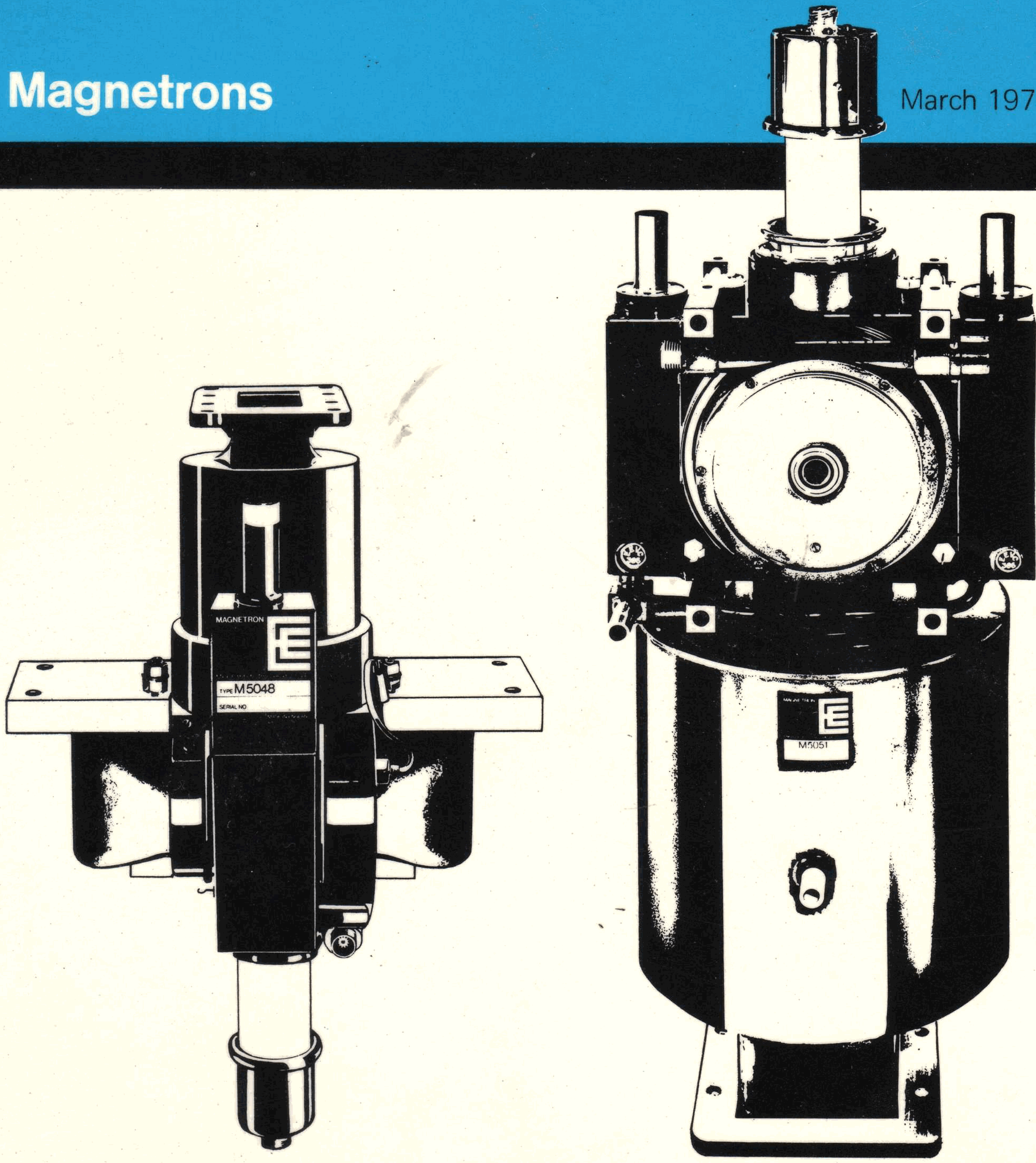
ENGLISH ELECTRIC VALVE CO LTD

Magnetrons

March 1970



MAGNETRONS

GENERAL SECTION

C.W. MAGNETRONS

PULSE MAGNETRONS, L-BAND

PULSE MAGNETRONS, S-BAND

PULSE MAGNETRONS, C-BAND

PULSE MAGNETRONS, X-BAND

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

- IGNITRONS
  RECTIFIERS
  INDUSTRIAL THYRATRONS
  COLD CATHODE TUBES
- TRIODES
- TETRODES
- MODULATORS
  - Hydrogen Thyratrons
  - Pulse Tetrodes

  SPARK GAPS
- MAGNETRONS
- AMPLIFIER KLYSTRONS
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- LIGHT CONVERSION DEVICES
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- VACUUM CAPACITORS

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

Magnetrons

English Electric Valve Company Limited

Chelmsford, Essex, England
Telephone: Chelmsford (0245) 61777
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March 1970

General Section

OVERSEAS REPRESENTATIVES AND DISTRIBUTORS

Argentine Republic	English Electric Marconi Argentina S.R.L.	Buenos Aires
Australia	Amalgamated Wireless Valve Company Pty. Ltd.	Rydalmere, NSW
Austria	William Pattermann, Rudolfinergasse 18	Vienna XIX
Belgium and Luxembourg	SAIT Electronics	Brussels
Brazil	Brazileira de Comercio Exterior Ltda. (BRASCOM)	Sao Paulo
Canada	English Electric Valve Company (Canada) Ltd.	Rexdale, Ontario
China	Marconi (China) Ltd.	Hong Kong
Colombia	Representaciones y Promociones Industriales Ltda.	Bogota
Congolese Republic, Katanga and Ruanda	SAIT Electronics	Kinshasa, Congolese Republic
Denmark	Sophus Berendsen A/S	Copenhagen
Eastern Europe: Albania, Bulgaria Czechoslovakia German Democratic Republic, Hungary Poland, Rumania and Yugoslavia	Friedrich Bernhardt, Isoppgasse 23, Mauer, A–1238	Vienna XXIII, Austria

Finland	Insinööritoimisto Oy Aseko Ab	Helsinki
France	Tranchant Electronique S.A.	Paris
German Federal Republic	Willy List, Franz-Rücker-Allee 42	6 Frankfurt-am-Main-90
Greece	Telectrotec	Athens
Iceland	Orka Ltd.	Reykjavik
India	Associated Instrument Manufacturers (India) Private Ltd.	Bombay, Calcutta, Madras and New Delhi
Iraq	Leon Kouyoumdjian and Co.	Baghdad
Italy	Marconi Italiana S.p.A.	Genoa, Milan and Rome
Japan	Cornes and Co. Ltd.	Osaka and Tokyo
Malaysia	Associated Instrument Manufacturers (Malaya) Sdn. Berhad.	Kuala Lumpur, Penang and Ipoh
Mexico	Agencias Canadenses Y Occidentales S.A. (ACOSA)	Mexico 4, D.F.
Netherlands	SAIT Electronics Nederland	Rotterdam
New Zealand	Amalgamated Wireless (Australasia) N.Z. Ltd.	Auckland, Christchurch and Wellington
Norway	Norsk Marconikompani A/S	Oslo
Pakistan	International Industries Ltd.	Karachi, Lahore and Dacca
Peru	Fernando Ezeta B, Casilla 3061	Lima
Portugal	MEDITROM, Comercial de Equipamentos Técnicos S.A.R.L.	Lisbon

Singapore	Associated Instrument Manufacturers (Singapore) Sdn. Berhad.	Singapore
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Switzerland	Woods AG	Zurich
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Trinidad & Tobago, and Guyana	Telecomm Ltd.	Port-of-Spain, Trinidad
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United States of America	Camera Tubes: Visual Electronics Corporation	New York
	General Distributors: Calvert Electronics International Inc.	New York
Uruguay	Pellmar S.A.	Montevideo
Venezuela	English Electric-Marconi de Venezuela C.A.	Caracas
Vietnam	International Group Ltd.	Saigon

EQUIVALENTS INDEX

Type to be replaced	EEV replacement	Sect.
2J42	2J42	X
2J42A	6027	X
2J42H	2J42H	X
2J55	2J55	X
2J70B	M5063/2J70B	S
4J31	4J31	S
4J32	4J32	S
4J33	4J33	S
4J34	4J34	S
4J35	4J35	S
4J43	4J43	S
4J44	4J44	S
4J50*	4J50A	X
4J50A	4J50A	X
4J52A	4J52A	X
4J53	4J53	S
5586	5586	S
5586A	5586A	S
5657	5657	S
6027	6027	X
6027H	6027H	X
6972	M575	X
7028	M599B	X
7182	7182	S
8356	8356	X

Type to be replaced	EEV replacement	Sect.
8684	BM25L	CW
BM25LB	BM25LB	CW
BM25LC	BM25LC	CW
BM25LD	BM25LD	CW
BM1001	M5015	S
BM1001A	M5015	S
BM1002	BM1002	X
BM1003	BM1003	S
BM1004	BM1004	S
BM1005	BM1005	S
BM1031	BM1031	X
CV513	4J53	S
CV1747	M505	X
CV1866	2J42	X
CV1897	4J34	S
CV1898	4J35	S
CV1914	4J31	S
CV1916	4J33	S
CV2186	BM1031	X
CV2281	M537A	X
CV2284	4J50A	X
CV2362	M525	S
CV2363	M525	S
CV2364	M525	S
CV2365	M525	S

* Near equivalent

Type to be replaced	EEV replacement	Sect.
CV2366	M525	S
CV2367	M525	S
CV2368	M525	S
CV2376	M521	X
CV2412	M523	†
CV2424	M549	†
CV2425	M539	†
CV2426	M529	†
CV2473	M538A	X
CV2744	4J34	S
CV3528	M513A	X
CV3611	5586	S
CV3676	2J42	X
CV3958	5657	S
CV3982	M506A	X
CV3997	M513B	X
CV5018	4J52A	X
CV5135	6027	X
CV6108	M537A	X
CV8002	M579	S
CV8505	8356	X
CV8904*	M577B	S
CV8905	M595B	S
CV9424	M5005	X
CV10210	M577B	S
CV10758	M599B	X
CV11154	M5035	S
EM15LS	BM25L	CW
ES105	M5063/2J70B	S
JP9–2.5D	M599A	X

Type to be replaced	EEV replacement	Sect.
JP9–2.5E	M599B	X
JP9–2.5F	M599A	X
JP9–7	2J42	X
JP9–7D	M503A	X
JP9–15	M513B	X
JP9–15B	BM1002	X
JP9–18	M598B	X
JP9–50A	2J55	X
JP9–75	M575	X
JP9–80	4J52A	X
JP9–250	4J50A	X
JP9–250B	M529	†
JP9–250D	M539	†
JP9–250E	M549	†
JP9–250F	M538A	X
L3219	M596	X
M502	4J50A	X
M503	M503A	X
M503A	M503A	X
M504	M504	X
M505	M505	X
M506	M506A	X
M506A	M506A	X
M513	M513A	X
M513A	M513A	X
M513B	M513B	X
M515	M515	X
M518A	4J31 to 4J35, 4J53	S
M521	M521	X

* Near equivalent

† Frequency variant of 4J50A. See Tabulated Data, page 5.

Type to be replaced	EEV replacement	Sect.
M523	M523	†
M525	M525	S
M526	2J42	X
M529	M529	†
M536	4J43 and 4J44	S
M537	M537A	X
M537A	M537A	X
M538	M538A	X
M538A	M538A	X
M539	M539	†
M540B	M540B	X
M542	5586	S
M542A	5586A	S
M543	7182	S
M546	M546	†
M547	M547	†
M549	M549	†
M551	4J52A	X
M554	M554	L
M559	8356	X
M561	M561	S
M565	M565	L
M566	M566	S
M569	M569	S
M570	M570	S
M573	M573	S
M574	M574	S
M575	M575	X
M577	M577B	S
M577A	M577B	S

Type to be replaced	EEV replacement	Sect.
M577B	M577B	S
M578	M578B	S
M578A	M578B	S
M578B	M578B	S
M579	M579	S
M581	M581	X
M586	M586	L
M592	M592	X
M595	M595B	S
M595B	M595B	S
M596	M596	X
M597	M597	X
M598B	M598B	X
M599A	M599A	X
M599B	M599B	X
M5005	M5005	X
M5008	M5032	C
M5009	M5033	C
M5015	M5015	S
M5019	M5019	X
M5020	M5020	S
M5022	M5022	X
M5023	M5023	X
M5024	M5024	X
M5025	M5025	X
M5028	M5028	S
M5030	M5030	S
M5032	M5032	C
M5033	M5033	C
M5034	M5034	S

† Frequency variant of 4J50A. See Tabulated Data, page 5.

Type to be replaced	EEV replacement	Sect.
M5035	M5035	S
M5039	M5039	X
M5043	M5043	X
M5044	M5044	X
M5048	M5048	S
M5051	M5051	L
M5052	M5052	L
M5058	M5058	S
M5063	M5063/2J70B	S
MAG3	2J42	X
MAG11	M506A	X
MC567*	M554	L
ME1101	2J42	X
ME1101D	M503A	X
TH4J50A	4J50A	X
TH4J52A	4J52A	X

Type to be replaced	EEV replacement	Sect.
TH1586	5586	S
TH1657	5657	S
TH5586	5586	S
TH5657	5657	S
VT123	5586	S
YJ1040*	8356	X
YJ1060	6027H	X
YJ1070	M537A	X
YJ1071	M597	X
YJ1110	M5023	X
YJ1111	M5024	X
YJ1112	M5025	X
YJ1120	M515	X
YJ1121	M5022	X
YJ1200	M5005	X
YJ1300	M5043	X

* Near equivalent

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 except where indicated

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
M5051††	1250–1310	2.3	39	150	SVAG
M5052††	1305–1365				

** Circular to rectangular waveguide transition section available
†† Tunable

PULSE MAGNETRONS Fixed frequency types except where indicated
S-Band (2.5 to 4.1GHz)

		Typical operation			
Type	Frequency range (MHz)	Peak output power (kW)	Peak anode voltage (kV)	Peak anode current (A)	Class (see page 6)
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
5586A††	2700–2900				
5657††	2900–3100				
7182	2750–2860	2500	35	157	EWAX
BM1003	3034–3052	2000	43	90	SWGG
BM1004	2989–3007				
BM1005	2944–2962				
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

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)
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
M5020	3040–3060	25	8.0	8.0	PANG
M5028††	2851–2861	5000	51	240	EWAZ
M5030†† **M5034††**	2900–3050 3050–3200	1000	33	70	PAG
M5035††	2900–3100	1000	30	70	SAC
M5048††	2900–3000	1200	33	70	PVAG
M5058††	2994–3002	1300	36	70	SWG
M5063/2J70B	3025–3075	50	9.0	15	PANG

PULSE MAGNETRONS Fixed frequency types

C-Band (4.1 to 7.0GHz)

M5032 **M5033**	5250–5350 5430–5530	840	34	60	EWAZ

†† Tunable

PULSE MAGNETRONS Fixed frequency types

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	12.5	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	7.2	7.5	PAG
8356	9345–9405	20	7.2	7.5	PANG
BM1002	9415–9475	21	7.8	8.0	PAG
BM1031	9420–9500	40	13	10	SAG
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
M513A	9345–9405	22	7.6	7.5	PANG
M513B	9345–9405	22	7.6	7.5	PANG
M515	9380–9440	25	8.2	8.0	PANG

Continued on page 5

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)
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
M540B	9345–9405	22	7.6	7.5	PANG
M546*	9700–9850	225	22	25	PAG
M547*	9850–10 000	225	22	25	PAG
M549*	8500–8665	225	22	25	PAG
M575	9345–9405	80	15	15	PAG
M581	9415–9475	65	14	14	PAG
M592	8925–8995	80	15.5	15	PAG
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

Continued on page 6

* Frequency variant of 4J50A. See 4J50A data sheet for all other information

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)
M599A **M599B**	9415–9475	4.0	3.6	3.0	PNG
M5005	9345–9405	53	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
M5039	9345–9405	25	8.2	8.0	PANG
M5043 **M5044**	9380–9440 9415–9475	7.5	4.35	5.0	PNG

CLASS

Magnetic Field

E Electromagnet
P Packaged integral magnet
S Separate magnet (not supplied)

Cooling

A Forced-air
AN Forced-air or natural
N Natural
VA Vapour and forced-air
W Water
WA Water and forced-air

Output

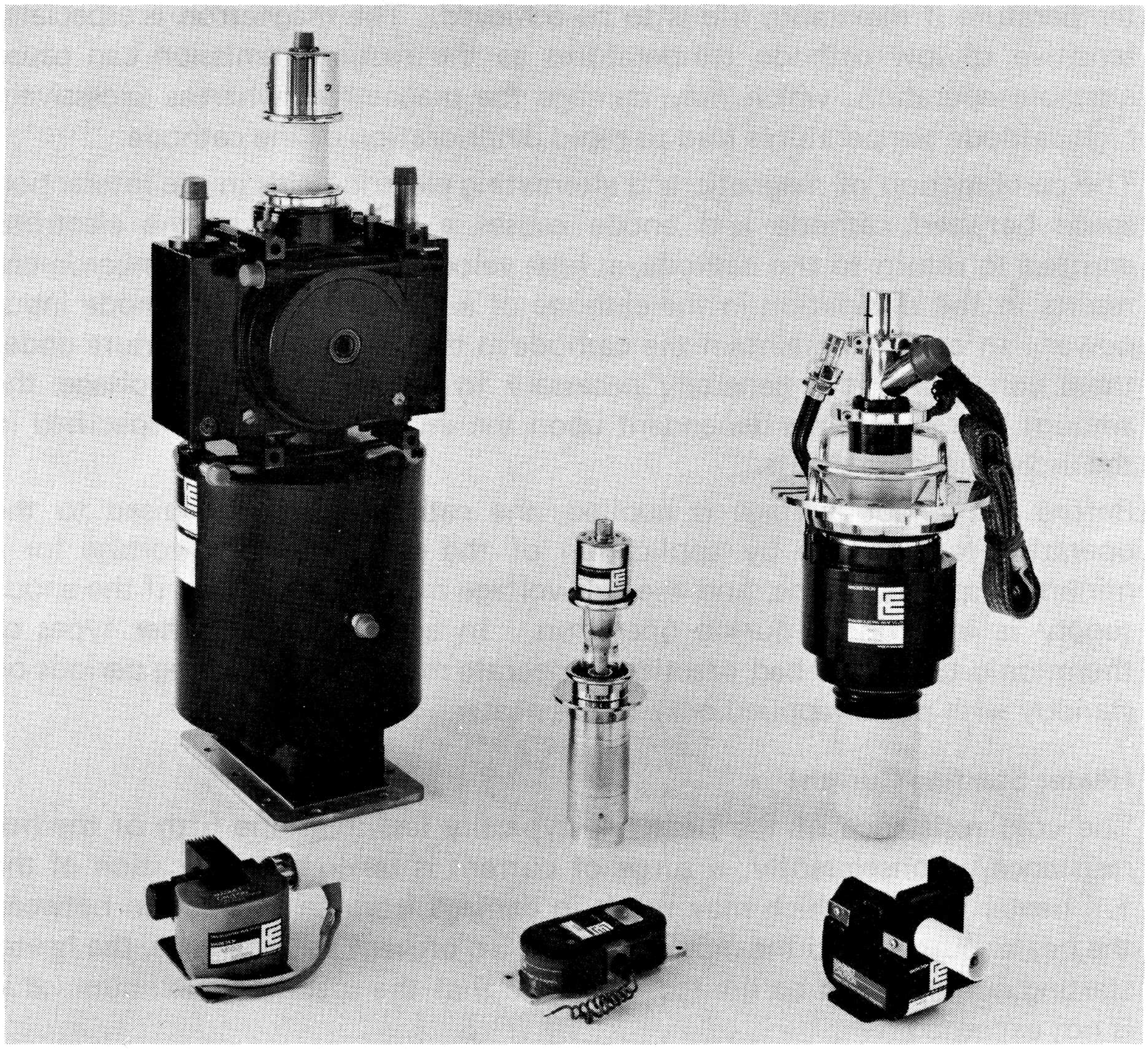
C Coaxial
G Waveguide
GG Waveguide output not sold with this valve
X Requires electromagnet with coaxial-to-waveguide launching section
Z Requires electromagnet with waveguide launching section

PREAMBLE

MAGNETRONS

INTRODUCTION

The magnetron is widely used as the high power transmitter in pulsed radar equipments and the Preamble has been written with this particular application in mind. However it does apply in general to all pulse magnetrons, both fixed frequency and tunable, when they are used for other purposes. Although c.w. magnetrons operate under rather different conditions, precautions similar to those described herein are still relevant.



