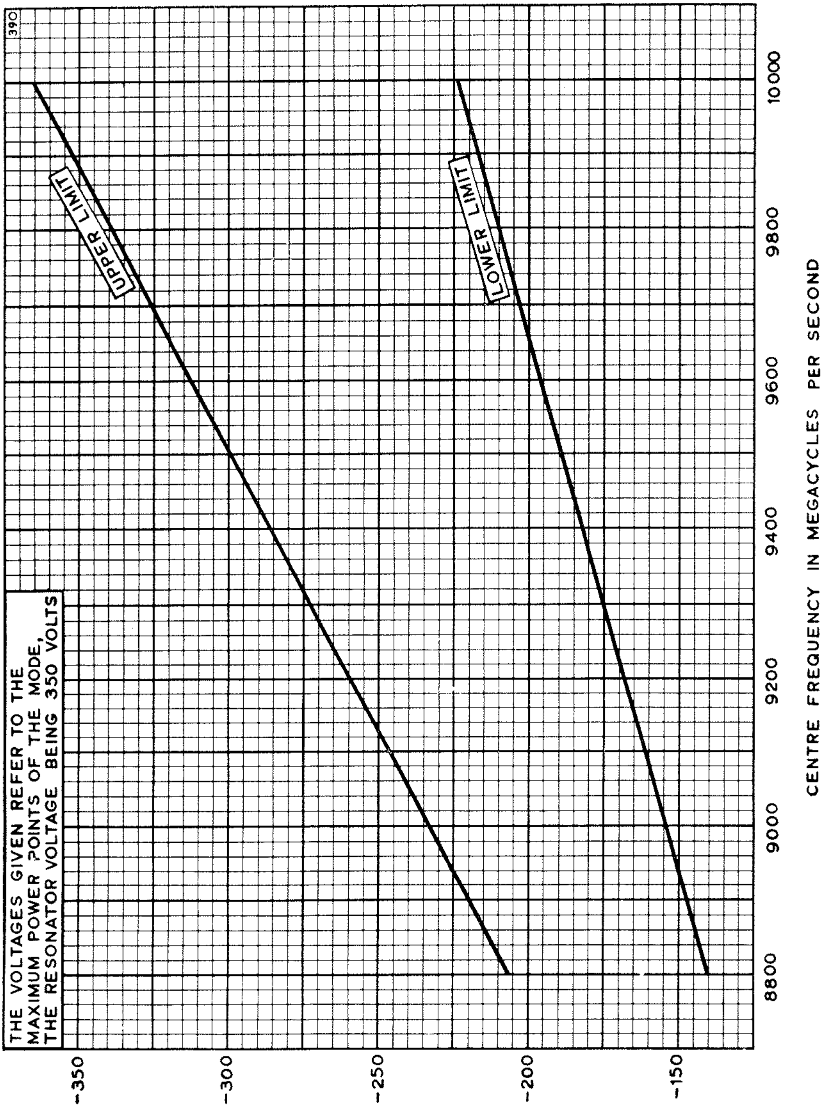
2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve. The reflector voltage must be capable of variation of $\pm$30 volts about the d.c. level in order to accommodate the total electronic tuning.

3. All valves giving from 25 to 33Mc/s electronic tuning range are tested for frequency change with resonator body temperature and accepted if their thermal factors fall within the shaded area on the graph on page 5.

4. At 8850$\pm$20Mc/s under typical operating conditions. The temperature range of the test is 0 to 100°C.

ENGLISH ELECTRIC

FREQUENCY CHARACTERISTIC



ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
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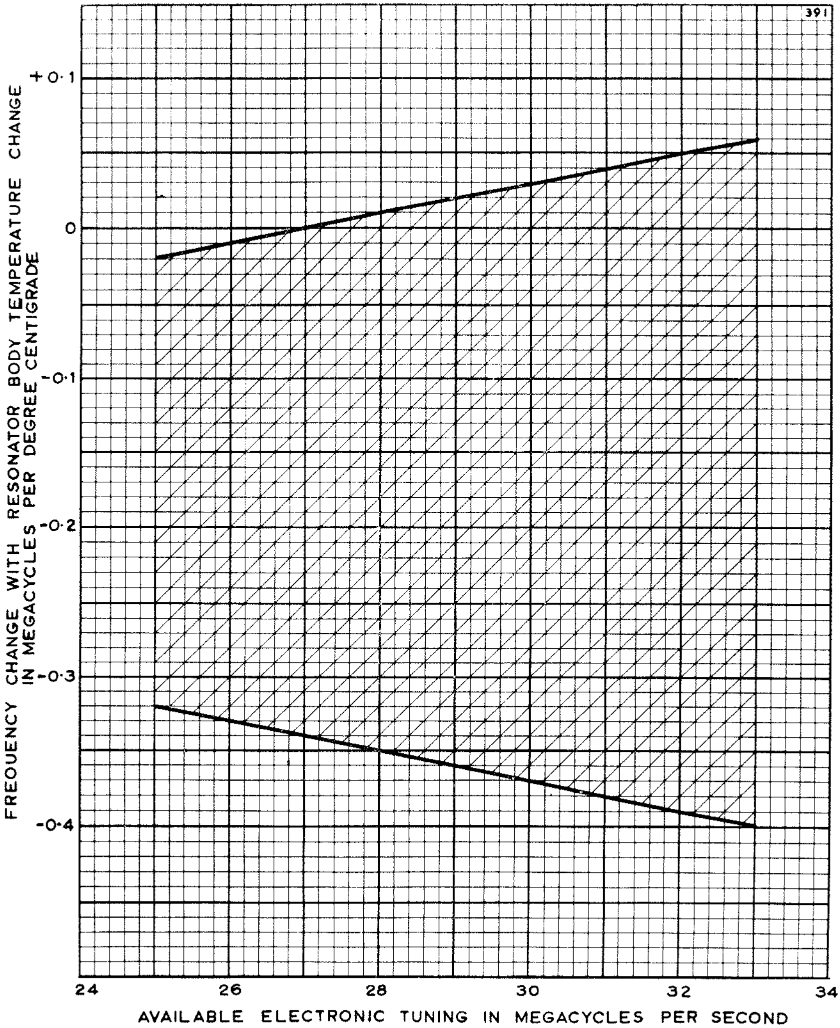
Printed in England

ENGLISH ELECTRIC

ELECTRONIC TUNING CHARACTERISTIC



THE LIMITS OF THERMAL FACTOR FOR ALL VALVES CAPABLE OF LESS THAN 33 Mc/s ELECTRONIC TUNING SHALL LIE WITHIN THE SHADED AREA OF THE GRAPH

ENGLISH ELECTRIC

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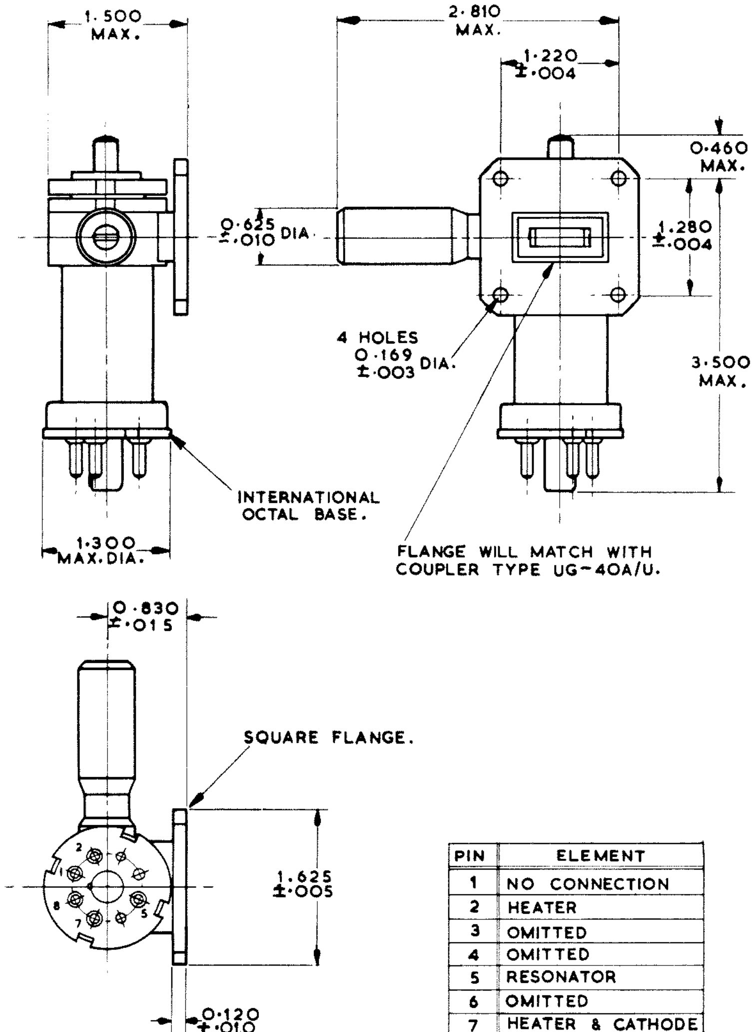

PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

ALL DIMENSIONS IN INCHES.

INTRODUCTION

The K311 is a wide band low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 8500 to 9500Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG–40A/U (Z830051).

Mechanical tuning is achieved by means of a capacitive electrode intruding into the resonant cavity. This electrode may be operated by means of the knob provided or remotely by means of a ¼-inch shaft to which the knob is attached. No stops are fitted to the tuner; adjustment beyond the specified frequency limits should not be attempted or damage may result. Clockwise rotation of the tuning shaft produces an increase in frequency.

The electronic tuning range is typically 30Mc/s obtained by a voltage sweep of 20 volts.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·39 × 1·94 × 1·91 inches	Max
	111·6 × 49·3 × 48·6 mm	Max
Net Weight	10 ounces (280 gm)	Approx
Mounting Position		Any
Top Cap		B.S.448/CT1

At the customer's request, this Klystron can be supplied with an insulated flying lead for the reflector connection. ←

Base	5-pin International Octal

Cooling (*See Note* 1) . . . Natural

← Indicates a change.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	Max	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

TYPICAL OPERATION

→ Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage Range	−175 to −355	V
Load V.S.W.R. not greater than	1·1 : 1	

→ Typical Performance

Resonator Current	35	mA
Output Power	45	mW
Mechanical Tuning Range	8500 to 9500	Mc/s
Mechanical Tuning Rate	7	Mc/s/turn
Tuner Torque	6	oz-in
Electronic Tuning Range	30	Mc/s
Nominal Reflector Voltage change to give 30Mc/s electronic tuning	20	V
Frequency Drift	3	Mc/s
Modulation Sensitivity (Reflector)	0·75	Mc/s/V

→ Indicates a change

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	20	44	mA
Reflector Voltage (negative) (*See Note* 2)	165	365	V
Output Power	30	—	mW
Mechanical Tuning Range	8500	9500	Mc/s
Tuner Torque (*See Note* 3)	—	20	oz–in
Electronic Tuning Range between 3db points	20	—	Mc/s
Frequency Drift (*See Note* 4)	—	5	Mc/s

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 140°C is not exceeded.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The torque is measured:
   (*a*) with all supplies off and all parts of the valve stabilised at an ambient temperature between 10°C and 40°C,
   (*b*) with all supplies on and the temperature stabilised at the normal operating temperature with an ambient temperature between 10°C and 40°C.

4. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9000±20Mc/s under typical operating conditions.

KLYSTRON

OUTLINE

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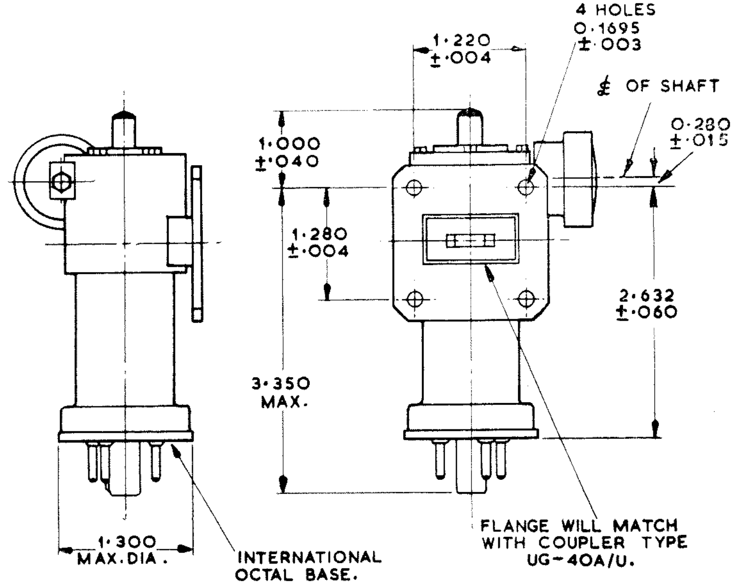

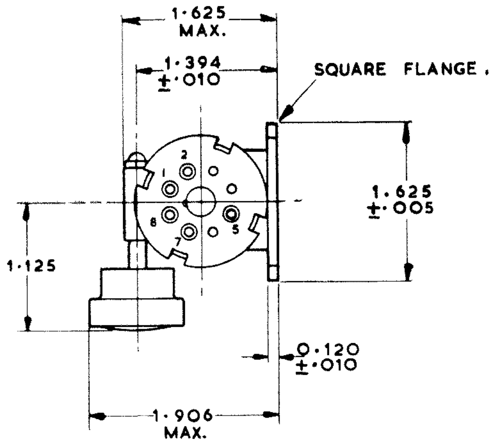

PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

ALL DIMENSIONS IN INCHES.

KLYSTRON

K324

Service Type CV2304

INTRODUCTION

The K324 is a wide band low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9000 to 10 000Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG–40A/U (Z830051).

Mechanical tuning is achieved by means of a capacitive electrode intruding into the resonant cavity. This electrode may be operated by means of the knob provided or remotely by means of a ¼-inch shaft to which the knob is attached. No stops are fitted to the tuner; adjustment beyond the specified frequency limits should not be attempted or damage may result. Clockwise rotation of the tuning shaft produces an increase in frequency.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·39 × 1·94 × 1·91 inches	Max
	111·6 × 49·3 × 48·6 mm	Max
Net Weight	10 ounces (280 gm)	Approx
Mounting Position		Any
Top Cap		B.S. 448/CT1

At the customer's request this Klystron can be supplied with an insulated flying lead for the reflector connection.

Base	5-pin International Octal

Cooling (*See Note* 1) .. .. Natural

← Indicates a change

KLYSTRON

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)
No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

TYPICAL OPERATION

→Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage Range	−260 to −390	V
Load V.S.W.R. not greater than	1·1 : 1	

→Typical Performance

Resonator Current	35	mA
Output Power	45	mW
Mechanical Tuning Range	9000 to 10 000	Mc/s
Mechanical Tuning Rate	7	Mc/s/turn
Tuner Torque	6	oz-in
Electronic Tuning Range	30	Mc/s
Nominal Reflector Voltage change to give 30Mc/s electronic tuning	20	V
Frequency Drift	3	Mc/s
Modulation Sensitivity (Reflector)	0·75	Mc/s/V

→Indicates a change

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

→Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

→Range of Characteristics

	Min	Max	
Heater Current	0·52	0·61	A
Resonator Current	25	40	mA
Reflector Voltage (negative) (*See Note* 2)	250	400	V
Output Power	30	—	mW
Mechanical Tuning Range	9000	10 000	Mc/s
Tuner Torque (*See Note* 3)	—	20	oz-in
Electronic Tuning Range between 3db points	20	—	Mc/s
Frequency Drift (*See Note* 4)	—	5	Mc/s

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 140°C is not exceeded.

2. Reflector voltages given here correspond to the maximum power point of the reflector mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The torque is measured:

   (*a*) with all supplies off and all parts of the valve stabilised at an ambient temperature between 10°C and 40°C,

   (*b*) with all supplies on and the temperature stabilised at the normal operating temperature with an ambient temperature between 10°C and 40°C.

4. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9500±20Mc/s under typical operating conditions.

→Indicates a change

OUTLINE

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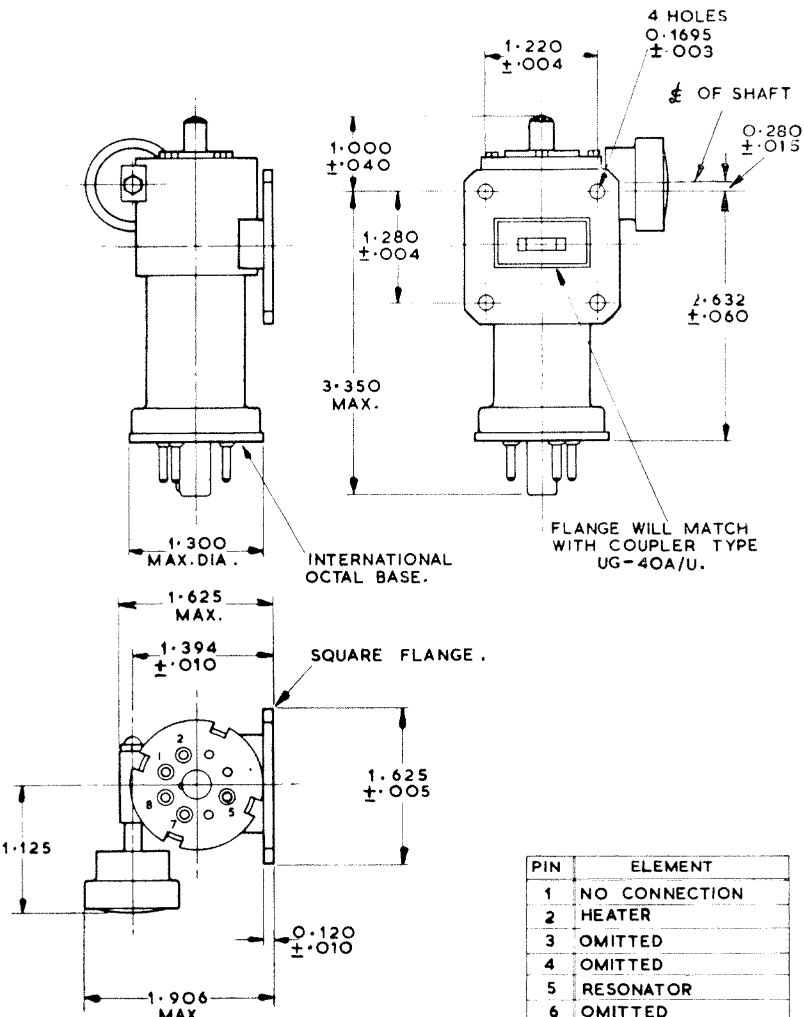


ALL DIMENSIONS IN INCHES.

PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

Printed in England

KLYSTRON

K335

Service Type CV2343

INTRODUCTION

The K335 is a low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9555 to 9685Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions).

Mechanical tuning is achieved by means of a reactive stub intruding into the waveguide. This stub may be operated directly by means of the micrometer provided or remotely by means of a shaft engaging a 1/16-in. diameter pin mounted across the diameter of a ¼-in. hole recessed in the micrometer.

The electronic tuning range is typically 30Mc/s obtained by a voltage sweep of 20 volts.

Each valve is marked with the reflector voltage and the micrometer reading to give maximum output power at 9620 ± 10Mc/s.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·60 × 2·75 × 1·63 inches	Max
	116·9 × 69·9 × 41·5 mm	Max
Net Weight	9 ounces (240 gm)	Approx
Mounting Position		Any
Top Cap		B.S. 448/CT1
Base		5-pin International Octal

Cooling (*See Note* 1) .. .. Natural

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure a safe body temperature.

2. Reflector voltages given here correspond to the maximum power point of the reflector mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9620$\pm$20Mc/s under typical operating conditions.

KLYSTRON

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

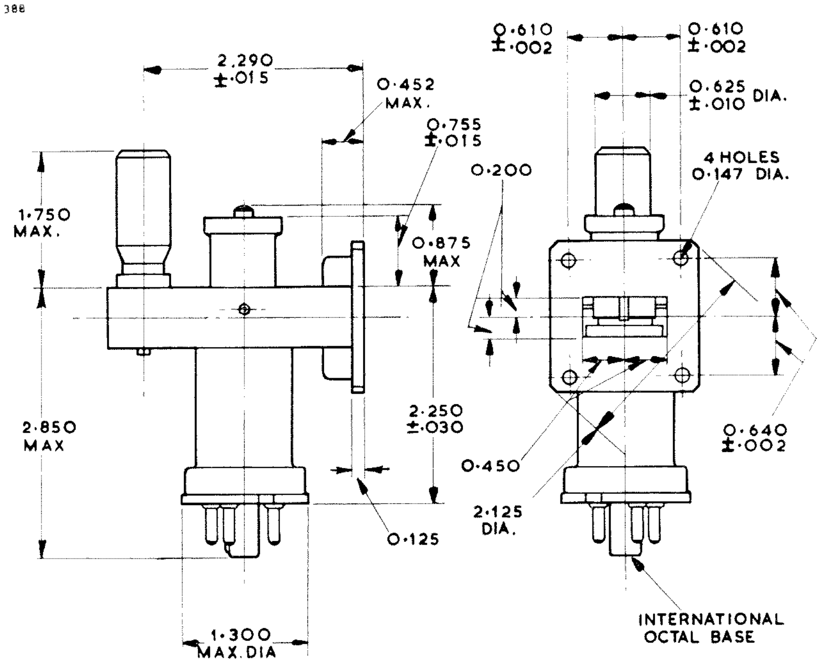
	Min	*Max*	
Heater Current at heater voltage 6·3V	0·52	0·61	A
Resonator Current*	20	44	mA
Reflector Voltage* (negative) (*See Note* 2)	110	180	V
Output Power* (Load V.S.W.R. ≯ 1·1 : 1)	15	—	mW
Mechanical Tuning Range	9555	9685	Mc/s
Mechanical Tuning Rate	—	5	Mc/s/turn
Electronic Tuning Range between 3db points*	20	70	Mc/s
Frequency Drift (*See Note* 3)	—	5	Mc/s

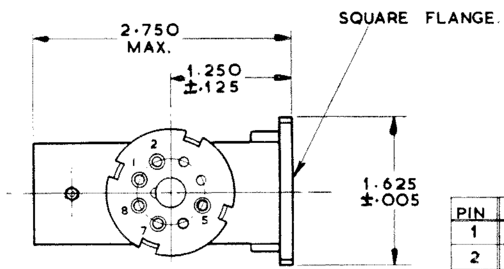
**Resonator Voltage* 350*V*; *Heater* 6·3*V*

TYPICAL OPERATION
(with load V.S.W.R. ≯ 1·1 : 1)

Resonator Voltage	350	V
Resonator Current	35	mA
Reflector Voltage Range	−120 to −170	V
Output Power	25	mW
Mechanical Tuning Range	9555 to 9685	Mc/s
Electronic Tuning Range	30	Mc/s
Nominal Reflector Voltage change to give 30Mc/s electronic tuning	20	V
Frequency Drift	3	Mc/s

OUTLINE





PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION
CAP	REFLECTOR

ALL DIMENSIONS IN INCHES

→ **Service Type CV4515**

INTRODUCTION

The K337 is a rugged wide band low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9 000 to 10 000Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG-40A/U (Z830051).

Mechanical tuning is achieved by means of a capacitive electrode intruding into the resonant cavity. This electrode may be operated by means of the ¼-inch shaft provided. No stops are fitted to the tuner; adjustment beyond the specified frequency limits should not be attempted or damage may result. Clockwise rotation of the tuning shaft produces an increase in frequency.

The electronic tuning range is typically 24Mc/s obtained by a voltage sweep of 20 volts.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·38 × 1·67 × 1·63 inches	Max
	111·3 × 42·5 × 41·5 mm	Max
Net Weight	12 ounces (350 gm)	Approx
Mounting Position		Any
Top Cap		Flying lead
Base		Solder tags

Cooling (*See Note* 1) .. .. Natural

→ Indicates a change

KLYSTRON

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage Range	−260 to −390	V
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Resonator Current	35	mA
Output Power over the band	45	mW
Mechanical Tuning Range	9 000 to 10 000	Mc/s
Electronic Tuning Range to 3db points	24	Mc/s
Nominal Reflector Voltage Change to give 24Mc/s electronic tuning	20	V
Modulation Sensitivity (Reflector) at mode optimum	0·75	Mc/s/V
Ratio of Modulation Sensitivity at mode optimum to that at the ± 10Mc/s points at a random datum frequency in the band 9 000 to 10 000Mc/s	0·6	

CHARACTERISTICS OF A TYPICAL VALVE

Tuner Torque (*See Note* 4)	10	oz-in
Resetting Accuracy (*See Note* 5)	±1	Mc/s
Mechanical Tuning Rate (*See Note* 3)	7	Mc/s/turn
Reflector Voltage Tracking Error (*See Note* 8)	2	V
Pulling (*See Note* 9):		
Frequency Pulling	±5	Mc/s
Output Power	30	mW
Electronic Tuning	±12	Mc/s
Peak Frequency Deviation when vibrated up to 500c/s at up to 30g	2	Mc/s
Frequency Deviation when subjected to a steady acceleration of 50g	1·5	Mc/s
Power Deviation when subjected to a steady acceleration of 50g	less than 1	db

This page has been completely revised.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

→ **Test Conditions**

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

→ **Range of Characteristics**

	Min	*Max*	
Heater Current..	0·52	0·61	A
Resonator Current	25	40	mA
Reflector Voltage (negative) (*See Note* 2) ..	250	400	V
Output Power	30	—	mW
Mechanical Tuning Range	9 000	10 000	Mc/s
Mechanical Tuning Rate (*See Note* 3) ..	6·5	8·0	Mc/s/turn
Tuner Torque (*See Note* 4)	—	20	oz–in
Resetting Accuracy (*See Note* 5)	—	3	Mc/s
Mechanical Tuning Tracking (*See Note* 6) ..	5·0	9·5	Mc/s/turn
Electronic Tuning Range between 3db points	20	—	Mc/s
Modulation Sensitivity (Reflector) (*See Note* 7)	0·5	—	Mc/s/V
Ratio of Modulation Sensitivity at mode optimum to that at the ±10Mc/s points at a random datum frequency in the band 9 000 to 10 000Mc/s	1 : 3	—	
Reflector Voltage Tracking Error (*See Note* 8)	—	3	V
Pulling (*See Note* 9)			
Frequency Pulling	—	±10	Mc/s
Output Power	15	—	mW
Electronic Tuning	±10	—	Mc/s
Frequency Modulation (peak to peak) when vibrated up to 500c/s at up to 30g ..	—	4	Mc/s
Frequency Deviation when subjected to a steady acceleration of 50g	—	3	Mc/s
Power Deviation when subjected to a steady acceleration of 50g	—	1	db

→ Indicates a change

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 140°C is not exceeded.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The mechanical tuning rate is given by the number of turns of the tuning shaft in a clockwise direction to change the frequency from 9 000 to 10 000Mc/s divided into 1 000. The reflector voltage is adjusted for mode optimum during this test.

4. The torque is measured
   (*a*) with all supplies off and all parts of the valve stabilised at an ambient temperature between 10°C and 40°C,
   (*b*) with all supplies on and the temperature stabilised at the normal operating temperature with an ambient temperature between 10°C and 40°C.

5. For a reversible frequency excursion of approximately 100Mc/s at a random point in the band from 9 000 to 10 000Mc/s, the maximum difference between possible frequencies for the same angular position of the tuning shaft is termed the resetting accuracy of the valve.

6. The frequency of oscillation with the reflector voltage adjusted for mode optimum is plotted as a function of the angular position of the tuning shaft. Measurements are made at frequency intervals of approximately 100Mc/s.

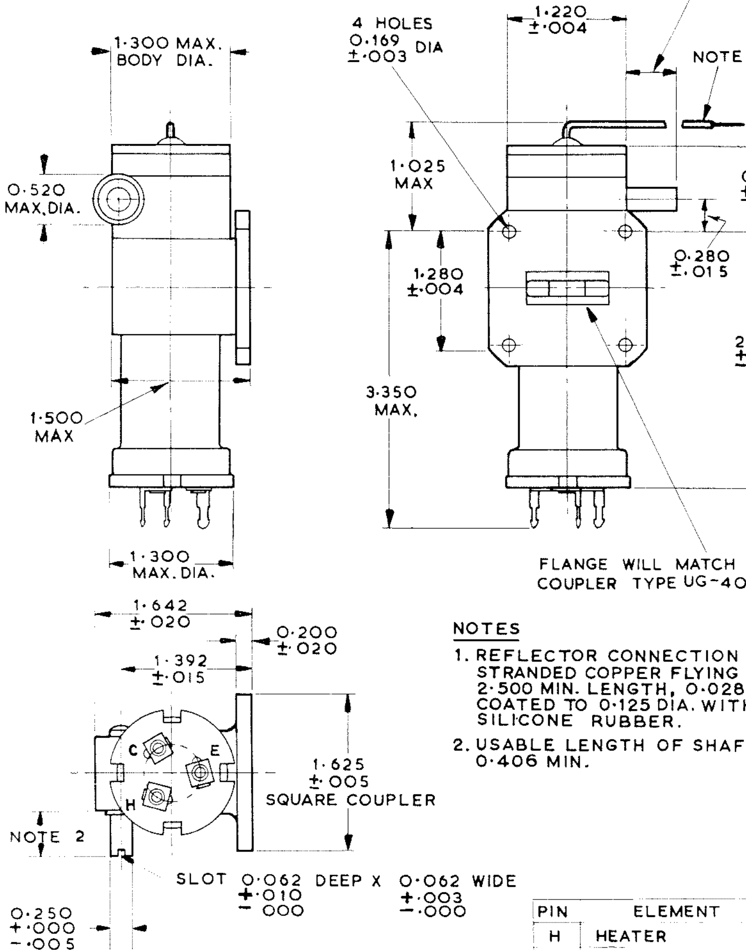
7. The modulation sensitivity is measured as the frequency deviation caused by a reflector voltage change of 1 volt.

8. When the reflector voltage for mode optimum is plotted as a function of the angular position of the tuning shaft, the tracking error is defined as the voltage deviation of this plotted curve from the straight line drawn through the two voltages corresponding to 9 000 and 10 000Mc/s respectively. The voltages are measured at intervals corresponding to 100Mc/s approximately.

9. Pulling—mismatch 1·5 : 1 moved through all phases.

OUTLINE

398A



NOTES

1. REFLECTOR CONNECTION STRANDED COPPER FLYING LEAD. 2·500 MIN. LENGTH, 0·028 DIA. COATED TO 0·125 DIA. WITH SILICONE RUBBER.
2. USABLE LENGTH OF SHAFT 0·406 MIN.

PIN	ELEMENT
H	HEATER
C	HEATER & CATHODE
E	RESONATOR

→ INDICATES A CHANGE

ALL DIMENSIONS IN INCHES

KLYSTRON

→ **Service Type CV6003**

INTRODUCTION

The K342 is a rugged low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 8500 to 9000Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG-40A/U (Z830051).

Mechanical tuning is achieved by means of a capacitive electrode intruding into the resonant cavity. This electrode may be operated by means of the ¼-inch shaft provided. No stops are fitted to the tuner; adjustment beyond the specified frequency limits should not be attempted or damage may result. Clockwise rotation of the tuning shaft produces an increase in frequency.

The electronic tuning range is typically 35Mc/s obtained by a voltage sweep of 20 volts.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	4·38 × 1·67 × 1·63 inches	Max
	111·3 × 42·5 × 41·5 mm	Max
Net Weight	12 ounces (350 gm)	Approx
Mounting Position		Any
Top Cap		Flying lead
Base		Solder tags

Cooling (*See Note* 1) .. .. Natural

→ Indicates a change

KLYSTRON

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	Max	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Resonator Dissipation	—	20	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage Range	−160 to −265	V
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Resonator Current	35	mA
Output Power over the band	45	mW
Mechanical Tuning Range	8500 to 9000	Mc/s
Electronic Tuning Range to 3db points	35	Mc/s
Nominal Reflector Voltage Change to give 35Mc/s electronic tuning	20	V
Modulation Sensitivity (Reflector) at mode optimum	0·75	Mc/s/V

CHARACTERISTICS OF A TYPICAL VALVE

Tuner Torque (*See Note* 4)	10	oz-in
Mechanical Tuning Rate (*See Note* 3)	7	Mc/s/turn
Pulling (*See Note* 8):		
Frequency Pulling	±3	Mc/s
Output Power	30	mW
Discontinuities	less than 6	db
Peak Frequency Deviation when vibrated up to 500c/s at up to 13g	0·25	Mc/s
Frequency Deviation when subjected to a steady acceleration of 13g	1·5	Mc/s
Power Deviation when subjected to a steady acceleration of 13g	1	db
Frequency Change with Resonator Body Temperature	−0.3	Mc/s/°C
Frequency Drift (*See Note* 6)	7	Mc/s

This page has been completely revised.

KLYSTRON

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

→Range of Characteristics

	Min	Max	
Heater Current	0·52	0·61	A
Resonator Current	25	40	mA
Reflector Voltage (negative) (*See Note* 2)	150	275	V
Output Power	30	—	mW
Mechanical Tuning Range	8500	9000	Mc/s
Mechanical Tuning Rate (*See Note* 3)	5·0	9·5	Mc/s/turn
Tuner Torque (*See Note* 4)	—	20	oz–in
Electronic Tuning Range between 3db points	30	—	Mc/s
Frequency Change with Resonator Body Temperature (negative) (*See Note* 5)	—	0·3	Mc/s/°C
Frequency Drift (*See Note* 6)	—	10	Mc/s
Modulation Sensitivity (Reflector) (*See Note* 7)	0·5	1·0	Mc/s/V
Pulling (*See Note* 8)			
Frequency Pulling	—	±5	Mc/s
Output Power	15	—	mW
Discontinuities	—	6	db
Frequency Modulation (peak to peak) when vibrated up to 500c/s at up to 13g	—	0·5	Mc/s
Frequency Deviation when subjected to a steady acceleration of 13g	—	2	Mc/s
Power Deviation when subjected to a steady acceleration of 13g	—	1·5	db

→ Indicates a change

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 140°C is not exceeded.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

3. The mechanical tuning rate is given by the number of turns of the tuning shaft in a clockwise direction to change the frequency from 8500 to 9000Mc/s divided into 500. The reflector voltage is adjusted for mode optimum during this test.

4. The torque is measured
   (*a*) with all supplies off and all parts of the valve stabilised at an ambient temperature between 10°C and 40°C,
   (*b*) with all supplies on and the temperature stabilised at the normal operating temperature with an ambient temperature between 10°C and 40°C.

5. At 8750±20Mc/s under typical operating conditions.

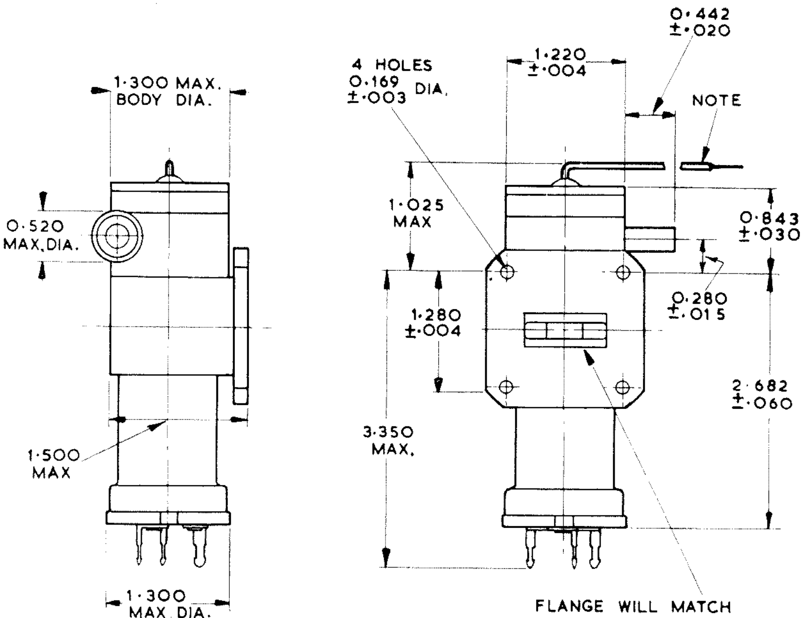
6. The frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 8750±20Mc/s under typical operating conditions.

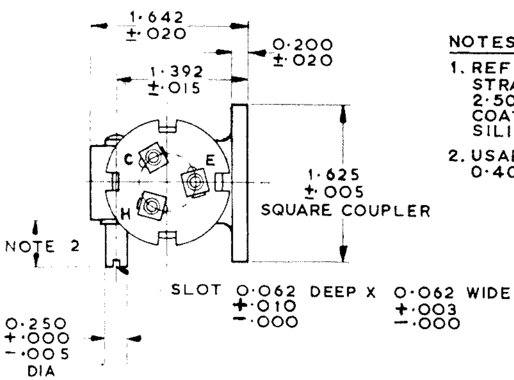
7. The modulation sensitivity is measured as the frequency deviation caused by a reflector voltage change of 1 volt.

8. Pulling—mismatch 1·5 : 1 moved through all phases.

OUTLINE

398A





NOTES

1. REFLECTOR CONNECTION STRANDED COPPER FLYING LEAD. 2·500 MIN. LENGTH, 0·028 DIA. COATED TO 0·125 DIA. WITH SILICONE RUBBER.
2. USABLE LENGTH OF SHAFT 0·406 MIN.

PIN	ELEMENT
H	HEATER
C	HEATER & CATHODE
E	RESONATOR

→ INDICATES A CHANGE

ALL DIMENSIONS IN INCHES

ABRIDGED DATA

Wide band low voltage reflex klystron for local oscillator applications.

Frequency Range	12·0 to 14·5	Gc/s
Typical Output Power:		
Mode A	40	mW
Mode B	80	mW
Electronic Tuning Range:		
Mode A	80	Mc/s
Mode B	50	Mc/s
Output	to No. 18 Waveguide (0·622 × 0·311 inch internal)	
Coupler	UG-541/U (Z830029)	
Mechanical Tuning	Screw and lock nuts	

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	3·000 × 1·625 × 1·350 inches	Max
	76·20 × 41·28 × 34·29 mm	Max
Net Weight	4 ounces (113 gm)	Approx
Mounting Position		Any
Top Cap	Moulded cap with flying lead	
Base	Moulded base with flying leads	

Cooling (*See Note* 1) .. .. .. Natural

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	40	mA
Resonator Dissipation	—	14	W
Reflector Voltage (negative) (*See Note* 2)	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C

TYPICAL OPERATION

Operational Conditions

	Mode A	*Mode B*	
Heater Voltage	6·3	6·3	V
Resonator Voltage	350	350	V
Reflector Voltage	−120	−220	V
Frequency	13	13	Gc/s
Load V.S.W.R. not greater than	1·1:1	1·1:1	

Typical Performance

Resonator Current	30	30	mA
Output Power	40	80	mW
Electronic Tuning Range	80	50	Mc/s
Modulation Sensitivity (Reflector)	3·0	2·0	Mc/s/V
Frequency Drift (after 3 minutes)	+5Mc/s with respect to final frequency		

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

Range of Characteristics

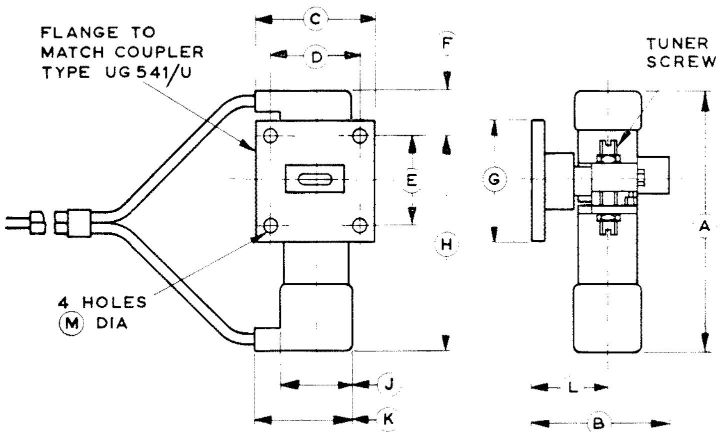
	Min	*Max*	
Heater Current	0·52	0·65	A
Resonator Current	25	40	mA
Mechanical Tuning Range (*See Note* 3)	12·0	14·5	Gc/s
Reflector Voltage (negative) (*See Note* 4):			
Mode A	50	250	V
Mode B	100	350	V
Output Power:			
Mode A	20	—	mW
Mode B	25	—	mW
Electronic Tuning Range between 3db points:			
Mode A	40	—	Mc/s
Mode B	20	—	Mc/s

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 150°C is not exceeded.
2. Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.
3. Serious mechanical damage may result if the klystron is tuned beyond the published tuning range.
4. The limits of reflector voltages given here include the variations over the mechanical tuning range and also variations from valve to valve.

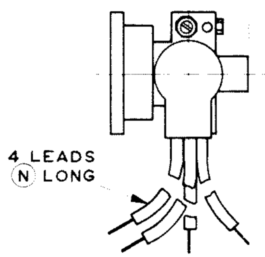
OUTLINE

340A



Lead Connections

Colour	Element	
Yellow	Heater	
White	Heater	Internally
Green	Cathode	Connected
Grey	Reflector	



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	3·000 Max	76·20 Max	H	2·500 Max	63·50 Max
B	1·625 Max	41·28 Max	J	0·750 ± 0·010	19·05 ± 0·25
C	1·312	33·32	K	0·950 ± 0·020	24·13 ± 0·51
D	0·994 ± 0·004	25·248 ± 0·102	L	0·840 ± 0·020	21·34 ± 0·51
E	0·956 ± 0·004	24·282 ± 0·102	M	0·147	3·73
F	0·500 Max	12·70 Max	N	9·000 Min	228·6 Min
G	1·312	33·32			

Millimetre dimensions have been derived from inches.

ABRIDGED DATA

Wide band low voltage reflex klystron for local oscillator applications.

Frequency Range	14·5 to 17·0	Gc/s
Typical Output Power:		
Mode A	35	mW
Mode B	45	mW
Electronic Tuning Range:		
Mode A	120	Mc/s
Mode B	75	Mc/s
Output	to No. 18 Waveguide (0·622 × 0·311 inch internal)	
Coupler	UG-541/U (Z830029)	
Mechanical Tuning	Screw and lock nuts	

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	3·000 × 1·625 × 1·350 inches	Max
	76·20 × 41·28 × 34·29 mm	Max
Net Weight	4 ounces (113 gm)	Approx
Mounting Position		Any
Top Cap	Moulded cap with flying lead	
Base	Moulded base with flying leads	

Cooling (*See Note* 1) .. .. **Natural**

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)
No individual rating should be exceeded

	Min	Max	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	400	V
Resonator Current	—	40	mA
Resonator Dissipation	—	14	W
Reflector Voltage (negative) (*See Note* 2)	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C

TYPICAL OPERATION

Operational Conditions

	Mode A	Mode B	
Heater Voltage	6·3	6·3	V
Resonator Voltage	350	350	V
Reflector Voltage	−120	−180	V
Frequency	16	16	Gc/s
Load V.S.W.R. not greater than	1·1:1	1·1:1	

Typical Performance

	Mode A	Mode B	
Resonator Current	30	30	mA
Output Power	35	45	mW
Electronic Tuning Range	120	75	Mc/s
Modulation Sensitivity (Reflector)	3·2	2·8	Mc/s/V

Frequency Drift (after 3 minutes) .. +5Mc/s with respect to final frequency

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

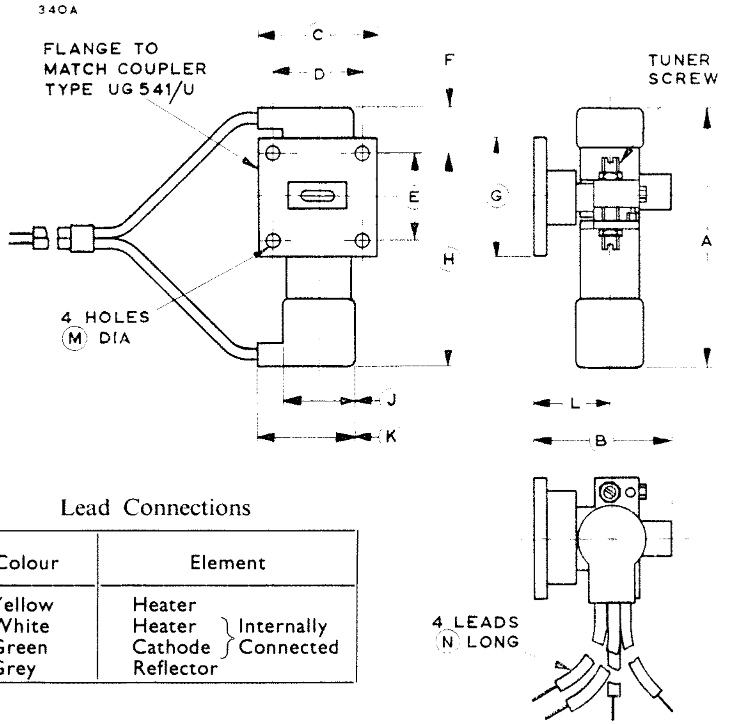
Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·65	A
Resonator Current	25	40	mA
Mechanical Tuning Range (*See Note* 3)	14·5	17·0	Gc/s
Reflector Voltage (negative) (*See Note* 4):			
Mode A	50	250	V
Mode B	100	350	V
Output Power:			
Mode A	15	—	mW
Mode B	20	—	mW
Electronic Tuning Range between 3db points:			
Mode A	50	—	Mc/s
Mode B	25	—	Mc/s

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 150°C is not exceeded.
2. Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.
3. Serious mechanical damage may result if the klystron is tuned beyond the published tuning range.
4. The limits of reflector voltages given here include the variations over the mechanical tuning range and also variations from valve to valve.

OUTLINE



Lead Connections

Colour	Element
Yellow	Heater
White	Heater } Internally
Green	Cathode } Connected
Grey	Reflector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	3·000 Max	76·20 Max	H	2·500 Max	63·50 Max
B	1·625 Max	41·28 Max	J	0·750 ± 0·010	19·05 ± 0·25
C	1·312	33·32	K	0·950 ± 0·020	24·13 ± 0·51
D	0·994 ± 0·004	25·248 ± 0·102	L	0·840 ± 0·020	21·34 ± 0·51
E	0·956 ± 0·004	24·282 ± 0·102	M	0·147	3·73
F	0·500 Max	12·70 Max	N	9·000 Min	228·6 Min
G	1·312	33·32			

Millimetre dimensions have been derived from inches.

KLYSTRON

→**Service Type CV5426**

INTRODUCTION

The K350 is a forced-air cooled two resonator klystron oscillator with mechanical tuning covering the frequency range from 8500 to 10 000Mc/s.

It has been specifically designed with low noise modulation and good frequency stability to make it suitable for the exacting demands of the latest airborne FM radar applications. Output power is approximately 1 watt. It can be used at high altitudes without pressurising.

The waveguide output flange is designed for coupling directly to waveguide No. 16, 0·900 inch × 0·400 inch (22·86mm × 10·16mm) internal dimensions, by means of coupler type UG–40A/U (Z830051).

Mechanical tuning is achieved by adjustment of the lock-nuts on both the resonators, or the frequency may be preset in the factory to customers' requirements.

The electronic tuning range is typically 12Mc/s, obtained by a voltage sweep of 70 volts.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
→ Heater Current	1·6	A
Minimum Ambient Pressure for satisfactory operation	25	mm Hg

Mechanical

Overall Dimensions	3·30 × 1·77 × 1·36 inches	Max
	83·9 × 45·0 × 34·6 mm	Max
Net Weight	5 ounces (150 gm)	Approx
Mounting Position		Any
Base	Moulded base with flying leads	

Cooling .. .. Forced-air

An air flow sufficient to maintain the temperature of any part of the radiator below 150°C is required.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Beam Voltage	—	1100	V
Resonator Dissipation	—	130	W
Radiator Temperature	—	150	°C

→ Indicates a change

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Beam Voltage	700	V
Frequency	8800	Mc/s
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Beam Current	70	mA
Output Power	1·2	W
Electronic Tuning Range (*See Note* 3)	12	Mc/s
Modulation Sensitivity (beam voltage) (*See Note* 3)	200	kc/s/V
Frequency Pulling (Load V.S.W.R. 1·5 : 1)	2	Mc/s
Random Frequency Deviation (peak to peak) (*See Note* 2)	1	kc/s
Frequency Change with Resonator Body Temperature (negative)	35	kc/s/°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Load V.S.W.R. not greater than	1·1 : 1	
Radiator Temperature	50 to 60	°C

Range of Characteristics

	Min	*Max*	
Heater Current	1·5	1·75	A ←
Mechanical Tuning Range	8500	10 000	Mc/s
Beam Voltage:			
At 8500Mc/s	620	710	V
At 10 000Mc/s	860	980	V
Beam Current:			
At 8500Mc/s	45	70	mA
At 10 000Mc/s	100	130	mA
Output Power	600	—	mW
Electronic Tuning Range between 3db points (*See Note* 3)	10	—	Mc/s
Modulation Sensitivity (*See Note* 3)	100	—	kc/s/V
Frequency Pulling (Load V.S.W.R. 1·5 : 1) (*See Note* 1)	—	2·5	Mc/s
Random Frequency Deviation (peak to peak) (*See Note* 2)	—	3·0	kc/s

← Indicates a change

→ **OPERATING INSTRUCTIONS**

1. Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the two-resonator klystron type K350. If the information given below is used, long and reliable performance of the valve will result.

The engineering staff of English Electric Valve Co. are always available to give further information if required.

2. Precautions

1. Never exceed the maximum ratings given on page 1.
2. Observe the cooling instructions.

3. Installation and Operation

1. *Mounting*

The valve may be mounted in an equipment at any angle provided the longitudinal axis of the waveguide load is the same as that for the valve waveguide and the cooling instructions are not violated.

Bolt the valve securely to its mating waveguide flange. The valve is intended to be operated with the body at earth potential with the circuit shown in Fig. 3 of the Preamble to this section of the Catalogue. If the body is operated above earth potential some suitable insulation between the valve and the waveguide load is required.

The valve is designed to give the performance shown on page 2 when working into a load of V.S.W.R. not greater than 1·1 : 1.

2. *Connections*

Ensure that the connections to the valve are correct: the leads colour code is given on page 12. For best noise performance the cathode connection should be made to the green lead.

3. *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period; voltage surges on switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(*a*) Heater Voltage and Blowers

(*b*) H.T. Voltage.

A delay of two minutes between (*a*) and (*b*) is recommended.

4. *Cooling*

For maximum life the radiator temperature should not exceed 150°C for more than a few minutes. When operating under the conditions stipulated on page 2, a blower providing 30cu.ft/min of air directed at the radiator fins is adequate.

→ Indicates a change.

5. *Tuning*

Before despatch, valves are normally factory pre-set in frequency to users' requirements. The absolute accuracy in frequency setting is $\pm$3Mc/s. Tuning adjustments can, however, be made in the field and the recommended procedure is given in the following tuning instructions.

→ TUNING INSTRUCTIONS

1. General Introduction

Oscillations in a two cavity klystron oscillator only occur within discrete ranges of accelerating voltage; these ranges are usually termed modes of oscillation. The mode pattern of any particular two cavity klystron oscillator depends mainly on the degree of coupling between the two cavities and also on their relative frequencies.

When the two cavities are tightly coupled, voltage modes occur in pairs and the maxima of these modes occur at voltages which correspond to electron drift transit angles between the two cavities given by

$\phi = 2\pi(n \pm \frac{1}{4})$ where n is an integer.

Either mode in each mode pair can be suppressed by suitable detuning of the cavities.

When the two cavities are lightly coupled the mode pairs merge into single modes for which the maxima occur at voltages corresponding to electron drift transit angles between the two cavities given by

$\phi = 2\pi(n + \frac{1}{2})$ where n is an integer.

The K350 is an example of the tightly coupled case where two families of modes occur. During the rigorous testing of this valve before despatch the unwanted family of modes is suppressed by careful detuning of the cavities. Further adjustments are then made to the tuning of each individual cavity to ensure the best overall performance in the mode recommended in this data sheet. If, therefore, changes of frequency are required in service, care must be taken to ensure the correct suppression of any unwanted modes and also the correct frequency alignment of the two cavities or inferior performance will result.

Information on how to achieve the best overall performance while tuning the K350 is given below. Should any uncertainties exist the E.E.V. Co. klystron engineers are always available to help and advise. For convenience and clarity the information is divided into three main sections. The second section deals with small frequency changes of the order of a few tens of Mc/s or less. The third deals with frequency changes of the order of 100Mc/s or more.

→ Indicates a change

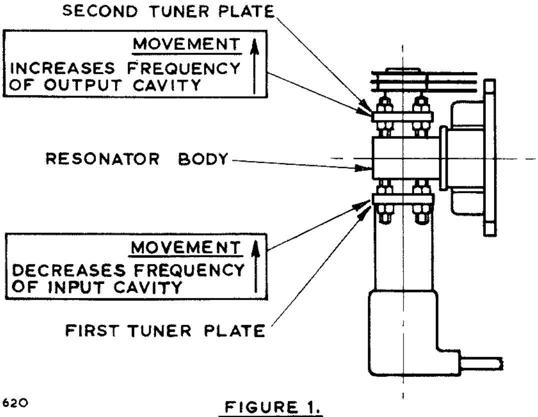


FIGURE 1.

2. Tuning Procedure

(i) *General*

Changes to the operating frequency of the K350 are accomplished by a combination of changes to both the input and output cavities. It should be noted that the output cavity is the more sensitive in controlling the operating frequency.

If an increase in operating frequency is desired the frequency of both the input and output cavities must be increased and vice versa. The frequency of the individual cavities can be adjusted by varying the distance between the tuner plates and the resonator body. Reference should be made to Fig. 1. Movement of the 'first tuner plate' towards the resonator body decreases the frequency of the input cavity and vice versa. Movement of the 'second tuner plate' towards the resonator body decreases the frequency of the output cavity and vice versa.

(ii) *Small Frequency Changes*

Small changes in operating frequency of the order of a few tens of Mc/s or less can readily be achieved while the valve is operating and delivering power provided that facilities are available to display the mode pattern.

The apparatus required is as shown in Fig. 2. A sweep voltage of some 70 volts RMS is superimposed on the d.c. resonator voltage and is also applied to the X-plates of an oscilloscope. A variac and isolating transformer working from the mains are quite suitable for the sweep supply. The output of the K350 is fed via a suitable attenuator and wavemeter to a crystal rectifier and the output of the crystal fed to the Y_1 amplifier of the oscilloscope.

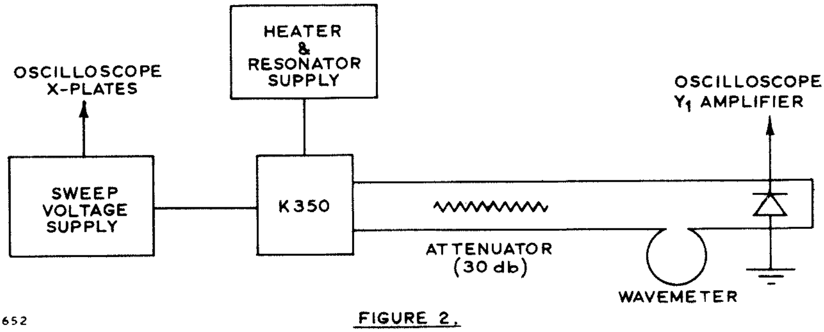
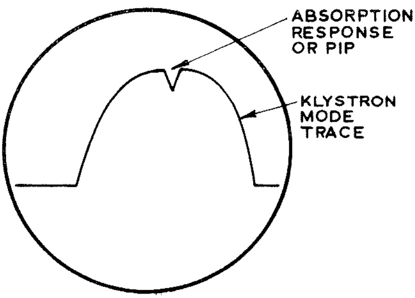


FIGURE 2.

The tuning procedure is then as follows:

1. Display the appropriate voltage mode with the circuit of Fig. 2.
2. Adjust the wavemeter until its absorption response appears at mode centre as shown in Fig. 3.
3. Adjust the frequency of the output cavity in the required direction until the operating frequency has changed by approximately 10Mc/s. An increase in the frequency will usually result in a decrease in the output power and an increase in electronic tuning range. A decrease in the frequency usually results in the opposite effect. The setting of the relative frequencies of the input and output cavities will always be a compromise between power and electronic tuning.
4. Adjust the frequency of the input cavity to obtain the best compromise between power and electronic tuning.
5. Repeat Operations 3 and 4 until the desired frequency is obtained. If any spurious modes appear during the tuning operations slight adjustments to the input cavity should be made to eliminate them. N.B. – During any tuning operations the tuner plates should remain square with the axis of the valve.

FIGURE 3



(iii) *Large Frequency Changes*

The tuning procedure outlined above becomes very tedious and complex when large frequency changes are required. A different approach is therefore suggested for such frequency changes.

Essentially the method to be described involves setting each cavity to the desired frequency when the valve is 'cold'. The relative frequencies of the two cavities are then adjusted while the valve is operating as in 2(ii) to give the best performance at the correct operating frequency.

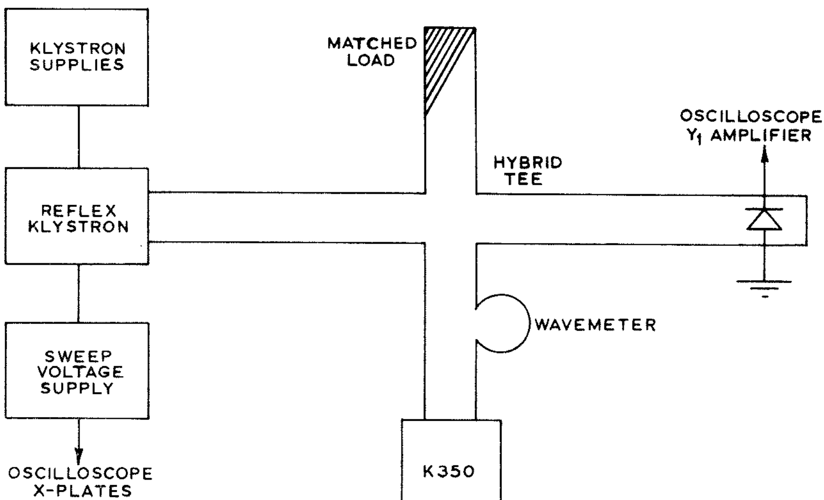


FIGURE 4.

The apparatus required for the 'cold' test is shown in Fig. 4. The output from a swept signal source such as a reflex klystron is fed to a hybrid tee. The 'cold' K350, a wavemeter, a matched load and a crystal rectifier are placed in the other branches of the tee as shown and the output of the crystal fed to the Y_1 amplifier of an oscilloscope. With suitable sweep applied to the X plates of the oscilloscope the mode trace of the reflex klystron can be displayed. When the reflex klystron is delivering power at a frequency equal to that of either the wavemeter or the cold K350 an absorption response or 'pip' will appear on the mode trace similar to that shown in Fig. 3.

The cold procedure is therefore:

1. Tune the wavemeter to the required frequency.
2. Tune the reflex klystron until the wavemeter pip appears at the centre of the mode trace as shown in Fig. 3.
3. Tune the output cavity until its absorption response is superimposed on the wavemeter pip.
4. Tune the input cavity until the absorption response of the output cavity starts to move from the centre of the mode trace.
5. Continue to tune the input cavity until the absorption responses of both cavities are symmetrically placed about the wavemeter pip. Normally for the K350 the two cavity responses will be approximately 80Mc/s apart when this condition is realised. It should be noted of course that unless the reflex klystron has an electronic tuning range of greater than 80Mc/s the three absorption responses will not be displayed simultaneously.

FIGURE 5

647

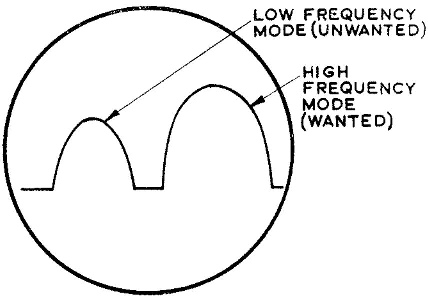


FIGURE 5.

The valve should now be operated as in 2(ii) with the circuit of Fig. 2 except that the resonator voltage should be reduced to 400 volts. Under these conditions a mode pair will be displayed on the screen of the oscilloscope as shown in Fig. 5 and the frequencies of the two modes will be different. The required mode is the high frequency mode of the pair. Normally the frequency of this high frequency mode will be 50Mc/s above the required operating frequency.

The procedure is now:

1. Reduce the frequency of the input cavity until the operating frequency is approximately 10Mc/s higher than the required frequency. This process will suppress the unwanted mode and increase the power output.
2. Increase the resonator voltage to the value which corresponds to the required frequency as given on Page 11. This increase in voltage will result in a decrease in operating frequency.
3. Tune the output cavity to give the required operating frequency.

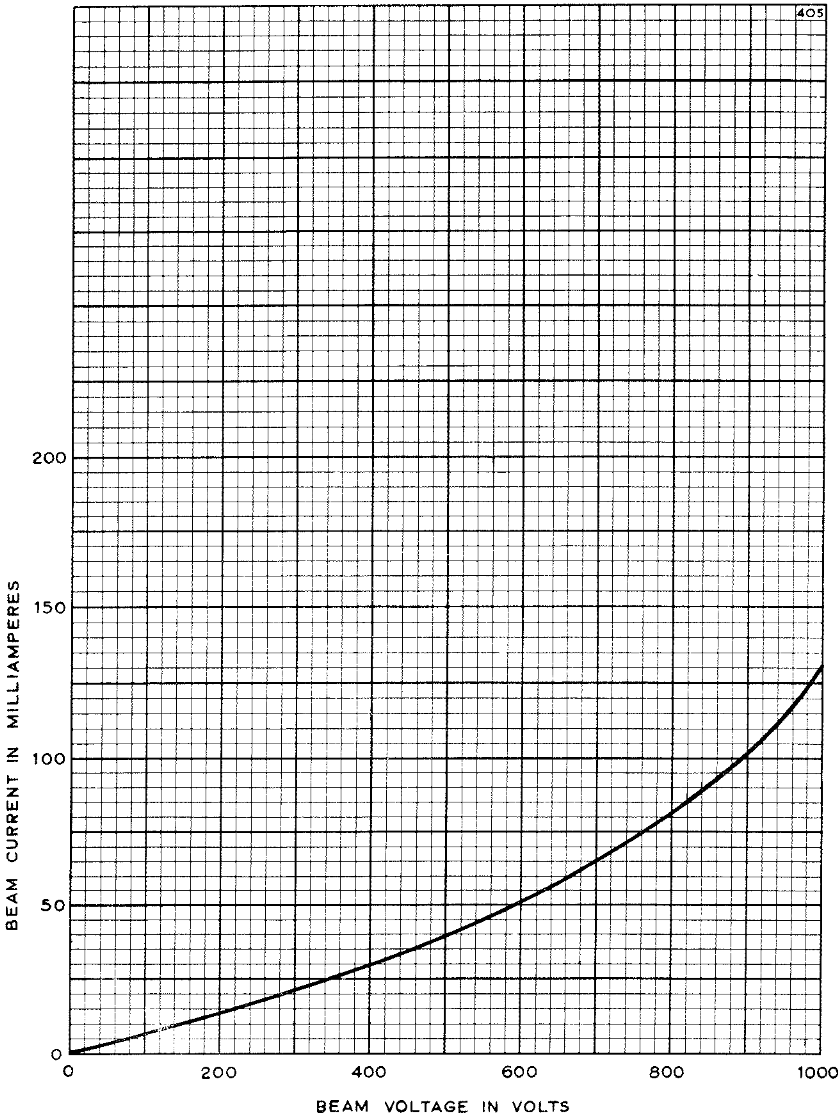
4. Slight changes to the input and output cavities should be made to achieve the best compromise between power and electronic tuning. N.B. – Unless otherwise requested the K350 is tuned in the factory to an absolute frequency of 8800 ± 3Mc/s.

NOTES

1. The frequency pulling is defined as the difference between the minimum and maximum frequencies of the output as the load is varied through all phases.
2. This represents the random deviations of the output frequency from the carrier frequency produced by random modulating frequencies in the range 150 to 11 000c/s.
3. The Electronic Tuning Range and Modulation Sensitivity are measured dynamically to eliminate spurious heating effects.

KLYSTRON

BEAM CHARACTERISTIC

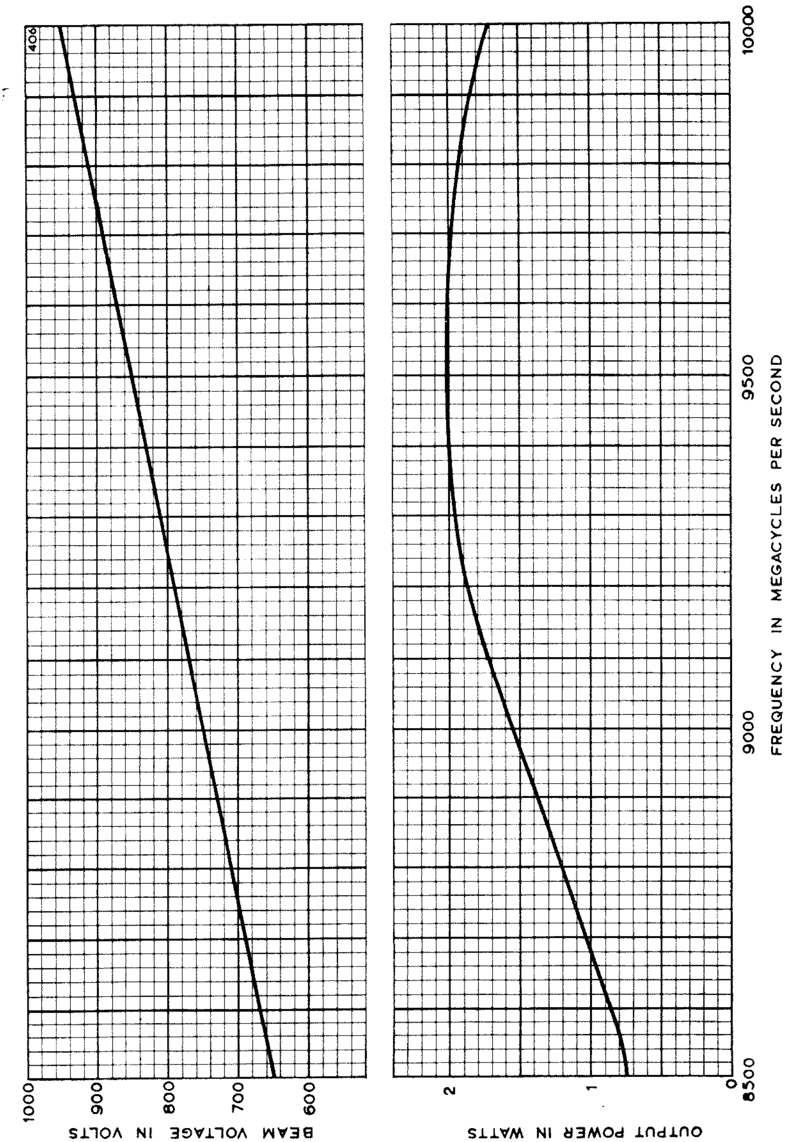


ENGLISH ELECTRIC VALVE CO. LTD. · CHELMSFORD ENGLAND

KLYSTRON

K350

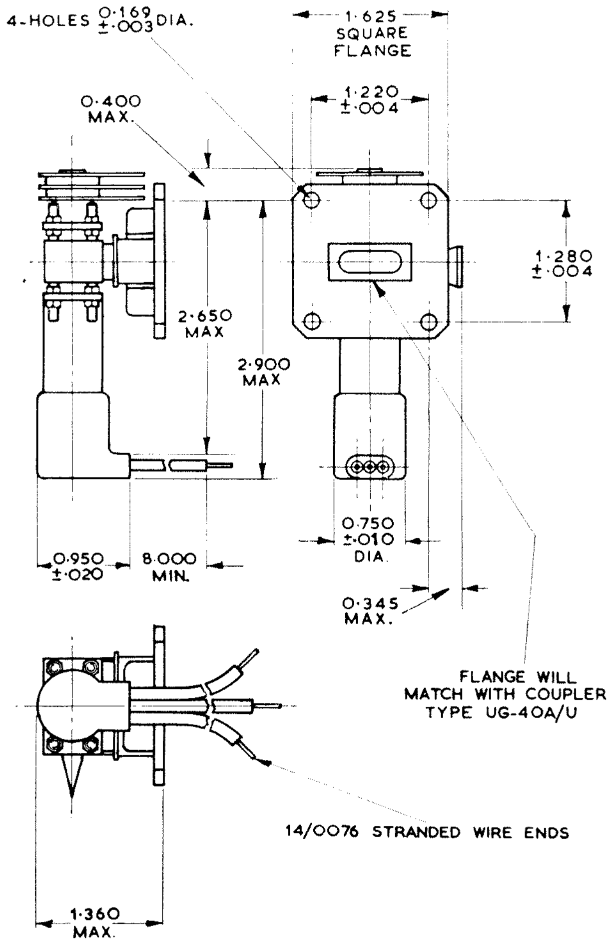
BEAM VOLTAGE AND OUTPUT POWER CHARACTERISTICS



KLYSTRON

OUTLINE

484A



COLOUR	CONNECTION
WHITE	HEATER CATHODE
YELLOW	HEATER
GREEN	CATHODE

→ INDICATES A CHANGE

ALL DIMENSIONS IN INCHES

→Service Type CV2494 American Equivalent VA201B

INTRODUCTION

The K351 is a rugged wide band low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from →8500 to 9655Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16, 0·900 inch × 0·400 inch internal dimensions (22·86 mm × 10·16 mm), by means of coupler type UG-39/U or UG-40A/U (Z830051). Removable eyelets are provided in the flange to facilitate use of the klystron with insulating bushes thus obviating the need of an earthed resonator supply.

Special features of the valve are extreme frequency stability and low noise under severe environmental conditions, rapid warm-up with negligible frequency drift, negligible barometric coefficient, moulded leads and base permitting high altitude operation without pressurising, low temperature coefficient, and low residual F.M. and noise.

Mechanical tuning is achieved by means of a single screw on an external tuning cavity, integral with the body. Clockwise rotation reduces the frequency, and about 4 turns covers the band from 9655 to 8500Mc/s.

Reflector voltages quoted are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	1·2	A
Total Impedance in Reflector-Cathode Circuit	0·5	MΩ

Mechanical

Overall Dimensions	2·810 × 1·937 × 1·640 inches	Max
	71·37 × 49·20 × 41·66 mm	Max
Net Weight	6 ounces (170 gm)	Approx
Mounting Position		Any
Top Cap	Moulded cap with flying lead	
Base	Moulded base with flying leads	
Tuner (*See Note* 1)	Single screw	
Output Coupling	Bolts to square flange coupler type UG-39/U or UG-40A/U (Z830051) into No. 16 waveguide	

Cooling (*See Note* 2) .. .. Conduction, and natural convection

→Indicates a change

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	350	V
Resonator Current	—	55	mA
Reflector Voltage (negative)	0	500	V
Body Temperature	—	200	°C
Altitude		..	No limit
Cathode to Heater Voltage	—	45	V
→ Load V.S.W.R.:			
at operating frequency	—	1·2 : 1	
in range 7800 to 8500Mc/s	—	1·5 : 1	
in range 9655 to 10 500Mc/s	—	1·5 : 1	

TYPICAL OPERATION
Condition (1)

Operational Conditions		
Resonator Voltage	300	V
Mode	5	
Reflector Voltage at 8500Mc/s	−100	V
→ at 9655Mc/s	−155	V
Load V.S.W.R. not greater than	1·1 : 1	
Typical Performance		
Resonator Current	40	mA
Output Power (mean over the band)	65	mW
Electronic Tuning Range to 3db points	35	Mc/s
Reflector Voltage Change to 3db points	18	V
Modulation Sensitivity (Reflector) at mode optimum	1·3	Mc/s/V
Modulation Sensitivity (Reflector) at 3db points	3·5	Mc/s/V

Condition (2)

Operational Conditions		
Resonator Voltage	250	V
Mode	6	
Reflector Voltage at 8500Mc/s	−60	V
→ at 9655Mc/s	−105	V
Load V.S.W.R. not greater than	1·1 : 1	
Typical Performance		
Resonator Current	30	mA
Output Power (mean over the band)	30	mW
Electronic Tuning Range to 3db points	42	Mc/s
Reflector Voltage Change to 3db points	12	V
Modulation Sensitivity (Reflector) at mode optimum	2·2	Mc/s/V
Modulation Sensitivity (Reflector) at 3db points	5·0	Mc/s/V

→ Indicates a change

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage		
Mode 5	300	V
Mode 6	250	V
Mode 7	235	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

Range of Characteristics

	Frequency	*Min*	*Max*	
Heater Current	—	1·08	1·32	A
Resonator Current (*See Note* 3):				
Mode 5	—	30	45	mA
Mode 6	—	22	36	mA
Reflector Voltage:				
Mode 5	8500	−80	−135	V
Mode 5	9655	−130	−190	V←
Mode 6	8500	−40	−90	V
Mode 6	9400	−82	−115	V
Mode 6	9655	−90	−125	V←
Mode 7	8500	−30	−90	V
Mode 7	9655	−30	−95	V←
Output Power (*See Note* 4):				
Mode 5	—	40	120	mW
Mode 6	—	12	66	mW
Mode 7	—	8	—	mW
Mechanical Tuning Range	—	8500	9655	Mc/s←
Tuner Torque (*See Note* 5)	—	—	50	oz-in
Electronic Tuning Range (*See Note* 6):				
Mode 5	—	20	—	Mc/s
Mode 6	—	30	—	Mc/s
Modulation Sensitivity (Reflector) (*See Note* 7):				
Mode 5	—	0·5	—	Mc/s/V
Mode 6	—	1·0	—	Mc/s/V
Hysteresis:				
Mode 5	—	—	50	%
Mode 6	—	—	50	%

← Indicates a change

CHARACTERISTICS OF A TYPICAL VALVE

Tuner Torque	35	oz-in
Resetting Accuracy (*See Note* 8)	1	Mc/s
Temperature Coefficient (Mode 5)	+0·03	Mc/s°/C
Warm-up Frequency Drift from 20 seconds to 30 minutes (Mode 5)—Frequency Deviation (*See Note* 9)	−3	Mc/s
Barometric Coefficient from 70mm to 760mm—Frequency Deviation (*See Note* 10)	1·5	Mc/s
Heater Voltage Coefficient from 5·7 to 7·0V	1	Mc/s/V
Noise (*See Note* 11)	less than 3×10^{-14}	W/Mc/s/mW
Peak Frequency Deviation when vibrated at frequencies from 20 to 1000c/s at 10g	0·1	Mc/s
Max Frequency Deviation when subjected to a shock of 100g with a duration of 0·006 second	1·5	Mc/s
Frequency Deviation when subjected to a steady acceleration of 50g	less than 0·5	Mc/s
Power Deviation when subjected to a steady acceleration of 50g	less than 1	db

OPERATING INSTRUCTIONS

1. Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the reflex klystron type K351. If the information given below is used, long and reliable performance of the valve will result.

The engineering staff of the English Electric Valve Co. are always available to give further information if required.

2. Precautions

1. Never apply the resonator voltage before the reflector voltage even for a short period.
2. Do not operate the valve at any time without a negative voltage on the reflector.
3. Never exceed the maximum ratings given on page 2.

3. Installation and Operation

1. *Mounting*

The valve may be mounted in an equipment at any angle provided the longitudinal axis of the waveguide load is the same as that for the valve waveguide.

Bolt the valve securely to its mating waveguide flange. Normally the valve is operated with the resonator at earth potential with the circuit as shown in Figure 1 of the preamble. If the resonator body is to be operated above earth potential, the removable eyelets in the flange may be replaced by insulating bushes.

The valve is designed to give the performance shown under Typical Operation when working into a load of V.S.W.R. not greater than 1·1 : 1.

2. *Connections*

Ensure that the connections to the valve are correct; the leads colour code is given on page 9.

3. *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period. Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(*a*) Heater voltage,
(*b*) Reflector voltage,
(*c*) Resonator voltage.

4. *Reflector*

The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied.

When the reflector is modulated the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible, a protective diode should be fitted at the reflector.

The maximum total impedance in the reflector circuit should not exceed 0·5 Megohm.

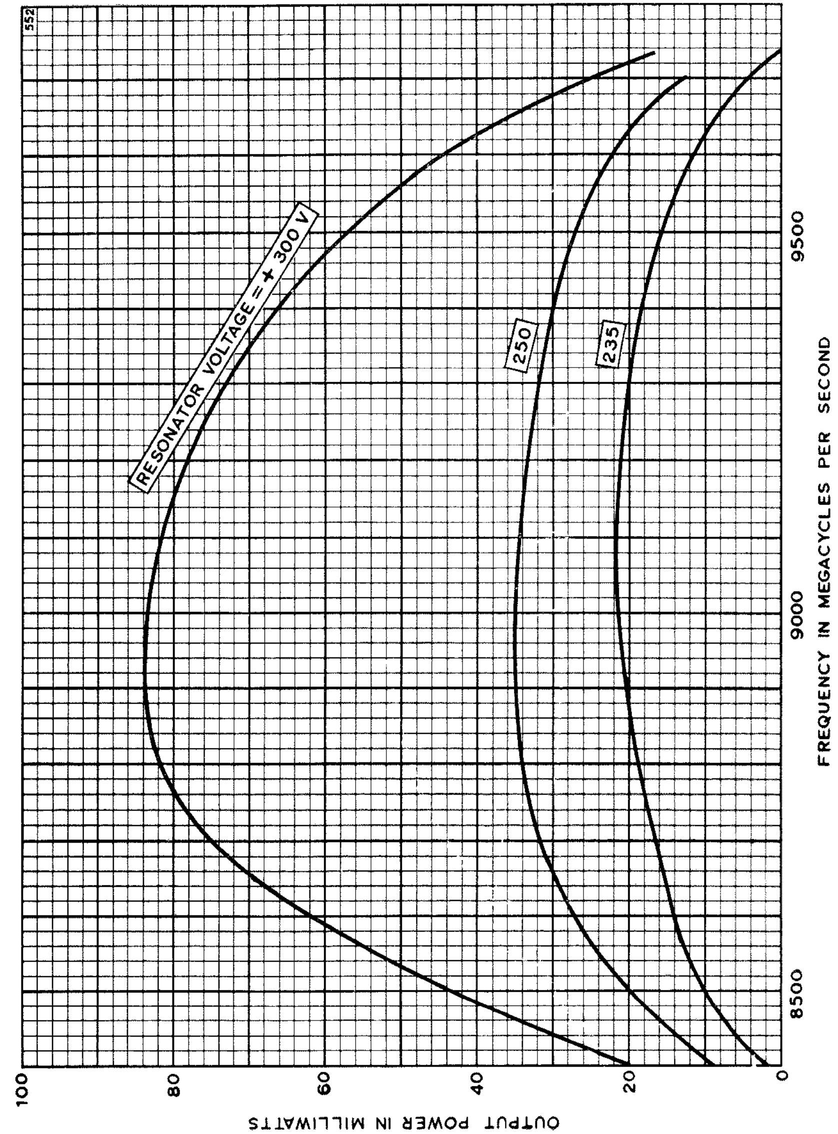
5. *Cooling*

For maximum life the valve body temperature should not exceed 100°C.

NOTES

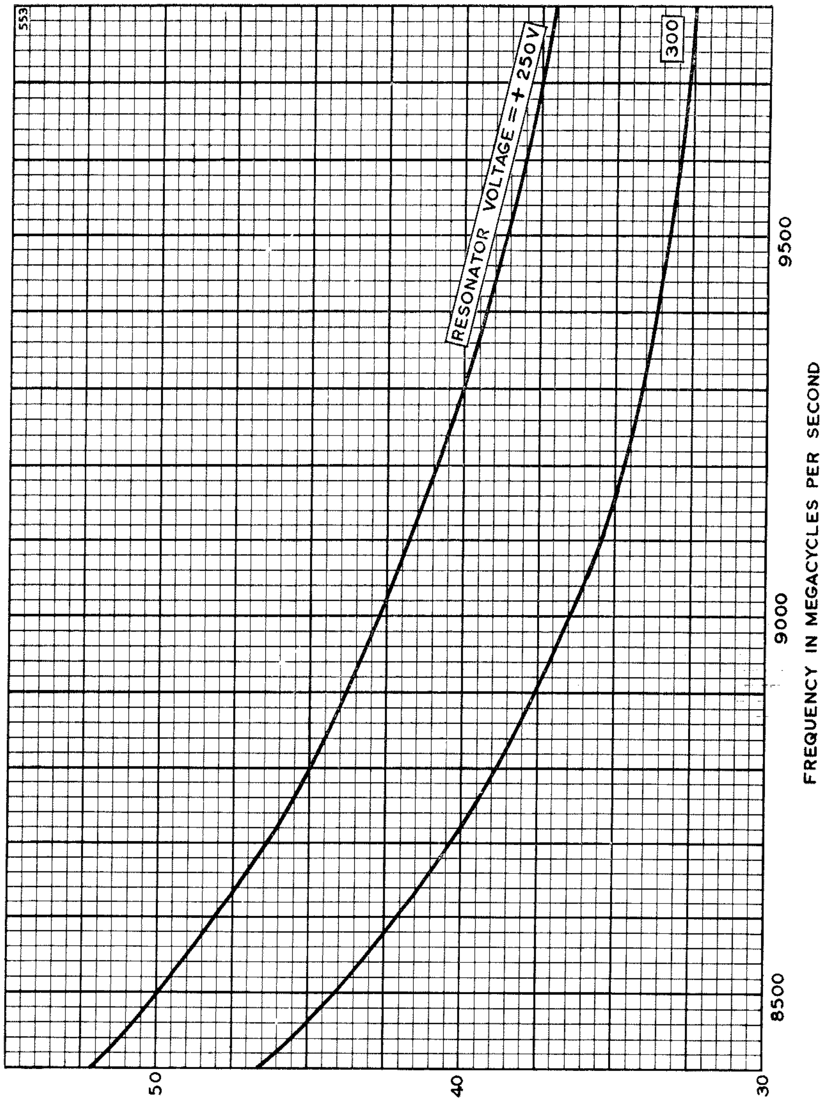
1. Approximately 4 turns covers the frequency range from 8500 to 9650Mc/s. Clockwise rotation reduces the frequency.
2. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this contact is not obtained, or the valve is operating under reduced atmospheric pressure for prolonged periods, care must be taken that the maximum safe body temperature is not exceeded.
3. The values given are measured at mode optimum at any frequency in the tuning band.
4. The values given are for a valve adjusted to mode optimum, and looking into a load V.S.W.R. not greater than 1·1 : 1.
5. The torque is measured:
   (*a*) with all supplies off and all parts of the valve stabilised at an ambient temperature between 10°C and 40°C;
   (*b*) with all supplies on and the temperature stabilised at the normal operating temperature with an ambient temperature between 10°C and 40°C.
6. The values given are between 3db power points with a load V.S.W.R. not greater than 1·1 : 1.
7. The modulation sensitivity is measured as the frequency deviation caused by a reflector voltage change of 1 volt at mode optimum.
8. The maximum difference between possible frequencies for the same position of the tuning screw, after the screw has been turned about half a turn and returned to its initial position, is termed the resetting accuracy of the valve.
9. The warm-up frequency drift is measured with the valve mounted on to at least 1 foot length of waveguide No. 16. The frequency under these conditions in free air is approximately stable after 10 minutes.
10. The pressure change is accomplished in less than 10 seconds to obviate frequency drift due to a temperature change of the valve body.
    The change of frequency noted is due to the change of dielectric in the external tuning cavity from air to a vacuum.
11. The noise is measured by comparison with a standard gas discharge noise source using a 1Mc/s bandwidth filter at a frequency 40Mc/s away from the carrier frequency and is expressed as the noise in watts per milliwatt output of the valve.

OUTPUT POWER CHARACTERISTICS

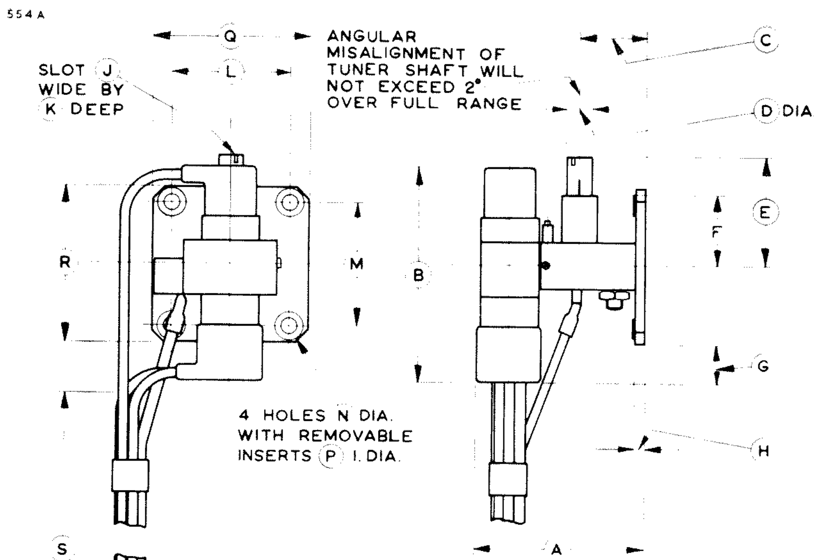


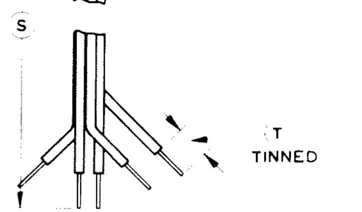
ENGLISH ELECTRIC

ELECTRONIC TUNING CHARACTERISTICS



OUTLINE





Colour	Element
Green	Cathode
Yellow (2)	Heater
Tan	Resonator
Grey	Reflector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	1·937 Max	49·20 Max	K	0·100	2·54
B	2·500 Max	63·50 Max	L	1·220 ± 0·004	30·988 ± 0·102
C	0·720 ± 0·010	18·29 ± 0·25	M	1·280 ± 0·004	32·512 ± 0·102
D	0·2795 ± 0·0015	7·099 ± 0·038	N	0·219	5·56
E	1·500 Max	38·10 Max	P	0·185	4·70
F	0·812 Max	20·62 Max	Q	1·625	41·27
G	0·490 Max	12·45 Max	R	1·625	41·27
H	0·117 ± 0·012	2·97 ± 0·30	S	18·0	457
J	0·040	1·02	T	0·375	9·53

Millimetre dimensions have been derived from inches.

KLYSTRON

INTRODUCTION

The K357 is a low voltage reflex klystron with mechanical tuning covering the frequency range 10 660 to 10 720Mc/s. It has been designed specifically for use in Railway and Police Doppler Speed Measuring Systems where long life and reliable performance are required.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG-40A/U (Z830051).

Mechanical tuning is achieved by means of a simple single screw intruding into the cavity.

Each valve is marked with the reflector voltage at which the valve will oscillate and deliver maximum output power at the midband frequency.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	3·75 × 1·83 × 1·50 inches	Max
	95·3 × 46·4 × 38·1 mm	Max
Net Weight	7 ounces (200 gm)	Approx
Mounting Position		Any
Top Cap		B.S.448/CT1
Base		International Octal

Cooling (*See Note* 1) .. .. Natural

KLYSTRON

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	350	V
Resonator Current	—	40	mA
Reflector Voltage (negative)	20	400	V
Body Temperature	—	140	°C

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	250	V
Reflector Voltage	−100	V
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Resonator Current	15	mA
Output Power	12	mW
Electronic Tuning Range	30	Mc/s

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	250	V
Reflector Voltage	..	Adjust
Load V.S.W.R. not greater than	1·1 : 1	

Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·62	A
Resonator Current	—	20	mA
Mechanical Tuning Range	10 660	10 720	Mc/s
Reflector Voltage (negative) (*See Note* 2)	80	130	V
Output Power	10	—	mW
Electronic Tuning Range	30	—	Mc/s

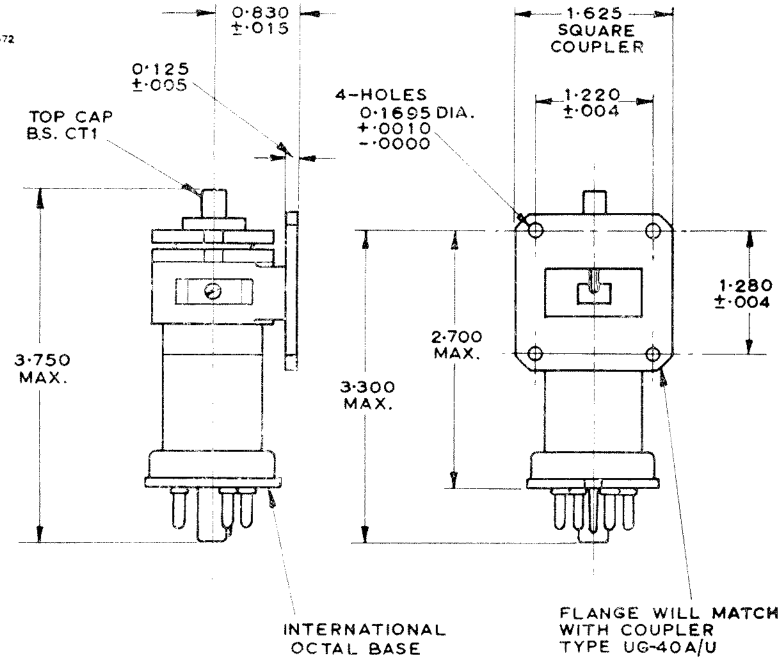
NOTES

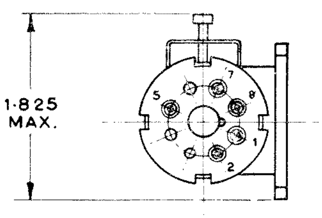
1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 140°C is not exceeded.

2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

KLYSTRON

OUTLINE





PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	CATHODE & HEATER
8	NO CONNECTION
CAP	REFLECTOR

ALL DIMENSIONS IN INCHES

KLYSTRON

INTRODUCTION

The K359 is a rugged wide band low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 8100 to 8750Mc/s. The valve is designed primarily to operate in the adverse conditions prevailing in airborne equipments and is also suitable for ground equipments where rapid warm-up and good frequency stability are important. The valve is intended for operation with a resonator voltage of 350 volts but 300 volts or 250 volts may be used where less output power is required.

Special features of the valve are extreme frequency stability and low noise under severe environmental conditions, rapid warm-up with small frequency drift, low barometric and temperature coefficients and low residual F.M. and noise. The moulded leads and base permit high altitude operation without pressurising.

Mechanical tuning is achieved by means of a single screw on an external tuning cavity, integral with the body. Clockwise rotation reduces the frequency, and about 1·25 turns cover the band from 8750 to 8100Mc/s.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of coupler type UG–39/U or UG–40A/U (Z830051). Removable eyelets are provided in the flange to facilitate use of the klystron with insulating bushes thus obviating the need of an earthed resonator supply.

GENERAL DATA

Electrical

Cathode		Indirectly Heated, Oxide Coated	
Heater Voltage		6·3	V
Heater Current		1·2	A
Total Impedance in Reflector-Cathode Circuit		0·5 MΩ	Max

Mechanical

Overall Dimensions	2·81 × 1·94 × 1·64 inches	Max
	71·4 × 49·3 × 41·7 mm	Max
Net Weight	6 ounces (170 gm)	Approx
Mounting Position		Any
Top Cap	Moulded cap with flying lead	
Base	Moulded base with flying leads	
Tuner (*See Note* 1)	Single screw	
Output Coupling	Bolts to square flange coupler type UG–39/U or UG–40A/U (Z830051) into No. 16 waveguide (0·900 × 0·400 inches internal dimensions)	

Cooling (*See Note* 2) .. .. .. Conduction, and natural convection

KLYSTRON

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual ratings should be exceeded

	Min	*Max*	
Heater Voltage	5·75	6·9	V
Resonator Voltage	—	380	V
Resonator Current	—	60	mA
Reflector Voltage (negative)	0	500	V
Body Temperature	—	200	°C
Altitude			No Limit
Cathode to Heater Voltage	—	45	V

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage at 8100Mc/s	−100	V Approx
at 8750Mc/s	−150	V Approx
Load V.S.W.R. not greater than	1·4 : 1	

Typical Performance

Resonator Current	45	mA
Output Power (mean over the band)	90	mW
Electronic Tuning Range to 3db points	55	Mc/s
Reflector Voltage Change to 3db points	20	V
Modulation Sensitivity (Reflector) at mode optimum	1·3	Mc/s/V
Modulation Sensitivity (Reflector) at ±10Mc/s points	2·0	Mc/s/V

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions (unless otherwise stated)

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·4 : 1	

Range of Characteristics

	Min	*Max*	
Heater Current	1·1	1·3	A
Resonator Current (*See Note* 3)	30	55	mA
Reflector Voltage (Negative) (*See Note* 4)	90	185	V
Mechanical Tuning Range (*See* Tuning Characteristic)	8100	8750	Mc/s
Tuner Torque (*See Note* 5)	3	25	oz–in
Resetting Accuracy (*See Note* 6)	—	1	Mc/s
Electronic Tuning Range between 3db points	±15	±40	Mc/s
Modulation Sensitivity (Reflector) (*See Notes* 7 and 8)	1	4·5	Mc/s/V
Frequency Deviation when subjected to a steady acceleration of 50g	—	1	Mc/s
Warm-up Drift (*See Notes* 8 and 9):			
Frequency Deviation	—	±3	Mc/s
Power Deviation	—	±1	db
Barometric Coefficient from 76mm to 760mm (*See Note* 10)—			
Frequency Deviation	—	2	Mc/s
Noise (*See Notes* 8 and 11)	—	5×10^{-14}	W/Mc/s/mW
Tuner Side Thrust (*See Note* 12)—			
Frequency Deviation	—	1	Mc/s

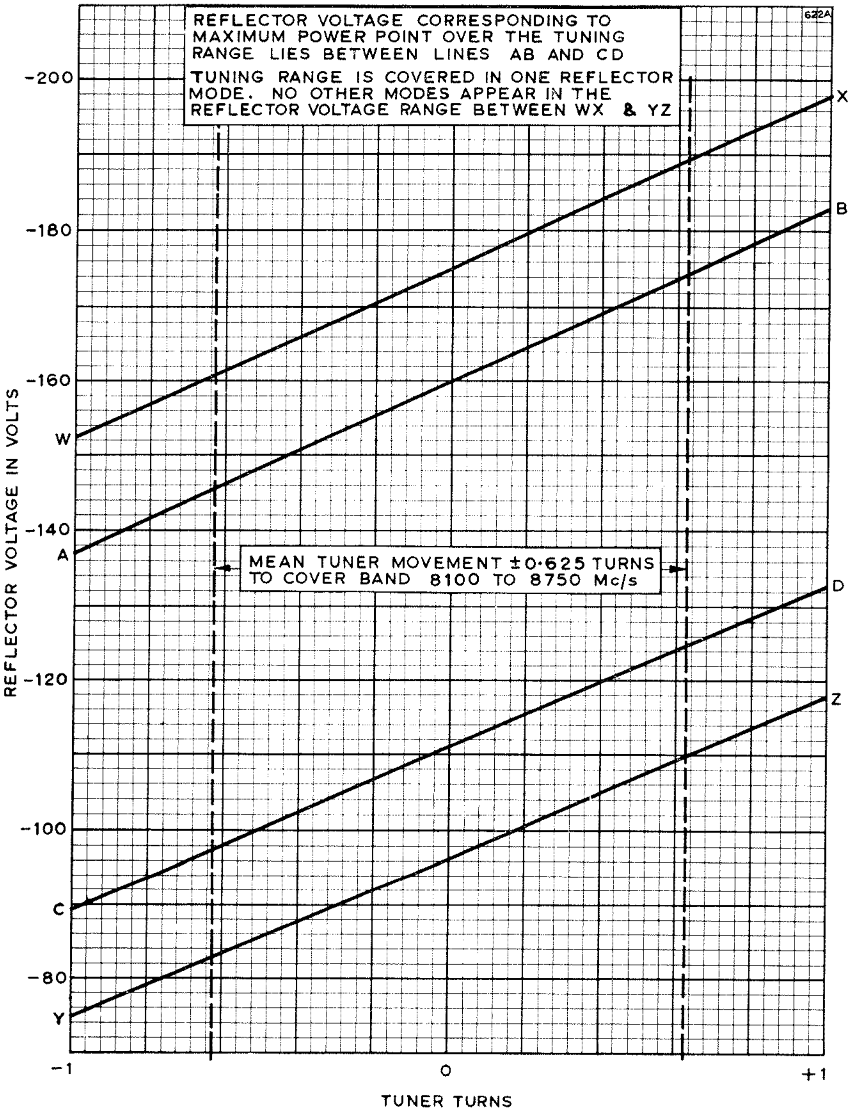
CHARACTERISTICS OF A TYPICAL VALVE

Tuner Torque	15	oz–in
Resetting Accuracy	0·5	Mc/s
Temperature Coefficient		Zero
Warm-up Frequency Drift		
from 20 seconds to 3 minutes 20 seconds	−1·0	Mc/s
from 20 seconds to 30 minutes	−3·0	Mc/s
Barometric Coefficient from 76mm to 760mm—Frequency Deviation	1·5	Mc/s
Heater Voltage Coefficient from 5·7 to 7·0V—Frequency Deviation	1·0	Mc/s/V
Noise	3×10^{-14}	W/Mc/s/mW
Peak Frequency Deviation when vibrated at frequencies from 20 to 1000c/s at 10g	less than 0·1	Mc/s
Power Deviation when vibrated at frequencies from 20 to 1000c/s at 10g	less than 10	%
Max Frequency Deviation when subjected to a shock of 150g with a duration of 0·004 second	1·5	Mc/s
Frequency Deviation when subjected to a steady acceleration of 50g	less than 0·5	Mc/s
Power Deviation when subjected to a steady acceleration of 50g	less than 1	db
Tuner Side Thrust Frequency Deviation	less than 0·2	Mc/s

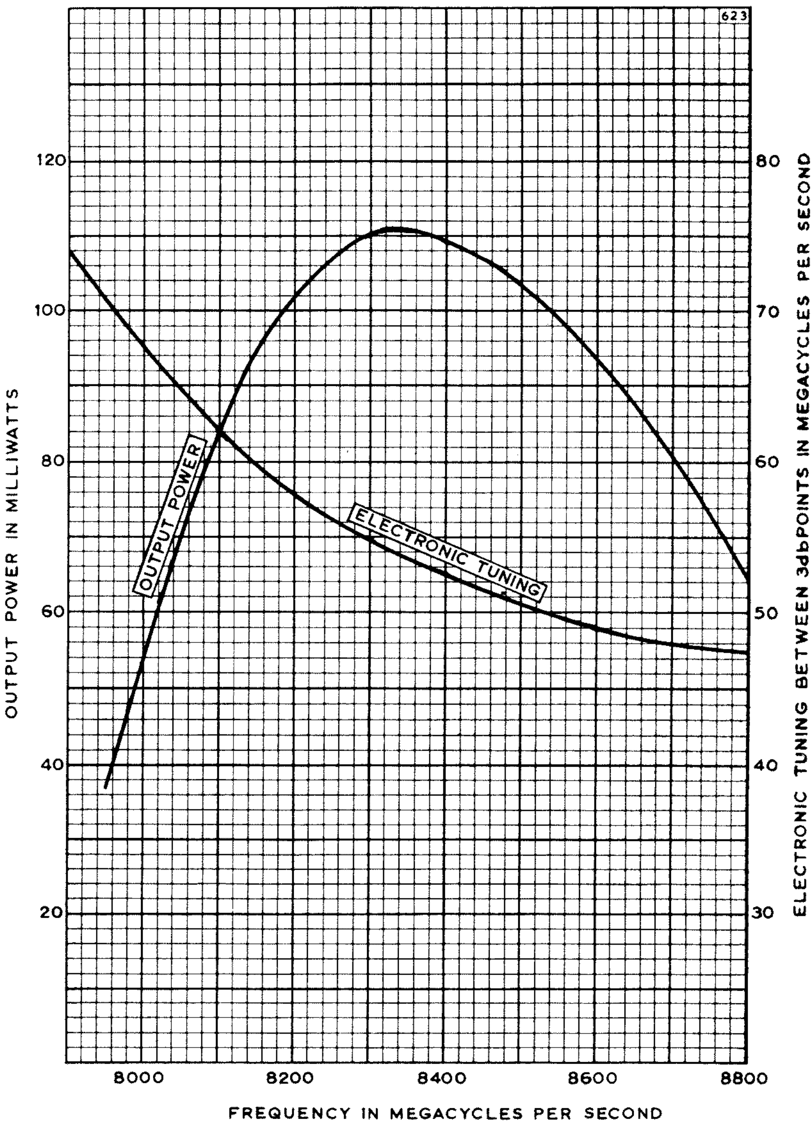
NOTES

1. Approximately 1·25 turns cover the frequency range from 8100 to 8750Mc/s. Clockwise rotation reduces the frequency.
2. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this contact is not obtained, or the valve is operating under reduced atmospheric pressure for prolonged periods, care must be taken that the maximum safe body temperature of 200°C is not exceeded.
3. The values given are for a valve operating with 6·3 heater voltage, and measured at mode optimum at any frequency in the tuning band.
4. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.
5. The torque is measured
   (*a*) with all supplies off and all parts of the valve stabilised at an ambient temperature between 10°C and 30°C.
   (*b*) with all supplies on and the valve body temperature stabilised at the normal operating temperature between 90°C and 130°C.
6. The maximum difference between possible frequencies for the same position of the tuning screw, after the screw has been turned about half a turn and returned to its initial position, is termed the resetting accuracy of the valve.
7. The modulation sensitivity is measured as the frequency deviation caused by a reflector voltage change of 1 volt at mode optimum.
8. Load V.S.W.R. not greater than 1·2 : 1.
9. The warm-up frequency and power deviation are measured with the valve in an approved mount. The power and frequency are measured 20 seconds after the simultaneous application of all supplies and compared with the conditions 3 minutes 20 seconds after switch on.
10. The atmospheric pressure surrounding the valve and inside the external cavity is increased from 76 to 760mm in 60 seconds maximum.
11. The noise has been measured by comparison with a standard gas discharge noise source using a 1Mc/s band width filter at a frequency 40Mc/s away from the carrier frequency and is expressed as the noise in Watts per milliwatt output of the valve.
12. The frequency deviation is measured with a side thrust of 1lb.wt. applied to the top of the tuning pin along two mutually perpendicular axes, both perpendicular to the axis of the tuning pin.

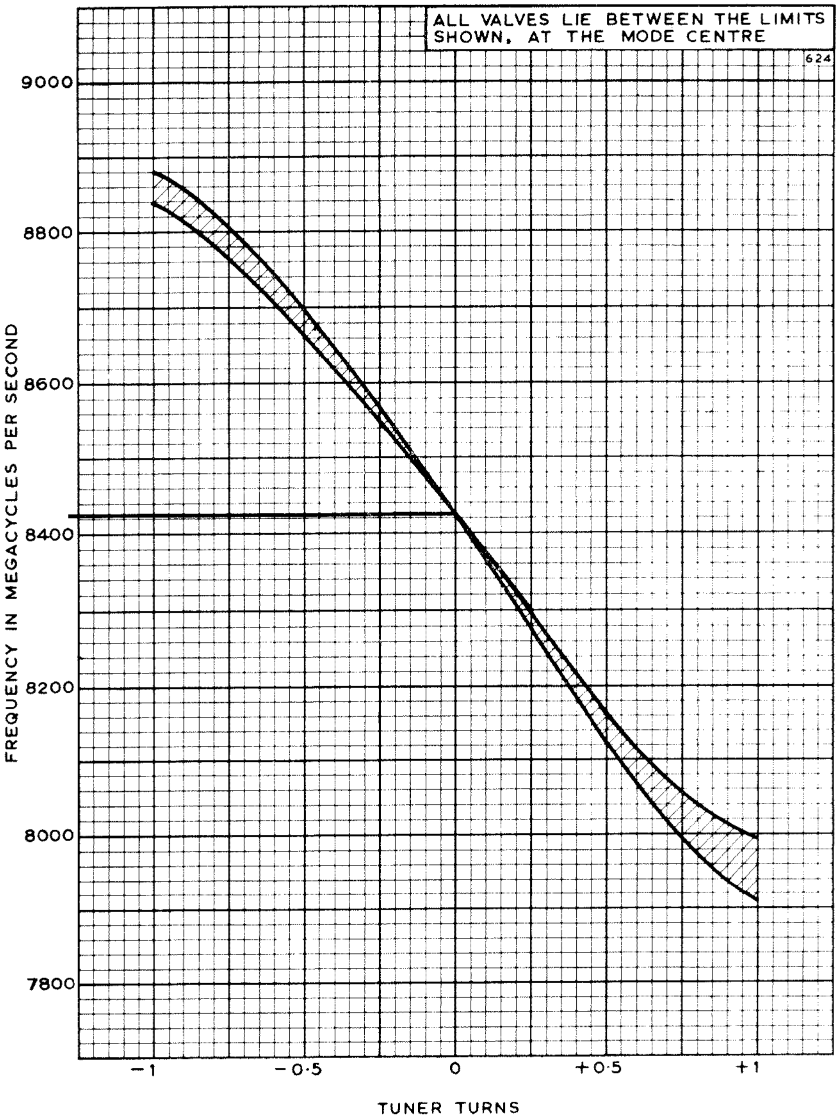
REFLECTOR CHARACTERISTIC



POWER & ELECTRONIC TUNING CHARACTERISTIC



MECHANICAL TUNING CHARACTERISTIC



KLYSTRON

OUTLINE

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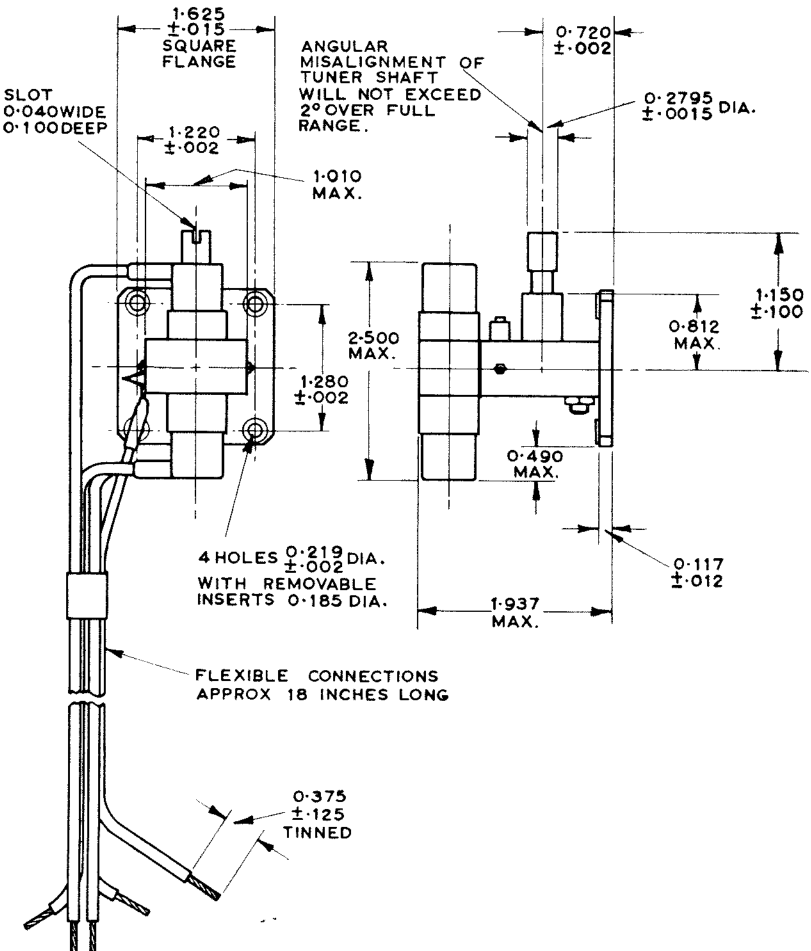


COLOUR	ELEMENT
GREEN	CATHODE
YELLOW (2)	HEATER
TAN	RESONATOR
GREY	REFLECTOR

ALL DIMENSIONS IN INCHES

ENGLISH ELECTRIC

ABRIDGED DATA

Low voltage reflex klystrons designed specifically for doppler speed measuring systems requiring long life and reliable performance.

Frequency Range:		
K361	10 700 to 10 725	Mc/s
K361B	10 675 to 10 700	Mc/s
Typical Output Power	27	mW
Electronic Tuning Range	20	Mc/s
Output	to No. 16 Waveguide (0·900 inch × 0·400 inch internal)	
Coupler	UG-40A/U (Z830051)	
Mechanical Tuning	Single Screw	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	2·625 × 1·875 × 1·500 inches	Max
	66·68 × 47·63 × 38·1 mm	Max
Net Weight	7 ounces (200g)	Approx
Mounting Position	Any	
Connections	Flying Leads	

Cooling (*See Note* 1) .. .. Natural

MAXIMUM AND MINIMUM RATINGS

(Absolute Values) (*See Note* 2)

All voltages are with respect to cathode.

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	350	V
Resonator Current	—	40	mA
Resonator Dissipation	—	12	W
Reflector Voltage (negative) (*See Note* 3)	20	400	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature	—	140	°C

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	300	V
Reflector Voltage (*See Note* 4)	−200	V
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Resonator Current	25	mA
Output Power	27	mW
Electronic Tuning Range to 3db points	20	Mc/s
Modulation Sensitivity (Reflector)	1·5	Mc/s/V

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	300	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

Range of Characteristics

	Min	Max	
Heater Current	0·52	0·62	A
Resonator Current	22	35	mA
Mechanical Tuning Range (*See Note 5*):			
K361	10 700	10 725	Mc/s
K361B	10 675	10 700	Mc/s
Reflector Voltage (negative) (*See Note* 6)	150	250	V
Output Power	20	—	mW
Electronic Tuning Range	15	—	Mc/s

NOTES

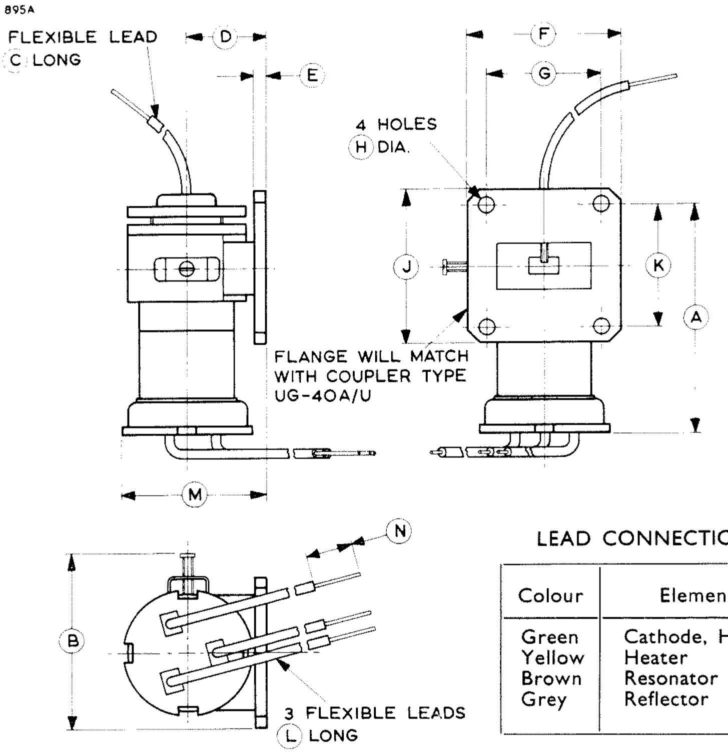
1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature rating of 140°C is not exceeded.
2. These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.
3. The reflector voltage must never be allowed to fall below the minimum value specified in the ratings, even when modulated. The reflector must always be connected to its supply while the resonator voltage is applied.
4. Each valve is marked with the reflector voltage at which the valve will oscillate and deliver maximum output power at the midband frequency.
5. Clockwise rotation of the tuning screw produces a decrease in frequency.
6. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variations over the mechanical tuning range and also variations from valve to valve.

ENGLISH ELECTRIC VALVE CO. LTD. CHELMSFORD ENGLAND

Printed in England

ENGLISH ELECTRIC

OUTLINE



LEAD CONNECTIONS

Colour	Element
Green	Cathode, Heater
Yellow	Heater
Brown	Resonator
Grey	Reflector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	2·450 Max	62·23 Max	H	$0{\cdot}1695^{+0{\cdot}001}_{-0{\cdot}000}$	$4{\cdot}305^{+0{\cdot}025}_{-0{\cdot}000}$
B	1·875 Max	47·63 Max	J	1·625	41·28
C	12·000	305	K	1·280 ± 0·004	32·512 ± 0·102
D	0·830 ± 0·015	21·08 ± 0·38	L	12·000	305
E	0·125 ± 0·005	3·18 ± 0·13	M	1·500 Max	38·10 Max
F	1·625	41·28	N	0·500 ± 0·250	12·70 ± 6·35
G	1·220 ± 0·004	30·988 ± 0·102			

Millimetre dimensions have been derived from inches.

INTRODUCTION

The K364 is a low voltage reflex klystron designed for use as a local oscillator with mechanical tuning covering the frequency range from 9295 to 9395Mc/s. This valve is specifically designed for use with systems requiring the local oscillator to track a magnetron in frequency over relatively large temperature variations without any adjustment of the mechanical tuner being necessary.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG-40A/U (Z830051).

Mechanical tuning is achieved by means of a reactive stub intruding into the waveguide. This stub may be operated directly by means of the micrometer provided or remotely by means of a shaft engaging a $\frac{1}{16}$-inch diameter pin mounted across the diameter of a $\frac{1}{4}$-inch hole recessed in the micrometer.

The electronic tuning range is typically 40Mc/s obtained by a voltage sweep of 45 volts.

Each valve is marked with the reflector voltage at which the valve will oscillate and give an output power of at least 10mW over the specified mechanical tuning range.

Reflector voltages are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A
Total Impedance in Reflector-Cathode Circuit	0·5	MΩ Max

Mechanical

Overall Dimensions	3·677 × 3·017 × 1·500 inches	Max
	93·40 × 76·64 × 38·1 mm	Max
Net Weight	7 ounces (210 gm)	Approx
Mounting Position		Any
Reflector Connection		Flying Lead
Base	B.S.448/B8-0 5-pin International Octal	
Cooling (*See Note* 1)		Natural

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Resonator Voltage	—	365	V
Resonator Current	—	45	mA
Resonator Dissipation	—	16	W
Reflector Voltage (negative)	20	500	V
Body Temperature	—	140	°C

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage Range	−150 to −250	V
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Resonator Current	32	mA
Output Power	40	mW
Mechanical Tuning Range	9295 to 9395	Mc/s
Electronic Tuning Range	40	Mc/s
Nominal Reflector Voltage Change to give 30Mc/s electronic tuning	40	V
Frequency Change with resonator body temperature ..	−0·17	Mc/s/°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R. not greater than	1·1 : 1	

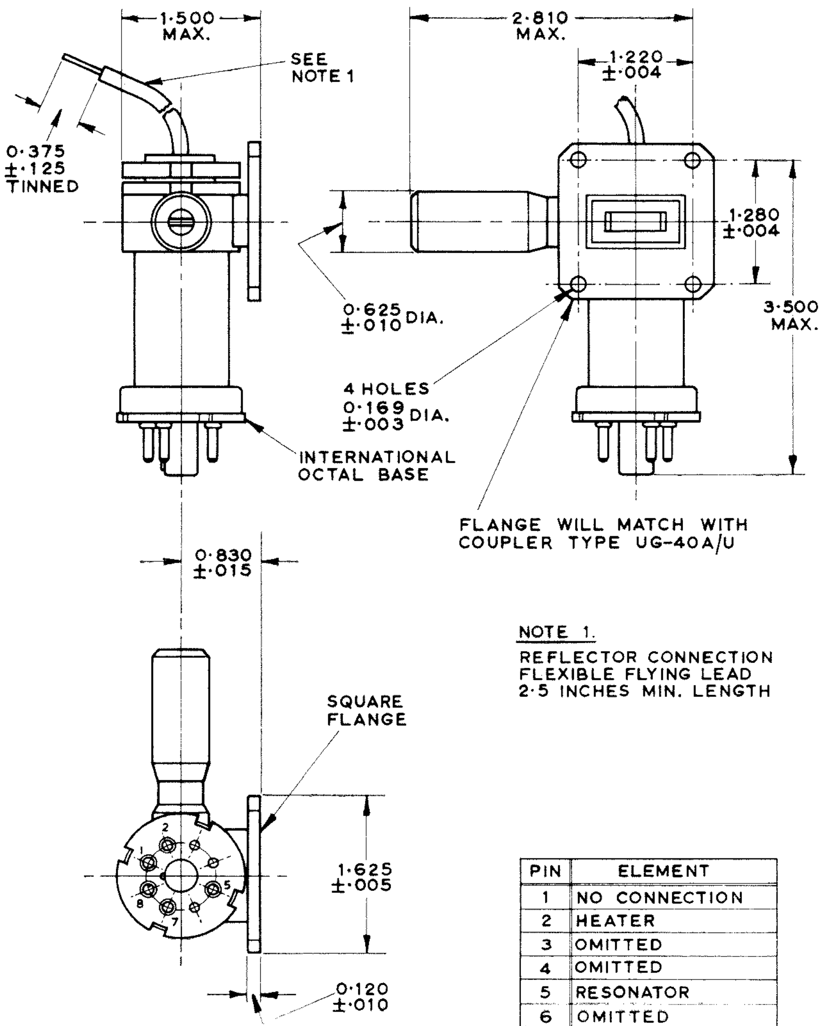
Range of Characteristics	*Min*	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	25	40	mA
Reflector Voltage (negative)(*See Note* 2)	150	250	V
Output Power	25	—	mW
Mechanical Tuning Range	9295	9395	Mc/s
Electronic Tuning Range between 3db points	25	—	Mc/s
Frequency Change with resonator body temperature	−0·02	−0·32	Mc/s/°C

NOTES

1. The valve is intended to be operated with the resonator in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature of 140°C is not exceeded.
2. Reflector voltages given here correspond to the maximum power point of the mode; the limits include the variation over the mechanical tuning range and also variations from valve to valve.

OUTLINE

867



NOTE 1.
REFLECTOR CONNECTION
FLEXIBLE FLYING LEAD
2·5 INCHES MIN. LENGTH

PIN	ELEMENT
1	NO CONNECTION
2	HEATER
3	OMITTED
4	OMITTED
5	RESONATOR
6	OMITTED
7	HEATER & CATHODE
8	NO CONNECTION

ALL DIMENSIONS IN INCHES

ENGLISH ELECTRIC

American Equivalent VA220

INTRODUCTION

The K366 series comprises six forced-air cooled reflex klystrons designed specifically for reliable transmitter service in microwave relays. The valves of this series cover the frequency range from 6125 to 7750Mc/s in steps of approximately 300Mc/s. The output power is typically 1·2 watts.

The waveguide output flange is designed to couple directly to waveguide No. 14 (1·372 inches × 0·622 inch internal dimensions) by means of Coupler type UG-343A/U (Z830037).

Mechanical tuning is achieved by means of a single screw intruding into an external cavity brazed to the main valve body. The particular features of this system are the convenient slow tuning rate, good frequency stability and good linearity of the frequency versus reflector voltage characteristic, ensuring low F.M. distortion.

The electronic tuning range is typically 30Mc/s obtained by a voltage sweep of 50 volts.

Reflector voltages quoted are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·8	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	3·75 × 3·19 × 2·375 inches	Max
	96 × 81 × 61 mm	Max
Net Weight	9 ounces (260 gm)	Approx
Mounting Position		Any
Top Cap		B.S. 448/CT2
Base		6-pin wafer octal

Cooling .. .. Forced-air

Normally a flow of 30 cubic feet per minute will give satisfactory cooling.

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

These ratings apply to each valve in the series

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	750	V
Resonator Current	—	80	mA
Reflector Voltage (negative)	50	1000	V
Peak Heater to Cathode Voltage:			
Heater negative with respect to cathode	—	45	V
Heater positive with respect to cathode	—	45	V
Body Temperature (*See Outline*)	—	150	°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

These characteristics apply to all valves in the series except where stated.

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	750	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1 : 1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·7	0·9	A
Resonator Current	55	80	mA
Reflector Voltage (negative)	250	400	V
Modulation Sensitivity (Reflector)	225	525	kc/s/V

Type	*Mechanical Tuning Range* (Mc/s)	*Minimum Output Power* (W)	*Minimum Electronic Tuning* (Mc/s)
K366A	7425 to 7750	0·5	25
K366B	7125 to 7425	0·7	28
K366C	6875 to 7125	0·7	28
K366D	6575 to 6875	0·7	28
K366E	6125 to 6425	0·7	28
K366G	6425 to 6575	0·7	28

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

TYPICAL OPERATION

(at 7000Mc/s)

Resonator Voltage	750	V
Resonator Current	75	mA
Reflector Voltage	−350	V
Output Power	1·2	W
Electronic Tuning Range	30	Mc/s
Modulation Sensitivity (Reflector)	270	kc/s/V
Mechanical Tuning Rate	100	Mc/s/turn

OPERATING INSTRUCTIONS

1. Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the reflex klystron type K366. If the information given below is used, long and reliable performance of the valve will result.

The Engineering Staff of the English Electric Valve Co. are always available to give further information if required.

2. Precautions

1. Never apply the resonator voltage before the reflector voltage even for a short period.
2. Do not operate the valve at any time without a negative voltage on the reflector.
3. Observe the cooling instructions.
4. Never exceed the maximum ratings given on page 2.

3. Installation and Operation

1. *Mounting*

The valve may be mounted in an equipment at any angle provided the longitudinal axis of the waveguide load is the same as that for the valve waveguide.

Bolt the valve securely to its mating waveguide flange. The valve is intended to be operated with the resonator at earth potential with the circuit as shown in Figure 1 of the preamble. If the resonator body is operated above earth potential some suitable insulation between the valve and the waveguide load is required.

The valve is designed to give the performance shown under Typical Operation when working into a load of V.S.W.R. not greater than 1·1:1.

2. *Connections*

Ensure that the connections to the valve are correct. For valve base connections see Page 5.

3. *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period. Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:
(*a*) Heater voltage and blowers,
(*b*) Reflector voltage,
(*c*) Resonator voltage.

4. *Reflector*

The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied.

When the reflector is modulated the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible, a protective diode should be fitted at the reflector.

The maximum total impedance in the reflector circuit should not exceed 0·5 Megohm.

5. *Cooling*

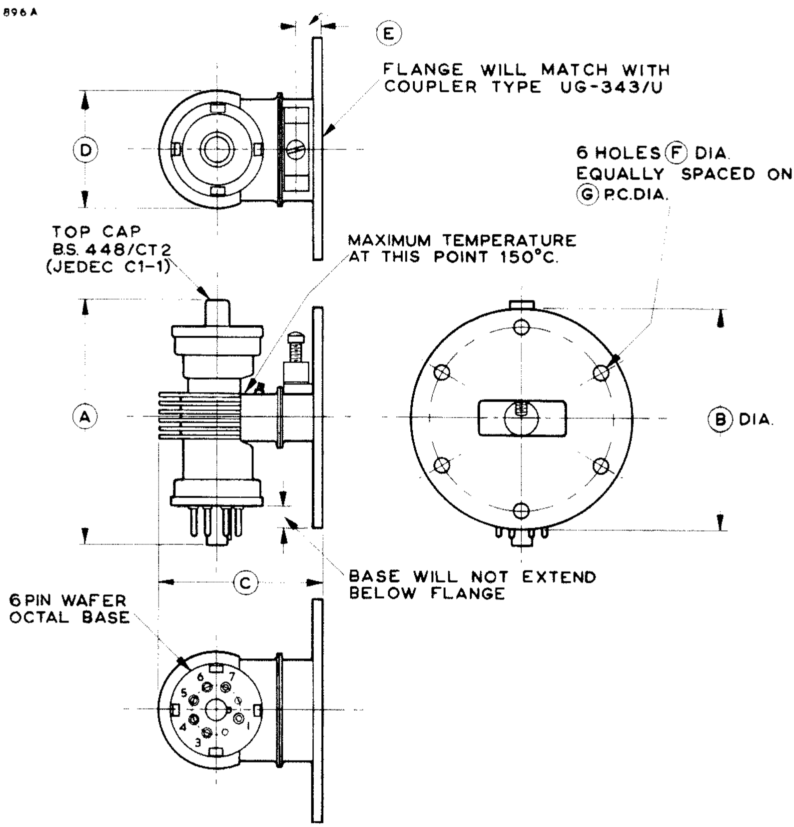
For maximum life the valve body temperature should not exceed 150°C at the point specified on the outline drawing. When operating under the conditions stipulated on page 3 a blower providing 30 cubic feet of air per minute directed on the valve body is adequate.

6. *Tuning*

When the valves are despatched they are tuned to the centre frequency of their respective bands.

Clockwise rotation of the tuning screw produces a decrease of frequency.

OUTLINE



Ref.	Inches	Millimetres
A	3·750 Max	95·25 Max
B	3·190 Max	81·03 Max
C	2·375 Max	60·33 Max
D	1·750 Max	44·45 Max
E	0·375 ± 0·015	9·53 ± 0·40
F	0·220	5·59
G	2·750 ± 0·010	69·85 ± 0·25

Millimetre dimensions have been derived from inches.

Pin	Element
1	Shell
2	Omitted
3	No Connection
4	Cathode
5	Heater
6	Heater
7	No Connection
8	Omitted

American Equivalent VA222

INTRODUCTION

The K367 series comprises six conduction cooled reflex klystrons designed specifically for reliable transmitter service in microwave relays. The valves of this series cover the frequency range from 6125 to 7750Mc/s in steps of approximately 300Mc/s. The output power is typically 1·2 watts.

The waveguide output flange is designed to couple directly to waveguide No. 14, 1·372 inches × 0·622 inch (34·85mm × 15·80mm) internal dimensions by means of coupler type CMR-137.

Mechanical tuning is achieved by means of a single screw intruding into an external cavity brazed to the main valve body. The particular features of this system are the convenient slow tuning rate, good frequency stability and good linearity of the frequency versus reflector voltage characteristic, ensuring low F.M. distortion.

The electronic tuning range is typically 30Mc/s obtained by a voltage sweep of 50 volts.

Reflector voltages quoted are with respect to the cathode. The reflector voltage must never become equal to or more positive than the cathode; if under A.F.C. working there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection be made at all times during operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·8	A
Total Impedance in Reflector-Cathode Circuit	0·5 MΩ	Max

Mechanical

Overall Dimensions	3·750 × 2·482 × 2·295 inches	Max
	95·25 × 63·04 × 58·29 mm	Max
Net Weight	12 ounces (340 gm)	Approx
Top Cap	B.S.448/CT2	
Base	6-pin wafer octal	
Cooling	Conduction	

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

No individual rating should be exceeded
These ratings apply to each valve in the series

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	750	V
Resonator Current	—	80	mA
Reflector Voltage (negative)	50	1000	V
Peak Heater to Cathode Voltage:			
Heater negative with respect to cathode	—	45	V
Heater positive with respect to cathode	—	45	V
Body Temperature (*See Outline*)	—	100	°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

These characteristics apply to all valves in the series except where stated

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	750	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1:1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·7	0·9	A
Resonator Current	55	80	mA
Reflector Voltage (negative)	250	400	V
Modulation Sensitivity (Reflector)	225	525	kc/s/V

Type	*Mechanical Tuning Range* (Mc/s)	*Minimum Output Power* (W)	*Minimum Electronic Tuning* (Mc/s)
K367A	7425 to 7750	0·5	25
K367B	7125 to 7425	0·7	28
K367C	6875 to 7125	0·7	28
K367D	6575 to 6875	0·7	28
K367E	6125 to 6425	0·7	28
K367G	6425 to 6575	0·7	28

TYPICAL OPERATION
(at 7000Mc/s)

Resonator Voltage	750	V
Resonator Current	75	mA
Reflector Voltage	−350	V
Output Power	1·2	W
Electronic Tuning Range	30	Mc/s
Modulation Sensitivity (Reflector)	270	kc/s/V
Mechanical Tuning Rate	100	Mc/s/turn

OPERATING INSTRUCTIONS

1. Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the reflex klystron type K367. If the information given below is used, long and reliable performance of the valve will result.

The engineering staff of the English Electric Valve Co. are always available to give further information if required.

2. Precautions

1. Never apply the resonator voltage before the reflector voltage even for a short period.
2. Do not operate the valve at any time without a negative voltage on the reflector.
3. Never exceed the maximum ratings given on page 2.

3. Installation and Operation

1. *Mounting*

The valve may be mounted in an equipment at any angle provided the longitudinal axis of the waveguide load is the same as that for the valve waveguide.

Bolt the valve securely to its mating waveguide flange. The valve is intended to be operated with the resonator at earth potential with the circuit as shown in Figure 1 of the preamble. If the resonator body is operated above earth potential some suitable insulation between the valve and the waveguide load is required.

The valve is designed to give the performance shown under Typical Operation when working into a load of V.S.W.R. not greater than 1·1 : 1.

2. *Connections*

Ensure that the connections to the valve are correct. For valve base connections see page 5.

3. *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period. Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(*a*) Heater voltage,

(*b*) Reflector voltage,

(*c*) Resonator voltage.

4. *Reflector*

The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied.

When the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible, a protective diode should be fitted at the reflector.

The maximum total impedance in the reflector circuit should not exceed 0·5 Megohm.

5. *Cooling*

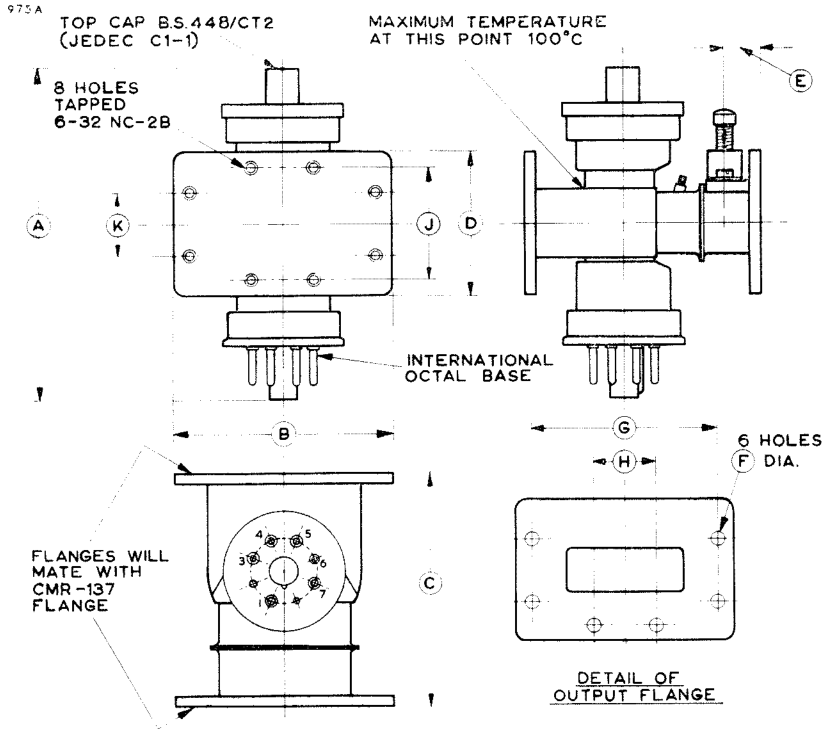
The heat sink should be maintained at a temperature sufficiently low to keep the temperature at the point indicated on the outline drawing below 100°C.

6. *Tuning*

When valves are despatched they are tuned to the centre frequency of their respective bands.

Clockwise rotation of the tuning screw produces a decrease of frequency.

OUTLINE



Ref.	Inches	Millimetres
A	3·750 Max	95·25 Max
B	2·295 Max	58·29 Max
C	2·467 ± 0·015	62·66 ± 0·38
D	1·545 Max	39·24 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·147	3·73
G	1·930 ± 0·004	49·022 ± 0·102
H	0·644 ± 0·004	16·358 ± 0·102
J	1·180 ± 0·004	29·972 ± 0·102
K	0·686 ± 0·004	17·424 ± 0·102

Millimetre dimensions have been derived from inches.

Pin	Element
1	Shell
2	Omitted
3	No Connection
4	Cathode
5	Heater
6	Heater
7	No Connection
8	Omitted

REFLEX KLYSTRON

K391

ABRIDGED DATA

Low voltage reflex klystron with integral tuning cavity, for local oscillator applications.

Frequency Range	9160 to 9340	Mc/s
Typical Output Power	40	mW
Electronic Tuning Range	30	Mc/s
Output	to No. 16 Waveguide (0·900 × 0·400 inch internal)	
Coupler	UG–39/U	
Mechanical Tuning	Single screw	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	2·260 × 1·400 × 1·640 inches	Max
	57·40 × 35·56 × 41·66 mm	Max
Net Weight	4½ ounces (128 gm)	Approx
Mounting Position	Any	
Connections	Flying Leads	

Cooling (*See Note* 1) .. .. Natural Convection

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	Max	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	325	V
Resonator Current	—	45	mA
Reflector Voltage (negative) (*See Note* 2)	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C
Storage Temperature	−55	+45	°C

TYPICAL OPERATION
(at 9250Mc/s)

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	275	V
Reflector Voltage (*See Note* 2)	−86	V
Load V.S.W.R. not greater than	1·1:1	

Typical Performance

Resonator Current	33	mA
Output Power	40	mW
Electronic Tuning Range	30	Mc/s
Mechanical Tuning Rate (*See Note* 3)	180	Mc/s/Turn
Tuner Torque	25	oz-in
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	100	kc/s
Temperature Coefficient of Frequency	−130	kc/s/°C
Frequency Pulling (V.S.W.R. 1·5:1, all phases)	4·0	Mc/s

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	275	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1 : 1	Max

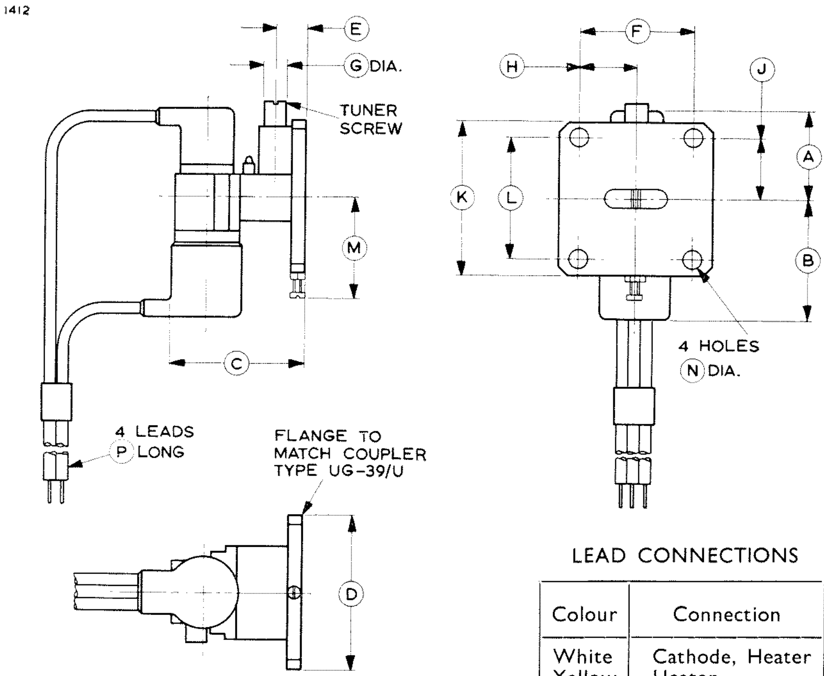
Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	20	40	mA
Mechanical Tuning Range	9160	9340	Mc/s
Reflector Voltage (*See Notes* 2, 4 *and* 5)	−75	−100	V
Electronic Tuning Range	25	—	Mc/s
Output Power	20	60	mW
Temperature Coefficient of Frequency	−50	−200	kc/s/°C
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	—	200	kc/s
Mechanical Tuning Rate	150	250	Mc/s/Turn
Tuner Torque	15	35	oz-in
Spurious Modes (*See Note* 5)	−50	−125	V

NOTES

1. The valve should be operated with its waveguide flange in good thermal contact with the main waveguide system. Maximum valve life is attained by operation at temperatures below the specified maximum.
2. The reflector voltage must never be allowed to fall below the minimum value specified in the ratings, even when modulated. The reflector must always be connected to its supply while the resonator voltage is applied.
3. Clockwise rotation of the tuning screw produces a decrease in frequency.
4. The values quoted correspond to the maximum power points of the mode; the limits include the variations over the mechanical tuning range and also the variations from valve to valve.
5. No mode or part of a mode, other than the required mode, will exist in the reflector voltage range quoted as the valve is tuned over the mechanical tuning range.

OUTLINE



LEAD CONNECTIONS

Colour	Connection
White	Cathode, Heater
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	1·000 Max	25·40 Max	H	0·610 ± 0·004	15·494 ± 0·102
B	1·260 Max	32·00 Max	J	0·640 ± 0·004	16·256 ± 0·102
C	1·400 Max	35·56 Max	K	1·625 ± 0·015	41·28 ± 0·38
D	1·625 ± 0·015	41·28 ± 0·38	L	1·280 ± 0·004	32·512 ± 0·102
E	0·322 ± 0·010	8·18 ± 0·25	M	1·063 Max	27·00 Max
F	1·220 ± 0·004	30·988 ± 0·102	N	0·170	4·32
G	0·250 ± 0·002	6·350 ± 0·051	P	8·000 Min	203·2 Min

Millimetre dimensions have been derived from inches.

ABRIDGED DATA

Robust low voltage Reflex Klystron with integral tuning cavity; for use in airborne applications, particularly where the local oscillator is required to track the magnetron in frequency over relatively large temperature variations without adjustment of the mechanical tuner.

Frequency Range	8800 to 8885	Mc/s
Typical Output Power	60	mW
Electronic Tuning Range	40	Mc/s
Output	to No. 16 Waveguide (0·900 × 0·400 inch internal)	
Coupler	UG–39/U	
Mechanical Tuning	Single screw	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	*See Outline*
Net Weight	5 ounces (142 gm) Approx
Mounting Position	Any
Connections	Flying Leads

Cooling (*See Note* 1) .. Natural Convection

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	400	V
Resonator Current	—	50	mA
Reflector Voltage (negative) (*See Note* 2)	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C
Altitude	—	80 000	ft
Storage Temperature	−55	+45	°C

TYPICAL OPERATION
(at 8845Mc/s)

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Load V.S.W.R.	1·1 : 1	

Typical Performance

Heater Current	0·6	A
Resonator Current	30	mA
Output Power	60	mW
Reflector Voltage (*See Note* 2)	−170	V
Electronic Tuning Range	40	Mc/s
Modulation Sensitivity (Reflector) at mode optimum	1·0	Mc/s/V
Temperature Coefficient of Frequency	−100	kc/s/°C
Mechanical Tuning Rate (*See Note* 3)	250	Mc/s/Turn
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	60	kc/s
Barometric Coefficient from 76mm Hg to 760mm Hg: Frequency Deviation	1·5	Mc/s

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1 : 1	

Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	20	40	mA
Mechanical Tuning Range	8800	8885	Mc/s
Reflector Voltage (*See Notes* 2 *and* 4)	−140	−220	V
Output Power	30	—	mW
Electronic Tuning Range	30	—	Mc/s
Modulation Sensitivity (Reflector) at mode optimum	0·5	1·5	Mc/s/V
Temperature Coefficient of Frequency	−50	−200	kc/s/°C
Peak Frequency Modulation with vibration at 10g from 30 to 1000c/s	—	100	kc/s

NOTES

1. The valve should be operated with its waveguide flange in good thermal contact with the main waveguide system. Maximum valve life is attained by operation at temperatures below the specified maximum.

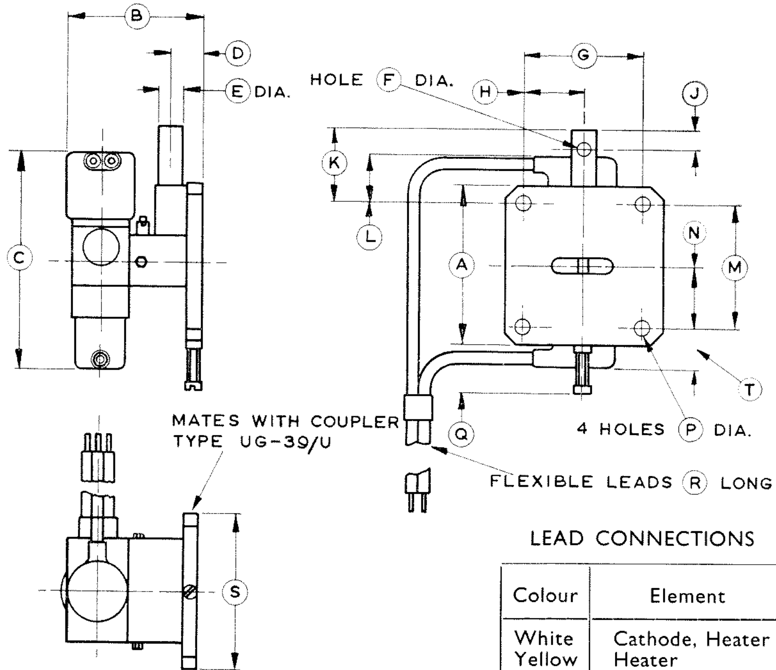
2. The reflector voltage must never be allowed to fall below the minimum value specfied in the ratings, even when modulated. The reflector must always be connected to its supply while the resonator voltage is applied.

3. Clockwise rotation of the tuning screw produces a decrease in frequency.

4. The values given correspond to the maximum power points of the mode; the limits quoted include the variations over the mechanical tuning range and also the variations from valve to valve.

OUTLINE

1196



LEAD CONNECTIONS

Colour	Element
White	Cathode, Heater
Yellow	Heater
Grey	Reflector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	1·625 ± 0·015	41·28 ± 0·38	K	0·760 Max	19·30 Max
B	1·400 Max	35·56 Max	L	0·658 Max	16·71 Max
C	2·400 Max	60·96 Max	M	1·280 ± 0·004	32·512 ± 0·102
D	0·312 ± 0·010	7·92 ± 0·25	N	0·640 ± 0·004	16·256 ± 0·102
E	0·250	6·35	P	0·171	4·34
F	0·110	2·79	Q	0·125 Max	3·18 Max
G	1·220 ± 0·004	30·988 ± 0·102	R	12·000 Min	304·8 Min
H	0·610 ± 0·004	15·494 ± 0·102	S	1·625 ± 0·015	41·28 ± 0·38
J	0·200 ± 0·005	5·08 ± 0·13	T	0·458 Max	11·63 Max

Millimetre dimensions have been derived from inches.

ABRIDGED DATA

Forced-air cooled, fixed frequency, two resonator klystron oscillator for air-borne applications.

Frequency	8800 ± 5	Mc/s
Typical Output Power	1·2	W
Electronic Tuning Range	12	Mc/s
Output	to No. 16 Waveguide (0·900 × 0·400 inch internal)	
Coupler	UG-40A/U (Z830051)	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	1·6	A

Mechanical

Overall Dimensions	3·50 × 1·77 × 1·50 inches Max
	88·9 × 45·0 × 38·1mm Max
Net Weight	5 ounces (150gm) Approx
Mounting Position	Any
Base	Moulded base with flying leads

Cooling .. .. Forced-air

An air flow sufficient to maintain the temperature of any part of the radiator below 150°C is required.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·8	6·8	V
Beam Voltage	—	1100	V
Resonator Dissipation	—	130	W
Radiator Temperature	—	150	°C
Ambient Pressure for satisfactory operation	25	—	mm Hg

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·3	V
Beam Voltage	700	V
Frequency	8800	Mc/s
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Beam Current	70	mA
Output Power	1·2	W
Electronic Tuning Range (*See Note* 1)	12	Mc/s
Modulation Sensitivity (beam voltage) (*See Note* 1)	200	kc/s/V
Frequency Pulling (Load V.S.W.R. 1·5 : 1)	2·0	Mc/s
Random Frequency Deviation (peak to peak) (*See Note* 2)	1·0	kc/s
Frequency Change with Resonator Body Temperature	−35	kc/s/°C
Peak Frequency Deviation when vibrated at 1g from 20 to 500c/s	5·0	kc/s

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Load V.S.W.R. not greater than	1·1 : 1	
Radiator Temperature	50 to 60	°C

Range of Characteristics

	Min	*Max*	
Heater Current	1·5	1·75	A
Frequency	8795	8805	Mc/s
Beam Voltage	680	750	V
Beam Current	55	80	mA
Output Power	1·0	—	W
Electronic Tuning Range between 3db points (*See Note* 1)	10	—	Mc/s
Modulation Sensitivity (*See Note* 1)	100	—	kc/s/V
Frequency Pulling (Load V.S.W.R. 1·5 : 1) (*See Note* 3)	—	2·5	Mc/s
Random Frequency Deviation (peak to peak) (*See Note* 2)	—	3·0	kc/s
Peak Frequency Deviation when vibrated at 1g from 20 to 500c/s	—	10	kc/s

OPERATING INSTRUCTIONS

1. Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the two-resonator klystron type K397. If the information given below is used, long and reliable performance of the valve will result.

The engineering staff of English Electric Valve Company are always available to give further information if required.

2. Precautions

1. Never exceed the maximum ratings given on page 1.
2. Observe the cooling instructions.

3. Installation and Operation

1. *Mounting*

The valve may be mounted in an equipment at any angle provided the longitudinal axis of the waveguide load is the same as that for the valve waveguide, and the cooling instructions are not violated.

Bolt the valve securely to its mating waveguide flange. The valve is intended to be operated with the body at earth potential with the circuit shown in Fig. 3 of the Preamble to the Klystron section of the Valve Data Book. If the body is operated above earth potential some suitable insulation between the valve and the waveguide load is required.

The valve is designed to give the performance shown on page 2 when working into a load of V.S.W.R. not greater than 1·1 : 1.

2. *Connections*

Ensure that the connections to the valve are correct: the leads colour code is given on page 5. For best noise performance the cathode connection should be made to the green lead.

3. *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period; voltage surges on switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(*a*) Heater Voltage and Blowers
(*b*) H.T. Voltage

A delay of two minutes between (*a*) and (*b*) is recommended.

4. *Cooling*

For maximum life the radiator temperature should not exceed 150°C for more than a few minutes. When operating under the conditions stipulated on page 2, a blower providing 30cu.ft/min (0·85cu.m/min) of air directed at the radiator fins is adequate.

NOTES

1. The electronic tuning range and modulation sensitivity are measured dynamically to eliminate spurious heating effects.

2. This represents the random deviations of the output frequency from the carrier frequency produced by random modulating frequencies in the range 150 to 11 000c/s.

3. The frequency pulling is defined as the difference between the minimum and maximum frequencies of the output as the load is varied through all phases.

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ENGLAND

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OUTLINE

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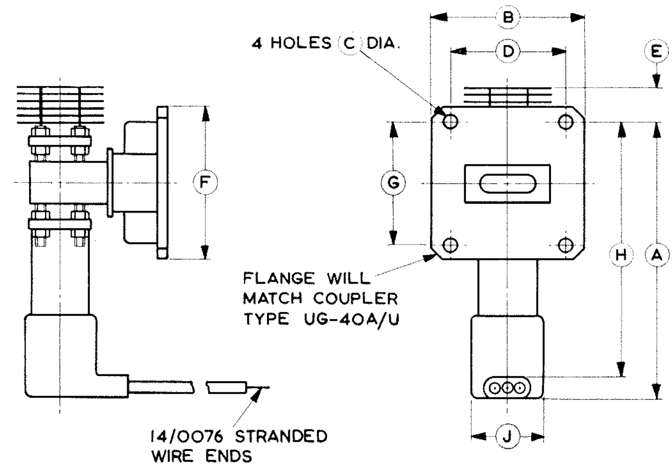

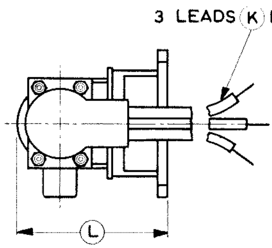

CONNECTIONS

Colour	Connection
White	Heater and Cathode
Yellow	Heater
Green	Cathode

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	2·900 Max	73·66 Max	F	1·625	41·28
B	1·625	41·28	G	1·280 $\pm$ 0·004	32·512 $\pm$ 0·102
C	0·1695 $^{+0·003}_{-0·000}$	4·305 $^{+0·076}_{-0·000}$	H	2·650 Max	67·31 Max
D	1·220 $\pm$ 0·004	30·988 $\pm$ 0·102	J	0·760 Max	19·30 Max
→ E	0·468 Max	11·89 Max	K	8·000 Min	203·2 Min
			L	1·500 Max	38·10 Max

Millimetre dimensions have been derived from inches.

→Indicates a change

REFLEX KLYSTRON

K3003

ABRIDGED DATA

Low voltage reflex klystron with integral tuning cavity, for local oscillator applications.

Frequency Range	9350 to 9550	Mc/s
Typical Output Power	55	mW
Electronic Tuning Range	50	Mc/s
Output	to No. 16 Waveguide (0·900 × 0·400 inch internal)	
Coupler	UG–39/U	
Mechanical Tuning	Single screw	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	3·380 × 1·750 × 1·640 inches	Max
	85·85 × 44·45 × 41·66 mm	Max
Net Weight	5 ounces (140 gm)	Approx
Mounting Position		Any
Top Cap		B.S.448–CT2
Base		International Octal
Cooling (*See Note* 1)		Natural

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	350	V
Resonator Current	—	35	mA
Reflector Voltage (negative) (*See Note* 2) ..	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C
Storage Temperature	−55	+45	°C

TYPICAL OPERATION
(at 9450Mc/s)

Operational Conditions		
Heater Voltage	6·3	V
Resonator Voltage	300	V
Reflector Voltage	−90	V
Load V.S.W.R. not greater than	1·1:1	
Typical Performance		
Resonator Current	22	mA
Output Power	55	mW
Electronic Tuning Range	50	Mc/s
Modulation Sensitivity (Reflector) at mode optimum	2·25	Mc/s/V
Mechanical Tuning Rate (*See Note* 3)	200	Mc/s/Turn
Tuner Torque	25	oz-in
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	100	kc/s
Temperature Coefficient of Frequency	−130	kc/s/°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	300	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1 : 1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	15	25	mA
Reflector Voltage (*See Notes* 2 *and* 4)	−65	−115	V
Electronic Tuning Range	30	70	Mc/s
Output Power	30	70	mW
Temperature Coefficient of Frequency	−50	−200	kc/s/°C
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	—	200	kc/s

NOTES

1. It is normal to operate the valve with the resonator earthed and in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature of 150°C is not exceeded.
2. The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied. When the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible a protective diode should be fitted at the reflector.
3. Clockwise rotation of the tuning screw produces a decrease in frequency.
4. The values quoted correspond to the maximum power points of the mode; the limits include the variations over the mechanical tuning range and also the variations from valve to valve.

OUTLINE

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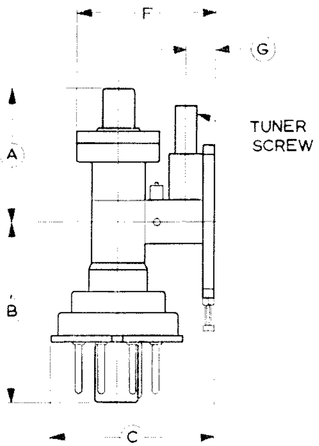

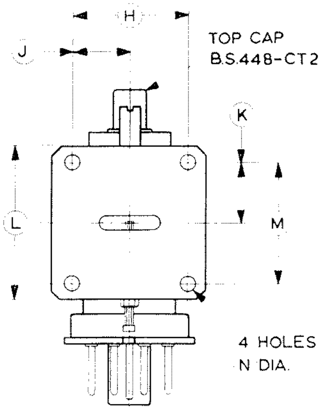

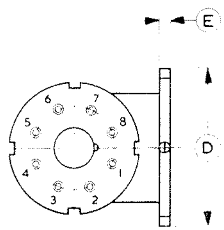

BASE CONNECTIONS

Pin	Element
1	Resonator
2	Heater
3	No connection
4	No connection
5	No connection
6	No connection
7	Heater
8	Cathode
Top Cap	Reflector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	1·450 Max	36·83 Max	H	1·220 ± 0·004	30·988 ± 0·102
B	1·930 Max	49·02 Max	J	0·610 ± 0·004	15·494 ± 0·102
C	1·750 Max	44·45 Max	K	0·640 ± 0·004	16·256 ± 0·102
D	1·625 ± 0·015	41·28 ± 0·38	L	1·625 ± 0·015	41·28 ± 0·38
E	0·135 ± 0·010	3·43 ± 0·25	M	1·280 ± 0·004	32·512 ± 0·102
F	1·600 Max	40·64 Max	N	0·170	4·32
G	0·312 ± 0·010	7·92 ± 0·25			

Millimetre dimensions have been derived from inches.

ABRIDGED DATA

Low voltage reflex klystron with integral tuning cavity, for local oscillator applications.

Frequency Range	9295 to 9395	Mc/s
Typical Output Power	40	mW
Electronic Tuning Range	32	Mc/s
Output	to No. 16 Waveguide (0·900 × 0·400 inch internal)	
Coupler	UG–39/U	
Mechanical Tuning	Single screw	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	2·404 × 1·400 × 1·640 inches	Max
	61·06 × 35·56 × 41·66 mm	Max
Net Weight	5·5 ounces (160 gm)	Approx
Mounting Position		Any
Connections		Flying leads
Cooling (*See Note* 1)		Natural

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	375	V
Resonator Current	—	45	mA
Reflector Voltage (negative) (*See Note* 2)	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C
Storage Temperature	−55	+45	°C

TYPICAL OPERATION
(at 9345Mc/s)

Operational Conditions		
Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage	−190	V
Load V.S.W.R. not greater than	1·1 : 1	
Typical Performance		
Resonator Current	33	mA
Output Power	40	mW
Electronic Tuning Range	32	Mc/s
Modulation Sensitivity (Reflector) at mode optimum	0·7	Mc/s/V
Mechanical Tuning Rate (*See Note* 3)	200	Mc/s/Turn
Tuner Torque	25	oz-in
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	100	kc/s
Temperature Coefficient of Frequency	−130	kc/s/°C
Barometric Coefficient of Frequency, 76mm to 760mm	−1·0	Mc/s
Frequency Pulling (V.S.W.R. 1·5 : 1, all phases)	4·0	Mc/s

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	350	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1 : 1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	25	40	mA
Reflector Voltage (*See Notes* 2 and 4)	−170	−220	V
Electronic Tuning Range	25	—	Mc/s
Output Power	25	50	mW
Temperature Coefficient of Frequency	−50	−200	kc/s/°C
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	—	200	kc/s
Modulation Sensitivity (Reflector) at mode optimum	0·5	2·0	Mc/s/V
Mechanical Tuning Rate	150	250	Mc/s/Turn
Tuner Torque	15	35	oz-in
Spurious Modes (*See Note* 5)	−150	−250	V

NOTES

1. It is normal to operate the valve with the resonator earthed and in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature of 150°C is not exceeded.
2. The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied. When the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible a protective diode should be fitted at the reflector.
3. Clockwise rotation of the tuning screw produces a decrease in frequency.
4. The values quoted correspond to the maximum power points of the mode; the limits include the variations over the mechanical tuning range and also the variations from valve to valve.
5. No mode or part of a mode, other than the required mode, will exist in the reflector voltage range quoted as the valve is tuned over the mechanical tuning range.

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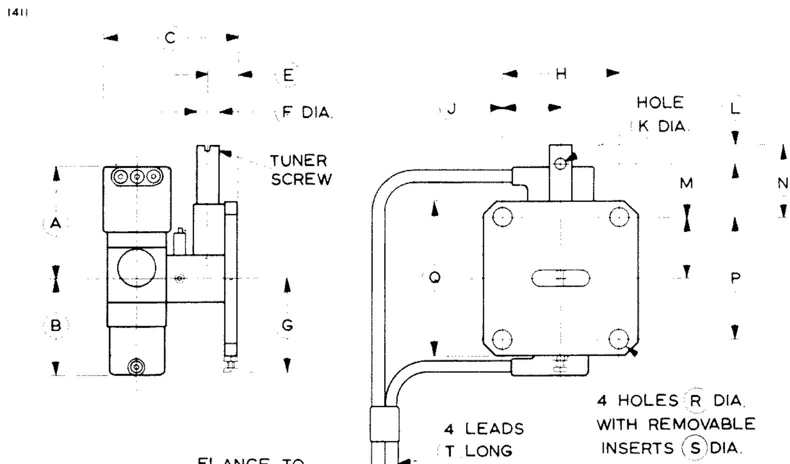

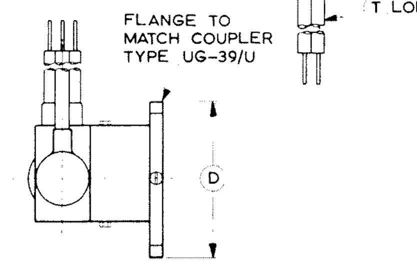

CONNECTIONS

Colour	Connection
White	Cathode and Heater
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	1·300 Max	33·02 Max	K	0·110	2·79
B	1·000 Max	25·40 Max	L	0·200	5·08
C	1·400 Max	35·56 Max	M	0·640 ± 0·004	16·256 ± 0·102
D	1·625 ± 0·015	41·28 ± 0·38	N	0·760 Max	19·30 Max
E	0·312 ± 0·010	7·92 ± 0·25	P	1·280 ± 0·004	32·512 ± 0·102
F	0·250	6·35	Q	1·625 ± 0·015	41·28 ± 0·38
G	1·000 Max	25·40 Max	R	0·220	5·59
H	1·220 ± 0·004	30·988 ± 0·102	S	0·170	4·32
J	0·610 ± 0·004	15·494 ± 0·102	T	12·000 Min	304·8 Min

Millimetre dimensions have been derived from inches.

ABRIDGED DATA

Low voltage reflex klystron with integral tuning cavity, for local oscillator applications.

Frequency Range	9350 to 9550	Mc/s
Typical Output Power	45	mW
Electronic Tuning Range	40	Mc/s
Output	to No. 16 Waveguide (0·900 × 0·400 inch internal)	
Coupler	UG-39/U	
Mechanical Tuning	Single screw	

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·6	A

Mechanical

Overall Dimensions	2·420 × 1·400 × 1·640 inches	Max
	61·47 × 35·56 × 41·66 mm	Max
Net Weight	6 ounces (170 gm)	Approx
Mounting Position		Any
Connections		Flying Leads
Cooling (*See Note* 1)		Natural

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No individual rating should be exceeded.

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	350	V
Resonator Current	—	27·5	mA
Reflector Voltage (negative) (*See Note* 2)	20	500	V
Reflector-Cathode Circuit Impedance	—	0·5	MΩ
Body Temperature (*See Note* 1)	—	150	°C
Storage Temperature	−55	+45	°C

TYPICAL OPERATION
(at 9450Mc/s)

Operational Conditions

Heater Voltage	6·3	V
Resonator Voltage	300	V
Reflector Voltage	−90	V
Load V.S.W.R. not greater than	1·1 : 1	

Typical Performance

Resonator Current	21	mA
Output Power	45	mW
Electronic Tuning Range to 3db points	40	Mc/s
Modulation Sensitivity (Reflector) at mode optimum	2·25	Mc/s/V
Mechanical Tuning Rate (*See Note* 3)	170	Mc/s/Turn
Tuner Torque	25	oz-in
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	100	kc/s
Temperature Coefficient of Frequency	−130	kc/s/°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	300	V
Reflector Voltage		Adjust
Selected Frequencies in the range	9350 to 9550	Mc/s
Load V.S.W.R.	1·1 : 1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·52	0·61	A
Resonator Current	15	25	mA
Reflector Voltage (*See Notes* 2 *and* 4)	−60	−120	V
Electronic Tuning Range	20	50	Mc/s
Output Power	30	70	mW
Temperature Coefficient of Frequency	−50	−200	kc/s/°C
Peak Frequency Modulation with Vibration at 10g from 30 to 1000c/s	—	200	kc/s

NOTES

1. It is normal to operate the valve with the resonator earthed and in good thermal contact with the main waveguide system. If for any reason this thermal contact is not obtained it will be necessary to provide cooling to ensure that the maximum body temperature of 150°C is not exceeded.
2. The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied. When the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible a protective diode must be fitted at the reflector.
3. Clockwise rotation of the tuning screw produces a decrease in frequency.
4. The values quoted correspond to the maximum power points of the mode; the limits include the variations over the mechanical tuning range and also the variations from valve to valve.

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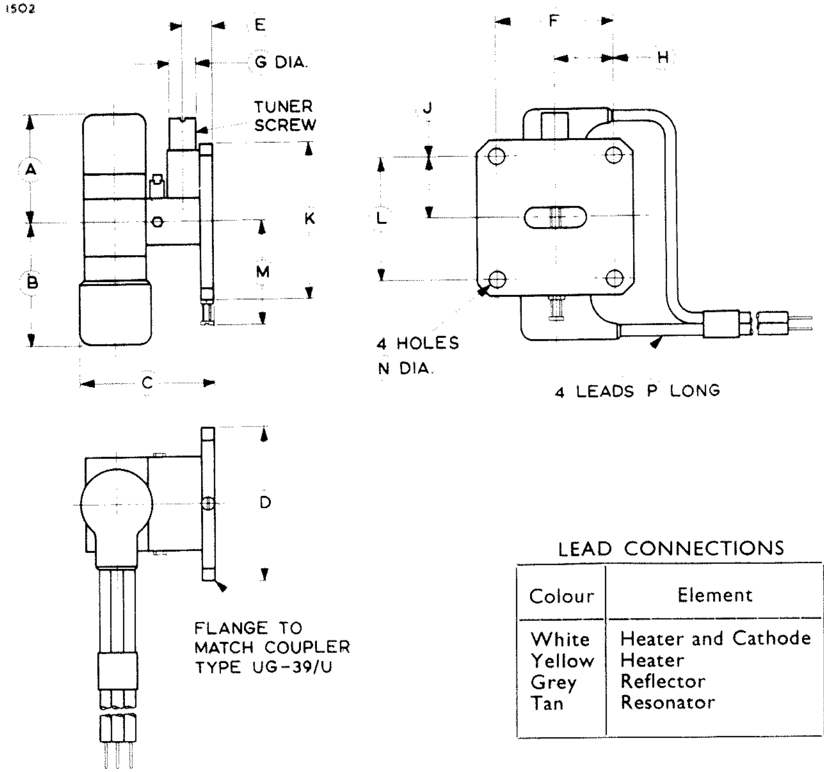
OUTLINE



LEAD CONNECTIONS

Colour	Element
White	Heater and Cathode
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	1·160 Max	29·46 Max	H	$0{\cdot}610 \pm 0{\cdot}004$	$15{\cdot}494 \pm 0{\cdot}102$
B	1·260 Max	32·00 Max	J	$0{\cdot}640 \pm 0{\cdot}004$	$16{\cdot}256 \pm 0{\cdot}102$
C	1·400 Max	35·56 Max	K	$1{\cdot}625 \pm 0{\cdot}015$	$41{\cdot}28 \pm 0{\cdot}38$
D	$1{\cdot}625 \pm 0{\cdot}015$	$41{\cdot}28 \pm 0{\cdot}38$	L	$1{\cdot}280 \pm 0{\cdot}004$	$32{\cdot}512 \pm 0{\cdot}102$
E	$0{\cdot}312 \pm 0{\cdot}010$	$7{\cdot}93 \pm 0{\cdot}25$	M	1·063 Max	27·00 Max
F	$1{\cdot}220 \pm 0{\cdot}004$	$30{\cdot}988 \pm 0{\cdot}102$	N	$0{\cdot}150^{+0{\cdot}000}_{-0{\cdot}003}$	$3{\cdot}810^{+0{\cdot}000}_{-0{\cdot}076}$
G	$0{\cdot}281^{+0{\cdot}000}_{-0{\cdot}003}$	$7{\cdot}137^{+0{\cdot}000}_{-0{\cdot}076}$	P	12·000 Min	304·8 Min

Millimetre dimensions have been derived from inches.

Variant of K366 Series

ABRIDGED DATA

Vapour Cooled Reflex Klystron Oscillators with integral boiler units, for microwave transmitters. An unusually low sensitivity to changes in ambient temperature is obtained by the use of vapour cooling, eliminating the need for A.F.C. and temperature stabilisation (See pages 2, 6 and 7).

Frequency Range (covered by six valves)	6125 to 7750	Mc/s
Typical Output Power	1·2	W
Electronic Tuning Range	35	Mc/s
Variation of Frequency with Ambient Temperature (*See Page* 2):		
In free air	10	kc/s/°C
With thermal insulation	2·4	kc/s/°C
Output	to No. 14 Waveguide (1·372 × 0·622 inch internal)	
Coupler	UG-343A/U (Z830037)	
Mechanical Tuning	Single Screw	

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·8	A

Mechanical Tuning Range

KY366A	7425 to 7750	Mc/s
KY366B	7125 to 7425	Mc/s
KY366C	6875 to 7125	Mc/s
KY366D	6575 to 6875	Mc/s
KY366E	6125 to 6425	Mc/s
KY366G	6425 to 6575	Mc/s

Mechanical

Overall Dimensions	See Outline Drawings
Net Weight	¾ pound (340 gm) Approx
Mounting Position (*See Note* 1)	With boiler outlet uppermost
Reflector Cap	B.S.448-CT2
Base	6-pin wafer octal

LIQUID-VAPOUR PHASE COOLING

With this method of cooling, the temperature of the resonant cavity is maintained at a constant level slightly higher than the boiling point of a liquid contained in a boiler unit integral with the valve. In operation, the heat dissipated in the valve is transferred by conduction through the cavity and boiler walls to the liquid and boiling takes place. The vapour produced is directed into a separate condenser where it is condensed and the liquid is returned to the boiler. The heat released in condensation of the vapour is conducted through the condenser walls and dissipated to the environment.

Since the wall of the resonant cavity is in direct contact with the wall of the boiler unit, it is maintained at a virtually constant temperature slightly in excess of the boiling point of the liquid. Ambient temperature changes have little effect on the valve body temperature and operating frequency (see page 6).

A further reduction in the effect of ambient temperature variations on valve body temperature may be obtained by insulating the valve from its environment with material such as expanded polystyrene. This reduces the amount of heat lost from the valve by means other than through liquid-vapour cooling and stabilises the valve body temperature to an even greater degree. The results obtained when using a $\frac{3}{4}$-inch layer of insulation around the valve are shown on page 7.

Distilled or demineralised water may be used as coolants, but where low ambient temperatures are encountered FC75 (developed by the Minnesota Mining and Manufacturing Company) is recommended. A sight glass in the boiler unit permits visual observation of the coolant level and the required volume of coolant is:

H version (See Note 1)	25cc
U version (See Note 1)	40cc
V version (See Note 1)	25cc

Details of a suitable condenser are given on page 9; English Electric Valve Company Limited should be consulted if other forms of condenser are required.

The breather hole in the top of the condenser maintains atmospheric pressure in the condenser and also limits the rate of liquid loss by evaporation to a satisfactory low level. Coolant losses are extremely low but may be eliminated by fitting a pliable rubber expansion chamber at the top of the condenser.

In an open system the pressure inside the condenser is atmospheric and variations in atmospheric pressure will change the boiling point of the liquid and the valve body temperature. The changes in boiling point versus pressure for FC75 and water are shown on page 8.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values. See Note 2)

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	750	V
Resonator Current	—	80	mA
Reflector Voltage (negative)	50	1000	V
Peak Heater to Cathode Voltage	—	±45	V
Total Impedance in Reflector-Cathode Circuit	—	0·5	MΩ

TYPICAL OPERATION
(at 7000Mc/s)

Resonator Voltage	750	V
Resonator Current	75	mA
Reflector Voltage	−350	V
Output Power	1·2	W
Electronic Tuning Range	35	Mc/s
Modulation Sensitivity (Reflector)	270	kc/s/V
Mechanical Tuning Rate	100	Mc/s/turn
Variation of Frequency with Ambient Temperature (*See Page* 2):		
In free air	10	kc/s/°C
With thermal insulation	2·4	kc/s/°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	750	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1:1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·7	0·9	A
Resonator Current	55	80	mA
Reflector Voltage (negative)	250	400	V
Modulation Sensitivity (Reflector)	225	525	kc/s/V

NOTES

1. Three versions of each frequency variant of the valve are available to allow for mounting with the output flange facing downwards, horizontally or upwards. They are identified by the suffix letters V, H and U respectively; this letter follows the frequency range code letter in the valve type number. For example, type KY366DH operates in the frequency range 6575 to 6875Mc/s and couples to a horizontal waveguide.
2. It is essential that the tube is not operated outside these ratings under any conditions. The ratings given are limiting values, and cannot necessarily be used simultaneously.

OPERATING INSTRUCTIONS

1. *Introduction*

These instructions are intended as a guide to circuit designers and valve users for installing and operating the reflex klystron type KY366. If the information given below is used, long and reliable performance of the valve will result.

The Engineering Staff of English Electric Valve Company Ltd. are always available to give further information if required.

2. *Precautions*

(*a*) Never apply the resonator voltage before the reflector voltage even for a short period.

(*b*) Do not operate the valve at any time without a negative voltage on the reflector.

(*c*) Never operate the valve without the correct charge of liquid in the boiler unit.

(*d*) Ensure that the connection between the condenser and the boiler of the valve is hermetically sealed.

(*e*) Never exceed the maximum ratings given on page 3.

3. *Installation and Operation*

(*a*) *Mounting*

The valve must be mounted with the boiler outlet uppermost. If the resonator body is to be operated at other than earth potential it must be suitably insulated from the waveguide load and FC75 coolant should be used.

The valve is designed to give the performance shown under Typical Operation when working into a load of V.S.W.R. not greater than 1·1 : 1.

(*b*) *Connections*

Ensure that the connections to the valve are correct. For valve base connections see page 10.

(*c*) *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period.

Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(i) Heater voltage

(ii) Reflector voltage

(iii) Resonator voltage

(*d*) *Reflector*

The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied.

When the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to cathode. If such a positive condition is possible, a protective diode should be fitted at the reflector.

The maximum total impedance in the reflector circuit should not exceed 0·5 Megohm.

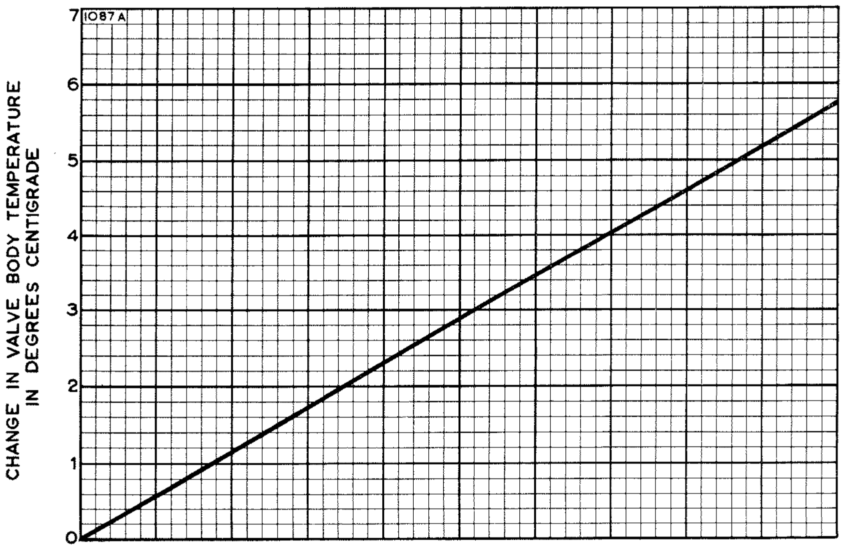
(*e*) *Tuning*

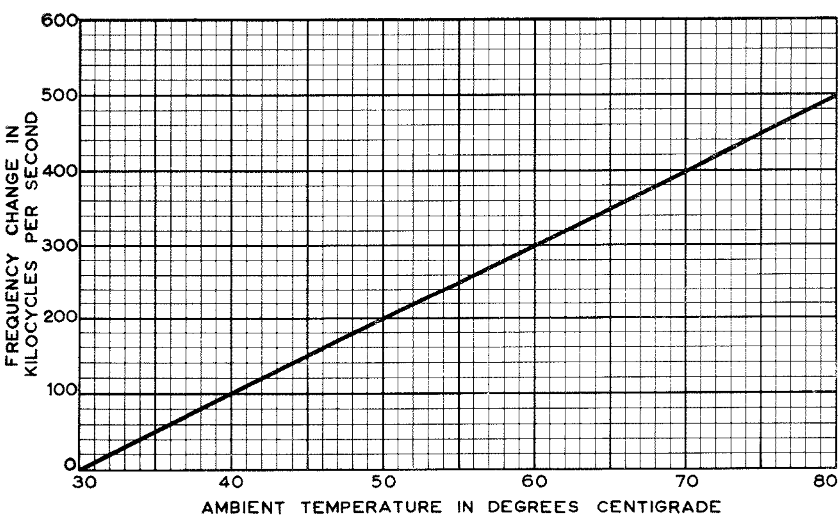
Valves are despatched tuned to the centre frequency of their respective bands.

Clockwise rotation of the tuning screw produces a decrease of frequency.

ENGLISH ELECTRIC

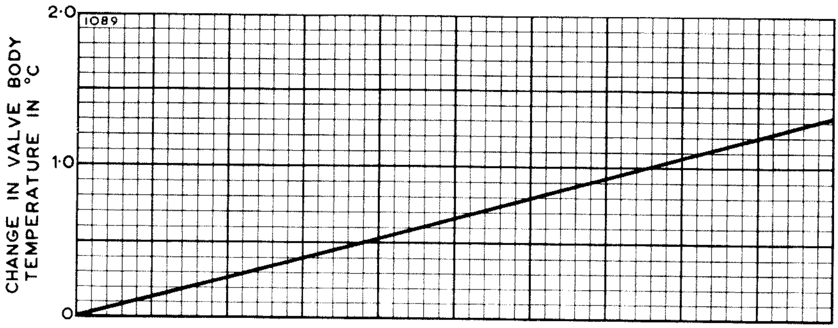
TEMPERATURE CHARACTERISTICS (IN FREE AIR)

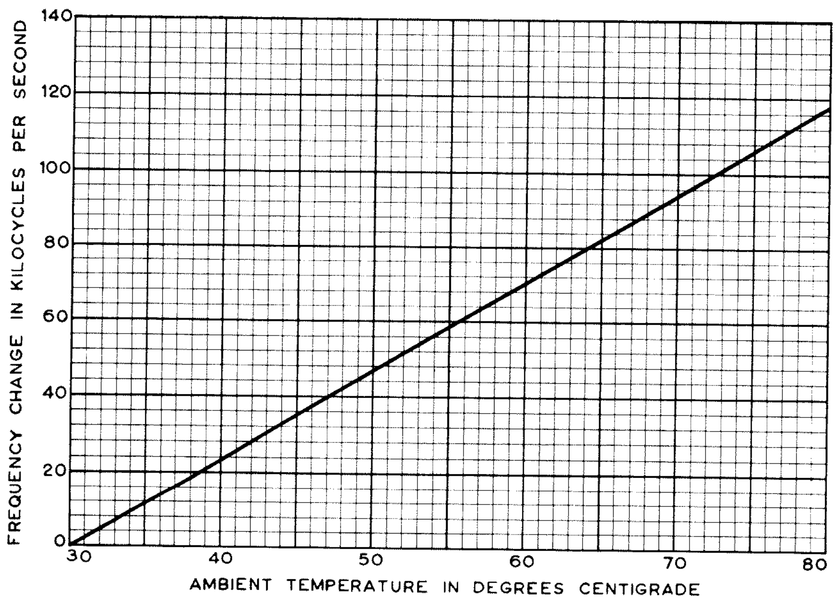




TEMPERATURE CHARACTERISTICS (WITH THERMAL INSULATION)

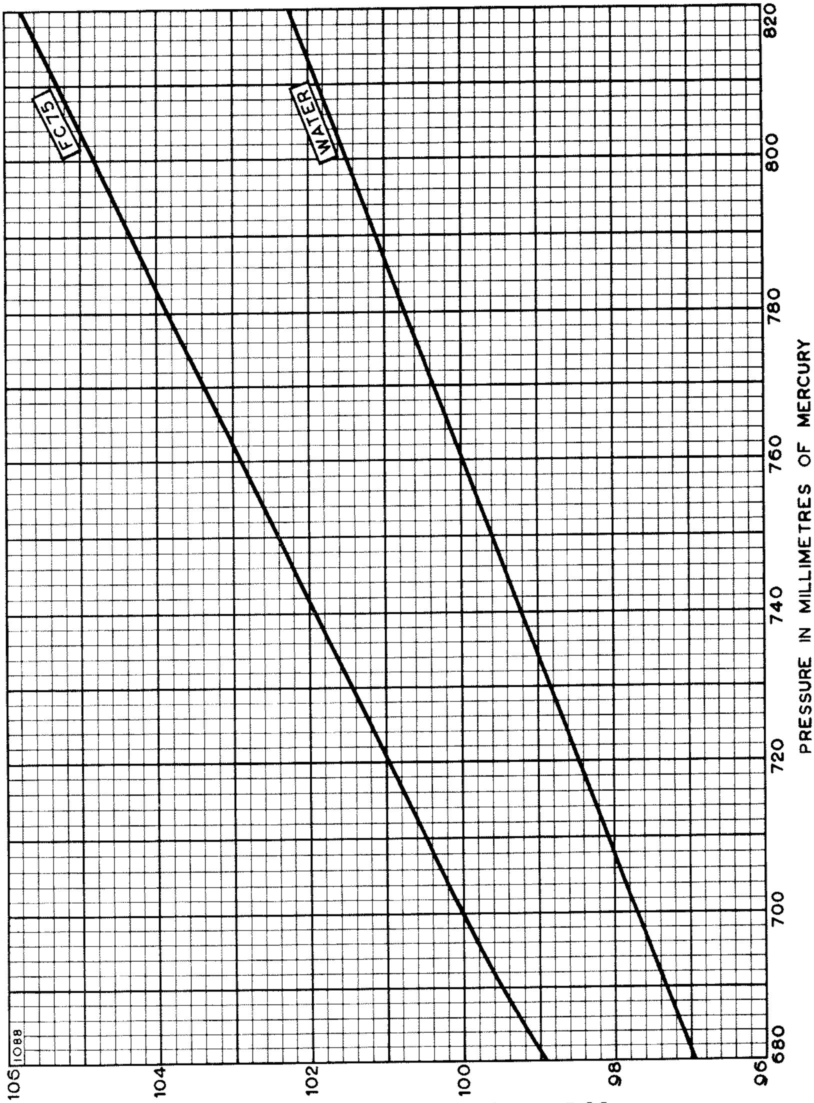
The graphs below show the stability which may be obtained with the valve thermally insulated from its environment and load.



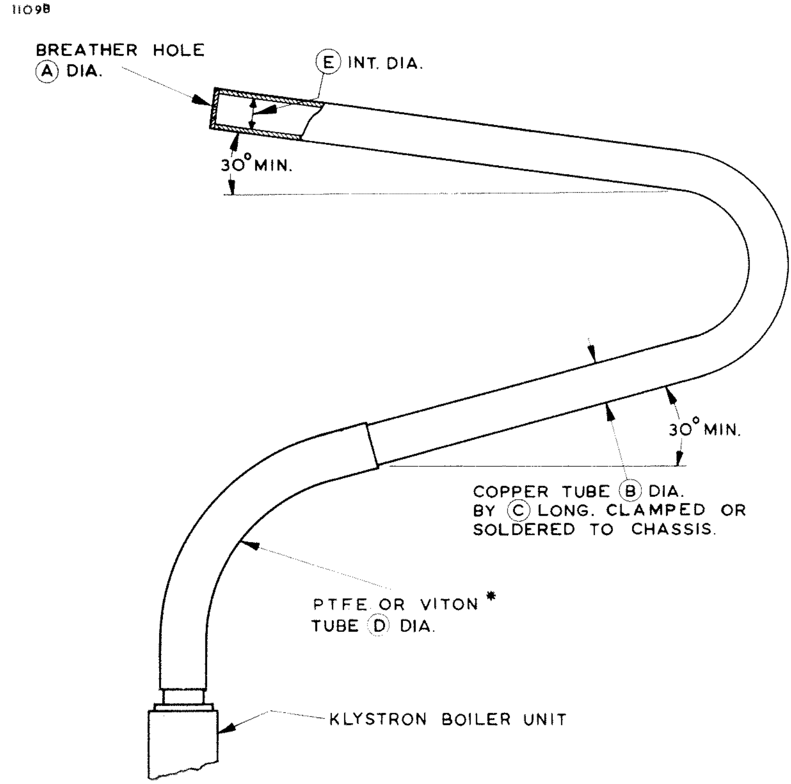


ENGLISH ELECTRIC

BOILING POINT VARIATION OF FC75 AND WATER



CONDENSER UNIT



Ref.	Inches	Millimetres
A	0·010	0·25
B	0·437	11·1
C	18·00	457
D	3·000	76
E	0·250 Min	6·35 Min

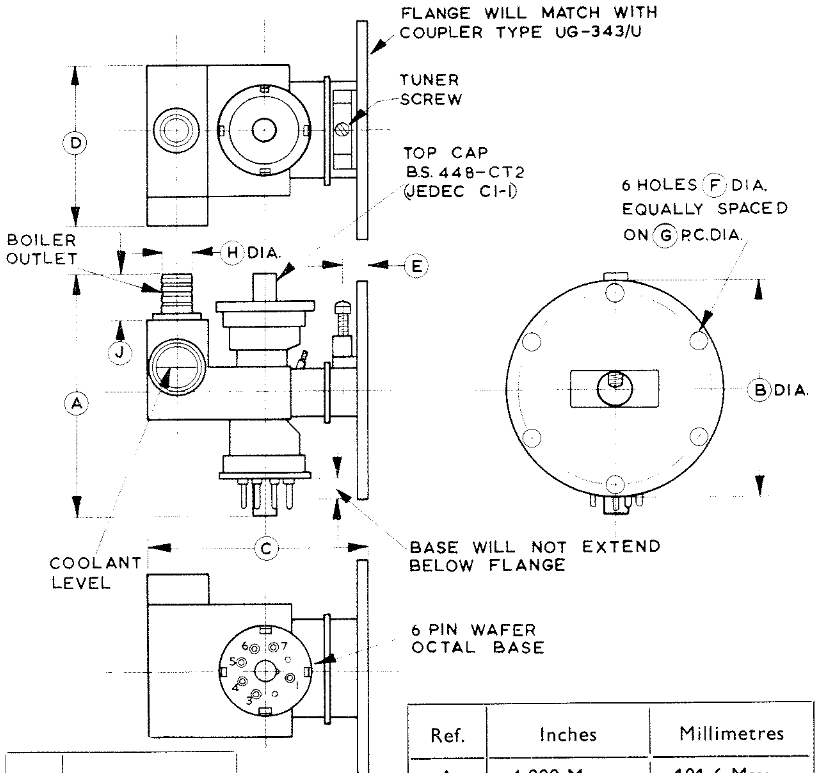
Millimetre dimensions have been derived from inches.

*A suitable grade of Viton is obtainable from Hall and Hall Ltd., Oldfield Works, Hampton, Middlesex.

ENGLISH ELECTRIC

OUTLINE FOR KY366*H
(*Frequency range code letter here)

1228

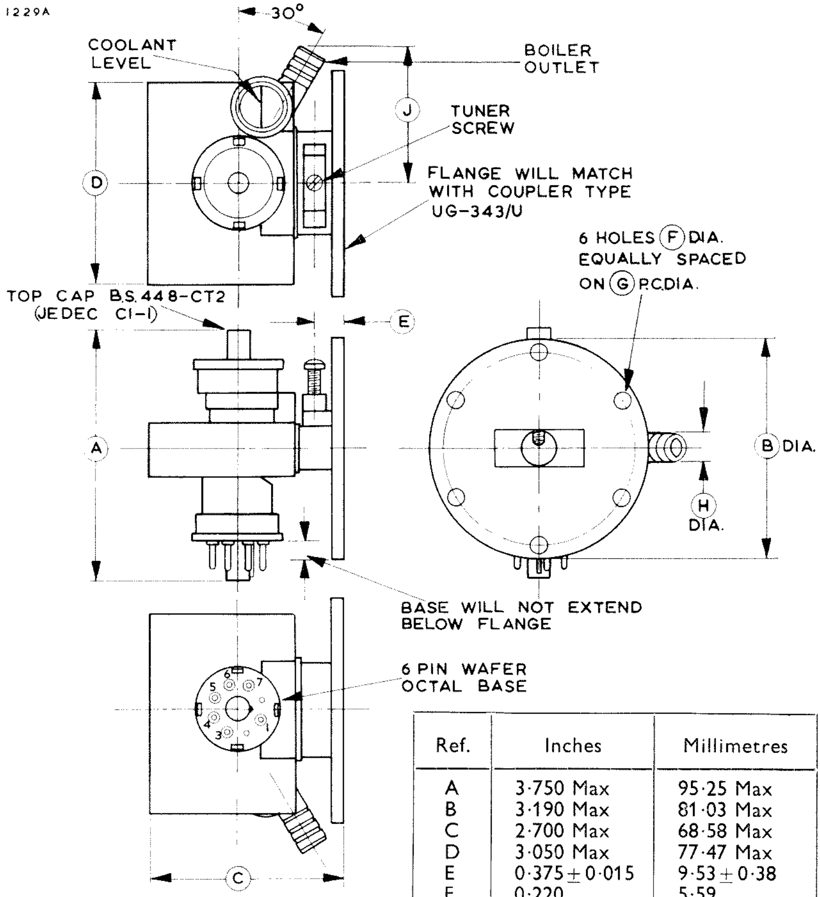


Pin	Element
1	Shell
2	Omitted
3	No Connection
4	Cathode
5	Heater
6	Heater
7	No Connection
8	Omitted
CAP	Reflector

Ref.	Inches	Millimetres
A	4·000 Max	101·6 Max
B	3·190 Max	81·03 Max
C	3·200 Max	81·28 Max
D	2·500 Max	63·50 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·220	5·59
G	2·750 ± 0·010	69·85 ± 0·25
H	0·437	11·10
J	0·700 ± 0·020	17·78 ± 0·51

Millimetre dimensions have been derived from inches.

OUTLINE FOR KY366*U
(*Frequency range code letter here)



Ref.	Inches	Millimetres
A	3·750 Max	95·25 Max
B	3·190 Max	81·03 Max
C	2·700 Max	68·58 Max
D	3·050 Max	77·47 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·220	5·59
G	2·750 ± 0·010	69·85 ± 0·25
H	0·375	9·53
J	2·187 Ref	55·55 Ref

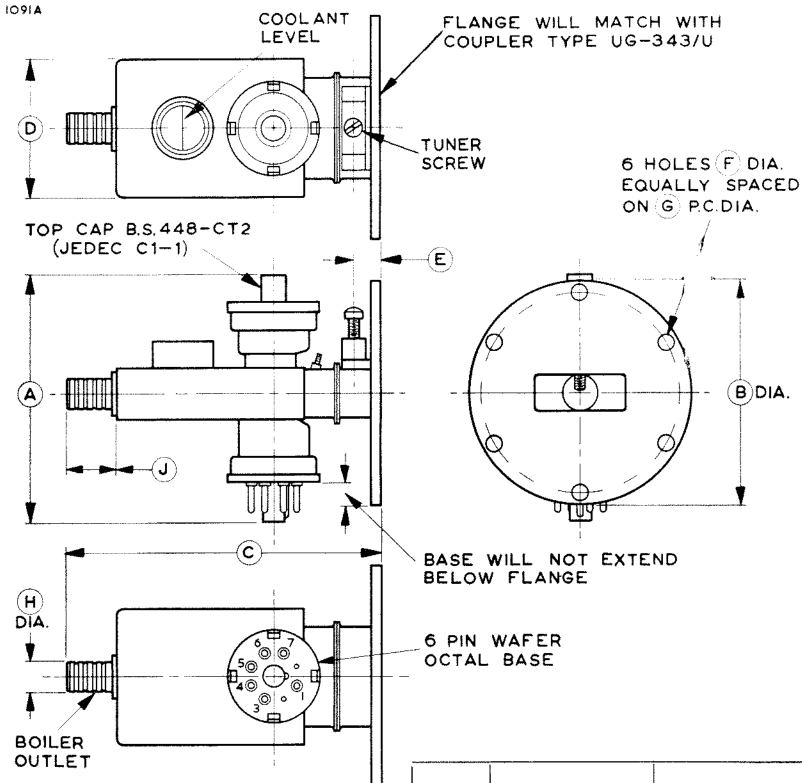
Millimetre dimensions have been derived from inches.

BASE CONNECTIONS

Please refer to page 10 for table of base pin connections.

ENGLISH ELECTRIC

OUTLINE FOR KY366*V
(*Frequency range code letter here)



Ref.	Inches	Millimetres
A	3·750 Max	95·25 Max
B	3·190 Max	81·03 Max
C	4·500 Max	114·3 Max
D	1·950 Max	49·53 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·220	5·59
G	2·750 ± 0·010	69·85 ± 0·25
H	0·437	11·10
J	0·700 ± 0·020	17·78 ± 0·51

Millimetre dimensions have been derived from inches.

BASE CONNECTIONS

Please refer to page 10 for table of base pin connections.

Variant of K367 Series

ABRIDGED DATA

Vapour Cooled Reflex Klystron Oscillators with integral boiler units, for microwave transmitters. An unusually low sensitivity to changes in ambient temperature is obtained by the use of vapour cooling, eliminating the need for A.F.C. and temperature stabilisation (See pages 2, 6 and 7).

Frequency Range (covered by six valves)	6125 to 7750	Mc/s
Typical Output Power	1·2	W
Electronic Tuning Range	35	Mc/s
Variation of Frequency with Ambient Temperature (*See Page* 2):		
In free air	10	kc/s/°C
With thermal insulation	2·4	kc/s/°C
Output	to No. 14 Waveguide (1·372 × 0·622 inch internal)	
Coupler	CMR-137	
Mechanical Tuning	Single Screw	

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·8	A

Mechanical Tuning Range

KY367A	7425 to 7750	Mc/s
KY367B	7125 to 7425	Mc/s
KY367C	6875 to 7125	Mc/s
KY367D	6575 to 6875	Mc/s
KY367E	6125 to 6425	Mc/s
KY367G	6425 to 6575	Mc/s

Mechanical

Overall Dimensions	See Outline Drawings
Net Weight	¾ pound (340 gm) Approx
Mounting Position (*See Note* 1)	With boiler outlet uppermost
Reflector Cap	B.S.448-CT2
Base	6-pin wafer octal

LIQUID-VAPOUR PHASE COOLING

With this method of cooling, the temperature of the resonant cavity is maintained at a constant level slightly higher than the boiling point of a liquid contained in a boiler unit integral with the valve. In operation, the heat dissipated in the valve is transferred by conduction through the cavity and boiler walls to the liquid and boiling takes place. The vapour produced is directed into a separate condenser where it is condensed and the liquid is returned to the boiler. The heat released in condensation of the vapour is conducted through the condenser walls and dissipated to the environment.

Since the wall of the resonant cavity is in direct contact with the wall of the boiler unit, it is maintained at a virtually constant temperature slightly in excess of the boiling point of the liquid. Ambient temperature changes have little effect on the valve body temperature and operating frequency (see page 6).

A further reduction in the effect of ambient temperature variations on valve body temperature may be obtained by insulating the valve from its environment with material such as expanded polystyrene. This reduces the amount of heat lost from the valve by means other than through liquid-vapour cooling and stabilises the valve body temperature to an even greater degree. The results obtained when using a $\frac{3}{4}$-inch layer of insulation around the valve are shown on page 7.

Distilled or demineralised water may be used as coolants, but where low ambient temperatures are encountered FC75 (developed by the Minnesota Mining and Manufacturing Company) is recommended. A sight glass in the boiler unit permits visual observation of the coolant level and the required volume of coolant is:

H version (See Note 1)	25cc
U version (See Note 1)	40cc
V version (See Note 1)	25cc

Details of a suitable condenser are given on page 9; English Electric Valve Company Limited should be consulted if other forms of condenser are required.

The breather hole in the top of the condenser maintains atmospheric pressure in the condenser and also limits the rate of liquid loss by evaporation to a satisfactory low level. Coolant losses are extremely low but may be eliminated by fitting a pliable rubber expansion chamber at the top of the condenser.

In an open system the pressure inside the condenser is atmospheric and variations in atmospheric pressure will change the boiling point of the liquid and the valve body temperature. The changes in boiling point versus pressure for FC75 and water are shown on page 8.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values. See Note 2)

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Resonator Voltage	—	750	V
Resonator Current	—	80	mA
Reflector Voltage (negative)	50	1000	V
Peak Heater to Cathode Voltage	—	±45	V
Total Impedance in Reflector-Cathode Circuit	—	0·5	MΩ

TYPICAL OPERATION
(at 7000Mc/s)

Resonator Voltage	750	V
Resonator Current	75	mA
Reflector Voltage	−350	V
Output Power	1·2	W
Electronic Tuning Range	35	Mc/s
Modulation Sensitivity (Reflector)	270	kc/s/V
Mechanical Tuning Rate	100	Mc/s/turn
Variation of Frequency with Ambient Temperature (*See Page* 2):		
In free air	10	kc/s/°C
With thermal insulation	2·4	kc/s/°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater Voltage	6·3	V
Resonator Voltage	750	V
Reflector Voltage		Adjust
Load V.S.W.R.	1·1:1	Max

Range of Characteristics

	Min	*Max*	
Heater Current	0·7	0·9	A
Resonator Current	55	80	mA
Reflector Voltage (negative)	250	400	V
Modulation Sensitivity (Reflector)	225	525	kc/s/V

NOTES

1. Three versions of each frequency variant of the valve are available to allow for mounting with the output flange facing downwards, horizontally or upwards. They are identified by the suffix letters V, H and U respectively; this letter follows the frequency range code letter in the valve type number. For example, type KY367DH operates in the frequency range 6575 to 6875Mc/s and couples to a horizontal waveguide.
2. It is essential that the tube is not operated outside these ratings under any conditions. The ratings given are limiting values, and cannot necessarily be used simultaneously.

OPERATING INSTRUCTIONS

1. **Introduction**

These instructions are intended as a guide to circuit designers and valve users for installing and operating the reflex klystron type KY367. If the information given below is used, long and reliable performance of the valve will result.

The Engineering Staff of English Electric Valve Company Ltd. are always available to give further information if required.

2. **Precautions**

(*a*) Never apply the resonator voltage before the reflector voltage even for a short period.

(*b*) Do not operate the valve at any time without a negative voltage on the reflector.

(*c*) Never operate the valve without the correct charge of liquid in the boiler unit.

(*d*) Ensure that the connection between the condenser and the boiler of the valve is hermetically sealed.

(*e*) Never exceed the maximum ratings given on page 3.

3. **Installation and Operation**

(*a*) *Mounting*

The valve must be mounted with the boiler outlet uppermost. If the resonator body is to be operated at other than earth potential it must be suitably insulated from the waveguide load and FC75 coolant should be used.

The valve is designed to give the performance shown under Typical Operation when working into a load of V.S.W.R. not greater than 1·1 : 1.

(*b*) *Connections*

Ensure that the connections to the valve are correct. For valve base connections see pages 10, 11 and 12.

(*c*) *Application of Voltages*

It is important that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. No voltages should exceed the maximum ratings even for a short period.

Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(i) Heater voltage
(ii) Reflector voltage
(iii) Resonator voltage

(*d*) *Reflector*

The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied.

When the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to cathode. If such a positive condition is possible, a protective diode should be fitted at the reflector.

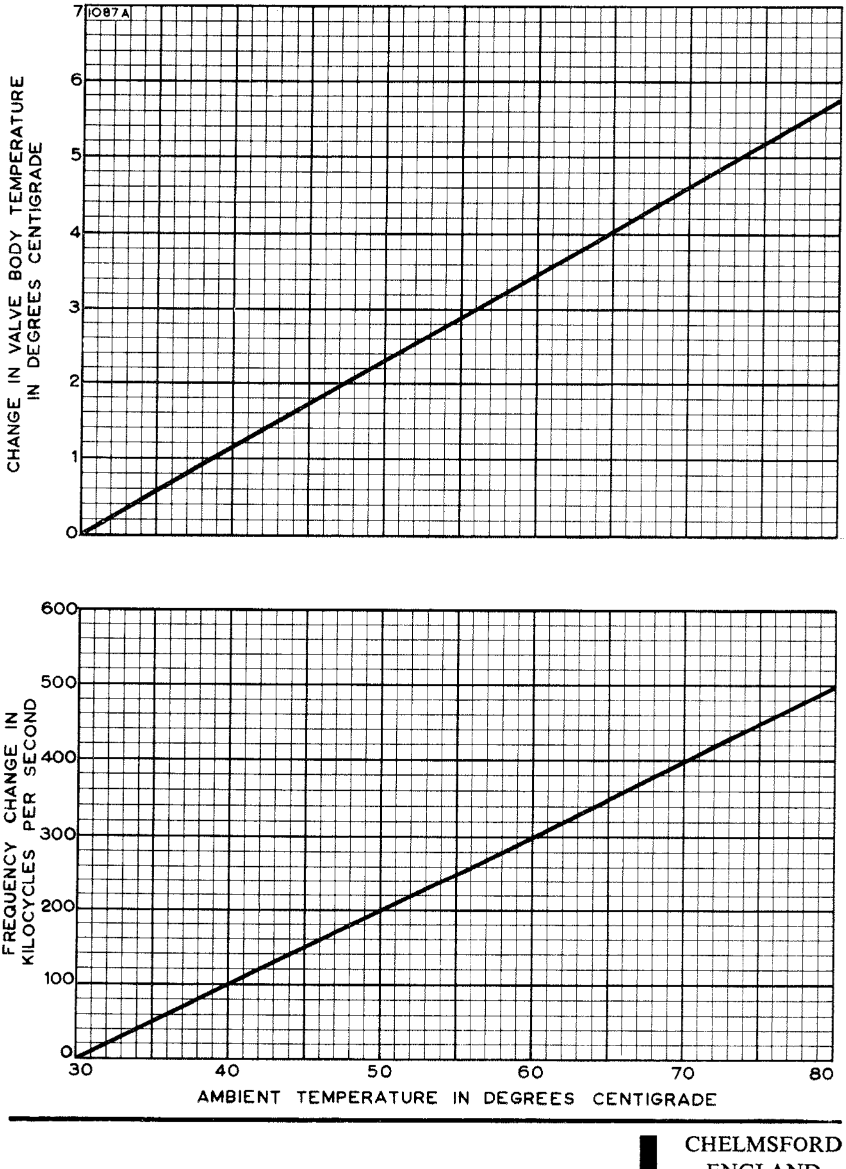
The maximum total impedance in the reflector circuit should not exceed 0·5 Megohm.