A selection from the range of EEV magnetrons

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 (1962): The Use of Electronic Valves.)

The operating conditions for magnetrons are inter-related in the ways described below, and it is important that all operating conditions remain within the specified limits when any alteration is made to one of them.

OPERATING NOTES

Cathode Temperature

The thermionic cathodes used in magnetrons must be operated at the correct temperature if maximum life is to be achieved. The magnetron is especially sensitive to low cathode temperatures as the reduced emission can cause unstable operation, which may damage the magnetron, whereas excessively high cathode temperatures lead to rapid deterioration of the cathode.

The combination of magnetic and alternating electric fields in the interaction space between cathode and anode causes a proportion of the electrons emitted to return to the cathode, at high velocities. This back bombardment results in the dissipation in the cathode of a proportion of the anode input power. In order to maintain the cathode at the optimum temperature under these conditions, it is generally necessary to reduce the heater voltage; the amount of reduction is dependent upon the input power and is specified in the individual data sheets.

Before the anode voltage is applied, the cathode must be raised to the operating temperature by application of the nominal heater voltage for a minimum specified time; and the full voltage must be re-applied if the anode supply is interrupted during operation. In common with other types of thermionic tube, it is bad practice to operate magnetrons for long periods on standby with power applied only to the heater.

Heater Starting Current

The cold resistance of the heater is typically less than one fifth of the hot resistance. Consequently, a 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 maximum value is not exceeded.

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 if 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 from the pulse transformer 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 (preferably several different values of capacitance in parallel) to minimise the effect of the capacitor lead inductance.

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

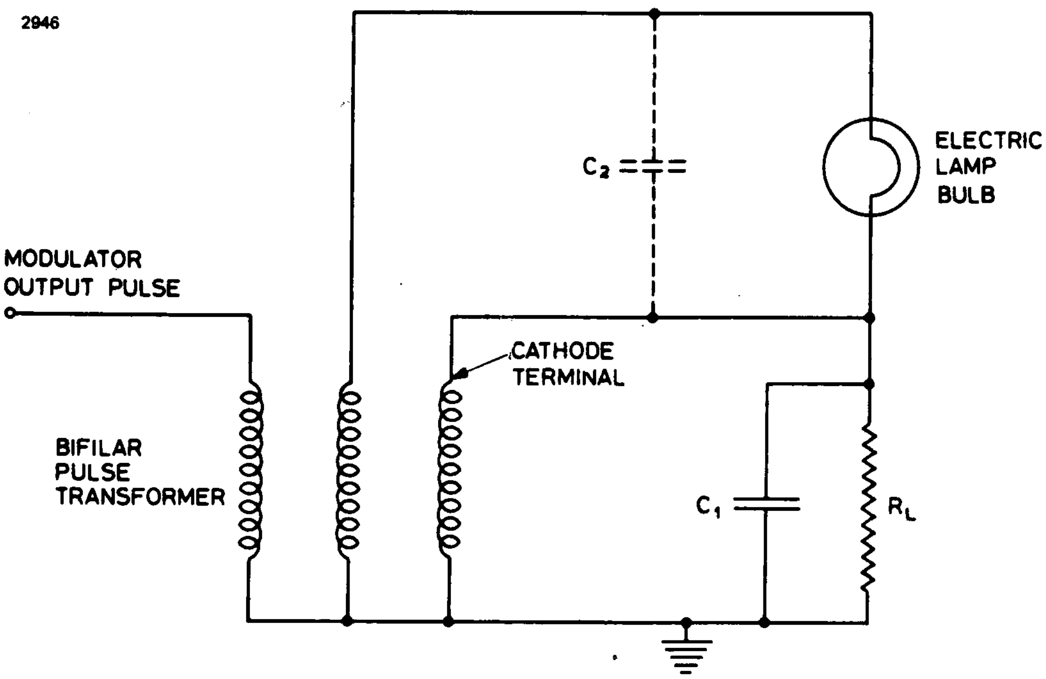


Fig. 1. Heater dissipation test circuit

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 in the lamp. 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.

An alternative method, which may be more convenient, is to measure the r.m.s. and average values of the heater current simultaneously. Any pulse energy coupled into the heater will modify the ratio of these values (1.1.for a sinusoidal waveform).

Frequency of heater supply

The frequency of heater supply (fundamental or harmonic) may excite mechanical resonances of the heater structure which can cause failure. If frequencies other than those quoted in the test specification are to be used, English Electric Valve Company Ltd. should be consulted.

For some uses, d.c. or a.c. synchronized with the pulse repetition frequency may have to be used to avoid frequency modulation of the r.f. output.

Magnetic Field

The magnetic field required for magnetron operation may be provided either by a separate electro-magnet, or by a permanent magnet which may be separate or packaged as part of the magnetron.

Electro-magnets are used mainly for the long-anode types of magnetron, which require the magnetic field to be within specified limits over the full length of the anode. In most cases, suitable electro-magnets are available from English Electric Valve Company Ltd. and a waveguide launching section is usually combined with the structure of the magnet.

Variations in the magnetic field will result in changes in the operating characteristics of the magnetron. It is usually necessary to keep the electro-magnet current within ±5% of the design value at all times and to limit the ripple to 1.5%. The magnet coils have considerable inductance and if supplied from a three phase full wave rectifier, additional smoothing should not be needed.

Many of the permanent magnet types are made with the magnet as a separate item; the magnets for these magnetrons are not normally supplied by English Electric Valve Company Ltd. but the data sheets give details of the magnetic field and pole piece design. Users are invited to consult the Company on the choice of magnets.

The field strength of permanent magnets may be decreased by mechanical shock, close proximity of ferro-magnetic materials, and stray magnetic fields. The effect of decreasing the magnetic field 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 characteristics are such that, unless it is adjusted, any reduction in magnetron 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.

Impedance Characteristics

The magnetron has an extremely non-linear current-voltage characteristic; once oscillation starts the anode voltage is almost constant over a wide range of current. The dynamic impedance near the typical operating current may be less than one tenth of the static impedance value (see Fig. 2).

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 in Fig. 2 in which AB is a typical V/I curve. As the V/I curve is nearly horizontal, any change in the

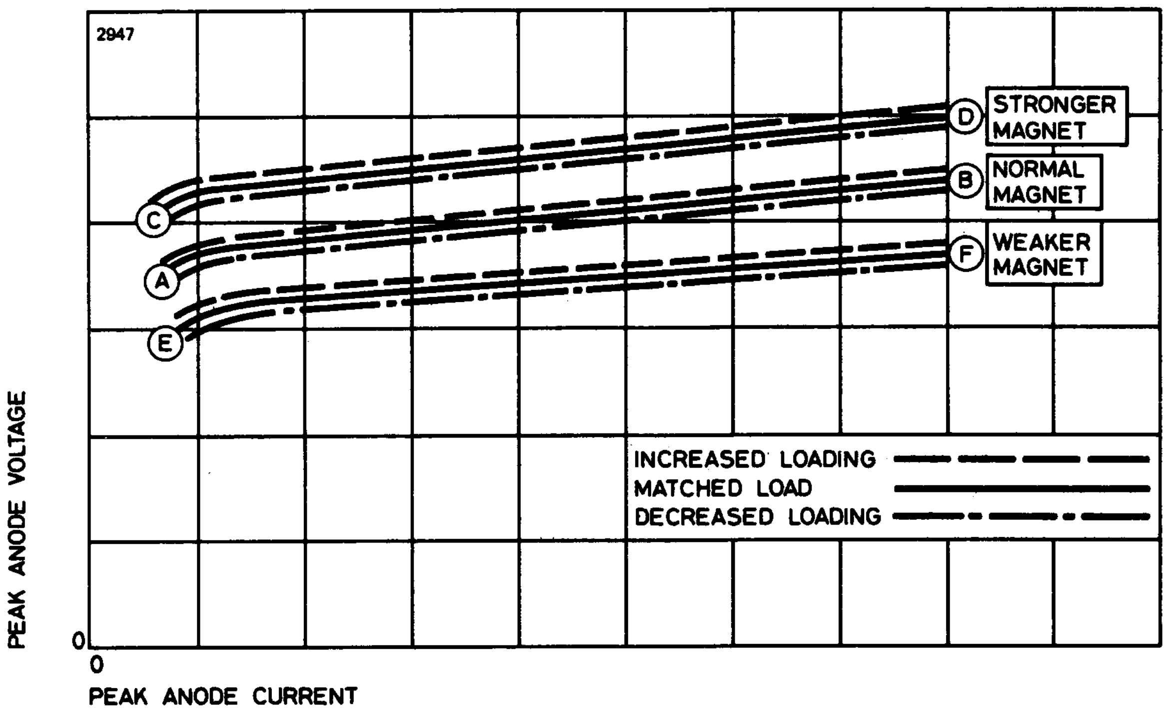


Fig. 2. Magnetron impedance characteristics

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 noticeably.

If the magnetic field is increased, the V/I curve will move upwards to CD, whereas if the field is reduced 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 of 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 will move from PR to LN, giving the new operating point M at

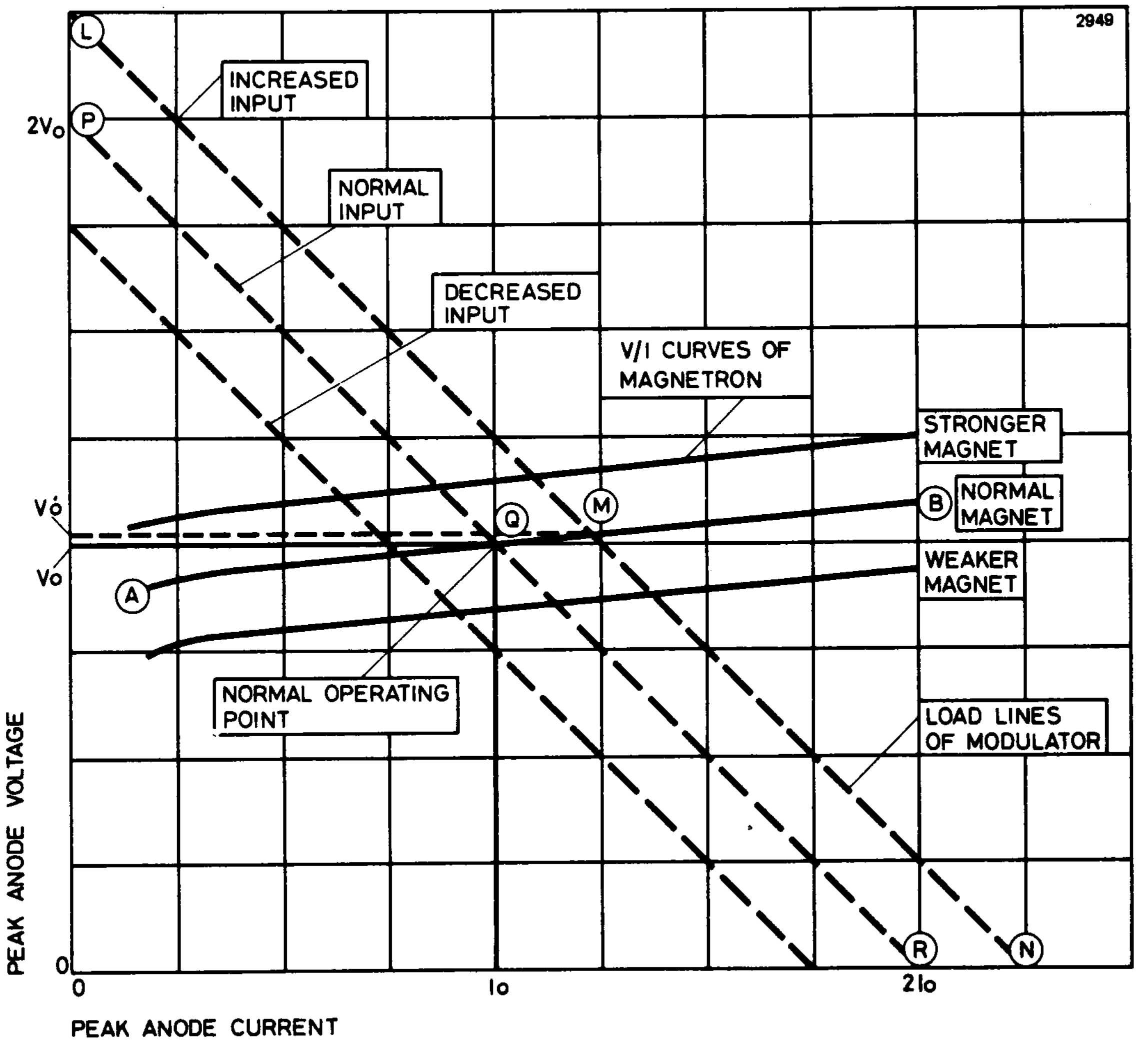


Fig. 3. Line type modulator characteristics

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.

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 at the normal operating current can be quite low – of the order of a hundred ohms (see Fig. 4). Two basic types of operation of hard valve modulators are

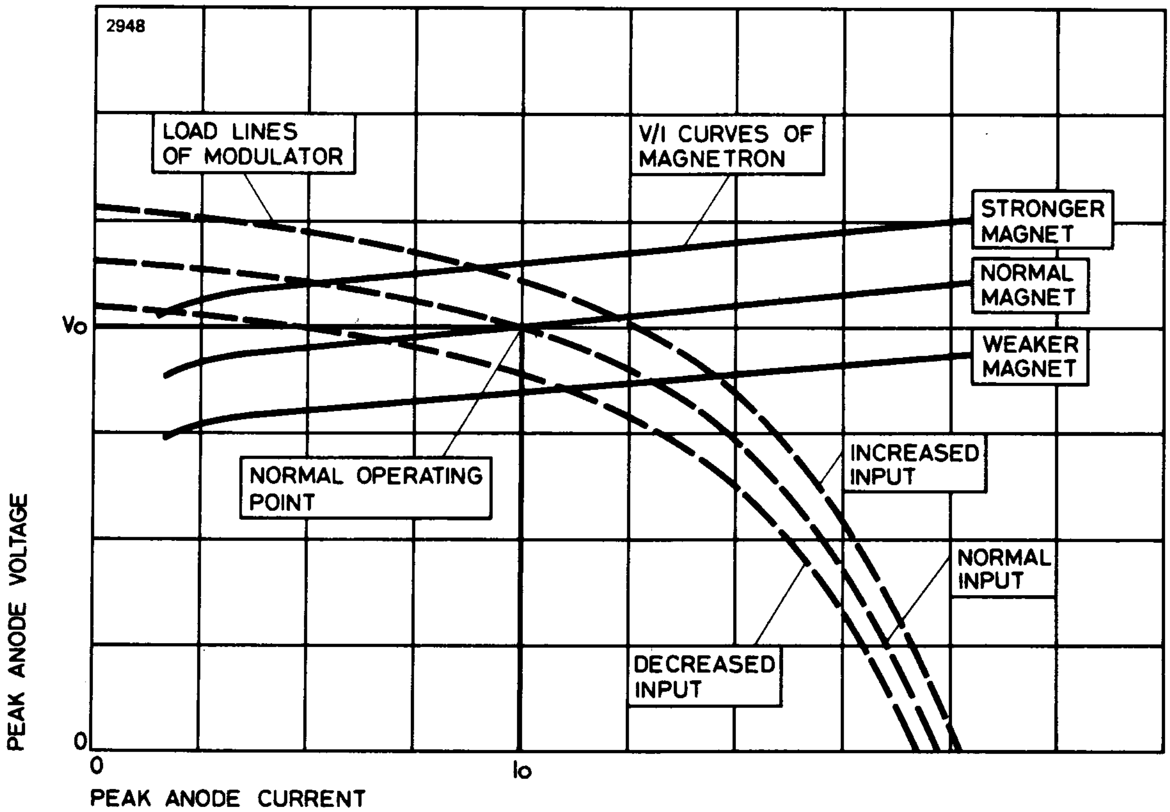


Fig. 4. Hard valve modulator characteristics

commonly used: Type 'A'. above the knee of the tetrode characteristic and type 'B' below the knee where the Ia/Va slope is steep. Where good regulation of tetrode power supplies is not possible it is advisable to use type 'A' operation even though the tetrode voltage drop will be greater in this case. This will minimize the large changes in magnetron current which might be experienced due to power supply regulation as the pulse repetition frequency is varied or the mains input voltage changes.

Under these conditions, it will probably be necessary to adjust the input to the modulator to give the correct anode current 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, following an arcing pulse, does not greatly exceed the normal.

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 (see Fig. 5).

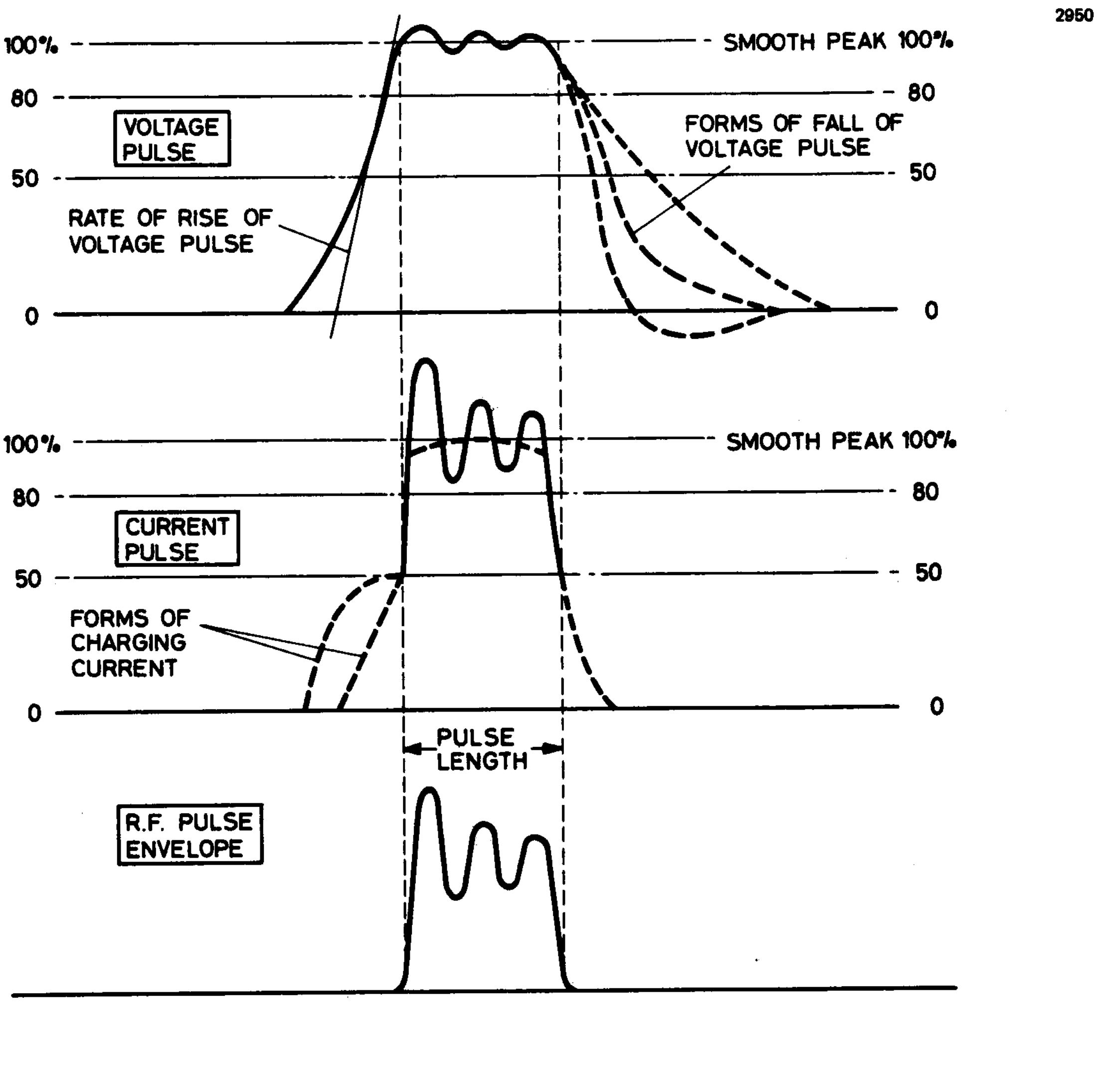


Fig. 5. Pulse waveforms

(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 unwanted mode, and even if this does not happen it can lead to a substantial reduction in life. 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.

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.

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 to 10% or less.

Cooling

Pulse magnetrons usually dissipate appreciable amounts of power at the anode, typically half of the mean input power, so that most types require some form of assisted cooling. Maximum temperature ratings are usually given for the anode and the cathode terminal assembly. In some cases data sheets give full details of the cooling requirements but for many of the smaller types natural convection cooling may be sufficient, depending on the layout of the equipment around the magnetron and other individual factors; in these cases only the temperature ratings are quoted. At higher power levels, the output window of the magnetron may also require cooling. Where assisted cooling is required for the cathode insulator, output window or tuner assembly, the data sheet will generally give full details.

Air cooling systems must have adequate cooling capacity to allow for variations in ambient temperature and, where appropriate, altitude. It may also be necessary to filter the air.

Water cooling is used for the anodes and electro-magnets of many high power magnetrons; the water used must be free from impurities so that no measurable furring occurs when it is heated. If anti-freeze additives are used they must not be corrosive to brass or copper. Vapour phase cooling can also be used, with the advantage of greater frequency stability by virtue of the nearly constant anode temperature over a wide range of dissipation levels. Variations in atmospheric pressure, however, will affect the temperature of a vapour-cooled anode.

Protection Devices

If a magnetron is to achieve its full life expectancy in an equipment, it must be protected from the consequences both of its own minor malfunctions and of failures in associated components. This is especially important in high power equipments, where dissipation levels may be so high as to ensure rapid destruction of the magnetron if operated incorrectly.

The following list of protection requirements is included as an indication of what may be necessary; it applies to a high power, tunable magnetron operating in an electro-magnet, water cooling being used for both the magnet and the anode of the tube.

a) If the magnetron presents either a short circuit or an open circuit to a pulse or group of pulses, the modulator must not deliver appreciably more than the normal pulse energy. This may require the following features:
   - (i) a spark gap, to prevent over-voltage
   - (ii) a limitation on the stored energy in the modulator
   - (iii) an interlock, operated by the overswing diode circuit, to cut off the modulator if the magnetron arcs for 25 consecutive pulses.

b) Anode power must also be cut off in the event of:
   - (i) failure of electro-magnet current
   - (ii) anode water flow falling below minimum
   - (iii) anode water outlet temperature exceeding maximum
   - (iv) output window air pressure falling below minimum
   - (v) output window air cooling flow falling below minimum

c) In addition, the heater power must be cut off if the anode water fails. The electro-magnet current must be cut off if the electro-magnet water fails.

d) A slipping clutch or similar device must be fitted in the tuner drive, to prevent the application of excessive torque to the tuner.

FACTORS AFFECTING PERFORMANCE

The performance and life of a pulse magnetron are dependent to a large extent upon the conditions imposed upon it by the equipment and environment in which it operates. A number of the more important parameters and the ways in which they may vary are described in this section.

Frequency of Oscillation

The normal oscillating frequency of a magnetron is the resonant frequency of the cavity structure when operating in the π mode – i.e. when fields in adjacent cavities are in antiphase. The magnetron may deviate from this frequency for several reasons and, in general, any such deviation is undesirable.

Thermal Effects The temperature of the anode block directly affects the size, and thereby the resonant frequency, of the cavity structure. The anode temperature at which the frequency is tested may be given in data sheets, and for most tubes a maximum value for the temperature coefficient of frequency is specified.

The anode temperature itself is a function of a great many factors, each of which can therefore have an indirect effect on the frequency; the use of coolant flow rates well above the recommended minimum will reduce the temperature variations. Vapour cooling almost eliminates temperature variations, except that due to the effect of atmospheric pressure changes on the boiling point of the coolant.

Frequency Pushing The oscillating frequency is affected by the electron density in the interaction space of the magnetron, and this is a function of the anode current. If the peak of the current pulse is not flat, this will result in modulation of the frequency as well as the power level.

The data sheets for some types include maximum limits on frequency pushing, expressed in megahertz per ampere over a specified current range. Unless otherwise specified the frequency pushing is measured with the magnetron feeding a matched load, and can be considerably greater under mismatched conditions.

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. The frequency pulling figure is the maximum change of oscillation frequency caused by variation through all phases of reflection from a discontinuity in an otherwise matched output feeder. The v.s.w.r. specified is 1.5:1 for nearly all magnetrons.

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. The effect on a tunable magnetron is a gap in the frequency range which cannot be tuned into from either direction.

To overcome these long line effects, an isolator may be fitted in the output, next to the magnetron.

OUTPUT POWER

The peak output power of a pulse magnetron is the product of the peak input power and the efficiency of the magnetron when oscillating. The input power is determined by the modulator design and is usually variable to some extent; the efficiency depends upon a number of factors of which the most important are the strength and uniformity of the magnetic field, the v.s.w.r. and phase presented to the magnetron by the load, and the shape of the input pulse.

As a general rule, increasing the magnetic field strength will increase the efficiency, both output power and peak voltage increasing while the anode current is reduced (see Figs. 3 and 4). Magnetic field variation is not normally used to control the magnetron, although it may be necessary if it is required to vary the peak output power over a wide range. In other cases the field, whether from permanent or electro-magnets, is set to a fixed value and precautions must be taken to ensure that it is not reduced.

The mismatch presented to a magnetron by its load is limited by a maximum rating, usually to a v.s.w.r. of 1.5:1. Although operation at this maximum rating may not harm the magnetron, it can result in a considerable reduction in output power. In general the load should be designed and adjusted to give a much better match than the maximum rating.

The shape of the voltage pulse may have appreciable influence on the efficiency, particularly if the rates of rise and fall are low enough to permit oscillation in useless modes before or after the main r.f. pulse. In general any departure from a rectangular pulse leads to reduced efficiency, and ripple on the flat peak of the pulse can cause large variations in the instantaneous power level (see Fig. 5).

STABILITY OF OSCILLATION

In the ideal case, every pulse applied to the magnetron would result in an r.f. output pulse of the correct length, power and frequency. In practice, any pulse in which the r.f. energy content in the specified frequency band is less than 70% of the normal value is considered to be missing; there are several ways in which this can happen.

Arcing A magnetron can suffer internal arcs as in other high voltage electron tubes. When this happens, the path of the arc is influenced by the magnetic field but the voltage is so much lower than normal that no useful r.f. power is generated. A small amount of arcing is not dangerous to the magnetron but in extreme cases it lowers the cathode temperature (since there is no back bombardment from an arc) and this increases the probability of further arcs. Persistent arcing for this or any other reason may destroy the magnetron.

Arcing is likely when a magnetron is first operated after a period of storage, and it is advisable to operate at reduced power input until the arcing is reduced to normal levels. Other factors likely to cause arcing are an excessively high rate of rise of voltage and low cathode temperature.

Moding It is usually possible for a magnetron to oscillate in modes other than the preferred π mode, resulting in an r.f. output pulse which is not usable by the system. Moding may be detected by a random incidence of different amplitude voltage or current pulses, or by missing lines on a spectrum analyser display. It can be caused by an equipment fault such as high or low rates of rise of voltage or excessive load mismatch.

Operation in the wrong mode causes increased back bombardment of the cathode which may be harmful over an extended period.

Bandwidth

The frequency spectrum of the r.f. output includes a main lobe of useful power and sidelobes which are useless in most applications. For optimum system performance the main lobe should have a narrow bandwidth and this is usually one of the parameters tested on every magnetron. The pulse shape is particularly important in this respect, as any departure from a flat top results in frequency modulation, and a low rate of fall at the end of the pulse will also contribute to the bandwidth.

Life

Unlike most types of electron tube, it is not usually possible to extend the life of a magnetron by operating at reduced power levels. Maximum life is normally achieved by operating at or near the recommended conditions and maintaining them accurately. Under good conditions, the eventual failure of the tube results from falling cathode emission which causes a fall in output power and increased instability. The magnetron is considered to have reached the end of its life when it no longer meets the specified end of life criteria, although it may be operating satisfactorily in other respects.

MEASUREMENT OF OPERATING CONDITIONS AND PERFORMANCE

During the development of a magnetron installation it may be necessary to measure as many parameters as possible, but once an equipment is in service measurements are normally limited to monitoring values which determine the end of life. Pulse operation leads to difficulty in measuring some of the more important parameters and it is necessary to use the same methods as the tube manufacturer when working to a specification.

It cannot be emphasized too strongly that a magnetron is a highly non-linear device, and any measurements carried out with a dummy load substituted for the magnetron should be regarded as a first-order approximation only.

Heater Voltage

For high power magnetrons, it is advisable to measure the heater voltage individually at the terminals on the magnetron, and adjust if necessary to the specified values. This is less important with low power types but should be done if practicable. If a saturable reactor is used to control the heater voltage, the true r.m.s. value must be measured regardless of waveform distortion.

Anode Voltage

A simple peak-reading diode voltmeter is used for this measurement; if accuracies better than ±3% are required it is necessary to allow for the pulse characteristics when calibrating the meter.

Anode Current

Test specifications are usually written in terms of average, rather than peak, anode current. The average current is measured quite simply with a meter in the cathode circuit (with appropriate pulse bypass capacitors), but if it is required to measure the peak current, or observe the current waveform, a small non-inductive resistance must be placed between the magnetron anode and its mounting. This may be difficult to arrange and a display of the rectified r.f. pulse will often give all the information that is needed.

Frequency

A cavity wavemeter is adequate for most radar applications, as it gives an accuracy of ±0.01% (i.e. within 1MHz at X-band).

Frequency Pushing

In order to eliminate thermal effects from the measurement, it is necessary to maintain a constant anode temperature by varying the anode current rapidly about the normal operating value. This may be done by applying alternate pulses at two current levels, and the frequency change must be measured by an equipment with a suitably rapid response, such as a spectrum analyser.

Anode Temperature

The anode temperature of a magnetron can readily be measured with a thermocouple while operating, since the anode is normally at earth potential. Many of the lower power magnetrons can operate with convection cooling only if the natural convection is not obstructed, and it is particularly important to check the operating temperatures of all parts of these types when new or modified equipment is developed.

Output Power

The peak output power of a pulse magnetron cannot be measured directly; many specifications are based on the average output power which can be measured accurately in a calorimeter. Bolometer or thermistor loads can be used although they require careful calibration, but crystal detectors are too unstable for power measurement. A monitor diode may be used to give an indication of power output and a display of the r.f. pulse shape.

Rate of Rise of Voltage

A special definition of rate of rise is used for this purpose, to suit the characteristics of the pulse magnetron. It is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude, as measured on an oscilloscope display (see Fig. 5).

This measurement should be made on a broad-band system with a low input capacitance (6pF or less) and high impedance. The rate of rise of voltage is a very important parameter in magnetron operation and should be accurately measured during the development of an equipment.

Pulse Length

The pulse length should be measured on either the current pulse or the r.f. pulse envelope at 50% amplitude.

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 for reliable contact, but not so rigid that the glass to metal seals are strained. The cathode and heater terminals may operate at a relatively high temperature and provision must be made for thermal expansion. To prevent anode current and transients passing through the heater and possibly 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 glass or ceramic vacuum seals may result. Any mechanical pressure should be applied uniformly and a section of flexible waveguide should be fitted close to the magnetron.

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.

WARNING

All magnetrons operate with anode voltages high enough to be lethal and suitable safety interlocks should be provided. In many cases radiation hazards may also be significant.

R.F. Leakage

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.

If the cathode sidearm is completely screened care must be taken that the screening does not cause overheating. The cathode sidearm temperature may be monitored by the use of temperature sensitive paints.

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 X-rays can constitute a health hazard unless adequate shielding is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than the anode voltage applied.

C.W. Magnetrons

BM25L

C.W. MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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 (Absolute values)

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	100	lb/in^2 max
	6.9	kg/cm^2 max

TYPICAL OPERATION

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.

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
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 pre-heated 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, if 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

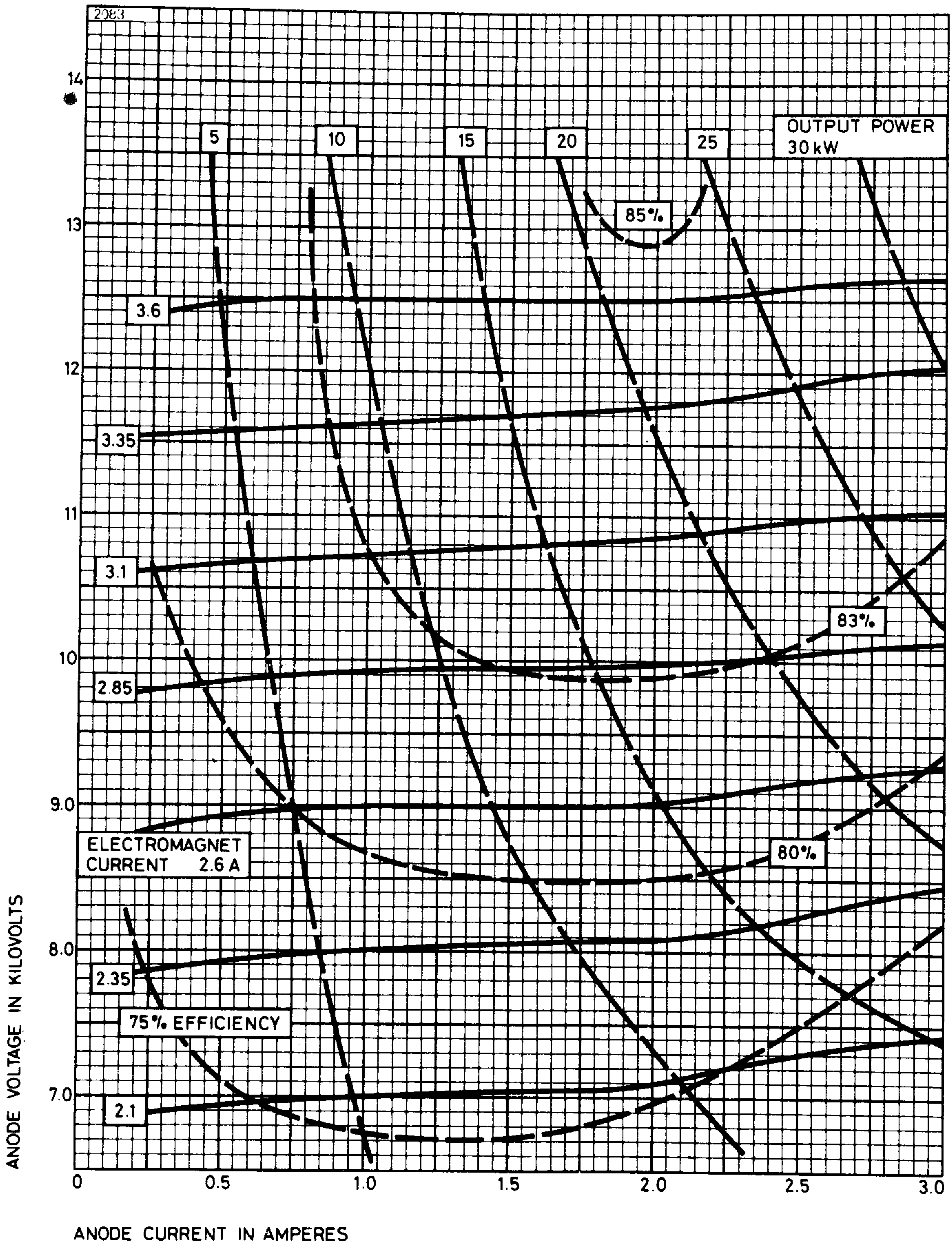
Care should be taken to protect the valve from excessive shocks during and after installation, with particular regard to the metal-ceramic seals.