(*e*) *Tuning*

Valves are despatched tuned to the centre frequency of their respective bands.

Clockwise rotation of the tuning screw produces a decrease of frequency.

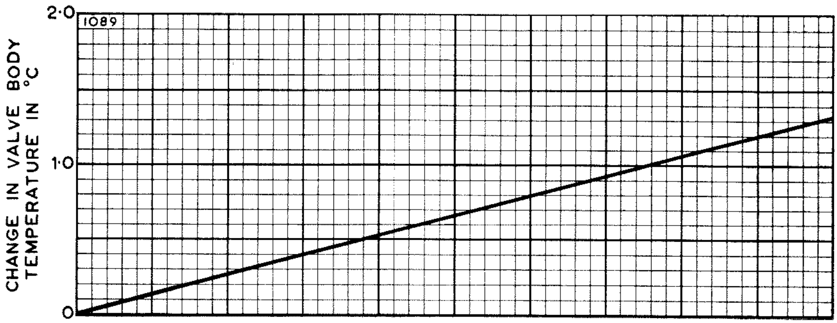
TEMPERATURE CHARACTERISTICS (IN FREE AIR)

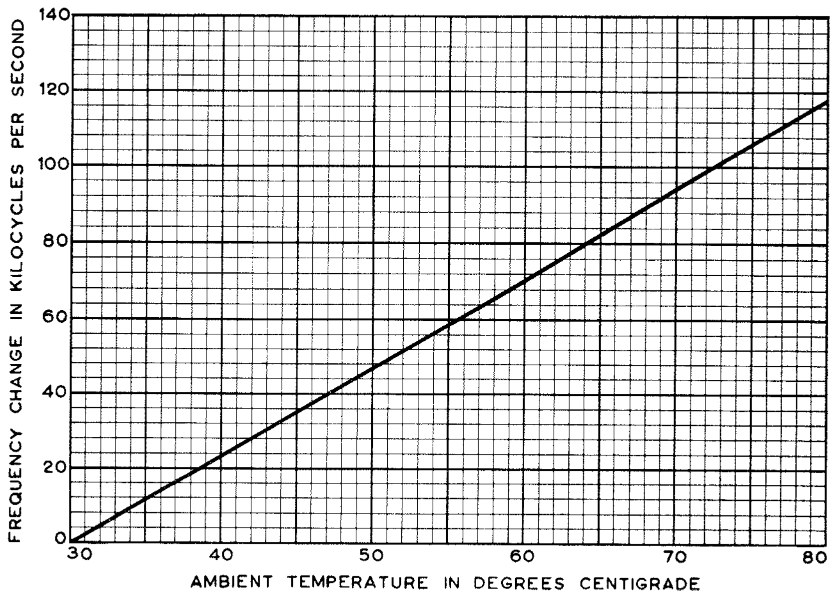


ENGLISH ELECTRIC

TEMPERATURE CHARACTERISTICS (WITH THERMAL INSULATION)

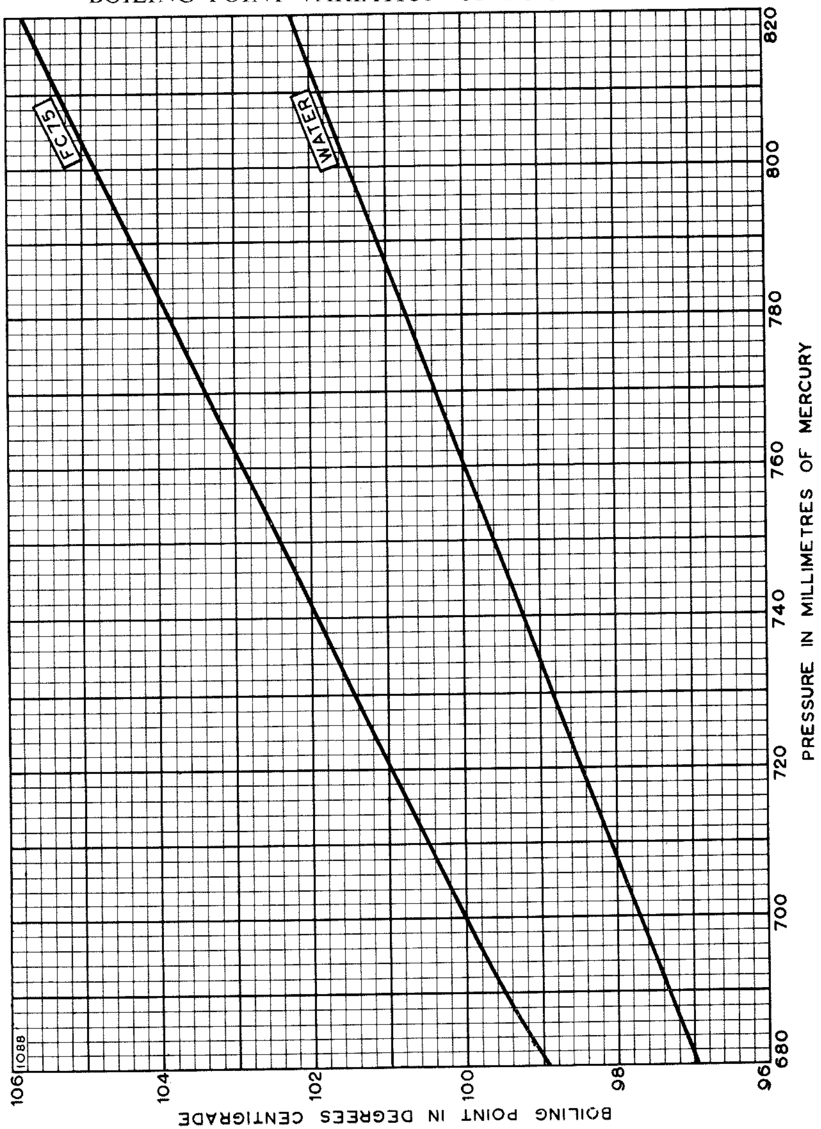
The graphs below show the stability which may be obtained with the valve thermally insulated from its environment and load.



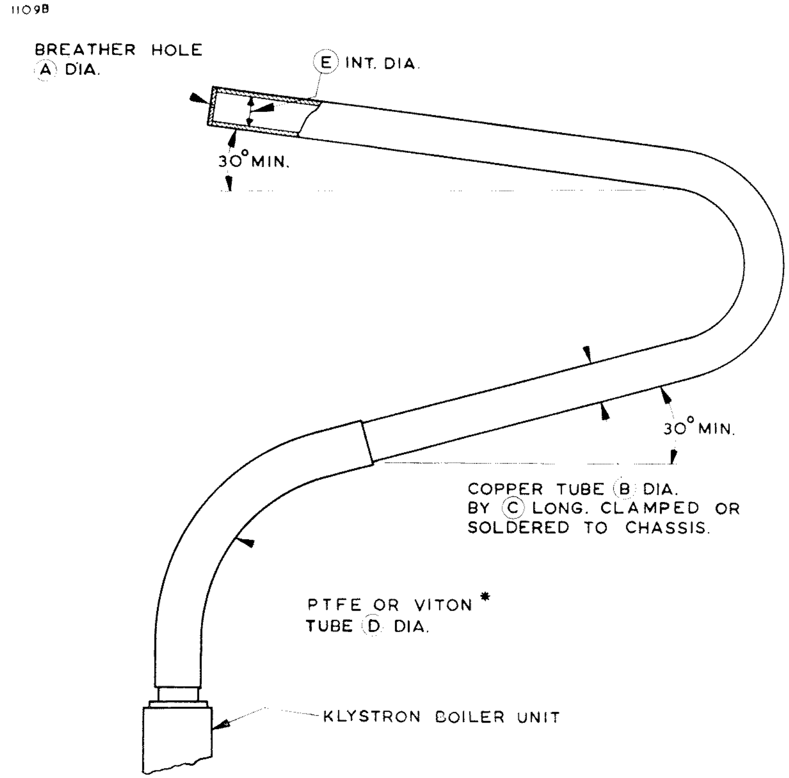


ENGLISH ELECTRIC

BOILING POINT VARIATION OF FC75 AND WATER



CONDENSER UNIT

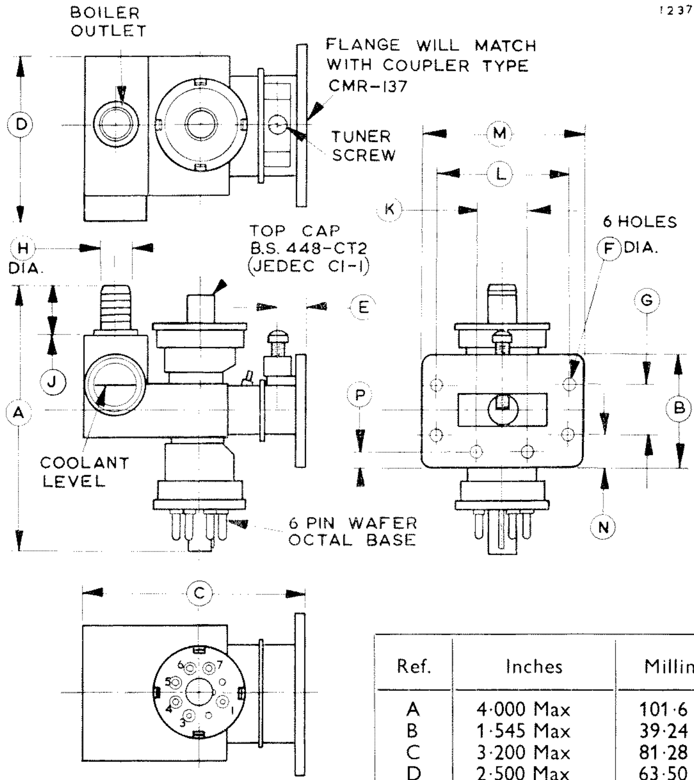


Ref.	Inches	Millimetres
A	0·010	0·25
B	0·437	11·1
C	18·00	457
D	3·000	76
E	0·250 Min	6·35 Min

Millimetre dimensions have been derived from inches.

*A suitable grade of Viton is obtainable from Hall and Hall Ltd., Oldfield Works, Hampton, Middlesex.

OUTLINE FOR KY367*H
(*Frequency range code letter here)

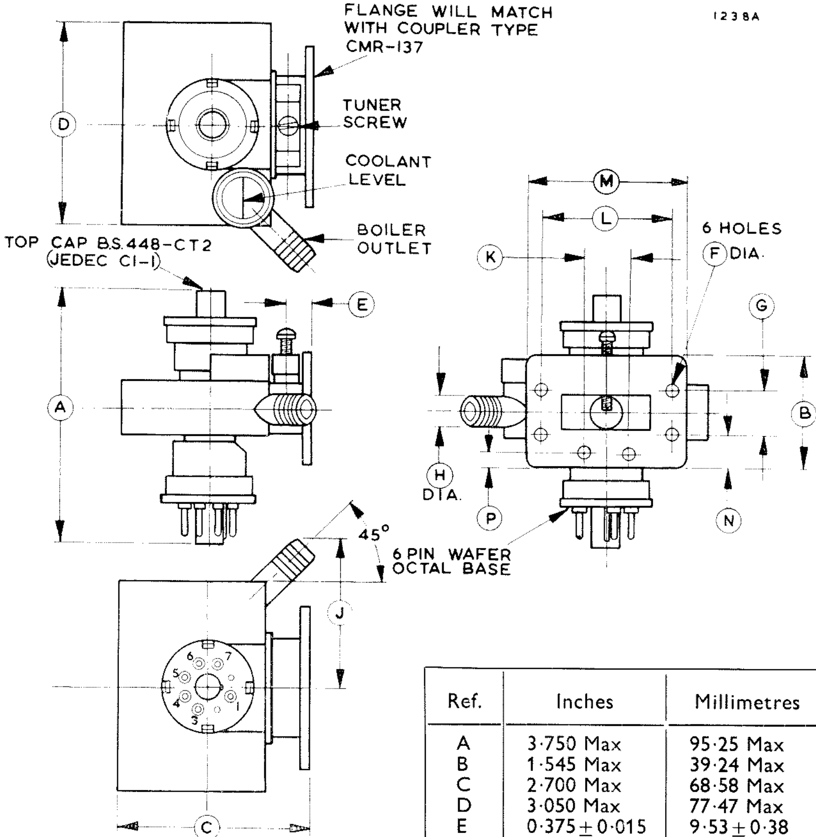


Pin	Element
1	Shell
2	Omitted
3	No Connection
4	Cathode
5	Heater
6	Heater
7	No Connection
8	Omitted
CAP	Reflector

Ref.	Inches	Millimetres
A	4·000 Max	101·6 Max
B	1·545 Max	39·24 Max
C	3·200 Max	81·28 Max
D	2·500 Max	63·50 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·147	3·73
G	0·686 ± 0·004	17·424 ± 0·102
H	0·437	11·10
J	0·700 ± 0·020	17·78 ± 0·51
K	0·644 ± 0·004	16·358 ± 0·102
L	1·930 ± 0·004	49·022 ± 0·102
M	2·295 Max	58·29 Max
N	0·422	10·72
P	0·176	4·47

Millimetre dimensions have been derived from inches.

OUTLINE FOR KY367*U
(*Frequency range code letter here)



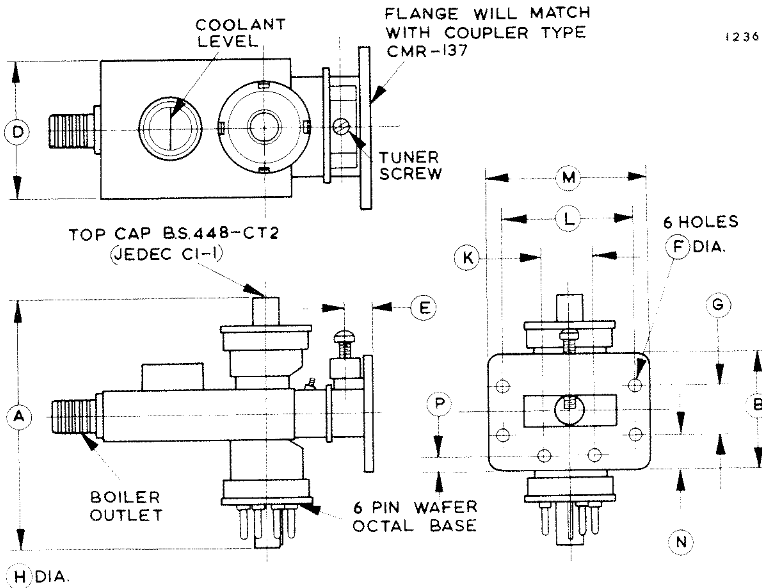
Pin	Element
1	Shell
2	Omitted
3	No Connection
4	Cathode
5	Heater
6	Heater
7	No Connection
8	Omitted
CAP	Reflector

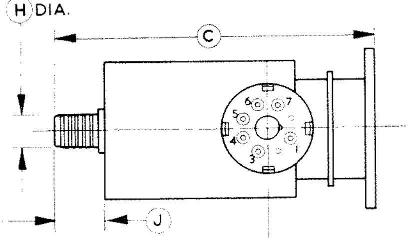
Ref.	Inches	Millimetres
A	3·750 Max	95·25 Max
B	1·545 Max	39·24 Max
C	2·700 Max	68·58 Max
D	3·050 Max	77·47 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·147	3·73
G	0·686 ± 0·004	17·424 ± 0·102
H	0·375	9·53
J	2·000 Ref	50·80 Ref
K	0·644 ± 0·004	16·358 ± 0·102
L	1·930 ± 0·004	49·022 ± 0·102
M	2·295 Max	58·29 Max
N	0·422	10·72
P	0·176	4·47

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC

OUTLINE FOR KY367*V
(*Frequency range code letter here)





Pin	Element
1	Shell
2	Omitted
3	No Connection
4	Cathode
5	Heater
6	Heater
7	No Connection
8	Omitted
CAP	Reflector

Ref.	Inches	Millimetres
A	3·750 Max	95·25 Max
B	1·545 Max	39·24 Max
C	4·500 Max	114·3 Max
D	1·950 Max	49·53 Max
E	0·375 ± 0·015	9·53 ± 0·38
F	0·147	3·73
G	0·686 ± 0·004	17·424 ± 0·102
H	0·437	11·10
J	0·700 ± 0·020	17·78 ± 0.51
K	0·644 ± 0·004	16·358 ± 0·102
L	1·930 ± 0·004	49·022 ± 0·102
M	2·295 Max	58·29 Max
N	0·422	10·72
P	0·176	4·47

Millimetre dimensions have been derived from inches.

MAGNETRONS

Complete List of Types in this Section

Preamble

Data Sheets

March 1961

ENGLISH ELECTRIC VALVE CO. LTD.

Printed in England

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

MAGNETRONS

TABULATED DATA

MAGNETRONS

CW MAGNETRONS Fixed frequency types

Type	Frequency (MHz)	Typical operation: Output power (kW)	Anode voltage (kV)	Anode current (A)	Class (see page 6)
BM25LB	896 ± 10*	25	12.5	2.4	EWAZ
BM25LC	915 ± 10†				
BM25LD‡	896 ± 10*				

* For U.K., mandatory from August 1968
† For U.S.A.
‡ Identical with BM25LB apart from external fittings

PULSE MAGNETRONS Fixed frequency types
L -Band (1.0 to 2.5GHz)

Type	Frequency range (MHz)	Typical operation: Peak output power (MW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see page 6)
M554**	1295–1365	2.6	39	150	SWGG
M565	1215–1365	5.0	48	240	EWAZ
M586**	1260–1300	2.6	39	150	SWGG

** Circular to rectangular waveguide transition section available

PULSE MAGNETRONS Fixed frequency types except where indicated

S-Band (2.5 to 4.1GHz)

Type	Frequency range (MHz)	Typical operation: Peak output power (kW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see page 6)
2J30	2860–2900	300	20	30	SAC
2J31	2820–2860				
2J32	2780–2820				
2J33	2740–2780				
2J34	2700–2740				
4J31	2860–2900	1000	28	70	SAC
4J32	2820–2860				
4J33	2780–2820				
4J34	2740–2780				
4J35	2700–2740				
4J43	2992–3019	900	28	70	SAC
4J44	2965–2992				
4J53	2793–2813	1000	28	70	SAC
5586††	2700–2900	1000	30	70	SAC
5657††	2900–3100				
7182	2750–2860	2500	35	157	EWAX
BM1003	3034–3052	2000	43	90	SWGG
BM1004	2989–3007				
BM1005	2944–2962				
M501	2940–3060	500	27	35	SAG
M501A	2940–3060	500	27	35	SAG

Continued on page 3

†† Tunable

S-Band (2.5 to 4.1GHz) – continued

Type	Frequency range (MHz)	Typical operation: Peak output power (kW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see page 6)
M507	3230–3380	425	27	40	SAG
M519	3450–3614	425	27	40	SAG
M525	2750–2855	1150	36	70	SWG
M561	3040–3060	80	13	15	SAC
M566	2750–2860	2500	38.5	145	EWAZ
M569	2850–2960	2500	40	140	EWAZ
M570	2950–3060	2500	40	140	EWAZ
M573	2850–2960	2500	38	144	EWAX
M574	2950–3060	2500	41	132	EWAX
M577B **M578B**	3000–3040 3060–3100	900	28	70	SAC
M579	3050–3160	2500	38.5	145	EWAZ
M595B	2860–2900	1000	28	70	SAC
M5015††	2994–3002	2000	43	90	SWG

PULSE MAGNETRONS Fixed frequency types
C-Band (4.1 to 7.0GHz)

M5008 **M5009** **M5032** **M5033**	5250–5310 5450–5510 5250–5350 5430–5530	2250	34	60	EWAZ

†† Tunable

PULSE MAGNETRONS Fixed frequency types except where indicated
X-Band (7.0 to 11.5GHz)

Type	Frequency range (MHz)	Typical operation: Peak output power (kW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see page 6)
2J42	9345–9405	8.3	5.5	4.5	PANG
2J42H	9345–9405	8.3	5.5	4.5	PANG
2J55	9345–9405	50	12	12	PAG
2J56	9215–9275	45	12	12	PAG
4J50A	9345–9405	225	22	25	PAG
4J52A	9350–9400	80	15.5	15	PAG
6027	9345–9405	20	6.9	7.0	PAG
6027H	9345–9405	20	7.3	7.5	PAG
8356	9345–9405	20	7.2	7.5	PANG
8357	9345–9405	25	7.5	8.5	PANG
BM1026	9505–9540	60	14	11	SAG
BM1027	9540–9580				
BM1028	9580–9620				
BM1029	9620–9660				
BM1030	9660–9695				
BM1031	9420–9500	40	12	10	SAG
BM1032††	9440–9510	70	17	12	SAG
BM1033††	9800–9860				
BM1034††	9620–9680				
BM1035††	9520–9580				
BM1036††	9245–9305				
BM1037††	9145–9205				

Continued on page 5

†† Tunable

X-Band (7.0 to 11.5GHz) – continued

Type	Frequency range (MHz)	Typical operation: Peak output power (kW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see page 6)
BM1040††	9040–9120	75	15	11	SAG
M502A	9325–9425	180	21	22.5	PAG
M503A	9345–9405	9.5	5.6	4.5	PANG
M504	9325–9425	750	35	50	EAG
M505	9360–9460	45	11.1	12	SAG
M506A	9360–9460	50	11.5	12	SAG
M508	9210–9270	8.0	5.5	4.5	PANG
M513A	9345–9405	22	7.5	7.5	PANG
M513B	9345–9405	22	7.5	7.5	PANG
M515	9380–9440	25	8.2	8.0	PANG
M521	9600–9700	45	11.1	12	SAG
M523	9580–9705	225	22	25	PAG
M529	8830–8995	225	22	25	PAG
M537A	8770–8830	9.0	5.5	4.5	PAG
M538A	9210–9270	225	22	25	PAG
M539	8665–8830	225	22	25	PAG
M546	9700–9850	225	22	25	PAG
M547	9850–10 000	225	22	25	PAG
M548	9003–9168	50	13.5	12	SAG
M549	8500–8665	225	22	25	PAG
M575	9345–9405	80	15	15	PAG

Continued on page 6

†† Tunable

X-Band (7.0 to 11.5GHz) – continued

Type	Frequency range (MHz)	Typical operation: Peak output power (kW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see below)
M581	9415–9475	65	14	14	PAG
M591B	9415–9475	22	7.5	7.5	PANG
M596	9370–9430	80	14.8	15	PAG
M597	9380–9440	10.5	5.7	5.0	PANG
M598B	9380–9440	22	7.6	7.5	PANG
M599A **M599B**	9415–9475	3.0	3.5	3.0	PAG
M5005	9345–9405	50	13	12	PAG
M5019	9345–9405	8.0	5.4	4.5	PANG
M5022	9415–9475	30	8.3	9.0	PANG
M5023 **M5024** **M5025**	9345–9405 9415–9475 9380–9440	20	7.8	7.5	PANG

CLASS

Magnetic Field

E Electromagnet
P Packaged integral magnet
S Separate magnet (not supplied)

Cooling

A Forced-air
AN Forced-air or natural
W Water
WA Water and forced-air

Output

C Coaxial
G Waveguide
GG Waveguide output not sold with this valve
X Requires electromagnet with coaxial-to-waveguide launching section
Z Requires electromagnet with waveguide launching section

GENERAL

Absolute Ratings

All the maximum and minimum ratings specified in this section are absolute ratings. This means that the equipment designer is responsible for ensuring that operation outside these ratings is not possible, even momentarily, under any conditions arising from mains fluctuations, surges or tolerances on component values. (See British Standard Code of Practice CP1005: Parts 1 and 2, 1954 and Part 4, 1958: The Use of Electronic Valves.)

The operating conditions for Magnetrons are inter-related in the way described below, and it is important that care should be taken that operating conditions of all the parameters remain within the specific limits when any alteration is made to one of them.

DEFINITIONS AND NOTES

Heater Voltage

The heater voltage applied to the valve should be at the nominal value when the anode input is zero. During operation, a fraction of the anode input power is dissipated at the cathode and heater voltage reductions are necessary in most cases to counteract the effects of back bombardment on cathode temperature. On the application of anode power, therefore, the heater voltage must be reduced in accordance with the formula relating heater voltage to anode input power as specified in the individual data sheets.

The regulation of the heater power supply should be sufficient to prevent the occurrence of any significant variations in heater power. Low heater power, resulting in a low cathode temperature, may give rise to arcing and instability whereas high heater power, with consequent high cathode temperature, may result in reduced cathode life.

Heater Starting Current

The cold resistance of the heater is less than one fifth of the hot resistance. Consequently, a high surge of current is taken on application of the full heater voltage which may result in damage from an interaction between the heater current and the magnetic field. To prevent such damage, the heater starting current must be limited to ensure that the specified safe maximum value is not exceeded.

Cathode Heating Time

The cathode must be preheated for the specified minimum time to allow the normal operating temperature to be reached before anode voltage is applied. For ambient temperatures below 0°C, a longer preheating time may be necessary.

Cathode Temperature

When oscillations start, the heater voltage must be adjusted in accordance with the formula relating heater voltage and anode input power in order to maintain the cathode operating temperature at the correct level.

There are several factors which will lead to the cathode temperature being wrong, even when the voltage has been adjusted in accordance with the manufacturer's recommendation. Three of these factors are:

(*a*) *Operation in the wrong mode*. A magnetron may operate in the wrong mode if the rate of rise of voltage is outside the specified limits, or if it is working into an excessive mismatch. This will result in excessive back bombardment, leading to over-heating of the cathode surface. Although this need not necessarily result in cathode damage, other harmful effects such as arcing are likely to be present when the valve is operating in the wrong mode.

(*b*) *Arcing*. Whenever the valve arcs it fails to oscillate and therefore produces no back bombardment energy. This condition may be catastrophic if the cathode temperature falls, as this gives rise to further arcing and a cumulative action may take place. A limited amount of arcing is tolerable since the valve will operate satisfactorily with cathode temperatures below the normal level and for this reason it is possible to recondition valves which initially are unstable. During the reconditioning process however, it is essential to ensure that the cathode is maintained at an adequate temperature.

When the valve fails to oscillate, the voltage may rise to twice the normal value and some form of protection such as a spark gap should be provided to prevent external sparking along the cathode sidearm.

(*c*) *Waste Current*. When arriving at the formula relating the heater voltage to the anode input power, the manufacturer has assumed that most of the input current is usefully used in the magnetron interaction space. It is possible, however, that there will be an excessive amount of current not usefully used. Some of this waste current can be in the interaction space and some in the magnetron end spaces and pole piece cavities.

(i) *Waste current in the interaction space*. Oscillation in the correct mode usually ceases when the voltage across the magnetron has fallen to about 80% of the normal value. While the voltage is falling from 80% to zero, the magnetron continues to take current although very much less than during normal operation, and r.f. energy is produced by the magnetron in the form of centimetric noise. The effect of this generation of noise is two-fold; firstly, it tends to produce objectionable clutter on the radar display at short range, but secondly, it represents inefficient operation by the magnetron, and if the time during which it occurs is excessive, the heating effect on the cathode is significantly greater than that allowed for in the heater voltage formula.

(ii) *Waste current outside the interaction space*. Because of the inevitable limitations in the design of the cathode and magnetic field, there is always some emission from the cathode which makes no contribution to the magnetron as a generator of r.f. energy. In the design of the magnetron, the manufacturer obviously attempts to make this waste current as small as possible and allows for the wastage when deriving his formula. The amount of waste current can, however, increase by a significant amount if the magnetron is incorrectly operated. The most frequent cause of increased waste current is operation of the magnetron for some time at excessive cathode temperatures.

When designing a modulator, attention should therefore be paid to these considerations, and every effort be made to ensure that during the life of the magnetron, the amount of back bombardment is maintained within the limits assumed by the magnetron designer, and it should be appreciated that whereas temporary misuse of the magnetron may not result in any immediate deterioration, it is possible for the valve to suffer a permanent change in characteristics, and that the life may in consequence, be severely curtailed.

Pulse Energy in Heater

When designing the pulse modulator output circuit, precautions should be taken to ensure that none of the pulse energy is dissipated in the magnetron heater. This is more liable to occur when bifilar pulse transformers are used, when unbalance of the windings and asymmetry of the loading may cause appreciable pulse voltages to be applied to the heater.

The pulse energy can normally be decoupled by fitting a capacitor across the heater terminals of the magnetron, although in some equipments a more elaborate low-pass filter in the heater lead may be necessary. The connecting leads to the magnetron should be as short as possible to keep their inductance to a minimum and the capacitor connections should be as close as possible to the magnetron and preferably directly across the heater terminals. Where large capacitors must be fitted, they should be shunted by small capacitors* to minimise the effect of the capacitor lead inductance.

*Preferably several different values of capacitance in parallel.

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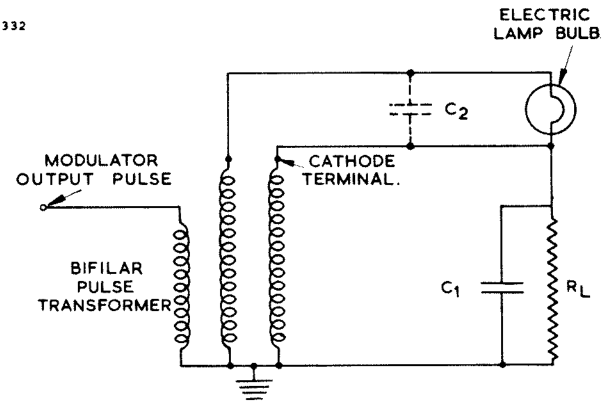


Fig. 1

The required capacitance value can best be determined by setting up the circuit shown in Fig. 1. Here the magnetron is replaced by a dummy load (R_L) and the magnetron heater by an electric lamp bulb of similar hot impedance and power rating. The dummy load R_L should have the same impedance as the magnetron under the proposed operating conditions. The capacitance C_1 across R_L should be comparable with the magnetron anode to cathode capacitance, normally of the order of 10pF. When the pulse is applied to this circuit the lamp will usually light, indicating that some pulse energy is being dissipated. Capacitors (C_2) should be added across the lamp until the light is extinguished. In this way, the minimum capacitance required to prevent pulse energy being dissipated in the magnetron heater can be determined.

Magnetic Field

Many magnetrons are designed for use with separate magnets, i.e. the magnet is not an integral part of the valve. The magnets for these non-packaged valves are not normally supplied by the English Electric Valve Co. Ltd. but the recommended pole tip dimensions, the position of the magnet, the required field strength and the polarity are specified on the individual data sheets; the user is invited to consult the Company on the choice of magnets.

Care must be taken to avoid mechanical shocks to the magnet since these may lead to a decrease in the field strength. The effect of this is to reduce the operating voltage below the acceptable minimum, with a consequent reduction in efficiency and an increase in back bombardment of the cathode. In most cases the modulator is a constant power device and, unless it is adjusted, any reduction in operating voltage will result in an increased peak anode current. This may not be serious with line type modulators having a load line with a comparatively steep slope but with hard valve modulators the peak anode current may increase to a value in excess of the maximum rating and cause arcing instability.

When designing the transmitter, care should be taken to ensure that the magnet is not shunted to any appreciable extent by any ferrous materials used in the construction of the framework. In some cases, stray fields from the magnet may affect the operation of adjacent components. Where it is necessary to use a magnetic shield to prevent undesirable stray field effects, the Company should be consulted on the correct spacing of the shield.

Current–Voltage Characteristic

Oscillation does not start until the magnetron anode voltage reaches a certain value and it ceases when the voltage falls below this value. A small anode current flows under non-oscillatory conditions and this current should be kept as low as possible as it represents wasted energy dissipated in the magnetron.

In the oscillatory condition, the current rises rapidly with increases in anode voltage and the dynamic impedance may be considerably lower than the static impedance, i.e. the ratio of the actual voltage and current. The magnetron is almost a constant voltage device therefore, and the dynamic impedance at the normal operating point is usually of the order of a hundred ohms.

The operating voltage is determined by the physical dimensions of the interaction space in the valve and by the magnetic field, with a slight correction for the small dynamic impedance. This is shown clearly by Fig. 2 in which AB is a typical V/I curve. As the V/I curve is nearly horizontal, any change in the operating conditions will have little effect on the anode voltage but a large effect on the current. Thus abnormal operation of a magnetron is shown up most clearly by an incorrect anode current, even though the anode voltage has not varied measurably.

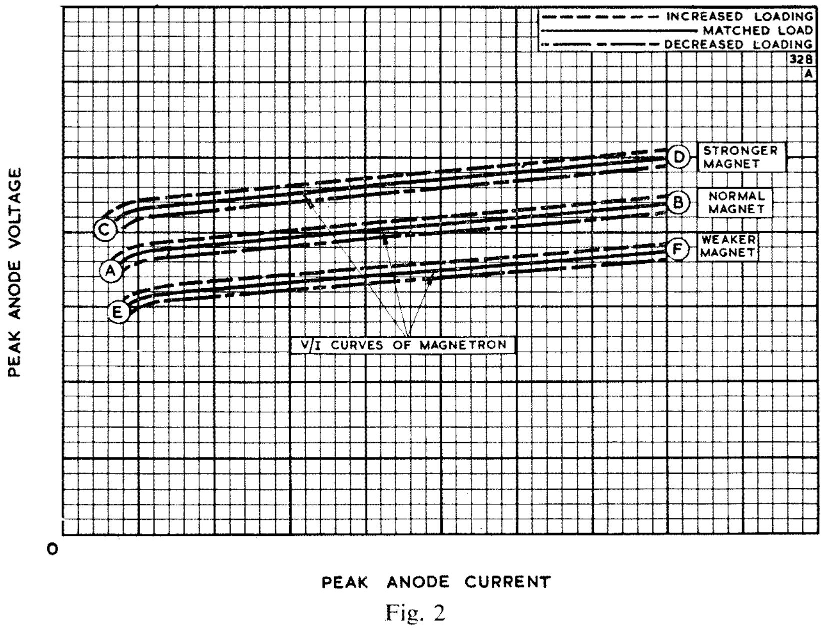


Fig. 2

If the magnetic field is increased, the V/I curve will move upwards to CD, whereas if the field is decreased it will move downwards to EF. A weak field is highly deleterious since it results in high anode current and low output power.

The solid curves in Fig. 2 are for matched loads; the effects of increasing and decreasing the load are also shown.

The determination of the operating point for a line type modulator is shown in Fig. 3. The normal V/I curve of the magnetron is represented by AB and the load line of the modulator by PR. The operating point is determined by the intersection of AB and PR at Q. If the input to the modulator is increased, the load line of the modulator will move from PR to LN, giving the new operating point M at the point of intersection with LN. The increase in anode voltage is the increase from V_0 to V_0', which is quite small, and it is clear that the operating voltage is determined mainly by the valve and the magnetic field. Therefore any appreciable deviation from the correct operating voltage must be the result of either incorrect field strength or an internal defect in the magnetron.

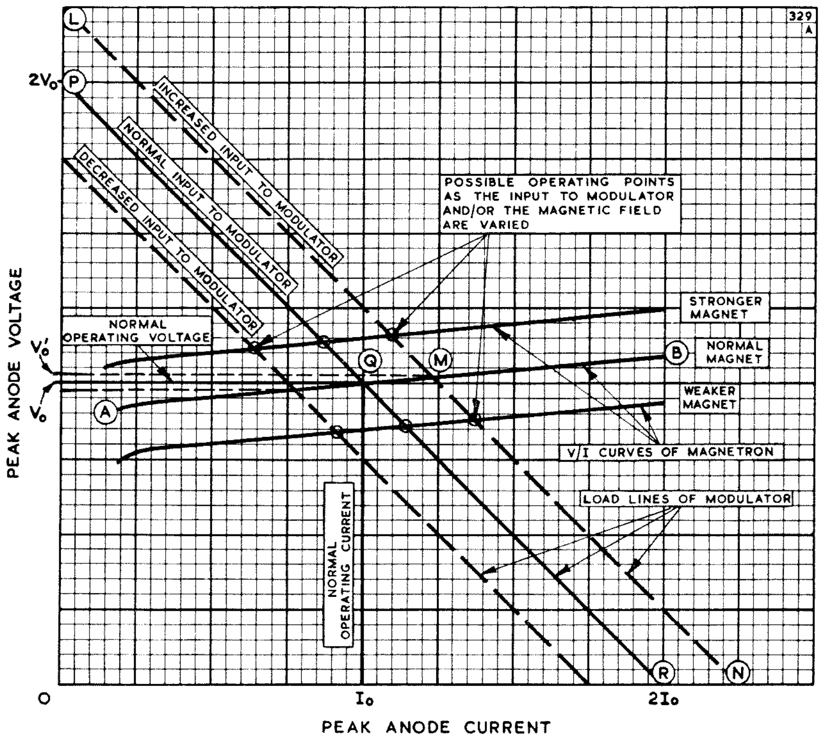


Fig. 3

The operating point indicated in Fig. 3 also gives the peak anode current of the magnetron. With line type modulators, the relatively steep slope of the load line limits the change in anode current arising from a change in anode voltage to a reasonable value. The load line is substantially a straight line with double voltage at zero current and double current at zero voltage.

With the hard valve modulator, however, the internal impedance can be quite low—of the order of a hundred ohms (See Fig. 4).

Under these conditions, it will probably be necessary to adjust the input to the modulator to give the correct anode current at the required magnetron operating voltage and to ensure that any variations in the power supply do not result in large variations in the operating point with consequent excessive changes in the magnetron current. The modulator design should ensure that the pulse energy delivered to the magnetron, followed by an arcing pulse, does not greatly exceed the normal energy per pulse.

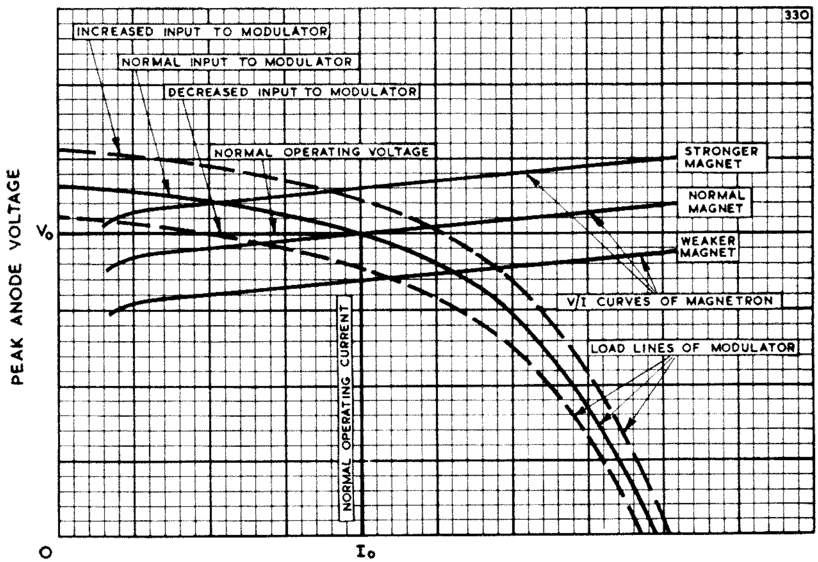


Fig. 4

Pulse Characteristics

Magnetron performance is usually very sensitive to the shape of the applied pulse which can be described by (*a*) the rate of rise, (*b*) the spike, (*c*) the flat and (*d*) the rate of fall.

(*a*) *Rate of Rise*. A maximum and a minimum rate of rise of voltage is normally specified for magnetrons. The rate of rise is defined as the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Too high or too low a rate of rise may increase the tendency to mode changing with consequent undesirable effects.

(*b*) *Spike*. A high spike on the leading edge of the pulse may cause the magnetron to start in an undesired mode. Measures should be taken, therefore, to reduce the spike, while ensuring that the rate of rise of voltage is not reduced below the specified minimum.

(*c*) *Flat.* The top of the voltage pulse should be flat and free from ripple or droop. Any small voltage ripples or droop tend to produce large variations in current as the dynamic impedance of the magnetron is low. Such variations in current give rise to frequency pushing effects with consequent frequency modulation during the pulse.

(*d*) *Rate of Fall.* The voltage pulse must fall rapidly at least to the value where oscillation ceases so as to reduce frequency pushing during periods of operation below full current. Oscillation usually ceases when the voltage has fallen to about 80% of the peak value. Although a lower rate of fall is permissible after oscillation has ceased, a significant amount of noise will be generated and the increase in 'waste' current may result in the overloading of the cathode.

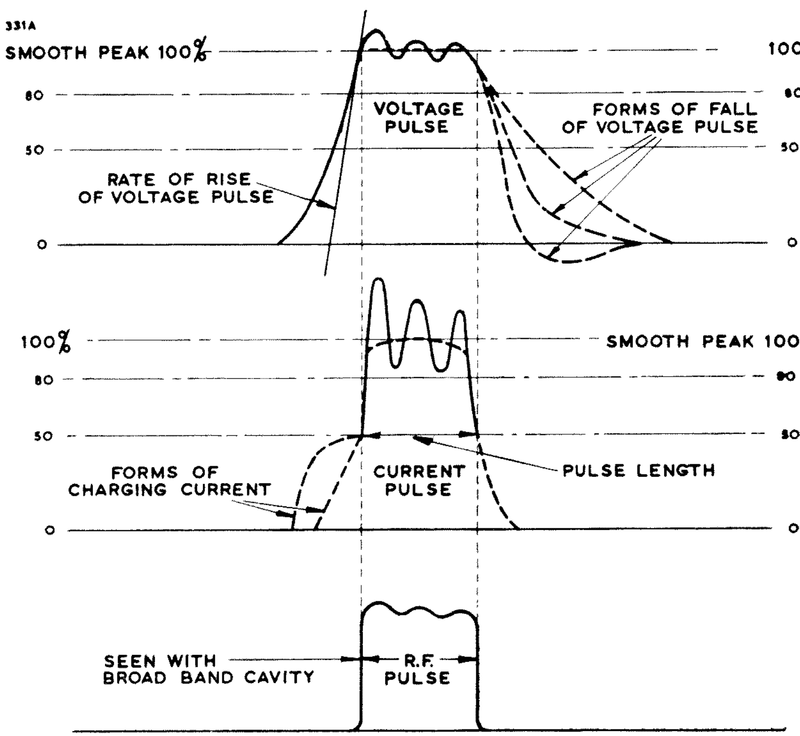


Fig. 5

In radar applications, the duration of the r.f. pulse, which is similar to that of the current pulse, is of major interest; both the r.f. and current pulses are shorter than the voltage pulse. The pulse length is defined as the time interval between the points on the current pulse where the instantaneous current is 50% of the smooth peak current.

Typical pulse characteristics are shown in Fig. 5 and these illustrate that the variations in the current along the top of the pulse are much greater than the voltage fluctuations producing them. This effect is best illustrated by taking a typical example, type 7182. The V/I curve for this valve shows 34·8kV for an anode current of 150A peak (with a magnetic field of 1400 Gauss) and this increases to 36·2kV for an anode current of 200A. If the magnetron were replaced by a resistive network, an increase of 33·3% in current would be associated with a similar increase in voltage but the magnetron gives this increase in current for only 4·3% increase in voltage. Thus in this particular case the deviation from the directly proportional relationship of current and voltage as presented by a resistive network is by a factor of 7·7 and a factor of more than 10 is quite usual. In some cases, such as the 4J50A, the factor may be in excess of 20 and this effect should be borne in mind when designing the modulator.

Any departure from the ideal flat top of the voltage pulse should be maintained at less than 1% so as to limit variations in the current pulse to 10% or less.

Frequency Pushing

The frequency of oscillation is dependent not only on anode temperature but also on the input conditions, particularly on the value of anode current. The change in frequency produced by changes in anode current is termed 'frequency pushing' and is given in megacycles per second per ampere. It is not a constant but is normally specified for a change in anode current over a given range.

Frequency Pulling

Frequency pulling denotes the changes in frequency produced by changes in the output conditions and provides a measure of the effect of the external circuit, particularly reflecting discontinuities, on the magnetron stability. The frequency pulling figure is the maximum change of oscillation frequency caused by variation through all phases of reflection from a discontinuity producing a voltage standing wave ratio of 1·5 : 1 in an otherwise matched output feeder.

Long output feeders may produce two particular cases of frequency pulling. Variation of the phase of a distant discontinuity may cause frequency jumps in C.W. valves whereas in pulsed valves the frequency may change between successive pulses, or groups of pulses, giving two frequency spectra. This is known as frequency splitting. To overcome long line effects, a phase shifter should be incorporated in the output feeder immediately before the magnetron and adjusted to give a satisfactory spectrum.

Frequency Stability with Temperature

The mean frequency of oscillation is influenced by the temperature of the anode block which in turn is determined by both the input and the output conditions. A figure for the maximum change in frequency that will be encountered with anode temperature changes is specified for individual magnetrons. By applying the recommended cooling conditions and where possible limiting any variations in input and output conditions, such changes in frequency may be minimised.

Loading

Incorrect loading of the magnetron may give rise to unsatisfactory operation such as moding or arcing. The loading may introduce a standing wave in such phase that starting in the π mode at a given rate of voltage rise is difficult compared to starting in the next mode and consequently mode shift occurs.

Radiations

Sufficient r.f. power may be radiated through the cathode stem and other apertures to interfere with adjacent circuit components. In some cases the radiations may be sufficiently intense to cause damage to the human body particularly to the eyes when observations of cathode temperature or arcing are being made. Such observations should be made through a small hole or an attenuator tube set in the wall of the output waveguide. Where this is not possible adequate r.f. screening, such as copper gauze with a mesh small compared with the wavelength, should be provided.

When magnetrons are to be operated at voltages in excess of 16kV, the Company should be consulted regarding the provision of protection against X-radiations.

STORAGE AND INSTALLATION

Storage

Magnetrons should be stored in their original packing or in suitable racks designed to protect the valve from excessive shock or vibration and to ensure that no stresses are imposed on the envelope or seals.

To prevent interaction between magnets and the possibility of some permanent demagnetisation, integral magnet valves stored in racks must not be positioned closer than the distance set by the size of the original packing. The racks must be made of non-magnetic materials.

The ambient temperature of the storage area must be maintained at least 10°C above the dew point or the valves must be stored in protective packing containing dessicants. The original packing of the valve includes a vapour proof envelope and this should not be opened until the valve is required for test or service.

Magnetrons should always be transported to and from the stores in the packing designed for the purpose.

Installation

Care must be taken in removing the magnetron from its packing, bearing in mind that it is a vulnerable article and liable to permanent damage if subjected to mechanical shocks. Prior to installation, the valve should be visually inspected, taking care to handle it by the mounting flange and not by the cathode or output side arms. All glass and ceramic parts should be examined for cracks; any dirt, grease or moisture on the external insulator surfaces or terminals must be carefully removed but at no time must steel wool be used for the purpose.

If the magnet is not integral, the valve must be handled carefully when it is fitted in the magnet to avoid mechanical shocks. Iron, nickel or other magnetic materials must be kept from close contact with the magnet and non-magnetic tools must be used for installation purposes. In the case of integral magnet types, the magnet must never be removed from the valve.

The electrical connections to the cathode and heater terminals and to the output should be sufficiently tight to avoid arcing and other contact troubles, but not so rigid that stress is placed on the glass to metal seals. The cathode and heater terminals may operate at a relatively high temperature and provision must be made to allow for thermal expansion. To prevent anode current and transients passing through the heater and thereby causing burnout, the anode voltage supply return must be connected to the cathode terminal. It is important to avoid any undue stressing of the output section as deformation of the metal or breakage of the the glass or ceramic vacuum seals may result. Any mechanical pressure should therefore be applied uniformly.

It may be desirable to operate the magnetron initially under reduced input conditions to clean up any gas that may be present in the valve and so reduce the risk of excessive arcing. This is particularly important when the valve has not been in service for an appreciable time.

Further advice on the installation and operation of magnetrons or any other problems arising from their use is available on request.

CW Magnetrons

English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

BM25L

C.W. MAGNETRON

ABRIDGED DATA

Fixed frequency c.w. magnetron for r.f. heating applications.

Type	Frequency (MHz)	Outline
BM25LB	896 ± 10 (U.K.)	Page 14
BM25LC	915 ± 10 (U.S.A.)	Page 14
BM25LD*	896 ± 10	Page 12

Output power into matched load	30	kW
Electromagnet and launching section		M4122
Output		probe radiating into no. 4 waveguide (9.750 x 4.875 inches internal)
Cooling		water and forced-air

GENERAL

Electrical

Cathode		directly heated tungsten filament
Filament voltage (single-phase a.c., r.m.s.) (for filament current of 112A)	11.5	V
Filament current (r.m.s.) (see note 1)	112	A
Maximum filament starting current (r.m.s.)	250	A
Filament cold resistance	0.01	Ω approx
Filament heating time	10	s
Electromagnet resistance at 18.5°C	12	Ω approx

Mechanical

BM25L Valve

Overall dimensions (excluding water pipes)	17 x 7 x 7 inches nom 43.2 x 17.8 x 17.8cm nom
Net weight	22 pounds (10kg) approx
Mounting position	axis vertical, filament terminals up or down

* The BM25LB and BM25LD are electrically identical.

Electromagnet and Launching Section M4122

Overall dimensions (including valve)	23.4 x 21.5 x 13.125 inches approx 59.43 x 54.61 x 33.34cm approx
Waveguide flange	see page 19
Net weight	143 pounds (65kg) approx

COOLING

The valve anode and electromagnet have integral water cooling jackets; the output window and filament seals are cooled by low-pressure air. All cooling supplies must be turned on before and during the application of any voltages and continued for at least 5 minutes after the removal of these voltages.

Valve

Anode cooling water flow rate	2.2 Imp.gal/min (10 l./min) min
Anode pressure drop	13lb/in^2 (0.9kg/cm^2) approx
Anode water outlet temperature	50°C max
Output window cooling air flow	20ft^3/min (0.57m^3/min)
Output window pressure drop	1.0 inch (25mm) water gauge
Filament terminals cooling air flow	5.0ft^3/min (0.14m^3/min)
Pressure drop	0.75 inch (19mm) water gauge
Filament terminal temperature	120°C max

Electromagnet

Cooling water flow rate	0.22 Imp.gal/min (1.0 l./min)

MAXIMUM RATINGS

Anode voltage	14.5	kV max
Anode current	3.0	A max
Input power	40	kW max
Anode dissipation	15	kW max
Filament starting current (r.m.s.)	250	A max
Anode water outlet temperature	50	°C max
Filament terminal temperature	120	°C max
Load v.s.w.r. (see note 2)	3:1	max
Inlet water pressure	100lb/in^2 (6.9kg/cm^2)	max

TYPICAL OPERATION

	Condition 1	Condition 2	
Operating Conditions			
Filament current	98	93	A
Electromagnet current (see note 3)	3.3	3.6	A
Anode current (see note 4)	2.1	2.4	A
Load v.s.w.r. (see note 5)	3:1	2.5:1	max
Waveguide coupling	see note 6	see note 6	
Typical Performance			
Filament voltage	10.4	10	V
Anode voltage	11.5	12.5	kV
Output power	20	25	kW
Frequency pushing (see note 7)	0.7	−0.4	MHz/A
Frequency modulation (see note 8)	0.2	0.2	MHz

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

	Oscillation 1	Oscillation 2	Oscillation 3	
Test Conditions				
Filament current	90	83	97	A
Electromagnet current	3.35	3.35	3.35	A
Anode current	2.5	2.5	2.5	A
V.S.W.R. at output coupler	1.1:1	3:1	3:1	

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage	12	13	–	–	–	–	kV
Output power	23	–	–	–	–	–	kW
Frequency:							
BM25LB	886	906	–	–	–	–	MHz
BM25LC	905	925	–	–	–	–	MHz
BM25LD	886	906	–	–	–	–	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	3.5	–	–	–	–	MHz
Stability	see note 9		see notes 9 and 10		see notes 9 and 11		
Filament current	–		see note 12		see note 12		

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the filament must be preheated by the application of 112A for at least ten seconds. On the application of anode voltage, the filament current must be reduced within 2 seconds in accordance with the graph on page 10. The upper and lower limits shown in this graph are absolute, and apply to the range of anode voltage and anode current shown in the performance chart on page 7.

   In applications where the r.f. load is approximately constant, reduction of heater voltage may be effected by manual or automatic switching to a fixed value, but where appreciable variations in load are likely an automatic variable control is preferable.

2. Over the frequency band of the magnetron and 5MHz above and below the band limits. The use of a reverse power detector is recommended to cut off the h.t. supply if the power reflected into the valve exceeds 5kW. For operating points in the 'sink' of the Rieke diagram the magnetron may stop oscillating, or oscillate in a different mode, it the v.s.w.r. exceeds this limit. In the event of oscillation in another mode the h.t. supply must be switched off and restarted; prolonged operation in other than the correct mode may damage the valve.

3. The output power may be controlled by direct adjustment of the anode current or the magnetic field. Stabilisation of supplies against input variations and drift is desirable. Automatic field control to keep the anode current or output power constant may be used. Alternatively the electromagnet can be operated in series with the anode supply (see page 5).

4. The valve is usually operated from a 3-phase bridge rectified supply, with or without a smoothing choke. The choice of supply and degree of smoothing are determined by the permissible power and frequency modulation of the r.f. output. The internal impedance of the h.t. supply should be such as to limit the peak anode current to 24A in the event of the magnetron arcing. A cut-out should be incorporated to switch off the h.t. supply in this case.

5. This is a maximum value for any phase of voltage reflection coefficient.

6. Load v.s.w.r. 1.5:1. The coupling between the magnetron and the waveguide is adjusted by a 2 inch diameter screw in the launching section. The nominal screw penetration is $11^1/_2 \pm {}^1/_8$ turns from the fully anti-clockwise position, unless otherwise stated on the valve test sheet. The screw must not be used to adjust the frequency of oscillation.

7. This is an approximate steady-state value and includes the contribution due to thermal effects.

8. Typical peak to peak value with the h.t. supply from a 6-phase rectifier and a 5 Henry choke in series with the anode, giving an anode current ripple of 0.16A peak to peak. With no series choke, typical values are 0.56A peak to peak current ripple and 0.7MHz peak to peak modulation. These results are obtained with a matched load and a.c. filament supply.

9. The valve shall not stop oscillating during 20 minutes of a 30 minute test period.

10. The phase of the mismatch shall be adjusted to give minimum mean anode current.

11. The phase of the mismatch shall be adjusted to give maximum mean anode current.

12. The filament current shall not vary by more than 2A as the mismatch is varied through all phases.

ELECTROMAGNET OPERATION

The magnet may be energised by a separate supply, or may be connected in series with the valve h.t. supply. Series field operation considerably reduces the variation in r.f. power output with variation in mains supply voltage and the addition of a field bias current supply allows the power output to be controlled by varying the magnet current rather than the h.t. voltage. The characteristics shown on page 8 may be obtained with the circuit for series field operation shown on page 11.

With the magnet coil connected in series, instantaneous application of anode voltage would result in the full h.t. voltage appearing across the coil. The recommended method of starting is to increase the bias current until the magnetic field is sufficient to prevent the valve drawing anode current at the no-load h.t. voltage, then switch on the h.t. supply and gradually reduce the bias current until the required operating point is reached.

INSTALLATION

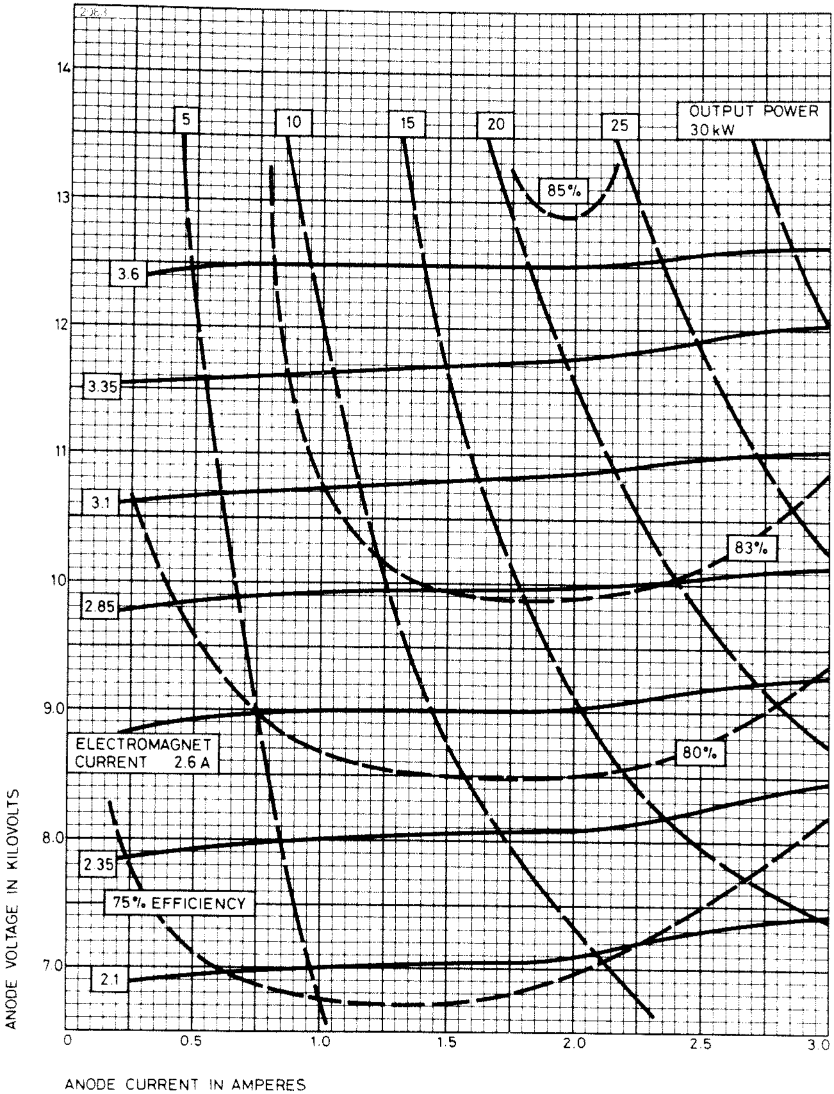
Care should be taken to protect the valve from excessive shocks during and after installation, with particular regard to the metal-ceramic seals.

R.F. connection between the valve and its launching section is by a copper washer. The valve must be seated squarely and the mounting screws uniformly tightened to ensure proper contact; a new washer should be fitted if the valve is removed and replaced for any reason.

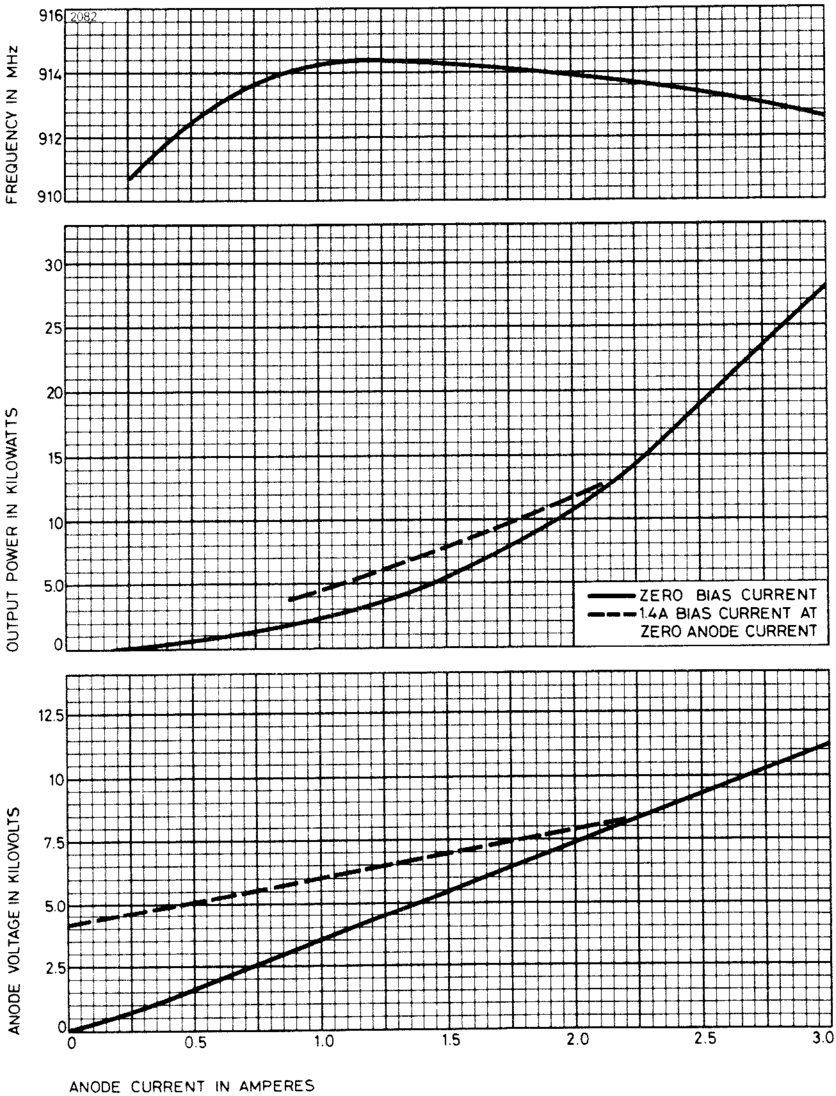
The domed output window is cooled by air ducted through an insulating cylinder, and it is necessary to ensure that the cylinder is concentric with the dome.

The filament terminals must be securely clamped to avoid overheating. They must be cooled by forced-air through a duct attached to the small filament terminal.

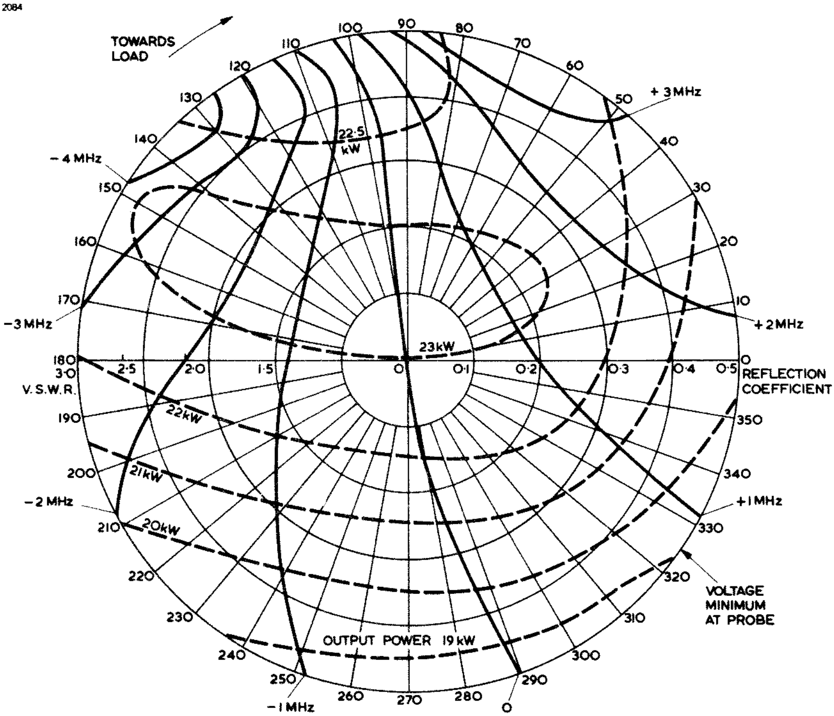
PERFORMANCE CHART



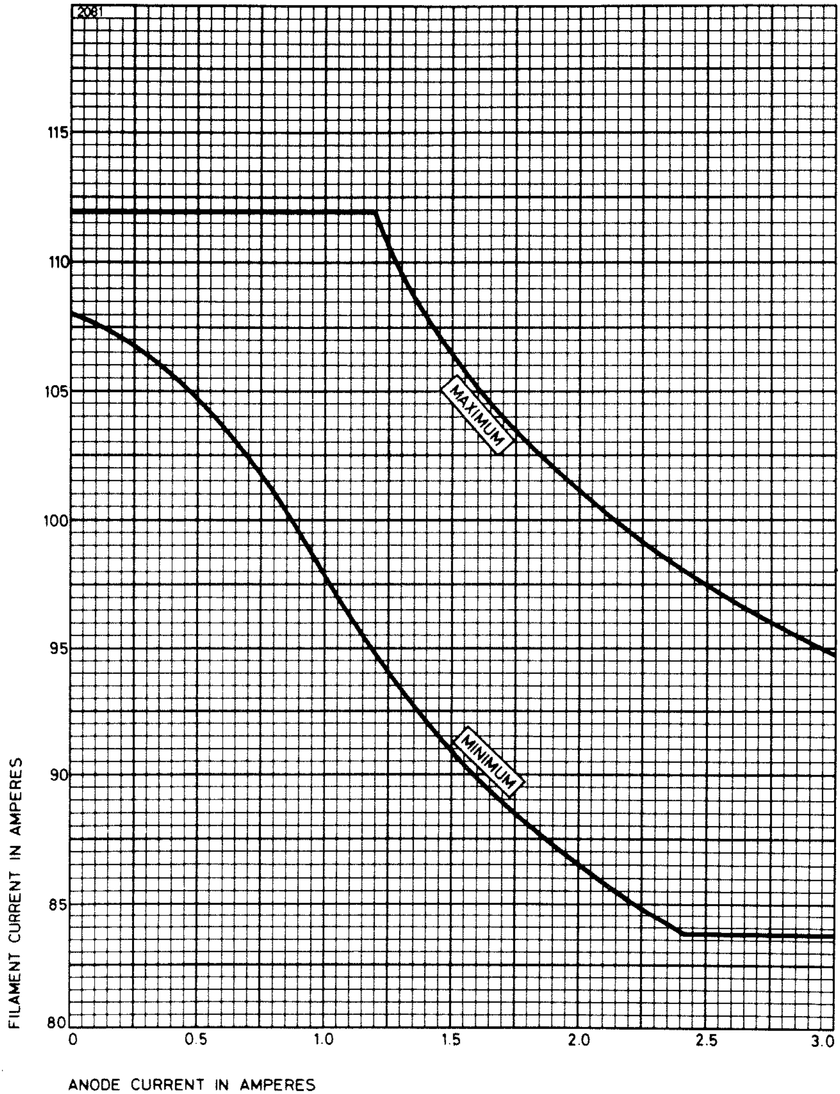
PERFORMANCE CHART WITH SERIES FIELD



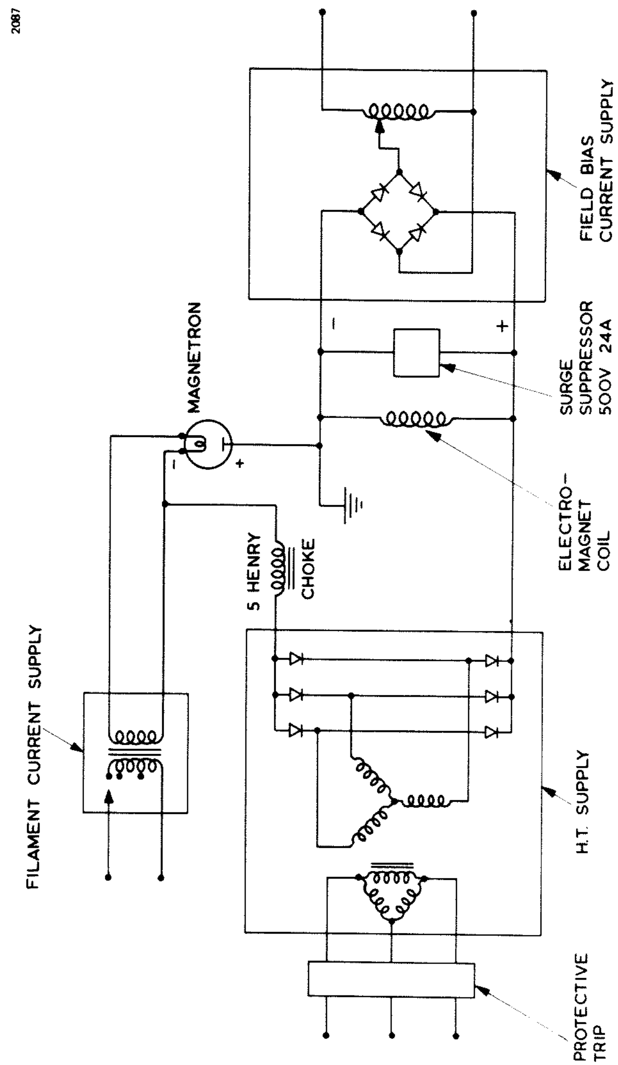
RIEKE DIAGRAM WITH SERIES FIELD



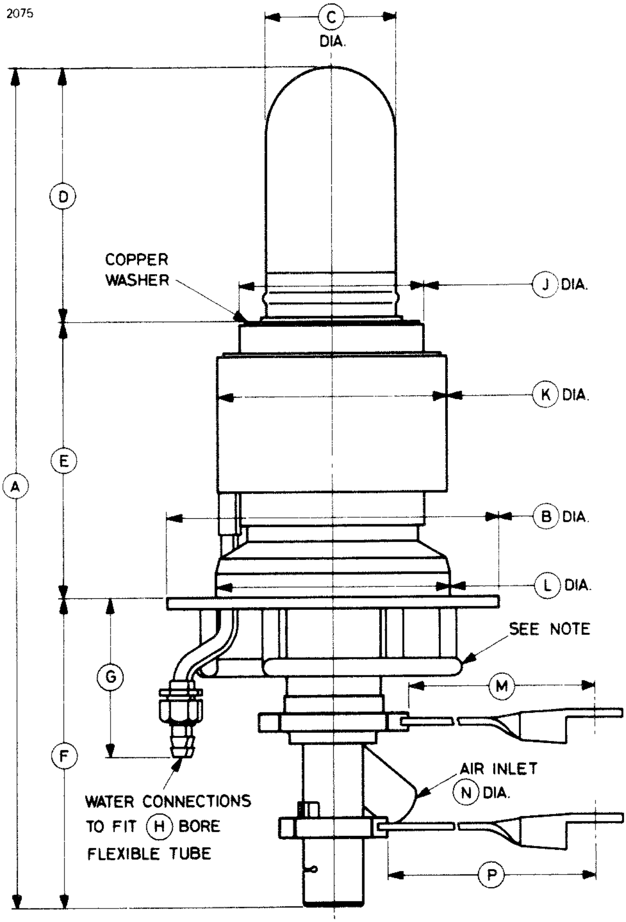
HEATER CURRENT LIMITS



TYPICAL CIRCUIT



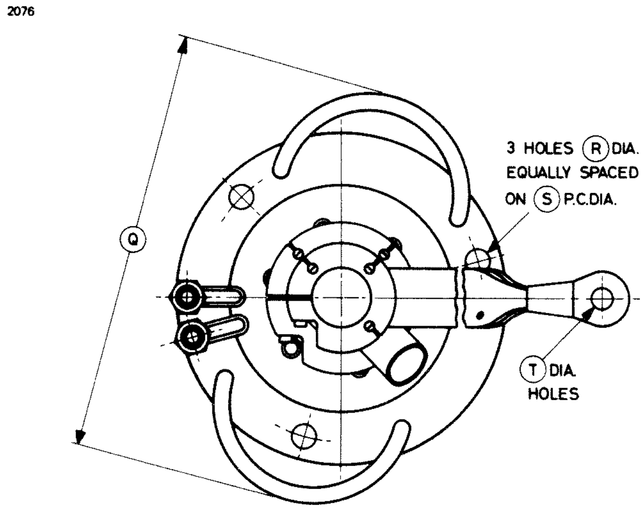
OUTLINE OF BM25LD



Note

Handles to facilitate handling and transit of magnetron, readily removable before installation if so required.

OUTLINE OF BM25LD

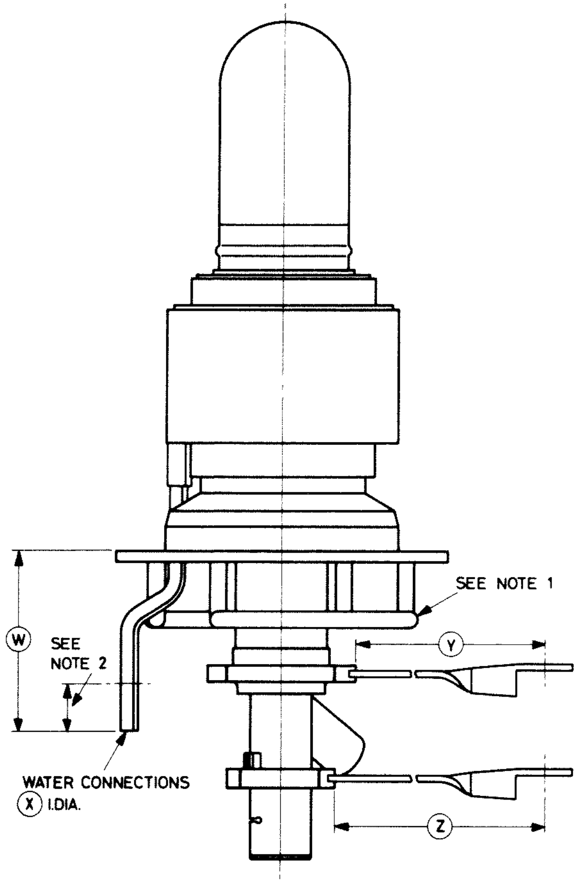


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	17.500 max	444.5 max	K	4.900 max	124.5 max
B	7.000 ± 0.030	177.8 ± 0.76	L	4.960 max	126.0 max
C	2.750	69.85	M	20.000	508.0
D	5.000	127.0	N	1.000	25.40
E	5.745 min	145.9 min	P	24.000	609.6
F	6.500 max	165.1 max	Q	9.000 max	228.6 max
G	3.250	82.55	R	0.437	11.10
H	0.375	9.53	S	6.000 ± 0.010	152.4 ± 0.25
J	3.985 max	101.2 max	T	0.437	11.10

Millimetre dimensions have been derived from inches.

OUTLINE OF BM25LB AND BM25LC

2077

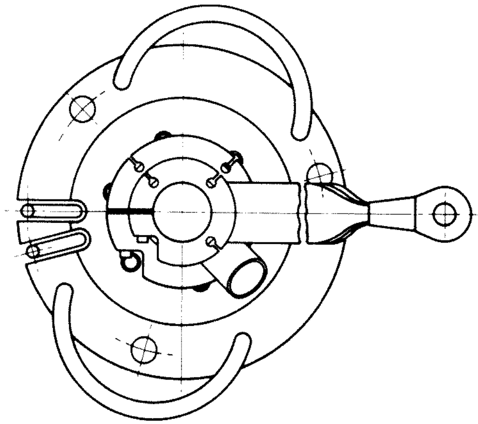


Notes

1. Handles to facilitate handling and transit of magnetron, readily removable before installation if so required.
2. First 1.000 inch (25.40mm) to be unpainted.

OUTLINE OF BM25LB AND BM25LC

2078

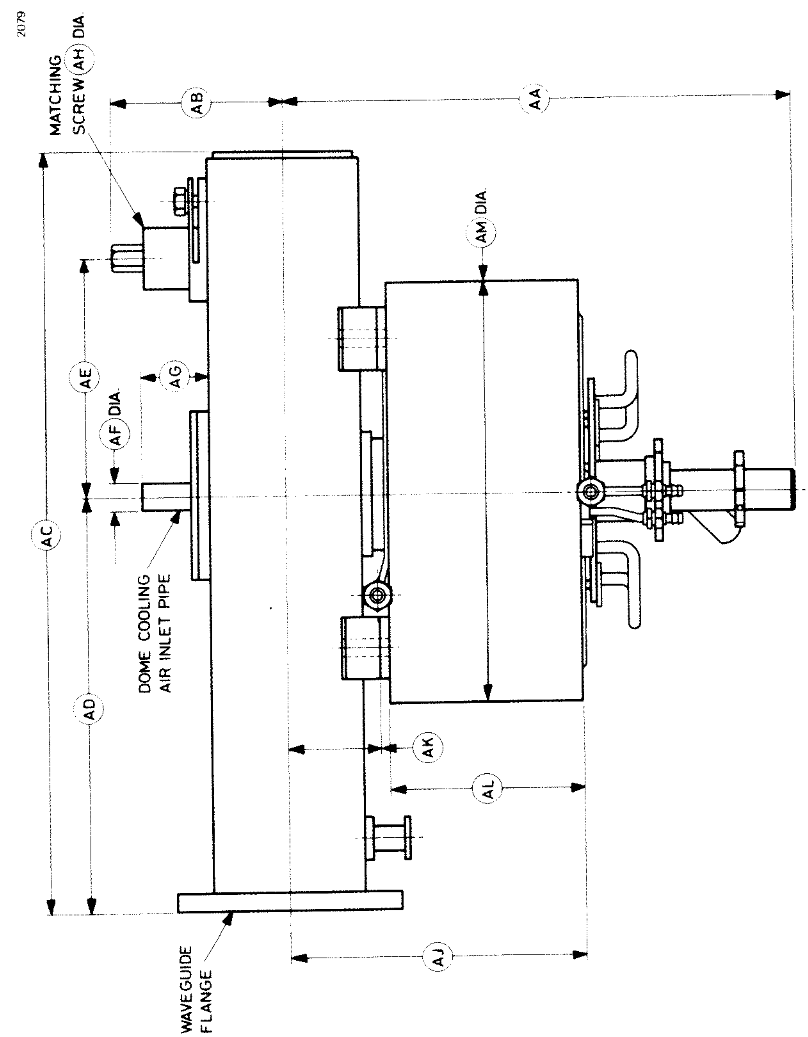


Ref	Inches	Millimetres
W	3.750	95.25
X	0.312	7.92
Y	10.500	266.7
Z	10.000	254.0

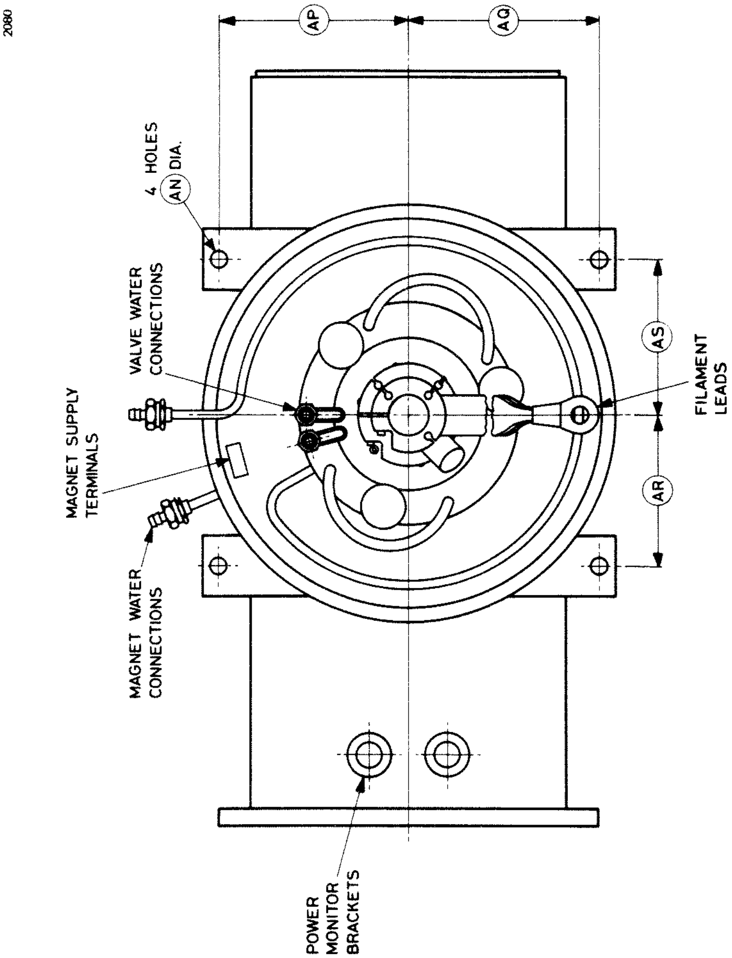
Millimetre dimensions have been derived from inches.

All other dimensions as for BM25LD.

OUTLINE OF M4122



OUTLINE OF M4122



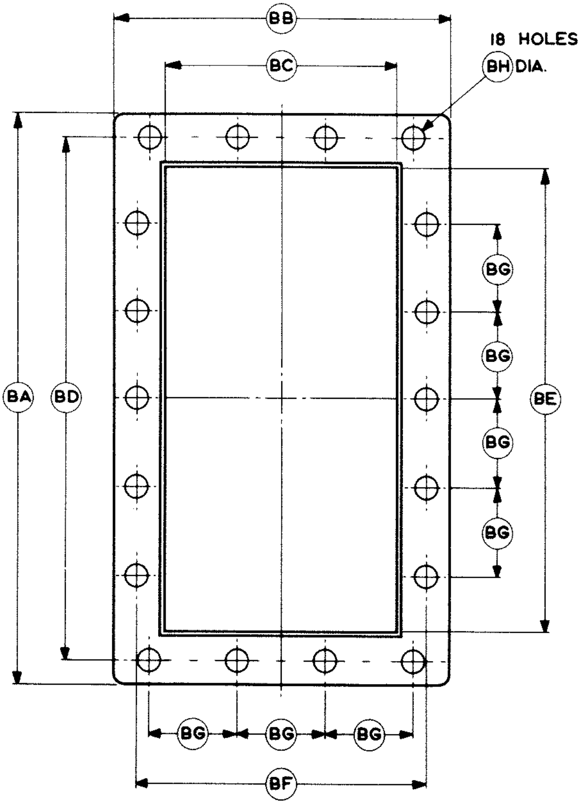
OUTLINE DIMENSIONS FOR M4122

Ref	Inches	Millimetres
AA	16.000	406.4
AB	5.500	139.7
AC	23.359	593.3
AD	13.000	330.2
AE	7.329	190.7
AF	1.000	25.40
AG	2.125	53.95
AH	2.000	50.80
AJ	9.250	235.0
AK	2.875	73.03
AL	6.125	155.6
AM	13.125	333.4
AN	0.563	14.30
AP	6.000	152.4
AQ	6.000	152.4
AR	4.875	123.8
AS	4.875	123.8

Millimetre dimensions have been derived from inches.

DETAIL OF WAVEGUIDE FLANGE

2091



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	12.000	304.8	BE	9.750	247.7
BB	7.125	181.0	BF	6.125	155.6
BC	4.875	123.8	BG	1.844	46.84
BD	11.000	279.4	BH	0.437	11.10

Millimetre dimensions have been derived from inches.

L-Band Magnetrons

English Electric Valve Company Limited
Chelmsford, Essex, England

June 1968
Printed in England

M554

L-BAND MAGNETRON

ABRIDGED DATA

Fixed frequency pulse magnetron	
Frequency range	1295 to 1365 MHz
Typical peak output power	2.6 MW
Magnet (see note 1)	separate magnet (not supplied)
Transition section (see note 2 and page 11)	M4016, coupling to no. 6 waveguide (6.500 x 3.250 inches internal) via coupler UG417A/U
Cooling	water

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 3)	20	V
Heater current	13.5	A
Heater starting current, peak value, not to be exceeded	60	A max
Cathode heating time (minimum) (see note 3)	5	minutes

Mechanical

Overall dimensions (including transition section)	26.06 x 9.75 x 8.5 inches max 662 x 248 x 216mm max
Net weight:	
valve	22 pounds (10kg) approx
transition section	16 pounds (7.3kg) approx
Mounting position	vertical, cathode and heater terminals up

COOLING

The water cooling system is connected to the valve via ½-inch B.S.P. unions. The water flow must be greater than 20 imp. gal/hour (91 litres/hour) with a maximum outlet temperature of 80°C. A 5-foot (1.5 metre) head of water will be adequate to ensure a flow of 20 imp. gal/hour (91 litres/hour).

The purity of the water must be such that no measurable degree of furring occurs. It must not contain impurities corrosive to copper or brass.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 4)	900	950	gauss
Heater voltage (see note 3)	18	22	V
Heater starting current (peak)	–	60	A
Anode voltage (peak)	35	42	kV
Anode current (peak)	–	150	A
Input power (peak)	–	6.0	MW
Input power (mean) (see note 5)	–	7.5	kW
Duty cycle	–	0.0015	
Pulse length (see note 6)	–	5.0	μs
Rate of rise of voltage pulse (see note 7)	50	70	kV/μs
Anode temperature (see note 8)	–	80	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler (see note 9)	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	925	gauss
Anode current (peak)	150	A
Pulse length	5.0	μs
Pulse repetition rate	250	p.p.s.

Typical Performance

Anode voltage (peak)	39	kV
Output power (peak)	2.6	MW
Output power (mean)	3.25	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 4)	950	950	gauss
Heater voltage (for test)	0	0	V
Anode current (mean)	190	190	mA
Duty cycle	0.00125	0.00125	
Pulse length (see note 6)	5.0	5.0	μs
V.S.W.R. at the output coupler	1.15:1	1.5:1	
Rate of rise of voltage pulse	70	70	kV/μs min

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	38	42	–	–	kV
Output power (mean)	3150	–	–	–	W
Frequency	1295	1365	–	–	MHz
R.F. bandwidth at ¼ power	–	0.5	–	–	MHz
Frequency pulling	–	–	–	4.0	MHz
Frequency pushing (see note 10)	–	50	–	–	kHz/A
Stability (see note 11)	–	0.25	–	0.5	%
Heater current					see note 12
Temperature coefficient of frequency					see note 13

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2500	W
R.F. bandwidth at ¼ power	0.5	MHz

Frequency must be within test limits above, Oscillation 1

NOTES

1. The valve is designed for use with a separate magnet, not supplied by English Electric Valve Company Ltd. The user is invited to consult the Company on the choice of suitable magnets.

2. The valve must be used with the circular to rectangular waveguide transition section M4016 (see pages 11 and 12). The satisfactory performance of the valve is guaranteed only when it is used in conjunction with M4016.

   The magnetron flange and the transition section are bolted together directly with 6 OBA bolts (shank length 0.375 inch - 9.53mm) and the distance between the axis of the anode and the face of the rectangular waveguide coupling flange is 15.213 ± 0.187 inches (386.41 ± 4.75mm). It is essential for the valve to be located correctly with respect to M4016, as shown on the outline drawing on page 11.

3. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 20 volts to the heater for at least 5 minutes.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	**Heater Voltage (V)**
Less than 2000	20
2000 to 3000	15
3000 to 4000	10
4000 to 5000	5
More than 5000	0

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 4μF may be necessary depending on the equipment design. For further details see the preamble to this section.

4. For normal operation the magnetic field should be 900 to 930 gauss measured at the centre of the gap. The variation of magnetic field

within a cylinder 3 inches (76.2mm) diameter and 2 inches (50.8mm) long situated centrally and co-axially between the poles must not exceed ± 50 gauss. The minimum gap between the pole pieces must be 3.750 inches (95.25mm).

The north pole of the magnet must be adjacent to the cathode terminal. The magnet position must be adjusted so that the axis of the field is within 0.062 inch (1.57mm) of the centre line of the anode (see outline drawing). It is necessary to provide for an axial adjustment to the magnet of ± 0.125 inch (± 3.18mm) relative to the M4016 waveguide flange.

5. The various parameters are related by the formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

6. Tolerance ± 10%.

7. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

8. The temperature of the anode measured at the hottest point where contact is made with the water jacket. The rate of water flow must be such that the anode temperature is maintained below this maximum and in any case the flow must exceed 20 gallons per hour (91 litres per hour).

9. The v.s.w.r. of the output system shall be less than 1.5:1 over the frequency range 1295 to 1400MHz and less than 2.0:1 over the frequency range 1400 to 1600MHz, or an approved output system shall be used.

10. The change in frequency when the peak input current is varied between the limits of 100 and 150A shall be less than 50kHz/A. The frequency shall vary smoothly without discontinuity within the specified limit.

11. Missing pulses are counted at the phase of maximum instability of a mismatch of v.s.w.r. 1.5:1 and also at matched conditions at a peak anode current of 150A after a holding period of 672 hours. Pulses are

defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 1295 to 1365MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the last minute of a test period not exceeding 5 minutes.

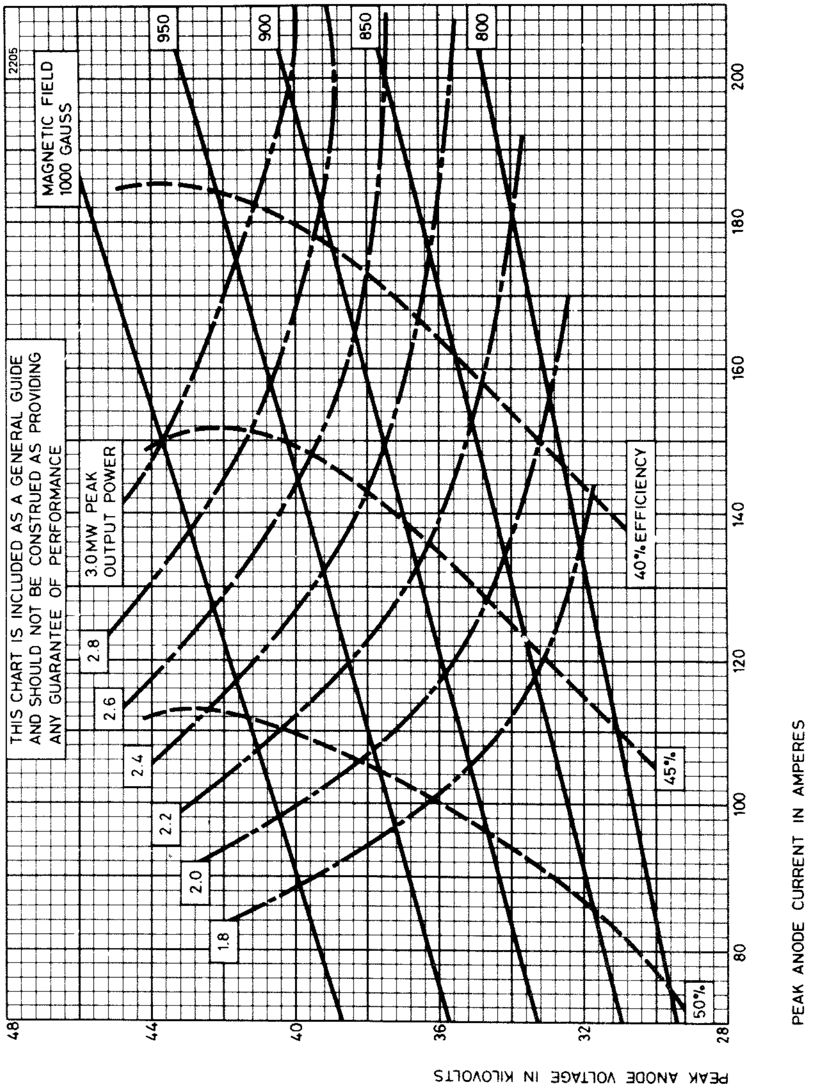
12. The heater current, measured with heater voltage of 20V and no anode input power, will be within the range 12 to 15A.

13. Design test only. The frequency change with anode temperature change after warm-up will not exceed -0.035MHz/°C.

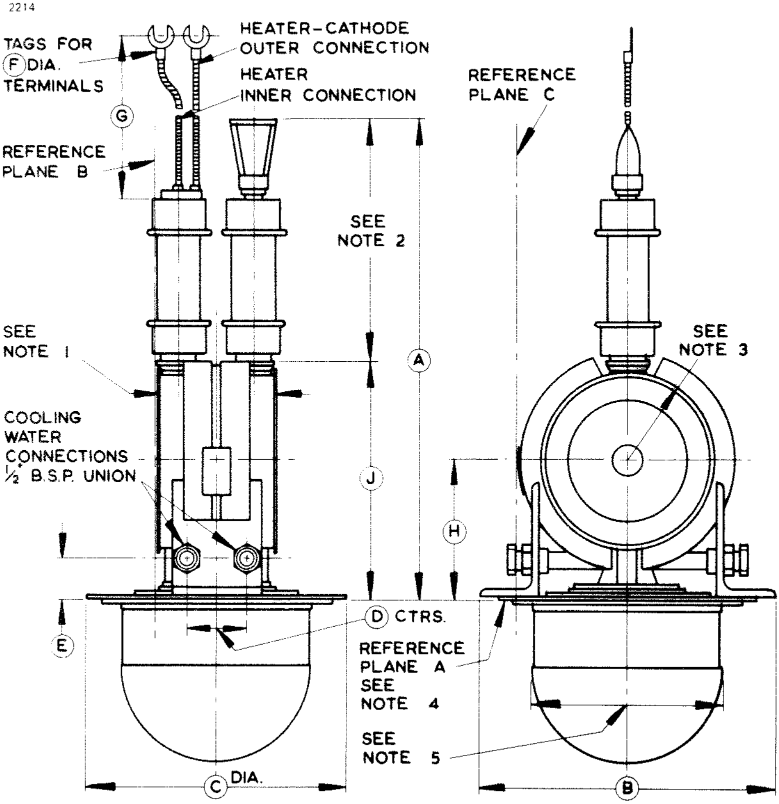
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART



OUTLINE



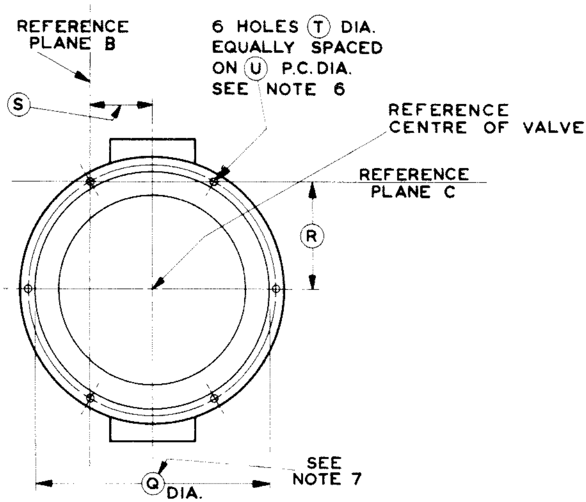
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.000 max	381.0 max	F	0.312	7.92
B	9.750 max	247.7 max	G	8.000 min	203.2 min
C	8.500 max	215.9 max	H	4.213	107.0
D	1.812 ± 0.062	46.02 ± 1.57	J	7.750 max	196.8 max
E	1.187 ± 0.062	30.15 ± 1.57			

Millimetre dimensions have been derived from inches.

OUTLINE

View of Output End of Valve

2216



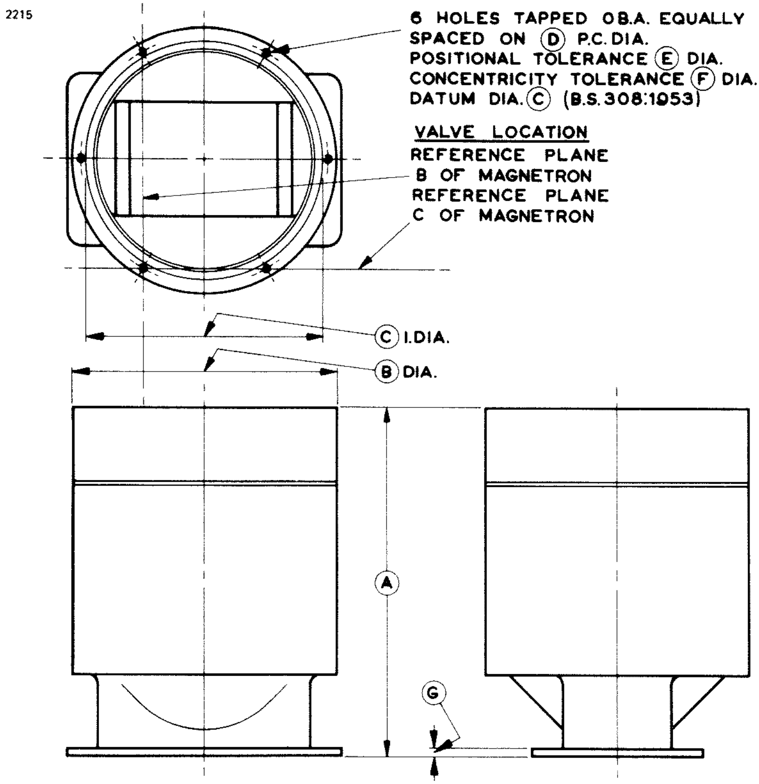
Ref	Inches	Millimetres
Q	See note 7	See note 7
R	3.383	85.93
S	1.953	49.61
T	0.261 $^{+0.004}_{-0.000}$	6.629 $^{+0.102}_{-0.000}$
U	7.813	198.5

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The overall width of the anode is such that it will pass between two planes 3.750 inches (95.25mm) apart equally spaced about the reference centre of the valve and parallel to reference plane B.
2. All parts of the valve within the limits shown will lie within a rectangular volume of sides 2.75 inches (69.8mm) perpendicular to reference plane C and 5.00 inches (127mm) perpendicular to reference plane B, centred on the reference centre of the valve.
3. The periphery of the anode will fall within a radius of 2.925 inches (74.30mm), positioned as shown.
4. The flatness of the mounting flange will be such that with reference plane A resting on a flat surface a feeler gauge 0.020 inches by 0.125 inches (0.51mm by 3.18mm) will not enter between plane A and the surface at any point.
5. Concentricity of the valve output will be such that diameter B will lie within a radius of 3.218 inches (81.74mm) from the reference centre of the valve.
6. Positional tolerance 0.005 inch (0.127mm) diameter (B.S.308:1953).
7. Diameter Q will lie within a radius of 3.718 inches (94.44mm) from the reference centre of the valve.

TRANSITION SECTION M4016

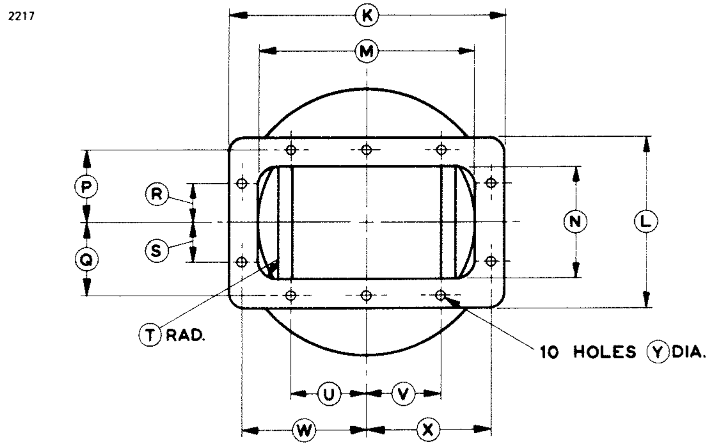


Ref	Inches	Millimetres
A	11.000 ± 0.062	279.40 ± 1.57
B	8.500 max	215.9 max
C	$7.443\ ^{+0.010}_{-0.000}$	$189.05\ ^{+0.25}_{-0.00}$
D	7.813	198.45
E	0.0075	0.19
F	0.005	0.127
G	0.312	7.92

Millimetre dimensions have been derived from inches.

DETAIL OF TRANSITION SECTION

View of Rectangular Output Flange



Ref	Inches	Millimetres
K	8.680	220.5
L	5.440	138.2
M	6.500 ± 0.013	165.10 ± 0.33
N	3.250 ± 0.013	82.55 ± 0.33
P	2.311 ± 0.005	58.70 ± 0.13
Q	2.311 ± 0.005	58.70 ± 0.13
R	1.249 ± 0.005	31.72 ± 0.13
S	1.249 ± 0.005	31.72 ± 0.13
T	0.625	15.88
U	2.374 ± 0.005	60.30 ± 0.13
V	2.374 ± 0.005	60.30 ± 0.13
W	3.937 ± 0.005	100.00 ± 0.13
X	3.937 ± 0.005	100.00 ± 0.13
Y	0.330	8.38

Millimetre dimensions have been derived from inches.

M565

L-BAND MAGNETRON

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	1215 to 1365	MHz
Typical peak output power	5.0	MW
Magnet	separate electromagnet	
Output	no. 6 waveguide (6.500 x 3.250 inches internal)	
Launching section	separate (see page 10)	
Cooling	water and forced-air	

GENERAL DATA

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	48	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum) (see note 1)	10	minutes

Mechanical

Overall dimensions	27 x 13 x 13 inches max 686 x 330 x 330mm max
Net weight	72 pounds (32.8kg) approx
Mounting position	vertical only

Cooling water and forced-air (high pressure)

The valve is water cooled and has an integral water jacket, the window is cooled by air at high pressure in the waveguide, while low pressure air cooling may be used on the cathode terminal. The minimum window cooling air flow is 3ft^3/min (0.085m^3/min) N.T.P., and the maximum air inlet temperature is 70°C.

The water flow should be at least 3 imp. gal/min (13.6 l./min), and the outlet temperature must not exceed 75°C. After all power has been removed from the magnetron, a water flow of at least 1.5 imp. gal/min (6.8 l./min) should be maintained for at least 15 minutes to remove stored heat. The purity of the cooling water must be such that no deposition occurs when the water is heated.

The anode sealing ring should be lubricated with grease type MS4 (Midland Silicones Ltd.).

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 2)	750	800	Gauss
Heater voltage (see note 1)	45.6	50.4	V
Heater starting current (peak)	–	40	A
Anode voltage (peak)	45	52	kV
Anode current (peak)	200	250	A
Input power (peak)	–	12	MW
Input power (mean) (see note 3)	–	30	kW
Duty cycle	–	0.0025	
Pulse length	–	10	μs
Pulse repetition rate	–	600	p.p.s.
Rate of rise of voltage pulse (see note 4)	75	100	kV/μs
Anode temperature	–	150	°C
Cathode terminal temperature	–	150	°C
V.S.W.R. at the output coupler (see note 5)	–	1.3:1	
Pressurising of waveguide (see note 6)	25	35	lb/in^2
	1.76	2.46	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	800	Gauss
Anode current (peak)	240	A
Pulse length	10	μs
Pulse repetition rate	250	p.p.s.

Typical Performance

Anode voltage (peak)	48	kV
Output power (peak)	5.0	MW
Output power (mean)	12.5	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions (See Note 7)

	Oscillation 1	Oscillation 2	
Air flow	see note 8		
Magnetic field (see note 9)	800	750	Gauss
Heater voltage (for test)	0	0	V
Anode current (mean) (see note 10)	500 to 585	see note 10	mA
Duty cycle	0.0025	0.0025	
Pulse length (see note 11)	10	10	μs
V.S.W.R. at the output coupler	<1.1:1	<1.1:1	
Rate of rise of voltage pulse (see note 4)	100 to 110	60 to 70	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	45	51	–	–	kV
Output power (mean)	10.0	–	–	–	kW
Frequency	1215	1365	–	–	MHz
R.F. bandwidth at ¼ power (see note 10)	–	0.25	–	0.25	MHz
Frequency pulling (v.s.w.r. 1.3:1)	–	2.25	–	–	MHz
Stability (see notes 10 and 12)	–	0.5	–	0.5	%
Heater current					see note 13
Temperature coefficient of frequency					see note 14

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 48 volts to the heater for at least ten minutes. The heater voltage must not exceed 50.4 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the mean input power as specified in the following table.

Mean Input Power (kW)	Heater Voltage (V) Min	Max
0	45.6	50.4
0 to 5	43	48
5 to 10	38	43
10 to 15	32	38
15 to 20	25	32
20 to 24	15	25
24 to 30	0	15

The valve heater shall be protected against arcing by the use of a minimum capacitance of 8μF shunted across the heater directly at the input terminals. Suitable contacts for the shunt capacitor are provided on the valve and details of a capacitor connector are shown on page 8.

For further details see the preamble to this section.

The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Measured at the point specified on the electro-magnet and launching section.

3. The various parameters are related by the formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

5. Where the load v.s.w.r. exceeds 1.3:1, a ferrite isolator or circulator should be incorporated in the output waveguide immediately before the magnetron.

6. At the maximum pressure of 35lb/in^2 (2.46kg/cm^2) the leakage will not exceed 0.06 litre (N.T.P.) per minute.

7. The modulator shall be such that the pulse energy delivered to the magnetron following an arcing pulse cannot greatly exceed the normal energy per pulse.

8. During this test the waveguide air pressure shall not exceed 25lb/in^2 (1.76kg/cm^2) absolute and the cooling air flow shall not exceed 3ft^3/min (0.085m^3/min) free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

9. The axial magnetic field shall be 800 gauss at the point specified on page 10 and shall decrease monotonically in the plane parallel to the axis of the electromagnet to points 4.000 ± 0.005 inches on each side of the specified point. At these two positions, the magnetic field shall be within the limits 700 to 720 gauss.

10. The anode current is adjusted to the value within the specified range giving optimum operation into all phases of a 1.3:1 mismatch; this value is marked on the valve. The spectrum bandwidth and stability will be within the required limits at all phases of a 1.3:1 mismatch at current levels ± 15mA about the marked value; the other tests are carried out at 15mA below the marked value.

11. Tolerance ± 10%.

12. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 1215 to 1365MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

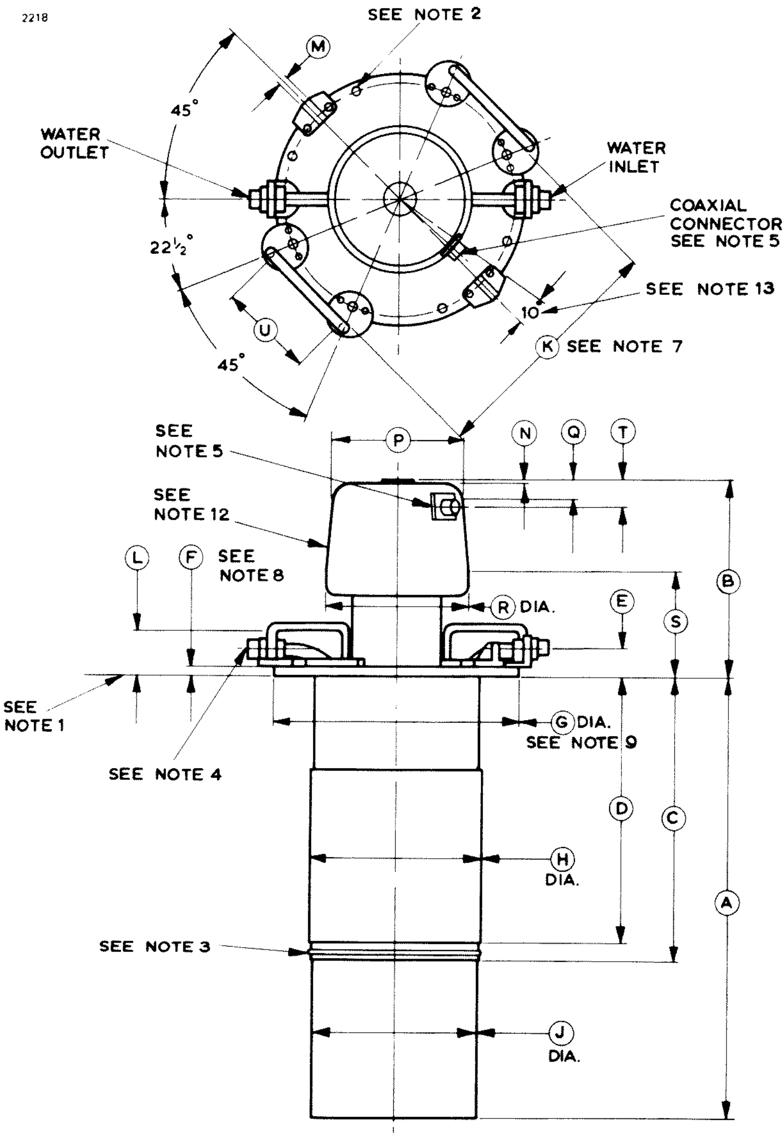
13. Measured with heater voltage of 48V and no anode input power the heater current limits are 13A minimum, 15A maximum after 10 minutes preheating.

14. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.03MHz/°C.

X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

OUTLINE (See page 9 for outline notes)



OUTLINE DIMENSIONS

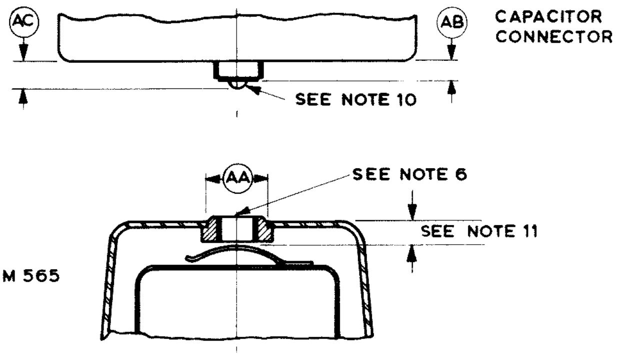
Ref	Inches	Millimetres
A	18.594	472.3
B	8.250 max	209.6 max
C	11.900	302.3
D	11.125	282.6
E	1.125 ± 0.020	28.58 ± 0.51
F	0.437 ± 0.010	11.10 ± 0.25
G	10.250 ± 0.015	260.35 ± 0.38
H	7.240 max	183.9 max
J	$7.000^{+0.000}_{-0.040}$	$177.80^{+0.00}_{-1.02}$
K	10.250	260.4
L	1.937	49.20
M	$0.375^{+0.000}_{-0.020}$	$9.53^{+0.00}_{-0.51}$
N	0.093	2.36
P	5.500 max	139.7 max
Q	0.500 max	12.70 max
R	6.000 max	152.4 max
S	3.125	79.38
T	1.093	27.76
U	4.032	102.4

Millimetre dimensions have been derived from inches.

OUTLINE DETAILS

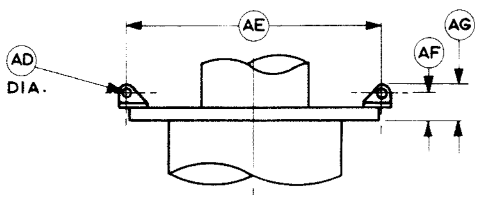
Capacitor Connector and Socket

2221



Lifting Lugs on Mounting Flange

2220



Outline Detail Dimensions

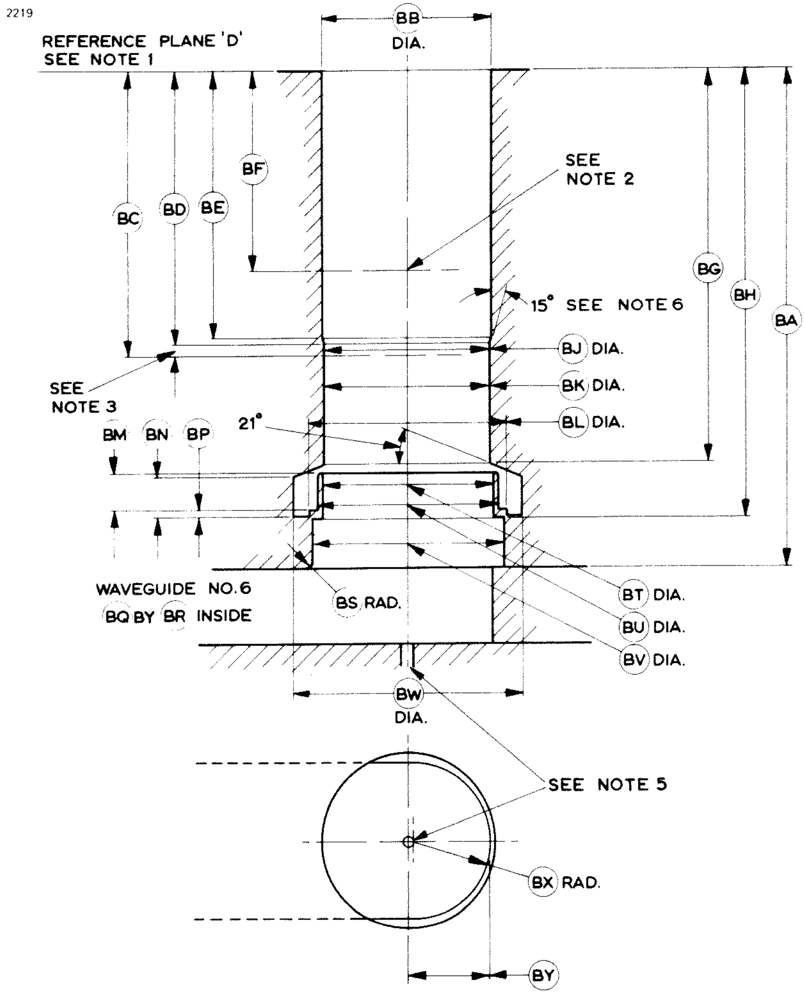
Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	1.247	31.67	AE	10.750 ± 0.125	273.05 ± 3.18
AB	0.452 ± 0.010	11.48 ± 0.25	AF	1.062 ± 0.062	26.97 ± 1.57
AC	0.577 ± 0.020	14.66 ± 0.51	AG	1.500 max	38.10 max
AD	0.391 $^{+0.004}_{-0.000}$	9.931 $^{+0.102}_{-0.000}$			

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Reference plane A. With this plane resting on a flat surface, a feeler gauge 0.010 inch (0.25mm) thick will not enter between them.
2. Holes 0.312 to 0.316 inch (7.925 to 8.027mm) diameter equally spaced on a pitch circle diameter to suit a gauge with 8 pins, 0.265 inch (6.73mm) diameter on 9.500 inch (241.3mm) pitch circle diameter.
3. 'O' Sealing Ring, 6.475 inch (164.5mm) internal diameter, 0.275 inch (6.99mm) section diameter, O.S.67 (B.S.1806:1951).
4. Water connections ½-inch B.S. screwed pipe to B.S.2051 part 2.
5. Heater-cathode connector, Joint Services Catalogue number 5935-99-932-5870; the number for the corresponding plug is 5935-99-940-1839.
6. Bush threaded 1-12 UNF-2B, silver plated brass.
7. Inside width of lifting handles.
8. This dimension will apply only within circles 0.625 inch (15.88mm) diameter centred on each of the 0.312 inch (7.925mm) diameter holes.
9. All parts mounted on the flange will lie within a 13.000 inch (330.2mm) diameter cylinder.
10. Domed contact, 0.187 inch (4.75mm) radius; silver plated brass.
11. The leaf spring will provide positive contact through the dimension range 0.540 to 0.600 inch (13.72 to 15.24mm).
12. Label reading 'DANGER X RADIATION HAZARD'.
13. Centre line through coaxial connector will lie within the arc shown.

LAUNCHING SECTION



LAUNCHING SECTION NOTES

1. The magnetron should be bolted down with Reference Plane 'A' of the magnetron in contact with Reference Plane 'D' of the launching section. At 20lb/in^2 (1.4kg/cm^2) excess pressure, the net upward thrust on the magnetron will be 700 pounds (318kg).
2. Magnetic field measured at this point.
3. All diameters concentric to 0.005 inch (0.13mm).
4. Radius on all inside corners.
5. Hole 0.375 inch (9.53mm) diameter for air cooling magnetron window.
6. The air sealing ring fitted on the magnetron seats on the 15° tapered portion.

LAUNCHING SECTION DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	20.687 ± 0.015	525.45 ± 0.38	BM	1.570 ± 0.010	39.88 ± 0.25
BB	7.250 min	184.2 min	BN	1.670 ± 0.010	42.42 ± 0.25
BC	11.844 ± 0.005	300.84 ± 0.13	BP	0.250 ± 0.005	6.35 ± 0.13
BD	11.343 ± 0.005	288.11 ± 0.13	BQ	6.500 ± 0.005	165.10 ± 0.13
BE	11.155 ± 0.005	283.34 ± 0.13	BR	3.250 ± 0.005	82.55 ± 0.13
BF	8.250 ± 0.005	209.55 ± 0.13	BS	0.250 ± 0.015	6.35 ± 0.38
BG	16.379 ± 0.005	416.03 ± 0.13	BT	7.250 ± 0.005	184.15 ± 0.13
BH	18.562 ± 0.015	471.47 ± 0.38	BU	7.612 ± 0.005	193.34 ± 0.13
BJ	$7.000\ ^{+0.004}_{-0.000}$	$177.80\ ^{+0.102}_{-0.000}$	BV	8.000 ± 0.005	203.20 ± 0.13
			BW	9.700 ± 0.005	246.38 ± 0.13
BK	$7.005\ ^{+0.010}_{-0.000}$	$177.93\ ^{+0.25}_{-0.00}$	BX	3.250 ± 0.005	82.55 ± 0.13
			BY	3.500 ± 0.005	88.90 ± 0.13
BL	8.246 ± 0.005	209.45 ± 0.13			

Millimetre dimensions have been derived from inches.

M586

L-BAND MAGNETRON

Frequency variant of M554

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	1260 to 1300	MHz
Typical peak output power	2.6	MW
Magnet (see note 1)	separate magnet (not supplied)	
Transition section (see note 2 and page 11)	M4016, coupling to no. 6 waveguide (6.500 x 3.250 inches internal) via coupler UG417A/U	
Cooling	water	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 3)	20	V
Heater current	13.5	A
Heater starting current, peak value, not to be exceeded	60	A max
Cathode heating time (minimum) (see note 3)	5	minutes

Mechanical

Overall dimensions (including transition section)	26.06 x 9.75 x 8.5 inches max 662 x 248 x 216mm max
Net weight:	
valve	22 pounds (10kg) approx
transition section	16 pounds (7.3kg) approx
Mounting position	vertical, cathode and heater terminals up

COOLING

The water cooling system is connected to the valve via ½-inch B.S.P. unions. The water flow must be greater than 20 imp. gal/hour (91 litres/hour) with a maximum outlet temperature of 80°C. A 5-foot (1.5 metre) head of water will be adequate to ensure a flow of 20 imp. gal/hour (91 litres/hour).

The purity of the water must be such that no measurable degree of furring occurs. It must not contain impurities corrosive to copper or brass.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 4)	900	950	gauss
Heater voltage (see note 3)	18	22	V
Heater starting current (peak)	–	60	A
Anode voltage (peak)	35	42	kV
Anode current (peak)	–	150	A
Input power (peak)	–	6.0	MW
Input power (mean) (see note 5)	–	7.5	kW
Duty cycle	–	0.0015	
Pulse length (see note 6)	–	5.0	μs
Rate of rise of voltage pulse (see note 7)	50	70	kV/μs
Anode temperature (see note 8)	–	80	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler (see note 9)	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	925	gauss
Anode current (peak)	150	A
Pulse length	5.0	μs
Pulse repetition rate	250	p.p.s.

Typical Performance

Anode voltage (peak)	39	kV
Output power (peak)	2.6	MW
Output power (mean)	3.25	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 4)	950	950	gauss
Heater voltage (for test)	0	0	V
Anode current (mean)	190	190	mA
Duty cycle	0.00125	0.00125	
Pulse length (see note 6)	5.0	5.0	μs
V.S.W.R. at the output coupler	1.15:1	1.5:1	
Rate of rise of voltage pulse	70	70	kV/μs min

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	38	42	–	–	kV
Output power (mean)	3150	–	–	–	W
Frequency	1260	1300	–	–	MHz
R.F. bandwidth at ¼ power	–	0.5	–	–	MHz
Frequency pulling	–	–	–	4.0	MHz
Frequency pushing (see note 10)	–	50	–	–	kHz/A
Stability (see note 11)	–	0.25	–	0.5	%
Heater current					see note 12
Temperature coefficient of frequency					see note 13

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2500	W
R.F. bandwidth at ¼ power	0.5	MHz

Frequency must be within test limits above, Oscillation 1

NOTES

1. The valve is designed for use with a separate magnet, not supplied by English Electric Valve Company Ltd. The user is invited to consult the Company on the choice of suitable magnets.

2. The valve must be used with the circular to rectangular waveguide transition section M4016 (see pages 11 and 12). The satisfactory performance of the valve is guaranteed only when it is used in conjunction with M4016.

   The magnetron flange and the transition section are bolted together directly with 6 OBA bolts (shank length 0.375 inch - 9.53mm) and the distance between the axis of the anode and the face of the rectangular waveguide coupling flange is 15.213 ± 0.187 inches (386.41 ± 4.75mm). It is essential for the valve to be located correctly with respect to M4016, as shown on the outline drawing on page 11.

3. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 20 volts to the heater for at least 5 minutes.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	**Heater Voltage (V)**
Less than 2000	20
2000 to 3000	15
3000 to 4000	10
4000 to 5000	5
More than 5000	0

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 4μF may be necessary depending on the equipment design. For further details see the preamble to this section.

4. For normal operation the magnetic field should be 900 to 930 gauss measured at the centre of the gap. The variation of magnetic field

within a cylinder 3 inches (76.2mm) diameter and 2 inches (50.8mm) long situated centrally and co-axially between the poles must not exceed ± 50 gauss. The minimum gap between the pole pieces must be 3.750 inches (95.25mm).

The north pole of the magnet must be adjacent to the cathode terminal. The magnet position must be adjusted so that the axis of the field is within 0.062 inch (1.57mm) of the centre line of the anode (see outline drawing). It is necessary to provide for an axial adjustment to the magnet of ± 0.125 inch (± 3.18mm) relative to the M4016 waveguide flange.

5. The various parameters are related by the formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

6. Tolerance ± 10%.

7. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

8. The temperature of the anode measured at the hottest point where contact is made with the water jacket. The rate of water flow must be such that the anode temperature is maintained below this maximum and in any case the flow must exceed 20 gallons per hour (91 litres per hour).

9. The v.s.w.r. of the output system shall be less than 1.5:1 over the frequency range 1220 to 1350MHz and less than 2.0:1 over the frequency range 1350 to 1600MHz, or an approved output system shall be used.

10. The change in frequency when the peak input current is varied between the limits of 100 and 150A shall be less than 50kHz/A. The frequency shall vary smoothly without discontinuity within the specified limit.

11. Missing pulses are counted at the phase of maximum instability of a mismatch of v.s.w.r. 1.5:1 and also at matched conditions at a peak anode current of 150A after a holding period of 672 hours. Pulses are

defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 1260 to 1300MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the last minute of a test period not exceeding 5 minutes.

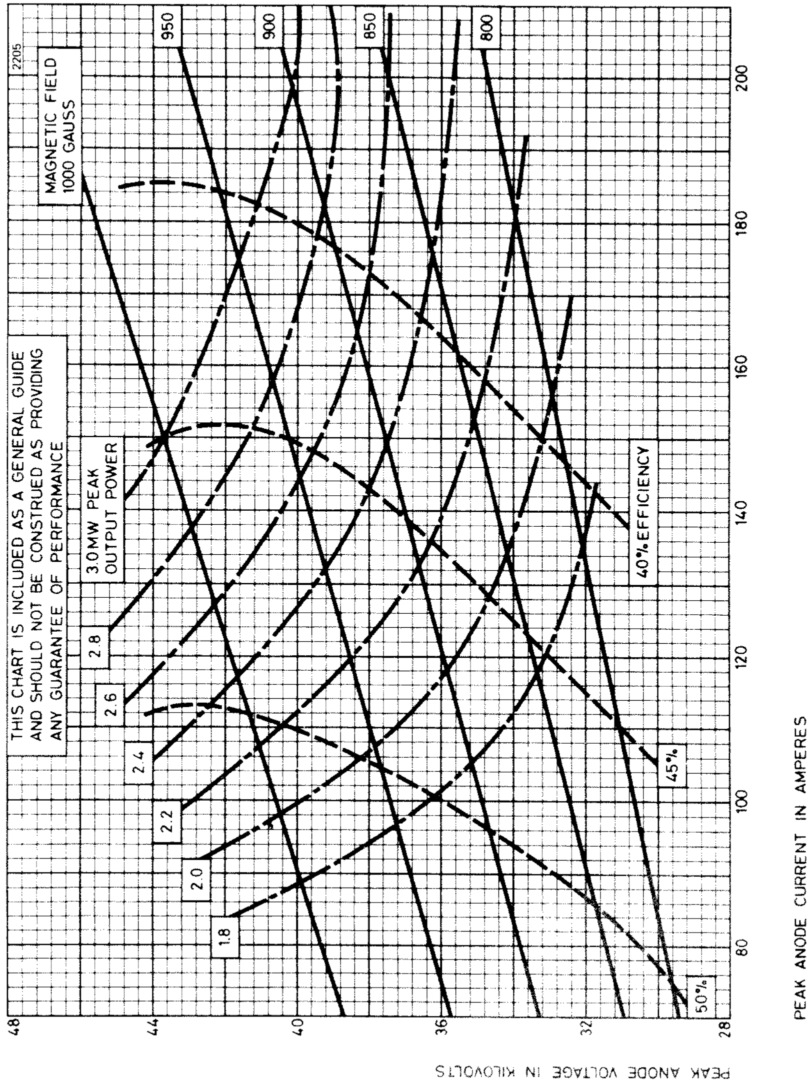
12. The heater current, measured with heater voltage of 20V and no anode input power, will be within the range 12 to 15A.

13. Design test only. The frequency change with anode temperature change after warm-up will not exceed -0.035MHz/°C.

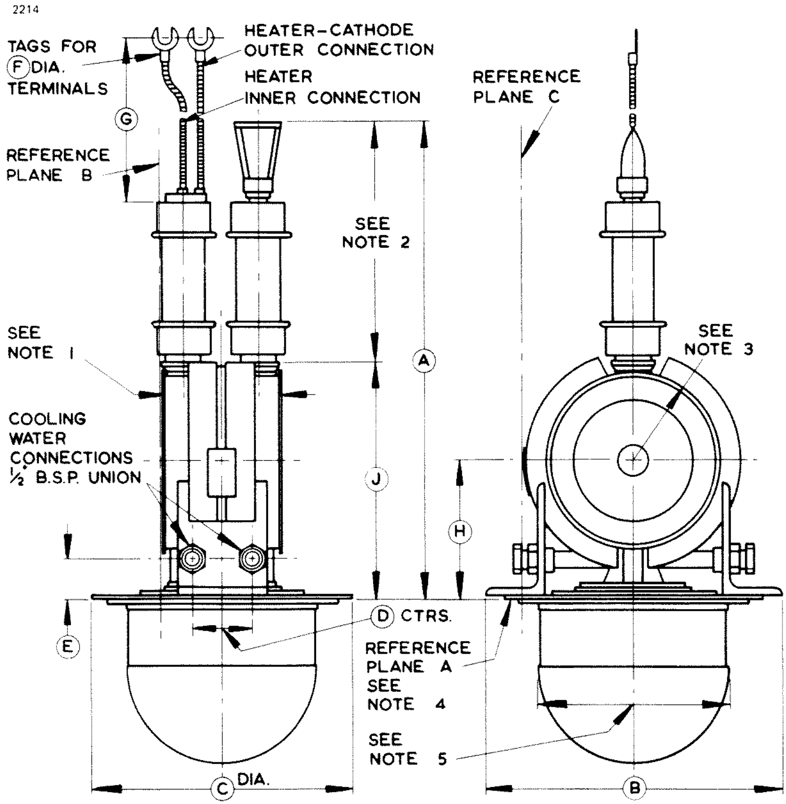
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART



OUTLINE

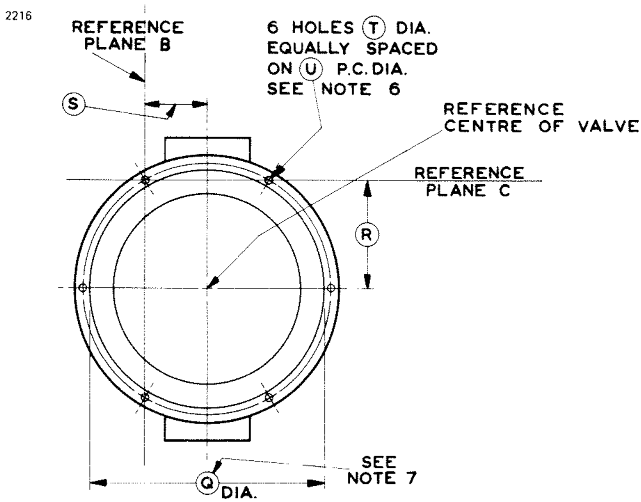


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.000 max	381.0 max	F	0.312	7.92
B	9.750 max	247.7 max	G	8.000 min	203.2 min
C	8.500 max	215.9 max	H	4.213	107.0
D	1.812 ± 0.062	46.02 ± 1.57	J	7.750 max	196.8 max
E	1.187 ± 0.062	30.15 ± 1.57			

Millimetre dimensions have been derived from inches.

OUTLINE

View of Output End of Valve



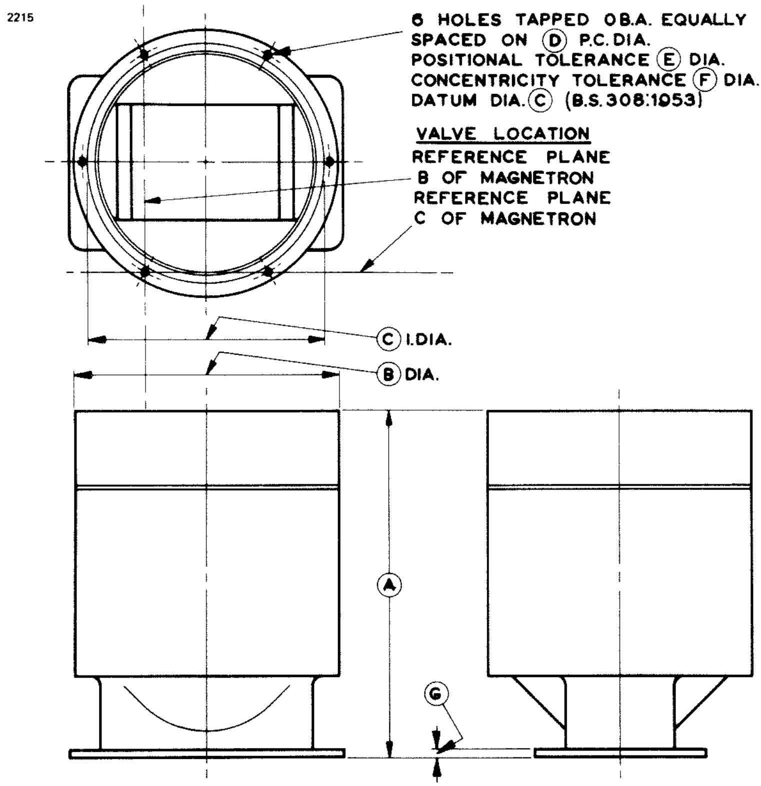
Ref	Inches	Millimetres
Q	See note 7	See note 7
R	3.383	85.93
S	1.953	49.61
T	$0.261\ ^{+0.004}_{-0.000}$	$6.629\ ^{+0.102}_{-0.000}$
U	7.813	198.5

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The overall width of the anode is such that it will pass between two planes 3.750 inches (95.25mm) apart equally spaced about the reference centre of the valve and parallel to reference plane B.
2. All parts of the valve within the limits shown will lie within a rectangular volume of sides 2.75 inches (69.8mm) perpendicular to reference plane C and 5.00 inches (127mm) perpendicular to reference plane B, centred on the reference centre of the valve.
3. The periphery of the anode will fall within a radius of 2.925 inches (74.30mm), positioned as shown.
4. The flatness of the mounting flange will be such that with reference plane A resting on a flat surface a feeler gauge 0.020 inches by 0.125 inches (0.51mm by 3.18mm) will not enter between plane A and the surface at any point.
5. Concentricity of the valve output will be such that diameter B will lie within a radius of 3.218 inches (81.74mm) from the reference centre of the valve.
6. Positional tolerance 0.005 inch (0.127mm) diameter (B.S.308:1953).
7. Diameter Q will lie within a radius of 3.718 inches (94.44mm) from the reference centre of the valve.

TRANSITION SECTION M4016



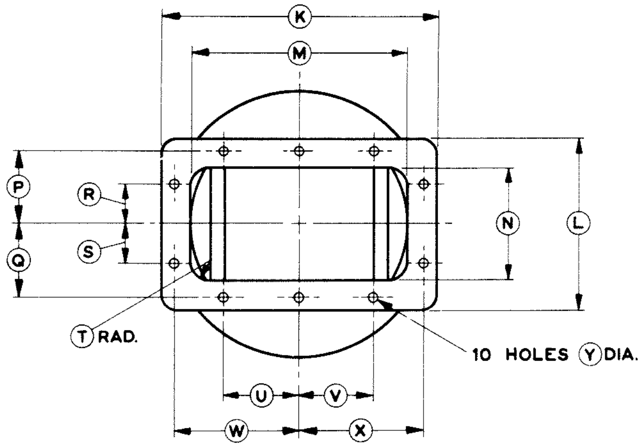
Ref	Inches	Millimetres
A	11.000 ± 0.062	279.40 ± 1.57
B	8.500 max	215.9 max
C	7.443 $^{+0.010}_{-0.000}$	189.05 $^{+0.25}_{-0.00}$
D	7.813	198.45
E	0.0075	0.19
F	0.005	0.127
G	0.312	7.92

Millimetre dimensions have been derived from inches.

DETAIL OF TRANSITION SECTION

View of Rectangular Output Flange

2217



Ref	Inches	Millimetres
K	8.680	220.5
L	5.440	138.2
M	6.500 ± 0.013	165.10 ± 0.33
N	3.250 ± 0.013	82.55 ± 0.33
P	2.311 ± 0.005	58.70 ± 0.13
Q	2.311 ± 0.005	58.70 ± 0.13
R	1.249 ± 0.005	31.72 ± 0.13
S	1.249 ± 0.005	31.72 ± 0.13
T	0.625	15.88
U	2.374 ± 0.005	60.30 ± 0.13
V	2.374 ± 0.005	60.30 ± 0.13
W	3.937 ± 0.005	100.00 ± 0.13
X	3.937 ± 0.005	100.00 ± 0.13
Y	0.330	8.38

Millimetre dimensions have been derived from inches.

S-Band Magnetrons

English Electric Valve Company Limited September 1968
Chelmsford, Essex, England Printed in England

2J30-2J34 inclusive

S-BAND MAGNETRONS

Service Types CV1807, CV1808 CV1809, CV1810

GENERAL DATA

The 2J30–2J34 series comprises five pulse operated, fixed frequency magnetrons. They are maintenance types and therefore only abridged data are given on this sheet. Full information is available on request.

Frequency range:

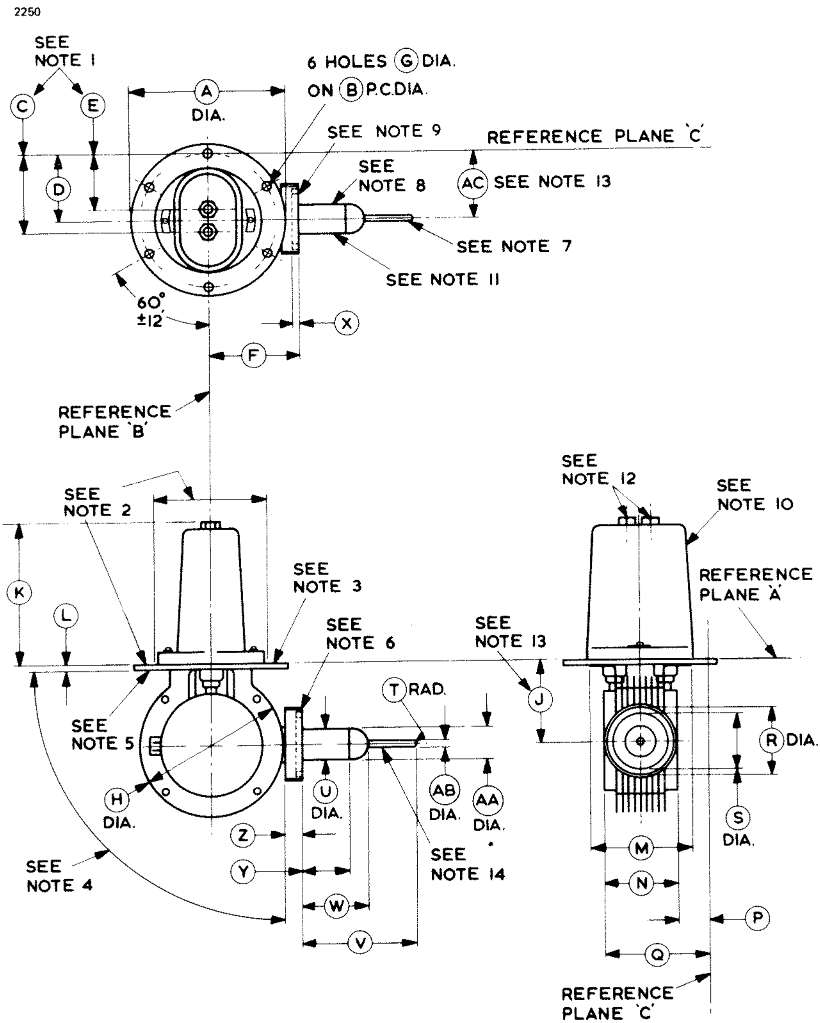
2J30	2860 to 2900	MHz
2J31 (CV1807)	2820 to 2860	MHz
2J32 (CV1808)	2780 to 2820	MHz
2J33 (CV1809)	2740 to 2780	MHz
2J34 (CV1810)	2700 to 2740	MHz

Typical Operation

Output power (peak)	300	kW
Anode voltage (peak)	20	kV
Anode current (peak)	30	A
Duty cycle	0.001	
Heater voltage	6.3	V
Heater current	1.5	A
Cathode heating time (minimum)	2.0	min
Magnetic field	1900	gauss

Magnet	separate
Output	Coaxial line. Internal diameter of outer conductor 0.812 inch, diameter of inner conductor 0.375 inch
Cooling	forced-air

OUTLINE (See page 4 for outline notes)



OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	3.250 ± 0.031	82.55 ± 0.79
B	2.875 ± 0.006	73.03 ± 0.15
C	1.687	42.85
D	1.437	36.50
E	1.187	30.15
F	1.875 ± 0.047	47.63 ± 1.19
G	0.193 ± 0.003	4.902 ± 0.076
H	3.000 ± 0.062	76.20 ± 1.57
J	1.687 ± 0.010	42.85 ± 0.25
K	2.984 ± 0.062	75.79 ± 1.57
L	0.125	3.18
M	2.480 max	62.99 max
N	1.490 max	37.85 max
P	0.677 min	17.20 min
Q	2.197 max	55.80 max
R	1.375 ± 0.010	34.93 ± 0.25
S	1.122 ± 0.005	28.50 ± 0.13
T	0.062	1.57
U	0.647 ± 0.022	16.43 ± 0.56
V	2.438 ± 0.062	61.93 ± 1.57
W	1.406 ± 0.031	35.71 ± 0.79
X	0.125 ± 0.010	3.18 ± 0.25
Y	1.000	25.40
Z	$0.365^{+0.010}_{-0.000}$	$9.27^{+0.25}_{-0.00}$
AA	0.670 max	17.02 max
AB	$0.125^{+0.002}_{-0.005}$	$3.175^{+0.051}_{-0.127}$
AC	1.457 ± 0.010	37.01 ± 0.25

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The jack holes will be within a radius of 0.023 inch (0.58mm) of the location specified, but will be spaced 0.500 ± 0.010 inch (12.70 ± 0.25mm) with respect to each other. The centre lines of the holes will be perpendicular to reference plane 'A' within 3°.
2. Any portion of the assembly extending above this surface will be within 1.110 inches (28.19mm) radius of the true centre of the plate.
3. With the flange resting on a plane surface, the flatness of the mounting plate 0.500 inch (12.70mm) from the outer edge will be such that a feeler gauge 0.010 inch (0.25mm) thick and 0.125 inch (3.18mm) wide will not enter for a distance of more than 0.250 inch (6.35mm).
4. Areas between these planes will be painted with a black heat resistant non-corrosive paint.
5. Soldered joints in the mounting flange and coupling adapter will be vacuum tight so that the mounting flange may be used to provide a hermetic seal.
6. U.S.F. 1.500 – 18 thread, class 2 fit.
7. The centre line of the lead measured at this end will be concentric with the centre line of the coupling adapter within 0.020 inch (0.51mm).
8. The centre line of the output cylinder will be concentric with the centre line of the coupling adapter within 0.010 inch (0.25mm).
9. This surface of the coupling adapter will be parallel to Reference Plane 'B' within 1°.
10. The common cathode connection is indicated by letter 'C' on this surface.
11. The output cylinder will be of non-corrosive material or will be painted black; minimum plating 20mg/in^2 silver, or 10mg/in^2 gold.
12. Hexagon head banana pin jacks 0.406 inch (10.31mm) long with holes 0.169 ± 0.005 inch (4.29 ± 0.13mm) diameter.
13. This dimension applies to the coupling adapter.
14. Polished, or gold plated.

4J31-4J35 inclusive

S-BAND MAGNETRONS

Service Types CV1914, CV1916, CV1897, CV1898, CV2744

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
4J31 (CV1914)	2860 to 2900	MHz
4J32	2820 to 2860	MHz
4J33 (CV1916)	2780 to 2820	MHz
4J34 (CV1897)	2740 to 2780	MHz
CV2744 (selected 4J34)	2740 to 2765	MHz
4J35 (CV1898)	2700 to 2740	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any

Cooling (see note 6) forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	13	10.5	V
Magnetic field (see note 8)	2150	2700	gauss
Anode current (peak)	56	70	A
Pulse length	1.0	1.0	μs
Pulse repetition rate	500	500	p.p.s.

Typical Performance

Anode voltage (peak)	22	28	kV
Output power (peak)	600	1000	kW
Output power (mean)	300	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	–	–	kV
Output power (mean)	400	–	–	–	W
Frequency:					
4J31 (CV1914)	2860	2900	–	–	MHz
4J32	2820	2860	–	–	MHz
4J33 (CV1916)	2780	2820	–	–	MHz
4J34 (CV1897)	2740	2780	–	–	MHz
CV2744*	2740	2765	–	–	MHz
4J35 (CV1898)	2700	2740	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.5	–	0.5	%
Heater current					see note 10
Temperature coefficient of frequency					see note 11

* Selected 4J34 with limited frequency band.

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

(b) The 4J31–4J35 types have hum-free heaters and have been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

where P_i = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance $\pm 10\%$.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of $45 lb/in^2$ absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

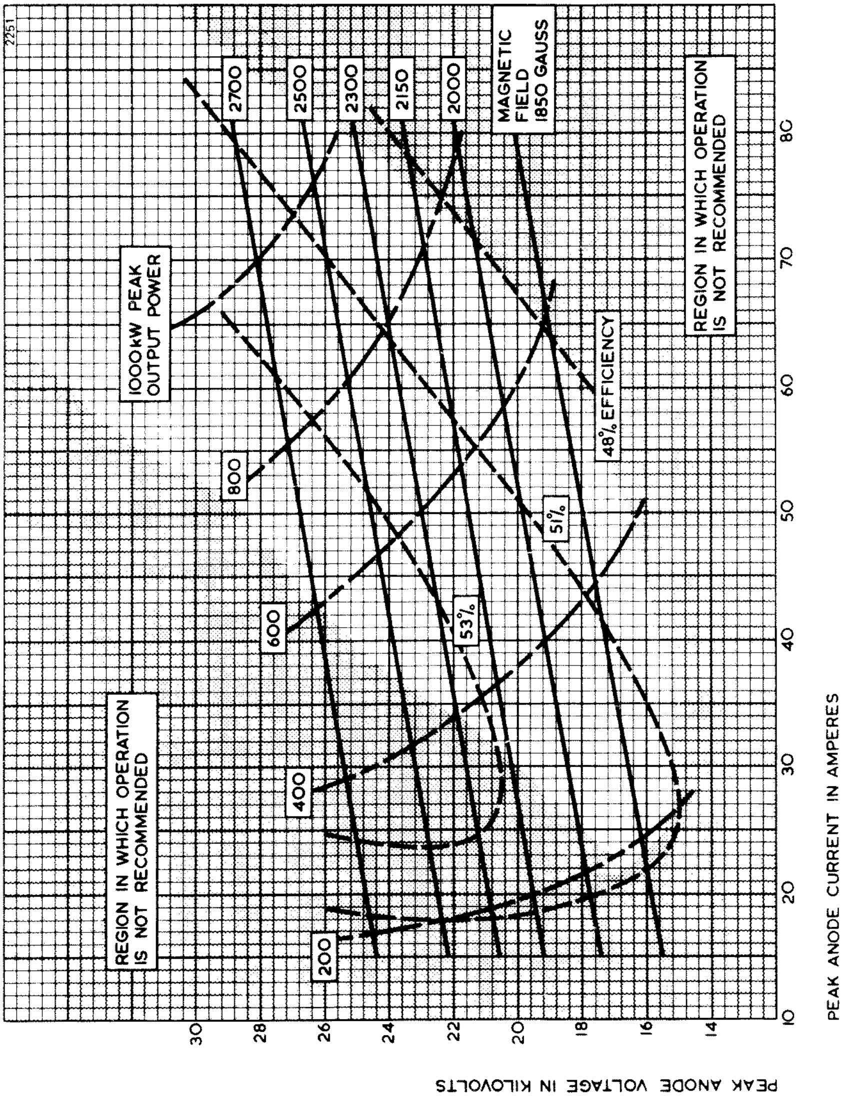
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

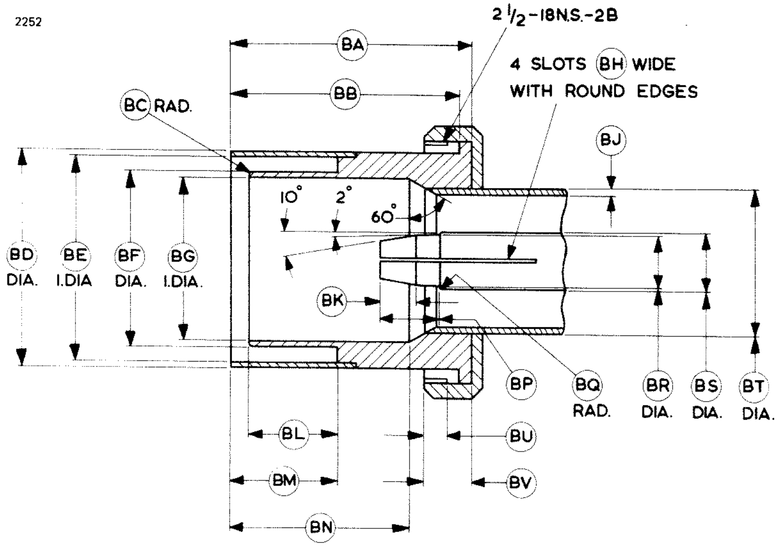
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.07 MHz/^{\circ}C$.

PERFORMANCE CHART



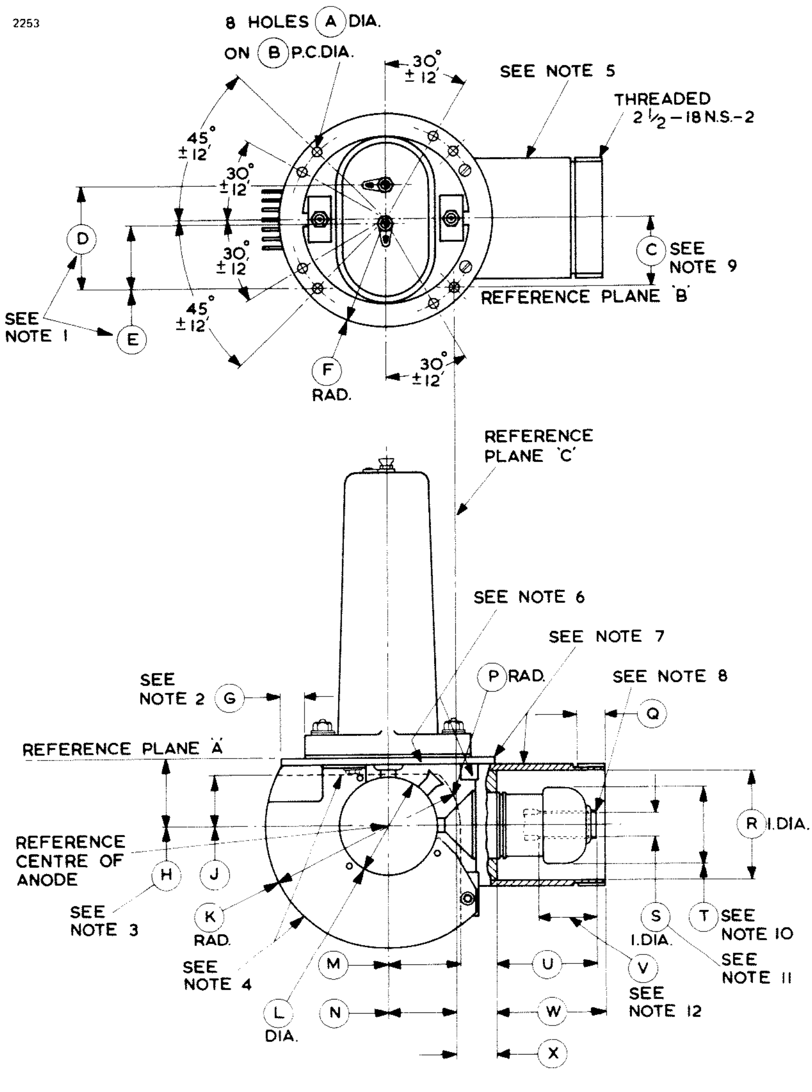
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE (See page 10 for outline notes)

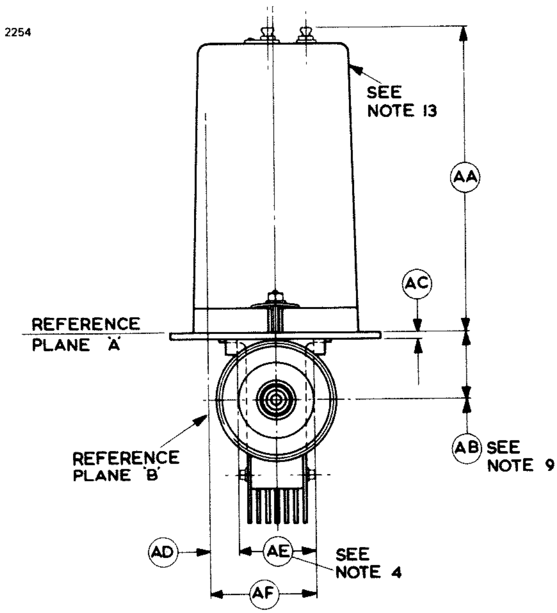


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

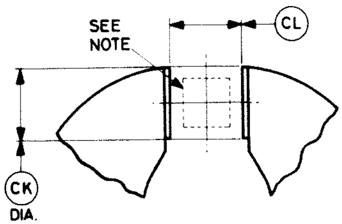
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION



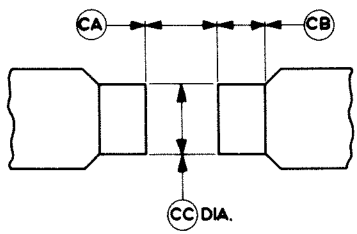
Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES

2255



Ref	Inches	Millimetres
CA	$1.500^{+0.005}_{-0.000}$	$38.10^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

4J43 4J44

S-BAND MAGNETRONS

ABRIDGED DATA

Fixed frequency pulse magnetrons		
Frequency range:		
4J43	2992 to 3019	MHz
4J44	2965 to 2992	MHz
Typical peak output power	900	kW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any
Cooling (see note 6)	forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	10.5	V
Magnetic field	2700	gauss
Anode current (peak)	70	A
Pulse length	1.0	μs
Pulse repetition rate	500	p.p.s.

Typical Performance

Anode voltage (peak)	28	kV
Output power (peak)	900	kW
Output power (mean)	450	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	–	–	kV
Output power (mean)	400	–	–	–	W
Frequency:					
4J43	2992	3019	–	–	MHz
4J44	2965	2992	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.5	–	0.5	%
Heater current					see note 10
Temperature coefficient of frequency					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	**Heater Voltage (V)**
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

(b) 4J43 and 4J44 have hum-free heaters and have been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

where P_i = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of 45lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

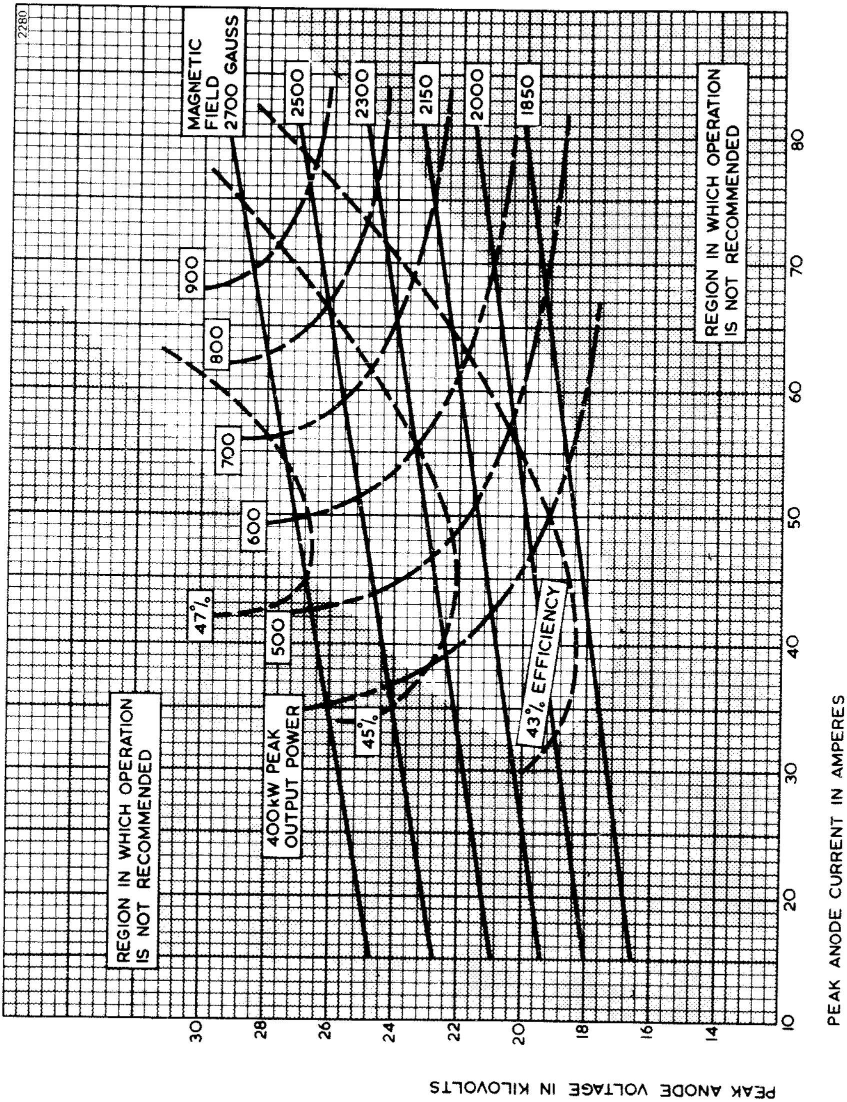
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

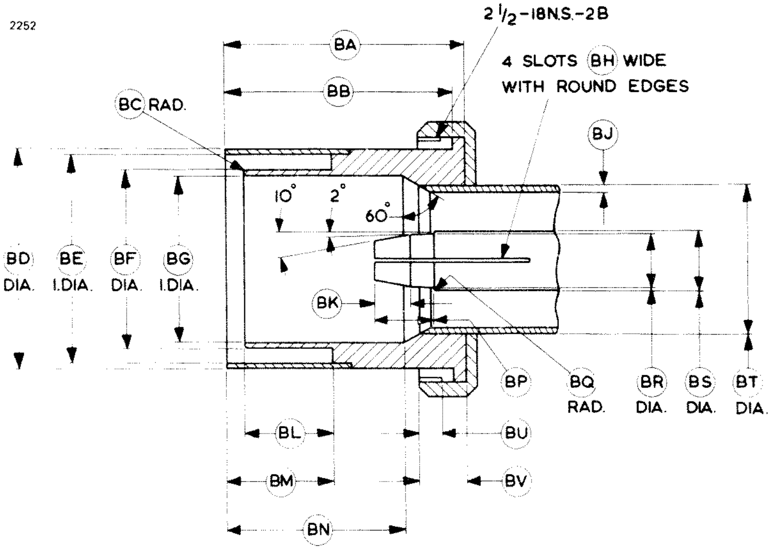
11. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.07MHz/°C.

PERFORMANCE CHART



COUPLER

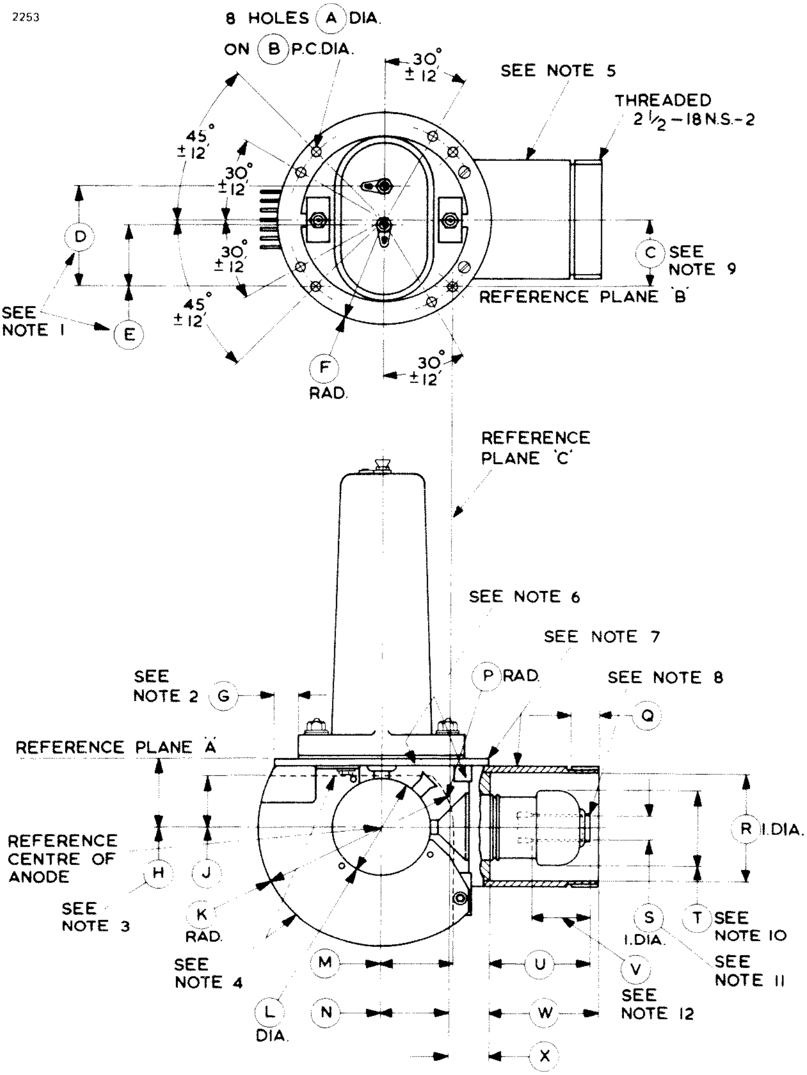
2252



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE (See page 10 for outline notes)

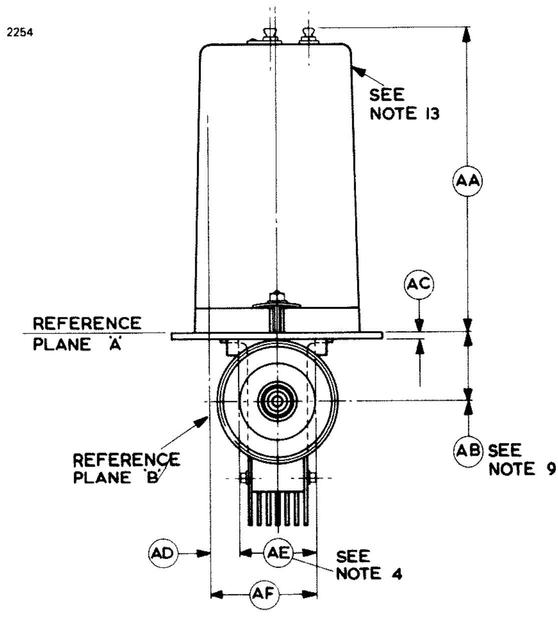


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

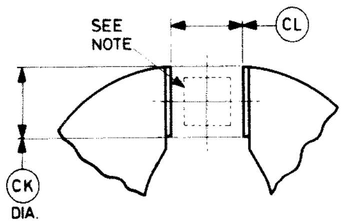
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION

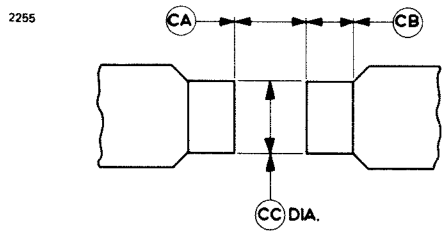


Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed $\pm$140 gauss.

ELECTRO-MAGNET POLE PIECES



Ref	Inches	Millimetres
CA	$1.500^{+0.005}_{-0.000}$	$38.10^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 $\pm$ 0.010	38.10 $\pm$ 0.25

Millimetre dimensions have been derived from inches.

4J53

S-BAND MAGNETRON

Service Type CV513

ABRIDGED DATA

Fixed frequency pulse magnetron, similar to type 4J33 but with closer frequency limits and controlled cold impedance.

Frequency range	2793 to 2813	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any

Cooling (see note 6) forced-air

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MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	13	10.5	V
Magnetic field	2150	2700	gauss
Anode current (peak)	56	70	A
Pulse length	1.0	1.0	μs
Pulse repetition rate	500	500	p.p.s.

Typical Performance

Anode voltage (peak)	22	28	kV
Output power (peak)	600	1000	kW
Output power (mean)	300	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2150	2700	gauss
Heater voltage (for test)	13	10	V
Anode current (mean)	28	35	mA
Duty cycle	0.0005	0.0005	
Pulse length (see note 4)	1.0	1.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	250	–	400	–	W
Frequency	2793	2813	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.5	–	0.5	%
Cold impedance					see note 10
Heater current					see note 11
Temperature coefficient of frequency					see note 12

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 2 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 2)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1	% max

NOTES

1. (a) With no anode input power.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

   The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   (b) 4J53 has a hum-free heater and has been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

where P_i = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance ±10%

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of 45lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

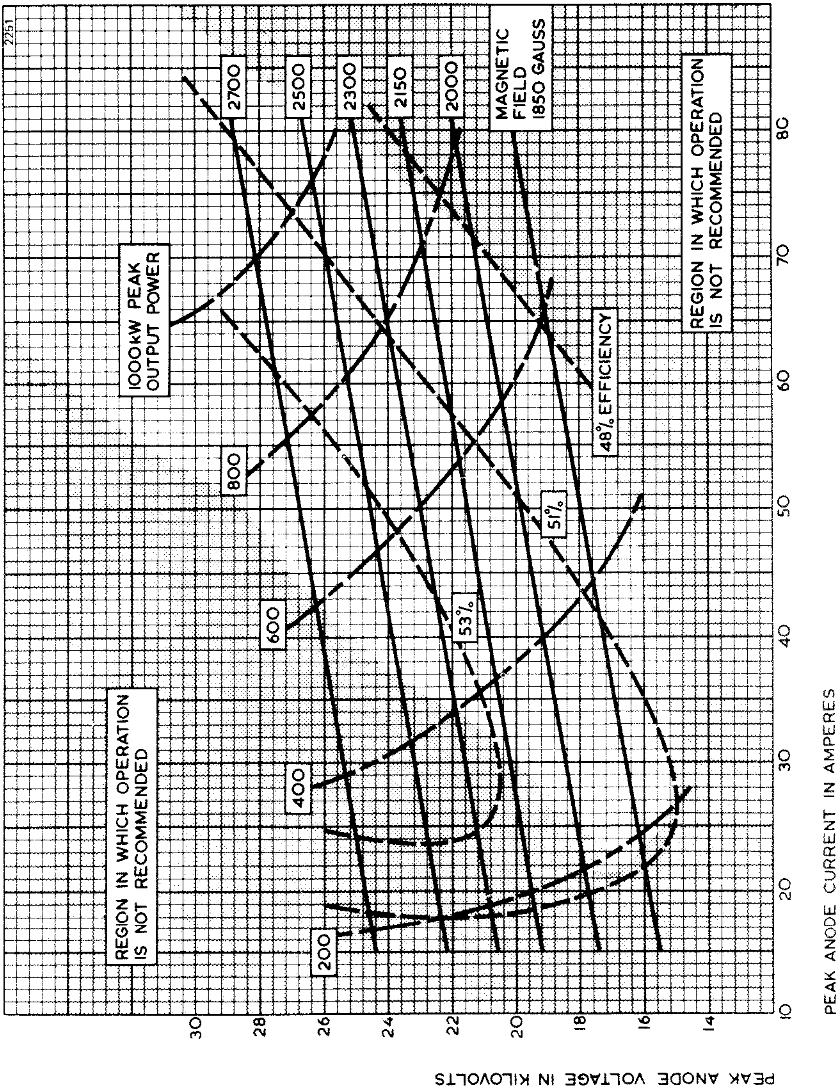
9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

10. When a signal of the same frequency as the valve operating frequency is fed into the valve, a standing wave is produced in the feeder system. The v.s.w.r. is tested to be greater than 10:1. The position of the standing wave minimum nearest the valve is tested to be within the limits 9.7 to 11.9cm measured from Reference Plane C on the outline drawing. The test is carried out in a coaxial system coupled by means of the test coupling shown on page 7.

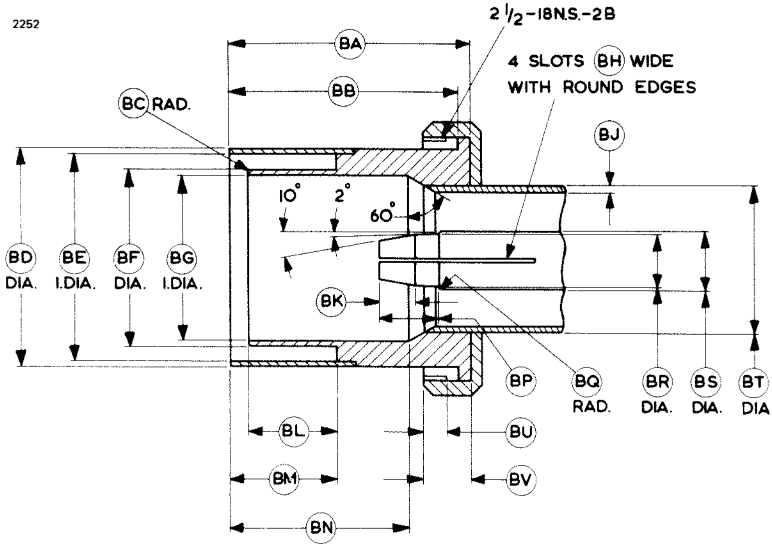
11. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07MHz/°C.

PERFORMANCE CHART



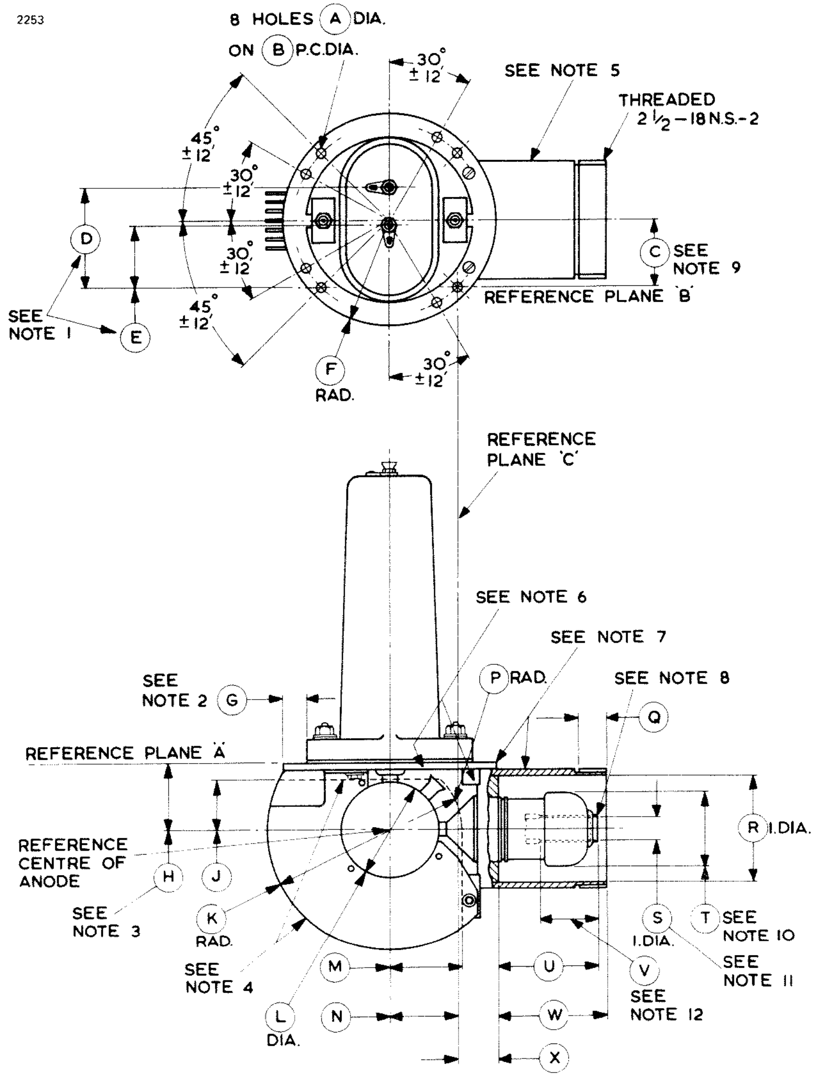
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE (See page 10 for outline notes)

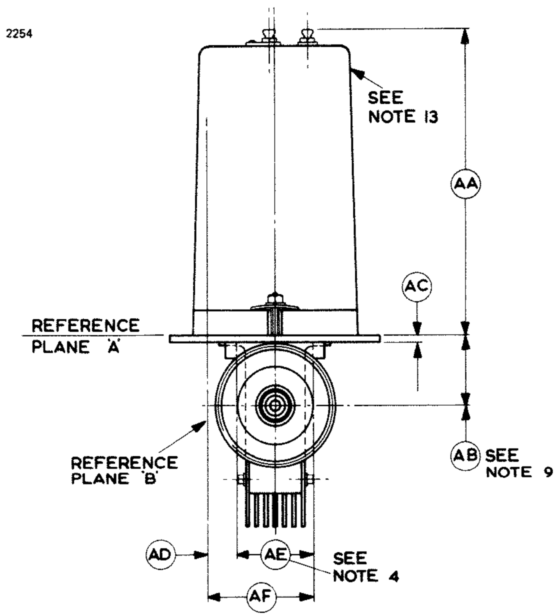


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

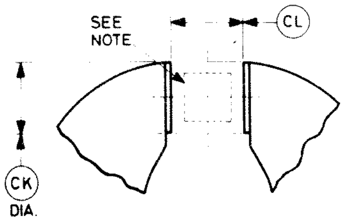
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION



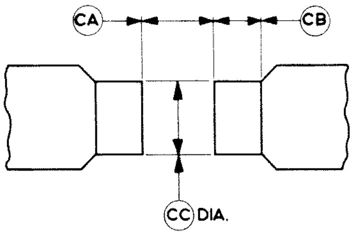
Ref	Inches	Millimetres
CK	1.500	38.10
CL	1.500 $^{+0.010}_{-0.000}$	38.10 $^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES

2255



Ref	Inches	Millimetres
CA	1.500 $^{+0.005}_{-0.000}$	38.10 $^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

5586

TUNABLE S-BAND MAGNETRON

Service Type CV3611

ABRIDGED DATA

Mechanically tuned pulse magnetron, frequency variant of type 5657

Frequency range	2700 to 2900	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 9 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max	
Net weight	5½ pounds (2.5kg) approx	
Mounting position	any	
Tuning (see note 3)	mechanical	
Tuner revolutions to cover frequency range	150	max

Cooling (see note 4) forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	32	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 5)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 6)	–	2.5	μs
Rate of rise of voltage pulse (see note 7)	100	200	kV/μs
Anode temperature (see note 4)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 8):			
input circuit	–	45	lb/in²
output circuit	–	45	lb/in²

TYPICAL OPERATION

Operational Conditions

Heater voltage	8.0	8.0	V
Magnetic field (see note 9)	2700	2700	gauss
Anode current (peak)	50	70	A
Pulse length	0.5	1.0	μs
Pulse repetition rate	1500	500	p.p.s.

Typical Performance

Anode voltage (peak)	30	30	kV
Output power (peak)	700	1000	kW
Output power (mean)	525	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 9)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	35	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 6)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 7)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak) (see note 10)	27	32	–	–	kV
Output power (mean) (see note 10)	400	–	400	–	W
Frequency (see note 11)	2700	2900	–	–	MHz
R.F. bandwidth at ¼ power (see note 12)	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see notes 10 and 13)	–	0.5	–	–	%
Heater current					see note 14
Temperature coefficient of frequency					see note 15

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 13)	1	% max

NOTES

1. With no anode input power.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

   The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. It has been verified that the valve will operate at ambient temperatures as low as –55°C. At this temperature the minimum cathode heating time is 3 minutes.

3. Tuning is achieved by rotating a splined shaft which can be fitted to the valve in two positions as shown on the outline drawing. The splined shaft mates with S.S. White 2666X end fitting ($^{13}/_{32}$ inch diameter).

4. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

5. The various parameters are related by the following formula:

   $P_i = i_{apk} \times v_{apk} \times D_u$

   where P_i = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and D_u = duty cycle.

6. Tolerance ±10%.

7. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

8. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input and the output circuit of the valve. At the maximum pressure of $45 lb/in^2$ absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

9. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 12. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA244, is available.

   If an electro-magnet is used, the pole tip dimensions should be as shown on page 12.

10. These tests are carried out with the valve tuned to 2700, 2800 and 2900MHz.

11. The valve will tune over the indicated frequency range.

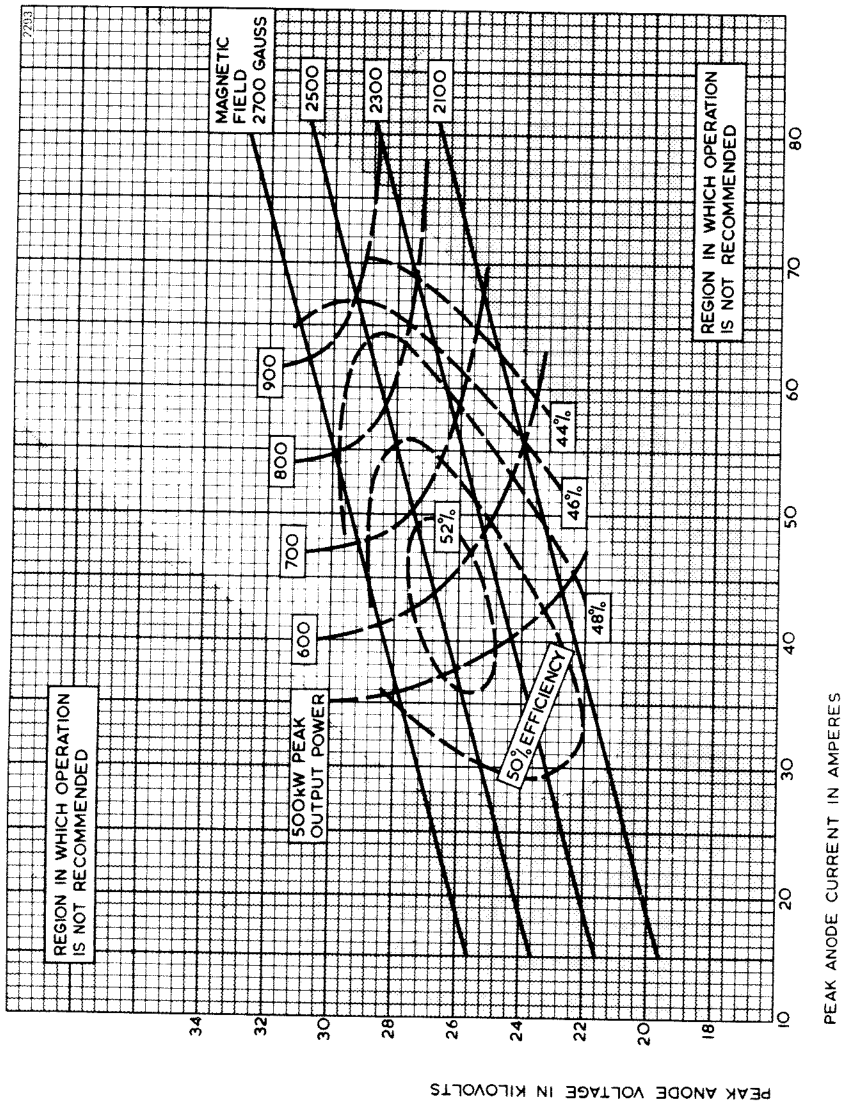
12. The specification limit for bandwidth applies over the whole tuning range.

13. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

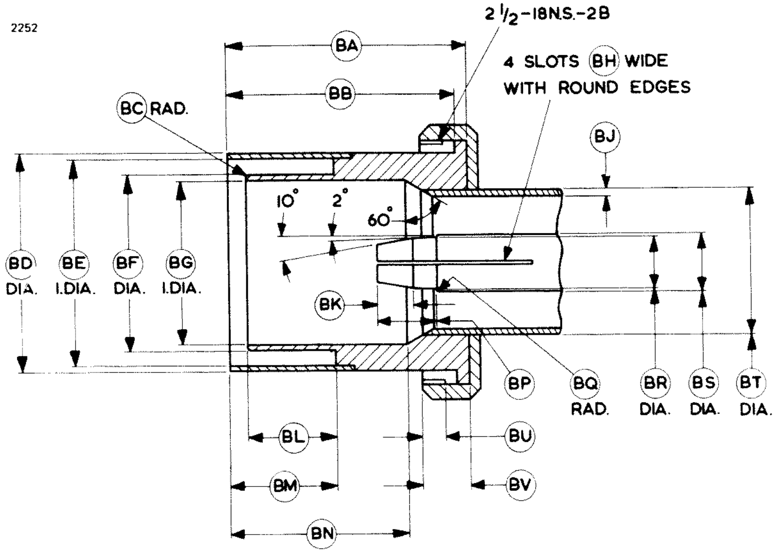
14. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

15. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.07 MHz/^{\circ}C$.

PERFORMANCE CHART



COUPLER

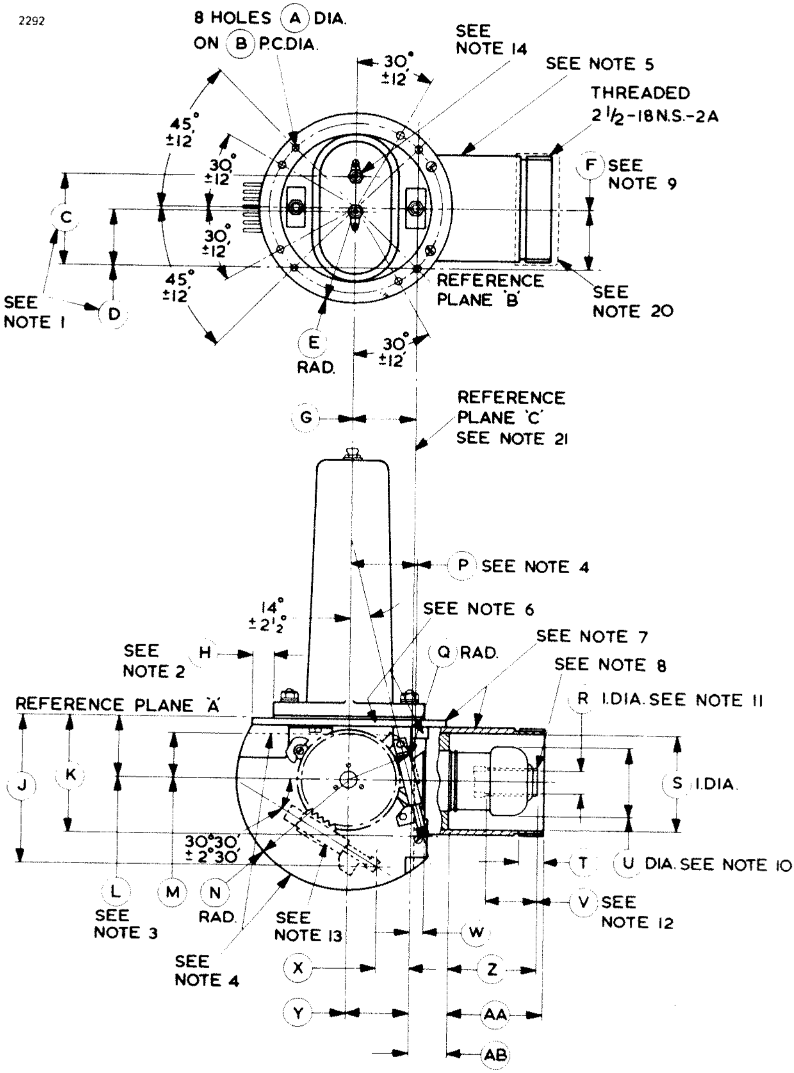


Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE

2292

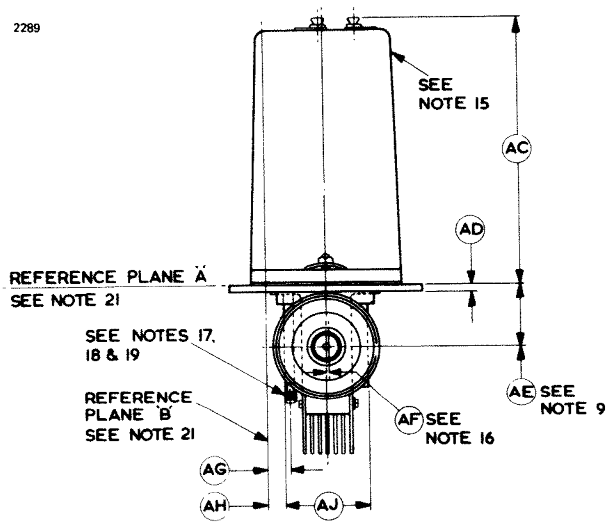


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	T	0.593 min	15.06 min
B	4.064 ± 0.006	103.23 ± 0.15	U	1.620 max	41.15 max
C	2.156	54.76	V	1.125 min	28.58 min
D	1.359	34.52	W	0.313	7.95
E	2.281 ± 0.015	57.94 ± 0.38	X	0.756	19.20
F	1.437 ± 0.020	36.50 ± 0.51	Y	1.437	36.50
G	1.437	36.50	Z	2.085 ± 0.025	52.96 ± 0.64
H	0.500 min	12.70 min	AA	2.297 ± 0.010	58.34 ± 0.25
J	3.500	88.90	AB	0.818 ± 0.015	20.78 ± 0.38
K	2.812	71.42	AC	6.313 ± 0.094	160.4 ± 2.4
L	1.440	36.58	AD	0.187	4.75
M	1.063 min	27.00 min	AE	1.440 ± 0.020	36.58 ± 0.51
N	2.656 max	67.46 max	AF	0.025	0.64
P	1.500 min	38.10 min	AG	0.563 ± 0.125	14.30 ± 3.18
Q	1.500 min	38.10 min	AH	0.575 ± 0.050	14.61 ± 1.27
R	0.555 ± 0.005	14.10 ± 0.13	AJ	1.740 max	44.20 max
S	2.321 ± 0.007	58.95 ± 0.18			

Millimetre dimensions have been derived from inches.

OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified but spaced 0.797 $\pm$ 0.015 inch (20.24 $\pm$ 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inches (54.86mm) diameter circle located as specified for the non-tunable side of the anode.
4. The maximum width specified by dimension 'AJ' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe, all surfaces inside guard pipe, tuning gear, stop, and worm shaft assembly.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe only.
10. The centre line of the maximum diameter will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. Optional location of tuning spline. The valve will be supplied with the spline located as specified by the customer.

14. Hexagon locking head banana pin jack, hole 0.169 ± 0.005 inch (4.29 ± 0.13mm) diameter x 0.593 inch (15.06mm) long as per Mil-E-1, latest issue.

15. The common cathode connection is marked with letter C.

16. This dimension shows the relation between a plane passing through the lateral centre of the anode, and a plane passing through the centre of the guard pipe.

17. The tuning mechanism will provide the full range of tuning with a maximum of 5 complete revolutions of the large tuning gear.

18. The spline for adjusting the tuning mechanism is as follows: 12 teeth, 48 pitch, 0.250 inch (6.35mm) pitch diameter.

19. The clearance between the tuning spline and the guard pipe will be sufficient to allow the use of S.S. White No. 2666X end fitting ($^{13}/_{32}$ inch diameter).

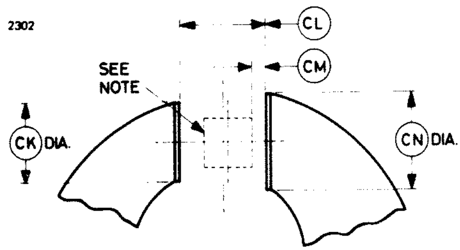
20. Protective guard for shipping purposes.

21. Reference plane 'A' is defined as a plane passing along the face of the mounting plate.

    Reference plane 'B' is defined as a plane perpendicular to plane 'A' and passing through the centre of the holes shown.

    Reference plane 'C' is defined as a plane mutually perpendicular to planes 'A' and 'B' and passing through the centre of the hole as shown.

PERMANENT MAGNET SPECIFICATION



Ref	Inches	Millimetres	Ref	Inches	Millimetres
CK	1.625	41.28	CM	0.270	6.86
CL	1.800 ± 0.005	45.72 ± 0.13	CN	2.000	50.80

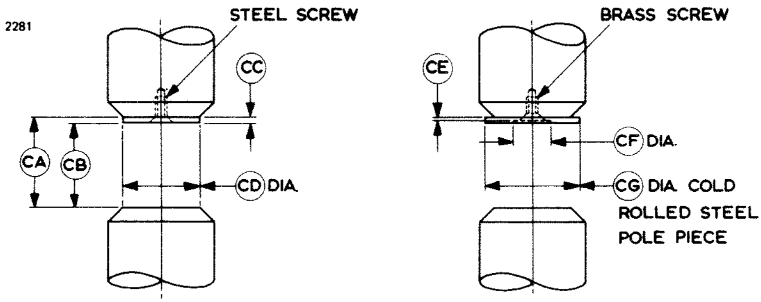
Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated as shown and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES

Magnet with Single Conventional Pole Piece

Magnet with Distortion Pole Piece



Ref	Inches	Millimetres	Ref	Inches	Millimetres
CA	1.925 ± 0.005	48.90 ± 0.13	CE	0.031 ± 0.015	0.79 ± 0.38
CB	1.800 ± 0.005	45.72 ± 0.13	CF	0.786 ± 0.005	19.96 ± 0.13
CC	0.125 ± 0.015	3.18 ± 0.38	CG	2.000 ± 0.015	50.80 ± 0.38
CD	1.625 ± 0.015	41.28 ± 0.38			

Millimetre dimensions have been derived from inches.

TUNABLE S-BAND MAGNETRON

Service Type CV3958

ABRIDGED DATA

Mechanically tuned pulse magnetron, frequency variant of type 5586

Frequency range	2900 to 3100	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 9 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 10	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max	
Net weight	5½ pounds (2.5kg) approx	
Mounting position	any	
Tuning (see note 3)	mechanical	
Tuner revolutions to cover frequency range	120	max

Cooling (see note 4) forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	32.5	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.2	MW
Input power (mean) (see note 5)	–	1.3	kW
Duty cycle	–	0.001	
Pulse length (see note 6)	–	2.5	μs
Rate of rise of voltage pulse (see note 7)	100	200	kV/μs
Anode temperature (see note 4)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 8):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	8.0	8.0	V
Magnetic field (see note 9)	2700	2700	gauss
Anode current (peak)	50	70	A
Pulse length	0.5	1.0	μs
Pulse repetition rate	1500	500	p.p.s.

Typical Performance

Anode voltage (peak)	30	30	kV
Output power (peak)	700	1000	kW
Output power (mean)	525	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 9)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	35	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 6)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 7)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak) (see note 10)	27.5	32.5	–	–	kV
Output power (mean) (see note 10)	400	–	400	–	W
Frequency (see note 11)	2900	3100	–	–	MHz
R.F. bandwidth at ¼ power (see note 12)	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see notes 10 and 13)	–	0.5	–	–	%
Heater current					see note 14
Temperature coefficient of frequency					see note 15

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 13)	1	% max

NOTES

1. With no anode input power.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

   The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. It has been verified that the valve will operate at ambient temperatures as low as –55°C. At this temperature the minimum cathode heating time is 3 minutes.

3. Tuning is achieved by rotating a splined shaft which can be fitted to the valve in two positions as shown on the outline drawing. The splined shaft mates with S.S. White 2666X end fitting ($^{13}/_{32}$ inch diameter).

4. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

5. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

6. Tolerance ±10%.

7. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

8. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input and the output circuit of the valve. At the maximum pressure of 45lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

9. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA244, is available.

   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

10. These tests are carried out with the valve tuned to 2900, 3000 and 3100MHz.

11. The valve will tune over the indicated frequency range.

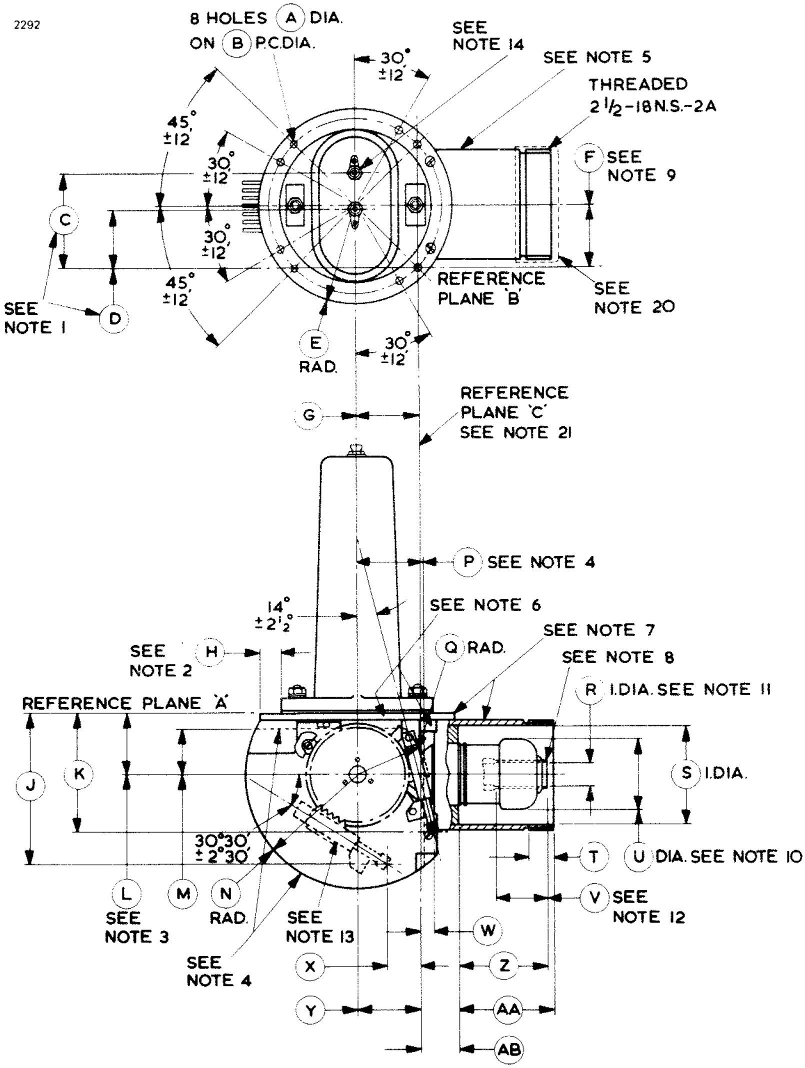
12. The specification limit for bandwidth applies over the whole tuning range.

13. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

14. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

15. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.07MHz/°C.

OUTLINE

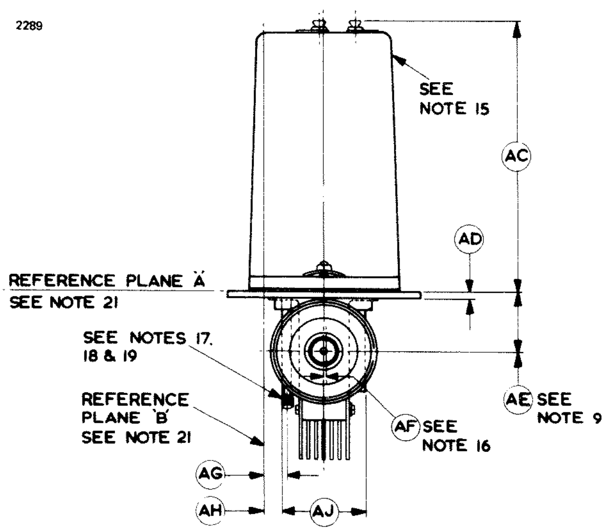

2292
8 HOLES A DIA.
ON B P.C.DIA.
30° ±12'
SEE NOTE 14
SEE NOTE 5
THREADED
2 1/2-18 N.S.-2A
45° ±12'
30° ±12'
30° ±12'
45° ±12'
C
F SEE NOTE 9
SEE NOTE 1
D
E
RAD.
30° ±12'
REFERENCE PLANE 'B'
SEE NOTE 20
G
REFERENCE PLANE 'C'
SEE NOTE 21
P SEE NOTE 4
14° ±2 1/2°
SEE NOTE 6
SEE NOTE 2
H
Q RAD.
SEE NOTE 7
SEE NOTE 8
REFERENCE PLANE 'A'
R I.DIA. SEE NOTE 11
J
K
S I.DIA.
30°30' ±2°30'
T
U DIA. SEE NOTE 10
L
M
N
V SEE NOTE 12
SEE NOTE 3
RAD.
SEE NOTE 13
W
X
Z
SEE NOTE 4
Y
AA
AB

OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	T	0.593 min	15.06 min
B	4.064 ± 0.006	103.23 ± 0.15	U	1.620 max	41.15 max
C	2.156	54.76	V	1.125 min	28.58 min
D	1.359	34.52	W	0.313	7.95
E	2.281 ± 0.015	57.94 ± 0.38	X	0.756	19.20
F	1.437 ± 0.020	36.50 ± 0.51	Y	1.437	36.50
G	1.437	36.50	Z	2.085 ± 0.025	52.96 ± 0.64
H	0.500 min	12.70 min	AA	2.297 ± 0.010	58.34 ± 0.25
J	3.500	88.90	AB	0.818 ± 0.015	20.78 ± 0.38
K	2.812	71.42	AC	6.313 ± 0.094	160.4 ± 2.4
L	1.440	36.58	AD	0.187	4.75
M	1.063 min	27.00 min	AE	1.440 ± 0.020	36.58 ± 0.51
N	2.656 max	67.46 max	AF	0.025	0.64
P	1.500 min	38.10 min	AG	0.563 ± 0.125	14.30 ± 3.18
Q	1.500 min	38.10 min	AH	0.575 ± 0.050	14.61 ± 1.27
R	0.555 ± 0.005	14.10 ± 0.13	AJ	1.740 max	44.20 max
S	2.321 ± 0.007	58.95 ± 0.18			

Millimetre dimensions have been derived from inches.

OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inches (54.86mm) diameter circle located as specified for the non-tunable side of the anode.
4. The maximum width specified by dimension 'AJ' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe, all surfaces inside guard pipe, tuning gear, stop, and worm shaft assembly.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe only.
10. The centre line of the maximum diameter will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. Optional location of tuning spline. The valve will be supplied with the spline located as specified by the customer.

14. Hexagon locking head banana pin jack, hole 0.169 $\pm$ 0.005 inch (4.29 $\pm$ 0.13mm) diameter x 0.593 inch (15.06mm) long as per Mil-E-1, latest issue.

15. The common cathode connection is marked with letter C.

16. This dimension shows the relation between a plane passing through the lateral centre of the anode, and a plane passing through the centre of the guard pipe.

17. The tuning mechanism will provide the full range of tuning with a maximum of 4 complete revolutions of the large tuning gear.