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.

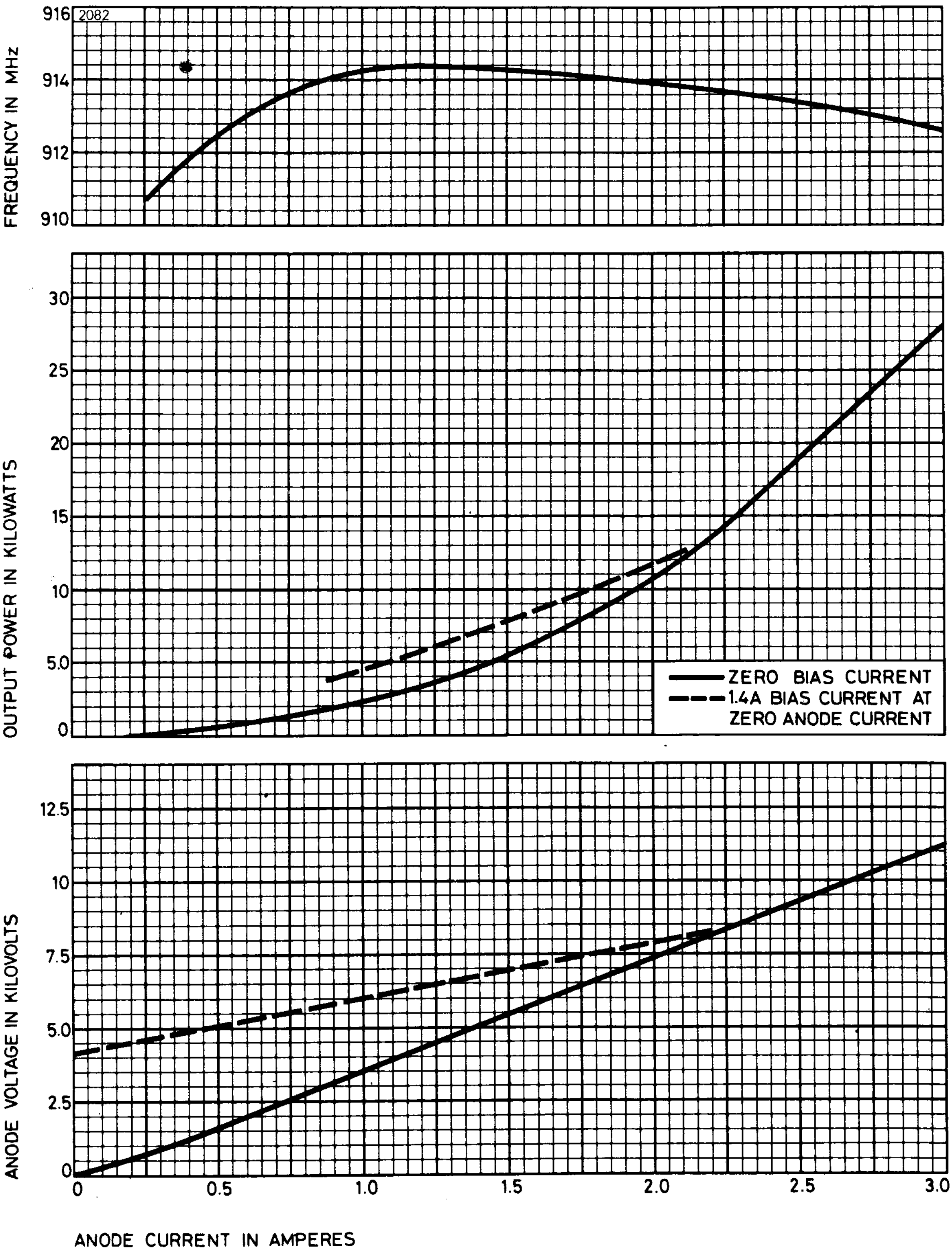
The domed output window is cooled by air ducted through an insulating cylinder, and it is necessary to ensure that the cylinder is concentric with the dome.

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.

TYPICAL PERFORMANCE CHART

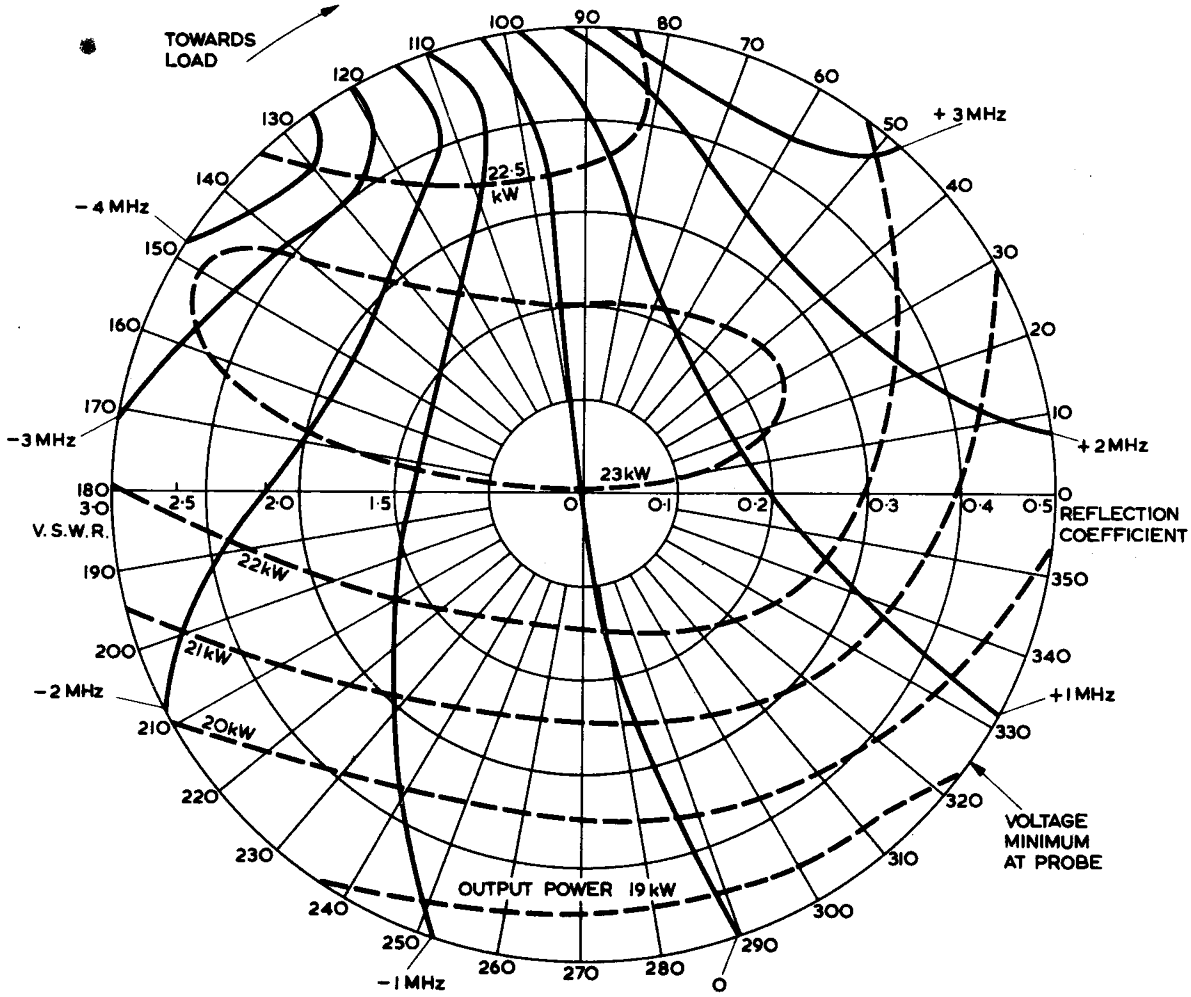


TYPICAL PERFORMANCE CHART WITH SERIES FIELD

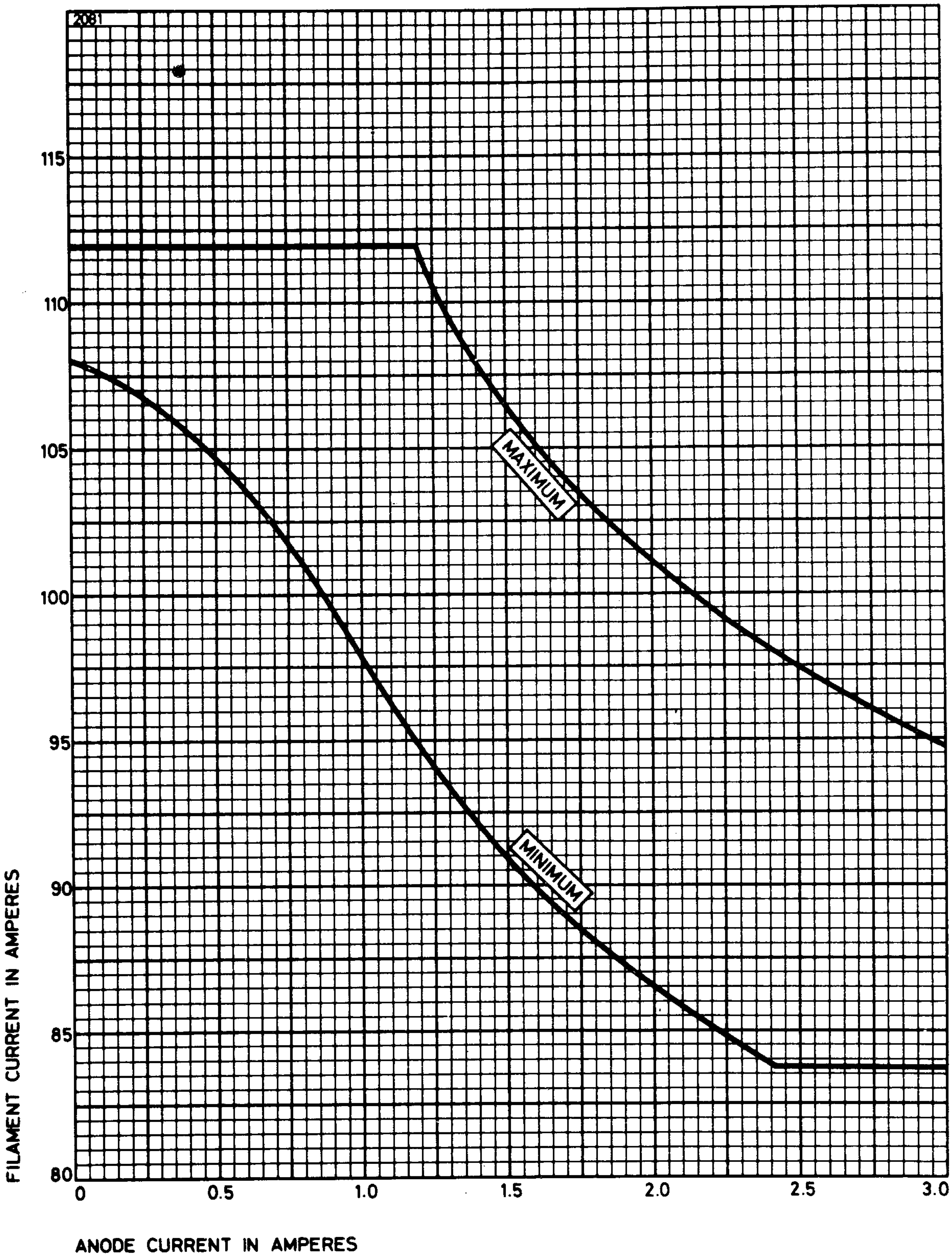


TYPICAL RIEKE DIAGRAM WITH SERIES FIELD

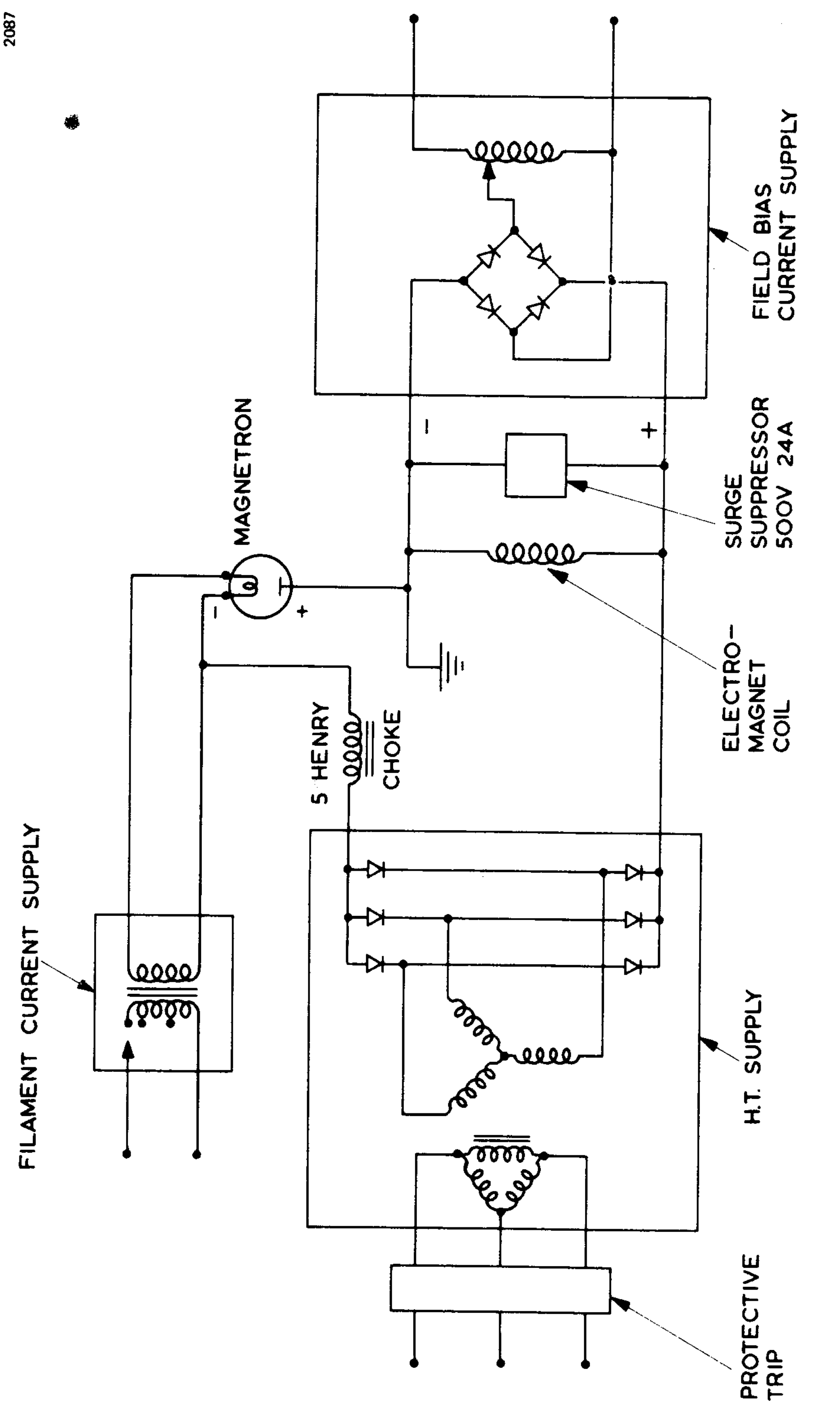
2084



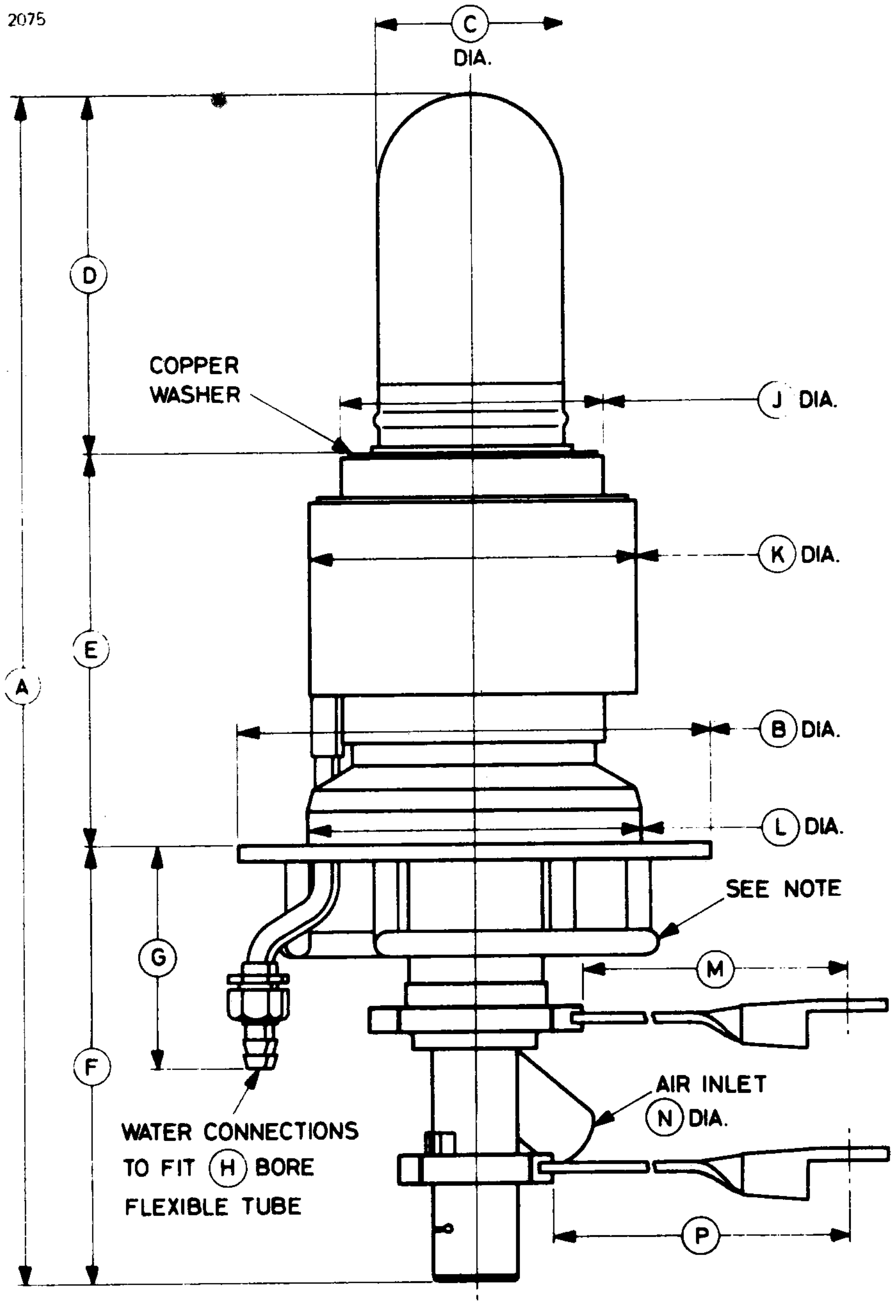
HEATER CURRENT LIMITS



TYPICAL CIRCUIT



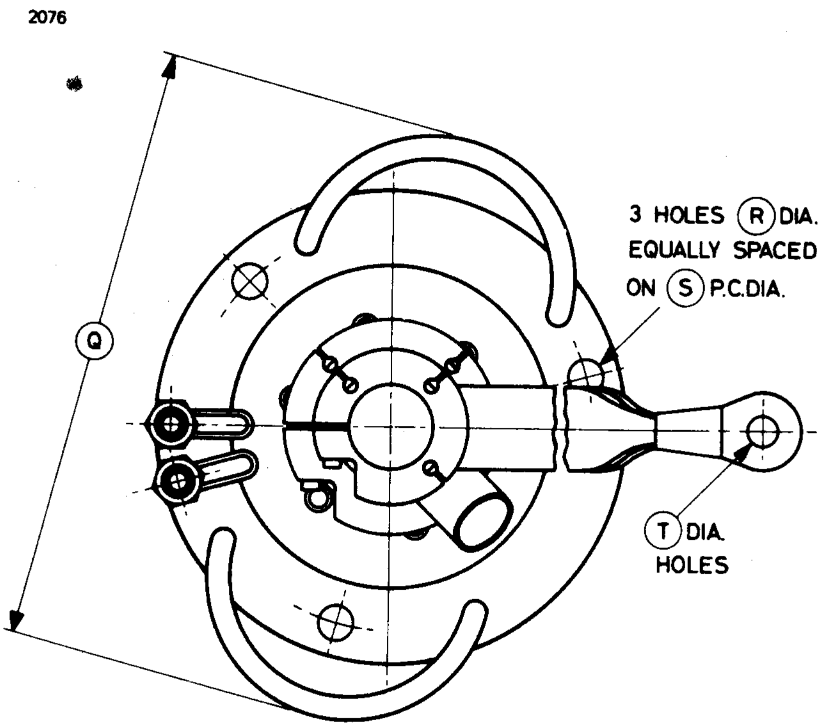
OUTLINE OF BM25LD



Note

Handles to facilitate handling and transit of magnetron, readily removable before installation if so required.

OUTLINE OF BM25LD
(All dimensions without limits are nominal)

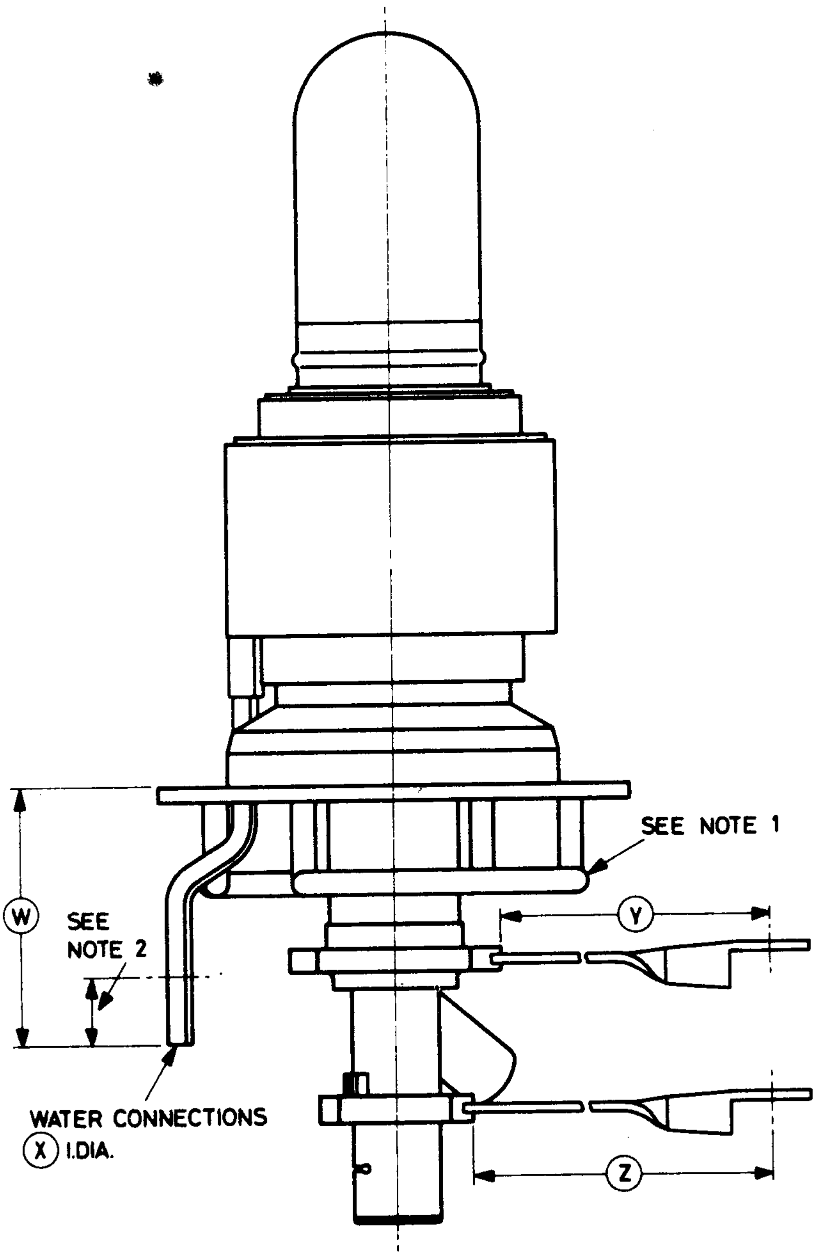


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	17.500 max	444.5 max	K	4.900 max	124.5 max
B	7.000 ± 0.030	177.8 ± 0.76	L	4.960 max	126.0 max
C	2.750	69.85	M	20.000	508.0
D	5.000	127.0	N	1.000	25.40
E	5.745 min	145.9 min	P	24.000	609.6
F	6.500 max	165.1 max	Q	9.000 max	228.6 max
G	3.250	82.55	R	0.437	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

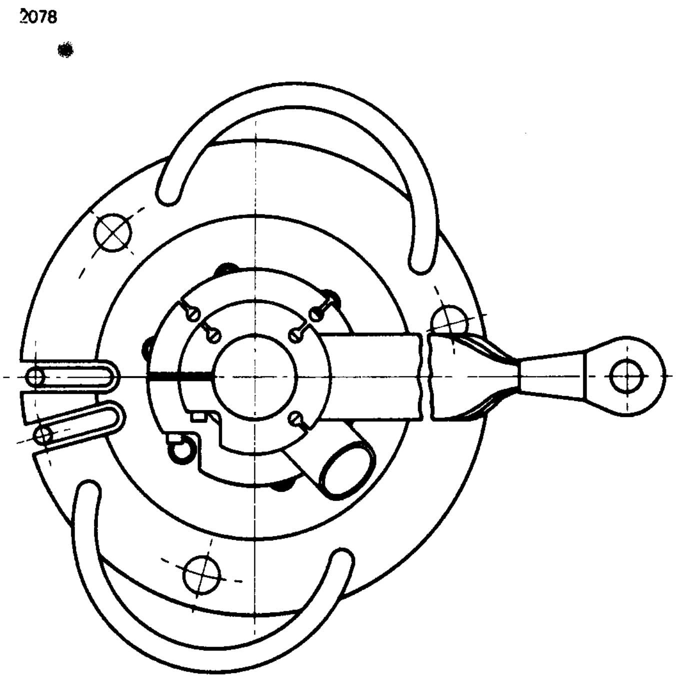
2077



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
(All dimensions without limits are nominal)

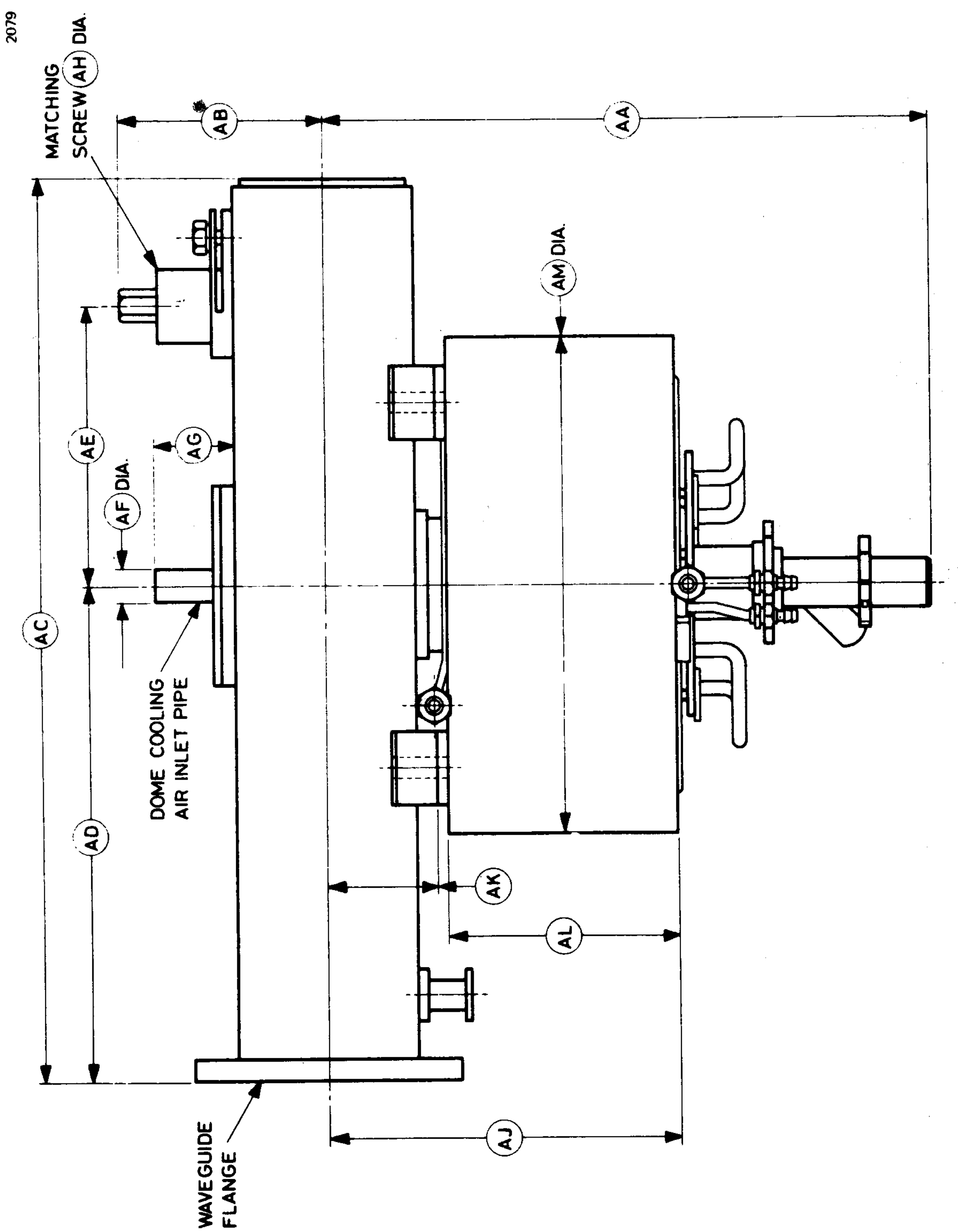


Ref	Inches	Millimetres
W	3.750	95.25
X	0.312	7.92
Y	10.500	266.7
Z	10.000	254.0

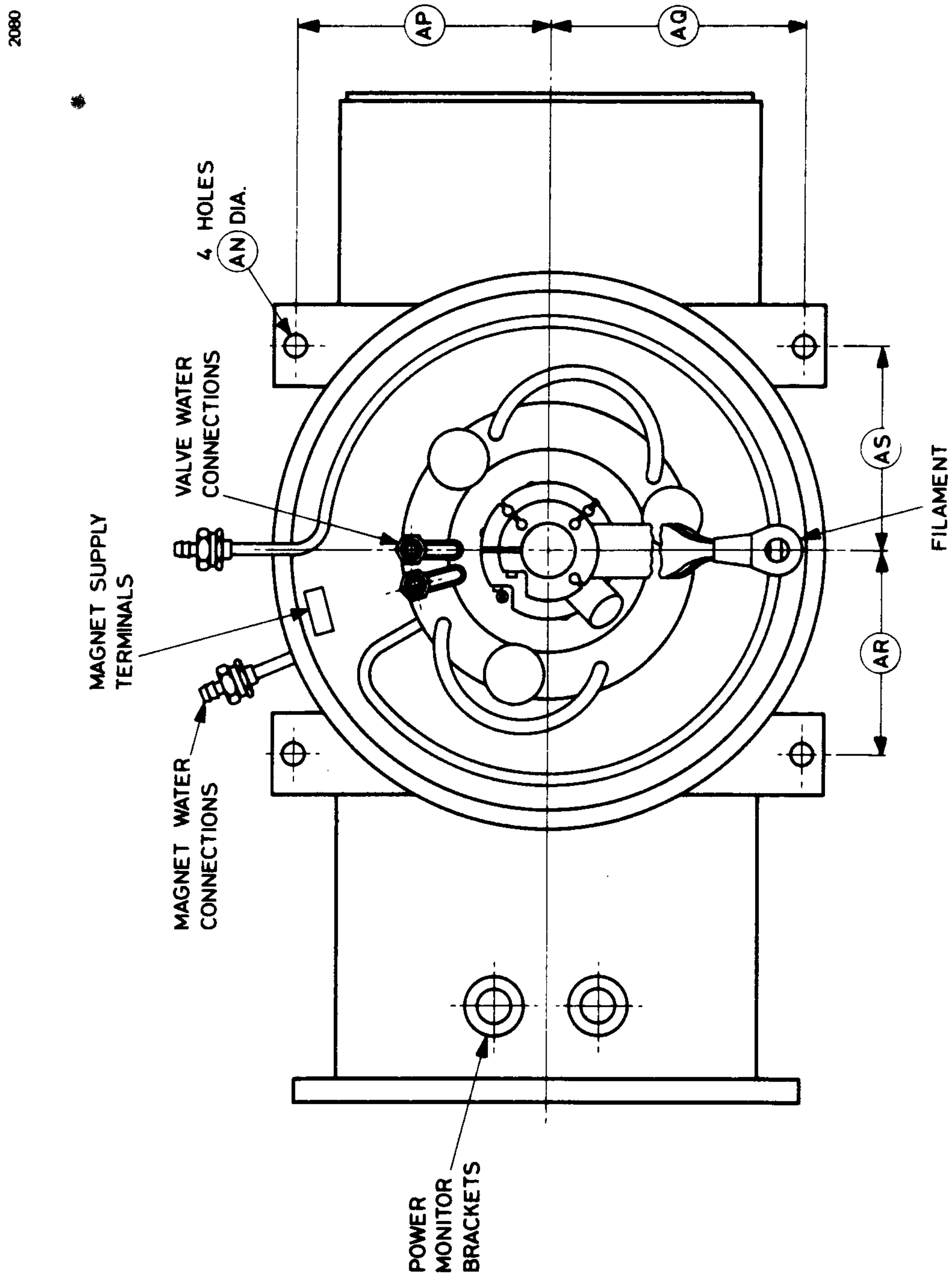
Millimetre dimensions have been derived from inches.

All other dimensions as for BM25LD.