18. The spline for adjusting the tuning mechanism is as follows: 12 teeth, 48 pitch, 0.250 inch (6.35mm) pitch diameter.

19. The clearance between the tuning spline and the guard pipe will be sufficient to allow the use of S.S. White No. 2666X end fitting ($^{13}/_{32}$ inch diameter.

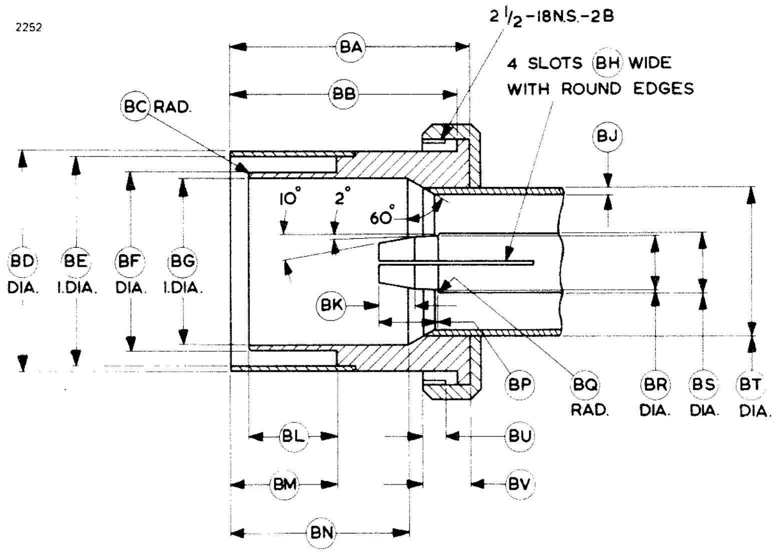
20. Protective guard for shipping purposes.

21. Reference plane 'A' is defined as a plane passing along the face of the mounting plate.

    Reference plane 'B' is defined as a plane perpendicular to plane 'A' and passing through the centre of the holes shown.

    Reference plane 'C' is defined as a plane mutually perpendicular to planes 'A' and 'B' and passing through the centre of the hole as shown.

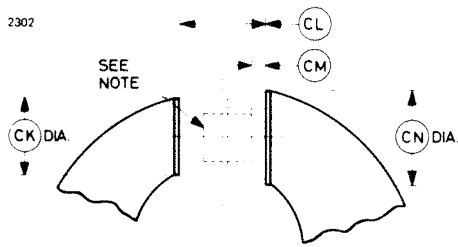
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

PERMANENT MAGNET SPECIFICATION



Ref	Inches	Millimetres	Ref	Inches	Millimetres
CK	1.625	41.28	CM	0.270	6.86
CL	1.800 ± 0.005	45.72 ± 0.13	CN	2.000	50.80

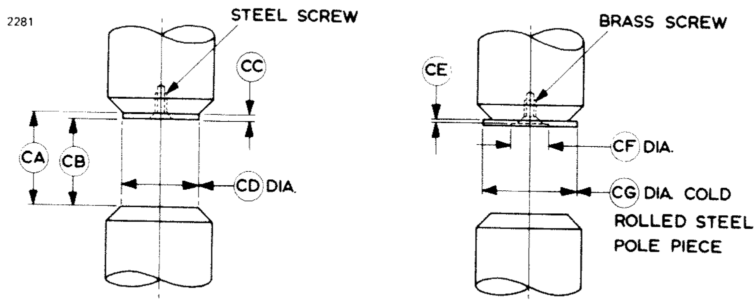
Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated as shown and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES

Magnet with Single Conventional Pole Piece

Magnet with Distortion Pole Piece



Ref	Inches	Millimetres	Ref	Inches	Millimetres
CA	1.925 ± 0.005	48.90 ± 0.13	CE	0.031 ± 0.015	0.79 ± 0.38
CB	1.800 ± 0.005	45.72 ± 0.13	CF	0.786 ± 0.005	19.96 ± 0.13
CC	0.125 ± 0.015	3.18 ± 0.38	CG	2.000 ± 0.015	50.80 ± 0.38
CD	1.625 ± 0.015	41.28 ± 0.38			

Millimetre dimensions have been derived from inches.

7182

S-BAND MAGNETRON

Frequency variant of M573, M574

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	2750 to 2860	MHz
Typical peak output power	2.5	MW
Magnet and launching section	separate electromagnet and launching section, see page 10	
Output	no. 10 waveguide (2.840 x 1.340 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	12	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum) (see note 1)	3	min

Mechanical

Overall dimensions	15.32 x 3.26 x 3.26 inches max 390 x 82.9 x 82.9mm max
Net weight	9¾ pounds (4.5kg) approx
Mounting position	vertical only

Any lubricants used on the anode should be sulphur free.

Cooling water and forced-air (high pressure)

Water-cooling of the anode is incorporated with the electro-magnet, the window is cooled by air at high pressure in the waveguide, while low pressure air cooling may be used on the cathode terminal. The minimum window cooling air flow is 3ft^3/min (0.085m^3/min) N.T.P., and the maximum air inlet temperature is 70°C.

The temperature rise across the water jacket should not exceed 15°C nor the water flow be less than 0.75 imp. gal/min (3.4 l./min). The design maximum temperature of the outlet water should be 70°C; under no conditions must 80°C be exceeded.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 2)	1340	1460	gauss
Heater voltage (see note 1)	11.4	15.0	V
Heater starting current (peak)	–	40	A
Anode voltage (peak)	32	38	kV
Anode current (peak)	125	185	A
Input power (peak)	–	6.0	MW
Input power (mean) (see note 3)	–	8.5	kW
Duty cycle	–	0.0015	
Pulse length (see note 4)	0.5	5.0	μs
Pulse repetition rate	–	600	p.p.s.
Rate of rise of voltage pulse (see note 5)	100	150	kV/μs
Anode temperature (see note 2)	–	150	°C
Cathode terminal temperature (see note 2)	–	150	°C
V.S.W.R. at the output coupler (see note 6)	–	1.5:1	
Pressurising of waveguide (see note 7)	35	65	lb/in^2
	2.46	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	1400	gauss
Anode current (peak)	157	A
Pulse length	5.0	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak)	35	kV
Output power (peak)	2.5	MW
Output power (mean)	3.75	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions (See Note 8)

	Oscillation 1	Oscillation 2	Oscillation 3	
Air flow				see note 9
Magnetic field (see note 10)	1400	1400	1485	gauss
Heater voltage (for test)	0	0	0	V
Anode current (mean)	235	195	213	mA
Duty cycle	0.0015	0.001	0.0015	
Pulse length (see note 4)	2.5	5.0	5.0	μs
V.S.W.R. at the output coupler				see note 11
Rate of rise of voltage pulse (see note 5)	72 to 90	150 to 180	113 to 137	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	33	37	–	–	–	–	kV
Output power (mean)	3375	–	–	–	–	–	W
Frequency	2750	2860	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see notes 12 and 13)	–	1.0	–	0.5	–	0.5	MHz
Frequency pulling (see note 12)	–	7.0	–	–	–	–	MHz
Frequency pushing (see note 14)	–	1.0	–	–	–	–	MHz
Stability (see notes 12, 13 and 15)	–	0.5	–	0.5	–	0.5	%
Heater current							see note 16
Temperature coefficient of frequency							see note 17

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Life Test Conditions

Heater voltage	0	V
Magnetic field	1400	gauss
Anode current (mean)	235	mA
Duty cycle	0.0015	
Pulse length	5.0	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage pulse	113 to 137	kV/μs

Switched off for 60 minutes every 24 hours.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2700	W min
R.F. bandwidth at ¼ power (see notes 12 and 13)	1.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see notes 12, 13 and 15)	1.0	% max

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12 volts to the heater for at least four minutes or by the application of 15 volts for three minutes. The heater voltage must not exceed 12.6 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the following formulae:

   V_h = 12.0–0.0010Pi for Pi less than 6000 watts

   V_h = 30.0–0.0040Pi for Pi greater than 6000 watts

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Measured at the point specified on the electro-magnet and launching section (see page 10).

3. The various parameters are related by the formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance $\pm10\%$.

5. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

6. A phase shifter should be incorporated into the waveguide immediately before the magnetron, and adjusted, if necessary, to give a satisfactory spectrum. The standing wave ratio between 3000 and 3100MHz should not exceed 2.0:1.

7. At the maximum pressure of 65lb/in^2 (4.57kg/cm^2) the leakage will not exceed 0.03 litre (N.T.P.) per minute.

8. The modulator shall be such that the pulse energy delivered to the magnetron, followed by an arcing pulse, cannot greatly exceed the normal energy per pulse.

9. During this test the waveguide air pressure shall not exceed 35lb/in^2 (2.46kg/cm^2) absolute and the cooling air flow shall not exceed 3ft^3/min (0.085m^3/min) free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

10. The value of the axial magnetic field should not vary by more than $\pm4\%$ from the value at the specified point of the valve shown on page 10, over a distance of 2 inches (50.8mm) in either direction along the axis. The sense of the field shall be such that a north-seeking pole at the specified point is attracted towards the cathode terminal of the magnetron.

11. The load termination of the magnetron during this test shall be a wave-

guide with a v.s.w.r. of less than 1.1:1 at the oscillation frequency and less than 1.5:1 between frequencies 3000 and 3100MHz, unless otherwise specified.

12. The valve shall be terminated by a mismatch giving a v.s.w.r. of at least 1.5:1 at the oscillating frequency. The mismatch shall be such that when the position of a voltage maximum is set to coincide with the launching section Reference Plane C (see page 12) the position of the voltage minimum at a frequency of 3050MHz shall lie between $\pm$10mm from the Reference Plane.

13. There shall be a range of at least $\lambda g/4$ where both the stability and bandwidth are less than the specified maxima, and they shall also be less than the maxima into a matched load.

14. The change in frequency when the mean input current is varied between the limits of 220 and 250mA shall be less than 1MHz. The current shall be varied continuously between the limits with a period not exceeding 5 seconds.

15. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 2750 to 2860MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

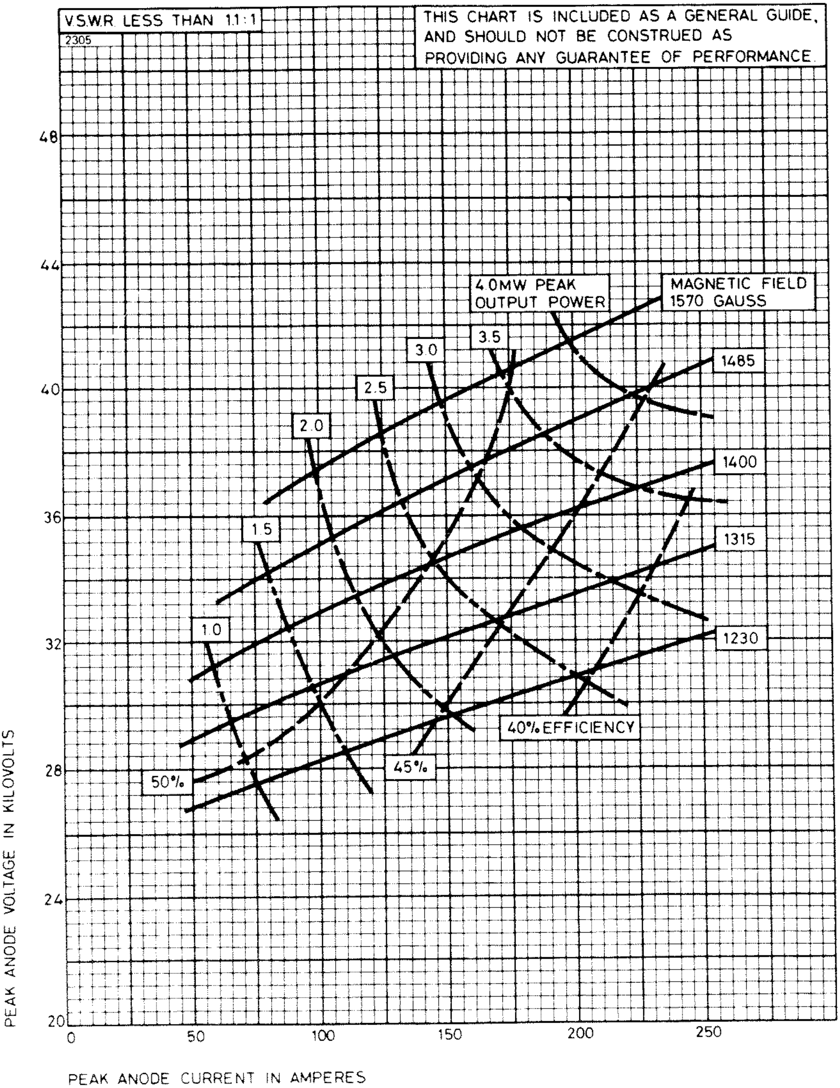
16. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

17. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.05MHz/$^{\circ}$C.

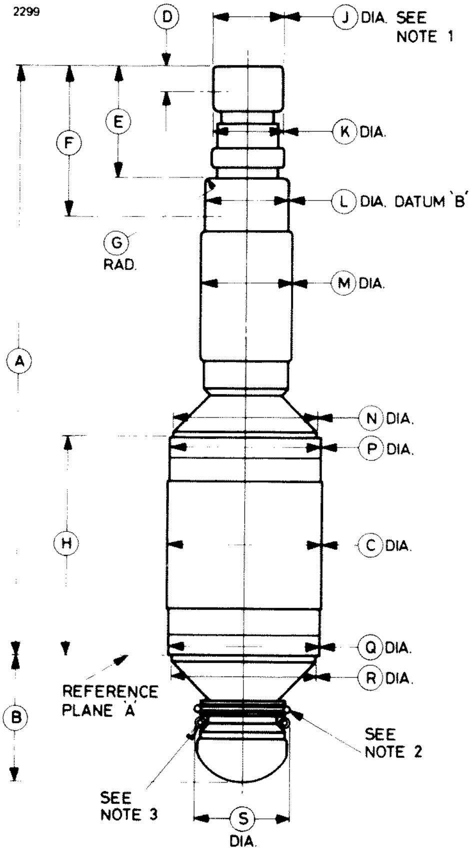
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART



OUTLINE



2299
D
J DIA. SEE NOTE 1
E
F
K DIA.
L DIA. DATUM 'B'
G RAD.
M DIA.
A
N DIA.
P DIA.
H
C DIA.
Q DIA.
R DIA.
REFERENCE PLANE 'A'
B
SEE NOTE 2
SEE NOTE 3
S DIA.

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	12.700 max	322.6 max
B	2.620 max	66.55 max
C	3.251 max	82.58 max
D	0.375 min	9.53 min
E	3.063 max	77.80 max
F	3.563 min	90.50 min
G	0.100 min	2.54 min
H	$4.625^{+0.015}_{-0.025}$	$117.48^{+0.38}_{-0.63}$
J	1.500 ± 0.010	38.10 ± 0.25
K	1.550 max	39.37 max
L	1.750 ± 0.010	44.45 ± 0.25
M	1.937 max	49.20 max
N	3.065 max	77.85 max
P	3.180 min	80.77 min
Q	3.180 min	80.77 min
R	3.065 max	77.85 max
S	1.980 min	50.29 min

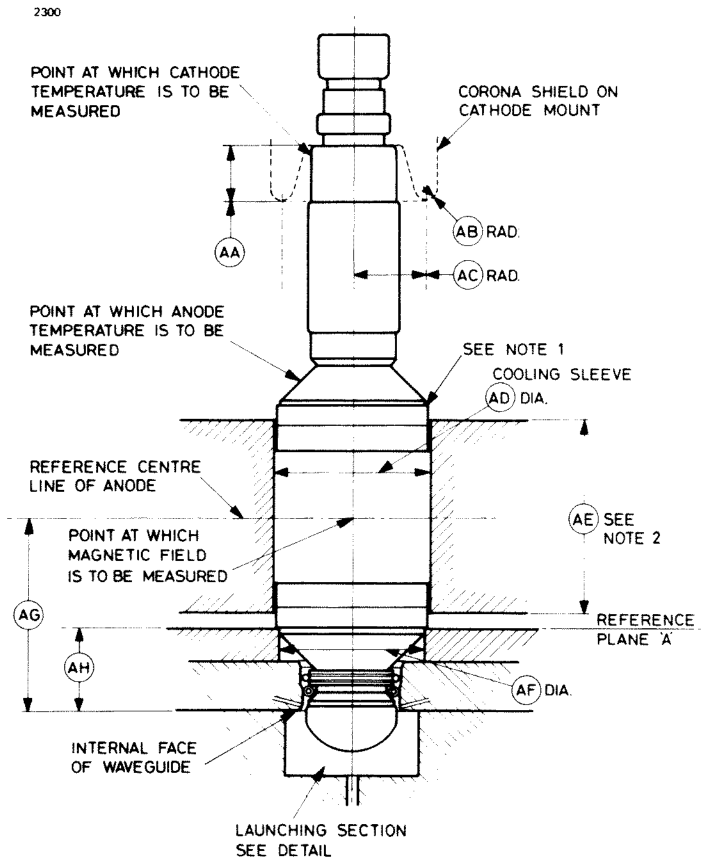
Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Concentric tolerance 0.050 inch (1.27mm) diameter, Datum 'B' (B.S.308: 1953).
2. Silicon rubber 'O' ring, 50° Shore hardness. The dimensions and fit of this section to be tested on a pressure and leakage test jig.
3. The contact spring dimensions to be measured when the part is not compressed.
4. All metal surfaces will be nickel or silver plated.

ELECTRO-MAGNET AND LAUNCHING SECTION

See page 12 for detail of launching section



DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	1.375 min	34.93 min	AN	0.405 max	10.29 max
AB	0.250 min	6.35 min		0.400 min	10.16 min
AC	1.500 min	38.10 min	AP	0.187	4.75
AD	3.253 $\pm$ 0.001	82.626 $\pm$ 0.025	AQ	0.094	2.39
AE	4.000 min	101.6 min	AR	0.170	4.32
AF	3.068 $\pm$ 0.002	77.927 $\pm$ 0.051	AS	0.050 max	1.27 max
AG	4.080	103.6	AT	0.125 $\pm$ 0.015	3.18 $\pm$ 0.38
AH	1.767 $\pm$ 0.020	44.88 $\pm$ 0.51	AU	1.062	26.97
AJ	0.125	3.18	AV	1.340 $\pm$ 0.004	34.036 $\pm$ 0.102
AK	2.021 $\pm$ 0.001	51.333 $\pm$ 0.025	AW	0.125 $\pm$ 0.015	3.18 $\pm$ 0.38
AL	1.963 $\pm$ 0.001	49.860 $\pm$ 0.025	AX	1.181	30.00
AM	0.062	1.57	AY	2.840 $\pm$ 0.004	72.136 $\pm$ 0.102

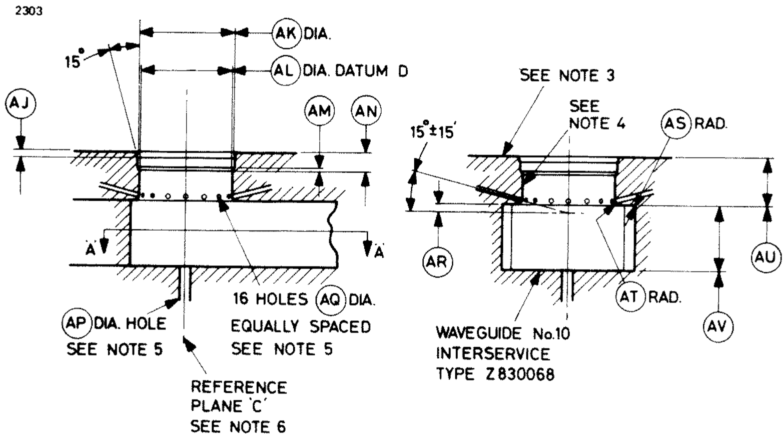
Millimetre dimensions have been derived from inches.

NOTES FOR ELECTRO-MAGNET AND LAUNCHING SECTION

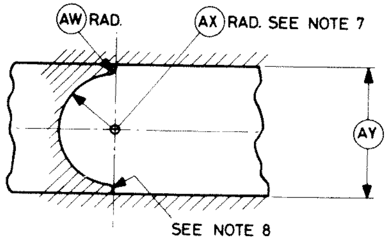
1. An adjustable device shall be used to bear on this shoulder and to ensure that the magnetron locates on reference plane 'A'. It must be able to withstand the thrust on the magnetron due to a pressure of 65 lb/in^2 absolute in the waveguide.
2. The length of the water jacket centre line to be within 0.025 inch (0.64mm) of the reference centre line.
3. The flange to be central in the broad face of the waveguide to within $\pm$0.005 inch ($\pm$0.13mm).
4. The internal surface of the flange to be silver plated 0.001 inch (0.025mm) thick, then rhodium plated 0.0001 inch (0.0025mm) thick.
5. Entry holes for window cooling air.
6. Reference plane 'C' is used for the definition of the phase of the standing wave in the waveguide.
7. Concentric tolerance 0.005 inch (0.13mm) Datum 'D' (B.S.308:1953).
8. The end plug profile to finish on a plane through the flange centre line and square to the waveguide internal profile to within $\pm$0.005 inch ($\pm$0.13mm).

DETAIL OF LAUNCHING SECTION

See page 11 for dimensions and notes



Section A - A' showing shorting plug



BM1003 BM1004 BM1005

S-BAND MAGNETRONS

ABRIDGED DATA

Fixed frequency pulse magnetrons		
Frequency range:		
BM1003	3034 to 3052	MHz
BM1004	2989 to 3007	MHz
BM1005	2944 to 2962	MHz
Typical peak output power	2.0	MW
Magnet		separate
Output	to no. 10 waveguide (2.840 x 1.340 inches internal) via the transition section M4117 shown on page 7	
Cooling		water

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	8.5	V
Heater current	9.0	A
Heater starting current, peak value, not to be exceeded	20	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	14.375 x 6.000 x 6.000 inches max 365.1 x 152.4 x 152.4mm max
Net weight	18 pounds (8.2kg) approx
Mounting position	any

Cooling

The valve is water cooled and has an integral water jacket, the connections being made via ¼-inch B.S.P. unions. The water flow through the jacket must not be less than 1.2 litres per minute and the outlet water temperature must not exceed 50°C.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 2)	1350	1600	gauss
Heater voltage (see note 1)	8.0	10	V
Heater starting current (peak)	–	20	A
Anode voltage (peak)	–	47	kV
Anode current (peak)	60	110	A
Input power (mean) (see note 3)	–	5.0	kW
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	5.0	μs
Rate of rise of voltage pulse (see note 5)	–	120	$kV/\mu s$
Outlet water temperature	–	50	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising of waveguide	14	45	lb/in^2
	0.99	3.5	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Magnetic field	1550 ± 25	gauss
Heater voltage	0	V
Anode current (peak)	90	A
Pulse length	2.0	μs
Pulse repetition rate	500	p.p.s.
Rate of rise of voltage pulse	110	$kV/\mu s$

Typical Performance

Anode voltage (peak)	43	kV
Output power (peak)	2.0	MW
Output power (mean)	2.0	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

Magnetic field	1550 ± 25	gauss
Heater voltage (for test)	0	V
Anode current (mean)	120	mA
Duty cycle	0.0015	
Pulse length (see note 4)	2.0	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 5)	110	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	40	46	kV
Output power (mean)	2.1	–	kW
Frequency (see note 6):			
BM1003	3034	3052	MHz
BM1004	2989	3007	MHz
BM1005	2944	2962	MHz
R.F. bandwidth at ¼ power	–	1.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	7.0	MHz
Stability (see note 7)	–	0.5	%
Heater current			see note 8
Temperature coefficient of frequency			see note 9

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Typical Conditions on page 2. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Anode voltage (peak)	38	kV min
Output power (mean)	1.8	kW min
R.F. bandwidth at ¼ power	2.0	MHz max

Frequency: must be within Test Limits above.

NOTES

1. With no anode input power.

   The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the schedule shown on page 6.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The valve is designed for use with a separate magnet (not supplied); the north pole of the magnet must be adjacent to the cathode terminal, marked C. The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.

3. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance $\pm$10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

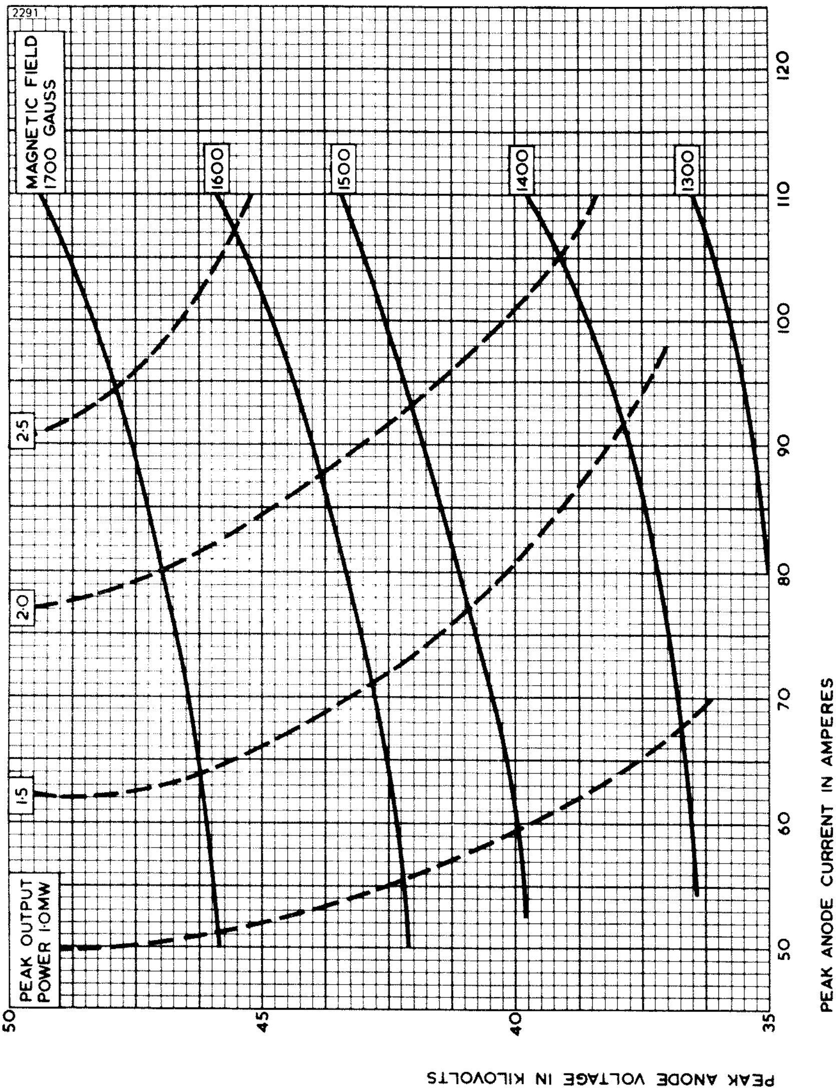
6. Other frequency ranges can be supplied on request.

7. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

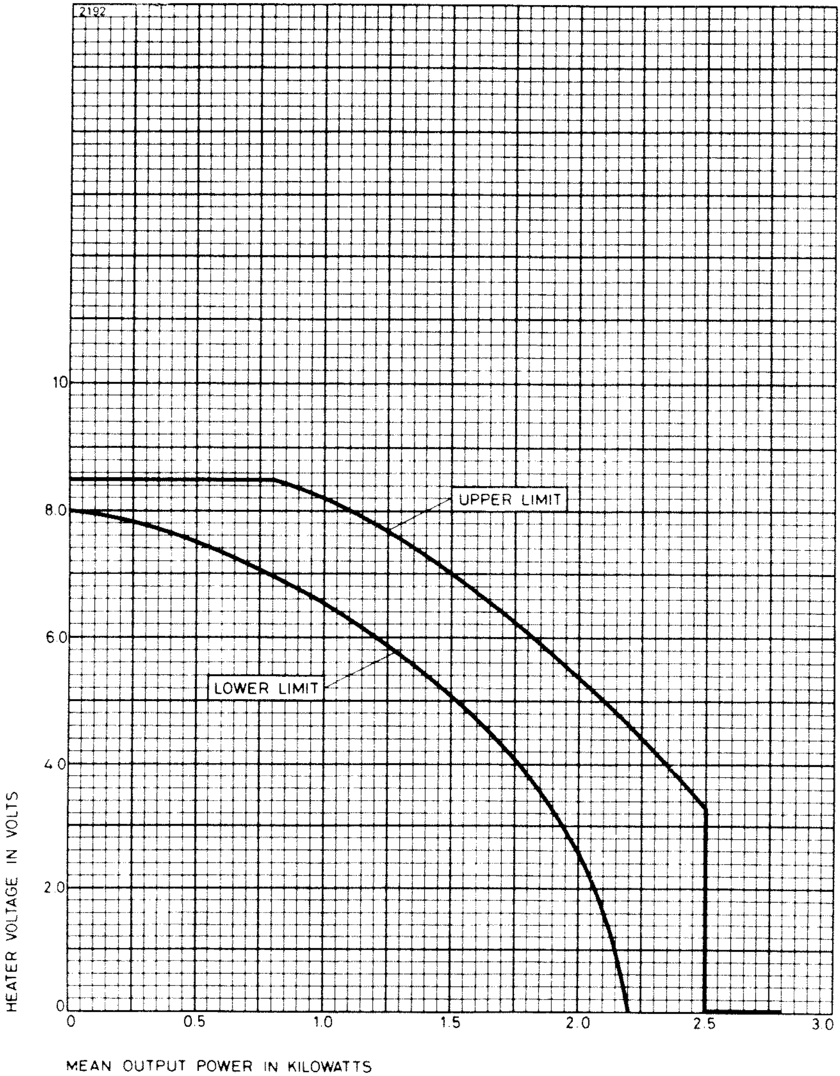
8. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 10A maximum.

9. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/$^{\circ}$C.

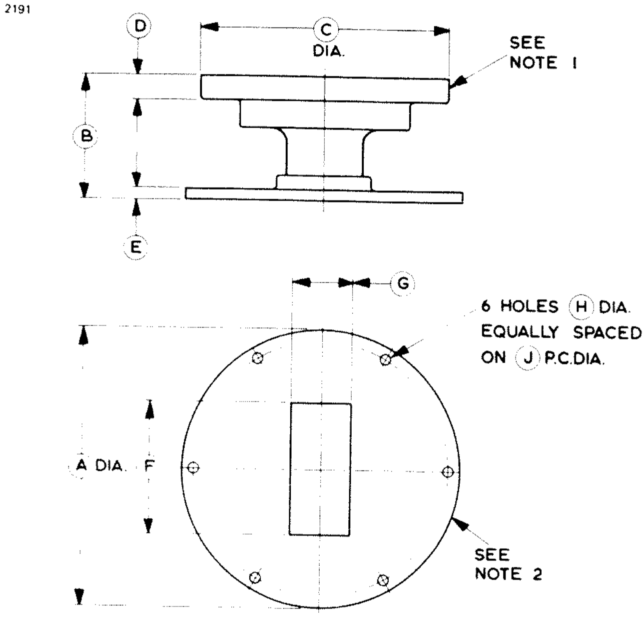
PERFORMANCE CHART



HEATER VOLTAGE ADJUSTMENT SCHEDULE



TRANSITION SECTION M4117



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875	149.2	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	5.375	136.5
E	0.250	6.35			

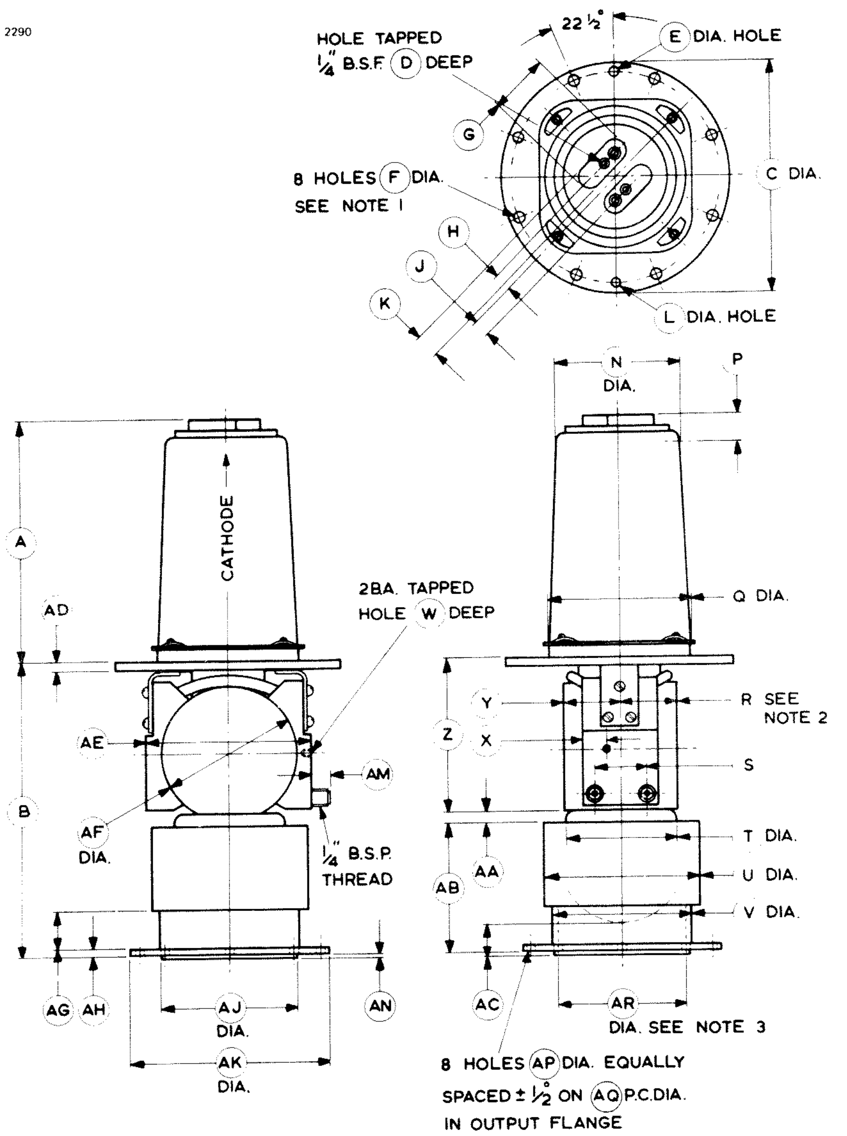
Millimetre dimensions have been derived from inches.

Notes for M4117

1. This flange mates with the output flange of the magnetron using 8—0.250 inch (6.35mm) diameter bolts, and an O-ring (supplied with M4117) 3.975 inches internal diameter and 0.210 inch diameter section. J.S.C. No. 5985-99-083-0011 or JAN MS 90064-17.
2. This flange is J.S.C. type No. 5985-99-083-1560.

OUTLINE (See page 10 for outline notes)

2290



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	6.375 ± 0.062	161.9 ± 1.57	W	0.250	6.35
B	7.780 ± 0.025	197.6 ± 0.64	X	0.625	15.88
C	$6.000^{+0.000}_{-0.010}$	$152.4^{+0.00}_{-0.25}$	Y	1.485 max (BM1003/4) 1.530 max (BM1005)	37.72 max (BM1003/4) 38.86 max (BM1005)
D	0.250	6.35	Z	4.035 ± 0.030	102.5 ± 0.76
E	$0.312^{+0.005}_{-0.000}$	$7.92^{+0.13}_{-0.00}$	AA	0.312	7.92
F	0.312	7.92	AB	3.437	87.30
G	1.625	41.28	AC	0.875	22.23
H	0.437	11.10	AD	0.250 ± 0.005	6.35 ± 0.13
J	0.437	11.10	AE	4.375	111.1
K	0.625	15.88	AF	3.625	92.08
L	$0.250^{+0.005}_{-0.000}$	$6.35^{+0.13}_{-0.00}$	AG	1.218	30.94
N	3.250	82.55	AH	0.218	5.54
P	0.750	19.05	AJ	$3.625^{+0.000}_{-0.006}$	$92.08^{+0.00}_{-0.15}$
Q	3.750	95.25	AK	5.250 ± 0.062	133.4 ± 1.57
R	1.485 max (BM1003/4) 1.530 max (BM1005)	37.72 max (BM1003/4) 38.86 max (BM1005)	AM	0.500	12.70
S	1.375	34.93	AN	0.125 ± 0.005	3.18 ± 0.13
T	2.937	74.60	AP	$0.250^{+0.0005}_{-0.0000}$	$6.350^{+0.013}_{-0.000}$
U	4.125	104.8	AQ	4.750 ± 0.005	120.7 ± 0.13
V	3.687	93.65	AR	$3.375^{+0.005}_{-0.000}$	$85.73^{+0.13}_{-0.00}$

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The 8 holes will clear studs 0.250 inch (6.35mm) diameter equally spaced on 5.500 inches (139.7mm) pitch circle diameter and within 0.005 inch (0.127mm) of their nominal positions, with the valve located by dowel pins 0.307 inch (7.80mm) diameter and 0.245 inch (6.22mm) diameter spaced 5.500 ± 0.002 inches (139.700 ± 0.051mm) apart.
2. The valve will fit between magnet poles 3.010 inches (76.45mm) diameter and 2.970 inches (75.44mm) apart, located symmetrically with respect to the dowel holes in the mounting flange and 2.500 inches (63.5mm) from the reference face.
3. This bore will accept a plug 3.335 inches (84.71mm) diameter.

M525

S-BAND MAGNETRON

Service Types CV2362 to CV2368

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range (in seven bands)	2750 to 2855	MHz
Typical peak output power	1.15	MW
Magnet		separate
Output		no. 10 waveguide (2.840 x 1.340 inches internal)
Coupler		see pages 7 and 8
Cooling		water

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	8.5	V
Heater current	9.0	A
Heater starting current, peak value, not to be exceeded	50	A max
Cathode heating time (minimum)	3	minutes

Mechanical

Overall dimensions	17.32 x 6.00 x 6.00 inches max 441 x 153 x 153mm max
Net weight	13 pounds (6kg) approx
Mounting position	any

Cooling water

The water cooling system is connected to the valve via ¼-inch B.S.P. unions. The water flow must exceed 1 litre/minute with a maximum outlet temperature of 90°C. A 5-foot head of water will be adequate to ensure the flow.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	7.65	9.35	V
Heater starting current (peak)	–	50	A
Anode voltage (peak)	–	40	kV
Anode current (peak)	–	80	A
Input power (peak)	–	3.0	MW
Input power (mean) (see note 2)	–	4.5	kW
Duty cycle	–	0.00125	
Pulse length (see note 3)	–	1.25	μs
Rate of rise of voltage pulse (see note 4)	100	200	kV/μs
Anode temperature	–	90	°C
Cathode terminal temperature	–	150	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	6.0	V
Magnetic field (see note 5)	1800	gauss
Anode current (peak)	70	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	36	kV
Output power (peak)	1.15	MW
Output power (mean)	1.15	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 5)	1800	1800	gauss
Heater voltage (for test)	6.0	6.0	V
Anode current (peak)	70	70	A
Duty cycle	0.00125	0.00125	
Pulse length (see note 3)	1.25	1.25	μs
V.S.W.R. at the output coupler	1.1:1	1.5:1	
Rate of rise of voltage pulse	150	150	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	34	38	–	–	kV
Efficiency	40	–	–	–	%
Frequency:					
CV2362	2750	2765	–	–	MHz
CV2363	2765	2780	–	–	MHz
CV2364	2780	2795	–	–	MHz
CV2365	2795	2810	–	–	MHz
CV2366	2810	2825	–	–	MHz
CV2367	2825	2840	–	–	MHz
CV2368	2840	2855	–	–	MHz
R.F. bandwidth at ¼ power	–	–	–	2.5	MHz
Frequency pulling	–	–	–	7.0	MHz
Stability (see note 6)	–	–	–	0.5	%
Heater current					see note 7
Temperature coefficient of frequency					see note 8

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Efficiency	35	% min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 6)	1.0	% max

NOTES

1. With no anode input power.

   During high voltage operation it is essential to operate the heater in accordance with the following schedule.

Mean Input Power (kW)	**Heater Voltage (V)**
less than 1.0	8.5
1.0 to 2.5	7.0
2.5 to 3.5	6.0
3.5 to 4.5	4.0

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section of the valve data book.

2. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

3. Tolerance $\pm$ 10%.

4. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

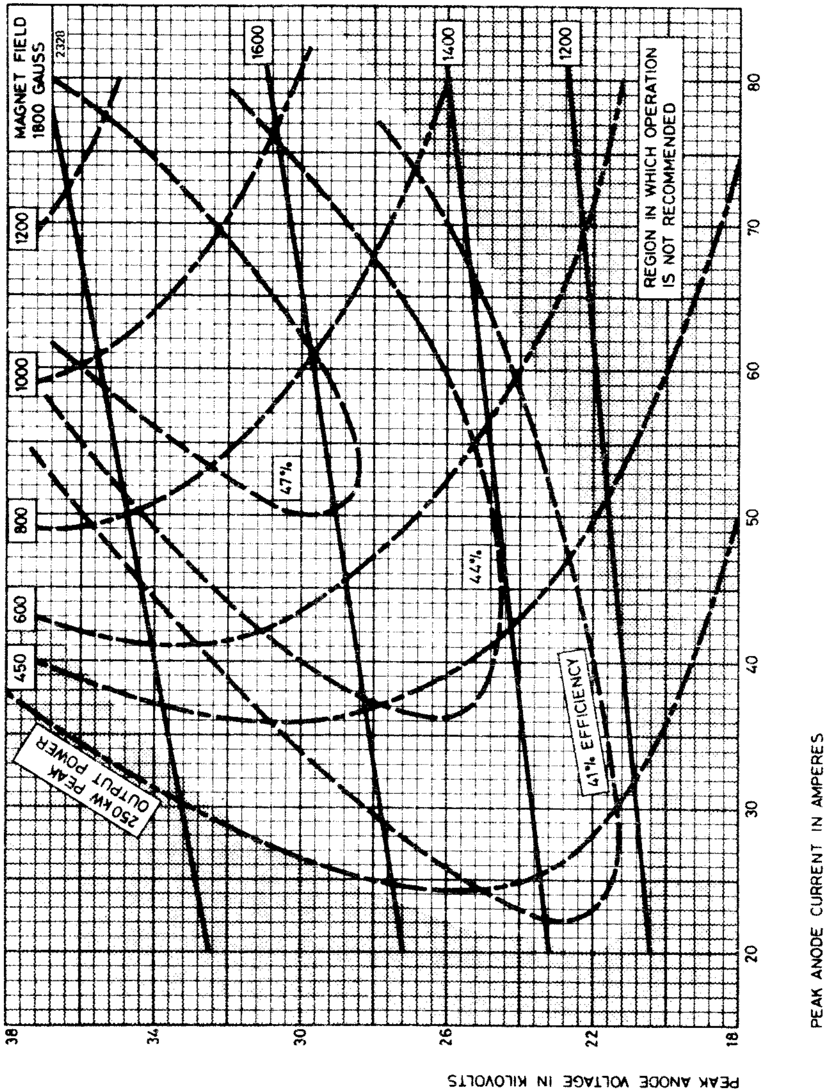
5. The variation of magnetic field within a cylinder 1½ inches (38.10mm) diameter and 1.125 inch (28.58mm) long, situated centrally and co-axially between the poles of the magnet should not exceed 10% overall. The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The north pole of the magnet must be adjacent to the cathode terminal. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.

6. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses over an interval of 60 seconds.

7. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 10A maximum.

8. Design test only. The maximum frequency change with anode temperature change (after warm-up) is -0.07MHz/°C.

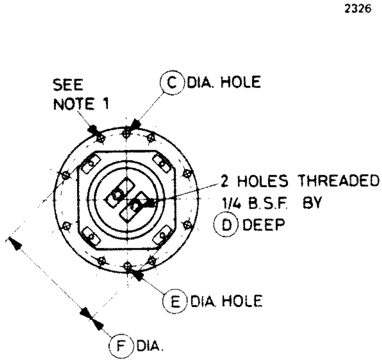
PERFORMANCE CHART

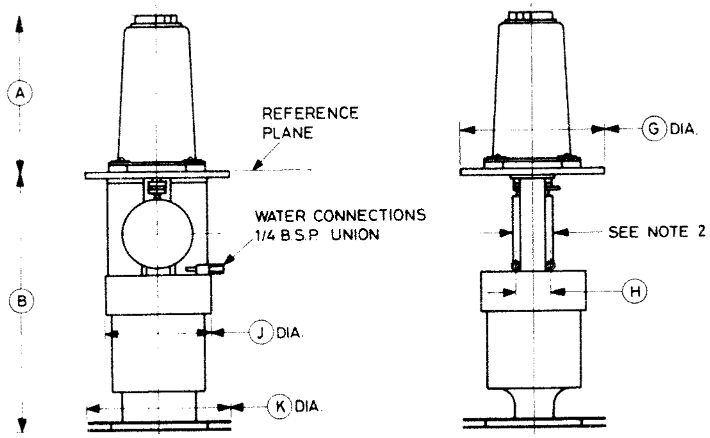


OUTLINE

Ref	Inches	Millimetres
A	6.375 ± 0.035	161.93 ± 0.89
B	10.875 ± 0.032	276.23 ± 0.81
C	$0.312^{+0.003}_{-0.000}$	$7.925^{+0.076}_{-0.000}$
D	0.250	6.35
E	$0.250^{+0.003}_{-0.000}$	$6.350^{+0.076}_{-0.000}$
F	4.750 max	120.7 max
G	$6.000^{+0.000}_{-0.010}$	$152.4^{+0.00}_{-0.25}$
H	$1.375^{+0.005}_{-0.025}$	$34.93^{+0.13}_{-0.64}$
J	4.406 ± 0.015	111.9 ± 0.38
K	5.875 ± 0.015	149.23 ± 0.38

Millimetre dimensions have been derived from inches.

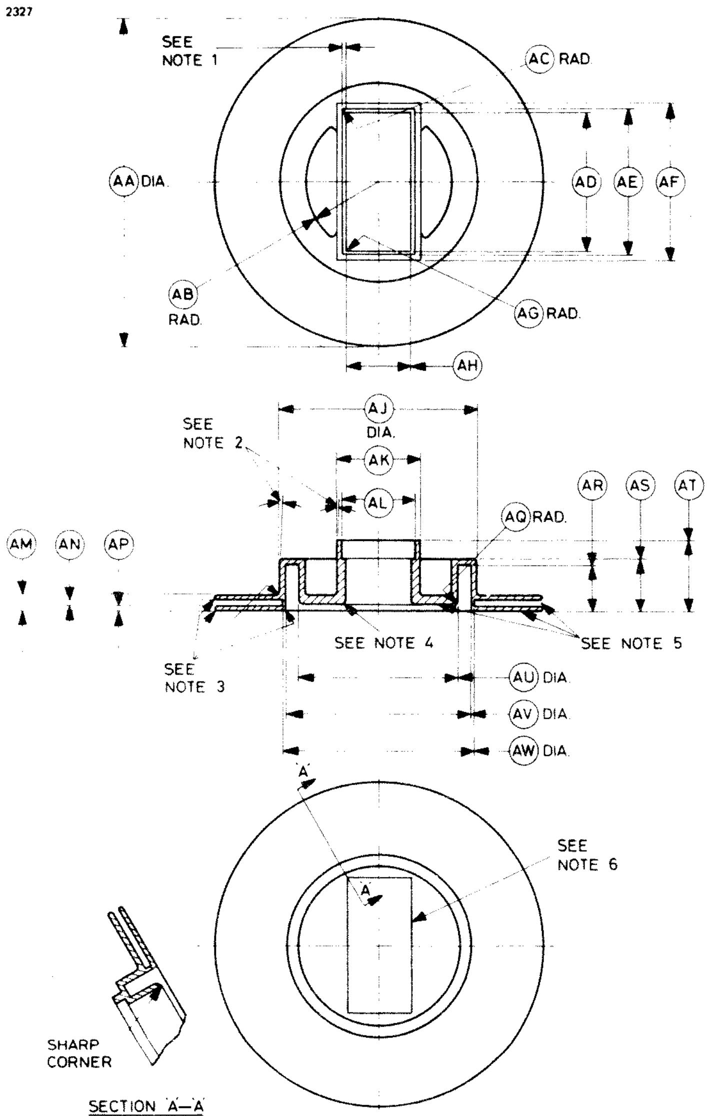




Outline Notes

1. Holes to clear 8 studs 0.250 inch (6.35mm) diameter equally spaced on 5.500 inch (139.7mm) P.C.D. and within 0.005 inch (0.13mm) of nominal position with the valve located by dowel pins 0.307 inch (7.80mm) diameter and 0.245 inch (6.22mm) diameter spaced 5.500 ± 0.002 inch (139.700 ± 0.051mm) apart.
2. The valve is to fit between magnet poles 3.010 inch (76.45mm) diameter and 2.125 inch (53.98mm) apart, located symmetrically with respect to dowel holes in the mounting flange and 2.500 inch (63.5mm) from the reference plane.

COUPLER



See page 8 for dimensions and notes.

Dimensions for Coupler

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	5.875	149.2	AM	0.375	9.53
AB	1.500	38.10	AN	0.125	3.18
AC	0.050 max	1.27 max	AP	0.125	3.18
AD	2.840 ± 0.003	72.136 ± 0.076	AQ	0.090	2.29
AE	$3.005^{+0.005}_{-0.000}$	$76.327^{+0.127}_{-0.000}$	AR	0.980 ± 0.005	24.89 ± 0.13
			AS	1.125	28.58
AF	3.250	82.55	AT	1.500	38.10
AG	0.025 max	0.64 max	AU	3.320 ± 0.005	84.33 ± 0.13
AH	1.340 ± 0.003	34.036 ± 0.076	AV	3.880 ± 0.005	98.55 ± 0.13
AJ	4.125	104.8	AW	4.000	101.6
AK	1.750	44.45			
AL	$1.505^{+0.005}_{-0.000}$	$38.227^{+0.127}_{-0.000}$			

Millimetre dimensions have been derived from inches.

Notes for Coupler

1. These faces parallel to within 25′.
2. Maximum draft angle 2°.
3. Radius on these corners 0.031 inch (0.79mm).
4. On all four sides 0.125 inch (3.2mm) radius at centre fairs to give a sharp corner as shown in section A - A; length of fairing not to exceed 0.125 inch (3.2mm).
5. These faces to be flat, smooth, free from machining marks and square with rectangular bore.
6. Rectangular bore to be within 0.003 inch (0.076mm) of nominal position.

M561

S-BAND MAGNETRON

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	3040 to 3060	MHz
Typical peak output power	80	kW
Magnet	separate, see note 7 on page 4	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 9	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	10	V
Heater current	1.1	A
Heater starting current, peak value, not to be exceeded	5.0	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	6.28 x 6.22 x 3.28 inches max 159.5 x 158.0 x 83.3mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

Cooling

forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	9.0	11	V
Heater starting current (peak)	–	5.0	A
Anode voltage (peak)	11	18	kV
Anode current (peak)	10	25	A
Input power (peak)	–	400	kW
Input power (mean) (see note 3)	–	500	W
Duty cycle	–	0.002	
Pulse length (see note 4)	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	100	180	kV/μs
Anode temperature (see note 6)	–	140	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	10	7.5	V
Magnetic field (see note 7)	1800	1800	gauss
Anode current (peak)	15	15	A
Pulse length (see note 4)	0.1	1.0	μs
Pulse repetition rate	1000	1000	p.p.s.
Rate of rise of voltage pulse	150	150	kV/μs

Typical Performance

Anode voltage (peak)	13	13	kV
Output power (peak)	80	80	kW
Output power (mean)	8	80	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 7)	1800	1800	gauss
Heater voltage (for test)	7.5	10	V
Anode current (mean)	15	1.5	mA
Duty cycle	0.001	0.0001	
Pulse length (see note 4)	1.0	0.1	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (minimum) (see note 5)	180	180	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	12	14	–	–	kV
Output power (mean)	65	–	–	–	W
Frequency	3040	3060	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	25	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	6.0	–	–	MHz
Frequency pushing (see note 8)	–	0.2	–	–	MHz/A
Stability (see note 9)	–	0.5			%
Stability (see note 10)			–	0.5	%
Cold impedance					see note 11
Heater current					see note 12
Temperature coefficient of frequency					see note 13

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

NOTES

1. With no anode input power.

   For average values of pulse input power greater than 50 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 10.0 \left[1 - \frac{Pi}{900}\right] \text{ volts}$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance ±10% for pulse length 1.0μs and ±50% for pulse length 0.1μs.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode fins.

7. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 10. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal.

   A suitable magnet, type MA290, is available. If an electro-magnet is used, the pole tip dimensions should be as shown on page 10.

8. The frequency pushing is the difference between the maximum and minimum frequencies as the peak anode current is varied rapidly between 10 and 18A.

9. With the valve operating into a v.s.w.r. of 1.1:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 3040 to 3060MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 5 minutes.

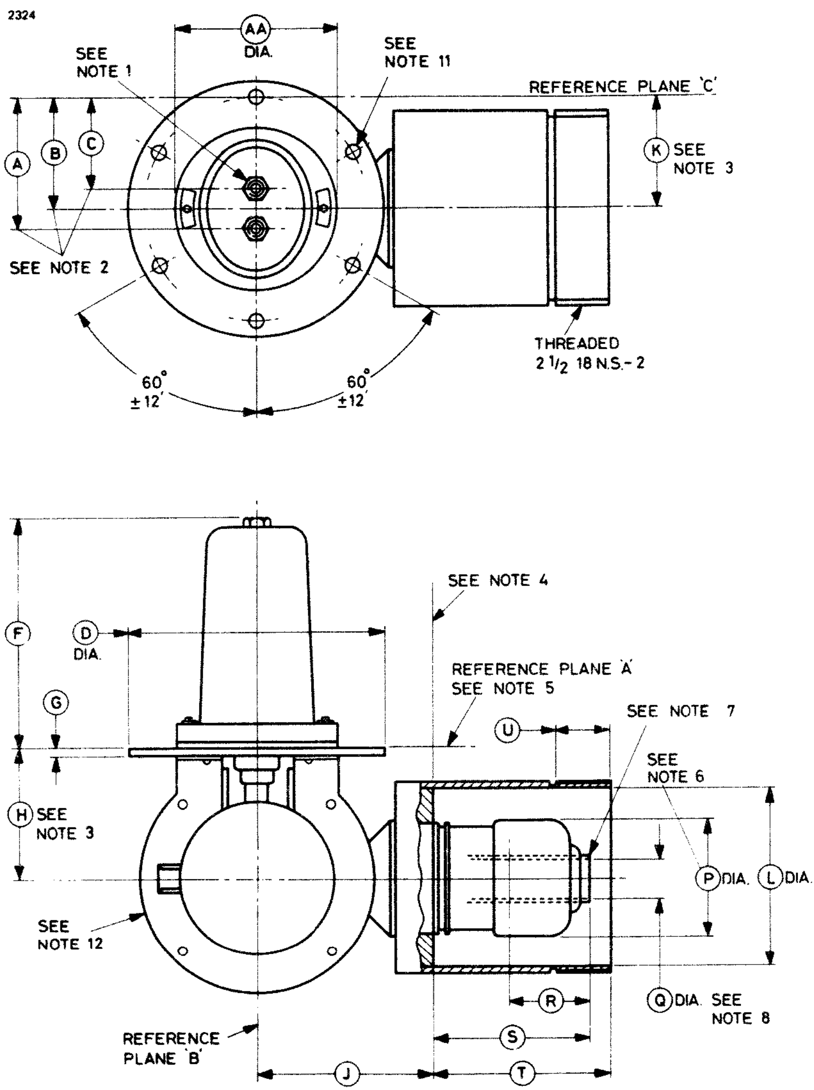
10. There shall be no evidence of mode change as the mean anode current is varied over the range 1.0 to 2.5mA.

11. For the range 3040 to 3060MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 10:1 with a minimum 77 to 87mm from the reference plane shown on the outline drawing.

12. Measured with heater voltage of 10V and no anode input power, the heater current limits are 0.9A minimum, 1.3A maximum.

13. Design test only. The maximum frequency change with anode temperature change (after warm-up) is –0.07MHz/°C.

OUTLINE



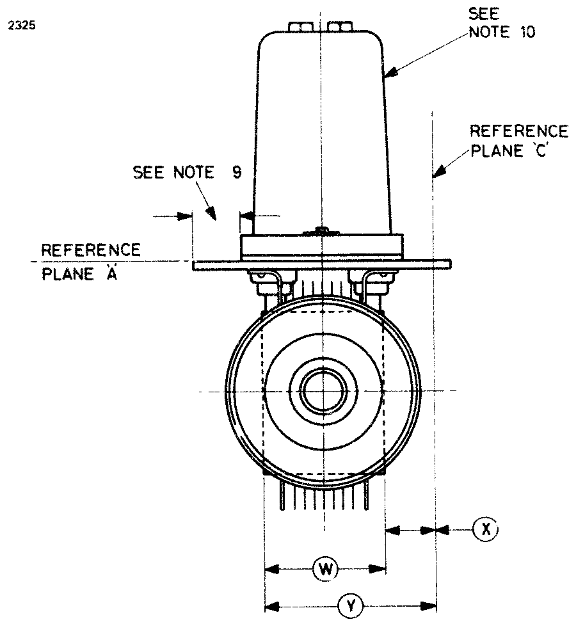
2324
AA
DIA.
SEE
NOTE 1
SEE
NOTE 11
REFERENCE PLANE 'C'
A
B
C
K SEE
NOTE 3
SEE NOTE 2
THREADED
2 1/2 18 N.S.-2
60°
±12'
60°
±12'
SEE NOTE 4
F
D
DIA.
REFERENCE PLANE 'A'
SEE NOTE 5
G
SEE NOTE 7
U
SEE
NOTE 6
H SEE
NOTE 3
P DIA.
L DIA.
SEE
NOTE 12
R
Q DIA. SEE
NOTE 8
S
REFERENCE
PLANE 'B'
J
T

OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.687	42.85	P	1.620 max	41.15 max
B	1.437	36.50	Q	0.555 ± 0.005	14.10 ± 0.13
C	1.187	30.15	R	1.125 min	28.58 min
D	3.250 ± 0.031	82.55 ± 0.79	S	2.085 ± 0.025	52.96 ± 0.64
F	2.984 ± 0.062	75.79 ± 1.57	T	2.297 ± 0.010	58.34 ± 0.25
G	0.125	3.18	U	0.583 min	14.81 min
H	1.687 ± 0.010	42.85 ± 0.25	W	1.490 max	37.85 max
J	2.255 ± 0.015	57.28 ± 0.38	X	0.677 min	17.20 min
K	1.437 ± 0.010	36.50 ± 0.25	Y	2.197 max	55.80 max
L	2.321 ± 0.007	58.95 ± 0.18	AA	2.218 max	56.34 max

Millimetre dimensions have been derived from inches.

OUTLINE

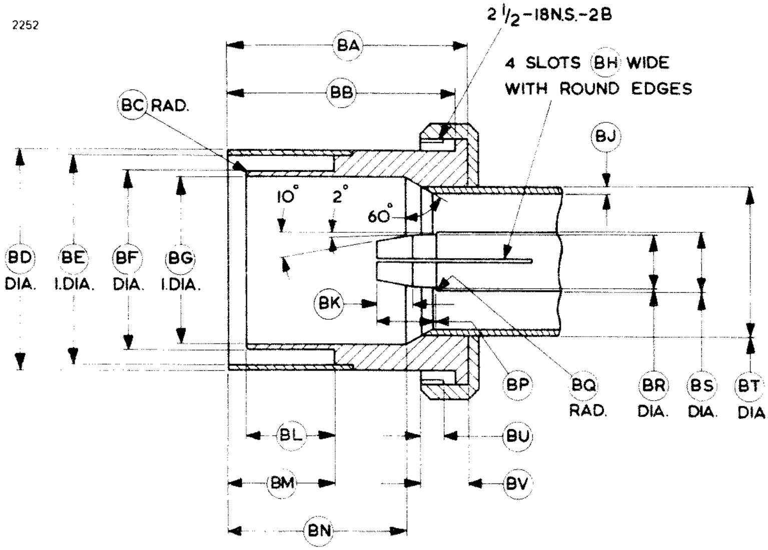


OUTLINE NOTES

1. Hole 0.169 ± 0.004 inch (4.293 ± 0.102mm) diameter in both pin jacks.
2. The pin jack holes will be within a radius of ± 0.023 inch (0.58mm) of the location specified and will be spaced 0.500 ± 0.010 inch (12.70 ± 0.25mm) between centres with respect to each other. The centre lines of these holes will be perpendicular to reference plane A to within 3 degrees.
3. Measured to centre line of guard pipe.
4. Reference plane for electrical cold impedance tests.
5. Any part of the assembly extending above reference plane A will be within a radius of 1.109 inch (28.17mm) of the true centre of the mounting plate, measured with respect to the mounting holes.
6. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
7. There will be no sharp edges on the outside diameter at the end of the inner conductor.
8. This dimension applies to the inner conductor insert only. The centre line of the insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
9. With the flange resting on a plane surface the flatness of the mounting plate 0.500 inch (12.70mm) from the edge will be such that a 0.010 inch (0.254mm) thickness gauge 0.125 inch (3.18mm) wide will not enter for a distance of more than 0.250 inch (6.35mm).
10. Common cathode connection indicated by 'C' embossed on this surface.
11. Six holes 0.193 ± 0.003 inch (4.902 ± 0.076mm) diameter, equally spaced on 2.875 ± 0.006 inch (73.03 ± 0.15mm) pitch circle diameter.
12. Radiator diameter 3.000 ± 0.062 inch (76.20 ± 1.57mm).

COUPLER

2252

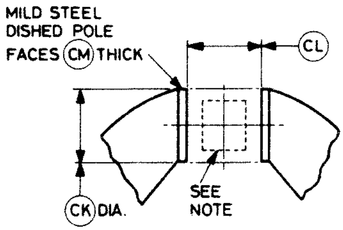


Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

PERMANENT MAGNET SPECIFICATION

2331



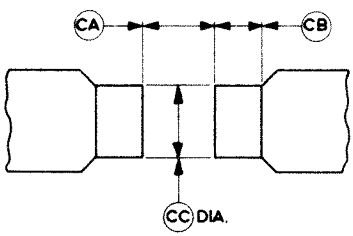
Ref	Inches	Millimetres
CK	1.500 ± 0.005	38.10 ± 0.13
CL	$1.500\ ^{+0.010}_{-0.000}$	$38.10\ ^{+0.25}_{-0.00}$
CM	0.187	4.75

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter, situated centrally and coaxially between the poles must not exceed ± 90 gauss.

ELECTRO-MAGNET POLE PIECES

2255



Ref	Inches	Millimetres
CA	$1.500\ ^{+0.005}_{-0.000}$	$38.10\ ^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

M566 M569 M570

S-BAND MAGNETRONS

Frequency variants of M579

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
M566	2750 to 2860	MHz
M569	2850 to 2960	MHz
M570	2950 to 3060	MHz
Typical peak output power	2.5	MW
Magnet and launching section	separate electromagnet and launching section assembly M4011 (see page 12 also)	
Isolator	use of an isolator is recommended (see note 8, page 6)	
Output	no. 10 waveguide (2.840 x 1.340 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	12	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum) (see note 1)	3	min

Mechanical

Overall dimensions	15.00 x 4.00 x 4.00 inches max 381 x 102 x 102mm max
Net weight	9¾ pounds (4.5kg) approx
Mounting position	vertical only

Any lubricants used on the anode should be sulphur free.

Electro-magnet and Launching Section

The complete electro-magnet and launching section is designated M4011 (see page 14); the launching section can be supplied as a separate item if required and is designated M4017 (see page 16).

	Min	Max	
D.C. current for 1580 gauss field (see note 2 and page 9)	27	30	A
Resistance of field windings:			
at 20°C	0.9	1.15	Ω
during operation	–	1.65	Ω
Overall dimensions (see page 14)	15.437 x 12.625 x 12.250 inches approx 392 x 320 x 310mm approx		
Net weight	110 pounds (50kg) approx		
Output flange	UG-53/U		

Cooling

The electro-magnet is water cooled and provides cooling for the magnetron anode by conduction through the inner liner of the magnet assembly into which the magnetron fits. The liner is machined to very fine limits and it is essential that the inner surface is carefully cleaned before the magnetron is fitted. Precautions must be taken to ensure that power to the magnetron and the electro-magnet is removed in the event of a cooling water supply failure. A flow of 1.5 imp. gal/min (6.8 l./min) is usually adequate, although this will depend on the method employed for mounting the assembly. The water pressure required for a flow of 1.5 imp. gal/min (6.8 l./min) is 4 lb/in^2 (0.28kg/cm^2) maximum.

The temperature rise across the water jacket should not exceed 15°C nor the water flow be less than 0.75 imp. gal/min (3.4 l./min). The design maximum temperature of the outlet water should be 70°C; under no conditions must 80°C be exceeded.

The magnetron output window is cooled by air at high pressure in the wave-guide; the minimum window cooling air flow is 3ft^3/min (0.085m^3/min) N.T.P., and the maximum air inlet temperature is 70°C.

The cathode terminal may be cooled by low pressure air.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 3)	1520	1675	gauss
Heater voltage (see note 1)	11.4	15.0	V
Heater starting current (peak)	–	40	A
Anode voltage (peak):			
M566	34.5	41.5	kV
M569, M570	36	43	kV
Anode current (peak):			
M566	119	176	A
M569, M570	115	170	A
Input power (peak)	–	6	MW
Input power (mean) (see note 4)	–	8.5	kW
Duty cycle	–	0.0015	
Pulse length (see note 5)	0.5	5.0	μs
Pulse repetition rate	–	600	p.p.s.
Rate of rise of voltage pulse (see note 6)	100	150	kV/μs
Anode temperature (see note 7)	–	150	°C
Cathode terminal temperature (see note 7)	–	150	°C
V.S.W.R. at the output coupler (see note 8)	–	1.5:1	
Pressurising of waveguide (see note 9)	35	65	lb/in^2
	2.46	4.57	kg/cm^2

TYPICAL OPERATION

	M566	M569, M570	
Operational Conditions			
Heater voltage	0	0	V
Magnetic field	1580	1580	gauss
Anode current (peak)	145	140	A
Pulse length	5.0	5.0	μs
Pulse repetition rate	300	300	p.p.s.
Typical Performance			
Anode voltage (peak)	38.5	40	kV
Output power (peak)	2.5	2.5	MW
Output power (mean)	3.75	3.75	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions (See Note 10)

	Oscillation 1	Oscillation 2	Oscillation 3	
Air flow			see note 11	
Magnetic field (see note 12)	1580	1580	1675	gauss
Heater voltage (for test)	0	0	0	V
Anode current (mean):				
M566	218	186	183	mA
M569, M570	210	180	177	mA
Duty cycle	0.0015	0.001	0.0015	
Pulse length (see note 5)	2.5	5.0	5.0	μs
V.S.W.R. at the output coupler			see note 13	
Rate of rise of voltage pulse (see note 6)	72 to 90	150 to 180	113 to 137	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak):							
M566	36.5	40.5	–	–	–	–	kV
M569, M570	38	42	–	–	–	–	kV
Output power (mean)	3375	–	–	–	–	–	W
Frequency:							
M566	2750	2860	–	–	–	–	MHz
M569	2850	2960	–	–	–	–	MHz
M570	2950	3060	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see notes 14 and 15)	–	1.0	–	0.5	–	0.5	MHz
Frequency pulling (see note 14)	–	7.0	–	–	–	–	MHz
Frequency pushing (see note 16)	–	1.0	–	–	–	–	MHz
Stability (see notes 14, 15 and 17)	–	0.5	–	0.5	–	0.5	%
Heater current						see note 18	
Temperature coefficient of frequency						see note 19	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Life Test Conditions

Heater voltage	0	V
Magnetic field	1580	gauss
Anode current (mean):		
M566	218	mA
M569, M570	210	mA
Duty cycle	0.0015	
Pulse length	5.0	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage pulse	113 to 137	kV/μs

Switched off for 60 minutes every 24 hours.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2700	W min
R.F. bandwidth at ¼ power (see notes 14 and 15)	1.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see notes 14, 15 and 17)	1.0	% max

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12 volts to the heater for at least four minutes or by the application of 15 volts for three minutes. The heater voltage must not exceed 12.6 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the following formulae:

   V_h = 12.0–0.0010Pi for Pi less than 6000 watts
   V_h = 30.0–0.0040Pi for Pi greater than 6000 watts
   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. The current required to give a field of 1580 gauss is marked on each M4017 electro-magnet assembly. Arrangements should be made for the magnetron input pulse to be switched off if the electro-magnet current varies by more than ±5% from this value.

   The ripple on the electro-magnet current should not exceed 1.5% overall. A three phase full wave rectifier output is normally suitable.

3. Measured at the point specified on the electro-magnet and launching section (page 12).

4. The various parameters are related by the formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

5. Tolerance ±10%.

6. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

7. Measured at the point indicated on the outline drawing.

8. In order to prevent malfunction, e.g. spectrum degradation, it is necessary to control the load v.s.w.r. in certain frequency bands other than the operating band; it is also necessary to avoid high Q resonances at frequencies adjacent to these band edges. The use of an isolator of approved design will facilitate the realization of these conditions.

Type	**Frequency band (MHz)**	**Maximum V.S.W.R.**
M566	3000 to 3100	2.0:1
	3450 to 3560	1.5:1
M569	3100 to 3200	2.0:1
	3450 to 3560	1.5:1
M570	3200 to 3300	2.0:1
	3510 to 3660	1.5:1

9. At the maximum pressure of 65lb/in^2 (4.57kg/cm^2) the leakage will not exceed 0.03 litre (N.T.P.) per minute.

10. The modulator shall be such that the pulse energy delivered to the magnetron, followed by an arcing pulse, cannot greatly exceed the normal energy per pulse.

11. During this test the waveguide air pressure shall not exceed 35lb/in^2 (2.46kg/cm^2) absolute and the cooling air flow shall not exceed 3ft^3/min (0.085m^3/min) free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

12. The value of the axial magnetic field shall fall to between 87.5% and 92% of the value at the specified point at points distant ±2 inches along

the magnetron axis from the specified point. The sense of the field shall be such that a north-seeking pole at the specified point is attracted towards the cathode terminal of the magnetron.

13. The load termination of the magnetron during this test shall be a waveguide with a v.s.w.r. of less than 1.1:1 at the oscillation frequency and less than 1.5:1 between the following frequencies unless otherwise specified.

M566	**M569**	**M570**
3000 to 3100MHz	3100 to 3200MHz	3200 to 3300MHz

14. The valve shall be terminated by a mismatch giving a v.s.w.r. of at least 1.5:1 at the oscillating frequency. The mismatch shall be such that when the position of a voltage maximum is set to coincide with the launching section Reference Plane C-C' (see page 12) the position of the voltage minimum at a frequency of 3050MHz for M566, 3150MHz for M569, and 3250MHz for M570, shall lie between ±10mm from the Reference Plane.

15. There shall be a range of at least $\lambda g/4$ where both the stability and bandwidth are less than the specified maxima, and they shall also be less than the maxima into a matched load.

16. The change in frequency when the mean input current is varied between the limits of 202 and 233mA for M566, and between the limits of 195 and 225mA for M569 and M570, shall be less than 1MHz. The current shall be varied continuously between the limits with a period not exceeding 5 seconds.

17. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the magnetron. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

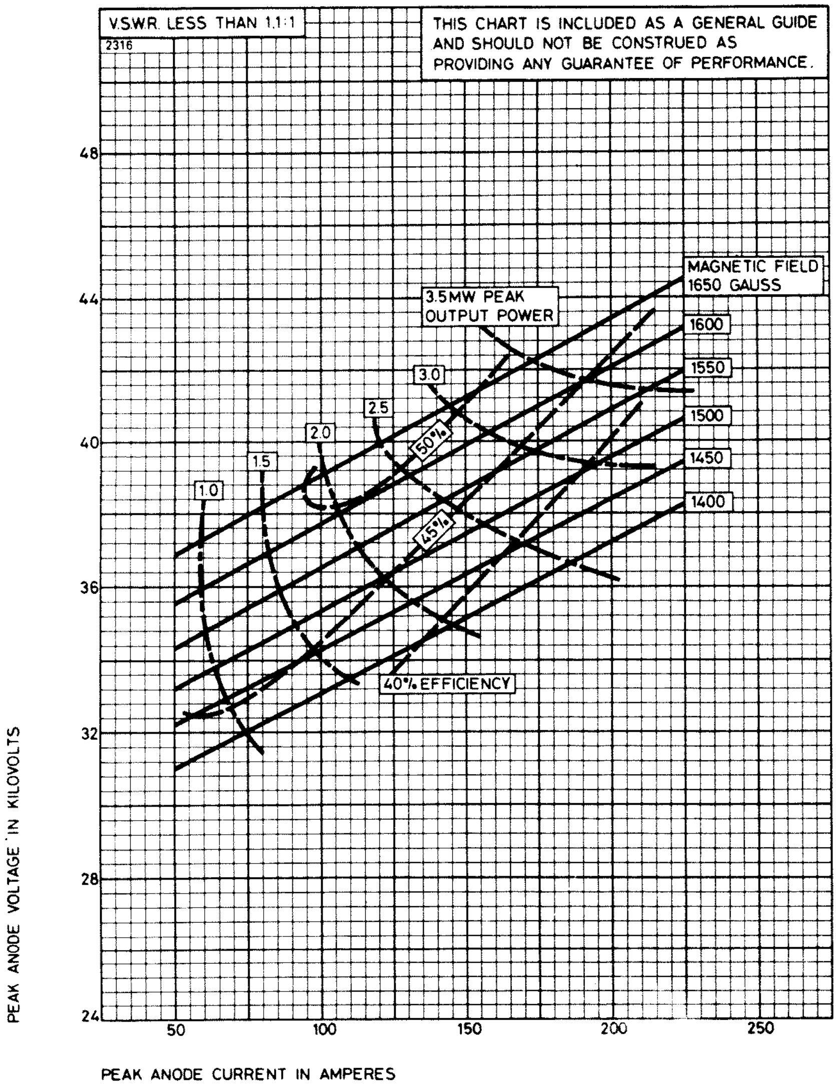
18. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

19. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.05MHz/°C.

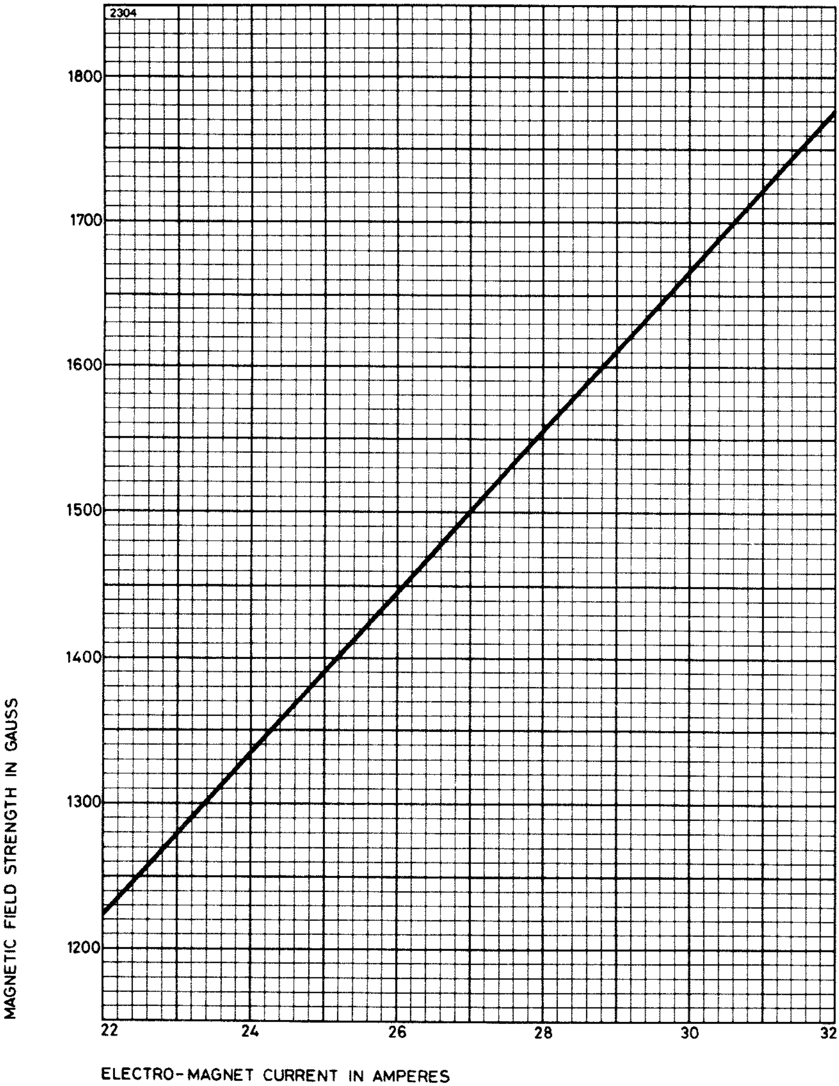
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART FOR M569

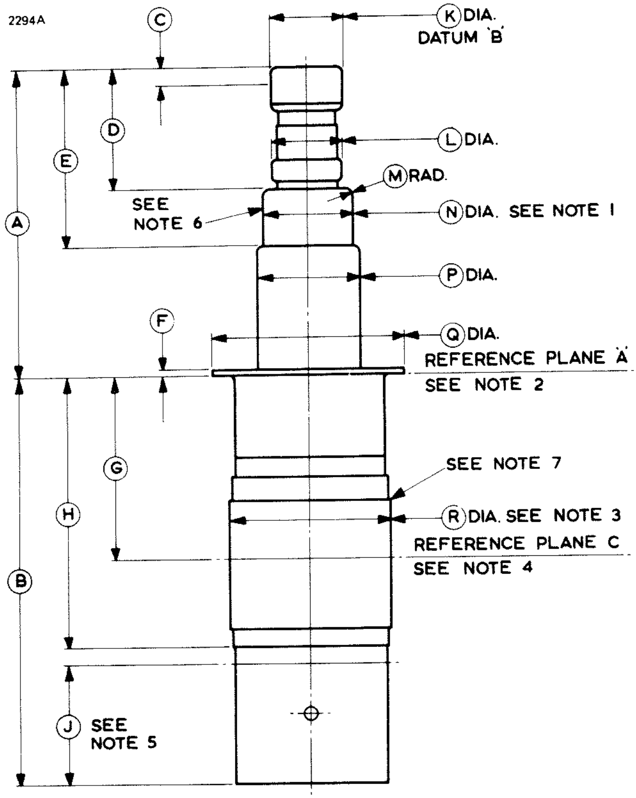


TYPICAL CURRENT CHARACTERISTIC FOR M4017



An individual calibration curve is supplied with each M4017 (see note 2 on page 6 also). Other types of electro-magnet will require calibration.

OUTLINE



2294A
C
K DIA.
DATUM 'B'
D
E
L DIA.
M RAD.
SEE
NOTE 6
N DIA. SEE NOTE 1
A
P DIA.
F
Q DIA.
REFERENCE PLANE 'A'
SEE NOTE 2
G
SEE NOTE 7
H
R DIA. SEE NOTE 3
REFERENCE PLANE C
SEE NOTE 4
B
J SEE
NOTE 5

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	6.427 max	163.2 max
B	8.514	216.3
C	0.375 min	9.53 min
D	3.063 max	77.80 max
E	3.563 min	90.50 min
F	0.125 ± 0.005	3.18 ± 0.13
G	3.939	100.1
H	5.689	144.5
J	2.500 min	63.50 min
K	1.500 ± 0.010	38.10 ± 0.25
L	1.550 max	39.37 max
M	0.100 min	2.54 min
N	1.750 ± 0.010	44.45 ± 0.25
P	1.937 max	49.20 max
Q	3.995 ± 0.005	101.5 ± 0.13
R	3.251 max	82.58 max

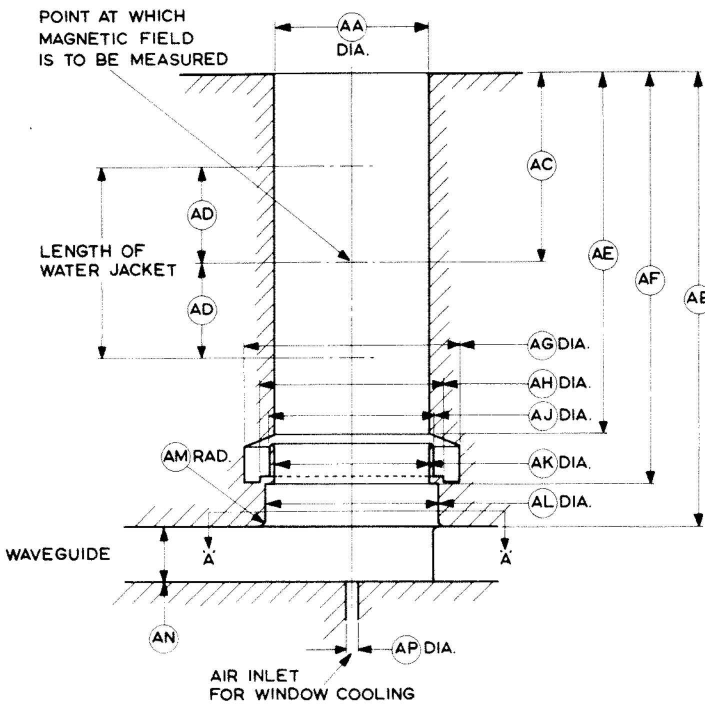
Millimetre dimensions have been derived from inches.

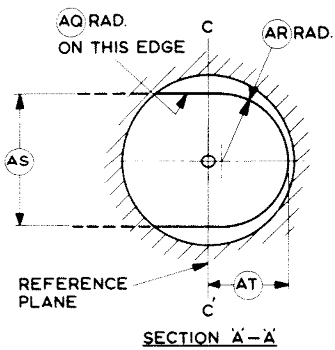
OUTLINE NOTES

1. Concentric tolerance 0.050 inch (1.27mm) diameter, Datum 'B' B.S.308-1953.
2. This plane will be square to the axis of diameter 'R' to within 10'.
3. This surface will be silver or nickel plated.
4. Reference plane 'C' is the plane at which the magnetic field is measured. The magnetic field must be within the specified limits for an axial distance of ±2.000 inches (50.80mm) from plane 'C' and the valve must be fitted into a water jacket 3.253 ± 0.001 inches (82.626 ± 0.025mm) diameter which extends for ±2.000 inches (50.80mm) from plane 'C'.
5. The diameter over dimension 'J' will be 3.200 ± 0.010 inches (81.28 ± 0.25mm).
6. Cathode terminal temperature measured here.
7. Anode temperature measured here.
8. All metal surfaces will be silver or nickel plated or black finish.

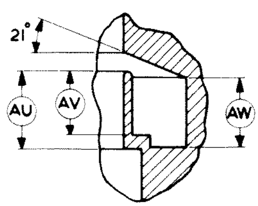
CROSS SECTION OF SUITABLE ELECTRO-MAGNET AND LAUNCHING SECTION

2295





SECTION A'–A'



DETAIL OF CHOKE DITCH

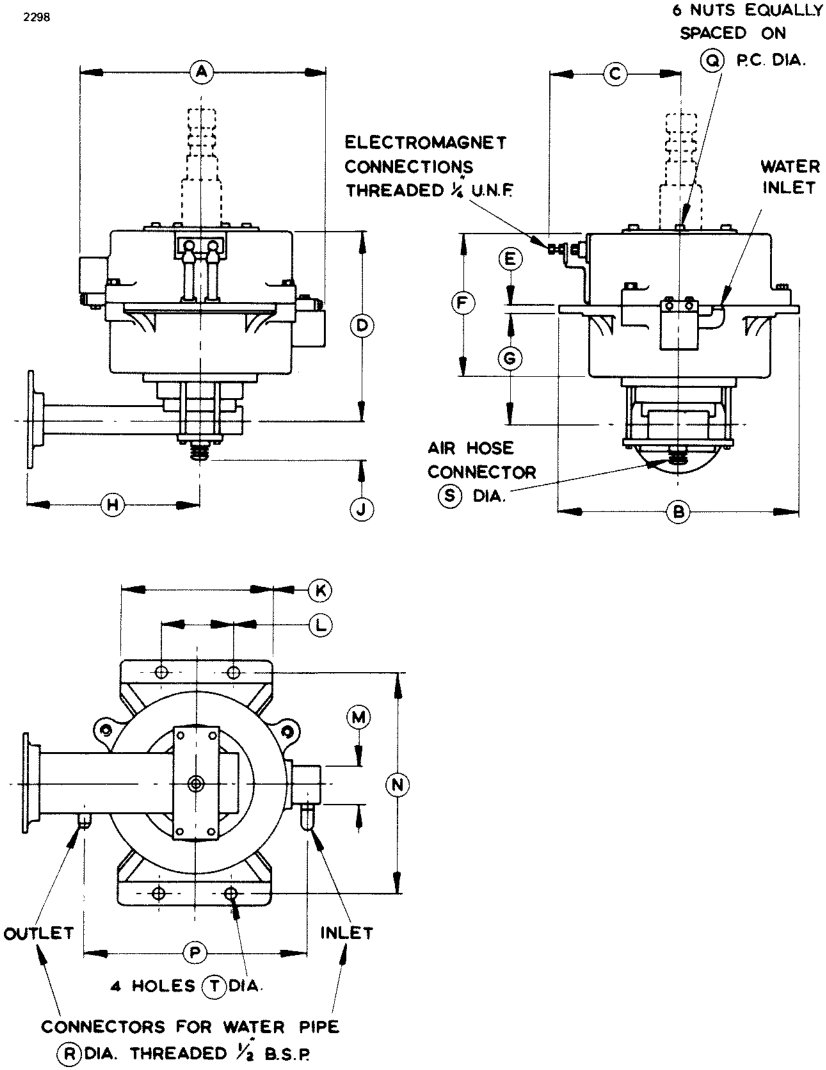
DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	3.253 ± 0.001	82.626 ± 0.025
AB	9.551	242.6
AC	3.939	100.1
AD	2.000 min	50.80 min
AE	7.637	194.0
AF	8.601	218.5
AG	4.340 ± 0.005	110.2 ± 0.13
AH	3.713 ± 0.003	94.310 ± 0.076
AJ	3.410 ± 0.005	86.61 ± 0.13
AK	3.250 ± 0.005	82.55 ± 0.13
AL	3.625 ± 0.003	92.075 ± 0.076
AM	0.125	3.18
AN	1.340	34.04
AP	0.250	6.35
AQ	0.125	3.18
AR	1.417 ± 0.005	35.99 ± 0.13
AS	2.840	72.14
AT	1.667 ± 0.010	42.34 ± 0.25
AU	0.813 ± 0.010	20.65 ± 0.25
AV	0.688 ± 0.010	17.48 ± 0.25
AW	0.750 ± 0.010	19.05 ± 0.25

Millimetre dimensions have been derived from inches.

OUTLINE FOR M4011

2298



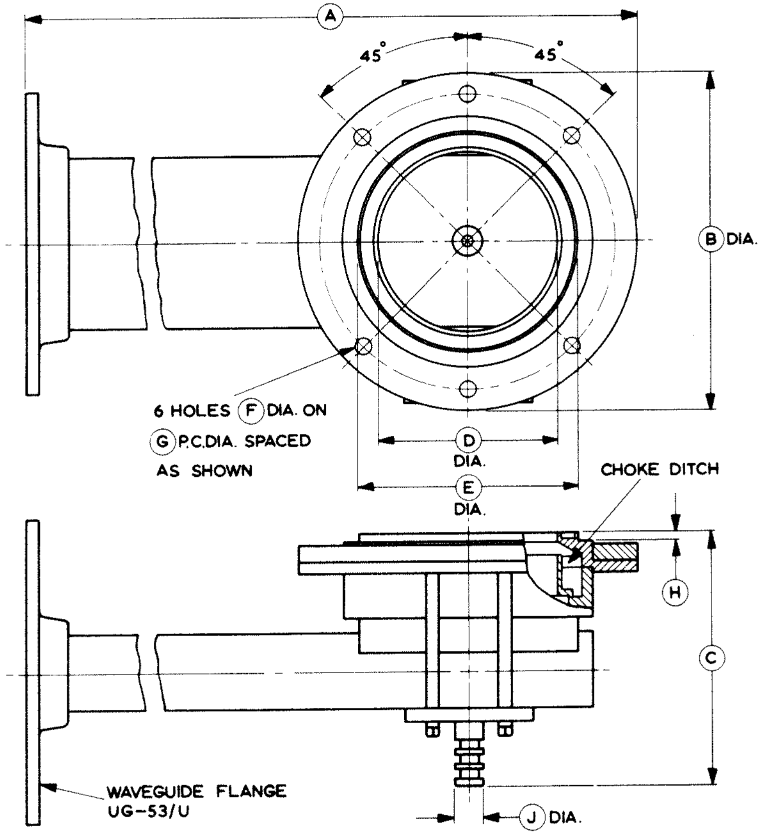
OUTLINE DIMENSIONS FOR M4011

Ref	Inches	Millimetres
A	12.875	327.0
B	12.625	320.7
C	7.000 max	177.8 max
D	10.031	254.8
E	0.375	9.53
F	7.500	190.5
G	5.906	150.0
H	9.000	228.6
J	2.000 max	50.80 max
K	8.000	203.2
L	3.750	95.25
M	2.000	50.80
N	11.625	295.3
P	11.375	288.9
Q	5.250	133.4
R	0.500	12.70
S	0.500	12.70
T	0.406	10.31

Millimetre dimensions have been derived from inches.

OUTLINE FOR M4017

2297



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.969	304.0	F	0.265	6.73
B	5.938	150.8	G	5.250	133.4
C	4.406	111.9	H	$0.140 \begin{smallmatrix} +0.005 \\ -0.000 \end{smallmatrix}$	$3.56 \begin{smallmatrix} +0.13 \\ -0.00 \end{smallmatrix}$
D	3.255	82.68			
E	3.865 ± 0.002	98.17 ± 0.25	J	0.500	12.70

Millimetre dimensions have been derived from inches.

M573 M574

S-BAND MAGNETRONS

Frequency variants of 7182

ABRIDGED DATA

Fixed frequency pulse magnetrons		
Frequency range:		
M573	2850 to 2960	MHz
M574	2950 to 3060	MHz
Typical peak output power	2.5	MW
Magnet and launching section	separate electromagnet and launching section, see page 10	
Output	no. 10 waveguide (2.840 x 1.340 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	12	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum) (see note 1)	3	min

Mechanical

Overall dimensions	15.32 x 3.26 x 3.26 inches max 390 x 82.9 x 82.9mm max
Net weight	9¾ pounds (4.5kg) approx
Mounting position	vertical only

Any lubricants used on the anode should be sulphur free.

Cooling water and forced-air (high pressure)

Water-cooling of the anode is incorporated with the electro-magnet, the window is cooled by air at high pressure in the waveguide, while low pressure air cooling may be used on the cathode terminal. The minimum window cooling air flow is 3ft^3/min (0.085m^3/min) N.T.P., and the maximum air inlet temperature is 70°C.

The temperature rise across the water jacket should not exceed 15°C nor the water flow be less than 0.75 imp. gal/min (3.4 l./min). The design maximum temperature of the outlet water should be 70°C; under no conditions must 80°C be exceeded.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 2):			
M573	1460	1580	gauss
M574	1520	1640	gauss
Heater voltage (see note 1)	11.4	15.0	V
Heater starting current (peak)	–	40	A
Anode voltage (peak):			
M573	35	41	kV
M574	38	44	kV
Anode current (peak):			
M573	115	170	A
M574	105	155	A
Input power (peak)	–	6.0	MW
Input power (mean) (see note 3)	–	8.3	kW
Duty cycle	–	0.0015	
Pulse length (see note 4)	0.5	5.0	μs
Pulse repetition rate	–	600	p.p.s.
Rate of rise of voltage pulse (see note 5)	100	150	kV/μs
Anode temperature (see note 2)	–	150	°C
Cathode terminal temperature (see note 2)	–	150	°C
V.S.W.R. at the output coupler (see note 6)	–	1.5:1	
Pressurising of waveguide (see note 7)	35	65	lb/in^2
	2.46	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field:		
M573	1520	gauss
M574	1580	gauss
Anode current (peak):		
M573	144	A
M574	132	A
Pulse length	5.0	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak):		
M573	38	kV
M574	41	kV
Output power (peak)	2.5	MW
Output power (mean)	3.75	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions (See Note 8)

	Oscillation 1	Oscillation 2	Oscillation 3	
Air flow			see note 9	
Magnetic field (see note 10):				
M573	1520	1520	1610	gauss
M574	1580	1580	1675	gauss
Heater voltage (for test)	0	0	0	V
Anode current (mean):				
M573	215	180	188	mA
M574	198	165	174	mA
Duty cycle	0.0015	0.001	0.0015	
Pulse length (see note 4)	2.5	5.0	5.0	μs
V.S.W.R. at the output coupler			see note 11	
Rate of rise of voltage pulse (see note 5)	72 to 90	150 to 180	113 to 137	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak):							
M573	36	40	–	–	–	–	kV
M574	39	43	–	–	–	–	kV
Output power (mean)	3375	–	–	–	–	–	W
Frequency:							
M573	2850	2960	–	–	–	–	MHz
M574	2950	3060	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see notes 12 and 13)	–	1.0	–	0.5	–	0.5	MHz
Frequency pulling (see note 12)	–	7.0	–	–	–	–	MHz
Frequency pushing (see note 14)	–	1.0	–	–	–	–	MHz
Stability (see notes 12, 13 and 15)	–	0.5	–	0.5	–	0.5	%
Heater current						see note 16	
Temperature coefficient of frequency						see note 17	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Life Test Conditions

Heater voltage	0	V
Magnetic field:		
M573	1520	gauss
M574	1580	gauss
Anode current (mean):		
M573	215	mA
M574	198	mA
Duty cycle	0.0015	
Pulse length	5.0	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage pulse	113 to 137	kV/μs

Switched off for 60 minutes every 24 hours.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2700	W min
R.F. bandwidth at ¼ power (see notes 12 and 13)	1.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see notes 12, 13 and 15)	1.0	% max

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12 volts to the heater for at least four minutes or by the application of 15 volts for three minutes. The heater voltage must not exceed 12.6 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the formulae:

   $V_h = 12.0 - 0.0010P_i$ for Pi less than 6000 watts

   $V_h = 30.0 - 0.0040P_i$ for Pi greater than 6000 watts

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as $2\mu F$ may be necessary depending on the equipment design. For further details see the preamble to this section.

The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Measured at the point specified on the electro-magnet and launching section (see page 10).

3. The various parameters are related by the formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

where P_i = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

6. A phase shifter should be incorporated into the waveguide immediately before the magnetron, and adjusted, if necessary, to give a satisfactory spectrum. The standing wave ratio between 3100 and 3200MHz for M573, and between 3200 and 3300MHz for M574, should not exceed 2.0:1.

7. At the maximum pressure of 65lb/in^2 (4.57kg/cm^2) the leakage will not exceed 0.03 litre (N.T.P.) per minute.

8. The modulator shall be such that the pulse energy delivered to the magnetron, followed by an arcing pulse, cannot greatly exceed the normal energy per pulse.

9. During this test the waveguide air pressure shall not exceed 35lb/in^2 (2.46kg/cm^2) absolute and the cooling air flow shall not exceed 3ft^3/min (0.085m^3/min) free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

10. The value of the axial magnetic field should not vary by more than ±4% from the value at the specified point of the valve shown on page 10, over a distance of 2 inches (50.8mm) in either direction along the axis. The sense of the field shall be such that a north-seeking pole at the specified point is attracted towards the cathode terminal of the magnetron.

11. The load termination of the magnetron during this test shall be a waveguide with a v.s.w.r. of less than 1.1:1 at the oscillation frequency and less than 1.5:1 between frequencies 3100 and 3200MHz for M573, and between 3200 and 3300MHz for M574, unless otherwise specified.

12. The valve shall be terminated by a mismatch giving a v.s.w.r. of at least 1.5:1 at the oscillating frequency. The mismatch shall be such that when the position of a voltage maximum is set to coincide with the launching section Reference Plane C (see page 12) the position of the voltage minimum at a frequency of 3150MHz for M573 and 3250MHz for M574 shall lie between ±10mm from the Reference Plane.

13. There shall be a range of at least $\lambda g/4$ where both the stability and bandwidth are less than the specified maxima, and they shall also be less than the maxima into a matched load.

14. The change in frequency when the mean input current is varied between the limits of 200 and 230mA for M573 and between the limits of 183 and 213mA for M574 shall be less than 1MHz. The current shall be varied continuously between the limits with a period not exceeding 5 seconds.

15. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the magnetron. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

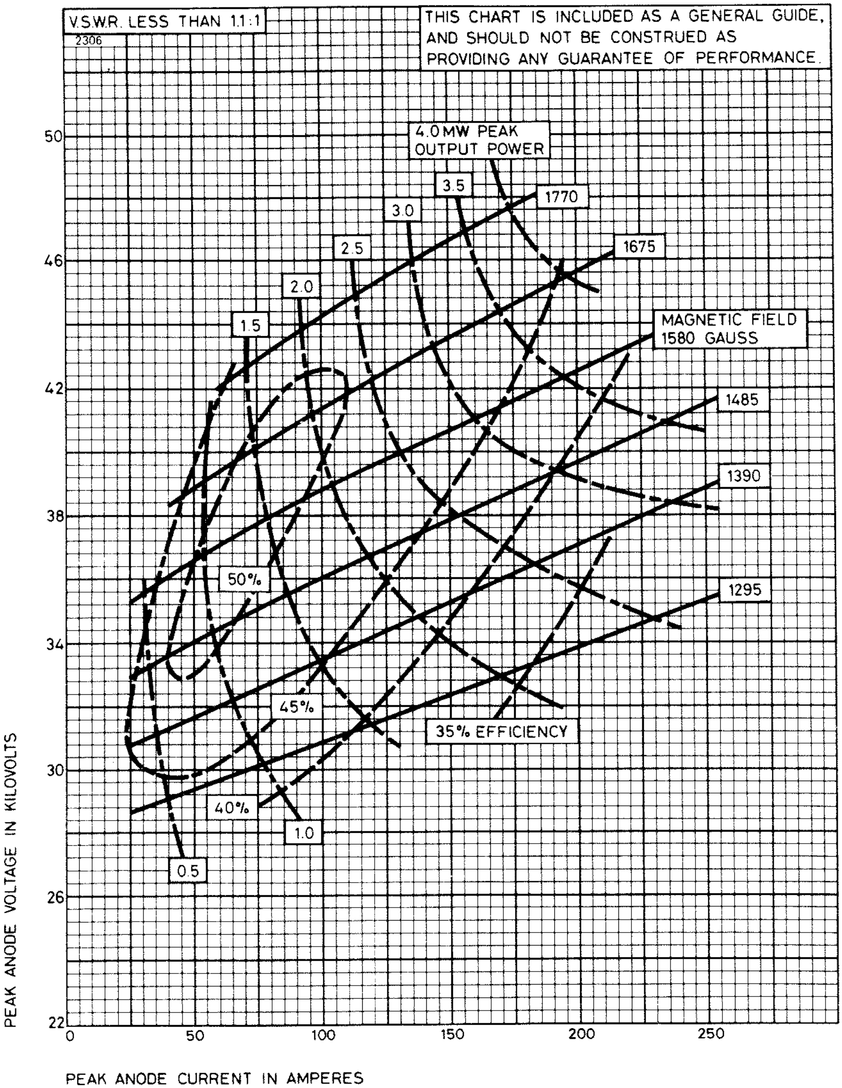
16. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

17. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.05MHz/°C.

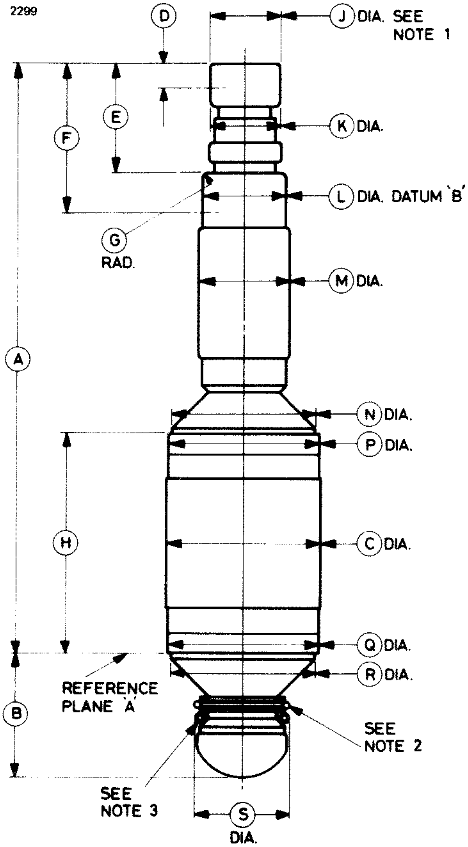
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART FOR M574



OUTLINE


2299
D
J DIA. SEE NOTE 1
E
F
K DIA.
L DIA. DATUM 'B'
G RAD.
M DIA.
A
N DIA.
P DIA.
H
C DIA.
Q DIA.
R DIA.
REFERENCE PLANE 'A'
B
SEE NOTE 2
SEE NOTE 3
S DIA.

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	12.700 max	322.6 max
B	2.620 max	66.55 max
C	3.251 max	82.58 max
D	0.375 min	9.53 min
E	3.063 max	77.80 max
F	3.563 min	90.50 min
G	0.100 min	2.54 min
H	$4.625^{+0.015}_{-0.025}$	$117.48^{+0.38}_{-0.63}$
J	1.500 ± 0.010	38.10 ± 0.25
K	1.550 max	39.37 max
L	1.750 ± 0.010	44.45 ± 0.25
M	1.937 max	49.20 max
N	3.065 max	77.85 max
P	3.180 min	80.77 min
Q	3.180 min	80.77 min
R	3.065 max	77.85 max
S	1.980 min	50.29 min

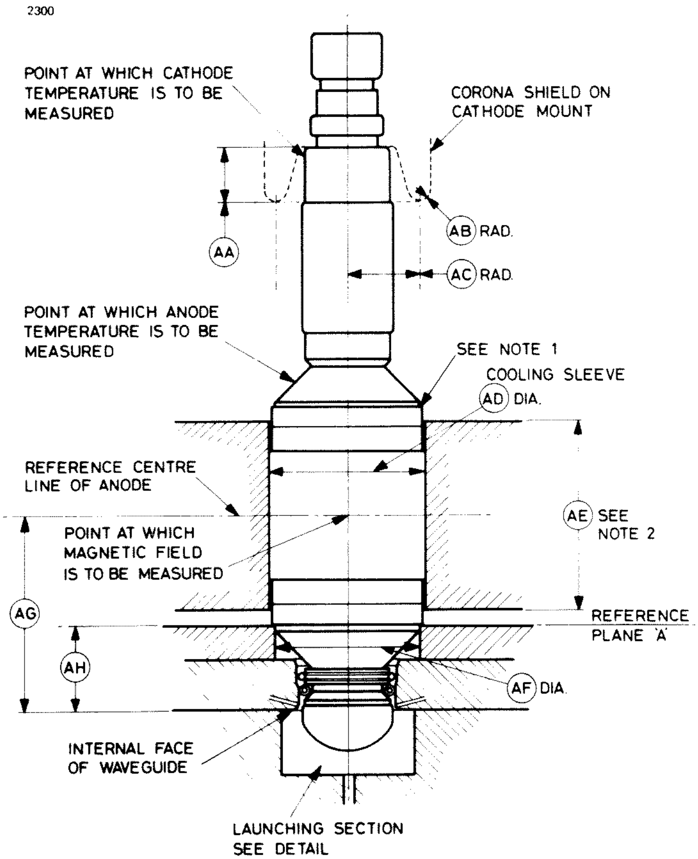
Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Concentric tolerance 0.050 inch (1.27mm) diameter, Datum 'B' (B.S.308: 1953).
2. Silicone rubber 'O' ring, 50° Shore hardness. The dimensions and fit of this section to be tested on a pressure and leakage testing jig.
3. The contact spring dimensions to be measured when the part is not compressed.
4. All metal surfaces will be nickel or silver plated.

ELECTRO-MAGNET AND LAUNCHING SECTION

See page 12 for detail of launching section



DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	1.375 min	34.93 min	AN	0.405 max	10.29 max
AB	0.250 min	6.35 min		0.400 min	10.16 min
AC	1.500 min	38.10 min	AP	0.187	4.75
AD	3.253 ± 0.001	82.626 ± 0.025	AQ	0.094	2.39
AE	4.000 min	101.6 min	AR	0.170	4.32
AF	3.068 ± 0.002	77.927 ± 0.051	AS	0.050 max	1.27 max
AG	4.080	103.6	AT	0.125 ± 0.015	3.18 ± 0.38
AH	1.767 ± 0.020	44.88 ± 0.51	AU	1.062	26.97
AJ	0.125	3.18	AV	1.340 ± 0.004	34.036 ± 0.102
AK	2.021 ± 0.001	51.333 ± 0.025	AW	0.125 ± 0.015	3.18 ± 0.38
AL	1.963 ± 0.001	49.860 ± 0.025	AX	1.181	30.00
AM	0.062	1.47	AY	2.840 ± 0.004	72.136 ± 0.102

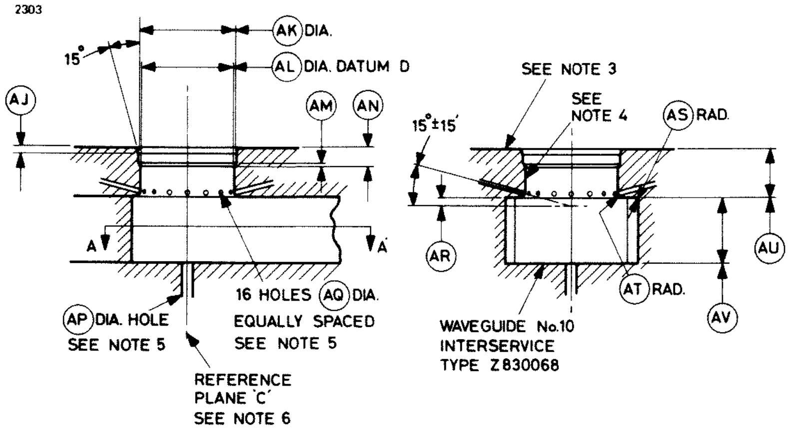
Millimetre dimensions have been derived from inches.

NOTES FOR ELECTRO-MAGNET AND LAUNCHING SECTION

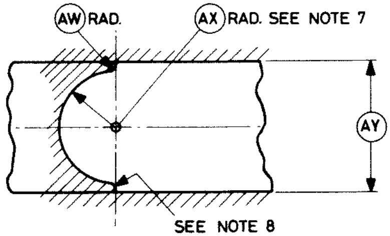
1. An adjustable device shall be used to bear on this shoulder and to ensure that the magnetron locates on reference plane 'A'. It must be able to withstand the thrust on the magnetron due to a pressure of 65 lb/in^2 absolute in the waveguide.
2. The length of the water jacket centre line to be within 0.025 inch (0.64mm) of the reference centre line.
3. The flange to be central in the broad face of the waveguide to within ±0.005 inch (±0.13mm).
4. The internal surface of the flange to be silver plated 0.001 inch (0.025mm) thick, then rhodium plated 0.0001 inch (0.0025mm) thick.
5. Entry holes for window cooling air.
6. Reference plane 'C' is used for the definition of the phase of the standing wave in the waveguide.
7. Concentric tolerance 0.005 inch (0.13mm) Datum 'D' (B.S.308:1953).
8. The end plug profile to finish on a plane through the flange centre line and square to the waveguide internal profile to within ±0.005 inch (±0.13mm).

DETAIL OF LAUNCHING SECTION

See page 11 for dimensions and notes



Section A - A' showing shorting plug



M577B M578B

S-BAND MAGNETRONS

Service Type CV10210 (M577B)

ABRIDGED DATA

Fixed frequency pulse magnetrons, replacing types M577, M577A and M578, M578A. Frequency variants of 4J43 and 4J44.

Frequency range:		
M577B	3000 to 3040	MHz
M578B	3060 to 3100	MHz
Typical peak output power	900	kW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any

Cooling

forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	10.5	V
Magnetic field (see note 8)	2700	gauss
Anode current (peak)	70	A
Pulse length	1.0	μs
Pulse repetition rate	500	p.p.s.

Typical Performance

Anode voltage (peak)	28	kV
Output power (peak)	900	kW
Output power (mean)	450	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	$kV/\mu s$

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	–	–	kV
Output power (mean)	400	–	–	–	W
Frequency:					
M577B	3000	3040	–	–	MHz
M578B	3060	3100	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.5	–	0.5	%
Heater current					see note 10
Temperature coefficient of frequency					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13.0
400–600	15.0
less than 400	16.0

The above schedule is valid only for pulse repetition rates of 300p.p.s. or higher.

The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

(b) M577B and M578B have hum-free heaters and have been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

where P_i = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit spe.``'ɔd by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of $45lb/in^2$ absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

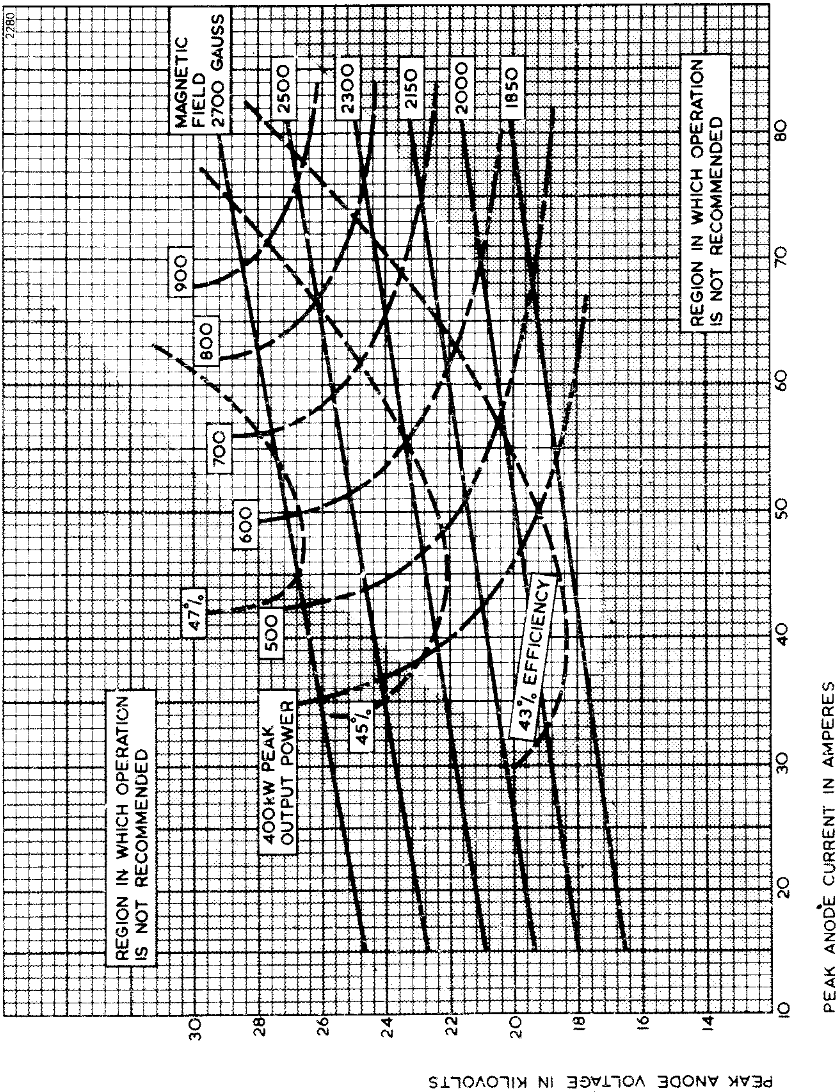
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

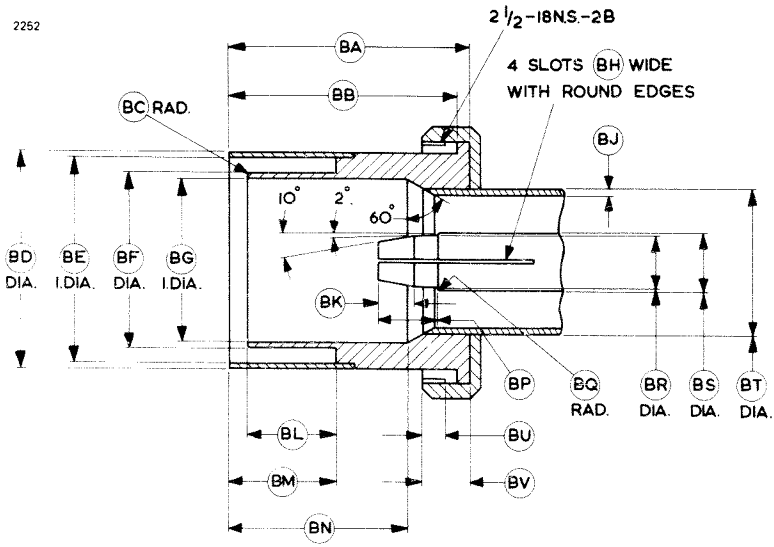
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07MHz/°C.

PERFORMANCE CHART



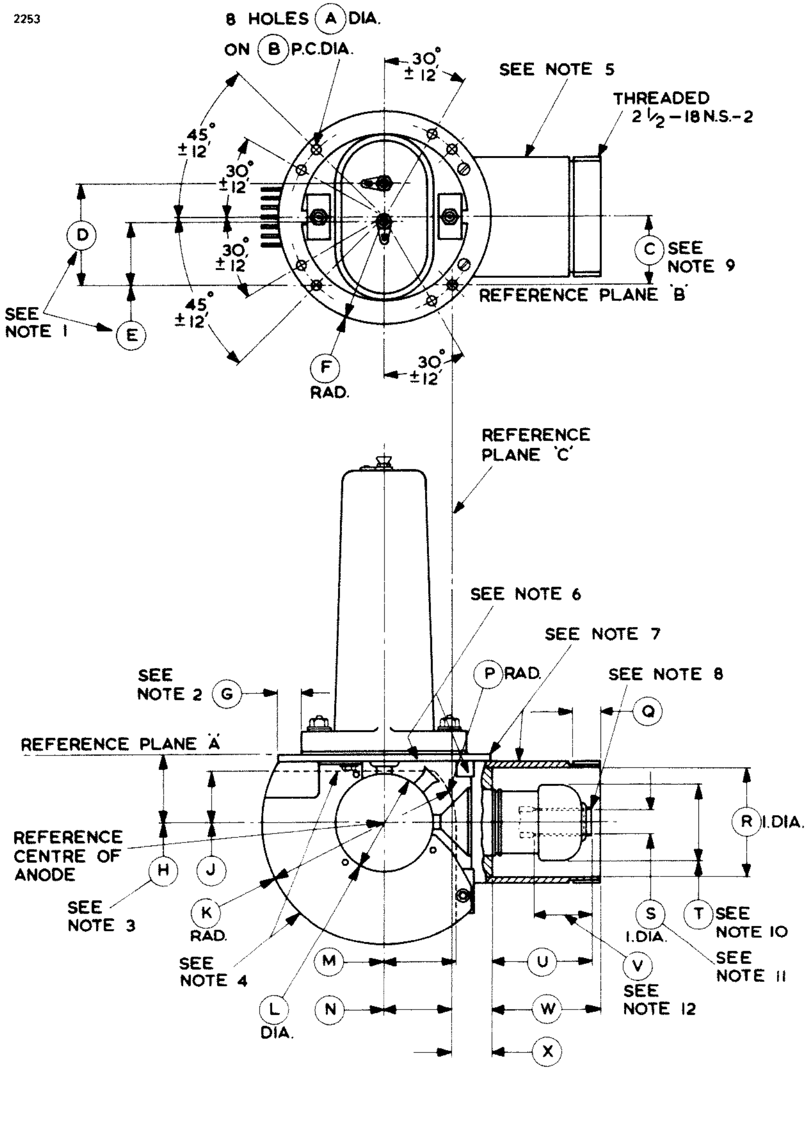
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches

OUTLINE (See page 10 for outline notes)

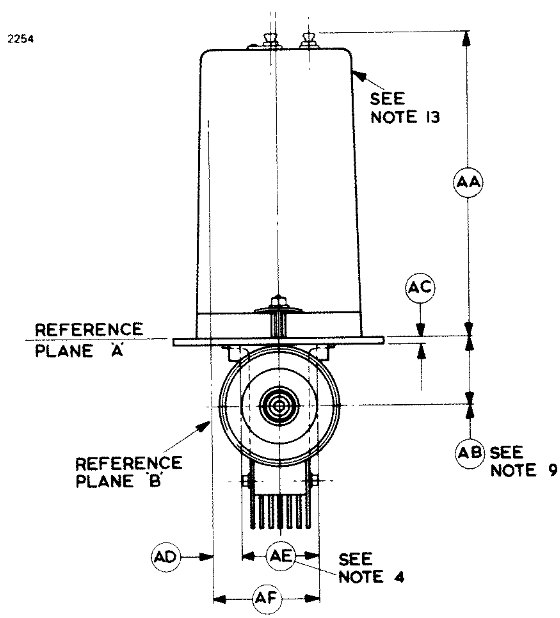


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

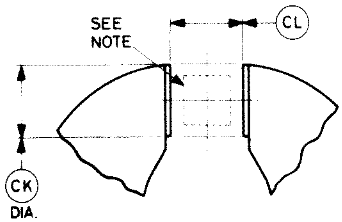
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 $\pm$ 0.015 inch (20.24 $\pm$ 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION



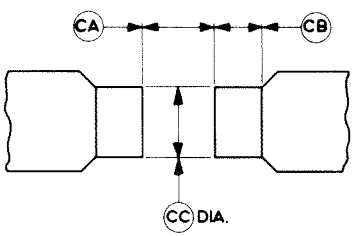
Ref	Inches	Millimetres
CK	1.500	38.10
CL	1.500 $^{+0.010}_{-0.000}$	38.10 $^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed $\pm$140 gauss.

ELECTRO-MAGNET POLE PIECES

2255



Ref	Inches	Millimetres
CA	1.500 $^{+0.005}_{-0.000}$	38.10 $^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 $\pm$ 0.010	38.10 $\pm$ 0.25

Millimetre dimensions have been derived from inches.

M579

S-BAND
MAGNETRON

Frequency variant of M566, M569, M570

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	3050 to 3160	MHz
Typical peak output power	2.5	MW
Magnet and launching section	separate electromagnet and launching section assembly M4011 (see page 12 also)	
Isolator	use of an isolator is recommended (see note 8, page 6)	
Output	no. 10 waveguide (2.840 x 1.340 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	12	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum) (see note 1)	3	min

Mechanical

Overall dimensions	15.00 x 4.00 x 4.00 inches max 381 x 102 x 102mm max
Net weight	9¾ pounds (4.5kg) approx
Mounting position	vertical only

Any lubricants used on the anode should be sulphur free.

Electro-magnet and Launching Section

The complete electro-magnet and launching section is designated M4011 (see page 14); the launching section can be supplied as a separate item if required and is designated M4017 (see page 16).

	Min	Max	
D.C. current for 1580 gauss field (see note 2 and page 9)	27	30	A
Resistance of field windings:			
at 20°C	0.9	1.15	Ω
during operation	–	1.65	Ω
Overall dimensions (see page 14)	15.437 x 12.625 x 12.250 inches approx 392 x 320 x 310mm approx		
Net weight	110 pounds (50kg) approx		
Output flange	UG-53/U		

Cooling

The electro-magnet is water cooled and provides cooling for the magnetron anode by conduction through the inner liner of the magnet assembly into which the magnetron fits. The liner is machined to very fine limits and it is essential that the inner surface is carefully cleaned before the magnetron is fitted. Precautions must be taken to ensure that power to the magnetron and the electro-magnet is removed in the event of a cooling water supply failure. A flow of 1.5 imp. gal/min (6.8 l./min) is usually adequate, although this will depend on the method employed for mounting the assembly. The water pressure required for a flow of 1.5 imp. gal/min (6.8 l./min) is 4 lb/in^2 (0.28kg/cm^2) maximum.

The temperature rise across the water jacket should not exceed 15°C nor the water flow be less than 0.75 imp. gal/min (3.4 l./min). The design maximum temperature of the outlet water should be 70°C; under no conditions must 80°C be exceeded.

The magnetron output window is cooled by air at high pressure in the wave-guide; the minimum window cooling air flow is 3ft^3/min (0.085m^3/min) N.T.P., and the maximum air inlet temperature is 70°C.

The cathode terminal may be cooled by low pressure air.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 3)	1200	1675	gauss
Heater voltage (see note 1)	11.4	15.0	V
Heater starting current (peak)	–	40	A
Anode voltage (peak)	27	41.5	kV
Anode current (peak)	70	176	A
Input power (peak)	–	6	MW
Input power (mean) (see note 4)	–	8.5	kW
Duty cycle	–	0.0015	
Pulse length (see note 5)	0.5	5.0	μs
Pulse repetition rate	–	600	p.p.s.
Rate of rise of voltage pulse (see note 6)	100	150	kV/μs
Anode temperature (see note 7)	–	150	°C
Cathode terminal temperature (see note 7)	–	150	°C
V.S.W.R. at the output coupler (see note 8)	–	1.5:1	
Pressurising of waveguide (see note 9)	35	65	lb/in^2
	2.46	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	1580	gauss
Anode current (peak)	145	A
Pulse length	5.0	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak)	38.5	kV
Output power (peak)	2.5	MW
Output power (mean)	3.75	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions (see note 10)

	Oscillation 1	Oscillation 2	Oscillation 3	
Air flow			see note 11	
Magnetic field (see note 12)	1580	1580	1675	gauss
Heater voltage (for test)	0	0	0	V
Anode current (mean)	210	180	187	mA
Duty cycle	0.0015	0.001	0.0015	
Pulse length (see note 5)	2.5	5.0	5.0	μs
V.S.W.R. at the output coupler			see note 13	
Rate of rise of voltage pulse (see note 6)	72 to 90	150 to 180	113 to 137	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	38.0	41.5	–	–	–	–	kV
Output power (mean)	3375	–	–	–	–	–	W
Frequency	3050	3160	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see note 14)	–	1.0	–	0.5	–	0.5	MHz
Frequency pulling	–	7	–	–	–	–	MHz
Frequency pushing (see note 15)	–	1.0	–	–	–	–	MHz
Stability (see notes 14 and 16)	–	0.5	–	0.5	–	0.5	%
Heater current					see note 17		
Temperature coefficient of frequency					see note 18		

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Life Test Conditions

Heater voltage	0	V
Magnetic field	1580	gauss
Anode current (mean)	218	mA
Duty cycle	0.0015	
Pulse length	5	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage pulse	113 to 137	kV/μs

Switched off for 60 minutes every 24 hours.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	2700	W min
R.F. bandwidth at ¼ power (see note 14)	1.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see notes 14 and 16)	1.0	% max

NOTES

1. With no anode input power.

   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12 volts to the heater for at least four minutes or by the application of 15 volts for three minutes. The heater voltage must not exceed 12.6 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the following formulae:

   V_h = 12.0–0.0010Pi for Pi less than 6000 watts

   V_h = 30.0–0.0040Pi for Pi greater than 6000 watts

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. The current required to give a field of 1580 gauss is marked on each M4017 electro-magnet assembly. Arrangements should be made for the magnetron input pulse to be switched off if the electro-magnet current varies by more than ±5% from this value.

   The ripple on the electro-magnet current should not exceed 1.5% overall. A three phase full wave rectifier output is normally suitable.

3. Measured at the point specified on the electro-magnet and launching section (page 12).

4. The various parameters are related by the formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

5. Tolerance ±10%.

6. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

7. Measured at the point indicated on the outline drawing.

8. In order to prevent malfunction, e.g. spectrum degradation, it is necessary to control the load v.s.w.r. in certain frequency bands other than the operating band; it is also necessary to avoid high Q resonances at frequencies adjacent to these band edges. The use of an isolator of approved design will facilitate the realization of these conditions.

Frequency Band (MHz)	**Maximum V.S.W.R.**
3300 to 3400	2.0:1
3620 to 3730	1.5:1

9. At the maximum pressure of 65lb/in² (4.57kg/cm²) the leakage will not exceed 0.03 litre (N.T.P.) per minute.

10. The modulator shall be such that the pulse energy delivered to the magnetron, followed by an arcing pulse, cannot greatly exceed the normal energy per pulse.

11. During this test the waveguide air pressure shall not exceed 35lb/in² (2.46kg/cm²) absolute and the cooling air flow shall not exceed

3ft^3/min (0.085m^3/min) free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

12. The value of the axial magnetic field shall fall to between 87.5% and 92% of the value at the specified point at points distant ± 2 inches along the magnetron axis from the specified point. The sense of the field shall be such that a north-seeking pole at the specified point is attracted towards the cathode terminal of the magnetron.

13. The load termination of the magnetron during this test shall be a waveguide with a v.s.w.r. of less than 1.1:1 at the oscillation frequency and less than 1.5:1 between frequencies 3300 and 3400MHz, and between 3620 and 3730MHz, unless otherwise specified.

14. There shall be a range of at least $\lambda g/4$ where both the stability and bandwidth are less than the specified maxima, and they shall also be less than the maxima into a matched load.

15. The change in frequency when the mean input current is varied between the limits of 202 and 233mA shall be less than 1MHz. The current shall be varied continuously between the limits with a period not exceeding 5 seconds.

16. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 3050 to 3160MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

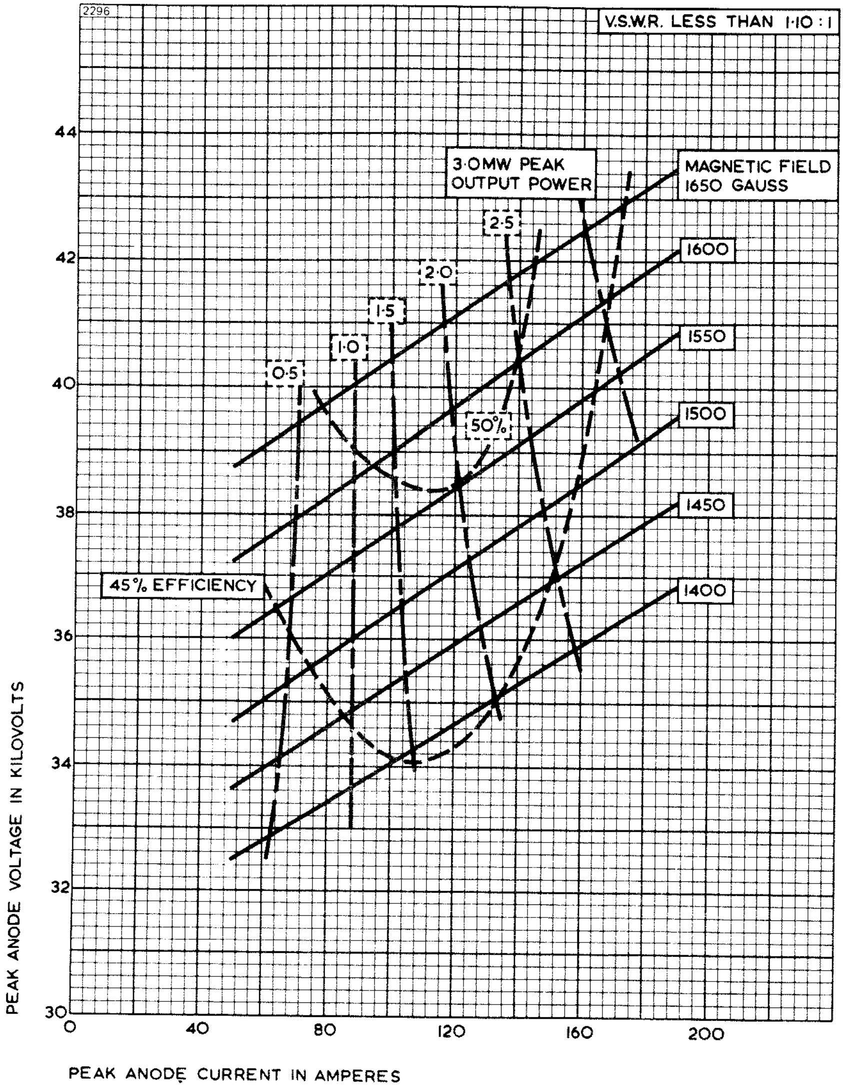
17. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

18. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.05MHz/°C.

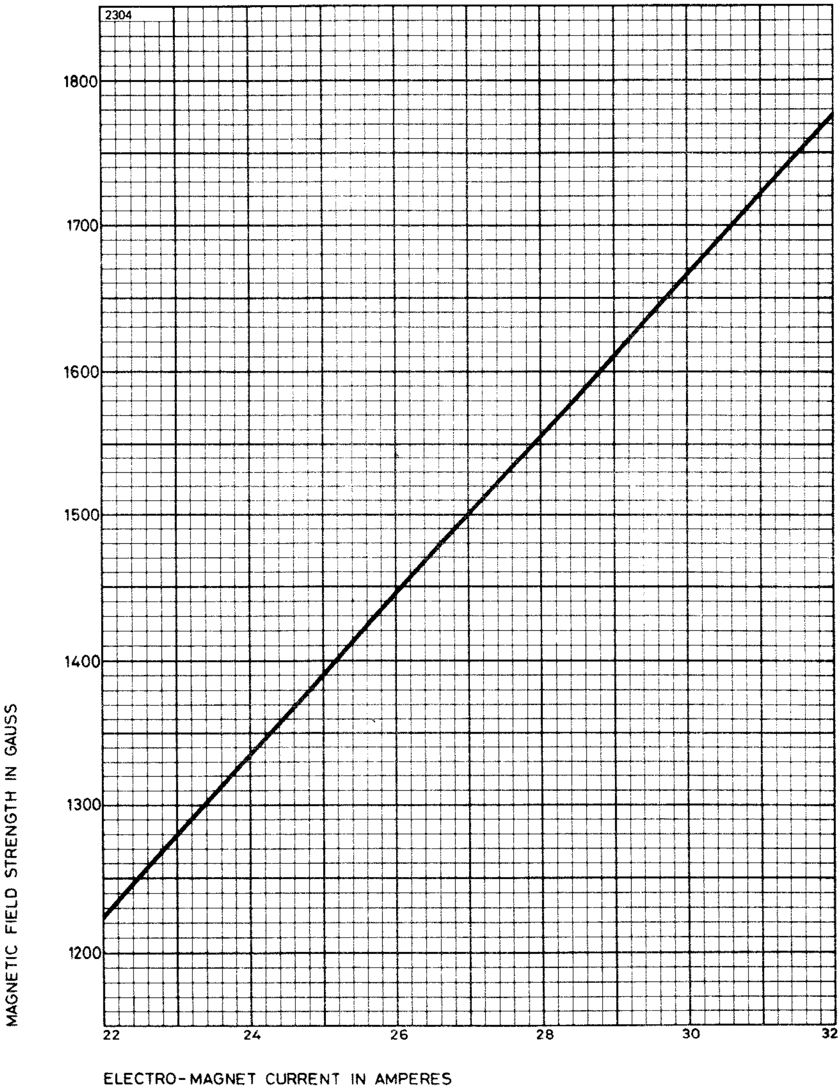
X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

PERFORMANCE CHART

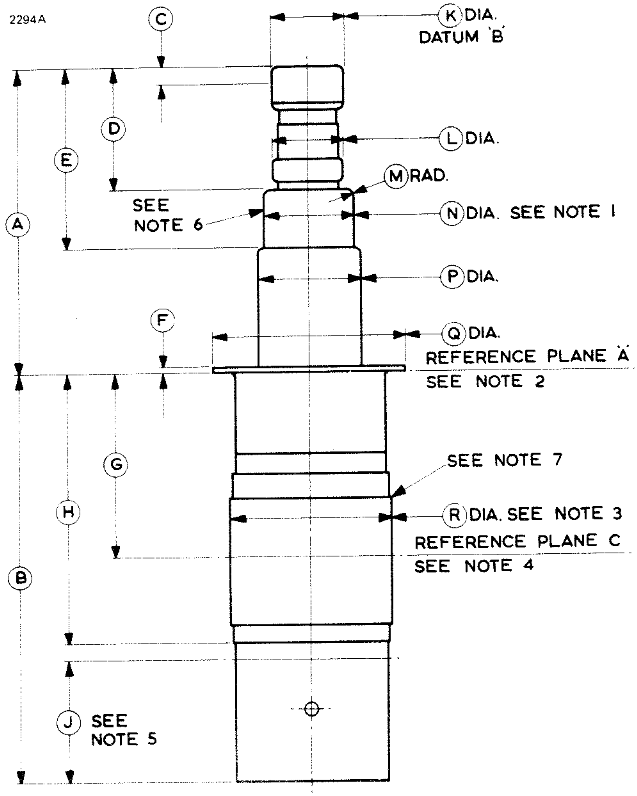


TYPICAL CURRENT CHARACTERISTIC FOR M4017



An individual calibration curve is supplied with each M4017 (see note 2 on page 6 also). Other types of electro-magnet will require calibration.

OUTLINE



2294A
C
K DIA.
DATUM 'B'
D
L DIA.
E
M RAD.
SEE
NOTE 6
N DIA. SEE NOTE 1
A
P DIA.
F
Q DIA.
REFERENCE PLANE 'A'
SEE NOTE 2
SEE NOTE 7
G
H
R DIA. SEE NOTE 3
REFERENCE PLANE C
SEE NOTE 4
B
J SEE
NOTE 5

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	6.427 max	163.2 max
B	8.514	216.3
C	0.375 min	9.53 min
D	3.063 max	77.80 max
E	3.563 min	90.50 min
F	0.125 ± 0.005	3.18 ± 0.13
G	3.939	100.1
H	5.689	144.5
J	2.500 min	63.50 min
K	1.500 ± 0.010	38.10 ± 0.25
L	1.550 max	39.37 max
M	0.100 min	2.54 min
N	1.750 ± 0.010	44.45 ± 0.25
P	1.937 max	49.20 max
Q	3.995 ± 0.005	101.5 ± 0.13
R	3.251 max	82.58 max

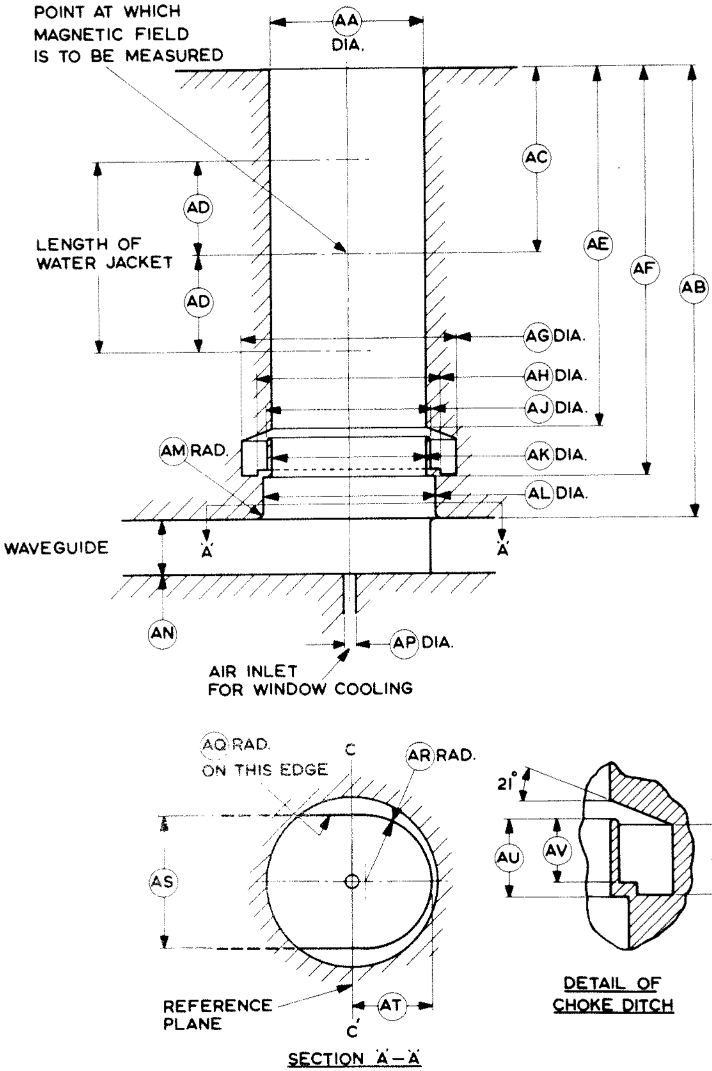
Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Concentric tolerance 0.050 inch (1.27mm) diameter, Datum 'B' B.S.308-1953.
2. This plane will be square to the axis of diameter 'R' to within 10'.
3. This surface will be silver or nickel plated.
4. Reference plane 'C' is the plane at which the magnetic field is measured. The magnetic field must be within the specified limits for an axial distance of ±2.000 inches (50.80mm) from plane 'C' and the valve must be fitted into a water jacket 3.253 ± 0.001 inches (82.626 ± 0.025mm) diameter which extends for ±2.000 inches (50.80mm) from plane 'C'.
5. The diameter over dimension 'J' will be 3.200 ± 0.010 inches (81.28 ± 0.25mm).
6. Cathode terminal temperature measured here.
7. Anode temperature measured here.
8. All metal surfaces will be silver or nickel plated or black finish.

CROSS SECTION OF SUITABLE ELECTRO-MAGNET AND LAUNCHING SECTION

2295

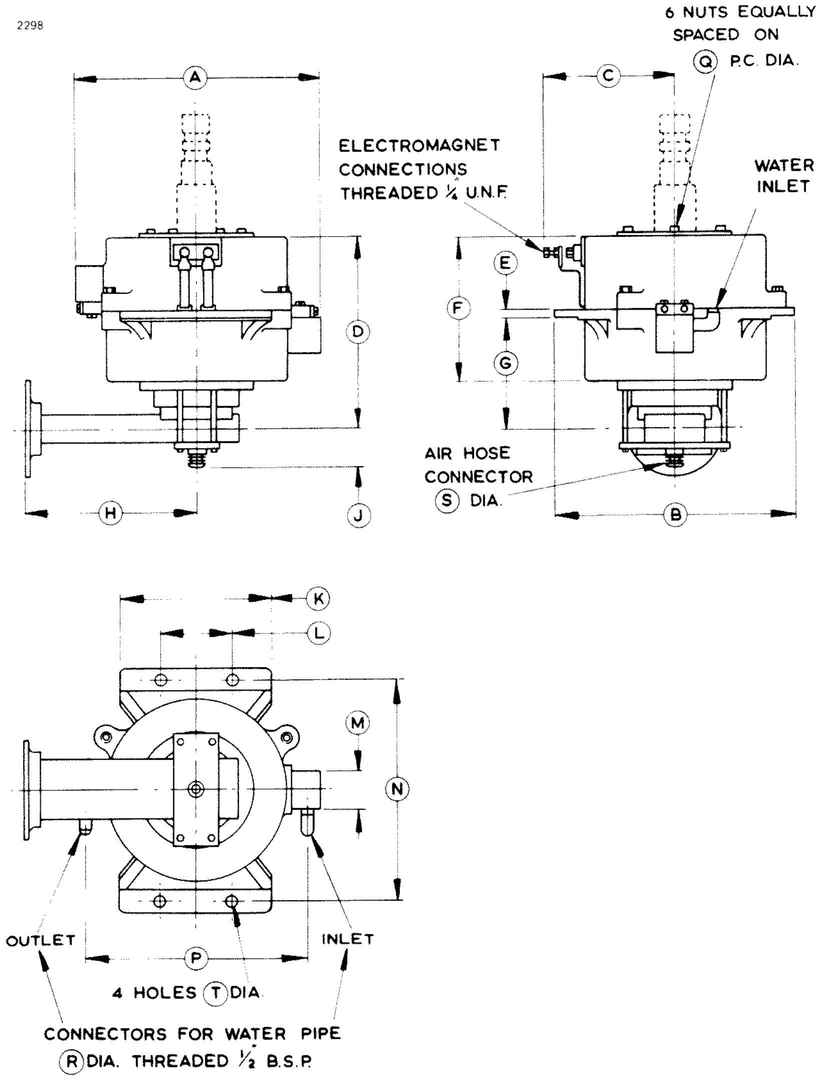


DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	3.253 ± 0.001	82.626 ± 0.025
AB	9.551	242.6
AC	3.939	100.1
AD	2.000 min	50.80 min
AE	7.637	194.0
AF	8.601	218.5
AG	4.340 ± 0.005	110.2 ± 0.13
AH	3.713 ± 0.003	94.310 ± 0.076
AJ	3.410 ± 0.005	86.61 ± 0.13
AK	3.250 ± 0.005	82.55 ± 0.13
AL	3.625 ± 0.003	92.075 ± 0.076
AM	0.125	3.18
AN	1.340	34.04
AP	0.250	6.35
AQ	0.125	3.18
AR	1.417 ± 0.005	35.99 ± 0.13
AS	2.840	72.14
AT	1.667 ± 0.010	42.34 ± 0.25
AU	0.813 ± 0.010	20.65 ± 0.25
AV	0.688 ± 0.010	17.48 ± 0.25
AW	0.750 ± 0.010	19.05 ± 0.25

Millimetre dimensions have been derived from inches.

OUTLINE FOR M4011

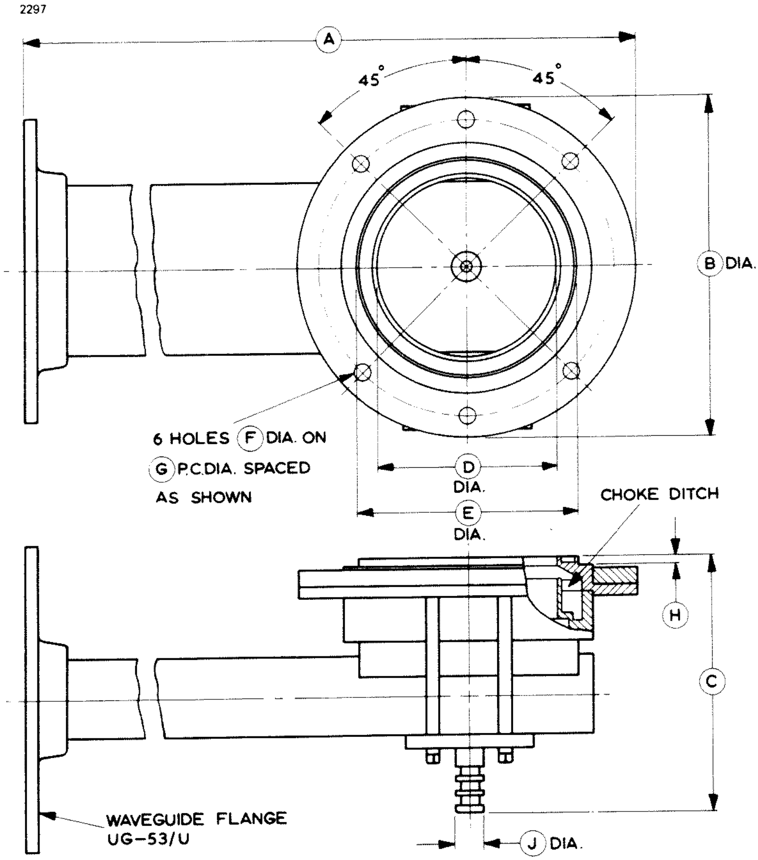


OUTLINE DIMENSIONS FOR M4011

Ref	Inches	Millimetres
A	12.875	327.0
B	12.625	320.7
C	7.000 max	177.8 max
D	10.031	254.8
E	0.375	9.53
F	7.500	190.5
G	5.906	150.0
H	9.000	228.6
J	2.000 max	50.80 max
K	8.000	203.2
L	3.750	95.25
M	2.000	50.80
N	11.625	295.3
P	11.375	288.9
Q	5.250	133.4
R	0.500	12.70
S	0.500	12.70
T	0.406	10.31

Millimetre dimensions have been derived from inches.

OUTLINE FOR M4017



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.969	304.0	F	0.265	6.73
B	5.938	150.8	G	5.250	133.4
C	4.406	111.9	H	$0.140 {}^{+0.005}_{-0.000}$	$3.56 {}^{+0.13}_{-0.00}$
D	3.255	82.68			
E	3.865 ± 0.002	98.17 ± 0.25	J	0.500	12.70

Millimetre dimensions have been derived from inches.

M595B

S-BAND MAGNETRON

Service Type CV8905

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	2860 to 2900	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any

Cooling forced-air

September 1968

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	13	10.5	V
Magnetic field (see note 8)	2150	2700	gauss
Anode current (peak)	56	70	A
Pulse length	1.0	1.0	μs
Pulse repetition rate	500	500	p.p.s.

Typical Performance

Anode voltage (peak)	22	28	kV
Output power (peak)	600	1000	kW
Output power (mean)	300	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	–	–	kV
Output power (mean)	400	–	–	–	W
Frequency	2860	2900	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.5	–	0.5	%
Heater current					see note 10
Temperature coefficient of frequency					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13.0
400–600	15.0
less than 400	16.0

The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

(b) The M595B has a hum-free heater and has been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$P_i = i_{apk} \times v_{apk} \times D_u$$

where P_i = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and D_u = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of $45 lb/in^2$ absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

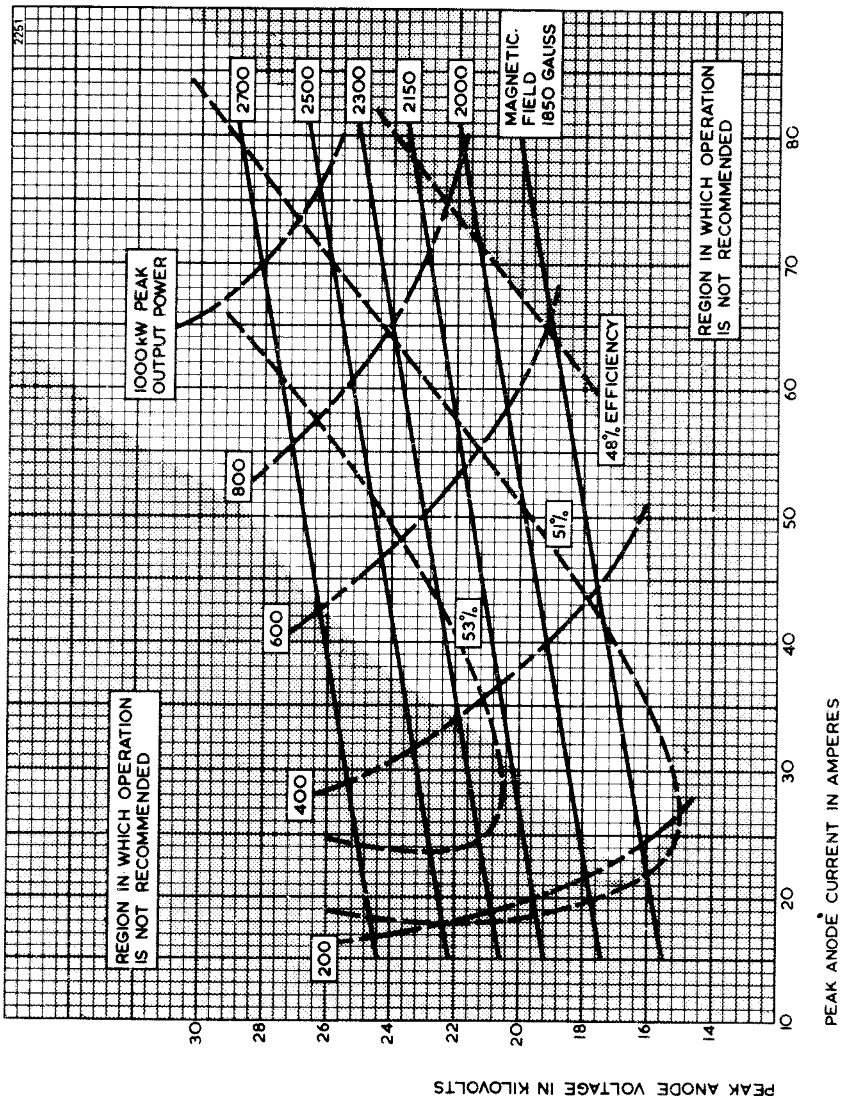
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

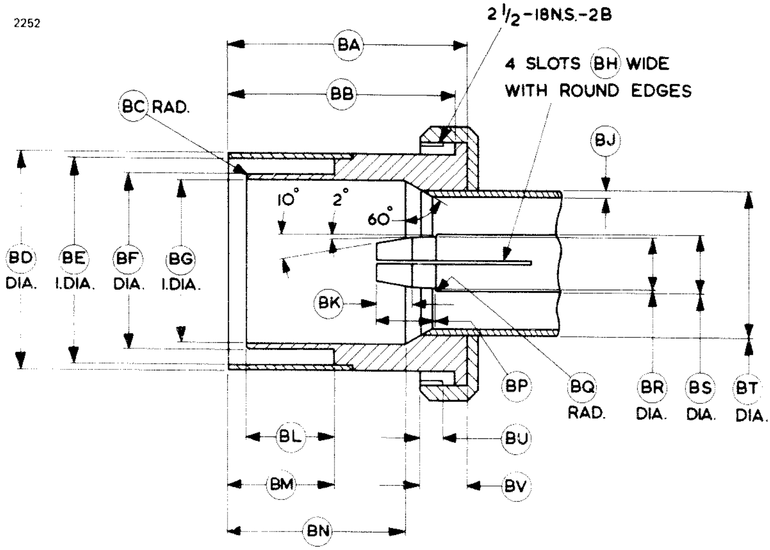
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.07 MHz/^{\circ}C$.

PERFORMANCE CHART



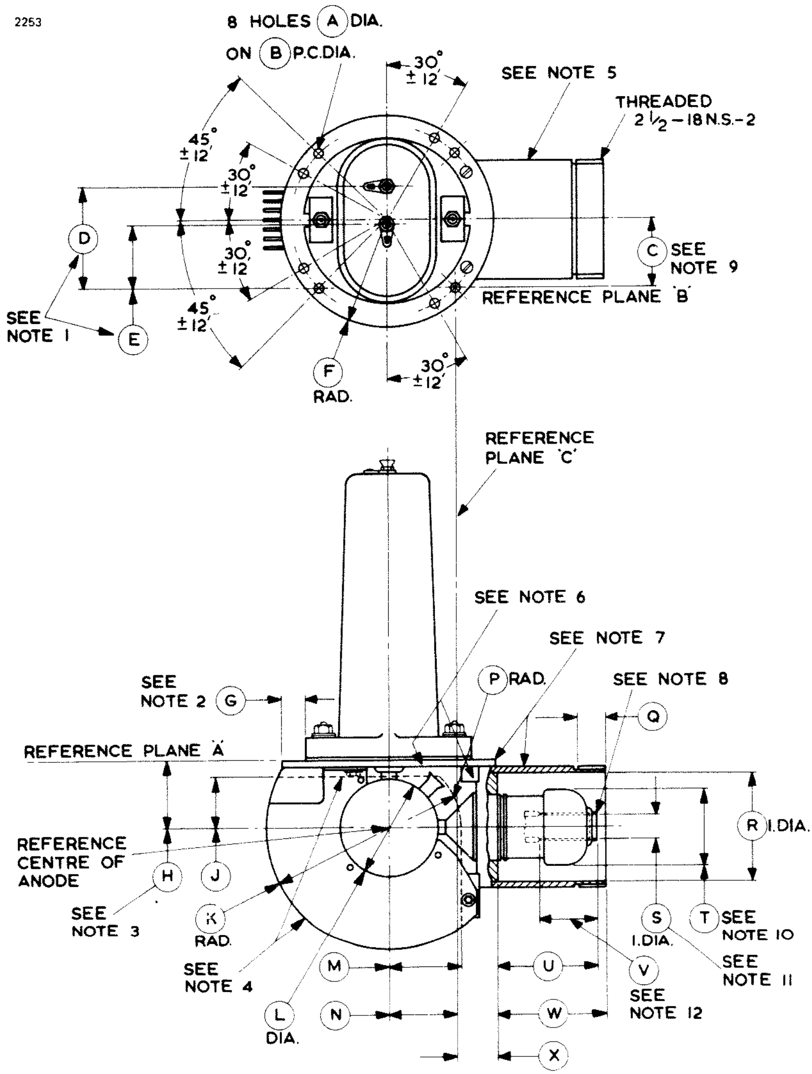
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE (see page 10 for outline notes)

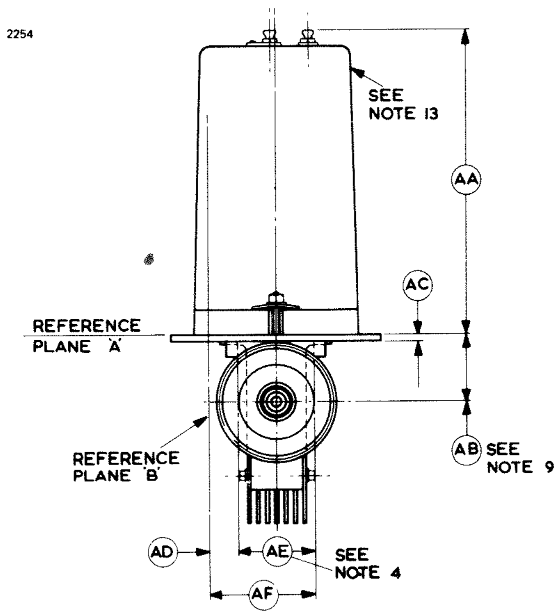


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

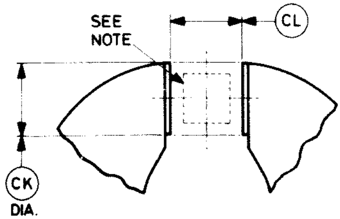
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 $\pm$ 0.015 inch (20.24 $\pm$ 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION



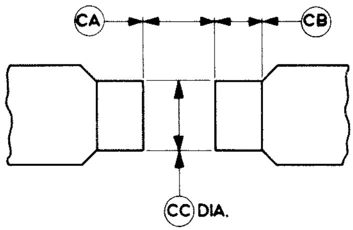
Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES

2255



Ref	Inches	Millimetres
CA	$1.500^{+0.005}_{-0.000}$	$38.10^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

M5015

TUNABLE S-BAND MAGNETRON

ABRIDGED DATA

Mechanically tuned pulse magnetron intended primarily for linear accelerators.

Frequency range	2994 to 3002	MHz
Peak output power	2.0	MW
Magnet		separate
Output	to No. 10 waveguide (2.840 x 1.340 inches internal) via the transition sections M4117 or M4119 shown on pages 11 and 12	
Isolator	the use of an isolator is recommended, see note 8 on page 4	
Cooling		water

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	8.5	V
Heater current	9.0	A
Heater starting current, peak value, not to be exceeded	20	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	14.750 x 7.250 x 6.000 inches max 374.7 x 184.2 x 152.4mm max	
Net weight	16 pounds (7.3kg) approx	
Tuner revolutions to cover frequency range (see note 2)	4	approx
Method of mounting		see note 3
Mounting position (see note 4)		any

Continued on page 2

Cooling

The valve is water cooled and has an integral water jacket, the connections being made via ¼-inch B.S.P. unions. The recommended water flow is 5 litres per minute or more; a pressure of approximately 1.25kg/cm^2 will be necessary to give this rate of flow. The outlet water temperature must not exceed 50°C.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 5)	1350	1600	gauss
Heater voltage (see note 1)	8.0	10	V
Heater starting current (peak)	–	20	A
Anode voltage (peak)	–	47	kV
Anode current (peak)	60	100	A
Input power (mean)	–	6.0	kW
Duty cycle	–	0.0015	
Pulse length (see note 6)	–	2.2	μs
Rate of rise of voltage pulse (see note 7)	–	120	kV/μs
Outlet water temperature	–	50	°C
V.S.W.R. at the output coupler (see note 8)	–	1.5:1	
Pressurising of waveguide (see note 9)	14	45	lb/in^2 abs.
	0.99	3.5	kg/cm^2 abs.

TYPICAL OPERATION

Operational Conditions

Magnetic field	1550 ± 25	gauss
Heater voltage	0	V
Anode current (peak)	90	A
Pulse length	2.0	μs
Pulse repetition rate	750	p.p.s.
Rate of rise of voltage pulse	110	kV/μs

Typical Performance

Anode voltage (peak)	43	kV
Output power (peak)	2.0	MW
Frequency drift		see note 10

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions (see note 11)

Magnetic field	1550 ± 25	gauss
Heater voltage (for test)	0	V
Output power (peak) (see note 12)	2.0	MW
Duty cycle	0.0015	
Pulse length (see note 6)	2.0	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 7)	110	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	40	46	kV
Anode current (peak) (see note 12)	85	100	A
Frequency (see note 13):			
lower end of tuning range	–	2994	MHz
upper end of tuning range	3002	–	MHz
R.F. bandwidth at ¼ power	–	1.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	7.0	MHz
Stability (see note 14)	–	0.5	%
Heater current			see note 15

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria

(Under the test conditions specified above but with anode current adjusted to give maximum output power)

Anode voltage (peak)	38	kV min
Output power (peak)	1.8	MW min
R.F. bandwidth at ¼ power	2.0	MHz max

Frequency: must be within the limits given above.

NOTES

1. With no anode input power.

   The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the schedule shown on page 7.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The tuner mechanism is driven by means of three tapped holes in the tuner knob (see outline drawing) via a flexible drive. The torque required is 0.5kg-cm minimum.

3. It is recommended that the magnetron should be mounted by means of the output flange (shown as Flange A on the outline drawing). Should a mounting arrangement employing Flange B be envisaged, care must be taken to avoid mechanical stress on the magnetron between the two flanges. Users are invited to submit details of their mounting arrangements to English Electric Valve Company Ltd. for approval.

4. To minimise frequency deviation when the magnetron is rotated about a horizontal axis, this axis should be parallel to the axis of the tuner.

5. The valve is designed for use with a separate magnet which can be supplied if requested. The north pole of the magnet must be adjacent to the cathode terminal, marked C. The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode and is at right angles to the H plane of the system waveguide. The user is invited to consult English Electric Valve Company Ltd. on the choice of alternative magnets.

6. The use of magnetron M5058, a variant of M5015, is recommended for applications requiring pulse lengths up to 5.0μs where a reduction in peak output power can be tolerated.

7. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

8. It is recommended that the magnetron should be isolated from the load by means of an isolator of approved design. Information on the characteristics of a suitable isolator may be obtained from English Electric Valve Company Ltd.

9. At the maximum pressure of $45lb/in^2$ ($3.5kg/cm^2$) absolute the maximum leakage will be such that with an enclosed volume of 1 litre the pressure will not drop by more than 10 pounds in 7 days.

10. The frequency of the valve will vary during the first 30 seconds after the application of anode voltage. Typically the frequency will be 0.4MHz high 5 seconds after switching on h.t. and 0.1MHz high 20 seconds after switching on.

11. These tests are carried out at 2998MHz except where otherwise specified.

12. The M5015 is designed to give 2.0MW peak output power. At this figure the peak anode current will be between 85 and 100A, depending on the efficiency of the magnetron. The magnetron should not be operated at a peak current greater than that necessary to achieve 2.2MW peak output power.

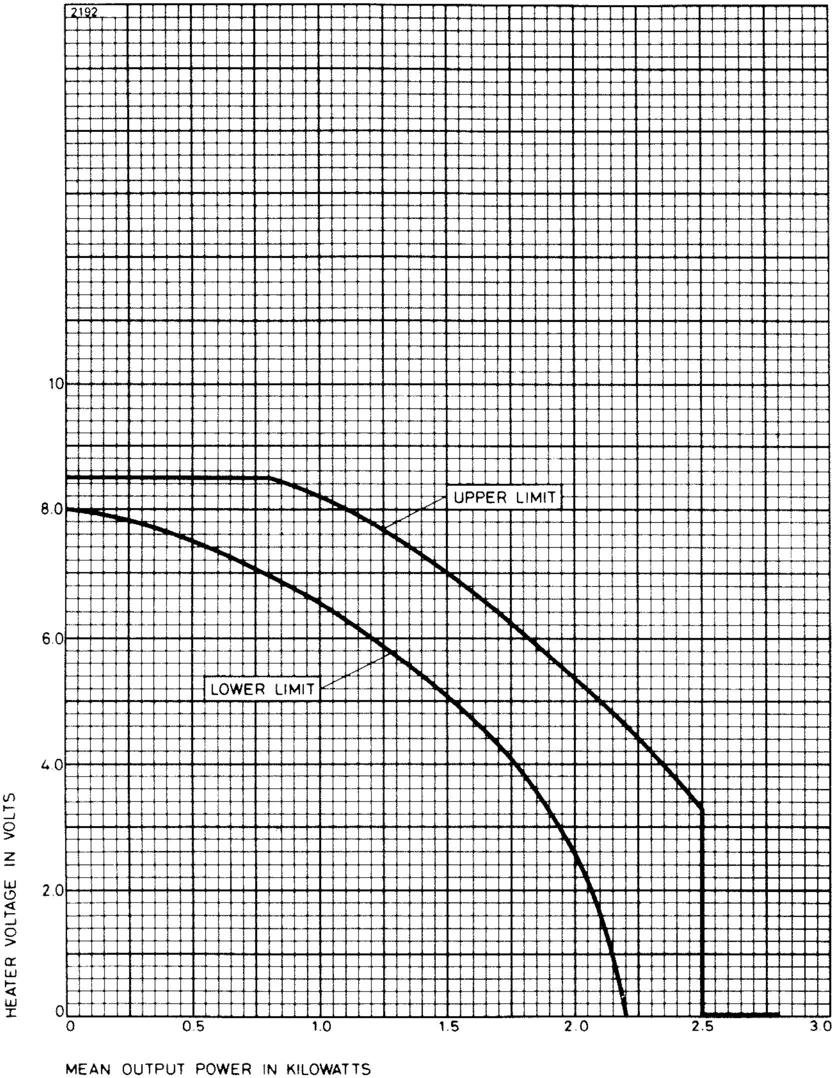
13. With ambient temperature 20°C, inlet water temperature 20°C and water flow rate 5.0 litres per minute. Other frequency ranges can be supplied on request.

14. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

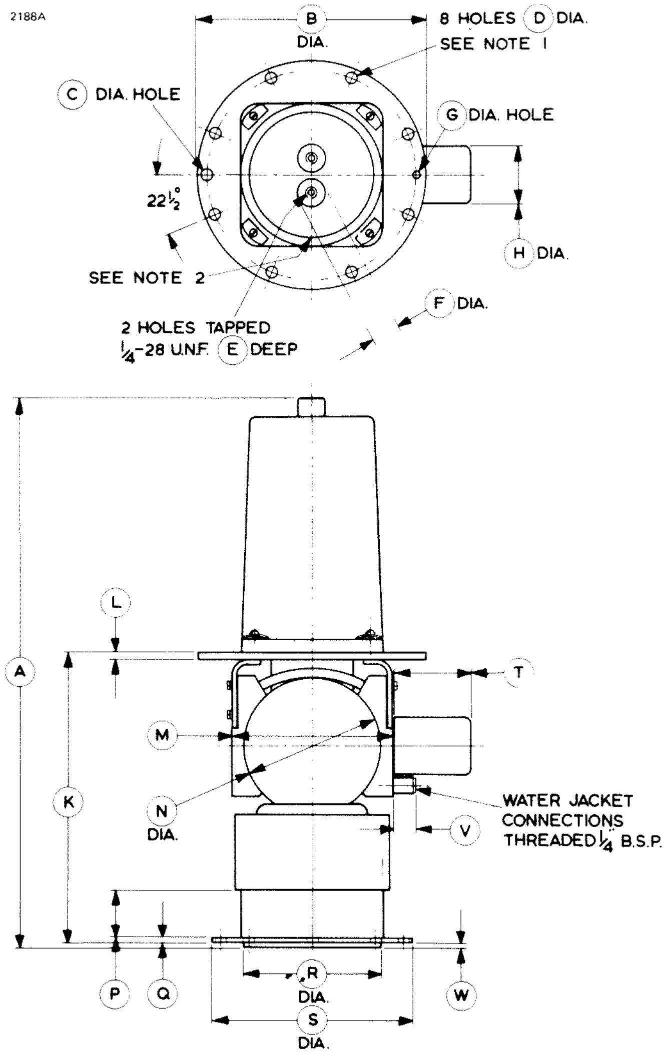
15. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 10.0A maximum.

PERFORMANCE CHART

HEATER VOLTAGE REDUCTION SCHEDULE



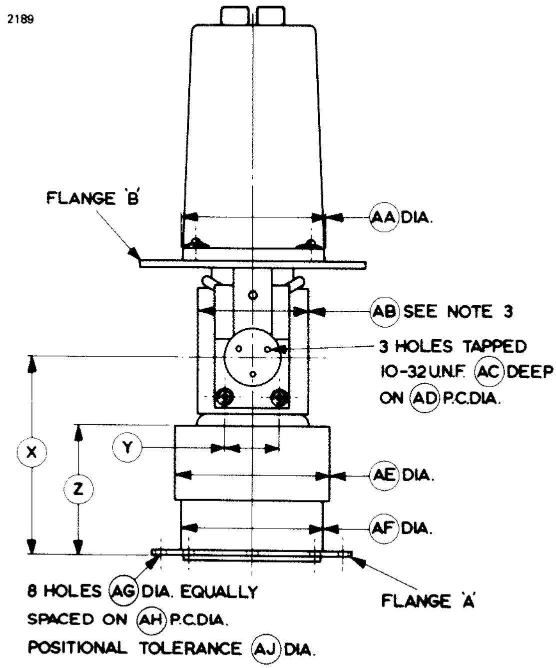
OUTLINE (See page 10 for dimensions)



OUTLINE NOTES

1. The 8 holes will clear studs 0.250 inch (6.35mm) diameter equally spaced on 5.500 inches (139.7mm) pitch circle diameter and within 0.005 inch (0.127mm) of their nominal positions, with the valve located by dowel pins 0.307 inch (7.80mm) diameter and 0.245 inch (6.22mm) diameter spaced 5.500 ± 0.002 inches (139.700 ± 0.051mm) apart.
2. This surface is marked with the letter 'C' to indicate the cathode terminal.
3. The valve will fit between magnet poles 3.010 inch (76.45mm) diameter and 2.970 inches (75.44mm) apart.

OUTLINE

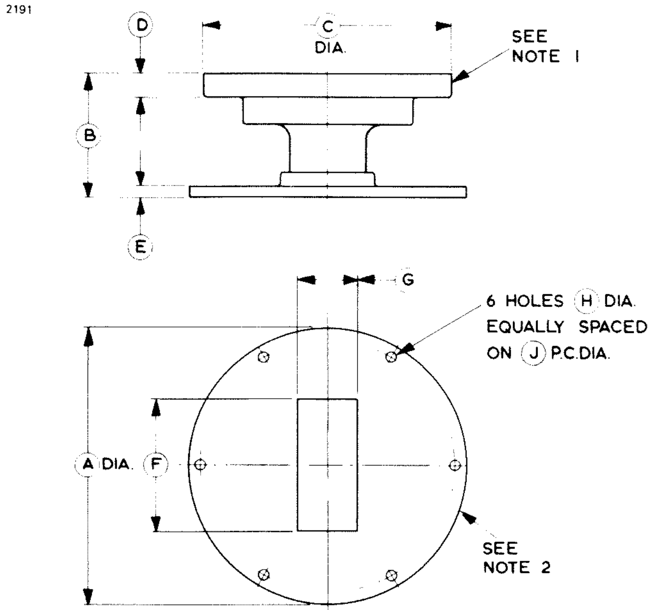


OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	14.750 max	374.7 max
B	$6.000\,^{+0.000}_{-0.010}$	$152.4\,^{+0.00}_{-0.25}$
C	$0.312\,^{+0.005}_{-0.000}$	$7.92\,^{+0.13}_{-0.00}$
D	0.312	7.92
E	0.250	6.35
F	0.750	19.05
G	$0.250\,^{+0.005}_{-0.000}$	$6.35\,^{+0.13}_{-0.00}$
H	1.500	38.10
K	7.780 ± 0.025	197.6 ± 0.64
L	0.250 ± 0.005	6.35 ± 0.13
M	4.375	111.1
N	3.625	92.08
P	1.218	30.94
Q	0.218	5.54
R	$3.625\,^{+0.000}_{-0.006}$	$92.08\,^{+0.00}_{-0.15}$
S	5.250 ± 0.062	133.4 ± 1.57
T	2.000 max	50.80 max
V	0.500	12.70
W	0.125 ± 0.005	3.18 ± 0.13
X	5.291 ± 0.015	134.4 ± 0.38
Y	1.375	34.93
Z	3.500 ± 0.125	88.90 ± 3.18
AA	3.750	95.25
AB	2.970 max	75.44 max
AC	0.187	4.75
AD	0.750	19.05
AE	4.125	104.8
AF	3.687	93.65
AG	0.250	6.35
AH	4.750 ± 0.005	120.7 ± 0.13
AJ	0.006	0.15

Millimetre dimensions have been derived from inches.

TRANSITION SECTION M4117



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875	149.2	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	5.375	136.5
E	0.250	6.35			

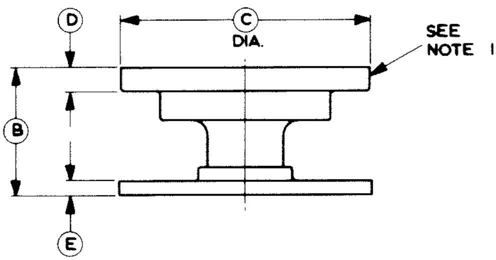
Millimetre dimensions have been derived from inches.

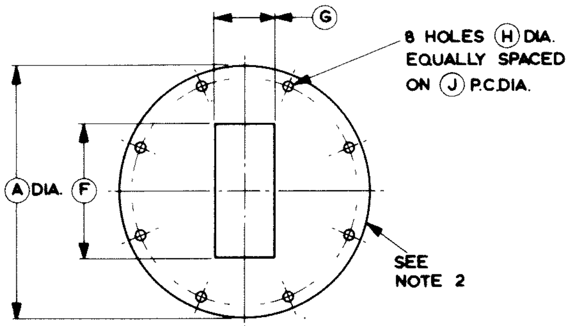
Notes for M4117

1. This flange mates with flange 'A' of the magnetron using 8–0.250 inch (6.35mm) diameter bolts, and an O-ring (supplied with M4117) 3.975 inches internal diameter and 0.210 inch diameter section. J.S.C. No. 5985-99-083-0011 or JAN MS 90064-17.
2. This flange is J.S.C. type No. 5985-99-083-1560.

TRANSITION SECTION M4119

2193





Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.312	134.9	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	4.750	120.7
E	0.312	7.93			

Millimetre dimensions have been derived from inches.

Notes for M4119

1. This flange mates with flange 'A' of the magnetron using 8–0.250 inch (6.35mm) diameter bolts, and an O-ring (supplied with M4119) 3.975 inches internal diameter and 0.210 inch diameter section. J.S.C. No. 5985-99-083-0011 or JAN MS 90064-17.
2. This flange is equivalent to J.S.C. Type No. 5985-99-083-0010 or JAN UG-53/U.

M5028

PRECISION TUNED MAGNETRON

ABRIDGED DATA

Precision tuned pulse magnetron for linear accelerators. The tuning drive will mechanically tune the valve to within 50kHz of any point in the frequency range and has been designed to be driven remotely by an electric motor.

Frequency range (see note 1)	2851–2861	MHz
Peak output power (nominal)	5.0	MW
Magnet and launching section	separate electro-magnet and launching section assembly M4121	
Isolator	use of an isolator is recommended (see note 2)	
Output	no. 10 waveguide (2.840 x 1.340 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 3)	12	V
Heater current	14	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum)	4.0	min

Mechanical

Overall dimensions	18 x 7.5 x 6.5 inches nom 457 x 190 x 165mm nom	
Net weight	18 pounds (8kg) approx	
Mounting position	any	
Tuning drive	splined shaft, to mate with S.S. White EX977 remote control flexible shaft	
Tuner turns between stops	350	

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Electro-magnet and Launching Section M4121

Overall dimensions	see outline drawing, page 12
Power consumption	1.5kW approx
Net weight	110 pounds (50kg) approx
R.F. output	no. 10 waveguide
Waveguide pressurising	see note 4

Cooling

The valve anode and the electro-magnet have integral water jackets. The valve requires a water flow of 4 to 6 imp.gal/min (18 to 27 l./min); the pressure drop across the water jacket is 15 lb/in^2 ($1.05kg/cm^2$) maximum. The electro-magnet requires a water flow of 1.0 imp.gal/min (4.5 l./min) at a pressure drop of 2.0 lb/in^2 ($0.14kg/cm^2$).

The valve output window is cooled by high pressure air; a flow of not less than $3ft^3/min$ ($0.085m^3/min$) (N.T.P.) into the air inlet at the base of the launching section is required. Low pressure air cooling may be required for the cathode terminal.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 5)	1300	1640	gauss
Heater voltage (see note 3)	11.4	12.3	V
Anode voltage (peak)	34	53	kV
Anode current (peak):			
at 5.0MW, 2.0μs, 1580 gauss	–	265	A
at 2.5MW, 4.0μs, 1530 gauss	–	160	A
at 1.0MW, 5.0μs, 1350 gauss	–	100	A
Input power (peak) (see note 6)	–	12	MW
Input power (mean) (see note 7)	–	7.0	kW
Duty cycle	–	0.003	
Pulse length:			
at 5.0MW peak	–	2.5	μs
at 2.5MW peak	–	4.5	μs
at 1.0MW peak	–	5.5	μs
Rate of rise of voltage pulse (see note 8)	100	150	kV/μs
V.S.W.R. at the output coupler (see note 2)	–	1.3:1	
Anode water outlet temperature	–	70	°C
Tuner torque	–	30	oz-in
Pressurising of waveguide (see note 4)	–	65	lb/in^2
	–	4.6	kg/cm^2

TYPICAL OPERATION

Operating Conditions

Heater voltage	0	0	0	V
Magnetic field	1350	1530	1580	gauss
Anode current (peak)	60	130	240	A
Pulse length	5.0	4.0	2.3	μs
Duty cycle	0.003	0.0012	0.0006	
Rate of rise of voltage	125	125	125	kV/μs

Typical Performance

Anode voltage	36.5	46	51	kV
Output power (peak)	1.0	2.5	5.0	MW
Output power (mean)	3.0	3.0	3.0	kW

TEST CONDITIONS AND LIMITS

The valve is tested in electro-magnet and launching section type M4121 to comply with the following electrical specification. For each oscillation condition, the performance is checked at each end of the specified frequency range.

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
Heater voltage (for test)	0	0	0	V
Output window cooling air flow (max)	3.0	3.0	3.0	ft^3/min
Waveguide air pressure (max)	25	35	45	lb/in^2 abs.
Magnetic field	1350	1530	1580	gauss
Anode current (mean)	180	148	133	mA
Duty cycle	0.003	0.001	0.0006	
Pulse length (see note 9)	5.0	5.0	2.5	μs
V.S.W.R. at the output coupler	see note 10	see note 10	see note 10	
Rate of rise of voltage pulse (see note 8)	60–70	120–130	140–150	kV/μs

Test Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	34.5	38.5	44	48	48	53	kV
Output power (mean)	2800	–	2800	–	2800	–	W
Frequency (see note 11)	2851	2861	2851	2861	2851	2861	MHz
R.F. bandwidth at 6db	–	0.5	–	0.5	–	1.0	MHz
Stability (see notes 12 and 13)	–	0.5	–	0.5	–	0.5	%
Frequency pulling (see note 12)	–	–	–	4.5	–	–	MHz
Heater current						see note 14	
Temperature coefficient of frequency						see note 15	

END OF LIFE CRITERIA (Under Test Conditions oscillation 3)

Output power (mean)	2500	W min
R.F. bandwidth at 6db	2.0	MHz max
Frequency (see note 11)	2851–2861	MHz
Stability (see notes 12 and 13)	1.0	% max

WARNING

X-rays High voltage magnetrons emit a significant intensity of X-rays not only from the region of the cathode insulator but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

R.F. Leakage There is a certain amount of r.f. radiation from the cathode insulator and it may be necessary to shield adjacent electrical circuits. If extensive shielding is fitted extra ventilation may be needed to ensure that the cathode seal temperature does not exceed 150°C. The temperature may be checked by temperature sensitive paint.

NOTES

1. The frequency range 2851 to 2861MHz is only achieved at the full mean input power rating of 7kW. For lower powers the frequency at any tuner setting will increase by 630kHz per kW reduction in mean input power.
2. The magnetron must be protected from the load by an isolator or circulator. The maximum v.s.w.r. at 2856MHz is 1.3:1 and must not exceed 2:1 over the range 2800–3500MHz.

3. With no anode input power.

Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12 volts to the heater for at least four minutes. Within 30 seconds after the application of anode voltage the heater voltage shall be reduced as follows:

Mean input power (kW)	**Heater voltage ($V_{r.m.s.}$)**
0–2.3	10.5
2.3–4.6	8.5
4.6–7.0	6.0
7.0 (maximum)	zero

The heater voltage shall be maintained within ±5% of the specified value. A rectified supply is recommended to reduce frequency modulation due to heater current when operating at less than 7kW input power. The valve is assumed to be operated with a heater supply frequency of 50 or 60Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

A coaxial lead shall be used to connect the magnetron to the filament transformer or pulse transformer, the outer being the cathode pulse connection. Capacitors shall be used to prevent pulse voltages being applied to the heater, either from unbalance of a bifilar pulse transformer or by induction from the pulse current; this protection must be effective both for normal operation and in the event of the magnetron sparking. Capacitors up to 10μF may be required, shunted by small high frequency capacitors.

4. The minimum air pressure in the output waveguide can vary with the peak power level at which the magnetron is operated. It should not be less than 25 lb/in^2 at 1MW, 35 lb/in^2 at 3MW and 45 lb/in^2 at 5MW. At the maximum pressure of 65 lb/in^2 (4.57kg/cm^2) the leakage will not exceed 0.03 litre (N.T.P.) per minute.

5. Measured at the point indicated on the outline drawing; the axial distribution must be that produced by the M4121 electro-magnet or authorized equivalent (see page 10).

6. The modulator must have an efficient overswing damping system, such that the pulse energy delivered to the magnetron following an arcing pulse does not appreciably exceed the normal pulse energy. An interlock relay shall be used to trip the modulator in the event of excessive magnetron arcing, preferably operated by the overswing diode current. The trip should operate if the magnetron arcs for 25 consecutive pulses.

7. The various parameters are related by the formula:

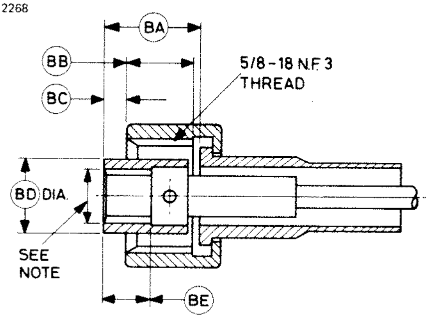
$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

8. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.
9. Tolerance ±10%.
10. The load termination of the magnetron during this test shall be a waveguide with a v.s.w.r. of less than 1.1:1 at the oscillation frequency and less than 1.5:1 between 3200 and 3500MHz.
11. The valve tuning range shall include the two limits given.
12. Measured with a v.s.w.r. of 1.3:1 at the frequency of oscillation, varied through all phases.
13. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 2851 to 2861MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.
14. Measured with a heater voltage of 12 volts and no anode input power, the heater current limits are 13A minimum, 15A maximum.
15. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.05MHz/°C.

DETAIL OF FLEXIBLE DRIVE CONNECTOR

2268

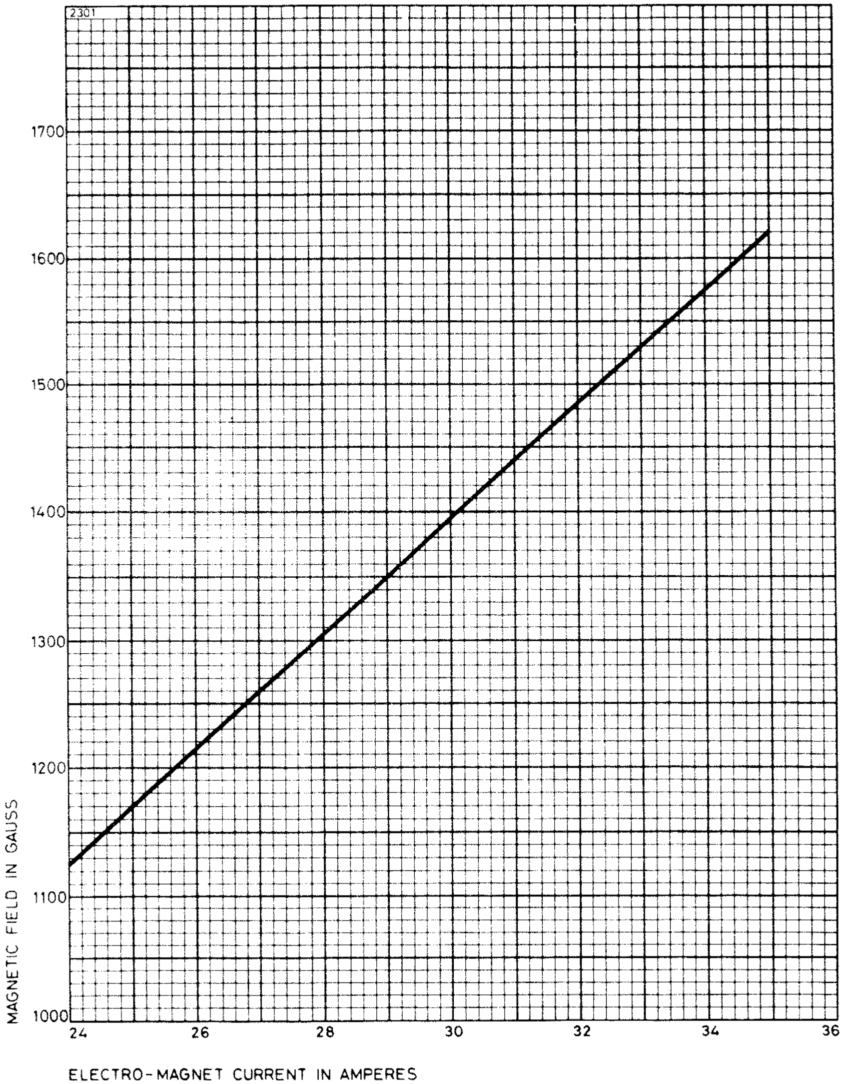


Ref	Inches	Millimetres
BA	0.500	12.70
BB	0.360	9.14
BC	0.112	2.84
BD	0.406	10.31
BE	0.250	6.35

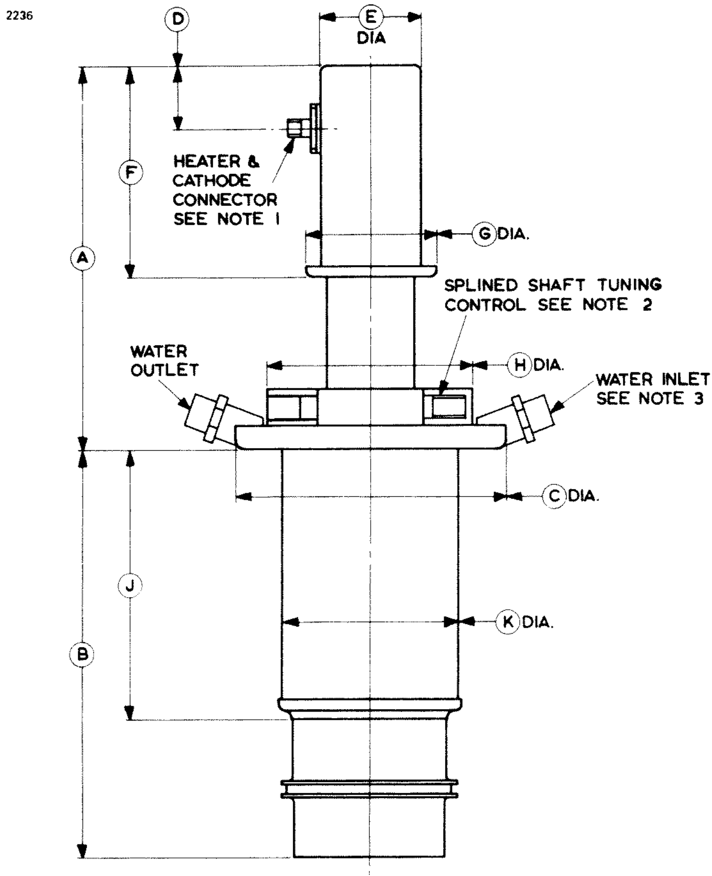
Millimetre dimensions have been derived from inches.

Note Internal spline, 12 tooth 48 DP, 14½° pressure angle, involute form.

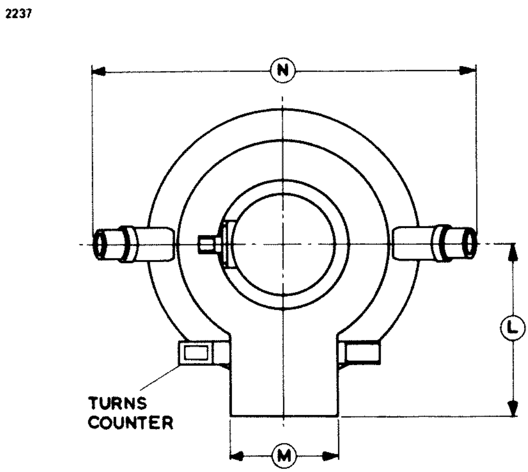
CURRENT-FIELD STRENGTH CHARACTERISTIC FOR M4121



OUTLINE OF M5028



OUTLINE OF M5028



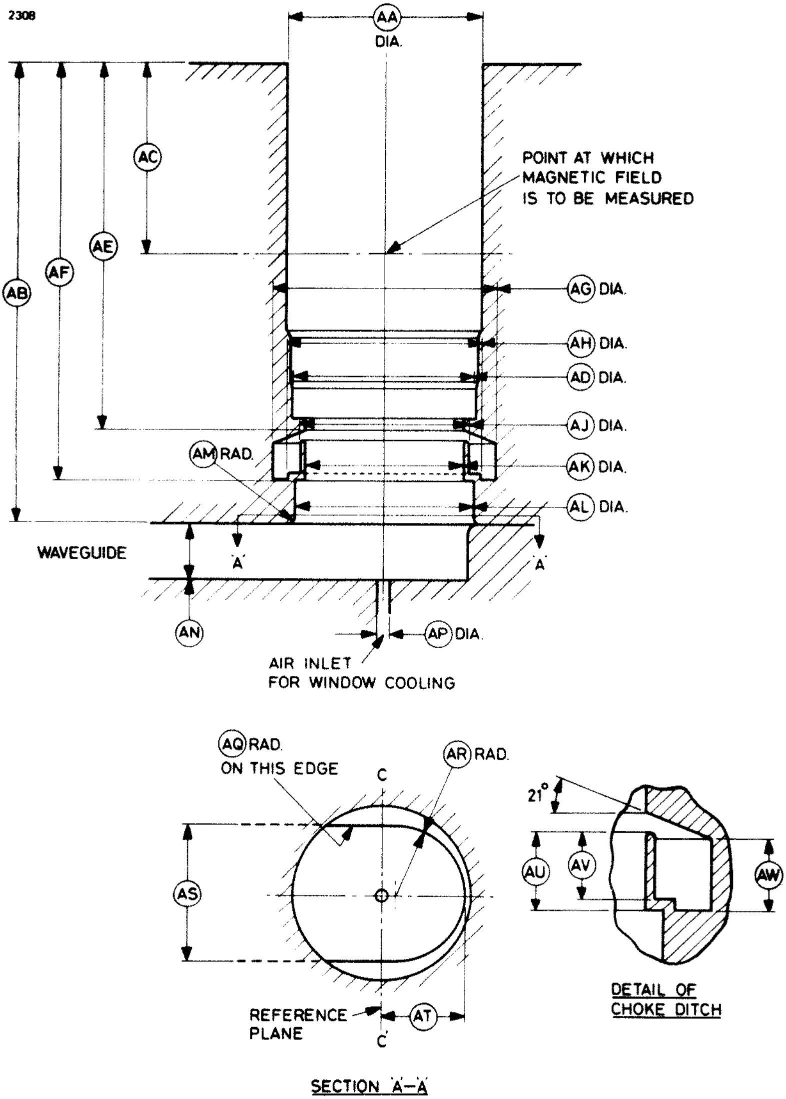
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.500	241.3	H	4.375	111.1
B	8.514	216.3	J	5.689	144.5
C	5.775 max	146.7 max	K	4.000 max	101.6 max
D	1.300	33.02	L	3.563	90.50
E	2.250 max	57.15 max	M	2.250	57.15
F	4.400	111.8	N	7.500	190.5
G	3.000 max	76.20 max			

Millimetre dimensions have been derived from inches.

NOTES

1. Heater-cathode connector, Joint Services Catalogue number 5935-99-932-5870; the number for the corresponding plug is 5935-99-940-1839.
2. Splined shaft, to mate with S.S. White EX977 remote control flexible shaft (see page 6).
3. Water connections ½ inch B.S. screwed pipe to B.S.2051 part 2.

CROSS-SECTION OF SUITABLE ELECTRO-MAGNET AND LAUNCHING SECTION

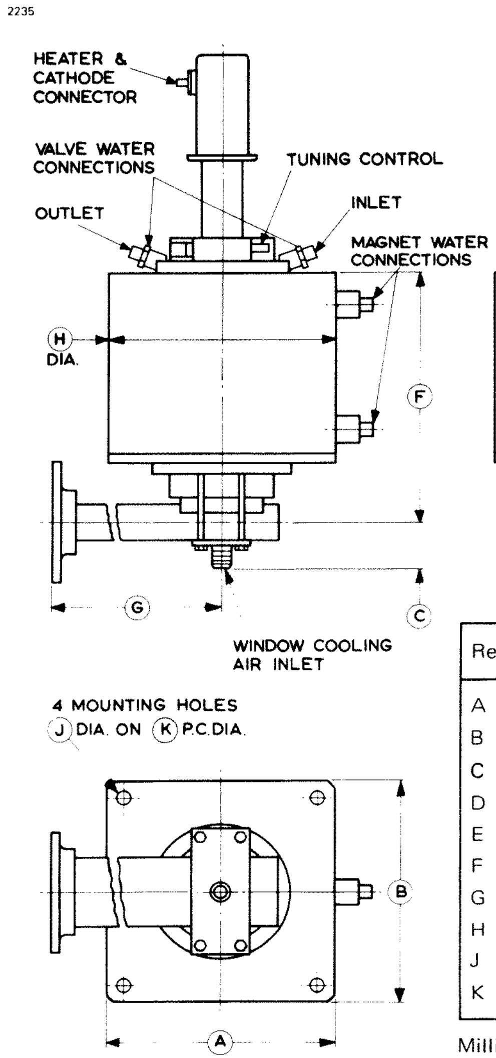


DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	$4.000^{+0.003}_{-0.000}$	$101.600^{+0.076}_{-0.000}$
AB	9.551	242.6
AC	3.939	100.1
AD	$3.750^{+0.002}_{-0.000}$	$95.250^{+0.051}_{-0.000}$
AE	7.637	194.0
AF	8.601	218.5
AG	4.340 ± 0.005	110.2 ± 0.13
AH	3.713 ± 0.003	94.310 ± 0.076
AJ	3.410 ± 0.005	86.61 ± 0.13
AK	3.250 ± 0.005	82.55 ± 0.13
AL	3.625 ± 0.003	92.075 ± 0.076
AM	0.125	3.18
AN	1.340	34.04
AP	0.250	6.35
AQ	0.125	3.18
AR	1.417 ± 0.005	35.99 ± 0.13
AS	2.840	72.14
AT	1.667 ± 0.010	42.34 ± 0.25
AU	0.813 ± 0.010	20.65 ± 0.25
AV	0.688 ± 0.010	17.48 ± 0.25
AW	0.750 ± 0.010	19.05 ± 0.25

Millimetre dimensions have been derived from inches.

OUTLINE OF M4121



Ref	Inches	Millimetres
A	9.250	235.0
B	9.250	235.0
C	2.000	50.80
D	9.500	241.3
E	8.000	203.2
F	10.530	267.5
G	9.000	228.6
H	9.250	235.0
J	0.219	5.56
K	11.000	279.4

Millimetre dimensions have been derived from inches.

M5030 M5034

TUNABLE S-BAND MAGNETRONS

ABRIDGED DATA

Mechanically tuned pulse magnetrons for m.t.i. operation

Frequency range:		
M5030	2900 to 3050	MHz
M5034	3050 to 3200	MHz
Typical peak output power	1.0	MW
Magnet		integral
Output (see note 1)		no. 10 waveguide - RG 48/U (2.840 x 1.340 inches internal)
Coupler		special
Cooling		forced air
Isolator		the use of an isolator is recommended

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 2)	8.5	V
Heater current (at 8.5V)	9.0	A
Heater starting current, peak value, not to be exceeded	40	A
Cathode heating time (minimum)	6	min

Mechanical

Overall dimensions		18.500 x 13.750 x 7.272 inches max 469.9 x 349.3 x 184.7mm max
Net weight		67 pounds (30kg) approx
Mounting position		cathode connector vertically downwards
Tuning (see note 3)		mechanical
Tuner turns to cover frequency range (see notes 4 and 5)	220	max

Cooling (see note 6)	forced air
Minimum rate of air flow (at 35°C)	200ft^3/min (5.7m^3/min)
Maximum pressure drop	2.5 inches (63.5mm) w.g.

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MAXIMUM AND MINIMUM RATINGS

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 2)	8.1	8.9	V
Heater starting current (peak)	–	40	A
Anode voltage (peak)	–	36	kV
Anode current (peak)	–	80	A
Input power (peak)	–	2.3	MW
Input power (mean) (see note 7)	–	4.6	kW
Duty cycle	–	0.002	
Pulse length (see note 8)	0.5	5.0	μs
Rate of rise of voltage pulse (see note 9)	–	100	kV/μs
Anode temperature	–	140	°C
Cathode terminal temperature	–	160	°C
V.S.W.R. at the output coupler	–	1.3:1	
Rate of air flow into magnetron waveguide	5.0	–	ft^3/min

The modulator shall be such that the pulse energy delivered to the magnetron following an arcing pulse cannot exceed the normal pulse energy.

TYPICAL OPERATION

Operating Conditions

Heater voltage	0	V
Anode current (peak)	70	A
Pulse length	2.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	33	kV
Output power (peak)	1.0	MW
Output power (mean)	2.0	kW
Frequency pushing (at 70A)	40	kHz/A

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following specification.

Electrical Test Conditions

Heater voltage (for test)	0	V
Anode current (mean)	150	mA
V.S.W.R. at the output coupler	1.15:1	max
Pulse length (see note 8)	5.0	μs
Duty cycle	0.002	
Rate of rise of voltage pulse (see note 9)	100	kV/μs min

Limits

	Min	Max	
Anode voltage (peak) (see note 10)	30	36	kV
Output power (mean) (see note 10)	2.0	–	kW
Frequency:			
M5030	2900	3050	MHz
M5034	3050	3200	MHz
R.F. bandwidth at ¼ power	–	0.4	MHz
Performance continuity	The spectrum shall be observed continuously over the specified frequency range.		
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	7.0	MHz
Stability (see notes 10 and 11)	–	0.25	%
Heater current			see note 12
Temperature coefficient of frequency			see note 13

Mechanical Test Conditions

1. Valve at room temperature, no voltages applied.
2. Valve operating under electrical test conditions.

Limits

	Min	Max	
Tuning shaft turns to cover specified frequency range (condition 2)	150	220	turns
Tuning shaft torque (conditions 1 and 2) (see note 10)	–	35	oz-in
Backlash in tuning shaft	–	60	degrees rotation

END OF LIFE CRITERIA (Under Test Conditions)

Output power (mean)	1.7	kW min
R.F. bandwidth at ¼ power	0.4	MHz max
Stability	0.5	% max
Backlash in tuning shaft	90	degrees max

NOTES

1. The magnetron must be protected from mechanical strain by the use of a section of flexible waveguide between the magnetron and the waveguide system.

2. With no anode input power. On the application of anode voltage the heater voltage must be reduced as follows:

Mean input power (kW)	Heater voltage ($V_{r.m.s.}$)
0 to 1	8.5
1 to 2	6.5
2 to 3	5.0
3 to 4	3.0
over 4	zero

The valve heater shall be protected against arcing by the use of a minimum capacitance of 1.0μF shunted across the heater directly at the input terminals. A specially designed capacitor with coaxial connectors for mating with the valve input socket is available; details may be obtained from English Electric Valve Company Ltd.

3. Tuning is achieved by rotating a splined shaft which mates with S.S. White flexible drive assembly EX 977 (see page 5).

4. The tuning shaft shall not be rotated at a rate greater than 300rev/min.

5. Under no circumstances should a torque greater than 50oz-in be applied to the tuner shaft. The drive to the tuner should be transmitted through a torque limiting clutch to protect the valve from the inertia of the drive mechanism.

6. The anode temperature must be kept below 140°C by means of a suitable flow of air over the cooling fins.

7. The various parameters are related by the following formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

8. Tolerance ±10%.

9. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

10. These tests are carried out at the following frequencies:

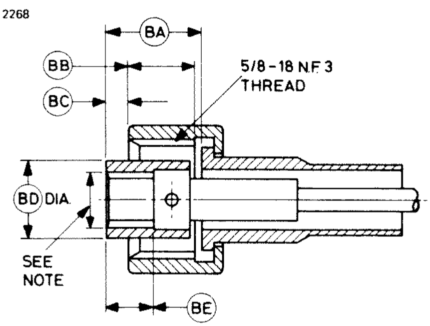
M5030	M5034
2900MHz	3050MHz
2950MHz	3100MHz
3000MHz	3150MHz
3050MHz	3200MHz

11. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses during the last 30 seconds of a test interval not to exceed 5 minutes.

12. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 12A maximum.

13. Design test only. The maximum frequency change with anode temperature change (after warm-up) is –0.07MHz/°C.

DETAIL OF FLEXIBLE DRIVE CONNECTOR

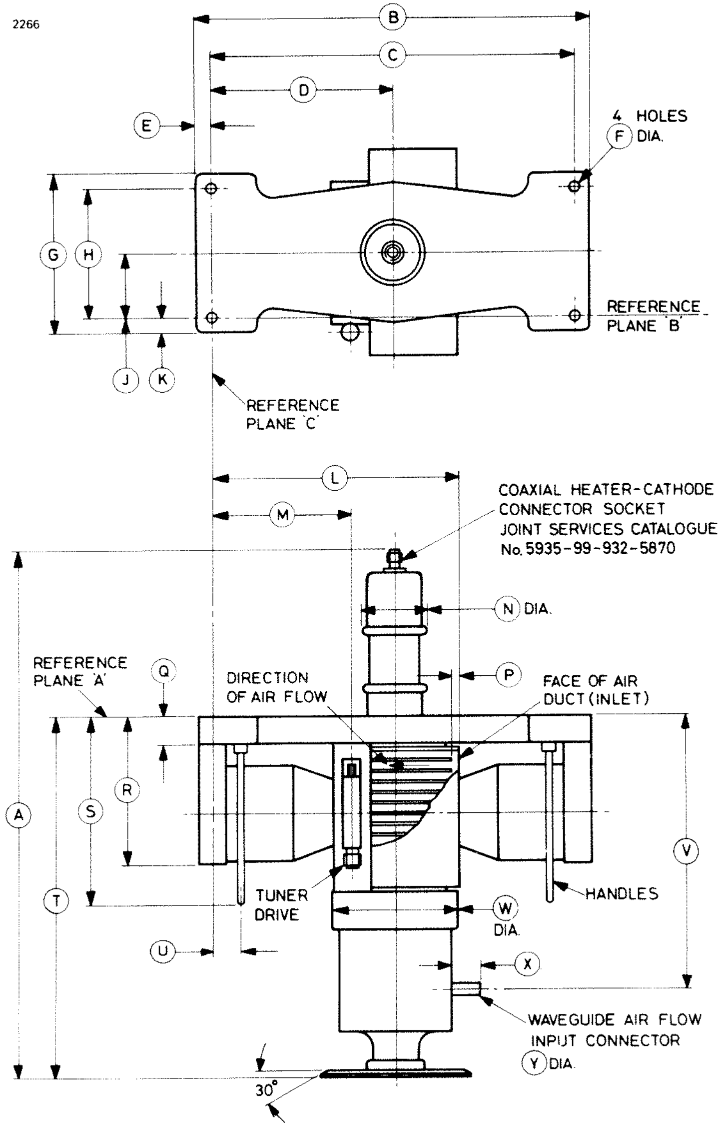


Ref	Inches	Millimetres
BA	0.500	12.70
BB	0.360	9.14
BC	0.112	2.84
BD	0.406	10.31
BE	0.250	6.35

Millimetre dimensions have been derived from inches.

Note Internal spline, 12 tooth 48 DP, 14½° pressure angle, involute form.

OUTLINE



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B
C
D
E
4 HOLES
F DIA.
G
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J
K
REFERENCE
PLANE 'B'
REFERENCE
PLANE 'C'
L
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COAXIAL HEATER-CATHODE
CONNECTOR SOCKET
JOINT SERVICES CATALOGUE
No. 5935-99-932-5870
N DIA.
REFERENCE
PLANE 'A'
Q
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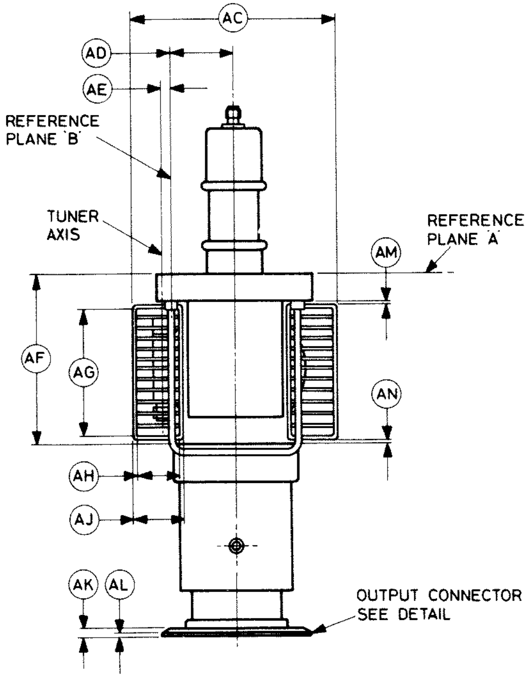
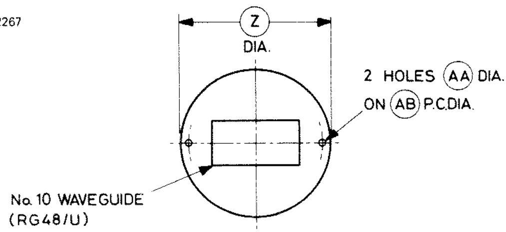
OUTLINE



Detail of Output Connector

2267



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	18.500 max	469.9 max	V	9.560 ± 0.050	242.8 ± 1.3
B	13.750 max	349.3 max	W	4.425 max	112.4 max
C	12.720 ± 0.030	323.09 ± 0.76	X	1.000 ± 0.060	25.4 ± 1.5
D	6.360 ± 0.020	161.54 ± 0.51	Y	0.500 ± 0.020	12.70 ± 0.51
E	0.500 ± 0.030	12.70 ± 0.76	Z	5.272 ± 0.030	133.91 ± 0.76
F	0.375 ± 0.015	9.53 ± 0.38	AA	0.207 ± 0.005	5.26 ± 0.13
G	5.530 max	140.5 max	AB	4.764 ± 0.004	121.006 ± 0.102
H	4.500 ± 0.015	114.30 ± 0.38	AC	7.252 ± 0.020	184.20 ± 0.51
J	2.250 ± 0.020	57.15 ± 0.51	AD	2.250 ± 0.020	57.15 ± 0.51
K	0.500 ± 0.030	12.70 ± 0.76	AE	0.326 ± 0.040	8.28 ± 1.02
L	8.623 ± 0.060	219.0 ± 1.5	AF	6.060 ± 0.030	153.92 ± 0.76
M	4.865 ± 0.040	123.6 ± 1.0	AG	4.862 ± 0.015	123.49 ± 0.38
N	2.280 max	57.91 max	AH	1.752 ± 0.010	44.50 ± 0.25
P	0.250 ± 0.030	6.35 ± 0.76	AJ	1.832 ± 0.015	46.53 ± 0.38
Q	1.000 ± 0.020	25.40 ± 0.51	AK	0.275 ± 0.007	6.99 ± 0.18
R	5.180 max	131.6 max	AL	0.137 ± 0.015	3.48 ± 0.38
S	6.500 ± 0.125	165.1 ± 3.2	AM	0.060 ± 0.020	1.52 ± 0.51
T	12.650 ± 0.040	321.3 ± 1.0	AN	0.060 ± 0.020	1.52 ± 0.51
U	0.985 ± 0.030	25.02 ± 0.76			

Millimetre dimensions have been derived from inches.

M5058

TUNABLE S-BAND MAGNETRON

ABRIDGED DATA

Mechanically tuned pulse magnetron intended primarily for linear accelerators.

Frequency range	2994 to 3002	MHz
Peak output power	1.3	MW
Magnet		separate
Output	to no. 10 waveguide (2.840 x 1.340 inches internal) via the transition sections M4117 or M4119 shown on pages 11 and 12	
Isolator	the use of an isolator is recommended, see note 8 on page 4	
Cooling		water

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	8.5	V
Heater current	9.0	A
Heater starting current, peak value, not to be exceeded	20	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	14.750 x 7.250 x 6.000 inches max 374.7 x 184.2 x 152.4mm max	
Net weight	16 pounds (7.3kg) approx	
Tuner revolutions to cover frequency range (see note 2)	4	approx
Method of mounting		see note 3
Mounting position (see note 4)		any

Continued on page 2

Cooling

The valve is water cooled and has an integral water jacket, the connections being made via ¼-inch B.S.P. unions. The recommended water flow is 5 litres per minute or more; a pressure of approximately 1.25kg/cm^2 will be necessary to give this rate of flow. The outlet water temperature must not exceed 50°C.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 5)	1350	1400	gauss
Heater voltage (see note 1)	8.0	10	V
Heater starting current (peak)	–	20	A
Anode voltage (peak)	–	40	kV
Anode current (peak)	60	80	A
Input power (mean)	–	5.0	kW
Duty cycle	–	0.0015	
Pulse length (see note 6)	–	5.0	μs
Rate of rise of voltage pulse (see note 7)	–	120	kV/μs
Outlet water temperature	–	50	°C
V.S.W.R. at the output coupler (see note 8)	–	1.5:1	
Pressurising of waveguide (see note 9)	14	45	lb/in^2 abs.
	0.99	3.5	kg/cm^2 abs.

TYPICAL OPERATION

Operational Conditions

Magnetic field	1375 ± 25	gauss
Heater voltage	4.0	V
Anode current (peak)	70	A
Pulse length	5.0	μs
Pulse repetition rate	300	p.p.s.
Rate of rise of voltage pulse	110	kV/μs

Typical Performance

Anode voltage (peak)	36	kV
Output power (peak)	1.3	MW
Output power (mean)	1.9	kW
Frequency drift		see note 10

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification (see note 11).

Test Conditions

Magnetic field	1375 ± 25	gauss
Heater voltage (for test)	4.0	V
Anode current (peak)	70	A
Duty cycle	0.0015	
Pulse length (see note 6)	5.0	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 7)	90	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	34	38	kV
Output power (peak)	1.25	–	MW
Frequency (see note 12):			
lower end of tuning range	–	2994	MHz
upper end of tuning range	3002	–	MHz
R.F. bandwidth at ¼ power	–	1.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	7.0	MHz
Stability (see note 13)	–	0.5	%
Heater current			see note 14
Temperature coefficient of frequency			see note 15

NOTES

1. With no anode input power.

   The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the schedule shown on page 7.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The tuner mechanism is driven by means of three tapped holes in the tuner knob (see outline drawing) via a flexible drive. The torque required is 0.5kg-cm minimum.

3. It is recommended that the magnetron should be mounted by means of the output flange (shown as Flange A on the outline drawing). Should a mounting arrangement employing Flange B be envisaged, care must be taken to avoid mechanical stress on the magnetron between the two flanges. Users are invited to submit details of their mounting arrangements to English Electric Valve Company Ltd. for approval.

4. To minimise frequency deviation when the magnetron is rotated about a horizontal axis, this axis should be parallel to the axis of the tuner.

5. The valve is designed for use with a separate magnet which can be supplied if requested. The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode and is at right angles to the H plane of the system waveguide. The user is invited to consult English Electric Valve Company Ltd. on the choice of alternative magnets.

6. The use of magnetron M5015 is recommended for applications requiring a peak output power of 2.0MW at a pulse length of 2.0μs.

7. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

8. It is recommended that the magnetron should be isolated from the load by means of an isolator of approved design. Information on the characteristics of a suitable isolator may be obtained from English Electric Valve Company Ltd.

9. At the maximum pressure of 45lb/in^2 (3.5kg/cm^2) absolute the maximum leakage will be such that with an enclosed volume of 1 litre the pressure will not drop by more than 10 pounds in 7 days.

10. The frequency of the valve will vary during the first 30 seconds after the application of anode voltage. Typically the frequency will be 0.4MHz high 5 seconds after switching on h.t. and 0.1MHz high 20 seconds after switching on.

11. These tests are carried out at 2998MHz except where otherwise specified.

12. With ambient temperature 20°C, inlet water temperature 20°C and water flow rate 5.0 l./s. Other frequency ranges can be supplied on request.

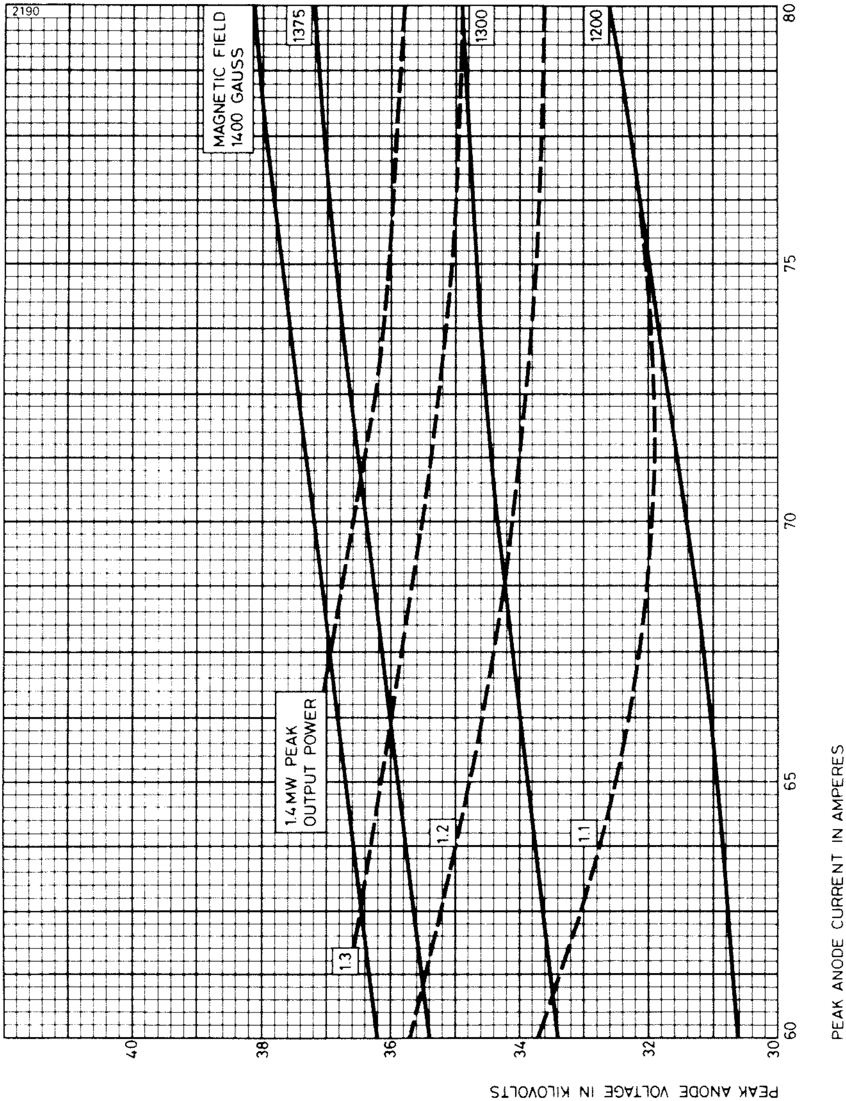
13. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as

missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

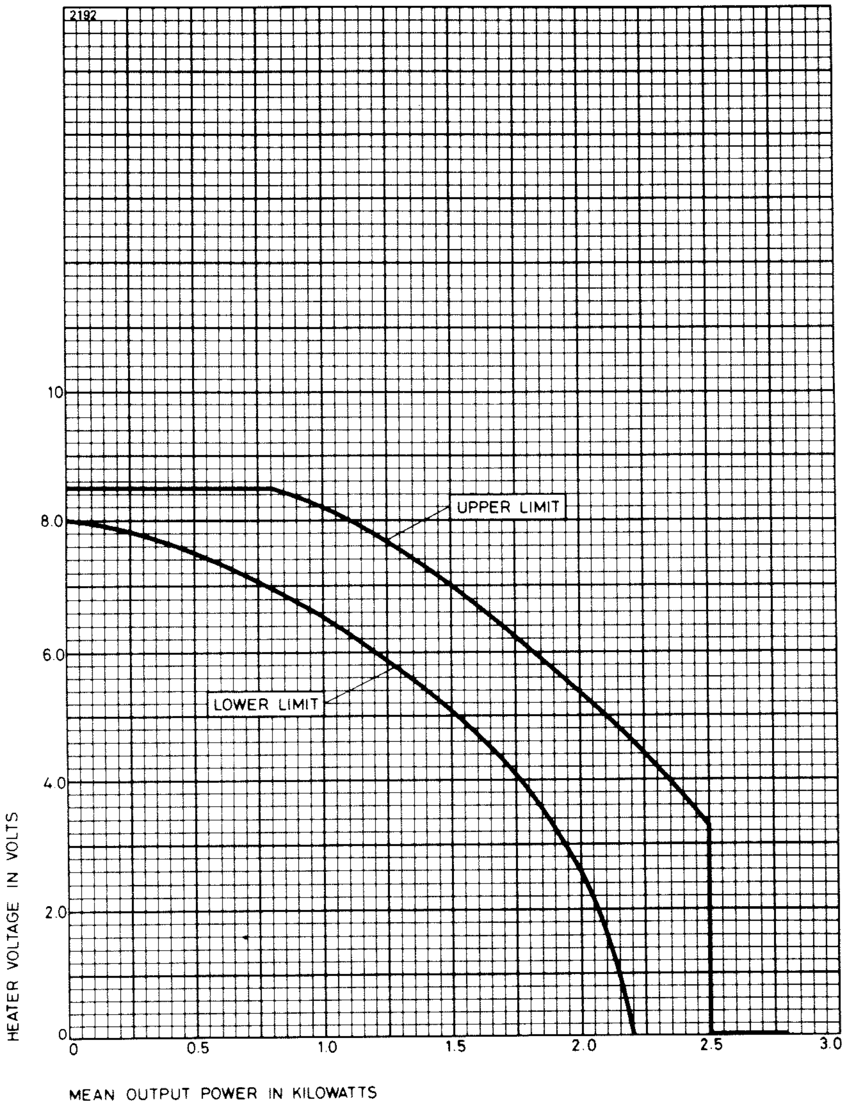
14. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 10.0A maximum.

15. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

PERFORMANCE CHART

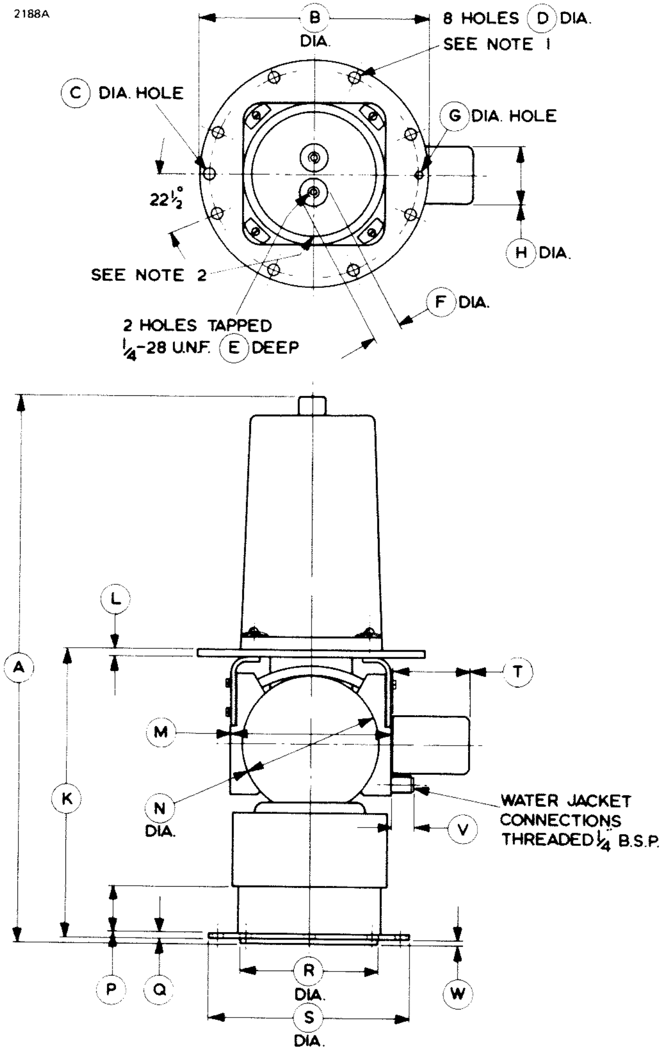


HEATER VOLTAGE ADJUSTMENT SCHEDULE



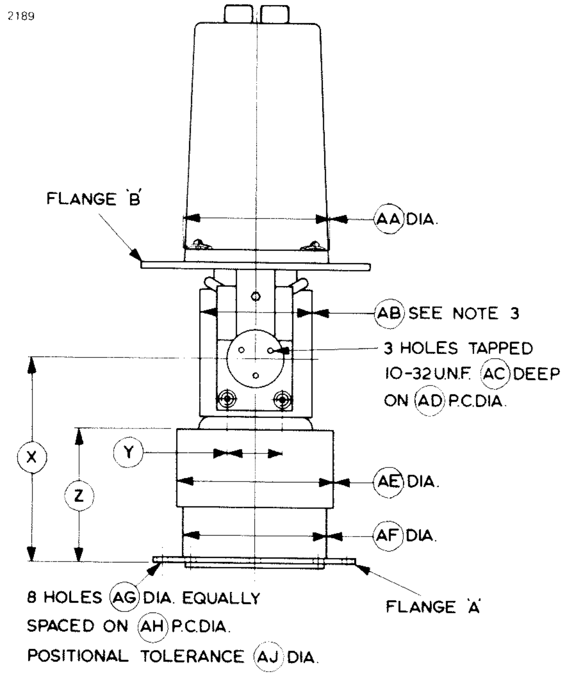
OUTLINE

See page 10 for outline dimensions



OUTLINE

See page 10 for outline dimensions



OUTLINE NOTES

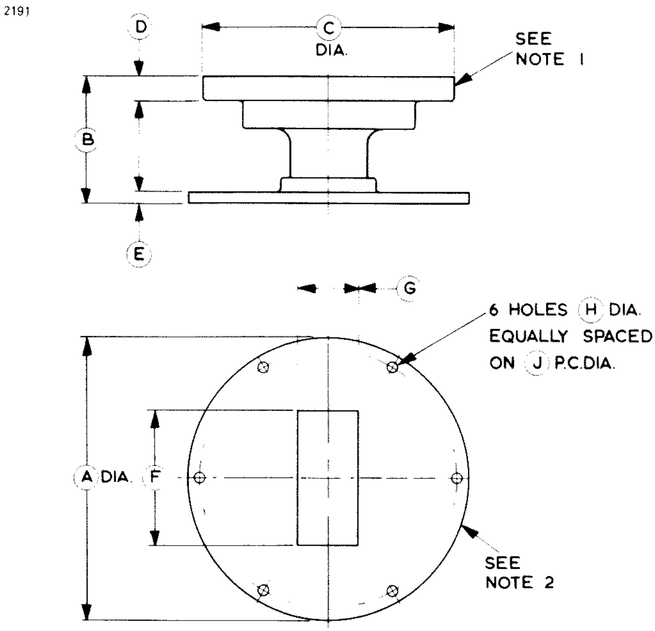
1. The 8 holes will clear studs 0.250 inch (6.35mm) diameter equally spaced on 5.500 inches (139.7mm) pitch circle diameter and within 0.005 inch (0.127mm) of their nominal positions, with the valve located by dowel pins 0.307 inch (7.80mm) diameter and 0.245 inch (6.22mm) diameter spaced 5.500 ± 0.002 inches (139.700 ± 0.051mm) apart.
2. This surface is marked with the letter 'C' to indicate the cathode terminal.
3. The valve will fit between magnet poles 3.010 inch (76.45mm) diameter and 2.970 inches (75.44mm) apart.

OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	14.750 max	374.7 max
B	$6.000^{+0.000}_{-0.010}$	$152.4^{+0.00}_{-0.25}$
C	$0.312^{+0.005}_{-0.000}$	$7.92^{+0.13}_{-0.00}$
D	0.312	7.92
E	0.250	6.35
F	0.750	19.05
G	$0.250^{+0.005}_{-0.000}$	$6.35^{+0.13}_{-0.00}$
H	1.500	38.10
K	7.780 ± 0.025	197.6 ± 0.64
L	0.250 ± 0.005	6.35 ± 0.13
M	4.375	111.1
N	3.625	92.08
P	1.218	30.94
Q	0.218	5.54
R	$3.625^{+0.000}_{-0.006}$	$92.08^{+0.00}_{-0.15}$
S	5.250 ± 0.062	133.4 ± 1.57
T	2.000 max	50.80 max
V	0.500	12.70
W	0.125 ± 0.005	3.18 ± 0.13
X	5.291 ± 0.015	134.4 ± 0.38
Y	1.375	34.93
Z	3.500 ± 0.125	88.90 ± 3.18
AA	3.750	95.25
AB	2.970 max	75.44 max
AC	0.187	4.75
AD	0.750	19.05
AE	4.125	104.8
AF	3.687	93.65
AG	0.250	6.35
AH	4.750 ± 0.005	120.7 ± 0.13
AJ	0.006	0.15

Millimetre dimensions have been derived from inches.

TRANSITION SECTION M4117



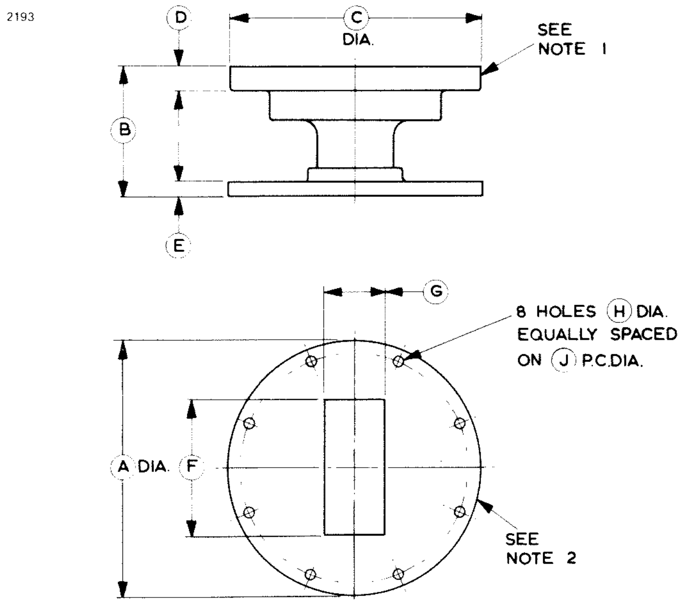
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875	149.2	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	5.375	136.5
E	0.250	6.35			

Millimetre dimensions have been derived from inches.

NOTES

1. This flange mates with flange 'A' of the Magnetron using 8–0.250 inch (6.35mm) diameter bolts, and an O-ring (supplied with M4117) 3.975 inches internal diameter and 0.210 inch diameter section. J.S. No. 5985-99-083-0011 or JAN MS 90064–17.
2. This flange is J.S. type No. 5985-99-083-1560.

TRANSITION SECTION M4119



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.312	134.9	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	4.750	120.7
E	0.312	7.93			

Millimetre dimensions have been derived from inches.

NOTES

1. This flange mates with flange 'A' of the Magnetron using 8–0.250 inch (6.35mm) diameter bolts, and an O-ring (supplied with M4119) 3.975 inches internal diameter and 0.210 inch diameter section. J.S. No. 5985-99-083-0011 or JAN MS 90064–17.
2. This flange is equivalent to J.S. Type No. 5985-99-083-0010 or JAN UG-53/U.

C-Band Magnetrons

English Electric Valve Company Limited
Chelmsford, Essex, England

December 1968
Printed in England

M5008 M5009

C-BAND MAGNETRONS

ABRIDGED DATA

Fixed frequency pulse magnetrons		
Frequency range:		
M5008	5250 to 5310	MHz
M5009	5450 to 5510	MHz
Typical peak output power	0.84	MW
Magnet and launching section	separate electro-magnet and launching section (see page 7 for dimensions)	
Isolator	use of an isolator is recommended (see note 7 on page 4)	
Output	no. 12 waveguide (1.872 x 0.872 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current	13	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	10.557 x 3.000 x 3.000 inches max 268.1 x 76.20 x 76.20mm max
Net weight	3.8 pounds (1.73kg) approx
Mounting position	any

Cooling

water and forced-air

Water cooling of the anode is incorporated in the electro-magnet; the minimum rate of flow of cooling water is 1 imp. gal/min (4.54 l./min) with a maximum inlet temperature of 60°C.

The output window is cooled by high pressure air in the waveguide; the minimum window cooling air flow is 55g/min (42.5 l./min) with a maximum inlet temperature of 60°C.

Any lubricants used on the anode should be sulphur free.

December 1968

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 2)	2900	3100	gauss
Heater voltage (see note 1)	5.85	6.75	V
Heater starting current (peak)	–	40	A
Cathode heating time (see note 1)	180	–	s
Anode current (peak)	55	65	A
Input power (mean) (see note 3)	–	3.0	kW
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	3.0	μs
Rate of rise of voltage pulse (see note 5)	170	210	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature (see note 6)	–	150	°C
V.S.W.R. at the output coupler (see note 7)	–	1.3:1	
Pressurising of waveguide	45	65	lb/in^2
	3.16	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	3000	gauss
Anode current (peak)	60	A
Pulse length	2.5	μs
Pulse repetition rate	600	p.p.s.

Typical Performance

Anode voltage (peak)	34	kV
Output power (peak)	0.84	MW
Output power (mean)	1.25	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions (see note 8)

Air flow		see note 9
Magnetic field (see note 10)	3000	gauss
Heater voltage (for test)	0	V
Anode current (mean)	90	mA
Duty cycle	0.0015	
Pulse length (see note 4)	2.5	μs
V.S.W.R. at the output coupler		see note 11
Rate of rise of voltage pulse (see note 5)	210	kV/μs min

Limits

	Min	Max	
Anode voltage (peak)	32	36	kV
Output power (mean)	1100	–	W
Frequency:			
M5008	5250	5310	MHz
M5009	5450	5510	MHz
R.F. bandwidth at ¼ power (see note 12)	–	1.0	MHz
Frequency pulling (see note 13)	–	10	MHz
Stability (see note 14)	–	0.25	%
Heater current			see note 15

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Heater voltage	0	V
Magnetic field	3000	gauss
Anode current (mean)	90	mA
Duty cycle	0.0015	
Pulse length	2.5	μs
V.S.W.R. at the output coupler		see note 11
Rate of rise of voltage pulse	210	kV/μs min

End of Life Criteria (under Test Conditions above)

Output power (mean)	1.0	kW min
Bandwidth	1.25	MHz max
Stability	0.5	% max

NOTES

1. With no input power.

   Prior to the application of anode voltage, the cathode must be heated for at least 3 minutes by the application of 6.3 volts (±7½%) to the heater. Immediately after the application of anode voltage, the heater voltage must be reduced according to the mean input power as follows:

Mean Input Power (kW)	Heater Voltage ($V_{r.m.s.}$)
0 to 1	6.3 ± 0.45
1 to 2	4.0 ± 0.45
2 to 3	Zero

   The valve heater must be protected against arcing by the use of a minimum capacitance of 1.0μF shunted across the heater directly at the input terminals. A specially designed capacitor with coaxial connectors for mating with the valve input socket is available; details may be obtained from English Electric Valve Company Ltd. The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Measured at the point specified on the electromagnet (see page 7).

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. Measured at the point specified on the valve outline (see page 6).

7. The magnetron will operate satisfactorily into a load with a v.s.w.r. of 1.3:1, at all phases of the mismatch. It will also operate into a load of v.s.w.r. 1.5:1, at all phases of the mismatch, but the valve characteristics may deteriorate and life may be impaired if such operation is for more than nominally short periods.

   It is recommended that the magnetron should be isolated from the load by means of an isolator of approved design. Information on the characteristics of a suitable isolator may be obtained from English Electric Valve Company Ltd.

8. The modulator must be such that the pulse energy delivered to the magnetron following an arcing pulse cannot greatly exceed the normal pulse energy.

9. During this test the waveguide air pressure must not exceed $45lb/in^2$ ($3.16kg/cm^2$) absolute and the cooling air flow shall not exceed 55g/min. For the purposes of this specification the following conversions and equivalents are to be used:

   1 litre of dry air (normal temperature and pressure) weighs 1.293 gramme.

   1 cubic foot = 28.3 litres

   453.6 grammes = 1 pound

10. The value of the magnetic field must fall monotonically to between 87.5 and 92% of the value at the specified point at $\pm$ 1.100 inches ($\pm$27.94mm) along the magnetron axis from the specified point. The sense of the field must be such that a north seeking pole at the specified point will move towards the magnetron cathode terminal.

11. The v.s.w.r. of the specified load is that measured at the output flange of the launching section. The load v.s.w.r. for this test will be less than 1.05:1.

12. The v.s.w.r. of the load for this test will be at least 1.3:1 and the phase adjusted for maximum deterioration of spectrum shape.

13. The v.s.w.r. of the load for this test will be at least 1.3:1, varied through all phases of the mismatch.

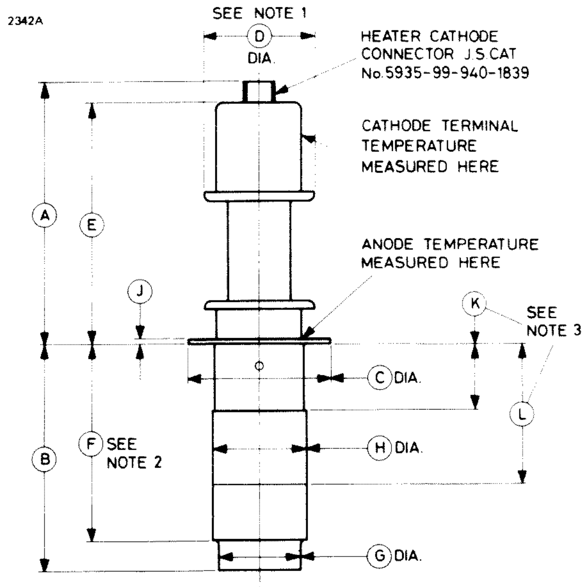
14. Stability is the ratio of missing pulses to the total number of input pulses. A pulse is considered to be missing when its energy is less than 70% of the normal energy level within the frequency band accommodating all the frequency bands plus an extension at each end of twice the pulling figure.

15. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 12A minimum, 14A maximum.

X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.800 max	147.3 max	G	1.721 ± 0.010	43.71 ± 0.25
B	4.725 ± 0.032	120.02 ± 0.81	H	2.000 ± 0.001	50.800 ± 0.025
C	2.995 ± 0.005	76.07 ± 0.13	J	0.125 ± 0.005	3.18 ± 0.13
D	2.500 max	63.50 max	K	1.441 max	36.60 max
E	5.225 max	132.7 max	L	2.936 min	74.57 min
F	4.100 ± 0.022	104.14 ± 0.56			

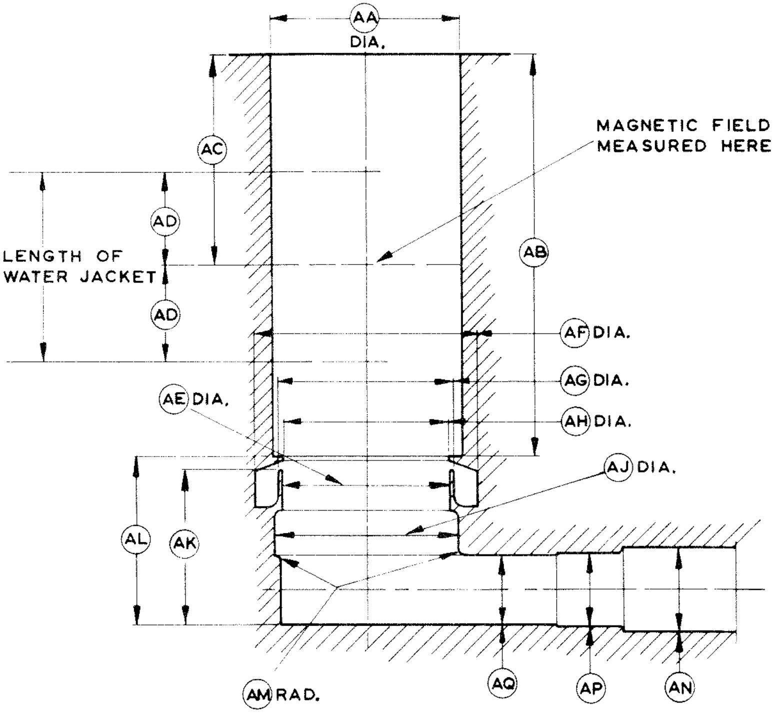
Millimetre dimensions have been derived from inches.

Outline Notes

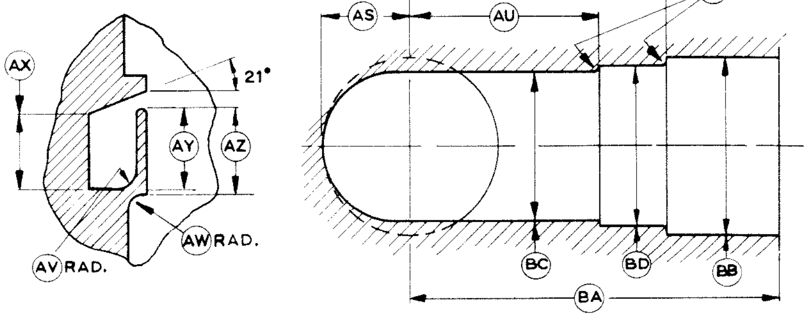
1. All cathode terminal features will lie within a cylinder of diameter D, concentric with datum diameter H.
2. All features over this length will lie within a cylinder of diameter 2.001 inches (50.825mm), concentric with datum diameter H.
3. Diameter H will be maintained between these dimensions.

ELECTRO-MAGNET AND LAUNCHING SECTION

2343



DETAIL OF CHOKE DITCH



DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	$2.002^{+0.002}_{-0.000}$	$50.851^{+0.051}_{-0.000}$
AB	4.145 ± 0.010	105.3 ± 0.25
AC	2.200	55.88
AD	1.000 min	25.40 min
AE	1.757	44.63
AF	2.346 ± 0.003	59.588 ± 0.076
AG	1.844	46.84
AH	1.757 ± 0.003	44.627 ± 0.076
AJ	1.959 ± 0.003	49.758 ± 0.076
AK	1.672	42.47
AL	1.812	46.02
AM	0.062	1.57
AN	0.870	22.10
AP	0.772	19.61
AQ	0.725	18.42
AR	0.020	0.51
AS	0.901	22.89
AT	2.687 ± 0.016	68.25 ± 0.41
AU	1.969 ± 0.016	50.01 ± 0.41
AV	0.100	2.54
AW	0.062	1.57
AX	0.392	9.96
AY	0.4215 ± 0.0025	10.706 ± 0.064
AZ	0.4415 ± 0.0025	11.214 ± 0.064
BA	3.875 ± 0.016	98.43 ± 0.41
BB	1.872	47.55
BC	1.536	39.01
BD	1.652	41.96

Millimetre dimensions have been derived from inches.

M5032 M5033

C-BAND MAGNETRONS

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
M5032	5250 to 5350	MHz
M5033	5430 to 5530	MHz
Typical peak output power	0.84	MW
Magnet and launching section	separate electro-magnet and launching section (see page 7 for dimensions)	
Isolator	use of an isolator is recommended (see note 7 on page 4)	
Output	no. 12 waveguide (1.872 x 0.872 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current	13	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	10.557 x 3.000 x 3.000 inches max 268.1 x 76.20 x 76.20mm max
Net weight	3.8 pounds (1.73kg) approx
Mounting position	any

Cooling water and forced-air

Water cooling of the anode is incorporated in the electro-magnet; the minimum rate of flow of cooling water is 1 imp. gal/min (4.54 l./min) with a maximum inlet temperature of 60°C.

The output window is cooled by high pressure air in the waveguide; the minimum window cooling air flow is 55g/min (42.5 l./min) with a maximum inlet temperature of 60°C.

Any lubricants used on the anode should be sulphur free.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic field (see note 2)	2900	3100	gauss
Heater voltage (see note 1)	5.85	6.75	V
Heater starting current (peak)	–	40	A
Cathode heating time (see note 1)	180	–	s
Anode current (peak)	55	65	A
Input power (mean) (see note 3)	–	3.0	kW
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	5.5	μs
Rate of rise of voltage pulse (see note 5)	170	210	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature (see note 6)	–	150	°C
V.S.W.R. at the output coupler (see note 7)	–	1.3:1	
Pressurising of waveguide	45	65	lb/in^2
	3.16	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	3000	gauss
Anode current (peak)	60	A
Pulse length	5.0	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak)	34	kV
Output power (peak)	0.84	MW
Output power (mean)	1.25	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions (see note 8)

Air flow		see note 9
Magnetic field (see note 10)	3000	gauss
Heater voltage (for test)	0	V
Anode current (mean)	90	mA
Duty cycle	0.0015	
Pulse length (see note 4)	5.0	μs
V.S.W.R. at the output coupler		see note 11
Rate of rise of voltage pulse (see note 5)	210	kV/μs min

Limits

	Min	Max	
Anode voltage (peak)	32	36	kV
Output power (mean)	1100	–	W
Frequency:			
M5032	5250	5350	MHz
M5033	5430	5530	MHz
R.F. bandwidth at ¼ power (see note 12)	–	0.5	MHz
Frequency pulling (see note 13)	–	10	MHz
Stability (see note 14)	–	0.25	%
Heater current			see note 15

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Heater voltage	0	V
Magnetic field	3000	gauss
Anode current (mean)	90	mA
Duty cycle	0.0015	
Pulse length	5.0	μs
V.S.W.R. at the output coupler		see note 11
Rate of rise of voltage pulse	210	kV/μs min

End of Life Criteria (under Test Conditions above)

Output power (mean)	1.0	kW min
Bandwidth	1.25	MHz max
Stability	0.5	% max

NOTES

1. With no input power.

   Prior to the application of anode voltage, the cathode must be heated for at least 3 minutes by the application of 6.3 volts (±7½%) to the heater. Immediately after the application of anode voltage, the heater voltage must be reduced according to the mean input power as follows:

Mean Input Power (kW)	Heater Voltage ($V_{r.m.s.}$)
0 to 1	6.3 ± 0.45
1 to 2	4.0 ± 0.45
2 to 3	Zero

   The valve heater must be protected against arcing by the use of a minimum capacitance of 1.0μF shunted across the heater directly at the input terminals. A specially designed capacitor with coaxial connectors for mating with the valve input socket is available; details may be obtained from English Electric Valve Company Ltd. The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Measured at the point specified on the electromagnet (see page 7).

3. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. Measured at the point specified on the valve outline (see page 6).

7. The magnetron will operate satisfactorily into a load with a v.s.w.r. of 1.3:1, at all phases of the mismatch. It will also operate into a load of v.s.w.r. 1.5:1, at all phases of the mismatch, but the valve characteristics may deteriorate and life may be impaired if such operation is for more than nominally short periods.

   It is recommended that the magnetron should be isolated from the load by means of an isolator of approved design. Information on the characteristics of a suitable isolator may be obtained from English Electric Valve Company Ltd.

8. The modulator must be such that the pulse energy delivered to the magnetron following an arcing pulse cannot greatly exceed the normal pulse energy.

9. During this test the waveguide air pressure must not exceed 45lb/in^2 (3.16kg/cm^2) absolute and the cooling air flow shall not exceed 55g/min. For the purposes of this specification the following conversions and equivalents are to be used:

    1 litre of dry air (normal temperature and pressure) weighs 1.293 gramme.

    1 cubic foot = 28.3 litres

    453.6 grammes = 1 pound

10. The value of the magnetic field must fall monotonically to between 87.5 and 92% of the value at the specified point at ± 1.100 inches (±27.94mm) along the magnetron axis from the specified point. The sense of the field must be such that a north seeking pole at the specified point will move towards the magnetron cathode terminal.

11. The v.s.w.r. of the specified load is that measured at the output flange of the launching section. The load v.s.w.r. for this test will be less than 1.05:1.

12. The v.s.w.r. of the load for this test will be at least 1.3:1 and the phase adjusted for maximum deterioration of spectrum shape.

13. The v.s.w.r. of the load for this test will be at least 1.3:1, varied through all phases of the mismatch.

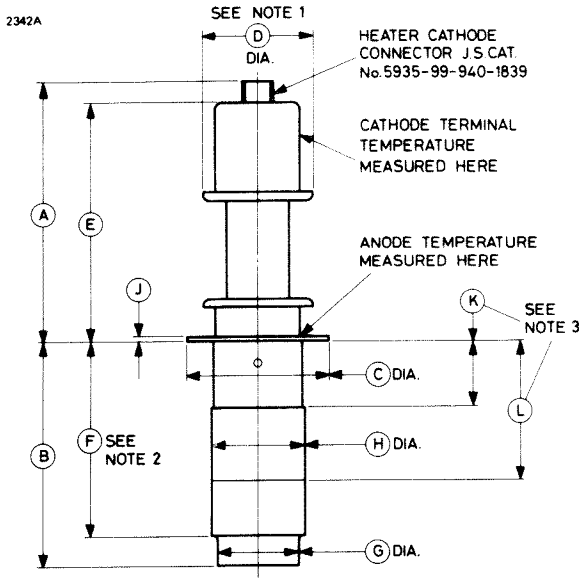
14. Stability is the ratio of missing pulses to the total number of input pulses. A pulse is considered to be missing when its energy is less than 70% of the normal energy level within the frequency band accommodating all the frequency bands plus an extension at each end of twice the pulling figure.

15. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 12A minimum, 14A maximum.

X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

OUTLINE



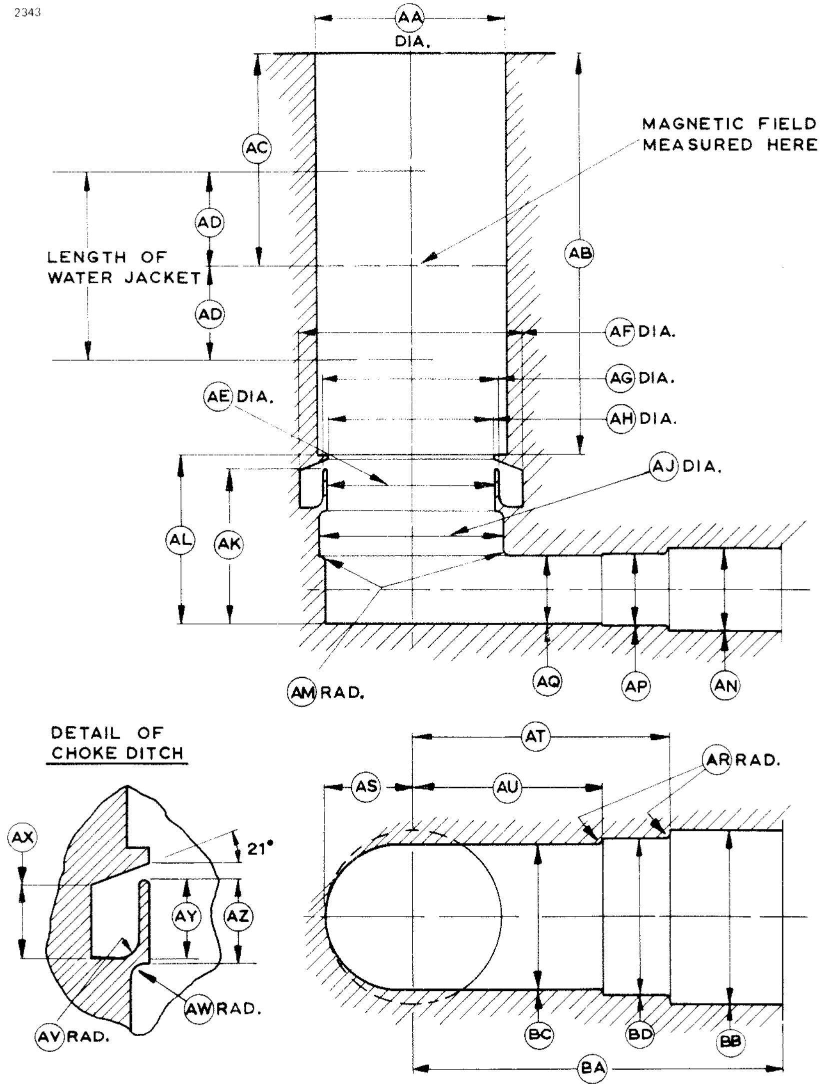
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.800 max	147.3 max	G	1.721 ± 0.010	43.71 ± 0.25
B	4.725 ± 0.032	120.02 ± 0.81	H	2.000 ± 0.001	50.800 ± 0.025
C	2.995 ± 0.005	76.07 ± 0.13	J	0.125 ± 0.005	3.18 ± 0.13
D	2.500 max	63.50 max	K	1.441 max	36.60 max
E	5.225 max	132.7 max	L	2.936 min	74.57 min
F	4.100 ± 0.022	104.14 ± 0.56			

Millimetre dimensions have been derived from inches.

Outline Notes

1. All cathode terminal features will lie within a cylinder of diameter D, concentric with datum diameter H.
2. All features over this length will lie within a cylinder of diameter 2.001 inches (50.825mm), concentric with datum diameter H.
3. Diameter H will be maintained between these dimensions.

ELECTRO-MAGNET AND LAUNCHING SECTION



DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	$2.002 \begin{smallmatrix} +0.002 \\ -0.000 \end{smallmatrix}$	$50.851 \begin{smallmatrix} +0.051 \\ -0.000 \end{smallmatrix}$
AB	4.145 ± 0.010	105.3 ± 0.25
AC	2.200	55.88
AD	1.000 min	25.40 min
AE	1.757	44.63
AF	2.346 ± 0.003	59.588 ± 0.076
AG	1.844	46.84
AH	1.757 ± 0.003	44.627 ± 0.076
AJ	1.959 ± 0.003	49.758 ± 0.076
AK	1.672	42.47
AL	1.812	46.02
AM	0.062	1.57
AN	0.870	22.10
AP	0.772	19.61
AQ	0.725	18.42
AR	0.020	0.51
AS	0.901	22.89
AT	2.687 ± 0.016	68.25 ± 0.41
AU	1.969 ± 0.016	50.01 ± 0.41
AV	0.100	2.54
AW	0.062	1.57
AX	0.392	9.96
AY	0.4215 ± 0.0025	10.706 ± 0.064
AZ	0.4415 ± 0.0025	11.214 ± 0.064
BA	3.875 ± 0.016	98.43 ± 0.41
BB	1.872	47.55
BC	1.536	39.01
BD	1.652	41.96

Millimetre dimensions have been derived from inches.

X-Band Magnetrons

English Electric Valve Company Limited
Chelmsford, Essex, England

December 1968
Printed in England

ENGLISH ELECTRIC

Service Type CV3676 American Designation 2J42

ABRIDGED

Fixed Frequency Pulse Magnetron

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	8·3	kW
Magnet		Integral
Output		No. 16 Waveguide
Coupler		UG–40A/U
Cooling		Natural or forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current (Peak)	3·0	A Max
Cathode Heating Time (Minimum. *See Note* 2)	2	minutes

Mechanical

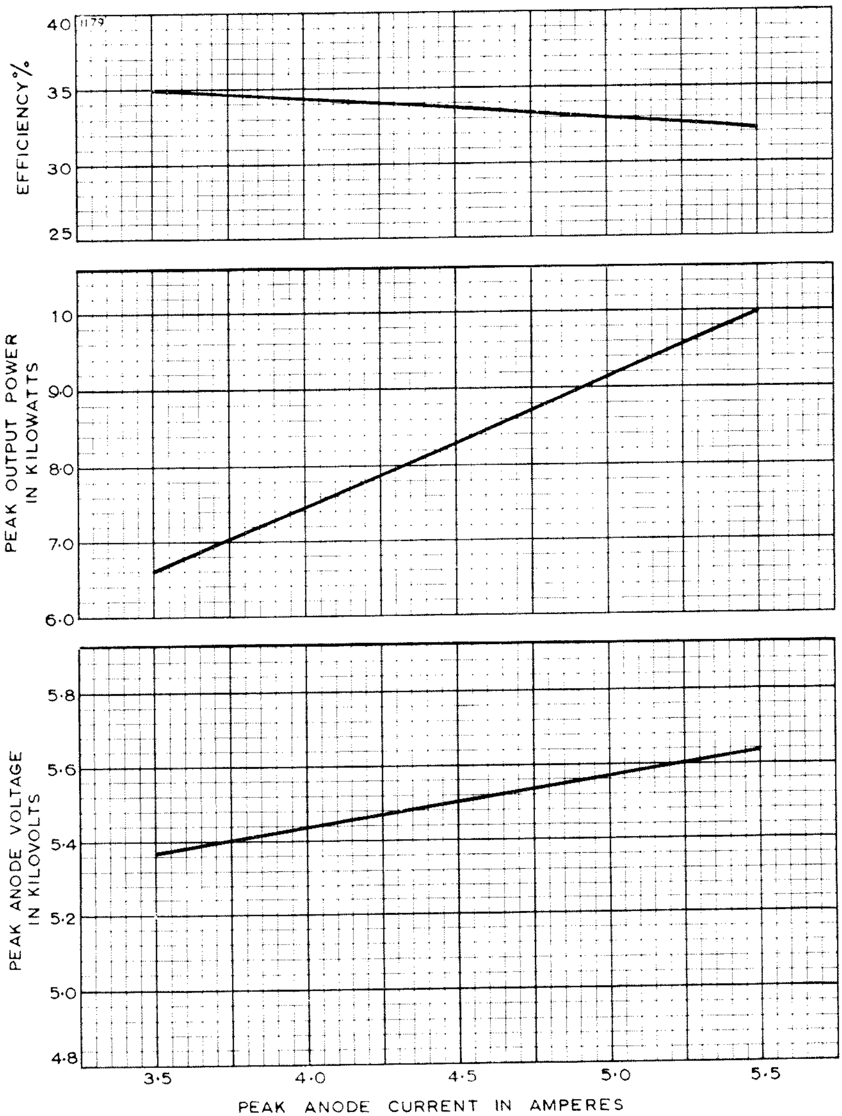
Overall Dimensions	4·469 × 3·313 × 5·250 inches	Max
	114 × 84·2 × 134 mm	Max
Net Weight	$3\frac{1}{4}$ pounds (1·5 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnet of this valve is preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnet. English Electric Valve Company Limited should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

ENGLISH ELECTRIC

PERFORMANCE CHART



ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Printed in England

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater Voltage	5·7	6·9	V
Heater Current at heater voltage 6·3V	0·43	0·60	A
Anode Voltage (Peak)	5·0	6·0	kV
Anode Current (Peak)	3·5	5·5	A
Input Power (Peak)	—	33	kW
Input Power (Mean)	—	82·5	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 3)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 4)	—	75	kV/μsec
Anode Temperature (*See Note* 5)	—	120	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·25	Mc/s/°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

	Condition 1	Condition 2	
Heater Voltage	4·5	6·3	V
Anode Voltage (Peak)	5·5	5·5	kV
Anode Current (Peak)	4·5	4·5	A
Pulse Length	1·0	2·0	μsec
Pulse Repetition Rate	2000	500	p.p.s.
Rate of Rise of Voltage Pulse	60	60	kV/μsec
Output Power (Peak)	8	8	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	
Heater Voltage (for test) ..	4·5	6·3	V
Anode Current (Mean)	9·0	4·5	mA
Duty Cycle	0·002	0·001	
Pulse Length (*See Note* 3) ..	1·0	2·0	μsec
V.S.W.R. at the output coupler..	1·1:1	1·1:1	
Rate of Rise of Voltage Pulse (*See Note* 4)	75	75	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	5·3	5·7			kV
Output Power (Mean)	14				W
Frequency (*See Note* 6)	9345	9405			Mc/s
R.F. Bandwidth at ¼ Power ..		2·5		1·25	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)		15			Mc/s
Stability (*See Note* 7)		0·25		0·25	%
Cold Impedance (*See Note* 8)					

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 2 conditions. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillations 1 and 2)

Output Power (Mean)	11	W Min
R.F. Bandwidth at ¼ Power	3·0	Mc/s Max
Frequency: Must be within Test Limits above, Oscillation 1		
Stability (*See Note* 7)	1	% Max

NOTES

1. With no anode input power.
   For average values of pulse input power greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right)\text{volts}$$

   where P_i = mean input power in watts.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. Tolerance ± 10%.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.

5. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

6. Other frequency ranges can be supplied on request.

7. With the valve operating into a V.S.W.R. of 1·1 : 1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9345 to 9405Mc/s. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

8. For the range 9345 to 9405Mc/s the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a V.S.W.R. of at least 8 : 1 with a minimum 13·5–22·5mm from the output flange towards the anode.

MAGNETRON

DIMENSIONS

A	4·453 ± ·016	G	1·220 ± ·004 centres.	Q	2·187 Max.
B	4·103	→ H	0·125 Max.	S	0·875 ± ·125
C	4 Holes 0·170 ± ·003 Dia.	J	1·000 Max.	T	4·000 Max.
D	0·175 ± ·003 Dia. (These Holes to be on indicated centres to within 0·005.)	K	1·220	U	1·937 Min.
		L	0·203 ± ·016	V	0·375 Max.
		M	1·625 ± ·016	W	0·125
E	0·172 ± ·016	→ N	2·937 ± ·125	X	3·312 Max.
F	1·280 ± ·004	P	2·187 Max.		

NOTES FOR OUTLINE

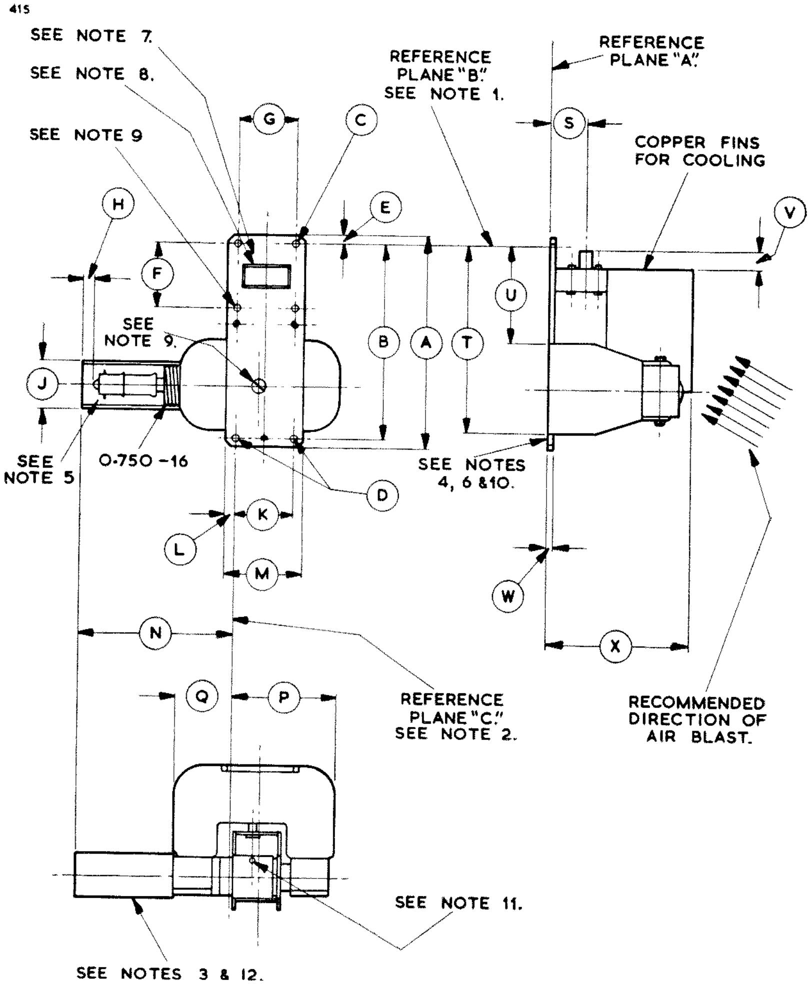
1. Reference plane 'B' passes through the centres of the two top holes of the mounting plate as shown and is perpendicular to plane 'A'.
2. Reference Plane 'C' passes through the upper left hole on mounting plate as shown and is mutually perpendicular to planes 'A' and 'B'.
3. The axis of the filament lead protector will be within 5° of a normal to reference plane 'C'.
4. With surface 'A' resting on a flat surface plate, a feeler gauge 0·020 thick and 0·125 wide will not enter more than 0·125 at any point.
5. The clearance between the inside surface of the protector and the 0·375 diameter cylindrical surface of the standard single contact miniature bayonet lamp base will → not be less than 0·157.
6. All metal surfaces except surface 'A' and the bayonet base will be painted black.
7. This area is gasketed for pressurizing wave guide output as with coupler Army-Navy designation UG-40A/U and is the area to be tested per MIL-E-1 Par. 4.19.13.
8. The position of wave guide hole is not specified on this drawing since tubes are tested and used into coupler Army-Navy designation UG-40A/U. (See Note 7).
9. Centre of this hole will be within 0·004 of reference plane 'C'.
10. Surface 'A' and interior surfaces of waveguide will be plated 10mg./sq. in. of gold or 30mg./sq. in. silver but will not be plated if the parts are made out of monel or equivalent corrosion resistant materials.
11. Anode temperature measured at this point.
12. The filament lead protector will not be used to support any cap fitting. This protector is a detachable sleeve of a non-conducting material.

All dimensions in inches

→ Indicates a change

MAGNETRON

OUTLINE



ALL DIMENSIONS IN INCHES

ABRIDGED DATA

Fixed Frequency Pulse Magnetron for airborne radar, complying with specification MIL–E–1/1002C.

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	8·3	kW
Magnet		Integral
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		Natural or Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current (Peak)	3·0	A Max
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes

Mechanical

Overall Dimensions	3·313 × 4·469 × 5·250 inches	Max
	84·15 × 113·5 × 133·4 mm	Max
Net Weight	3¼ pounds (1·5 kg)	Approx
Mounting Position		Any

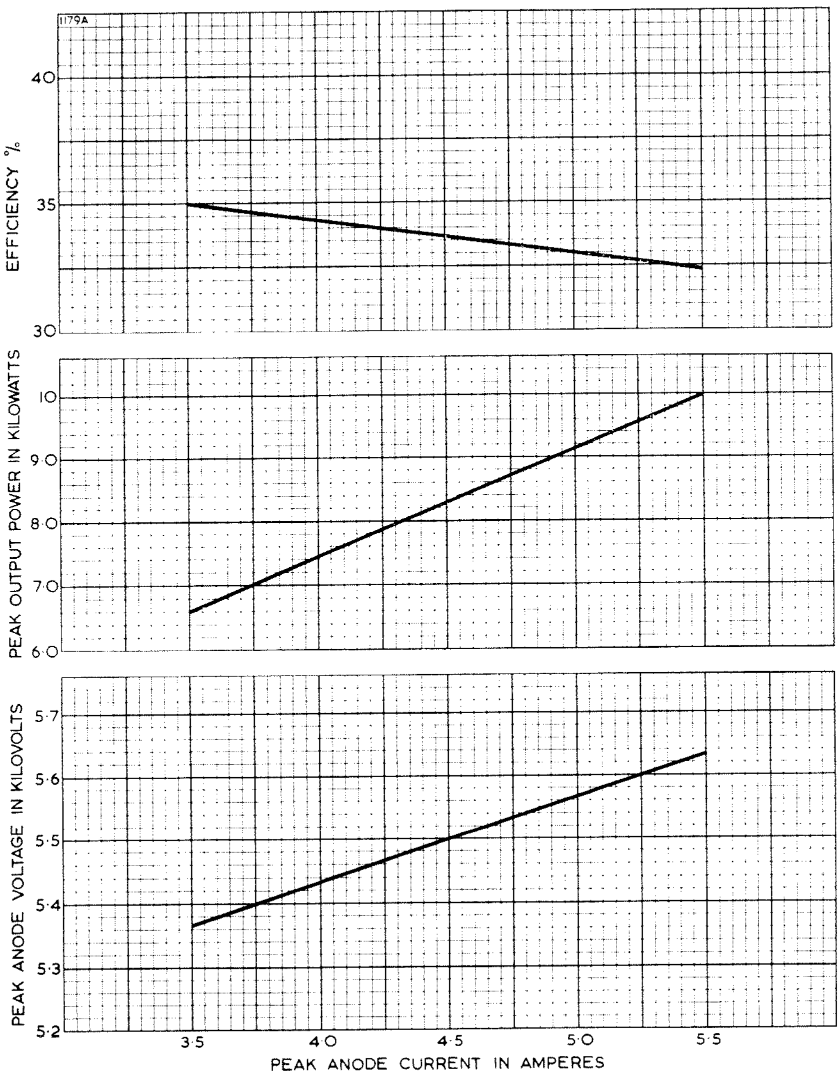
The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnet of this valve is preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnet. English Electric Valve Company Limited should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

Cooling .. .. Natural or Forced-air

ENGLISH ELECTRIC

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	6·9	V
Heater Starting Current (Peak)	—	3·0	A
Anode Voltage (Peak)	—	6·0	kV
Anode Current (Peak)	3·7	5·5	A
Input Power (Peak)	18	35	kW
Input Power (Mean) (*See Note* 3)	—	70	W
Duty Cycle	—	0·002	
Pulse Length (*See Note* 4)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	85	kV/μsec
Anode Temperature	—	120	°C
Pressurising of Waveguide System and Input Terminals (*See Note* 6)	0·97	45	lb/in^2
	0·07	3·16	kg/cm^2
Altitude:			
Output System (*See Note* 7)	—	60 000	ft
		18	km
Input Terminals	—	70 000	ft
		21·5	km
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

Heater Voltage	6·0	V
Anode Current (Peak)	4·5	A
Pulse Length (*See Note* 4)	0·45	μsec
Pulse Repetition Rate	800	p.p.s.
Rate of Rise of Voltage Pulse	60	kV/μsec

Typical Performance

Anode Voltage (Peak)	5·5	kV
Output Power (Peak)	8·3	kW
Output Power (Mean)	3·0	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

Heater Voltage (for test)	5·3	V
Anode Current (Mean)	4·5	mA
Duty Cycle	0·001	
Pulse Length (*See Note* 4)	1·0	μsec
V.S.W.R. at the output coupler	1·1 : 1	
Rate of Rise of Voltage Pulse (*See Note* 5)	85	kV/μsec Min

Limits

	Min	*Max*	
Anode Voltage (Peak)	5·0	5·55	kV
Output Power (Mean)	7·0	11·0	W
Frequency (*See Note* 8)	9345	9405	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5 : 1)	—	20	Mc/s
Stability (*See Note* 9)	—	0·25	%
R.F. Bandwidth at ¼ Power (*See Note* 10)	—	2·0	Mc/s
Heater Current		*See Note* 11	
Temperature Coefficient of Frequency		*See Note* 12	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the test conditions specified above.

If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA

(Under Test Conditions above)

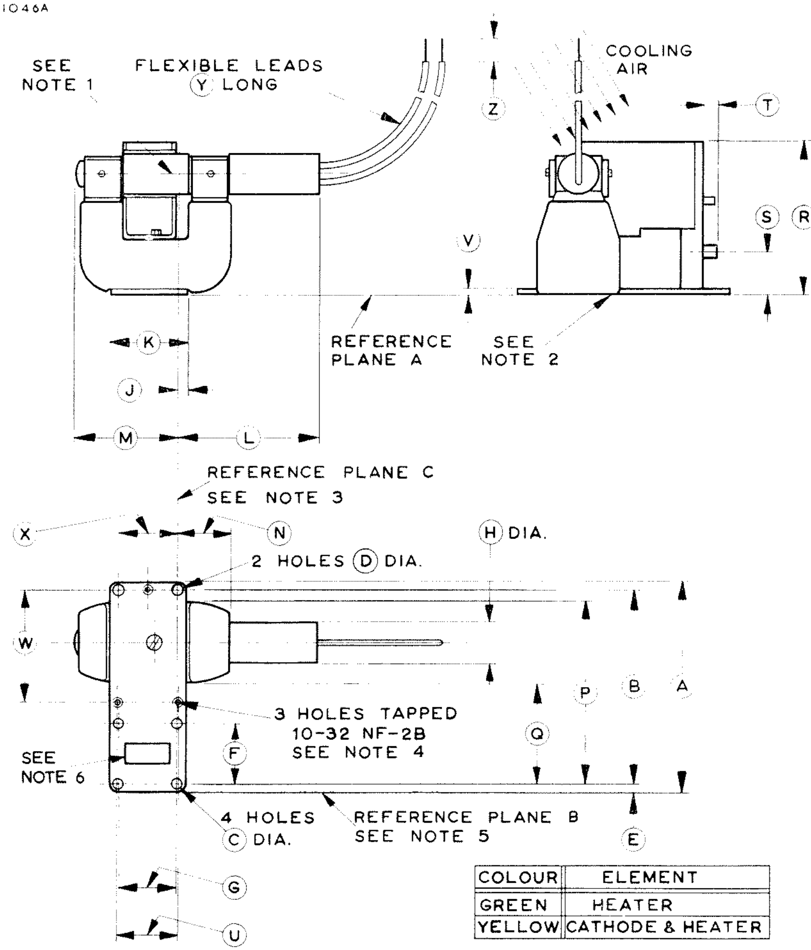
Output Power (Mean)	5·5	W Min
R.F. Bandwidth at ¼ Power	2·5	Mc/s Max
Stability (*See Note* 9)	0·5	% Max

NOTES

1. With no anode input power.
The heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:
$$V_h = 6{\cdot}3(1 - 0{\cdot}03I_a) \text{ volts}$$
where I_a = mean anode current in milliamperes.
The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.
3. The various parameters are related by the following formula:
$$P_i = i_{apk} \times v_{apk} \times Du$$
where P_i = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.
4. Tolerance ±10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6·0pF.
6. The gas used for pressurisation must have properties at least equal to those of clean, dry air at the pressure indicated.
7. This rating applies when the magnetron is operated under the typical operating conditions into a mismatched load of V.S.W.R. 1·3:1 at the worst phase for breakdown, via a coupler UG-40A/U of standard manufacture.
8. Temperature of anode block 40±10°C, measured at the point indicated on the outline drawing. Other frequency ranges can be supplied on request.
9. With the valve operating into a V.S.W.R. of 1·5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9345 to 9405Mc/s. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 3 minutes of a test period not exceeding 6 minutes. This test shall start within 1 minute of the application of h.t.
10. The bandwidth will be within the limits specified when the peak anode current is varied between 3·7 and 5·5A with the magnetron operating into a V.S.W.R. of 1·5:1 phased to give maximum spectrum degradation.
11. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·43A minimum, 0·60A maximum.
12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

ENGLISH ELECTRIC

OUTLINE



COLOUR	ELEMENT
GREEN	HEATER
YELLOW	CATHODE & HEATER

LEAD CONNECTIONS

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	4·453 ± 0·016	113·11 ± 0·41	N	1·188 Max	30·18 Max
B	4·103 ± 0·005	104·22 ± 0·13	P	4·000 Max	101·6 Max
C	0·170 ± 0·003	4·318 ± 0·762	Q	1·938 Min	49·23 Min
D	0·175 ± 0·003	4·445 ± 0·762	R	3·313 Max	84·15 Max
E	0·172 ± 0·016	4·37 ± 0·41	S	0·875 ± 0·125	22·23 ± 3·18
F	1·280 ± 0·004	32·512 ± 0·102	T	0·375 Max	9·53 Max
G	1·220 ± 0·004	30·988 ± 0·102	U	1·250	31·75
H	1·000 Max	25·40 Max	V	0·125	3·18
J	0·203 ± 0·016	5·16 ± 0·41	W	2·393	60·78
K	1·625 ± 0·016	41·28 ± 0·41	X	1·220 ± 0·004	30·988 ± 0·102
L	2·938 ± 0·125	74·63 ± 3·18	Y	8·000	203·2
M	2·188 Max	55·58 Max	Z	0·500	12·70

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Anode temperature measured at this point.
2. With the valve resting on a flat surface, a feeler gauge 0·020 inch (0·51mm) thick and 0·125 inch (3·18mm) wide will not enter more than 0·125 inch (3·18mm) at any point.
3. Reference plane C is perpendicular to reference planes A and B. The three planes intersect at the centre of the hole indicated.
4. Positional tolerance 0·015 inch (0·38mm) diameter.
5. Reference plane B is perpendicular to plane A and passes through the centres of the holes indicated.
6. The position of the waveguide aperture is not specified on this drawing since the magnetron is tested and used with coupler UG–40A/U.

American Designation 2J55

ABRIDGED DATA

Fixed Frequency Pulse Magnetron complying with JAN specification.

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	50	kW
Magnet		Integral
Output		No. 15 Waveguide (1·122 inches × 0·497 inch internal)
Coupler		Special
Cooling		Forced-air

GENERAL DATA

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	1·0	A
Heater Starting Current (Peak)	5·0	A Max
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes

Mechanical

Overall Dimensions	6·171 × 5·375 × 5·600 inches	Max
	156·7 × 136·5 × 142·2 mm	Max
Net Weight	4 pounds (1·9 kg)	Approx
Mounting Position		Any

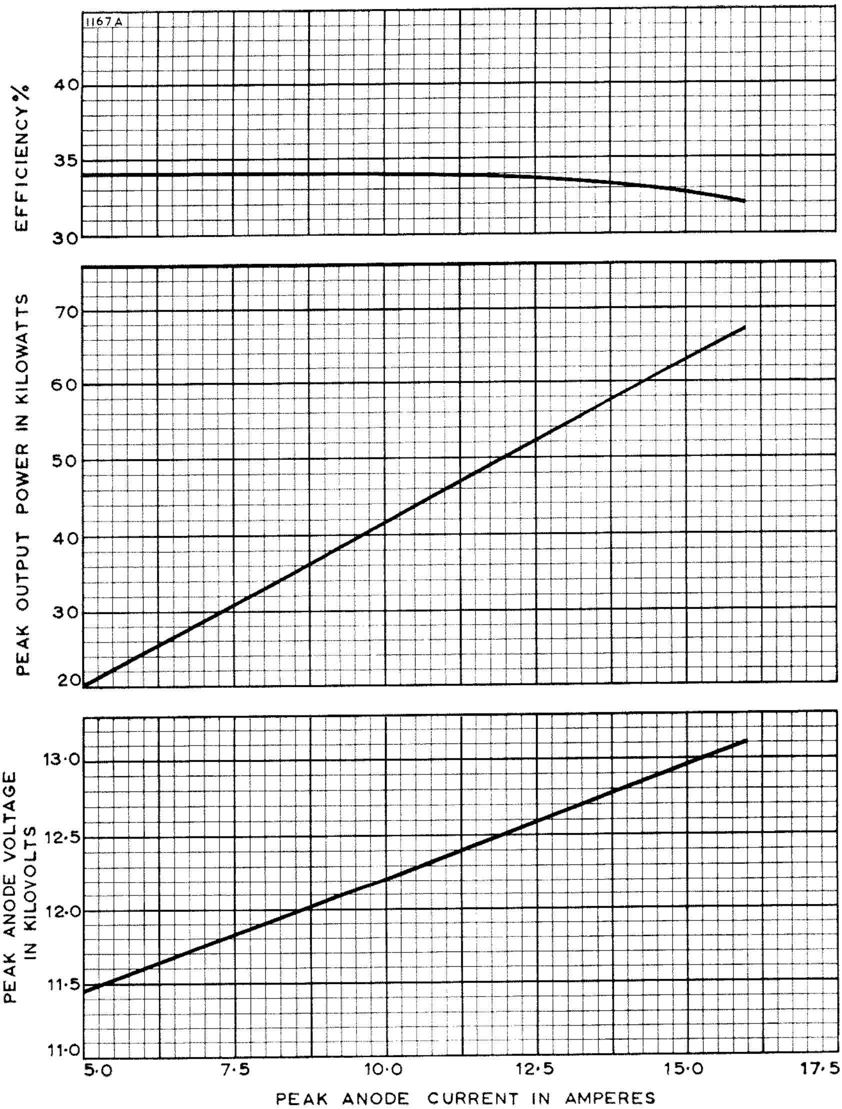
The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnets of this valve are preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnets. English Electric Valve Company Limited should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

Cooling (*See Note* 3) . . . . Forced-air

ENGLISH ELECTRIC

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	7·0	V
Heater Starting Current (Peak)	—	5·0	A
Anode Voltage (Peak)	—	16	kV
Anode Current (Peak)	—	16	A←
Input Power (Mean) (*See Note* 4)	—	180	W←
Duty Cycle (*See Note* 5)	—	0·001	
Pulse Length	—	2·5	μsec←
Rate of Rise of Voltage Pulse (*See Note* 6):			
Pulse length 0·5μsec	—	150	kV/μsec
Pulse length 2·0μsec	—	100	kV/μsec
Anode Temperature (*See Note* 3)	—	150	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·25	Mc/s/°C
V.S.W.R. at the output coupler	—	1·5:1	
Altitude	—	10 000	ft
	—	3·05	km
Pressurising of Waveguide (*See Note* 7)	—	45	lb/sq.in
		3·2	kg/sq.cm

TYPICAL OPERATION

Operational Conditions

Heater Voltage	0	V
Anode Current (Peak)	12	A
Pulse Length	1·0	μsec
Pulse Repetition Rate	1000	p.p.s.
Rate of Rise of Voltage Pulse	100	kV/μsec

Typical Performance

Anode Voltage (Peak)	12·5	kV←
Output Power (Peak)	50	kW←
Output Power (Mean)	50	W←

← Indicates a change.

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions (*See Note* 8)

	Oscillation 1	Oscillation 2	
Heater Voltage (for test)	0	2·5	V
Anode Current (Mean)	12	8·0	mA
Duty Cycle	0·001	0·00065	
Pulse Length	1·0 ± 10%	2·0 (min)	μsec
V.S.W.R. at the output coupler (max)	1·15:1	1·15:1	
Time of Rise of Voltage Pulse (max)	0·2	0·2	μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	11	13	—	—	kV
Output Power (Mean)	40	—	—	—	W
Frequency (*See Note* 9)	9345	9405	—	—	Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 10)	—	3·0	—	—	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5 : 1)	—	15	—	—	Mc/s
Stability (*See Note* 11)	—	—	—	0·5	%
Heater Current (*See Note* 12)					
In addition, the valve is tested as follows:					
Stability (*See Note* 13)	—	0·5	—	0·5	%
R.F. Bandwidth at ¼ Power (*See Note* 14)	—	3·0	—	1·25	Mc/s

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Limited should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Output Power (Mean)	30	W Min
R.F. Bandwidth at ¼ Power	3·0	Mc/s Max
Frequency: Must be within the limits specified above		
Stability (*See Note* 13)	1·0	% Max

NOTES

1. With no anode input power.
   For average values of pulse input power less than 150 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6{\cdot}3\sqrt{1 - \frac{P_i}{150}} \text{ volts}$$

   where P_i = mean input power in watts.
   For input powers greater than 150 watts the heater voltage shall be reduced to zero.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins. At 50°C ambient temperature and standard atmospheric pressure an air flow of 65cu.ft/min (1·84cu.m/min) from an orifice of 1¼ inches (32mm) diameter located ¼ inch (6·4mm) from the cooling fins is adequate.

4. The various parameters are related by the following formula:

   $P_i = i_{apk} \times v_{apk} \times Du$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

5. For peak input powers exceeding 150kW, the duty cycle must not exceed 0·0007.

6. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.

7. At the maximum pressure of 45lb/sq.in absolute, the leakage will not exceed 0·5 litre (N.T.P.) per minute.

8. Specification MIL-E-1/297A.

9. Other frequency ranges can be supplied on request.

10. The bandwidth shall remain within the specified limit as the mean current is varied between 11 and 13mA.

11. With the valve operating into a V.S.W.R. of 1·1:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level within a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 3 minutes of a test interval not to exceed 6 minutes.

12. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·9A minimum, 1·1A maximum.

13. As in Note 11 but with V.S.W.R. of 1·5:1, phased to give maximum instability.

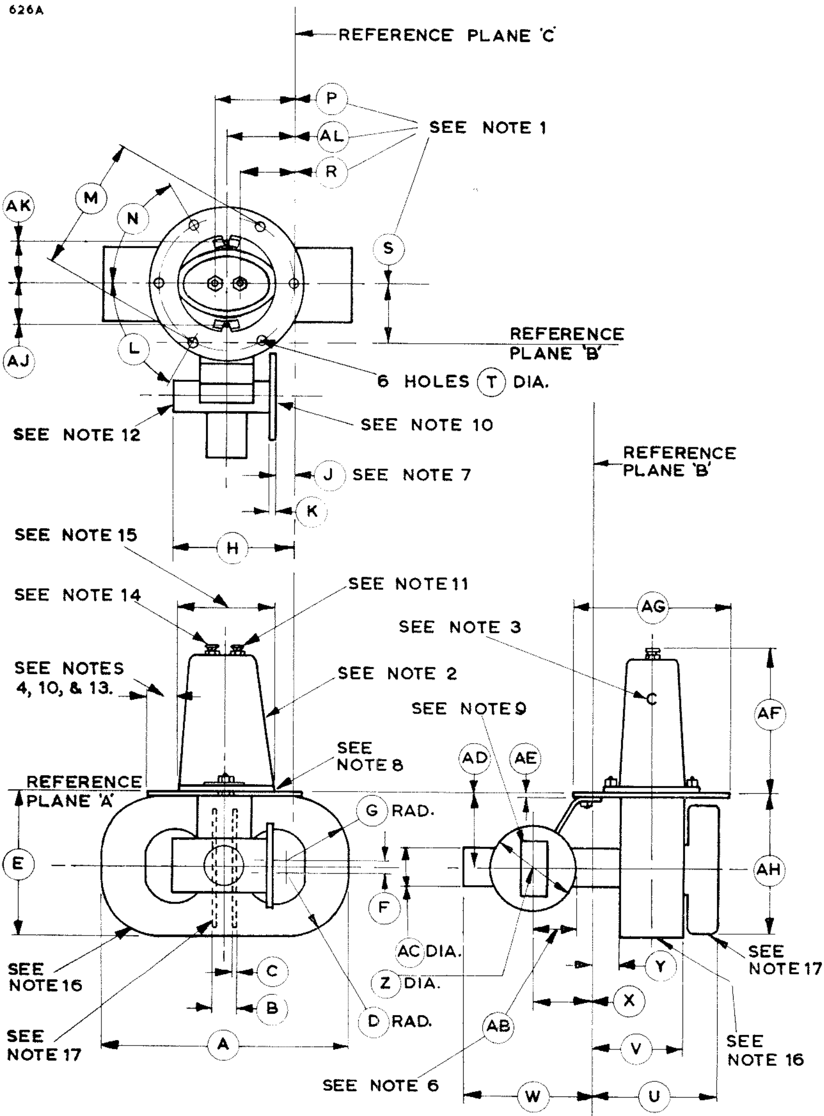
14. The bandwidth shall remain within the specified limits as the peak current is varied between 10 and 14A.

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	5·375 Max	136·5 Max	U	2·745 Max	69·72 Max
B	0·500 Max	12·70 Max	V	2·057	52·25
C	0·063	1·60	W	2·661 Max	67·59 Max
D	1·344	34·14	X	1·192 ± 0·020	30·28 ± 0·51
E	3·125 Max	79·38 Max	Y	0·432 Min	10·97 Min
F	0·374	9·50	Z	1·750 ± 0·007	44·45 ± 0·18
G	1·344	34·14	AB	0·875 ± 0·016	22·23 ± 0·41
H	2·500 Max	63·50 Max	AC	0·750	19·05
J	0·437 ± 0·020	11·10 ± 0·51	AD	1·562 ± 0·020	39·67 ± 0·51
K	0·085 ± 0·005	2·16 ± 0·13	AE	0·125 ± 0·005	3·18 ± 0·13
L	60° ± 12′	60° ± 12′	AF	2·984 ± 0·062	75·79 ± 1·57
M	2·875 ± 0·006	73·03 ± 0·15	AG	3·250 ± 0·031	82·55 ± 0·79
N	60° ± 12′	60° ± 12′	AH	2·969 Max	75·41 Max
P	1·687	42·85	AJ	0·906 ± 0·031	23·01 ± 0·79
R	1·187	30·15	AK	0·906 ± 0·031	23·01 ± 0·79
S	1·245	31·62	AL	1·437 ± 0·031	36·50 ± 0·79
T	0·193 ± 0·003	4·902 ± 0·076			

Millimetre dimensions have been derived from inches.

OUTLINE
(*See Page 8 for Outline Notes*)



OUTLINE NOTES

1. The jack holes will be within a radius of 0·023 inch (0·58mm) of their true location specified, but will be spaced 0·500±0·010 inch (12·70±0·25mm) with respect to each other. The centre lines of the holes will be perpendicular to Reference Plane 'A' within 3°.
2. Pyrex glass, porcelain, or approved equivalent.
3. Common cathode connection indicated by letter C.
4. With the flange resting on a plane surface the flatness of the mounting flange 0·500 inch (12·70mm) from the outer edge will be such that a 0·010 inch (0·25mm) thick feeler gauge 0·125 inch (3·18mm) wide will not enter for more than 0·250 inch (6·35mm).
5. All metal surfaces will be covered by a black finish, except inside of wave-guide, jack terminals, and surfaces covered by Note 10.
6. Output flange will be concentric with open end of waveguide to within 0·010 inch (0·25mm).
7. Tolerance includes angular as well as lateral deviations of this surface.
8. 0·032 inch (0·81mm) asbestos gasket (optional).
9. 1·250×0·625 inch (31·75×15·88mm) external dimensions×0·064 inch (1·63mm) wall commercial rectangular brass tubing.
10. This surface will be free from paint.
11. Hexagon locking head banana pin jacks, hole 0·169±0·005 inch (4·29±0·13mm) diameter as per Mil–E–1B.
12. All joints in waveguide assembly will be vacuum tight to provide a hermetic seal at flange.
13. All joints in mounting flange will be vacuum tight to provide a hermetic seal.
14. Heater connection.
15. Any portion of the assembly extending above this surface will be within 1·109 inch (28·17mm) radius of the true centre of the flange.
16. Magnets with protective coating.
17. Radiator fins.

MAGNETRON

Service Type CV2852
CV5235 (near)

American Designation 2J56

INTRODUCTION

The 2J56 is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 230kW and operates at a fixed frequency within the limits of 9215 and 9275Mc/s, when used under the conditions specified below.

The valve has a packaged integral magnet.

The waveguide output flange is designed for coupling directly to waveguide No. 15 (1·122 inches × 0·497 inch internal dimensions) by means of a special Coupler. The waveguide may be pressurised to 45lb/sq.in. absolute when the leakage will not exceed 0·5 litre (N.T.P.) per minute.

It is necessary to keep all magnetic material as far as possible (at least 2 inches) from the magnets and mounting plate.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	1·0	A
Heater Starting Current:		
Peak Value, not to be exceeded	5	A
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes
Minimum Ambient Pressure for satisfactory operation	500	mm Hg

Mechanical

Overall Dimensions	6·18 × 5·38 × 5·60 inches	Max
	157 × 137 × 143 mm	Max
Net Weight	4 pounds (1·9 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling (*See Note* 5) .. .. Forced-air

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	7·0	V
Heater Current at heater voltage 6·3V	0·9	1·1	A
Anode Voltage (Peak)	—	16·0	kV
Anode Current (Peak)	11	13	A
Input Power (Mean)	—	170	W
Duty Cycle	—	0·001	
Pulse Length (*See Note* 3)	—	2·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 4):			
With a Pulse Length of 0·5μsec	—	150	kV/μsec
With a Pulse Length of 2·0μsec	—	100	kV/μsec
Anode Temperature (*See Note* 5)	—	150	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·25	Mc/s/°C
V.S.W.R. at the output coupler	—	1·5 : 1	

TYPICAL OPERATION

Operational Conditions

Heater Voltage	0	V
Anode Current (Peak)	12	A
Pulse Length	1·0	μsec
Pulse Repetition Rate	1000	p.p.s.
Rate of Rise of Voltage Pulse	100	kV/μsec

Typical Performance

Anode Voltage (Peak)	12	kV
Output Power (Peak)	45	kW
Output Power (Mean)	45	W

MAGNETRON

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	
Heater Voltage (for test)	0	2·5	V
Anode Current (Mean)	12·0	8·0	mA
Duty Cycle	0·001	0·00065	
Pulse Length (*See Note* 3) ..	0·5	2·0	μsec
V.S.W.R. at the output coupler ..	1·1 : 1	1·1 : 1	
Rate of Rise of Voltage Pulse (*See Note* 4)	150	100	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	11	13			kV
Output Power (Mean)	40		26		W
Frequency (*See Note* 6)	9215	9275			Mc/s
R.F. Bandwidth at ¼ Power ..		4		1·25	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5 : 1)		15			Mc/s
Stability (*See Note* 7)		0·5		0·5	%
Minor Lobes	6		6		db

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA

(under Test Conditions Oscillation 1)

Output Power (Mean)	30	W Min
R.F. Bandwidth at ¼ Power	6·0	Mc/s Max
Frequency	9210–9280	Mc/s
Stability (*See Note* 7)	1	% Max
Minor Lobes	6	db Min

NOTES

1. With no anode input power.
   For average values of pulse input power less than 150 watts the heater voltage shall be reduced within 3 seconds after the application of H.T. according to the following schedule:
   $$V_h = 6{\cdot}3\left(1 - \frac{P_i}{150}\right) \text{ volts}$$
   where P_i = mean input power in watts.
   For input powers greater than 150 watts the heater voltage shall be reduced to zero.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For full details see Notes on the Protection of Magnetrons in the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.
3. Tolerance ±10%.
4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.
5. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins. At 50°C ambient temperature and standard atmospheric pressure an air flow of 65cu.ft/min from an orifice of 1¼ inches diameter located ¼ inch from the cooling fins is adequate.
6. Other frequency ranges can be supplied on request.
7. With the valve operating into a V.S.W.R. of 1·5:1 phased to give maximum instability. Pulses are defined as missing when the R.F. energy level is less than 70% of the normal energy level in the frequency range 9215 to 9275Mc/s. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 3 minutes of a test interval not to exceed 6 minutes.

MAGNETRON

OUTLINE

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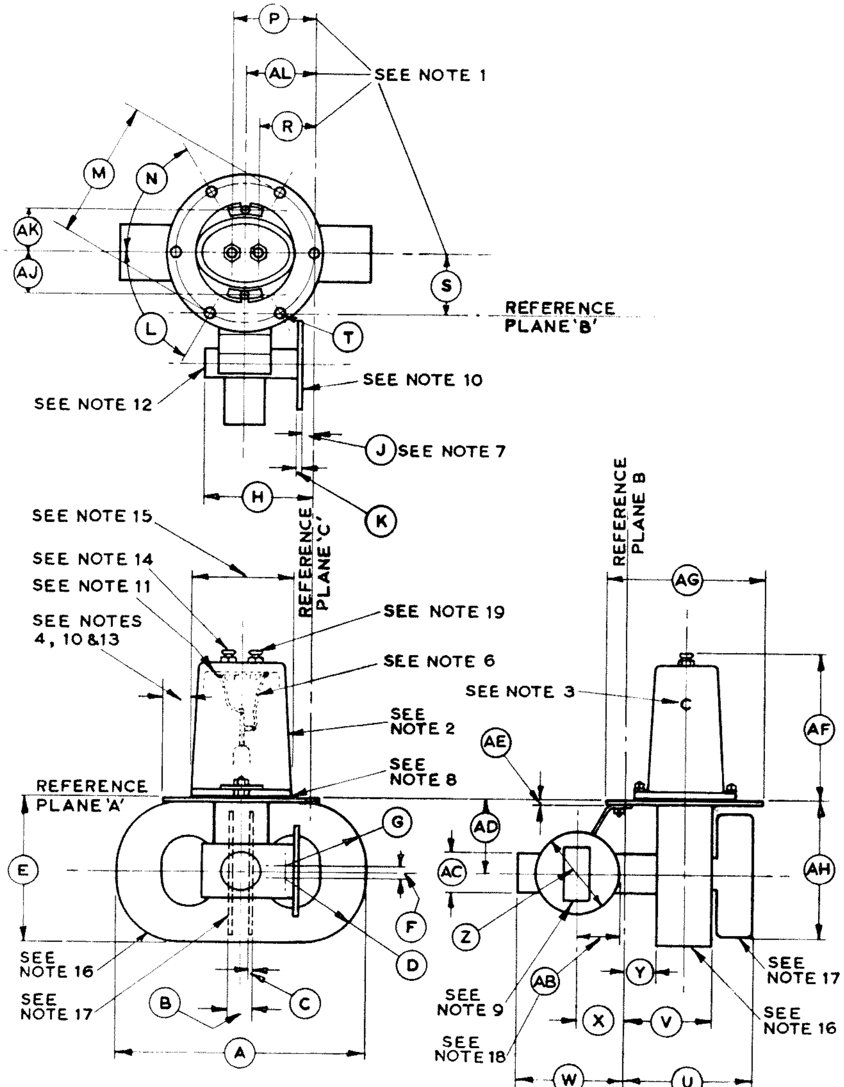


ALL DIMENSIONS IN INCHES

DIMENSIONS

A	5·375 Max	N	60° ± 12′	AB	0·875 ± ·016
B	0·500 Max	P	1·687	AC	0·750 Dia
C	0·063	R	1·187	AD	1·562 ± ·020
D	1·344 Rad	S	1·245	AE	0·125 ± ·005
E	3·125 Max	T	6 holes	AF	2·984 ± ·062
F	0·374		0·193 ± ·003 Dia	AG	3·250 ± ·031 Dia
G	1·344 Rad	U	2·745 Max	AH	2·969 Max
H	2·500 Max	V	2·057	AJ	0·906 ± ·031
J	0·437 ± ·020	W	2·661 Max	AK	0·906 ± ·031
K	0·085 ± ·005	X	1·192 ± ·020	AL	1·437 ± ·031
L	60° ± 12′	Y	0·432 Min		
M	2·875 ± ·006	Z	1·750 ± ·007 Dia		

ALL DIMENSIONS IN INCHES

NOTES FOR OUTLINE

1. The Jack holes will be within a radius of 0·023 of their true location specified, but will be spaced 0·500 ± ·010 with respect to each other. The centre lines of the holes will be perpendicular to Reference Plane 'A' within 3°.
2. Pyrex glass, porcelain, or approved equivalent.
3. Common cathode connection indicated by letter C.
4. With the flange resting on a plane surface the flatness of the mounting flange 0·500 from the outer edge will be such that a 0·010 thick feeler gauge 0·125 wide will not enter for more than 0·250.
5. All metal surfaces will be covered by a black finish, except inside of waveguide, jack terminals, and surfaces covered by Note 10.
6. Leads will be flexible and slack.
7. Tolerance includes angular as well as lateral deviations of this surface.
8. 0·032 asbestos gasket (optional).
9. 1·250 × 0·625 O.D. × 0·064 wall commercial rectangular brass tubing.
10. This surface will be free from paint.
11. Leads soldered internally to terminal clips.
12. All joints in waveguide assembly will be vacuum tight to provide a hermetic seal at flange.
13. All joints in mounting flange will be vacuum tight to provide a hermetic seal.
14. Heater connection.
15. Any portion of the assembly extending above this surface will be within 1·109 radius of the true centre of the flange.
16. Magnets with protective coating.
17. Radiator fins.
18. Output flange will be concentric with open end of waveguide to within 0·010.
19. Hexagon locking head banana pin jacks, hole 0·169 ± ·005 Dia. as per Mil–E 1.

ALL DIMENSIONS IN INCHES

4J50A

X-BAND MAGNETRON

Service Type CV2284

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9345 to 9405	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	60	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $V_h = 14 - 0.0125\,Pi$

   and for input powers above 595 watts,

   $V_h = 24 - 0.0293\,Pi$,

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $i_{apk} = 29.6 - 1.934t_p$

   where i_{apk} = peak anode current in amperes

   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

Pulse length (μs)	Rate of rise of voltage (kV/μs) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of 80ft^3/min (2.3m^3/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

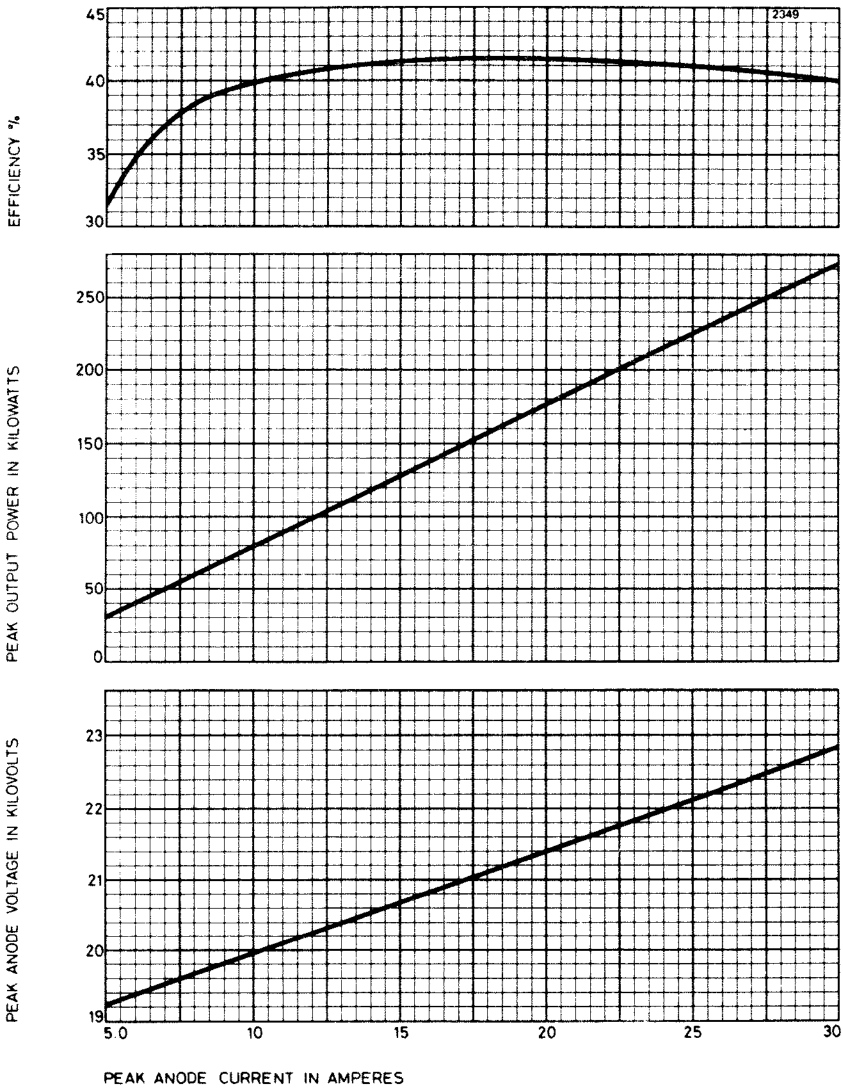
8. At anode temperature of 100°C.

9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).

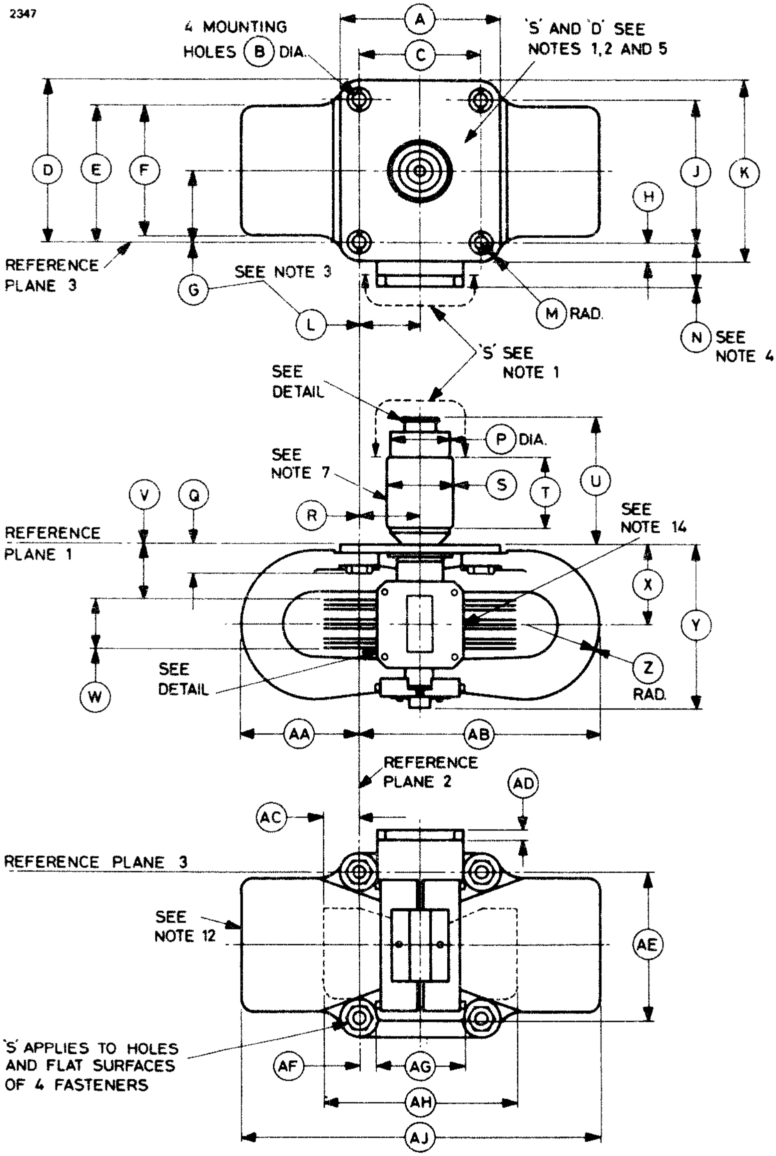
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9330 to 9425MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

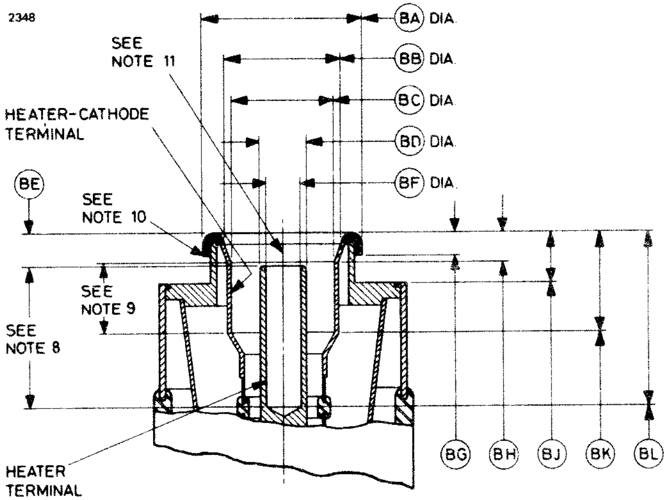


OUTLINE (See page 10 for Outline Notes)

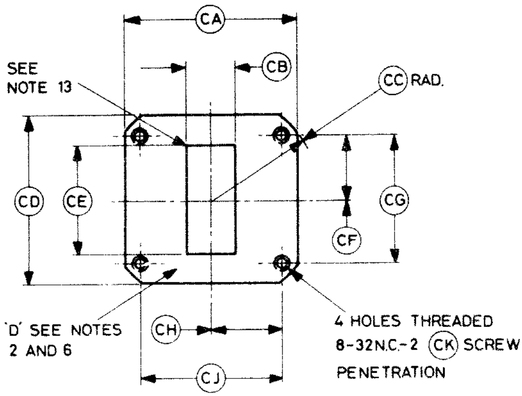


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	3.468 max	88.09 max
B	0.281 ± 0.005	7.14 ± 0.13
C	2.500 ± 0.010	63.50 ± 0.25
D	3.421 max	86.89 max
E	3.000 max	76.20 max
F	2.875 max	73.02 max
G	1.500	38.10
H	0.421 max	10.61 max
J	3.000 ± 0.010	76.20 ± 0.25
K	3.875 max	98.42 max
L	1.250	31.75
M	0.406	10.31
N	0.907 ± 0.025	23.04 ± 0.64
P	1.250	31.75
Q	0.625 ± 0.031	15.87 ± 0.79
R	1.250	31.75
S	1.500 max	38.10 max
T	1.500 min	38.10 min
U	2.687 ± 0.062	68.25 ± 1.57
V	1.141 ± 0.046	28.98 ± 1.17
W	1.000 ± 0.046	25.40 ± 1.17
X	1.653 ± 0.020	41.99 ± 0.51
Y	3.406 max	86.51 max
Z	1.562	39.67
AA	2.593 max	65.86 max
AB	5.093 max	129.4 max
AC	0.750	19.05
AD	0.250	6.35

Ref	Inches	Millimetres
AE	3.125 max	79.38 max
AF	0.312	7.92
AG	1.875	47.62
AH	4.000	101.6
AJ	7.687 max	195.2 max
BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
BB	0.610	15.49
BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
BD	0.250 ± 0.015	6.35 ± 0.38
BE	0.156 ± 0.031	3.96 ± 0.79
BF	0.169 ± 0.005	4.29 ± 0.13
BG	0.125 ± 0.010	3.18 ± 0.25
BH	0.156 max	3.96 max
BJ	0.250	6.35
BK	0.516 min	13.11 min
BL	0.750 min	19.05 min
CA	1.830	46.48
CB	0.497	12.62
CC	1.156	29.36
CD	1.830 ± 0.010	46.48 ± 0.25
CE	1.122	28.50
CF	0.676 ± 0.005	17.17 ± 0.13
CG	1.352 ± 0.004	34.341 ± 0.102
CH	0.737 ± 0.005	18.72 ± 0.13
CJ	1.474 ± 0.004	37.440 ± 0.102
CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

4J52A

X-BAND MAGNETRON

Service Type CV5018

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9350 to 9400	MHz
Typical peak output power	80	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	12.6	V
Heater current at 12.6V	2.2	A
Heater starting current, peak value, not to be exceeded	10	A max
Cathode heating time (minimum)	1.5	min

Mechanical

Overall dimensions	5.937 x 5.374 x 4.243 inches max 150.8 x 136.5 x 107.8mm max
Net weight	5¼ pounds (2.4kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	14.0	V
Heater starting current (peak)	–	10	A
Anode voltage (peak)	14	16	kV
Anode current (peak)	12	15	A
Input power (mean) (see note 2)	–	240	W
Pulse length (see note 3)	–	5	μs
Rate of rise of voltage pulse (see note 4):			
pulse length 0.4μs	120	160	kV/μs
pulse length 1.0μs	100	150	kV/μs
pulse length 4.5μs	70	100	kV/μs
Anode temperature	–	150	°C
Cathode terminal temperature	–	175	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising of waveguide (see note 5)	–	40	lb/in^2
	–	2.8	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.8	V
Anode current (peak)	15	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	15.5	kV
Output power (peak)	80	kW
Output power (mean)	80	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	9.1	7.9	V
Anode current (mean)	9.8	15.0	mA
Duty cycle	0.00065	0.001	
Pulse length (see note 3)	0.4	5.0	μs
V.S.W.R. at the output coupler	1.5:1	1.05:1	
Rate of rise of voltage pulse (see note 4)	170 ± 15	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	–	–	14	16	kV
Output power (mean)	–	–	70	–	W
Frequency (see note 6)	–	–	9350	9400	MHz
R.F. bandwidth at ¼ power (see note 7)	–	5.0	–	0.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	13	–	–	MHz
Frequency pushing	–	–	–	0.5	MHz/A
Stability (see note 8)	–	0.25	–	0.25	%
Heater current					see note 9
Temperature coefficient of frequency					see note 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the following cycling conditions:

(1) Standby – heater voltage only, 3 minutes;
(2) Oscillation 1 – 3 minutes;
(3) Oscillation 2 – 15 minutes;
(4) Off – 9 minutes.

If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 2)

Output power (mean)	56	W min
R.F. bandwidth at ¼ power	0.5	MHz max
Frequency: must be within Test Limits, Oscillation 2		
Stability (see note 8)	2	% max

NOTES

1. With no anode input power.

   On standby the heater voltage must not exceed 12.6 volts. On application of anode power, the heater voltage must be reduced according to the following formula:

   $$V_h = 11.6 - 0.017\ Pi$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

3. Tolerance ±10%.

4. Defined as the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

5. At the maximum pressure of 40lb/in^2 (2.8kg/cm^2) absolute, the leakage will not exceed 0.03 litre (N.T.P.) per minute.

6. With anode temperature of 100°C ± 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

7. The maximum r.f. bandwidth in MHz is given by 2.5/pulse length in μs. This test is carried out at the following peak currents:

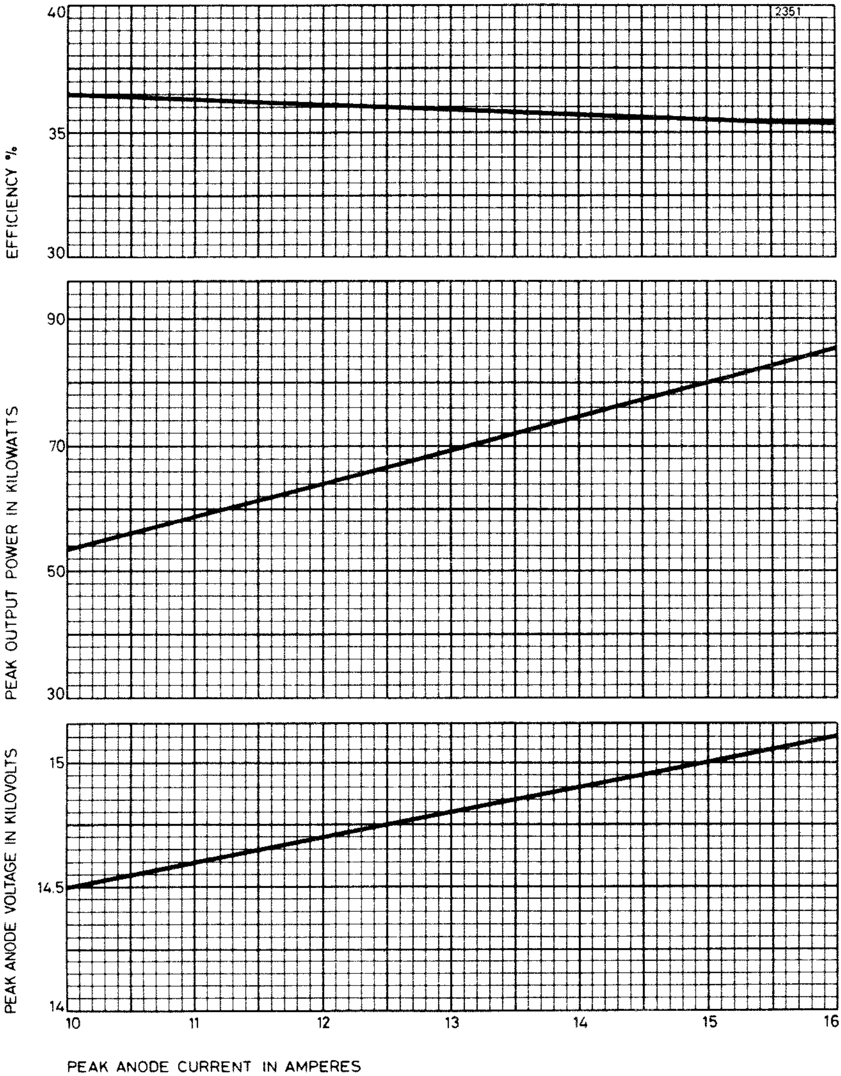
   Oscillation 1 – 11 and 15A
   Oscillation 2 – 12 and 15A

8. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 5 minutes operation.

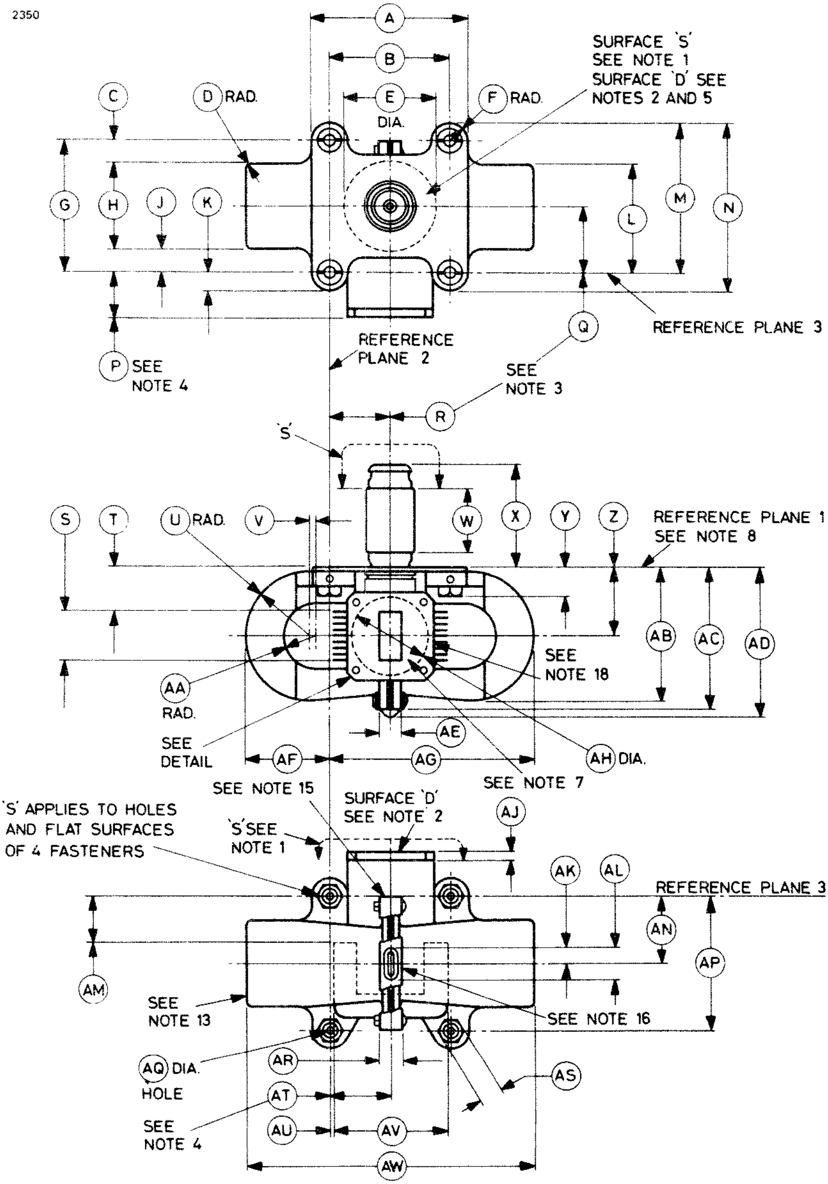
9. Measured with heater voltage 12.6V and no anode input power, the heater current limits are 2.0A minimum, 2.4A maximum.

10. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.25MHz/°C.

PERFORMANCE CHART

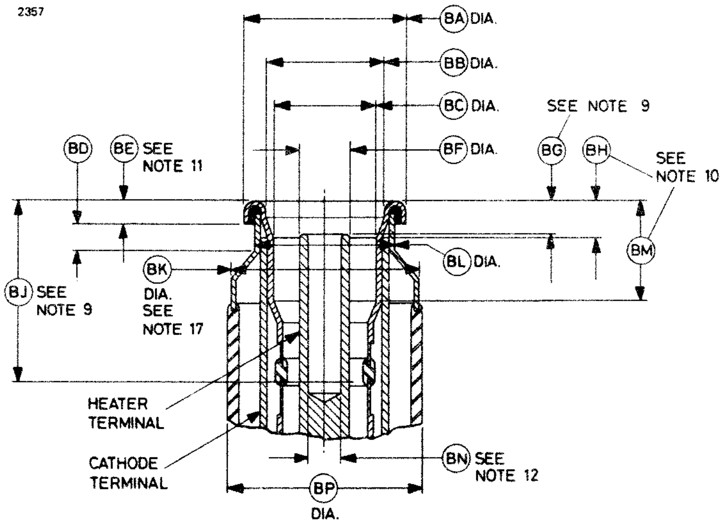


OUTLINE (See page 10 for Outline Notes)

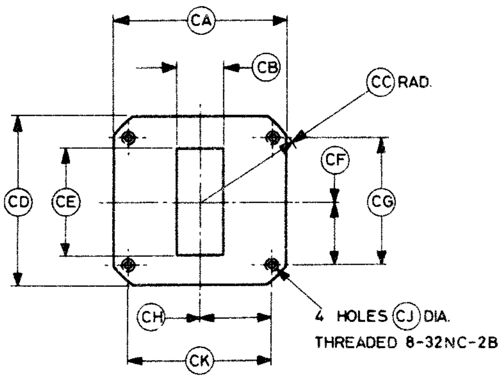


OUTLINE DETAILS (See Page 10 for Outline Notes)

Heater and Cathode Terminals



Output Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.437 max	87.30 max	AN	1.391 $\pm$ 0.047	35.33 $\pm$ 1.19
B	2.531 $\pm$ 0.010	64.29 $\pm$ 0.25	AP	2.875 max	73.03 max
C	0.594 max	15.09 max	AQ	0.281 $\pm$ 0.005	7.14 $\pm$ 0.13
D	0.031 min	0.79 min	AR	1.437 max	36.50 max
E	1.875 min	47.63 min	AS	0.500	12.70
F	0.375	9.53	AT	1.265 $\pm$ 0.015	32.13 $\pm$ 0.38
G	2.781 $\pm$ 0.010	70.64 $\pm$ 0.25	AU	0.078	1.98
H	1.937 max	49.20 max	AV	2.375	60.33
J	0.594 max	15.09 max	AW	5.937 max	150.8 max
K	0.422 max	10.72 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
L	2.375 max	60.33 max			
M	3.203 max	81.36 max	BB	0.610 or 0.650	15.49 or 16.51
N	3.625 max	92.08 max			
P	1.015 $\pm$ 0.025	25.78 $\pm$ 0.64	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
Q	1.391	35.33			
R	1.265	32.13	BD	0.125	3.18
S	1.000	25.40	BE	0.125 $\pm$ 0.010	3.18 $\pm$ 0.25
T	0.922	23.42	BF	0.250 $\pm$ 0.016	6.35 $\pm$ 0.41
U	1.328	33.73	BG	0.156 $\pm$ 0.031	3.96 $\pm$ 0.79
V	0.141	3.58	BH	0.200 max	5.08 max
W	1.250 min	31.75 min	BJ	0.750 min	19.05 min
X	2.156 $\pm$ 0.062	54.76 $\pm$ 1.57	BK	1.000	25.40
Y	0.625 $\pm$ 0.031	15.88 $\pm$ 0.79	BL	0.750	19.05
Z	1.406 $\pm$ 0.020	35.71 $\pm$ 0.51	BM	0.516 min	13.11 min
AA	0.625	15.88	BN	0.169 $\pm$ 0.005	4.29 $\pm$ 0.13
AB	2.844 max	72.24 max	BP	1.125	28.58
AC	2.937 max	74.60 max	CA	1.830	46.48
AD	3.156 max	80.16 max	CB	0.497	12.62
AE	0.625 max	15.88 max	CC	1.156	29.36
AF	1.687 max	42.85 max	CD	1.830	46.48
AG	4.250 max	108.0 max	CE	1.122	28.50
AH	1.625	41.28	CF	0.676 $\pm$ 0.005	17.17 $\pm$ 0.13
AJ	0.250	6.35	CG	1.352 $\pm$ 0.004	34.341 $\pm$ 0.102
AK	0.406 max	10.31 max	CH	0.737 $\pm$ 0.005	18.72 $\pm$ 0.13
AL	0.812 max	20.62 max	CJ	0.164	4.17
AM	0.797	20.24	CK	1.474 $\pm$ 0.004	37.440 $\pm$ 0.102

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces will be covered by a black finish, except those marked 'S' and 'D'. 'S' will be silver, nickel plated or brass surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. With the dimension E diameter resting on a plane surface coincident with reference plane 1, a feeler gauge 0.010 inch (0.254mm) thick and 0.125 inch (3.18mm) wide will not enter, and areas of the base plate outside the dimension E diameter will be within 0.010 inch (0.254mm) of the plane surface.
6. Dimensions without limits are for equipment design and qualification approval only and need not be checked.
7. With the dimension AH diameter resting on a plane surface, a feeler gauge 0.005 inch (0.127mm) thick and 0.125 inch (3.18mm) wide will not enter.
8. Any portion of the assembly extending above reference plane 1 will be within a 0.625 inch (15.87mm) radius of the specified axis of the input.
9. These dimensions define the extremities of the cylindrical section given by the dimension BN.
10. These dimensions define the extremities of the cylindrical section given by the dimension BC.
11. No clamping means to bear beyond this dimension.
12. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.254mm).
13. **Warning.** A minimum clearance of 2 inches (50mm approx) must be maintained between the magnet and any other magnetic materials (magnets, steel tools, plates etc.).
14. The opening in the waveguide must be enclosed by a dust cover when the valve is not in use.
15. The extremity of the magnet lug will coincide with reference plane 3 within 0.094 inch (2.39mm).
16. The seal off protector may be circular in shape.
17. The reference point for cathode temperature measurements is located on the dimension BK.
18. The reference point for anode temperature measurements is located where a central fin meets the anode block near the output section.

American Designation 6027

ABRIDGED DATA

Fixed Frequency Pulse Magnetron

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	20	kW
Magnet		Integral
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		UG–40A/U (Z830051)
Cooling		Forced-air

GENERAL DATA

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current (Peak)	3·0	A Max
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes

Mechanical

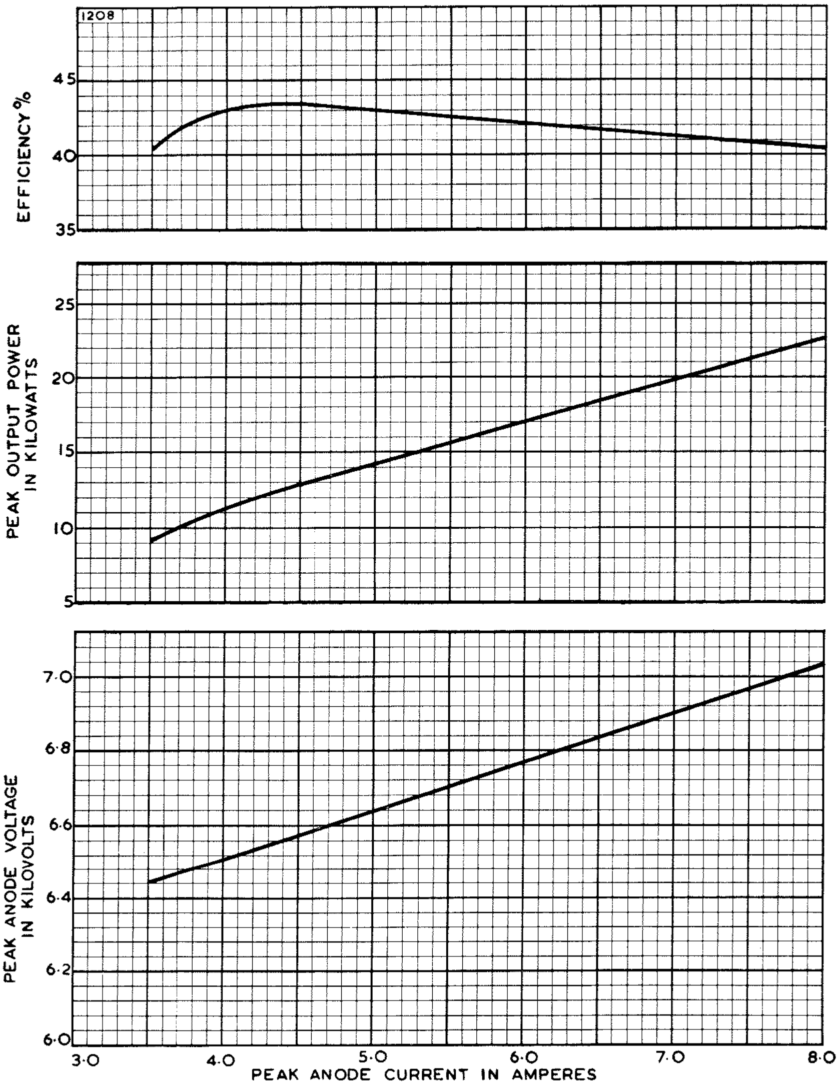
Overall Dimensions	5·250 × 4·468 × 5·375 inches	Max
	133·4 × 113·5 × 136·5 mm	Max
Net Weight	5 pounds (2·3 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnets of this valve are preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnets. English Electric Valve Company Limited should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

Cooling .. .. Forced-air

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	6·9	V
Heater Starting Current (Peak)	—	3·0	A
Anode Voltage (Peak)	6·0	8·0	kV
Anode Current (Peak)	3·5	8·0	A
Input Power (Peak)	21	64	kW
Input Power (Mean) (*See Note* 3)	—	80	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 4)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	60	kV/μsec
Anode Temperature (*See Note* 6)	—	120	°C
V.S.W.R. at the output coupler	—	1·5:1	
Ambient Pressure for satisfactory operation	500	—	mm Hg
Pressurising of Waveguide (*See Note* 7)	—	45	lb/sq.in
		3·16	kg/sq.cm

TYPICAL OPERATION

Operational Conditions

Heater Voltage	4·6	V
Anode Current (Peak)	7·0	A
Pulse Length	1·0	μsec
Pulse Repetition Rate	1000	p.p.s.

Typical Performance

Anode Voltage (Peak)	6·9	kV
Output Power (Peak)	20	kW
Output Power (Mean)	20	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater Voltage (for test) ..	6·3	4·5 (*See Note* 8)	V
Anode Current (Mean)	7·5	7·0	mA
Duty Cycle	0·001	0·002	
Pulse Length (*See Note* 4) ..	1·0	1·0	μsec
V.S.W.R. at the output coupler..	1·15:1 (Max)	1·15:1 (Max)	
Rate of Rise of Voltage Pulse (*See Note* 5)	60	60	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	6·4	7·4	6·0	7·0	kV
Output Power (Mean)	18	—	—	—	W
Frequency (*See Note* 9) ..	9345	9405	—	—	Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 10)	—	2·5	—	2·5	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	—	—	Mc/s
Stability (*See Note* 11)	—	0·25	—	—	%
Heater Current (*See Note* 12)					
Frequency Change with Anode Temperature Change (after warming) (*See Note* 13)					

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 2 conditions, but with the heater voltage 3·0V. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA

(under Test Conditions Oscillation 1)

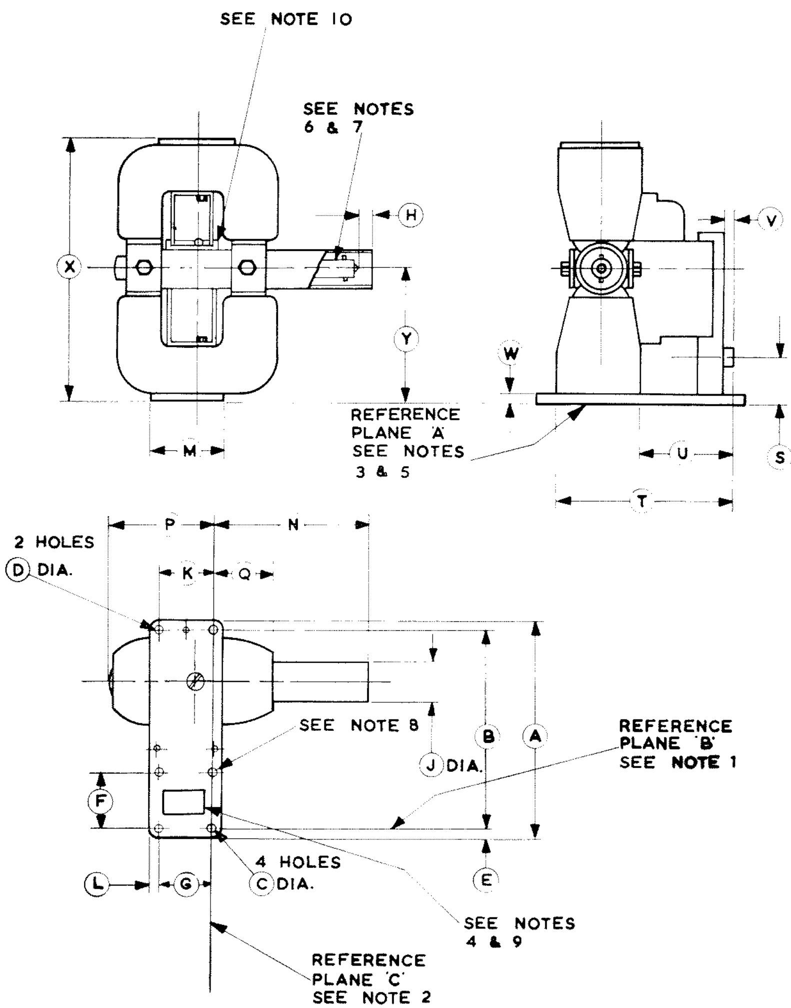
Output Power (Mean)	13·5	W Min
R.F. Bandwidth at ¼ Power	3·0	Mc/s Max
Frequency: Must be within Test Limits above, Oscillation 1		
Stability (*See Note* 11)	1·0	% Max

NOTES

1. With no anode input power.
   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:
   $$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right) \text{ volts}$$
   where P_i = mean input power in watts.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes.
3. The various parameters are related by the following formula:
   $P_i = i_{apk} \times v_{apk} \times Du$
   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Tolerance ±10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6·0pF.
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. At the maximum pressure of 45lb/sq.in (3·16kg/sq.cm) absolute, the leakage will not exceed 0·5 litre (N.T.P.) per minute.
8. The heater voltage shall be reduced to 4·5 volts three seconds after applying h.t.
9. Temperature of anode block 40°±5°C, measured at the point indicated on the outline drawing.
10. The bandwidth in Mc/s is given by 2·5/(pulse length in microseconds).
11. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9345 to 9405Mc/s. Missing pulses are expressed as a percentage of the number of input pulses applied during any consecutive 5 minute interval of a 15 minute test period.
12. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·43A minimum, 0·60A maximum.
13. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

OUTLINE

339A



OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	4·468 Max	113·5 Max	M	1·625 ± 0·016	41·28 ± 0·41
B	4·103 ± 0·004	104·216 ± 0·102	N	3·187 Max	80·95 Max
C	0·170 ± 0·003	4·318 ± 0·076	P	2·187 Max	55·55 Max
D	0·175 ± 0·003	4·445 ± 0·076	Q	1·187 Max	30·15 Max
E	0·172 ± 0·016	4·37 ± 0·41	S	0·875 ± 0·125	22·22 ± 3·18
F	1·280 ± 0·004	32·512 ± 0·102	T	4·000 Max	101·6 Max
G	1·220 ± 0·004	30·988 ± 0·102	U	1·938 Max	49·23 Max
H	0·250 Max	6·35 Max	V	0·375 Max	9·53 Max
J	1·000 Max	25·40 Max	W	0·125	3·18
K	1·220 ± 0·004	30·988 ± 0·102	X	5·250 Max	133·4 Max
L	0·203 ± 0·016	5·16 ± 0·41	Y	2·500 ± 0·050	63·50 ± 1·27

Millimetre dimensions have been derived from inches.

NOTES FOR OUTLINE

1. Reference plane 'B' passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane 'A'.
2. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes 'A' and 'B'.
3. With surface 'A' resting on a flat surface plate, a feeler gauge 0·020 inch (0·51mm) thick and 0·125 inch (3·18mm) wide will not enter more than 0·125 inch (3·18mm) at any point.
4. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U.
5. Surface 'A' and interior surfaces of waveguide will be plated with 10mg/sq.in (1·55mg/sq.cm) of gold or 30mg/sq.in (4·65mg/sq.cm) of silver.
6. The axis of the heater lead protector will be within 5° of a normal to reference plane 'C'.
7. The clearance between the inside surface of the protector and the 0·375 inch (9·53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52-1952, type BA9s/14) will not be less than 0·125 inch (3·18mm).
8. The centre of this hole will lie within 0·004 inch (0·102mm) of reference plane 'C'.
9. This area is gasketed for pressurising the waveguide output as with the coupler Army-Navy designation UG-40A/U.
10. The anode temperature is measured at this point on the round anode surface between the radiator fin and pole piece.

American Designation 6027H

ABRIDGED DATA

Fixed Frequency Pulse Magnetron intended primarily for airborne radars. The output waveguide is sealed to allow operation at high altitude without pressurising. Flying leads are fitted.

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	20	kW
Magnets		Integral
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current (Peak)	3·0	A Max
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes

Mechanical

Overall Dimensions	5·250 × 4·468 × 5·375 inches	Max
	133·4 × 113·5 × 136·5 mm	Max
Net Weight	5 pounds (2·3 kg)	Approx
Mounting Position		Any

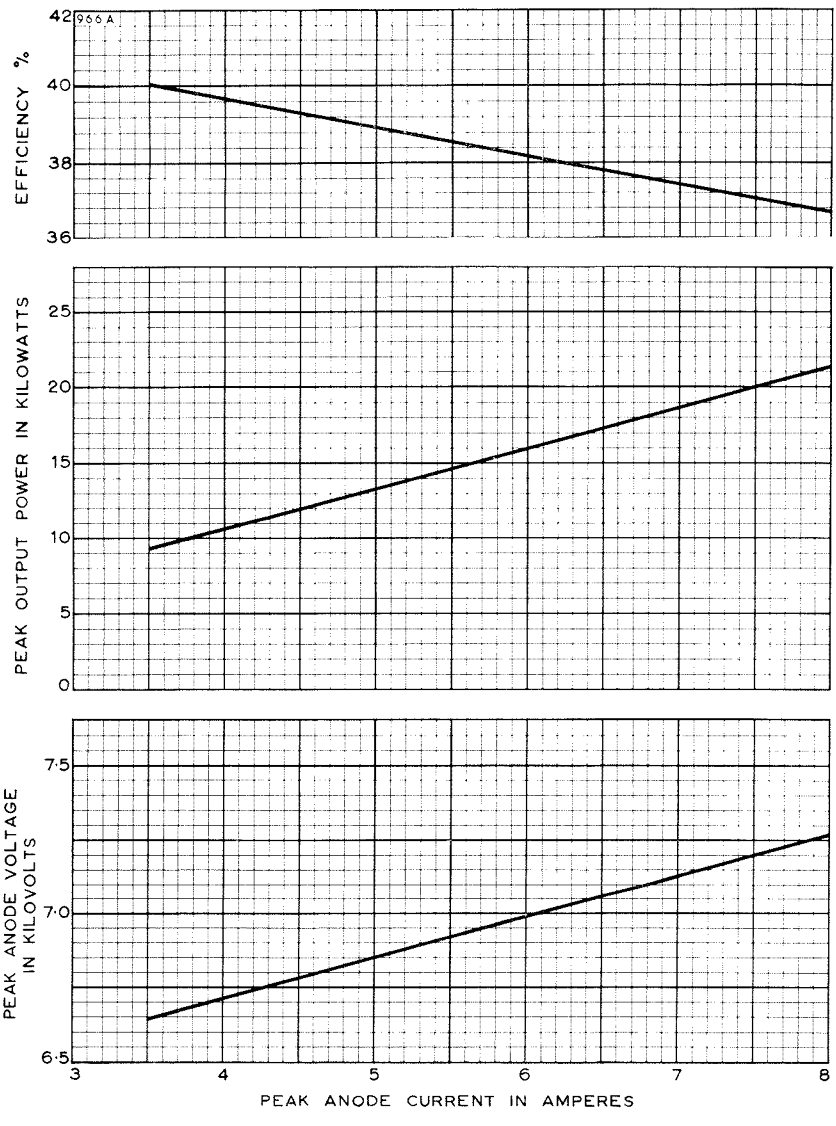
The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnets of this valve are preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnets. English Electric Valve Company Ltd. should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

Cooling .. .. Forced-air

ENGLISH ELECTRIC

PERFORMANCE CHART



ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
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Printed in England

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	6·9	V
Heater Starting Current (Peak)	—	3·0	A
Anode Voltage (Peak)	6·0	8·0	kV
Anode Current (Peak)	3·5	8·0	A
Input Power (Peak)	21	64	kW
Input Power (Mean) (*See Note* 3)	—	80	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 4)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	60	kV/μsec
Anode Temperature (*See Note* 6)	—	120	°C
Altitude:			
Output System (*See Note* 7)	—	45 000	feet
		13·5	km
Input Terminals	—	70 000	feet
		21·5	km
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

Heater Voltage	4·5	V
Anode Current (Peak)	7·5	A
Pulse Length	2·5	μsec
Pulse Repetition Rate	400	p.p.s.

Typical Performance

Anode Voltage (Peak)	7·2	kV
Output Power (Peak)	20	kW
Output Power (Mean)	20	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

Heater Voltage (for test)	4·5	V
Anode Current (Mean)	7·5	mA
Duty Cycle	0·001	
Pulse Length (*See Note* 4)	2·5	μsec
V.S.W.R. at the output coupler (Maximum)	1·1:1	
Rate of Rise of Voltage Pulse (*See Note* 5)	60	kV/μsec Min

Limits

	Min	*Max*	
Anode Voltage (Peak)	7·0	7·4	kV
Output Power (Mean)	18	—	W
Frequency (*See Note* 8)	9345	9405	Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 9)	—	1·0	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	Mc/s
Minor Lobes	6·0	—	db
Stability (*See Note* 10)	—	0·25	%
Heater Current		*See Note* 11	
Temperature Coefficient of Frequency		*See Note* 12	
Dynamic Impedance (*See Note* 13)	0·2	—	kV

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the test conditions specified above.

If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria

Output Power (Mean)	13·5	W Min
R.F. Bandwidth at ¼ Power	1·2	Mc/s Max
Frequency: Must be within Test Limits above		
Stability (*See Note* 10)	1·0	% Max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right)\text{volts}$$

   where P_i = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes.
3. The various parameters are related by the following formula:

   $P_i = i_{apk} \times v_{apk} \times Du$

   where P_i = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.
4. Tolerance ±10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6·0pF.
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. This rating applies when the magnetron is operated at the maximum power input and pulse length into a mismatched load of V.S.W.R. 1·5:1 at the worst phase for breakdown, via a coupler UG-40A/U of standard manufacture.
8. Temperature of anode block 40°±5°C, measured at the point indicated on the outline drawing.
9. The bandwidth in Mc/s is given by 2·5/pulse length in microseconds. The peak current is varied over the range 6·0 to 7·5 amperes for this measurement.
10. With the valve operating into a V.S.W.R. of 1·5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during any consecutive 5 minute interval of a 15 minutes test period.

11. The heater current, measured with heater voltage of 6·3V and no anode input power, will be within the range 0·43 to 0·60A.
12. Design test only. The frequency change with anode temperature change after warm-up will not exceed −0·25Mc/s/°C.
13. Design test only. The dynamic impedance is defined in terms of the change in peak anode voltage when the peak anode current is varied from 5·5 to 7·0A.

NOTES FOR OUTLINE

1. With the valve resting on a plane surface, the flatness of the mounting plate will be such that a feeler gauge 0·020 inch (0·51mm) thick and 0·125 inch (3·18mm) wide will not enter more than 0·125 inch (3·18mm) at any point.
2. The position of the waveguide and fixing holes will be such that the valve operates into coupler type UG-40A/U.
3. The centre of this hole will be within 0·004 inch (0·1mm) of Reference Plane C.
4. These holes must be in alignment with the holes marked thus* within 0·010 inch (0·254mm).
5. The south seeking pole of the magnet will be adjacent to the cathode leads.

OUTLINE DIMENSIONS

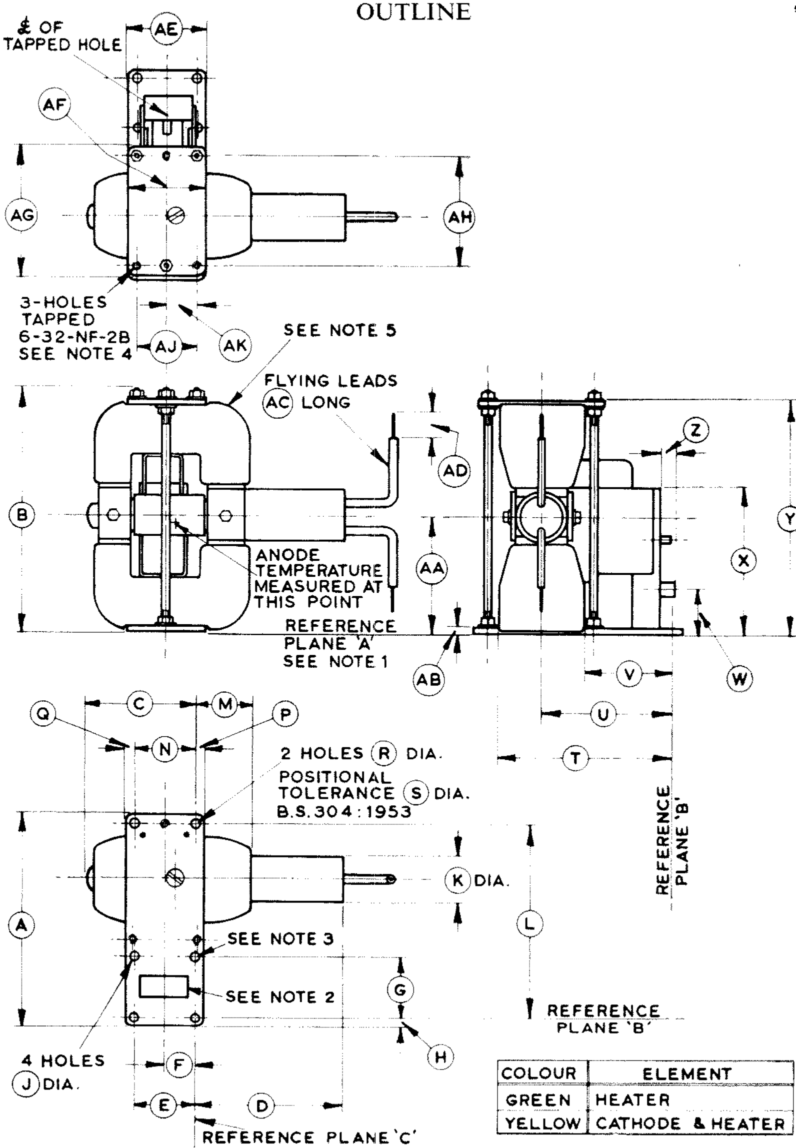
Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	4·453±0·015	113·12±0·38	T	3·900 Max	99·06 Max
B	5·250 Max	133·35 Max	U	2·971±0·073	75·46±1·85
C	2·187 Max	55·55 Max	V	1·960 Min	49·78 Min
D	2·937±0·250	74·60±6·35	W	0·875±0·125	22·23±3·18
E	1·220±0·004	30·99±0·10	X	3·250 Max	82·55 Max
F	0·610	15·49	Y	4·973±0·062	126·31±1·57
G	1·280±0·004	32·51±0·10	Z	0·375 Max	9·53 Max
H	0·172	4·37	AA	2·495±0·062	63·37±1·57
J	0·170±0·003	4·318±0·076	AB	0·125	3·18
K	1·005 Max	25·53 Max	AC	6·000	152·4 ←
L	4·103±0·005	104·22±0·13	AD	0·500	12·70
M	1·187 Max	30·15 Max	AE	1·625±0·015	41·28±0·38
N	1·220	30·99	AF	1·620±0·020	41·15±0·51
P	0·203	5·16	AG	2·750	69·85
Q	0·203	5·16	AH	2·393±0·005	60·78±0·13
R	0·175±0·003	4·445±0·076	AJ	1·220±0·005	30·99±0·13
S	0·008	0·203	AK	0·610±0·005	15·49±0·13

Millimetre dimensions have been derived from inches

← Indicates a change

OUTLINE

967



COLOUR	ELEMENT
GREEN	HEATER
YELLOW	CATHODE & HEATER

ENGLISH ELECTRIC

JEDEC Designation 8356

INTRODUCTION

The 8356 is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 64kW and operates at a fixed frequency within the limits of 9345 and 9405Mc/s, when used under the conditions specified below.

The valve has a packaged integral magnet. It is fitted with flying leads and the output waveguide is sealed with a vacuum-tight window to allow operation at high altitude without pressurising.

The waveguide output flange is designed for coupling directly to waveguide No. 16, 0·900 inch × 0·400 inch internal dimensions (22·86mm × 10·16mm), by means of coupler type UG-40A/U (Z830051).

It is necessary to keep all magnetic material as far as possible (at least 2 inches —50mm approx.) from the magnet and mounting plate.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current:		
Peak Value, not to be exceeded	3	A
Cathode Heating Time (Minimum)	*See Note* 2	

Mechanical

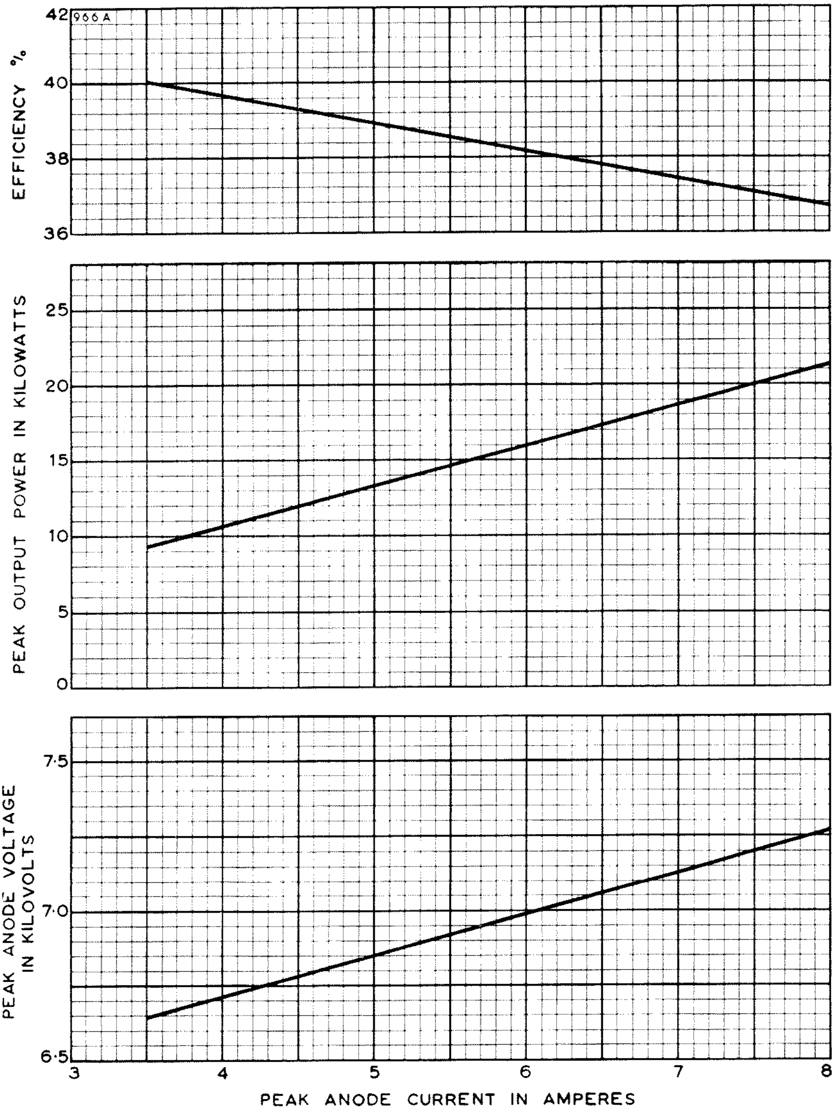
Overall Dimensions	5·38 × 4·47 × 3·31 inches	Max
	137 × 114 × 84·1 mm	Max
Net Weight	3¼ pounds (1·5 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling .. .. *See Note* 3

ENGLISH ELECTRIC

PERFORMANCE CHART



ENGLISH ELECTRIC VALVE CO. LTD.

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Printed in England

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	6·9	V
Heater Current at heater voltage 6·3V	0·43	0·60	A
Anode Voltage (Peak)	6·0	8·0	kV
Anode Current (Peak)	3·5	8·0	A
Input Power (Peak)	21	64	kW
Input Power (Mean)	—	80	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 4)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	100	kV/μsec
Anode Temperature	—	120	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·25	Mc/s/°C
Altitude:			
Output System (See Note 6)	—	45 000	feet
	—	13·5	km
Input Terminals	—	60 000	feet
	—	18·3	km
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

Heater Voltage	4·5	V
Anode Current (Peak)	7·5	A
Pulse Length	2·5	μsec
Pulse Repetition Rate	400	p.p.s.

Typical Performance

Anode Voltage (Peak)	7·2	kV
Output Power (Peak)	20	kW
Output Power (Mean)	20	W

ENGLISH ELECTRIC

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	*Oscillation* 2	
Heater Voltage (for test)	6·3	4·5 (*See Note* 7)	V
Anode Current (Mean)	7·5	7·5	mA
Duty Cycle	0·001	0·001	
Pulse Length (*See Note* 4)	1·0	2·5	μsec
V.S.W.R. at the output coupler (Maximum)	1·15:1	1·15:1	
Rate of Rise of Voltage Pulse (*See Note* 5)	100	100	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	6·4	7·4	—	—	kV
Output Power (Mean)	18	—	18	—	W
Frequency (*See Note* 8)	9345	9405	—	—	Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 9)	—	2·5	—	1·0	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	—	—	Mc/s
Stability (*See Note* 10)	—	0·25	—	0·25	%

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 2 conditions. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Output Power (Mean)	13·5	W Min
R.F. Bandwidth at ¼ Power	1·2	Mc/s Max
Frequency: Must be within Test Limits above, Oscillation 1		
Stability (*See Note* 10)	1·0	% Max

NOTES

1. With no anode input power.
   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

$$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right)\text{volts}$$

   where P_i = mean input power in watts.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. The minimum cathode heating time for ambient temperatures above −55°C is 20 seconds from the heater voltage reaching 5·7 volts. If the valve has been stored for six months or more without h.t. being applied, a longer initial cathode heating time may be required.
3. Convection cooling is usually adequate but at high ambient temperatures and in confined surroundings a degree of forced-air cooling may be necessary.
4. Tolerance ±10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6·0pF.
6. This rating applies when the magnetron is operated at the maximum power input and pulse length into a mismatched load of V.S.W.R. 1·5:1 at the worst phase for breakdown, via a coupler UG-40A/U of standard manufacture.
7. The heater voltage shall be reduced to 4·5 volts three seconds after applying the h.t.
8. Temperature of anode block 40 ±5°C, measured at the point indicated on the outline drawing.
9. The bandwidth in Mc/s is given by 2·5/pulse length in microseconds.
10. With the valve operating into a V.S.W.R. of 1·5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9345 to 9405Mc/s. Missing pulses are expressed as a percentage of the number of input pulses applied during any consecutive 5 minute interval of a 15 minutes test period.

ENGLISH ELECTRIC

NOTES FOR OUTLINE

1. Reference plane A contains the mounting surface of the valve as shown.
2. Reference plane B passes through the centres of the two holes of the mounting plate as shown, and is perpendicular to plane A.
3. Reference plane C passes through the centre of the lower right hole of the mounting plate as shown, and is perpendicular to planes A and B.
4. With the valve resting on a plane surface, the flatness of the mounting plate will be such that a feeler gauge 0·015 inch (0·38mm) thick and 0·125 inch (3·18mm) wide will not enter more than 0·125 inch (3·18mm) at any point.
5. The anode temperature to be measured at this point which is on the centre-line of the anode and at 45° to the horizontal (approximately).
6. The north seeking pole of the magnet will be adjacent to the cathode leads.
7. These holes will be within 0·005 inch (0·13mm) of the indicated centres. The clearance between the centre line of the holes and the magnet will be 0·165 inch (4·19mm) minimum.
8. The axis of the heater lead cover will be perpendicular to reference plane C within 5°.
9. The position of the waveguide and fixing holes will be such that the valve operates into coupler type UG-40A/U.
10. The centre of this hole will lie within 0·004 inch (0·102mm) of the reference plane C.

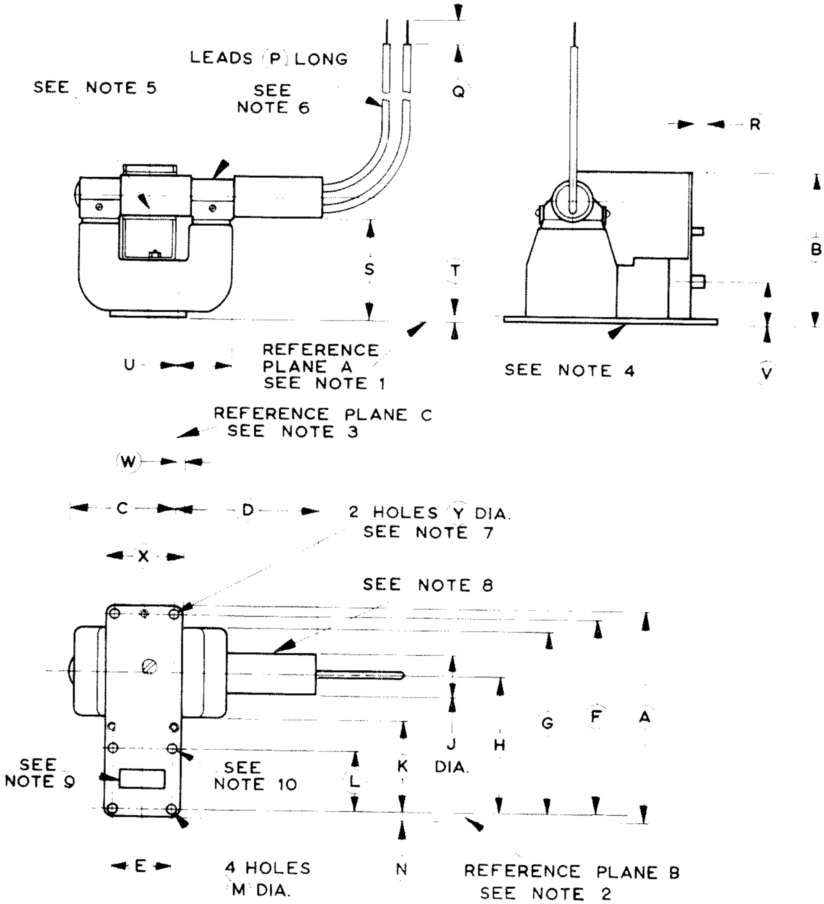
OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	4·453 ± 0·015	113·11 ± 0·38	N	0·187 Max	4·75 Max
B	3·313 Max	84·15 Max	P	6·000	152·4
C	2·187 Max	55·55 Max	Q	0·500	12·70
D	3·187 Max	80·95 Max	R	0·375 Max	9·53 Max
E	1·220 ± 0·004	30·988 ± 0·102	S	2·000 Min	50·80 Min
F	4·103 ± 0·004	104·2 ± 0·102	T	0·125	3·18
G	4·000 Max	101·6 Max	U	1·187 Max	30·15 Max
H	2·937 ± 0·250	74·60 ± 6·35	V	0·875	22·23
J	1·000 Max	25·40 Max	W	0·218 Max	5·54 Max
K	1·811 Min	46·00 Min	X	1·625	41·28
L	1·280 ± 0·004	32·512 ± 0·102	Y	0·175 ± 0·003	4·445 ± 0·076
M	0·170 ± 0·003	4·318 ± 0·076			

Millimetre dimensions have been derived from inches

OUTLINE

719 C



COLOUR	ELEMENT
GREEN	HEATER
YELLOW	CATHODE & HEATER

LEAD CONNECTIONS

BM1002

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9415 to 9475	MHz
Typical peak output power	21	kW
Magnet (see footnote)		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current (at 6.3V)	0.55	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	4.468 x 3.500 x 5.380 inches max 113.5 x 88.9 x 136.7mm max
Net weight	4 pounds (2kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling

forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.0	8.2	kV
Anode current (peak)	5.0	7.5	A
Input power (peak)	–	60	kW
Input power (mean) (see note 3)	–	83	W
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	–	100	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	4.5	V
Anode current (peak)	8.0	7.0	A
Pulse length	0.1	1.0	μs
Pulse repetition rate	2000	1000	p.p.s.
Rate of rise of voltage pulse	90	60	kV/μs

Typical Performance

Anode voltage (peak)	7.8	7.5	kV
Output power (peak)	21	20	kW
Output power (mean)	4.2	20	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	4.5	V
Anode current (mean)	3.5	7.0	mA
Duty cycle	0.0005	0.001	
Pulse length (see note 4)	0.1	1.0	μs
V.S.W.R. at the output coupler	1.1:1	1.1:1	
Rate of rise of voltage pulse (see note 5)	90	70	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.0	8.2	7.0	8.2	kV
Output power (mean)	4.2	–	16	–	W
Frequency (see note 7)	9415	9475	9415	9475	MHz
R.F. bandwidth at ¼ power	–	20	–	3.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	–	–	18	MHz
Stability (see note 8)	–	–	–	0.1	%
Cold impedance					see note 9
Heater current					see note 10
Temperature coefficient of frequency					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 2. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA (under Test Conditions Oscillation 2)

Anode voltage (peak)	6.8	kV min
Output power (mean)	11	W min
R.F. bandwidth at ¼ power	3.5	MHz max
Frequency: must be within Test Limits above		
Stability (see note 8)	1	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{volts}$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to the Magnetron Section of the Valve Data Book.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. Other frequency ranges can be supplied on request.

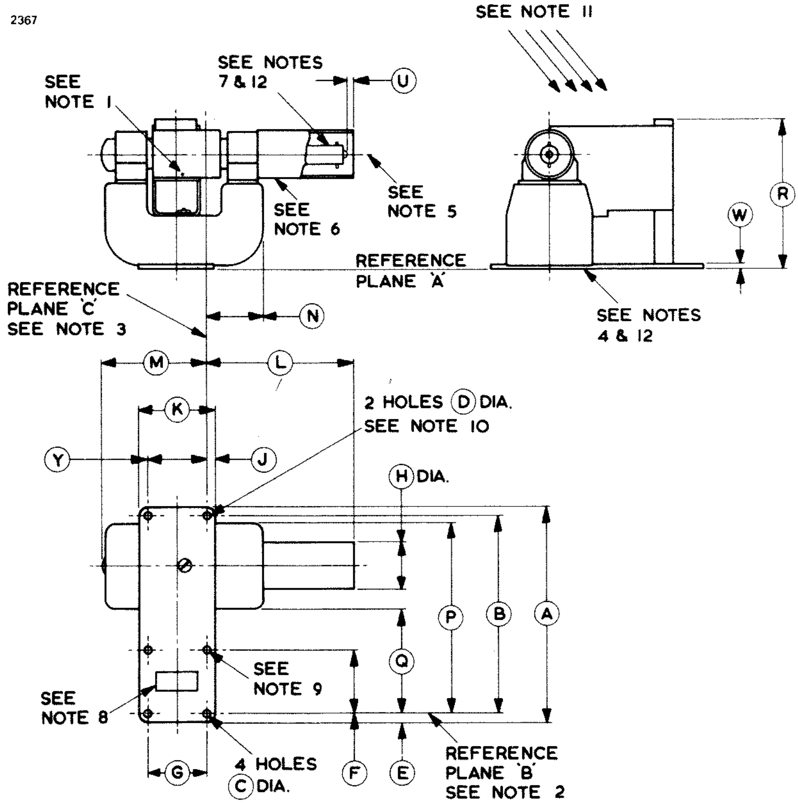
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. For the range 9415 to 9475MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 13.5 to 22.5mm from the output flange towards the anode.

10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

OUTLINE



Bayonet Cap Connections

Contact	Element
End Contact Shell	Heater Heater, Cathode

OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	L	3.192 max	81.08 max
B	4.103	104.2	M	2.188 max	55.58 max
C	0.170 ± 0.003	4.318 ± 0.076	N	1.194 max	30.33 max
D	0.175 ± 0.003	4.445 ± 0.076	P	4.000 max	101.6 max
E	0.172 ± 0.016	4.37 ± 0.41	Q	1.795 min	45.59 min
F	1.280 ± 0.004	32.512 ± 0.102	R	3.500 max	88.90 max
G	1.220 ± 0.004	30.988 ± 0.102	U	0.125 max	3.18 max
H	1.000	25.40	W	0.120	3.05
J	0.204 ± 0.015	5.18 ± 0.38	Y	1.220	30.99
K	1.625 ± 0.016	41.28 ± 0.41			

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. Anode temperature measured at this point.
2. Reference plane 'B' passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane 'A'.
3. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes 'A' and 'B'.
4. With surface 'A' resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. The axis of the heater lead protector will be within 5° of a normal to reference plane 'C'.
6. The heater lead protector will not be used to support any cap fitting. This protector is a sleeve of non-conducting material.
7. The clearance between the inside surface of the protector and the 0.375 inch (9.53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52 (1952) Type BA9s/14) will not be less than 0.125 inch (3.18mm).
8. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U.

9. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane 'C'.
10. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.
11. Recommended direction of air flow.
12. Surface 'A' and interior surfaces of the waveguide will be plated. All other metal surfaces will be painted or otherwise treated to prevent corrosion.

ABRIDGED DATA

Fixed Frequency Pulse Magnetrons

Frequency Range:		
BM1026	9505 to 9540	Mc/s
BM1027	9540 to 9580	Mc/s
BM1028	9580 to 9620	Mc/s
BM1029	9620 to 9660	Mc/s
BM1030	9660 to 9695	Mc/s
Typical Peak Output Power	50	kW
Magnet		Separate
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		Special
Cooling		Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·9	A
Heater Starting Current (Peak)	2·5	A Max
Cathode Heating Time (Minimum)	3·0	minutes

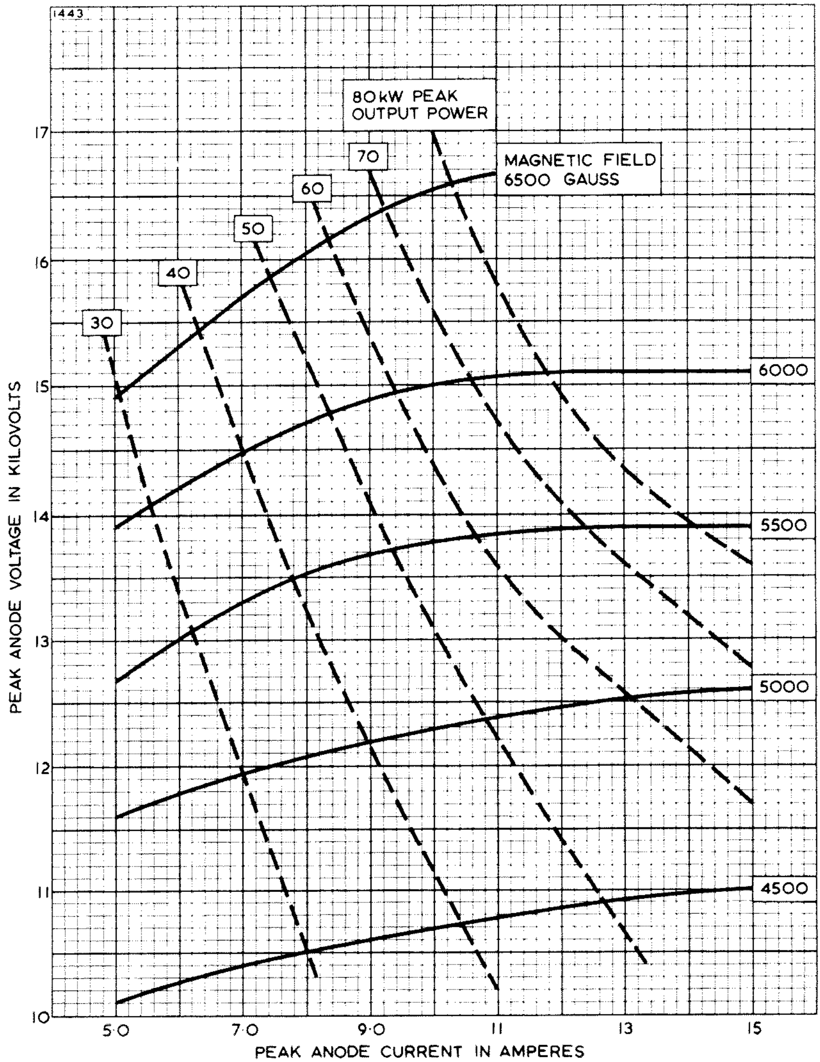
Mechanical

Overall Dimensions	5·312 × 3·698 × 3·241 inches	Max
	134·9 × 93·93 × 82·32 mm	Max
Net Weight	1·3 pounds (0·59 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling .. .. Forced-air

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic Field (*See Note* 2)	5000	5600	Gauss
Heater Voltage (*See Note* 1)	6·0	6·6	V
Heater Starting Current (Peak)	—	2·5	A
Anode Voltage (Peak)	11	16	kV
Anode Current (Peak)	—	15	A
Input Power (Peak)	—	180	kW
Duty Cycle (*See Note* 3)	—	0·001	
Pulse Length (*See Note* 4)	—	1·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	120	200	kV/μsec
Anode Temperature (*See Note* 6)	—	100	°C
V.S.W.R. at the output coupler	—	1·5:1	
Pressurising of Waveguide	—	20	lb/in²
	—	1·4	kg/cm²

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Magnetic Field (*See Note* 2)	5500±50	5500±50	Gauss
Heater Voltage	0	0	V
Anode Current (Peak)	11	11	A
Pulse Length	0·25	0·5	μsec
Pulse Repetition Rate	4000	2000	p.p.s.
Rate of Rise of Voltage Pulse	200	200	kV/μsec
Typical Performance			
Anode Voltage (Peak)	14	14	kV
Output Power (Peak)	60	60	kW
Output Power (Mean)	60	60	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic Field	5500	5500	Gauss
Heater Voltage (for test)	0	0	V
Anode Current (Mean)	11	11	mA
Duty Cycle	0·001	0·001	
Pulse Length (*See Note* 4)	0·25	0·5	μsec
V.S.W.R. at the output coupler	1·5:1	1·5:1	
Rate of Rise of Voltage Pulse (*See Note* 5)	200	200	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	13	15	13	15	kV
Output Power (Mean)	40	—	40	—	W
Frequency (*See Note* 7):					
BM1026	9505	9540	—	—	Mc/s
BM1027	9540	9580	—	—	Mc/s
BM1028	9580	9620	—	—	Mc/s
BM1029	9620	9660	—	—	Mc/s
BM1030	9660	9695	—	—	Mc/s
R.F. Bandwidth at ¼ Power	—	10	—	5·0	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	—	15	Mc/s
Stability (*See Note* 8)	—	0·1	—	0·1	%
Heater Current					*See Note* 9
Temperature Coefficient of Frequency					*See Note* 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions above)

Anode Voltage (Peak)	12	kV Min
Output Power (Mean)	32	W Min
R.F. Bandwidth at ¼ Power	6·0	Mc/s Max
Frequency: Must be within ±10Mc/s of initial value		
Stability (*See Note* 8)	0·1	% Max

NOTES

1. With no anode input power.
The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the following schedule:

$$V_h = 6{\cdot}3\sqrt{1 - \frac{Pi}{150}} \text{ volts}$$

where Pi = mean input power in watts.
The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.

3. The various parameters are related by the following formula:
$Pi = i_{apk} \times v_{apk} \times Du$
where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

4. Tolerance ± 10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

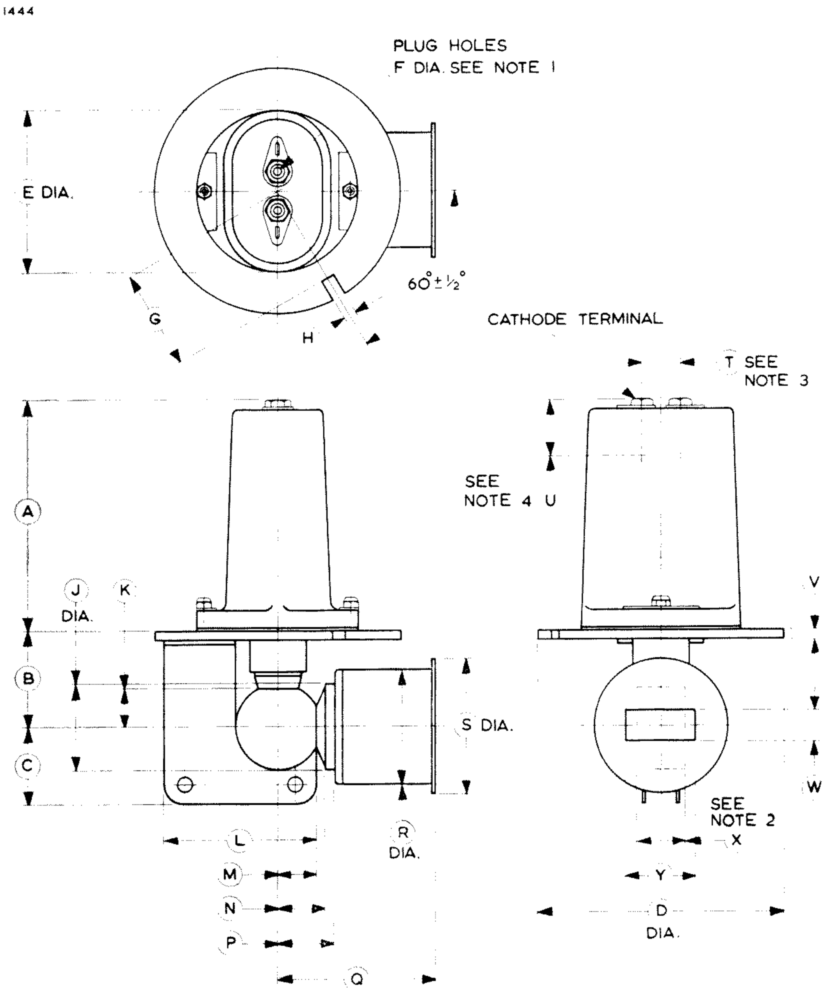
7. Other frequency ranges can be supplied on request.

8. With the valve operating into a V.S.W.R. of 1·5:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·7A minimum, 0·9A maximum.

10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

OUTLINE


1444
PLUG HOLES
F DIA. SEE NOTE 1
E DIA.
60°±½°
G
H
CATHODE TERMINAL
T SEE
NOTE 3
SEE
NOTE 4 U
A
J
DIA.
K
B
C
V
S DIA.
W
SEE
NOTE 2
X
L
R
DIA.
M
N
P
Q
Y
D
DIA.

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	3·000 ± 0·062	76·20 ± 1·57	M	0·500	12·70
B	1·125 ± 0·031	28·58 ± 0·79	N	$0{\cdot}620^{+0{\cdot}020}_{-0{\cdot}000}$	$15{\cdot}75^{+0{\cdot}51}_{-0{\cdot}00}$
C	1·000	25·40			
D	$3{\cdot}241^{+0{\cdot}000}_{-0{\cdot}002}$	$82{\cdot}321^{+0{\cdot}000}_{-0{\cdot}051}$	P	0·711 Min	18·06 Min
			Q	2·062 ± 0·015	52·37 ± 0·38
E	2·125 Max	53·98 Max	R	1·500 Max	38·10 Max
F	0·169 ± 0·002	4·293 ± 0·051	S	1·750	44·45
G	1·312	33·32	T	0·500 ± 0·010	12·70 ± 0·25
H	$0{\cdot}187^{+0{\cdot}002}_{-0{\cdot}000}$	$4{\cdot}750^{+0{\cdot}051}_{-0{\cdot}000}$	U	0·750 Max	19·05 Max
			V	0·125 ± 0·003	3·175 ± 0·076
J	1·125 Max	28·58 Max	W	0·400	10·16
K	0·500	12·70	X	0·620 Max	15·75 Max
L	2·000	50·80	Y	0·900	22·86

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The plug holes will be within ±0·010 inch (±0·25mm) about the centre line.
2. The anode block will be equally spaced about the centre line to within ±0·010 inch (±0·25mm).
3. The distance of the plug holes from the centre line will be equal to within ±0·010 inch (±0·25mm).
4. Maximum clearance for plug.

Service Type CV2186

ABRIDGED DATA

Fixed Frequency Pulse Magnetron

Frequency Range	9420 to 9500	Mc/s
Typical Peak Output Power	40	kW
Magnet		Separate
Output		No. 15 Waveguide (1·122 × 0·497 inch internal)
Coupler		Special
Cooling		Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·8	A
Heater Starting Current (Peak)	2·5	A Max
Cathode Heating Time (Minimum)	3·0	minutes

Mechanical

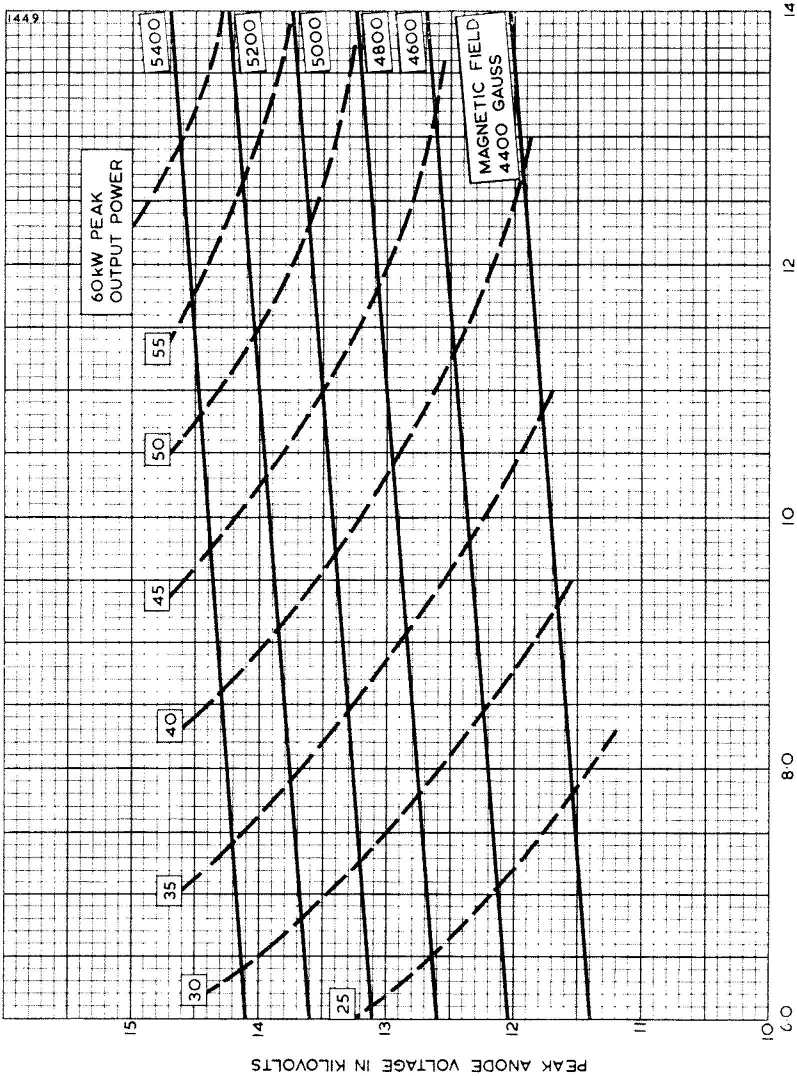
Overall Dimensions	9·077 × 3·400 × 3·240 inches	Max
	230·6 × 86·36 × 82·30 mm	Max
Net Weight	1½ pounds (0·7 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling .. .. Forced-air

ENGLISH ELECTRIC

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Magnetic Field (*See Note* 2)	4500	5200	Gauss
Heater Voltage (*See Note* 1)	6·0	6·6	V
Heater Starting Current (Peak)	—	2·5	A
Anode Voltage (Peak)	—	14	kV
Anode Current (Peak)	—	12	A
Input Power (Mean) (*See Note* 3)	—	110	W
Duty Cycle	—	0·001	
Pulse Length (*See Note* 4)	—	1·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	250	kV/μsec
Anode Temperature (*See Note* 6)	—	100	°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Magnetic Field	4850±50	4850±50	Gauss
Heater Voltage	0	0	V
Anode Current (Peak)	10	10	A
Pulse Length	1·0	0·25	μsec
Pulse Repetition Rate	1000	1500	p.p.s.
Rate of Rise of Voltage Pulse	200	200	kV/μsec

Typical Performance

Anode Voltage (Peak)	12	12	kV
Output Power (Peak)	40	40	kW
Output Power (Mean)	40	15	W

ENGLISH ELECTRIC

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

Magnetic Field	4850	Gauss
Heater Voltage (for test)	0	V
Anode Current (Mean)	10	mA
Duty Cycle	0·001	
Pulse Length (*See Note* 4)	1·0	μsec
V.S.W.R. at the output coupler	1·1 : 1	
Rate of Rise of Voltage Pulse (*See Note* 5)	150	kV/μsec

Limits

	Min	*Max*	
Anode Voltage (Peak)	11	14	kV
Output Power (Mean)	30	—	W
Frequency (*See Note* 7)	9420	9500	Mc/s
R.F. Bandwidth at ¼ Power	—	2·5	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5 : 1)	—	15	Mc/s
Stability (*See Note* 8)	—	0·2	%
Heater Current		*See Note* 9	
Temperature Coefficient of Frequency		*See Note* 10	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions above)

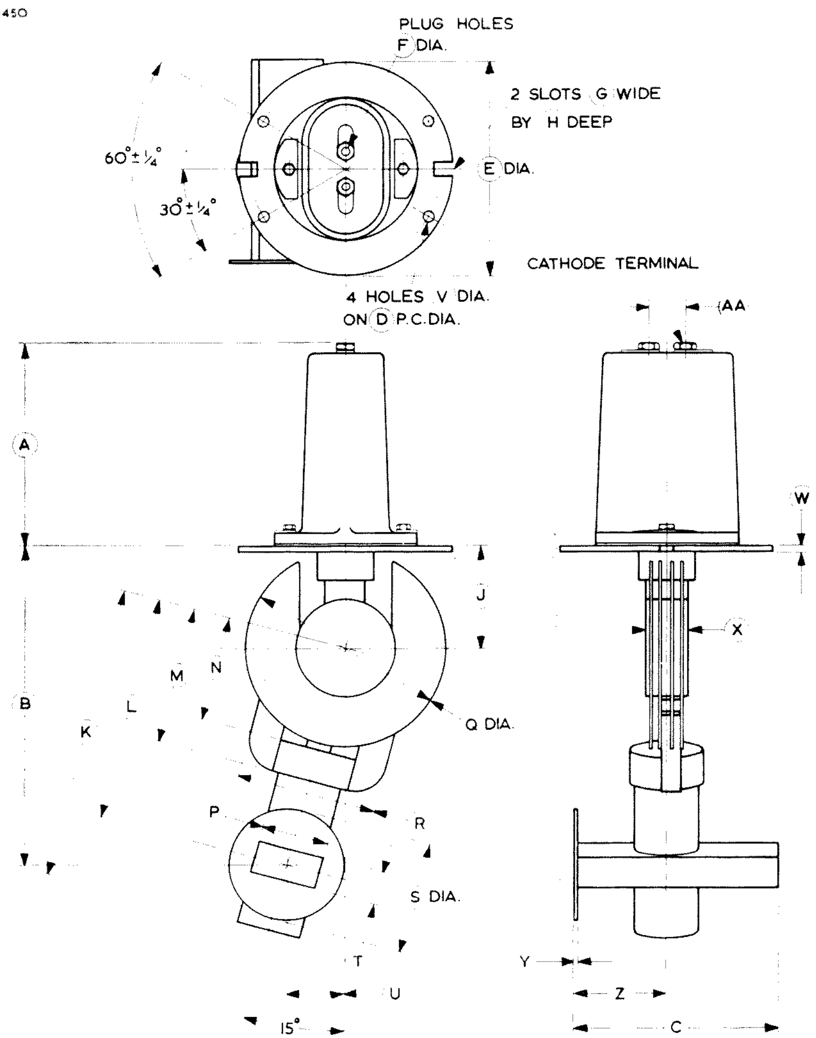
Anode Voltage (Peak)	10	kV Min
Output Power (Mean)	25	W Min
R.F. Bandwidth at ¼ Power	3·0	Mc/s Max
Frequency: Must be within Test Limits above		
Stability (*See Note* 8)	0·5	% Max

NOTES

1. With no anode input power.
The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the following schedule:
$$V_h = 6{\cdot}3\sqrt{1 - \frac{Pi}{150}} \text{ volts}$$
where Pi = mean input power in watts.
The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.
3. The various parameters are related by the following formula:
$$Pi = i_{apk} \times v_{apk} \times Du$$
where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.
4. Tolerance ±10%.
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.
6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. Other frequency ranges can be supplied on request.
8. With the valve operating into a V.S.W.R. of 1·15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.
9. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·7A minimum, 0·9A maximum.
10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

ENGLISH ELECTRIC

OUTLINE



OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	$3{\cdot}000 \pm 0{\cdot}062$	$76{\cdot}20 \pm 1{\cdot}57$	N	$1{\cdot}570 \pm 0{\cdot}020$	$39{\cdot}88 \pm 0{\cdot}51$
B	$4{\cdot}800 \pm 0{\cdot}020$	$121{\cdot}92 \pm 0{\cdot}51$	P	1·000	25·40
C	3·062	77·77	Q	$3{\cdot}000^{+0{\cdot}000}_{-0{\cdot}012}$	$76{\cdot}20^{+0{\cdot}00}_{-0{\cdot}30}$
D	$2{\cdot}875 \pm 0{\cdot}010$	$73{\cdot}03 \pm 0{\cdot}25$			
E	$3{\cdot}241^{+0{\cdot}000}_{-0{\cdot}002}$	$82{\cdot}321^{+0{\cdot}000}_{-0{\cdot}051}$	R	2·125	53·98
			S	1·750	44·45
F	$0{\cdot}169 \pm 0{\cdot}002$	$4{\cdot}293 \pm 0{\cdot}051$	T	0·500	12·70
G	$0{\cdot}187^{+0{\cdot}002}_{-0{\cdot}000}$	$4{\cdot}750^{+0{\cdot}051}_{-0{\cdot}000}$	U	$0{\cdot}870 \pm 0{\cdot}020$	$22{\cdot}10 \pm 0{\cdot}51$
			V	0·201	5·11
H	0·312	7·92	W	$0{\cdot}125 \pm 0{\cdot}005$	$3{\cdot}18 \pm 0{\cdot}13$
J	$1{\cdot}562 \pm 0{\cdot}020$	$39{\cdot}67 \pm 0{\cdot}51$	X	0·620 Max	15·75 Max
K	4·437	112·7	Y	0·064	1·63
L	$3{\cdot}355 \pm 0{\cdot}020$	$85{\cdot}22 \pm 0{\cdot}51$	Z	$1{\cdot}387 \pm 0{\cdot}020$	$35{\cdot}23 \pm 0{\cdot}51$
M	2·062	52·37	AA	$0{\cdot}500 \pm 0{\cdot}010$	$12{\cdot}70 \pm 0{\cdot}25$

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC

ABRIDGED DATA

Mechanically Tuned Pulse Magnetrons

Frequency Range:		
BM1032	9440 to 9510	Mc/s
BM1033	9800 to 9860	Mc/s
BM1034	9620 to 9680	Mc/s
BM1035	9520 to 9580	Mc/s
BM1036	9245 to 9305	Mc/s
BM1037	9145 to 9205	Mc/s
Typical Peak Output Power	50	kW
Magnet		Separate
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		Special
Cooling		Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·8	A
Heater Starting Current (Peak)	2·5	A Max
Cathode Heating Time (Minimum)	3·0	minutes

Mechanical

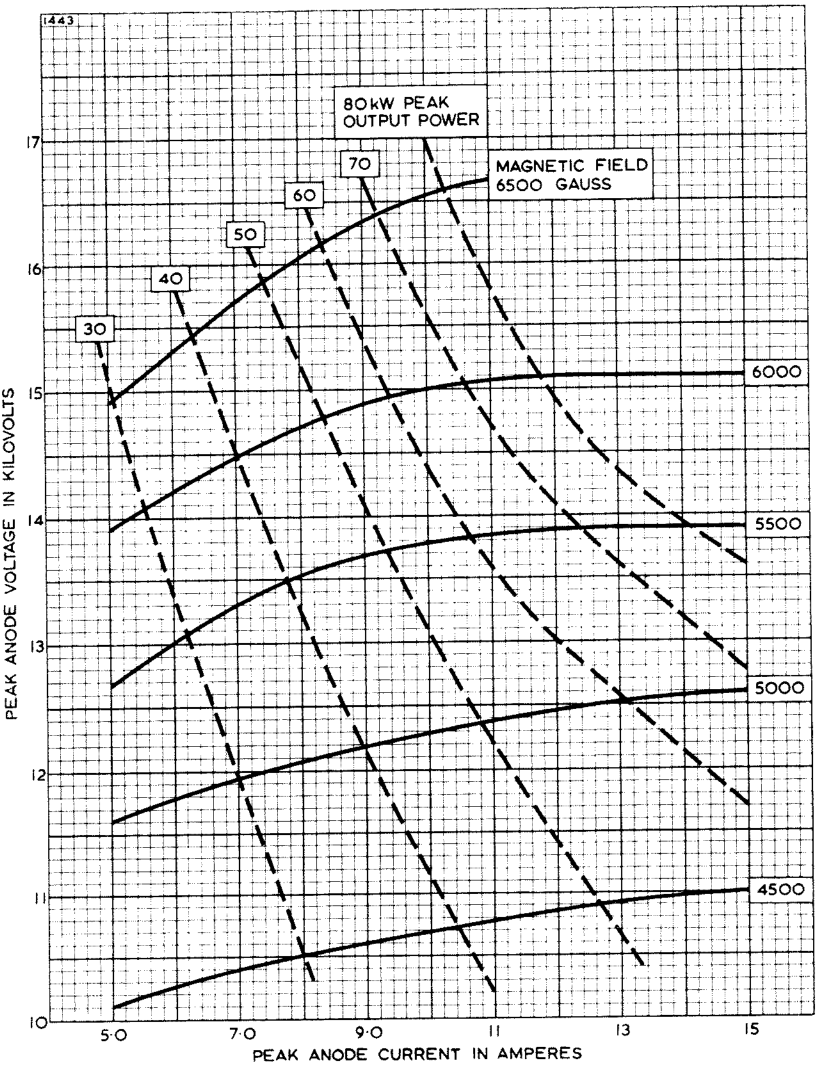
Overall Dimensions	6·532 × 3·714 × 3·241 inches	Max
	165·9 × 94·34 × 82·32 mm	Max
Net Weight	1½ pounds (0·68 kg)	Approx
Tuner Revolutions to cover frequency range	1¾	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling .. .. Forced-air

ENGLISH ELECTRIC

PERFORMANCE CHART



ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Magnetic Field (*See Note* 2)	5500	6800	Gauss
Heater Voltage (*See Note* 1)	6·0	6·6	V
Heater Starting Current (Peak)	—	2·5	A
Anode Voltage (Peak)	—	18	kV
Anode Current (Peak)	—	12	A
Input Power (Mean) (*See Note* 3)	—	150	W
Duty Cycle	—	0·001	
Pulse Length (*See Note* 4)	—	1·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	200	kV/μsec
Anode Temperature (*See Note* 6)	—	100	C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

Magnetic Field	6600 ± 100	Gauss
Heater Voltage	0	V
Anode Current (Peak)	12	A
Pulse Length	0·5	μsec
Pulse Repetition Rate	1820	p.p.s.
Rate of Rise of Voltage Pulse	150	kV/μsec

Typical Performance

Anode Voltage (Peak)	16	kV
Output Power (Peak)	50	kW
Output Power (Mean)	45·5	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

Magnetic Field	6600	Gauss
Heater Voltage (for test)	0	V
Anode Current (Peak)	12	A
Duty Cycle	0·001	
Pulse Length (*See Note* 4)	0·5	μsec
V.S.W.R. at the output coupler	1·1 : 1	
Rate of Rise of Voltage Pulse (*See Note* 5)	150	kV/μsec

Limits

	Min	*Max*	
Anode Voltage (Peak)	14	18	kV
Output Power (Peak)	42	—	kW
Frequency (*See Note* 7):			
BM1032	9440	9510	Mc/s
BM1033	9800	9860	Mc/s
BM1034	9620	9680	Mc/s
BM1035	9520	9580	Mc/s
BM1036	9245	9305	Mc/s
BM1037	9145	9205	Mc/s
R.F. Bandwidth at ¼ Power	—	5·0	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5 : 1)	—	15	Mc/s
Stability (*See Note* 8)	—	0·2	%
Heater Current			*See Note* 9
Temperature Coefficient of Frequency			*See Note* 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Conditions. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions above)

Anode Voltage (Peak)	13	kV Min
Output Power (Mean)	38	W Min
R.F. Bandwidth at ¼ Power	7·0	Mc/s Max

Frequency: Must be within Test Limits above.

ENGLISH ELECTRIC

NOTES

1. With no anode input power.
   The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the following schedule:
   $$V_h = 6{\cdot}3\sqrt{1 - \frac{Pi}{150}}\ \text{volts}$$
   where Pi = mean input power in watts.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.
3. The various parameters are related by the following formula:
   $Pi = i_{apk} \times v_{apk} \times Du$
   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Tolerance ±10%.
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.
6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. Other frequency ranges can be supplied on request.
8. With the valve operating into a V.S.W.R. of 1·5:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.
9. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·7A minimum, 0·9A maximum.
10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

ENGLISH ELECTRIC

OUTLINE

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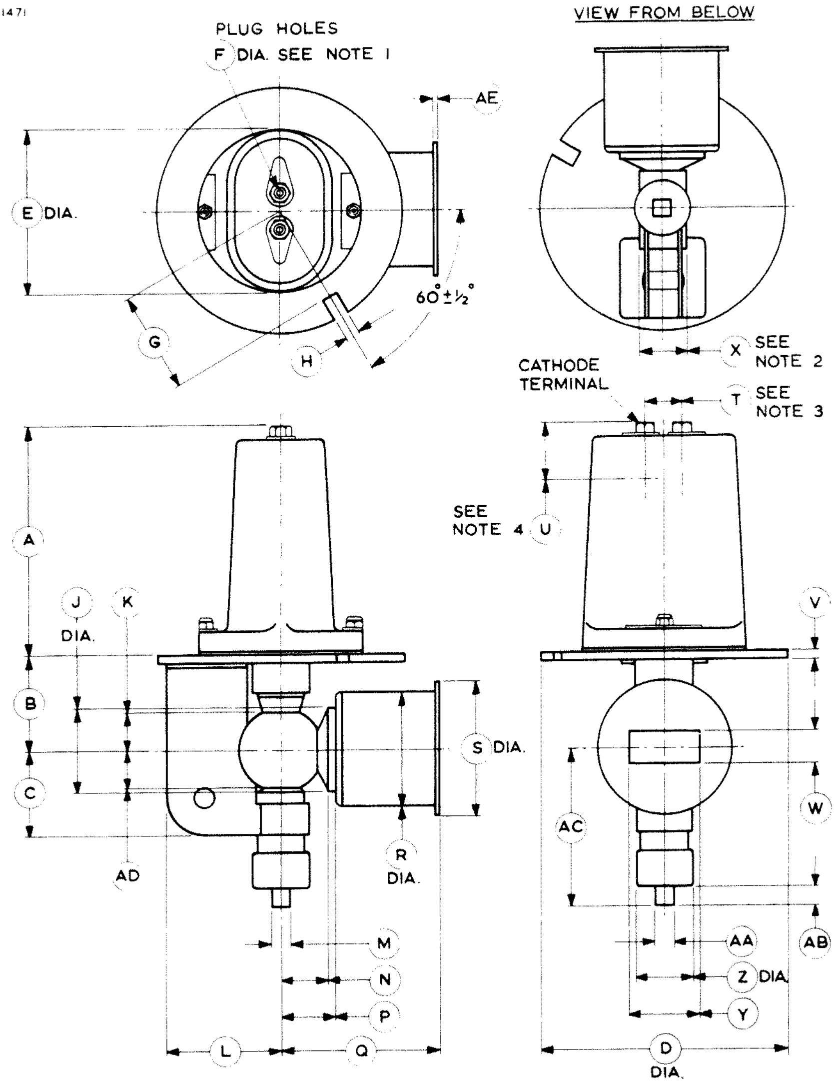


OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	$3{\cdot}000 \pm 0{\cdot}062$	$76{\cdot}20 \pm 1{\cdot}57$	P	0·711 Min	18·06 Min
B	$1{\cdot}250 \pm 0{\cdot}031$	$31{\cdot}75 \pm 0{\cdot}79$	Q	$2{\cdot}062 \pm 0{\cdot}031$	$52{\cdot}37 \pm 0{\cdot}79$
C	1·125	28·58	R	1·500 Max	38·10 Max
D	$3{\cdot}241 \begin{smallmatrix}+0{\cdot}000\\-0{\cdot}002\end{smallmatrix}$	$82{\cdot}321 \begin{smallmatrix}+0{\cdot}000\\-0{\cdot}051\end{smallmatrix}$	S	1·750	44·45
			T	$0{\cdot}500 \pm 0{\cdot}010$	$12{\cdot}70 \pm 0{\cdot}25$
E	2·125 Max	53·98 Max	U	0·750 Max	19·05 Max
F	$0{\cdot}169 \pm 0{\cdot}002$	$4{\cdot}293 \pm 0{\cdot}051$	V	$0{\cdot}125 \pm 0{\cdot}003$	$3{\cdot}175 \pm 0{\cdot}076$
G	$1{\cdot}312 \pm 0{\cdot}010$	$33{\cdot}32 \pm 0{\cdot}25$	W	$0{\cdot}400 \pm 0{\cdot}003$	$10{\cdot}160 \pm 0{\cdot}076$
H	$0{\cdot}187 \begin{smallmatrix}+0{\cdot}002\\-0{\cdot}000\end{smallmatrix}$	$4{\cdot}750 \begin{smallmatrix}+0{\cdot}051\\-0{\cdot}000\end{smallmatrix}$	X	0·620 Max	15·75 Max
			Y	$0{\cdot}900 \pm 0{\cdot}003$	$22{\cdot}860 \pm 0{\cdot}076$
J	1·125 Max	28·58 Max	Z	0·750	19·05
K	0·500	12·70	AA	$0{\cdot}250 \pm 0{\cdot}002$	$6{\cdot}350 \pm 0{\cdot}051$
L	1·500	38·10	AB	0·250	6·35
M	$0{\cdot}250 \pm 0{\cdot}002$	$6{\cdot}350 \pm 0{\cdot}051$	AC	2·093	53·16
N	$0{\cdot}620 \begin{smallmatrix}+0{\cdot}020\\-0{\cdot}000\end{smallmatrix}$	$15{\cdot}75 \begin{smallmatrix}+0{\cdot}51\\-0{\cdot}00\end{smallmatrix}$	AD	0·500	12·70
			AE	$0{\cdot}062 \pm 0{\cdot}005$	$1{\cdot}57 \pm 0{\cdot}13$

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The plug holes will be within ± 0·010 inch (± 0·25mm) about the centre line.

2. The anode block will be equally spaced about the centre line to within ± 0·010 inch (± 0·25mm).

3. The distance of the plug holes from the centre line will be equal to within ± 0·010 inch (± 0·25mm).

4. Maximum clearance for plug.

Service Type CV5167

ABRIDGED DATA

Mechanically Tuned Pulse Magnetron

Frequency Range	9040 to 9120	Mc/s
Typical Peak Output Power	65	kW
Magnet		Separate
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		Special
Cooling		Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·8	A
Heater Starting Current (Peak)	2·5	A Max
Cathode Heating Time (Minimum)	3·0	minutes

Mechanical

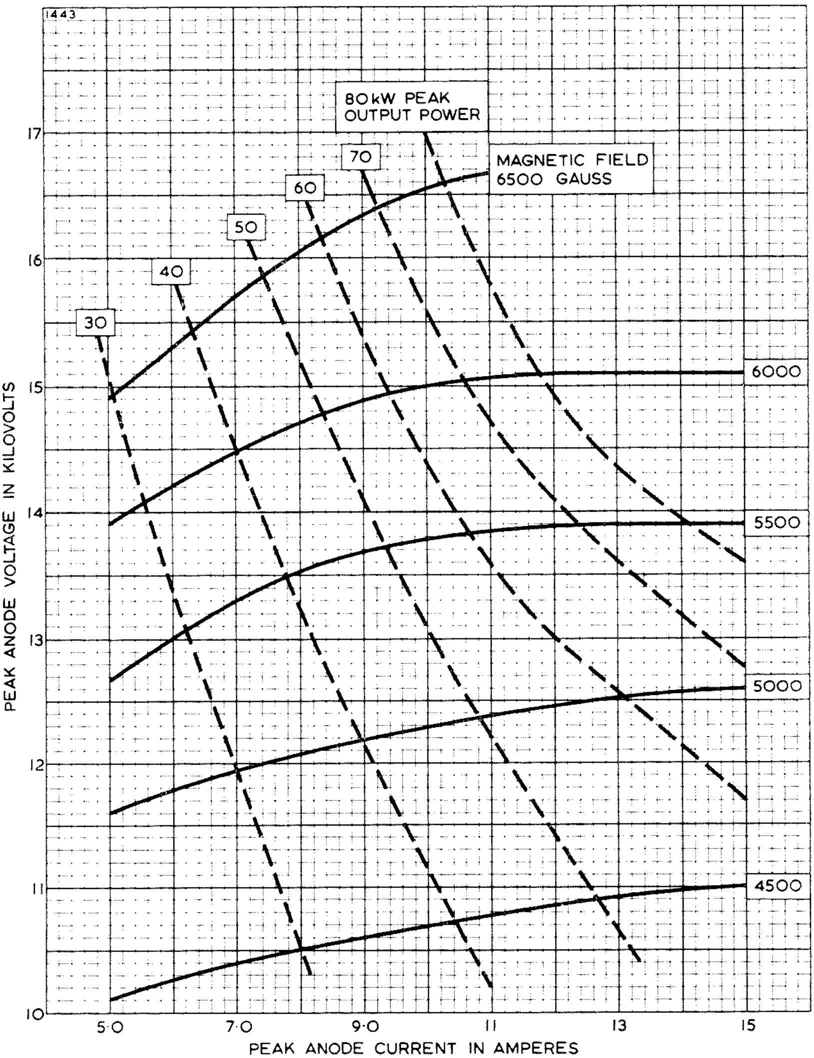
Overall Dimensions	6·532 × 3·714 × 3·241 inches	Max
	165·9 × 94·35 × 82·32 mm	Max
Net Weight	$1\frac{1}{2}$ pounds (0·68 kg)	Approx
Tuner Revolutions to cover frequency range	$1\frac{3}{4}$	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling .. .. Forced-air

ENGLISH ELECTRIC

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Magnetic Field (*See Note* 2)	4800	6800	Gauss
Heater Voltage (*See Note* 1)	6·0	6·6	V
Heater Starting Current (Peak)	—	2·5	A
Anode Voltage (Peak)	—	16	kV
Anode Current (Peak)	—	12	A
Input Power (Mean) (*See Note* 3)	—	120	W
Duty Cycle	—	0·001	
Pulse Length (*See Note* 4)	—	1·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 5) ..	—	250	kV/μsec
Anode Temperature (*See Note* 6)	—	100	°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Magnetic Field	6000±50	5500±50	Gauss
Heater Voltage..	0	0	V
Anode Current (Peak).. ..	11	11	A
Pulse Length	0·5	0·25	μsec
Pulse Repetition Rate.. ..	1440	4000	p.p.s.
Rate of Rise of Voltage Pulse..	200	200	kV/μsec

Typical Performance

Anode Voltage (Peak).. ..	15	14	kV
Output Power (Peak)	75	60	kW
Output Power (Mean).. ..	54	60	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic Field	5000	6000	Gauss
Heater Voltage (for test)	0	0	V
Anode Current (Peak)	9·0	11	A
Duty Cycle	0·0007	0·0007	
Pulse Length (*See Note* 4) ..	0·5	0·5	μsec
V.S.W.R. at the output coupler ..	1·5:1	1·5:1	
Rate of Rise of Voltage Pulse (*See Note* 5)	200	200	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	10	14	13	17	kV
Output Power (Peak)	22	—	60	—	kW
Frequency (*See Note* 7)	9040	9120	9040	9120	Mc/s
R.F. Bandwidth at ¼ Power ..	—	12·5	—	12·5	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	—	17	Mc/s
Stability (*See Note* 8)	—	0·1	—	0·1	%

Heater Current .. .. *See Note* 9

Temperature Coefficient of Frequency .. .. .. *See Note* 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA

(under Test Conditions Oscillation 1 and 2)

	Oscillation 1	Oscillation 2	
Anode Voltage (Peak)	9	12	kV Min
Output Power (Peak)	20	50	kW Min
R.F. Bandwidth at ¼ Power ..	14	14	Mc/s Max

Frequency: Must be within Test Limits above.

NOTES

1. With no anode input power.

   The heater voltage shall be reduced within 5 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6{\cdot}3\sqrt{1 - \frac{Pi}{150}}\ \text{volts}$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

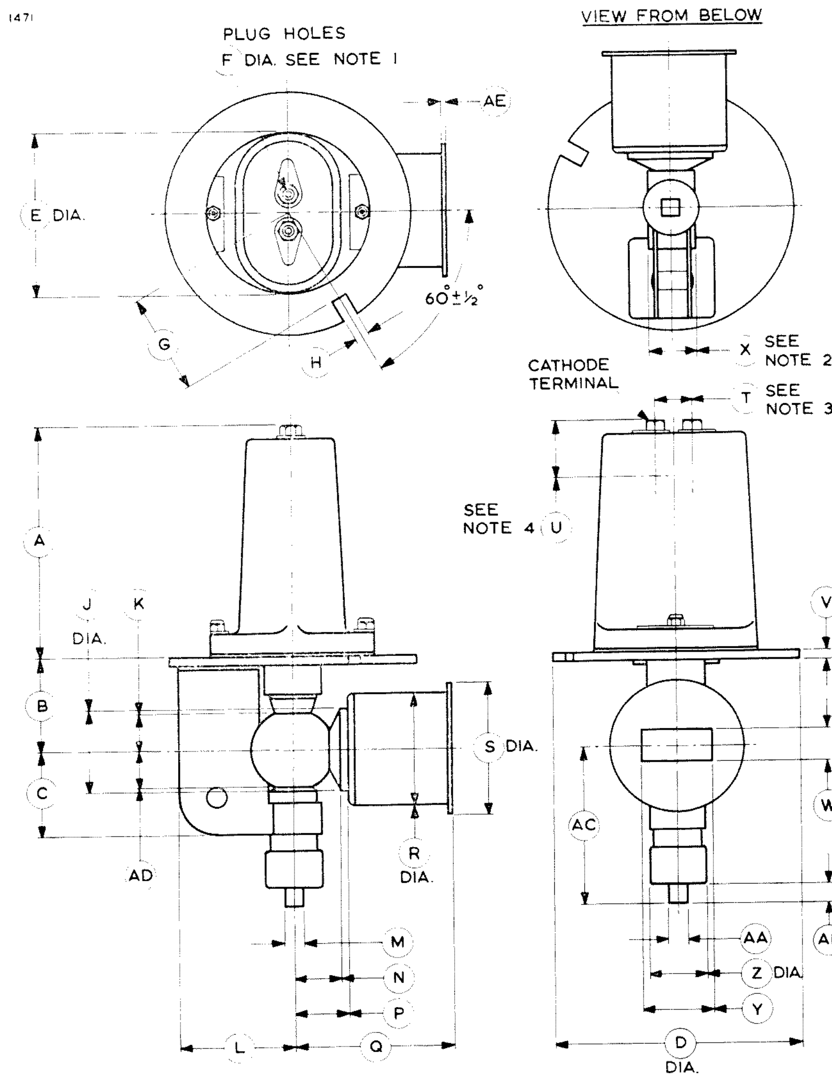
7. Other frequency ranges can be supplied on request.

8. With the valve operating into a V.S.W.R. of 1·5:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·7A minimum, 0·9A maximum.

10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

OUTLINE


1471
PLUG HOLES
F DIA. SEE NOTE 1
AE
E DIA.
60° ± ½°
G
H
VIEW FROM BELOW
X SEE NOTE 2
CATHODE TERMINAL
T SEE NOTE 3
SEE NOTE 4 U
A
J DIA.
K
B
C
AD
S DIA.
R DIA.
M
N
P
L
Q
V
W
AC
AA
AB
Z DIA.
Y
D DIA.

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	$3{\cdot}000 \pm 0{\cdot}062$	$76{\cdot}20 \pm 1{\cdot}57$	P	0·711 Min	18·06 Min
B	$1{\cdot}250 \pm 0{\cdot}031$	$31{\cdot}75 \pm 0{\cdot}79$	Q	$2{\cdot}062 \pm 0{\cdot}031$	$52{\cdot}37 \pm 0{\cdot}79$
C	1·125	28·58	R	1·500 Max	38·10 Max
D	$3{\cdot}241 {}^{+0{\cdot}000}_{-0{\cdot}002}$	$82{\cdot}321 {}^{+0{\cdot}000}_{-0{\cdot}051}$	S	1·750	44·45
			T	$0{\cdot}500 \pm 0{\cdot}010$	$12{\cdot}70 \pm 0{\cdot}25$
E	2·125 Max	53·98 Max	U	0·750 Max	19·05 Max
F	$0{\cdot}169 \pm 0{\cdot}002$	$4{\cdot}293 \pm 0{\cdot}051$	V	$0{\cdot}125 \pm 0{\cdot}003$	$3{\cdot}175 \pm 0{\cdot}076$
G	$1{\cdot}312 \pm 0{\cdot}010$	$33{\cdot}32 \pm 0{\cdot}25$	W	$0{\cdot}400 \pm 0{\cdot}003$	$10{\cdot}160 \pm 0{\cdot}076$
H	$0{\cdot}187 {}^{+0{\cdot}002}_{-0{\cdot}000}$	$4{\cdot}750 {}^{+0{\cdot}051}_{-0{\cdot}000}$	X	0·620 Max	15·75 Max
			Y	$0{\cdot}900 \pm 0{\cdot}003$	$22{\cdot}860 \pm 0{\cdot}076$
J	1·125 Max	28·58 Max	Z	0·750	19·05
K	0·500	12·70	AA	$0{\cdot}250 \pm 0{\cdot}002$	$6{\cdot}350 \pm 0{\cdot}051$
L	1·500	38·10	AB	0·250	6·35
M	$0{\cdot}250 \pm 0{\cdot}002$	$6{\cdot}350 \pm 0{\cdot}051$	AC	2·093	53·16
N	$0{\cdot}620 {}^{+0{\cdot}020}_{-0{\cdot}000}$	$15{\cdot}75 {}^{+0{\cdot}51}_{-0{\cdot}00}$	AD	0·500	12·70
			AE	$0{\cdot}062 \pm 0{\cdot}005$	$1{\cdot}57 \pm 0{\cdot}13$

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The plug holes will be within $\pm 0{\cdot}010$ inch ($\pm 0{\cdot}25$mm) about the centre line.
2. The anode block will be equally spaced about the centre line to within $\pm 0{\cdot}010$ inch ($\pm 0{\cdot}25$mm).
3. The distance of the plug holes from the centre line will be equal to within $\pm 0{\cdot}010$ inch ($\pm 0{\cdot}25$mm).
4. Maximum clearance for plug.

MAGNETRON

M502A

Service Type CV2373

INTRODUCTION

The M502A is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 500kW and operates at a fixed frequency within the limits of 9325 and 9425Mc/s, when used under the conditions specified below.

The valve has a packaged integral magnet.

The waveguide output flange is designed for coupling directly to waveguide No. 15 (1·122 inches × 0·497 inch internal dimensions) by means of Coupler type UG–52A/U (Z830033).

The waveguide may be pressurised to 45 lb/sq.in. absolute when the leakage will not exceed 0·5 litre (N.T.P.) per minute.

It is necessary to keep all magnetic material as far as possible (at least 2 inches) from the magnets and mounting plate.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	12·6	V
Heater Current	2·25	A
Heater Starting Current:		
Peak Value, not to be exceeded	6·75	A
Cathode Heating Time (Minimum)	3	minutes
Minimum Ambient Pressure for satisfactory operation	600	mm Hg

Mechanical

Overall Dimensions	7·69 × 6·16 × 4·64 inches	Max
	196 × 157 × 118 mm	Max
Net Weight	10 pounds (4·6 kg)	Approx
Mounting Position		Any

Cooling . . Forced-air

TYPICAL OPERATION

Heater Voltage	8·0	V
Anode Voltage (Peak)	21	kV
Anode Current (Peak)	22·5	A
Pulse Length	1·0	μsec
Pulse Repetition Rate	400	p.p.s.
Efficiency	38	%
Output Power (Peak)	180	kW

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Current at heater voltage 12·6V	2·0	2·5	A
Anode Voltage (Peak)	—	23	kV
Anode Current (Peak)	18	25	A
Input Power (Peak) (*See Note* 2)	—	500	kW
Input Power (Mean)	—	250	W
Duty Cycle	—	0·0005	
Pulse Length (*See Note* 3)	—	2·25	μsec
Rate of Rise of Voltage Pulse (*See Note* 4)	—	110	kV/μsec
Anode Temperature	—	140	°C
Cathode Terminal Temperature	—	200	°C
Frequency Change with Anode Temperature Change (after warming)	—	0·25Mc/s/°C	
V.S.W.R. at the output coupler	1·5:1		

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1		Oscillation 2		Oscillation 3		
Heater Voltage (for test) ..	8·0		8·0		8·0		V
Anode Current (Mean) ..	9·0						mA
Input Power (Peak) ..			500		400		kW
Duty Cycle	0·0004		0·0004		0·0004		
Pulse Length (*See Note* 3) ..	1·0		0·5		2·0		μsec
V.S.W.R. at the output coupler	<1·1:1		1·5:1		1·5:1		
Rate of Rise of Voltage Pulse (*See Note* 4)	110		110		110		kV/μsec
Limits	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	
Anode Voltage (Peak) ..	18	23					kV
Efficiency	35						%
Frequency	9325	9425					Mc/s
R.F. Bandwidth at ½ Power		3					Mc/s
Frequency Pulling (V.S.W.R. 1·5:1)		15					Mc/s
Stability:							
Missing Pulse Count (*See Note* 5)				0·5			%
Arc Count (*See Note* 6) ..						0·5	%

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Efficiency .. .. 25 % Min

Frequency: Must be within Test Limits above, Oscillation 1

NOTES

1. With no anode input power. The valve shall be operated with the heater voltage applied for 3 minutes (maximum) before the application of full H.T. The heater shall be reduced to 8 volts immediately after the application of full power.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For full details see Notes on the Protection of Magnetrons, in the preamble to this section.

2. The maximum peak input power shall not exceed 400kW with pulse length 2·0μsecs.

3. Tolerance ±10%.

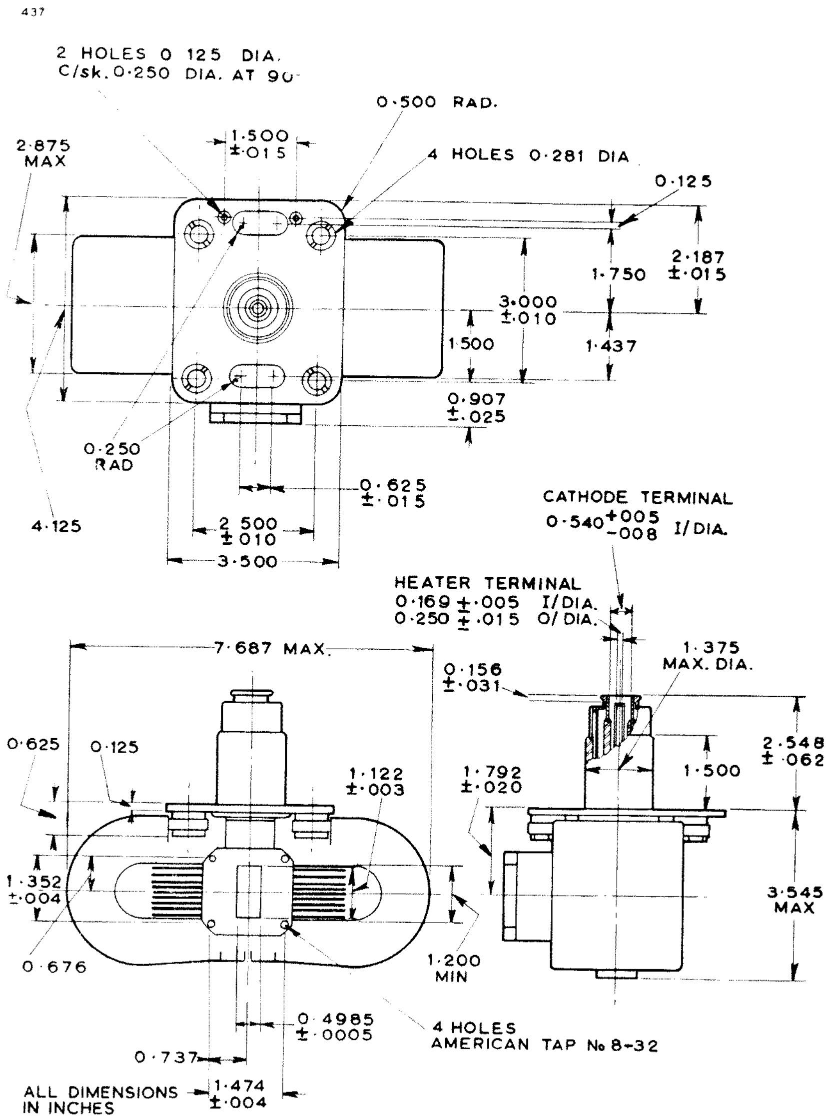
4. Measured as:

   $$\text{Rate of rise of voltage pulse} = \frac{0{\cdot}65 \times \text{peak anode voltage}}{\text{Time interval between } 20\% \text{ and } 85\% \text{ of peak}}$$

5. The valve shall be operated into a waveguide line giving a V.S.W.R. of not less than 1·5:1 adjusted in phase for maximum coupling. The valve shall be considered satisfactory when it shows less than the specified number of missing pulses during any 5 minute interval of a test period of 15 minutes. The percentage of missing pulses is defined as the number of pulses of R.F. energy less than 70% of normal in the 5 minute interval, divided by the total number of modulator pulses in that interval.

6. The test shall be performed after a holding period of not less than 168 hours. The valve shall be operated into a waveguide line giving a V.S.W.R. of not less than 1·5:1 adjusted in phase for minimum coupling. The valve shall be considered stable when it shows less than 0·5% of arcs during any 5 minute period within 15 minutes of switching on the H.T. The percentage of arcs is defined as the number of arcs in the 5 minute interval divided by the total number of magnetron pulses during that interval. Arcs shall be recorded by an electronic counter which is adjusted to respond to 10% above the operating peak current.

OUTLINE



437
2 HOLES 0 125 DIA. C/sk. 0·250 DIA. AT 90°
0·500 RAD.
2·875 MAX
1·500 ±·015
4 HOLES 0·281 DIA
0·125
2·187 ±·015
1·750
3·000 ±·010
1·500
1·437
0·907 ±·025
0·250 RAD
0·625 ±·015
4·125
2 500 ±010
3·500
CATHODE TERMINAL 0·540 +005 -008 I/DIA.
HEATER TERMINAL 0·169 ±·005 I/DIA. 0·250 ±·015 O/DIA.
7·687 MAX.
0·156 ±·031
1·375 MAX. DIA.
0·625
0·125
1·122 ±·003
1·792 ±·020
1·500
2·548 ±·062
1·352 ±·004
3·545 MAX
0·676
1·200 MIN
0·4985 ±·0005
4 HOLES AMERICAN TAP No 8-32
0·737
ALL DIMENSIONS IN INCHES
1·474 ±·004

ENGLISH ELECTRIC

ABRIDGED DATA

Fixed Frequency Pulse Magnetron similar to 2J42 and CV3676 but recommended for applications requiring short pulse lengths and higher rates of rise of voltage; cold impedance is controlled within closer limits.

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	9·5	kW
Magnet		Integral
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		UG–40A/U (Z830051)
Cooling		Natural or Forced-air

GENERAL DATA

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current (Peak)	3·0	A Max
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes

Mechanical

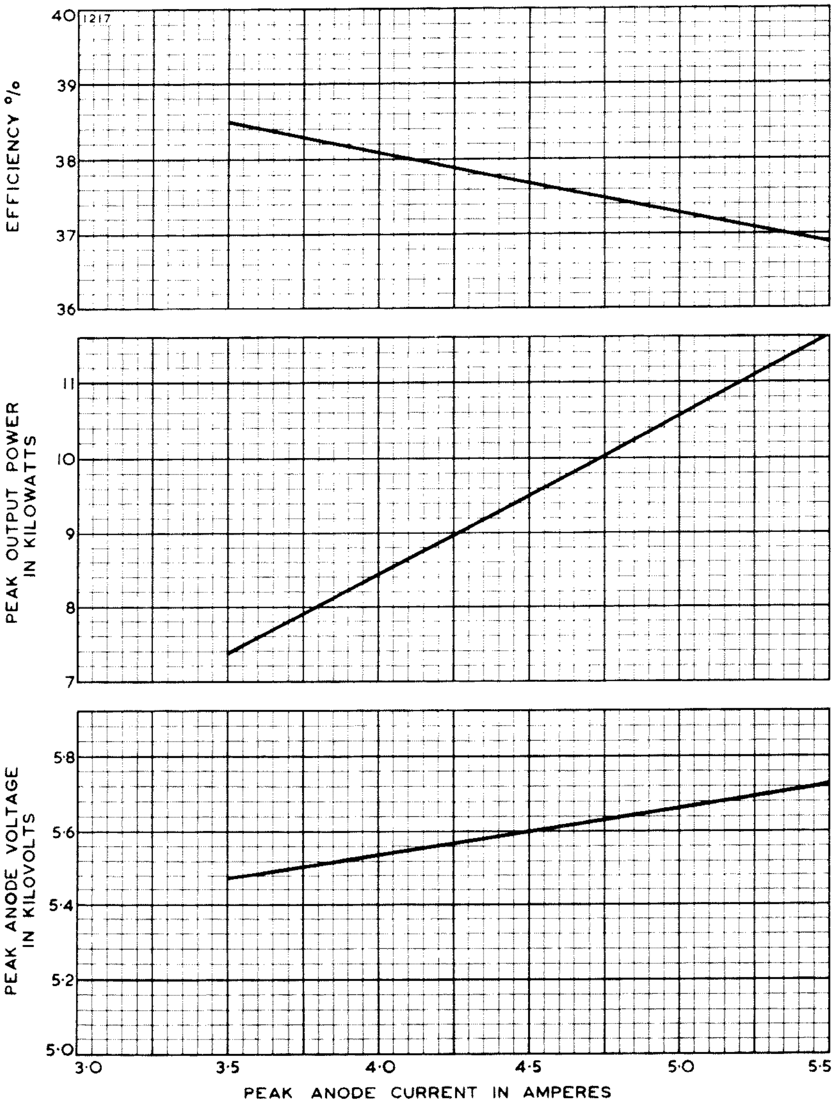
Overall Dimensions	4·468 × 3·312 × 5·250 inches	Max
	113·5 × 84·13 × 133·4 mm	Max
Net Weight	3¼ pounds (1·5 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnet of this valve is preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnet. English Electric Valve Company Limited should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

Cooling .. .. Natural or Forced-air

PERFORMANCE CHART



ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

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Printed in England

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater Voltage (*See Note* 1)	5·7	6·9	V
Heater Starting Current (Peak)	—	3·0	A
Anode Voltage (Peak)	5·0	6·2	kV
Anode Current (Peak)	3·5	5·5	A
Input Power (Peak)	—	33	kW
Input Power (Mean) (*See Note* 3)	—	82·5	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 4)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 5) ..	—	125	kV/μsec
Anode Temperature (*See Note* 6)	—	120	°C
V.S.W.R. at the output coupler	—	1·5:1	
Ambient Pressure for satisfactory operation ..	500	—	mm Hg

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater Voltage..	4·5	6·3	V
Anode Current (Peak)..	4·5	4·5	A
Pulse Length	0·5	0·05	μsec
Pulse Repetition Rate	1000	1000	p.p.s.
Rate of Rise of Voltage Pulse	100	125	kV/μsec

Typical Performance

	Condition 1	Condition 2	
Anode Voltage (Peak)..	5·6	5·6	kV
Output Power (Peak)	9·5	8·5	kW
Output Power (Mean)..	4·75	0·42	W

ENGLISH ELECTRIC

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater Voltage (for test)	6·3	6·3	V
Anode Current (Mean)	2·5	0·25	mA
Duty Cycle	0·0005	0·00005	
Pulse Length (*See Note* 4)	0·5	0·05	μsec
V.S.W.R. at the output coupler	1·15:1	1·15:1	
Rate of Rise of Voltage Pulse (Minimum) (*See Note* 5)	100	125	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	5·2	6·0	—	—	kV
Output Power (Mean)	3·5	—	—	—	W
Frequency (*See Note* 7)	9345	9405	—	—	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	—	—	Mc/s
Stability (*See Notes* 8 *and* 9)	—	0·1	—	0·1	%
R.F. Bandwidth at ¼ Power	—	5·0	—	50	Mc/s
Frequency Pushing (*See Notes* 9 *and* 10)	—	1·5	—	—	Mc/s/A
Cold Impedance (*See Note* 11)					
Heater Current (*See Note* 12)					
Frequency Change with Anode Temperature Change (after warming) (*See Note* 13)					

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA

(under Test Conditions Oscillation 1)

Anode Voltage (Peak)	5·0 kV Min
Output Power (Mean)	3·2 W Min
Frequency: Must be within Test Limits above, Oscillation 1	
Stability (*See Note* 8)	0·1 % Max

NOTES

1. With no anode input power.
For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:
$$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right)\text{volts}$$
where P_i = mean input power in watts.
The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.
3. The various parameters are related by the following formula:
$P_i = i_{apk} \times v_{apk} \times Du$
where P_i = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.
4. Tolerance ±10%.
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. Other frequency ranges can be supplied on request.
8. With the valve operating into a V.S.W.R. of 1·5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.
9. Measured over the peak current range of 3·0 to 8·5 amperes.
10. The change in frequency when the peak anode current is varied over the range.
11. For the range 9345 to 9405Mc/s the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a V.S.W.R. of at least 6:1 with a minimum 16·5 to 22·5mm from the output flange towards the anode.
12. Measured with heater voltage of 6·3V and no anode input power, the heater current limits are 0·43A minimum, 0·60A maximum.
13. Design test only. The maximum frequency change with anode temperature change (after warming) is −0·25Mc/s/°C.

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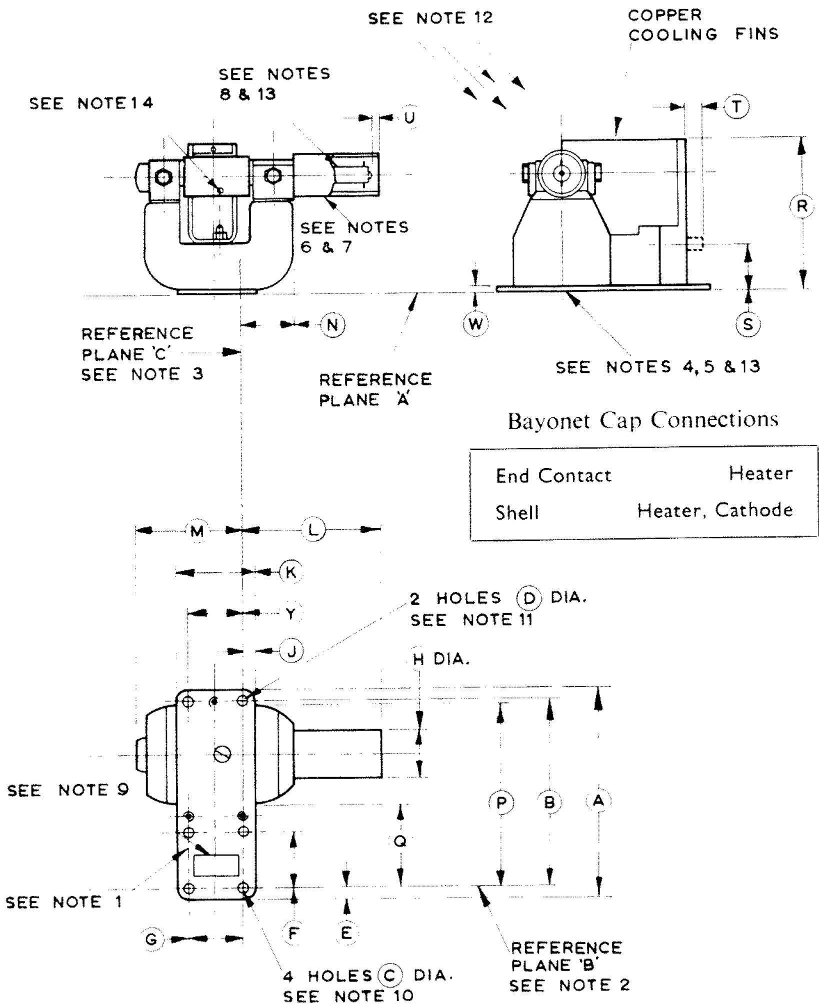
ENGLISH ELECTRIC

OUTLINE

439C



Bayonet Cap Connections

End Contact	Heater
Shell	Heater, Cathode

ENGLISH ELECTRIC

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	4·453 ± 0·015	113·11 ± 0·38	M	2·188 Max	55·58 Max
B	4·103	104·2	N	1·188 Max	30·18 Max
C	0·170 ± 0·003	4·318 ± 0·076	P	4·000 Max	101·6 Max
D	0·175 ± 0·003	4·445 ± 0·076	Q	1·938 Min	49·23 Min
E	0·172 ± 0·016	4·37 ± 0·41	R	3·312 Max	84·13 Max
F	1·280 ± 0·004	32·512 ± 0·102	S	0·875 ± 0·125	22·23 ± 3·18
G	1·220 ± 0·004	30·988 ± 0·102	T	0·375 Max	9·53 Max
H	1·000 Max	25·40 Max	U	0·125 Max	3·18 Max
J	0·203 ± 0·015	5·16 ± 0·38	W	0·125	3·18
K	1·625 ± 0·016	41·28 ± 0·41	Y	1·220	30·99
L	2·937 ± 0·125	74·60 ± 3·18			

Millimetre dimensions have been derived from inches.

NOTES FOR OUTLINE

1. This area is gasketed for pressurizing the waveguide output as with the coupler UG–40A/U (Z830051) and is the area tested in accordance with specification MIL–E–1 Par. 4.9.13.

2. Reference plane 'B' passes through the centres of two mounting plate holes as shown and is perpendicular to plane 'A'.

3. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown, and is perpendicular to planes 'A' and 'B'.

4. With surface 'A' resting on a flat surface plate, a feeler gauge 0·020 inch (0·51mm) thick and 0·125 inch (3·18mm) wide will not enter more than 0·125 inch (3·18mm) at any point.

5. Surface 'A' and interior surfaces of the waveguide will be plated with 10mg/sq.in (1·55mg/sq.cm) of gold or 30mg/sq.in (4·65mg/sq.cm) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials.

6. The axis of the heater lead protector will be within 5° of a normal to reference plane 'C'.

7. The heater lead protector will not be used to support any cap fitting. This protector is a detachable sleeve of a non-conducting material.

8. The clearance between the inside surface of the protector and the 0·375 inch (9·53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52(1952) Type BA9s/14) will not be less than 0·125 inch (3·18mm).
9. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler UG–40A/U (Z830051) (*See Note* 1 on page 7).
10. The centre of this hole will lie within 0·004 inch (0·102mm) of reference plane 'C'.
11. These holes will lie within 0·005 inch (0·127mm) of the indicated centres. A cylinder of 0·330 inch (8·38mm) diameter and centred on these holes will clear the side of the magnet.
12. Recommended direction of air flow.
13. All metal surfaces except surface 'A' will be painted with heat resistant paint or otherwise treated to prevent corrosion.
14. Anode temperature measured at this point.

MAGNETRON

M504

INTRODUCTION

The M504 is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 1·9MW and operates at a fixed frequency within the limits of 9325 and 9425Mc/s when used under the conditions specified below.

The valve is designed for use with a separate electro-magnet (not supplied).

The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The diagram on page 9 shows a dummy pole piece assembly which can be used in conjunction with the electro-magnet to check that it is producing the correct magnetic field. The user is invited to consult the English Electric Valve Co. Ltd. on the choice of magnets.

The waveguide output flange is designed for coupling directly to waveguide No. 15 (1·122 inch × 0·497 inch internal dimensions) by means of coupler type UG-52A/U (Z830033).

The waveguide must be pressurised to a minimum pressure of 35 lb/sq.in. absolute to prevent waveguide breakdown and to provide cooling air across the valve output window.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	5·0	V
Heater Current (*See Note* 1)	40	A
Heater Starting Current:		
Peak Value, not to be exceeded	175	A
Cathode Heating Time (Minimum)	5	minutes

Mechanical

Overall Dimensions (excluding flexible leads)	14·16 × 8 × 8 inches	Max
	360 × 204 × 204 mm	Max
Net Weight	$5\frac{1}{2}$ pounds (2·5 kg)	Approx
Mounting Position		Any

Cooling

Cooling .. .. Forced-air

MAGNETRON

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage at heater current 40A	4·3	5·2	V
Heater Current (*See Note* 1)	—	40	A
Anode Voltage (Peak)	32	38	kV
Anode Current (Peak) (*See Note* 2)	—	50	A
Input Power (Peak)	—	1·9	MW
Input Power (Mean) (*See Note* 2)	—	1·2	kW
Duty Cycle (*See Note* 2)	—	0·0006	
Pulse Length (*See Note* 4)	—	1·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 3)	—	200	kV/μsec
Anode Temperature	—	150	°C
Cathode Terminal Temperature	—	165	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·25	Mc/s/°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Heater Current	30	A
Magnetic Field	7000	Gauss
Anode Voltage (Peak)	35	kV
Anode Current (Peak)	50	A
Pulse Length	0·6	μsec
Pulse Repetition Rate	1000	p.p.s.
Output Power (Peak)	750	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	
Magnetic Field	7000	6500	Gauss
Heater Current (for test) ..	30	30	A
Anode Current (Mean)	30	30	mA
Duty Cycle (*See Note* 2).. ..	0·0006	0·0006	
Pulse Length (*See Note* 4) ..	0·6	0·6	μsec
Voltage Standing Wave Ratio at the output coupler	1·05:1	1·05:1	
Rate of Rise of Voltage Pulse (*See Note* 3)	150	150	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	32	38			kV
Output Power (Mean)	400				W
Frequency	9325	9425			Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 5)		4·2		4·2	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)		15			Mc/s
Stability:					
Arc Count (*See Note* 6) ..		1·0		1·0	%
Side Lobes (Ratio)	6		6		db

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Output Power (Mean)	310	W Min
R.F. Bandwidth at ¼ Power	5·0	Mc/s Max

Frequency: Must be within Test Limits above, Oscillation 1

Stability:

Arc Count (*See Note* 6)	2·0	% Max
Side Lobes (Ratio)	6	db Min

NOTES

1. With no anode input power.

   On stand-by the heater current shall not exceed 40 amperes. On the application of anode power the heater current should be lowered according to the following formula:

   input powers up to 1050 watts,

   $I_h = 40 - 0{\cdot}0095\ P_i$

   where P_i = mean input power in watts.

   For input powers above 1050 watts,

   $I_h = 80 - 0{\cdot}0476\ P_i$.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For full details see Notes on the Protection of Magnetrons, in the preamble to this section.

2. The various parameters are related by the following formula:

   $P_i = i_{apk} \times Du \times 35 \times 1000$

   where P_i = mean input power in watts

   i_{apk} = peak anode current and

   Du = duty cycle.

3. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6·0pF.

4. Tolerance ±0·1 μsec.

5. The R.F. Bandwidth in Mc/s is given by 2·5/pulse length in μsecs.

6. The valve shall be operated into a transmission line with a V.S.W.R. of 1·5 to 1 adjusted in phase to produce maximum instability. The valve shall be considered stable when it shows less than the maximum allowable percentage of arcs during the last five minute interval of a test period at fifteen minutes. The percentage of arcs is defined as the number of arcs in the five minute interval divided by the total number of magnetron pulses during that interval. Arcs shall be recorded by an electronic counter which is adjusted to respond to 10% above operating peak current.

OUTLINE

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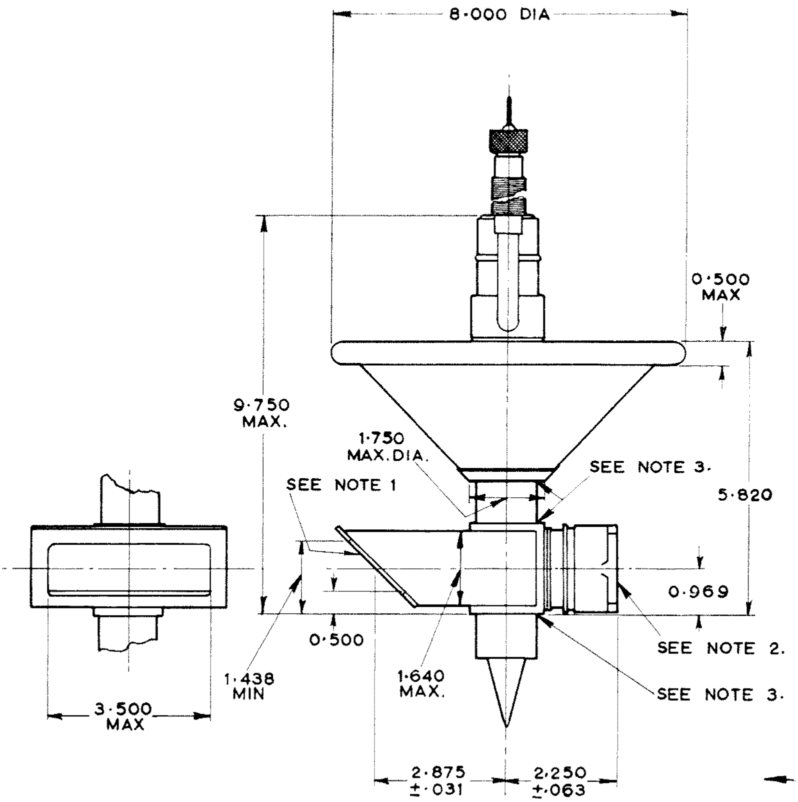
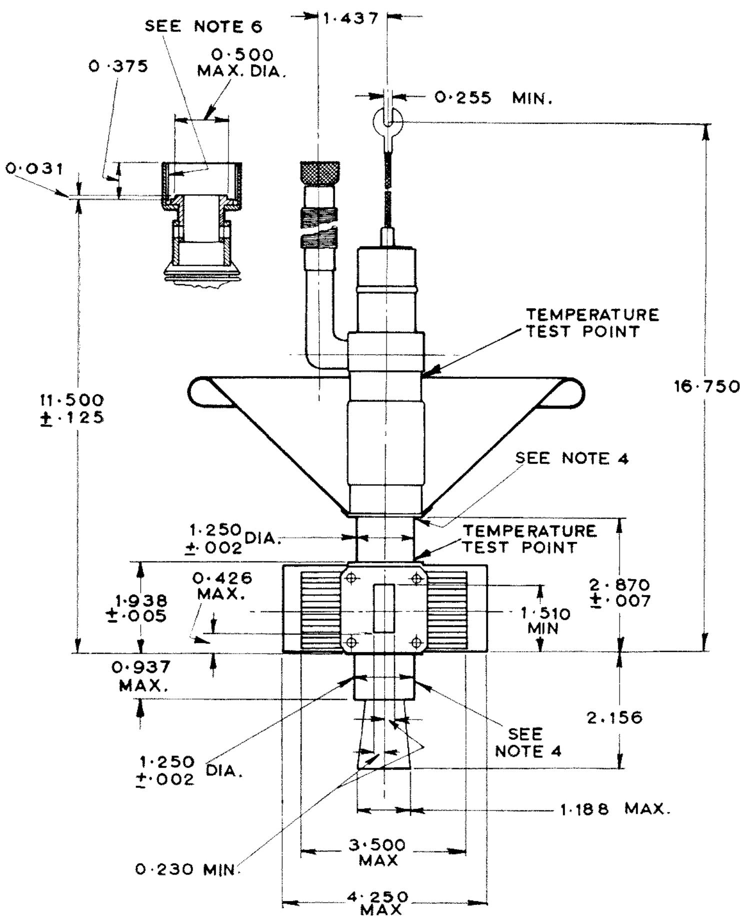


ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

OUTLINE

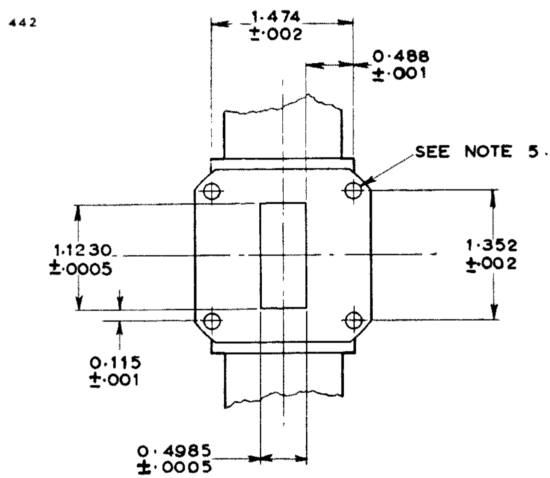
518



ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

OUTLINE DETAILS



NOTES FOR OUTLINE

1. With the valve mounted in an approved gauge a feeler 0·045 thick and 0·125 wide will not enter at any point between this flange and a surface plate brought into contact with this flange.

2. With the valve mounted in an approved gauge a feeler 0·032 thick and 0·125 wide will not enter at any point between this flange and a surface brought into contact with this flange.

3. Maximum radius of solder 0·125.

4. The pole pieces will be concentric to within 0·005.

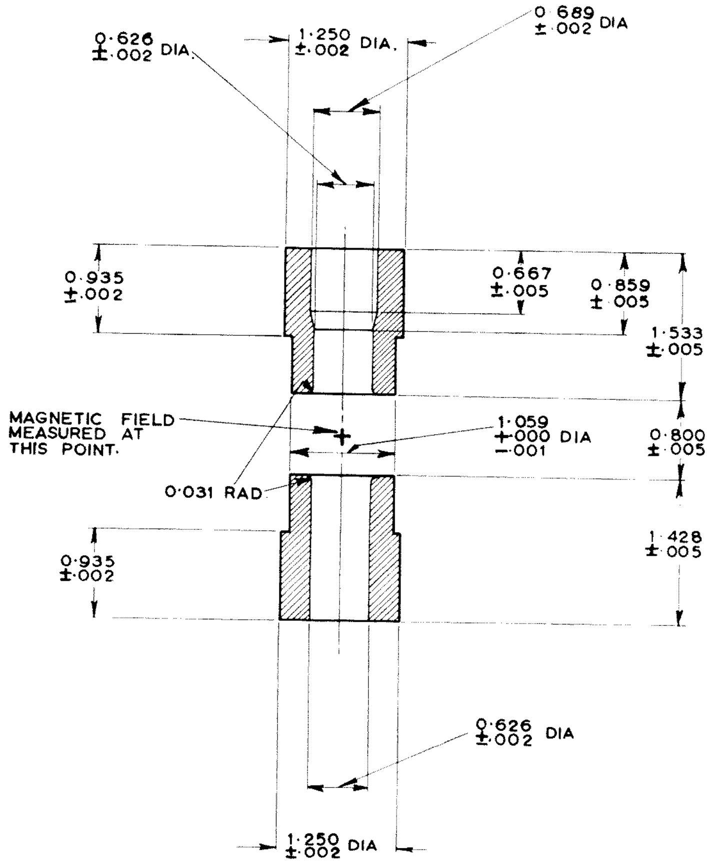
5. Four holes $\begin{smallmatrix}0{\cdot}167\\0{\cdot}166\end{smallmatrix}$ Dia.

6. Threaded 0·750 B.S.F. (Medium fit).

ALL DIMENSIONS IN INCHES

DUMMY POLE PIECE ASSEMBLY

443



ALL DIMENSIONS IN INCHES

MAGNETRON

M505

Service Type CV1747

INTRODUCTION

The M505 is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 150kW and operates at a fixed frequency within the limits of 9360 and 9460Mc/s when used under the conditions specified below.

The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult the English Electric Valve Co. Ltd. on the choice of magnets.

The waveguide output flange is designed for coupling directly to waveguide size B (1·000 inch × 0·500 inch internal dimensions) by means of Coupler to A.S.R.E. drawing No. 37820.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	3·0	V
Heater Current	3·5	A
Cathode Heating Time (Minimum)	1·5	minutes

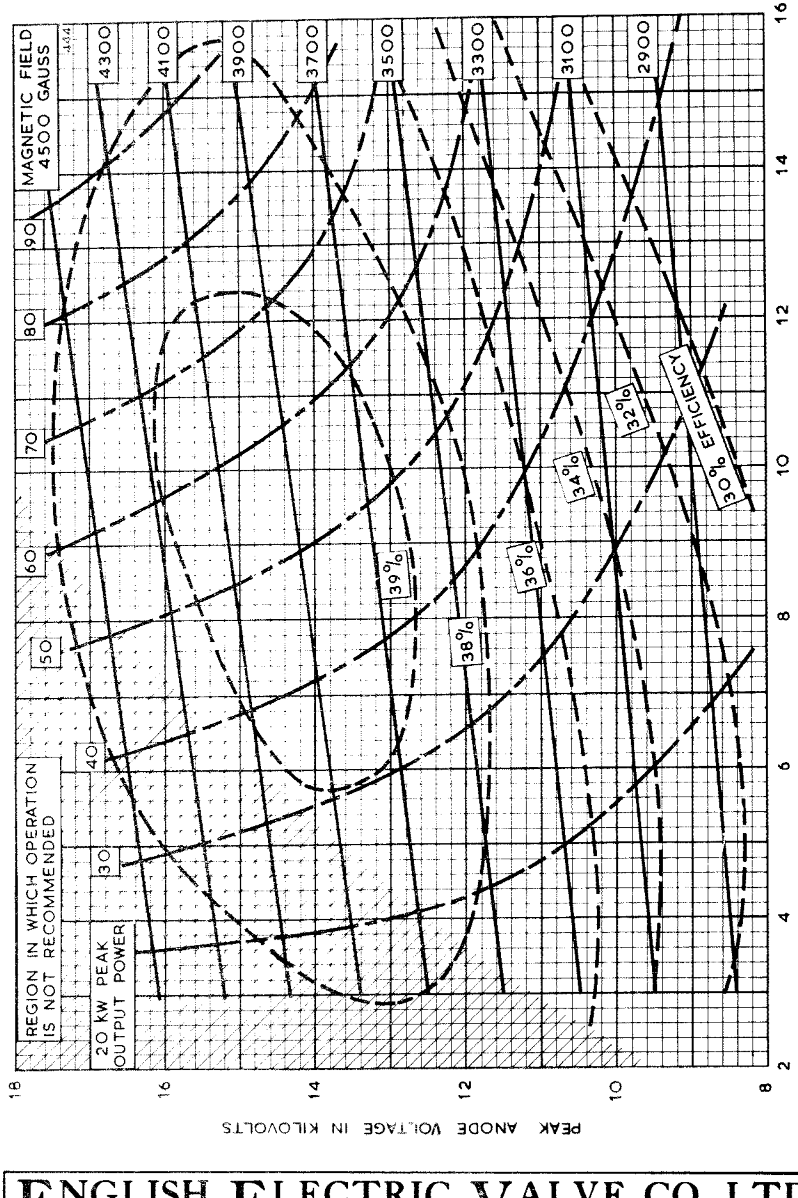
Mechanical

Overall Dimensions	8·22 × 3·30 × 3·51 inches	Max
	209 × 83·9 × 89·2 mm	Max
Net Weight	1¾ pounds (0·8 kg)	Approx
Mounting Position		Any

Cooling .. .. Forced-air

MAGNETRON

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	2·7	3·3	V
Heater Current at heater voltage 3·0V	3·0	4·0	A
Anode Voltage (Peak)	10·0	16·0	kV
Anode Current (Peak)	—	12	A
Input Power (Peak)	—	150	kW
Input Power (Mean)	—	150	W
Duty Cycle	—	0·001	
Pulse Length (*See Note* 4)	—	2·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 2)	—	150	kV/μsec
Anode Temperature	—	140	°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Heater Voltage	1·5	V
Magnetic Field	3250	Gauss
Anode Voltage (Peak)	11·1	kV
Anode Current (Peak)	12	A
Pulse Length	1	μsec
Pulse Repetition Rate	1000	p.p.s.
Output Power (Peak)	45	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	Oscillation 3	
Magnetic Field (*See Note* 3)	3250	3250	3250	Gauss
Heater Voltage (for test) ..	1·5	1·5	1·5	V
Anode Current (Mean) ..	12	10	12	mA
Duty Cycle	0·001	0·001	0·001	
Pulse Length (*See Note* 4) ..	1·0	1·0	2·0	μsec
V.S.W.R. at the output coupler	1·05:1	1·5:1	1·5:1	
Rate of Rise of Voltage Pulse (*See Note* 2)	150	150	150	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	*Min*	*Max*	
Anode Voltage (Peak) ..	10·5	12·5					kV
Output Power (Mean) ..	35						W
Efficiency	27						%
Frequency (*See Note* 5) ..	9360	9460					Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 6)				3·0			Mc/s
Frequency Pulling				15			Mc/s
Stability (*See Note* 7) ..				0·25			%
Cold Impedance (*See Note* 8)							
Frequency Pushing (*See Note* 9)		5·0					Mc/s
Mode Change (*See Note* 10)							

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 3 conditions. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA

(under Test Conditions Oscillation 1)

Output Power (Mean)	28	W Min
R.F. Bandwidth at ¼ Power (Oscillation 2)	3·0	Mc/s Max

Frequency: Must be within Test Limits above, Oscillation 1

NOTES

1. With no anode input power.
   On the application of anode power, the heater voltage should be lowered as indicated below:
   For mean input powers up to 40 watts $V_h = 3{\cdot}0V$
   For mean input powers 40 to 110 watts $V_h = 2{\cdot}0V$
   For mean input powers 110 to 150 watts $V_h = 1{\cdot}5V$
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.
3. Tolerance $\pm$50 gauss.
4. Tolerance $\pm$10%.
5. At anode temperature 25°C.
6. Maximum bandwidth in Mc/s is given by 3·0/(pulse length in microseconds).
7. The mismatch is varied through all phases during a 30 second period while the count is taken. Missing pulses are expressed as a percentage of the number of input pulses applied during this 30 second period. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9360 to 9460Mc/s.
8. When a signal of the same frequency as the valve operating frequency is fed into the valve, a standing wave is produced in the feeder system. The V.S.W.R. is tested to be greater than 6:1 and its phase such that a position of standing wave minimum is 4·5 to 10·5mm from the flange toward the anode.
9. The change in frequency when the mean input current is varied between the limits of 12 and 14mA shall be less than 5Mc/s.
10. Over the range 8 to 15mA, no pulses shall be missing when viewed with a spectrum analyser, nor double traces of voltage or current observed on the oscilloscope.

NOTES FOR OUTLINE

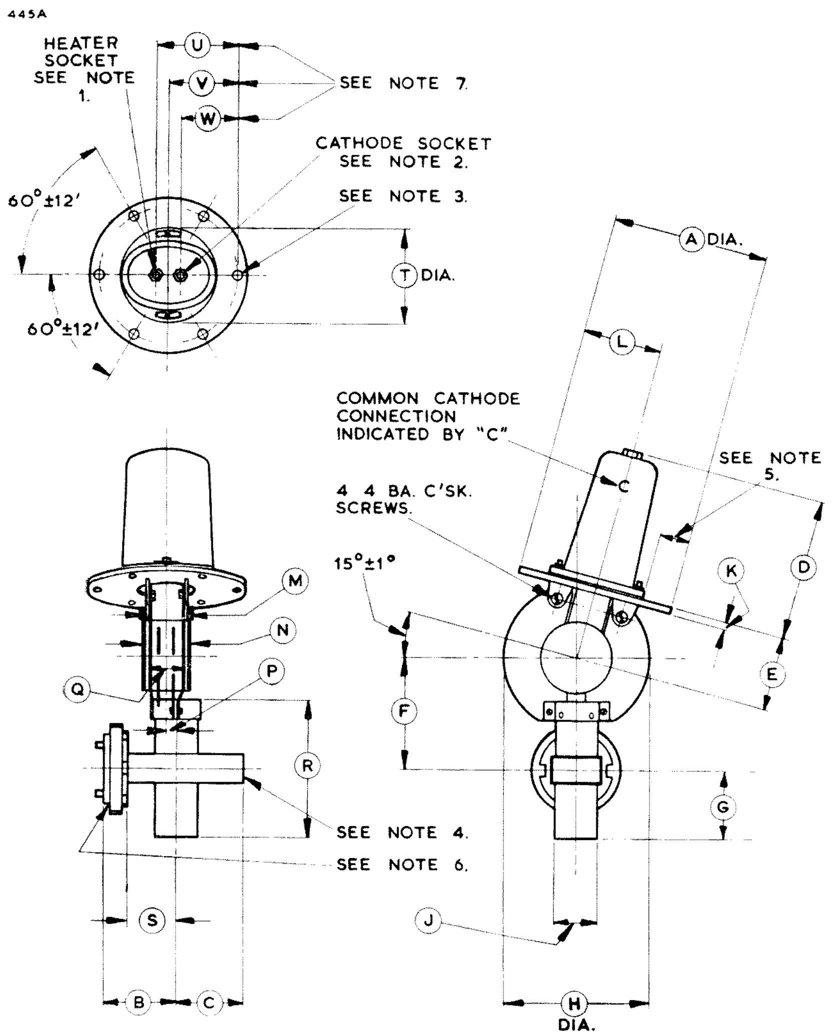
1. Hole in heater pin jack 0·125 ± 0·002 inch (3·175 ± 0·051mm) diameter.
2. Hole in cathode pin jack 0·169 ± 0·004 inch (4·293 ± 0·101mm) diameter.
3. 6 Holes 0·193 ± 0·003 inch (4·902 ± 0·076mm) equally spaced on 2·875 ± 0·006 inches (73·025 ± 0·152mm) P.C. Dia.
4. Waveguide 1·000 inch × 0·500 inch (25·40mm × 12·70mm) internal dimensions; wall thickness 0·050 inch (1·27mm).
5. This surface of the mounting flange will be flat to within 0·010 inch (0·254mm).
6. The face of the flange may deviate 1° from the nominal position relative to the axis of the waveguide. Details relating to the coupler may be obtained from the English Electric Valve Company Ltd.
7. The centre-line will be within 0·023 inch (0·584mm) of the nominal position and the spacing between the pin jacks will be 0·500 ± 0·010 inch (12·70 ± 0·254mm).

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	3·250 ± 0·031	82·55 ± 0·79
B	1·500 ± 0·010	38·10 ± 0·25
C	1·438 Max	36·53 Max
D	2·984 ± 0·062	75·79 ± 1·57
E	1·500 ± 0·020	38·10 ± 0·51
F	2·437 ± 0·020	61·90 ± 0·51
G	1·281 Max	32·54 Max
H	3·062 Max	77·77 Max
J	0·875 ± 0·010	22·23 ± 0·25
K	0·125	3·18
L	1·625	41·28
M	1·107 Max	28·12 Max
N	0·974 Max	24·74 Max
P	0·219	5·56
Q	$0{\cdot}8070^{+0{\cdot}0050}_{-0{\cdot}0045}$	$20{\cdot}498^{+0{\cdot}127}_{-0{\cdot}114}$
R	2·812 Max	71·42 Max
S	0·830 Min	21·08 Min
T	2·218 Max	56·34 Max
U	1·687	42·85
V	1·437	36·50
W	1·187	30·15

Millimetre dimensions have been derived from inches

OUTLINE


445A
HEATER SOCKET SEE NOTE 1.
U
V
W
SEE NOTE 7.
CATHODE SOCKET SEE NOTE 2.
SEE NOTE 3.
60°±12′
60°±12′
T DIA.
A DIA.
L
COMMON CATHODE CONNECTION INDICATED BY "C"
C
SEE NOTE 5.
4 4 BA. C'SK. SCREWS.
15°±1°
K
D
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Q
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SEE NOTE 4.
SEE NOTE 6.
S
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H DIA.

Service Type CV3982

INTRODUCTION

The M506A is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 150kW and operates at a fixed frequency within the limits of 9360 and 9460Mc/s when used under the conditions specified herein. It supersedes type M506, with which it is interchangeable.

The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult the English Electric Valve Co. Ltd. on the choice of magnets.

The waveguide output flange is designed for coupling directly to waveguide No. 16, 0·900 inch × 0·400 inch (22·86 mm × 10·16 mm) internal dimensions, by means of coupler type UG-40A/U (Z830051).

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	3·0	V
Heater Current	3·8	A ←
Cathode Heating Time (Minimum)	2·0	minutes ←

Mechanical

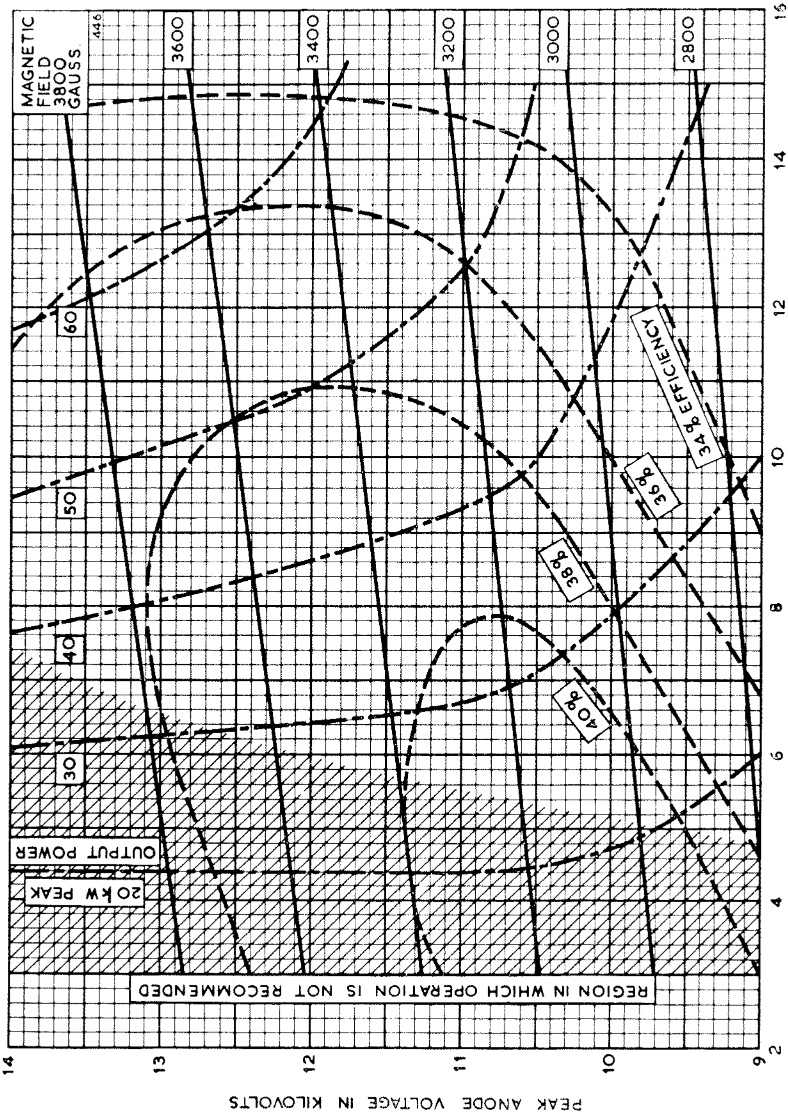
Overall Dimensions	6·40 × 6·16 × 4·27 inches	Max
	163 × 157 × 109 mm	Max
Net Weight	1¾ pounds (0·8 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

Cooling .. .. Forced-air

← Indicates a change

PERFORMANCE CHART



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MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater Voltage (*See Note* 1)	2·7	3·3	V
Heater Current at heater voltage 3·0V	3·5	4·0	A ←
Anode Voltage (Peak)	10·0	15·0	kV
Anode Current (Peak)	—	12	A
Input Power (Peak)	—	150	kW
Input Power (Mean)	—	150	W
Duty Cycle	—	0·001	
Pulse Length (*See Note* 2)	—	2	μsec
Rate of Rise of Voltage Pulse (*See Note* 3)	—	200	kV/μsec
Anode Temperature	—	140	°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

Operational Conditions

Heater Voltage	2·5	1·5	V ←
Magnetic Field (*See Note* 4)	3800	3250	Gauss ←
Anode Current (Peak)	12	12	A ←
Pulse Length	0·4	1	μsec ←
Pulse Repetition Rate	1100	1000	p.p.s. ←
Rate of Rise of Voltage Pulse (*See Note* 3)	200	150	kV/μsec ←

Typical Performance

Anode Voltage (Peak)	14·2	11·5	kV ←
Output Power (Peak)	50	50	kW ←
Output Power (Mean)	22	50	W ←

← Indicates a change

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	Oscillation 3	
Magnetic Field (*See Notes* 4 *and* 5) ..	3250	3250	3800	Gauss
Heater Voltage (for test) ..	1·5	1·5	2·5	V
Anode Current (Peak) ..	12	12	12	A
Duty Cycle	0·001	0·001	0·0044	
Pulse Length (*See Note* 2) ..	1·0	1·0	0·4	μsec
V.S.W.R. at the output coupler	1·05:1	1·5:1	1·05:1	
Rate of Rise of Voltage Pulse	150	150	200	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	*Min*	*Max*	
Anode Voltage (Peak) ..	10·5	12·5	—	—	13·0	15·5	kV
Output Power (Mean) ..	35	—	—	—	20	—	W
Efficiency	27	—	—	—	—	—	%
Frequency (*See Note* 6) ..	9360	9460	—	—	—	—	Mc/s
R.F. Bandwidth at ¼ Power (*See Note* 7)	—	—	—	3·0	—	7·5	Mc/s
Frequency Pulling	—	—	—	15	—	—	Mc/s
Stability (*See Note* 8) ..	—	—	—	0·25	—	—	%
Cold Impedance (*See Note* 9)	—	—	—	—	—	—	
Frequency Pushing (*See Note* 10)	—	5·0	—	—	—	—	Mc/s
Mode Change	(*See Note* 11)		—	—	—	—	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 3 conditions. If the valve is to be run continuously under conditions differing from the typical operating conditions given on Page 3, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Output Power (Mean)	28	W Min
R.F. Bandwidth at ¼ Power (Oscillation 2)	3·0	Mc/s Max

Frequency: Must be within Test Limits above, Oscillation 1

NOTES

1. With no anode input power.

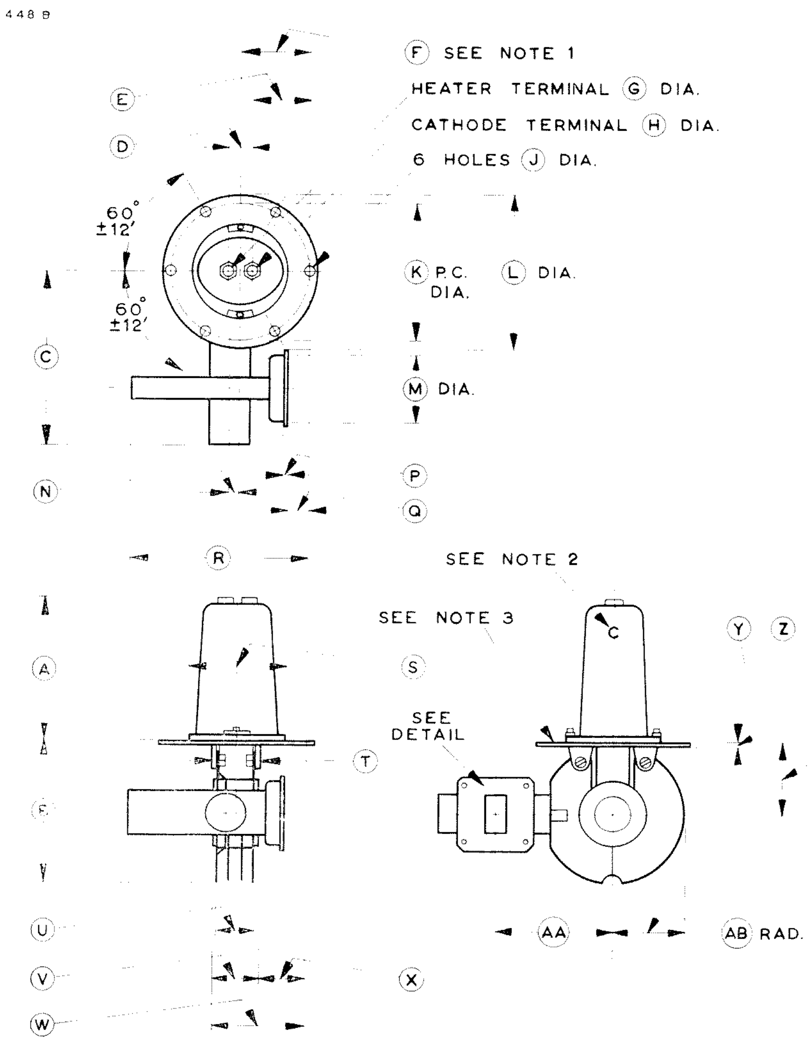
   On the application of anode power, the heater voltage shall be reduced according to the following schedule.

Mean Input Power in Watts	Heater Voltage in Volts
up to 30	3·0
31 to 80	2·5
81 to 120	2·0
121 to 150	1·5

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   The M506A has been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 1100 and 2000c/s. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used.
2. Tolerance ±10%.
3. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system shall not exceed 6·0pF.
4. The valve should be operated with the north pole of the magnet adjacent to the cathode terminal.
5. Tolerance ±50 gauss at 3250 gauss and ±100 gauss at 3800 gauss.
6. At anode temperature 25°C.
7. Maximum bandwidth in Mc/s is given by 3·0/(pulse length in microseconds).
8. The mismatch is varied through all phases during a 30 second period while the count is taken. Missing pulses are expressed as a percentage of the number of input pulses applied during this 30 second period. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9350 – 9470Mc/s.
9. When a signal of the same frequency as the valve operating frequency is fed into the valve, a standing wave is produced in the feeder system. The V.S.W.R. is tested to be greater than 6:1 and its phase such that a position of standing wave minimum is 16·5 to 22·5mm from the flange toward the anode.
10. The change in frequency when the mean input current is varied between the limits of 12 and 14mA shall be less than 5Mc/s.
11. Over the range 8 to 15mA, no pulse shall be missing when viewed with a spectrum analyser, nor double traces of voltage or current observed on the oscilloscope.

OUTLINE



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OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	2·984 ± 0·062	75·79 ± 1·57
B	3·125 Max	79·38 Max
C	4·000 Max	101·6 Max
D	0·500 ± 0·010	12·70 ± 0·25
E	1·187	30·15
F	1·437	36·50
G	0·169 ± 0·005	4·29 ± 0·13
H	0·169 ± 0·005	4·29 ± 0·13
J	0·193 ± 0·003	4·902 ± 0·076
K	2·875 ± 0·006	73·03 ± 0·15
L	3·250 ± 0·031	82·55 ± 0·79
M	1·422 ± 0·015	36·12 ± 0·38
N	0·219	5·56
P	0·110 ± 0·005	2·79 ± 0·13
Q	0·437 ± 0·020	11·10 ± 0·51
R	4·062 Max	103·2 Max
S	2·218 Max	56·34 Max
T	1·107 Max	28·12 Max
U	0·812 Max	20·62 Max
V	0·974 Max	24·74 Max
W	1·938 Max	49·23 Max
X	0·812 Min	20·62 Min
Y	0·125	3·18
Z	1·562 ± 0·020	39·67 ± 0·51
AA	2·437 ± 0·015	61·90 ± 0·38
AB	1·531 Max	38·89 Max

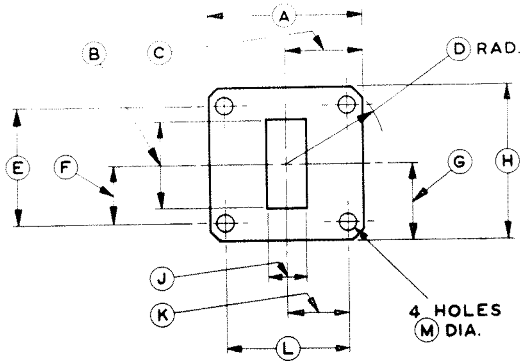
Millimetre dimensions have been derived from inches

NOTES FOR OUTLINE

1. Positional tolerance on centreline 0·023 inch (0·58mm).
2. Common cathode connection will be adjacent to letter 'C' as shown.
3. With the mounting plate resting on a plane surface a feeler gauge 0·010 inch (0·25mm) thick and 0·125 inch (3·18mm) wide will not enter for a distance greater than 0·250 inch (6·35mm).

OUTLINE DETAILS
Waveguide Output Flange

449 A



Ref.	Inches	Millimetres
A	1·625	41·28
B	0·900	22·86
C	0·812 ± 0·015	20·62 ± 0·38
D	1·062	26·97
E	1·220 ± 0·004	30·988 ± 0·102
F	0·610 ± 0·004	15·494 ± 0·102
G	0·812 ± 0·015	20·62 ± 0·38
H	1·625	41·28
J	0·400	10·16
K	0·640 ± 0·004	16·256 ± 0·102
L	1·280 ± 0·004	32·512 ± 0·102
M	0·1495 ± 0·003	3·797 ± 0·076

Millimetre dimensions have been derived from inches.

MAGNETRON

M508

Service Type CV370

Frequency Variant of Type 2J42

INTRODUCTION

The M508 is a forced-air cooled multi-resonator pulse operated Magnetron with a peak input power rating of 33kW and operates at a fixed frequency within the limits of 9210 and 9270Mc/s, when used under conditions specified below.

The valve has a packaged integral magnet.

The waveguide output flange is designed for coupling directly to waveguide No. 16 (0·900 inch × 0·400 inch internal dimensions) by means of Coupler type UG-40A/U (Z830051). The waveguide may be pressurised to 45 lb/sq.in. absolute when the leakage will not exceed 0·5 litre (N.T.P.) per minute.

It is necessary to keep all magnetic material as far as possible (at least 2 inches) from the magnets and mounting plate.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current:		
Peak Value, not to be exceeded	3	A
Cathode Heating Time (Minimum. *See Note* 2)	2	minutes
Minimum Ambient Pressure for satisfactory operation	500	mm Hg

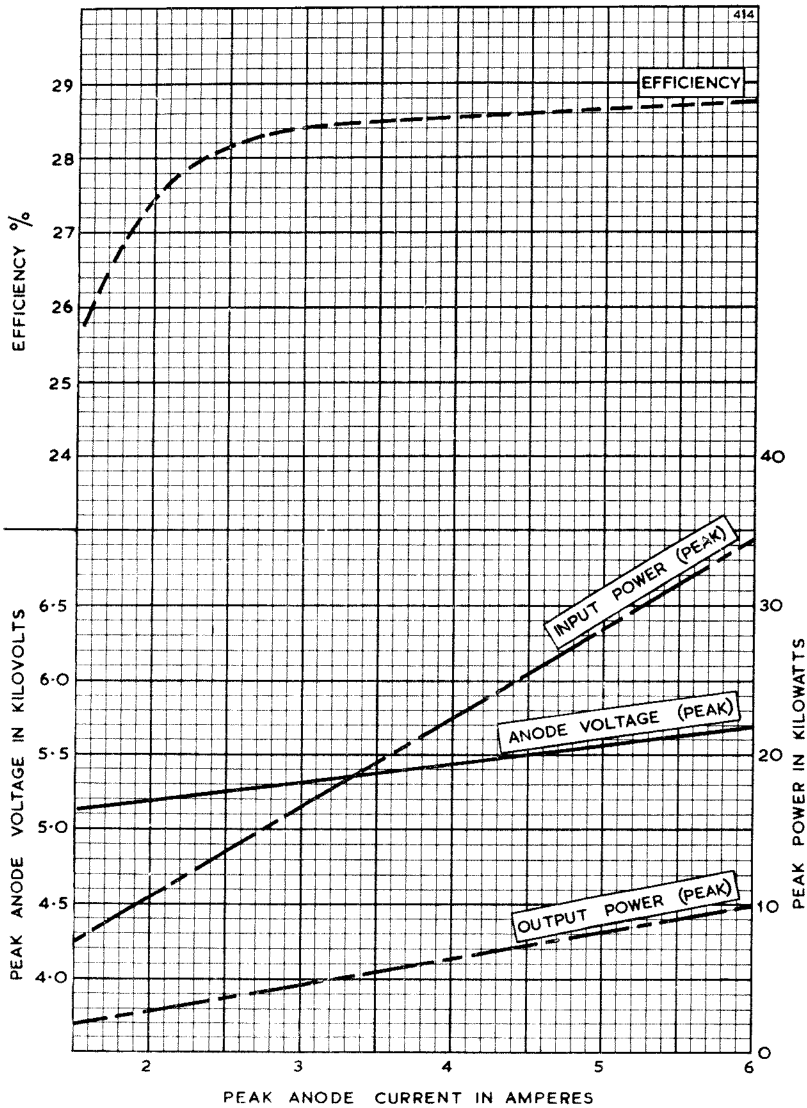
Mechanical

Overall Dimensions	4·47 × 3·57 × 5·38 inches	Max
	114 × 90·7 × 137 mm	Max
Net Weight	3¼ pounds (1·5 kg)	Approx
Mounting Position		Any

Cooling .. .. Natural or Forced-air

MAGNETRON

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage	5·7	6·9	V
Heater Current at heater voltage 6·3V	0·43	0·6	A
Anode Voltage (Peak)	5·0	6·0	kV
Anode Current (Peak)	3·5	5·5	A
Input Power (Peak)	—	33	kW
Input Power (Mean)	—	82·5	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 3)	—	2·5	μsec
Rate of Rise of Voltage Pulse (*See Note* 4) ..	—	75	kV/μsec
Anode Temperature (*See Note* 5)	—	140	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·25	Mc/s/°C
V.S.W.R. at the output coupler	—	1·5:1	

TYPICAL OPERATION

	Condition 1	Condition 2	
Heater Voltage	4·5	6·3	V
Anode Voltage (Peak)	5·5	5·5	kV
Anode Current (Peak)	4·5	4·5	A
Pulse Length	1·0	2·0	μsec
Pulse Repetition Rate	2000	500	p.p.s.
Rate of Rise of Voltage Pulse	60	60	kV/μsec
Output Power (Peak)	8	8	kW

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	Oscillation 3	
Heater Voltage (for test) ..	6·3	6·3	6·3	V
Anode Current (Mean) ..	4·5	*Note* 6	*Note* 6	mA
Duty Cycle	0·001	0·001	0·001	
Pulse Length (*See Note* 3) ..	1·0	1·0	2·5	μsec
V.S.W.R. at the output coupler	1·1:1 Max	1·1:1 Max	1·1:1 Max	
Rate of Rise of Voltage Pulse (*See Note* 4)	60			kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	*Min*	*Max*	
Anode Voltage (Peak) ..	5·3	5·7					kV
Efficiency	27·5						%
Frequency (*See Note* 7) ..	9210	9270					Mc/s
R.F. Bandwidth at ½ Power		3					Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1) ..		15					Mc/s
Stability			*Note* 8		*Note* 8		

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 2. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Output Power (Mean)	5·5 W Min
R.F. Bandwidth at ½ Power	3 Mc/s Max

Frequency: Must be within Test Limits above, Oscillation 1

NOTES

1. With no anode input power.

   For average values of pulse input power greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of H.T. according to the following schedule.

   $$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right)\text{volts}$$

   where P_i = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For full details see Notes on the Protection of Magnetrons, in the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. Tolerance ±10%.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.

5. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

6. The peak anode current is varied over the range from 3·5 to 6·0A.

7. Other frequency ranges can be supplied on request.

8. There shall be no mode change. No pulse shall be missing as viewed on a spectrum analyser. No double traces of voltage or current shall appear during a 5 sec interval, as the peak current is varied over the specified range.

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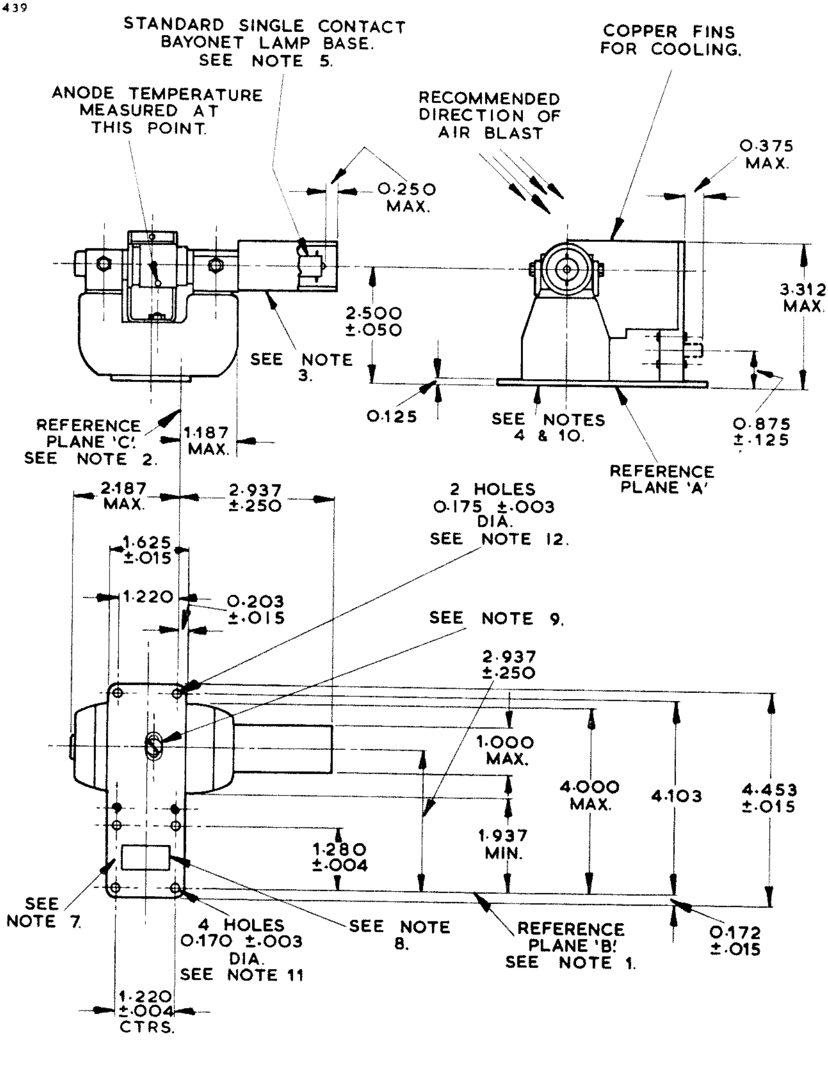
NOTES FOR OUTLINE

1. Reference Plane 'B' passes through the centres of the two bottom holes of the mounting plate as shown, and is perpendicular to Plane 'A'.
2. Reference Plane 'C' passes through the lower right hole on the mounting plate as shown, and is mutually perpendicular to planes 'A' and 'B'.
3. The axis of the heater lead protector will be within 5° of a normal to reference plane 'C'.
4. Surface 'A'. With valve resting on a flat surface a feeler gauge 0·020 thick and 0·125 wide will not enter more than 0·125 at any point.
5. The clearance between the inside surface of the protector and the 0·375 diameter cylindrical surface of the bayonet base will not be less than 0·125.
6. All metal surfaces except surface 'A' and the bayonet base will be painted black.
7. This area is gasketed for pressurizing waveguide output as with coupler, Army-Navy designation UG-40A/U.
8. The position of the waveguide hole is not specified on this drawing since valves are tested and used into coupler, Army-Navy designation UG-40A/U.
9. Soft solder will be used. As an alternative, tip of screw may be soldered.
10. Surface 'A' and interior surfaces of waveguide will be plated 10mg./sq. in. of gold or 30mg./sq. in. of silver.
11. The centre of this hole will be within 0·004 of the reference plane.
12. These holes will be on indicated centres within 0·005.

ALL DIMENSIONS IN INCHES

OUTLINE

439



ALL DIMENSIONS IN INCHES

Service Type CV3528

ABRIDGED DATA

Fixed Frequency Pulse Magnetron

Frequency Range	9345 to 9405	Mc/s
Typical Peak Output Power	22	kW
Magnets		Integral
Output		No. 16 Waveguide (0·900 × 0·400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		Natural or Forced-air

GENERAL

Electrical

Cathode		Indirectly Heated
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·5	A
Heater Starting Current (Peak)	3·0	A Max
Cathode Heating Time (Minimum) (*See Note* 2)	2	minutes

Mechanical

Overall Dimensions	5·031 × 4·468 × 5·375 inches	Max
	127·8 × 113·5 × 136·5 mm	Max
Net Weight	5 pounds (2·3 kg)	Approx
Mounting Position		Any

The valve is vibration tested to ensure that it will withstand normal conditions of service.

The magnets of this valve are preset during manufacture to ensure correct operation; a permanent deterioration in the performance of the magnetron may result if any magnetic material is allowed to approach the magnets. English Electric Valve Company Limited should be consulted to verify that the design of any magnetic screening or supporting structure does not impair the operation of the valve.

Cooling .. .. Natural or forced-air

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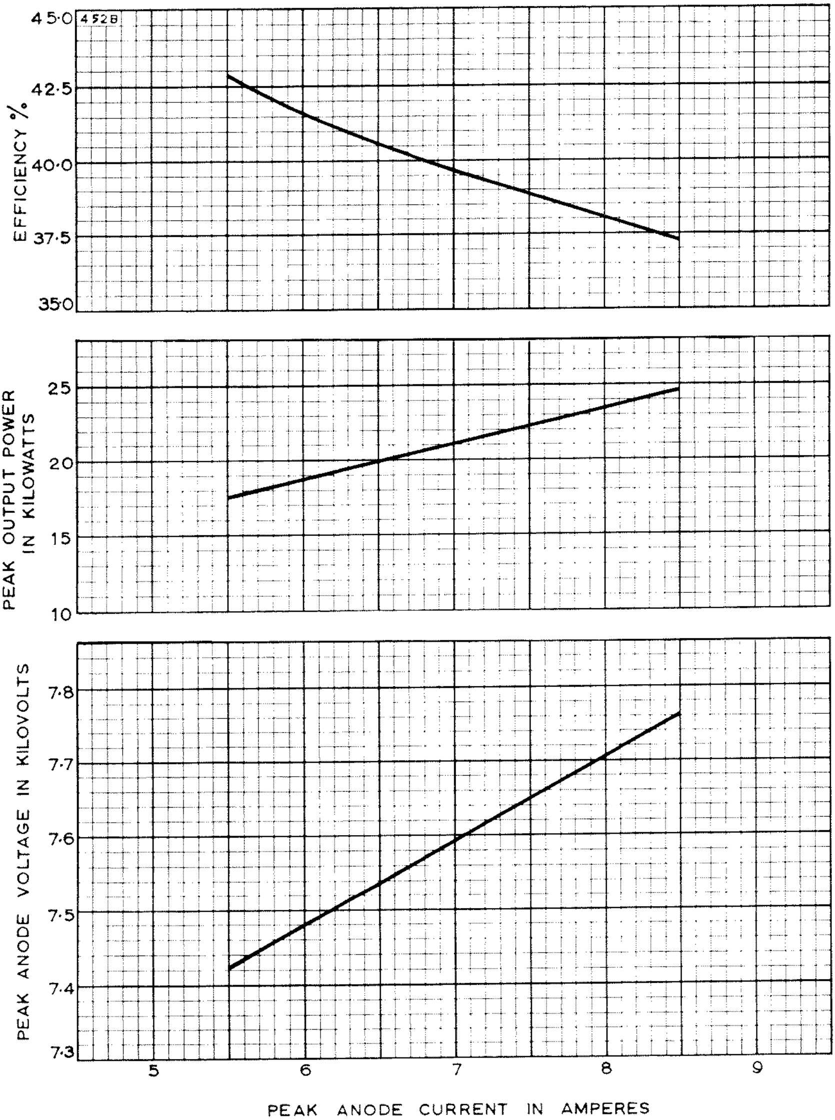
PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage (*See Note* 1)	5·7	6·9	V
Heater Starting Current (Peak)	—	3·0	A
Anode Voltage (Peak)	7·0	8·0	kV
Anode Current (Peak)	5·5	8·5	A
Input Power (Peak)	—	64	kW
Input Power (Mean) (*See Note* 3)	—	80	W
Duty Cycle	—	0·0025	
Pulse Length (*See Note* 4)	—	2·0	μsec
Rate of Rise of Voltage Pulse (*See Note* 5)	—	100	kV/μsec
Anode Temperature (*See Note* 6)	—	120	°C
V.S.W.R. at the output coupler	—	1·5:1	
Ambient Pressure for satisfactory operation	500	—	mm Hg
Pressurising of Waveguide (*See Note* 7)	—	45	lb/sq.in
		3·16	kg/sq.cm

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater Voltage	6·3	6·3	V
Anode Current (Peak)	7·5	7·5	A
Pulse Length	1·0	0·1	μsec
Pulse Repetition Rate	500	1000	p.p.s.
Rate of Rise of Voltage Pulse	100	100	kV/μsec
Typical Performance			
Anode Voltage (Peak)	7·6	7·6	kV
Output Power (Peak)	22	22	kW
Output Power (Mean)	11	2·2	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater Voltage (for test) ..	6·3	6·3	V
→Anode Current (Mean)	3·75	0·375	mA
Duty Cycle	0·0005	0·00005	
Pulse Length (*See Note* 4) ..	1·0	0·05	μsec
V.S.W.R. at the output coupler	1·15:1	1·15:1	
Rate of Rise of Voltage Pulse (*See Note* 5)	100	100	kV/μsec

Limits

	Min	*Max*	*Min*	*Max*	
Anode Voltage (Peak)	7·0	8·0	7·0	8·0	kV
Output Power (Mean)	9·0	—	0·75	—	W
Frequency (*See Note* 8)	9345	9405	—	—	Mc/s
R.F. Bandwidth at ¼ Power ..	—	2·5	—	50	Mc/s
Frequency Pulling (V.S.W.R. not less than 1·5:1)	—	15	—	—	Mc/s
Stability (*See Note* 9)	—	0·25	—	0·25	%
Cold Impedance				*See Note* 10	
Heater Current				*See Note* 11	
Temperature Coefficient of Frequency				*See Note* 12	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

END OF LIFE CRITERIA
(under Test Conditions Oscillations 1 and 2)

	Oscillation 1	Oscillation 2	
Anode Voltage (Peak)	7·0	7·0	kV Min
Output Power (Mean)	8·0	—	W Min
R.F. Bandwidth at ¼ Power	3·5	—	Mc/s Max
Frequency: Must be within Test Limits above, Oscillation 1			
Stability (*See Note* 9)	2·0	—	% Max

→ Indicates a change

NOTES

1. With no anode input power.
   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

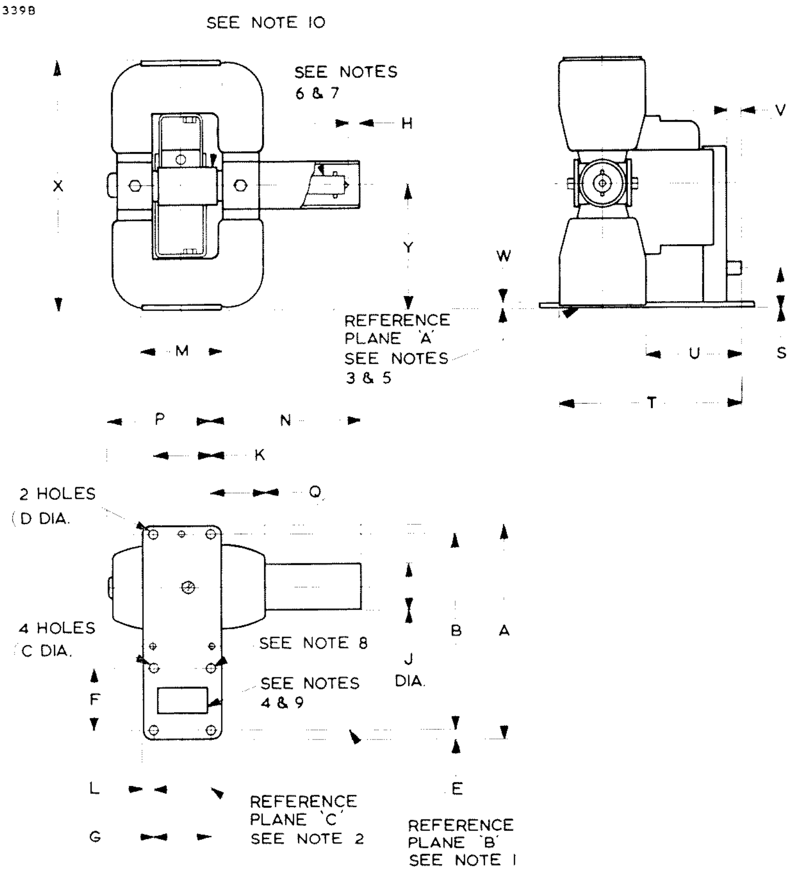
   $$V_h = 6{\cdot}3\left(1 - \frac{P_i}{180}\right)\text{volts}$$

   where P_i = mean input power in watts.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.
3. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Tolerance ±10%.
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6·0pF.
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. At the maximum pressure of 45lb/sq.in (3·16kg/sq.cm) absolute, the leakage will not exceed 0·5 litre (N.T.P.) per minute.
8. Other frequency ranges can be supplied on request.
9. With the valve operating into a V.S.W.R. of 1·15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0·5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.
10. For the range 9345 to 9405Mc/s the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a V.S.W.R. of at least 6:1 with a minimum 16·5 to 22·5mm from the output flange towards the anode.
11. The heater current, measured with heater voltage of 6·3V and no anode input power, will be within the range 0·43 to 0·60A.
12. Design test only. The frequency change with anode temperature change after warm-up will not exceed −0·25Mc/s/°C.

OUTLINE



Bayonet Cap Connections

End Contact	Heater
Shell	Heater, Cathode

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	4·468 Max	113·5 Max	M	1·625 ± 0·016	41·28 ± 0·41
B	4·103 ± 0·004	104·216 ± 0·102	N	3·187 Max	80·95 Max
C	0·170 ± 0·003	4·318 ± 0·076	P	2·187 Max	55·55 Max
D	0·175 ± 0·003	4·445 ± 0·076	Q	1·187 Max	30·15 Max
E	0·172 ± 0·016	4·37 ± 0·41	S	0·875 ± 0·125	22·22 ± 3·18
F	1·280 ± 0·004	32·512 ± 0·102	T	4·000 Max	101·6 Max
G	1·220 ± 0·004	30·988 ± 0·102	U	1·938 Max	49·23 Max
H	0·250 Max	6·35 Max	V	0·375 Max	9·53 Max
J	1·000 Max	25·40 Max	W	0·125	3·18
K	1·220 ± 0·004	30·988 ± 0·102	X	5·031 Max	127·8 Max
L	0·203 ± 0·016	5·16 ± 0·41	Y	2·500 ± 0·050	63·50 ± 1·27

Millimetre dimensions have been derived from inches.

NOTES FOR OUTLINE

1. Reference plane 'B' passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane 'A'.
2. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes 'A' and 'B'.
3. With surface 'A' resting on a flat surface plate, a feeler gauge 0·020 inch (0·51mm) thick and 0·125 inch (3·18mm) wide will not enter more than 0·125 inch (3·18mm) at any point.
4. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U.
5. Surface 'A' and interior surfaces of waveguide will be plated with 10mg/sq.in (1·55mg/sq.cm) of gold or 30mg/sq.in (4·65mg/sq.cm) of silver.
6. The axis of the heater lead protector will be within 5° of a normal to reference plane 'C'.
7. The clearance between the inside surface of the protector and the 0·375 inch (9·53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52-1952, type BA9s/14) will not be less than 0·125 inch (3·18mm).
8. The centre of this hole will lie within 0·004 inch (0·102mm) of reference plane 'C'.
9. This area is gasketed for pressurising the waveguide output as with the coupler Army-Navy designation UG-40A/U.
10. The anode temperature is measured at this point on the round anode surface between the radiator fin and pole piece.

M513B

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, electrically identical with type M513A

Frequency range	9345 to 9405	MHz
Typical peak output power	22	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2.0	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.312 inches max 133.4 x 113.5 x 84.13mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.0	8.0	kV
Anode current (peak)	5.5	8.5	A
Input power (peak)	–	64	kW
Input power (mean) (see note 3)	–	80	W
Duty cycle	–	0.0025	
Pulse length (see note 4)	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	100	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising of waveguide (see note 7)	–	45	lb/in^2
	–	3.16	kg/cm^2

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	7.5	7.5	A
Pulse length	1.0	0.1	μs
Pulse repetition rate	500	1000	p.p.s.
Rate of rise of voltage pulse	100	100	kV/μs

Typical Performance

Anode voltage (peak)	7.6	7.6	kV
Output power (peak)	22	22	kW
Output power (mean)	11	2.2	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	6.3	V
Anode current (mean)	3.75	0.375	mA
Duty cycle	0.0005	0.00005	
Pulse length (see note 4)	1.0	0.05	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	100	100	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.0	8.0	7.0	8.0	kV
Output power (mean)	9.0	–	0.75	–	W
Frequency (see note 8)	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	50	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.25	–	0.25	%
Cold impedance					see note 10
Heater current					see note 11
Temperature coefficient of frequency					see note 12

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1 and 2)

	Oscillation 1	Oscillation 2	
Anode voltage (peak)	7.0	7.0	kV min
Output power (mean)	8.0	–	W min
R.F. bandwidth at ¼ power	3.5	–	MHz max
Frequency: must be within Test Limits above, Oscillation 1			
Stability (see note 9)	2.0	–	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3 \left[1 - \frac{Pi}{180}\right] \text{volts}$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as $2\mu F$ may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above $0^\circ C$. For ambient temperatures between 0 and $-55^\circ C$ the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as steepest tangent to leading edge of voltage pulse above 80% amplitude. Any capacitance in viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. At the maximum pressure of $45 lb/in^2$ ($3.16 kg/cm^2$) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. Other frequency ranges can be supplied on request.

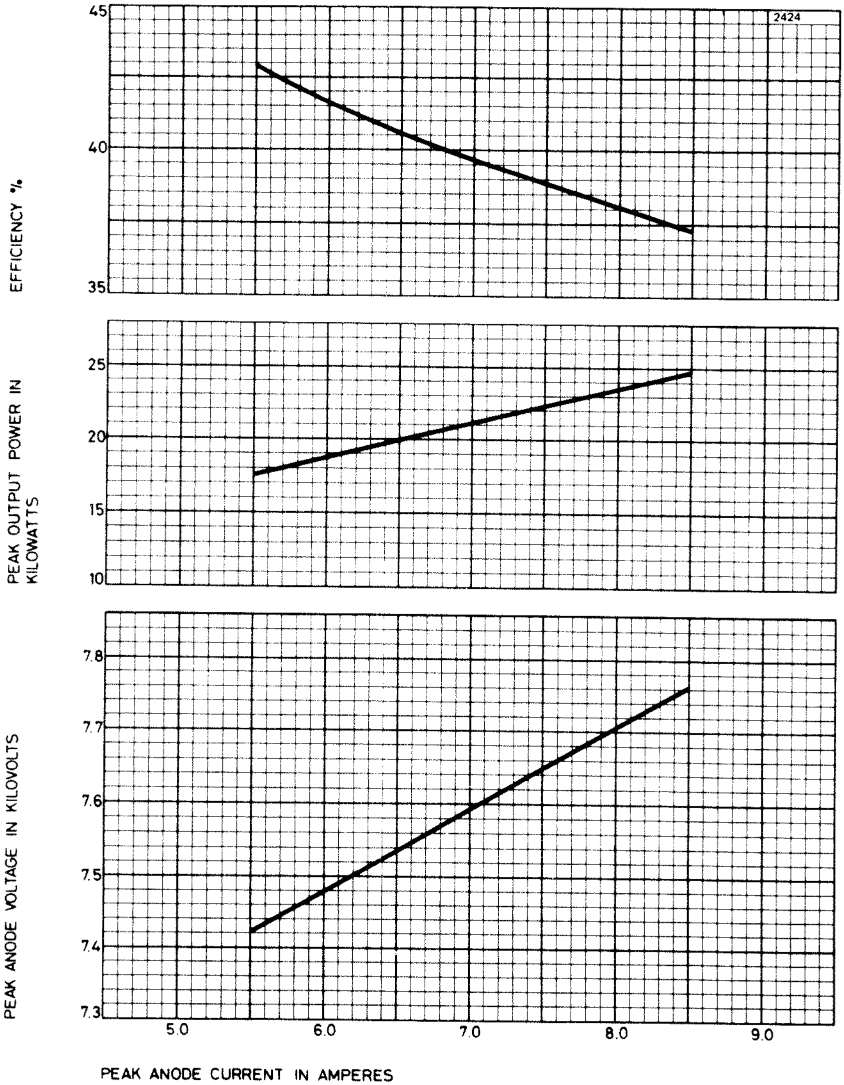
9. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

10. For the range 9345 to 9405MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

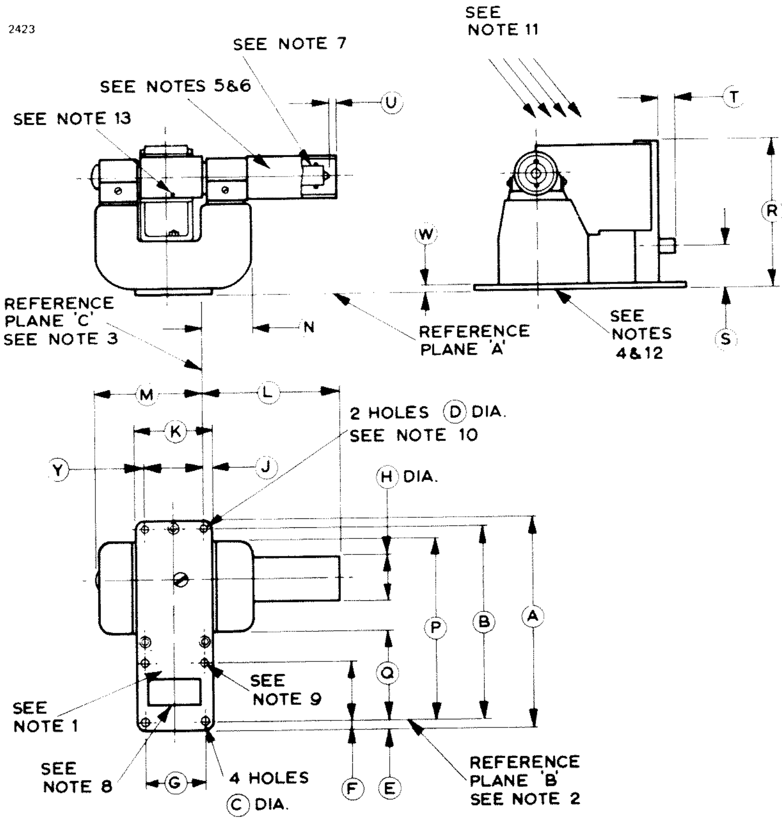
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.25 MHz/^\circ C$.

PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End Contact Shell	Heater Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	M	2.187 max	55.55 max
B	4.103 ± 0.004	104.22 ± 0.10	N	1.187 max	30.15 max
C	0.170 ± 0.003	4.328 ± 0.076	P	4.000 max	101.6 max
D	0.175 ± 0.003	4.445 ± 0.076	Q	1.811 min	46.00 min
E	0.172 ± 0.016	4.37 ± 0.41	R	3.312 max	84.13 max
F	1.280 ± 0.004	32.51 ± 0.10	S	0.875 ± 0.125	22.23 ± 3.18
G	1.220 ± 0.004	30.99 ± 0.10	T	0.375 max	9.53 max
H	1.000 max	25.40 max	U	0.125 max	3.18 max
J	0.204 ± 0.015	5.18 ± 0.38	W	0.125	3.18
K	1.625 ± 0.016	41.28 ± 0.41	Y	1.220 ± 0.004	30.99 ± 0.10
L	2.937 ± 0.125	74.60 ± 3.18			

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler Army-Navy designation UG-40A/U and is the area tested in accordance with specification MIL-E-1 Par. 4.9.13.
2. Reference plane B passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes A and B.
4. With surface A resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. The axis of the heater lead protector will be within 5° of a normal to reference plane C.
6. The heater lead protector must not be used to support any cap fitting. This protector is a detachable sleeve of a non-conducting material.

7. The clearance between the inside surface of the protector and the 0.375 inch (9.53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52 (1952) Type BA9s/14) will not be less than 0.125 inch (3.18mm).

8. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U (see note 1 on page 7).

9. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane C.

10. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.

11. Recommended direction of air flow.

12. Surface A and interior surfaces of the waveguide will be plated with $10mg/in^2$ ($1.55mg/cm^2$) of gold or $30mg/in^2$ ($4.65mg/cm^2$) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.

13. Anode temperature measured at this point.

M515

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9380 to 9440	MHz
Typical peak output power	25	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.55	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	60	s

Mechanical

Overall dimensions	4.250 x 4.468 x 3.312 inches max
	108 x 113.5 x 84.13mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.5	8.5	kV
Anode current (peak)	6.0	10	A
Input power (peak)	–	75	kW
Input power (mean) (see note 3)	–	85	W
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	120	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	8.0	8.0	A
Pulse length	1.0	0.1	μs
Pulse repetition rate	500	1000	p.p.s.
Rate of rise of voltage pulse	120	120	kV/μs

Typical Performance

Anode voltage (peak)	8.2	8.2	kV
Output power (peak)	25	25	kW
Output power (mean)	12.5	2.5	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	6.3	V
Anode current (mean)	4.0	0.8	mA
Duty cycle	0.0005	0.0001	
Pulse length (see note 4)	0.5	0.05	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	120	120	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.5	8.5	7.5	8.5	kV
Output power (mean)	10.0	–	2.0	–	W
Frequency (see note 7)	9380	9440	–	–	MHz
R.F. bandwidth at ¼ power	–	5.0	–	50	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	18	–	–	MHz
Stability (see note 8)	–	0.25	–	0.25	%
Cold impedance					see note 9
Heater current					see note 10
Temperature coefficient of frequency					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Test Conditions Oscillation 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Anode voltage (peak)	7.5 to 8.5	kV
Output power (peak)	16	kW min
R.F. bandwidth at ¼ power	7.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 8)	2.0	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 40 watts the heater voltage will need to be reduced.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and –55°C the cathode heating time is 90 seconds.

3. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. Other frequency ranges can be supplied on request.

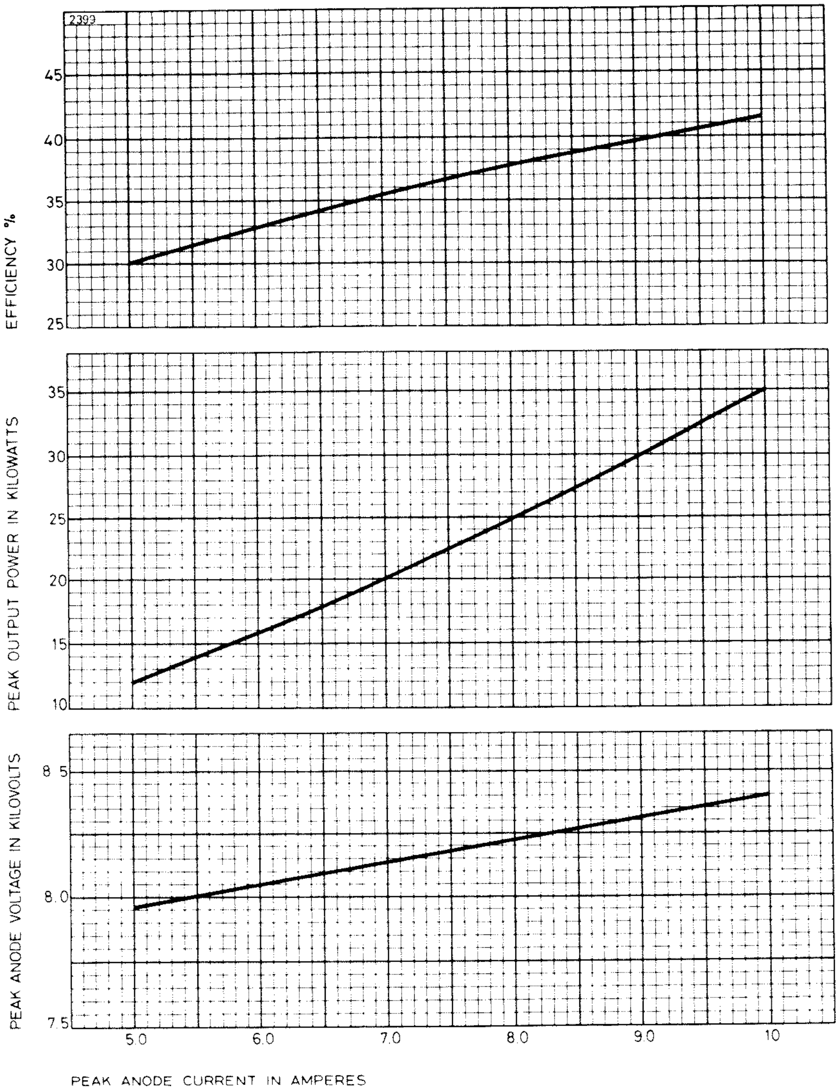
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. For the range 9380 to 9440MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

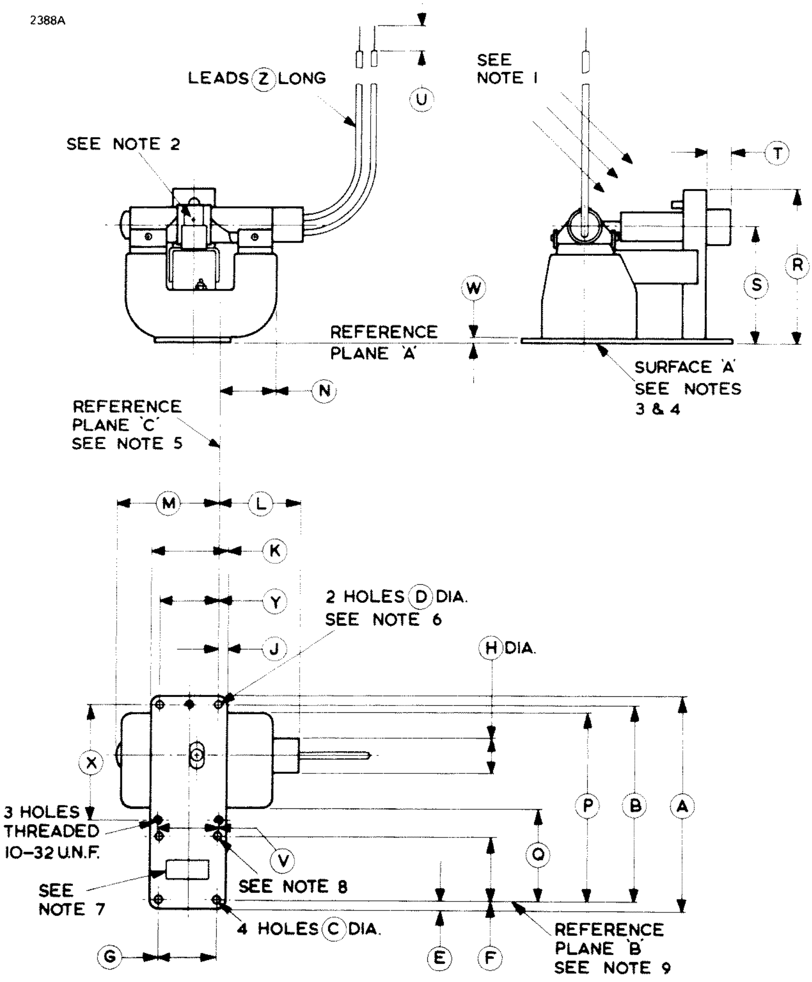
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.25MHz/°C.

PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	N	1.187 max	30.15 max
B	4.103 ± 0.004	104.22 ± 0.10	P	4.000 max	101.6 max
C	0.170 ± 0.003	4.328 ± 0.076	Q	1.811 min	46.00 min
D	0.175 ± 0.003	4.445 ± 0.076	R	3.312 max	84.13 max
E	0.172 ± 0.016	4.37 ± 0.41	S	2.500	63.50
F	1.280 ± 0.004	32.51 ± 0.10	T	0.500 max	12.70 max
G	1.220 ± 0.004	30.99 ± 0.10	U	0.500	12.70
H	1.000 max	25.40 max	V	1.250	31.75
J	0.204 ± 0.015	5.18 ± 0.38	W	0.125	3.18
K	1.625 ± 0.016	41.28 ± 0.41	X	2.393	60.78
L	2.063 max	52.40 max	Y	1.220 ± 0.004	30.99 ± 0.10
M	2.187 max	55.55 max	Z	9.750 ± 0.500	247.7 ± 12.7

Millimetre dimensions have been derived from inches.

Outline Notes

1. Recommended direction of air flow if required.
2. Anode temperature measured at this point.
3. With surface 'A' resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
4. Surface 'A' and interior surfaces of the waveguide will be plated with $10mg/in^2$ ($1.55mg/cm^2$) of gold or $30mg/in^2$ ($4.65mg/cm^2$) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.
5. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes 'A' and 'B'.
6. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.

7. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U.
8. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane 'C'.
9. Reference plane 'B' passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane 'A'.

M521

X-BAND
MAGNETRON

Service Type CV2376

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9600 to 9700	MHz
Typical peak output power	45	kW
Magnet		separate
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		forced-air

GENERAL

Electrical

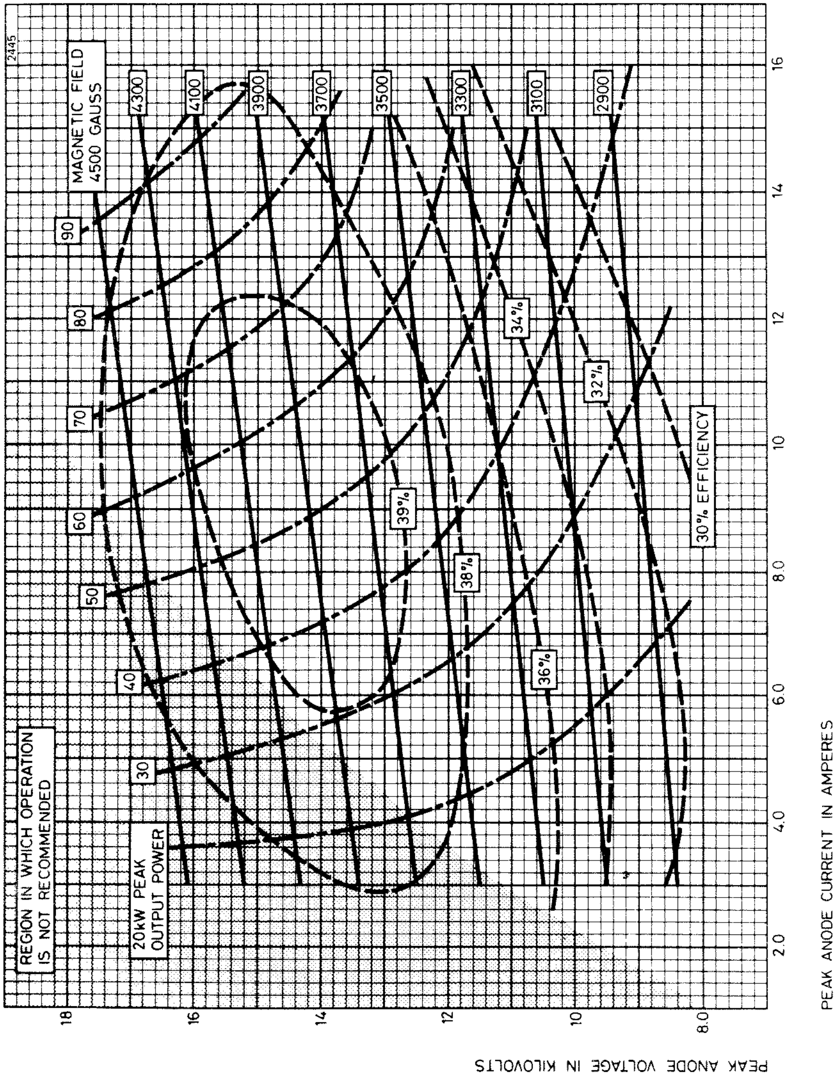
Cathode		indirectly heated
Heater voltage (see note 1)	3.0	V
Heater current at 3.0V	3.5	A
Cathode heating time (minimum)	2.0	min

Mechanical

Overall dimensions	6.390 x 6.170 x 4.263 inches max
	162.3 x 156.7 x 108.3mm max
Net weight	1¾ pounds (0.8kg) approx
Mounting position	any

Cooling (see note 5) forced-air

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	2.7	3.3	V
Anode voltage (peak)	10	16	kV
Anode current (peak)	–	12	A
Input power (peak)	–	150	kW
Input power (mean) (see note 2)	–	150	W
Duty cycle	–	0.001	
Pulse length (see note 3)	–	2.0	μs
Rate of rise of voltage pulse (see note 4)	–	150	kV/μs
Anode temperature (see note 5)	–	140	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	1.5	V
Magnetic field (see note 6)	3250	gauss
Anode current (peak)	12	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	11.1	kV
Output power (peak)	45	kW
Output power (mean)	45	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
Magnetic field (see note 6)	3250	3250	3800	gauss
Heater voltage (for test)	1.5	1.5	1.5	V
Anode current (mean)	12	6.0	12	mA
Duty cycle	0.001	0.0005	0.001	
Pulse length (see note 3)	1.0	1.0	2.0	μs
V.S.W.R. at the output coupler	1.05:1	1.5:1	1.5:1	
Rate of rise of voltage pulse (see note 4)	150	150	150	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	10.5	12.5	–	–	–	–	kV
Output power (mean)	35	–	–	–	–	–	W
Frequency (see note 7)	9600	9700	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see note 8)	–	–	–	3.0	–	–	MHz
Frequency pulling	–	–	–	15	–	–	MHz
Missing pulse count (see note 9)	–	–	–	0.25	–	0.5	%
Cold impedance						see note 10	
Mode change						see note 11	
Heater current						see note 12	
Temperature coefficient of frequency						see note 13	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 3 conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	28	W min
R.F. bandwidth at ¼ power (Oscillation 2)	3.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		

NOTES

1. With no anode input power.

   On the application of anode power, the heater voltage must be reduced in accordance with the following schedule.

Mean input power (W)	Heater voltage (V)
up to 40	3.0
40 to 110	2.0
110 to 150	1.5

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The various parameters are related by the following formula:

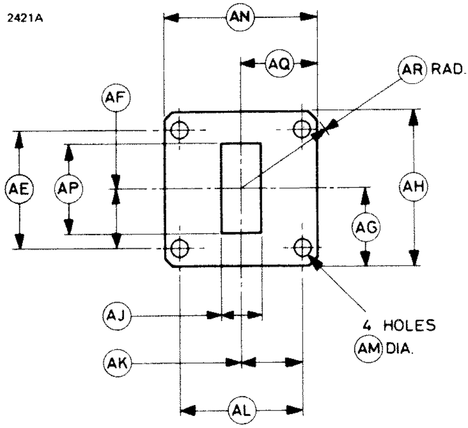
   $$P_i = i_{apk} \times v_{apk} \times D_u$$

   where P_i = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and D_u = duty cycle.

3. Tolerance $\pm$10%.
4. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.
5. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode fins.
6. Tolerance $\pm$50 gauss. The north pole of the magnet must be adjacent to the cathode terminal.
7. At anode temperature 25°C.
8. The maximum bandwidth in MHz is given by 3.0/(pulse length in μs).
9. The mismatch is varied through all phases during a 30 second period while the count is taken. Missing pulses are expressed as a percentage of the number of input pulses applied during this 30 second period. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range.
10. When a signal of the same frequency as the valve operating frequency is fed into the valve, a standing wave is produced in the feeder system. The v.s.w.r. is tested to be greater than 6:1 and its phase such that a position of standing wave minimum is within 3mm of either side of the flange.

11. Over the range 8 to 14mA, no pulses shall be missing when viewed with a spectrum analyser, nor double traces of voltage or current observed on the oscilloscope.
12. Measured with heater voltage of 3.0V and no anode input power, the heater current limits are 3.0A minimum, 4.0A maximum.
13. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.25MHz/^{\circ}C$.

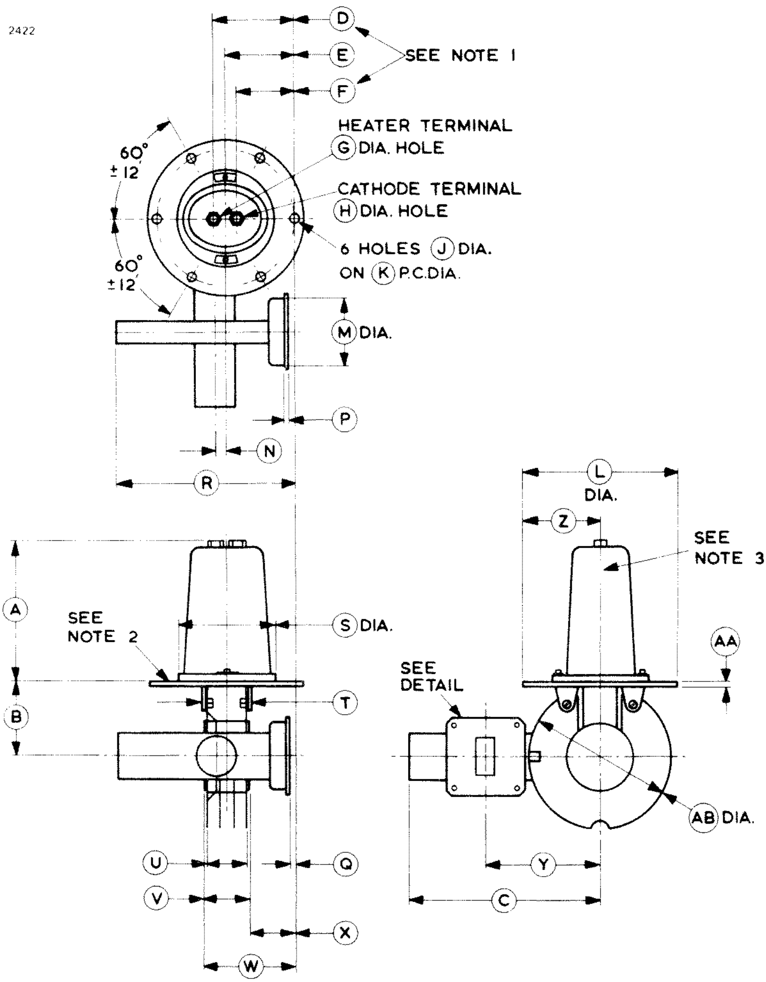
Output Flange



Ref	Inches	Millimetres
AE	1.220	30.99
AF	0.610	15.49
AG	0.812 ± 0.015	20.62 ± 0.38
AH	1.625 ± 0.015	41.28 ± 0.38
AJ	0.400	10.16
AK	0.640	16.26
AL	1.280	32.51
AM	0.1695	4.305
AN	1.625 ± 0.015	41.28 ± 0.38
AP	0.900	22.86
AQ	0.812 ± 0.015	20.62 ± 0.38
AR	1.062	26.97

Millimetre dimensions have been derived from inches.

OUTLINE (See page 8 for outline dimensions and notes)



Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.984 ± 0.062	75.79 ± 1.57	Q	0.437 ± 0.020	11.10 ± 0.51
B	1.562 ± 0.020	39.67 ± 0.51	R	4.062 max	103.2 max
C	4.750 max	120.7 max	S	2.218 max	56.34 max
D	1.687	42.85	T	1.107 max	28.12 max
E	1.437	36.50	U	$0.8070 \begin{array}{l}+0.0050 \\ -0.0045\end{array}$	$20.498 \begin{array}{l}+0.127 \\ -0.114\end{array}$
F	1.187	30.15			
G	0.169 ± 0.005	4.29 ± 0.13	V	0.974 max	24.74 max
H	0.169 ± 0.005	4.29 ± 0.13	W	1.938 max	49.23 max
J	0.193 ± 0.003	4.902 ± 0.076	X	0.812 min	20.62 min
K	2.875 ± 0.006	73.03 ± 0.15	Y	2.437 ± 0.020	61.90 ± 0.51
L	3.250 ± 0.031	82.55 ± 0.79	Z	1.625	41.28
M	1.422 ± 0.015	36.12 ± 0.38	AA	0.125	3.18
N	0.219	5.56	AB	3.062 max	77.77 max
P	0.110 ± 0.005	2.79 ± 0.13			

Millimetre dimensions have been derived from inches.

Outline Notes

1. The jack holes will be within a radius of 0.023 inch (0.58mm) of the location specified, but will be spaced 0.500 ± 0.010 inch (12.70 ± 0.25mm) with respect to each other.
2. With the flange resting on a plane surface, the flatness of the mounting plate 0.500 inch (12.70mm) from the outer edge will be such that a feeler gauge 0.010 inch (0.25mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The common cathode connection is indicated by a letter 'C' on this surface.

M523

X-BAND MAGNETRON

Service Type CV2412

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J50A

Frequency range	9580 to 9705	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	13.5	A max
Cathode heating time (minimum)	4	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max				
Heater voltage (see note 1)	–	14				V
Heater starting current (peak)	–	13.5				A
Anode voltage (peak)	20	23				kV
Anode current (peak) (see note 2)	–	27.5	18.0	14.5	9.5	A
Input power (peak) (see note 2)	–	635	380	320	190	kW
Input power (mean) (see notes 2 and 3)	–	635	380	635	380	W
Duty cycle (see note 2)	–	0.001	0.001	0.002	0.002	
Pulse length (see notes 2 and 4)	–	0.3 to 1.2	6.0	0.3 to 1.2	6.0	μs
Operation time in any 100μs interval	–	6				μs
Rate of rise of voltage pulse (see note 5)	70	110				kV/μs
Anode temperature (see note 6)	–	150				°C
Cathode terminal temperature	–	165				°C
V.S.W.R. at the output coupler	–	1.5:1				
Pressurising (see note 7):						
input	–	45				lb/in^2
output	–	45				lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
Heater voltage (for test)	6.6	9.1	7.7	V
Anode current (mean)	27.5	18	23.5	mA
Duty cycle	0.001	0.001	0.001	
Pulse length (see note 8)	1.0	5.5	3.0	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	110	110	110	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	–	–	kV
Output power (mean)	225	–	140	–	185	–	W
Frequency (see note 9)	9580	9705	–	–	–	–	MHz
R.F. bandwidth at ¼ power	–	3.0	–	1.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	–	–	MHz
Stability: arc count (see note 10)	–	0.25	–	0.25	–	0.25	%
Heater current						see note 11	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 3 conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 3)

Output power (mean)	140	W min
R.F. bandwidth at ¼ power	1.5	MHz max
Frequency: must be within Test Limits above, Oscillation 3		
Stability: arc count (see note 10)	0.5	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $V_h = 14 - 0.0125\,Pi$

   and for input powers above 595 watts,

   $V_h = 24 - 0.0293\,Pi,$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse lengths between 1.2 and 6.0μs, the maximum values of peak input power, mean input power and peak anode current are to be determined by linear interpolation. For values of duty cycle between 0.001 and 0.002, the maximum values of peak and mean input power are to be determined by linear interpolation.

   For values of duty cycle less than 0.001, the value of the peak or mean input power shall not exceed the rating determined at 0.001 duty cycle for the applicable value of pulse length.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. The product of pulse length in seconds and pulse rate in Hz must not exceed 0.002 at maximum input power.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. An air flow of 80ft^3/min (2.3m^3/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches (108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

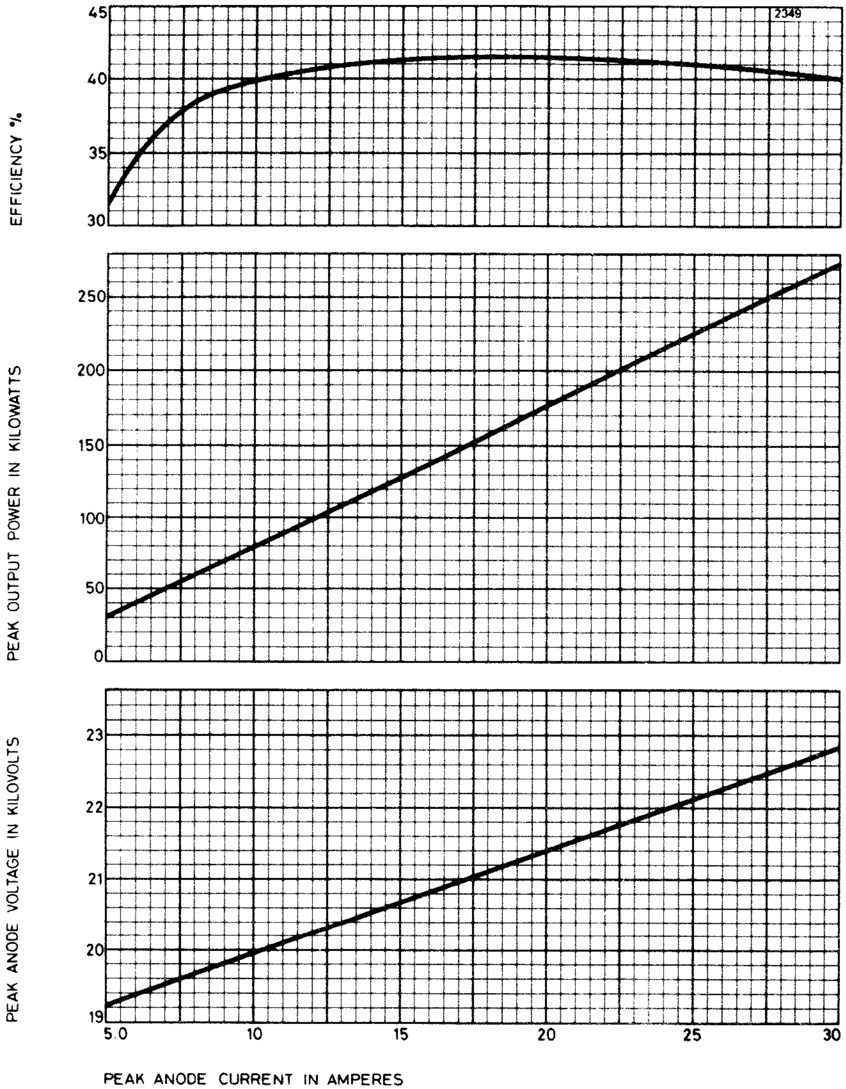
8. Tolerance ±10%.

9. At anode temperature of 100°C.

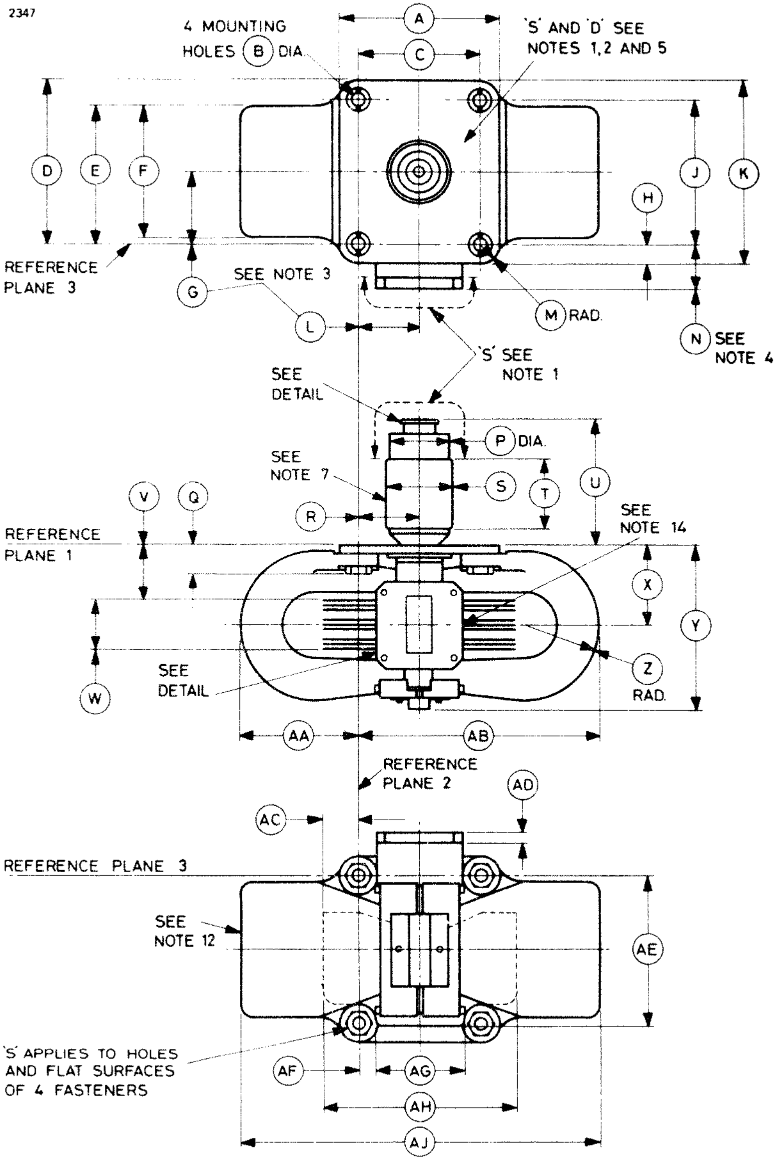
10. With the valve operating into a v.s.w.r. of 1.5:1 adjusted in phase to produce maximum instability. The valve is considered stable when it shows less than the maximum allowable percentage of arcs during the last five minute interval of a test period of fifteen minutes. The percentage of arcs is defined as the number of arcs in the five minute interval divided by the total number of magnetron pulses during that interval. Arcs are recorded by an electronic counter which is adjusted to respond to 10% above operating peak current.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

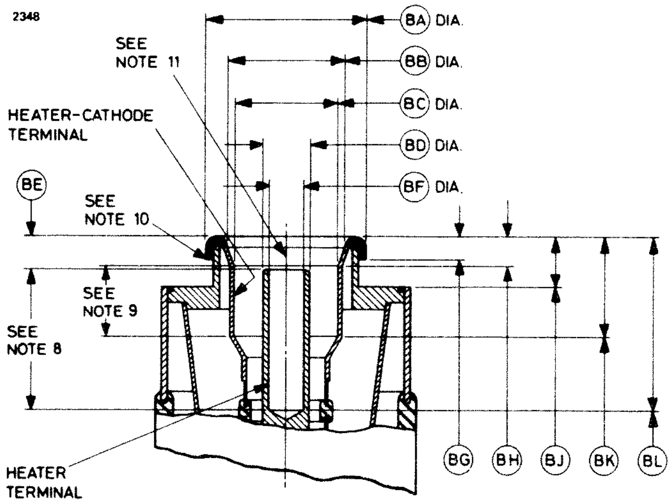


OUTLINE (See page 10 for Outline Notes)

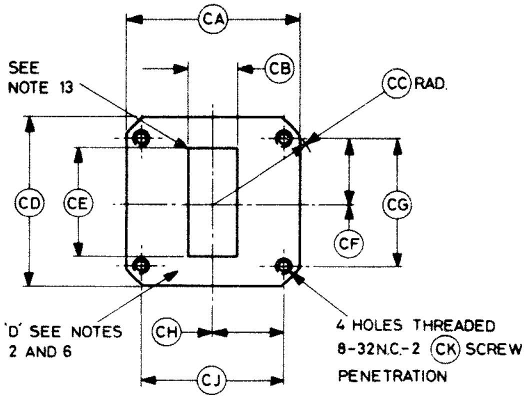


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.468 max	88.09 max	AE	3.125 max	79.38 max
B	0.281 ± 0.005	7.14 ± 0.13	AF	0.312	7.92
C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M529

X-BAND MAGNETRON

Service Type CV2426

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J50A

Frequency range	8830 to 8995	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	60	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	8830	8995	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $$V_h = 14 - 0.0125\,Pi$$

   and for input powers above 595 watts,

   $$V_h = 24 - 0.0293\,Pi,$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $$i_{apk} = 29.6 - 1.934t_p$$

   where i_{apk} = peak anode current in amperes

   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

Pulse length (μs)	Rate of rise of voltage (kV/μs) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of 80ft³/min (2.3m³/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

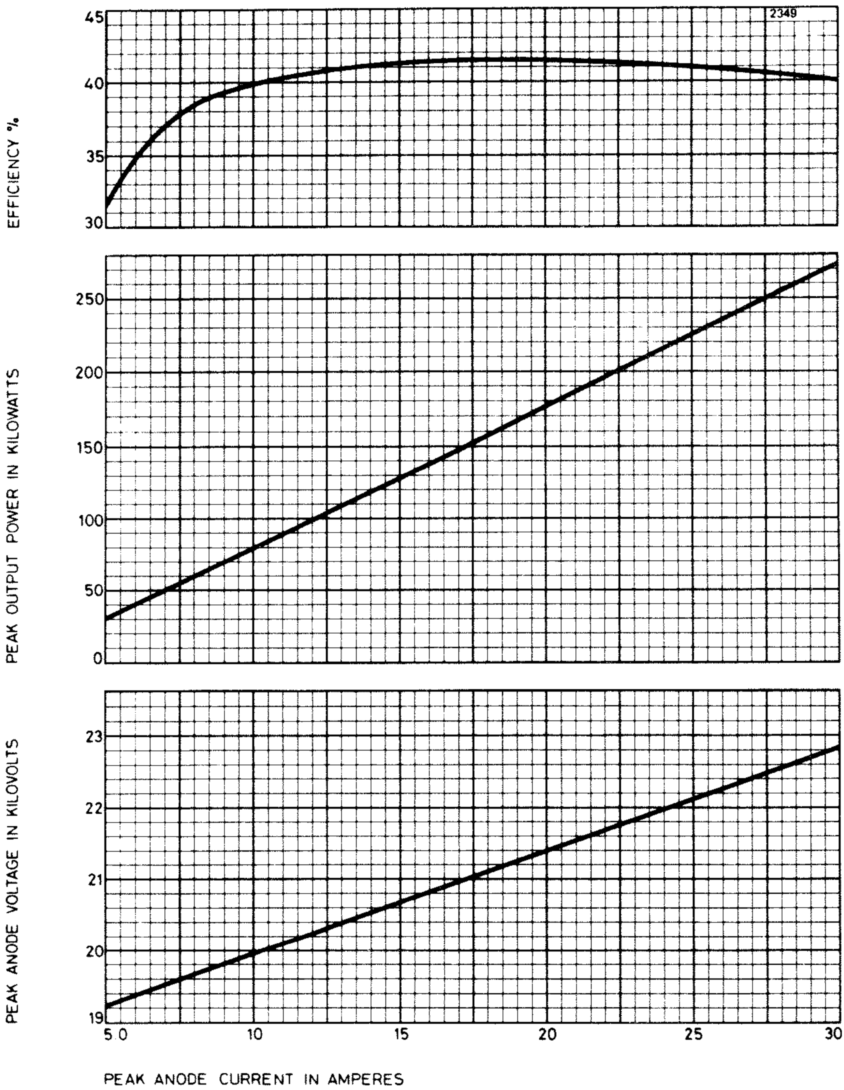
8. At anode temperature of 100°C.

9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).

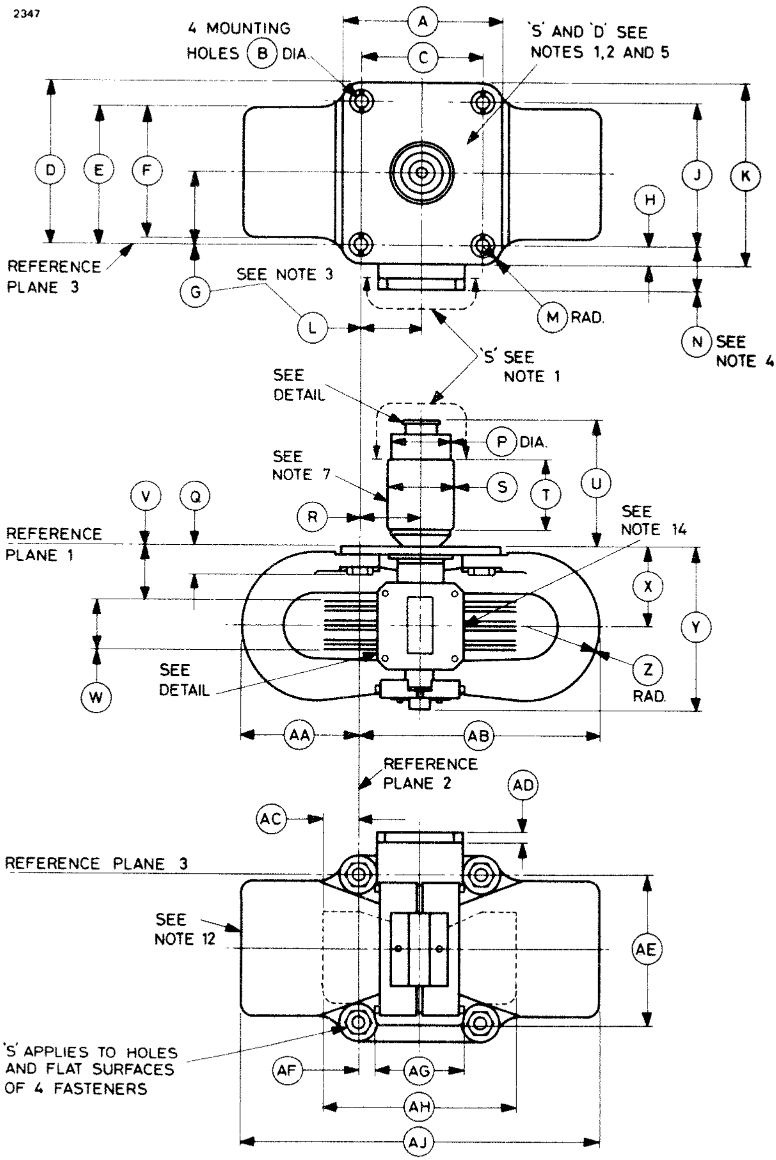
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 8800 to 9025MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

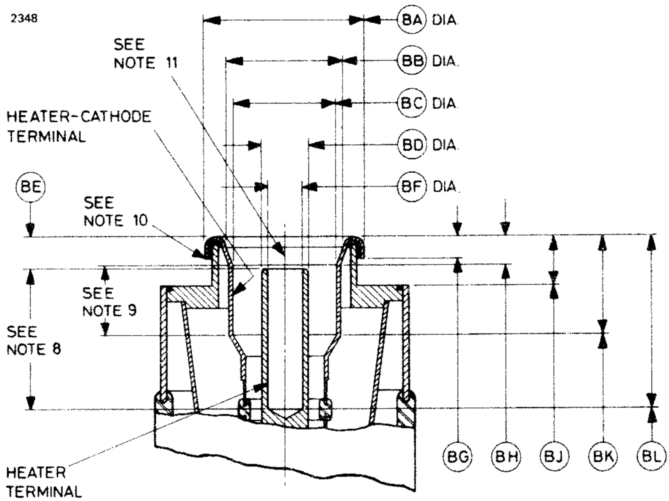


OUTLINE (See page 10 for Outline Notes)

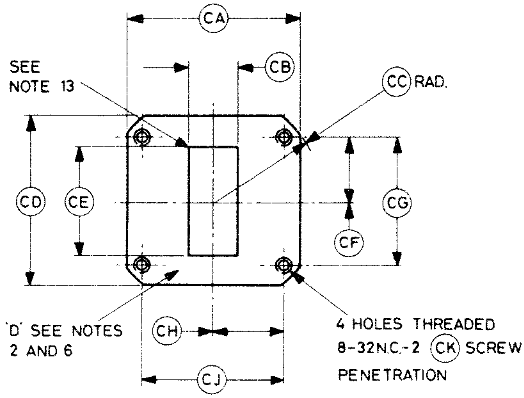


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.468 max	88.09 max	AE	3.125 max	79.38 max
B	0.281 ± 0.005	7.14 ± 0.13	AF	0.312	7.92
C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M537A

X-BAND MAGNETRON

Service Type CV6108

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	8770 to 8830	MHz
Typical peak output power	9.0	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		forced-air

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	5.375 x 4.468 x 3.562 inches max
	136.5 x 113.5 x 90.47mm max
Net weight	3.25 pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling

forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage	5.7	7.0	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	–	6.0	kV
Anode current (peak)	3.5	5.5	A
Input power (peak)	–	33	kW
Input power (mean) (see note 3)	–	82.5	W
Duty cycle (see note 4)	–	0.0025	
Pulse length (see notes 4 and 5)	–	2.5	μs
Rate of rise of voltage pulse (at 4.5A peak anode current) (see note 6)	–	75	kV/μs
Anode temperature (see note 7)	–	140	°C
V.S.W.R. at the output coupler	–	1.5:1	
Altitude	–	10 000	ft
	–	3.05	km

TYPICAL OPERATION

Operational Conditions

Heater voltage	5.4	V
Anode current (peak)	4.5	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	5.5	kV
Output power (peak)	9.0	kW
Output power (mean)	9.0	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	4.5	6.3	V
Anode current (mean)	9.0	4.5	mA
Duty cycle	0.002	0.001	
Pulse length (see note 5)	1.0	2.0	μs
V.S.W.R. at the output coupler (maximum)	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 6)	75	75	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	5.3	5.7	–	–	kV
Output power (mean)	16	–	–	–	W
Frequency (see note 8)	8770	8830	–	–	MHz
R.F. bandwidth (see note 9)	–	2.5	–	1.25	MHz
Frequency pulling (see note 10)	–	15	–	–	MHz
Stability (see note 11)	–	0.25	–	0.25	%
Cold impedance					see note 12
Heater current					see note 13
Temperature coefficient of frequency					see note 14

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 2 Test Conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillations 1 and 2)

	Oscillation 1	Oscillation 2	
Output power (mean)	12.5	–	W min
R.F. bandwidth at ¼ power (anode current 7.5mA mean)	3.0	–	MHz max
Frequency: must be within Test Limits above, Oscillation 1			
Stability	–	1.0	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \pm 0.6 \text{ volts}$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. These ratings apply only for equally spaced pulses.

5. Tolerance ±10%.

6. Defined as the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

7. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

8. With anode temperature 40°C ± 10°C measured at the point indicated on the outline drawing.

9. The bandwidth is measured at ¼ power points. The side lobes will be at least 6db down.

10. Measured with a v.s.w.r. greater than 1.5:1 in all phases of the mis-

match. Frequency pulling is the maximum variation in frequency as the mismatch is varied through all phases.

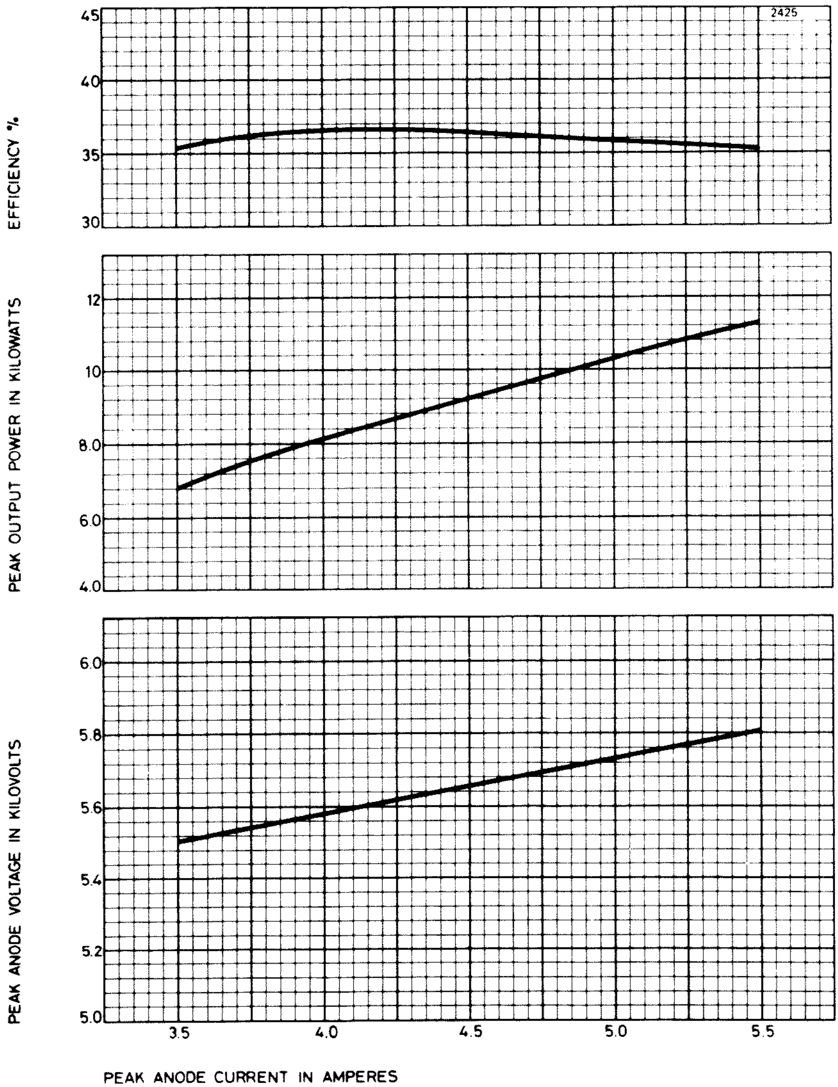
11. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 8770–8830MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any consecutive 5 minute interval of a 15 minute test period.

12. When a signal of the same frequency as the magnetron operating frequency is fed into the valve, a standing wave is produced in the feeder system. The v.s.w.r. is tested to be greater than 8:1.

13. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

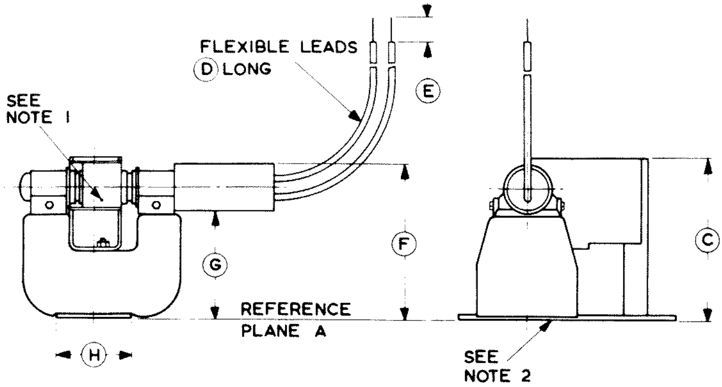
14. Design test only. The maximum frequency change with anode temperature change (after warm-up) is −0.25MHz/°C.

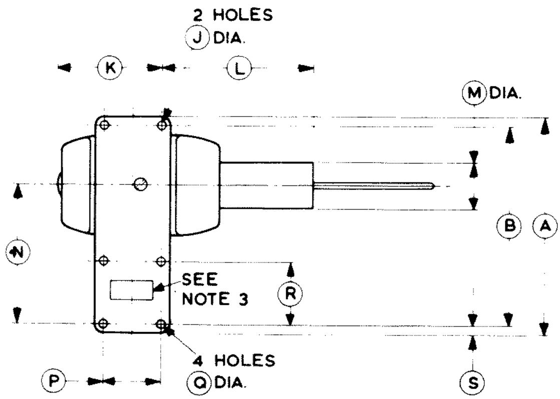
PERFORMANCE CHART



OUTLINE

2427





Lead Connections

Colour	Element
Yellow	Heater
Green	Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres
A	4.468 max	113.5 max
B	4.103 ± 0.004	104.216 ± 0.102
C	3.562 max	90.47 max
D	6.000 min	152.4 min
E	0.500	12.70
F	3.325 max	84.46 max
G	2.225 min	56.52 min
H	1.640 max	41.66 max
J	0.175 ± 0.003	4.445 ± 0.076
K	2.390 max	60.71 max
L	3.187 max	80.95 max
M	1.250 max	31.75 max
N	2.937 ± 0.250	74.60 ± 6.35
P	1.220 ± 0.004	30.988 ± 0.102
Q	0.170 ± 0.003	4.318 ± 0.076
R	1.280 ± 0.004	32.512 ± 0.102
S	0.187 max	4.75 max

Millimetre dimensions have been derived from inches.

Outline Notes

1. Anode temperature to be measured at this point.
2. The flatness of the mounting plate will be such that with the valve resting on a plane surface a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
3. The position of the waveguide and fixing holes will be such that the magnetron operates into coupler type UG-40A/U.

M538A

X-BAND MAGNETRON

Service Type CV2473

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9210 to 9270	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling (see note 6) forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	70	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	9210	9270	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6.0	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2.0	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $$V_h = 14 - 0.0125\,Pi$$

   and for input powers above 595 watts,

   $$V_h = 24 - 0.0293\,Pi,$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $$i_{apk} = 29.6 - 1.934t_p$$

   where i_{apk} = peak anode current in amperes
   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance $\pm$10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

Pulse length (μs)	Rate of rise of voltage (kV/μs) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of 80ft^3/min (2.3m^3/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

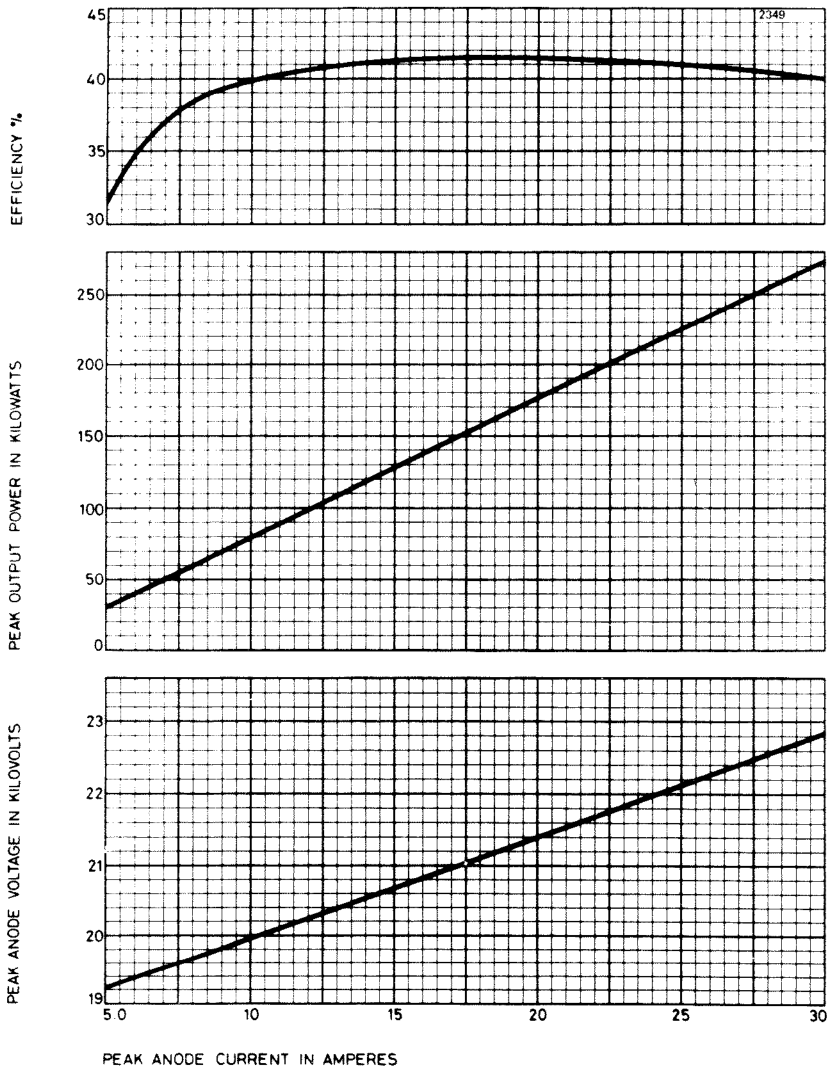
8. At anode temperature of 100°C.

9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).

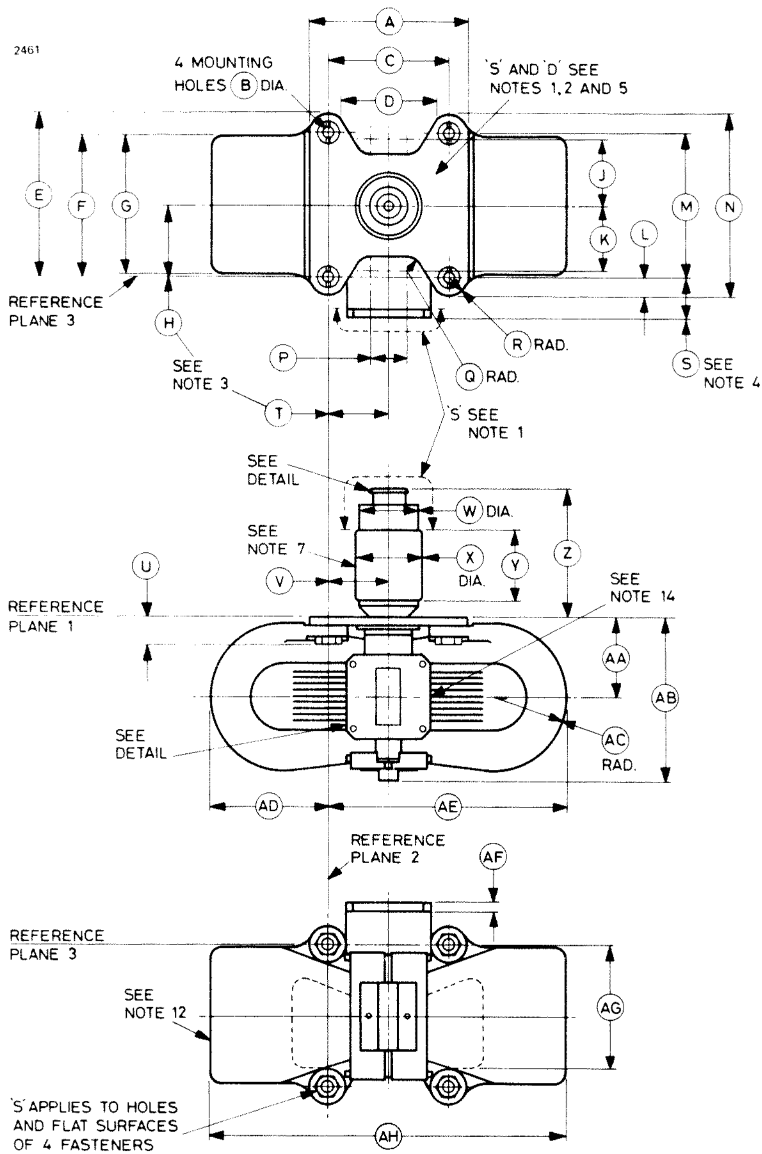
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9210 to 9270MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

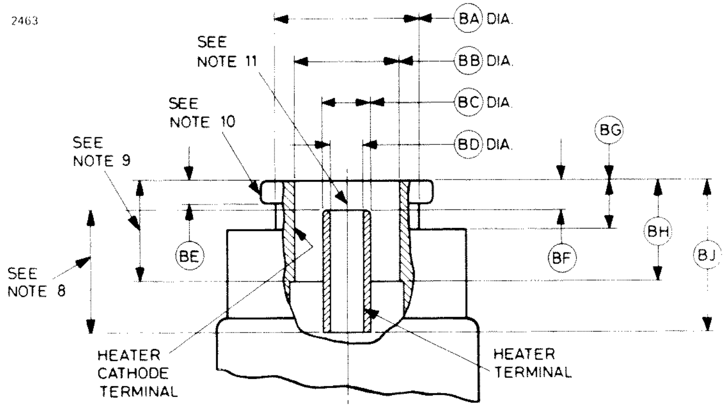


OUTLINE (See page 10 for Outline Notes)

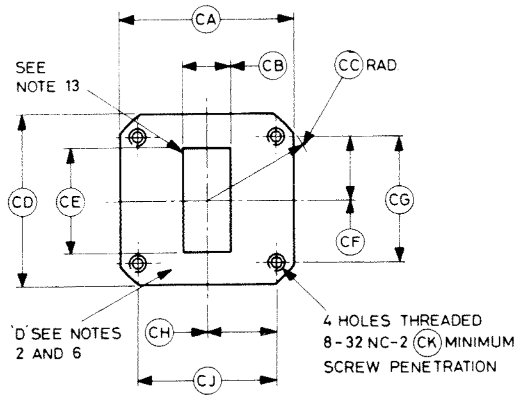


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.312 ± 0.010	84.12 ± 0.25	AC	1.562	39.67
B	0.281 ± 0.005	7.14 ± 0.13	AD	2.593 max	65.86 max
C	2.500 ± 0.010	63.50 ± 0.25	AE	5.093 max	129.4 max
D	2.050 ± 0.015	52.07 ± 0.38	AF	0.250	6.35
E	3.421 max	86.89 max	AG	2.700 max	68.58 max
F	3.000 max	76.20 max	AH	7.687 max	195.2 max
G	2.875 max	73.02 max	BA	0.750	19.05
H	1.500	38.10	BB	0.593 ± 0.007	15.06 ± 0.18
J	1.387 ± 0.005	35.23 ± 0.13	BC	0.250 ± 0.016	6.35 ± 0.41
K	1.387 ± 0.005	35.23 ± 0.13	BD	0.169 ± 0.005	4.29 ± 0.13
L	0.421 max	10.61 max	BE	0.125 ± 0.010	3.18 ± 0.25
M	3.000 ± 0.010	76.20 ± 0.25	BF	0.156 ± 0.031	3.96 ± 0.79
N	3.812 ± 0.010	96.82 ± 0.25	BG	0.250	6.35
P	0.775 ± 0.005	19.69 ± 0.13	BH	0.516 min	13.11 min
Q	0.300 ± 0.005	7.62 ± 0.13	BJ	0.750 min	19.05 min
R	0.406	10.31	CA	1.830	46.48
S	0.907 ± 0.025	23.04 ± 0.64	CB	0.497	12.62
T	1.250	31.75	CC	1.156	29.36
U	0.625 ± 0.031	15.87 ± 0.79	CD	1.830	46.48
V	1.250	31.75	CE	1.122	28.50
W	1.250	31.75	CF	0.676 ± 0.005	17.17 ± 0.13
X	1.375 max	34.93 max	CG	1.352 ± 0.004	34.341 ± 0.102
Y	1.657 ± 0.062	42.09 ± 1.57	CH	0.737 ± 0.005	18.72 ± 0.13
Z	2.687 ± 0.062	68.25 ± 1.57	CJ	1.474 ± 0.004	37.440 ± 0.102
AA	1.653 ± 0.020	41.99 ± 0.51	CK	0.250	6.35
AB	3.406 max	86.51 max			

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BD.
9. These dimensions define the extremities of the cylindrical section given by the dimension BB.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M539

X-BAND MAGNETRON

Service Type CV2425

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J50A

Frequency range	8665 to 8830	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	70	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	8665	8830	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $V_h = 14 - 0.0125\,Pi$

   and for input powers above 595 watts,

   $V_h = 24 - 0.0293\,Pi$,

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $i_{apk} = 29.6 - 1.934t_p$

   where i_{apk} = peak anode current in amperes

   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

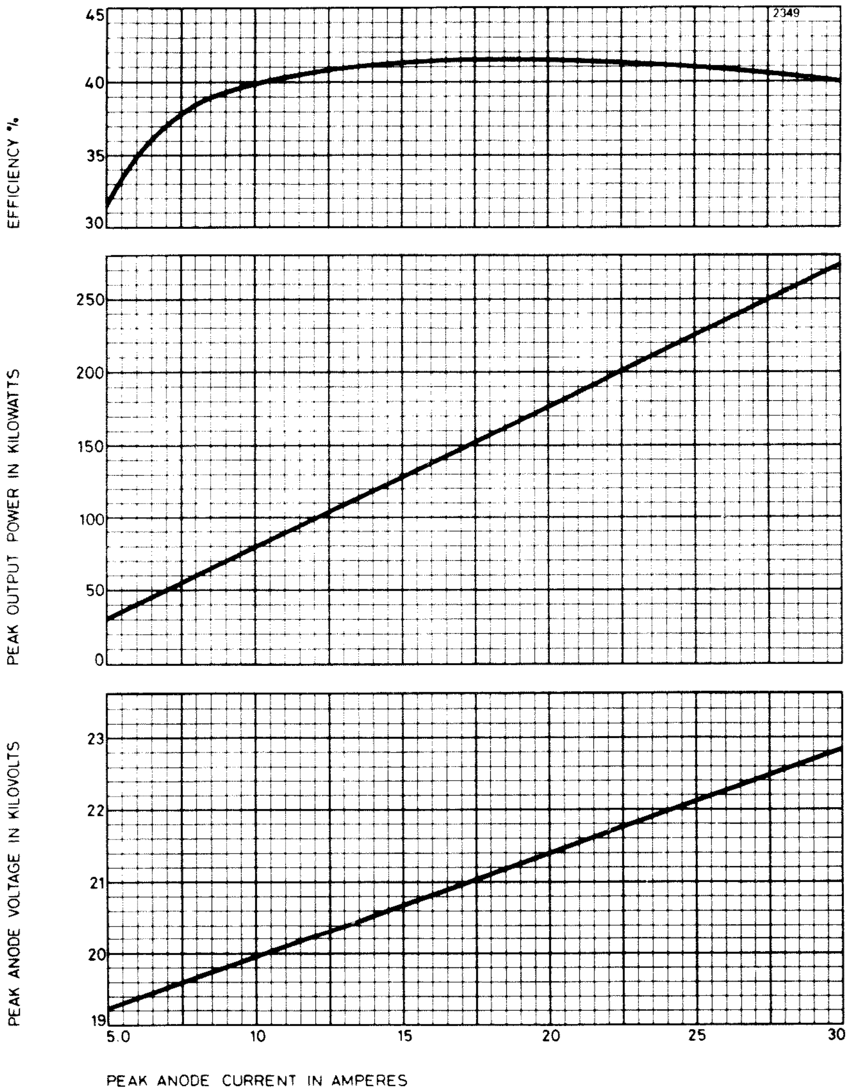
Pulse length (μs)	Rate of rise of voltage (kV/μs) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of 80ft³/min (2.3m³/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

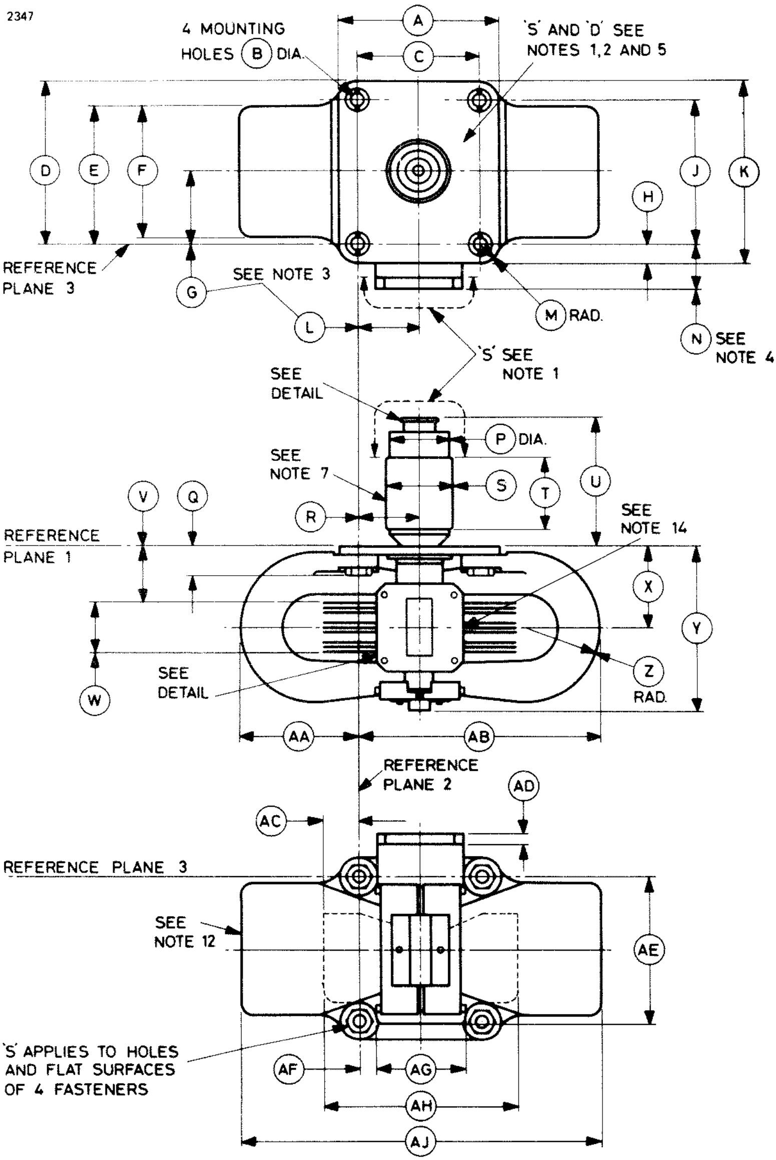
(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.
8. At anode temperature of 100°C.
9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 8635 to 8860MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.
11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

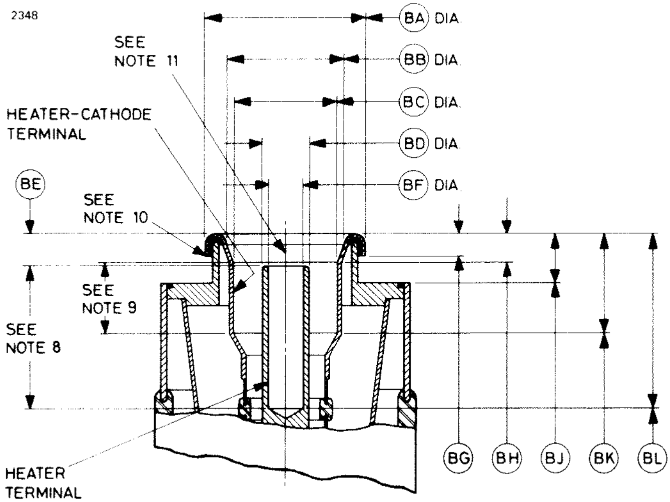


OUTLINE (See page 10 for Outline Notes)

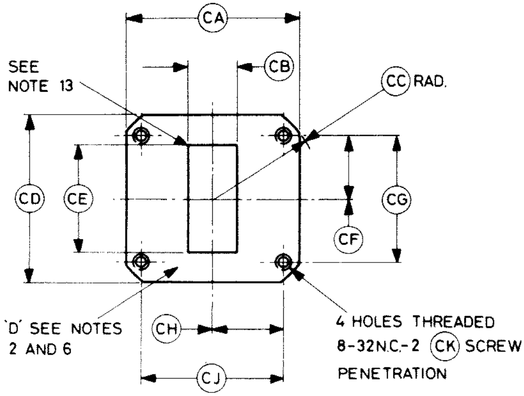


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.468 max	88.09 max	AE	3.125 max	79.38 max
B	0.281 ± 0.005	7.14 ± 0.13	AF	0.312	7.92
C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M546

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J50A

Frequency range	9700 to 9850	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max
	195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	60	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	9700	9850	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 11)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $$V_h = 14 - 0.0125\,Pi$$

   and for input powers above 595 watts,

   $$V_h = 24 - 0.0293\,Pi,$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $$i_{apk} = 29.6 - 1.934t_p$$

   where i_{apk} = peak anode current in amperes

   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance $\pm$10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

Pulse length (μs)	Rate of rise of voltage (kV/μs) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of 80ft^3/min (2.3m^3/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

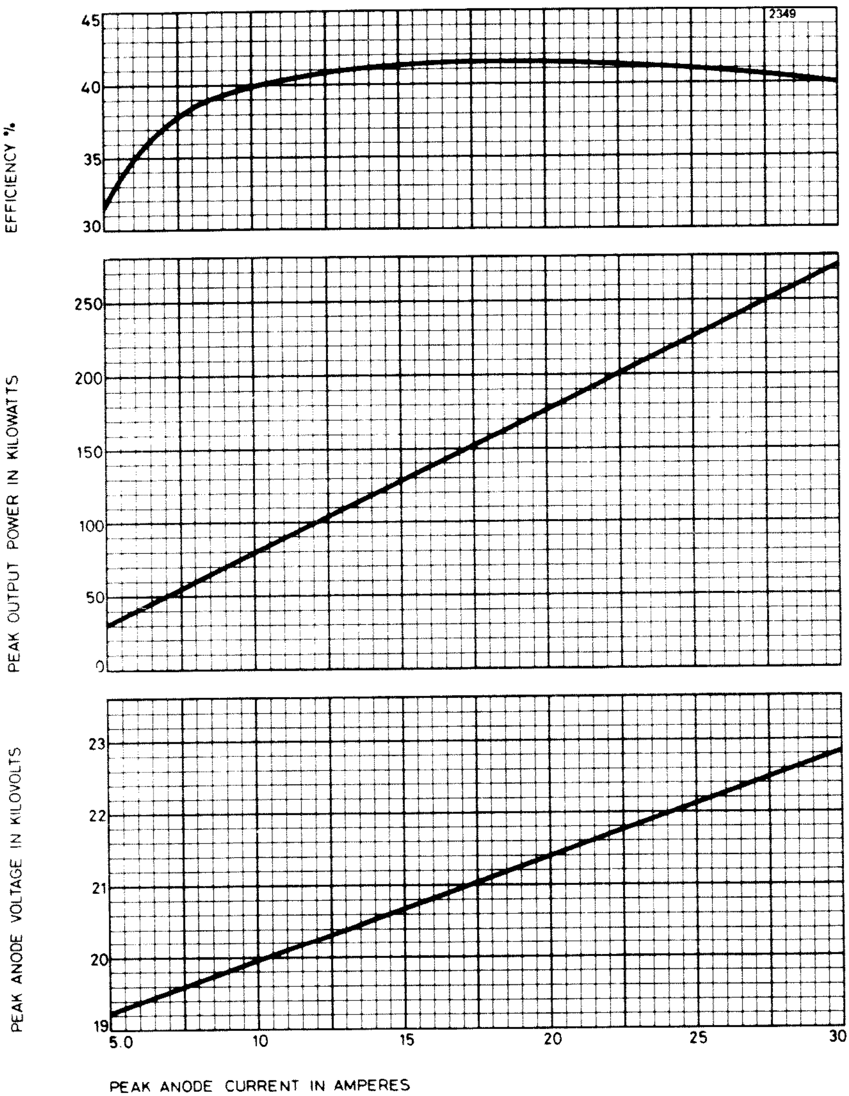
8. At anode temperature of 100°C.

9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).

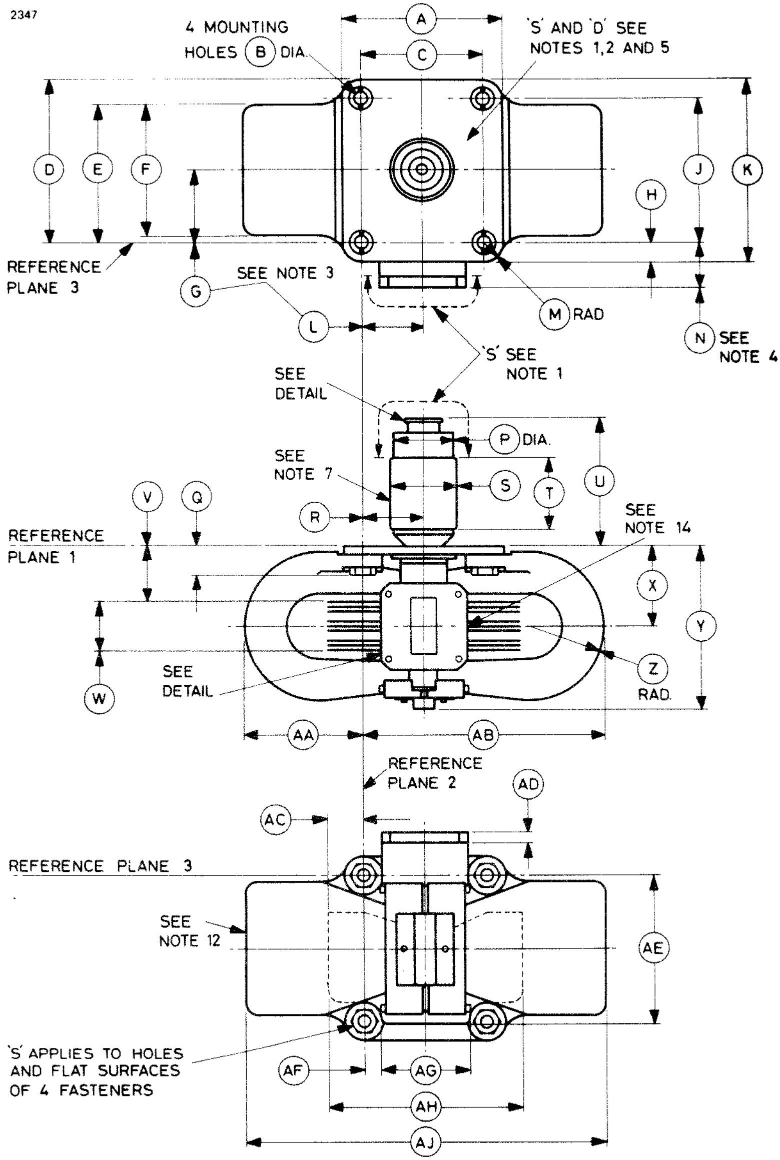
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9700 to 9850MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

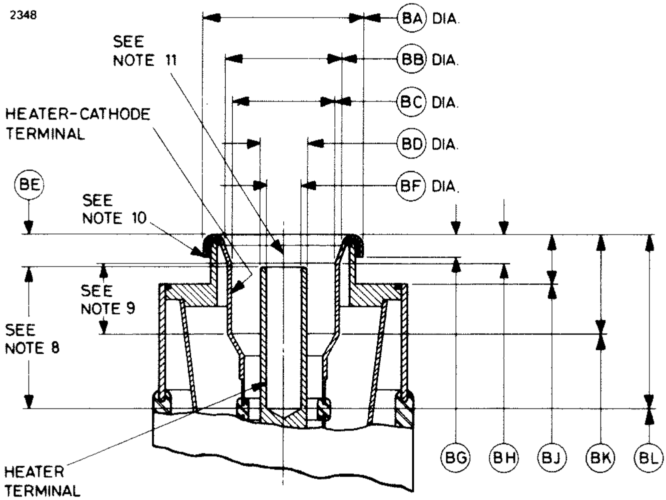


OUTLINE (See page 10 for Outline Notes)

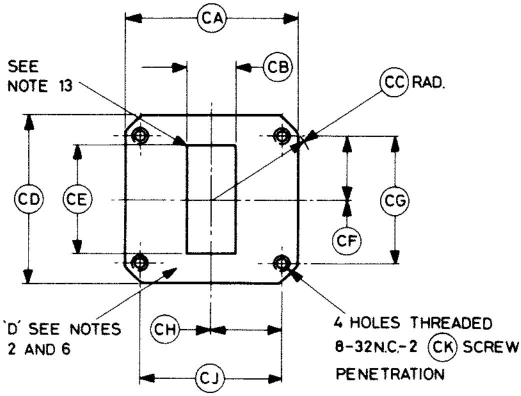


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.468 max	88.09 max	AE	3.125 max	79.38 max
B	0.281 ± 0.005	7.14 ± 0.13	AF	0.312	7.92
C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	9850	10 000	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2	% max

M547

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J50A

Frequency range	9850 to 10 000	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	60	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	9850	10 000	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $$V_h = 14 - 0.0125\,Pi$$

   and for input powers above 595 watts,

   $$V_h = 24 - 0.0293\,Pi,$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as $2\mu F$ may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above $1.2\mu s$ the maximum design peak anode current must be reduced in accordance with the following formula:

   $$i_{apk} = 29.6 - 1.934 t_p$$

   where i_{apk} = peak anode current in amperes
   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance $\pm 10\%$.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

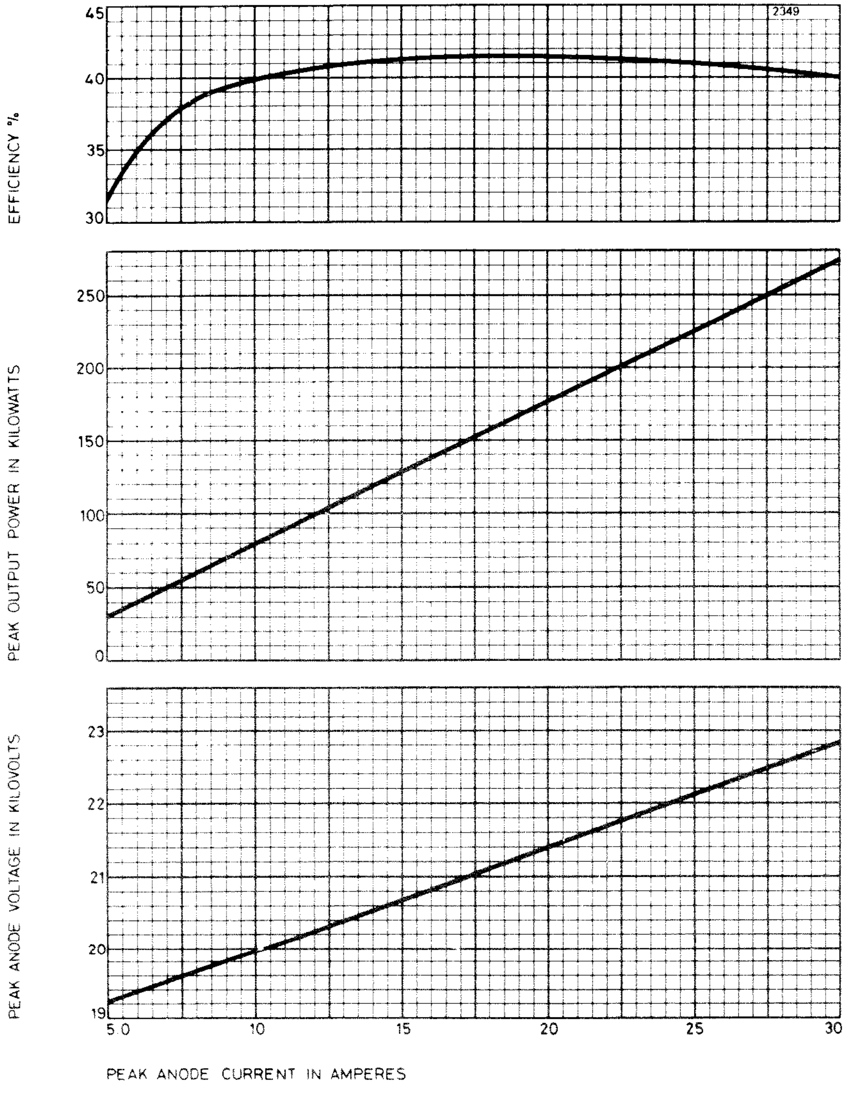
Pulse length (μs)	Rate of rise of voltage ($kV/\mu s$) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of $80 ft^3/min$ ($2.3 m^3/min$) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

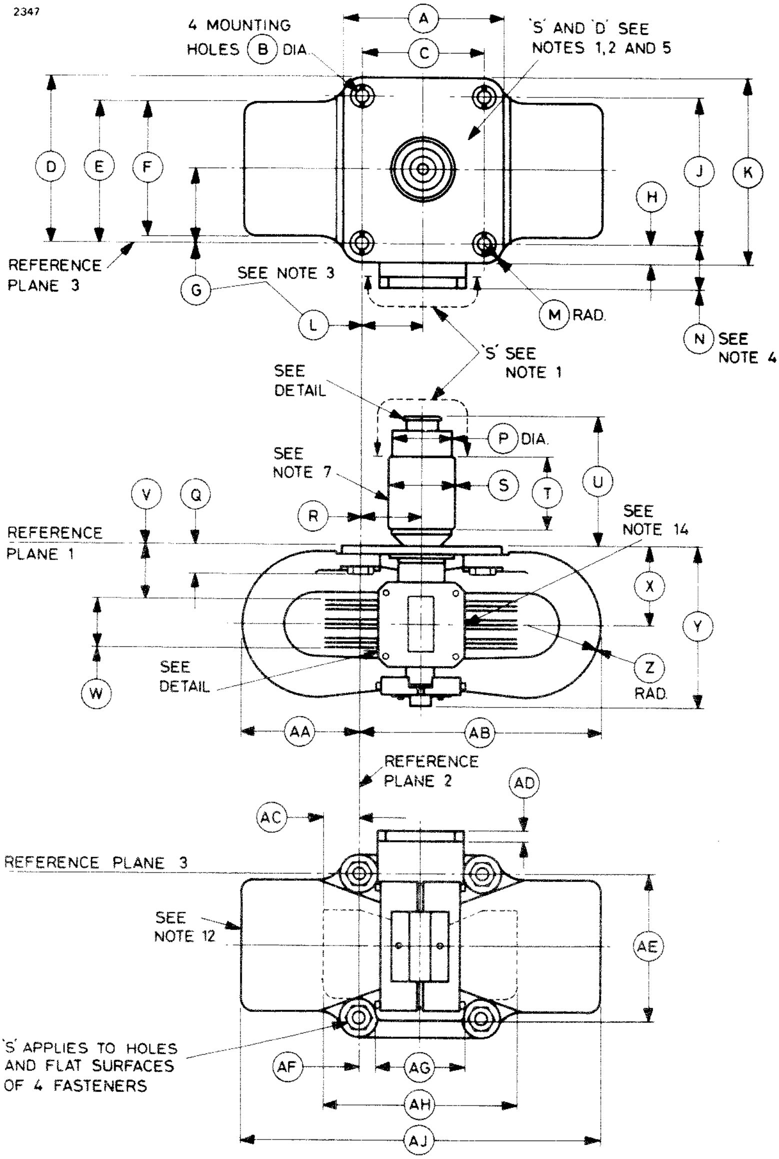
(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.
8. At anode temperature of 100°C.
9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9850 to 10 000MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.
11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

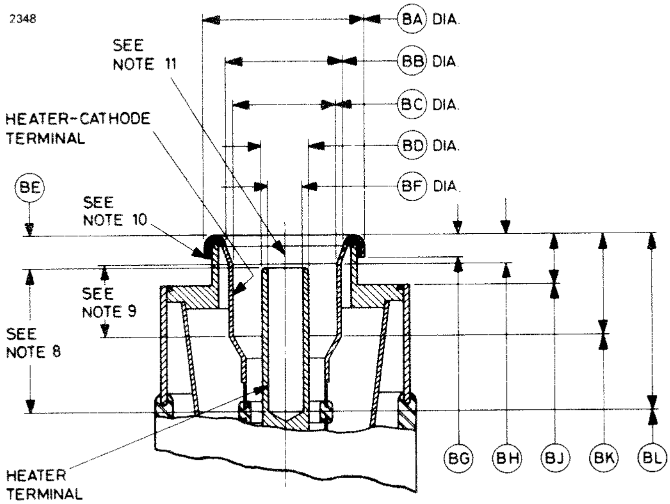


OUTLINE (See page 10 for Outline Notes)

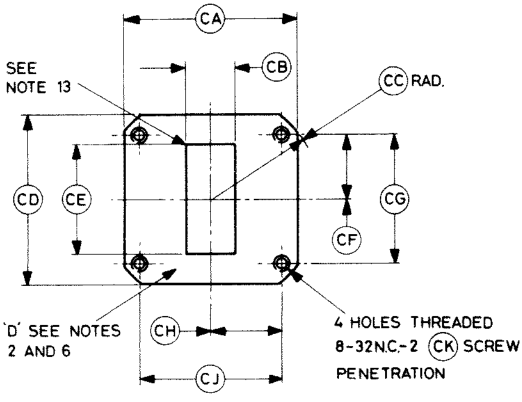


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

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A	3.468 max	88.09 max	AE	3.125 max	79.38 max
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C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M548

X-BAND MAGNETRON

Service Type CV5031

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

GENERAL

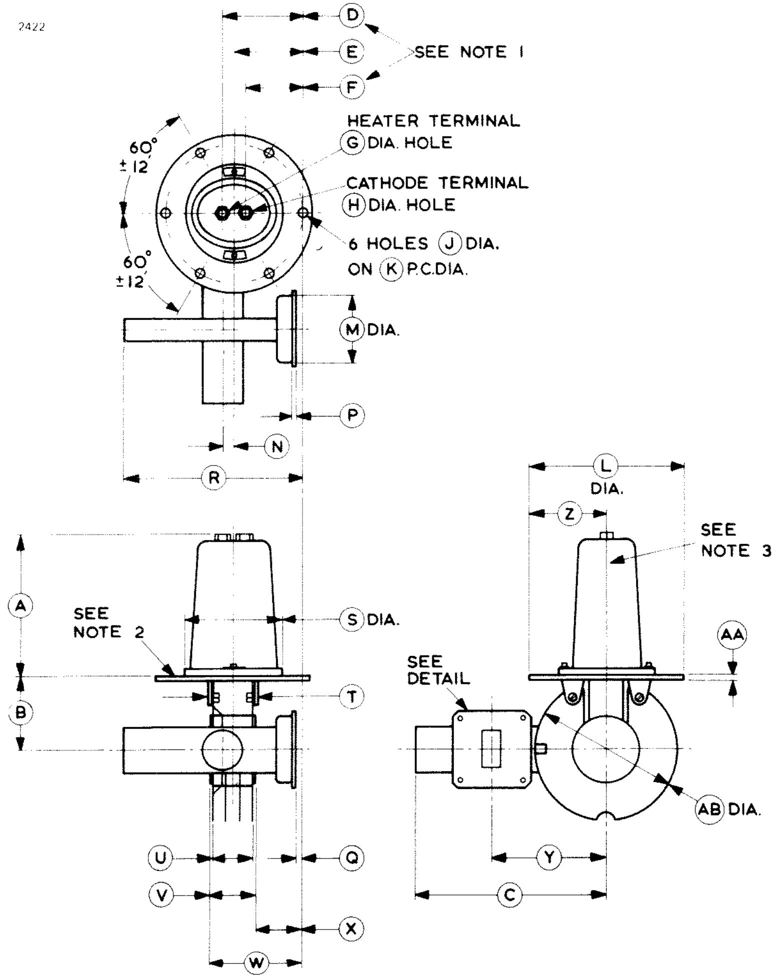
The M548 is a pulse operated, fixed frequency magnetron for use in the range 9003 to 9168MHz. It is a maintenance type and therefore only abridged data are given on this sheet. Full information is available on request.

Magnet	separate
Output	no. 16 waveguide
	(0.900 x 0.400 inch internal)
Coupler	UG-40A/U (Z830051)
Net weight	1¾ pounds (0.8kg) approx
Mounting position	any
Cooling	forced-air

Typical Operation

Output power (peak)	50	kW
Anode voltage (peak)	13.5	kV
Anode current (peak)	12	A
Duty cycle	0.001	
Heater voltage (warm-up)	3.0	V
Heater current at 3.0V	3.5	A
Cathode heating time (minimum)	1.5	min
Heater voltage (operating)	1.5	V
Magnetic field	3800	gauss

OUTLINE (See page 4 for Flange Details)



Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.984 ± 0.062	75.79 ± 1.57	Q	0.122 ± 0.020	3.10 ± 0.51
B	1.562 ± 0.020	39.67 ± 0.51	R	4.062 max	103.2 max
C	4.750 max	120.7 max	S	2.218 max	56.34 max
D	1.687	42.85	T	1.107 max	28.12 max
E	1.437	36.50	U	$0.8070^{+0.0050}_{-0.0045}$	$20.498^{+0.127}_{-0.114}$
F	1.187	30.15			
G	0.169 ± 0.005	4.29 ± 0.13	V	0.974 max	24.74 max
H	0.169 ± 0.005	4.29 ± 0.13	W	1.938 max	49.23 max
J	0.193 ± 0.003	4.902 ± 0.076	X	0.812 min	20.62 min
K	2.875 ± 0.006	73.03 ± 0.15	Y	2.437 ± 0.020	61.90 ± 0.51
L	3.250 ± 0.031	82.55 ± 0.79	Z	1.625	41.28
M	1.422 ± 0.015	36.12 ± 0.38	AA	0.125	3.18
N	0.219	5.56	AB	3.062 max	77.77 max
P	0.110 ± 0.005	2.79 ± 0.13			

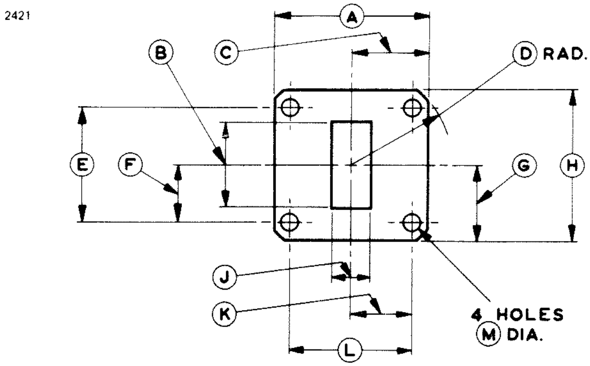
Millimetre dimensions have been derived from inches.

Outline Notes

1. The jack holes will be within a radius of 0.023 inch (0.58mm) of the location specified, but will be spaced 0.500 ± 0.010 inch (12.70 ± 0.25mm) with respect to each other.
2. With the flange resting on a plane surface, the flatness of the mounting plate 0.500 inch (12.70mm) from the outer edge will be such that a feeler gauge 0.010 inch (0.25mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The common cathode connection is indicated by a letter 'C' on this surface.

OUTLINE DETAIL

Output Flange



Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38
B	0.900	22.86
C	0.812 ± 0.015	20.62 ± 0.38
D	1.062	26.97
E	1.220	30.99
F	0.610	15.49
G	0.812 ± 0.015	20.62 ± 0.38
H	1.625 ± 0.015	41.28 ± 0.38
J	0.400	10.16
K	0.640	16.26
L	1.280	32.51
M	0.1695	4.305

Millimetre dimensions have been derived from inches.

M549

X-BAND MAGNETRON

Service Type CV2424

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J50A

Frequency range	8500 to 8665	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	60	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in^2
output	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8)	8500	8665	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, oscillation 1		
Stability (see note 10)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $V_h = 14 - 0.0125\,Pi$

   and for input powers above 595 watts,

   $V_h = 24 - 0.0293\,Pi,$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $i_{apk} = 29.6 - 1.934t_p$

   where i_{apk} = peak anode current in amperes
   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

Pulse length (μs)	Rate of rise of voltage (kV/μs) Min	Max
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of $80ft^3/min$ ($2.3m^3/min$) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

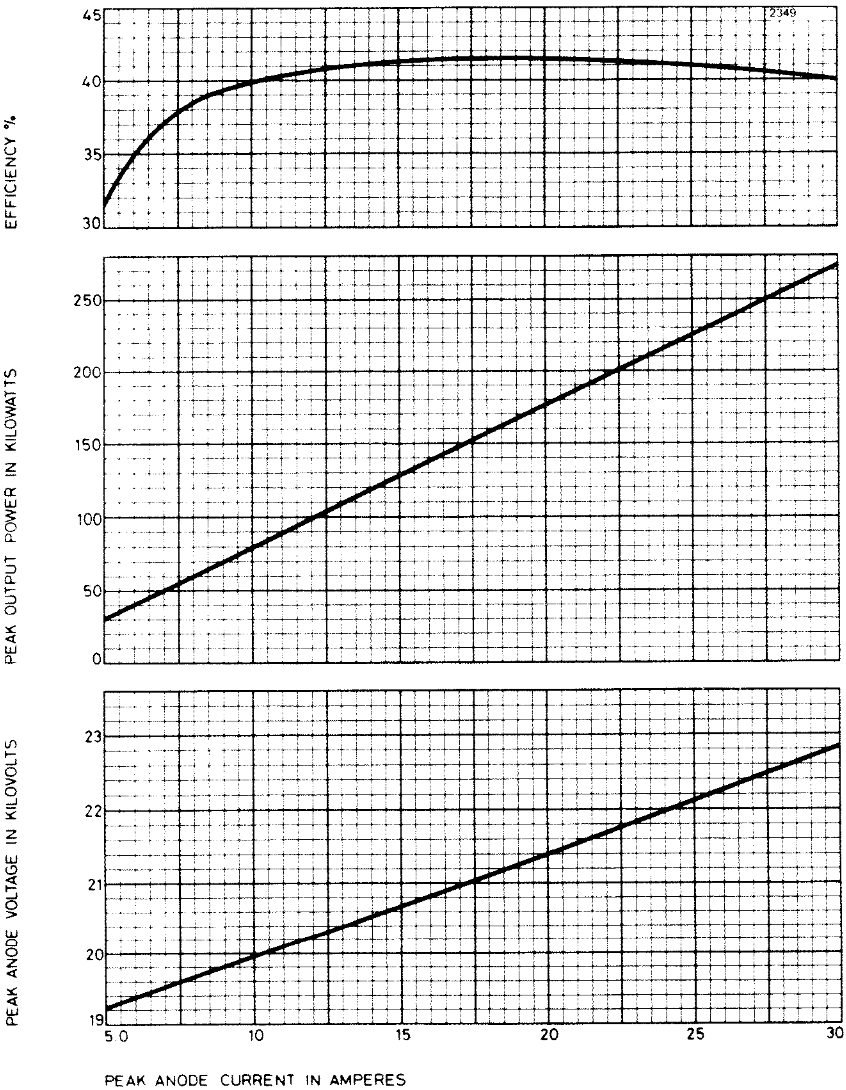
8. At anode temperature of 100°C.

9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).

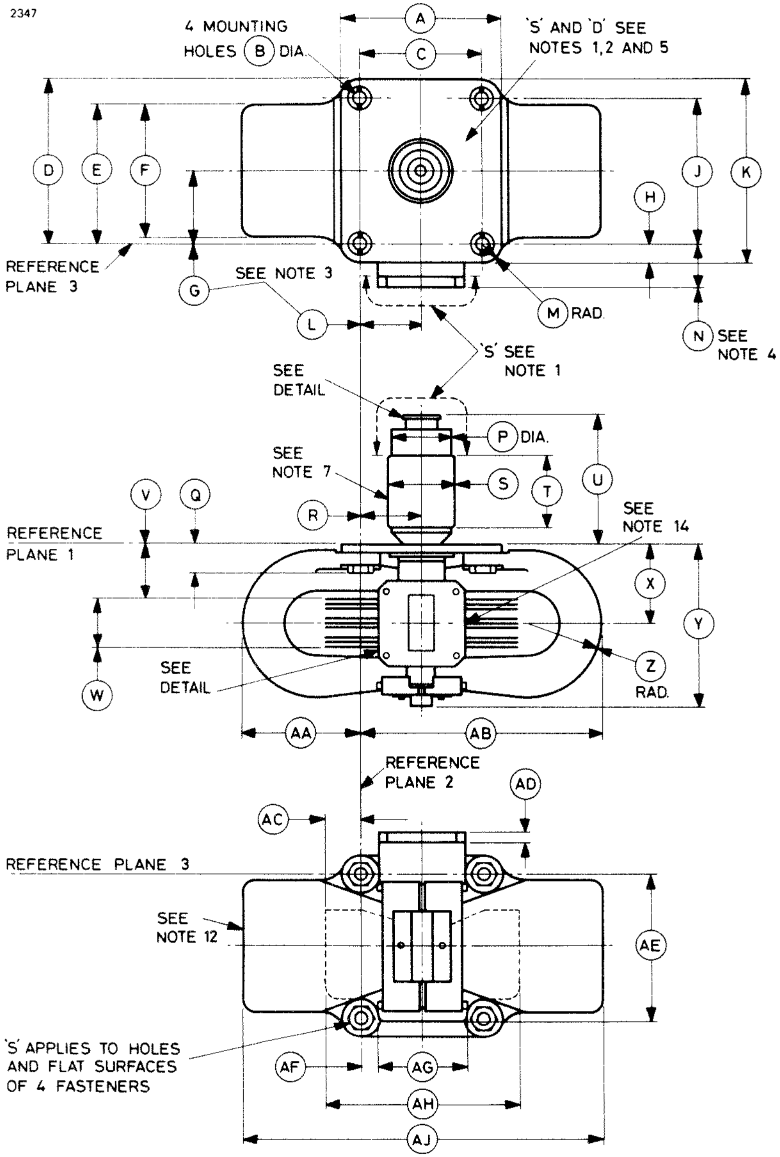
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 8500 to 8665MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

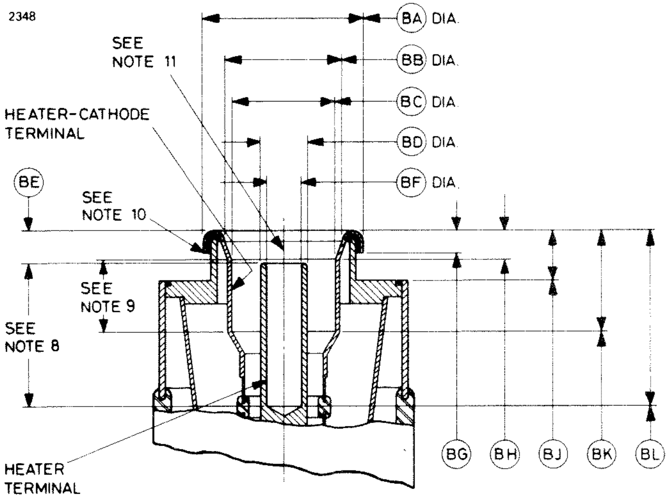


OUTLINE (See page 10 for Outline Notes)

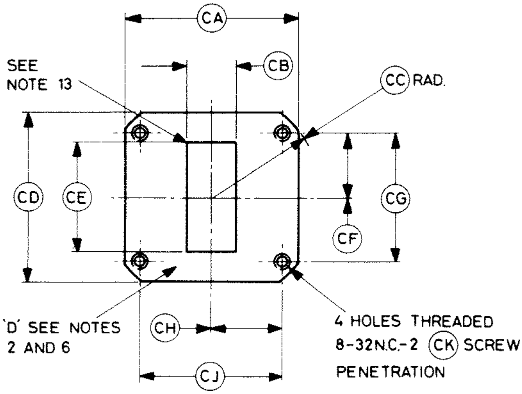


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.468 max	88.09 max	AE	3.125 max	79.38 max
B	0.281 ± 0.005	7.14 ± 0.13	AF	0.312	7.92
C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830\ ^{+0.008}_{-0.005}$	$21.08\ ^{+0.20}_{-0.13}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540\ ^{+0.005}_{-0.008}$	$13.72\ ^{+0.13}_{-0.20}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M575

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9345 to 9405	MHz
Typical peak output power	80	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051) or Z831611
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	10	V
Heater current at 10V	2.85	A
Heater starting current, peak value, not to be exceeded	11.5	A max
Cathode heating time (minimum) (see note 2)	3	min

Mechanical

Overall dimensions	6.312 x 5.937 x 3.625 inches max 160.3 x 150.8 x 92.1mm max
Net weight	5 pounds (2.28kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	9.0	11	V
Heater starting current (peak)	–	11.5	A
Anode voltage (peak)	13.5	16.5	kV
Anode current (peak)	10	18	A
Input power (peak)	–	270	kW
Input power (mean) (see note 3)	–	400	W
Duty cycle	–	0.002	
Pulse length (see note 4)	–	5.5	μs
Rate of rise of voltage pulse (see note 5)	–	150	kV/μs
Anode temperature (see note 6)	–	175	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	Condition 3	
Heater voltage	10	7.5	9.0	V
Anode current (peak)	15	15	15	A
Pulse length	0.1	1.0	0.5	μs
Pulse repetition rate	1000	1000	1000	p.p.s.
Rate of rise of voltage pulse	150	150	150	kV/μs

Typical Performance

Anode voltage (peak)	15	15	15	kV
Output power (peak)	80	80	80	kW
Output power (mean)	8.0	80	40	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	7.5	10	V
Anode current (mean)	15	1.5	mA
Duty cycle	0.001	0.0001	
Pulse length (see note 4)	1.0	0.1	μs
V.S.W.R. at the output coupler	1.05:1	1.5:1	
Rate of rise of voltage pulse (see note 5)	150	150	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	14	16	–	–	kV
Output power (mean)	65	–	–	–	W
Frequency	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	25	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 7)	–	0.5	–	–	%
Stability (see note 8)	–	–	–	0.5	%
Frequency pushing (see note 9)	–	15	–	–	MHz
Cold impedance					see note 10
Heater current					see note 11
Temperature coefficient of frequency					see note 12

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1 above)

Output power (mean)	52	W min
R.F. bandwidth at ¼ power	3.0	MHz max
Frequency: must be within Test Limits above		
Stability (see note 7)	2.0	% max

NOTES

1. With no anode input power.

   For average values of pulse input power greater than 50 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 10.0\left[1 - \frac{P_i}{900}\right] \text{ volts}$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section. The valve is normally tested with a heater supply frequency of 50Hz and is also suitable for operation with heater supply frequencies of 400Hz or 1000Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 5 minutes minimum.

3. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10% for pulse length 1.0μs, ±50% for pulse length 0.1μs.

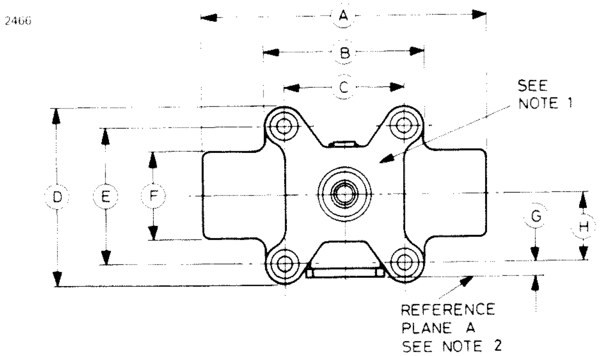
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

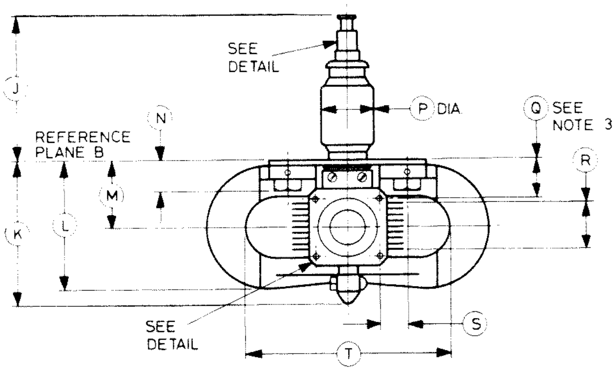
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode fins.

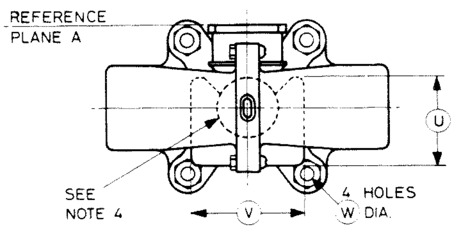
7. With the valve operating into a v.s.w.r. of 1.5:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 5 minutes.

8. There will be no evidence of mode change as the input is varied over the range 1.0 to 1.8mA.
9. The frequency pushing is the difference between the maximum and minimum frequencies as the peak anode current is varied rapidly between the limits 10 and 18 amperes.
10. The impedance of the valve measured at the operating frequency recorded in Oscillation 1 is such that the distance of the v.s.w.r. minimum from the face of the mounting plate into the valve is between 11.8 and 17.8mm, and the standing wave ratio greater than 6:1.
11. Measured with heater voltage of 10V and no anode input power, the heater current limits are 2.5A minimum, 3.2A maximum.
12. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

OUTLINE (See page 8 for outline details)







Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.937 max	150.8 max	S	0.626 ± 0.024	15.90 ± 0.61
B	3.437 max	87.30 max	T	3.812 min	96.82 min
C	2.531 ± 0.010	64.29 ± 0.25	U	1.050 max	26.67 max
D	3.625 max	92.08 max	V	2.375	60.33
E	2.781 ± 0.010	70.64 ± 0.25	W	0.281 ± 0.005	7.14 ± 0.13
F	1.937 max	49.20 max	AA	0.917 min	23.29 min
G	0.197 ± 0.118	5.00 ± 3.0	AB	0.156 min	3.96 min
H	1.391	35.33	AC	0.276 min	7.01 min
J	3.156 max	80.16 max	AD	0.394 ± 0.008	10.01 ± 0.20
K	3.156 max	80.16 max	AE	0.323 ± 0.008	8.20 ± 0.20
L	2.844 max	72.24 max	AF	0.433 max	11.00 max
M	1.437 ± 0.024	36.50 ± 0.61	AG	0.470 ± 0.010	11.94 ± 0.25
N	0.650 ± 0.060	16.51 ± 1.52	BA	1.654 ± 0.020	42.01 ± 0.51
P	1.125	28.58	BB	1.280 ± 0.004	32.512 ± 0.102
Q	0.827 ± 0.024	21.01 ± 0.61	BC	1.654 ± 0.020	42.01 ± 0.51
R	1.000	25.40	BD	1.220 ± 0.004	30.988 ± 0.102

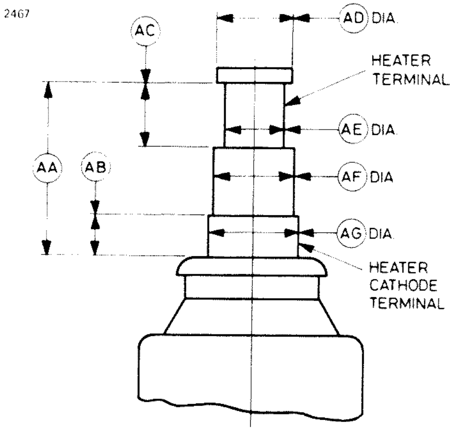
Millimetre dimensions have been derived from inches.

Outline Notes

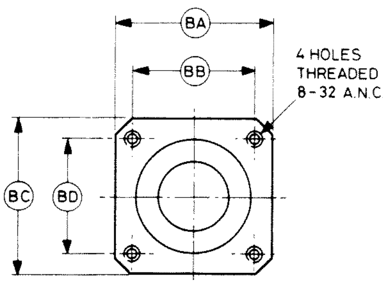
1. The flatness of the mounting flange will be such that with reference plane B resting on a flat surface a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) between reference plane B and the surface at any point.
2. With reference plane B resting on a flat surface, no point on the surface of the output flange (reference plane A) will vary from the perpendicular plane by more than 0.010 inch (0.25mm).
3. The angular tolerance between the output flange holes and the mounting plate will not exceed 1°.
4. The anode temperature is measured at this point.

OUTLINE DETAILS (See page 7 for outline notes and dimensions)

Terminal Assembly



Waveguide Flange



M581

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9415 to 9475	MHz
Typical peak output power	65	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	1.0	A
Heater starting current, peak value, not to be exceeded	5.0	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	5.375 x 6.172 x 5.261 inches max 136.5 x 156.8 x 133.6mm max
Net weight	4 pounds (1.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	7.0	V
Heater starting current (peak)	–	5.0	A
Anode voltage (peak)	–	16	kV
Anode current (peak)	12	16	A
Input power (mean) (see note 3)	–	160	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	1.0	μs
Rate of rise of voltage pulse (see note 5)	100	150	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	1.0	V
Anode current (peak)	14	A
Pulse length	0.5	μs
Pulse repetition rate	1250	p.p.s.
Rate of rise of voltage pulse	145	kV/μs

Typical Performance

Anode voltage	14	kV
Output power (peak)	65	kW
Output power (mean)	40.5	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

Heater voltage (for test)	0	V
Anode current (mean)	8.8	mA
Duty cycle	0.00062	
Pulse length (see note 4)	0.5	µs
V.S.W.R. at the output coupler (maximum)	1.1:1	
Rate of rise of voltage pulse (minimum) (see note 5)	150	kV/µs

Limits

	Min	Max	
Anode voltage (peak)	12.5	15.0	kV
Output power (mean)	34	–	W
Frequency (see note 7)	9415	9475	MHz
R.F. bandwidth at ¼ power	–	5.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	MHz
Stability (see note 8)	–	0.25	%
Minor lobes	6.0	–	db
Heater current			see note 9
Temperature coefficient of frequency			see note 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life tested under the Typical Operating Conditions on page 2. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Output power (peak)	50	kW min
R.F. bandwidth at ¼ power	7.0	MHz max
Frequency	9415 to 9475	MHz
Stability (see note 8)	0.5	% max

NOTES

1. With no anode input power.

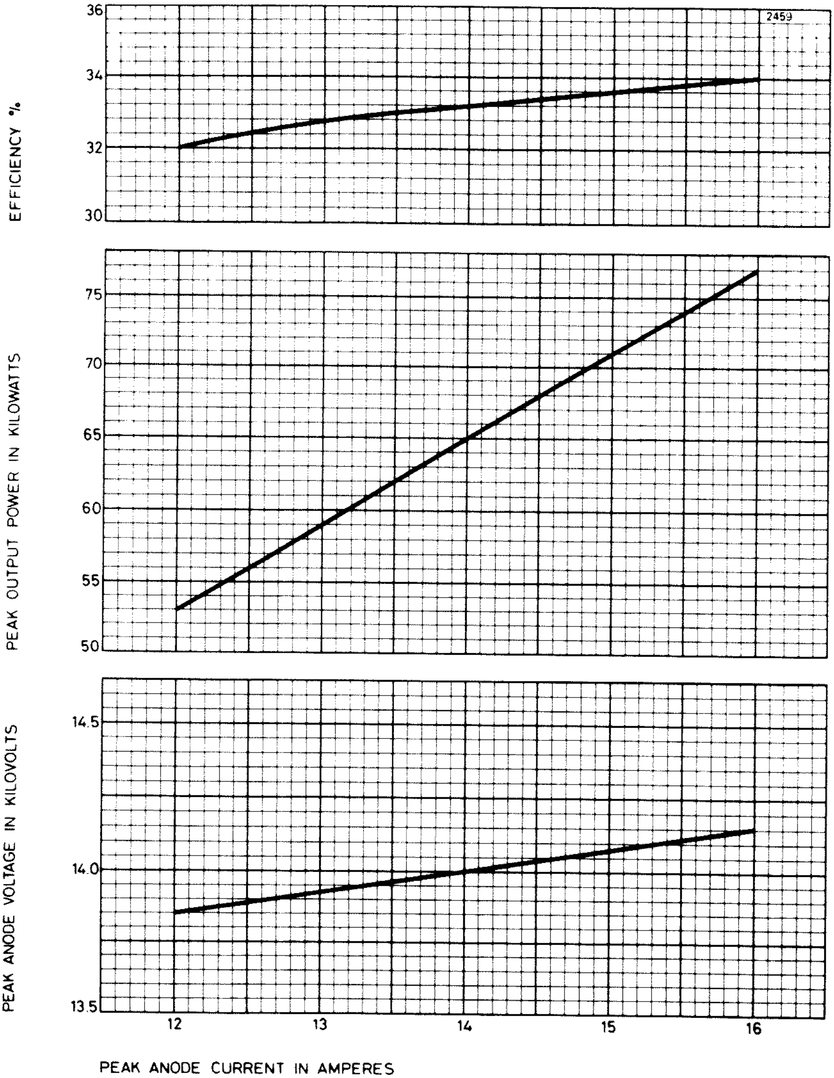
   The heater voltage during operation is very dependent upon the particular application and should be agreed with English Electric Valve Company Ltd. The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section. The M581 has been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50 and 1100Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used.
2. For ambient temperatures above -15°C. For ambient temperatures between -15 and -55°C the cathode heating time is 3 minutes min.
3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

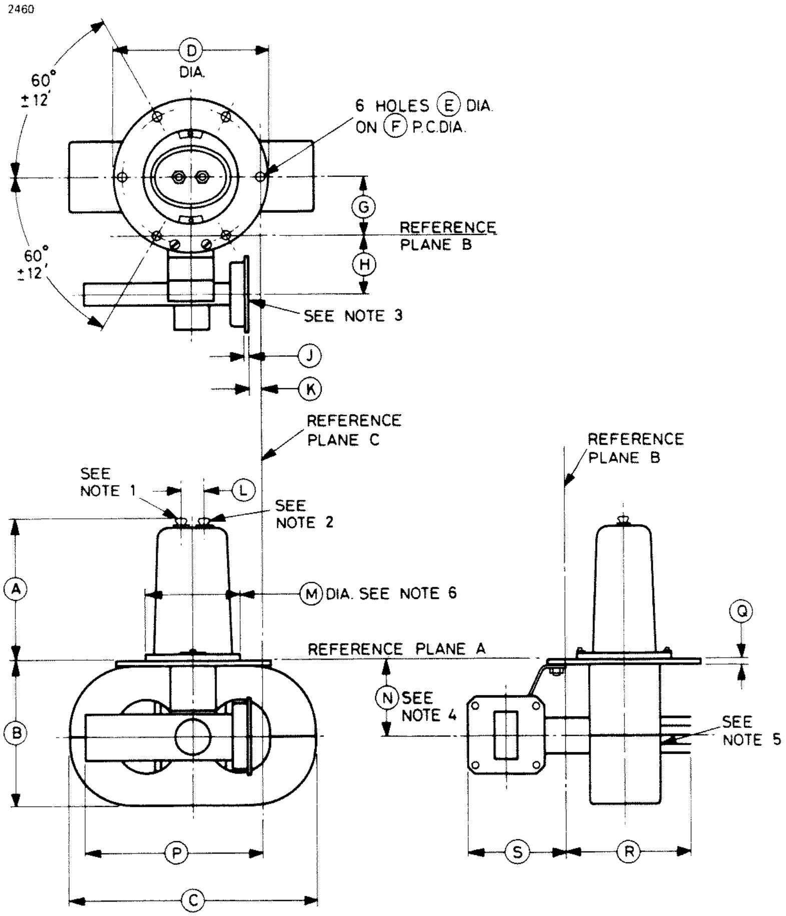
   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Tolerance $\pm$10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.
6. The anode temperature, measured at the point indicated on the outline drawing, must be kept below the limit specified.

   Adequate cooling is provided at maximum mean input power by an airflow of 15ft^3/min (0.43m^3/min) at 55°C ambient temperature and standard pressure from an orifice of 1.250 inches (31.75mm) diameter located 0.250 inch (6.35mm) from the cooling fins.
7. Other frequency ranges can be supplied on request.
8. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 3 minutes of a test interval not to exceed 6 minutes.
9. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.9A minimum, 1.1A maximum.
10. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/$^\circ$C.

PERFORMANCE CHART



OUTLINE (See page 8 for Output Flange Details)



Outline Dimensions

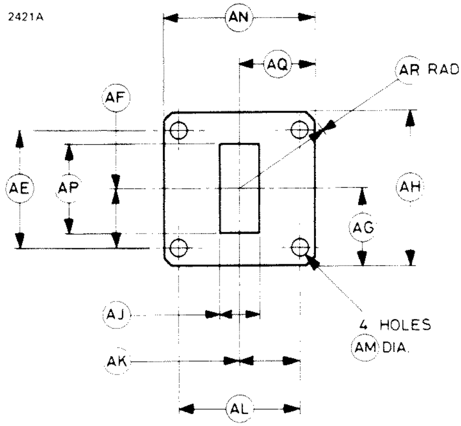
Ref	Inches	Millimetres
A	2.985 ± 0.062	75.82 ± 1.57
B	3.125 max	79.38 max
C	5.375 max	136.5 max
D	3.250 ± 0.031	82.55 ± 0.79
E	0.193 ± 0.003	4.902 ± 0.076
F	2.875 ± 0.006	73.03 ± 0.15
G	1.245	31.62
H	1.243 ± 0.020	31.57 ± 0.51
J	0.110 ± 0.005	2.79 ± 0.13
K	0.219 ± 0.020	5.56 ± 0.51
L	0.500 ± 0.010	12.70 ± 0.25
M	2.218 max	56.34 max
N	1.562 ± 0.020	39.67 ± 0.51
P	3.875 max	98.43 max
Q	0.125 ± 0.005	3.18 ± 0.13
R	2.745 max	69.72 max
S	2.375 max	60.33 max

Millimetre dimensions have been derived from inches.

Outline Notes

1. Heater terminal pin jack with hole 0.125 ± 0.003 inch (3.175 ± 0.076mm) diameter.
2. Heater-cathode terminal pin jack with hole 0.169 ± 0.003 inch (4.293 ± 0.076mm) diameter.
3. Face of waveguide output flange will be parallel to reference plane C to within 0.5°.
4. Centre line of waveguide output flange will be parallel to reference plane A to within 0.5°.
5. Anode temperature measured between cooling fins at this point.
6. This diameter, concentric with the pitch circle diameter F, will clear all parts of the valve above reference plane A.

Detail of Waveguide Output Flange



Ref	Inches	Millimetres
AE	1.220	30.99
AF	0.610	15.49
AG	0.812 ± 0.015	20.62 ± 0.38
AH	1.625 ± 0.015	41.28 ± 0.38
AJ	0.400	10.16
AK	0.640	16.26
AL	1.280	32.51
AM	0.1695	4.305
AN	1.625 ± 0.015	41.28 ± 0.38
AP	0.900	22.86
AQ	0.812 ± 0.015	20.62 ± 0.38
AR	1.062	26.97

Millimetre dimensions have been derived from inches.

M591B

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of M513B

Frequency range	9415 to 9475	MHz
Typical peak output power	22	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2.0	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.312 inches max 133.4 x 113.5 x 84.13mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.0	8.0	kV
Anode current (peak)	5.5	8.5	A
Input power (peak)	–	64	kW
Input power (mean) (see note 3)	–	80	W
Duty cycle	–	0.0025	
Pulse length (see note 4)	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	100	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising of waveguide (see note 7)	–	45	lb/in^2
	–	3.16	kg/cm^2

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	7.5	7.5	A
Pulse length	1.0	0.1	μs
Pulse repetition rate	500	1000	p.p.s.
Rate of rise of voltage pulse	100	100	kV/μs

Typical Performance

Anode voltage (peak)	7.6	7.6	kV
Output power (peak)	22	22	kW
Output power (mean)	11	2.2	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	6.3	V
Anode current (mean)	3.75	0.375	mA
Duty cycle	0.0005	0.00005	
Pulse length (see note 4)	1.0	0.05	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	100	100	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.0	8.0	7.0	8.0	kV
Output power (mean)	9.0	–	0.75	–	W
Frequency (see note 8)	9415	9475	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	50	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.25	–	0.25	%
Cold impedance					see note 10
Heater current					see note 11
Temperature coefficient of frequency					see note 12

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1 and 2)

	Oscillation 1	Oscillation 2	
Anode voltage (peak)	7.0	7.0	kV min
Output power (mean)	8.0	–	W min
R.F. bandwidth at ¼ power	3.5	–	MHz max
Frequency: must be within Test Limits above, Oscillation 1			
Stability (see note 9)	2.0	–	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{volts}$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as steepest tangent to leading edge of voltage pulse above 80% amplitude. Any capacitance in viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. At the maximum pressure of 45lb/in^2 (3.16kg/cm^2) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. Other frequency ranges can be supplied on request.

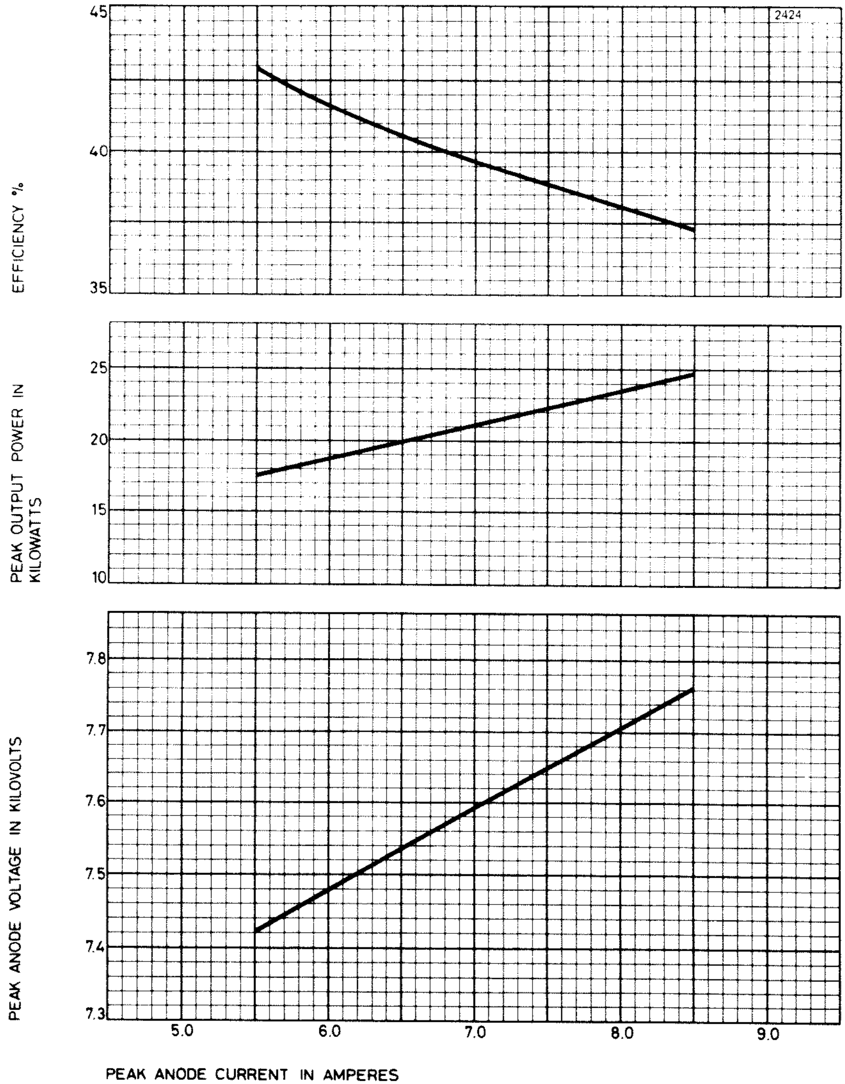
9. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

10. For the range 9415 to 9475MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

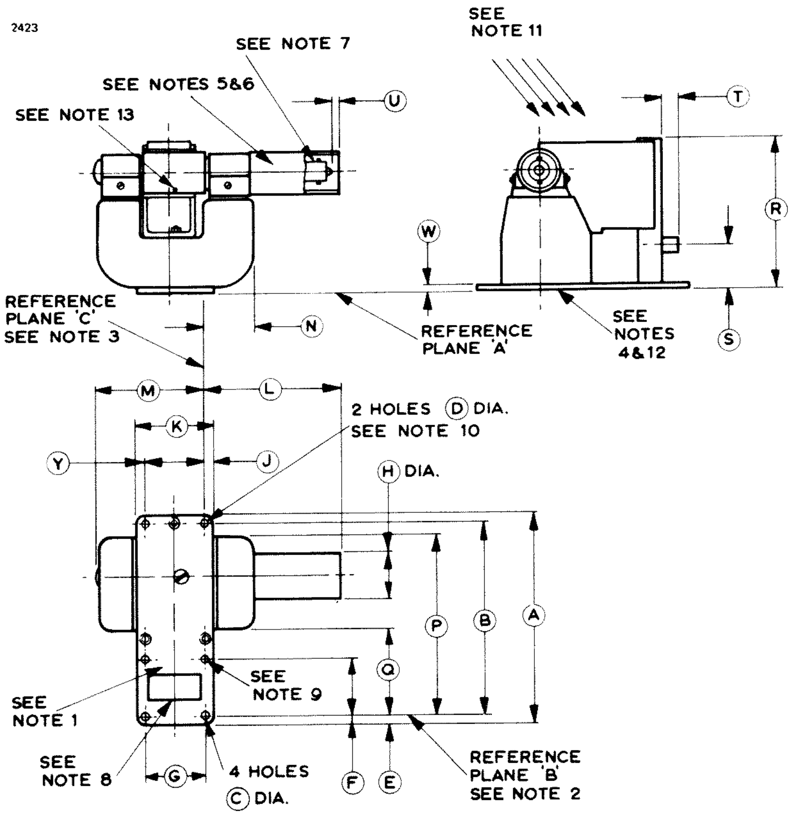
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End Contact Shell	Heater Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	M	2.187 max	55.55 max
B	4.103 ± 0.004	104.22 ± 0.10	N	1.187 max	30.15 max
C	0.170 ± 0.003	4.328 ± 0.076	P	4.000 max	101.6 max
D	0.175 ± 0.003	4.445 ± 0.076	Q	1.811 min	46.00 min
E	0.172 ± 0.016	4.37 ± 0.41	R	3.312 max	84.13 max
F	1.280 ± 0.004	32.51 ± 0.10	S	0.875 ± 0.125	22.23 ± 3.18
G	1.220 ± 0.004	30.99 ± 0.10	T	0.375 max	9.53 max
H	1.000 max	25.40 max	U	0.125 max	3.18 max
J	0.204 ± 0.015	5.18 ± 0.38	W	0.125	3.18
K	1.625 ± 0.016	41.28 ± 0.41	Y	1.220 ± 0.004	30.99 ± 0.10
L	2.937 ± 0.125	74.60 ± 3.18			

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler Army-Navy designation UG-40A/U and is the area tested in accordance with specification MIL-E-1 Par. 4.9.13.
2. Reference plane B passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes A and B.
4. With surface A resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. The axis of the heater lead protector will be within 5° of a normal to reference plane C.
6. The heater lead protector must not be used to support any cap fitting. This protector is a detachable sleeve of a non-conducting material.

7. The clearance between the inside surface of the protector and the 0.375 inch (9.53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52 (1952) Type BA9s/14) will not be less than 0.125 inch (3.18mm).

8. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U (see note 1 on page 7).

9. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane C.

10. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.

11. Recommended direction of air flow.

12. Surface A and interior surfaces of the waveguide will be plated with $10mg/in^2$ ($1.55mg/cm^2$) of gold or $30mg/in^2$ ($4.65mg/cm^2$) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.

13. Anode temperature measured at this point.

M596

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J52A

Frequency range	9370 to 9430	MHz
Typical peak output power	80	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	12.6	V
Heater current at 12.6V	2.2	A
Heater starting current, peak value, not to be exceeded	10	A max
Cathode heating time (minimum)	1.5	min

Mechanical

Overall dimensions	5.937 x 5.374 x 4.243 inches max
	150.8 x 136.5 x 107.8mm max
Net weight	5¼ pounds (2.4kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	14	V
Heater starting current (peak)	–	10	A
Anode voltage (peak)	14	16	kV
Anode current (peak)	12	15	A
Input power (mean) (see note 2)	–	240	W
Pulse length (see note 3)	–	5.0	μs
Rate of rise of voltage pulse (see note 4):			
pulse length 0.4μs	120	160	kV/μs
pulse length 1.0μs	100	150	kV/μs
pulse length 4.5μs	70	100	kV/μs
Anode temperature	–	150	°C
Cathode terminal temperature	–	175	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising of waveguide (see note 5)	–	40	lb/in²
	–	2.8	kg/cm²

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.8	V
Anode current (peak)	15	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	14.8	kV
Output power (peak)	80	kW
Output power (mean)	80	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	9.1	7.9	V
Anode current (mean)	9.8	15	mA
Duty cycle	0.00065	0.001	
Pulse length (see note 3)	0.4	5.0	μs
V.S.W.R. at the output coupler	1.5:1	1.05:1	
Rate of rise of voltage pulse (see note 4)	170 ± 15	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	–	–	14	16	kV
Output power (mean)	–	–	70	–	W
Frequency (see note 6)	–	–	9370	9430	MHz
R.F. bandwidth at ¼ power (see note 7)	–	5.0	–	0.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	13	–	–	MHz
Frequency pushing	–	–	–	0.5	MHz/A
Stability (see note 8)	–	0.25	–	0.25	%
Heater current					see note 9
Temperature coefficient of frequency					see note 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the following cycling conditions:

(1) Standby – heater voltage only, 3 minutes;

(2) Oscillation 1 – 3 minutes;

(3) Oscillation 2 – 15 minutes;

(4) Off – 9 minutes.

If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 2)

Output power (mean)	56	W min
R.F. bandwidth at ¼ power	0.5	MHz max
Frequency: must be within Test Limits, Oscillation 2		
Stability (see note 8)	2	% max

NOTES

1. With no anode input power.

   On standby the heater voltage must not exceed 12.6 volts. On application of anode power, the heater voltage must be reduced according to the following formula:

   $V_h = 11.6 - 0.017\ Pi$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

3. Tolerance $\pm$10%.

4. Defined as the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

5. At the maximum pressure of 40lb/in^2 (2.8kg/cm^2) absolute, the leakage will not exceed 0.03 litre (N.T.P.) per minute.

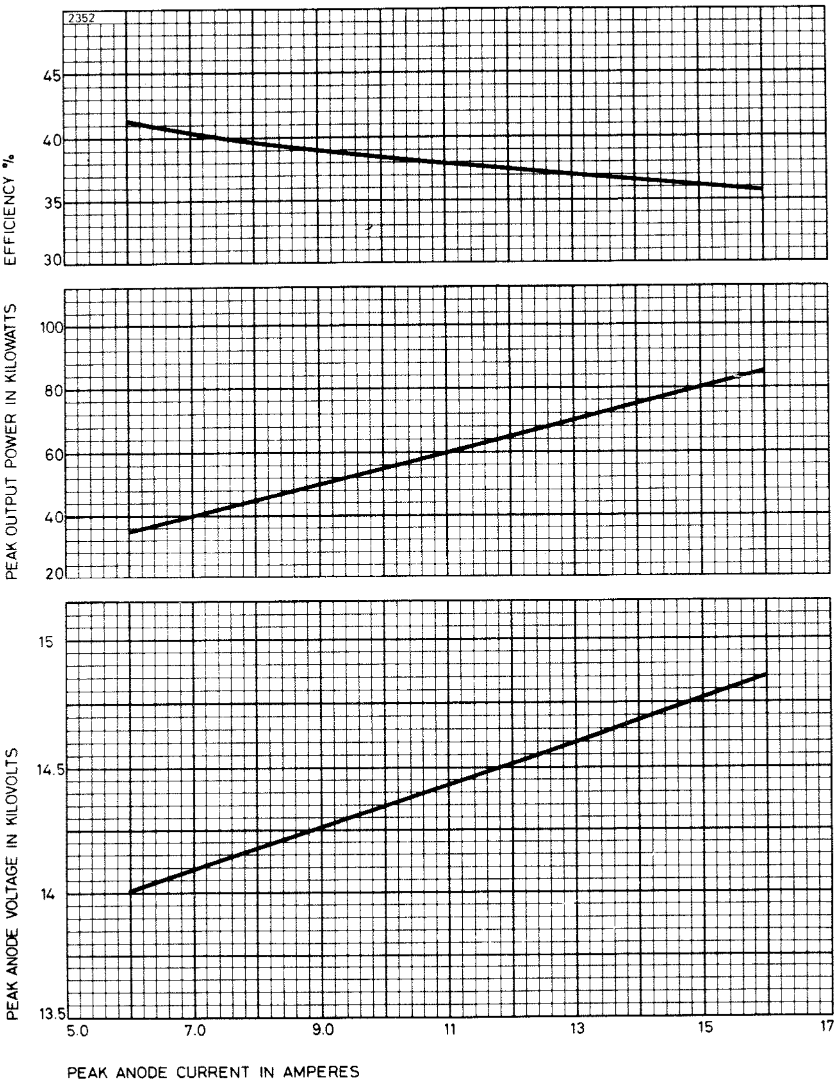
6. With anode temperature of 100°C $\pm$ 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

7. The maximum r.f. bandwidth in MHz is given by 2.5/pulse length in μs. This test is carried out at the following peak currents:

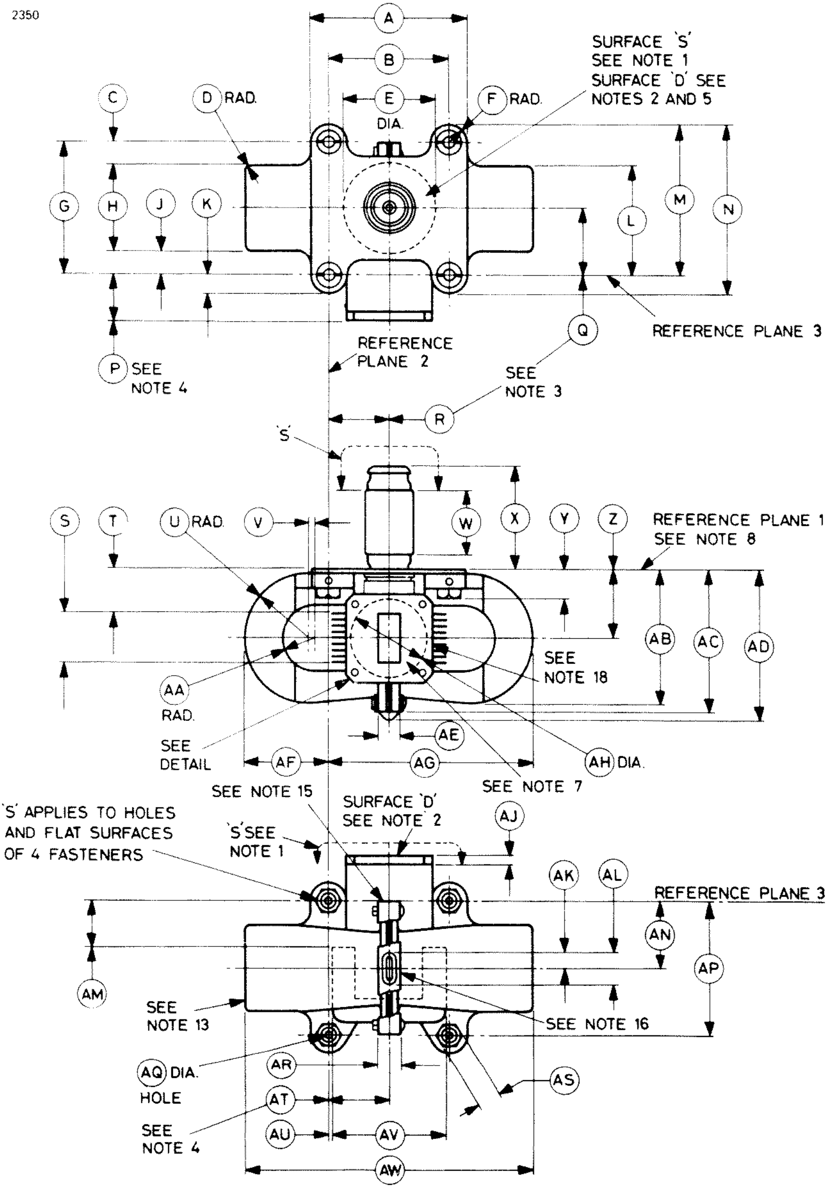
   Oscillation 1 – 11 and 15A
   Oscillation 2 – 12 and 15A

8. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 5 minutes operation.
9. Measured with heater voltage 12.6V and no anode input power, the heater current limits are 2.0A minimum, 2.4A maximum.
10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART

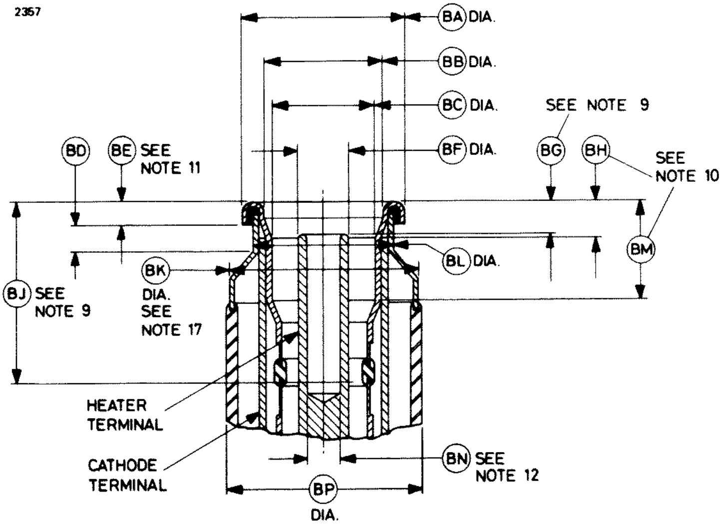


OUTLINE (See page 10 for Outline Notes)

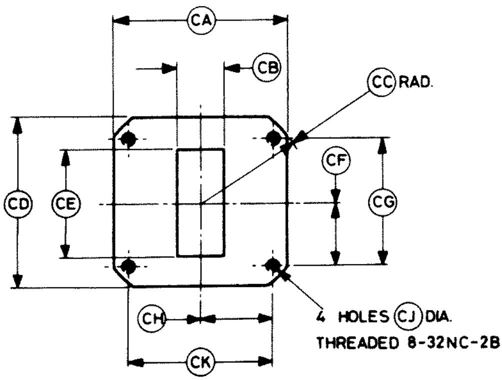


OUTLINE DETAILS (See Page 10 for Outline Notes)

Heater and Cathode Terminals



Output Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.437 max	87.30 max	AN	1.391 ± 0.047	35.33 ± 1.19
B	2.531 ± 0.010	64.29 ± 0.25	AP	2.875 max	73.03 max
C	0.594 max	15.09 max	AQ	0.281 ± 0.005	7.14 ± 0.13
D	0.031 min	0.79 min	AR	1.437 max	36.50 max
E	1.875 min	47.63 min	AS	0.500	12.70
F	0.375	9.53	AT	1.265 ± 0.015	32.13 ± 0.38
G	2.781 ± 0.010	70.64 ± 0.25	AU	0.078	1.98
H	1.937 max	49.20 max	AV	2.375	60.33
J	0.594 max	15.09 max	AW	5.937 max	150.8 max
K	0.422 max	10.72 max	BA	$0.830^{+0.008}_{-0.005}$	$21.08^{+0.20}_{-0.13}$
L	2.375 max	60.33 max			
M	3.203 max	81.36 max	BB	0.610 or 0.650	15.49 or 16.51
N	3.625 max	92.08 max			
P	1.015 ± 0.025	25.78 ± 0.64	BC	$0.540^{+0.005}_{-0.008}$	$13.72^{+0.13}_{-0.20}$
Q	1.391	35.33			
R	1.265	32.13	BD	0.125	3.18
S	1.000	25.40	BE	0.125 ± 0.010	3.18 ± 0.25
T	0.922	23.42	BF	0.250 ± 0.016	6.35 ± 0.41
U	1.328	33.73	BG	0.156 ± 0.031	3.96 ± 0.79
V	0.141	3.58	BH	0.200 max	5.08 max
W	1.250 min	31.75 min	BJ	0.750 min	19.05 min
X	2.156 ± 0.062	54.76 ± 1.57	BK	1.000	25.40
Y	0.625 ± 0.031	15.88 ± 0.79	BL	0.750	19.05
Z	1.406 ± 0.020	35.71 ± 0.51	BM	0.516 min	13.11 min
AA	0.625	15.88	BN	0.169 ± 0.005	4.29 ± 0.13
AB	2.844 max	72.24 max	BP	1.125	28.58
AC	2.937 max	74.60 max	CA	1.830	46.48
AD	3.156 max	80.16 max	CB	0.497	12.62
AE	0.625 max	15.88 max	CC	1.156	29.36
AF	1.687 max	42.85 max	CD	1.830	46.48
AG	4.250 max	108.0 max	CE	1.122	28.50
AH	1.625	41.28	CF	0.676 ± 0.005	17.17 ± 0.13
AJ	0.250	6.35	CG	1.352 ± 0.004	34.341 ± 0.102
AK	0.406 max	10.31 max	CH	0.737 ± 0.005	18.72 ± 0.13
AL	0.812 max	20.62 max	CJ	0.164	4.17
AM	0.797	20.24	CK	1.474 ± 0.004	37.440 ± 0.102

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces will be covered by a black finish, except those marked 'S' and 'D'. 'S' will be silver, nickel plated or brass surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. With the dimension E diameter resting on a plane surface coincident with reference plane 1, a feeler gauge 0.010 inch (0.254mm) thick and 0.125 inch (3.18mm) wide will not enter, and areas of the base plate outside the dimension E diameter will be within 0.010 inch (0.254mm) of the plane surface.
6. Dimensions without limits are for equipment design and qualification approval only and need not be checked.
7. With the dimension AH diameter resting on a plane surface, a feeler gauge 0.005 inch (0.127mm) thick and 0.125 inch (3.18mm) wide will not enter.
8. Any portion of the assembly extending above reference plane 1 will be within a 0.625 inch (15.87mm) radius of the specified axis of the input.
9. These dimensions define the extremities of the cylindrical section given by the dimension BN.
10. These dimensions define the extremities of the cylindrical section given by the dimension BC.
11. No clamping means to bear beyond this dimension.
12. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.254mm).
13. **Warning.** A minimum clearance of 2 inches (50mm approx) must be maintained between the magnet and any other magnetic materials (magnets, steel tools, plates etc.).
14. The opening in the waveguide must be enclosed by a dust cover when the valve is not in use.
15. The extremity of the magnet lug will coincide with reference plane 3 within 0.094 inch (2.39mm).
16. The seal off protector may be circular in shape.
17. The reference point for cathode temperature measurements is located on the dimension BK.
18. The reference point for anode temperature measurements is located where a central fin meets the anode block near the output section.

M597

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of M503A and 2J42

Frequency range	9380 to 9440	MHz
Typical peak output power	10.5	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2.0	min

Mechanical

Overall dimensions	4.468 x 3.312 x 5.250 inches max 113.5 x 84.13 x 133.4mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling

natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	5.0	6.2	kV
Anode current (peak)	3.5	6.0	A
Input power (peak)	–	35	kW
Input power (mean) (see note 3)	–	82.5	W
Duty cycle	–	0.0025	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	–	125	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg

TYPICAL OPERATION

Operational Conditions

Heater voltage	6.3	V
Anode current (peak)	5.0	A
Pulse length	0.5	μs
Pulse repetition rate	1000	p.p.s.
Rate of rise of voltage pulse	100	kV/μs

Typical Performance

Anode voltage (peak)	5.7	kV
Output power (peak)	10.5	kW
Output power (mean)	5.25	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	6.3	V
Anode current (mean)	3.0	0.3	mA
Duty cycle	0.0005	0.00005	
Pulse length (see note 4)	0.5	0.05	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (minimum) (see note 5)	120	125	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	5.5	5.9	–	–	kV
Output power (mean)	4.5	–	–	–	W
Frequency (see note 7)	9380	9440	–	–	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see notes 8 and 9)	–	0.1	–	0.1	%
R.F. bandwidth at ¼ power	–	5.0	–	50	MHz
Frequency pushing (see notes 9 and 10)	–	1.5	–	–	MHz/A
Cold impedance					see note 11
Heater current					see note 12
Temperature coefficient of frequency					see note 13

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Typical Operating Conditions given on page 2. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Anode voltage (peak)	5.5	kV min
Output power (mean)	4.0	W min
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 8)	0.1	% max

NOTES

1. With no anode input power.
   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

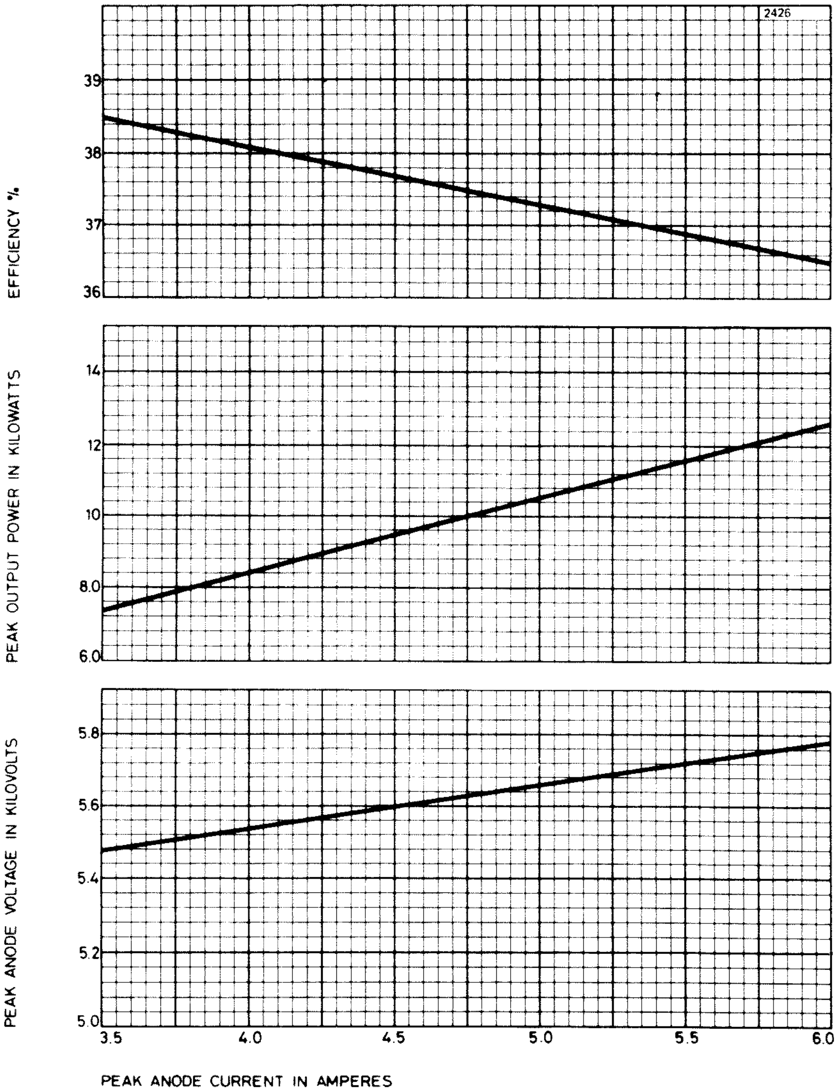
   $$V_h = 6.3 \left[1 - \frac{Pi}{180} \right] \text{ volts}$$

   where Pi = mean input power in watts.
   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.
3. The various parameters are related by the following formula:

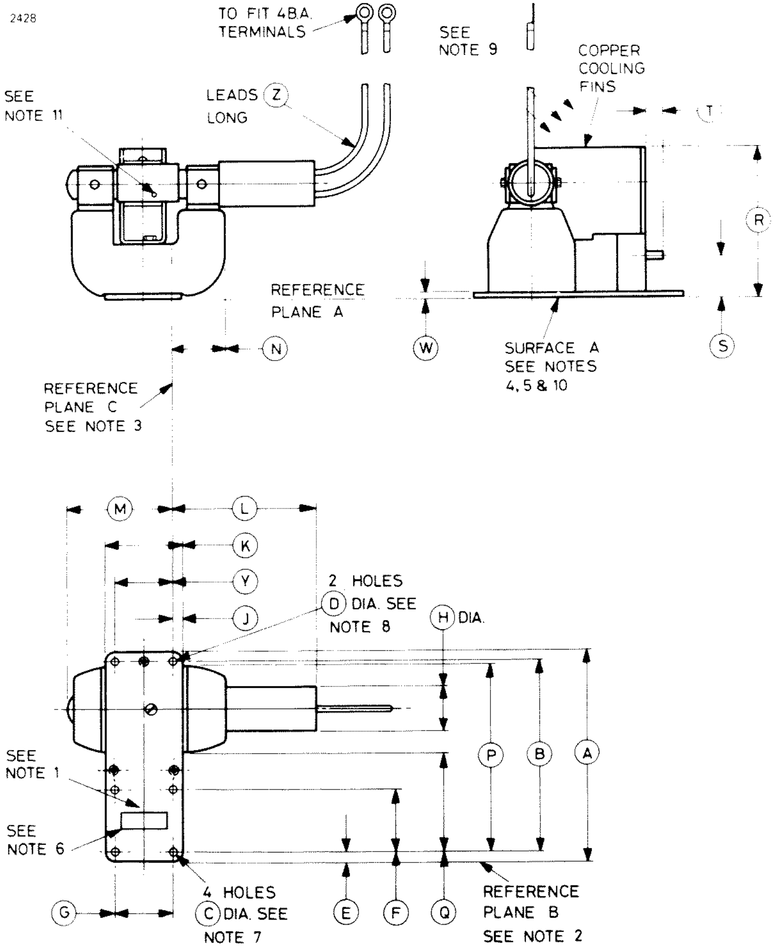
   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Tolerance ±10%.
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
7. Other frequency ranges can be supplied on request.
8. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.
9. Measured over the peak current range of 3.0 to 7.5 amperes.
10. The change in frequency when the peak anode current is varied over the range.
11. For the range 9380 to 9440MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.
12. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.
13. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	M	2.188 max	55.58 max
B	4.103	104.2	N	1.188 max	30.18 max
C	0.170 ± 0.003	4.318 ± 0.076	P	4.000 max	101.6 max
D	0.175 ± 0.003	4.445 ± 0.076	Q	1.938 min	49.23 min
E	0.172 ± 0.016	4.37 ± 0.41	R	3.313 max	84.15 max
F	1.280 ± 0.004	32.512 ± 0.102	S	0.875 ± 0.125	22.23 ± 3.18
G	1.220 ± 0.004	30.988 ± 0.102	T	0.375 max	9.53 max
H	1.000 max	25.40 max	W	0.125	3.18
J	0.203 ± 0.015	5.16 ± 0.38	Y	1.220	30.99
K	1.625 ± 0.016	41.28 ± 0.41	Z	9.000 nom	229 nom
L	2.937 ± 0.125	74.60 ± 3.18			

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler UG-40A/U (Z830051) and is the area tested in accordance with specification MIL-E-1 Par. 4.9.13.
2. Reference plane B passes through the centres of two mounting plate holes as shown and is perpendicular to plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown, and is perpendicular to planes A and B.
4. With surface A resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. Surface A and interior surfaces of the waveguide will be plated with $10mg/in^2$ ($1.55mg/cm^2$) of gold or $30mg/in^2$ ($4.65mg/cm^2$) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials.
6. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler UG-40A/U (Z830051) (see note 1 above).

7. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane C.

8. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.

9. Recommended direction of air flow.

10. All metal surfaces except surface A will be painted with heat resistant paint or otherwise treated to prevent corrosion.

11. Anode temperature measured at this point.

M598B

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of M513B

Frequency range	9380 to 9440	MHz
Typical peak output power	22	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2.0	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.312 inches max 133.4 x 113.5 x 84.13mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.0	8.0	kV
Anode current (peak)	5.5	8.5	A
Input power (peak)	–	64	kW
Input power (mean) (see note 3)	–	80	W
Duty cycle	–	0.0025	
Pulse length (see note 4)	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	100	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising of waveguide (see note 7)	–	45	lb/in²
	–	3.16	kg/cm²

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	7.5	7.5	A
Pulse length	1.0	0.1	μs
Pulse repetition rate	500	1000	p.p.s.
Rate of rise of voltage pulse	100	100	kV/μs

Typical Performance

Anode voltage (peak)	7.6	7.6	kV
Output power (peak)	22	22	kW
Output power (mean)	11	2.2	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	6.3	V
Anode current (mean)	3.75	0.375	mA
Duty cycle	0.0005	0.00005	
Pulse length (see note 4)	1.0	0.05	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	100	100	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.0	8.0	7.0	8.0	kV
Output power (mean)	9.0	–	0.75	–	W
Frequency (see note 8)	9380	9440	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	50	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.25	–	0.25	%
Cold impedance					see note 10
Heater current					see note 11
Temperature coefficient of frequency					see note 12

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1 and 2)

	Oscillation 1	Oscillation 2	
Anode voltage (peak)	7.0	7.0	kV min
Output power (mean)	8.0	–	W min
R.F. bandwidth at ¼ power	3.5	–	MHz max
Frequency: must be within Test Limits above, Oscillation 1			
Stability (see note 9)	2.0	–	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{volts}$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as steepest tangent to leading edge of voltage pulse above 80% amplitude. Any capacitance in viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. At the maximum pressure of 45lb/in^2 (3.16kg/cm^2) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. Other frequency ranges can be supplied on request.

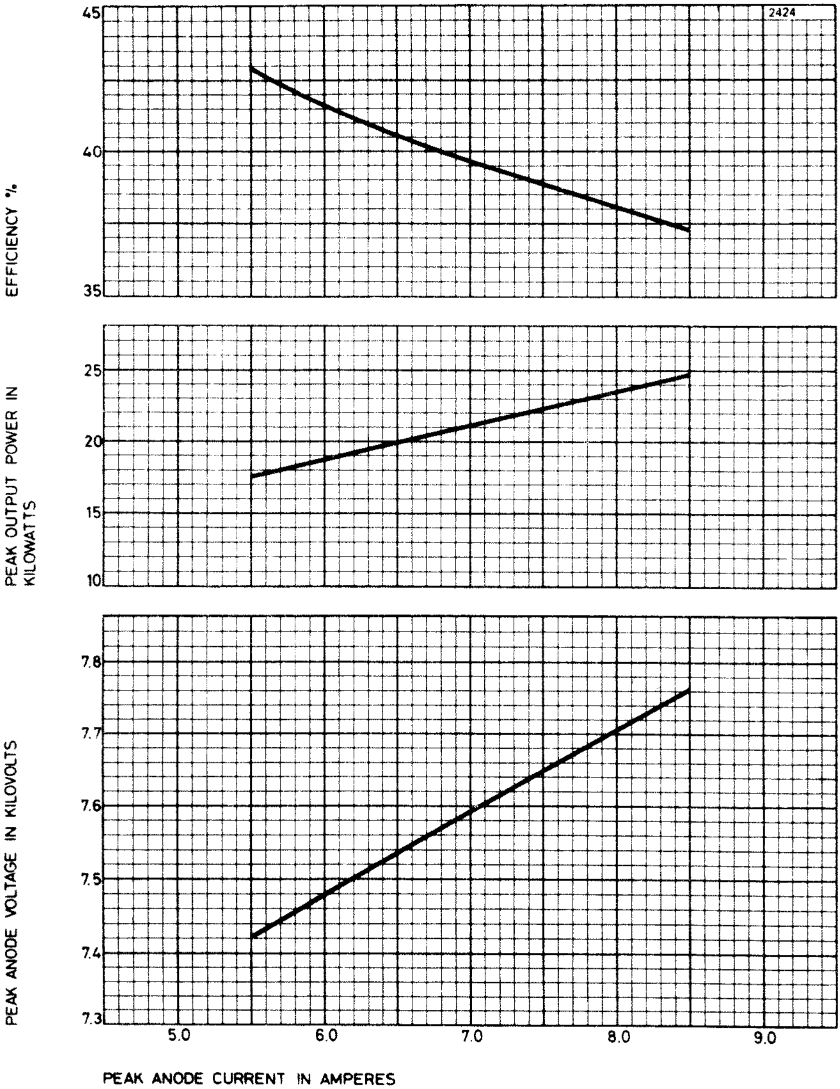
9. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

10. For the range 9380 to 9440MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

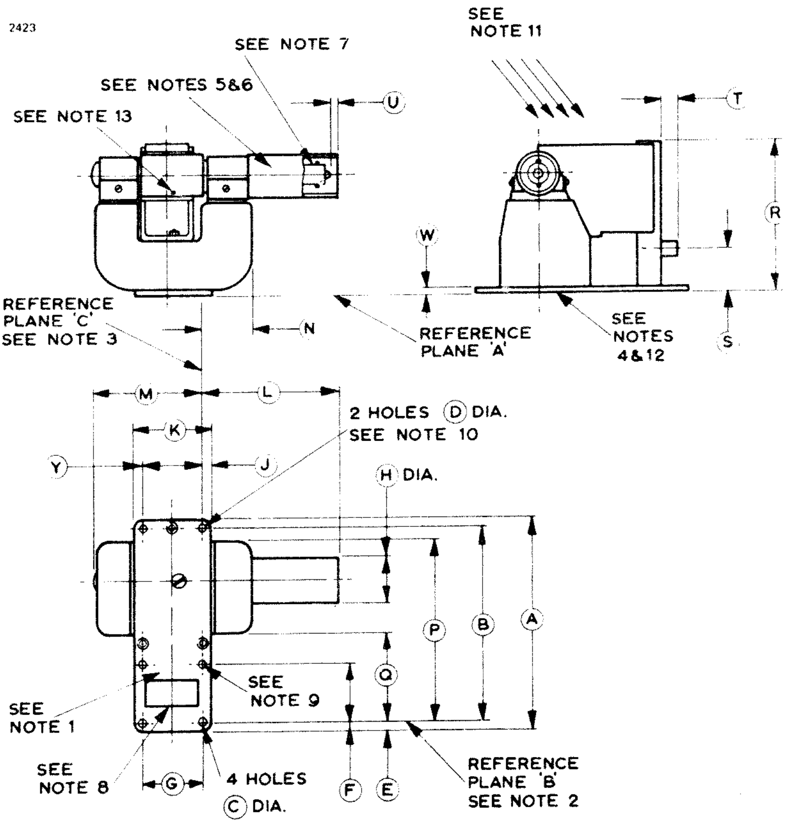
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End Contact	Heater
Shell	Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	M	2.187 max	55.55 max
B	4.103 ± 0.004	104.22 ± 0.10	N	1.187 max	30.15 max
C	0.170 ± 0.003	4.328 ± 0.076	P	4.000 max	101.6 max
D	0.175 ± 0.003	4.445 ± 0.076	Q	1.811 min	46.00 min
E	0.172 ± 0.016	4.37 ± 0.41	R	3.312 max	84.13 max
F	1.280 ± 0.004	32.51 ± 0.10	S	0.875 ± 0.125	22.23 ± 3.18
G	1.220 ± 0.004	30.99 ± 0.10	T	0.375 max	9.53 max
H	1.000 max	25.40 max	U	0.125 max	3.18 max
J	0.204 ± 0.015	5.18 ± 0.38	W	0.125	3.18
K	1.625 ± 0.016	41.28 ± 0.41	Y	1.220 ± 0.004	30.99 ± 0.10
L	2.937 ± 0.125	74.60 ± 3.18			

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler Army-Navy designation UG-40A/U and is the area tested in accordance with specification MIL-E-1 Par. 4.9.13.
2. Reference plane B passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes A and B.
4. With surface A resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. The axis of the heater lead protector will be within 5° of a normal to reference plane C.
6. The heater lead protector must not be used to support any cap fitting. This protector is a detachable sleeve of a non-conducting material.

7. The clearance between the inside surface of the protector and the 0.375 inch (9.53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52 (1952) Type BA9s/14) will not be less than 0.125 inch (3.18mm).

8. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U (see note 1 on page 7).

9. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane C.

10. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.

11. Recommended direction of air flow.

12. Surface A and interior surfaces of the waveguide will be plated with $10mg/in^2$ ($1.55mg/cm^2$) of gold or $30mg/in^2$ ($4.65mg/cm^2$) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.

13. Anode temperature measured at this point.

M599A M599B

X-BAND MAGNETRONS

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetrons, differing only in cold impedance and heater/cathode connections.

Frequency range	9415 to 9475	MHz
Typical peak output power	3.0	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		J.S.C. no. 5985-99-083-0051
Cooling		natural

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	6.3	V
Heater current at 6.3V	0.5	A
Cathode heating time (minimum) (see note 1)	30	s
Input capacitance	9.0	pF max
Distance of voltage standing wave minimum from output flange towards the anode:		
M599A	3.0 to 9.0	mm
M599B	0 to 6.0	mm

Mechanical

Overall dimensions	5.342 x 3.937 x 1.457 inches max 135.7 x 100.0 x 37.01mm max
Net weight	2.25 pounds (1.0kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling natural

December 1968

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Anode voltage (peak)	3.2	3.8	kV
Anode current (peak)	2.5	3.5	A
Input power (mean) (see note 2)	–	13	W
Duty cycle	–	0.001	
Pulse length (see note 3)	0.02	1.0	μs
Rate of rise of voltage pulse (see note 4)	–	60	kV/μs
Anode temperature	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage (for operation)	6.3	V
Anode current (peak)	3.0	A
Pulse length	0.1	μs
Pulse repetition rate	2000	p.p.s.
Rate of rise of voltage pulse	50	kV/μs

Typical Performance

Anode voltage (peak)	3.5	kV
Output power (peak)	3.0	kW
Output power (mean)	0.6	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

Heater voltage (for test)	6.3	V
Anode current (peak)	3.0	A
Duty cycle	0.001	
Pulse length (see note 3)	1.0	μs
V.S.W.R. at the output coupler	1.15:1	
Rate of rise of voltage pulse (see note 4)	50	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	3.2	3.8	kV
Output power (peak)	2.5	–	kW
Frequency (see note 5)	9415	9475	MHz
R.F. bandwidth at ¼ power	–	2.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5.1)	–	18	MHz
Frequency pushing	–	2.5	MHz/A
Stability (see note 6)	–	0.25	%
Cold impedance			see note 7
Heater current			see note 8
Temperature coefficient of frequency			see note 9

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operating Conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

	Min	Max	
Anode voltage (peak)	3.2	3.8	kV
Output power (peak)	2.0	–	kW

Frequency: must be within Test Limits above

NOTES

1. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 45 seconds minimum.

2. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

3. Tolerance ±10%.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

5. Other frequency ranges can be supplied on request.

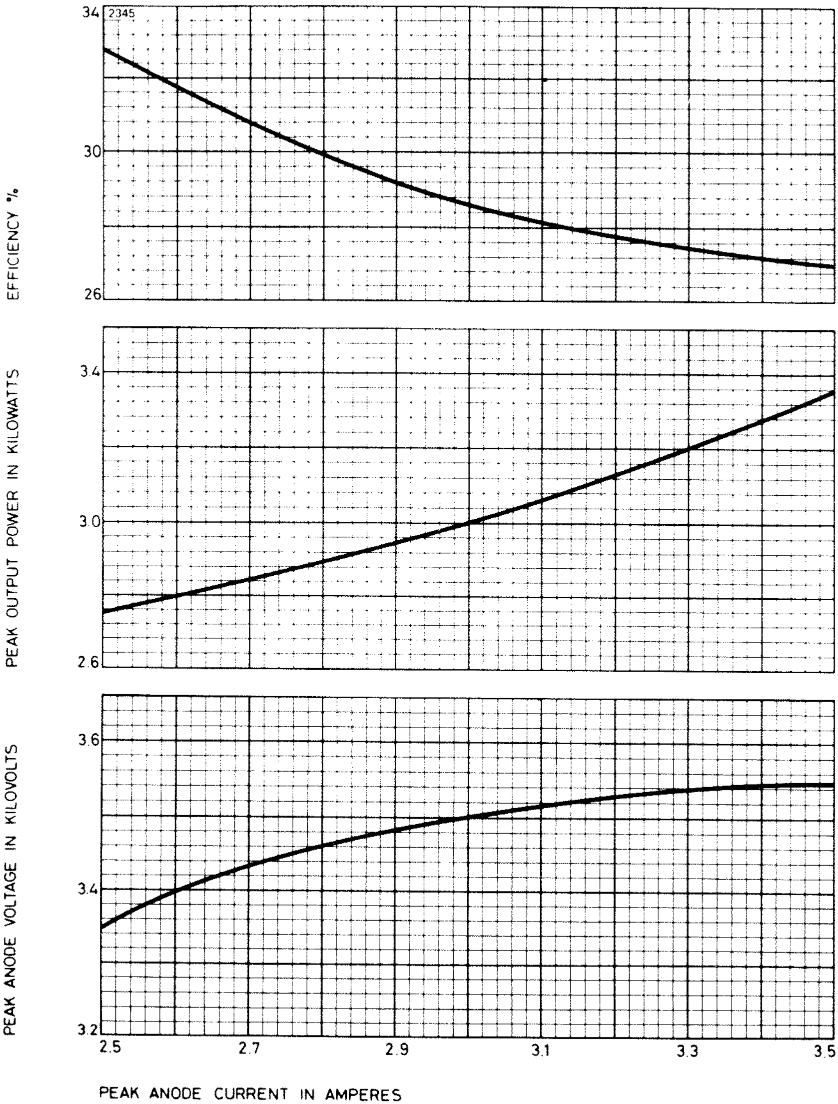
6. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

7. For the range 9415 to 9475MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1. The voltage minimum will be 3.0 to 9.0mm from the output flange of the M599A and 0 to 6.0mm from the output flange of the M599B, towards the anode.

8. The heater current, measured with heater voltage of 6.3V and no anode input power, will be within the range 0.43A and 0.60A.

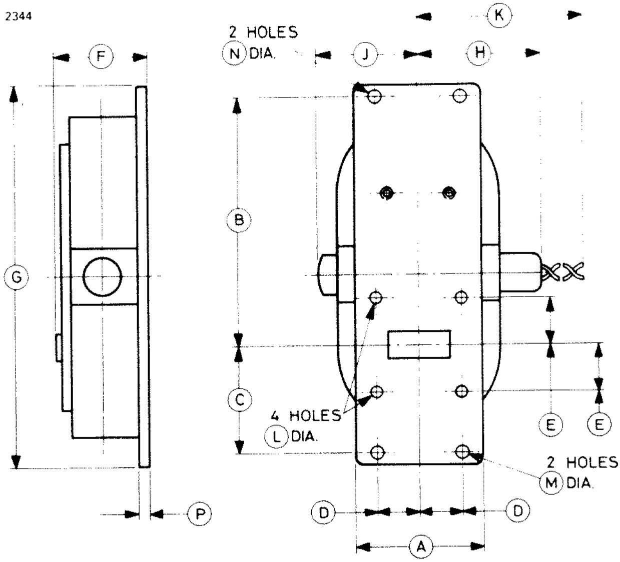
9. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART

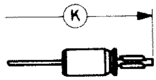


OUTLINE

M599B is identical in outline with M599A but the heater and cathode terminals are fitted with plugs (see detail drawing below).



Detail of M599B Heater and Cathode Terminals



Lead Connections

Colour	M599B Plug	Element
Red Blue	XE450 XE451	Heater Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38
B	3.463 ± 0.004	87.960 ± 0.102
C	1.521 ± 0.004	38.633 ± 0.102
D	0.610 ± 0.002	15.494 ± 0.051
E	0.640 ± 0.004	16.256 ± 0.102
F	1.457 max	37.01 max
G	5.335 ± 0.007	135.51 ± 0.18
H	2.165 max	54.99 max
J	1.772 max	45.01 max
K	9.625 min (M599A) 10.250 ± 0.500 (M599B)	244.5 min (M599A) 260.4 ± 12.7 (M599B)
L	$0.170^{+0.003}_{-0.005}$	$4.318^{+0.076}_{-0.127}$
M	0.175 ± 0.003	4.445 ± 0.076
N	0.175 ± 0.003	4.445 ± 0.076
P	0.157 min	3.99 min

Millimetre dimensions have been derived from inches.

M5005

X-BAND MAGNETRON

Service Type CV9424

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9345 to 9405	MHz
Typical peak output power	53	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	12.6	V
Heater current at 12.6V	1.8	A
Heater starting current, peak value, not to be exceeded	10	A max
Cathode heating time (minimum)	1.5	min

Mechanical

Overall dimensions	5.844 x 4.137 x 2.900 inches max 148.4 x 105.1 x 73.66mm max
Net weight	3¾ pounds (1.7kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	14	V
Heater starting current (peak)	–	10	A
Anode voltage (peak)	11.5	13.5	kV
Anode current (peak)	9.0	12	A
Input power (mean) (see note 2)	–	240	W
Pulse length (see note 3)	–	5.0	μs
Rate of rise of voltage pulse (see note 4)	40	120	kV/μs
Anode temperature	–	150	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising of waveguide	–	40	lb/in²
	–	2.8	kg/cm²
Altitude (at v.s.w.r. 1.2:1 max)	–	20 000	ft
			(360mm Hg min)

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.5	V
Anode current (peak)	12	A
Pulse length	4.0	μs
Pulse repetition rate	400	p.p.s.

Typical Performance

Anode voltage (peak)	13	kV
Output power (peak)	53	kW
Output power (mean)	85	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

Heater voltage (for test)	9.3	V
Anode current (mean)	12	mA
Duty cycle	0.001	
Pulse length (see note 3)	5.0	μs
V.S.W.R. at the output coupler	1.05:1	
Rate of rise of voltage pulse (see notes 4 and 5)	75	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	11.5	13.5	kV
Output power (mean)	40	–	W
Frequency (see note 6)	9345	9405	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	13	MHz
Stability (see note 7)	–	0.5	%
Frequency pushing	–	0.5	MHz/A
Altitude (v.s.w.r. 1.2:1) (see note 8)	20 000	–	ft
	6.1	–	km
Heater current			see note 9
Temperature coefficient of frequency			see note 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under test conditions above, but with a v.s.w.r. of 1.5:1 (min) cycled through λg in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Output power (mean)	32	W min
Frequency: must be within Test Limits above.		
Stability (see note 7)	2.0	% max

NOTES

1. With no anode input power.

   On stand by the heater voltage must not exceed 12.6 volts. Prior to the application of h.t. the cathode shall be heated by applying to the heater 12.6 volts for 3 minutes. On application of anode power, the heater voltage must be lowered according to the following formula:

   $$V_h = 11.6 - 0.017Pi$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

3. Tolerance $\pm$10%.

4. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

5. All valves are also tested functionally with the following pulse conditions:

Rate of rise of voltage pulse	60	kV/μs max
Pulse length	4.0	μs
Duty cycle	0.0016	
Anode current (mean)	19.2	mA

   Load v.s.w.r. 1.5:1 varied through all phases.

6. With anode temperature of 100°C $\pm$ 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

7. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range.

Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 5 minutes.

8. The altitude test is carried out under the typical operation conditions, that is

Pulse length	4.0	μs
Duty cycle	0.0016	
Anode current (peak)	12	A

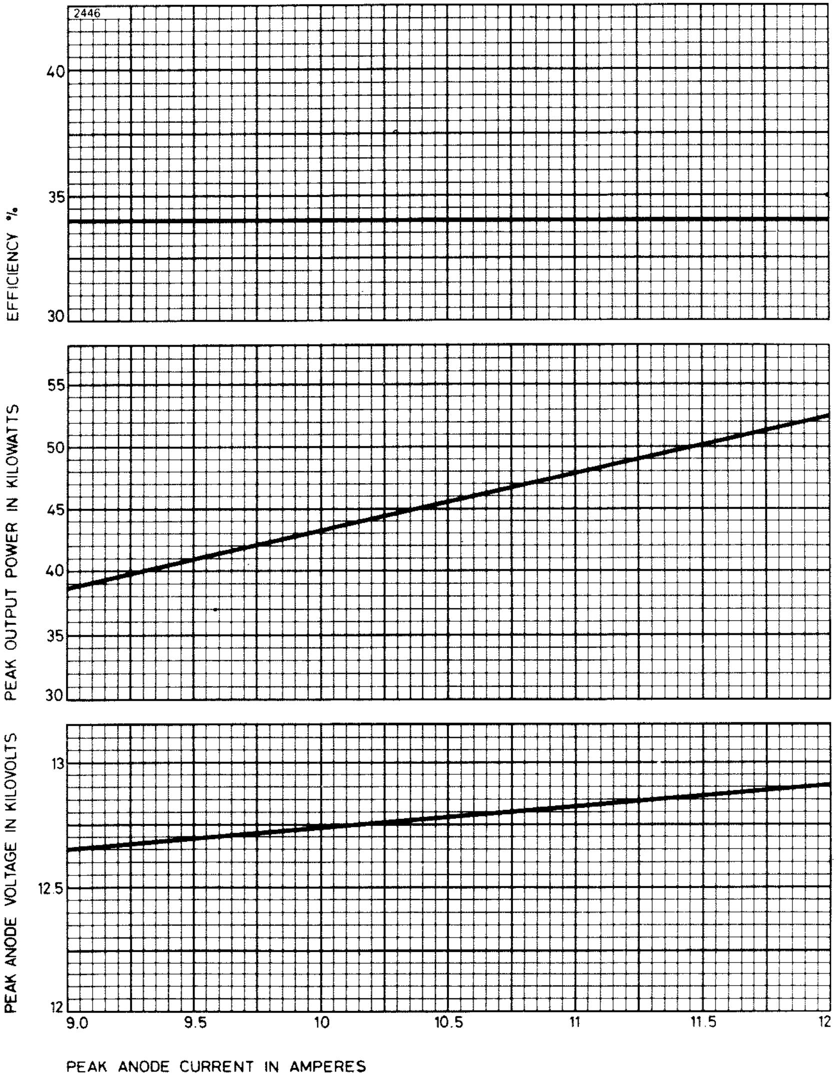
The phase of the mismatch is adjusted to present a voltage maximum at the output flange of the magnetron.

The altitude is computed from pressure readings by means of the I.C.A.O. Standard Atmosphere.

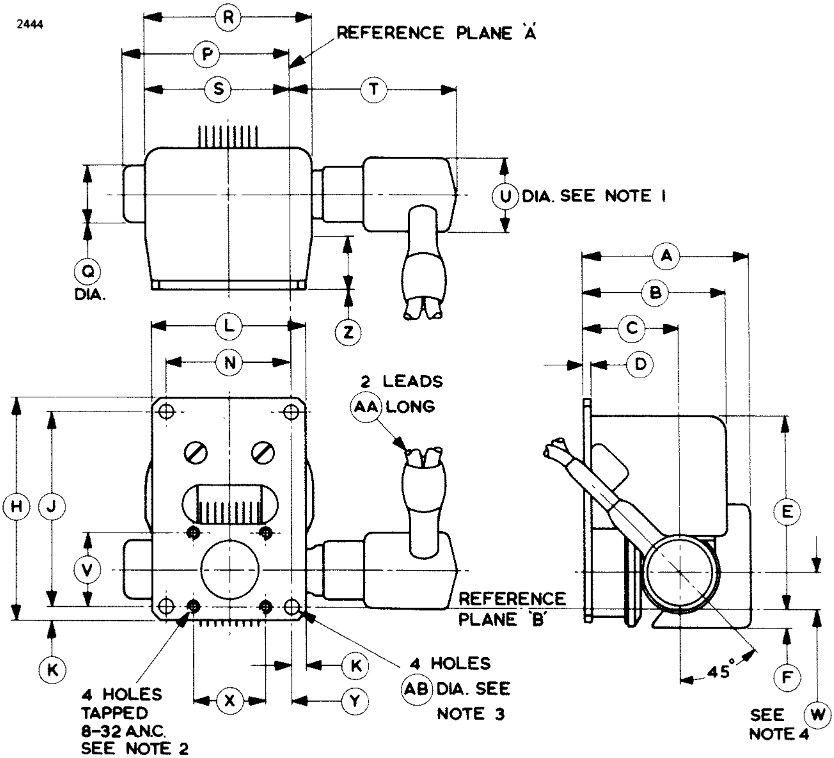
9. Measured with heater voltage of 12.6V and no anode input power, the heater current limits are 1.6A minimum, 2.0A maximum.

10. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.25MHz/°C.

PERFORMANCE CHART



OUTLINE (See page 8 for Outline Notes and Connections)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.900 max	73.66 max	Q	1.000 ± 0.015	25.40 ± 0.38
B	2.500 max	63.50 max	R	3.250 max	82.55 max
C	1.670 ± 0.125	42.42 ± 3.18	S	2.850 max	72.39 max
D	0.150 max	3.81 max	T	2.900 max	73.66 max
E	3.390 max	86.11 max	U	1.312 max	33.32 max
F	0.472 max	11.99 max	V	1.280	32.51
H	3.905 max	99.19 max	W	0.640	16.26
J	3.400	86.36	X	1.220	30.99
K	0.250 ± 0.010	6.35 ± 0.25	Y	0.490	12.45
L	2.705 max	68.71 max	Z	0.940 min	23.88 min
N	2.200	55.88	AA	9.500 min	241.3 min
P	2.944 max	74.78 max	AB	0.201	5.105

Millimetre dimensions have been derived from inches.

Outline Notes

1. The cathode side arm, including rubber encapsulation, will lie within a cylinder of 1.562 inch (39.67mm) diameter, on the axis defined by dimensions C and W.
2. Positional tolerance 0.004 inch (0.102mm) diameter (B.S.308).
3. Positional tolerance 0.005 inch (0.127mm) diameter (B.S.308).
4. Dimension W refers only to the axis of the cathode side arm.

Lead Connections

Colour	Element
Green Yellow	Heater Heater, Cathode

M5006 M5007 M5010

X-BAND MAGNETRONS

Frequency variants of 4J50A

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetrons		
Frequency range:		
M5006	9070 to 9130	MHz
M5007	9210 to 9270	MHz
M5010	9130 to 9210	MHz
Typical peak output power	225	kW
Magnets		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		UG-52A/U (Z830033)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	13.75	V
Heater current at 13.75V	3.25	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum)	3	min

Mechanical

Overall dimensions	7.687 x 4.353 x 6.155 inches max 195.2 x 110.6 x 156.3mm max
Net weight	10½ pounds (4.8kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	–	15	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	23	kV
Anode current (peak) (see note 2)	–	27.5	A
Input power (mean) (see note 3)	–	750	W
Duty cycle	–	0.001	
Pulse length (see note 4)	–	6.0	μs
Rate of rise of voltage pulse (see note 5)	60	160	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising (see note 7):			
input	–	45	lb/in²
output	–	45	lb/in²

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.1	V
Anode current (peak)	25	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	22	kV
Output power (peak)	225	kW
Output power (mean)	225	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.6	9.2	V
Anode current (mean)	27.5	18	mA
Duty cycle	0.001	0.001	
Pulse length (see note 4)	0.5	5.5	μs
V.S.W.R. at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 5)	160	110	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	20	23	–	–	kV
Output power (mean)	225	–	140	–	W
Frequency (see note 8):					
M5006	9070	9130	–	–	MHz
M5007	9210	9270	–	–	MHz
M5010	9130	9210	–	–	MHz
R.F. bandwidth at ¼ power (see note 9)	–	5.0	–	1.0	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	15	–	–	MHz
Stability (see note 10)	–	1.0	–	1.0	%
Heater current					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions, but with a v.s.w.r. of 1.5:1 (min) cycled through λ_g in 30 minutes max. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	170	W min
R.F. bandwidth at ¼ power	6	MHz max
Frequency: must be within Test Limits above, Oscillation 1		
Stability (see note 10)	2	% max

NOTES

1. With no anode input power.

   On standby, the heater voltage must not exceed 13.75 volts. On the application of anode power, the heater voltage must be lowered in accordance with the following formulae:

   For input powers up to, and including, 595 watts,

   $$V_h = 14 - 0.0125\,Pi$$

   and for input powers above 595 watts,

   $$V_h = 24 - 0.0293\,Pi,$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For pulse widths above 1.2μs the maximum design peak anode current must be reduced in accordance with the following formula:

   $$i_{apk} = 29.6 - 1.934t_p$$

   where i_{apk} = peak anode current in amperes
   and t_p = pulse length in microseconds.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

   The limits for the rate of rise of voltage vary according to the pulse length, as follows:

Pulse length	Rate of rise of voltage (kV/μs)	
(μs)	**Min**	**Max**
0.5	120	160
1.75	95	140
5.0	70	110

6. An air flow of 80ft³/min (2.3m³/min) at approximately 760mm mercury directed on to the cooling fins from an orifice of 4¼ x 1¼ inches

(108 x 31.8mm) will keep the temperature rise below 50°C.

7. Pressurising is required to prevent breakdown in the waveguide.

8. At anode temperature of 100°C.

9. The maximum r.f. bandwidth in MHz under oscillation 1 conditions is 2.5/(pulse length in μs).

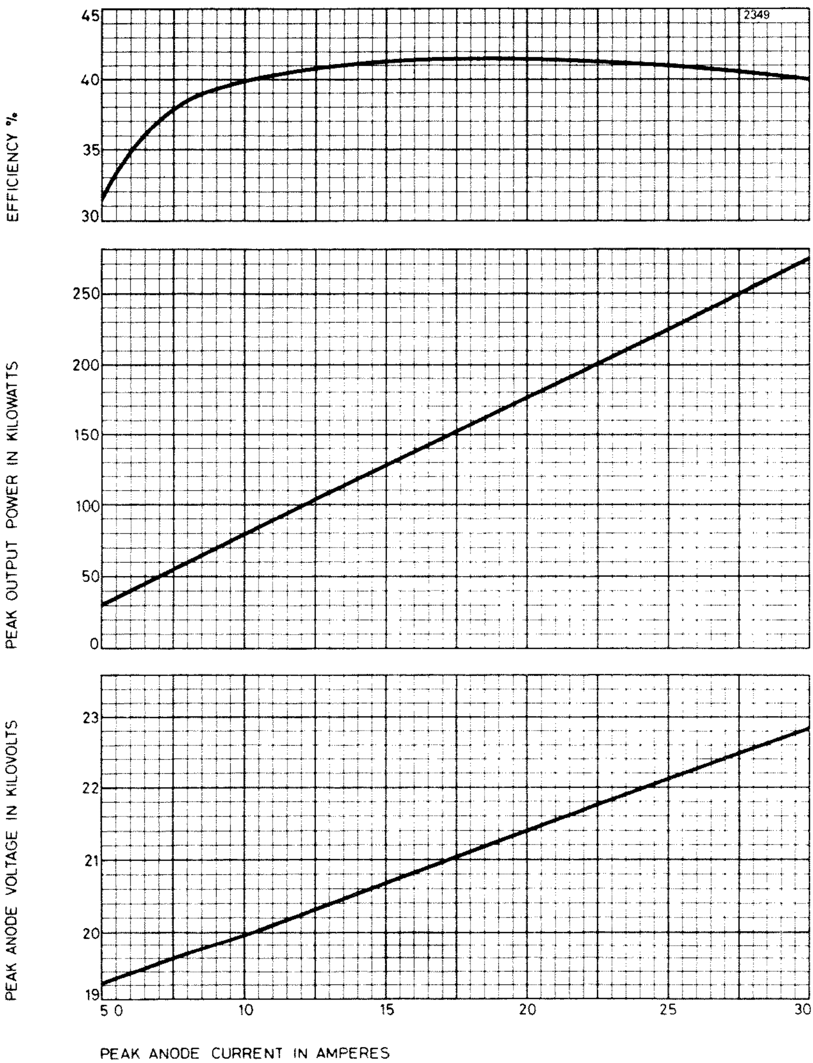
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the following frequency ranges:

M5006	9055 to 9150MHz
M5007	9195 to 9290MHz
M5010	9115 to 9230MHz

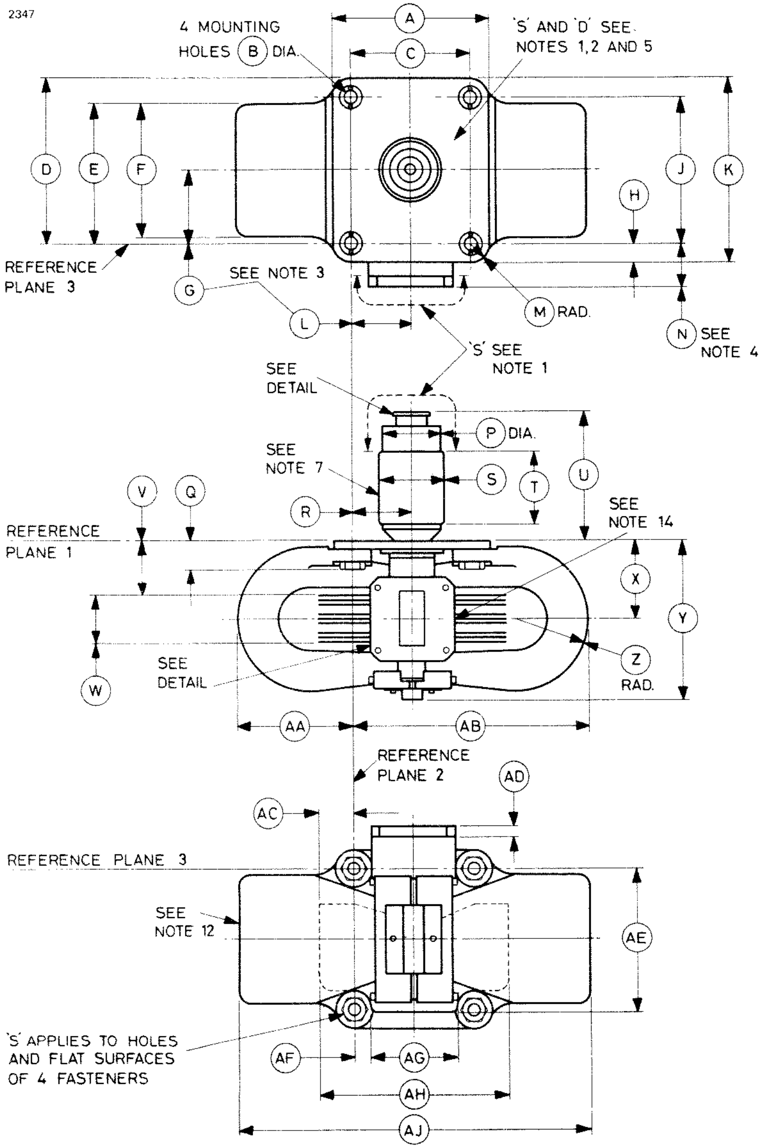
Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

11. Measured with heater voltage of 13.75V and no anode input power, the heater current limits are 3.0A minimum, 3.5A maximum.

PERFORMANCE CHART

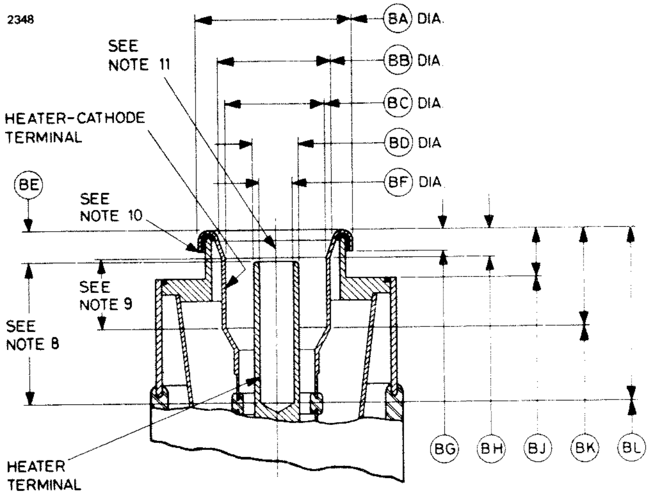


OUTLINE (See page 10 for Outline Notes)

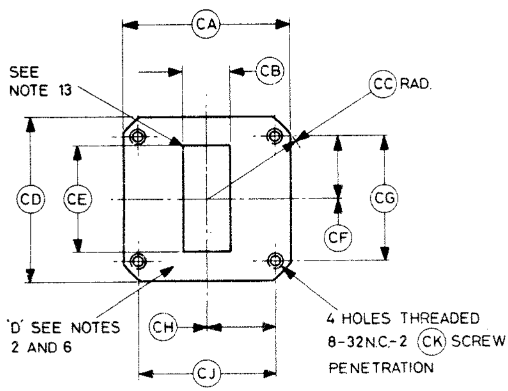


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.468 max	88.09 max	AE	3.125 max	79.38 max
B	0.281 ± 0.005	7.14 ± 0.13	AF	0.312	7.92
C	2.500 ± 0.010	63.50 ± 0.25	AG	1.875	47.62
D	3.421 max	86.89 max	AH	4.000	101.6
E	3.000 max	76.20 max	AJ	7.687 max	195.2 max
F	2.875 max	73.02 max	BA	$0.830\begin{smallmatrix}+0.008\\-0.005\end{smallmatrix}$	$21.08\begin{smallmatrix}+0.20\\-0.13\end{smallmatrix}$
G	1.500	38.10			
H	0.421 max	10.61 max	BB	0.610	15.49
J	3.000 ± 0.010	76.20 ± 0.25	BC	$0.540\begin{smallmatrix}+0.005\\-0.008\end{smallmatrix}$	$13.72\begin{smallmatrix}+0.13\\-0.20\end{smallmatrix}$
K	3.875 max	98.42 max			
L	1.250	31.75	BD	0.250 ± 0.015	6.35 ± 0.38
M	0.406	10.31	BE	0.156 ± 0.031	3.96 ± 0.79
N	0.907 ± 0.025	23.04 ± 0.64	BF	0.169 ± 0.005	4.29 ± 0.13
P	1.250	31.75	BG	0.125 ± 0.010	3.18 ± 0.25
Q	0.625 ± 0.031	15.87 ± 0.79	BH	0.156 max	3.96 max
R	1.250	31.75	BJ	0.250	6.35
S	1.500 max	38.10 max	BK	0.516 min	13.11 min
T	1.500 min	38.10 min	BL	0.750 min	19.05 min
U	2.687 ± 0.062	68.25 ± 1.57	CA	1.830	46.48
V	1.141 ± 0.046	28.98 ± 1.17	CB	0.497	12.62
W	1.000 ± 0.046	25.40 ± 1.17	CC	1.156	29.36
X	1.653 ± 0.020	41.99 ± 0.51	CD	1.830 ± 0.010	46.48 ± 0.25
Y	3.406 max	86.51 max	CE	1.122	28.50
Z	1.562	39.67	CF	0.676 ± 0.005	17.17 ± 0.13
AA	2.593 max	65.86 max	CG	1.352 ± 0.004	34.341 ± 0.102
AB	5.093 max	129.4 max	CH	0.737 ± 0.005	18.72 ± 0.13
AC	0.750	19.05	CJ	1.474 ± 0.004	37.440 ± 0.102
AD	0.250	6.35	CK	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. All metal surfaces covered by black finish except those marked 'S' and 'D'. 'S' will be silver or nickel plated surfaces.
2. Hermetic connections can be made to surface 'D'.
3. The axis of the cathode terminal will be within a radius of 0.046 inch (1.17mm) of the specified location. (Note 4 applies).
4. The limits include angular as well as lateral deviations.
5. All points on the mounting surface will be within 0.005 inch (0.127 mm) of reference plane 1.
6. With the flange on a plane surface, a 0.005 inch (0.127mm) thickness gauge 0.125 inch (3.18mm) wide will not enter.
7. Any portion of the assembly above reference plane 1 will be within a 0.750 inch (19.05mm) radius of the specified axis of the cathode terminal.
8. These dimensions define the extremities of the cylindrical section given by the dimension BF.
9. These dimensions define the extremities of the cylindrical section given by the dimension BC.
10. No clamping means to bear beyond this dimension.
11. The heater terminal will be concentric with the cathode terminal within 0.010 inch (0.25mm).
12. **Warning.** Maintain a minimum clearance of 2 inches (5cm) between this magnet and magnetic material (magnets, steel tools, plates, etc.).
13. The opening in the waveguide will be enclosed by a dust cover when tube is not in use.
14. Temperature rise test point. This point is on the anode block in front of the cooling fins.

M5019

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	8.0	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2.0	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.312 inches max 133.4 x 113.5 x 84.13mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	–	6.0	kV
Anode current (peak)	4.0	5.0	A
Input power (peak)	–	30	kW
Input power (mean) (see note 3)	–	60	W
Duty cycle	–	0.002	
Pulse length (see note 4)	–	1.0	μs
Rate of rise of voltage pulse (see note 5)	–	100	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg

TYPICAL OPERATION

Operational Conditions

Heater voltage	6.3	V
Anode current (peak)	4.5	A
Pulse length	0.25	μs
Pulse repetition rate	1500	p.p.s.

Typical Performance

Anode voltage (peak)	5.4	kV
Output power (peak)	8.0	kW
Output power (mean)	3.0	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

Heater voltage (for test)	6.3	V
Anode current (mean)	4.5	mA
Duty cycle	0.001	
Pulse length (see note 4)	0.5	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 5)	100	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	5.0	5.5	kV
Output power (mean)	6.0	–	W
Frequency (see note 7)	9345	9405	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	MHz
Stability (see note 8)	–	0.25	%
R.F. bandwidth at ¼ power	–	4.0	MHz
Cold impedance			see note 9
Heater current			see note 10
Temperature coefficient of frequency			see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the conditions specified in Typical Operation. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Output power (mean)	5.0	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Frequency: must be within Test Limits above		
Stability (see note 8)	0.5	% max

NOTES

1. With no anode input power.

   For average values of pulse input power greater than 25 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{ volts}$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. Other frequency ranges can be supplied on request.

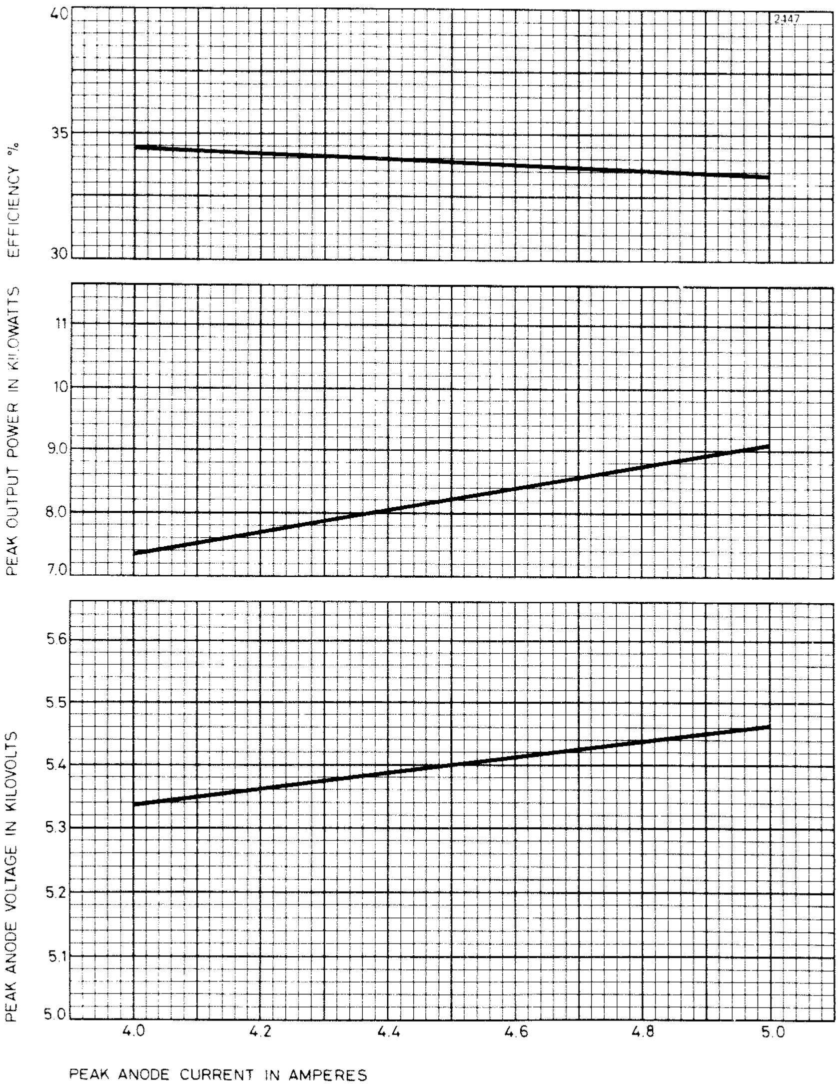
8. The peak current is varied between 4A and 6A. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. For the range 9345 to 9405MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

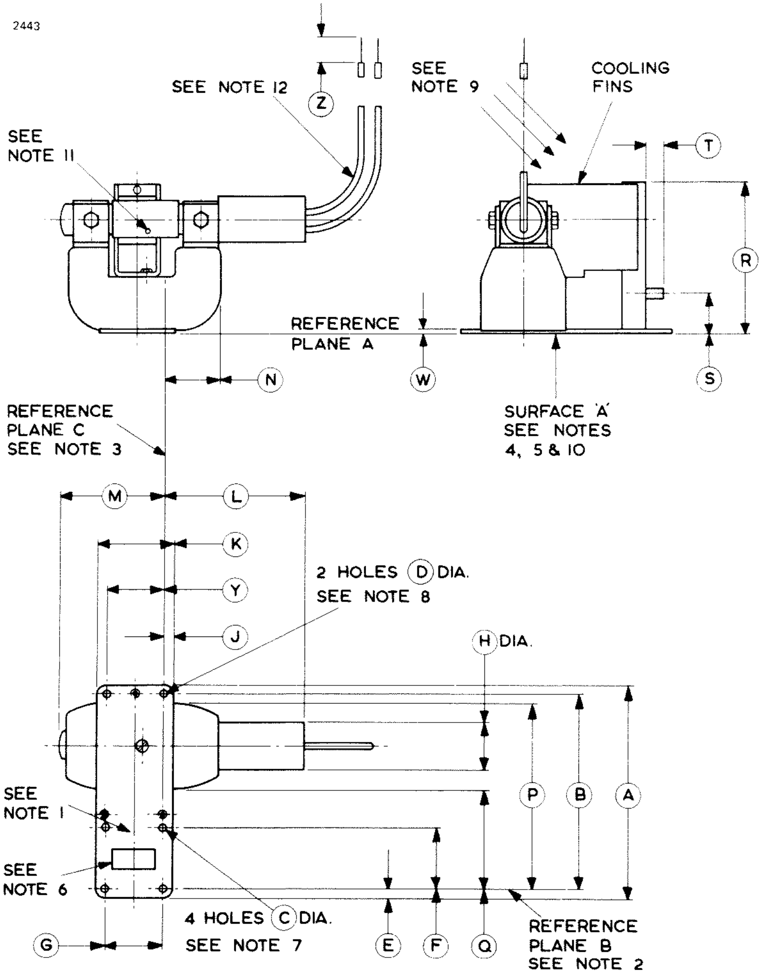
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.5A minimum, 0.6A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART



OUTLINE



2443
SEE NOTE 12
Z
SEE NOTE 9
COOLING FINS
T
SEE NOTE 11
R
REFERENCE PLANE A
S
N
W
REFERENCE PLANE C SEE NOTE 3
SURFACE 'A' SEE NOTES 4, 5 & 10
M
L
K
2 HOLES D DIA.
SEE NOTE 8
Y
J
H DIA.
SEE NOTE 1
P
B
A
SEE NOTE 6
4 HOLES C DIA.
SEE NOTE 7
G
E
F
Q
REFERENCE PLANE B SEE NOTE 2

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	M	2.187 max	55.55 max
B	4.103 ± 0.005	104.22 ± 0.13	N	1.187 max	30.15 max
C	0.170 ± 0.003	4.318 ± 0.076	P	4.000 max	101.6 max
D	0.175 ± 0.003	4.445 ± 0.076	Q	1.937 min	49.20 min
E	0.172 ± 0.016	4.37 ± 0.41	R	3.312 max	84.13 max
F	1.280 ± 0.004	32.512 ± 0.102	S	0.875 ± 0.125	22.23 ± 3.18
G	1.220 ± 0.004	30.988 ± 0.102	T	0.375 max	9.53 max
H	1.000 max	25.40 max	W	0.125	3.18
J	0.203 ± 0.015	5.16 ± 0.38	Y	1.220 ± 0.004	30.988 ± 0.102
K	1.625 ± 0.016	41.28 ± 0.41	Z	0.500	12.70
L	2.937 ± 0.125	74.60 ± 3.18			

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler UG-40A/U (Z830051) and is the area tested in accordance with specification MIL-E-1 Par. 4.9.13.
2. Reference plane B passes through the centres of two mounting plate holes as shown and is perpendicular to plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown, and is perpendicular to planes A and B.
4. With surface A resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. Surface A and interior surfaces of the waveguide will be plated with 10mg/in^2 (1.55mg/cm^2) of gold or 30mg/in^2 (4.65mg/cm^2) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials.
6. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler UG-40A/U (Z830051) (see note 1 above).

7. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane C.
8. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.
9. Recommended direction of air flow.
10. All metal surfaces except surface A will be painted with heat resistant paint or otherwise treated to prevent corrosion.
11. Anode temperature measured at this point.
12. Green heater lead 3.000 inches (76.2mm) long. Yellow heater and cathode lead 2.500 inches (63.5mm) long.

M5022

X-BAND MAGNETRON

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	9415 to 9475	MHz
Typical peak output power	30	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U (Z830051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.55	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	60	s

Mechanical

Overall dimensions	4.250 x 4.468 x 3.312 inches max 108 x 113.5 x 84.13mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.5	8.5	kV
Anode current (peak)	6.0	10	A
Input power (peak)	–	75	kW
Input power (mean) (see note 3)	–	85	W
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	120	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	9.0	9.0	A
Pulse length	1.0	0.05	μs
Pulse repetition rate	500	2000	p.p.s.
Rate of rise of voltage pulse	120	120	kV/μs

Typical Performance

Anode voltage (peak)	8.3	8.3	kV
Output power (peak)	30	30	kW
Output power (mean)	15	3.0	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

Heater voltage (for test)	6.3	V
Anode current (mean)	4.5	mA
Duty cycle	0.0005	
Pulse length (see note 4)	0.5	μs
V.S.W.R. at the output coupler	1.15:1	
Rate of rise of voltage pulse (see note 5)	120	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	7.5	8.5	kV
Output power (mean)	11.0	–	W
Frequency (see note 7)	9415	9475	MHz
R.F. bandwidth at ¼ power	–	5.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	18	MHz
Stability (see note 8)	–	0.25	%
Cold impedance			see note 9
Heater current			see note 10
Temperature coefficient of frequency			see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Test Conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Anode voltage (peak)	7.5 to 8.5	kV
Output power (peak)	18	kW min
R.F. bandwidth at ¼ power	7.0	MHz max
Frequency: must be within Test Limits above		
Stability (see note 8)	2.0	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 40 watts the heater voltage will need to be reduced.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 90 seconds.

3. The various parameters are related by the following formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. Other frequency ranges can be supplied on request.

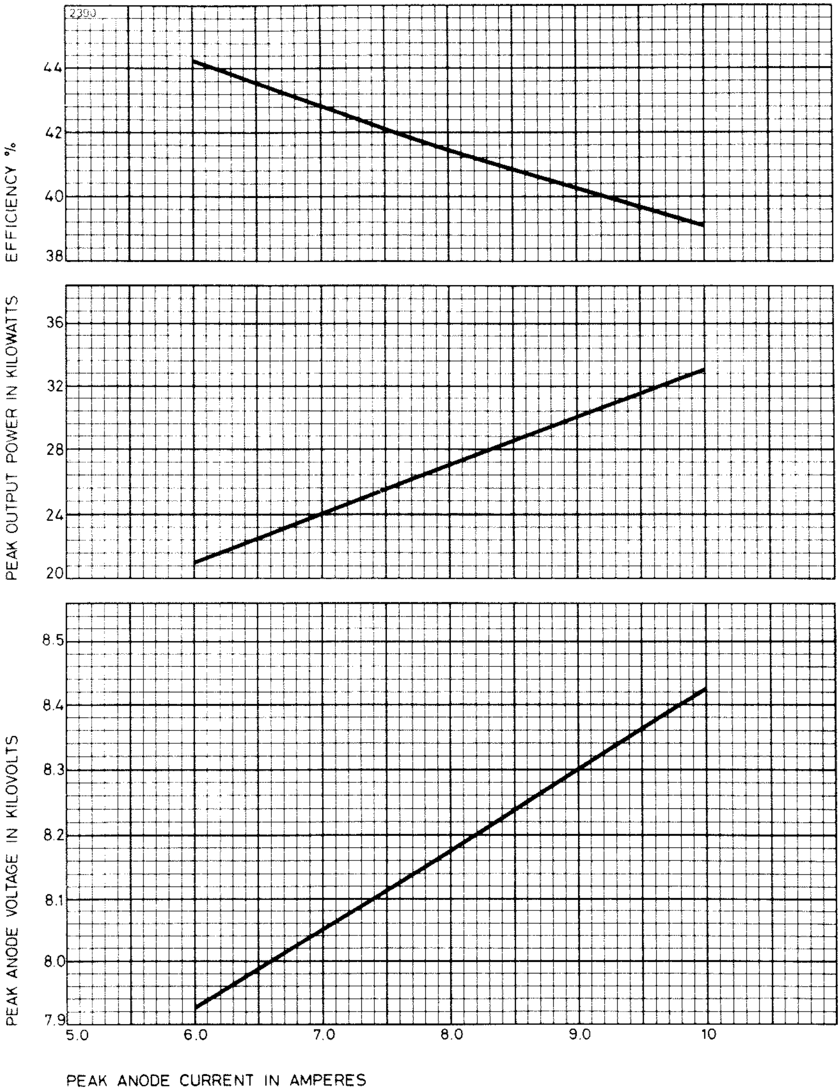
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. For the range 9415 to 9475MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

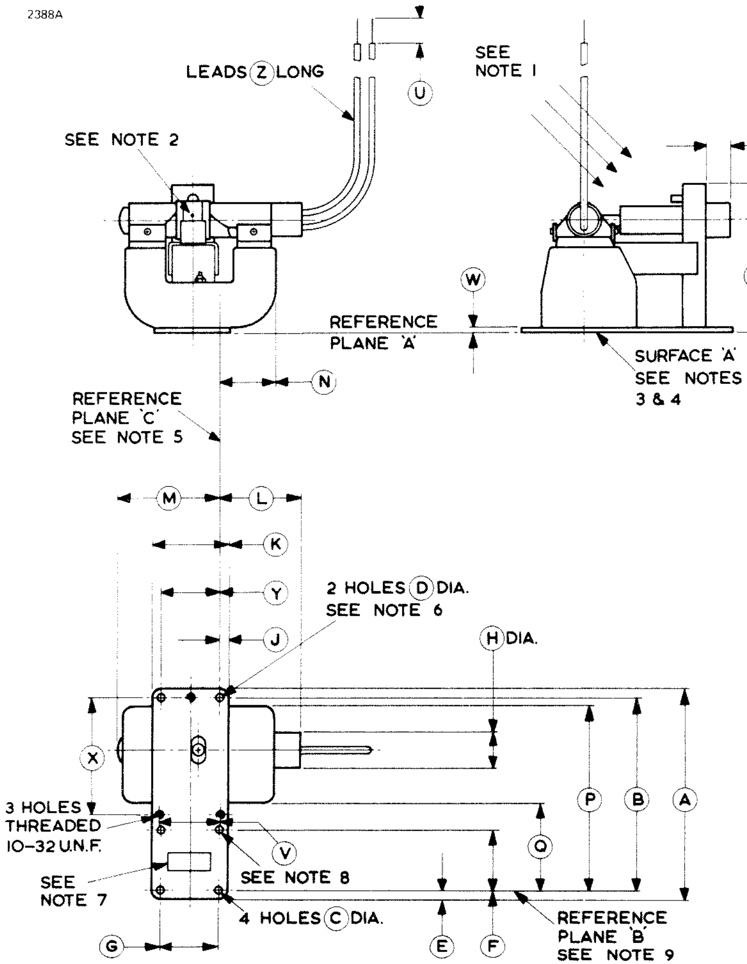
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green Yellow	Heater Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	N	1.187 max	30.15 max
B	4.103 ± 0.004	104.22 ± 0.10	P	4.000 max	101.6 max
C	0.170 ± 0.003	4.328 ± 0.076	Q	1.811 min	46.00 min
D	0.175 ± 0.003	4.445 ± 0.076	R	3.312 max	84.13 max
E	0.172 ± 0.016	4.37 ± 0.41	S	2.500	63.50
F	1.280 ± 0.004	32.51 ± 0.10	T	0.500 max	12.70 max
G	1.220 ± 0.004	30.99 ± 0.10	U	0.500	12.70
H	1.000 max	25.40 max	V	1.250	31.75
J	0.204 ± 0.015	5.18 ± 0.38	W	0.125	3.18
K	1.625 ± 0.016	41.28 ± 0.41	X	2.393	60.78
L	2.063 max	52.40 max	Y	1.220 ± 0.004	30.99 ± 0.10
M	2.187 max	55.55 max	Z	9.750 ± 0.500	247.7 ± 12.7

Millimetre dimensions have been derived from inches.

Outline Notes

1. Recommended direction of air flow if required.
2. Anode temperature measured at this point.
3. With surface 'A' resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
4. Surface 'A' and interior surfaces of the waveguide will be plated with 10mg/in^2 (1.55mg/cm^2) of gold or 30mg/in^2 (4.65mg/cm^2) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.
5. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes 'A' and 'B'.
6. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.
7. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U.
8. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane 'C'.
9. Reference plane 'B' passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane 'A'.

M5023 M5024 M5025

X-BAND MAGNETRONS

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
M5023	9345 to 9405	MHz
M5024	9415 to 9475	MHz
M5025	9380 to 9440	MHz
Typical peak output power	20	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40A/U
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.55	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	30	s

Mechanical

Overall dimensions	4.468 x 3.312 x 5.250 inches max 113.5 x 84.13 x 133.4mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 6) — natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.0	8.2	kV
Anode current (peak)	6.0	9.0	A
Input power (peak)	–	60	kW
Input power (mean) (see note 3)	–	85	W
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	–	120	kV/μs
Anode temperature (see note 6)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	Condition 3	
Heater voltage	6.3	6.3	6.3	V
Anode current (peak)	7.5	7.5	7.5	A
Pulse length	0.5	0.1	0.05	μs
Pulse repetition rate	1000	1000	1000	p.p.s.
Rate of rise of voltage pulse	80	100	100	kV/μs

Typical Performance

Anode voltage (peak)	7.8	7.8	7.8	kV
Output power (peak)	20	20	20	kW
Output power (mean)	10	2.0	1.0	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification.

Test Conditions

Heater voltage (for test)	4.5	V
Anode current (mean)	7.0	mA
Duty cycle	0.001	
Pulse length (see note 4)	1.0	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 5)	90	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	7.0	8.2	kV
Output power (mean)	16	–	W
Frequency range:			
M5023	9345	9405	MHz
M5024	9415	9475	MHz
M5025	9380	9440	MHz
R.F. bandwidth at ¼ power	–	3.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	18	MHz
Stability (see note 8)	–	0.1	%
Cold impedance			see note 9
Heater current			see note 10
Temperature coefficient of frequency			see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Test Conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Anode voltage (peak)	7.0 to 8.4	kV
Output power (mean)	14	W min
R.F. bandwidth at ¼ power	3.5	MHz max
Frequency: must be within Test Limits above		
Stability (see note 8)	1	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage must be reduced in accordance with the schedule on page 5.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 1 minute minimum.

3. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Tolerance ±10%.

5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. Other frequency ranges can be supplied on request.

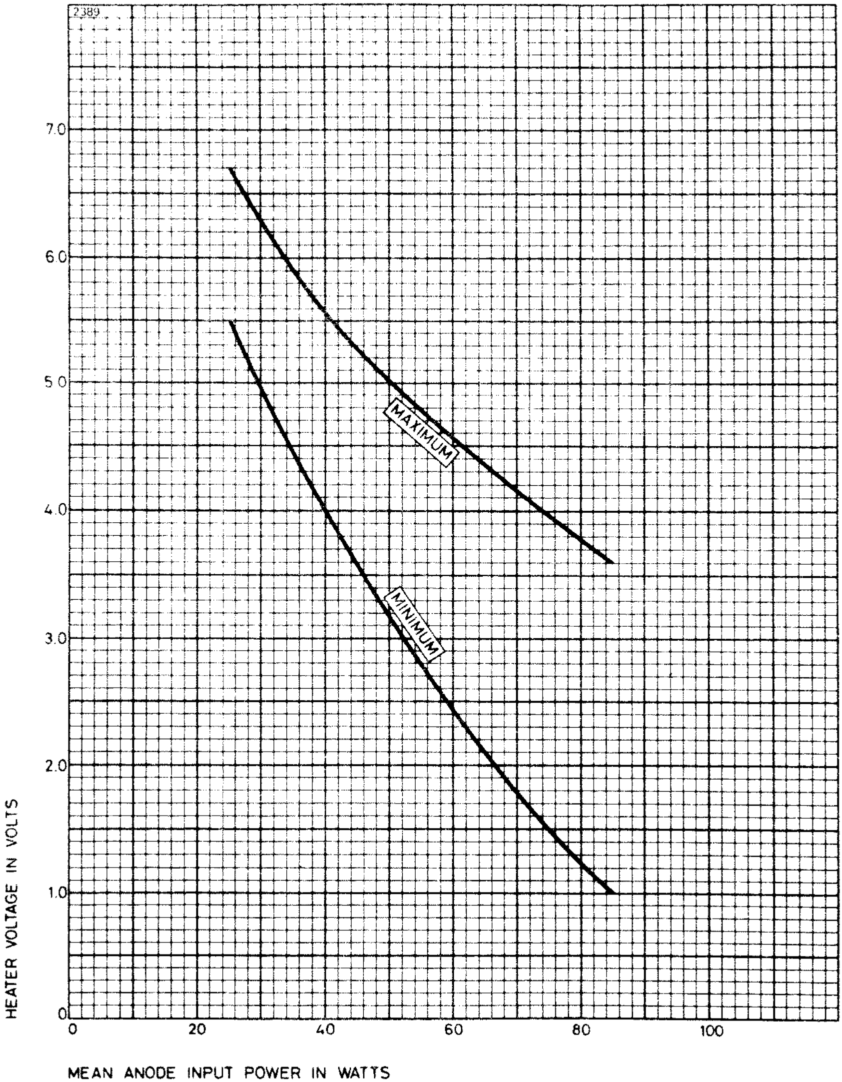
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. For the range 9345 to 9405MHz the impedance of the M5023 measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

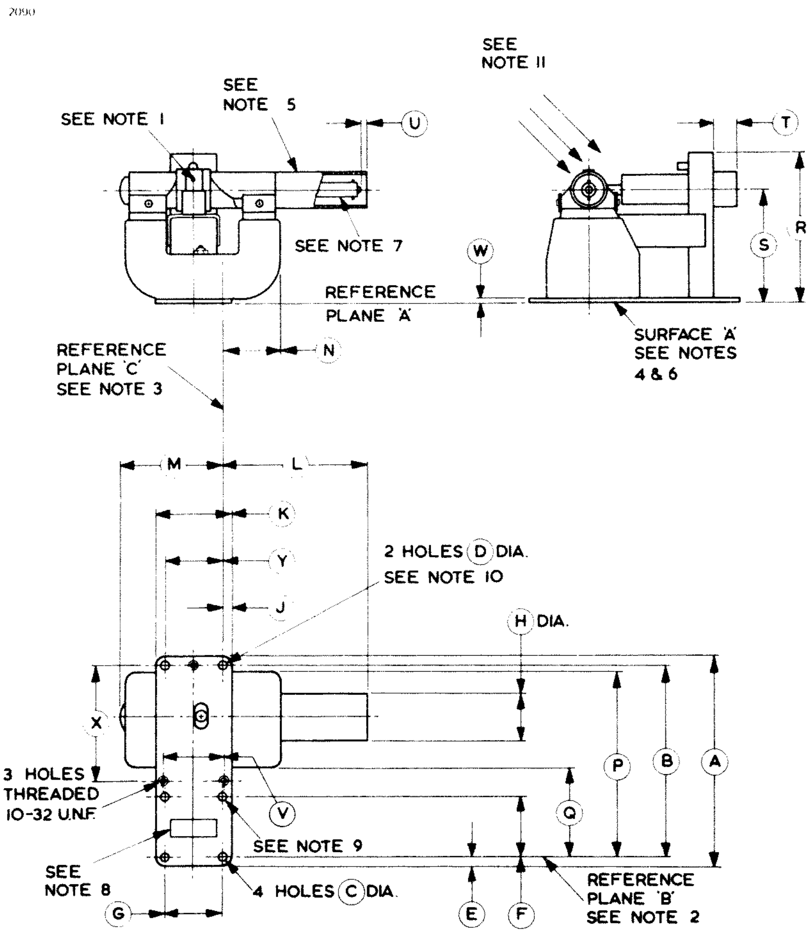
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

HEATER VOLTAGE REDUCTION SCHEDULE



OUTLINE



Bayonet Cap Connections

Contact	Element
End Contact	Heater
Shell	Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	N	1.187 max	30.15 max
B	4.103 ± 0.004	104.22 ± 0.10	P	4.000 max	101.6 max
C	0.170 ± 0.003	4.328 ± 0.076	Q	1.811 min	46.00 min
D	0.175 ± 0.003	4.445 ± 0.076	R	3.312 max	84.13 max
E	0.172 ± 0.016	4.37 ± 0.41	S	2.500	63.50
F	1.280 ± 0.004	32.51 ± 0.10	T	0.500	12.70
G	1.220 ± 0.004	30.99 ± 0.10	U	0.125 max	3.18 max
H	1.000 max	25.40 max	V	1.250	31.75
J	0.204 ± 0.015	5.18 ± 0.38	W	0.125	3.18
K	1.625 ± 0.016	41.28 ± 0.41	X	2.393	60.78
L	2.937 ± 0.125	74.60 ± 3.18	Y	1.220 ± 0.004	30.99 ± 0.10
M	2.187 max	55.55 max			

Millimetre dimensions have been derived from inches.

Outline Notes

1. Anode temperature measured at this point.
2. Reference plane 'B' passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane 'A'.
3. Reference plane 'C' intersects plane 'B' at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes 'A' and 'B'.
4. With surface 'A' resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
5. The axis of the heater lead protector will be within 5° of a normal to reference plane 'C'.
6. Surface 'A' and interior surfaces of the waveguide will be plated with 10mg/in^2 (1.55mg/cm^2) of gold or 30mg/in^2 (4.65mg/cm^2) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.

7. The clearance between the inside surface of the protector and the 0.375 inch (9.53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52 (1952) Type BA9s/14) will not be less than 0.125 inch (3.18mm).

8. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler Army-Navy designation UG-40A/U.

9. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane 'C'.

10. These holes will lie within 0.005 inch (0.127mm) of the indicated centres. A cylinder of 0.330 inch (8.38mm) diameter and centred on these holes will clear the side of the magnet.

11. Recommended direction of air flow.

M5043 M5044

X-BAND MAGNETRONS

The data should be read in conjunction with the Preamble to the Magnetron Section of the Valve Data Book.

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
M5043	9380 to 9440	MHz
M5044	9415 to 9475	MHz
Typical peak output power	6.5	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		joint services number 5985-99-083-0051
Cooling		natural

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	6.3	V
Heater current at 6.3V	0.5	A
Cathode heating time (minimum) (see note 1)	30	s
Input capacitance	9.0	pF max

Mechanical

Overall dimensions	5.342 x 3.937 x 1.850 inches max 135.7 x 100.0 x 46.99mm max
Net weight	2.75 pounds (1.25kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling

natural

MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Anode voltage (peak)	4.0	4.6	kV
Anode current (peak)	4.0	6.0	A
Input power (mean) (see note 2)	–	20	W
Duty cycle	–	0.0008	
Pulse length (see note 3)	–	1.0	μs
Rate of rise of voltage pulse (see note 4)	–	70	kV/μs
Anode temperature	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage (for operation)	6.3	6.3	V
Anode current (peak)	5.0	5.0	A
Pulse length	0.2	0.8	μs
Pulse repetition rate	2000	1000	p.p.s.
Rate of rise of voltage pulse	65	65	kV/μs

Typical Performance

Anode voltage (peak)	4.35	4.35	kV
Output power (peak)	6.5	6.5	kW
Output power (mean)	2.6	5.2	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

Heater voltage (for test)	6.3	V
Anode current (mean)	2.5	mA
Duty cycle	0.0005	
Pulse length (see note 3)	1.0	μs
Rate of rise of voltage pulse (see note 4)	75	kV/μs min

Limits

	Min	Max	
Anode voltage (peak)	4.0	4.5	kV
Output power (mean)	2.5	–	W
Frequency (see note 5):			
M5043	9380	9440	MHz
M5044	9415	9475	MHz
R.F. bandwidth at ¼ power	–	2.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	18	MHz
Stability (see note 6)	–	0.25	%
Cold impedance			see note 7
Heater current			see note 8
Temperature coefficient of frequency			see note 9

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Test Conditions above. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

	Min	Max	
Anode voltage (peak)	4.0	4.5	kV
Output power (mean)	2.0	–	W

Frequency: must be within Test Limits above.

NOTES

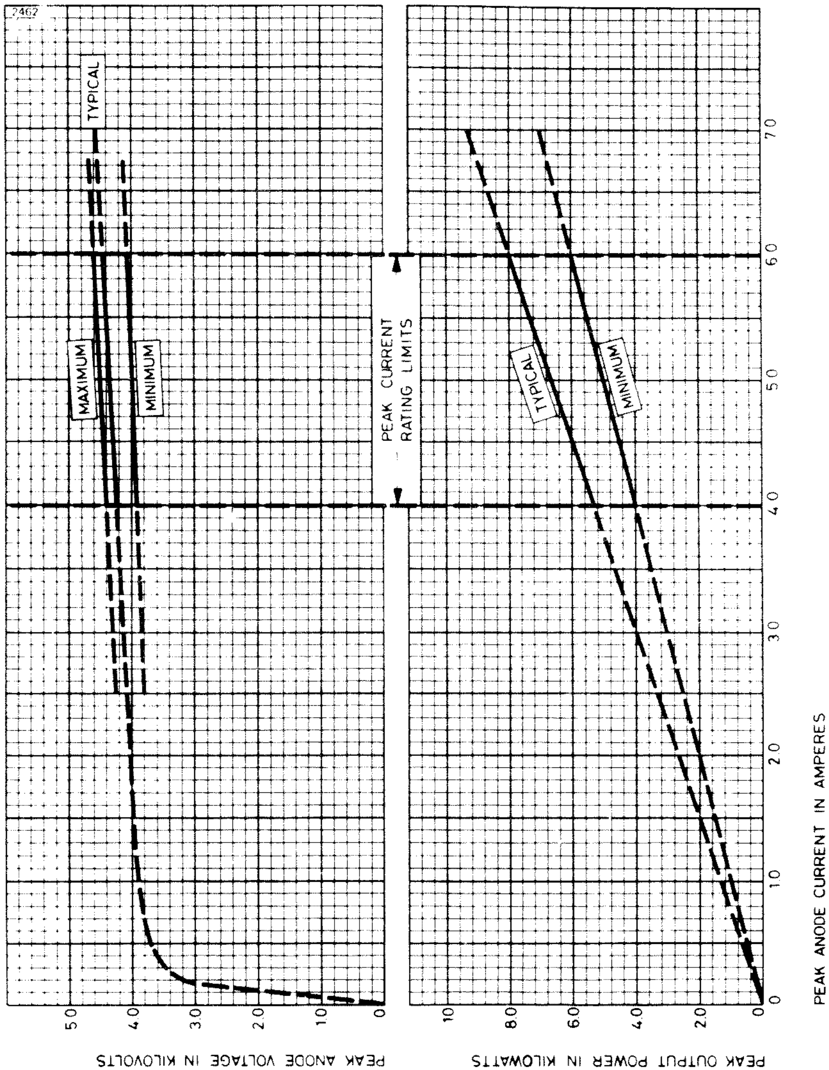
1. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 45 seconds minimum.
2. The various parameters are related by the following formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

3. Tolerance ±10%.
4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.
5. Other frequency ranges can be supplied on request.
6. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.
7. The impedance of the valve measured over the operating frequency range when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a voltage minimum 3.0 to 9.0mm from the output flange towards the anode.
8. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.
9. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

PERFORMANCE CHART



OUTLINE

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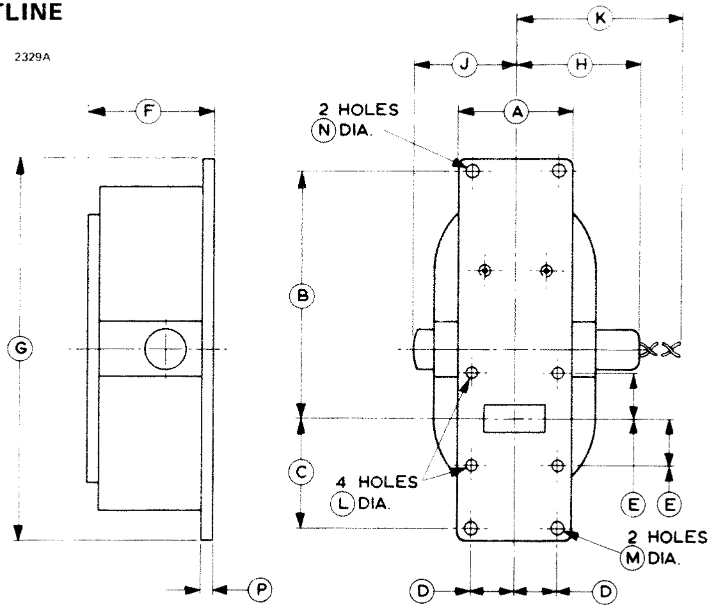

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38	J	1.772 max	45.01 max
B	3.463 ± 0.004	87.960 ± 0.102	K	9.625 min	244.5 min
C	1.521 ± 0.004	38.633 ± 0.102	L	$0.172 \begin{smallmatrix}+0.003\\-0.005\end{smallmatrix}$	$4.369 \begin{smallmatrix}+0.076\\-0.127\end{smallmatrix}$
D	0.610 ± 0.002	15.494 ± 0.051			
E	0.640 ± 0.004	16.256 ± 0.102	M	0.175 ± 0.003	4.445 ± 0.076
F	1.850 max	46.99 max	N	0.175 ± 0.003	4.445 ± 0.076
G	5.335 ± 0.007	135.51 ± 0.18	P	0.157 min	3.99 min
H	2.165 max	54.99 max			

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Red	Heater
Blue	Heater, cathode

TRAVELLING WAVE TUBES

Complete List of Types in this Section

Preamble

Data Sheets

TRAVELLING WAVE TUBES

March 1961

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

TRAVELLING WAVE TUBES

ENGLISH ELECTRIC

TRAVELLING WAVE TUBES—High Power

EEV Type	Frequency Range (GHz)	Output Power (kW)	Gain (db)	Beam Voltage (kV)	Beam Current (A)	Duty Cycle
N1061‡	X-Band*	900–500**	35–25	100	31	0·005
N1062††	8·42–9·08	5–3	23–17	32–18	0·84–1·5	CW
N1063††	8·82–9·58	5–3	23–17	32–18	0·84–1·5	CW
N1064††	9·35–10·13	5–3	23–17	32–18	0·84–1·5	CW

*Tubes covering 450MHz bands centred on various frequencies in X-band can be supplied.
**Peak value.
‡Requires solenoid N4115.
††Integral solenoid.

TRAVELLING WAVE TUBES—Medium Power

EEV Type	Frequency Range (GHz)	Gain (db)	Noise Factor (db)	Output Power (W)	Mount Type	R.F. Connections
N1001†	1·7–2·3	36	30	15	Solenoid	Waveguide
N1004†	3·8–4·2	33	30	5·0	Solenoid	Waveguide
N1013†	1·7–2·3	33	20	0·25	Solenoid	Waveguide
N1025M	3·6–4·2	33	21	0·10	N4001	Coaxial
N1029	5·8–7·2	43	27	10	N4047‡‡	Waveguide
N1032†	3·8–4·2	38	19	0·30	N4020	Waveguide
N1033	3·8–4·8	37	28	7·0	N4006	Waveguide
N1038	7·0–8·5	40	27	10	N4051‡‡	Waveguide
N1055	5·85–7·05	40	27	5–10	N4073‡‡ N4085‡‡	Waveguide
N1056	3·6–5·0	37	27	5–10	N4074‡‡ N4075‡‡	Waveguide

†Maintenance type. Not recommended for new equipment.
‡‡Periodic permanent magnet mount.

(See Page 2 for Low Noise Tubes)

TRAVELLING WAVE TUBES—Low Noise

EEV Type	Frequency Range (GHz)	Gain (db)	Noise Factor (db)	Output Power (mW)	Mount Type	R.F. Connections
6861	2·7–3·5	25	6·5	1·0	N4004	Coaxial
N1002†	1·7–2·3	23	9·0	2·5	Solenoid	Waveguide
N1016M	4·1–7·0	37	9·5	3·5	N4001	Coaxial
N1017M	1·2–1·4	26	6·5	2·0	N4003	Coaxial
N1024M	3·6–4·2	20	9·0	1·5	N4001	Coaxial
N1031†	3·8–4·2	25	8·5	2·3	N4021	Waveguide
N1042M	2·7–3·5	25	6·5	1·0	N4004	Coaxial
N1045M	2·5–4·1	28	8·0	3·0	N4004	Coaxial
N1047M	2·7–3·2	24	4·0	1·5	N4041	Coaxial

†Maintenance type. Not recommended for new equipment.

LOW NOISE TRAVELLING WAVE TUBE

→Service Type CV5362 **JEDEC Designation 6861**

INTRODUCTION

The 6861 is a Travelling Wave Tube designed for use as a low noise amplifier in the frequency range 2·7 to 3·5Gc/s. The tube itself is housed in a metal canister and fitted with coaxial input and output connectors. The noise factor of a typical tube is 6·5db and the low level gain 25db.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	5·0	V
Heater Current	0·5	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4	A
Cathode Heating Time (Minimum)	1	minute
Cold Insertion Loss	80	db
Operating Frequency:		
Minimum	2·7	Gc/s
Maximum	3·5	Gc/s
Gain	25	db
Noise Factor	6·5	db
Output Power (Saturated)	1	mW
Magnetic Field	525	Gauss
→ Recommended Solenoid		N4004

Mechanical

Overall Length	19·375 inches (492·1 mm)	Max
Overall Diameter	1·380 inches (35·1 mm)	Max
Net Weight	1·75 pounds (800 gm)	Approx
R.F. Connections	50Ω Coaxial plug connectors type 'N' U.S. Military No. UG-1185/U	
Base	International Octal	
Collector Connection	4mm socket	
Mounting Position	Any	
Cooling	Natural	

→Indicates a change.

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CHELMSFORD ESSEX, ENGLAND TECHNICAL PUBLICATIONS
Printed in England

LOW NOISE TRAVELLING WAVE TUBE

MAXIMUM AND MINIMUM RATINGS

(Absolute Values) (*See Note* 1)

No individual rating should be exceeded

	Min	Max	
Heater Voltage	—	5·25	V
Collector Voltage	—	500	V
Collector Current	—	500	μA
Helix Voltage	—	500	V
Helix Current (*See Note* 2)	—	5	μA
Grid 4 Voltage	—	500	V
Grid 4 Dissipation	—	0·1	W
Grid 3 Voltage	—	300	V
Grid 3 Dissipation	—	0·1	W
Grid 2 Voltage	—	75	V
Grid 2 Dissipation	—	0·1	W
Grid 1 Voltage	—	20	V
Grid 1 Dissipation	—	0·1	W
Magnetic Field (*See Note* 3)	400	—	Gauss
Peak Input Power	—	100	W
Mean Input Power	—	0·4	W
Canister Temperature (at hottest point)	—	175	°C

TYPICAL OPERATION

(at 3·1Gc/s)

Operational Conditions (*See Note* 1)

Heater Voltage	5·0	V
Collector Voltage (*See Note* 4)	400	V
Collector Current	150	μA
Helix Voltage (*See Notes* 5 *and* 6)	375	V
Grid 4 Voltage (*See Note* 6)	200	V
Grid 3 Voltage (*See Note* 6)	40	V
Grid 2 Voltage (*See Note* 7)	20	V Approx
Grid 1 Voltage	0	V
Magnetic Field (*See Notes* 8 *and* 9)	525	Gauss

LOW NOISE TRAVELLING WAVE TUBE

Typical Performance

Helix Current (*See Note* 6)	0·5	μA
Grid 4 Current	less than 1	μA
Grid 3 Current	less than 1	μA
Grid 2 Current	less than 1	μA
Grid 1 Current	less than 1	μA
Gain	25	db
Noise Factor (*See Note* 6)	6·5	db
Output Power (Saturated)	1	mW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Over the frequency range 2·7 to 3·5Gc/s)

Recommended Applied Conditions (*See Note* 1)

Heater Voltage (*See Note* 10)	5·0	V
Collector Voltage (*See Note* 4)	400	V
Collector Current	150	μA
Helix Voltage (*See Notes* 5 *and* 6)	350 to 390	V
Grid 4 Voltage (*See Note* 6)	160 to 275	V
Grid 3 Voltage (*See Note* 6)	20 to 50	V
Grid 2 Voltage (*See Note* 7)	0 to 30	V ←
Grid 1 Voltage	0	V
Magnetic Field (*See Notes* 8 *and* 9)	525	Gauss

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	—	0·85	A
Helix Current	—	5	μA ←
Grid 4 Current	—	10	μA ←
Grid 3 Current	—	10	μA ←
Grid 2 Current	—	10	μA ←
Grid 1 Current	—	10	μA ←
Gain	20	—	db
Noise Factor	—	7	db
Output Power (Saturated)	0·25	—	mW
Tube Input V.S.W.R. (*See Note* 11)	—	1·7 : 1	
Tube Output V.S.W.R. (*See Note* 11)	—	2·0 : 1	

←Indicates a change

LOW NOISE TRAVELLING WAVE TUBE

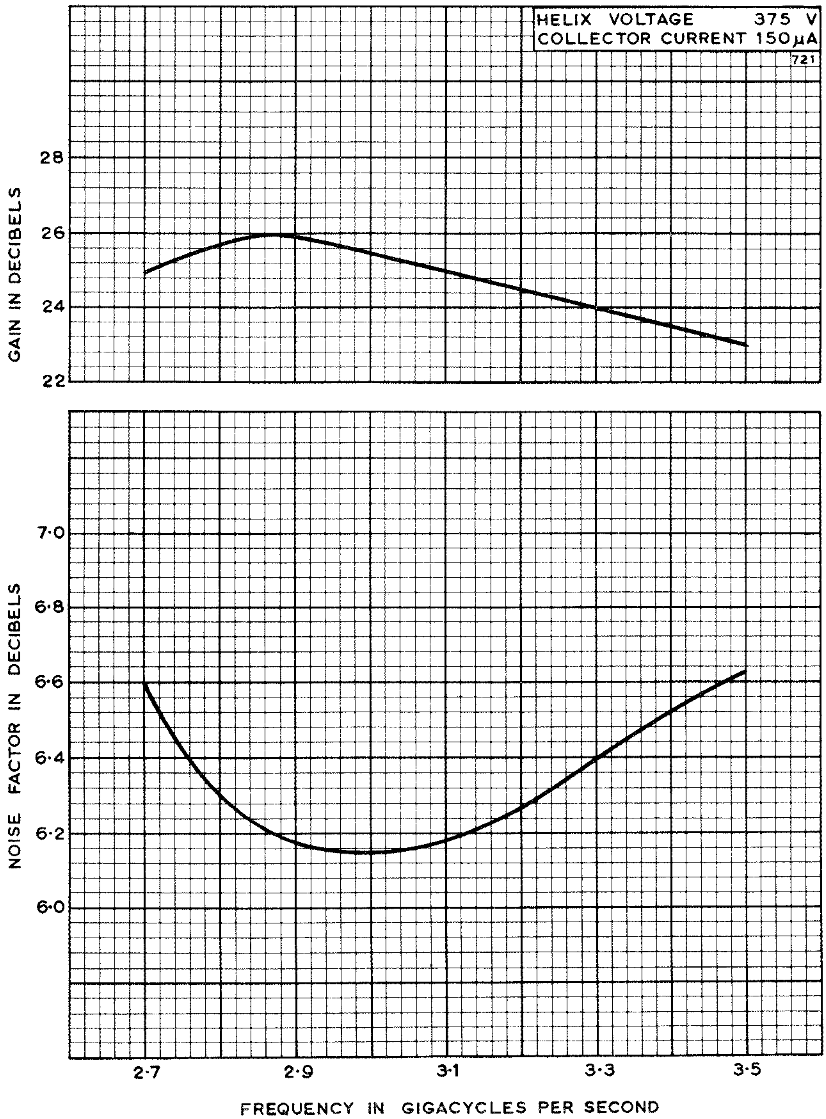
NOTES

1. All voltages are with respect to the cathode. It may be sometimes convenient to earth the collector and maintain the cathode at a negative potential.
2. During alignment in the magnetic focusing field this maximum value of helix current may be exceeded for short periods, but must never exceed 25μA.
3. This minimum value of magnetic field strength will focus the electron beam but the optimum noise figure will not be obtained.
4. It is necessary to maintain the collector positive with respect to the helix. Fluctuations in collector voltage should be less than ±10%.
5. The helix voltage should be set to the optimum value for the frequency of operation and stabilised to within ±5%.
6. In order to operate the tube at the lowest noise factor it is necessary to adjust the electrode voltages as follows: First align the travelling wave tube for minimum helix current. Then with the tube connected in its circuit and a signal or noise input applied to the valve, adjust the helix voltage to give maximum output. This value of helix voltage simultaneously produces optimum gain and minimum noise factor. Next, with no input signal, vary Grid 3 and Grid 4 voltages alternately until the receiver output reaches a minimum. The voltages reached in this way are those which will operate the 6861 at the lowest noise factor for the particular frequency to which the equipment is tuned. For wide band operation these adjustments should be carried out at the centre frequency. If the focusing field changes, it will be necessary to repeat the adjustment above. Grid 3 and Grid 4 voltages should be stabilised to within ±5%.
7. Grid 2 voltage is adjusted to give 150μA collector current and should be stabilised to within ±5%.
8. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.
9. The measurements are made with the magnetic field adjusted to 525 Gauss ±5%. Provision must be made for aligning the tube in the solenoid. An adjustment of ±0·100 inch about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the E.E.V. Co. lightweight solenoid type N4004 is recommended.
10. Tolerance ±5%.
11. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

This page has been completely revised

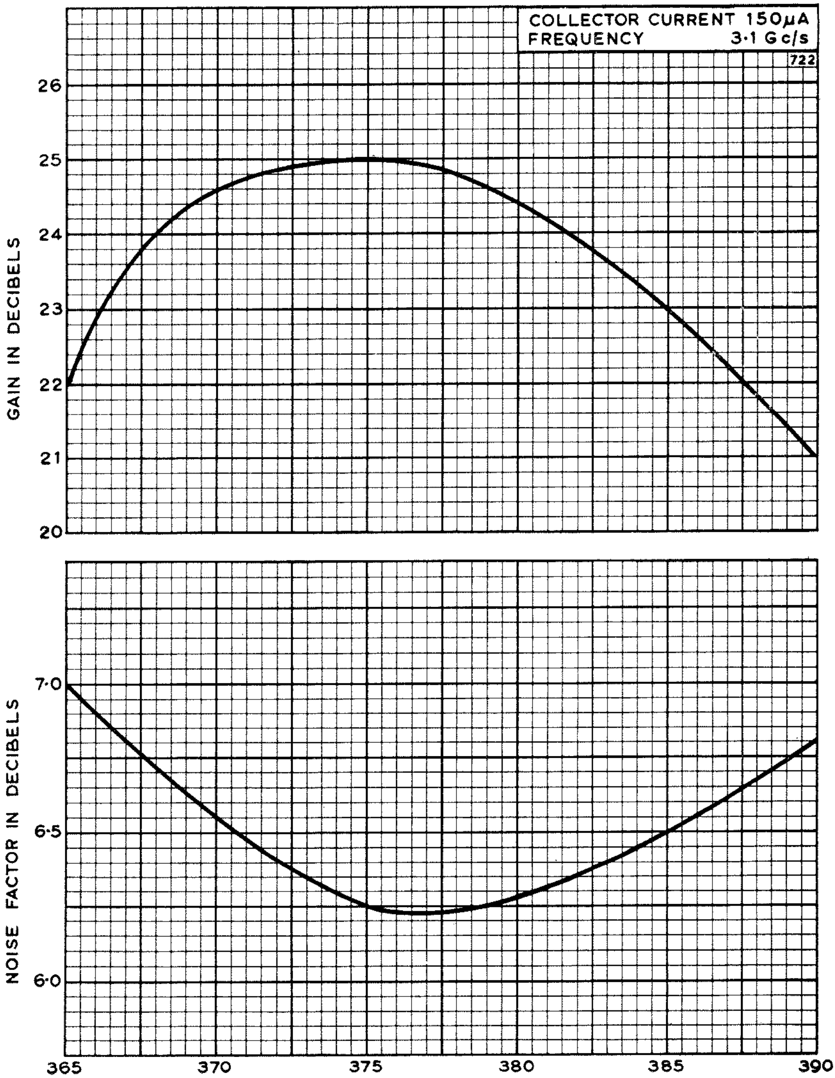
LOW NOISE TRAVELLING WAVE TUBE

FREQUENCY CHARACTERISTIC



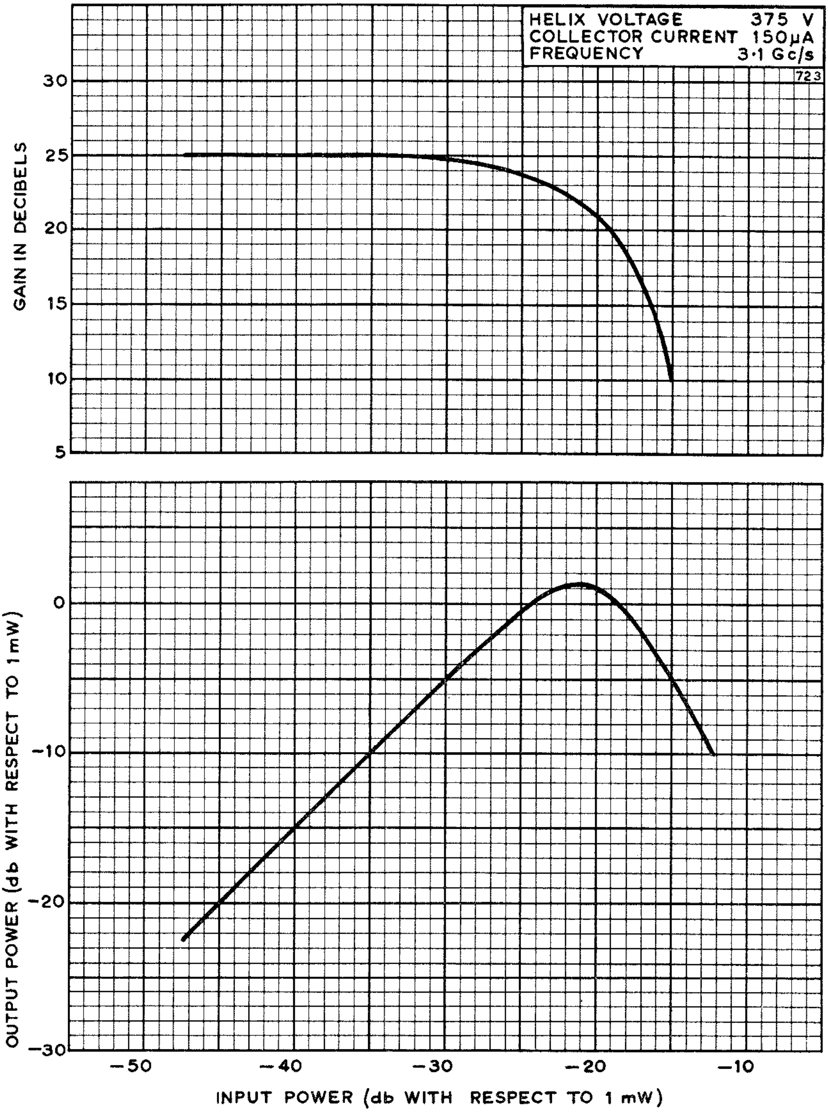
LOW NOISE TRAVELLING WAVE TUBE

HELIX VOLTAGE CHARACTERISTIC



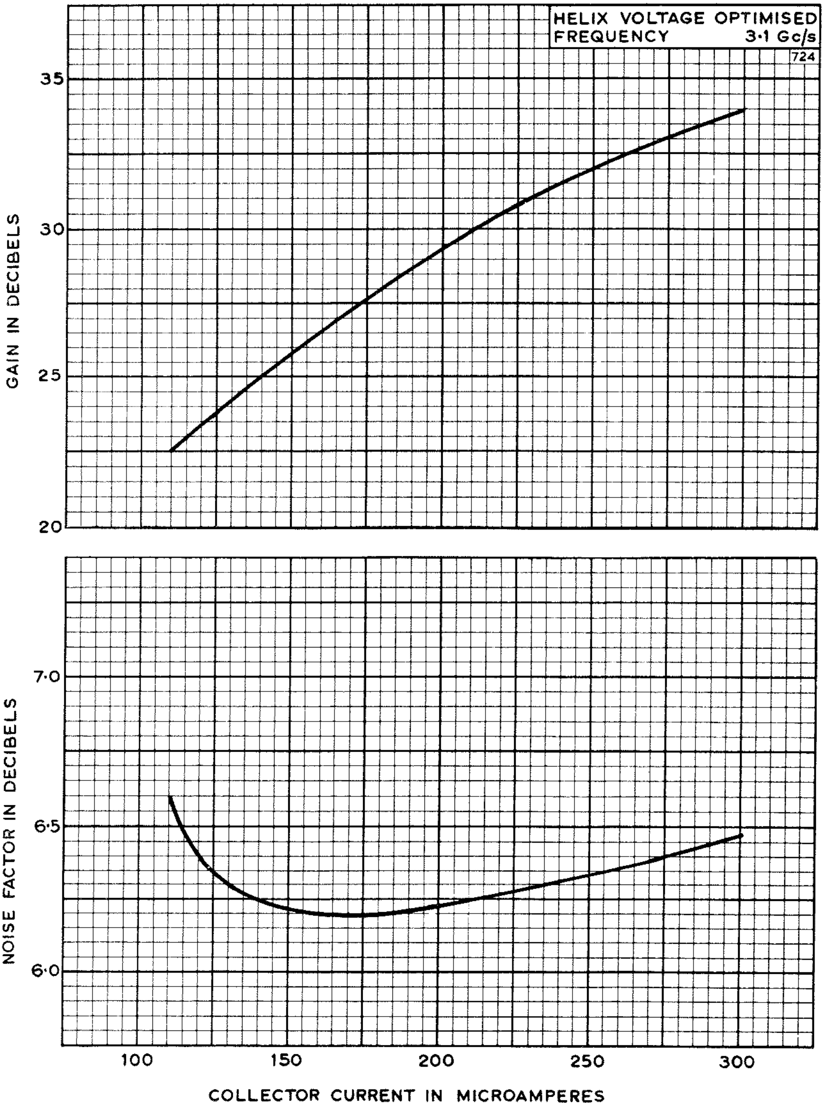
LOW NOISE TRAVELLING WAVE TUBE

POWER CHARACTERISTIC



LOW NOISE TRAVELLING WAVE TUBE

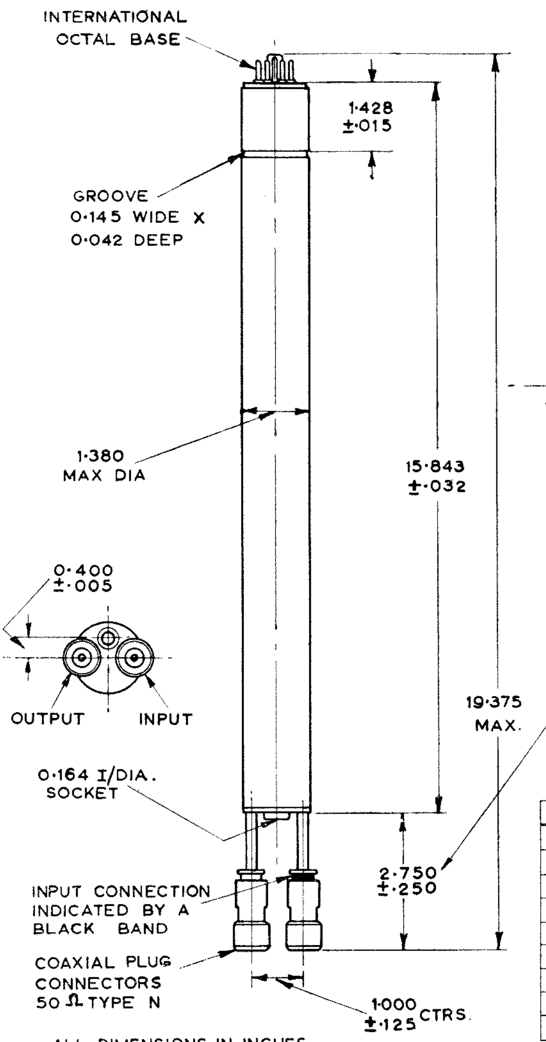
COLLECTOR CURRENT CHARACTERISTIC

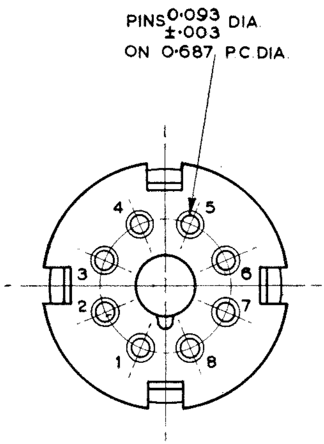


LOW NOISE TRAVELLING WAVE TUBE

OUTLINE

488A





TOP VIEW ON BASE

ALL DIMENSIONS IN INCHES

PIN	ELEMENT
1	GRID 1
2	NO CONNECTION
3	HELIX
4	GRID 4
5	GRID 3
6	GRID 2
7	HEATER
8	HEATER, CATHODE
SOCKET	COLLECTOR

INDICATES A CHANGE ←

POWER TRAVELLING WAVE TUBE

N1001

Service Type CV5406

GENERAL

The N1001 is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	1·5	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections		Waveguide
Mounting Position		Any
Cooling		Forced-air
Frequency Range	1·7 to 2·3	Gc/s

MAXIMUM RATINGS
(Absolute Values)

Collector Voltage	3·0	kV Max
Collector Current	45	mA Max
Helix Voltage	2·8	kV Max
Helix Current	0·8	mA Max
Grid 2 Voltage	1·5	kV Max
Grid 2 Dissipation	1·5	W Max
Grid 1 Voltage (negative value, never positive)	250	V Max
Grid 1 Dissipation	0·25	W Max
Collector Temperature	200	°C Max
Bulb Temperature	70	°C Max

TYPICAL OPERATION
(at centre of frequency range)

Collector Voltage	2·8	kV
Collector Current	43	mA
Helix Voltage	2·63	kV
Grid 2 Voltage	1·25	kV
Grid 1 Voltage	−80	V
Magnetic Field:		
in region of helix	450	Gauss
in region of cathode		Zero
Helix Current	0·25	mA
Gain (Saturated)	25	db
Output Power (Saturated)	15	W

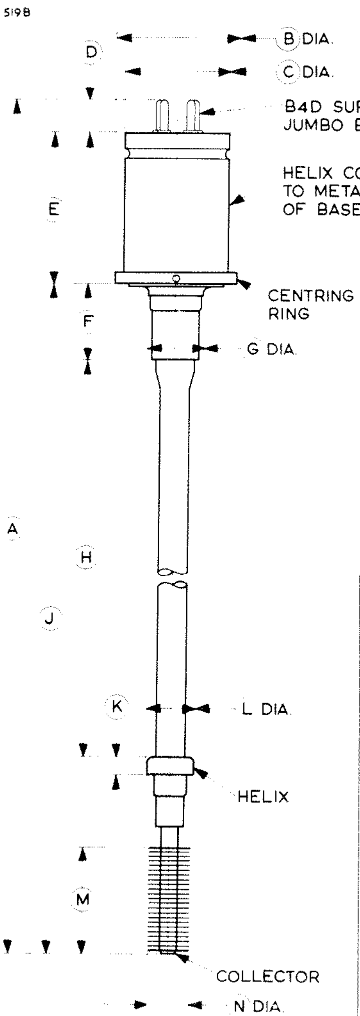
ENGLISH ELECTRIC VALVE CO. LTD. CHELMSFORD ENGLAND

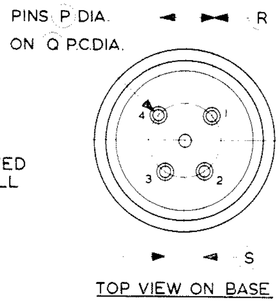
Printed in England

POWER TRAVELLING WAVE TUBE

N1001

OUTLINE





Pin	Element
1	Grid 1
2	Heater
3	Cathode and Heater
4	Grid 2

Ref.	Inches	Millimetres
A	23·850 Max	605·8 Max
B	$2{\cdot}562^{+0{\cdot}000}_{-0{\cdot}003}$	$65{\cdot}075^{+0{\cdot}000}_{-0{\cdot}076}$
C	2·203 ± 0·010	55·96 ± 0·25
D	0·703 Max	17·86 Max
E	3·125 ± 0·025	79·38 ± 0·64
F	1·625 ± 0·002	41·275 ± 0·051
G	1·172 Max	29·77 Max
H	14·173 ± 0·010	360·0 ± 0·25
J	19·930 ± 0·080	506·2 ± 2·03
K	0·375 ± 0·005	9·53 ± 0·13
L	1·000 ± 0·002	25·400 ± 0·051
M	2·281 ± 0·016	57·94 ± 0·41
N	0·906 Max	23·01 Max
P	0·187 ± 0·003	4·750 ± 0·076
Q	1·000	25·40
R	0·750	19·05
S	0·562	14·27

Millimetre dimensions have been derived from inches.

LOW NOISE TRAVELLING WAVE TUBE

N1002

Service Type CV5407

GENERAL

The N1002 is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections	Waveguide	
Mounting Position	Any	
Cooling	Natural	
Frequency Range	1·7 to 2·3	Gc/s

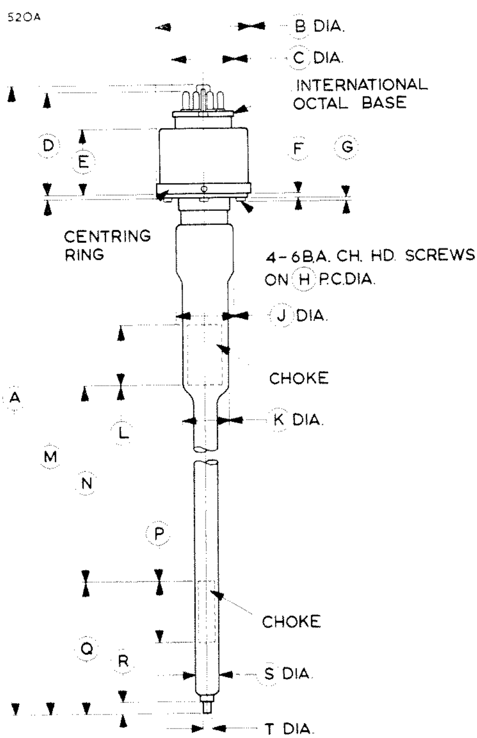
MAXIMUM RATINGS
(Absolute Values)

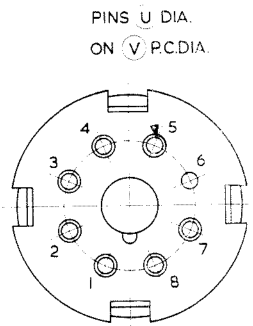
Collector Voltage	800	V Max
Collector Current	220	μA Max
Helix Voltage	700	V Max
Helix Current	20	μA Max
Grid 3 Voltage	250	V Max
Grid 3 Dissipation	100	mW Max
Grid 2 Voltage	100	V Max
Grid 2 Dissipation	100	mW Max
Grid 1 Voltage	±50	V Max
Grid 1 Dissipation	100	mW Max
Collector Temperature	100	°C Max
Bulb Temperature	70	°C Max

TYPICAL OPERATION
(at centre of frequency range)

Collector Voltage	700	V
Collector Current	200	μA
Helix Voltage	565	V
Grid 3 Voltage	50	V
Grid 2 Voltage	30	V
Grid 1 Voltage	−3	V
Magnetic Field:		
in region of helix	150	Gauss
in region of cathode	450	Gauss
Helix Current	1	μA
Gain (Low Level)	23	db
Noise Factor	9	db
Output Power (Saturated)	2·5	mW

OUTLINE





TOP VIEW ON BASE

Pin	Element
1	Cathode
2	Heater
3	Heater
4	Grid 2
5	Grid 4 and Helix
6	Omitted
7	Grid 1
8	Grid 3
Top	Collector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	23·000 Max	584·2 Max	L	1·250 ± 0·005	31·75 ± 0·13
B	$2{\cdot}063^{+0{\cdot}000}_{-0{\cdot}003}$	$52{\cdot}400^{+0{\cdot}000}_{-0{\cdot}076}$	M	20·437 ± 0·062	519·1 ± 1·57
C	1·300 Max	33·02 Max	N	13·600 ± 0·040	345·4 ± 1·02
D	2·226 ± 0·040	56·54 ± 1·02	P	1·250 ± 0·005	31·75 ± 0·13
E	1·460 ± 0·015	37·08 ± 0·38	Q	2·795 ± 0·070	70·99 ± 1·78
F	0·093 ± 0·010	2·36 ± 0·25	R	0·200 Min	5·08 Min
G	0·085 Max	2·16 Max	S	0·545 Max	13·84 Max
H	1·750	44·45	T	0·1875 ± 0·001	4·763 ± 0·025
J	1·225 Max	31·12 Max	U	0·093 ± 0·003	2·362 ± 0·076
K	0·950 Max	24·13 Max	V	0·687	17·45

Millimetre dimensions have been derived from inches.

POWER TRAVELLING WAVE TUBE

N1004

GENERAL

The N1004 is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·68	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections		Waveguide
Mounting Position		Any
Cooling		Forced-air
Frequency Range	3·8 to 4·2	Gc/s

MAXIMUM RATINGS
(Absolute Values)

Collector Voltage	3·0	kV Max
Collector Current	25	mA Max
Helix Voltage	2·8	kV Max
Helix Current	1·0	mA Max
Grid 2 Voltage	2·5	kV Max
Grid 2 Dissipation	1·5	W Max
Grid 1 Voltage (negative value, never positive)	100	V Max
Collector Temperature	200	°C Max
Bulb Temperature	70	°C Max

TYPICAL OPERATION
(at centre of frequency range)

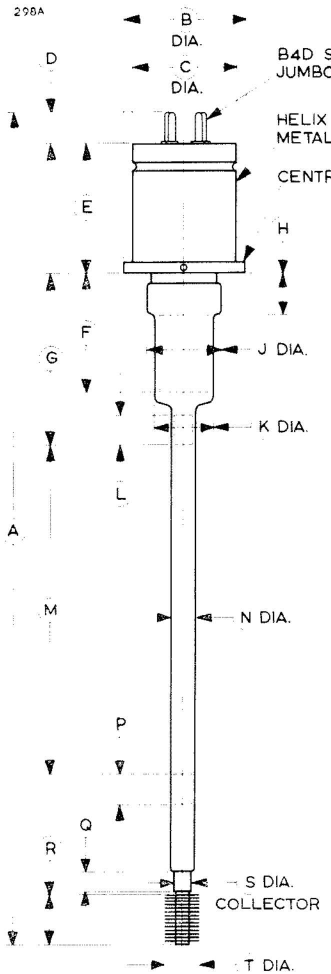
Collector Voltage	2·6	kV
Collector Current	20	mA
Helix Voltage	2·2	kV
Grid 2 Voltage	1·8	kV
Grid 1 Voltage	—7·0	V
Magnetic Field:		
in region of helix	500	Gauss
in region of cathode		Zero
Helix Current	200	μA
Gain (Saturated)	24 db	Approx
Output Power (Saturated)	5	W

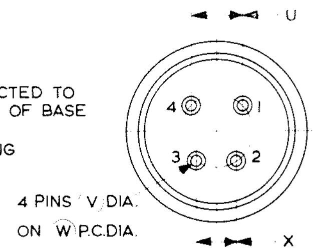
POWER TRAVELLING WAVE TUBE

N1004

ENGLISH ELECTRIC

OUTLINE





TOP VIEW ON BASE

Pin	Element
1	Grid 1
2	Heater
3	Cathode and Heater
4	Grid 2

Ref.	Inches	Millimetres
A	17·625 Max	447·7 Max
B	$2{\cdot}562^{+0{\cdot}000}_{-0{\cdot}002}$	$65{\cdot}075^{+0{\cdot}000}_{-0{\cdot}051}$
C	2·203 ± 0·010	55·96 ± 0·25
D	0·703 Max	17·86 Max
E	2·719 ± 0·010	69·06 ± 0·25
F	2·580 ± 0·060	65·53 ± 1·52
G	3·670 ± 0·040	93·22 ± 1·02
H	0·870 ± 0·060	22·10 ± 1·52
J	1·600 Max	40·64 Max
K	1·400 Max	35·56 Max
L	0·625 ± 0·005	15·88 ± 0·13
M	6·950 ± 0·040	176·5 ± 1·02
N	0·530 Max	13·46 Max
P	0·625 ± 0·005	15·88 ± 0·13
Q	0·400 Min	10·16 Min
R	1·260 Max	32·00 Max
S	0·433 ± 0·001	10·998 ± 0·025
T	0·750 ± 0·010	19·05 ± 0·25
U	0·750	19·05
V	0·187 ± 0·003	4·750 ± 0·076
W	1·000	25·40
X	0·562	14·27

Millimetre dimensions have been derived from inches.

MEDIUM POWER TRAVELLING WAVE TUBE

N1013

Service Type CV5408

GENERAL

The N1013 is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections	Waveguide	
Mounting Position	Any	
Cooling	Heat Sink	
Frequency Range	1·7 to 2·3	Gc/s

MAXIMUM RATINGS
(Absolute Values)

Collector Voltage	800	V Max
Collector Current	4·5	mA Max
Helix Voltage	700	V Max
Helix Current	500	μA Max
Grid 2 Voltage	700	V Max
Grid 2 Dissipation	100	mW Max
Grid 1 Voltage (negative value, never positive)	50	V Max
Grid 1 Dissipation	100	mW Max
Collector Temperature	200	°C Max
Bulb Temperature	70	°C Max

TYPICAL OPERATION
(at centre of frequency range)

Collector Voltage	750	V
Collector Current	4	mA
Helix Voltage	650	V
Grid 2 Voltage	480	V
Grid 1 Voltage	−10	V
Magnetic Field	400	Gauss
Helix Current	50	μA
Gain:		
at 5mW output	33	db
at 50mW output	30	db
Noise Factor	20	db
Output Power (Saturated)	250	mW

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MEDIUM POWER TRAVELLING WAVE TUBE

N1013

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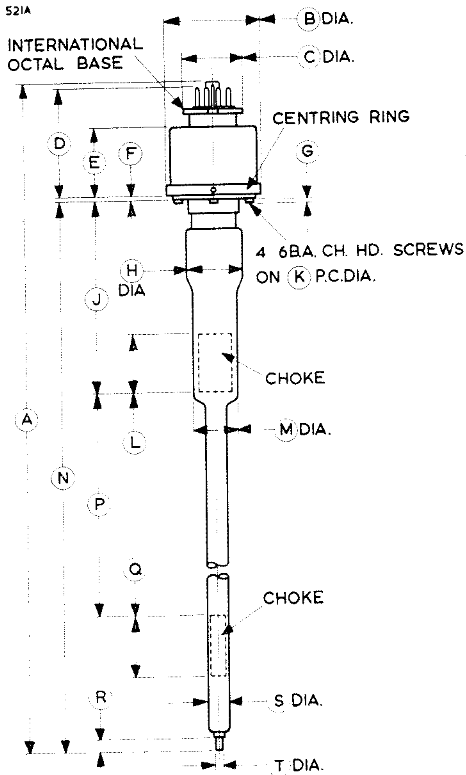
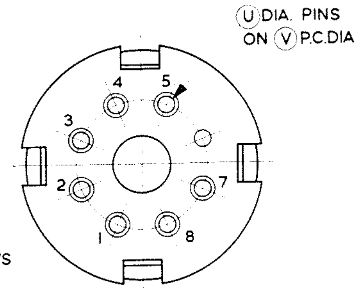
OUTLINE





TOP VIEW ON BASE

Pin	Element
1	Grid 2
2	Cathode
3	Heater
4	Heater
5	Grid 3 and Helix
6	Omitted
7	No Connection
8	Grid 1
Top	Collector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	17·500 Max	444·5 Max	L	1·250 ± 0·005	31·75 ± 0·13
B	$2{\cdot}063^{+0{\cdot}000}_{-0{\cdot}003}$	$52{\cdot}400^{+0{\cdot}000}_{-0{\cdot}076}$	M	0·950 Max	24·13 Max
C	1·300 Max	33·02 Max	N	14·937 ± 0·062	379·4 ± 1·57
D	2·226 ± 0·040	56·54 ± 1·02	P	8·100 ± 0·040	205·7 ± 1·02
E	1·460 ± 0·015	37·08 ± 0·38	Q	1·250 ± 0·005	31·75 ± 0·13
F	0·093 ± 0·010	2·36 ± 0·25	R	0·200 Min	5·08 Min
G	0·085 Max	2·16 Max	S	0·545 Max	13·84 Max
H	1·225 Max	31·12 Max	T	0·1875 ± 0·001	4·763 ± 0·025
J	4·042 ± 0·010	102·7 ± 0·25	U	0·093 ± 0·003	2·362 ± 0·076
K	1·750	44·45	V	0·687	17·45

Millimetre dimensions have been derived from inches.

LOW NOISE TRAVELLING WAVE TUBE

N1016M

ENGLISH ELECTRIC

Service Type CV6098 ←

INTRODUCTION

The N1016M is a Travelling Wave Tube designed for use as a low noise amplifier in the frequency range 4·1 to 7·0Gc/s. The tube is housed in a metal canister and fitted with coaxial input and output connectors. It is designed to cover the frequency range without voltage or impedance adjustments and under these conditions the average noise factor of a typical tube is 9·5db and the average low level gain 37db.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4·0	A
Cathode Heating Time (Minimum) (*See Note* 1)	1·5	minutes
Cold Insertion Loss	65	db
Operating Frequency:		
Minimum	4·1	Gc/s
Maximum	7·0	Gc/s
Gain (Low Level) (*See Note* 2):		
over the frequency range 4·5 to 6·5Gc/s	40	db
over the frequency range 4·1 to 7·0Gc/s	37	db
Noise Factor (*See Note* 2):		
over the frequency range 4·5 to 6·5Gc/s	9·0	db
over the frequency range 4·1 to 7·0Gc/s	9·5	db
Output Power (Saturated) (*See Note* 2):		
over the frequency range 4·5 to 6·5Gc/s	4·5	mW
over the frequency range 4·1 to 7·0Gc/s	3·5	mW
Magnetic Field (*See Notes* 3, 4 *and* 5)	520	Gauss
Recommended Solenoid	N4001	

Mechanical

Overall Length	17·375 inches (441·4 mm)	Max
Overall Diameter	1·30 inches (33 mm)	Max
Net Weight	1·25 pounds (567 gm)	Approx
R.F. Connections	50Ω Coaxial jack connectors type 'C' U.S. Military No. UG-572/U	
Base	International Octal	
Mounting Position	Any	
Cooling	Natural	

←Indicates a change

MAXIMUM RATINGS
(Absolute Values) (*See Note* 6)

Heater Voltage	6·6	V
Collector Voltage	800	V
Collector Current	400	μA
Helix Voltage	650	V
Helix Current	25	μA
Grid 4 Voltage	650	V
Grid 4 Dissipation	0·1	W
Grid 3 Voltage	300	V
Grid 3 Dissipation	0·1	W
Grid 2 Voltage	150	V
Grid 2 Dissipation	0·1	W
Grid 1 Voltage (negative value, never positive)	100	V
Grid 1 Dissipation	0·1	W
Peak R.F. Input Power	100	W
Mean R.F. Input Power	0·5	W
Canister Temperature	150	°C

TYPICAL OPERATION
(at 5·6Gc/s)

Operational Conditions (*See Note* 6)		
Heater Voltage	6·3	V
Collector Voltage (*See Note* 7)	720	V
Collector Current	350	μA
Helix Voltage (*See Note* 8)	585	V
Grid 4 Voltage (*See Note* 9)	440	V
Grid 3 Voltage (*See Note* 9)	70	V
Grid 2 Voltage (*See Note* 10)	45	V
Grid 1 Voltage (*See Note* 12)	−7·5	V
Magnetic Field (*See Notes* 3, 4 *and* 5)	520	Gauss
Typical Performance		
Helix Current (*See Note* 5)	1·0	μA
Grid 4 Current	..	Zero
Grid 3 Current	..	Zero
Grid 2 Current	..	Zero
Grid 1 Current	..	Zero
Gain (Low Level) (*See Note* 2):		
over the frequency range 4·5 to 6·5Gc/s	40	db
over the frequency range 4·1 to 7·0Gc/s	37	db
Noise Factor (*See Note* 2):		
over the frequency range 4·5 to 6·5Gc/s	9·0	db
over the frequency range 4·1 to 7·0Gc/s	9·5	db
Output Power (Saturated) (*See Note* 2):		
over the frequency range 4·5 to 6·5Gc/s	4·5	mW
over the frequency range 4·1 to 7·0Gc/s	3·5	mW
Tube Input and Output V.S.W.R.:		
over the frequency range 4·5 to 6·5Gc/s	1·5:1	
over the frequency range 4·1 to 7·0Gc/s	3·0:1	

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RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(Over the frequency range 4·1 to 7·0Gc/s)

Recommended Applied Conditions (*See Notes* 6 *and* 11)

Heater Voltage (*See Note* 12)	6·3	V
Collector Voltage (*See Note* 7)	720	V
Collector Current	320	μA
Helix Voltage (*See Note* 8)	565 to 605	V
Grid 4 Voltage (*See Note* 9)	380 to 500	V
Grid 3 Voltage (*See Note* 9)	50 to 90	V
Grid 2 Voltage (*See Note* 10)	30 to 60	V
Grid 1 Voltage	−7·5	V
Magnetic Field (*See Notes* 3, 4 *and* 5)	520	Gauss

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·33	0·39	A
Helix Current	—	10	μA
Grid 4 Current	—	5·0	μA
Grid 3 Current	—	5·0	μA
Grid 2 Current	—	5·0	μA
Grid 1 Current	—	5·0	μA
Gain (Low Level) (*See Note* 2):			
over the frequency range 4·5 to 6·5Gc/s	32	—	db
over the frequency range 4·1 to 7·0Gc/s	27	—	db
Noise Factor (*See Note* 2):			
over the frequency range 4·5 to 6·5Gc/s	—	11	db
over the frequency range 4·1 to 7·0Gc/s	—	13·5	db
Output Power (Saturated) (*See Note* 2):			
over the frequency range 4·5 to 6·5Gc/s	1·0	—	mW
over the frequency range 4·1 to 7·0Gc/s	1·0	—	mW
Tube Input and Output V.S.W.R. (*See Note* 13):			
over the frequency range 4·5 to 6·5Gc/s	—	2·5:1	
over the frequency range 4·1 to 7·0Gc/s	—	3·5:1	

NOTES

1. The time between the application of full heater voltage and the application of h.t. voltages. In the event of a power supply failure of less than 30 seconds duration, all voltages may be re-applied simultaneously.

2. The value specified is the average over the frequency range when the tube has been adjusted for best performance at 5·6Gc/s.

3. The magnitude of this field is not critical and it may be reduced from the nominal value of 520 Gauss if a slight increase in noise factor can be tolerated. The use of the E.E.V. Co. lightweight solenoid type N4001 is recommended.

4. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified non-magnetic material should be used for such parts.

5. Correct focusing (i.e. minimum helix current) can only be achieved when the axes of the tube and the magnetic field are accurately aligned. Provision must be made for aligning the tube in the solenoid. An adjustment of $\pm 0{\cdot}100$ inch about the axis should be sufficient.

6. All voltages are with respect to the cathode. The collector, r.f. connectors and canister are internally connected; the collector should be earthed and the cathode maintained at a negative potential.

7. The collector should be maintained at least 100 volts positive with respect to the helix.

8. For narrow band operation the helix voltage should be set to the optimum value for the mean frequency of operation (see page 5). For full band operation the tube should be set up at 5·6Gc/s. The helix voltage should be stabilised to within $\pm 2\frac{1}{2}\%$.

9. Grid 4 and grid 3 voltages should be adjusted to give minimum noise factor and stabilised to within $\pm 5\%$.

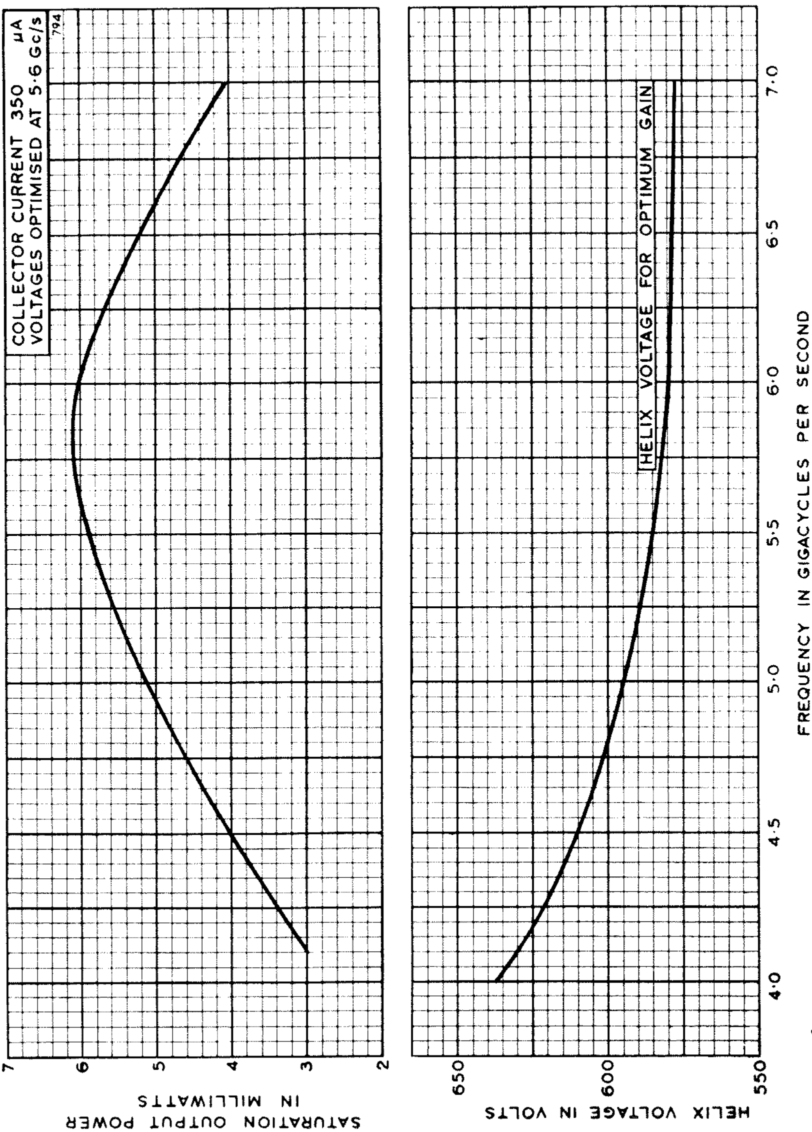
10. Grid 2 voltage should be adjusted to give 350μA collector current and stabilised to within $\pm 5\%$.

11. Fixed voltages are recommended wherever possible for ease of operation. However, the helix, grid 4 and grid 3 voltages should be optimised to obtain best performance.

12. Tolerance $\pm 5\%$.

13. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

FREQUENCY CHARACTERISTICS



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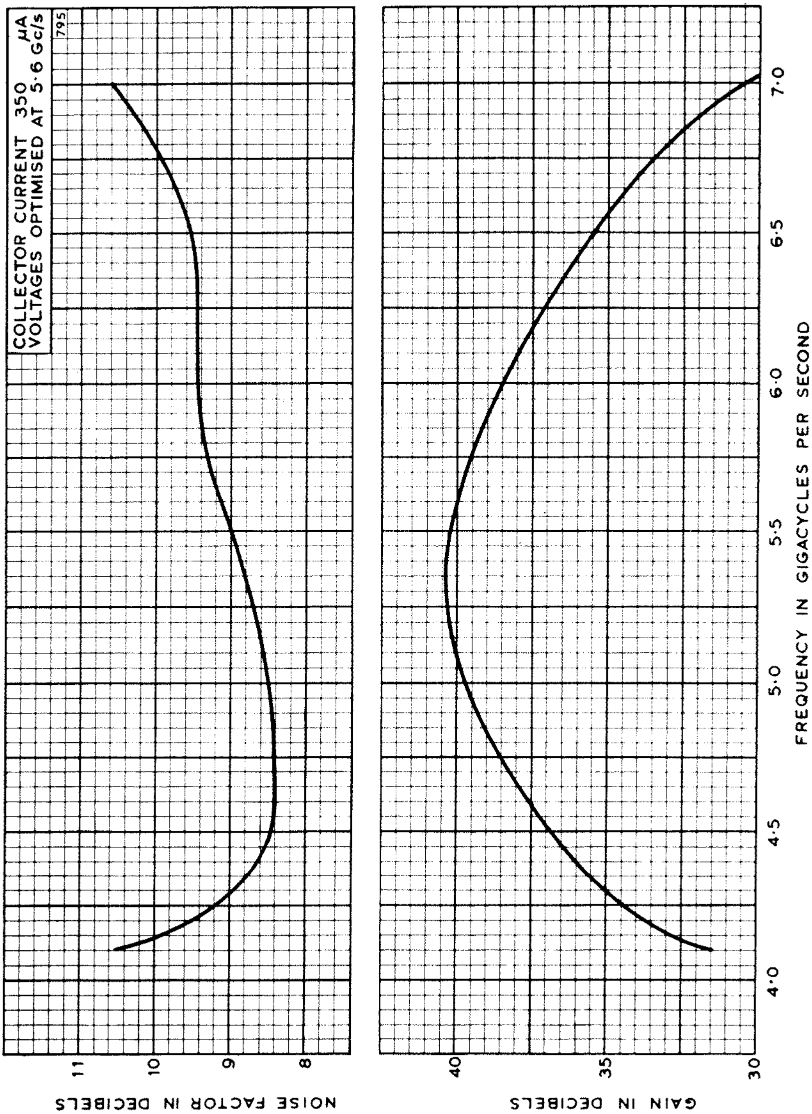
FREQUENCY CHARACTERISTICS



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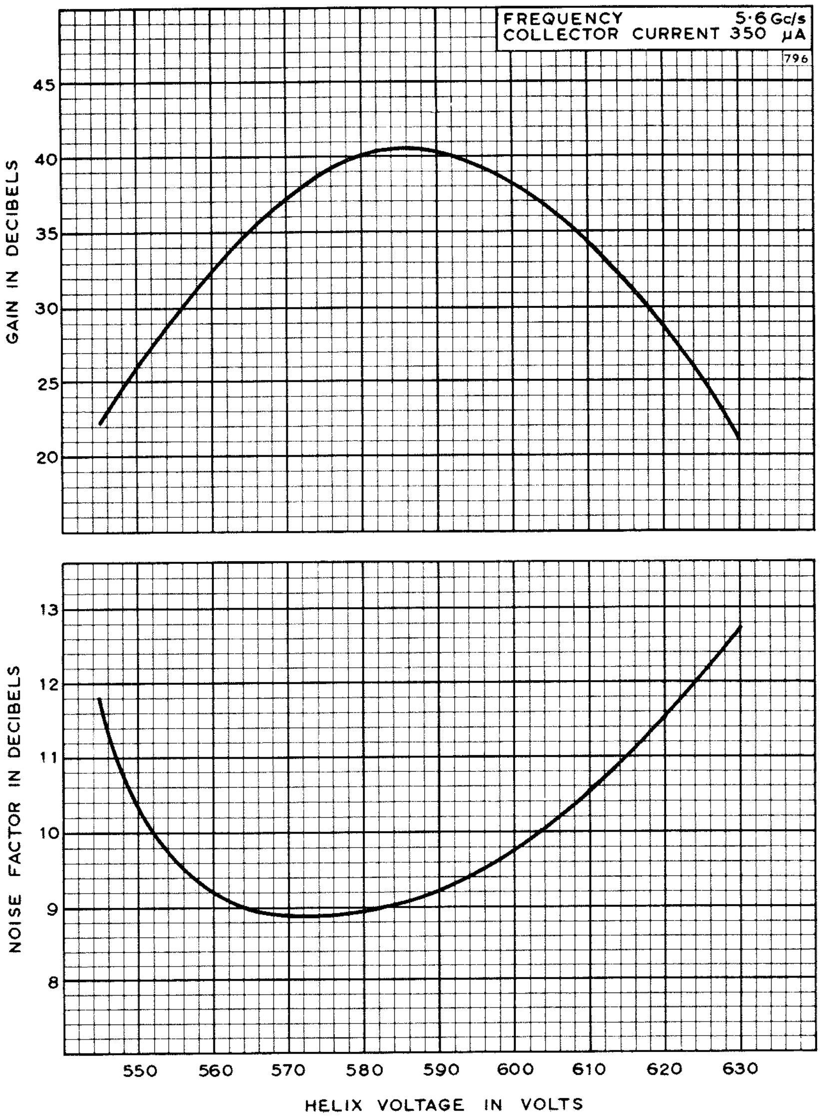
LOW NOISE TRAVELLING WAVE TUBE

N1016M

HELIX VOLTAGE CHARACTERISTICS



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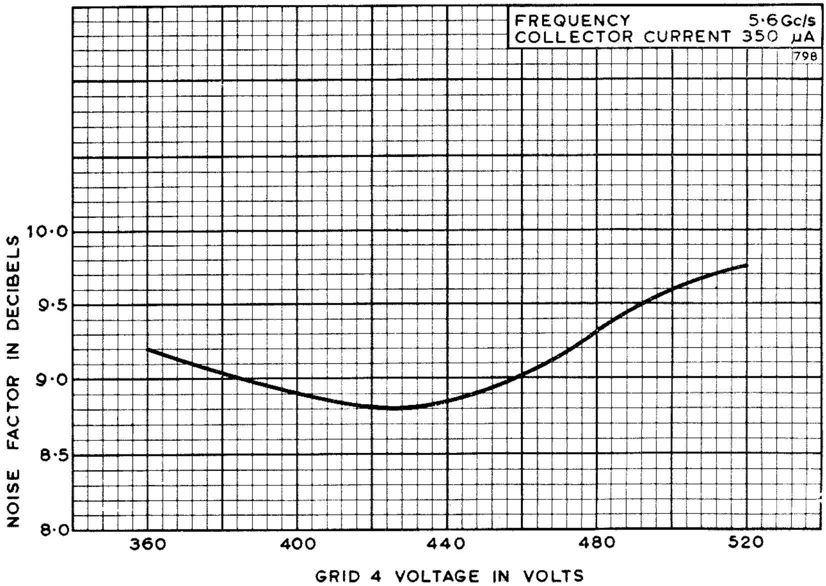
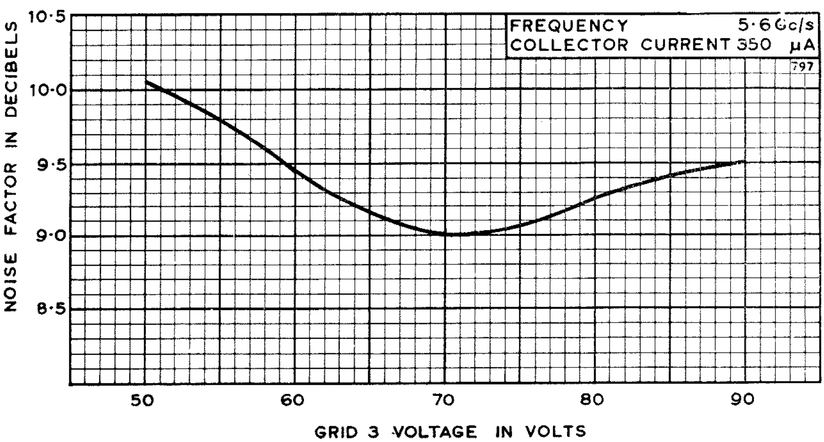
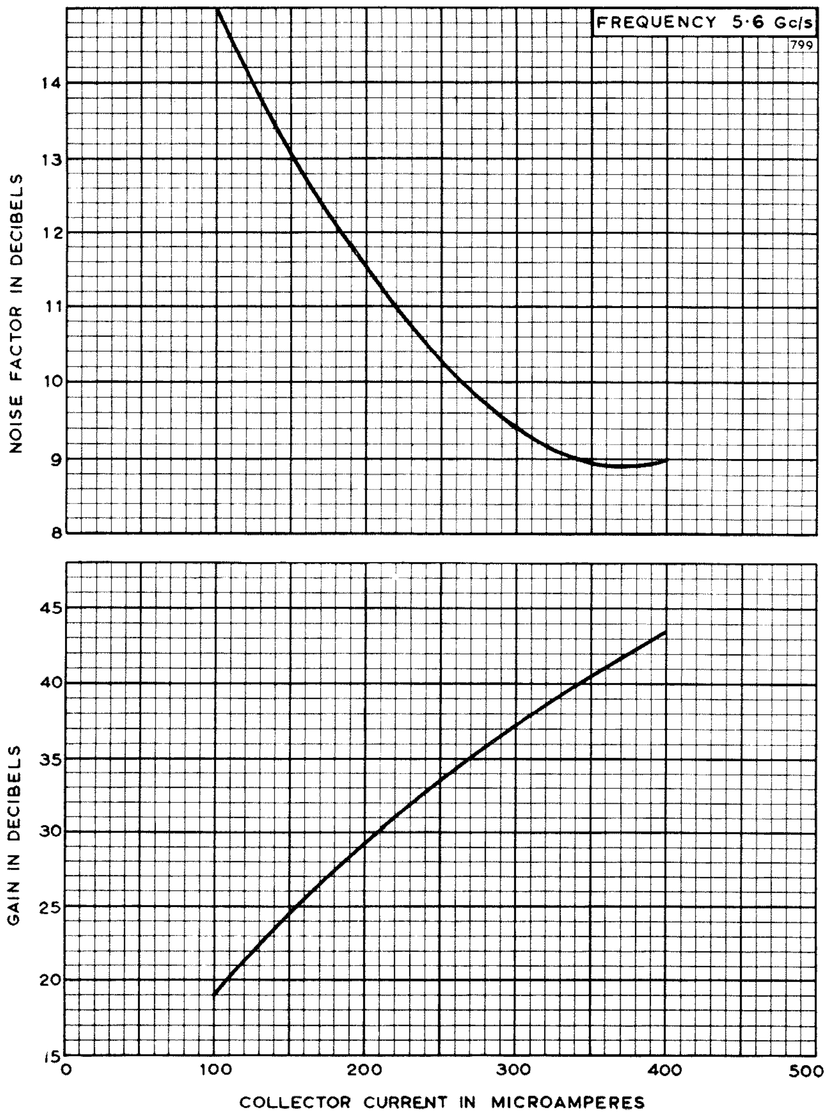
GRID 4 VOLTAGE CHARACTERISTIC



GRID 3 VOLTAGE CHARACTERISTIC



COLLECTOR CURRENT CHARACTERISTICS



LOW NOISE TRAVELLING WAVE TUBE

N1016M

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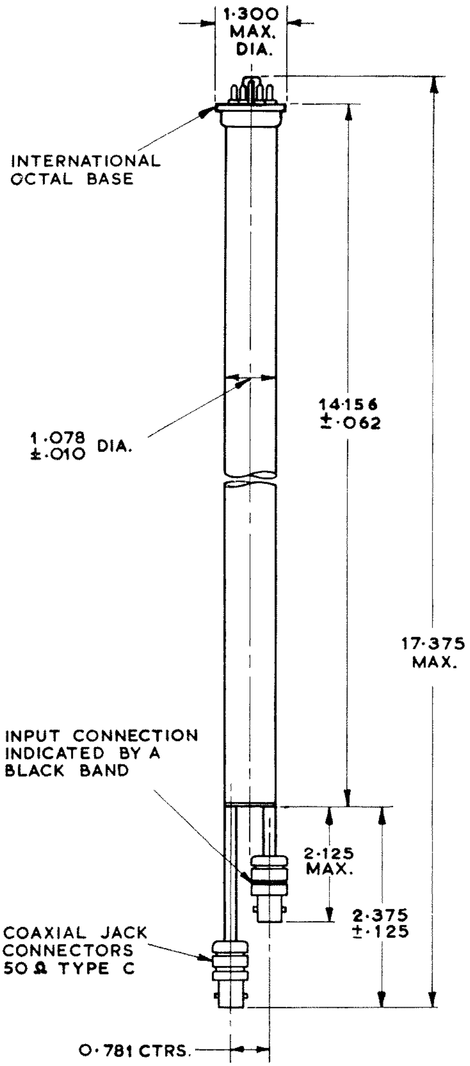
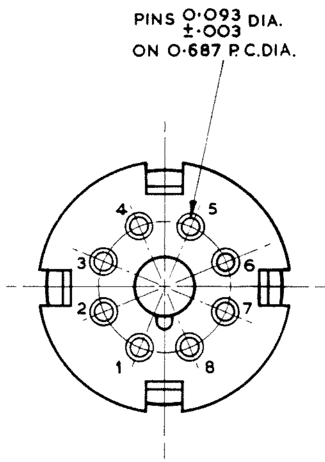
OUTLINE

314B





TOP VIEW ON BASE

PIN	ELEMENT
1	CATHODE AND HEATER
2	HEATER
3	GRID 2
4	GRID 4
5	HELIX
6	COLLECTOR AND CANISTER
7	GRID 1
8	GRID 3

ALL DIMENSIONS IN INCHES

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N1017M

LOW NOISE TRAVELLING WAVE TUBE

→Service Type CV6106

INTRODUCTION

The N1017M is a Travelling Wave Tube designed for use as a low noise amplifier in the frequency range 1·2 to 1·4Gc/s. The tube itself is housed in a metal canister and fitted with coaxial input and output connectors. The noise factor of a typical tube is 6·5db and the low level gain 26db.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Heater Starting Current:		
Peak instantaneous value must not exceed	1·5	A
Cathode Heating Time (Minimum) (*See Note* 1)	2	minutes
Cold Insertion Loss greater than	40	db
Operating Frequency:		
Minimum	1·2	Gc/s
Maximum	1·4	Gc/s
Gain (Low Level)	26	db
Noise Factor	6·5	db
Output Power (Saturated)	2	mW
Magnetic Field (*See Notes* 2, 3 *and* 4):		
in region of helix	100	Gauss
in region of gun	450	Gauss

Mechanical

Overall Length	21·75 inches (552 mm)	Max
Overall Diameter	1·30 inches (33 mm)	Max
Net Weight	1·5 pounds (0·7 kg)	Approx
R.F. Connections	70Ω Coaxial jack connectors type 'C'	
Base	International Octal	
Collector Connection	External Cap	
Mounting Position	Any	
Cooling	Natural	

→Indicates a change

LOW NOISE TRAVELLING WAVE TUBE

MAXIMUM RATINGS

(Absolute Values) (*See Note* 5)

Heater Voltage	6·6	V Max
Collector Voltage	600	V Max
Collector Current	200	μA Max
Helix Voltage	400	V Max
Helix Current	20	μA Max
Grid 3 Voltage	150	V Max
Grid 3 Dissipation	0·1	W Max
Grid 2 Voltage	150	V Max
Grid 2 Dissipation	0·1	W Max
Grid 1 Voltage:		
Positive value	20	V Max
Negative value	50	V Max
Heater to Cathode Voltage (*See Note* 6)	30	V Max
Canister Temperature	90	°C Max

TYPICAL OPERATION

(at 1·3Gc/s)

Operational Conditions (*See Note* 5)

Heater Voltage	6·3	V
Collector Voltage (*See Note* 7)	450	V
Collector Current	150	μA
Helix Voltage (*See Note* 8)	260	V
Grid 3 Voltage (*See Note* 9)	60	V
Grid 2 Voltage (*See Note* 10)	25	V
Grid 1 Voltage (*See Note* 9)	−3	V
Magnetic Field (*See Notes* 2, 3 *and* 4)		
in region of helix	100	Gauss
in region of gun	450	Gauss

Typical Performance

Helix Current (*See Note* 4)	2	μA
Grid 3 Current		Zero
Grid 2 Current		Zero
Grid 1 Current		Zero
Gain (Low Level)	26	db
Noise Factor	6·5	db
Output Power (Saturated)	2·0	mW
Tube Input V.S.W.R.	1·2:1	
Tube Output V.S.W.R.	1·5:1	

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(Over the frequency range 1·2 to 1·4Gc/s)

Recommended Applied Conditions (*See Notes* 5 *and* 11)

Heater Voltage (*See Note* 12)	6·3	V
Collector Voltage (*See Note* 7)	450	V
Collector Current	150	μA
Helix Voltage (*See Note* 8)	230 to 290	V
Grid 3 Voltage (*See Note* 9)	0 to 120	V
Grid 2 Voltage (*See Note* 10)	0 to 60	V
Grid 1 Voltage (*See Note* 9)	−10 to +10	V
Magnetic Field (*See Notes* 2, 3 *and* 4):		
in region of helix	100	Gauss
in region of gun	450	Gauss

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·33	0·39	A
Helix Current	—	5	μA
Grid 3 Current	—	10	μA
Grid 2 Current	—	10	μA
Grid 1 Current	—	5	μA
Gain (Low Level)	20	—	db
Noise Factor	—	8	db
Output Power (Saturated)	1·5	—	mW
Tube Input V.S.W.R. (*See Note* 13)		2·0:1	
Tube Output V.S.W.R. (*See Note* 13)		2·5:1	

NOTES

1. In the event of a power supply failure of less than 30 seconds duration, all voltages may be re-applied simultaneously.

2. The distribution of the magnetic field required to focus the tube is shown on page 8. The magnitude of the field is not critical but should be within ±10% of the values shown and the shape of the distribution must be preserved. The use of E.E.V. Company lightweight solenoid type N4003 is recommended.

3. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.