OUTLINE OF M4122



OUTLINE OF M4122



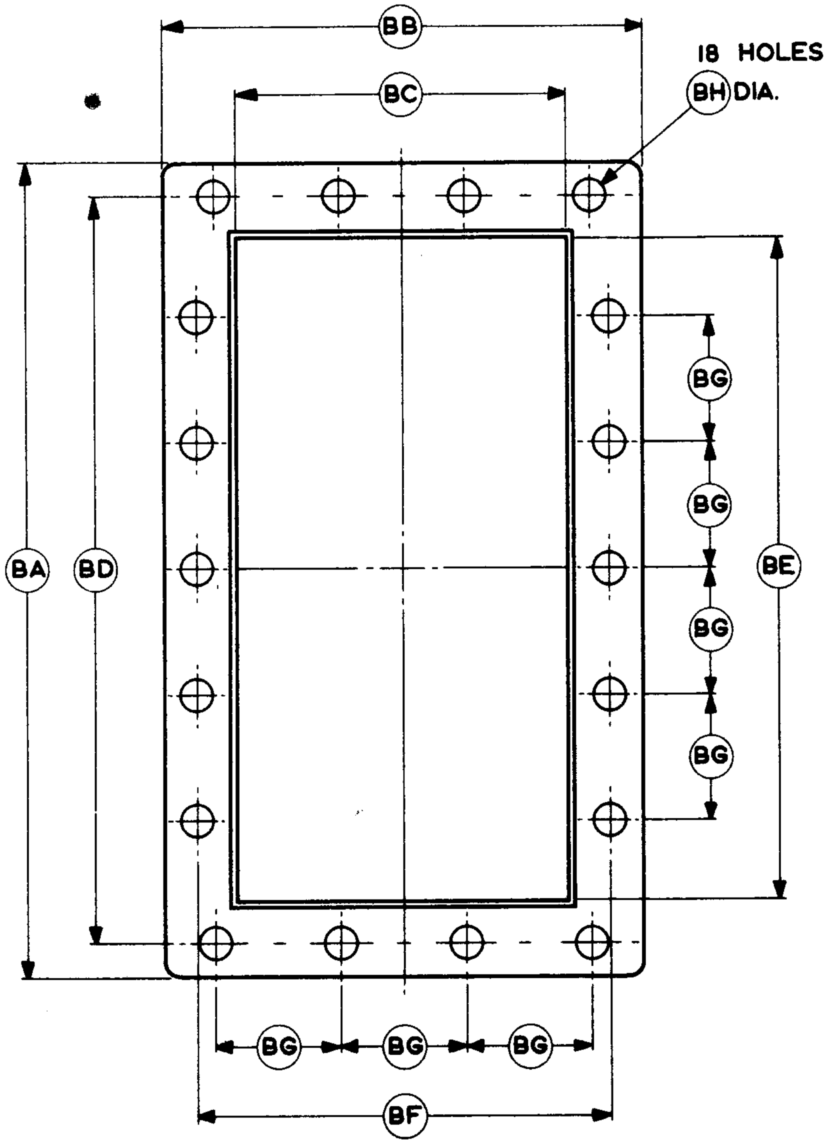
Outline Dimensions for M4122 (All dimensions nominal)

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 (All dimensions nominal)

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.

Pulse Magnetrons, L-Band

M554

L-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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	–	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	1295 to 1365	MHz

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 $\pm$ 0.187 inches (386.41 $\pm$ 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:

$$P_i = i_{apk} \times v_{apk} \times D_u$$

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 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.

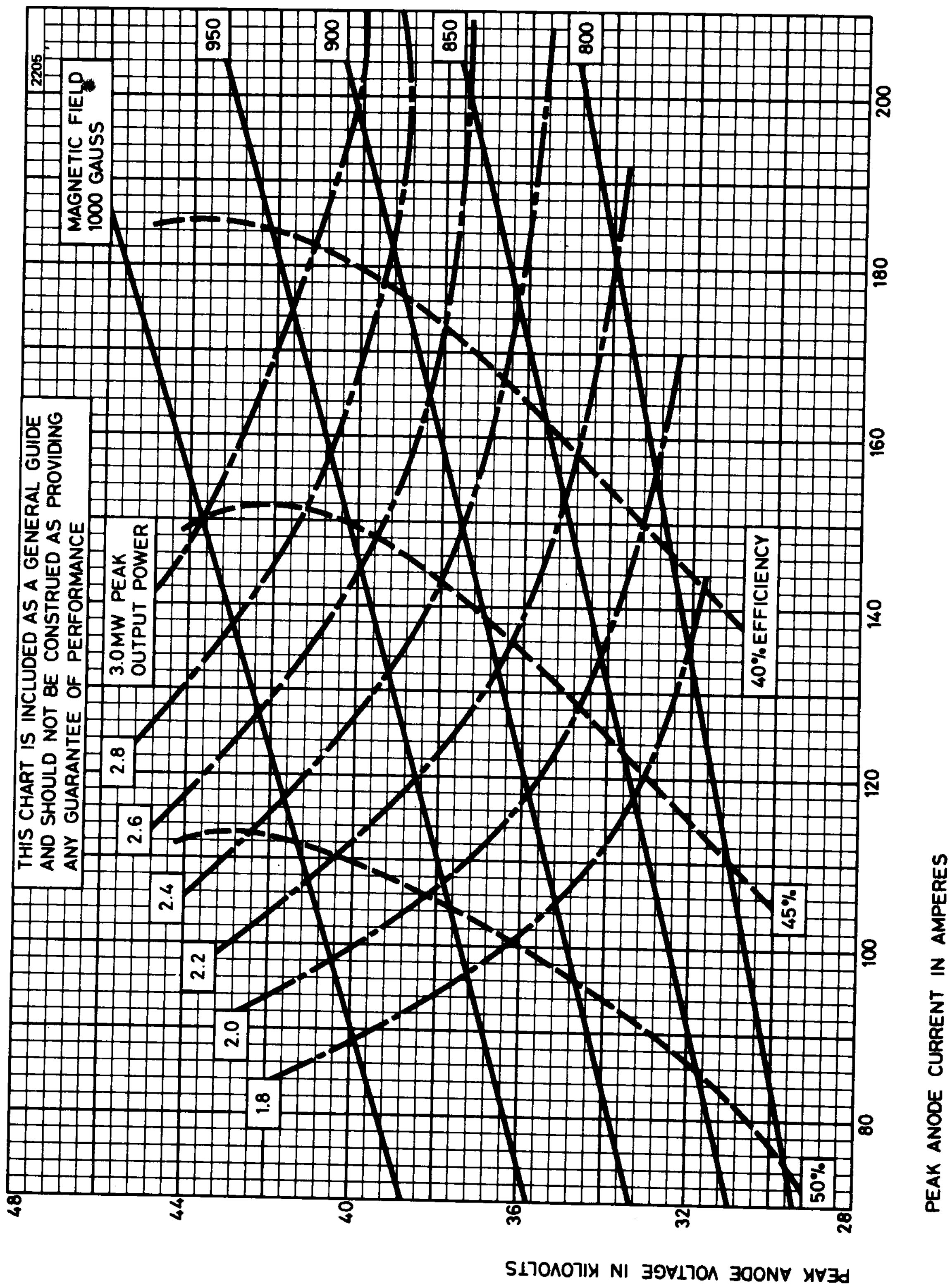
12. The heater current, measured with heater voltage of 20V and no anode input power, will be within the range 12 to 15A.

13. Design test only. The frequency change with anode temperature change after warm-up will not exceed –0.035MHz/°C.

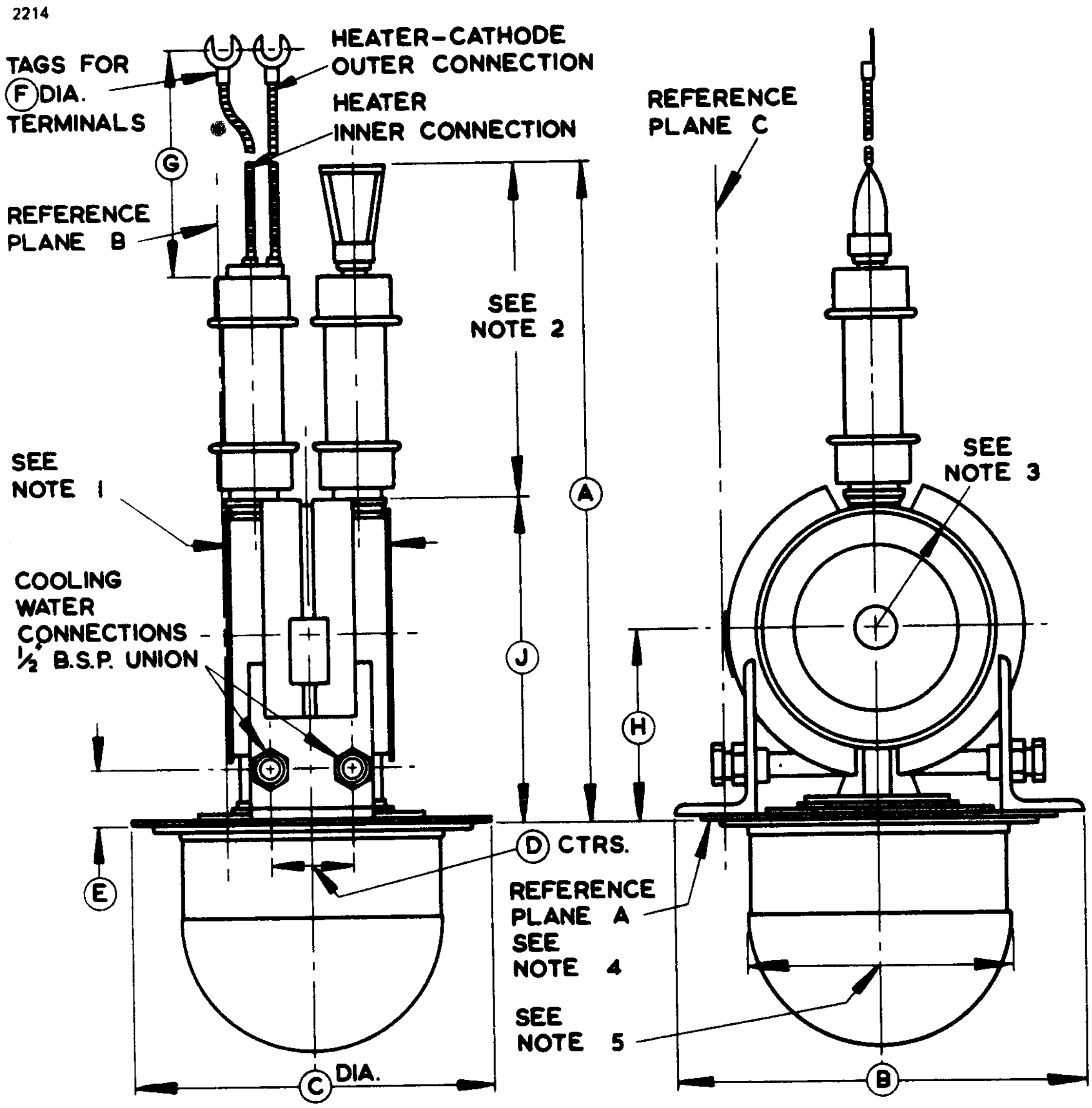
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



OUTLINE (All dimensions without limits are nominal)



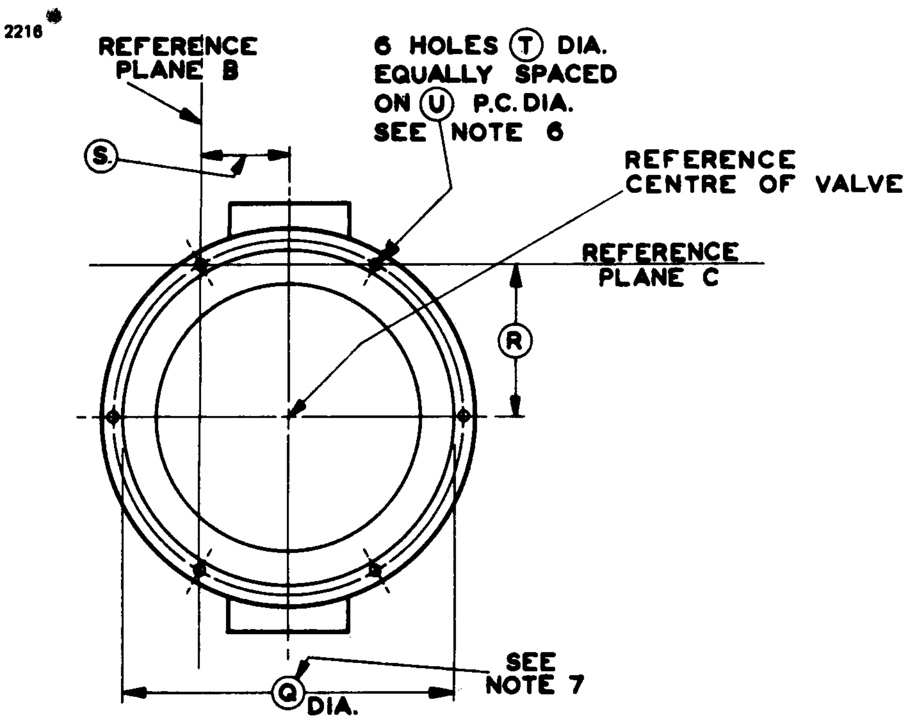
Ref	Inches	Millimetres
A	15.000 max	381.0 max
B	9.750 max	247.7 max
C	8.500 max	215.9 max
D	1.812 ± 0.062	46.02 ± 1.57
E	1.187 ± 0.062	30.15 ± 1.57

Ref	Inches	Millimetres
F	0.312	7.92
G	8.000 min	203.2 min
H	4.213	107.0
J	7.750 max	196.8 max

Millimetre dimensions have been derived from inches.

OUTLINE

View of Output End of Valve



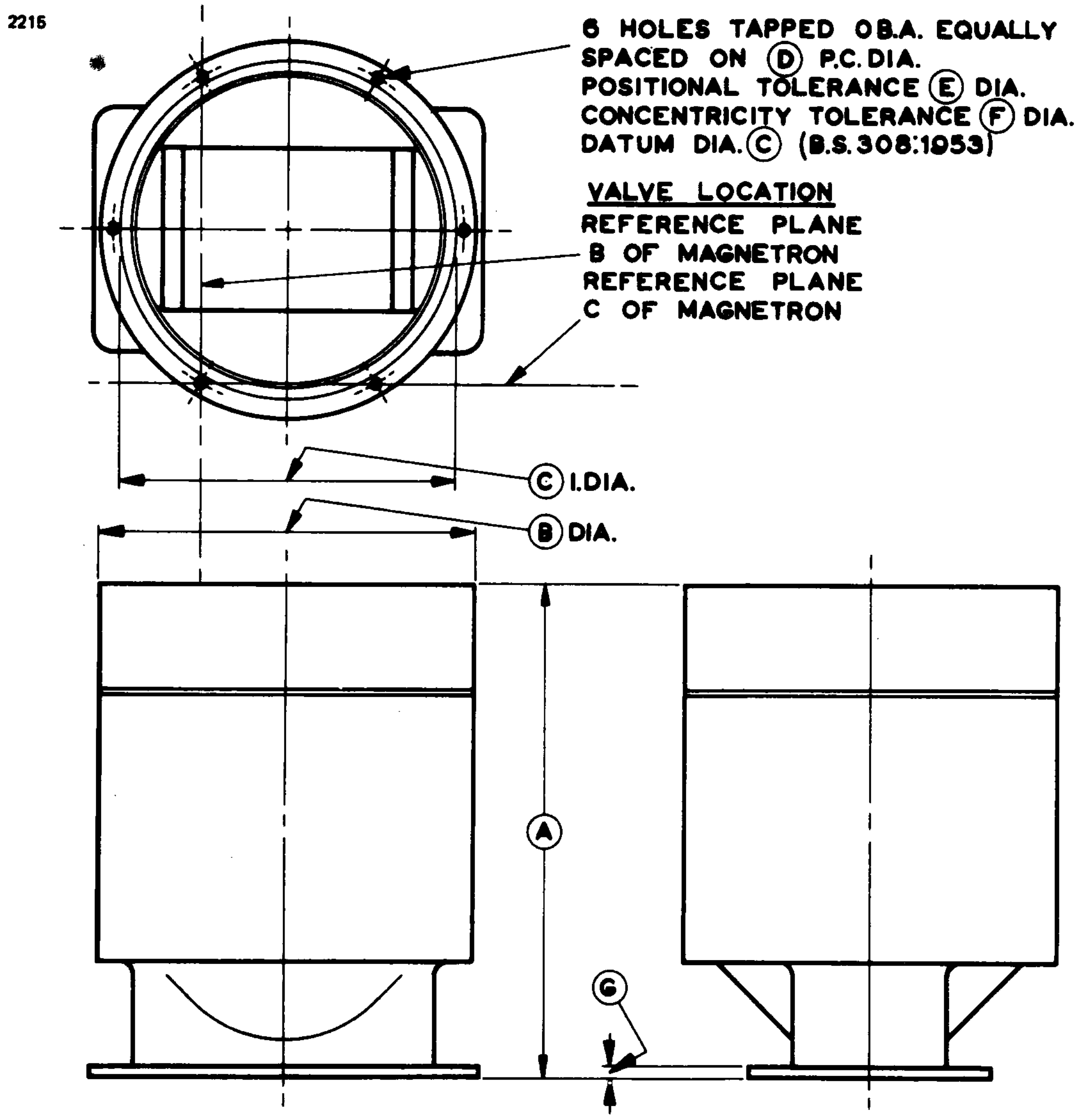
Ref	Inches	Millimetres
Q	See note 7	See note 7
R	3.383	85.93
S	1.953	49.61
T	$0.261^{+0.004}_{-0.000}$	$6.629^{+0.102}_{-0.000}$
U	7.813	198.5

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
(All dimensions without limits are nominal)

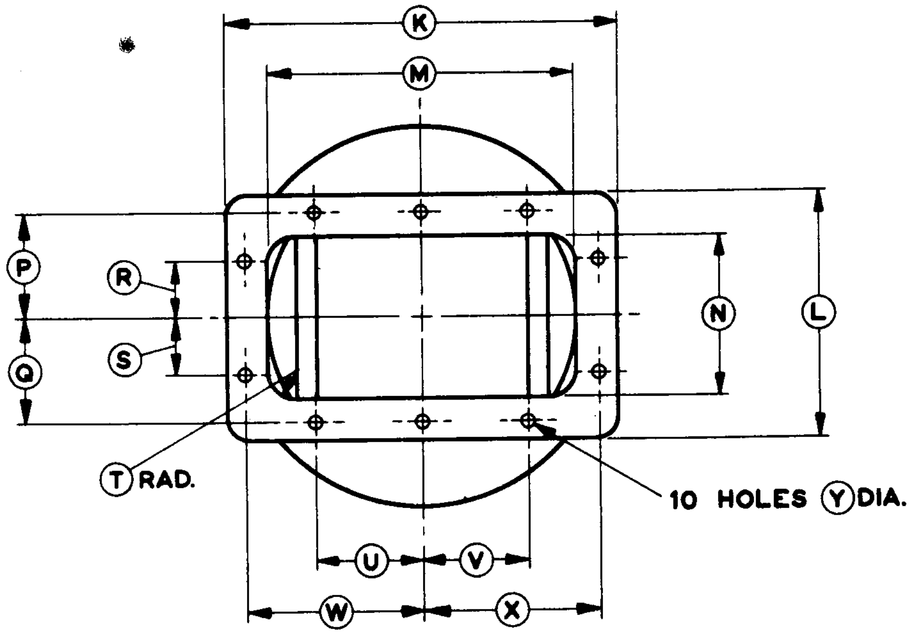


Ref	Inches	Millimetres
A	11.000 ± 0.062	279.40 ± 1.57
B	8.500 max	215.9 max
C	$7.443^{+0.010}_{-0.000}$	$189.05^{+0.25}_{-0.00}$
D	7.813	198.45
E	0.0075	0.19
F	0.005	0.127
G	0.312	7.92

Millimetre dimensions have been derived from inches.