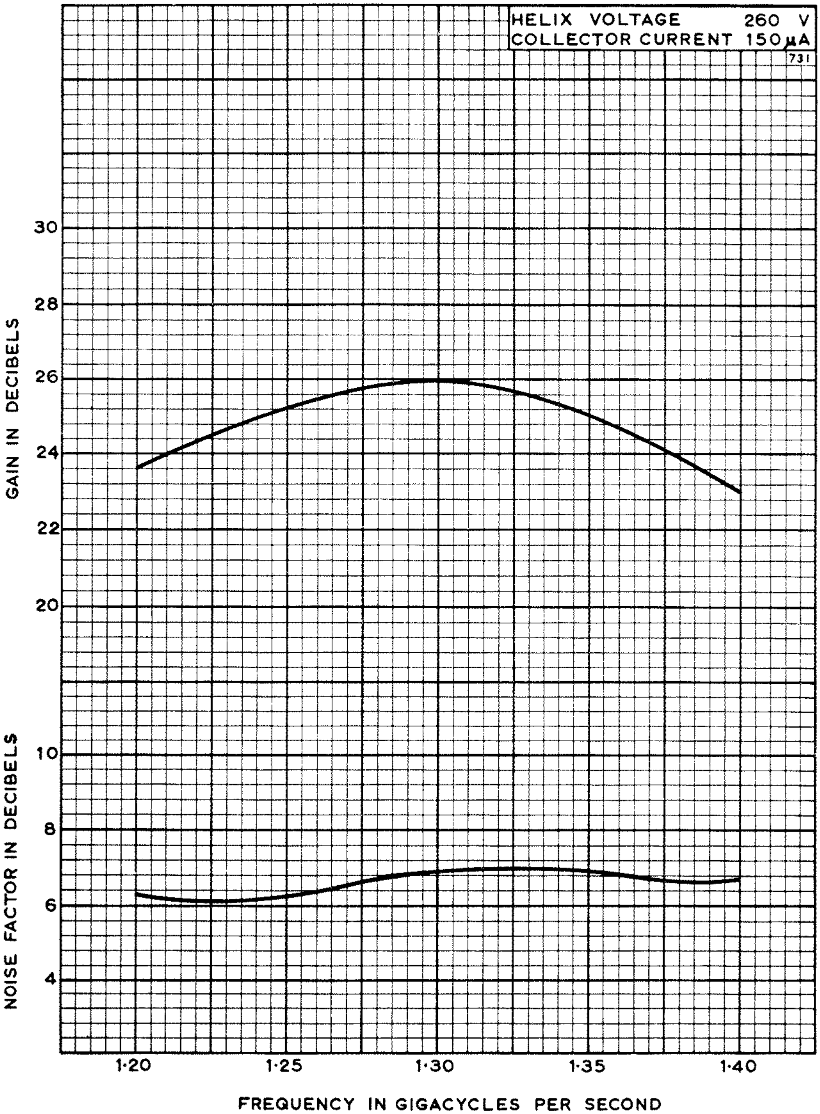
This page has been completely revised

4. Correct focusing (i.e. minimum helix current) can only be achieved when the axes of the tube and the magnetic field are accurately aligned. Provision must be made for aligning the tube in the solenoid. An adjustment of $\pm 0{\cdot}200$ inch about the axis is normally sufficient.
5. All voltages are with respect to the cathode.
6. In normal operation it is recommended that the cathode lead should be connected to one side of the heater.
7. It is necessary to maintain the collector positive with respect to the helix. Fluctuations in collector voltage should be less than $\pm 10\%$.
8. The helix voltage should be set to the optimum value and stabilised to within $\pm 5\%$.
9. Grid 1 and Grid 3 voltages should be stabilised to within $\pm 5\%$.
10. Grid 2 voltage should be adjusted to give $150\mu A$ collector current and stabilised to within $\pm 5\%$.
11. Fixed voltages are recommended wherever possible for ease of operation. However, if the helix and Grid 1 voltages are optimised better performance may be obtained.
12. Tolerance $\pm 5\%$.
13. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

N1017M

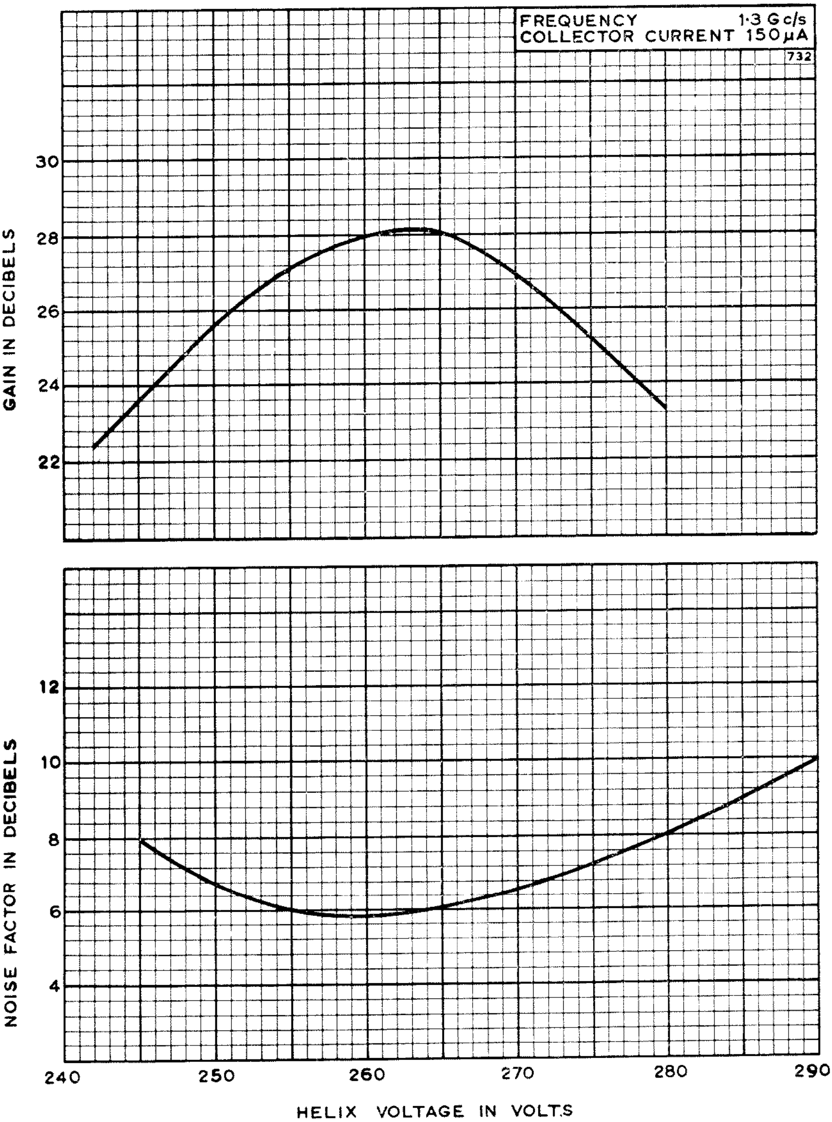
LOW NOISE TRAVELLING WAVE TUBE

FREQUENCY CHARACTERISTIC

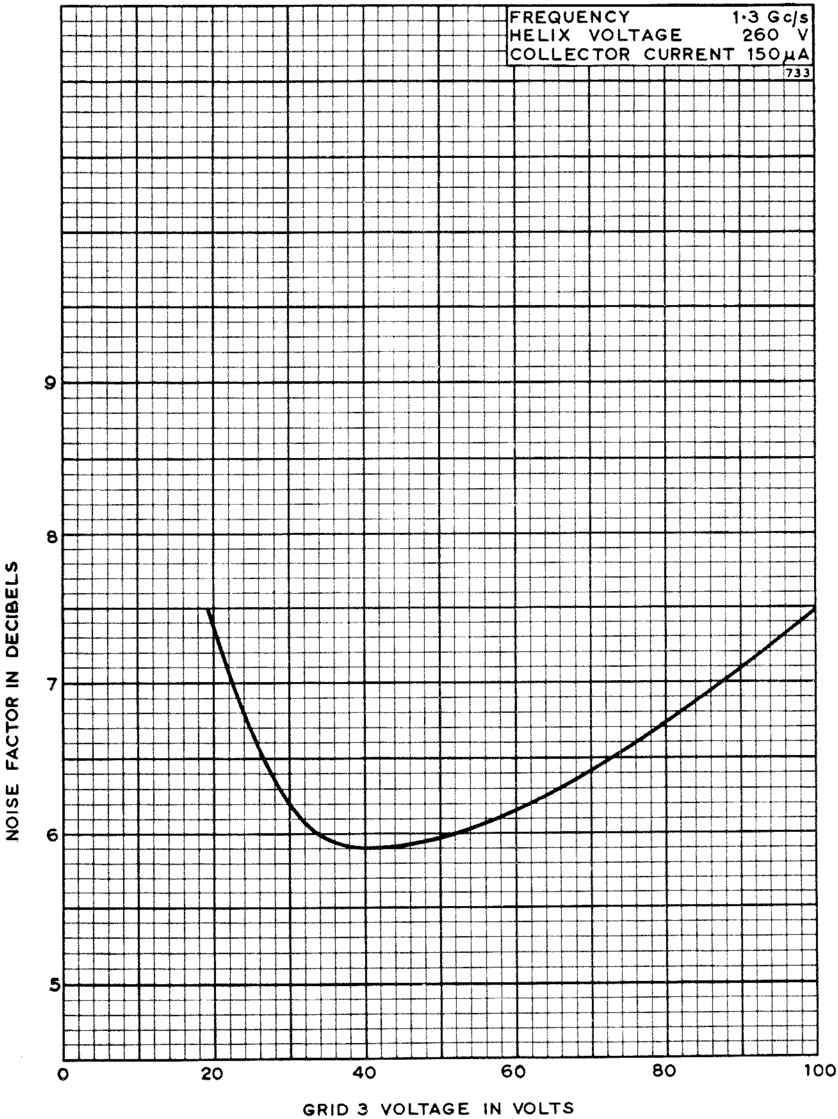


LOW NOISE TRAVELLING WAVE TUBE

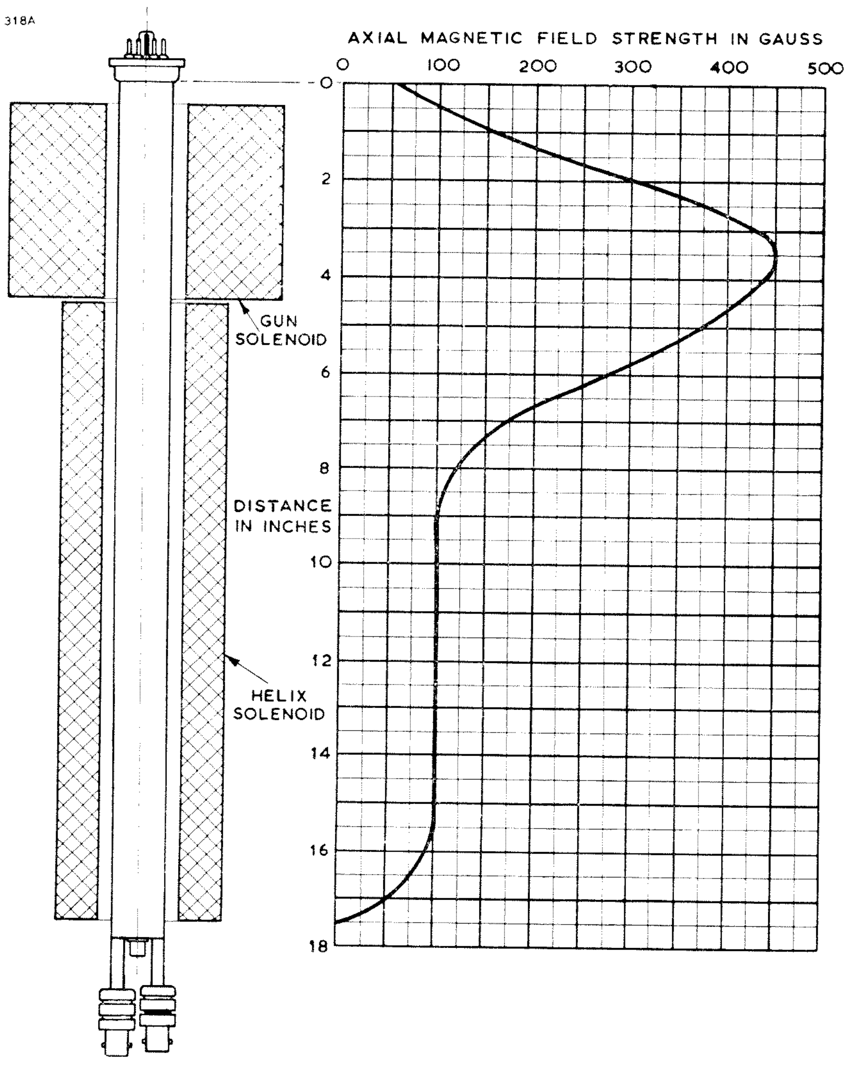
HELIX VOLTAGE CHARACTERISTIC



GRID 3 VOLTAGE CHARACTERISTIC



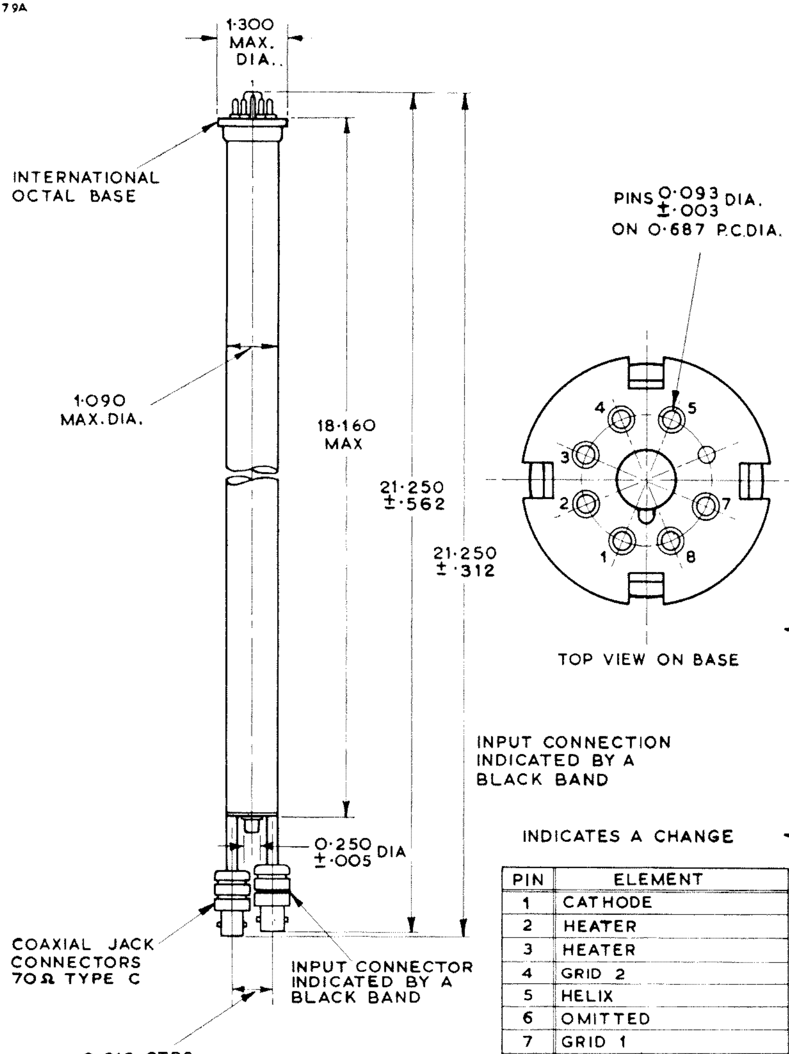
RECOMMENDED MAGNETIC FIELD DISTRIBUTION



LOW NOISE TRAVELLING WAVE TUBE

OUTLINE

579A



INDICATES A CHANGE ←

PIN	ELEMENT
1	CATHODE
2	HEATER
3	HEATER
4	GRID 2
5	HELIX
6	OMITTED
7	GRID 1
8	GRID 3
CAP	COLLECTOR

ALL DIMENSIONS IN INCHES

LOW NOISE TRAVELLING WAVE TUBE

N1024M

GENERAL

The N1024M is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections	50Ω Coaxial jack connectors (UG–89/U)	
Mounting Position		Any
Cooling		Natural
Recommended Solenoid		N4001
Frequency Range	3·6 to 4·2	Gc/s

MAXIMUM RATINGS
(Absolute Values)

Collector Voltage	750	V Max
Collector Current	220	μA Max
Helix Voltage	500	V Max
Helix Current	20	μA Max
Grid 3 Voltage	200	V Max
Grid 3 Dissipation	0·1	W Max
Grid 2 Voltage	75	V Max
Grid 2 Dissipation	0·1	W Max
Grid 1 Voltage (negative value, never positive)	50	V Max
Canister Temperature	70	°C Max

TYPICAL OPERATION
(at 4·0Gc/s)

Collector Voltage	700	V
Collector Current	200	μA
Helix Voltage	380	V
Grid 3 Voltage	50	V
Grid 2 Voltage	45	V
Grid 1 Voltage	−15	V
Helix Current	1	μA
Gain (Low Level)	20	db
Noise Factor	9	db
Output Power (Saturated)	1·5	mW

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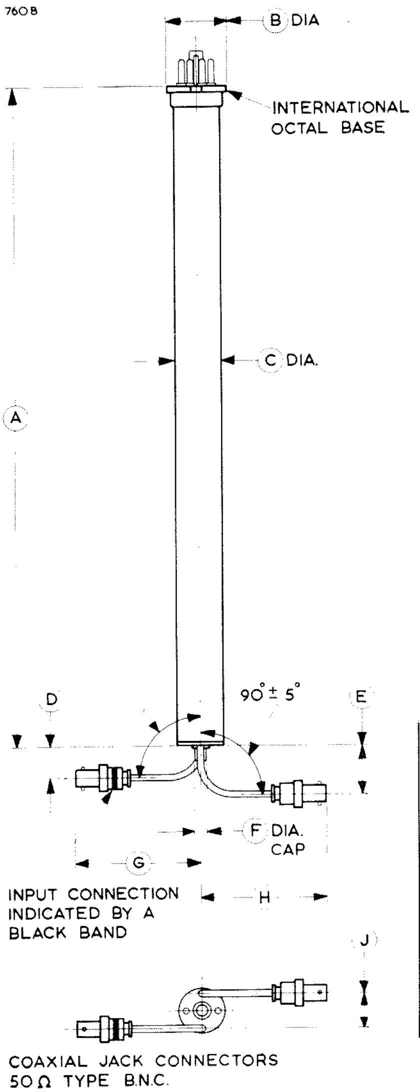
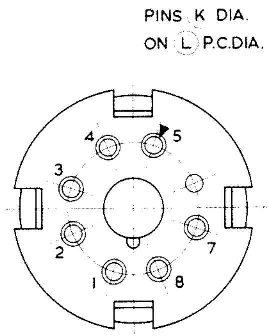




TOP VIEW ON BASE

Pin	Element
1	Cathode
2	Heater
3	Heater
4	Grid 2
5	Grid 4 and Helix
6	Omitted
7	Grid 1
8	Grid 3
Cap	Collector

Ref.	Inches	Millimetres
A	13·875 ± 0·060	352·4 ± 1·52
B	1·286 ± 0·010	32·66 ± 0·25
C	1·020 ± 0·002	25·908 ± 0·051
D	0·625 ± 0·375	15·88 ± 9·53
E	1·000 ± 0·500	25·40 ± 12·70
F	0·250 ± 0·005	6·35 ± 0·13
G	2·625 ± 0·375	66·68 ± 9·53
H	2·625 ± 0·375	66·68 ± 9·53
J	0·800 ± 0·020	20·32 ± 0·51
K	0·093 ± 0·003	2·362 ± 0·076
L	0·687	17·45

Millimetre dimensions have been derived from inches.

MEDIUM POWER TRAVELLING WAVE TUBE

N1025M

GENERAL

The N1025M is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections	50Ω Coaxial jack connectors (UG–89/U)	
Mounting Position	Any	
Cooling	Natural	
Recommended Solenoid	N4001	
Frequency Range	3·6 to 4·2	Gc/s

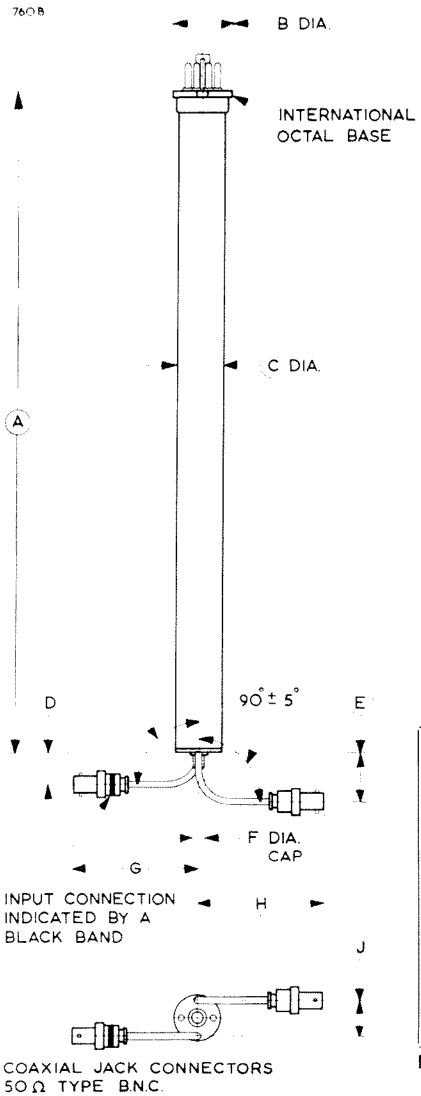
MAXIMUM RATINGS
(Absolute Values)

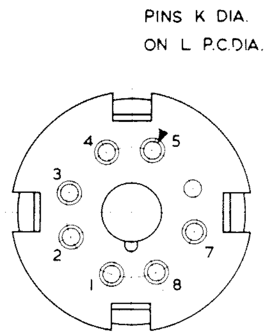
Collector Voltage	800	V Max
Collector Current	2·5	mA Max
Helix Voltage	800	V Max
Helix Current	500	μA Max
Grid 2 Voltage	400	V Max
Grid 2 Dissipation	100	mW Max
Grid 1 Voltage (negative value, never positive)	50	V Max
Grid 1 Dissipation	100	mW Max
Canister Temperature	70	°C Max

TYPICAL OPERATION
(at 4·0Gc/s)

Collector Voltage	750	V
Collector Current	2·0	mA
Helix Voltage	600	V
Grid 2 Voltage	300	V
Grid 1 Voltage	−15	V
Helix Current	40	μA
Gain:		
at low level	33	db
at saturation	25	db
Noise Factor	21	db
Output Power (Saturated)	100	mW

OUTLINE





TOP VIEW ON BASE

Pin	Element
1	Cathode
2	Heater
3	Heater
4	No Connection
5	Grid 3 and Helix
6	Omitted
7	Grid 1
8	Grid 2
Cap	Collector

Ref.	Inches	Millimetres
A	13·875 ± 0·060	352·4 ± 1·52
B	1·286 ± 0·010	32·66 ± 0·25
C	1·020 ± 0·002	25·908 ± 0·051
D	0·625 ± 0·375	15·88 ± 9·53
E	1·000 ± 0·500	25·40 ± 12·70
F	0·250 ± 0·005	6·35 ± 0·13
G	2·625 ± 0·375	66·68 ± 9·53
H	2·625 ± 0·375	66·68 ± 9·53
J	0·800 ± 0·020	20·32 ± 0·51
K	0·093 ± 0·003	2·362 ± 0·076
L	0·687	17·45

Millimetre dimensions have been derived from inches.

POWER TRAVELLING WAVE TUBE

N1029

INTRODUCTION

The N1029 is a Travelling Wave Tube designed primarily for use as a power amplifier in waveguide systems operating in the frequency range 5·9 to 7·2Gc/s. The rated output power is 5 watts with a minimum gain of 43db.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	1·2	A
Heater Starting Current:		
Peak instantaneous value must not exceed	3·0	A
Cold Insertion Loss	60	db
Operating Frequency:		
Minimum	5·9	Gc/s
Maximum	7·2	Gc/s
Magnetic Field (*See Notes* 1 *and* 2)	600	Gauss
Hot Input V.S.W.R. over any 40Mc/s band (*See Note* 3)	1·3 : 1	Max
Hot Output V.S.W.R. over any 40Mc/s band (*See Note* 3)	1·3 : 1	Max

Mechanical

Overall Length	14·41 inches	(366 mm)	Max
Overall Width (excluding flexible leads)	2·07 inches	(53 mm)	Max
R.F. Connections	Waveguide		
Base	Moulded cap with flying leads		
Collector Connection	Direct to radiator		
Mounting Position	Any		
Cooling	Conduction and natural convection		

POWER
TRAVELLING WAVE TUBE

N1029

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MAXIMUM RATINGS (See Note 4)
(Absolute Values)

Collector Voltage	3000	V Max
Collector Current	40	mA Max
Helix Voltage	3000	V Max
Helix Current (*See Note* 5)	1·0	mA Max
Grid 2 Voltage	3000	V Max
Grid 2 Current	1·0	mA Max
Grid 2 Dissipation	1·5	W Max
Grid 1 Voltage (negative value)	100	V Max
Collector Temperature	200	°C Max
Bulb Temperature	70	°C Max

TYPICAL OPERATION
(at 6·5Gc/s) (See Note 6)

Operational Conditions (*See Note* 4)

Collector Voltage (*See Note* 7)	1600	V
Collector Current	35	mA
Helix Voltage (*See Note* 7)	2650	V
Grid 2 Voltage	2900	V
Grid 1 Voltage (*See Note* 8)	−15	V
Magnetic Field (*See Notes* 1 *and* 2)	600	Gauss

Typical Performance

Helix Current (*See Note* 5)	0·5	mA
Grid 2 Current	0·1	mA
Grid 1 Current		Zero
Gain at 5 watts output	43	db
Output Power	5	W
Saturation Output Power	9	W

POWER
TRAVELLING WAVE TUBE

N1029

INTRODUCTION

The N1029 Travelling Wave Tube is a wideband power amplifier operating in the frequency range 5·8 to 7·2Gc/s.

It is recommended that the tube be operated in the periodic permanent magnet focusing mount type N4047, but operation in an equivalent solenoid type focusing mount is equally satisfactory.

The N4047 mount incorporates waveguide input and output connections fitted with short circuit matching devices which are pre-set for a selected 500Mc/s band. Convection cooling is adequate when the mount is fixed with its axis horizontal and air can circulate freely past the radiator. Forced air cooling is required if the axis of the mount is vertical.

Tubes are fully interchangeable in the approved mount and tube replacement is a relatively simple operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·8	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4·0	A
Heater Cold Resistance	1·72	Ω ←
Cathode Heating Time (Minimum) (*See Note* 1)	1	minute ←
Cold Insertion Loss	70	db Min
Operating Frequency:		
Minimum	5·8	Gc/s
Maximum	7·2	Gc/s
Output Power (Saturated) (*See Note* 10):		
at 5·80Gc/s	13·5	W ←
at 6·45Gc/s	11·0	W ←
at 7·20Gc/s	9·5	W ←
Input V.S.W.R. over any 500Mc/s band (*See Note* 2)	1·5:1	Max
Output V.S.W.R. over any 500Mc/s band (*See Note* 2)	1·5:1	Max

Mechanical

Overall Length	13·88 inches	(352·5 mm)	Max
Overall Width (excluding flexible leads)	2·07 inches	(52·58 mm)	Max
R.F. Connections (on mount N4047) (*See Note* 3)	Waveguide fitted with modified RETMA standard flange type CMR137		
Tube Base	Moulded cap and flying leads fitted with plug type BA7P		
Mounting Position (N1029 only)	Any		

Cooling .. .. Conduction and natural convection

← Indicates a change

POWER
TRAVELLING WAVE TUBE

N1029

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MAXIMUM RATINGS
(Absolute Values) (*See Note* 4)

Collector Voltage	3300	V Max
Collector Current	40	mA Max
→Collector Dissipation	80	W Max
Helix Voltage	3300	V Max
Helix Current (*See Note* 5):		
→ Continuous	1·0	mA Max
→ For 10sec maximum duration	1·5	mA Max
Grid 2 Voltage	3300	V Max
Grid 2 Current	1·0	mA Max
Grid 2 Dissipation	1·5	W Max
Grid 1 Voltage (negative value, never positive)	150	V Max
→Heater Voltage	6·6	V Max
Collector Seal Temperature	200	°C Max
→Bulb Temperature (2 inches or more from collector)	150	°C Max

TYPICAL OPERATION
(at 6·45Gc/s) (*See Note* 6)

Operational Conditions (*See Note* 4)

Collector Voltage (*See Note* 7)	1800	V
Collector Current (*See Note* 8)	35	mA
Helix Voltage (*See Note* 7)	2640	V
Grid 2 Voltage	2900	V
Grid 1 Voltage (*See Note* 8)	−15	V

Typical Performance

Helix Current (*See Note* 5)	0·4	mA
Grid 2 Current	0·1	mA
Grid 1 Current		Zero
Gain at 5 watts output (*See Note* 10)	43	db
Saturation Output Power (*See Note* 10)	10·5	W

→Indicates a change

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RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Tube operated in mount type N4047)

Recommended Applied Conditions (*See Note* 4)

Frequency Range	5·8 to 7·2	Gc/s
Heater Voltage (*See Note* 9)	6·3	V
Collector Voltage (*See Note* 7)	1800	V
Collector Current (*See Note* 8)	35	mA
Grid 2 Voltage	2900	V
Load V.S.W.R.	1·5:1	Max

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·75	0·85	A
Helix Voltage (*See Note* 10)	2400	2900	V
Grid 2 Current	—	0·2	mA←
Grid 1 Voltage (*See Note* 8)	−80	0	V
Grid 1 Current	—	0·2	mA←
Helix Current (zero r.f. drive)	—	0·4	mA←
Helix Current (at 5 watts output)	—	0·8	mA←
Output Power		(*See Note* 10)	
Saturation Output Power		(*See Note* 10)	
Noise Factor (*See Note* 11)	—	30	db
Self-oscillation (*See Note* 12)			None
Gain Flatness (*See Note* 13)	—	0·01	db/Mc/s

← Indicates a change

SETTING-UP PROCEDURE

The following procedure for setting-up the N1029 in the approved mount N4047 is recommended:

(*a*) Before inserting the travelling wave tube, the two pairs of focusing screws on the mount must be set to a central position. This is obtained when the screws are about $\frac{3}{4}$ turn from fully clockwise position with the blue dots towards the collector end of the mount.

(*b*) Open the end cover, pull down the sprung retaining finger and insert the travelling wave tube in the mount, taking care to avoid radial force. Slightly increase pressure to overcome the extra resistance as the collector enters the radiator and ensure that the keyway on the tube mates correctly with the spigot on the mount.

Release the retaining finger so that it presses against the moulded base of the tube.

(*c*) Apply grease gun loaded with Midland Silicones grease type MS4 to the collector greasing nipple until grease appears at the overflow tube. This operation may push the tube from its seating and so it should be reseated if necessary. Subsequently the mount should be regreased at monthly intervals and whenever a new tube is installed.

(*d*) Engage the 7-pin plug on the end of the travelling wave tube leads with the supply socket and close the cover.

(*e*) Switch on the travelling wave tube heater and allow a minimum of three minutes cathode preheating time.

(*f*) Set the helix voltage and grid 1 voltage to approximately 2600V and −25V respectively.

(*g*) Apply all h.t. voltages except grid 2 voltage.

(*h*) Grid 2 voltage must be held at less than 1000 volts with respect to cathode (or floating) until all other voltages have reached their full operating values.

(*j*) Successively adjust the focusing screws until the helix current is reduced to a minimum and grid 1 voltage until the collector current is 35mA. Note: If grid 1 voltage is made less negative with respect to cathode so that the collector current rises above 35mA, this current will rise to a maximum and then decrease again. The decrease in current is due to grid 2 current being taken and can cause damage to the tube. The tube must not therefore be operated in this condition.

Once the travelling wave tube has been set up and focused as described above it may be subsequently switched on again from cold, without further adjustment to the focusing screws or grid 1 voltage, as follows:

(1) Allow one minute minimum cathode preheating time.

(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

NOTES

1. In the event of a power supply failure of less than 30 seconds duration, all voltages may be re-applied simultaneously excepting grid 2 voltage which must be delayed. For interruptions in excess of 10 seconds, the normal switching on procedure must be followed.

2. Matching adjustments on the mount are pre-set during manufacture for a selected 500Mc/s frequency band in the range 5·8 to 7·2Gc/s. This band should be specified when ordering the mount. With any tube operated in the mount under the recommended applied conditions the V.S.W.R. will remain below the value quoted over the selected 500Mc/s band without adjustment of the matching devices.

   If additional matching arrangements are provided the V.S.W.R. at any spot frequency can be reduced below 1·1:1 and will remain below 1·3:1 over a 50Mc/s band centered on this frequency without further adjustment.

3. Transitions to standard circular waveguide flanges UG-344/U or RETMA miniature waveguide flanges CMR137 (pressurised—CPR137) can also be supplied.

4. All voltages apart from the heater voltage are quoted with respect to the cathode. The grid 2 and grid 1 supplies should be stabilised to within $\pm 5\%$; that for the helix should be within $\pm 2\%$.

5. The helix should be protected against damage caused by excessive helix current. The protection circuit should be set to interrupt the tube supplies if this current exceeds 2·0mA.

6. For other frequencies within the operating range of the tube the helix voltage will need adjustment if maximum gain is to be obtained.

7. The tube may be operated with the helix and collector at the same potential provided the collector temperature does not exceed its maximum rated value. The use of a lower collector potential is recommended to promote long life of the tube.

8. The collector current is set to the recommended value by adjustment of the potential applied to grid 1.

9. To obtain maximum life the heater voltage should be maintained within $\pm 5\%$ of the nominal value.

10. The helix voltage is adjusted for maximum r.f. output power with the given r.f. input power. The output will be greater than the value specified in column 3 of the table below.

The helix voltage is then increased until the output power falls to 5 watts. At this voltage setting the saturation output power will exceed the minimum value specified below.

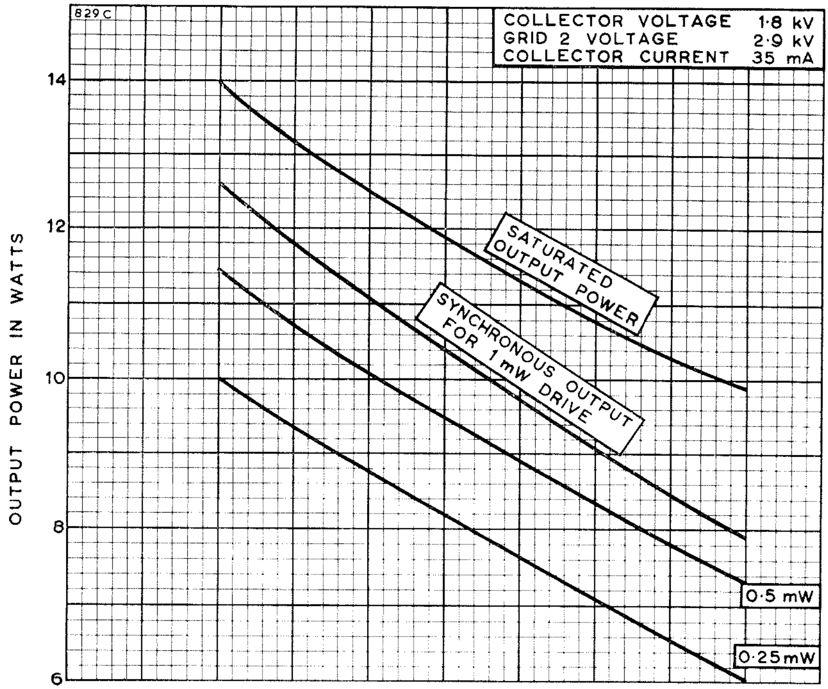
Frequency (Gc/s)	Input Power (mW)	Output Power (W)	Saturated Output Power (W)	
			Minimum	Typical
5·80	0·25 0·5 1·0	5·0	10·0 10·0 10·0	13·0 13·5 14·0
6·45	0·25 0·5 1·0	5·0	9·0 10·0 10·0	10·5 11·0 11·5
7·20	0·25 0·5 1·0	5·0	8·0 9·0 9·0	9·0 9·5 10·0

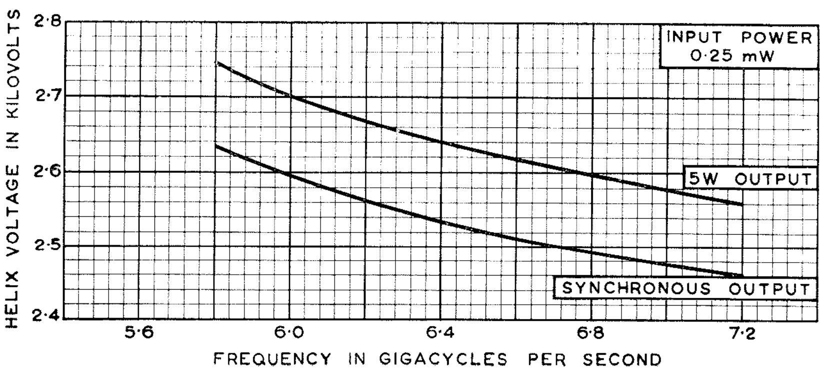
11. The output spectrum is examined with the tube set up as described in Note 10 to an output carrier level of 5 watts. In any 20kc/s band over the range up to $\pm$10Mc/s from the carrier, the spectrum will contain no thermal or spurious mode noise power exceeding the value appropriate to the maximum noise factor specified.

12. With the operating voltages as described in Note 10, the power in the input and output waveguides is measured with these waveguides terminated in short circuits of variable phase.

13. Over 50Mc/s range. This is a type approval test only.

FREQUENCY CHARACTERISTICS





POWER TRAVELLING WAVE TUBE

N1029

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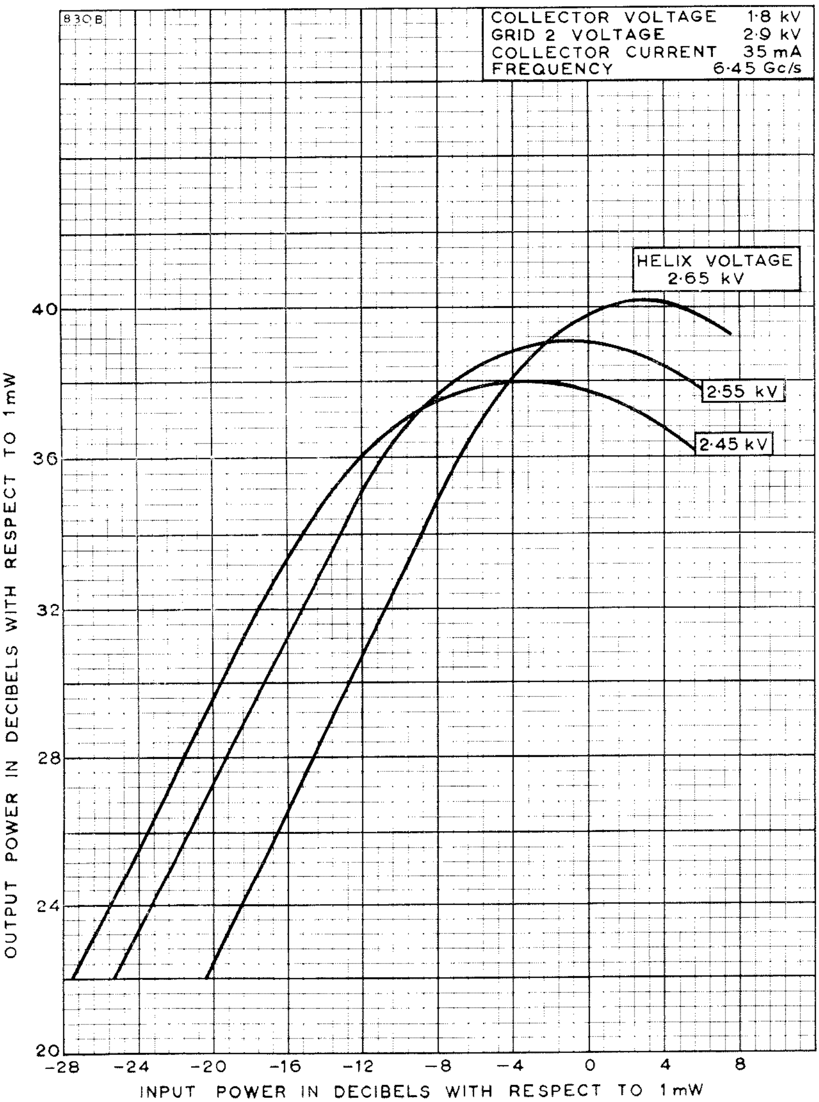
POWER CHARACTERISTICS



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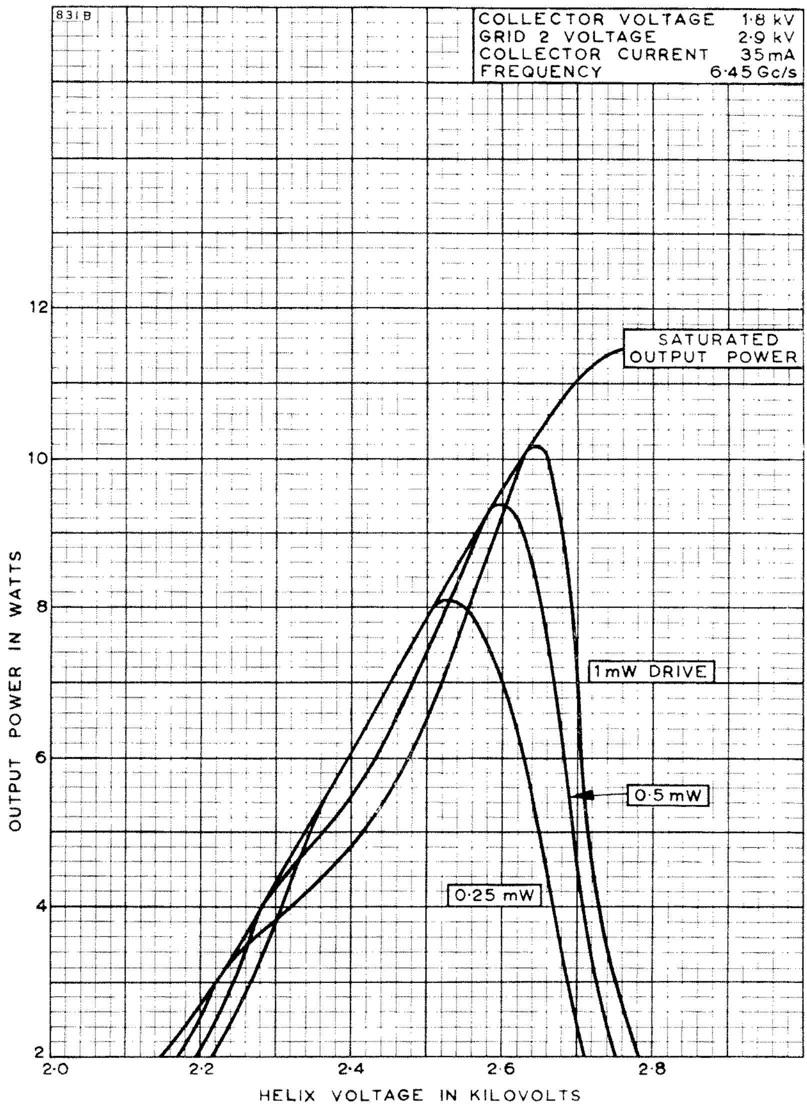
POWER TRAVELLING WAVE TUBE

N1029

HELIX VOLTAGE CHARACTERISTICS



POWER
TRAVELLING WAVE TUBE

N1029

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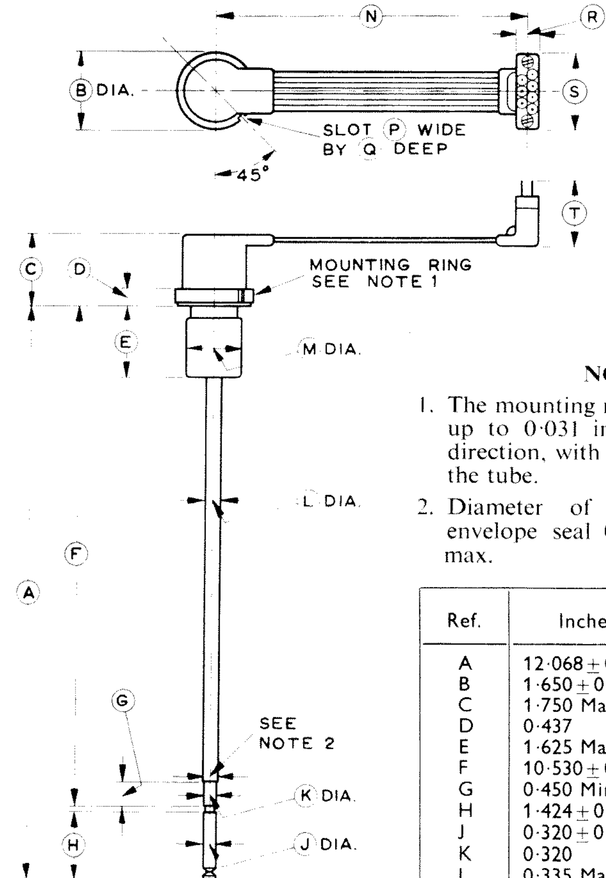

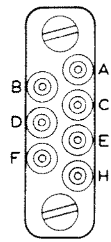

DETAIL OF PLUG
TYPE BA7P

NOTES

1. The mounting ring may be off set by up to 0·031 inch (0·79mm) in any direction, with respect to the axis of the tube.
2. Diameter of glass at collector-envelope seal 0·350 inch (8·89mm) max.

Ref.	Inches	Millimetres
A	12·068 ± 0·062	306·53 ± 1·57
B	1·650 ± 0·001	41·910 ± 0·025
C	1·750 Max	44·45 Max
D	0·437	11·10
E	1·625 Max	41·28 Max
F	10·530 ± 0·025	267·46 ± 0·64
G	0·450 Min	11·43 Min
H	1·424 ± 0·032	36·17 ± 0·81
J	0·320 ± 0·003	8·128 ± 0·076
K	0·320	8·13
L	0·335 Max	8·51 Max
M	1·200 Max	30·48 Max
N	6·500 ± 0·250	165·10 ± 6·35
P	0·125	3·18
Q	0·062	1·58
R	0·500	12·70
S	1·625	41·28
T	1·375	34·93

Millimetre dimensions have been derived from inches.

Pin	Element	Pin	Element
A	Grid 2	E	Heater
B	Heater	F	Cathode
C	Helix	H	N.C.
D	Grid 1	CAP	Collector

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LOW NOISE TRAVELLING WAVE TUBE

N1031

Service Type CV5401

GENERAL

The N1031 is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections	Waveguide	
Mounting Position	Any	
Cooling	Natural	
Recommended Solenoid	N4021	
Frequency Range	3·8 to 4·2	Gc/s

MAXIMUM RATINGS
(Absolute Values)

Collector Voltage	1000	V Max
Collector Current	300	μA Max
Helix Voltage	600	V Max
Helix Current	5	μA Max
Grid 4 Voltage	600	V Max
Grid 4 Dissipation	0·1	W Max
Grid 3 Voltage	80	V Max
Grid 3 Dissipation	0·1	W Max
Grid 2 Voltage	80	V Max
Grid 2 Dissipation	0·1	W Max
Grid 1 Voltage (negative value, never positive)	75	V Max
Grid 1 Dissipation	0·1	W Max
Envelope Temperature	120	°C Max

TYPICAL OPERATION
(at centre of frequency range)

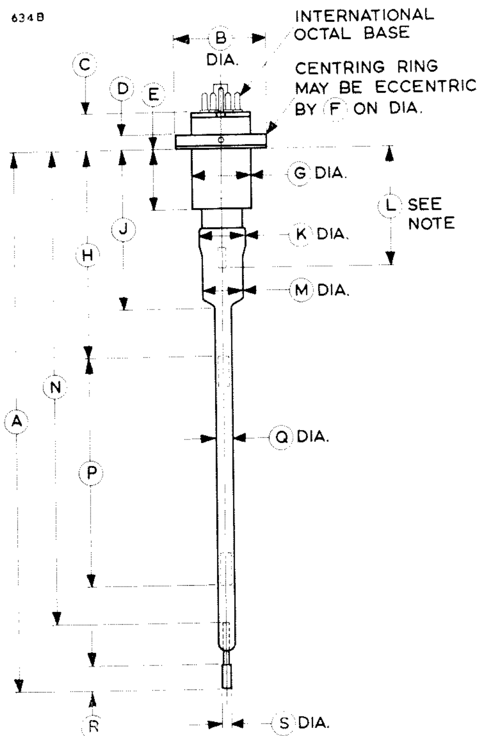
Collector Voltage	700	V
Collector Current	250	μA
Helix Voltage	490	V
Grid 4 Voltage	365	V
Grid 3 Voltage	45	V
Grid 2 Voltage	20	V
Grid 1 Voltage	−5	V
Helix Current	2	μA
Gain (Low Level)	25	db
Noise Factor	8·5	db
Output Power (Saturated)	2·3	mW

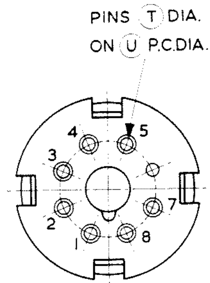
LOW NOISE TRAVELLING WAVE TUBE

N1031

ENGLISH ELECTRIC

OUTLINE





TOP VIEW ON BASE

Pin	Element
1	Cathode and Heater
2	Heater
3	Grid 2
4	Grid 4
5	Helix
6	Omitted
7	Grid 1
8	Grid 3
Cap	Collector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	11·400 ± 0·125	289·6 ± 3·18	K	1·000 Max	25·40 Max
B	1·938 ± 0·002	49·225 ± 0·051	L	2·500	63·50
C	0·745 ± 0·075	18·92 ± 1·90	M	0·950 Max	24·13 Max
D	$0{\cdot}312^{+0{\cdot}032}_{-0{\cdot}062}$	$7{\cdot}92^{+0{\cdot}81}_{-1{\cdot}57}$	N	10·036	254·9
			P	4·896 ± 0·010	124·4 ± 0·25
E	1·250 Max	31·75 Max	Q	0·350 Max	8·89 Max
F	0·062	1·57	R	0·500	12·70
G	1·312 Max	33·32 Max	S	0·187 ± 0·003	4·750 ± 0·076
H	4·390 ± 0·010	111·5 ± 0·25	T	0·093 ± 0·003	2·362 ± 0·076
J	3·375 Max	85·73 Max	U	0·687	17·45

Millimetre dimensions have been derived from inches.

Note. Approximate distance of cathode from flange.

MEDIUM POWER TRAVELLING WAVE TUBE

N1032

Service Type CV5402

GENERAL

The N1032 is a maintenance type and therefore only abridged data are given on this sheet. **Full information is available on request.**

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·36	A
Cathode Heating Time (Minimum)	2	min
R.F. Connections	Waveguide	
Mounting Position	Any	
Cooling	Natural	
Recommended Solenoid	N4020	
Frequency Range	3·8 to 4·2	Gc/s

MAXIMUM RATINGS
(Absolute Values)

Collector Voltage	2·0	kV Max
Collector Current	4·0	mA Max
Helix Voltage	1·8	kV Max
Helix Current	500	μA Max
Grid 3 Voltage	1·9	kV Max
Grid 3 Dissipation	0·1	W Max
Grid 2 Voltage	900	V Max
Grid 2 Dissipation	0·1	W Max
Grid 1 Voltage (negative value, never positive)	150	V Max
Grid 1 Dissipation	0·1	W Max
Envelope Temperature	120	°C Max

TYPICAL OPERATION
(at centre of frequency range)

Collector Voltage	1·75	kV
Collector Current	3·5	mA
Helix Voltage	1·45	kV
Grid 3 Voltage	Collector Potential	
Grid 2 Voltage	650	V
Grid 1 Voltage	−40	V
Helix Current	100	μA
Gain (at 25mW output)	38	db
Noise Factor	19	db
Output Power (Saturated)	300	mW

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MEDIUM POWER TRAVELLING WAVE TUBE

N1032

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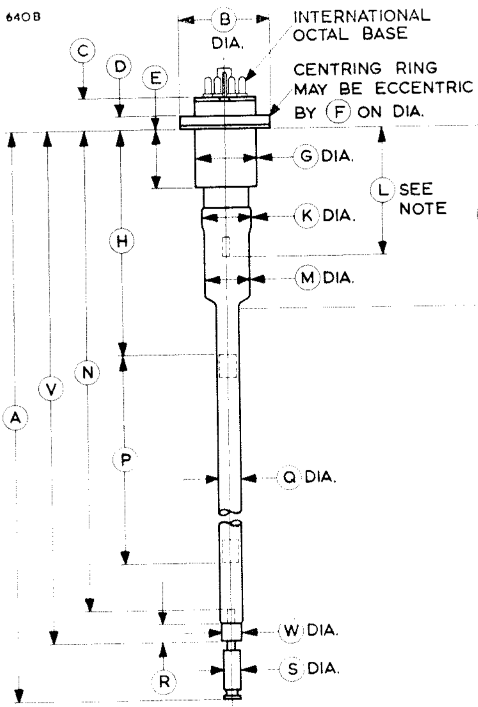
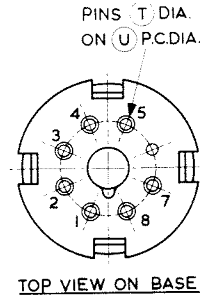
OUTLINE





Pin	Element
1	Cathode and Heater
2	Heater
3	Grid 2
4	Grid 3
5	Helix
6	Omitted
7	Grid 1
8	No Connection
Cap	Collector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	16·550 ± 0·150	420·4 ± 3·81	M	0·950 Max	24·13 Max
B	1·938 ± 0·002	49·225 ± 0·051	N	14·546	369·5
C	0·745 ± 0·075	18·92 ± 1·90	P	8·968 ± 0·010	227·8 ± 0·25
D	$0{\cdot}312^{+0{\cdot}032}_{-0{\cdot}062}$	$7{\cdot}92^{+0{\cdot}81}_{-1{\cdot}57}$	Q	0·500 Max	12·70 Max
			R	0·375 Min	9·53 Min
E	1·250 Max	31·75 Max	S	0·375 ± 0·003	9·525 ± 0·076
F	0·062	1·57	T	0·093 ± 0·003	2·362 ± 0·076
G	1·312 Max	33·32 Max	U	0·687	17·45
H	4·703 ± 0·010	119·5 ± 0·25	V	15·396 ± 0·087	391·1 ± 2·21
J	3·750 Max	95·25 Max	W	$0{\cdot}433^{+0{\cdot}002}_{-0{\cdot}001}$	$10{\cdot}998^{+0{\cdot}051}_{-0{\cdot}025}$
K	1·000 Max	25·40 Max			
L	2·650	67·31			

Millimetre dimensions have been derived from inches.

Note Approximate distance of cathode from flange.

POWER TRAVELLING WAVE TUBE

N1033

Service Type CV5403 ←

INTRODUCTION

The N1033 is a Travelling Wave Tube designed for use as a power amplifier in the frequency range 3·8 to 4·8Gc/s. The tube operates in a waveguide mount. The typical output power of the tube at saturation is 7 watts and the gain 37db at 4 watts output.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·71	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4·0	A
Cathode Heating Time (Minimum) (*See Note* 1)	3	minutes
Cold Insertion Loss	70	db
Operating Frequency:		
Minimum	3·8	Gc/s
Maximum	4·8	Gc/s
Gain (at 4 watts output)	37	db
Output Power (Saturated)	7	W
Magnetic Field at centre of coil (*See Notes* 2, 3 *and* 4)	550	Gauss
Recommended Solenoid		N4006←

Mechanical

Overall Length	18·10 inches	(459·8 mm)	Max
Overall Diameter	2·063 inches	(52·4 mm)	Max
Net Weight	12 ounces	(350 gm)	Approx
R.F. Connections by Waveguide			(*See Note* 5)
Base			Giant 7-pin
Collector Connection			External Cap
Mounting Position			Any
Collector Cooling (*See Note* 6)			Heat Sink

← Indicates a change.

POWER TRAVELLING WAVE TUBE

N1033

ENGLISH ELECTRIC

MAXIMUM RATINGS (*See Note* 7)

(Absolute Values)

Heater Voltage	6·6	V Max
Collector Voltage (*See Note* 8)	2500	V Max
Collector Current	30	mA Max
Helix Voltage	2500	V Max
Helix Current (*See Note* 9)	1·5	mA Max
Grid 2 Voltage	2800	V Max
Grid 2 Current	1·0	mA Max
Grid 2 Dissipation	1·5	W Max
Grid 1 Voltage (negative value, never positive)	150	V Max
Collector Temperature	150	°C Max
Bulb Temperature	120	°C Max

TYPICAL OPERATION

(at 4·0Gc/s)

Operational Conditions (*See Note* 7)

Heater Voltage	6·3	V
Collector Voltage (*See Note* 8)	1400	V
Collector Current	24	mA
Helix Voltage (*See Note* 10)	2175	V
Grid 2 Voltage (*See Note* 11)	2600	V
Grid 1 Voltage (*See Note* 12)	−5	V
Magnetic Field (*See Notes* 2, 3 *and* 4):		
At Centre of Coil	550	Gauss
At Cathode		near zero

Typical Performance

Helix Current (*See Note* 4)	0·5	mA
Grid 2 Current	0·2	mA
Grid 1 Current	Substantially	zero
Gain (at 4 watts output)	37	db
Output Power (Saturated) (*See Note* 13)	7	W
Tube Input V.S.W.R.	1·15:1	
Tube Output V.S.W.R. (beam on)	1·15:1	

ENGLISH ELECTRIC

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(Over the frequency range 3·8 to 4·8Gc/s)

Recommended Applied Conditions (*See Note* 7)

Heater Voltage (*See Note* 14)	6·3	V
Collector Voltage	1400	V
Collector Current	24	mA
Helix Voltage (*See Note* 10)	2000 to 2500	V
Grid 2 Voltage (*See Note* 11)	2600	V
Grid 1 Voltage (*See Note* 12)	0 to −80	V
Magnetic Field (*See Notes* 2, 3 *and* 4)		
At Centre of Coil	550	Gauss
At Cathode		near zero

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·68	0·74	A
Helix Current (*See Note* 4)	—	1·25	mA←
Grid 2 Current	—	0·75	mA←
Grid 1 Current			Zero←
Gain (at 4 watts output)	36	—	db
Output Power (Saturated) (*See Note* 13)	6	—	W
Noise Factor	—	30	db
Tube Input and Output V.S.W.R. (*See Note* 5)	—	1·25:1	

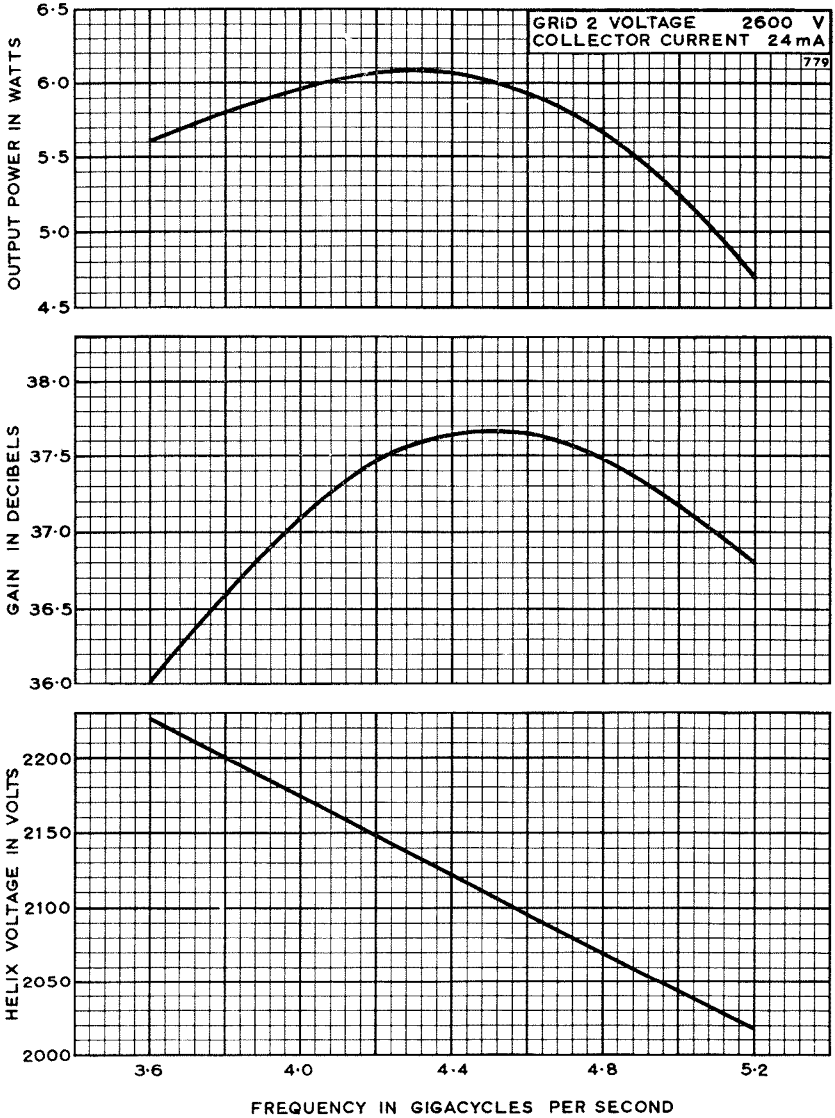
NOTES

1. In the event of a power supply failure of less than 30 seconds duration, all voltages may be re-applied simultaneously.
2. The magnetic field distribution for normal operation of the tube should be reasonably constant over the length of the helix, and in the region of 550 gauss. However, the gun end of the tube requires a low flux density, usually about 25 gauss in the cathode region, and for this reason an independently controlled gun coil is necessary. To achieve a proper focus of field at the gun end, it is usually necessary to surround the gun with a soft iron shield. Narrow waveguides are recommended to minimise the effect of the gaps in the solenoids. For the same reason, the material used for the walls of the waveguides should be as thin as practicable.

← Indicates a change

3. A mild steel insert in the collector end of the mount must be used to minimise secondary emission. The mouth of the insert must be 11·300 inches $\pm$0·032 (287·02mm$\pm$0·81) from the reference plane, at least 0·75 inch (19·05mm) long and 0·125 inch (3·18mm) wall. An internal diameter of 0·625 inch (15·88mm) is recommended to ensure clearance around the tube envelope.
4. Correct focusing (i.e. minimum helix current) can only be achieved when the axes of the tube and the magnetic field are accurately aligned. The tube is adjusted during manufacture to align the electron beam and helix with the mechanical axis through the mounting ring and collector. Provided the axis of the magnetic field in the mount is coincident with the mechanical axis through the seatings for the tube, no mechanical adjustments should be necessary apart from rotation of the tube to obtain minimum helix current.
5. For best matching there is an optimum position of the tube with respect to the waveguides, depending on the frequency. For the best average condition when using waveguides with internal dimensions 1·872inches$\times$0·250 inch it is recommended that the mount be so designed that the helix chokes protrude across the guide by 0·040 inch (1·016mm). Provided the correct adjustments have been made the V.S.W.R. over a band of $\pm$10Mc/s from the centre frequency will be less than the specified maximum.
6. The collector end of the tube is terminated in a 0·375 inch copper stub which is provided as connection to a heat sink.
7. All voltages quoted are with respect to the cathode.
8. The collector may be operated at a voltage as low as 1200 volts in a suitably designed mount.
9. An excess-current trip-out relay in the helix circuit is recommended, and this should be so arranged as to switch off the h.t. supplies in the event of the helix current rising to 1·5mA (continuous). The current may rise to a maximum value of 2·0mA for a period not exceeding 1 second.
10. The helix voltage should be set to the optimum value for the frequency of operation (*see page* 5) and stabilised to within $\pm$5%.
11. Grid 2 voltage should be stabilised to within $\pm$5%.
12. Grid 1 voltage should be adjusted to give 24mA collector current and stabilised to within $\pm$5%.
13. With the helix voltage increased to give 36db gain and with 1mW input power.
14. Tolerance $\pm$5%.

FREQUENCY CHARACTERISTIC

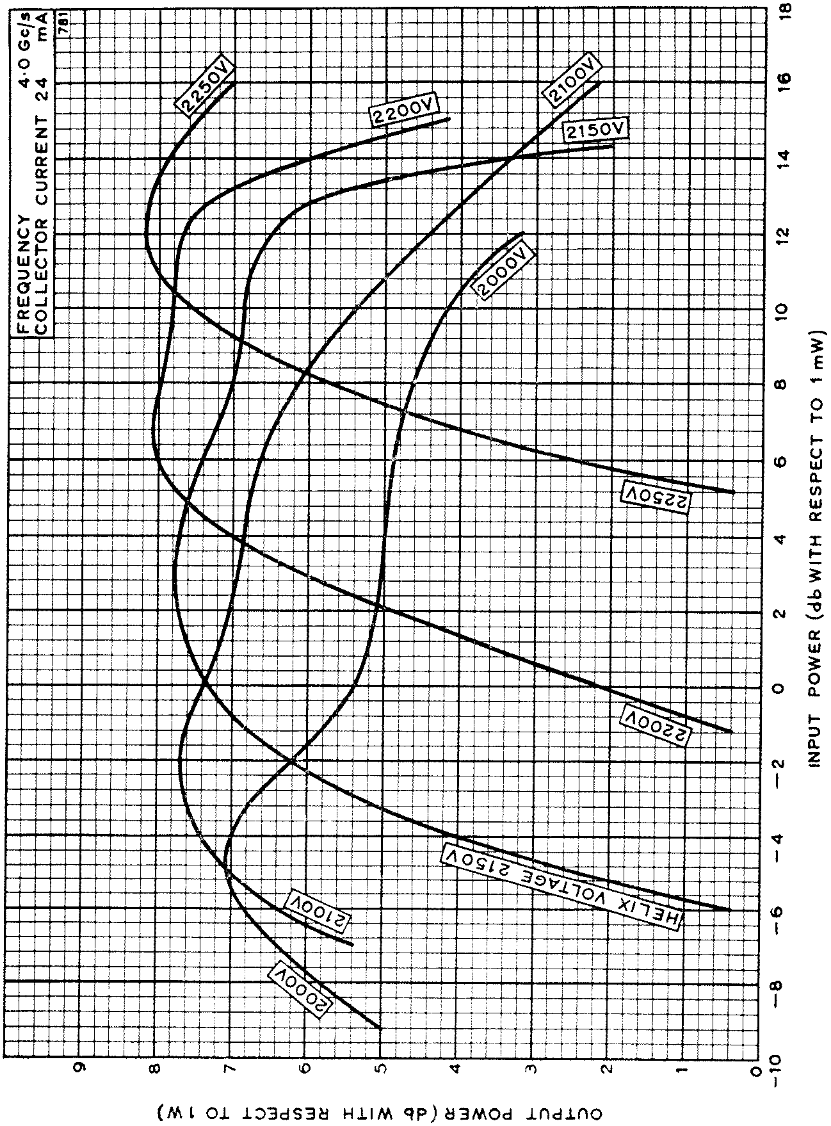


POWER TRAVELLING WAVE TUBE

N1033

ENGLISH ELECTRIC

POWER CHARACTERISTIC



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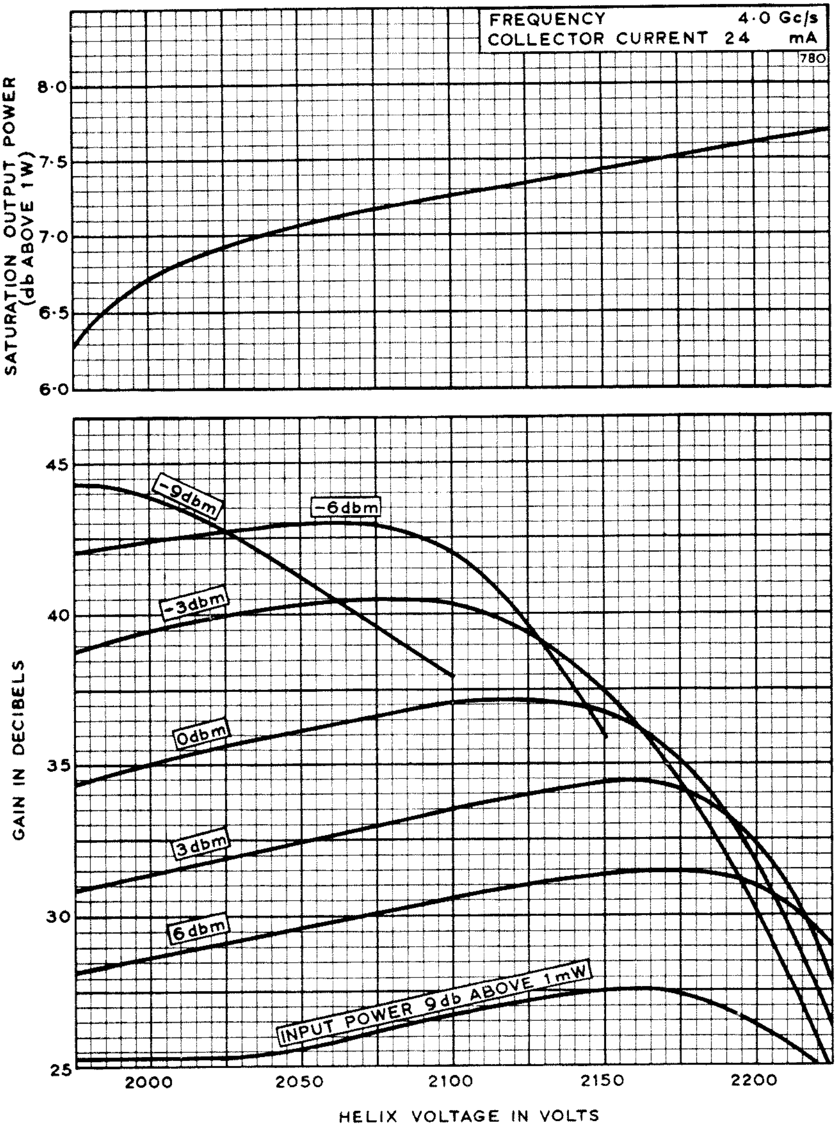
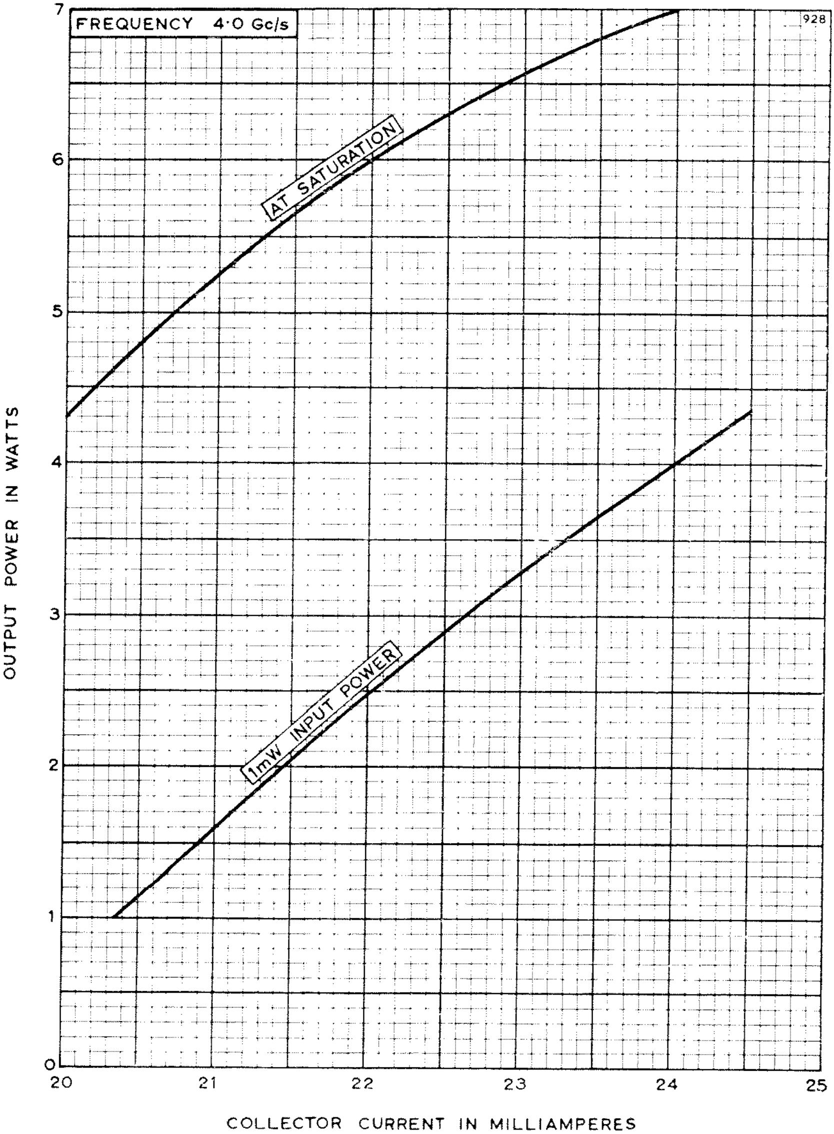
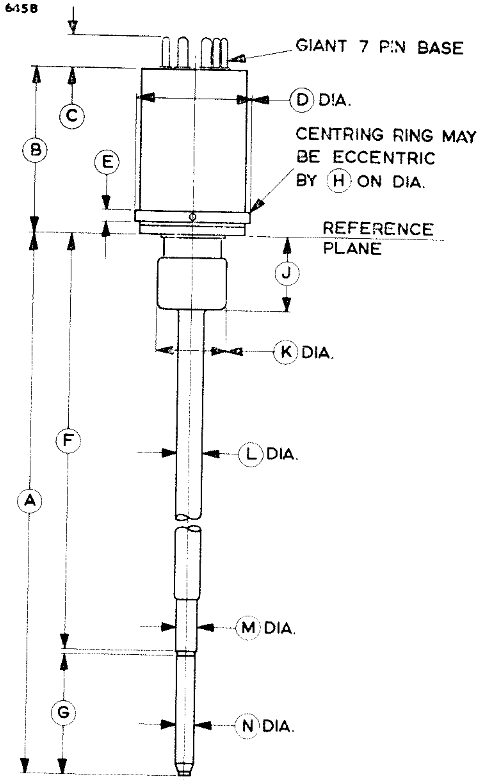
HELIX VOLTAGE CHARACTERISTIC

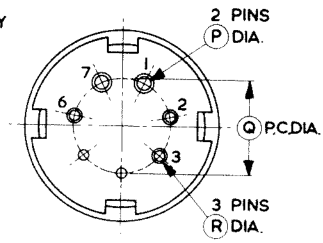


COLLECTOR CURRENT CHARACTERISTICS



OUTLINE





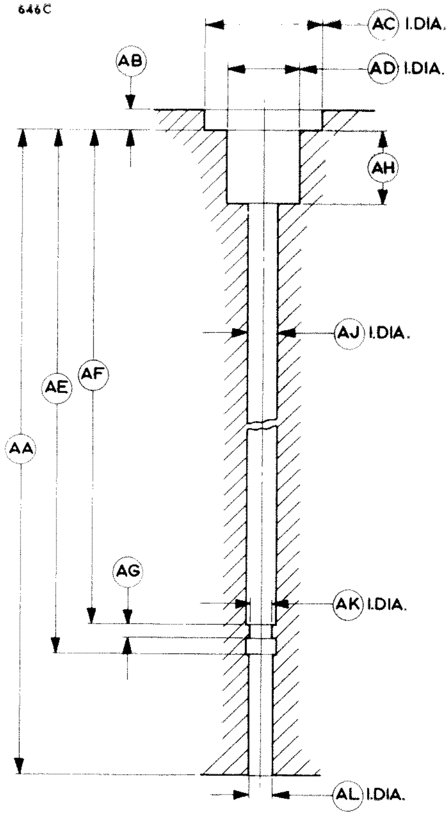
TOP VIEW ON BASE

Pin	Element
1	Cathode, Heater
2	Grid 2
3	Helix
4	Omitted
5	Omitted
6	Grid 1
7	Heater
Cap	Collector

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	14·516 ± 0·062	368·7 ± 1·57	J	1·312 Max	33·32 Max
B	2·875 ± 0·010	73·03 ± 0·25	K	1·200 Max	30·48 Max
C	0·625 Max	15·88 Max	L	0·440 Max	11·18 Max
D	$2{\cdot}063^{+0{\cdot}000}_{-0{\cdot}003}$	$52{\cdot}400^{+0{\cdot}000}_{-0{\cdot}076}$	M	0·392 ± 0·003	9·957 ± 0·076
E	0·187	4·75	N	0·375 ± 0·003	9·525 ± 0·076
F	12·386 ± 0·075	314·6 ± 1·91	P	0·156	3·96
G	2·000 ± 0·032	50·80 ± 0·81	Q	1·000	25·40
H	0·062	1·57	R	0·125	3·18

Millimetre dimensions have been derived from inches.

OUTLINE GAUGE



OUTLINE GAUGE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
AA	14·578	370·3	AG	0·250	6·35
AB	0·344	8·74	AH	1·312	33·32
AC	2·063	52·40	AJ	0·488	12·40
AD	1·262	32·05	AK	0·396	10·06
AE	12·422	315·5	AL	0·397	10·08
AF	11·910	302·5			

Millimetre dimensions have been derived from inches.

NOTE: The tube must be able to turn through 360° when in this gauge.

RECOMMENDED MAGNETIC FIELD DISTRIBUTION

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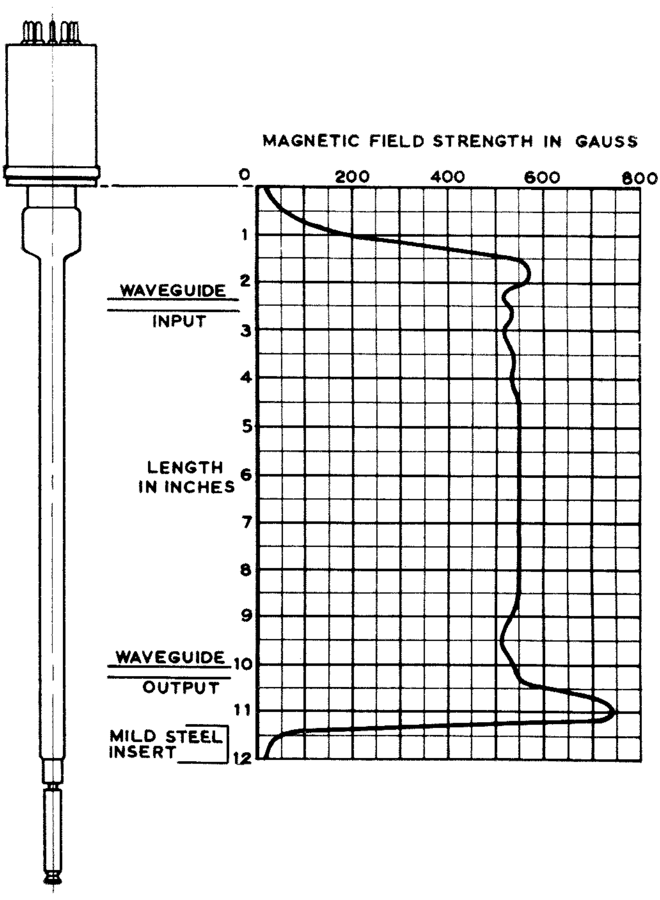

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POWER TRAVELLING WAVE TUBE

N1038

ENGLISH ELECTRIC

INTRODUCTION

The N1038 Travelling Wave Tube is a wideband power amplifier operating in the frequency range 7·0 to 8·5Gc/s.

The tube is designed to be operated in the periodic permanent magnet focusing mount type N4051, but operation in an equivalent solenoid type focusing mount is equally satisfactory.

The N4051 mount incorporates waveguide input and output connections fitted with short circuit matching devices which are preset for a selected 500Mc/s band. Convection cooling is adequate when the mount is fixed with its axis horizontal and air can circulate freely past the radiator. Forced air cooling is required if the axis of the mount is vertical.

Tubes are fully interchangeable in the mount and tube replacement is a relatively simple operation.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	0·8	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4·0	A
Heater Cold Resistance	1·72	Ω ←
Cathode Heating Time (Minimum) (*See Note* 1)	1	minute ←
Cold Insertion Loss	65	db Min
Operating Frequency:		
Minimum	7·0	Gc/s
Maximum	8·5	Gc/s
Output Power (Saturated) (*See Note* 10):		
at 7·0Gc/s	10·5	W ←
at 7·8Gc/s	9·0	W ←
at 8·5Gc/s	5·0	W ←
Input V.S.W.R. over a 500Mc/s band (*See Note* 2)	1·5:1	Max
Output V.S.W.R. over a 500Mc/s band (*See Note* 2)	1·5:1	Max

Mechanical

Overall Length	13·88 inches (352·5 mm)	Max
Overall Width (excluding flexible leads)	2·07 inches (52·58 mm)	Max
R.F. Connections (on mount N4051) (*See Note* 3)	Waveguide fitted with modified RETMA standard flange type CMR137	
Tube Base	Moulded cap and flexible leads fitted with plug type BA7P	
Mounting Position (N1038 only)	Any	

Cooling .. .. Conduction and natural convection

← Indicates a change

ENGLISH ELECTRIC

MAXIMUM RATINGS

(Absolute Values) (*See Note* 4)

Collector Voltage	3300	V Max
Collector Current	40	mA Max
Collector Dissipation	80	W Max←
Helix Voltage	3300	V Max
Helix Current (*See Note* 5):		
Continuous	1·0	mA Max←
For 10sec maximum duration	1·5	mA Max←
Grid 2 Voltage	3300	V Max
Grid 2 Current	1·0	mA Max
Grid 2 Dissipation	1·5	W Max
Grid 1 Voltage (negative value, never positive)	150	V Max
Heater Voltage	6·6	V Max←
Collector Seal Temperature	200	°C Max
Bulb Temperature (2 inches or more from collector)	150	°C Max←

TYPICAL OPERATION

(at 7·4Gc/s) (*See Note* 6)

Operational Conditions (*See Note* 4)

Collector Voltage (*See Note* 7)	1800	V
Collector Current (*See Note* 8)	35	mA
Helix Voltage (*See Note* 7)	2790	V←
Grid 2 Voltage	3000	V←
Grid 1 Voltage (*See Note* 8)	−15	V

Typical Performance

Helix Current (*See Note* 5)	0·4	mA
Grid 2 Current	0·1	mA
Grid 1 Current	negligible	
Gain at 5 watts output (*See Note* 10)	40	db
Saturation Output Power (*See Note* 10)	10	W

← Indicates a change

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Tube operated in mount type N4051)

Recommended Applied Conditions (*See Note* 4)

Frequency Range	7·0 to 8·5	Gc/s
Heater Voltage (*See Note* 9)	6·3	V
Collector Voltage (*See Note* 7)	1800	V
Collector Current (*See Note* 8)	35	mA
Grid 2 Voltage	3000	V ←
Load V.S.W.R.	1·5:1	Max

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater Current..	0·75	0·85	A
Helix Voltage (*See Note* 10)	2400	2900	V
Grid 2 Current..	—	0·2	mA ←
Grid 1 Voltage (*See Note* 8)	−80	0	V
Grid 1 Current..	—	0·2	mA ←
Helix Current (zero r.f. drive)	—	0·4	mA ←
Helix Current (at 5 watts output)	—	0·8	mA ←
Output Power		(*See Note* 10)	
Saturation Output Power		(*See Note* 10)	
Noise Factor (*See Note* 11)	—	30	db
Self-oscillation (*See Note* 12)			None
Gain Flatness (*See Note* 13)	—	0·01 db/Mc/s	

← Indicates a change

SETTING-UP PROCEDURE

The following procedure for setting-up the N1038 in the approved mount N4052 is recommended:

(*a*) Before inserting the travelling wave tube, the two pairs of focusing screws on the mount must be set to a central position. This is obtained when the screws are about $\frac{3}{4}$ turn from fully clockwise position with the blue dots towards the collector end of the mount.

(*b*) Open the end cover, pull down the sprung retaining finger and insert the travelling wave tube in the mount, taking care to avoid radial force. Slightly increase pressure to overcome the extra resistance as the collector enters the radiator and ensure that the keyway on the tube mates correctly with the spigot on the mount.
Release the retaining finger so that it presses against the moulded base of the tube.

(*c*) Apply grease gun loaded with Midland Silicones grease type MS4 to the collector greasing nipple until grease appears at the overflow tube. This operation may push the tube from its seating and so it should be reseated if necessary. Subsequently the mount should be regreased at monthly intervals and whenever a new tube is installed.

(*d*) Engage the 7-pin plug on the end of the travelling wave tube leads with the supply socket and close the cover.

(*e*) Switch on the travelling wave tube heater and allow a minimum of three minutes cathode preheating time.

(*f*) Set the helix voltage and grid 1 voltage to approximately 2600V and −25V respectively.

(*g*) Apply all h.t. voltages except grid 2 voltage.

(*h*) Grid 2 voltage must be held at less than 1000 volts with respect to cathode (or floating) until all other voltages have reached their full operating values.

(*j*) Successively adjust the focusing screws until the helix current is reduced to a minimum, and grid 1 voltage until the collector current is 35mA. Note: If grid 1 voltage is made less negative with respect to cathode so that the collector current rises above 35mA, this current will rise to a maximum and then decrease again. The decrease in current is due to grid 2 current being taken and can cause damage to the tube. The tube must not therefore be operated in this condition.

Once the travelling wave tube has been set up and focused as described above it may be subsequently switched on again from cold, without further adjustment to the focusing screws or grid 1 voltage, as follows:

(1) Allow one minute minimum cathode preheating time.

(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

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NOTES

1. In the event of a power supply failure of less than 10 seconds duration, all voltages may be re-applied simultaneously, excepting grid 2 voltage which must be delayed. For interruptions in excess of 10 seconds, the normal switching on procedure must be followed.

2. Matching adjustments on the mount are pre-set during manufacture for a selected 500Mc/s frequency band in the range 7·0 to 8·5Gc/s. This band should be specified when ordering the mount. With any tube operated in the mount under the recommended applied conditions the V.S.W.R. will remain below the value quoted over the selected 500Mc/s band without adjustment of the matching devices.

   If additional matching arrangements are provided the V.S.W.R. at any spot frequency can be reduced below 1·1:1 and will remain below 1·3:1 over a 50Mc/s band centered on this frequency without further adjustment.

3. Transitions to standard circular waveguide flanges UG-344/U or RETMA miniature waveguide flanges CMR137 (pressurised—CPR137) can also be supplied.

4. All voltages apart from the heater voltage are quoted with respect to the cathode. The grid 2 and grid 1 supplies should be stabilised to within $\pm 5\%$; that for the helix should be within $\pm 2\%$.

5. The helix should be protected against damage caused by excessive helix current. The protection circuit should be set to interrupt the tube supplies if this current exceeds 2·0mA.

6. For other frequencies within the operating range of the tube the helix voltage will need adjustment if maximum gain is to be obtained.

7. The tube may be operated with the helix and collector at the same potential provided the collector temperature does not exceed its maximum rated value. The use of a lower collector potential is recommended to promote long life of the tube.

8. The collector current is set to the recommended value by adjustment of the potential applied to grid 1.

9. To obtain maximum life the heater voltage should be maintained within $\pm 5\%$ of the nominal value.

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10. The helix voltage is adjusted for maximum r.f. output power with the given r.f. input power. The output power will be greater than the value specified in column 3 of the table below.

    The helix voltage is then increased until the output power falls to the value given in column 3. At this voltage setting the saturation output power will exceed the minimum value specified below.

Frequency Gc/s	Input Power (mW)	Output Power (W)	Saturated Output Power (W) Minimum	Typical
7·0	0·25	5·0	9·0	10·0
	0·50	5·0	9·0	10·5
	1·0	5·0	9·0	10·5
7·8	0·25	4·0	6·5	7·3
	0·50	5·0	8·0	9·0
	1·0	5·0	8·5	9·5
8·5	1·0	3·0	4·0	5·0
	2·0	3·0	4·5	5·5

11. The output spectrum is examined with the tube set up as described in Note 10 to an output carrier level of 5W. In any 4kc/s band over the range up to ±10Mc/s from the carrier, the spectrum will contain no thermal or spurious mode noise power exceeding the value appropriate to the maximum noise factor specified.

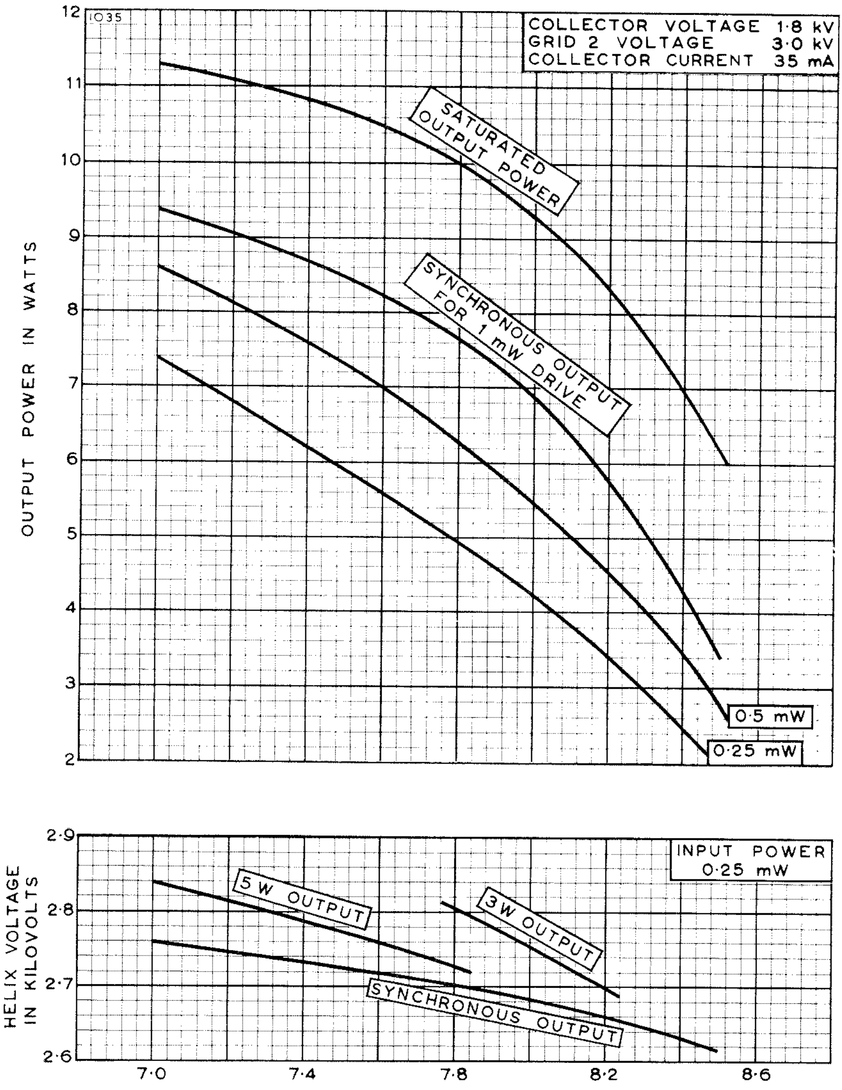
12. With the operating voltages as described in Note 10, the power in the input and output waveguides is measured with these waveguides terminated in short circuits of variable phase.

13. Over 50Mc/s range. This is a type approval test only.

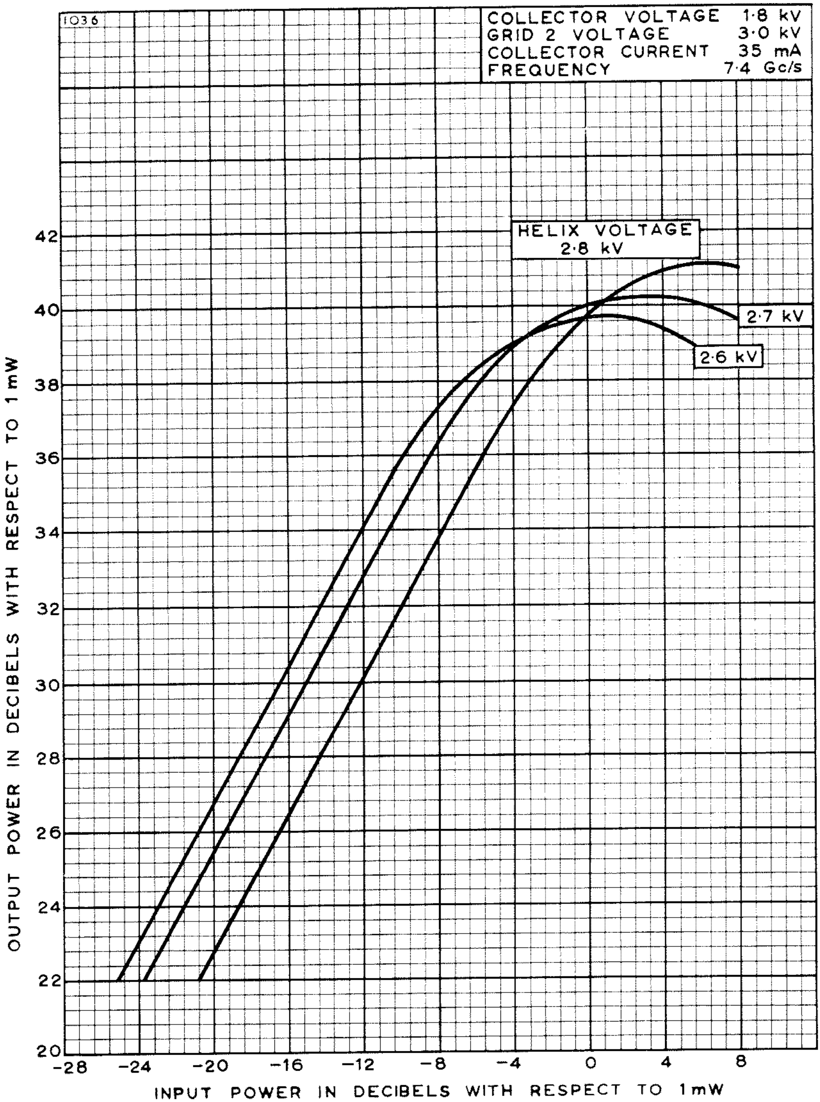
POWER TRAVELLING WAVE TUBE

N1038

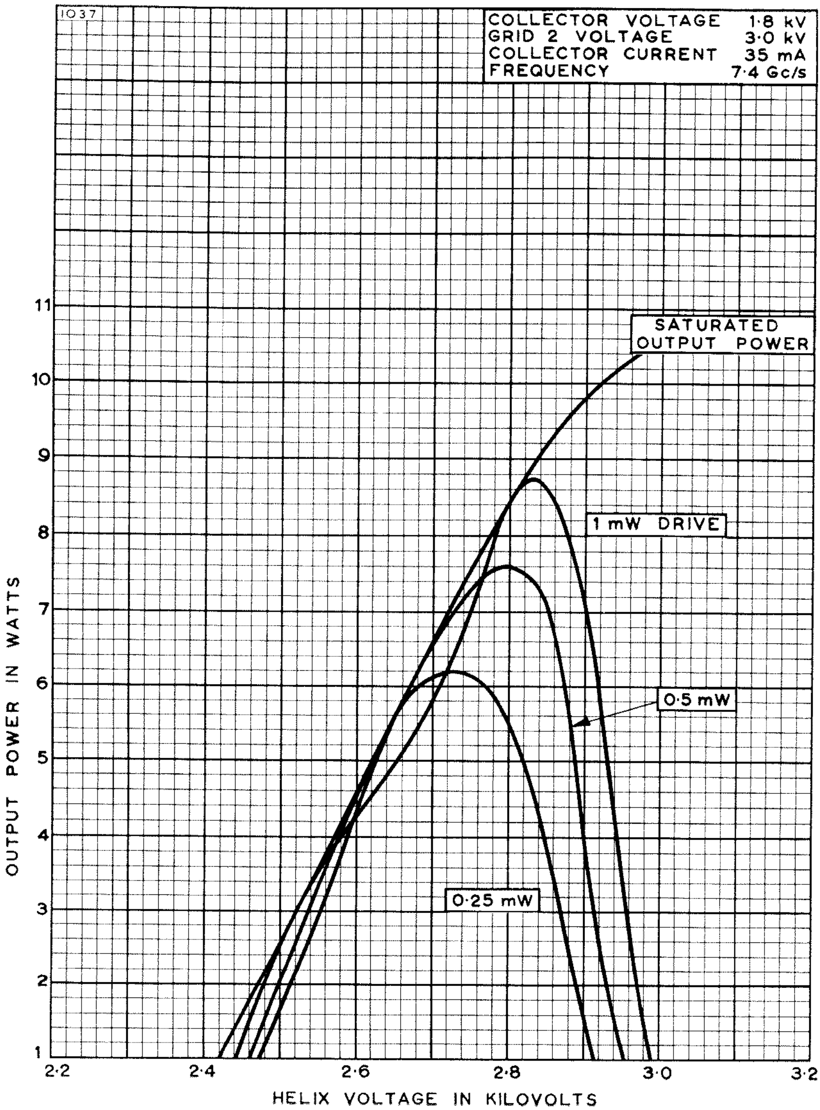
FREQUENCY CHARACTERISTICS



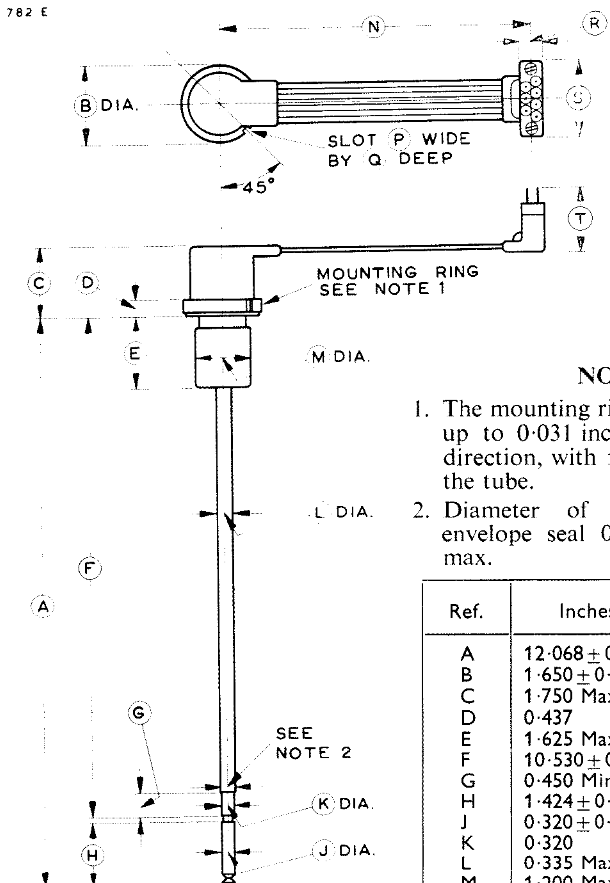
POWER CHARACTERISTICS

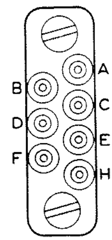


HELIX VOLTAGE CHARACTERISTICS



OUTLINE





DETAIL OF PLUG
TYPE BA7P

NOTES

1. The mounting ring may be off set by up to 0·031 inch (0·79mm) in any direction, with respect to the axis of the tube.
2. Diameter of glass at collector envelope seal 0·350 inch (8·89mm) max.

Ref.	Inches	Millimetres
A	12·068 ± 0·062	306·53 ± 1·57
B	1·650 ± 0·001	41·910 ± 0·025
C	1·750 Max	44·45 Max
D	0·437	11·10
E	1·625 Max	41·28 Max
F	10·530 ± 0·025	267·46 ± 0·64
G	0·450 Min	11·43 Min
H	1·424 ± 0·032	36·17 ± 0·81
J	0·320 ± 0·003	8·128 ± 0·076
K	0·320	8·13
L	0·335 Max	8·51 Max
M	1·200 Max	30·48 Max
N	6·500 ± 0·250	165·10 ± 6·35
P	0·125	3·18
Q	0·062	1·58
R	0·500	12·70
S	1·625	41·28
T	1·375	34·93

Millimetre dimensions have been derived from inches.

Pin	Element	Pin	Element
A	Grid 2	E	Heater
B	Heater	F	Cathode
C	Helix	H	N.C.
D	Grid 1	CAP	Collector

LOW NOISE TRAVELLING WAVE TUBE

N1042M

September 1961

ENGLISH ELECTRIC

Electrically identical with 6861

INTRODUCTION

The N1042M is a Travelling Wave Tube designed for use as a low noise amplifier in the frequency range 2·7 to 3·5Gc/s. The tube itself is housed in a metal canister and fitted with coaxial input and output connectors. The noise factor of a typical tube is 6·5db and the low level gain 25db.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	5·0	V
Heater Current	0·5	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4	A
Cathode Heating Time (Minimum)	1	Minute
Cold Insertion Loss	80	db
Operating Frequency:		
Minimum	2·7	Gc/s
Maximum	3·5	Gc/s
Gain	25	db
Noise Factor	6·5	db
Output Power (Saturated)	1	mW
Magnetic Field	525	Gauss

Mechanical

Overall Length	18·45 inches (468·7 mm)	Max
Overall Diameter	1·38 inches (35·1 mm)	Max
Net Weight	1·75 pounds (800 gm)	Approx
R.F. Connections	50Ω Coaxial plug connectors type 'N' U.S. Military No. UG-1185/U	
Base	International Octal	
Collector Connection	4mm socket	
Mounting Position	Any	
Cooling	Natural	

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MAXIMUM AND MINIMUM RATINGS

(Absolute Values) (*See Note* 1)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	—	5·25	V
Collector Voltage	—	500	V
Collector Current	—	500	μA
Helix Voltage	—	500	V
Helix Current (*See Note* 2)	—	5	μA
Grid 4 Voltage	—	500	V
Grid 4 Dissipation	—	0·1	W
Grid 3 Voltage	—	300	V
Grid 3 Dissipation	—	0·1	W
Grid 2 Voltage	—	75	V
Grid 2 Dissipation	—	0·1	W
Grid 1 Voltage	—	20	V
Grid 1 Dissipation	—	0·1	W
Magnetic Field (*See Note* 3)	400	—	Gauss
Peak Input Power	—	100	W
Mean Input Power	—	0·4	W
Canister Temperature (at hottest point)	—	175	°C

TYPICAL OPERATION
(at 3·1Gc/s)

Operational Conditions (*See Note* 1)

Heater Voltage	5·0	V
Collector Voltage (*See Note* 4)	400	V
Collector Current	150	μA
Helix Voltage (*See Notes* 5 *and* 6)	375	V
Grid 4 Voltage (*See Note* 6)	200	V
Grid 3 Voltage (*See Note* 6)	40	V
Grid 2 Voltage (*See Note* 7)	20	V Approx
Grid 1 Voltage	0	V
Magnetic Field (*See Notes* 8 *and* 9)	525	Gauss

Typical Performance

Helix Current (*See Note* 6)	0·5	μA
Grid 4 Current	less than 1	μA
Grid 3 Current	less than 1	μA
Grid 2 Current	less than 1	μA
Grid 1 Current	less than 1	μA
Gain	25	db
Noise Factor (*See Note* 6)	6·5	db
Output Power (Saturated)	1	mW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Over the frequency range 2·7 to 3·5Gc/s)

Recommended Applied Conditions (*See Note* 1)

Heater Voltage (*See Note* 10)	5·0	V
Collector Voltage (*See Note* 4)	400	V
Collector Current	150	μA
Helix Voltage (*See Notes* 5 *and* 6)	350 to 390	V
Grid 4 Voltage (*See Note* 6)	160 to 275	V
Grid 3 Voltage (*See Note* 6)	20 to 50	V
Grid 2 Voltage (*See Note* 7)	0 to 30	V
Grid 1 Voltage	0	V
Magnetic Field (*See Notes* 8 *and* 9)	525	Gauss

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	—	0·85	A
Helix Current	—	5	μA
Grid 4 Current	—	10	μA
Grid 3 Current	—	10	μA
Grid 2 Current	—	10	μA
Grid 1 Current	—	10	μA
Gain	20	—	db
Noise Factor	—	7	db
Output Power (Saturated)	0·25	—	mW
Tube Input V.S.W.R. (*See Note* 11)	—	1·7 : 1	
Tube Output V.S.W.R. (*See Note* 11)	—	2·0 : 1	

NOTES

1. All voltages are with respect to the cathode. It may be sometimes convenient to earth the collector and maintain the cathode at a negative potential.
2. During alignment in the magnetic focusing field this maximum value of helix current may be exceeded for short periods, but must never exceed 25μA.
3. This minimum value of magnetic field strength will focus the electron beam but the optimum noise figure will not be obtained.
4. It is necessary to maintain the collector positive with respect to the helix. Fluctuations in collector voltage should be less than ±10%.
5. The helix voltage should be set to the optimum value for the frequency of operation and stabilised to within ±5%.
6. In order to operate the tube at the lowest noise factor it is necessary to adjust the electrode voltages as follows: First align the travelling wave tube for minimum helix current. Then with the tube connected in its circuit and a signal or noise input applied to the valve, adjust the helix voltage to give maximum output. This value of helix voltage simultaneously produces optimum gain and minimum noise factor. Next, with no input signal, vary Grid 3 and Grid 4 voltages alternately until the receiver output reaches a minimum. The voltages reached in this way are those which will operate the N1042M at the lowest noise factor for the particular frequency to which the equipment is tuned. For wide band operation these adjustments should be carried out at the centre frequency. If the focusing field changes, it will be necessary to repeat the adjustment above. Grid 3 and Grid 4 voltages should be stabilised to within ±5%.
7. Grid 2 voltage is adjusted to give 150μA collector current and should be stabilised to within ±5%.
8. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.
9. The measurements are made with the magnetic field adjusted to 525 Gauss ±5%. Provision must be made for aligning the tube in the solenoid. An adjustment of ±0·100 inch about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the E.E.V. Co. lightweight solenoid type N4004 is recommended.
10. Tolerance ±5%.
11. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

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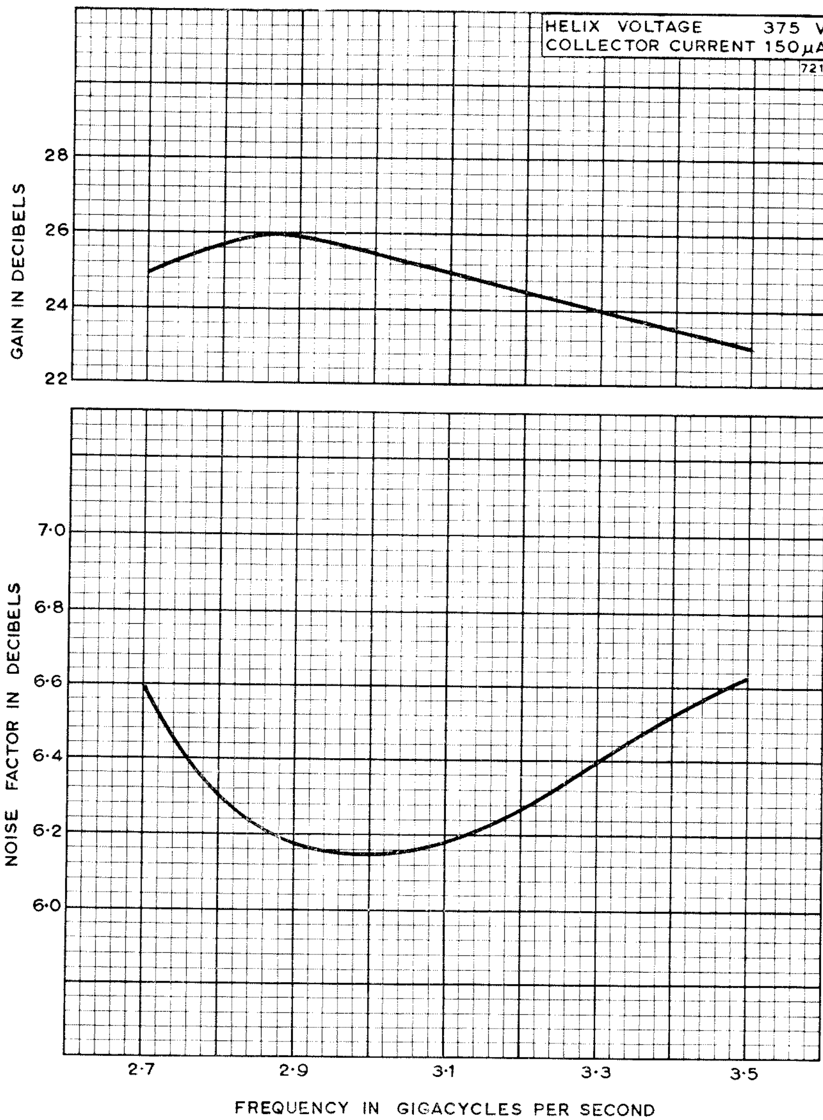
FREQUENCY CHARACTERISTIC

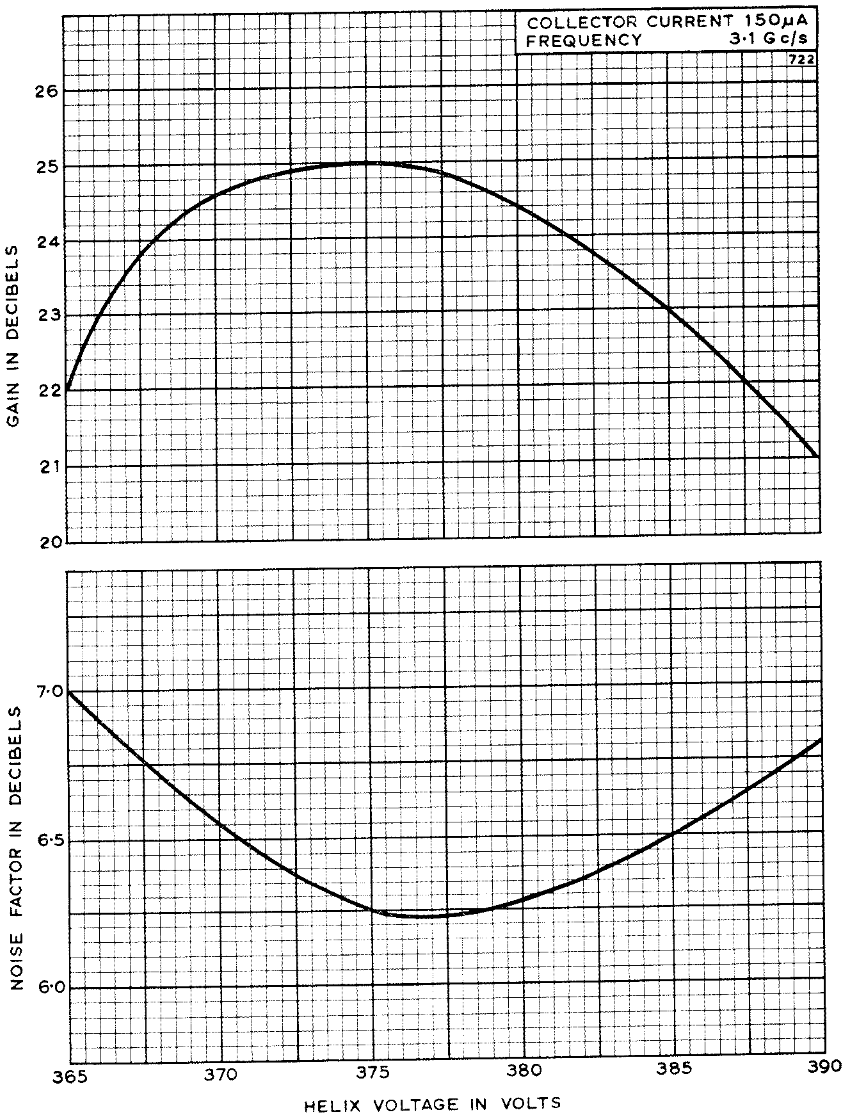


LOW NOISE TRAVELLING WAVE TUBE

N1042M

ENGLISH ELECTRIC

HELIX VOLTAGE CHARACTERISTIC



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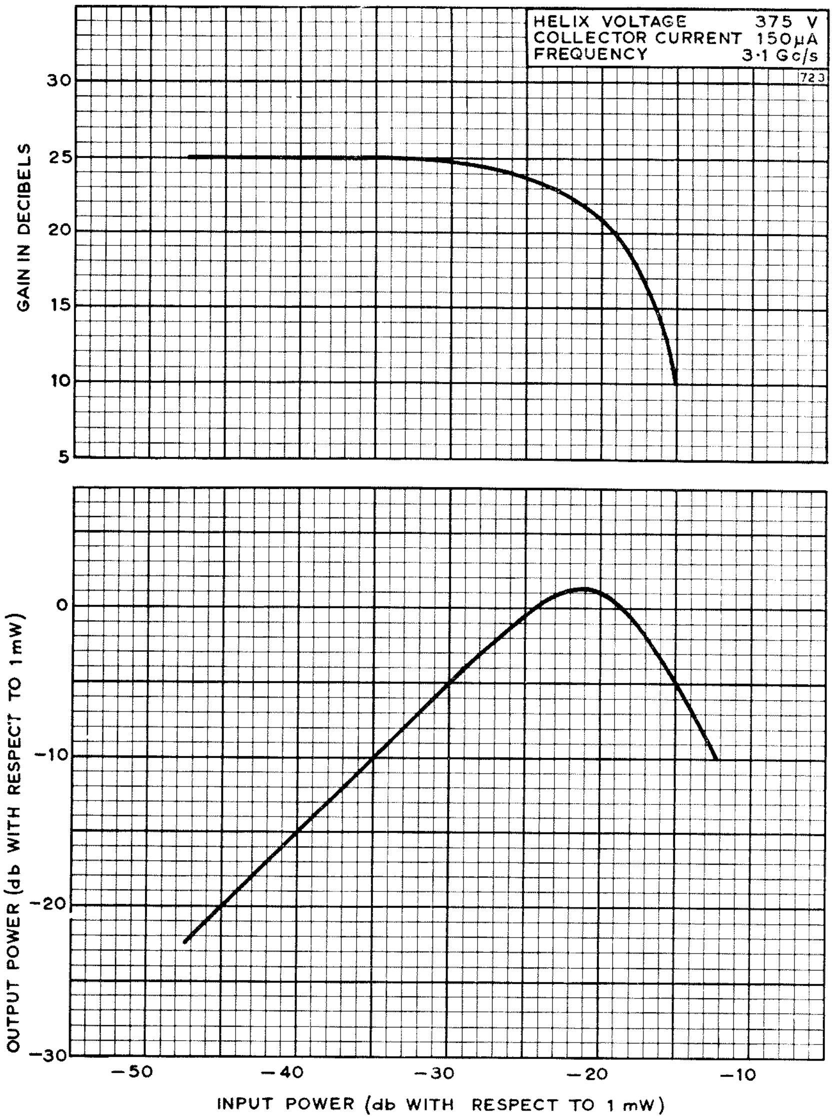
POWER CHARACTERISTIC



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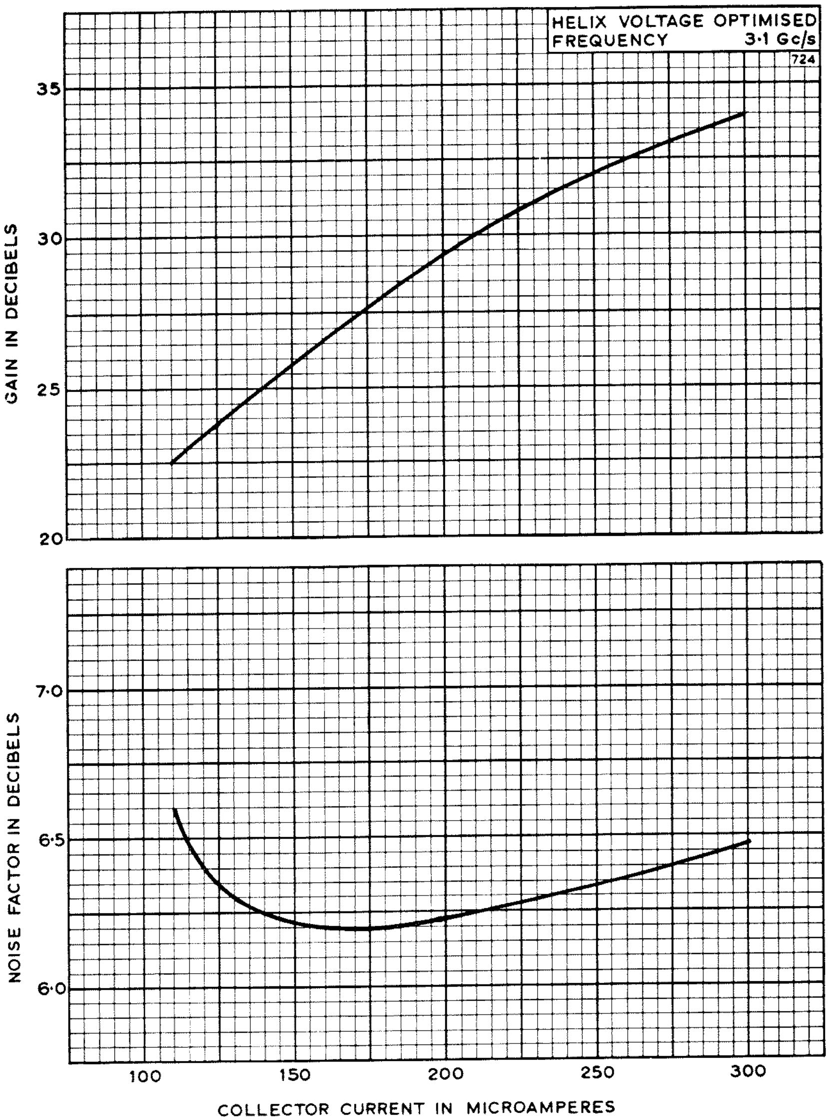
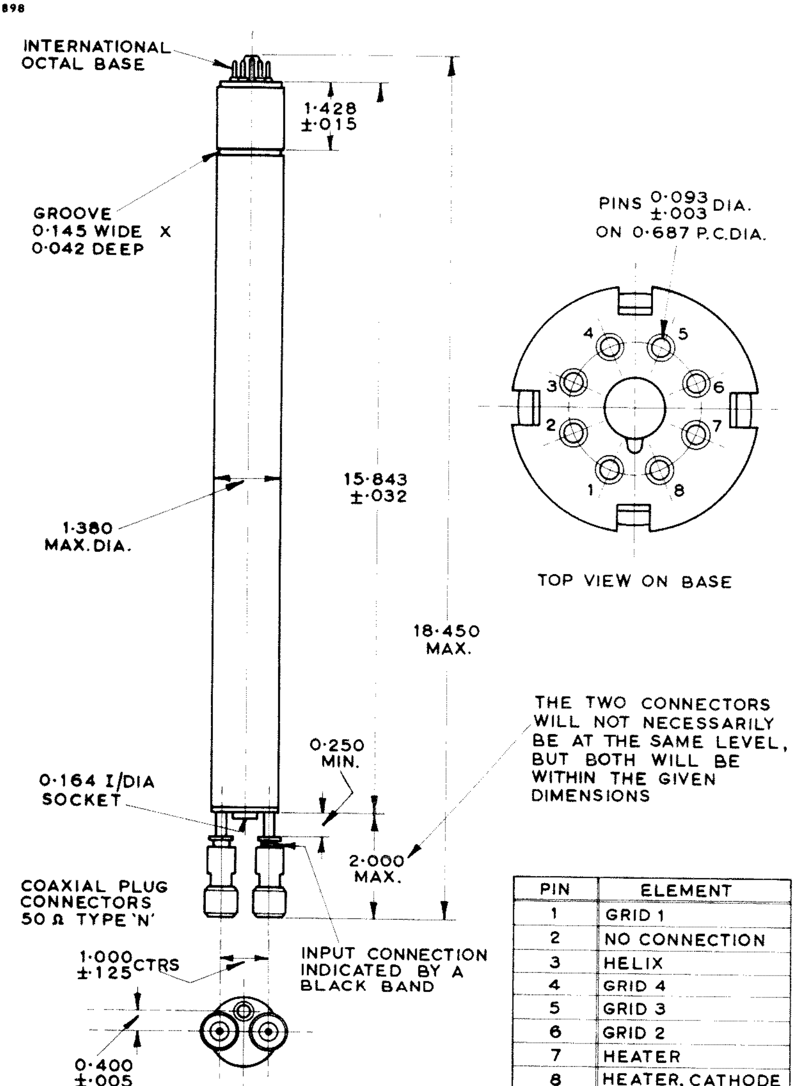
COLLECTOR CURRENT CHARACTERISTIC



OUTLINE



ALL DIMENSIONS IN INCHES

PIN	ELEMENT
1	GRID 1
2	NO CONNECTION
3	HELIX
4	GRID 4
5	GRID 3
6	GRID 2
7	HEATER
8	HEATER, CATHODE
SOCKET	COLLECTOR

LOW NOISE TRAVELLING WAVE TUBE

N1045M

ENGLISH ELECTRIC

Service Type CV5386

INTRODUCTION

The N1045M is a Travelling Wave Tube designed for use as a solenoid focused low noise amplifier in the frequency range 2·5 to 4·1Gc/s. The tube itself is housed in a metal canister and fitted with coaxial input and output connectors. The noise factor of a typical tube is 8·0db and the low level gain 28db over the full frequency range. In the frequency range 2·7 to 3·5Gc/s, the typical noise factor is 7·0db and the low level gain 33db.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	5·0	V
Heater Current	0·32	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4·0	A
Cathode Heating Time (Minimum)	1·5	minutes
Cold Insertion Loss	70	db
Operating Frequency:		
Minimum	2·5	Gc/s
Maximum	4·1	Gc/s
Over the frequency range 2·7 to 3·5Gc/s (*See Note* 1):		
Gain (Low Level)	33	db
Noise Factor	7·0	db
Output Power (Saturated)	3·0	mW
Over the frequency range 2·5 to 4·1Gc/s (*See Note* 1):		
Gain (Low Level)	28	db
Noise Factor	8·0	db
Output Power (Saturated)	3·0	mW
Magnetic Field (*See Note* 2)	525	Gauss

Mechanical

Overall Length	19·50 inches (495·3 mm)	Max
Overall Diameter	1·390 inches (35·31 mm)	Max
Net Weight	1·75 pounds (800 gm)	Approx
R.F. Connections	50Ω Coaxial Plug connectors type 'N' U.S. Military No. UG-1185/U	

The input connection is indicated by a black or blue band.

Mounting Position	Any
Cooling	Natural
Base	B.S.448/B8-0 International Octal

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LOW NOISE TRAVELLING WAVE TUBE

N1045M

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MAXIMUM AND MINIMUM RATINGS

(Absolute Values) (*See Note* 3)

No individual rating should be exceeded

	Min	*Max*	
Heater Voltage	4·75	5·25	V
Collector Voltage (*See Note* 4)	—	500	V
Collector Current	—	350	µA
Helix Voltage	—	450	V
Helix Current (*See Note* 5)	—	25	µA
Grid 4 Voltage	—	500	V
Grid 4 Dissipation	—	0·1	W
Grid 3 Voltage	—	300	V
Grid 3 Dissipation	—	0·1	W
Grid 2 Voltage	—	75	V
Grid 2 Dissipation	—	0·1	W
Grid 1 Voltage (negative value)	—	25	V
Grid 1 Dissipation	—	0·1	W
Peak R.F. Input Power	—	100	W
Mean R.F. Input Power	—	0·4	W
Canister Temperature	—	150	°C

TYPICAL OPERATION

(*See Notes* 2, 3 *and* 6)

Operational Conditions

Heater Voltage	5·0	V
Collector Voltage (*See Notes* 4 *and* 7)	400	V
Collector Current	225	µA
Helix Voltage (*See Notes* 7 *and* 8)	365	V
Grid 4 Voltage (*See Note* 9)	250	V
Grid 3 Voltage (*See Note* 9)	45	V
Grid 2 Voltage (*See Note* 9)	20	V
Grid 1 Voltage	0	V
Magnetic Field (*See Note* 2)	525	Gauss

Typical Performance

Helix Current	1·0	µA
Grid 4 Current	0	µA
Grid 3 Current	0	µA
Grid 2 Current	0	µA
Grid 1 Current	0	µA
Over the frequency range 2·7 to 3·5Gc/s (*See Note* 1):		
Gain (Low Level)	33	db
Noise Factor	7·0	db
Output Power (Saturated)	3·0	mW
Over the frequency range 2·5 to 4·1Gc/s (*See Note* 1):		
Gain (Low Level)	28	db
Noise Factor	8·0	db
Output Power (Saturated)	3·0	mW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Recommended Applied Conditions (*See Notes* 2, 3 *and* 6):

Heater Voltage (*See Note* 9)	5·0	V
Collector Voltage (*See Notes* 4 *and* 7)	400	V
Collector Current	225	µA
Helix Voltage (*See Notes* 7 *and* 8)	350 to 390	V
Grid 4 Voltage (*See Note* 9)	200 to 350	V
Grid 3 Voltage (*See Note* 9)	20 to 60	V
Grid 2 Voltage (*See Note* 9)	0 to 30	V
Grid 1 Voltage	0	V
Magnetic Field (*See Note* 2)	500 to 550	Gauss

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Helix Current	—	5·0	µA
Grid 4 Current	—	5·0	µA
Grid 3 Current	—	5·0	µA
Grid 2 Current	—	5·0	µA
Grid 1 Current	—	5·0	µA
Over the frequency range 2·7 to 3·5Gc/s (*See Note* 10):			
Gain (Low Level)	28	—	db
Noise Factor	—	8·5	db
Output Power (Saturated)	0·25	—	mW
Over the frequency range 2·5 to 4·1Gc/s (*See Note* 10):			
Gain (Low Level)	25	—	db
Noise Factor	—	10	db
Output Power (Saturated)	0·25	—	mW

NOTES

1. The figures given are the average values over the specified frequency range when the tube has been adjusted for optimum performance at 3·6Gc/s.

2. The tube is operated in a solenoid giving an axial field of the value stated; the use of the E.E.V. Co. lightweight solenoid type N4004 is recommended. Care must be taken to avoid distortion of the magnetic field by magnetic material or other magnets in the vicinity of the tube.

3. All voltages except the heater voltage are with respect to cathode.

4. The collector, pin 2 of the base, the r.f. connectors and the metal canister are internally connected and are at the same potential as the solenoid frame which is normally earthed.

5. For short periods only during setting up.

6. The recommended setting-up procedure is as follows:

    (*a*) Insert the tube in the solenoid. Apply pressure to the end cap rather than the r.f. connectors and ensure that the tube is fully home in the socket. Centralise the tube with the centring screws. Check that the solenoid current is switched on.

    (*b*) Set grid 2 voltage control to the minimum position and switch on the heater and h.t. voltages.

    (*c*) Allow the cathode to heat up for approximately 2 minutes and then adjust all voltages except grid 2 voltage to the values recommended on the test sheet accompanying the tube.

    (*d*) Increase grid 2 voltage slowly, observing both helix and collector currents. The helix current will normally rise rapidly towards its limiting value and it will be necessary to adjust the centring of the tube to obtain a minimum. Continue to increase grid 2 voltage and to adjust the centring until a collector current of 225μA is obtained with a helix current of less than 5μA. The helix current should never be allowed to exceed 25μA and should finally be set to the lowest possible value.

    Provided the voltages recommended on the test sheet accompanying the tube have been adhered to the tube should now be ready for operation over the whole frequency range 2·5 to 4·1Gc/s. For subsequent operation the tube may be switched on without adjustment.

    If the test sheet information is not available or it is desired to obtain optimum performance at a particular frequency, the following procedure should be followed:

(*e*) Apply an r.f. signal of power level less than −50dbm to the input of the tube, connect a suitable receiver to the output and adjust the helix voltage to give the maximum output power.

(*f*) Remove the input signal and adjust grid 3 and grid 4 voltages alternately until the receiver noise output is a minimum.

The tube is now set up to give the lowest noise factor for the frequency used. To obtain best full band performance these operations should be carried out at 3·6Gc/s.

7. The collector voltage must be maintained at least 20 volts positive with respect to the helix.

8. The helix voltage should be stabilised within ±2%.

9. This voltage should be stabilised within ±5%.

10. The figures given are the limiting values at any point in the frequency range.

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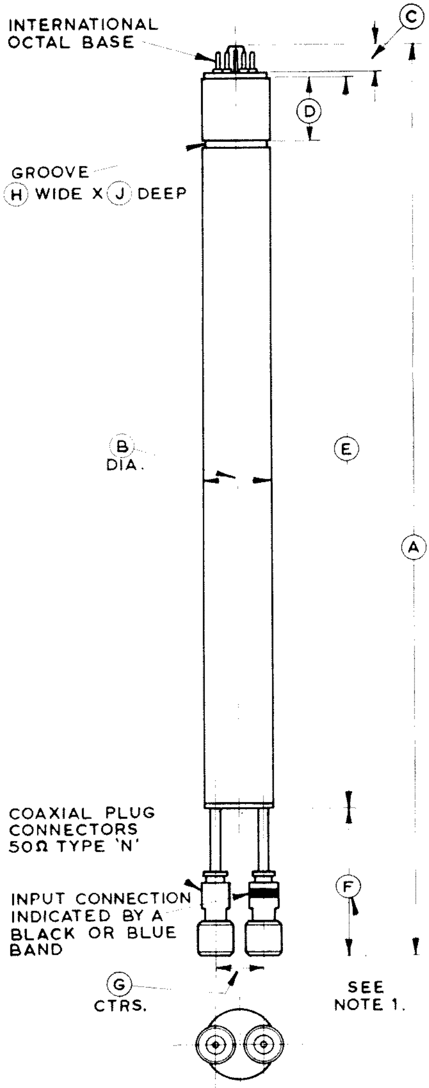
LOW NOISE TRAVELLING WAVE TUBE

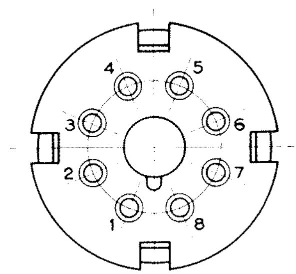
N1045M

ENGLISH ELECTRIC

OUTLINE

930





TOP VIEW ON BASE

CONNECTIONS

Pin	Element
1	Grid 1
2	Collector and Canister
3	Helix
4	Grid 4
5	Grid 3
6	Grid 2
7	Heater
8	Heater and Cathode

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	19·500 Max	495·3 Max
B	1·390 Max	35·31 Max
C	0·560 ± 0·010	14·22 ± 0·25
D	1·328 ± 0·015	33·73 ± 0·38
E	15·743 ± 0·032	399·87 ± 0·81
F	3·125 Max	79·38 Max
G	1·000 ± 0·125	25·40 ± 3·18
H	0·145	3·68
J	0·042	1·07

Millimetre dimensions have been derived from inches.

Note. The two connectors will not necessarily be at the same level but both will be within the maximum dimension.

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LOW NOISE TRAVELLING WAVE TUBE

N1047M

ENGLISH ELECTRIC

INTRODUCTION

The N1047M is a Travelling Wave Tube designed for use as a very low noise amplifier in the frequency range 2·7 to 3·2Gc/s. The noise factor of a typical tube is 4·0db and the low level gain 24db.

The tube is contained in a metal canister and fitted with 50Ω coaxial plug connectors type 'N'.

A suitable solenoid, type N4041, for use with the N1047M is available. This solenoid operates at 10·5A d.c. at approximately 95V and is forced-air cooled by means of an integral fan unit requiring a supply of 200–250V, 50c/s, 72W.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	5·0	V
Heater Current	0·3	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4·0	A
Cathode Heating Time (Minimum) (*See Note* 1)	2	minutes
Cold Insertion Loss	70	db
Operating Frequency:		
Minimum	2·7	Gc/s
Maximum	3·2	Gc/s
Gain	24	db
Noise Factor	4·0	db
Output Power (Saturated)	1·5	mW
Magnetic Field (*See Note* 2)	1400	Gauss
Recommended Solenoid		N4041

Mechanical

Overall Length	18·000 inches (457·2mm)	Max
Canister Diameter	1·400 inches (35·56mm)	Max
Net Weight	1·75 pounds (800gm)	Approx
R.F. Connections	50Ω Coaxial plug connectors type 'N' U.S. Military No. UG-1185/U	
Base	International Octal	
Collector Connection (earthed)	Tag and screw to hole tapped 4BA	
Mounting Position	Any	

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MAXIMUM AND MINIMUM RATINGS

(Absolute Values) (*See Note* 3)

No individual rating should be exceeded

	Min	Max	
Heater Voltage	4·75	5·25	V
Collector Voltage	400	1100	V
Collector Current	—	200	μA
Helix Voltage	—	500	V
Helix Current (*See Note* 4)	—	5·0	μA
Grid 4 Voltage	—	500	V
Grid 3 Voltage	—	150	V
Grid 1 and 2 Voltage	—	20	V
Magnetic Field (*See Note* 5)	600	—	Gauss
Peak R.F. Input Power	—	75	W
Mean R.F. Input Power	—	0·3	W
Canister Temperature (at hottest point)	—	150	°C

TYPICAL OPERATION

(at 2·9Gc/s)

Operational Conditions (*See Note* 3)

Heater Voltage	5·0	V
Collector Voltage (*See Note* 6)	800	V
Collector Current	130	μA
Helix Voltage (*See Notes* 7 *and* 8)	375	V
Grid 4 Voltage (*See Note* 8)	230	V
Grid 3 Voltage (*See Note* 8)	25	V
Grid 1 and 2 Voltage (*See Note* 9)	8·5	V
Magnetic Field (*See Notes* 10 *and* 11)	1400	Gauss

Typical Performance

Helix Current (*See Note* 8)	0·5	μA
Grid 4 Current	less than 1	μA
Grid 3 Current	less than 1	μA
Grid 1 and 2 Current	50	μA
Gain	24	db
Noise Factor (*See Note* 8)	4·0	db
Output Power (Saturated)	1·5	mW

LOW NOISE TRAVELLING WAVE TUBE

N1047M

ENGLISH ELECTRIC

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(Over the frequency range 2·7 to 3·2Gc/s)

Recommended Applied Conditions (*See Note* 3)

Heater Voltage (*See Note* 12)	5·0	V
Collector Voltage (*see Note* 6)	800	V
Collector Current (*See Note* 9)	100 to 200	μA
Helix Voltage (*See Notes* 7 *and* 8)	350 to 400	V
Grid 4 Voltage (*See Note* 8)	150 to 400	V
Grid 3 Voltage (*See Note* 8)	0 to 50	V
Grid 1 and 2 Voltage (*See Note* 9)	0 to 20	V
Magnetic Field (*See Notes* 10 and 11)	1400±70	Gauss

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·2	0·5	A
Helix Current	—	5	μA
Grid 4 Current	—	10	μA
Grid 3 Current	—	10	μA
Grid 1 and 2 Current	—	100	μA
Gain	21	27	db
Noise Factor	—	4·5	db
Output Power (Saturated)	1·0	—	mW
Tube Input V.S.W.R. (*See Note* 13)	—	1·7 : 1	
Tube Output V.S.W.R. (*See Note* 13)	—	2·0 : 1	

NOTES

1. The time between the application of full heater voltage and the application of h.t. voltages. In the event of a power supply failure of less than 10 seconds' duration, all voltages may be re-applied simultaneously.
2. The magnitude of this field is not critical and it may be reduced if an increase in noise factor can be tolerated.
3. All voltages apart from the heater voltage are with respect to the cathode. The collector and canister are internally connected; the collector should be earthed and the cathode maintained at a negative potential. One side of the heater is connected internally to the cathode.
4. During alignment in the magnetic focusing field, this maximum value of helix current may be exceeded for short periods but must never exceed 25μA.

5. This minimum value of magnetic field strength will focus the electron beam but the optimum noise figure will not be obtained.

6. It is necessary to maintain the collector positive with respect to the helix. Fluctuations in collector voltage should be less than $\pm 10\%$.

7. The helix voltage should be set to the optimum value for the frequency of operation and stabilised to within $\pm 1\%$.

8. In order to operate the tube at the lowest noise factor it is necessary to adjust the electrode voltages as follows: After a cathode pre-heating time of at least 2 minutes, switch on the h.t. voltage with grid 1 and 2 voltage at zero and the other voltages at the values specified under Typical Operation on page 2. Slowly increase the grid 1 and 2 voltage, adjusting the centring of the tube in the magnetic field to obtain minimum helix current, until the specified collector current is reached. With a signal or noise input applied to the valve, adjust the helix voltage to give maximum output. This value of helix voltage simultaneously produces optimum gain and minimum noise factor. Next, with no input signal, vary Grid 3 and Grid 4 voltages alternately until the receiver output reaches a minimum. The voltages reached in this way are those which will operate the N1047M at the lowest noise factor for the particular frequency to which the equipment is tuned. For wide band operation these adjustments should be carried out at the centre frequency. If the focusing field changes, it will be necessary to repeat the adjustment above. Grid 3 and Grid 4 voltages should be stabilised to within $\pm 5\%$.

9. Grid 1 and 2 voltage is adjusted to give the correct collector current and should be stabilised to within $\pm 5\%$.

10. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.

11. Provision must be made for aligning the tube in the solenoid. An adjustment of $\pm 0{\cdot}100$ inch ($\pm 2{\cdot}54$mm) about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the EEV solenoid type N4041 is recommended, if minimum noise figures are to be obtained.

12. Tolerance $\pm 5\%$.

13. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

LOW NOISE TRAVELLING WAVE TUBE

N1047M

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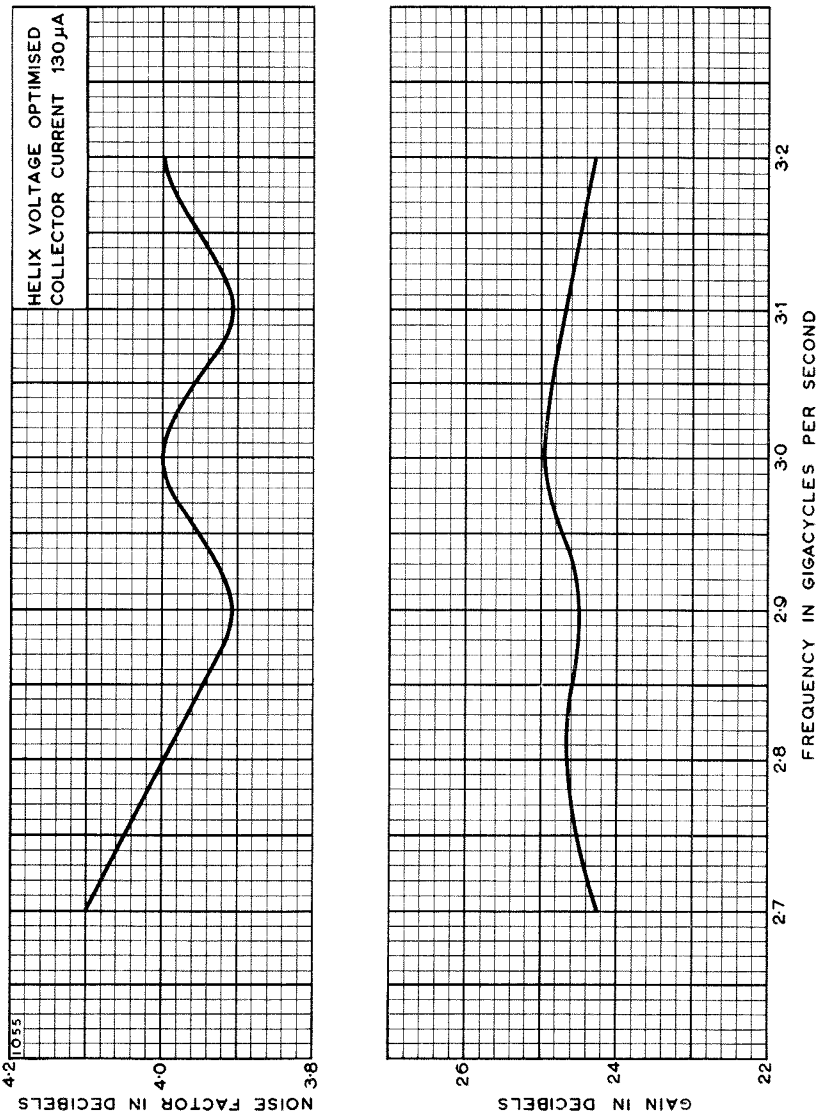
FREQUENCY CHARACTERISTICS



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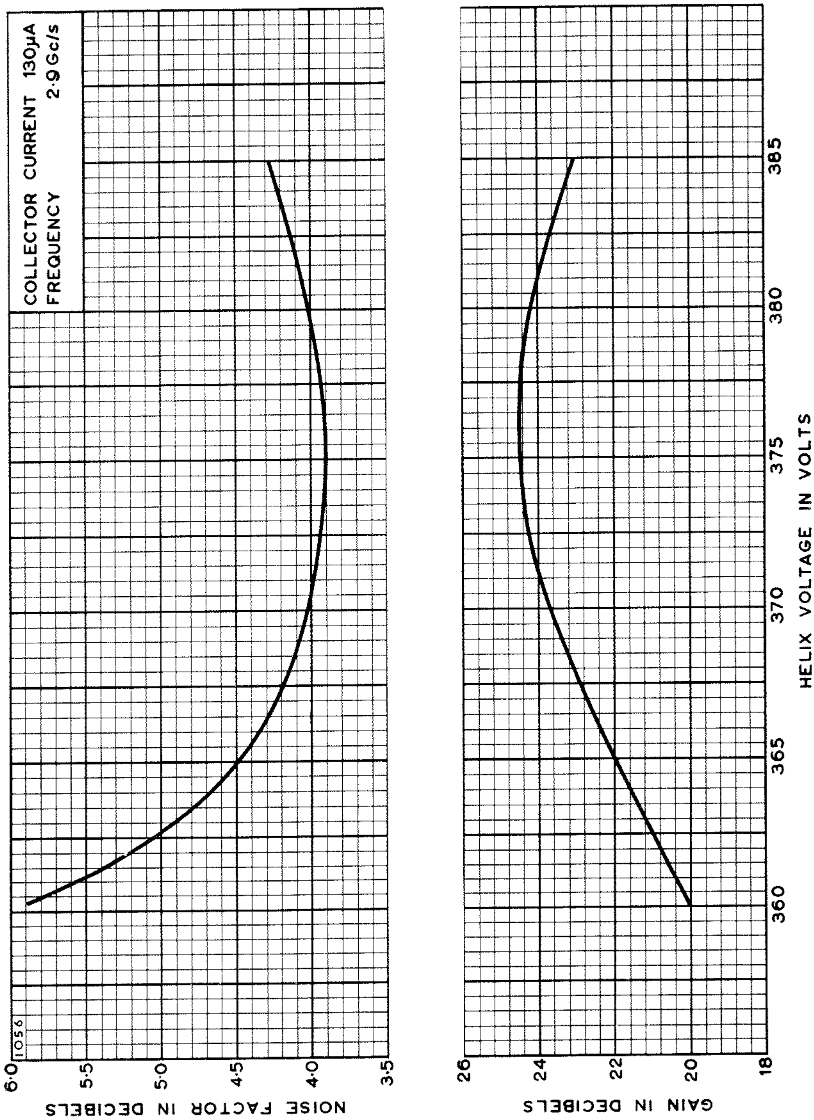
HELIX VOLTAGE CHARACTERISTICS



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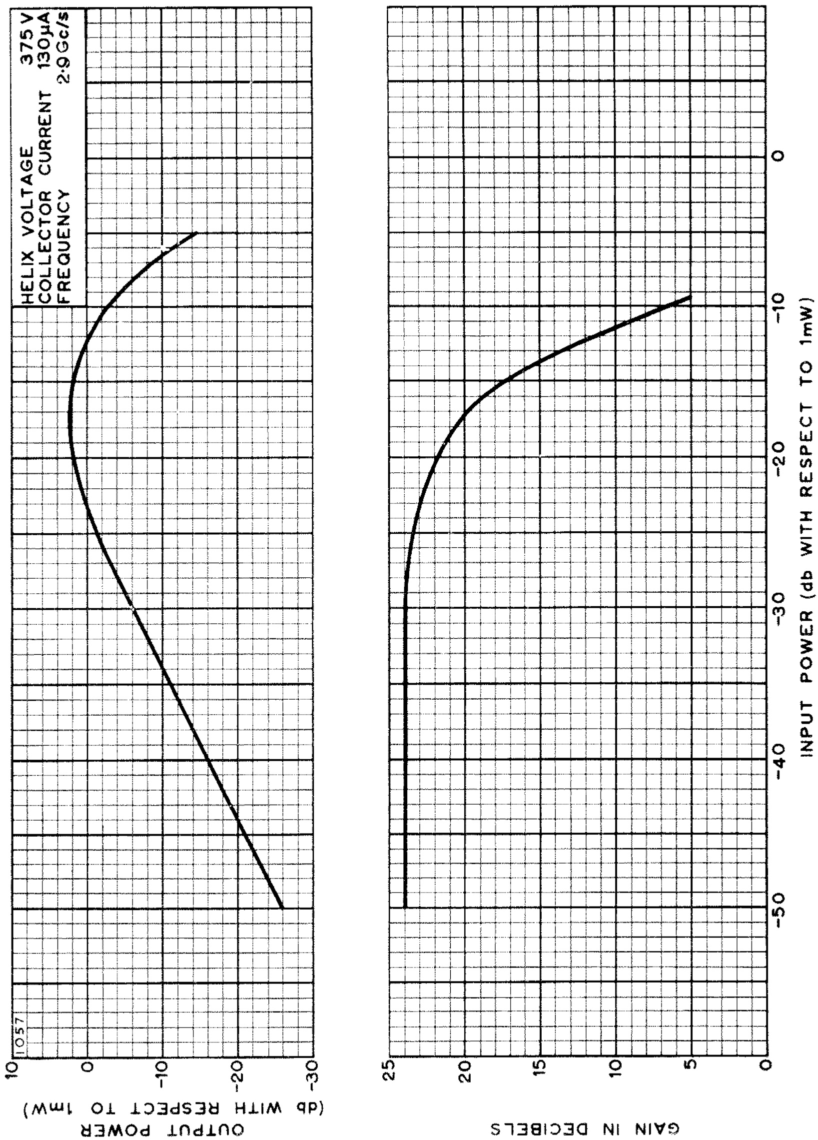
POWER CHARACTERISTICS



LOW NOISE TRAVELLING WAVE TUBE

N1047M

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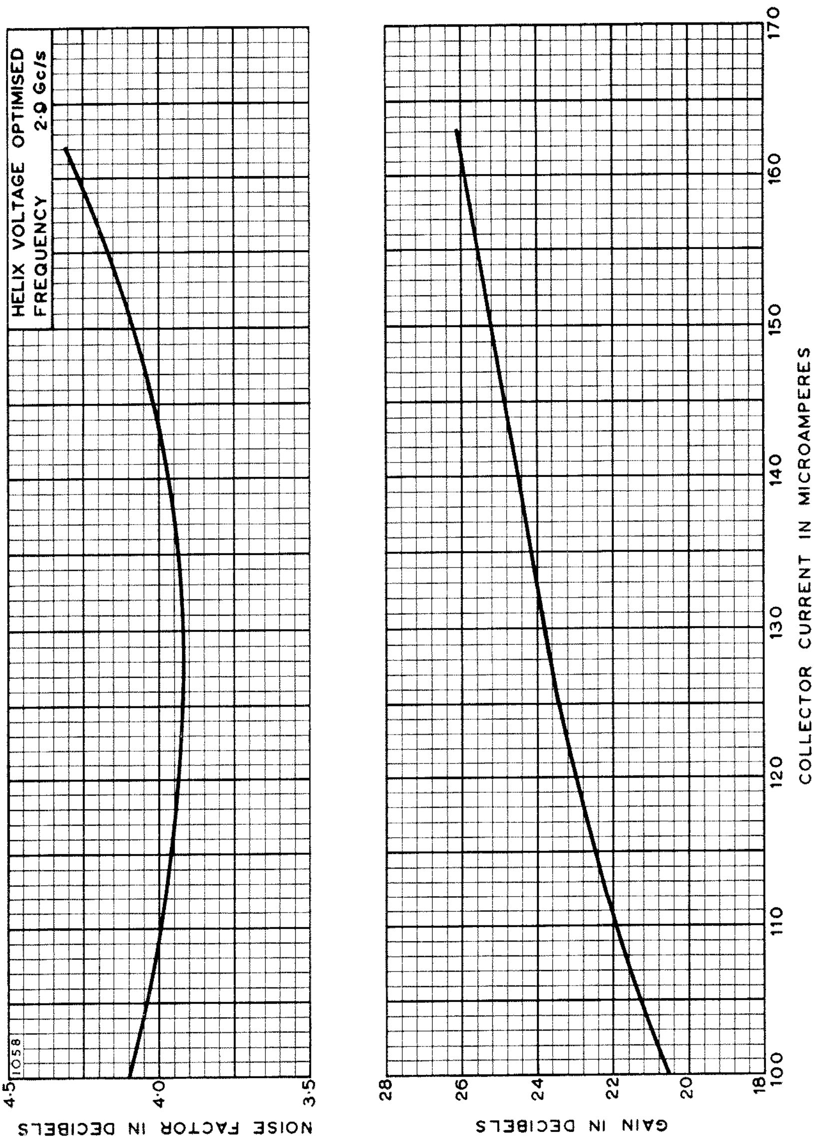
COLLECTOR CURRENT CHARACTERISTICS



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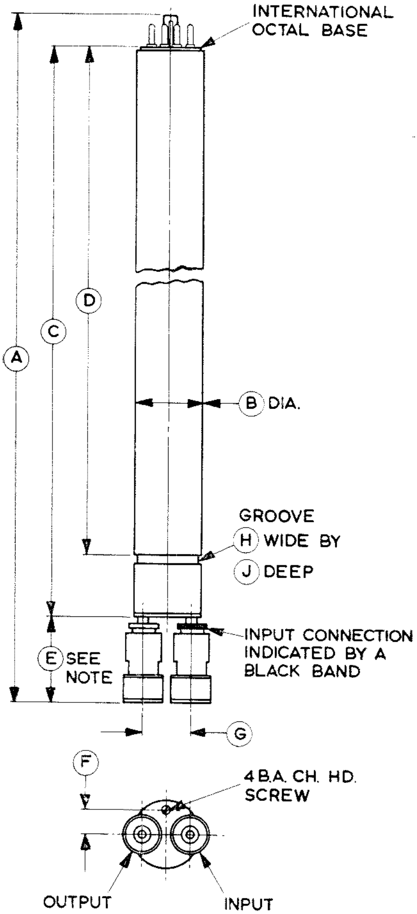
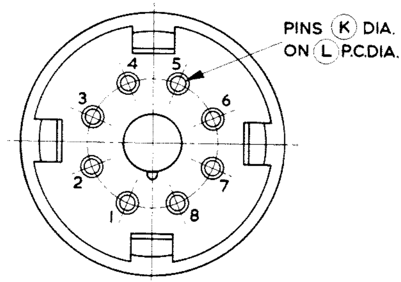
OUTLINE





TOP VIEW ON BASE

Pin	Element
1	Grid 1 and 2
2	No Connection
3	Helix
4	Grid 4
5	Grid 3
6	No Connection
7	Heater
8	Heater, Cathode

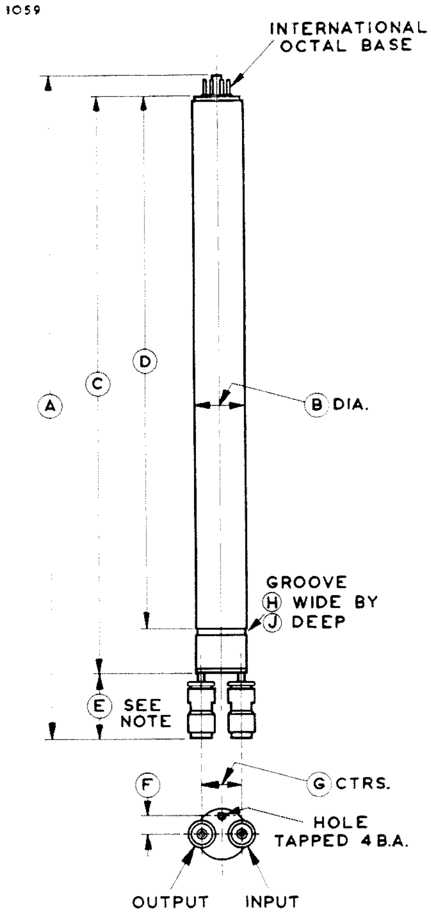
Ref.	Inches	Millimetres
A	18·000 Max	457·2 Max
B	1·400 Max	35·56 Max
C	15·325 ± 0·050	389·3 ± 1·27 ←
D	14·090 ± 0·050	357·9 ± 1·3
E	1·800 Max	45·72 Max
F	0·500	12·70
G	1·062 ± 0·020	26·97 ± 0·51
H	0·156	3·96
J	0·015	0·38
K	0·093 ± 0·003	2·362 ± 0·076
L	0·687	17·45

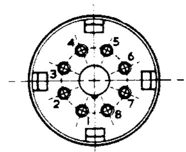
Note: The two connectors will not necessarily be at the same level but both will be within the maximum dimension.

Millimetre dimensions have been derived from inches.

← Indicates a change

OUTLINE





VIEW ON BASE

Pin	Element
1	Grid 1 and 2
2	No Connection
3	Helix
4	Grid 4
5	Grid 3
6	No Connection
7	Heater
8	Heater, Cathode

Ref.	Inches	Millimetres
A	18·000 Max	457·2 Max
B	1·400 Max	35·56 Max
C	15·350 ± 0·100	389·9 ± 2·5
D	14·090 ± 0·050	357·9 ± 1·3
E	1·800 Max	45·72 Max
F	0·500	12·70
G	1·062 ± 0·020	26·97 ± 0·51
H	0·156	3·96
J	0·015	0·38

Note: The two connectors will not necessarily be at the same level but both will be within the maximum dimension.

Millimetre dimensions have been derived from inches.

POWER
TRAVELLING WAVE TUBE

N1055

ENGLISH ELECTRIC

ABRIDGED DATA

Power Amplifier Travelling Wave Tube for wideband communication systems requiring low AM/PM conversion, low noise factor and high gain. The tube is operated in a conduction cooled periodic permanent magnet focusing mount with waveguide r.f. connections. Tubes are fully interchangeable in the mount and tube replacement is a relatively simple operation.

Frequency Range	5·85 to 7·15	GHz
Saturation Output Power (Nominal, *See Note* 10)	20	W
Working Output Power (*See Note* 10)	5·0 to 10	W
Nominal Gain	40	db
Noise Factor	27	db
AM/PM Conversion (at 10W output)	1·0	degree/db

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·8	A
Heater Starting Current (Peak)	5·0	A Max
Cathode Heating Time	*See Note* 2	

Mechanical

Overall Dimensions	See Page 16
Tube Base	Moulded cap and flying leads fitted with plug type BA7P
Mounting Position	Horizontal, or vertical with collector uppermost

Focusing Mounts (See Note 3)

Two conduction cooled mounts are available

Frequency Range 5·85 to 6·45 GHz	N4085	
Frequency Range 6·45 to 7·15 GHz	N4094	
R.F. Connections on mount	Waveguide, 1·372×0·125 inch internal, with modified RETMA flange CMR137	
Transition to No. 14 Waveguide	Details on application	
Transition to 'N' type Coaxial Socket	Details on application	
Net Weight	16½ pounds (7·6 kg)	Approx
Mounting Position	Horizontal, or vertical with collector uppermost	
Cooling	*See Note* 3	
Mount Body Temperature Range (operating) (*See Note* 3):		
minimum	−10	°C
maximum	+70	°C
Ambient Temperature Range (storage) (*See Note* 14)	−50 to +85	°C

MAXIMUM RATINGS
(Absolute Values) (*See Note* 4)

Collector Voltage	4·0 kV	Max
Collector Current	50 mA	Max
Collector Dissipation	120 W	Max
Helix Voltage	4·0 kV	Max
Helix Current:		
Continuous	2·0 mA	Max
For 1 second max	4·0 mA	Max
Grid 2 Voltage	4·0 kV	Max
Grid 2 Current	0·5 mA	Max
Grid 1 Voltage (negative value, never positive)	150 V	Max
Heater Voltage	6·6 V	Max
Collector Temperature	275 °C	Max
Mount Temperature Range (operating), excluding conduction block or heat sink (*See Note* 3)	−10 to +70°C	Max
Mount Temperature Range (storage) (*See Note* 14)	−50 to +85°C	Max
Temperature of Collector Conduction Block (*See Note* 3)	105 °C	Max
Temperature Difference over length of mount (excluding Collector Conduction Block)	10 °C	Max

TYPICAL OPERATION
(at 6·2GHz) (*See Note* 5)

	5 Watts Output	*10 Watts Output*	
Operational Conditions (*See Note* 4)			
Collector Voltage	2·0	2·3	kV
Collector Current (*See Note* 6)	40	45	mA
Helix Voltage	3·42	3·52	kV
Grid 2 Voltage	3·45	3·75	kV
Grid 1 Voltage (*See Note* 6)	−40	−40	V
Typical Performance			
Helix Current	0·4	0·6	mA
Grid 2 Current	0·1	0·1	mA
Grid 1 Current	Zero	Zero	
Gain at 5·0W output	40	—	db
Gain at 10W output	—	37	db
Working Output Power	5·0	10	W
Saturation Output Power (*See Note* 7)	14	18	W
Maximum Saturation Output Power (*See Note* 8)	20	22	W
Noise Factor	27	27	db
Cold Insertion Loss	60		db
Input V.S.W.R. over the band (*See Note* 9)	1·5 : 1		Max
Output V.S.W.R. over the band (*See Note* 9)	1·5 : 1		Max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 5W Output Power Operation) (*See Note* 10)

Recommended Applied Conditions (*See Note* 4)

Frequency Range	5·85 to 7·15	GHz
Heater Voltage (*See Note* 1)	6·3	V
Collector Voltage	2·0	kV
Collector Current (*See Note* 6)	40	mA
Grid 2 Voltage	3·45	kV
Input Power	0·5	mW
Load V.S.W.R.	less than 1·5 : 1	

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·75	1·0	A
Helix Voltage	3·2	3·7	kV
Helix Current:			
Switching on, zero r.f. drive	—	2·0	mA
Focused, with r.f. drive	—	1·5	mA
Grid 2 Current	—	0·5	mA
Grid 1 Voltage (negative value) (*See Note* 6)	0	80	V
Output Power	5·0	—	W
Saturation Output Power (*See Note* 7)	12	—	W
Noise Factor (*See Note* 11)	—	28	db
Gain Flatness (*See Note* 12)	—	0·01	db/MHz
AM/PM Conversion (*See Note* 13)	—	2·5	degree/db
Harmonic Content (below output power level of fundamental)	20	—	db
Input V.S.W.R. (hot) (*See Note* 9)	—	1·5 : 1	
Output V.S.W.R. (hot) (*See Note* 9)	—	1·5 : 1	
Cold Insertion Loss	55	—	db

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 10W Output Power Operation) (*See Note* 10)

Recommended Applied Conditions (*See Note* 4)

Frequency Range	5·85 to 7·15	GHz
Heater Voltage (*See Note* 1)	6·3	V
Collector Voltage	2·3	kV
Collector Current (*See Note* 6)	45	mA
Grid 2 Voltage	3·75	kV
Input Power	2·0	mW
Load V.S.W.R.	less than 1·5 : 1	

(*Continued on page* 4)

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current . .	0·75	1·0	A
Helix Voltage	3·2	3·7	kV
Helix Current:			
Switching on, zero r.f. drive	—	2·0	mA
Focused, with r.f. drive	—	1·5	mA
Grid 2 Current	—	0·5	mA
Grid 1 Voltage (negative value) (*See Note* 6)	0	80	V
Output Power . .	10	—	W
Saturation Output Power (*See Note* 7)	17	—	W
Noise Factor (*See Note* 11)	—	28	db
Gain Flatness (*See Note* 12)	—	0·01	db/MHz
AM/PM Conversion (*See Note* 13)	—	2·0	degree/db
Harmonic Content (below output power level of fundamental)	20	—	db
Input V.S.W.R. (hot) (*See Note* 9)	—	1·5 : 1	
Output V.S.W.R. (hot) (*See Note* 9)	—	1·5 : 1	
Cold Insertion Loss	55	—	db

NOTES

1. The heater voltage must be maintained within ±5% of the nominal value.
2. The cathode heating time for a tube on initial installation is 2½ minutes minimum; this time may be reduced to one minute minimum for subsequent switching on.
3. Conduction cooled mounts can be mounted horizontally or vertically with the collector uppermost, being designed for use where direct convection cooling of the collector block is difficult. The collector conduction block must be cooled by means of a further heat sink, e.g. a finned panel, which is not supplied but is normally incorporated in the structure of the equipment. The heat sink should be designed so that the body of the mount is no more than 10°C above the ambient temperature of its surroundings (this implies a maximum ambient temperature of 60°C).
4. All voltages apart from the heater voltage are specified with respect to the cathode.
5. For other frequencies within the operating range of the tube and mount the helix voltage will need adjustment if maximum gain is to be obtained.
6. The collector current is set to the recommended value by adjustment of the potential applied to grid 1.
7. With the helix voltage fixed and only the input power adjusted for maximum output.

8. With both the helix voltage and input power adjusted for maximum output. The tube must not be operated continuously under these conditions.
9. The matching adjustments on the mount are preset during manufacture. With any tube operated in the mount under the recommended applied conditions, the V.S.W.R. will remain below the quoted value over the specified frequency range of the mount.
10. The tube is intended for operation at 5 to 10 watts output power under the conditions specified. Reference should be made to English Electric Valve Company Ltd. if operation under conditions other than those specified herein is required.
11. The noise factor is measured under full operating conditions, using a suitable FM receiver, demodulator and baseband selective amplifier. The limit applies for any 4·0kHz bandwidth in the demodulated frequency band from 10kHz to 10MHz.
12. Over the recommended frequency range.
13. The value given for AM/PM conversion is that obtained under the specified conditions. Lower values may be achieved with other settings of helix voltage and input power.
14. Exposure to temperatures lower than −50°C will cause an irreversible change to the permanent magnets in the mount and a complete failure of the mount.

OPERATING NOTES FOR N1055 IN P.P.M. MOUNTS N4085 AND N4094

The operating principles of a periodic permanent magnet array focusing an electron beam in a travelling wave tube are complex and complete transmission of the beam can only be achieved over a limited range of electrode potentials. Consequently there are certain requirements that must be complied with when designing the power supply and installing a tube.

A. **Power Supply**

(1) The travelling wave tube heater voltage must be applied at least 2½ minutes before any h.t. voltages are applied.

(2) During switch-on, the grid 2 voltage must be delayed so that it does not reach its full value until all other electrodes have reached their final voltages.

(3) During switch off, the grid 2 voltage should be reduced before all other voltages or excessive currents may be drawn.

(4) The grid 1, grid 2 and helix voltages should be stabilised to ±2%.

(5) A protective device must be included in the helix circuit to cut off the h.t. supply if the helix current exceeds 2mA. This device may be overridden during installation as long as the helix current does not exceed 4mA for a maximum period of 1 second.

B. **Initial Installation of Travelling Wave Tube**

(1) Before inserting the travelling wave tube the focusing screws on the mount must be set to a central position pointing to the white line.

(2) Pull down the sprung retaining finger and insert the travelling wave tube in the mount taking care to avoid radial force. Slightly increase the pressure to overcome the extra resistance as the collector enters the conduction block, and ensure that the keyway on the travelling wave tube mates correctly with the spigot on the mount, and the tube is pushed right in. Release the retaining finger so that it presses against the moulded base of the travelling wave tube.

(3) Engage the 7-pin plug on the end of the travelling wave tube leads with the supply socket.

(4) Close the cover.

C. **Initial Switching On**

(1) Switch on the travelling wave tube heater and allow a minimum of $2\frac{1}{2}$ minutes cathode preheating time.

(2) Set helix voltage to 3400 volts and grid 1 voltage to −50 volts, with zero r.f. input.

(3) Apply h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

(4) Successively adjust the focusing screws until the helix current is reduced to a minimum, and grid 1 voltage until the collector current is 40 or 45mA, as required.

Note: If grid 1 voltage is made less negative with respect to cathode so that the collector current rises above 45mA this current will rise to a maximum and then decrease again. This decrease in current is due to grid 2 current being taken and can cause damage to the tube. The tube must not therefore be operated in this condition.

D. **Subsequent Switching On**

Once the travelling wave tube has been set up and focused as described above it may be subsequently switched on again from cold, without further adjustment to the focusing screws or grid 1 voltage, as follows:

(1) Allow one minute minimum cathode preheating time.

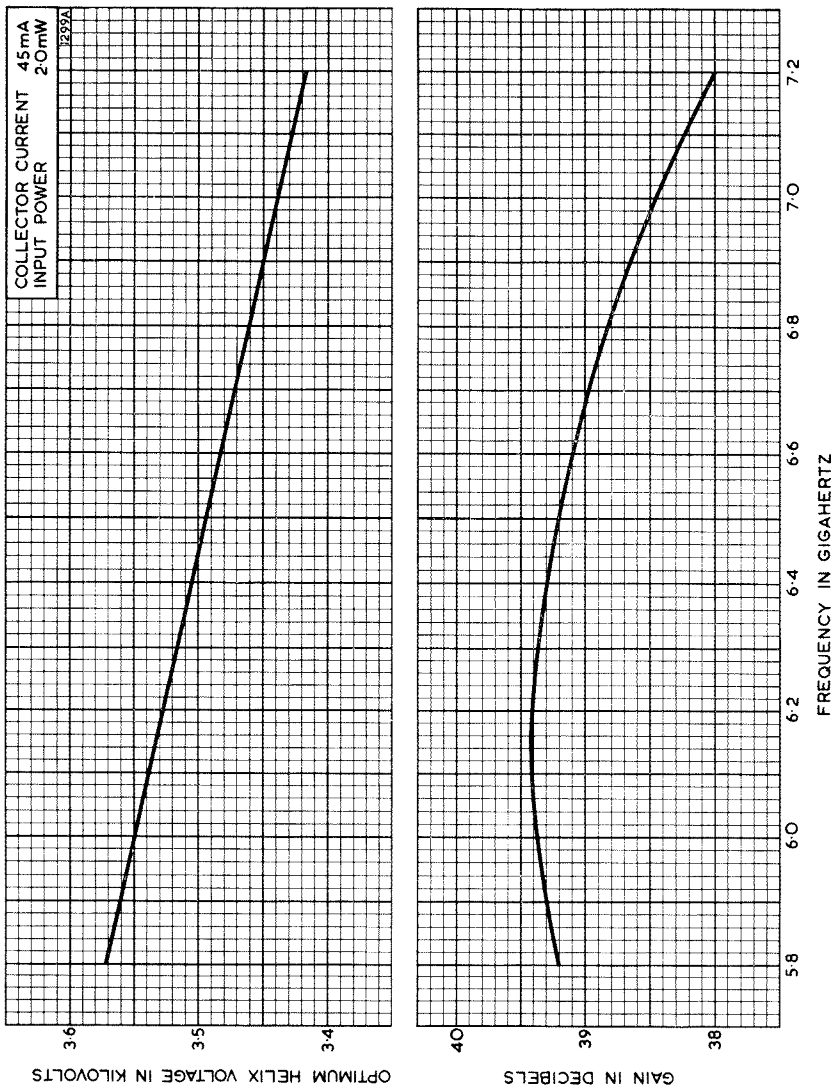
(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

E. **Supply Interruption**

(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting grid 2 voltage which must be delayed as in C(3) above.

(2) For interruptions in excess of ten seconds all voltages must be re-applied in accordance with paragraph D above.

FREQUENCY CHARACTERISTICS

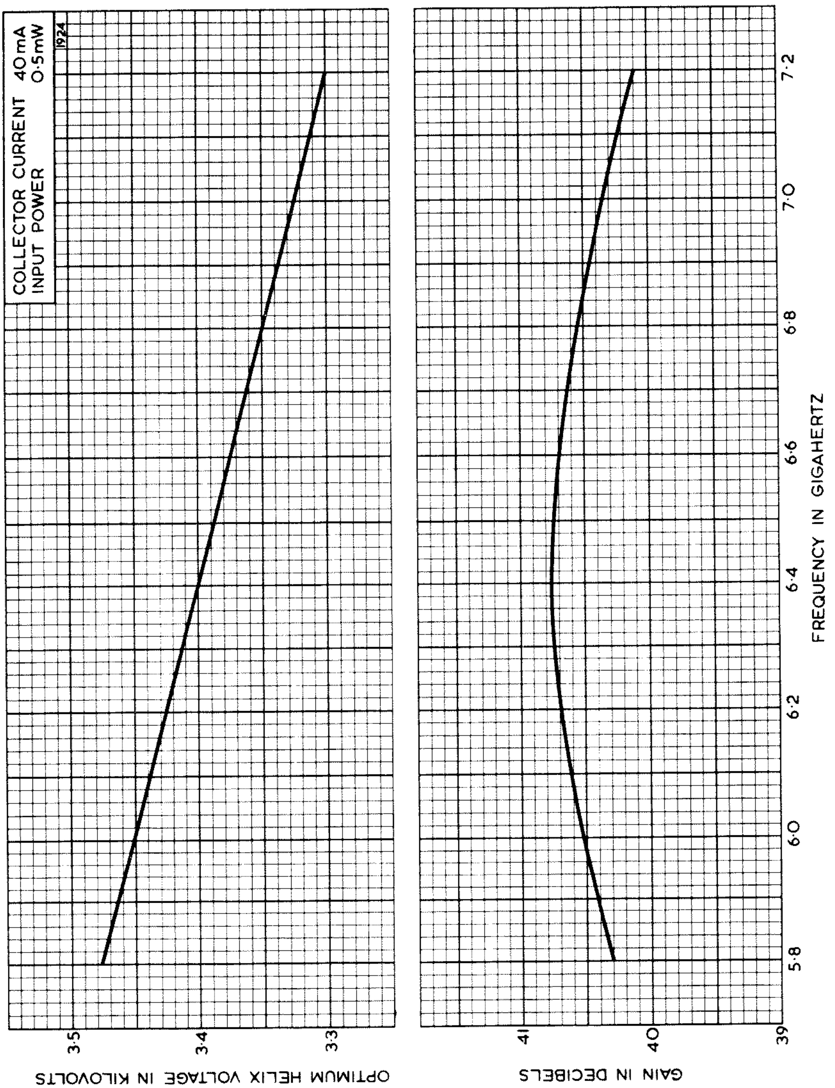


POWER
TRAVELLING WAVE TUBE

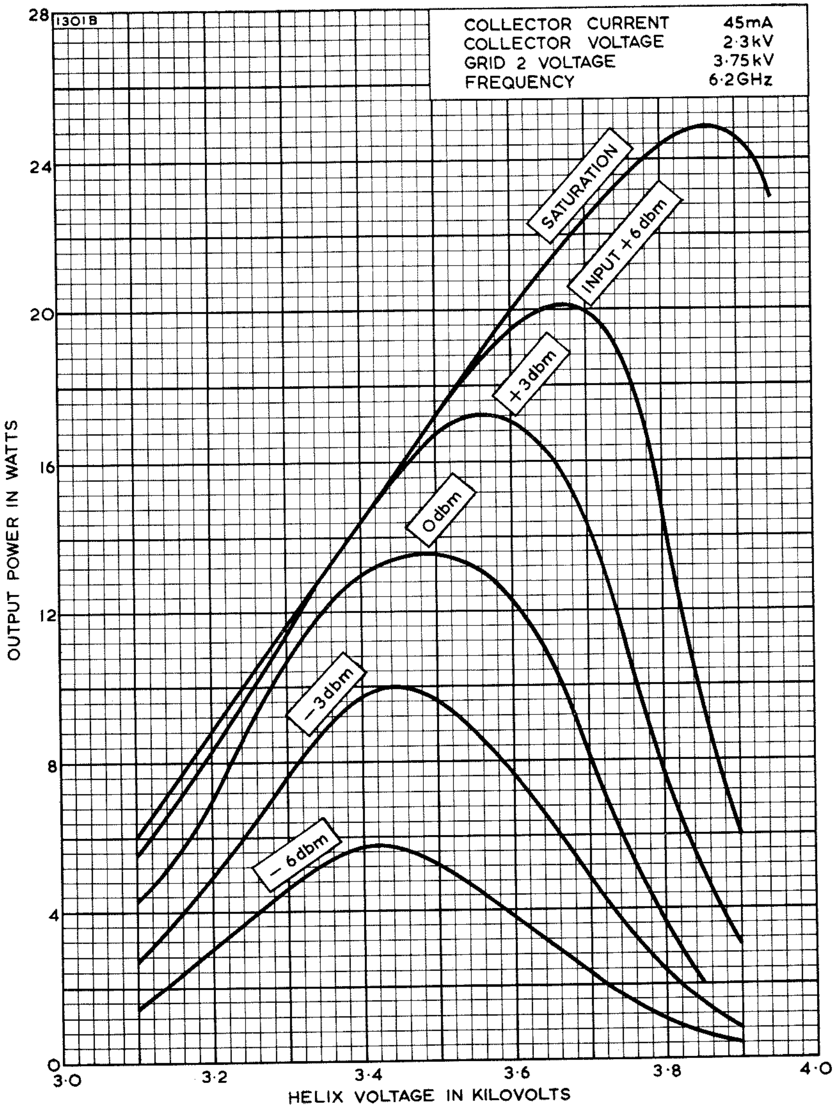
N1055

ENGLISH ELECTRIC

FREQUENCY CHARACTERISTICS



HELIX VOLTAGE CHARACTERISTICS



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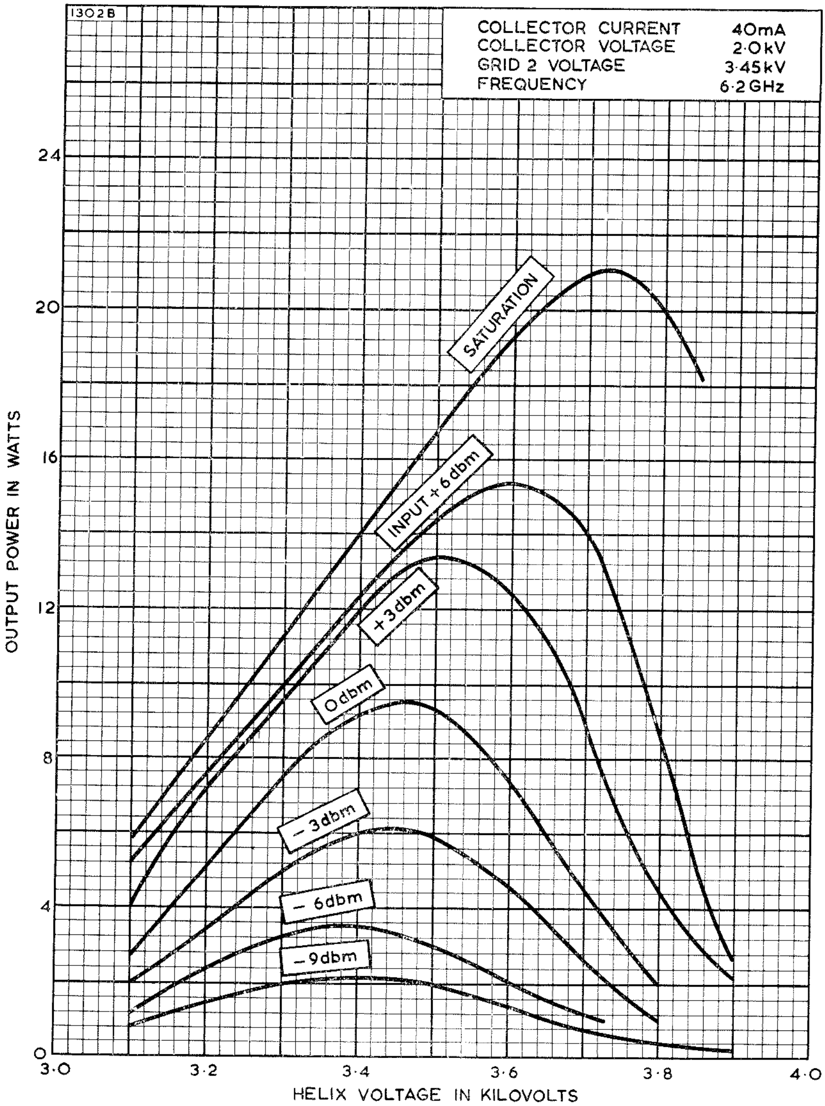
HELIX VOLTAGE CHARACTERISTICS



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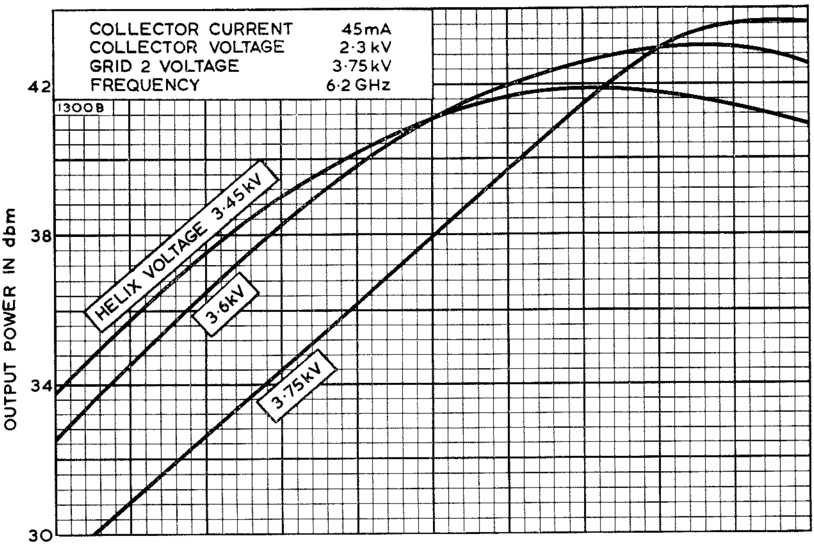
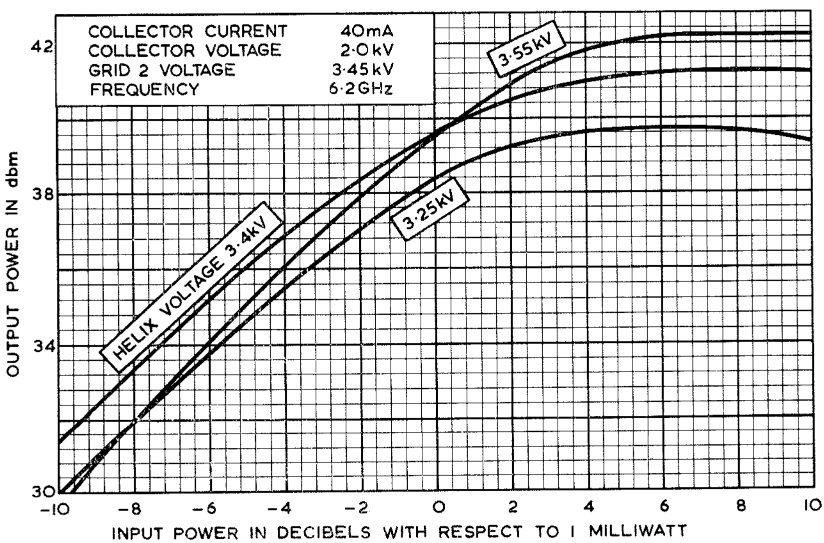
POWER CHARACTERISTICS





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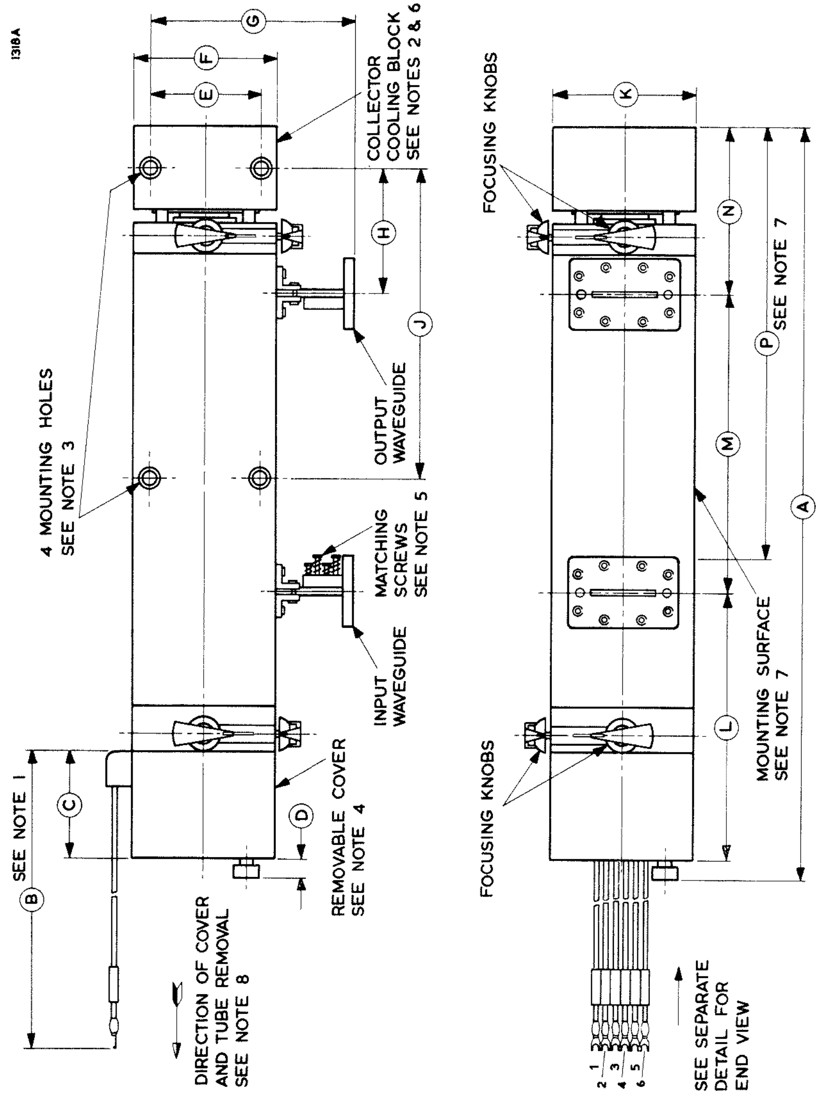
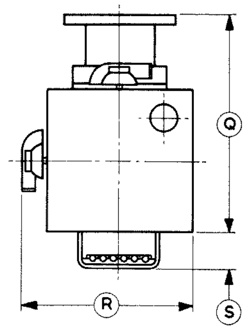
OUTLINE FOR N4085 AND N4094 MOUNTS
(See Note 11 on Page 15)



OUTLINE FOR N4085 AND N4094 MOUNTS

1925



Lead Connections
(See Note 2 on Page 15)

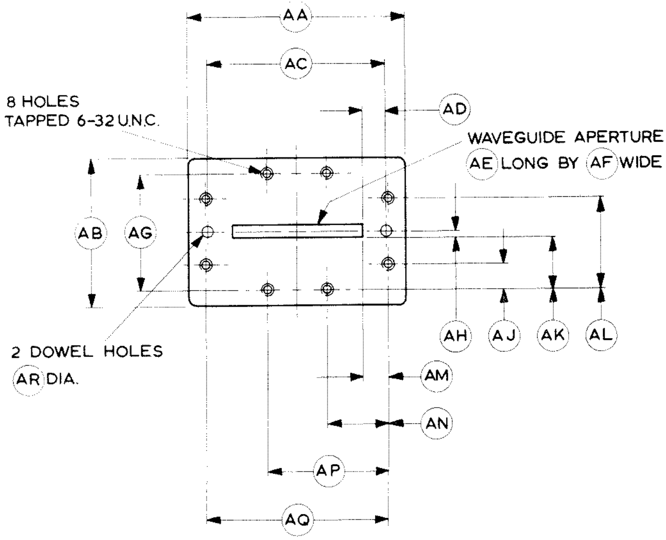
Lead	Colour	Element
1	Yellow	Cathode
2	Brown	Heater
3	Brown	Heater
4	Green	Grid 1
5	Blue	Grid 2
6	Orange	Helix

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	15·750 Max	400 Max	K	2·968 ± 0·032	75·39 ± 0·81
B	12 Nom	305 Nom	L	5·600 Max	142·2 Max
C	2·250 ± 0·015	57·15 ± 0·38	M	6·245 ± 0·020	158·6 ± 0·5
D	0·375 Max	9·53 Max	N	3·500 Max	88·90 Max
E	2·450 ± 0·010	62·23 ± 0·25	P	9 Nom	229 Nom
F	2·968 ± 0·032	75·39 ± 0·81	Q	4·375 Max	111·1 Max
G	4·056 ± 0·020	103·02 ± 0·51	R	3·750 Max	95·25 Max
H	2·625 ± 0·015	66·68 ± 0·38	S	0·750 Max	19·05 Max
J	6·500 ± 0·015	165·10 ± 0·38			

Millimetre dimensions have been derived from inches.

WAVEGUIDE FLANGE

1319



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
AA	2·281	57·94	AK	0·527 ± 0·002	13·386 ± 0·051
AB	1·531	38·89	AL	0·932 ± 0·004	23·673 ± 0·102
AC	1·875 ± 0·002	47·625 ± 0·051	AM	0·279 ± 0·002	7·087 ± 0·051
AD	0·2515 ± 0·002	6·388 ± 0·051	AN	0·643 ± 0·004	16·332 ± 0·102
AE	1·372 ± 0·004	34·849 ± 0·102	AP	1·287 ± 0·004	32·690 ± 0·102
AF	0·125 ± 0·004	3·175 ± 0·102	AQ	1·930 ± 0·004	49·022 ± 0·102
AG	1·179 ± 0·004	29·947 ± 0·102	AR	0·129 Max	3·277 Max
AH	0·0625 ± 0·001	1·588 ± 0·025		0·128 Min	3·251 Min
AJ	0·247 ± 0·004	6·274 ± 0·102			

Millimetre dimensions have been derived from inches.

NOTES FOR N4085 AND N4094 OUTLINE

1. The mount has six screened leads fitted with spade terminals to suit 4BA or 6–32 screws. Alternative lead lengths can be supplied to suit customers' requirements.
2. The collector connection is to the body of the mount which must always be properly earthed during operation.
3. Clearance holes 9/32 inch (7·14mm) diameter, counterbored 13/32 inch (10·32mm) diameter and 7/16 inch (11·11mm) deep, to suit ¼ inch (6·35mm) diameter socket head cap screws.
4. An end clearance of 2¼ inches (57mm) must be allowed to permit the removal of the cover for tube insertion or withdrawal. The travelling wave tube leads plug into a socket inside the cover. An alternative cover, measuring 3 × 4¼ × 2¼ inches (76·2 × 108 × 57·2mm) and incorporating a mains interlock, can be supplied.
5. Matching screws on both the input and output waveguides can be fitted if required.
6. For efficient operation the collector cooling block must be bolted to a heat sink having a thermal impedance of 0·5°C/watt.
7. This surface of the mount is flat to within 0·003 inch (0·076mm) over the length indicated. The mating surface must be equally flat and must be smeared with silicone grease before bolting down the mount, to ensure good thermal contact.
8. The overall length of the mount together with an adequate allowance for tube withdrawal is 28 inches (711mm).
9. The waveguide flange is based on RETMA flange CMR137. The fixing holes may be tapped or clearance to suit customers' requirements.
10. Transitions to full size No. 14 waveguide are available.
11. Certain alternative orientations of end cover and focusing screws, and position of mounting holes, are possible by arrangement.

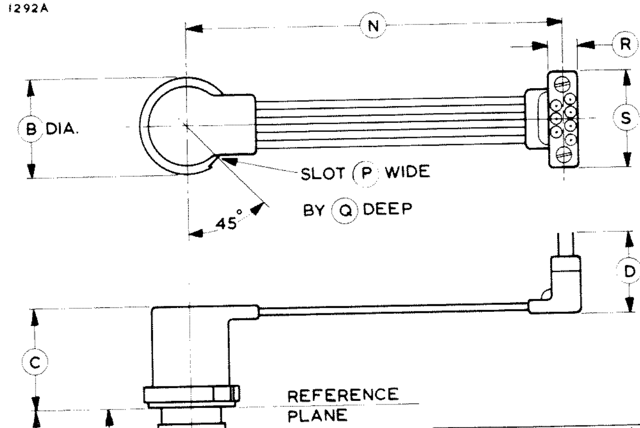
POWER TRAVELLING WAVE TUBE

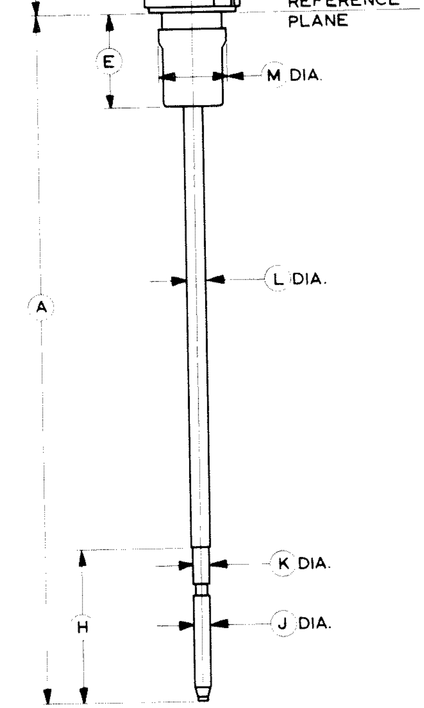
N1055

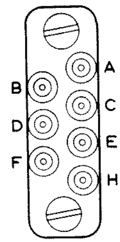
ENGLISH ELECTRIC

OUTLINE

1292A







DETAIL OF PLUG TYPE BA7P

Pin	Element	Pin	Element
A	Grid 2	E	Heater
B	Heater	F	Cathode
C	Helix	H	N.C.
D	Grid 1	CAP	Collector

NOMINAL DIMENSIONS

Ref.	Inches	Millimetres
A	12·140	308·4
B	1·650	41·91
C	1·750 Max	44·45 Max
D	1·375	34·93
E	1·625 Max	41·28 Max
H	2·720	69·09
J	0·320	8·13
K	0·320	8·13
L	0·335 Max	8·51 Max
M	1·170 Max	29·72 Max
N	6·500	165·1
P	0·400	10·16
Q	0·062	1·57
R	0·500	12·70
S	1·625	41·28

Millimetre dimensions have been derived from inches.

POWER
TRAVELLING WAVE TUBE

N1056

ENGLISH ELECTRIC

ABRIDGED DATA

Power Amplifier Travelling Wave Tube for wideband communication systems requiring low AM/PM conversion, low noise factor and high gain. The tube is operated in a conduction cooled periodic permanent magnet focusing mount with waveguide r.f. connections. Tubes are fully interchangeable in the mount and tube replacement is a relatively simple operation.

Frequency Range	3·6 to 5·0	GHz
Saturated Output Power	18	W Min
Working Output Power	10	W
Nominal Gain	38	db
Noise Factor	27	db
AM/PM Conversion (at 10W output)	1·0	degree/db

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·8	A
Heater Starting Current (Peak)	5·0	A Max
Cathode Heating Time		*See Note* 2

Mechanical

Dimensions	*See Page* 15
Tube Base	Moulded cap and flying leads fitted with plug type BA7P
Mounting Position	Any

Focusing Mounts (*See Note* 3)

Two mounts are available covering American F.C.C. bands.

Frequency Range 3·7 to 4·2GHz		N4074
Frequency Range 4·4 to 5·0GHz		N4075
R.F. Connections:		
N4074	No. 11A Waveguide (WR229) with RETMA flange CMR229	
N4075	No. 12 Waveguide (WR187) with RETMA flange CMR187	
Net Weight	$17\frac{3}{4}$ pounds (8·5kg)	Approx
Mounting Position	Horizontal, or vertical with collector uppermost	
Cooling		*See Note* 3
Ambient Temperature Range (operating):		
minimum	−10	°C
maximum		*See Note* 3
Ambient Temperature Range (storage)	−50 to +85	°C

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MAXIMUM RATINGS

(Absolute Values) (*See Note* 4)

Collector Voltage	3·5 kV Max
Collector Current	50 mA Max
Collector Dissipation	100 W Max
Helix Voltage	3·5 kV Max
Helix Current:	
Continuous	2·0 mA Max
For 1 second max	4·0 mA Max
Grid 2 Voltage	3·5 kV Max
Grid 2 Current	0·5 mA Max
Grid 1 Voltage (negative value, never positive)	150 V Max
Heater Voltage	6·6 V Max
Temperature of Hottest Part of mount (excluding conduction block or heat sink) (*See Note* 3)	85 °C Max
Temperature of Collector Conduction Block (*See Note* 3)	105 °C Max
Temperature Difference over length of mount (excluding Collector Conduction Block)	10 °C Max

TYPICAL OPERATION

(at 4·0GHz) (*See Note* 5)

Operational Conditions (*See Note* 4)			
Collector Voltage	2·0	2·0	kV
Collector Current (*See Note* 6)	40	45	mA
Helix Voltage	3·0	3·0	kV
Grid 2 Voltage	3·2	3·25	kV
Grid 1 Voltage (*See Note* 6)	−75	−60	V
Typical Performance			
Helix Current	0·5	0·5	mA
Grid 2 Current	0·1	0·1	mA
Grid 1 Current	Zero	Zero	
Gain at 5·0W output	37	—	db
Gain at 10W output	—	38	db
Working Output Power	5·0	10	W
Saturated Output Power (*See Note* 7)	13	17	W
Maximum Saturated Output Power (*See Note* 8)	19	20	W
Noise Factor	27	27	db
Cold Insertion Loss	55		db Min
Input V.S.W.R. over the band (*See Note* 9)	1·5:1		Max
Output V.S.W.R. over the band (*See Note* 9)	1·5:1		Max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 5·0W Output Power Operation)

Recommended Applied Conditions (*See Note* 4)

Frequency Range	3·6 to 5·0	GHz
Heater Voltage (*See Note* 1)	6·3	V
Collector Voltage	2·0	kV
Collector Current (*See Note* 6)	40	mA
Grid 2 Voltage	3·2	kV
Input Power	1·0	mW
Output Power	5·0	W
Load V.S.W.R.	less than 1·5:1	

Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·75	1·0	A
Helix Voltage	2·75	3·15	kV
Helix Current:			
Switching on, zero r.f. drive	—	2·0	mA
Focused, with r.f. drive	—	2·0	mA
Grid 2 Current	—	0·5	mA
Grid 1 Voltage (negative value) (*See Note* 6)	0	100	V
Maximum Saturated Output Power (*See Note* 8)	14	—	W
Noise Factor (*See Note* 10)	—	27	db
Gain Flatness (*See Note* 11)	—	0·01	db/MHz
AM/PM Conversion (*See Note* 12)	—	2·0	degrees/db
Power Level of Harmonics (below output level of fundamental)	20	—	db
Input V.S.W.R. (hot) (*See Note* 9)	—	1·5:1	
Output V.S.W.R. (hot) (*See Note* 9)	—	1·5:1	

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 10W Output Power Operation)

Recommended Applied Conditions (*See Note* 4)

Frequency Range	3·6 to 5·0	GHz
Heater Voltage (*See Note* 1)	6·3	V
Collector Voltage	2·0	kV
Collector Current (*See Note* 6)	45	mA
Grid 2 Voltage	3·25	kV
Input Power	2·0	mW
Output Power	10	W
Load V.S.W.R.	less than 1·5:1	

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Range of Characteristics (with recommended applied conditions)

	Min	*Max*	
Heater Current	0·75	1·0	A
Helix Voltage	2·75	3·15	kV
Helix Current:			
Switching on, zero r.f. drive	—	2·0	mA
Focused, with r.f. drive	—	2·0	mA
Grid 2 Current	—	0·5	mA
Grid 1 Voltage (negative value) (*See Note* 6)	0	100	V
Maximum Saturated Output Power (*See Note* 8)	18	—	W
Noise Factor (*See Note* 10)	—	27	db
Gain Flatness (*See Note* 11)	—	0·01	db/MHz
AM/PM Conversion (*See Note* 12)	—	2·0	degrees/db
Power Level of Harmonics (below output level of fundamental)	20	—	db
Input V.S.W.R. (hot) (*See Note* 9)	—	1·5:1	
Output V.S.W.R. (hot) (*See Note* 9)	—	1·5:1	

NOTES

1. The heater voltage must be maintained within ±5% of the nominal value.
2. The cathode heating time for a tube on initial installation is 2½ minutes minimum; this time may be reduced to one minute minimum for subsequent switching on.
3. Conduction cooled mounts can be mounted horizontally or vertically with the collector uppermost, being designed for use where direct convection cooling of the collector block is difficult. The collector conduction block must be cooled by means of a further heat sink, e.g. a finned panel, which is not supplied but is normally incorporated in the structure of the equipment. It is important that the secondary heat sink is designed in such a way that the temperature of the mount remains below its maximum rating at the maximum ambient temperature of the equipment. The body of the mount will usually be between 5 and 20°C above ambient, depending on the design of heat sink.
4. All voltages apart from the heater voltage are specified with respect to the cathode.
5. For other frequencies within the operating range of the tube and mount the helix voltage will need adjustment if maximum gain is to be obtained.
6. The collector current is set to the recommended value by adjustment of the potential applied to grid 1.
7. With the helix voltage fixed and only the input power adjusted for maximum output.

8. With both the helix voltage and input power adjusted for maximum output.
9. The matching adjustments on the mount are preset during manufacture. With any tube operated in the mount under the recommended applied conditions, the V.S.W.R. will remain below the quoted value over the specified frequency range of the mount.
10. The noise factor is measured under full operating conditions, using a suitable FM receiver, demodulator and baseband selective amplifier. The limit applies for any 4·0kHz bandwidth in the demodulated frequency band from 10kHz to 10MHz.
11. Over the recommended frequency range of the tube.
12. The value given for AM/PM conversion is that obtained under the specified conditions. Lower values may be achieved with other settings of helix voltage and input power.

OPERATING NOTES FOR N1056 IN P.P.M. MOUNTS N4074 AND N4075

The operating principles of a periodic permanent magnet array focusing an electron beam in a travelling wave tube are complex and complete transmission of the beam can only be achieved over a limited range of electrode potentials. Consequently there are certain requirements that must be complied with when designing the power supply and installing a tube.

A. **Power Supply**

(1) The travelling wave tube heater voltage must be applied at least $2\frac{1}{2}$ minutes before any h.t. voltages are applied.

(2) During switch-on, the grid 2 voltage must be delayed so that it does not reach its full value until all other electrodes have reached their final voltages.

(3) During switch off, the grid 2 voltage should be reduced before all other voltages or excessive currents may be drawn.

(4) The grid 1, grid 2 and helix voltages should be stabilised to $\pm 2\%$.

(5) A protective device must be included in the helix circuit to cut off the h.t. supply if the helix current exceeds 2mA. This device may be overridden during installation as long as the helix current does not exceed 4mA for a maximum period of 1 second.

B. **Initial Installation of Travelling Wave Tube**

(1) Before inserting the travelling wave tube the focusing screws on the mount must be set to a central position (white line).

(2) Pull down the sprung retaining finger and insert the travelling wave tube in the mount taking care to avoid radial force. Slightly increase the pressure to overcome the extra resistance as the collector enters the radiator, and ensure that the keyway on the travelling wave tube mates correctly with the spigot on the mount, and the tube is pushed right in. Release the retaining finger so that it presses against the moulded base of the travelling wave tube.

(3) Engage the 7-pin plug on the end of the travelling wave tube leads with the supply socket.

(4) Close the cover.

C. **Initial Switching On**

(1) Switch on the travelling wave tube heater and allow a minimum of $2\frac{1}{2}$ minutes cathode preheating time.

(2) Set helix voltage to 3000 volts and grid 1 voltage to −75 volts.

(3) Apply h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

(4) Successively adjust the focusing screws until the helix current is reduced to a minimum, and grid 1 voltage until the collector current is 40 or 45mA, as required.

Note: If grid 1 voltage is made less negative with respect to cathode so that the collector current rises above 45mA this current will rise to a maximum and then decrease again. This decrease in current is due to grid 2 current being taken and can cause damage to the tube. The tube must not therefore be operated in this condition.