Detail of Rectangular Output Flange
(All dimensions without limits are nominal)

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.

M565

L-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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:

$$P_i = i_{apk} \times v_{apk} \times Du$$

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. 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 35 lb/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 25 lb/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.

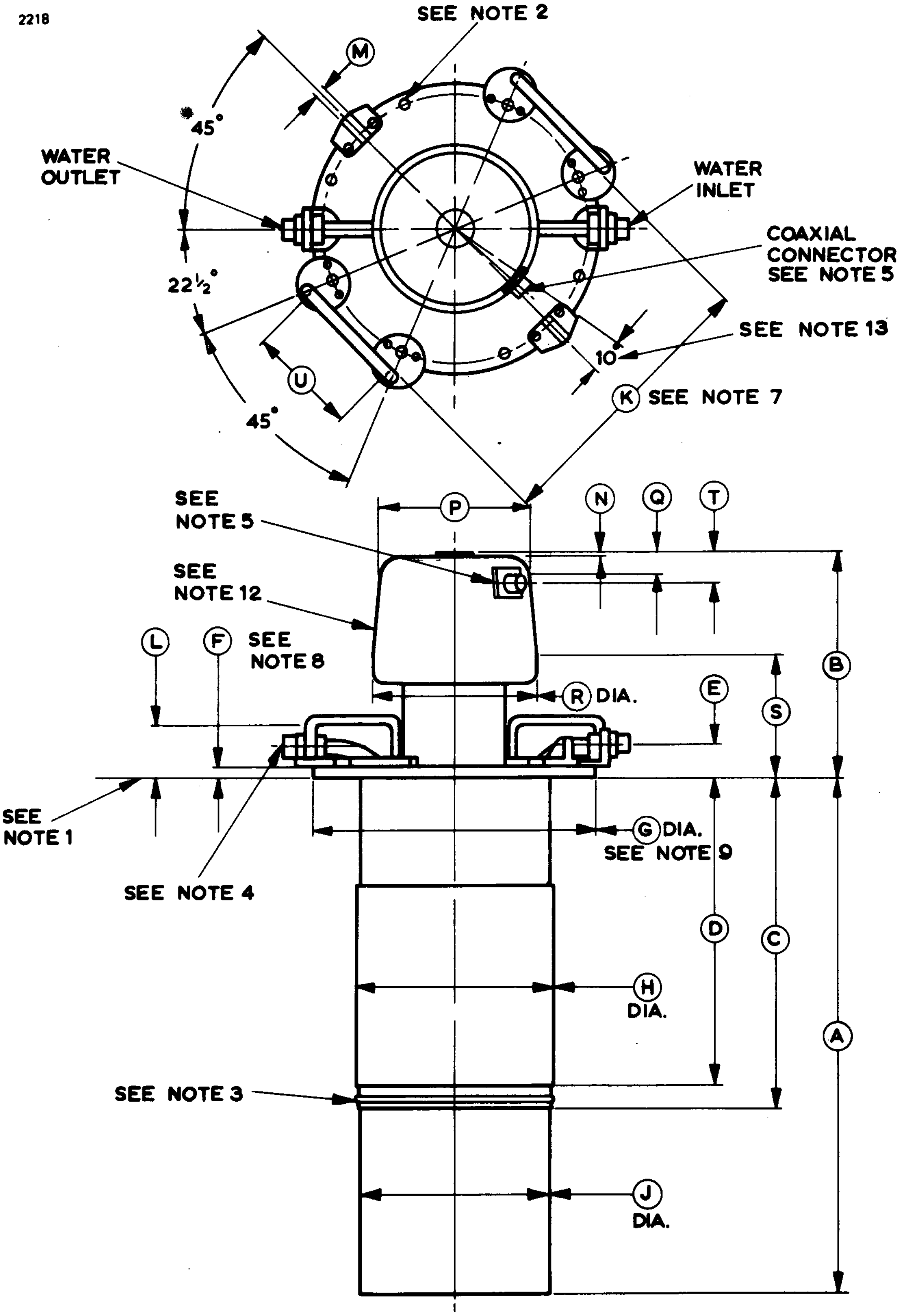
13. Measured with heater voltage of 48V and no anode input power, the heater current limits are 13A minimum, 15A maximum after 10 minutes preheating.

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
(All dimensions without limits are nominal)

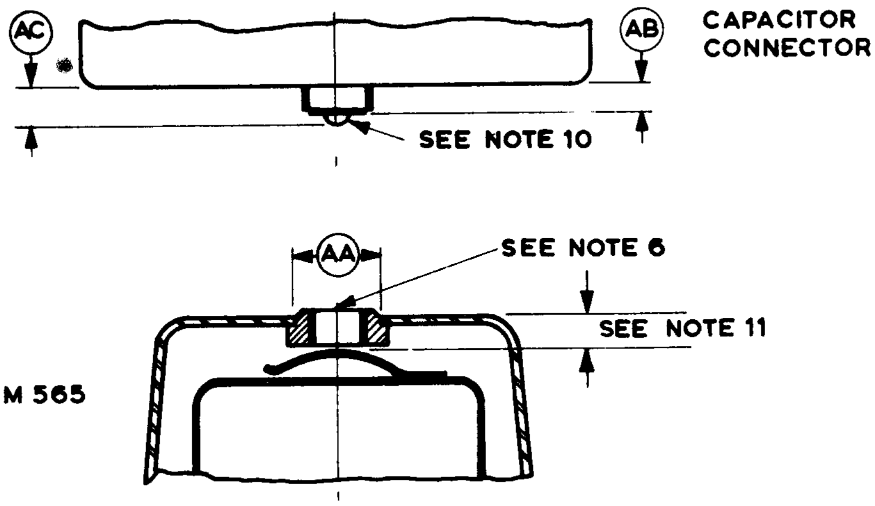
Ref	Inches	Millimetres
A	18.594	472.3
B	8.250 max	209.6 max
C	11.900	302.3
D	11.125	282.6
E	1.125 ± 0.020	28.58 ± 0.51
F	0.437 ± 0.010	11.10 ± 0.25
G	10.250 ± 0.015	260.35 ± 0.38
H	7.240 max	183.9 max
J	$7.000^{+0.000}_{-0.040}$	$177.80^{+0.00}_{-1.02}$
K	10.250	260.4
L	1.937	49.20
M	$0.375^{+0.000}_{-0.020}$	$9.53^{+0.00}_{-0.51}$
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

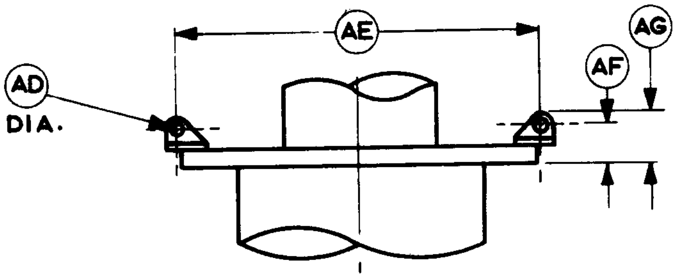
Capacitor Connector and Socket

2221



Lifting Lugs on Mounting Flange

2220



Outline Detail Dimensions

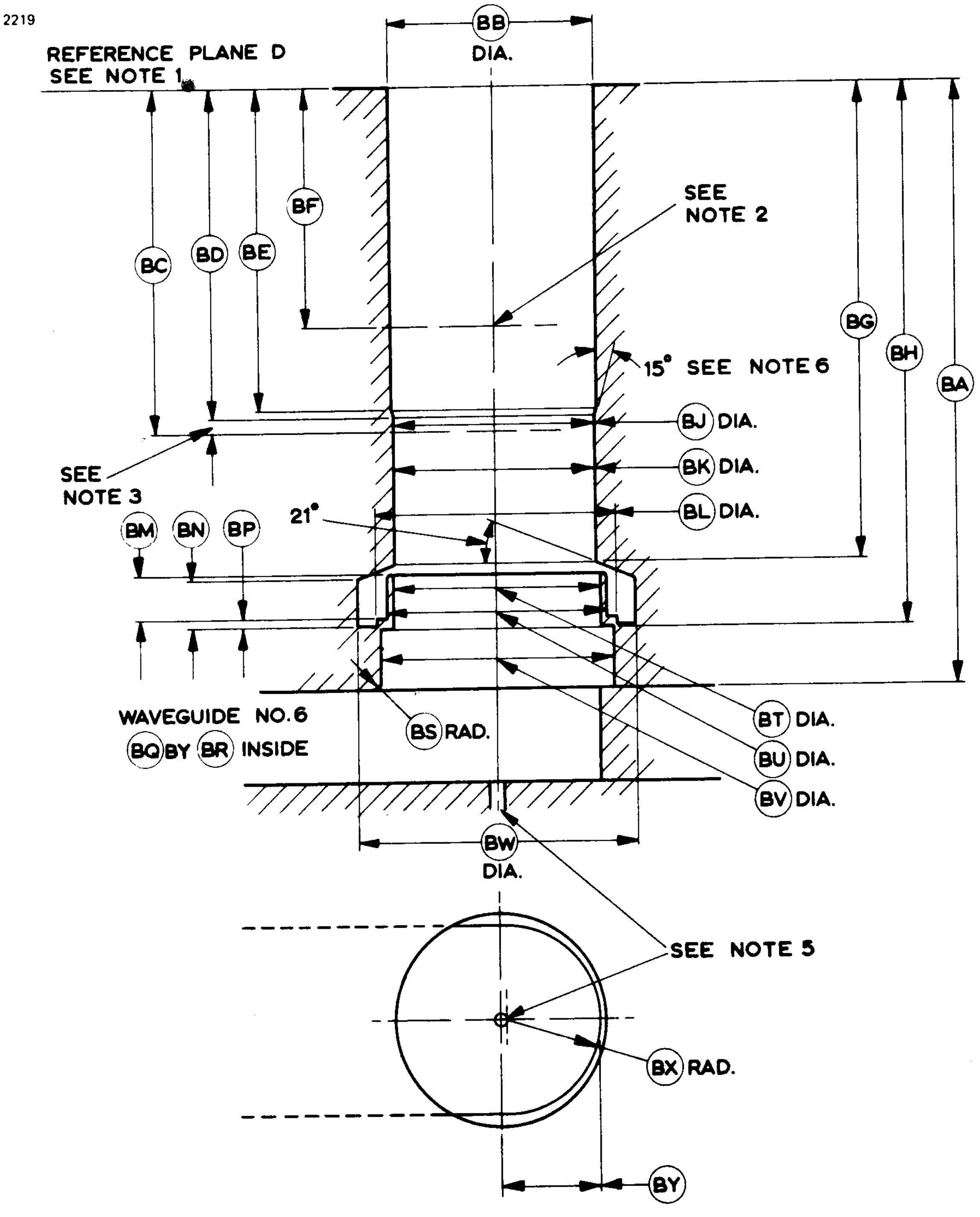
Ref	Inches	Millimetres
AA	1.247	31.67
AB	0.452 ± 0.010	11.48 ± 0.25
AC	0.577 ± 0.020	14.66 ± 0.51
AD	0.391 +0.004 −0.000	9.931 +0.102 −0.000
AE	10.750 ± 0.125	273.05 ± 3.18
AF	1.062 ± 0.062	26.97 ± 1.57
AG	1.500 max	38.10 max

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 20 lb/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

The data should be read in conjunction with the Magnetron Preamble.

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	–	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	1260 to 1300	MHz

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.

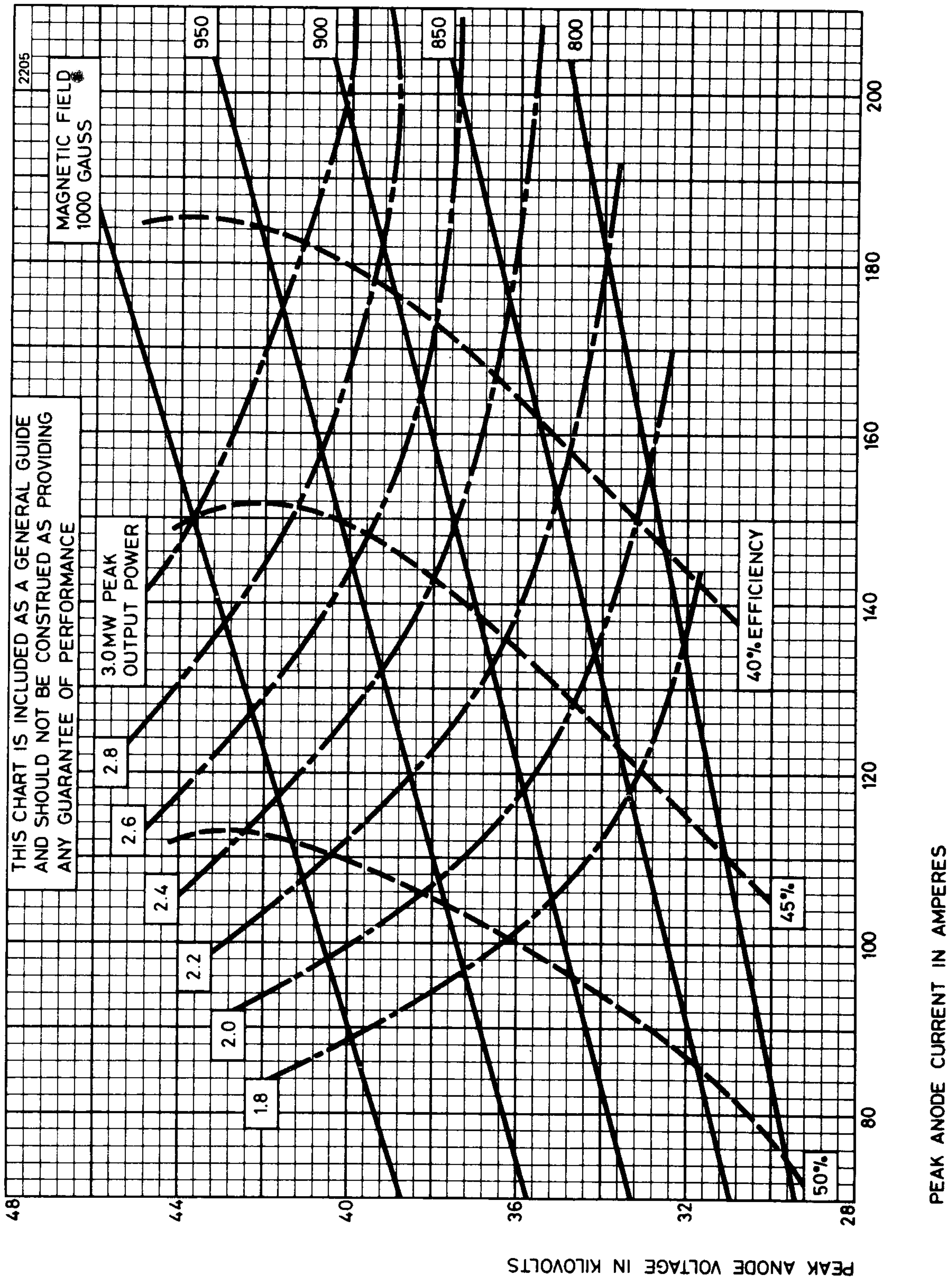
12. The heater current, measured with heater voltage of 20V and no anode input power, will be within the range 12 to 15A.