D. **Subsequent Switching On**

Once the travelling wave tube has been set up and focused as described above it may be subsequently switched on again from cold, without further adjustment to the focusing screws or grid 1 voltage, as follows:

(1) Allow one minute minimum cathode preheating time.

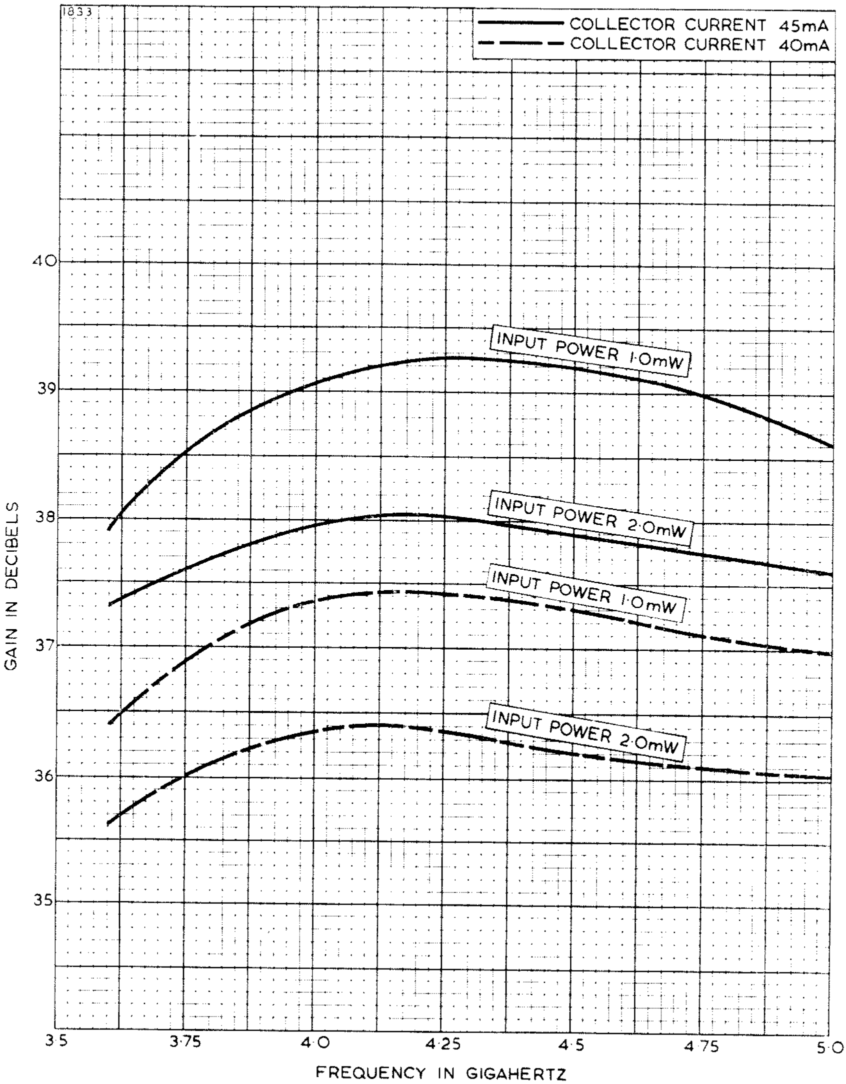
(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

E. **Supply Interruption**

(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting grid 2 voltage which must be delayed as in C(3) above.

(2) For interruptions in excess of ten seconds all voltages must be re-applied in accordance with paragraph D above.

FREQUENCY CHARACTERISTICS



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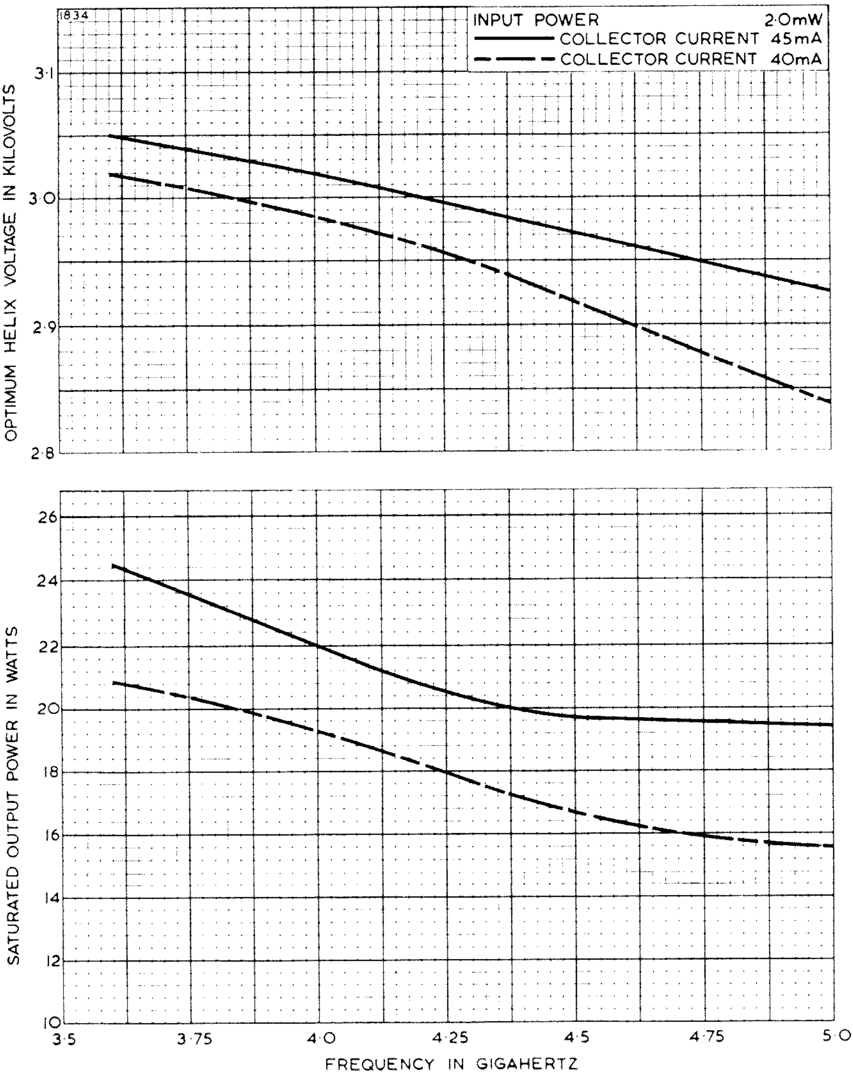
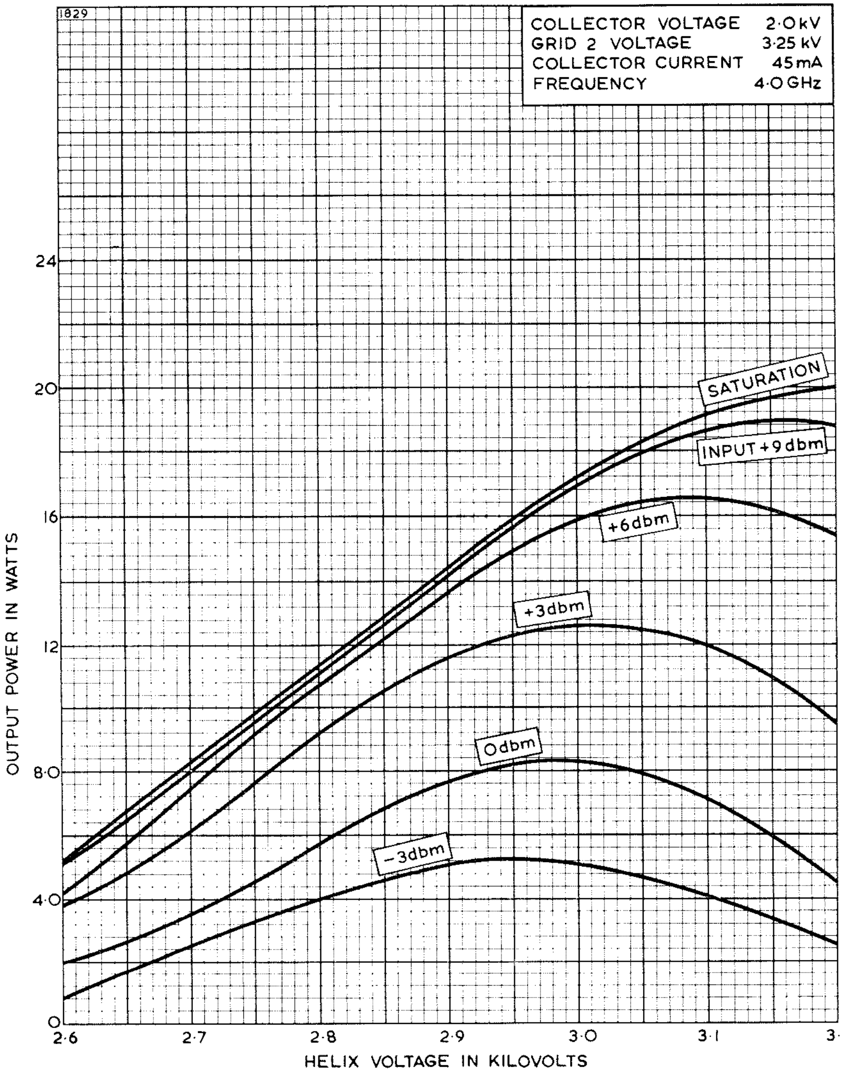
FREQUENCY CHARACTERISTICS



HELIX VOLTAGE CHARACTERISTICS



POWER
TRAVELLING WAVE TUBE

N1056

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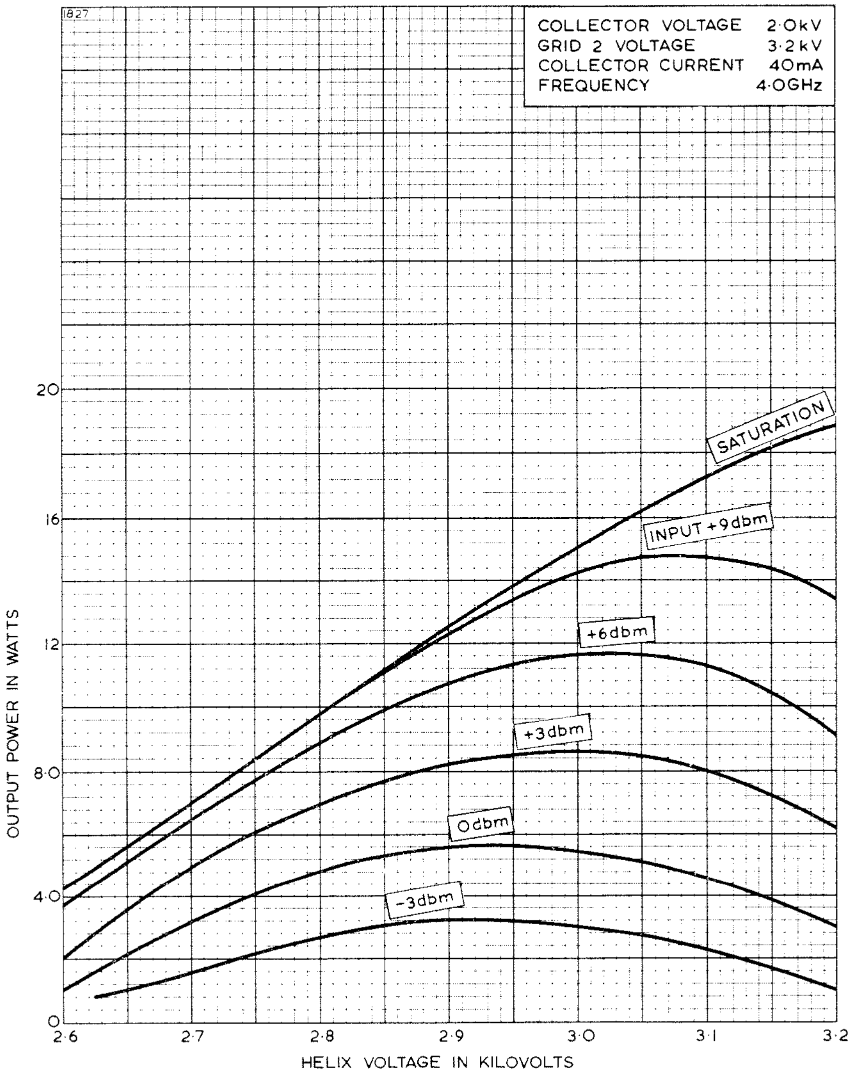
HELIX VOLTAGE CHARACTERISTICS



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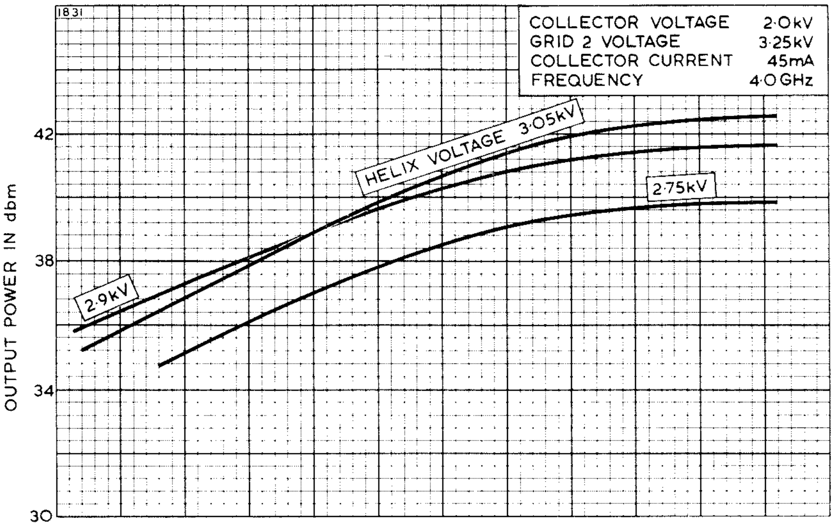
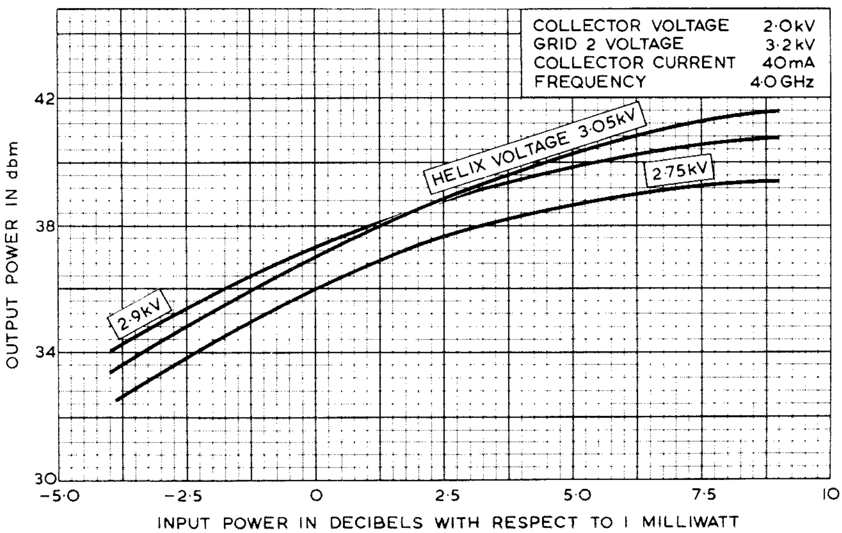
POWER CHARACTERISTICS





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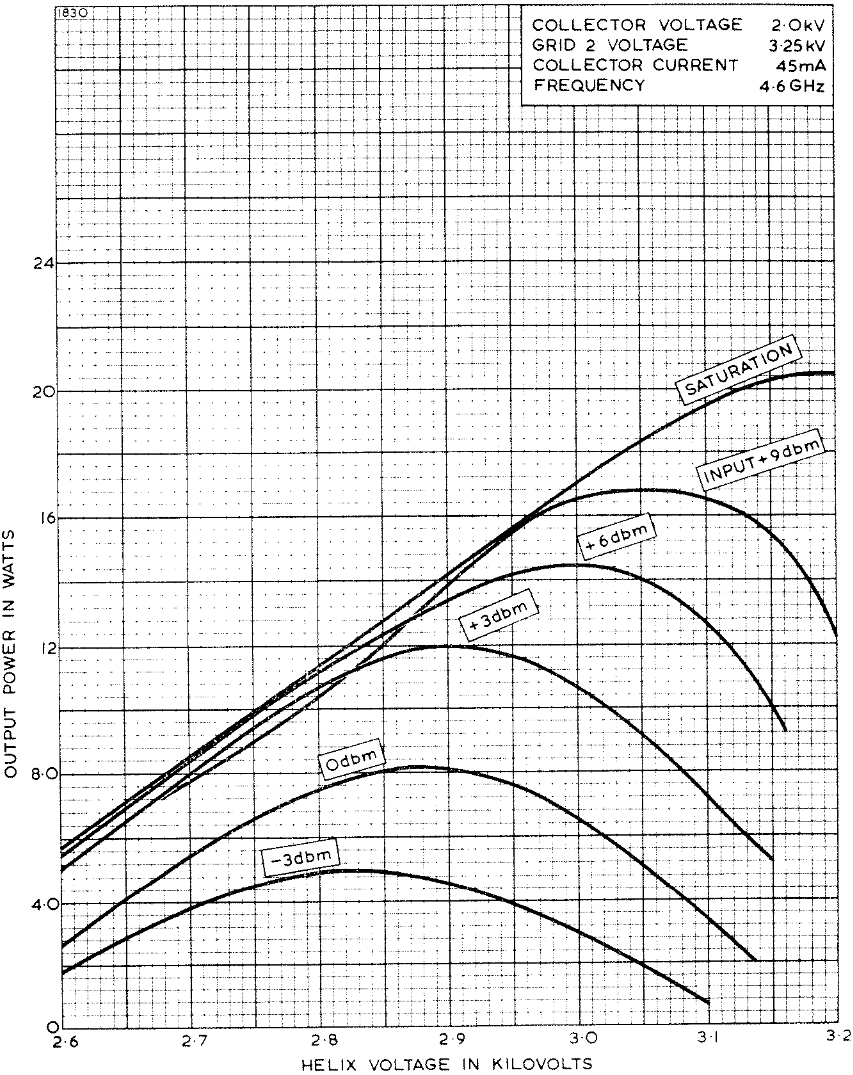

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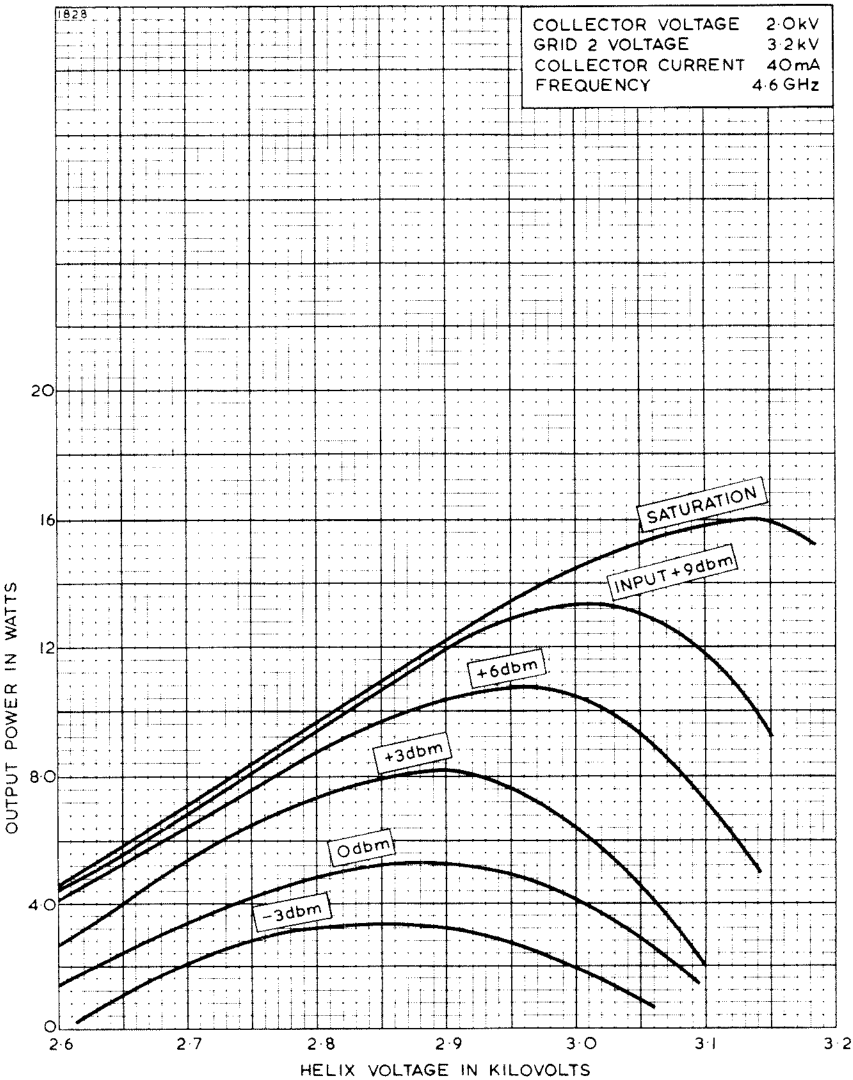
HELIX VOLTAGE CHARACTERISTICS



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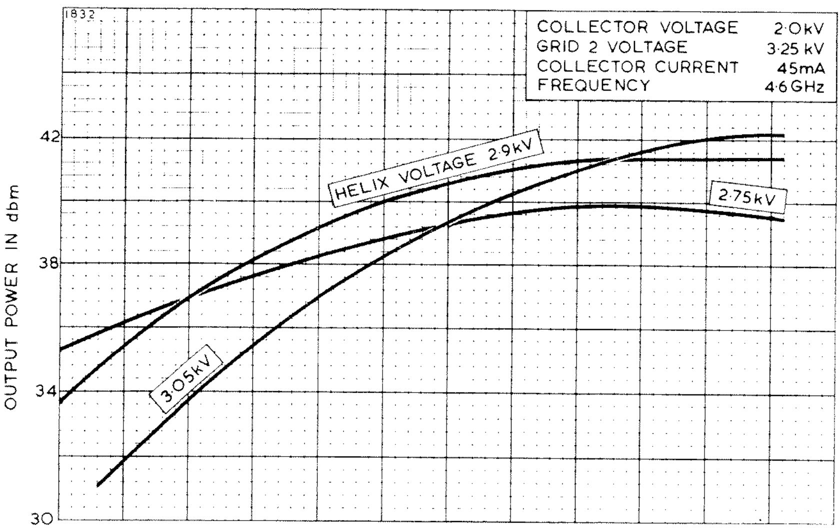
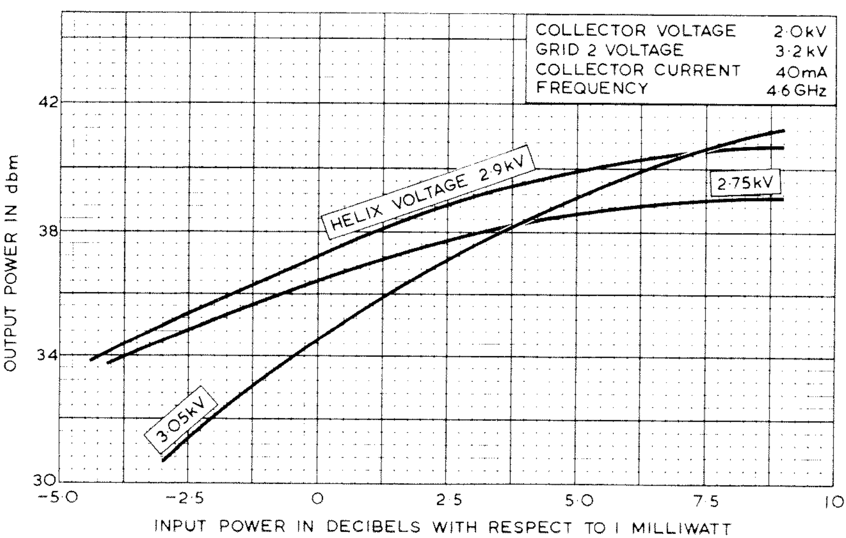


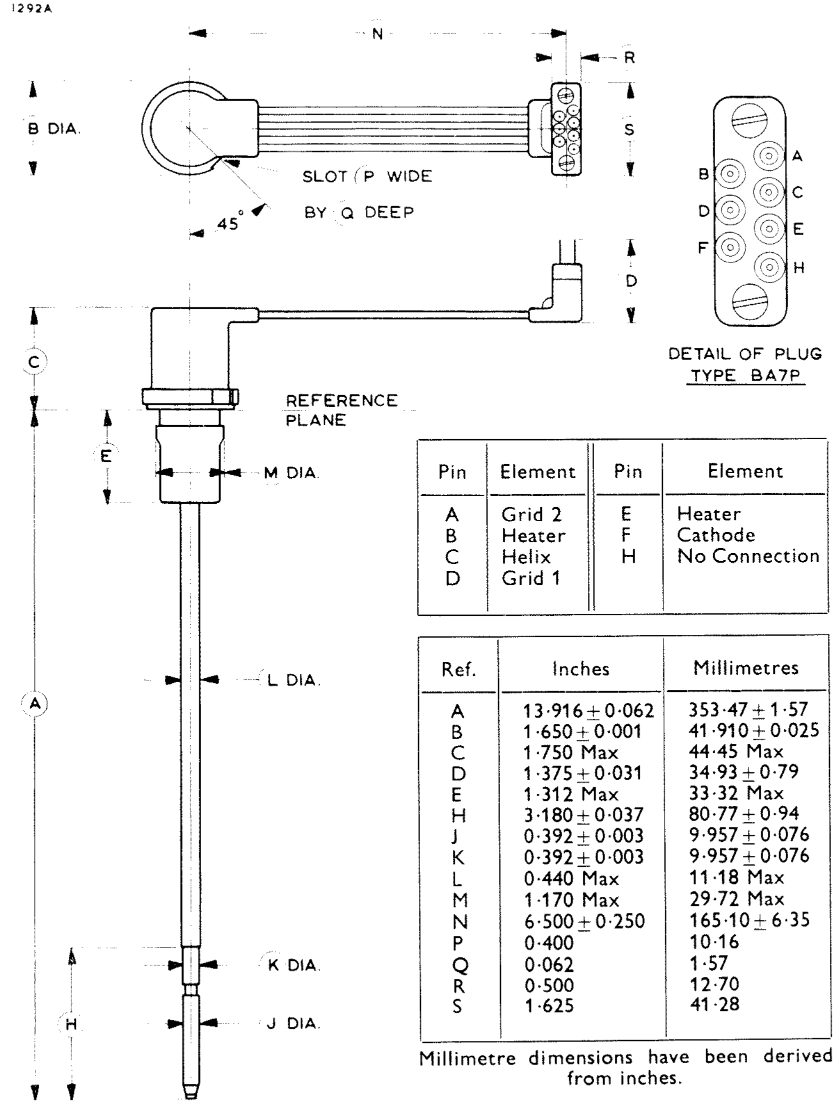


POWER TRAVELLING WAVE TUBE

N1056

OUTLINE

1292A



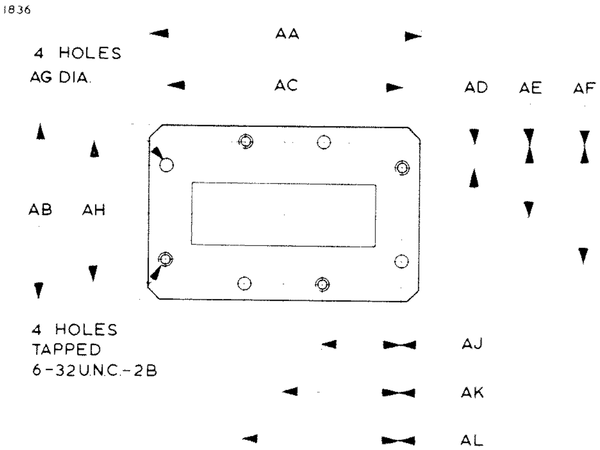
Pin	Element	Pin	Element
A	Grid 2	E	Heater
B	Heater	F	Cathode
C	Helix	H	No Connection
D	Grid 1		

Ref.	Inches	Millimetres
A	13·916 ± 0·062	353·47 ± 1·57
B	1·650 ± 0·001	41·910 ± 0·025
C	1·750 Max	44·45 Max
D	1·375 ± 0·031	34·93 ± 0·79
E	1·312 Max	33·32 Max
H	3·180 ± 0·037	80·77 ± 0·94
J	0·392 ± 0·003	9·957 ± 0·076
K	0·392 ± 0·003	9·957 ± 0·076
L	0·440 Max	11·18 Max
M	1·170 Max	29·72 Max
N	6·500 ± 0·250	165·10 ± 6·35
P	0·400	10·16
Q	0·062	1·57
R	0·500	12·70
S	1·625	41·28

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC

N4074 WAVEGUIDE FLANGE DETAILS (RETMA type CMR229)



Ref.	Inches	Millimetres
AA	3·156 ± 0·016	80·16 ± 0·41
AB	2·000 ± 0·016	50·80 ± 0·41
AC	2·844 ± 0·004	72·238 ± 0·102
AD	0·438 ± 0·004	11·125 ± 0·102
AE	0·844 ± 0·004	21·438 ± 0·102
AF	1·250 ± 0·004	31·750 ± 0·102
AG	0·147 ± 0·005	3·73 ± 0·13
AH	1·688 ± 0·004	42·875 ± 0·102
AJ	0·922 ± 0·004	23·419 ± 0·102
AK	1·422 ± 0·004	36·119 ± 0·102
AL	1·922 ± 0·004	48·819 ± 0·102

Millimetre dimensions have been derived from inches.

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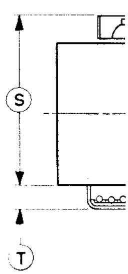
June 1967



Ref.	
A	17
B	2·9
C	3·2
D	2·9
E	1·9
F	0·2
G	0·2
H	0·3

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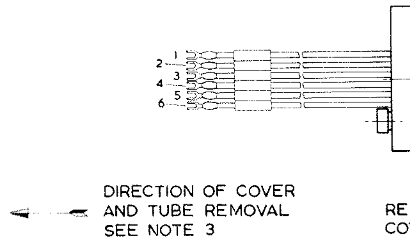
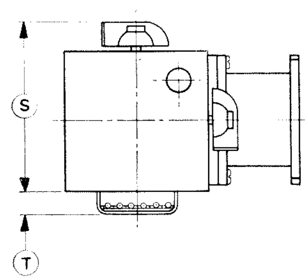
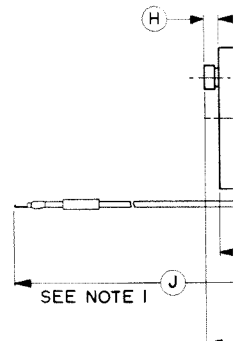
OUTLINE FOR N4075 MOUNT
(See Note 5 on Page 20)







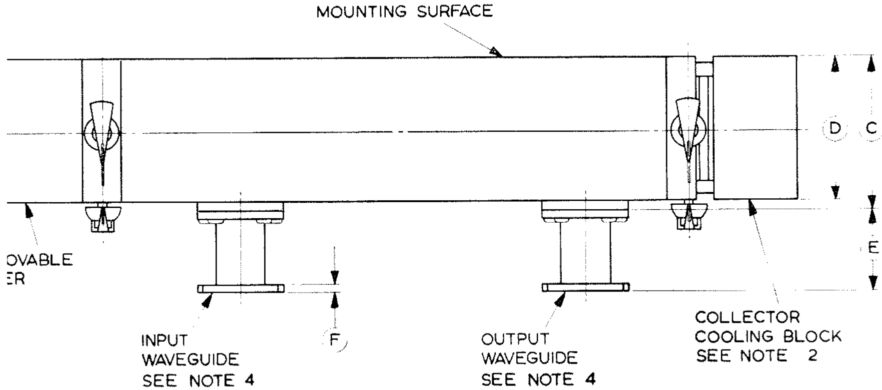
Ref.	Inches	Millimetres	Ref.	Inches
A	17·382 Max	441·5 Max	J	12·000 N
B	2·968±0·032	75·39±0·81	K	2·270 Ma
C	3·200±0·062	81·28±1·57	M	7·150±0·
D	2·968±0·032	75·39±0·81	N	3·563±0·
E	1·700±0·010	43·18±0·25	P	7·000±0·
F	$0{\cdot}250^{+0{\cdot}000}_{-0{\cdot}032}$	$6{\cdot}35^{+0{\cdot}00}_{-0{\cdot}81}$	Q	4·400 Ma
			R	2·450±0·
G	0·290	7·37	S	3·750 Ma
H	0·312 Nom	7·92 Nom	T	0·500

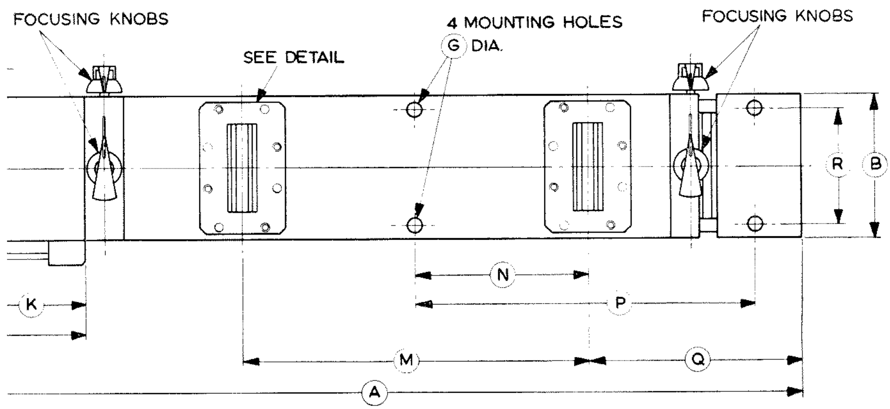
Millimetre dimensions have been derived from

POWER TRAVELLING WAVE TUBE

N1056

ENGLISH ELECTRIC





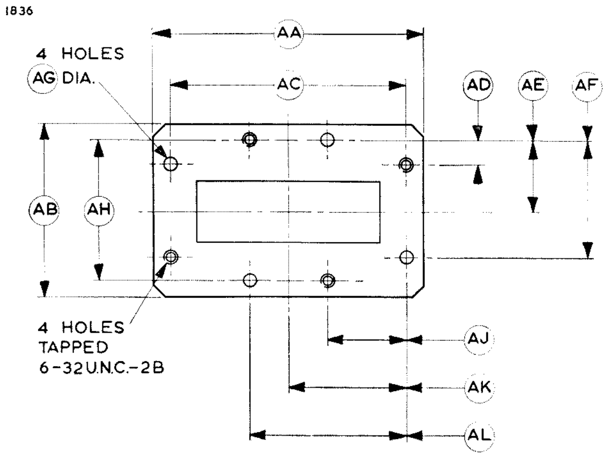
	Millimetres
n	304·8 Nom
	57·66 Max
20	181·6 ± 0·5
5	90·50 ± 0·38
0	177·80 ± 0·25
	111·8 Max
0	62·23 ± 0·25
	95·25 Max
	12·70

ches.

LEAD CONNECTIONS

Lead	Colour	Element
1	Yellow	Cathode
2	Brown	Heater
3	Brown	Heater
4	Green	Grid 1
5	Blue	Grid 2
6	Orange	Helix

N4075 WAVEGUIDE FLANGE DETAILS
(RETMA type CMR187)



Ref.	Inches	Millimetres
AA	2·781 ± 0·005	70·64 ± 0·13
AB	1·781 ± 0·005	45·24 ± 0·13
AC	2·430 ± 0·005	61·72 ± 0·13
AD	0·247 ± 0·005	6·27 ± 0·13
AE	0·715 ± 0·005	18·16 ± 0·13
AF	1·183 ± 0·005	30·05 ± 0·13
AG	0·147 ± 0·005	3·73 ± 0·13
AH	1·430 ± 0·005	36·32 ± 0·13
AJ	0·810 ± 0·005	20·57 ± 0·13
AK	1·215 ± 0·005	30·86 ± 0·13
AL	1·620 ± 0·005	41·15 ± 0·13

Millimetre dimensions have been derived from inches.

OUTLINE NOTES FOR N4074 AND N4075 MOUNTS

1. The mount has six screened leads fitted with spade terminals to suit 4B.A. or 6–32 screws. Alternative lead lengths can be supplied to suit customers' requirements.
2. The collector conduction block must be bolted to a heat sink having a thermal impedance of not more than 0·5°C/watt. The surface of the conduction block is flat to within 0·003 inch (0·076mm). The mating surface must be equally flat and must be coated with silicone grease before bolting down the mount, to ensure good thermal contact. The collector connection is to the body of the mount which must always be properly earthed during operation.
3. An end clearance of $2\frac{1}{4}$ inches (57mm) must be allowed to permit the removal of the cover for tube insertion or withdrawal. The overall length of the mount together with an adequate allowance for tube withdrawal is 35 inches (889mm). The travelling wave tube leads plug into a socket inside the cover. An alternative cover, measuring $3 \times 4\frac{1}{4} \times 2\frac{1}{4}$ inches ($76{\cdot}2 \times 108 \times 57{\cdot}2$mm) and incorporating a mains interlock, can be supplied.
4. The waveguide input and output ports of N4074 are designed for connection to full size number 11A waveguide (WR229), and those of N4075 for connection to full size number 12 waveguide (WR187), via the transition sections fitted. At least 1·0 inch of plain waveguide must be allowed before any bend, twist etc., or the match may be affected.

   The mount can be supplied without the waveguide transitions, in which case the waveguide aperture is $1{\cdot}872 \times 0{\cdot}250$ inches ($47{\cdot}55 \times 6{\cdot}35$mm) and the flange is CMR187 with all holes threaded.
5. Certain alternative orientations of end cover and focusing screws and position of mounting holes are possible by arrangement.

INTRODUCTION

The N1061 is a high power, magnetically focused, broadband pulsed travelling wave amplifier. It is intended primarily for radar applications and is capable of output powers up to 1·0MW over an instantaneous bandwidth in excess of 450MHz at X-band. The gain of the tube at saturation is between 25 and 35db and the rated duty cycle is 0·005.

The tube is of the 'severed' type, the connections to the slow wave structure at the sever being taken to waveguide loads external to the vacuum envelope. This overcomes the disadvantages of internal loads at high mean power levels.

The tube is of rugged metal-ceramic construction and is liquid cooled. R.F. connections to the tube are made via No. 15 waveguide (WR112, RG–51/U). Pressurisation in the output waveguide system is required.

Focusing of the tube is by means of a separate liquid cooled solenoid type N4115. The tube is self-locating in the solenoid, no focusing adjustments being required. An energising power of some 4kW is needed to provide the required axial field of 2000 gauss.

The tube is designed for vertical mounting with the cathode end down, the gun assembly being mounted in an oil-filled pulse transformer.

Variants of the tube covering 450MHz bands centred on various frequencies in X-band can be supplied.

GENERAL DATA

Travelling Wave Amplifier N1061

Electrical

Cathode	Indirectly Heated	
Heater Voltage	3·3	V
Heater Current	54	A
Beam Voltage (Peak)	100	kV
Beam Current (Peak)	31	A
Pulse Width	8·0	μs
Duty Cycle	0·005	
Instantaneous Bandwidth	450	MHz
Output Power (Peak)	900	kW
Gain	33	db
Efficiency	30	%

GENERAL DATA—*continued*

Mechanical

Overall Length	30 inches	(76·2 cm)	Nom
Overall Diameter	10 inches	(25·4 cm)	Nom
Net Weight	75 pounds	(34 kg)	Approx

Cooling .. .. .. Water

Collector Water Flow	10 Imp.gal/min (45·4 l./min)
Collector Pressure Drop	25 lb/in^2 (1·75kg/cm^2)
Body Water Flow	1 Imp.gal/min (4·54 l./min)
Body Pressure Drop	10 lb/in^2 (0·7kg/cm^2)

Solenoid N4115

Electrical

Solenoid Voltage	80	V
Solenoid Current	55	A

Mechanical

Overall Dimensions	15 × 15 × 13 inches	Approx
	38 × 38 × 33 cm	Approx
Net Weight	320 pounds (145 kg)	Approx

Cooling .. .. .. Water

Water Flow Rate	3 Imp.gal/min (13·6 l./min)
Pressure Drop	35 lb/in^2 (2·45 kg/cm^2)

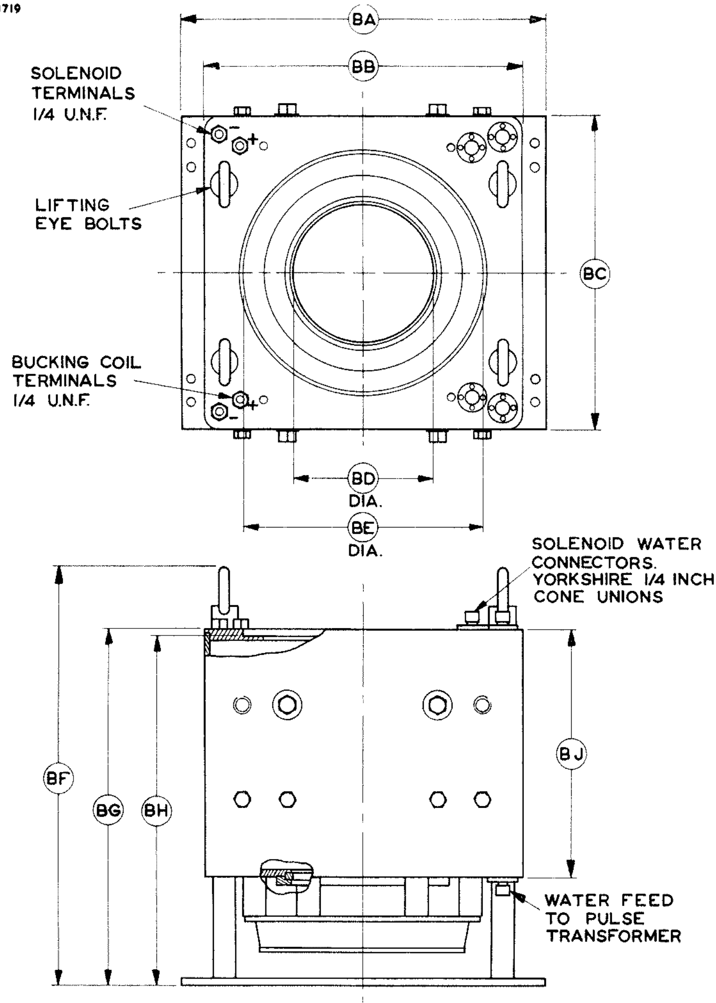
OUTLINE DIMENSIONS FOR SOLENOID N4115

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
BA	15·180	385·6	BF	17·750 Max	450·9 Max
BB	13·250	336·6	BG	14·835	376·8
BC	13·180	334·8	BH	14·548	369·5
BD	$5{\cdot}830^{+0{\cdot}003}_{-0{\cdot}000}$	$148{\cdot}082^{+0{\cdot}076}_{-0{\cdot}000}$	BJ	10·560	268·2
BE	$10{\cdot}010^{+0{\cdot}005}_{-0{\cdot}000}$	$254{\cdot}254^{+0{\cdot}127}_{-0{\cdot}000}$			

Millimetre dimensions have been derived from inches.

OUTLINE OF SOLENOID N4115

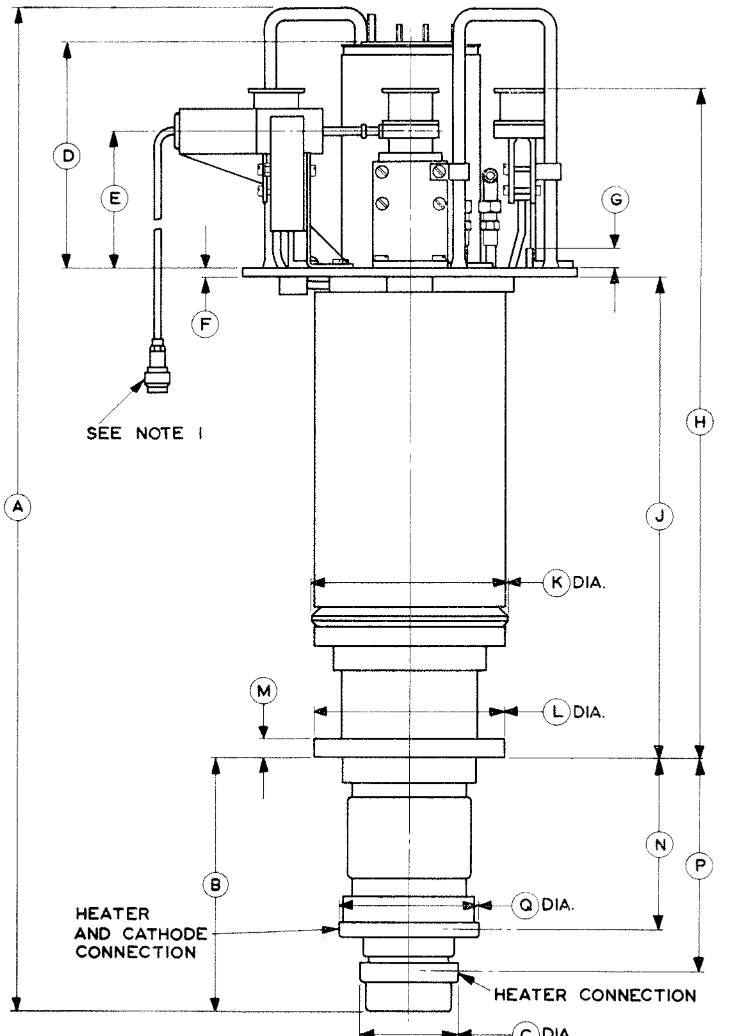
1719



OUTLINE

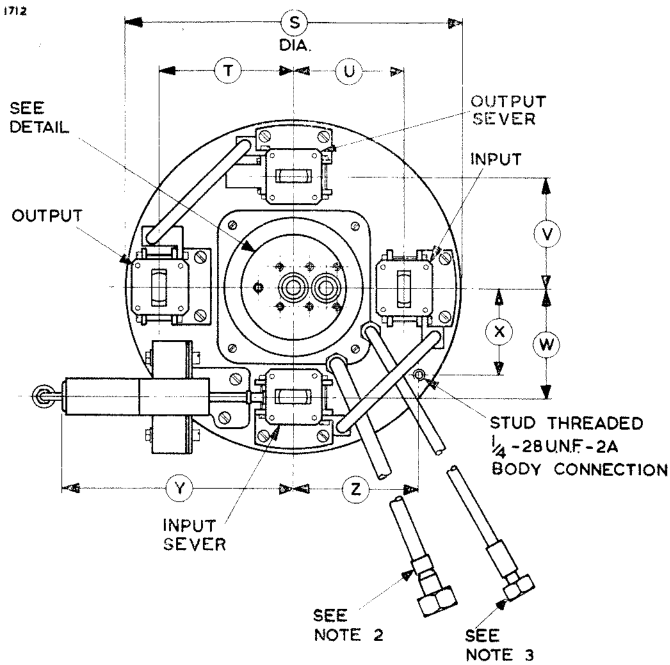
1711

(See Page 6 for Outline Dimensions)



OUTLINE

(See Page 6 for Outline Dimensions)



NOTES

1. Appendage pump connections P.E.T.201 socket.
2. Body cooling water connection, $\frac{3}{8}$ B.S.P.
3. Body cooling water connection, $\frac{1}{4}$ B.S.P.

OUTLINE DIMENSIONS

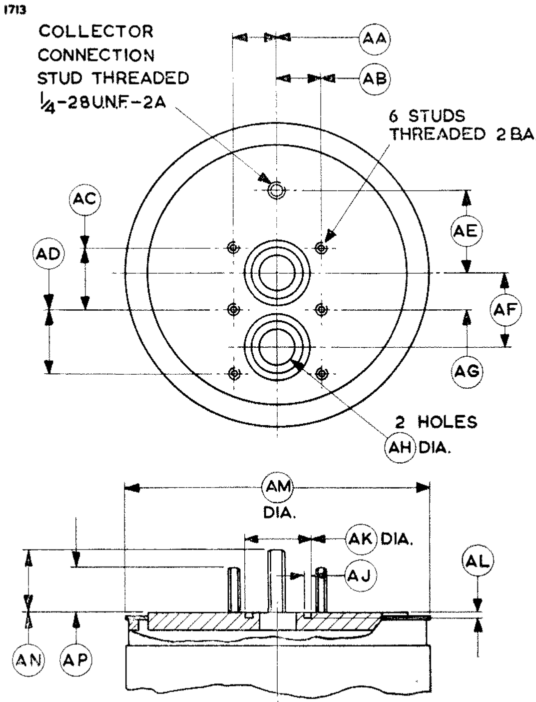
Ref.	Inches	Millimetres
A	$30{\cdot}000 \pm 0{\cdot}060$	$762{\cdot}0 \pm 1{\cdot}52$
B	$7{\cdot}667 \pm 0{\cdot}030$	$194{\cdot}7 \pm 0{\cdot}76$
C	3·000	76·20
D	$6{\cdot}875 \pm 0{\cdot}060$	$174{\cdot}6 \pm 1{\cdot}5$
E	$4{\cdot}125 \pm 0{\cdot}060$	$104{\cdot}8 \pm 1{\cdot}5$
F	0·312	7·92
G	0·625	15·88
H	$20{\cdot}000 \pm 0{\cdot}003$	$508{\cdot}000 \pm 0{\cdot}076$
J	$14{\cdot}262 \pm 0{\cdot}030$	$362{\cdot}3 \pm 0{\cdot}76$
K	$5{\cdot}828^{+0{\cdot}000}_{-0{\cdot}003}$	$148{\cdot}031^{+0{\cdot}000}_{-0{\cdot}076}$
L	5·750	146·1
M	0·600	15·24
N	$5{\cdot}075 \pm 0{\cdot}015$	$128{\cdot}9 \pm 0{\cdot}38$
P	$6{\cdot}415 \pm 0{\cdot}015$	$162{\cdot}9 \pm 0{\cdot}38$
Q	4·187	106·3
S	$10{\cdot}005^{+0{\cdot}000}_{-0{\cdot}003}$	$254{\cdot}127^{+0{\cdot}000}_{-0{\cdot}076}$
T	$4{\cdot}000 \pm 0{\cdot}005$	$101{\cdot}6 \pm 0{\cdot}13$
U	$3{\cdot}355 \pm 0{\cdot}005$	$85{\cdot}22 \pm 0{\cdot}13$
V	$3{\cdot}355 \pm 0{\cdot}005$	$85{\cdot}22 \pm 0{\cdot}13$
W	$3{\cdot}355 \pm 0{\cdot}005$	$85{\cdot}22 \pm 0{\cdot}13$
X	$2{\cdot}625 \pm 0{\cdot}015$	$66{\cdot}68 \pm 3{\cdot}81$
Y	7·375	187·3
Z	$3{\cdot}750 \pm 0{\cdot}015$	$95{\cdot}25 \pm 3{\cdot}81$

Millimetre dimensions have been derived from inches.

X-BAND PULSED TRAVELLING WAVE TUBE

N1061

OUTLINE DETAILS



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
AA	0·625	15·88	AK	$0{\cdot}927^{+0{\cdot}020}_{-0{\cdot}000}$	$23{\cdot}55^{+0{\cdot}51}_{-0{\cdot}00}$
AB	0·625	15·88	AL	$0{\cdot}081^{+0{\cdot}010}_{-0{\cdot}000}$	$2{\cdot}06^{+0{\cdot}25}_{-0{\cdot}00}$
AC	0·875	22·23	AM	4·250 Max	108·0 Max
AD	0·875	22·23	AN	0·875	22·23
AE	1·187	30·15	AP	0·625	15·88
AF	1·000	25·40			
AG	0·500	12·70			
AH	0·500	12·70			
AJ	$0{\cdot}141^{+0{\cdot}010}_{-0{\cdot}000}$	$3{\cdot}58^{+0{\cdot}25}_{-0{\cdot}00}$			

Millimetre dimensions have been derived from inches.

Note Collector water seals use O-ring type OS14 (B.S.1806).

INTRODUCTION

The N1062, N1063 and N1064 high power, magnetically focused, c.w. amplifiers provide complete coverage of the frequency range 8·5 to 10GHz. Each valve has a 6% tuning range and delivers an r.f. output power of 3 to 5kW for a saturation gain of 17 to 23db. Optimum operation at any frequency within the range is obtained by adjustment of the body voltage, the anode voltage being adjusted to maintain the beam power constant. For a beam power of 27kW, the instantaneous bandwidth is 1 to 2%. Efficiencies of 20 to 30% are obtained by operating with the collector potential depressed below that of the body.

The tubes are of the 'severed' type, the connections to the slow wave structure at the sever being taken to waveguide loads external to the vacuum envelope. This overcomes the disadvantages of internal loads at high c.w. power levels of operation.

The tubes are of rugged construction and are liquid cooled. Air cooling is required for each of the r.f. waveguide windows and also at the cathode end. R.F. connections to the tubes are via No. 15 waveguide (WR112, RG–51/U).

Focusing is by means of an electro-magnet integral with the tubes, the electro-magnet cooling being incorporated in the body coolant supply.

It is recommended that the tubes be operated vertically with the cathode end down.

Variants of the tubes can be supplied with similar tuning ranges centred on various frequencies in X-band.

GENERAL DATA

Electrical

Cathode	Indirectly Heated	
Heater Voltage (a.c.)	2·5	V
Heater Current (a.c.)	24	A
Beam Power	27	kW Max
Collector Depression	40	%
Anode Voltage	26	kV Max
Body (Beam) Voltage	32	kV Max
Magnet Voltage	400	V
Magnet Current	5·0	A

ENGLISH ELECTRIC

GENERAL DATA—*continued*

Typical Operation

Body Voltage	18 to 32	kV
Body Current	35 to 15	mA
Anode Voltage	25 to 17	kV
Anode Current	2·0 to 0·5	mA
Beam Current	1·5 to 0·84	A
Output Power at Saturation	3·0 to 4·8	kW
Gain at Saturation	17 to 23	db
Instantaneous Bandwidth	2 to 1	%
Frequency Range (output power 2kW):		
N1062	9·08 to 8·42	GHz
N1063	9·58 to 8·82	GHz
N1064	10·13 to 9·35	GHz

Mechanical

Overall Length	34 inches	(86·4 cm)	Approx
Overall Width	11 inches	(28 cm)	Approx
Net Weight	85 pounds	(39 kg)	Approx

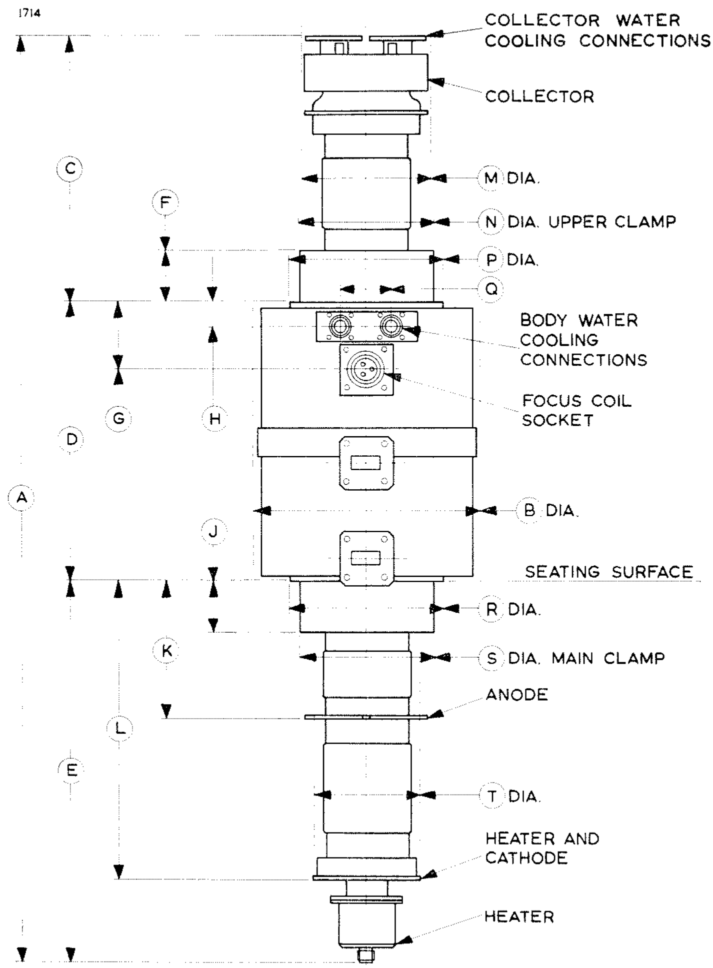
Cooling .. .. Water and Forced-air

Water Flow to Collector (at 40% depression)	10 Imp.gal/min (45 l./min)
Collector Pressure Drop	20lb/in^2 (1·4kg/cm^2)
Water Flow to Body	1 Imp.gal/min (4·5 l./min)
Body Pressure Drop	30lb/in^2 (2·1kg/cm^2)
Air Flow to Output Window	6ft^3/min (0·17m^3/min)
Air Flow to Sever Window, output end	3ft^3/min (0·08m^3/min)
Air Flow to Sever Window, input end	2ft^3/min (0·057m^3/min)
Air Flow to Input Window	1ft^3/min (0·028m^3/min)

CONNECTIONS TO 3-PIN FOCUS COIL SOCKET
Plessey Mk.4 type CZ84806

Ref.	Connection
A	Focus Coil Positive
B	Focus Coil Negative
C	No connection

OUTLINE
(See Page 6 for Outline Dimensions)

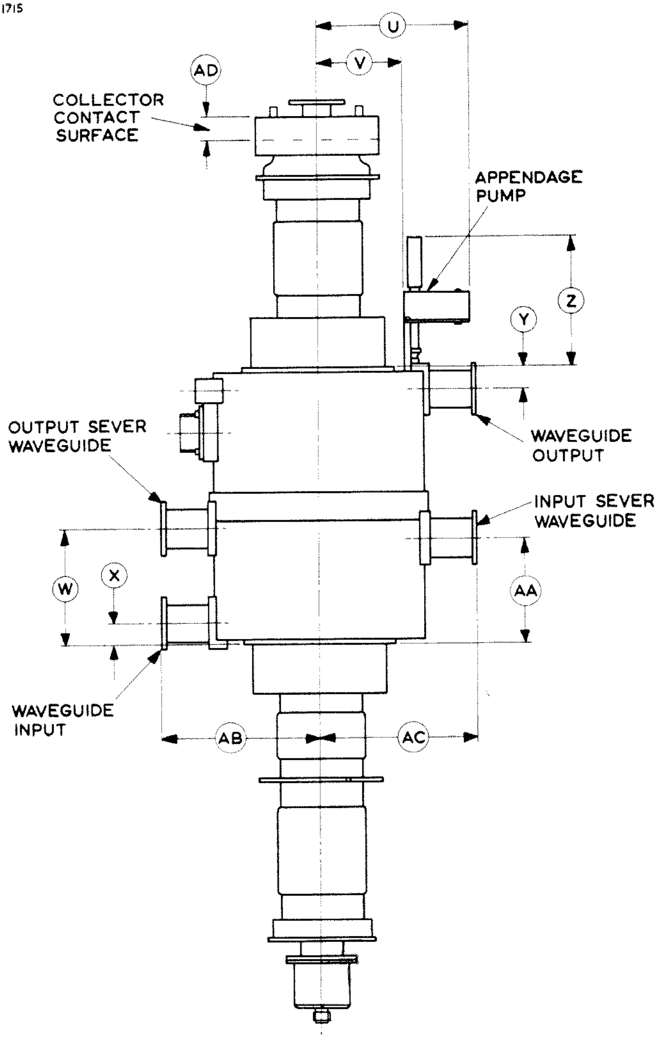


ENGLISH ELECTRIC

OUTLINE

(See Page 6 for Outline Dimensions)

1715

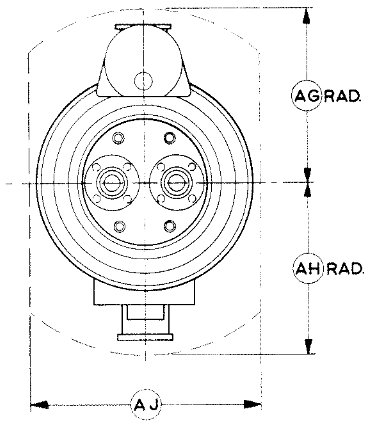


OUTLINE DETAILS

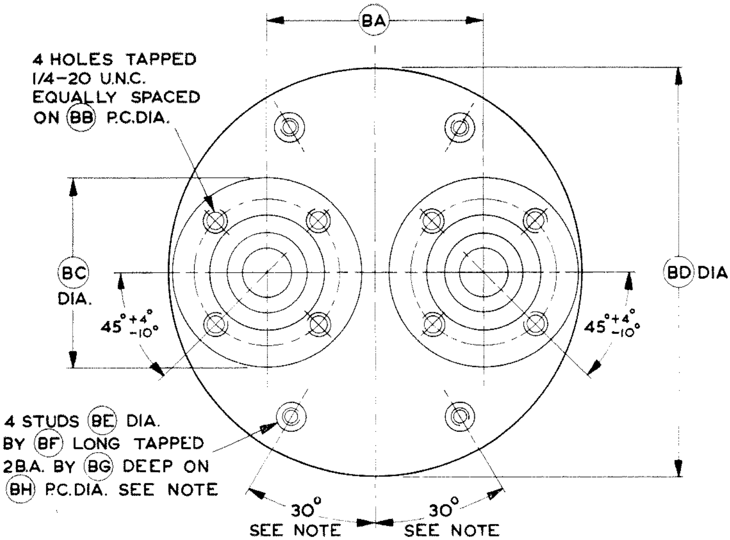
(See Page 6 for Outline Dimensions)

VIEW ON COLLECTOR END

1716



DETAIL OF COLLECTOR WATER CONNECTORS



Note Positional tolerance 0·056 inch (1·422mm) diameter.

OUTLINE DIMENSIONS FOR N1062*

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A*	32·885 Max	835·3 Max	W*	4·126 ± 0·150	104·8 ± 3·81
B	8·000 Max	203·2 Max	X	0·800 ± 0·015	20·32 ± 0·38
C	9·317 ± 0·125	236·7 ± 3·18	Y	0·800 ± 0·015	20·32 ± 0·38
D*	9·780 ± 0·200	248·4 ± 5·08	Z	4·500 Max	114·3 Max
E	13·338 ± 0·125	338·8 ± 3·18	AA*	3·746 ± 0·150	95·15 ± 3·81
F	1·750	44·45	AB	5·500	139·7
G	2·325	59·06	AC	5·500	139·7
H	0·825	20·96	AD	0·500 Min	12·70 Min
J	1·750	44·45	AG	6·000 Max	152·4 Max
K	4·825 ± 0·060	122·6 ± 1·52	AH	6·000 Max	152·4 Max
L	10·449 ± 0·125	265·4 ± 3·18	AJ	8·000 Max	203·2 Max
M	4·500 Max	114·3 Max	BA	2·250	57·15
N	4·812 ± 0·008	122·2 ± 0·20	BB	1·500	38·10
P	5·470 ± 0·030	138·9 ± 0·76	BC	2·000 Max	50·80 Max
Q	2·100	53·34	BD	4·310 ± 0·008	109·47 ± 0·20
R	5·470 ± 0·030	138·9 ± 0·76	BE	0·312	7·92
S	4·812 ± 0·008	122·2 ± 0·20	BF	0·250	6·35
T	3·875 Max	98·43 Max	BG	0·312	7·92
U	5·500	139·7	BH	3·500	88·90
V	2·875 Min	73·03 Min			

*Outline dimensions for N1063 and N1064 are as above, with the following exceptions.

N1063 Ref.	Inches	Millimetres	N1064 Ref.	Inches	Millimetres
A	33·309 Max	846·0 Max	A	32·852 Max	834·4 Max
D	10·204 ± 0·200	259·2 ± 5·08	D	9·747 ± 0·200	247·6 ± 5·08
W	4·506 ± 0·150	114·5 ± 3·81	W	4·322 ± 0·150	109·8 ± 3·81
AA	4·126 ± 0·150	104·8 ± 3·81	AA	3·942 ± 0·150	100·1 ± 3·81

Millimetre dimensions have been derived from inches.

SOLENOID for TRAVELLING WAVE TUBES

N4001

ENGLISH ELECTRIC

INTRODUCTION

The N4001 is a lightweight aluminium foil solenoid designed to produce a magnetic field of up to 550 gauss, for use with travelling wave tube types:

N1005M, N1016M, N1018M, N1024M, N1025M

GENERAL DATA

Field Strength	60 Gauss per ampere Approx
Resistance:	
at 25°C core temperature	1·35 Ω Approx
at 75°C core temperature	1·55 Ω Approx
Temperature Coefficient of Resistance	0·0034 Ω/°C
Temperature Rise (above ambient):	
at 5 Amperes	30 °C Approx
6 Amperes	42 °C Approx
7 Amperes	54 °C Approx
8 Amperes	66 °C Approx
9 Amperes	82 °C Approx
Maximum Temperature at centre of core (*See Note* 1)	125 °C
Overall Dimensions	15·314 × 5·625 × 4·875 inches Max 390 × 142·9 × 123·9 mm Max
Net Weight	17 pounds (7·7kg) Approx
Cooling	Natural air circulation or forced air at maximum ratings at high ambient temperatures (*See Note 2*)

TYPICAL OPERATING CONDITIONS

	N1005M N1024M	N1018M N1025M	N1016M	
Field	350	400	520	Gauss
Current D.C.	5·8	6·7	8·7	A
Voltage D.C. (approx)	8·7	10	13·3	V
Core Temperature	60	71	96	°C
Ambient Temperature	20	20	20	°C

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

SOLENOID CONNECTIONS

1. Unscrew the clamping ring and remove the International Octal valve holder assembly.
2. Solder leads to the appropriate pin tabs according to the valve base connections (see the tube data sheets) and re-assemble the valve holder and large aluminium ring.
3. Thread leads through the clamping ring and screw the clamping ring home, adjusting the valve base assembly to be approximately central.
4. Connect the valve leads to a suitable power supply.
5. Connect the d.c. supply to the lugs as marked but note that one of the connecting lugs is common to the mounting feet of the solenoid. See that the d.c. leads to the solenoid are capable of carrying the current required without appreciable voltage drop.

INSTALLING A TRAVELLING WAVE TUBE

1. Unscrew the three alignment screws sufficiently to allow the T.W.T. to be inserted, base end first, into the solenoid. Rotate the tube until the key of the base fits into the socket and push home. Apply pressure to the collector cap rather than the r.f. connectors. Adjust the alignment screws so that the T.W.T. is approximately central. Connect the collector lead.
2. Switch on the T.W.T. heater, and adjust the solenoid current to a value about 10% greater than the values shown on page 1.
3. After 3 minutes switch on the h.t. with Grid No. 2 voltage control set at minimum, and the other voltages at their specified values.
4. Slowly increase Grid No. 2 voltage and note whether the helix current is excessive. If so, adjust the alignment screws to reduce the helix current and increase Grid No. 2 voltage to give the rated collector current.
5. If it is found that the alignment screws cannot give sufficient movement of the T.W.T. for optimum focus, that is for low helix current, slacken the clamping ring and readjust the centring of the base. Screw the clamping ring tight, and repeat steps 4 and 5 until satisfactory focusing conditions are reached. (Having performed these adjustments, it is not usually necessary to repeat the adjustment of the valve base when the T.W.T. is replaced.)
6. After a time the solenoid will warm up, and it will be necessary to readjust the current through it. Adjust this current to the specified value or the minimum value at which the T.W.T. operates satisfactorily.

NOTES

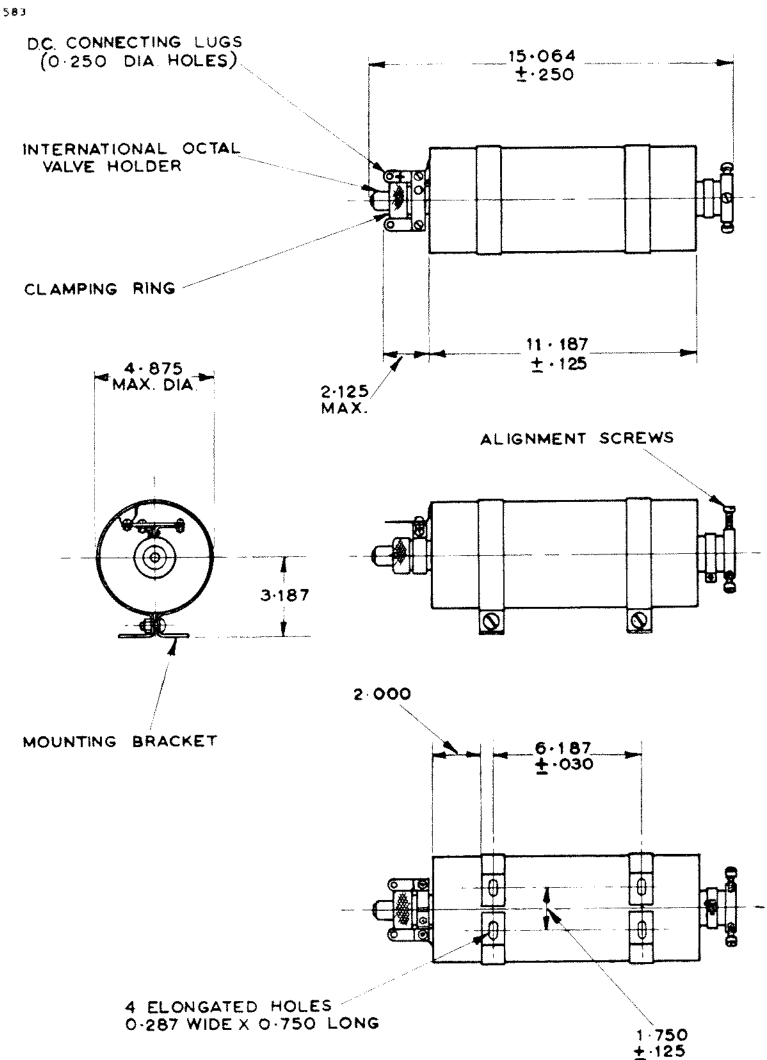
1. Reference should be made to the valve data sheets for the maximum valve operating temperature which may be lower than the solenoid operating temperature, in which case forced-air cooling may be necessary.
2. The N4001 has been designed for minimum weight. Consequently, when it is to be operated at a high ambient temperature, forced-air cooling is necessary. An air flow of 5 cubic feet per minute from a small blower is recommended. The blower nozzle should not be closer than 2 inches to the solenoid (unless care is taken to prevent distortion of the magnetic field and vibration due to the blower) and it should be shaped to direct a blast of air perpendicular to the axis and extending over an appreciable length of the solenoid.

SOLENOID for TRAVELLING WAVE TUBES

N4001

ENGLISH ELECTRIC

OUTLINE



ALL DIMENSIONS IN INCHES

SOLENOID FOR TRAVELLING WAVE TUBES

N4003

INTRODUCTION

The N4003 is a lightweight solenoid for use with the 1·2Gc/s low noise travelling wave tube type N1017M.

GENERAL DATA

Field Strength:		
Gun Field	185 Gauss per ampere	Approx
Main Field	13 Gauss per ampere	Approx
Resistance at 20°C core temperature:		
Gun Field	5·5 Ω	Approx
Main Field	0·25 Ω	Approx
Resistance at 55°C core temperature:		
Gun Field	6·5 Ω	Approx
Main Field	0·27 Ω	Approx
Maximum temperature inside of centre tube for operation of type N1017M	75	°C
Maximum Mean Winding Temperature	150	°C
Maximum Ambient Temperature	40	°C
Overall Dimensions	19·375 × 7·00 × 6·00 inches	Max
	492·2 × 177·8 × 152·4 mm	Max
Net Weight	17·5 pounds (8 kg)	Approx
Cooling	Natural air circulation	

TYPICAL OPERATING CONDITIONS

For Gun Field 450 Gauss: Main Field 100 Gauss

Current D.C.:		
Gun Field	2·4	A
Main Field	7·2	A
Voltage D.C. (Approx):		
Gun Field	17	V
Main Field	2·0	V
Running temperature inside of centre tube (for 20°C ambient temperature)	55	°C Approx

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
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Printed in England

SOLENOID CONNECTIONS

1. Unscrew the clamping ring and remove the International Octal valve holder assembly.
2. Solder leads to the appropriate pin tabs according to the valve base connections (see the tube data sheet) and re-assemble the valve holder and large aluminium ring.
3. Thread the leads through the clamping ring and screw the clamping ring home, adjusting the valve base assembly to be approximately central.
4. Connect the valve leads to a suitable power supply.
5. In order to combine low weight with good focusing and low noise factor for travelling wave tube type N1017M, this solenoid has been made in two parts, the gun field and the main or helix field. Since the solenoid is made from aluminium foil wound directly on an aluminium tube former, this means that the coils have a common connection at the centres so care must be taken in making the connections so that the magnetic fields are not in opposition.

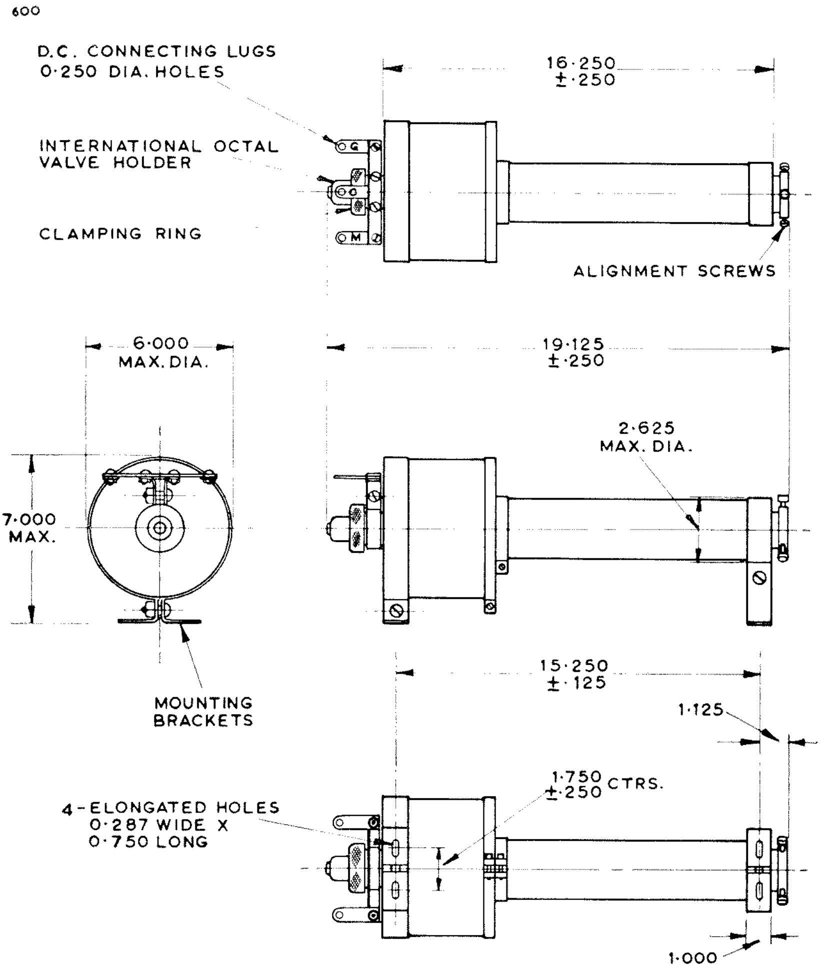
INSTALLING A TRAVELLING WAVE TUBE

1. Unscrew the three alignment screws sufficiently to allow the T.W.T. to be inserted, base end first, into the solenoid. Rotate the tube until the key of the base fits into the socket and push home. Apply pressure to the collector cap rather than the r.f. connectors. Adjust the alignment screws so that the T.W.T. is approximately central. Connect the collector lead.
2. Switch on the T.W.T. heater, and adjust the solenoid current to a value about 10% greater than that shown on page 1.
3. After 3 minutes switch on the h.t. with Grid No. 2 voltage control set at minimum, and the other voltages at their specified values.
4. Slowly increase Grid No. 2 voltage and note whether the helix current is excessive. If so, adjust the alignment screws to reduce the helix current and increase Grid No. 2 voltage to give the rated collector current.
5. If it is found that the alignment screws cannot give sufficient movement of the T.W.T. for optimum focus, i.e., low helix current, slacken the clamping ring and readjust the centring of the base. Screw the clamping ring tight, and repeat steps 4 and 5 until satisfactory focusing conditions are reached. (Having performed these adjustments, it is not usually necessary to repeat the adjustment of the valve base when the T.W.T. is replaced).
6. After a time the solenoid will warm up, and it will be necessary to readjust the current through it. Adjust this current to the minimum value at which the T.W.T. operates satisfactorily.

SOLENOID FOR TRAVELLING WAVE TUBES

N4003

OUTLINE



REF	CONNECTION
G	GUN FIELD
C	COMMON
M	MAIN FIELD

ALL DIMENSIONS IN INCHES

SOLENOID for TRAVELLING WAVE TUBES

N4004

ENGLISH ELECTRIC

INTRODUCTION

The N4004 is a lightweight solenoid for use with the 3·1Gc/s low noise travelling wave tube type 6861.

GENERAL DATA

Field Strength	60 Gauss per ampere	Approx
Resistance:		
at 20°C core temperature	1·4 Ω	Approx
at 120°C core temperature	1·9 Ω	Approx
Maximum Mean Winding Temperature	150	°C
Maximum Ambient Temperature with typical mounting	40	°C
Overall Dimensions	17·00 × 6·03 × 6·00 inches	Max
	431·8 × 153·2 × 152·4 mm	Max
Weight	26 pounds (12 kg)	Approx
Cooling	Natural air circulation and conduction through mounting blocks (*See Note* 1)	

TYPICAL OPERATING CONDITIONS
For Field 525 Gauss

Current D.C.	9·0	A
Voltage D.C. (Approx)	17·5	V
Running Temperature, inside of centre tube (for 20°C ambient temperature)	120	°C

SOLENOID CONNECTIONS

1. Unscrew the clamping ring and remove the International Octal valve holder assembly.
2. Solder leads to the appropriate pin tabs according to the valve base connections (see the tube data sheet) and re-assemble the valve holder and large aluminium ring.
3. Thread the leads through the clamping ring and screw the clamping ring home. Adjust the valve base assembly to be approximately central.
4. Connect the valve leads to a suitable power supply.

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INSTALLING A TRAVELLING WAVE TUBE

1. Unscrew the three alignment screws sufficiently to allow the T.W.T. to be inserted, base end first, into the solenoid. Rotate the tube until the key of the base fits into the socket and push home. Apply pressure to the collector cap rather than to the r.f. connectors. Adjust the alignment screws so that the T.W.T. is approximately central. Connect the collector lead.

2. Switch on the T.W.T. heater, and adjust the solenoid current to a value about 10% greater than that shown on page 1.

3. After 2 minutes switch on the h.t. with Grid No. 2 voltage control set at minimum, and the other voltages at their specified values.

4. Slowly increase Grid No. 2 voltage and note whether the helix current is excessive. If so, adjust the alignment screws to reduce the helix current and increase Grid No. 2 voltage to give the rated collector current.

5. If it is found that the alignment screws cannot give sufficient movement of the T.W.T. for optimum focus, i.e., low helix current, slacken the clamping ring and readjust the centring of the base. Screw the clamping ring tight, and repeat steps 4 and 5 until satisfactory focusing conditions are reached. (Having performed these adjustments, it is not usually necessary to repeat the adjustment of the valve base when the T.W.T. is replaced).

6. After a time the solenoid will warm up, and it will be necessary to readjust the current through it. Adjust this current to the value required to give the specified field.

NOTES

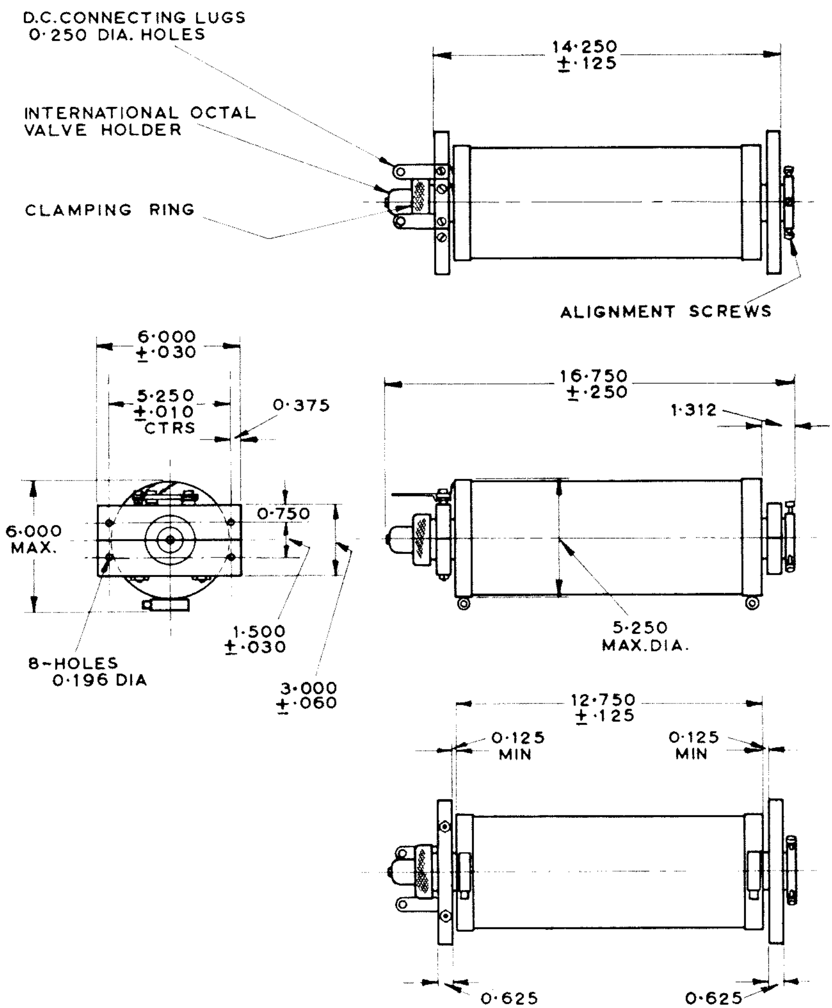
1. A considerable reduction in running temperature may be achieved by mounting the solenoid, by means of the mounting blocks, directly on to a chassis or panel which then acts as a heat sink. Care should be taken that the material of the chassis or panel does not disturb the magnetic field.

SOLENOID for TRAVELLING WAVE TUBES

N4004

OUTLINE

601



ALL DIMENSIONS IN INCHES

SOLENOID for TRAVELLING WAVE TUBES

N4006

INTRODUCTION

The N4006 is a lightweight solenoid for use with the power travelling wave tube type N1033. It incorporates waveguide couplers with short circuit plungers for operation over the normal frequency range of the tube.

GENERAL DATA

Field Strength (*See Note* 1)	73 Gauss per Ampere	Approx
Resistance at 20°C core temperature:		
Gun Coil	5·4 Ω	Approx
Main Coil + Collector Coil (*See Note* 2)	1·45 Ω	Approx
Resistance at 120°C core temperature:		
Gun Coil	7·2 Ω	Approx
Main Coil + Collector Coil (*See Note* 2)	1·93 Ω	Approx
Maximum Temperature inside centre tube	140	°C
Maximum Ambient Temperature (*See Note* 3)	40	°C
Overall Dimensions	20·0 × 7·375 × 5·625 inches	Max
	508 × 187·4 × 142·9 mm	Max
Net Weight	30 pounds (13·6 kg)	Approx
R.F. Connections	Narrow No. 12 Waveguide (*See Page* 4)	
Cooling (*See Note* 3)	Natural air circulation	

TYPICAL OPERATING CONDITIONS

For Field 550 Gauss

Current D.C.:		
Gun Coil	2·4	A
Main Coil + Collector Coil	7·6	A
Voltage D.C.:		
Gun Coil	17·3	V
Main Coil + Collector Coil	14·7	V
Running Temperature inside centre tube (for 20°C ambient temperature) (*See Note* 4)	120	°C Approx

TRAVELLING WAVE TUBE CONNECTIONS AND INSTALLATION

1. Solder leads to the appropriate pins of the valve holder assembly according to the tube base connections (see tube data sheet).
2. Assemble the tube and valve holder and insert the tube, collector end first, into the solenoid, ensuring that the collector is pushed home.
3. Switch on the travelling wave tube heater.

4. Switch on the solenoid supply; adjust the gun coil current to the rated value and increase the main field to a value about 10% above that shown under typical operating conditions.
5. After three minutes, switch on the h.t. supply with Grid 1 fully negative, Grid 2 at zero potential and the other electrode voltages set at the typical values specified on the tube data sheet.
6. Slowly increase Grid 2 voltage to the specified value and adjust Grid 1 voltage to give the rated collector current.
7. As the helix current rises, rotate the tube and also adjust the gun field to minimise the interception current.
8. Screw the clamping ring home.
9. After a time the solenoid will warm up and it will be necessary to readjust the current through it. Adjust this current to give the field specified in the tube data.

NOTES

1. The actual field strength of the solenoid is marked on the label.
2. The solenoid is supplied with the main coil and collector coil connected in parallel and a separate gun coil connection.
3. The solenoid may be operated with ambient temperatures higher than 40°C if a flow of cooling air is directed over the fins of the collector heat sink.
4. The running temperature of 120°C is obtained with the solenoid mounted by means of the mounting blocks directly on to a chassis or panel which then acts as a heat sink. Care should be taken to ensure that the material of the chassis or panel does not disturb the magnetic field.

OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	18·625 Max	473·08 Max
B	7·375 Max	187·33 Max
C	5·625 Max	142·88 Max
D	7·703	195·66
E	4·880 Max	123·95 Max
F	4·750	120·65
G	5·750	146·05
H	5·500	139·70
J	3·000	76·20
K	0·281	7·14
L	1·300	33·02

Millimetre dimensions have been derived from inches.

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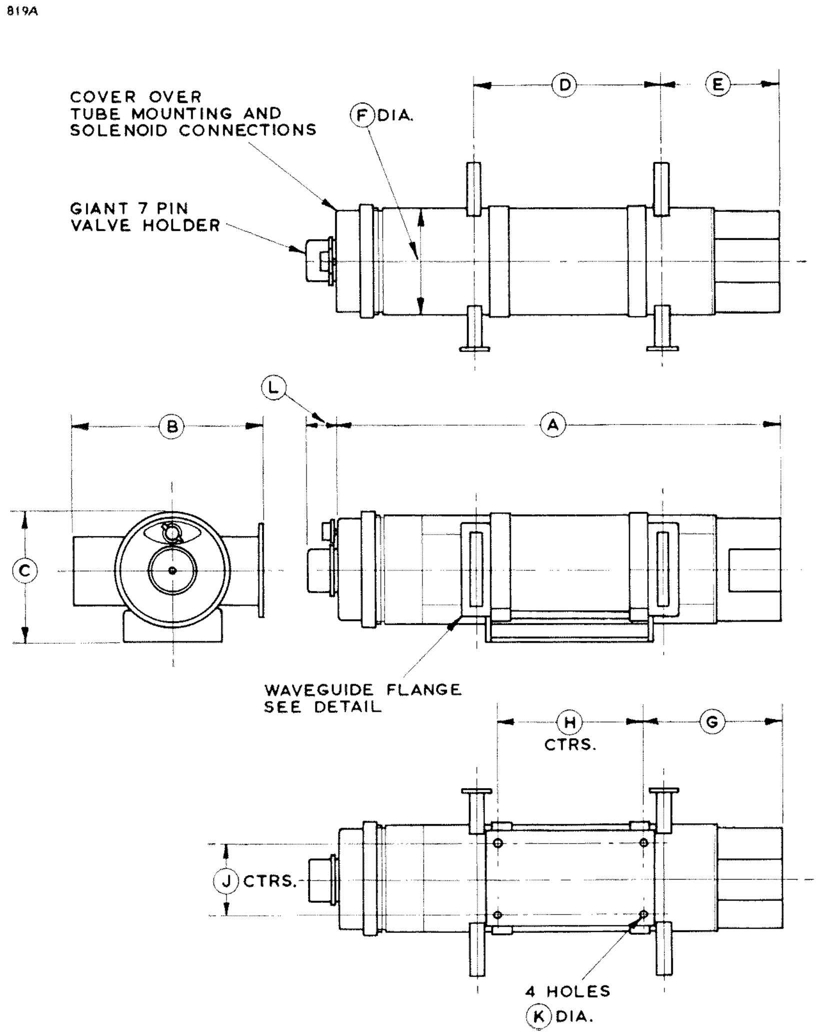
OUTLINE


819A
COVER OVER
TUBE MOUNTING AND
SOLENOID CONNECTIONS
F DIA.
D
E
GIANT 7 PIN
VALVE HOLDER
L
B
A
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WAVEGUIDE FLANGE
SEE DETAIL
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CTRS.
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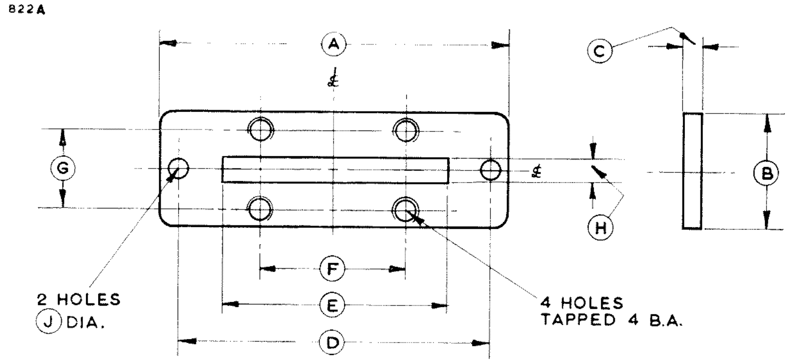
J CTRS.
4 HOLES
K DIA.

ENGLISH ELECTRIC

DETAILS OF WAVEGUIDE FLANGE



WAVEGUIDE FLANGE DIMENSIONS

Ref.	Inches	Millimetres
A	3·625	92·08
B	1·187	30·15
C	0·187	4·75
D	3·250	82·55
E	1·872	47·55
F	1·500	38·10
G	0·812	20·62
H	0·250	6·35
J	0·1875	4·76

Millimetre dimensions have been derived from inches.

SOLENOID for TRAVELLING WAVE TUBES

N4021

ENGLISH ELECTRIC

INTRODUCTION

The N4021 is a lightweight solenoid for use with the low noise travelling wave tube type N1031. It incorporates waveguide couplers with short circuit plungers for operation over the normal frequency range of the tube.

GENERAL DATA

Field Strength (*See Note* 1)	61 Gauss per Ampere	Approx
Resistance (*See Note* 2):		
at 20°C core temperature	1·32 Ω	Approx
at 120°C core temperature	1·76 Ω	Approx
Maximum Temperature inside centre tube	140	°C
Maximum Ambient Temperature (*See Note* 3)	40	°C
Overall Dimensions	15·000 × 7·375 × 5·625 inches	Max
	381 × 187·4 × 142·9 mm	Max
Net Weight	23¼ pounds (10·5 kg)	Approx
R.F. Connections	Narrow No. 11 Waveguide (*See Page* 4)	
Cooling (*See Note* 3)	Natural air circulation	

TYPICAL OPERATING CONDITIONS
For Field 550 Gauss

Current D.C.	9·0	A
Voltage D.C.	15·8	V Approx
Running Temperature inside centre tube (for 20°C ambient temperature) (*See Note* 4)	120	°C Approx

TRAVELLING WAVE TUBE CONNECTIONS AND INSTALLATION

1. Solder leads to the appropriate pins of the valve holder assembly according to the tube base connections (See tube data sheet).
2. Assemble the tube and valve holder and insert the tube, collector end first, into the solenoid, ensuring that the collector is pushed home.
3. Switch on the travelling wave tube heater and adjust the solenoid current to a value about 10% higher than that shown under typical operating conditions.

4. After three minutes switch on the h.t. supply. With Grid 2 voltage at zero, increase the voltages on all other electrodes to their normal values. Slowly increase Grid 2 voltage and as the collector and helix currents increase, rotate the tube to the position giving minimum helix current.
5. Adjust Grid 2 voltage to give the rated collector current.
6. Screw the clamping ring home.
7. Adjust the helix voltage to give the required gain.
8. Optimise Grid 4 voltage to give minimum noise.
9. After a time the solenoid will warm up and it will be necessary to readjust the current through it. Adjust this current to give the field specified in the tube data.

NOTES

1. The actual field strength of the solenoid is marked on the label.
2. The solenoid is supplied with all coils connected in parallel.
3. The solenoid may be operated with ambient temperatures higher than 40°C if a flow of cooling air is directed over the body.
4. The running temperature of 120°C is obtained with the solenoid mounted by means of the mounting blocks directly on a chassis or panel which then acts as a heat sink. Care should be taken to ensure that the material of the chassis or panel does not disturb the magnetic field.

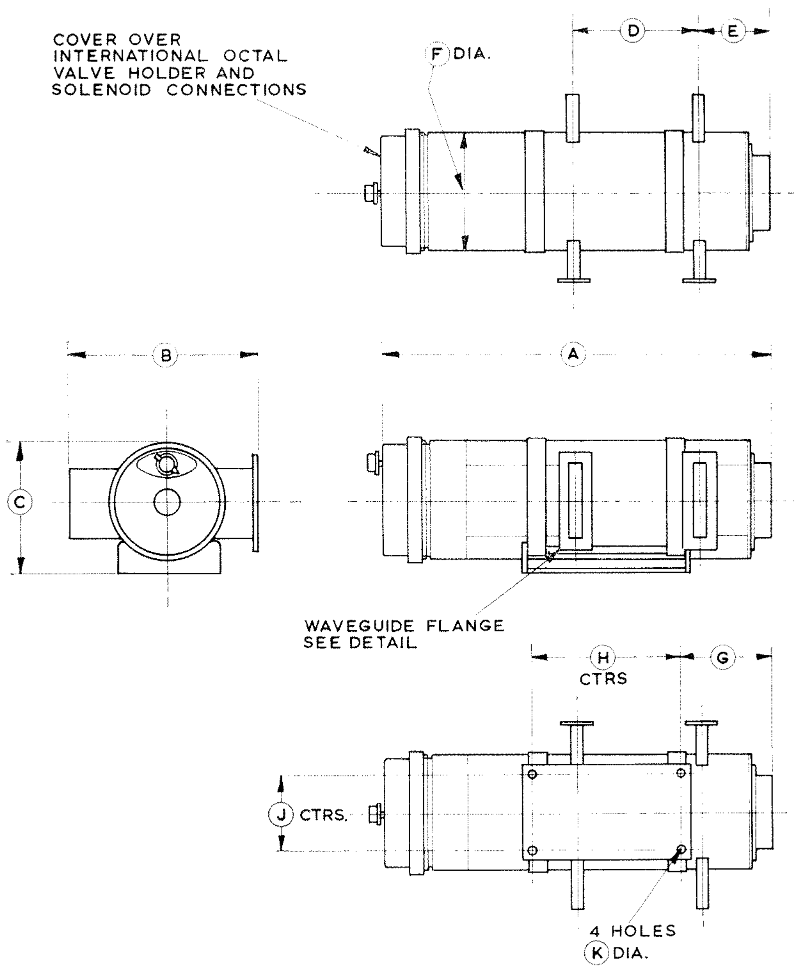
OUTLINE DIMENSIONS

Ref.	Inches	Millimetres
A	15·000 Max	381 Max
B	7·375 Max	187·33 Max
C	5·625 Max	142·88 Max
D	5·186	131·72
E	3·000	76·20
F	4·750	120·65
G	4·000	101·60
H	5·500	139·70
J	3·000	76·20
K	0·281	7·14

Millimetre dimensions have been derived from inches.

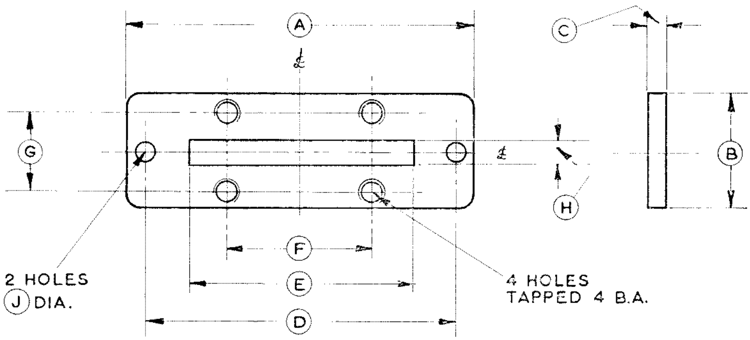
OUTLINE

821A



DETAILS OF WAVEGUIDE FLANGE

822A



WAVEGUIDE FLANGE DIMENSIONS

Ref.	Inches	Millimetres
A	3·625	92·08
B	1·187	30·15
C	0·187	4·75
D	3·250	82·55
E	2·372	60·25
F	1·500	38·10
G	0·812	20·62
H	0·250	6·35
J	0·1875	4·76

Millimetre dimensions have been derived from inches.

FOCUSING MOUNT

N4041

ENGLISH ELECTRIC

INTRODUCTION

The N4041 is a wire wound magnetic focusing mount designed for use with the low noise travelling wave tube type N1047M. The solenoid in the mount operates at 10·5A d.c. at approximately 95V and provides a uniform field of 1400 gauss. Forced-air cooling of the solenoid winding and the travelling wave tube is provided by an integral fan unit.

The tube is inserted into the mount at the end remote from the fan unit and plugs into an international octal socket within the mount. Power supplies are connected to the tube, the solenoid and the fan unit via four multi-pin plugs situated on the terminal box on the top of the mount. An interlock circuit prevents supplies being connected to the solenoid or the tube until all four plugs are inserted. R.F. connections are made direct to the coaxial plugs of the travelling wave tube.

The mount is provided with an internal protection switch which may be incorporated in a simple relay circuit. If for any reason the solenoid temperature should exceed the safe limit, the switch opens and the relay circuit should be arranged so that it isolates both tube and solenoid from the supplies until the relay is set.

GENERAL DATA

Field Strength	130 Gauss per ampere	Approx
Solenoid Resistance at 20°C core temperature	7·5 Ω	Approx
Solenoid Resistance at operating temperature	9·0 Ω	Approx
Overall Dimensions	16·75 × 8·25 × 11·625 inches	Max ←
	426 × 210 × 295mm	Max
Overall Length of Tube and Mount Assembly	19·75 inches (502mm)	Max
Net Weight	76 pounds (35 kg)	Approx
Cooling	By integral fan unit	
Mounting Position	Any	
Fan Unit Supply	200/250V single phase a.c., 50 or 60c/s, 100W ←	

← Indicates a change

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MAXIMUM RATINGS

Input Power to solenoid when in thermal equilibrium ..	1200	W Max
Surge Current when switched on cold	15	A Max
Continuous Operating Current when in thermal equilibrium	11	A Max
Voltage between solenoid winding and earthed cover ..	150	V Max
Voltage between thermal cut-out and earth	250	V Max
Thermal Cut-Out Contacts:		
A.C. Voltage	250	V Max
A.C. Current	3·0	A Max
D.C. Voltage	50	V Max
D.C. Current	0·5	A Max
Ambient and Air Inlet Temperature	40	°C Max

TYPICAL OPERATING CONDITIONS

Solenoid Current, D.C.	10·5	A
Solenoid Voltage, D.C. (10·5A solenoid current, in thermal equilibrium, and ambient temperature 20°C)	95	V
Field Strength	1400	Gauss
Running Temperature, inside of centre tube (for 20°C ambient temperature)	50	°C

FOCUSING MOUNT AND TUBE CONNECTIONS

Supplies are connected to the tube, solenoid and fan by means of Plessey plugs and sockets (the plugs only are supplied with the solenoid). Each of the four plugs on the top of the mount casing is different so that the sockets are not interchangeable. The connections are shown on page 6.

TRAVELLING WAVE TUBE INSTALLATION

1. Unscrew the four alignment screws sufficiently to allow the travelling wave tube to be inserted. Insert the tube and rotate it until the key of the base fits into the socket, then push home, applying pressure to the collector cap rather than to the r.f. connectors. Screw down the alignment screws just sufficiently to touch the tube and unlock the spring loaded alignment plungers. Adjust the alignment screws so that the tube is approximately central. Connect the collector lead.

2. Switch on the tube heater and the solenoid fan. Adjust the solenoid voltage to the value shown on the solenoid casing. The solenoid current will be higher than 10·5A until the solenoid reaches the correct operating temperature.

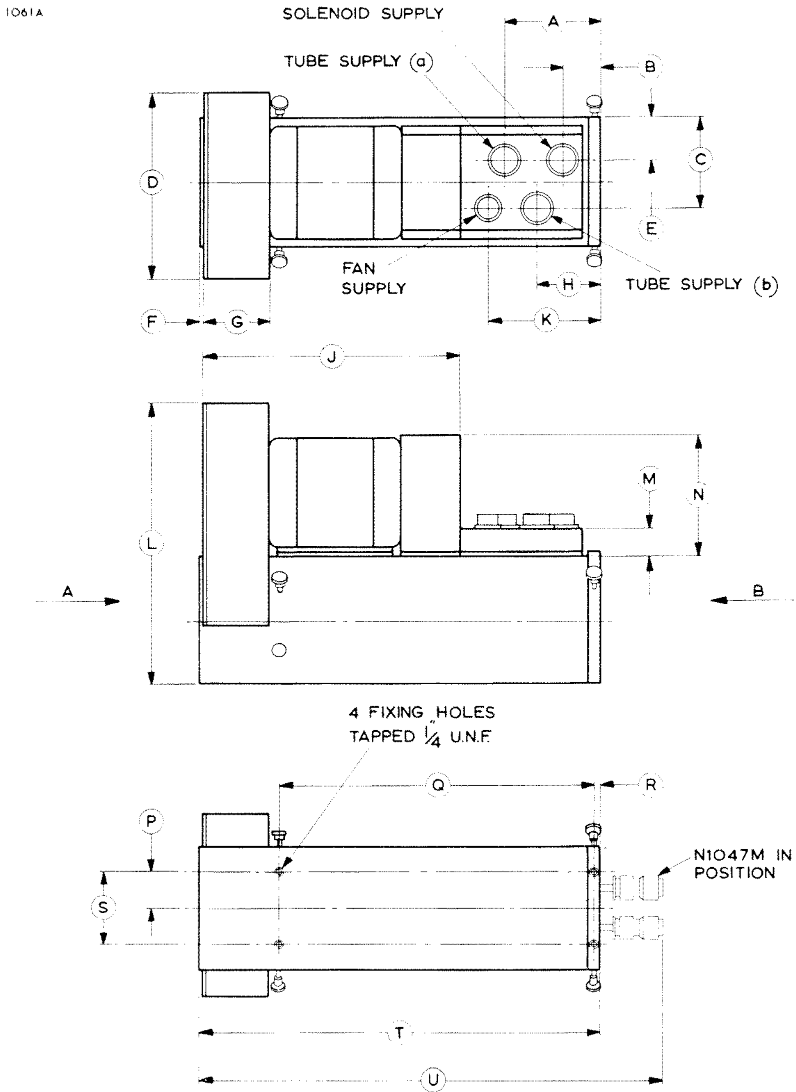
3. After at least two minutes switch on the h.t. voltage with grid 1 and 2 voltage set at zero, and the other voltages at the values specified on the valve data sheet.

4. Slowly increase the grid 1 and 2 voltage, adjusting the alignment screws to reduce the helix current (if any) to a minimum. Continue increasing the grid 1 and 2 voltage until the specified collector current is reached. The grid 1 and 2 voltage should now be checked by means of a high resistance voltmeter. The helix current should be below 0·5μA.

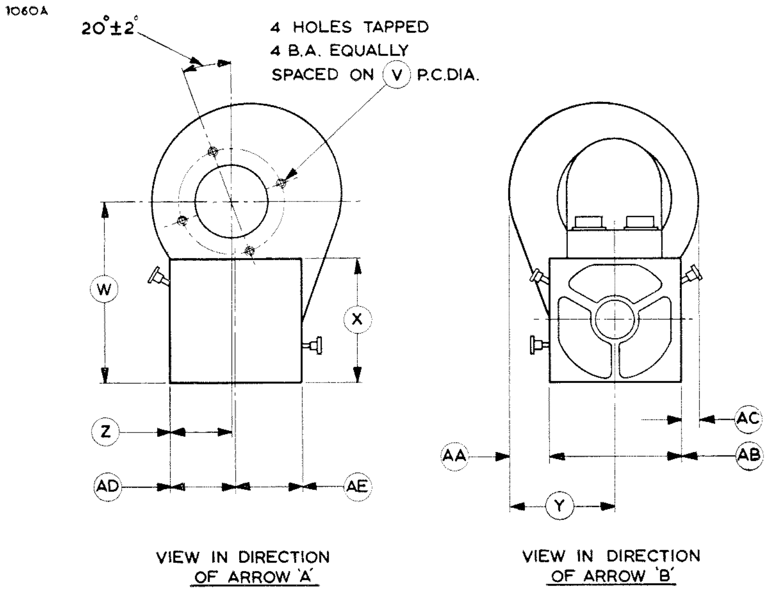
5. Adjust the helix, grid 3 and grid 4 voltages for minimum noise factor and optimum gain as specified in the N1047M data sheet.

6. A further fine adjustment of the alignment screws may later be necessary to reduce the noise output of the travelling wave tube to a minimum.

OUTLINE
(See Page 6 for Connections)



OUTLINE DETAILS



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	3·937	100·0	R	0·250 ± 0·015	6·35 ± 0·38
B	1·562	39·68	S	3·000 ± 0·015	76·20 ± 0·38
C	3·625	92·08	T	16·750 Max	425·5 Max
D	8·250 Max	209·6 Max	U	19·750 Max	501·7 Max
E	1·625	41·28	V	4·375	111·1
F	0·125	3·18	W	7·700 ± 0·062	195·6 ± 1·57
G	2·875	73·03	X	5·297	134·5
H	2·750	69·85	Y	4·312	109·5
J	10·875	276·2	Z	2·625 ± 0·062	66·68 ± 1·57
K	4·750	120·7	AA	1·625	41·28
L	11·625 Max	295·3 Max	AB	5·375	136·5
M	1·125	28·58	AC	0·813	20·65
N	5·000	127·0	AD	2·687	68·25
P	1·500 ± 0·015	38·10 ± 0·38	AE	2·687	68·25
Q	13·062 ± 0·031	331·77 ± 0·79			

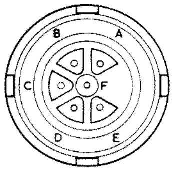
Millimetre dimensions have been derived from inches.

OUTLINE DETAILS

Plug Connections

1062

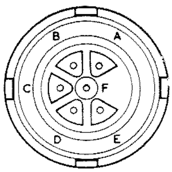
Tube Supply (a)



PLESSEY PLUG CZ 63958

Pin	Element
A	Helix
B	Grid 4
C	Grid 3
D	Interlock
E	Heater
F	Heater, Cathode

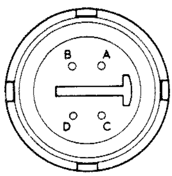
Tube Supply (b)



PLESSEY PLUG CZ 63958/1

Pin	Element
A	No Connection
B	Cathode
C	Grids 1 and 2
D	Interlock
E	Earth
F	No Connection

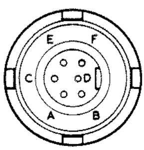
Solenoid Supply



PLESSEY PLUG CZ 63956

Pin	Element
A	Solenoid +
B	Solenoid—
C	Interlock
D	Interlock

Fan Supply



PLESSEY PLUG CZ 63955

Pin	Element
A	Fan +
B	Fan —
C	Fan (Earth)
D	Thermal Switch
E	Thermal Switch
F	No Connection

FOCUSING MOUNT

N4047

INTRODUCTION

The N4047 is a periodic permanent magnet focusing mount designed for use with the power travelling wave amplifier type N1029. It incorporates waveguide input and output connectors fitted with pre-set short circuits for broadband matching over selected bands in the frequency range 5·8 to 7·2Gc/s.

The travelling wave tube is the only source of heat in the combination of mount and tube. The heat is transferred from the tube collector to a heat sink on the mount and this is cooled adequately by natural convection of air provided the mount axis is arranged horizontally and the ambient temperature is less than 55°C.

A socket type BA7S for making connections to the travelling wave tube is incorporated in the mount; the connections are fully screened and protected by a connector cover containing a mains interlock.

Although not shown on the outline drawing, alternative positions are possible for the alignment screws and the connecting socket. These can be arranged to suit individual requirements.

GENERAL DATA

Overall Dimensions	15·760 × 4·750 × 3·750 inches	Max
	400·3 × 120·7 × 95·25 mm	Max
Waveguide Flanges (*See Note* 1 *and Outline*)	Modified RETMA CMR137	
Frequency Range (*See Note* 2)	5·8 to 7·2	Gc/s
Input and Output V.S.W.R. (*See Note* 3)	1·5 : 1	Max
R.F. Leakage		*See Note* 4
Net Weight	15 pounds (6·8 kg)	Approx
Storage Temperature:		
Minimum	−50	°C
Maximum	+85	°C
Radiator Fin Temperature	150	°C Max
Cooling:		
Horizontal mounting (55°C Max ambient temperature)	Natural air circulation	
Vertical mounting	Forced air draught	

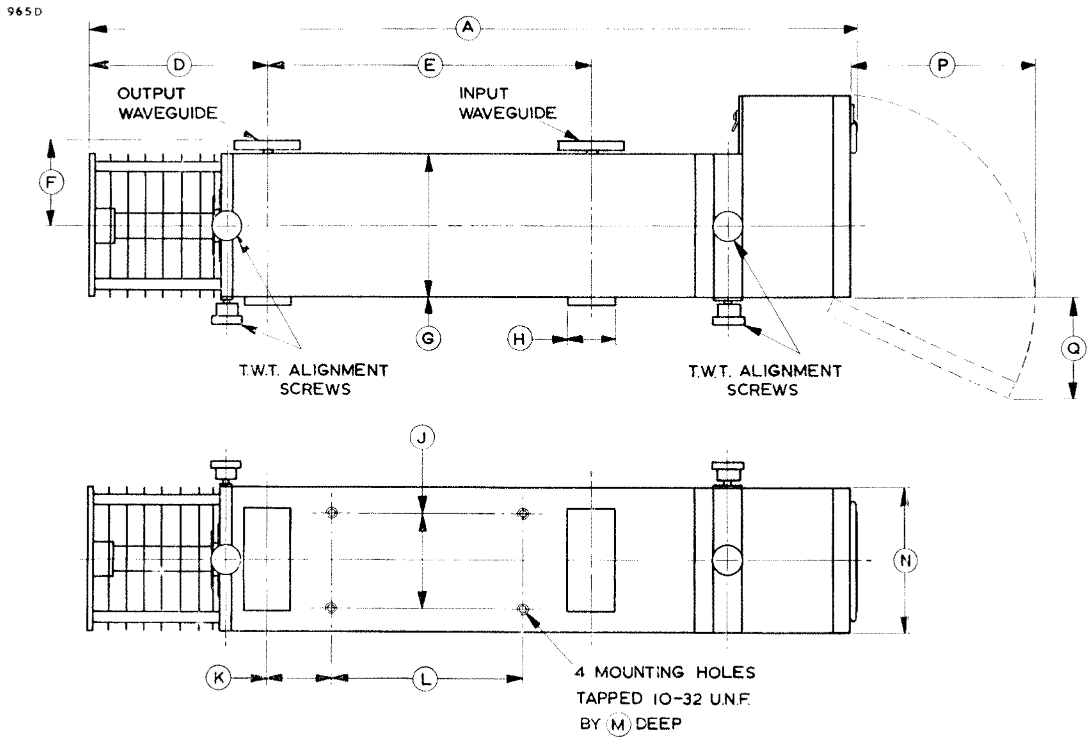
NOTES

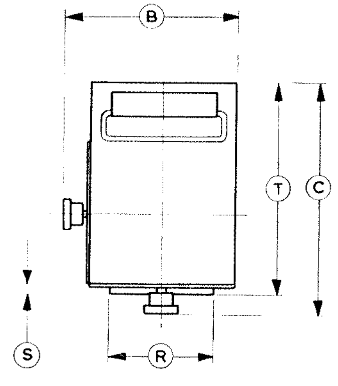
1. Transition sections tapering to standard size waveguide WR137 can be supplied, with either circular flanges UG-344/U or RETMA miniature flanges CMR137 (pressurised version CPR137).
2. Suffix letters have been allocated as follows to indicate the frequency band for which the mount has been matched.

N4047A	5·85 to 6·45 Gc/s
N4047B	6·45 to 7·05 Gc/s
N4047L	5·925 to 6·425Gc/s
N4047M	6·575 to 7·125Gc/s

3. The V.S.W.R. will be 1·5 : 1 maximum within the selected frequency band of the mount. With additional matching adjustments external to the mount it is possible to obtain a match better than 1·25 : 1 over a 40Mc/s band.
4. The r.f. leakage will be 65db minimum below the output power of the tube within the frequency range 5·8 to 7·2Gc/s. It should be noted however that this value may be exceeded unless soft copper gaskets are used.

OUTLINE





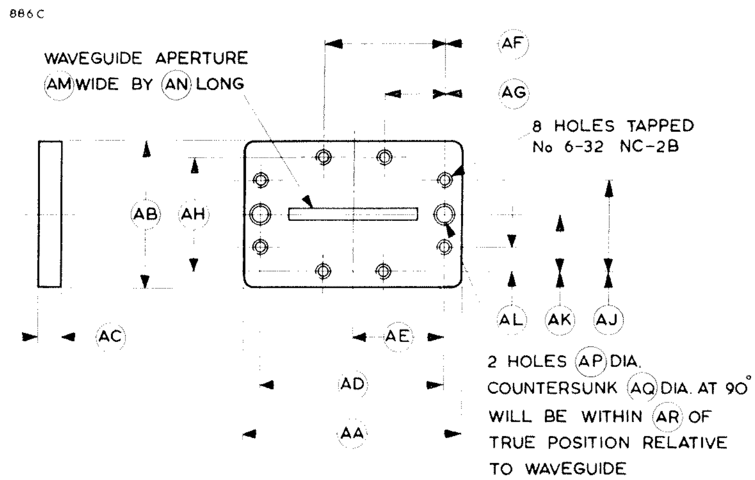
Ref.	Inches	Millimetres
A	15·760 Max	400·3 Max
B	3·687 Max	93·65 Max
C	5·000 Max	127·0 Max
D	3·750 Max	95·25 Max
E	6·785 ± 0·015	172·3 ± 0·38
F	1·750 ± 0·015	44·45 ± 0·38
G	2·968 ± 0·032	75·39 ± 0·81
H	1·250 Max	31·75 Max
J	2·000	50·80
K	1·375 ± 0·032	34·93 ± 0·81
L	4·000	101·6
M	0·375	9·53
N	2·968 ± 0·032	75·39 ± 0·81
P	3·875 Max	98·43 Max
Q	1·500 Min	38·10 Min
R	2·500 Max	63·50 Max
S	0·125	3·18
T	4·375	111·1

Millimetre dimensions have been derived from inches.

Note This drawing may be varied in certain details. Alternative positions are possible for the alignment screws and the connecting socket; these can be arranged to suit individual requirements.

WAVEGUIDE FLANGE

(Modified RETMA CMR137)



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
AA	2·281 ± 0·015	57·94 ± 0·38	AK	0·590	14·99
AB	1·531 ± 0·015	38·89 ± 0·38	AL	0·247	6·27
AC	0·250 ± 0·015	6·35 ± 0·38	AM	0·125 ± 0·003	3·175 ± 0·076
AD	1·930 ± 0·001	49·022 ± 0·025	AN	1·372 ± 0·003	34·849 ± 0·076
AE	0·9650 ± 0·0005	24·511 ± 0·013	AP	0·1563 to 0·1570	3·97 to 3·99
AF	1·287	32·69	AQ	0·218	5·54
AG	0·643	16·33	AR	0·0005	0·013
AH	1·180	29·97			
AJ	0·933	23·70			

Millimetre dimensions have been derived from inches.

FOCUSING MOUNT

N4051

INTRODUCTION

The N4051 is a periodic permanent magnet focusing mount designed for use with the power travelling wave amplifier type N1038. It incorporates waveguide input and output connectors fitted with pre-set short circuits for broadband matching over selected bands in the frequency range 7·0 to 8·5Gc/s.

The travelling wave tube is the only source of heat in the combination of mount and tube. The heat is transferred from the tube collector to a heat sink on the mount and this is cooled adequately by natural convection of air provided the mount axis is arranged horizontally and the ambient temperature is less than 55°C.

A socket type BA7S for making connections to the travelling wave tube is incorporated in the mount; the connections are fully screened and protected by a connector cover containing a mains interlock.

Although not shown on the outline drawing, alternative positions are possible for the alignment screws and the connecting socket. These can be arranged to suit individual requirements.

GENERAL DATA

Overall Dimensions	15·760 × 4·750 × 3·750 inches	Max
	400·3 × 120·7 × 95·25 mm	Max
Waveguide Flanges (*See Note* 1 *and Outline*)	Modified RETMA CMR137	
Frequency Range (*See Note* 2)	7·0 to 8·5	Gc/s
Input and Output V.S.W.R. (*See Note* 3)	1·5 : 1	Max
R.F. Leakage		*See Note* 4
Net Weight	15 pounds (6·8 kg)	Approx
Storage Temperature:		
Minimum	−50	°C
Maximum	+85	°C
Radiator Fin Temperature	150	°C Max
Cooling:		
Horizontal mounting		
(55°C Max ambient temperature)	Natural air circulation	
Vertical mounting	Forced air draught	

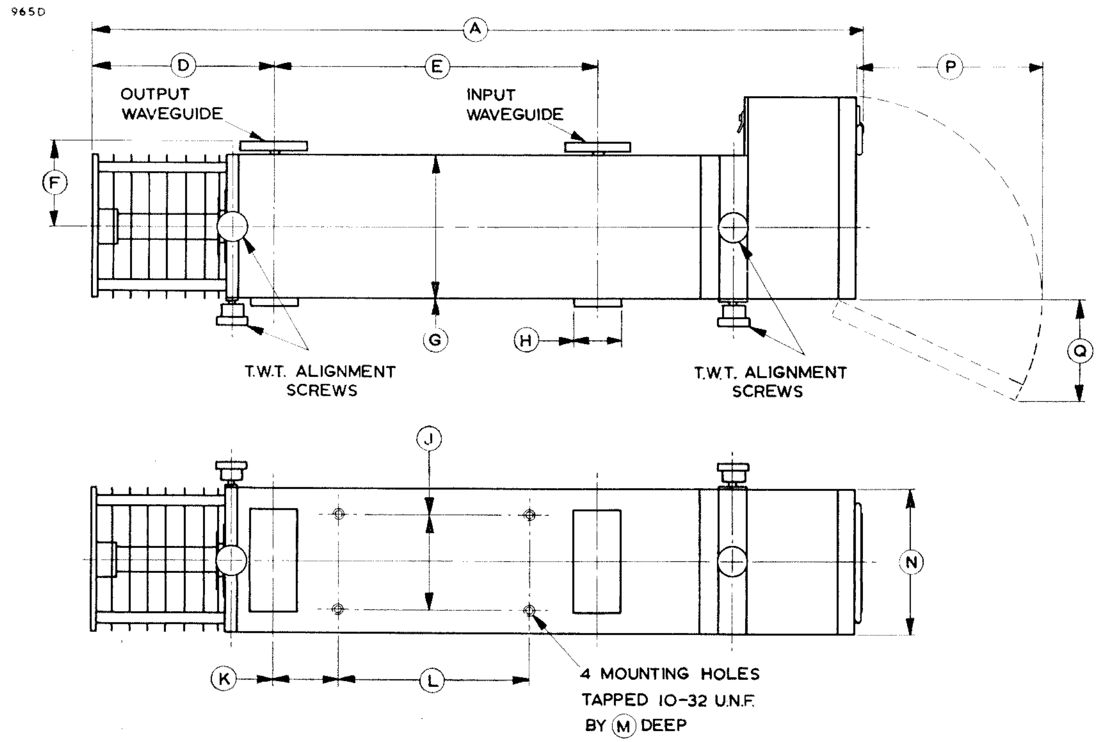
NOTES

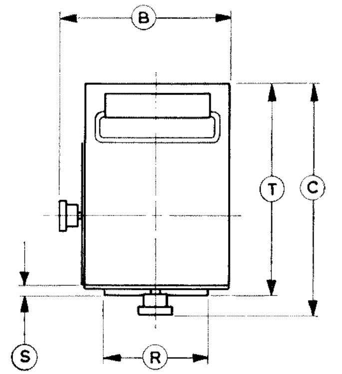
1. Transition sections tapering to standard size waveguide WR137 can be supplied, with either circular flanges UG-344/U or RETMA miniature flanges CMR137 (pressurised version CPR137).
2. Suffix letters have been allocated as follows to indicate the frequency band for which the mount has been matched.

   N4051C .. .. 7·05 to 7·80 Gc/s

   N4051D .. .. 7·75 to 8·50 Gc/s
3. The V.S.W.R. will be 1·5 : 1 maximum within the selected frequency band of the mount. With additional matching adjustments external to the mount it is possible to obtain a match better than 1·25 : 1 over a 40Mc/s band.
4. The r.f. leakage will be 65db minimum below the output power of the tube within the frequency range 7·0 to 8·5Gc/s. It should be noted however that this value may be exceeded unless soft copper gaskets are used.

OUTLINE





Ref.	Inches	Millimetres
A	15·760 Max	400·3 Max
B	3·687 Max	93·65 Max
C	5·000 Max	127·0 Max
D	3·750 Max	95·25 Max
E	6·785 ± 0·015	172·3 ± 0·38
F	1·750 ± 0·015	44·45 ± 0·38
G	2·968 ± 0·032	75·39 ± 0·81
H	1·250 Max	31·75 Max
J	2·000	50·80
K	1·375 ± 0·032	34·93 ± 0·81
L	4·000	101·6
M	0·375	9·53
N	2·968 ± 0·032	75·39 ± 0·81
P	3·875 Max	98·43 Max
Q	1·500 Min	38·10 Min
R	2·500 Max	63·50 Max
S	0·125	3·18
T	4·375	111·1

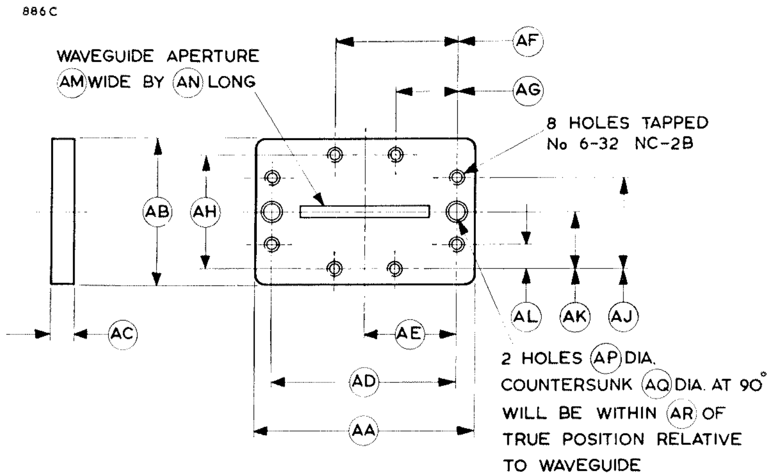
Millimetre dimensions have been derived from inches.

Note This drawing may be varied in certain details. Alternative positions are possible for the alignment screws and the connecting socket; these can be arranged to suit individual requirements.

ENGLISH ELECTRIC

WAVEGUIDE FLANGE

(Modified RETMA CMR137)



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
AA	2·281±0·015	57·94±0·38	AK	0·590	14·99
AB	1·531±0·015	38·89±0·38	AL	0·247	6·27
AC	0·250±0·015	6·35±0·38	AM	0·125±0·003	3·175±0·076
AD	1·930±0·001	49·022±0·025	AN	1·372±0·003	34·849±0·076
AE	0·9650±0·0005	24·511±0·013	AP	0·1563 to 0·1570	3·97 to 3·99
AF	1·287	32·69	AQ	0·218	5·54
AG	0·643	16·33	AR	0·0005	0·013
AH	1·180	29·97			
AJ	0·933	23·70			

Millimetre dimensions have been derived from inches.

MISCELLANEOUS MICROWAVE VALVES

Complete List of Types in this Section

Backward Wave Oscillators

Preamble

December 1961

ENGLISH ELECTRIC VALVE CO. LTD.

Printed in England

CHELMSFORD
ENGLAND

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MISC. MICROWAVE VALVES

MISCELLANEOUS
MICROWAVE VALVES
Complete List of Types

All references are to the front of the sheet only.

E.E.V. Type	American Equivalent	Service Type	Page Nos.	Date
BACKWARD WAVE OSCILLATORS				
N1010 N1010A N1010S		— CV2393 CV6024	1, 3, 5, 7, 9, 11, 13	March 1962 ←
N1034 N1034A N1034S		— CV2381 CV6023	1, 3, 5, 7, 9, 11, 13, 15	March 1962 ←

← Indicates a change

March 1962

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BACKWARD WAVE OSCILLATOR

N1010

Service Type CV2393
CV6024

INTRODUCTION

The N1010 is a magnetically focused Backward Wave Oscillator which can be tuned electronically and continuously over the frequency range 7000 to 11 500 Mc/s. It is designed specifically for use in wide band microwave receivers and generators where rapid frequency sweeping by electronic means is required. Control electrodes are provided to facilitate low voltage pulse or amplitude modulation.

The output coupling provided is a standard 50 ohm N-type coaxial connector designed for coupling to the cable plug UG-21B/U.

There are three versions of the basic valve:

N1010 The N1010 is provided with an integral permanent magnet. The delay line and collector are connected internally to the metal outer shell. It is intended therefore that this valve shall be operated with the delay line at earth potential.

N1010A (CV2393) The N1010A is also provided with an integral permanent magnet. In this valve however d.c. insulation is built into the output connector and all valve electrodes are insulated from the output connector and outer shell. This enables any electrode to be operated at earth potential which facilitates modulation and simplifies the design of associated power supplies.

N1010S (CV6024) The N1010S is similar to the N1010A except that the permanent magnet is replaced by an integral electromagnet in the form of an aluminium foil solenoid. The solenoid is designed to operate from a 24V d.c. supply, the solenoid current being typically 4·5A. Connections to the solenoid are made via a 2-pin plug type AP208600 attached to the metal shell of the valve. Pin A is the negative terminal.

The information given herein refers to all the versions except where stated.

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BACKWARD WAVE OSCILLATOR

N1010

ENGLISH ELECTRIC

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	2·3	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4	A
Cathode Heating Time (Minimum)	2	minutes

Mechanical

Overall Dimensions:

N1010	9·50 × 6·00 × 5·03 inches	Max
	242 × 153 × 128 mm	Max
N1010A	10·50 × 6·00 × 5·03 inches	Max
	267 × 153 × 128 mm	Max
N1010S	10·50 × 6·03 × 5·38 inches	Max
	267 × 154 × 137 mm	Max

Net Weight	11 pounds (5 kg)	Approx
Mounting Position		Any
Base	Medium Shell Medium 7 Pin (JEDEC No. A7–13)	
Cooling (*See Note* 1)		Forced Air

This valve is vibration tested to ensure that it will withstand the normal conditions of service.

MAXIMUM AND MINIMUM RATINGS (*See Note* 2)
(Absolute Values)

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage	5·7	6·8	V
Grid Voltage (negative value, never positive)	0	250	V
Anode Voltage	—	300	V
Anode Current	—	10	mA
Delay Line Voltage	250	1700	V
Delay Line Dissipation	—	50	W
Delay Line Current (*See Note* 3)	—	40	mA
Body Temperature	—	120	°C
Solenoid Voltage (for N1010S)	20	24	V
Solenoid Current (for N1010S)	3	7	A

TYPICAL OPERATION

Operational Conditions (*See Note* 2)

Heater Voltage	6·3	V
Grid Voltage	0	V
Anode Voltage (*See Note* 4)	150	V←
Delay Line Voltage:		
at 7000Mc/s	315	V←
at 9000Mc/s	615	V←
at 11 500Mc/s	1400	V
Solenoid Current (for N1010S) (*See Note* 4)	4·5	A←
Load V.S.W.R. not greater than	1·2:1	

Typical Performance

Anode Current	2	mA
Delay Line Current (*See Note* 3):		
at 7000Mc/s	22	mA
at 9000Mc/s	25	mA←
at 11 500Mc/s	33	mA
Solenoid Voltage (for N1010S)	23	V←
Output Power:		
at 7000Mc/s	40	mW←
at 9000Mc/s	80	mW←
at 11 500Mc/s	130	mW←

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(*See Note* 2)

	Min	*Max*	
Heater Current at heater voltage 6·3V	2·0	2·5	A
Grid Cut-off Voltage (negative value) (*See Note* 5)	0	100	V←
Grid Insulation (*See Note* 6)	—	30	μA
Anode Voltage	100	200	V
Anode Current	—	10	mA
Solenoid Current (for N1010S)	3	7	A
At 7000Mc/s			
Delay Line Voltage	300	350	V
Delay Line Current (*See Note* 3)	—	25	mA
Output Power	20	—	mW
At 9000Mc/s			
Delay Line Voltage	580	700	V
Delay Line Current (*See Note* 3)	—	30	mA
Output Power	20	—	mW
At 11 500Mc/s			
Delay Line Voltage	1300	1500	V
Delay Line Current	—	35	mA
Output Power	20	—	mW

← Indicates a change

CHARACTERISTICS OF A TYPICAL VALVE

Voltage Tuning Range	7000 to 11 500	Mc/s
→Grid Cut-off Voltage (negative value) (*See Note* 5)	70	V
Grid Insulation (*See Note* 6)	5	μA
Grid Modulation	*See Page* 11	
Anode Modulation	*See Page* 10	
Frequency Pulling (V.S.W.R. not greater than 1·5:1):		
at 7000Mc/s	6	Mc/s
at 11 500Mc/s	6	Mc/s
→Frequency Pushing:		
at 7000Mc/s	−3	Mc/s/mA
at 9000Mc/s	−5	Mc/s/mA
at 11 500Mc/s	−1	Mc/s/mA
→Change of Frequency with Anode Voltage:		
at 7000Mc/s	−0·75	Mc/s/V
at 9000Mc/s	−1·0	Mc/s/V
at 11 500Mc/s	−0·25	Mc/s/V
Signal to Noise Ratio (*See Note* 7)	155	db/c/s
Inter-electrode Capacitances :		
Cathode to Grid, Anode and Delay Line	10	pF
Grid to Cathode, Anode and Delay Line	15	pF
Anode to Delay Line, Cathode and Grid	15	pF
→ Delay Line to Cathode, Grid and Anode	10	pF
→ Delay Line to earthed Outer Shell (where applicable)	300	pF

→ Indicates a change

OPERATING INSTRUCTIONS FOR N1010 SERIES

Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the N1010 Series of Backward Wave Oscillators. Careful attention to the points detailed below will result in long and reliable performance.

The Engineering Staff of E.E.V. Co. are always available to give further advice and information if required.

Precautions

1. When using the permanent magnet versions all magnetic materials must be kept at least 8 inches away from any part of the valve or permanent damage may result.
2. Never apply the anode voltage before the delay line voltage.
3. Never allow the grid to become positive with respect to cathode. For normal c.w. operation the grid should be connected to the cathode.
4. Always observe the cooling requirements.
5. Do not use force when making connection to the coaxial output connector of the valve.

Installation and Operation

Mounting The valve may be mounted in an equipment in any position provided that cooling requirements are met and the required protection from magnetic interference exists.

Bolt the valve securely to the equipment chassis ensuring that the output cable does not place undue strain on the connector.

The valve is designed to give the quoted performance when working into a load of V.S.W.R. not greater than 1·2:1 except where otherwise stated.

Connections Ensure that the connections to the valve are correct. See outline drawing for base connections.

Application of Voltages It is essential that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. Voltages must not exceed the maximum ratings even for a short period. Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(*a*) Heater voltage, blowers and solenoid voltage where applicable

(*b*) After 2 minutes minimum, delay line voltage

(*c*) Anode voltage

(*d*) Grid voltage if required.

Noise For low noise performance the permanent magnet versions should not be operated within 18 inches of other magnetic materials.

Either the cathode, anode or delay line must be operated at earth potential.

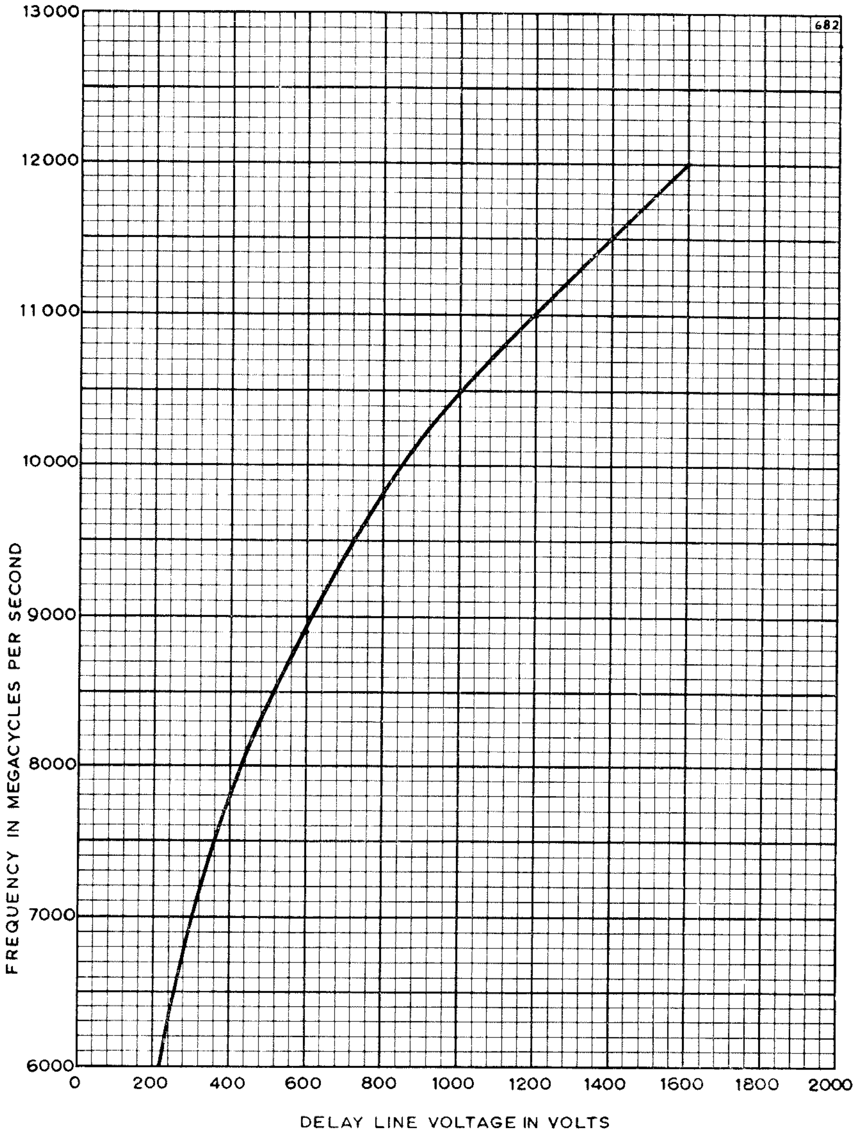
ENGLISH ELECTRIC

NOTES

1. For the N1010S a flow of air of 20cu.ft/min is required; a pressure of not more than 1 inch standard water gauge will suffice. For the N1010 and N1010A a flow of air of 10cu.ft/min is required.
   The cooling air should be directed at the radiator for the N1010 and N1010A but at the radiator and the sides of the solenoid for the N1010S.
2. All voltages except the heater voltage are with respect to the cathode.
3. The delay line and collector are connected internally. Delay line current therefore includes collector current.
4. → The optimum anode voltage and solenoid current for each tube are marked on the outer shell of the tube.
5. The grid cut-off voltage is that grid voltage at which oscillations are cut-off.
6. Grid insulation is measured as a function of grid current under the following conditions. With the anode voltage set at the recommended value and the delay line voltage at 1500 volts, the grid voltage is adjusted to give a total delay line current plus anode current of 10mA. The anode voltage is then reduced to zero and the grid current is measured.
7. This ratio, expressed in db/c/s, is the ratio of the signal to the average noise in a bandwidth of 10Mc/s centred at frequencies greater than 20Mc/s from the carrier.

→ Indicates a change

DELAY LINE VOLTAGE CHARACTERISTIC



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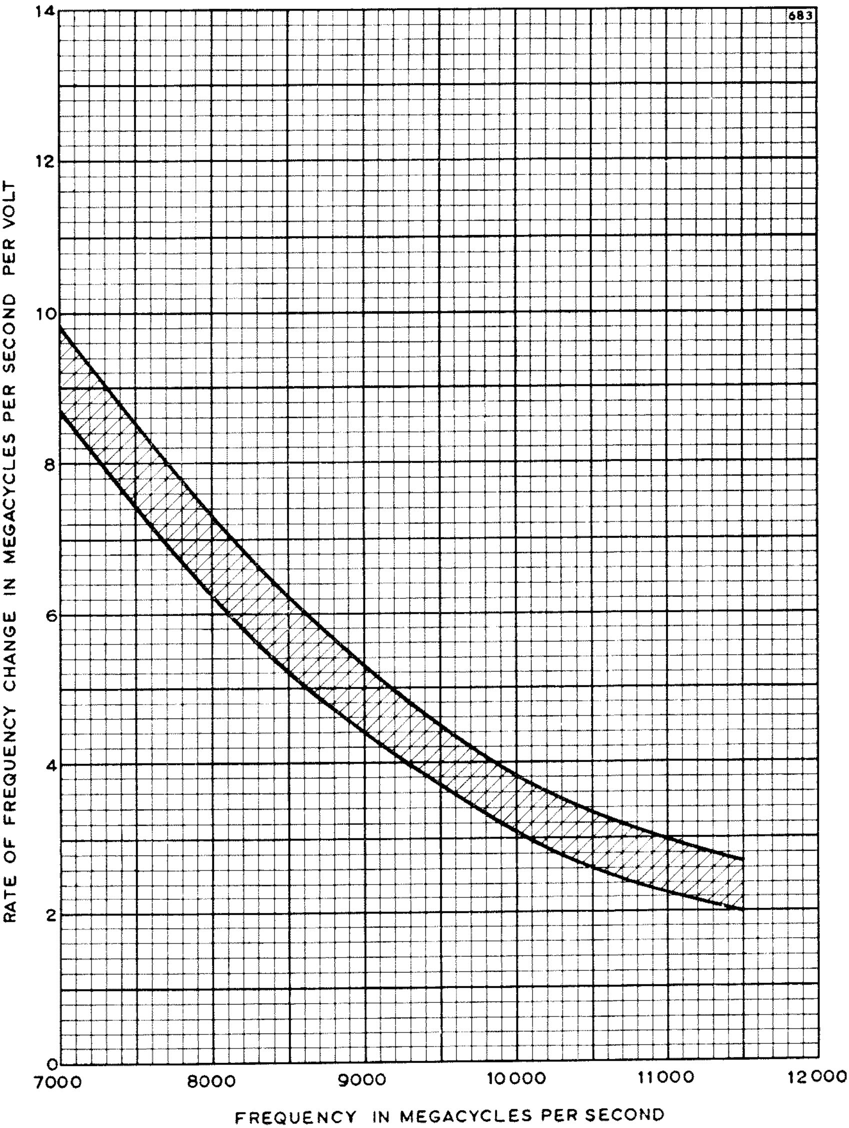
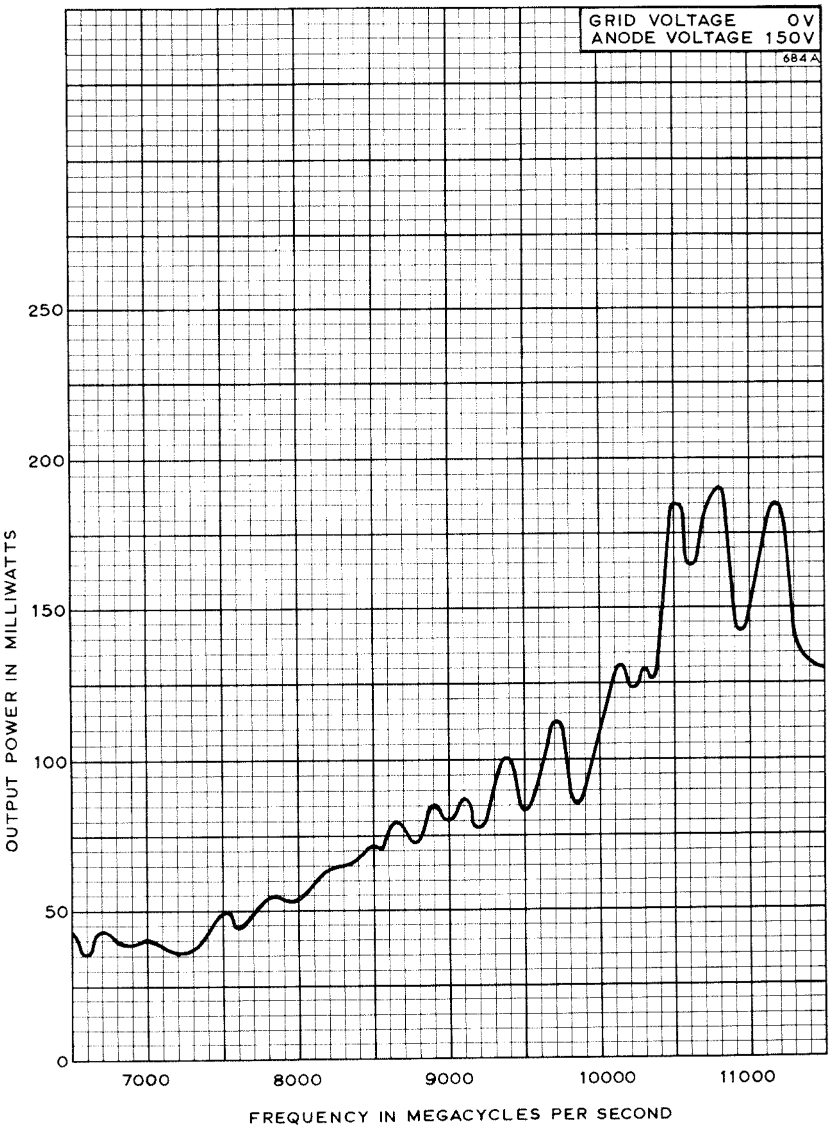
FREQUENCY CHANGE CHARACTERISTIC



POWER CHARACTERISTIC



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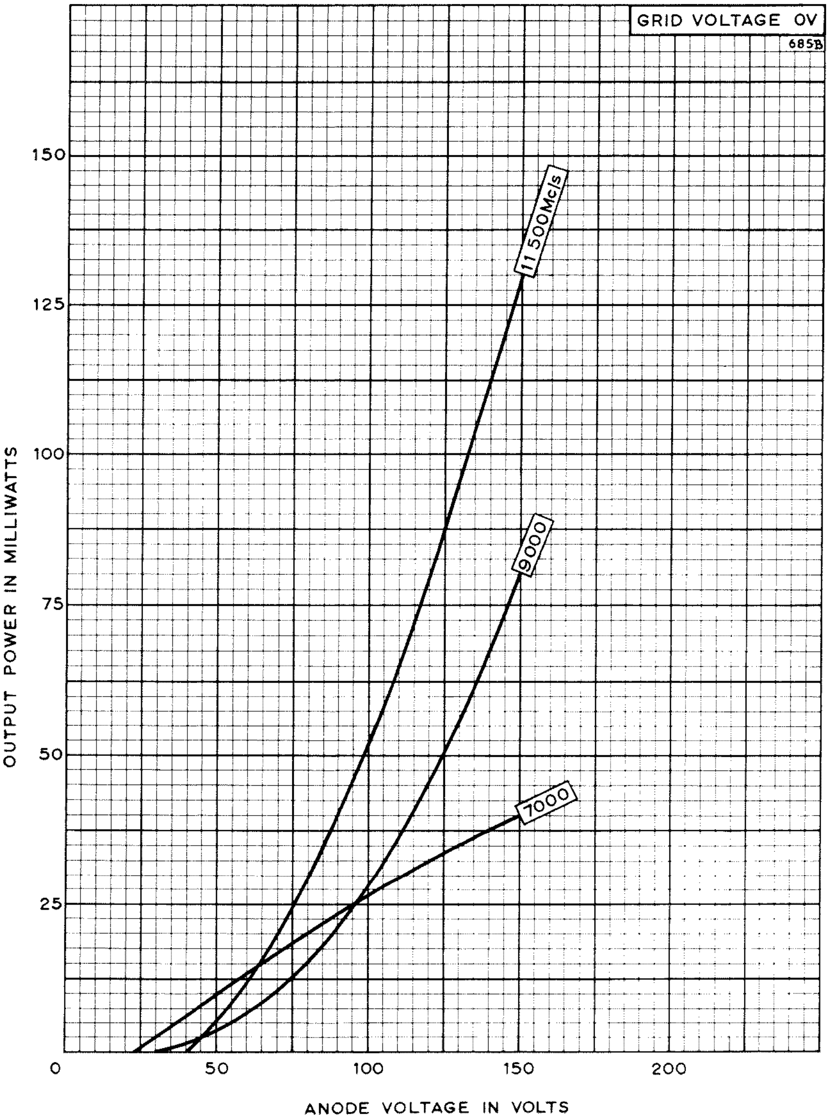
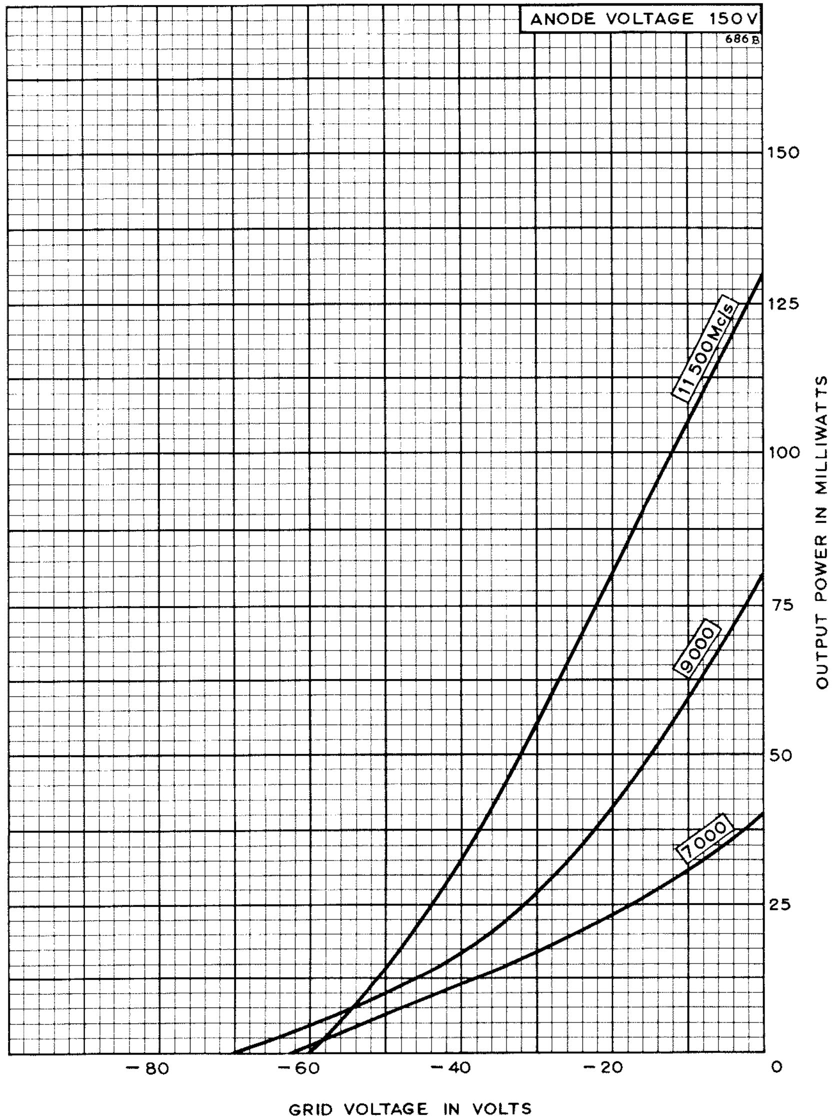
ANODE MODULATION CHARACTERISTICS



BACKWARD WAVE OSCILLATOR

N1010

GRID MODULATION CHARACTERISTICS



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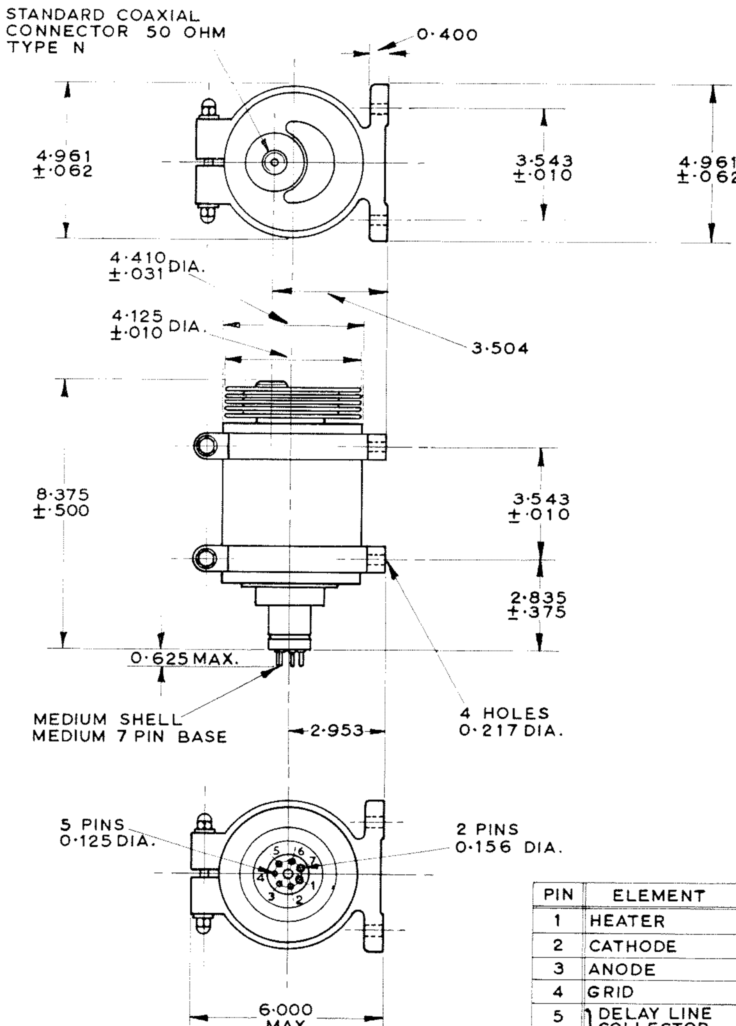
ENGLISH ELECTRIC

OUTLINE FOR N1010

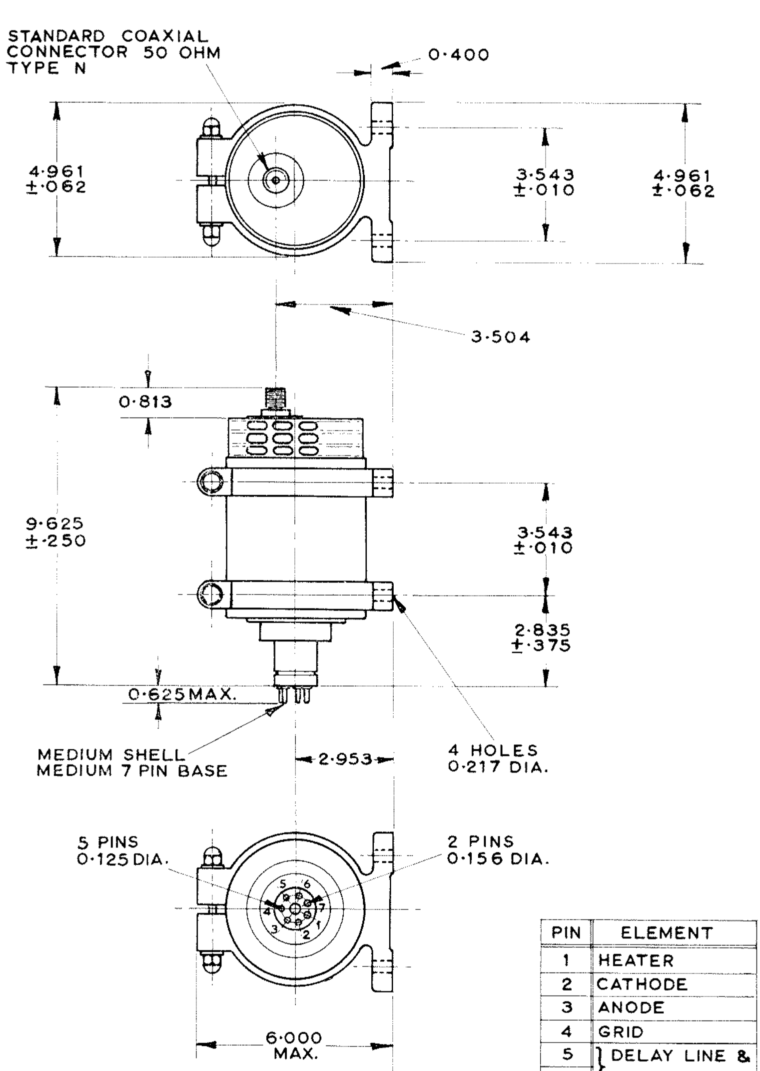
687A



PIN	ELEMENT
1	HEATER
2	CATHODE
3	ANODE
4	GRID
5	DELAY LINE COLLECTOR AND SHELL
6	DELAY LINE COLLECTOR AND SHELL
7	HEATER

ALL DIMENSIONS IN INCHES

OUTLINE FOR N1010A

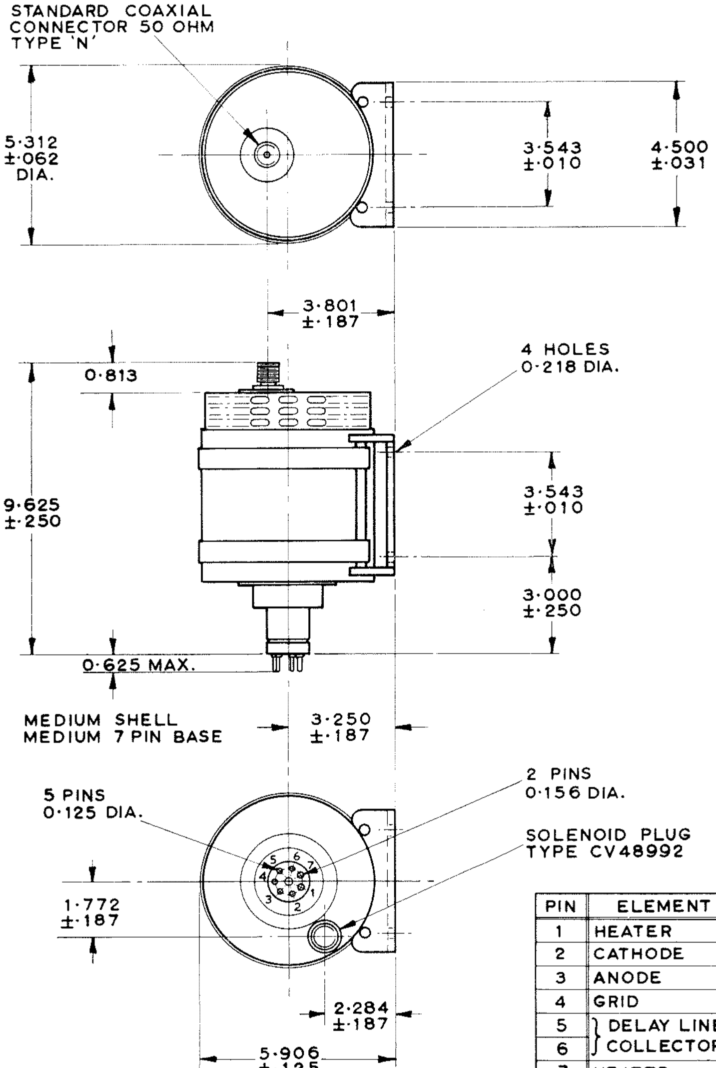


PIN	ELEMENT
1	HEATER
2	CATHODE
3	ANODE
4	GRID
5	DELAY LINE &
6	COLLECTOR
7	HEATER

ALL DIMENSIONS IN INCHES

OUTLINE FOR N1010S

699B



PIN	ELEMENT
1	HEATER
2	CATHODE
3	ANODE
4	GRID
5	DELAY LINE & COLLECTOR
6	DELAY LINE & COLLECTOR
7	HEATER

ALL DIMENSIONS IN INCHES

BACKWARD WAVE OSCILLATOR

N1034

Service Type CV2381
CV6023

INTRODUCTION

The N1034 is a magnetically focused Backward Wave Oscillator which can be tuned electronically and continuously over the frequency range 2400 to 4500 Mc/s. It is designed specifically for use in wide band microwave receivers and generators where rapid frequency sweeping by electronic means is required. Control electrodes are provided to facilitate low voltage pulse or amplitude modulation.

The output coupling provided is a standard 50 ohm N-type coaxial connector designed for coupling to the cable plug UG-21B/U.

There are three versions of the basic valve:

N1034 The N1034 is provided with an integral permanent magnet. The delay line and collector are connected internally to the metal outer shell. It is intended therefore that this valve shall be operated with the delay line at earth potential.

N1034A (CV2381) The N1034A is also provided with an integral permanent magnet. In this valve however d.c. insulation is built into the output connector and all valve electrodes are insulated from the output connector and outer shell. This enables any electrode to be operated at earth potential which facilitates modulation and simplifies the design of associated power supplies.

N1034S (CV6023) The N1034S is similar to the N1034A except that the permanent magnet is replaced by an integral electromagnet in the form of an aluminium foil solenoid. The solenoid is designed to operate from a 24V d.c. supply, the solenoid current being typically 4·0A. Connections to the solenoid are made via a 2-pin plug type AP208600 attached to the metal shell of the valve. Pin A is the negative terminal.

The information given herein refers to all the versions except where stated.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6·3	V
Heater Current	2·4	A
Heater Starting Current:		
Peak instantaneous value must not exceed	4	A
Cathode Heating Time (Minimum)	2	minutes

Mechanical

Overall Dimensions:		
N1034	9·50 × 6·00 × 5·03 inches	Max
	242 × 153 × 128 mm	Max
N1034A	10·50 × 6·00 × 5·03 inches	Max
	267 × 153 × 128 mm	Max
N1034S	10·50 × 6·03 × 5·38 inches	Max
	267 × 154 × 137 mm	Max
Net Weight	11 pounds (5 kg)	Approx
Mounting Position		Any
Base	Giant 7-pin B7D (JEDEC A7–17)	
Cooling (*See Note* 1)		Forced-air

This valve is vibration tested to ensure that it will withstand the normal conditions of service.

MAXIMUM AND MINIMUM RATINGS (*See Note* 2)
(Absolute Values)

These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min	*Max*	
Heater Voltage	5·7	6·8	V
Grid Voltage (negative value, never positive)	0	150	V
Anode Voltage	—	200	V
Anode Current	—	20	mA
Delay Line Voltage	150	1500	V
Delay Line Current (*See Note* 3)	—	50	mA
Delay Line Dissipation	—	60	W
Body Temperature	—	120	°C
Solenoid Voltage (for N1034S)	20	24	V
Solenoid Current (for N1034S)	3	7	A

TYPICAL OPERATION

Operational Conditions (*See Note* 2)

Heater Voltage	6·3	V
Grid Voltage	0	V
Anode Voltage (*See Note* 4)	150	V←
Delay Line Voltage:		
at 2400Mc/s	190	V←
at 2600Mc/s	225	V←
at 3400Mc/s	440	V←
at 4500Mc/s	1130	V
Solenoid Current (for N1034S) (*See Note* 4)	4	A←
Load V.S.W.R. not greater than	1·2:1	

Typical Performance

Anode Current	3	mA
Delay Line Current (*See Note* 3):		
at 2400Mc/s	35	mA
at 2600Mc/s	36	mA
at 3400Mc/s	38	mA
at 4500Mc/s	45	mA
Solenoid Voltage (for N1034S)	21	V←
Output Power:		
at 2400Mc/s	90	mW←
at 2600Mc/s	160	mW←
at 3400Mc/s	340	mW←
at 4500Mc/s	400	mW←

← Indicates a change

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(*See Note* 2)

	Min	*Max*	
Heater Current at heater voltage 6·3V	2·1	2·6	A
Grid Cut-off Voltage (negative value) (*See Note* 5)	—	100	V
Grid Insulation (*See Note* 6)	—	40	μA
Anode Voltage	100	200	V
Solenoid Current (for N1034S)	3	7	A
At 2400Mc/s			
Anode Current	—	20	mA
Delay Line Voltage	150	200	V
Delay Line Current	16	40	mA
Output Power	20	—	mW
At 2600Mc/s			
Delay Line Voltage	180	235	V
Output Power	50	—	mW
At 3400Mc/s			
Anode Current	—	20	mA
Delay Line Voltage	400	460	V
Delay Line Current	30	50	mA
Output Power	150	—	mW
At 4500Mc/s			
Anode Current	—	20	mA
Delay Line Voltage	1030	1170	V
Delay Line Current	30	50	mA
Output Power	250	—	mW

CHARACTERISTICS OF A TYPICAL VALVE

Voltage Tuning Range	2400 to 4500	Mc/s
Grid Cut-off Voltage (negative value) (*See Note* 5)	50	V
Grid Insulation (*See Note* 6)	5	µA
Grid Modulation	*See Page* 12	
Anode Modulation	*See Page* 11	
Frequency Pulling (V.S.W.R. not greater than 1·5:1):		
at 2600Mc/s	6	Mc/s
at 4500Mc/s	6	Mc/s ←
Frequency Pushing: ←		
at 2400Mc/s	−3	Mc/s/mA
at 3400Mc/s	−1	Mc/s/mA
at 4500Mc/s	−2	Mc/s/mA
Change of Frequency with Anode Voltage: ←		
at 2400Mc/s	−1·0	Mc/s/V
at 3400Mc/s	−0·4	Mc/s/V
at 4500Mc/s	−0·6	Mc/s/V
Signal to Noise Ratio (*See Note* 7)	155	db/c/s
Inter-electrode Capacitances:		
Cathode to Grid, Anode and Delay Line	10	pF
Grid to Cathode, Anode and Delay Line	15	pF
Anode to Delay Line, Cathode and Grid	15	pF
Delay Line to Cathode, Grid and Anode	10	pF ←
Delay Line to earthed Outer Shell (where applicable)	300	pF ←

← Indicates a change

OPERATING INSTRUCTIONS FOR N1034 SERIES

Introduction

These instructions are intended as a guide to circuit designers and valve users for installing and operating the N1034 Series of Backward Wave Oscillators. Careful attention to the points detailed below will result in long and reliable performance.

The Engineering Staff of E.E.V. Co. are always available to give further advice and information if required.

Precautions

1. When using the permanent magnet versions all magnetic materials must be kept at least 8 inches away from any part of the valve or permanent damage may result.
2. Never apply the anode voltage before the delay line voltage.
3. Never allow the grid to become positive with respect to cathode. For normal c.w. operation the grid should be connected to the cathode.
4. Always observe the cooling requirements.
5. Do not use force when making connection to the coaxial output connector of the valve.

Installation and Operation

Mounting The valve may be mounted in an equipment in any position provided that cooling requirements are met and the required protection from magnetic interference exists.

Bolt the valve securely to the equipment chassis ensuring that the output cable does not place undue strain on the connector.

The valve is designed to give the quoted performance when working into a load of V.S.W.R. not greater than 1·2:1 except where otherwise stated.

Connections Ensure that the connections to the valve are correct. See outline drawing for base connections.

Application of Voltages It is essential that the circuit in which a new valve is being installed be thoroughly checked before any voltages are applied to the valve. Voltages must not exceed the maximum ratings even for a short period. Voltage surges at switching on must be limited to be within the maximum ratings.

The recommended sequence of application of voltages is:

(*a*) Heater voltage, blowers and solenoid voltage where applicable.
(*b*) After 2 minutes minimum, delay line voltage.
(*c*) Anode voltage.
(*d*) Grid voltage if required.

Noise For low noise performance the permanent magnet versions should not be operated within 18 inches of other magnetic materials.

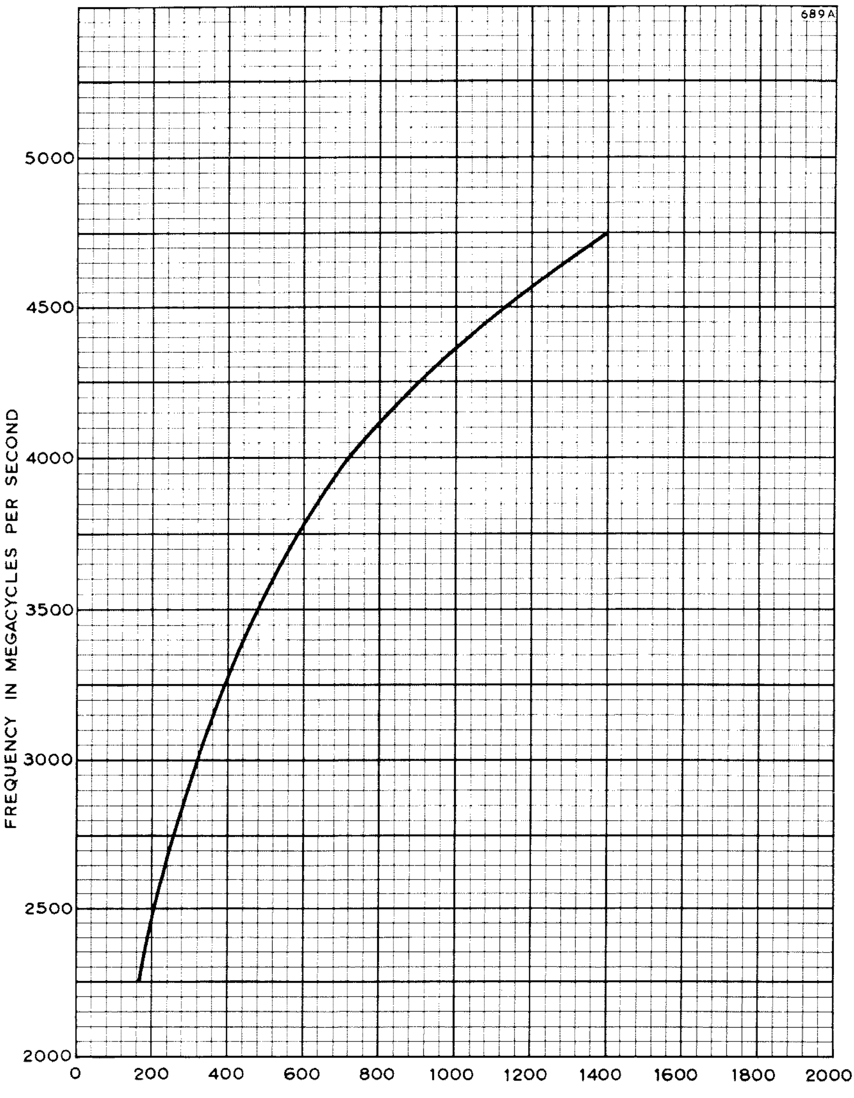
Either the cathode, anode or delay line must be operated at earth potential.

NOTES

1. For the N1034S an air flow of 20cu.ft/min is required; a pressure of not more than 1 inch standard water gauge will suffice. For the N1034 and N1034A an air flow of 10cu.ft/min is required.
   The cooling air should be directed at the radiator for the N1034 and N1034A but at the radiator and the sides of the solenoid for the N1034S.
2. All voltages except the heater voltage are with respect to the cathode.
3. The delay line and collector are connected internally. Delay line current therefore includes collector current.
4. The optimum anode voltage and solenoid current for each tube are marked ← on the outer shell of the tube.
5. The grid cut-off voltage is that grid voltage at which oscillations are cut-off.
6. Grid insulation is measured as a function of grid current under the following conditions. With the anode voltage set at the recommended value and the delay line voltage at 1200 volts, the grid voltage is adjusted to give a total delay line current plus anode current of 10mA. The anode voltage is then reduced to zero and the grid current is measured.
7. This ratio, expressed in db/c/s, is the ratio of the signal to the average noise in a bandwidth of 10Mc/s centred at frequencies greater than 20Mc/s from the carrier.

← Indicates a change

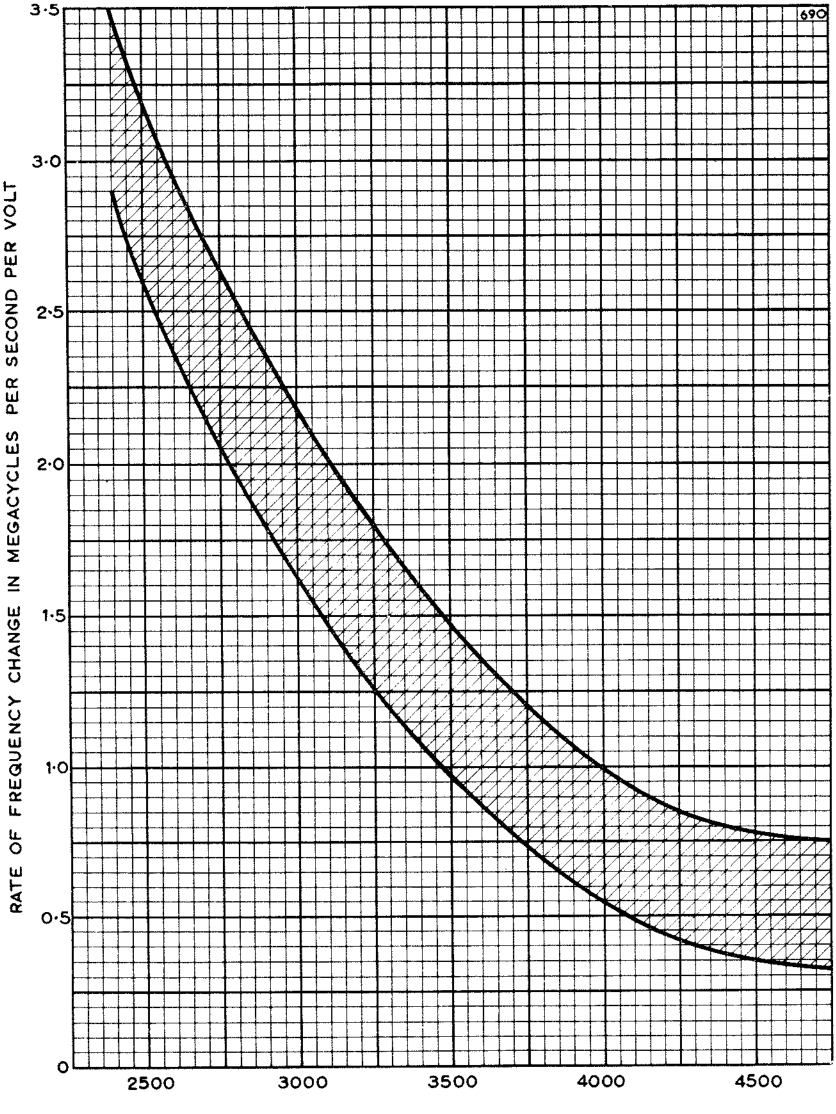
DELAY LINE VOLTAGE CHARACTERISTIC



BACKWARD WAVE OSCILLATOR

N1034

FREQUENCY CHANGE CHARACTERISTIC



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ENGLAND
Telephone:
Chelmsford 3491

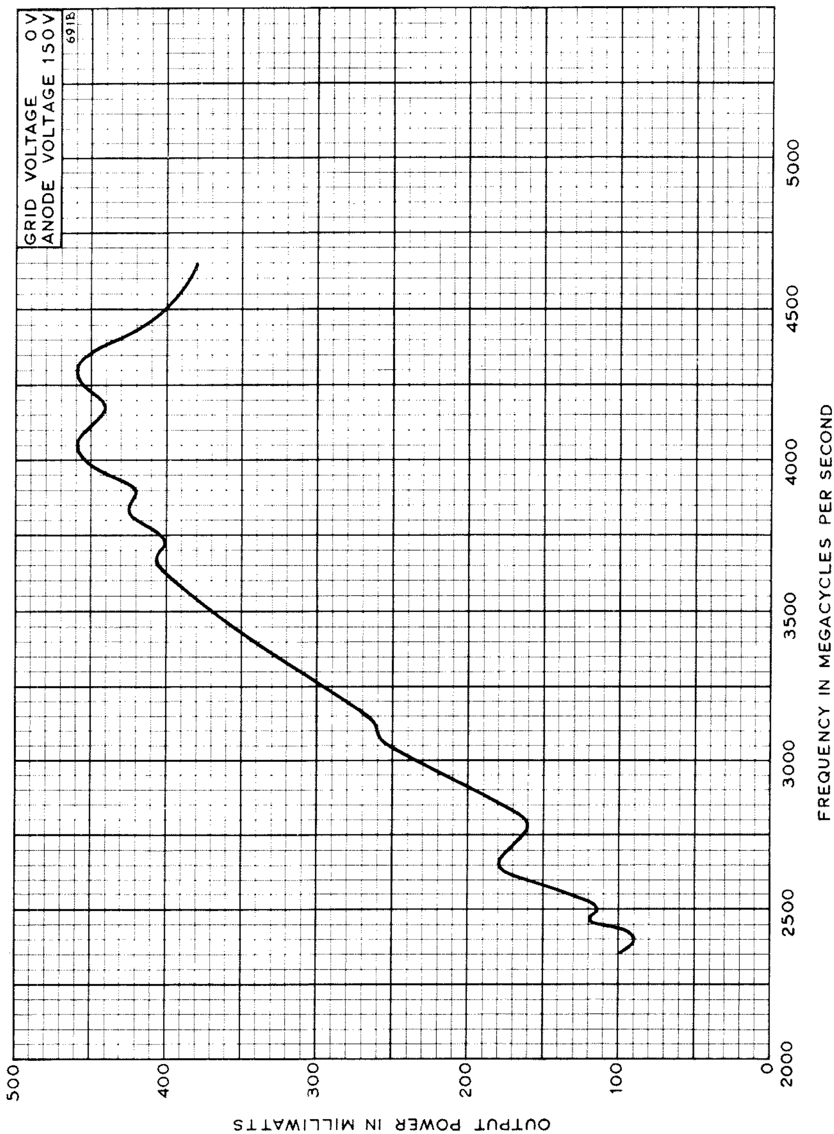
Printed in England

BACKWARD WAVE OSCILLATOR

N1034

ENGLISH ELECTRIC

POWER CHARACTERISTIC



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CHELMSFORD
ENGLAND

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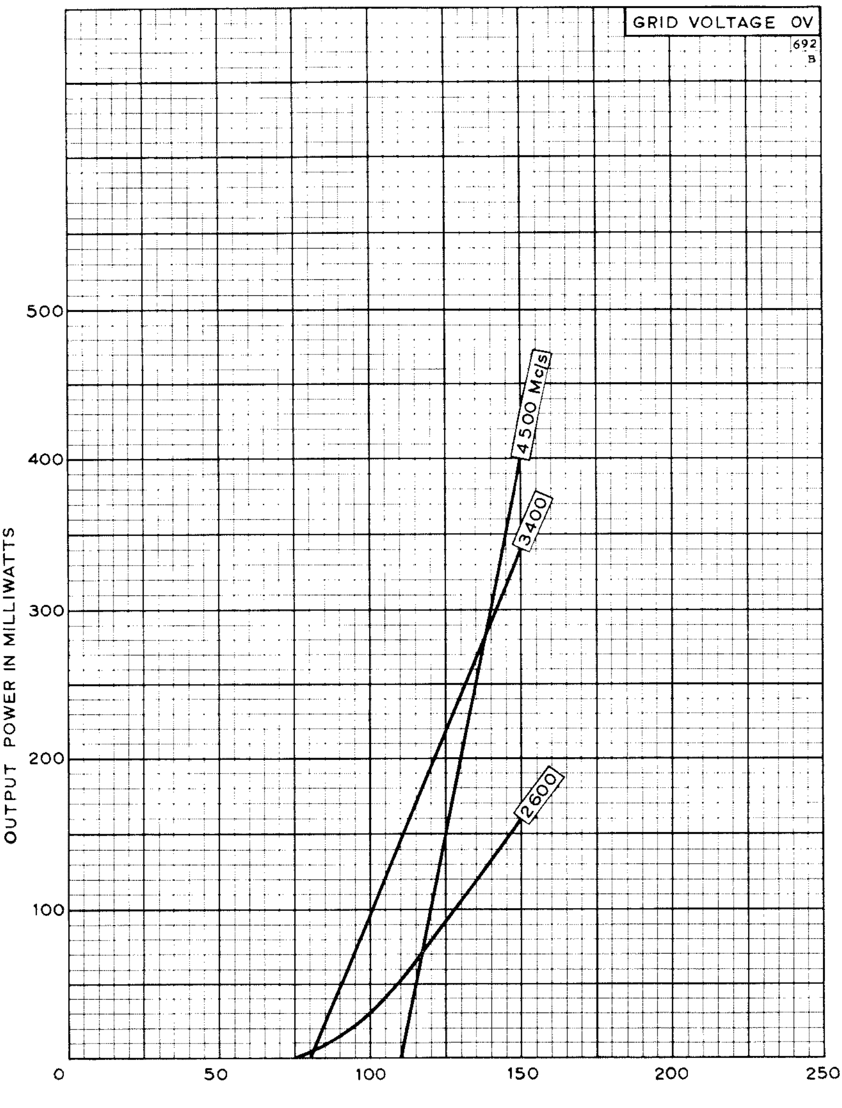
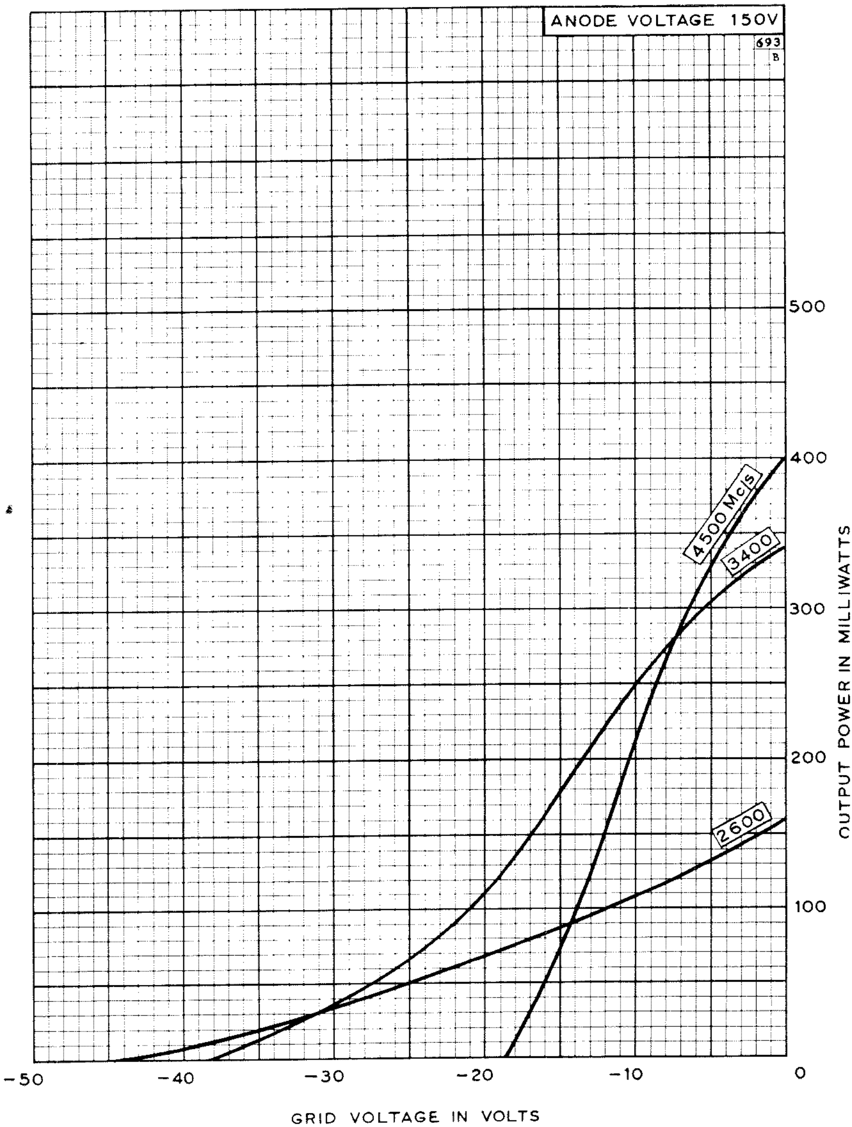
ANODE MODULATION CHARACTERISTICS

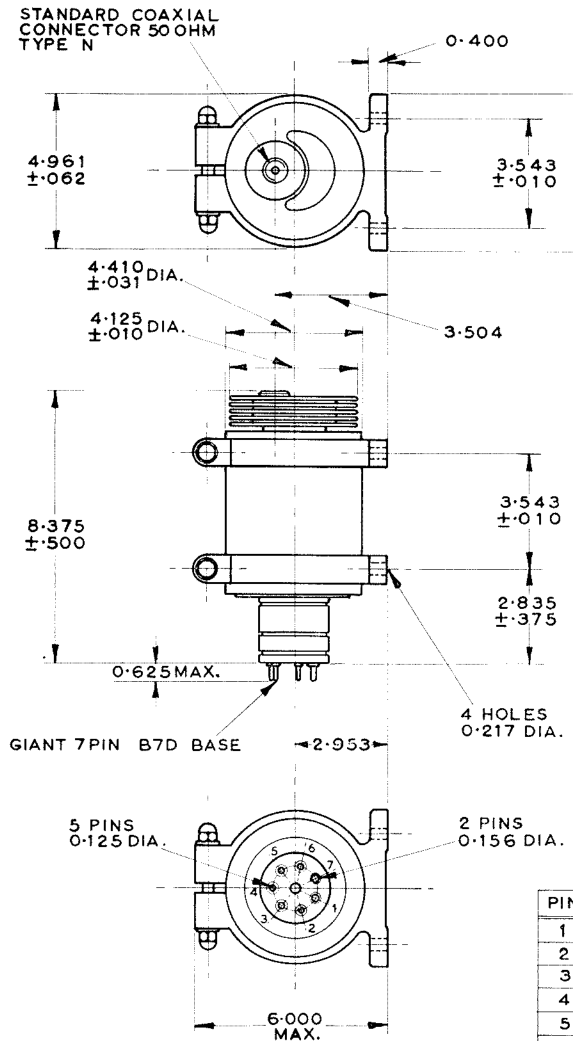


GRID MODULATION CHARACTERISTICS



OUTLINE for N1034

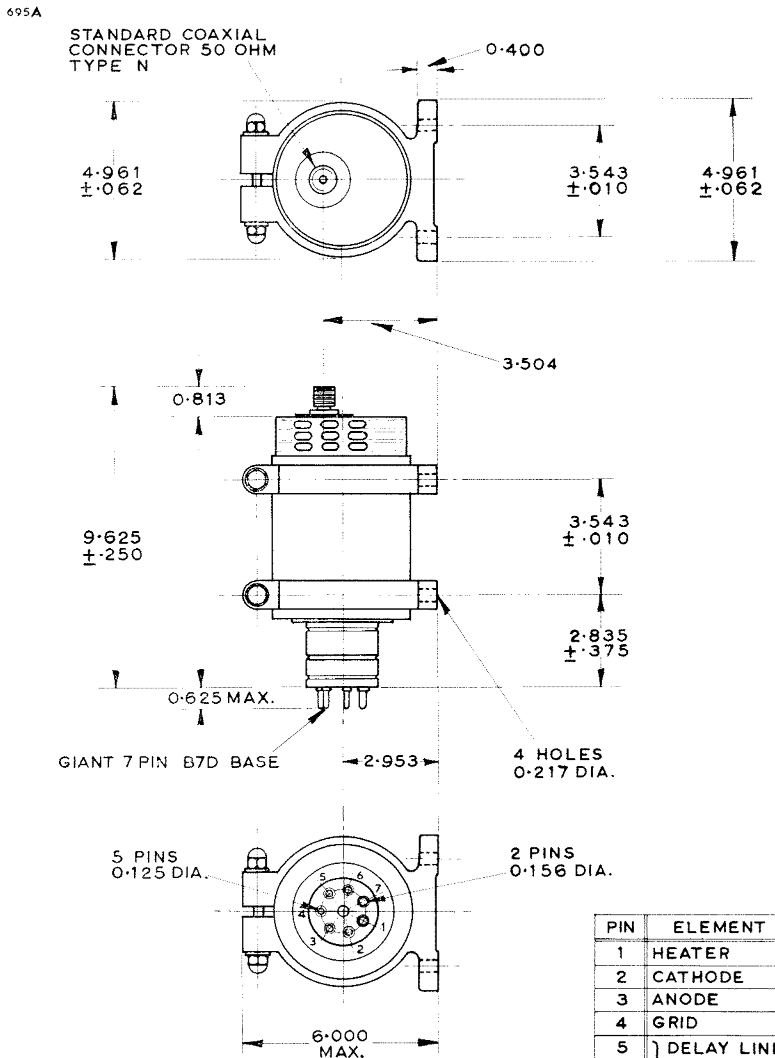
694A



PIN	ELEMENT
1	HEATER
2	CATHODE
3	ANODE
4	GRID
5	DELAY LINE COLLECTOR AND SHELL
6	DELAY LINE COLLECTOR AND SHELL
7	HEATER

ALL DIMENSIONS IN INCHES

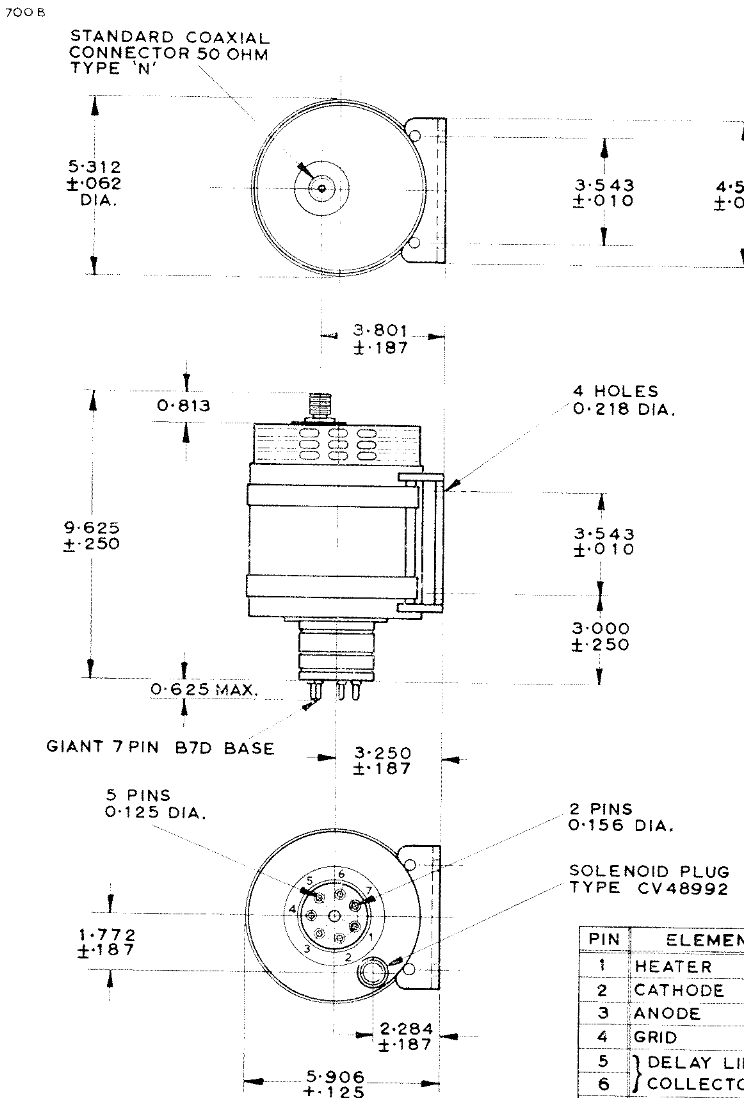
OUTLINE for N1034A



PIN	ELEMENT
1	HEATER
2	CATHODE
3	ANODE
4	GRID
5	DELAY LINE &
6	COLLECTOR
7	HEATER

ALL DIMENSIONS IN INCHES

OUTLINE for N1034S



ALL DIMENSIONS IN INCHES

PIN	ELEMENT
1	HEATER
2	CATHODE
3	ANODE
4	GRID
5	DELAY LINE & COLLECTOR
6	DELAY LINE & COLLECTOR
7	HEATER

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TO ALL VOLUMES

December 1963

ENGLISH ELECTRIC VALVE CO. LTD.

Printed in England

CHELMSFORD
ENGLAND

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Chelmsford 3491

INDEX TO ALL VOLUMES

INDEX TO ALL VOLUMES

Abbreviations used in 'Section' Column

BWO	Backward Wave Oscillator (Vol. 2)
CCT	Cold Cathode Tube (Vol. 3)
CRT	Cathode Ray Tube (Vol. 3)
IGN	Ignitron (Vol. 1)
INT	Image Intensifier (Vol. 3)
ITH	Industrial Thyratron (Vol. 1)
KLY	Klystron (Vol. 2)
MAG	Magnetron (Vol. 2)
OP	Other Product (Vol. 3)
PM	Photomultiplier (Vol. 3)
REC	Rectifier (Vol. 1)
ST	Storage Tube (Vol. 3)
TET	Tetrode (Vol. 1)
THY	Hydrogen Thyratron (Vol. 3)
TCT	Television Camera Tube (Vol. 3)
TR	TR & TB Cell (Vol. 3)
TRI	Triode (Vol. 1)
TWT	Travelling Wave Tube (Vol. 2)
VC	Vacuum Capacitor (Vol. 3)

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EEV Type	Section (see page 1)
5736	TRI
5762	TRI
5820A/E	TCT
5867	TRI
6027	MAG
6027H	MAG
6181	TET
6587	THY
6777	THY
6849	TCT
6861	TWT
7038	TCT
7182	MAG
7293B	TCT
7295C	TCT
7384	THY
7389C	TCT
7735A	TCT
7735B	TCT
8093B	TCT
8356	MAG
8357	MAG
8503	THY
8507	TCT
8541	TCT
8572	TCT
8625	TCT
8626	TCT
68504	REC
68506	REC
68530	REC
A207	REC
A235	REC
A237	REC
A292	REC
A296	REC
AFX203	ITH
AFX234	ITH
AH200	REC
AH205/857B	REC
AH211A	REC
AH213	REC
AH221	REC

EEV Type	Section (see page 1)
AH238	REC
AX228	REC
B142	TRI
B1152	TRI
B1153	TRI
BD10	REC
BD12	REC
BK24/5552A	IGN
BK42/5551A	IGN
BK44/5554	IGN
BK46/5555	IGN
BK66/5550	IGN
BK146/5553B	IGN
BK168/5822A	IGN
BK178	IGN
BK442/7669	IGN
BK444/7671	IGN
BK446/7673	IGN
BK468/7672	IGN
BK542/1081	IGN
BM25L	MAG
BM1003	MAG
BM1004	MAG
BM1005	MAG
BM1026	MAG
BM1027	MAG
BM1028	MAG
BM1029	MAG
BM1030	MAG
BM1031	MAG
BM1032	MAG
BM1033	MAG
BM1034	MAG
BM1035	MAG
BM1036	MAG
BM1037	MAG
BM1040	MAG
BR128B	TRI
BR140	TRI
BR152B	TRI
BR153	TRI
BR155	TRI
BR161	TRI

EEV Type	Section (see page 1)
BR175	TRI
BR179	TRI
BR189	TRI
BR194	TRI
BR195	TRI
BR1102	TRI
BR1103	TRI
BR1106	TRI
BR1115	TRI
BR1121	TRI
BR1122	TRI
BR1124	TRI
BR1126	TRI
BR1129	TRI
BR1131	TRI
BR1132	TRI
BR1138	TRI
BR1143	TRI
BR1160	TRI
BR1161	TRI
BR1162	TRI
BR1165	TRI
BR1169	TRI
BR1181	TRI
BS48	TR
BS52	TR
BS82	TR
BS84	TR
BS92	TR
BS104	TR
BS114	TR
BS116	TR
BS118	TR
BS148	TR
BS154	TR
BS156	TR
BS158	TR
BS198	TR
BS200	TR
BS202	TR
BS204	TR
BS248	TR
BS272	TR

EEV Type	Section (see page 1)
BS280	TR
BS286	TR
BS310	TR
BS316	TR
BS324	TR
BS332	TR
BS384	OP
BS390	TR
BS426	TR
BS430	TR
BS440	TR
BS450	TR
BS452	TR
BS456	TR
BS458	TR
BS462	TR
BS466	TR
BS800	TR
BS810	TR
BS814	TR
BS816	TR
BS824	TR
BS826	TR
BS832	TR
BS834	TR
BS836	TR
BS838	TR
BS844	TR
BS846	TR
BS848	TR
BS850	TR
BT17	ITH
BT19	ITH
BT29	ITH
BT69	ITH
BT89	ITH
BT95	ITH
BW140	TRI
BW153	TRI
BW161	TRI
BW165	TRI
BW173	TRI
BW179	TRI

EEV Type	Section (see page 1)
BW189	TRI
BW194	TRI
BW1102	TRI
BW1102J2	TRI
BW1103	TRI
BW1121	TRI
BW1121J	TRI
BW1121J2	TRI
BW1122	TRI
BW1124	TRI
BW1124J1	TRI
BW1124J2	TRI
BW1126	TRI
BW1139	TRI
BW1143	TRI
BW1143J2	TRI
BW1144	TRI
BW1156	TRI
BW1162	TRI
BW1162J3	TRI
BW1165	TRI
BW1165J3	TRI
BW1169J3	TRI
BW1176J1	TRI
BW1176J2	TRI
BW1181J3	TRI
BW4027	TRI
BW4028	TRI
BW4029	TRI
BW4034	TRI
BW4035	TRI
BW4050	TRI
BW4070	TRI
BW4088	TRI
BY189A	TRI
BY194	TRI
BY1102	TRI
BY1121	TRI
BY1122	TRI
BY1124	TRI
BY1143	TRI
BY1144	TRI
BY1144L	TRI

EEV Type	Section (see page 1)
BY1156	TRI
BY1161	TRI
BY4030	TRI
BY4031	TRI
BY4032	TRI
BY4033	TRI
BY4036	TRI
BY4037	TRI
BY4038	TRI
BY4039	TRI
BY4048A	TRI
BY4049	TRI
BY4060	TRI
BY4063	TRI
BY4064	TRI
BY4093	TRI
C178A/5894	TET
C1108	TET
C1112	TET
C1134	TET
C1136	TET
C1148	TET
C1149/1	TET
C1150/1	TET
C1158	TET
C1166	TET
CR176	TET
CR192A	TET
CR1100	TET
CW1100	TET
CX1120	THY
CX1140	THY
CX1154	THY
CX1157	THY
CX1159	THY
CX1168	THY
CY1170J	TET
E702A	ST
E702B	ST
E702C	ST
E712A	ST
E713B	ST
FX215	THY

EEV Type	Section (see page 1)
M573	MAG
M574	MAG
M575	MAG
M577B	MAG
M578B	MAG
M579	MAG
M581	MAG
M586	MAG
M591B	MAG
M595B	MAG
M596	MAG
M597	MAG
M598B	MAG
M599	MAG
M4011	See M566 Series (MAG)
M4016	See M554, M586 (MAG)
M4017	See M566 Series (MAG)
M5005	MAG
M5008	MAG
M5009	MAG
M5015	MAG
M5019	MAG
M5022	MAG
M5023	MAG
M5024	MAG
M5025	MAG
M5028	MAG
M5030	MAG
M5032	MAG
M5033	MAG
M5034	MAG
M5043	MAG
M5044	MAG
M5058	MAG
MA52	See (VC)
MA54	See (VC)
MA66	TRI
MA66A, MA66B	TRI
MA87	See 4CX5000A (TET)

EEV Type	Section (see page 1)
MA91 MA92	See CX1140 (THY)
MA100	See U2000/3/40B (VC)
MA104 MA104A	See 4CX5000A, 4CX10,000D (TET)
MA125	See (VC)
MA126	See (VC)
MA130, MA131	TRI
MA135, MA135A	TRI
MA136, MA137	See CR192A (TET)
MA146A,B	TRI
MA147A	TRI
MA149A	TRI
MA151	See T940 (CRT)
MA166 MA166B	See 4CX35,000C (TET)
N1001	TWT
N1002	TWT
N1004	TWT
N1010	BWO
N1013	TWT
N1016M	TWT
N1017M	TWT
N1024M	TWT
N1025M	TWT
N1029	TWT
N1031	TWT
N1032	TWT
N1033	TWT
N1034	BWO
N1038	TWT
N1042M	TWT
N1045M	TWT
N1047M	TWT
N1055	TWT
N1056	TWT
N1061	TWT