13. Design test only. The frequency change with anode temperature change after warm-up will not exceed -0.035MHz/°C.

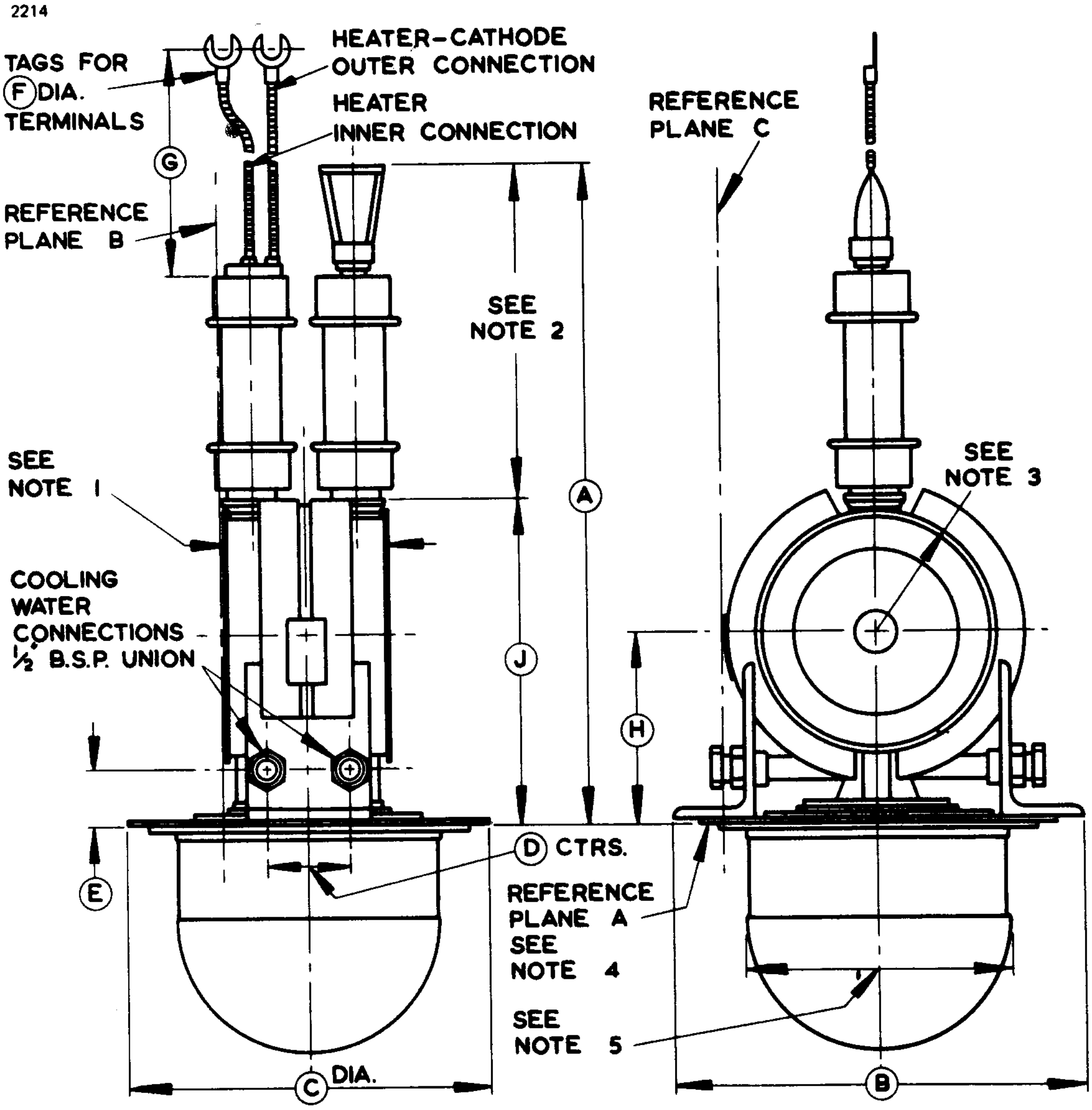
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



OUTLINE (All dimensions without limits are nominal)

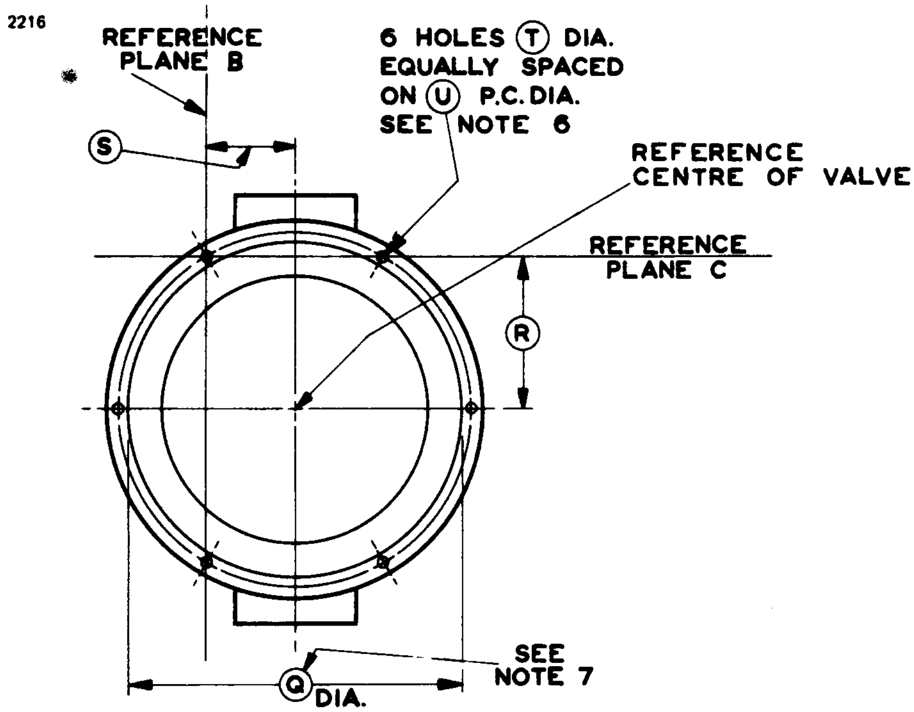


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.000 max	381.0 max	F	0.312	7.92
B	9.750 max	247.7 max	G	8.000 min	203.2 min
C	8.500 max	215.9 max	H	4.213	107.0
D	1.812 ± 0.062	46.02 ± 1.57	J	7.750 max	196.8 max
E	1.187 ± 0.062	30.15 ± 1.57			

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

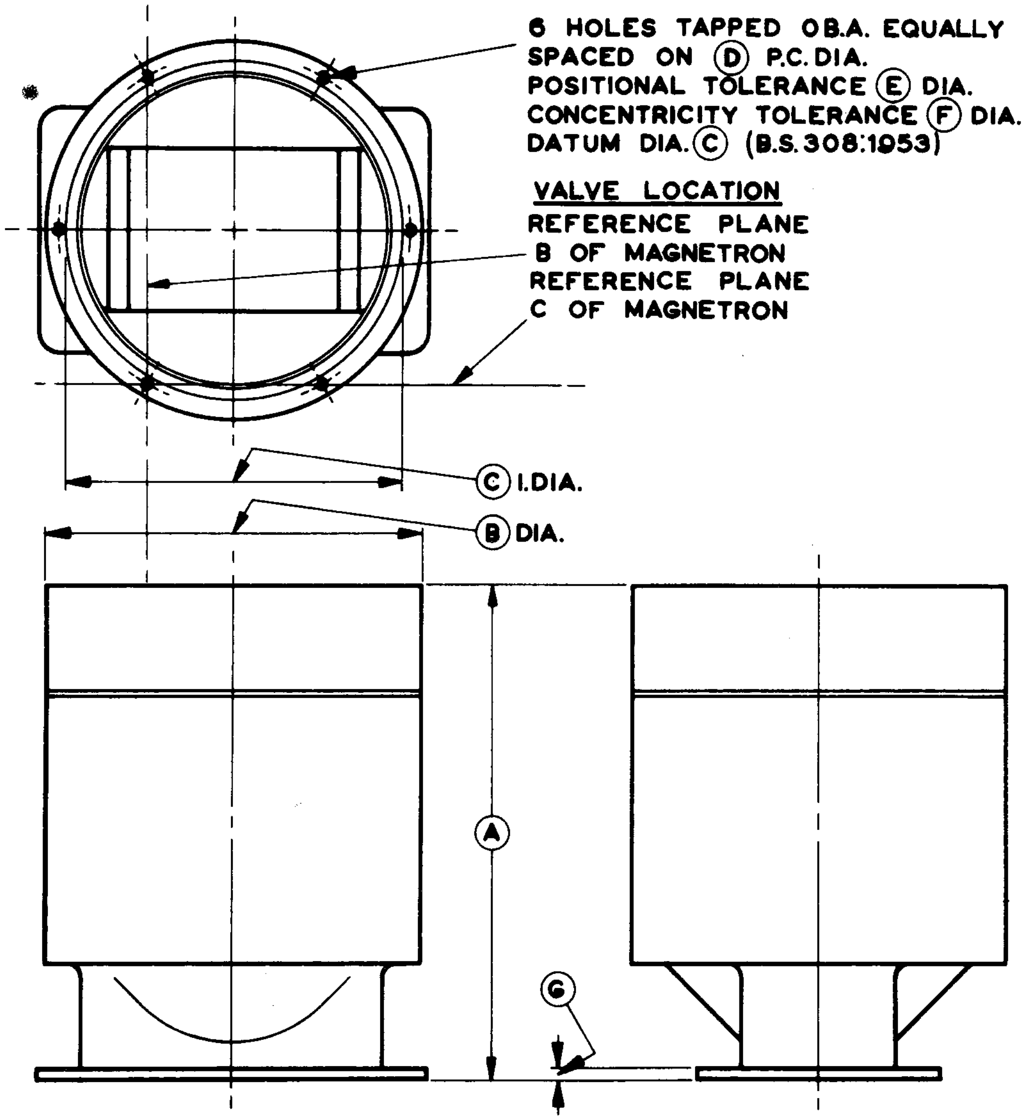
Millimetre dimensions have been derived from inches.

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
(All dimensions without limits are nominal)

2215

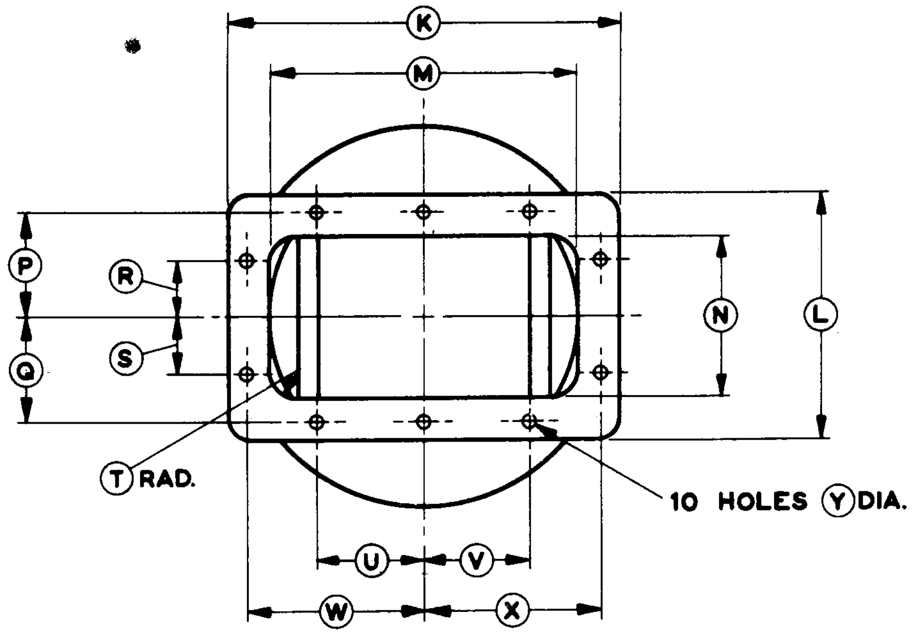


Ref	Inches	Millimetres
A	11.000 ± 0.062	279.40 ± 1.57
B	8.500 max	215.9 max
C	$7.443^{+0.010}_{-0.000}$	$189.05^{+0.25}_{-0.00}$
D	7.813	198.45
E	0.0075	0.19
F	0.005	0.127
G	0.312	7.92

Millimetre dimensions have been derived from inches.

Detail of Rectangular Output Flange
(All dimensions without limits are nominal)

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.

M5051 M5052

TUNABLE L-BAND MAGNETRONS

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Mechanically tuned, vapour cooled pulse magnetrons for m.t.i. operation

Frequency ranges:		
M5051	1250 to 1310	MHz
M5052	1305 to 1365	MHz
Typical peak output power	2.3	MW
Magnet (see page 12)	MA297	
Output	no. 6 waveguide (6.500 x 3.250 inch internal)	
Coupler (see page 10)	UG-417A/U	
Isolator	the use of an isolator or circulator is recommended	
Cooling (see page 2)	vapour and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	20	V
Heater current (at 20V)	13.5	A
Heater starting current, peak value, not to be exceeded	60	A
Cathode heating time (minimum)	5	min

Mechanical

Overall dimensions:	
valve only	25.380 x 9.300 x 9.755 inches max 644.7 x 236.2 x 247.8mm max
valve assembled in magnet	25.380 x 13.559 x 20.656 inches max 644.7 x 344.4 x 524.7mm max
Net weight:	
valve	60 pounds (27kg) max
magnet	130 pounds (59kg) max
Mounting position (see note 2)	vertical, cathode connector up
Tuning (see note 3)	mechanical
Tuner turns to cover frequency range (see notes 4 and 5)	190 max

Cooling

The anode is vapour cooled by two integral boilers. The water level in the boilers during operation must be as shown on the outline drawing to ensure safe, stable operation. Distilled water only must be used in the boilers. A suggested cooling circuit is shown on page 7.

Two thermal fuses type MA311 (see page 15) are fitted to the magnetron for protection against overheating; they normally provide a short-circuit to the anode block. In the event of a cooling failure they become permanently open-circuit. The fuses are rated at 5A max current, 250V a.c. max open-circuit voltage. Replacement fuses can be supplied to order.

The tuner mechanism is cooled by an airflow of 4.5ft^3/min (0.13m^3/min) minimum, via a tubular stud through the magnet.

The cooling must not be switched off simultaneously with the anode voltage. Water must be retained in the boiler for 5 minutes. Tuner air cooling must be kept on for 10 minutes to remove stored heat in the tuner assembly.

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 page 12)	900	950	gauss
Heater voltage (see note 1)	18	22	V
Heater starting current (peak)	–	60	A
Anode voltage (peak)	35	45	kV
Anode current (peak)	–	160	A
Input power (peak)	–	6.7	MW
Input power (mean) (see note 6)	–	10	kW
Duty cycle	–	0.0015	
Pulse length (see note 7)	–	5	μs
Rate of rise of voltage (see note 8)	–	55	kV/μs
Cathode terminal temperature	–	165	°C
V.S.W.R. at output coupler	–	1.3:1	
Tuner torque (see note 5)	–	75	oz-in
	–	5.4	kg-cm
Tuner air flow	4.5	–	ft^3/min
	0.13	–	m^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

Magnetic field	925	gauss
Heater voltage	0	V
Anode current (peak)	150	A
Pulse length	5	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak)	39	kV
Output power (peak)	2.3	MW
Output power (mean)	3.3	kW
Frequency pushing (see note 9)	–20	kHz/A

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following specification

Electrical Test Conditions

Magnetic field	925	gauss
Heater voltage (for test)	0	V
Anode current (mean)	225	mA
Duty cycle	0.0015	
Pulse length (see note 7)	5.0	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage	55	kV/μs

Limits

	Min	Max	
Anode voltage (peak) (see note 10)	36	44	kV
Output power (mean) (see note 10)	3.0	–	kW
Minimum frequency range:			
M5051	1250	1310	MHz
M5052	1305	1365	MHz
R.F. bandwidth at ¼ power (see notes 10 and 11)	–	0.5	MHz
Frequency pulling (v.s.w.r. not less than 1.3:1) (see note 10)	–	5.0	MHz
Stability (see notes 10, 11 and 12)	–	0.25	%
Performance continuity		see note 13	
Heater current		see note 14	

Mechanical Test Conditions

1. Valve at ambient temperature, no voltages applied.
2. Valve operating under electrical test conditions.

Limits

	Min	Max	
Tuning shaft turns to cover specified frequency range (condition 2)	160	190	turns
Tuning shaft torque (conditions 1 and 2) (see note 5)	–	50	oz-in
Backlash in tuning shaft	–	60	degrees rotation

End of Life Criteria

Output power (mean)	2.5	kW min
R.F. bandwidth at ¼ power	0.5	MHz max
Stability	0.5	% max
Backlash of tuning shaft	90	degrees max
Tuner torque	60	oz-in 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 the pulse voltage applied to the valve.

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 165°C. The temperature may be checked by temperature sensitive paint.

Handling The magnetron may appear to be solid and robust, but it can be damaged by careless handling. It is supplied in a pack designed to insulate it from shocks and vibration, but once removed from this pack great care must be taken to avoid giving it mechanical shocks by knocking against a bench or the magnet. The valve may be stored in the inner shipping container, but this inner container alone is not sufficient protection for shipping purposes.

NOTES

1. With no anode input power. On application of anode voltage the heater voltage must be reduced as follows

* Mean input power (kW)	Heater voltage ($V_{r.m.s.}$)
less than 2	20
2 to 3	15
3 to 4	10
4 to 5	5
over 5	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.

2. The valve is suspended from the magnet by four 0.312 inch (7.92mm) diameter pins supplied with each valve. The output connection must be by a section of flexible waveguide. Electrical connections are required to the anode block (earth return), the heater-cathode socket and the thermal fuses; water inlet and steam outlet connections to the boilers and the tuner drive are also necessary. No other connections or devices may be attached to the valve.
3. Tuning is achieved by rotating a splined shaft which mates with S.S. White flexible drive assembly EX977 (see page 15).
4. The tuning shaft should not be rotated faster than 150rev/min.
5. Under no circumstances should a torque greater than 75oz-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 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.

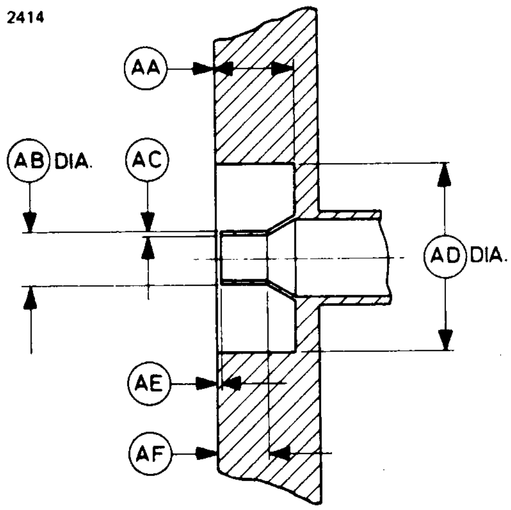
7. Tolerance ±10%.

8. 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.
9. The frequency pushing is measured under dynamic conditions at a peak anode current of 140 to 150A.
10. These tests are carried out at the following frequencies

M5051	M5052
1250MHz	1305MHz
1280MHz	1335MHz
1310MHz	1365MHz

11. The limits will not be exceeded at any phase of a 1.3:1 load v.s.w.r.
12. 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.
13. The spectrum quality will be observed continuously over the specified frequency range, operating into a matched load. R.F. bandwidth and stability will be within the limits specified.
14. Measured with a heater voltage of 20V and no anode input power, the heater current limits are 12A minimum, 15A maximum.

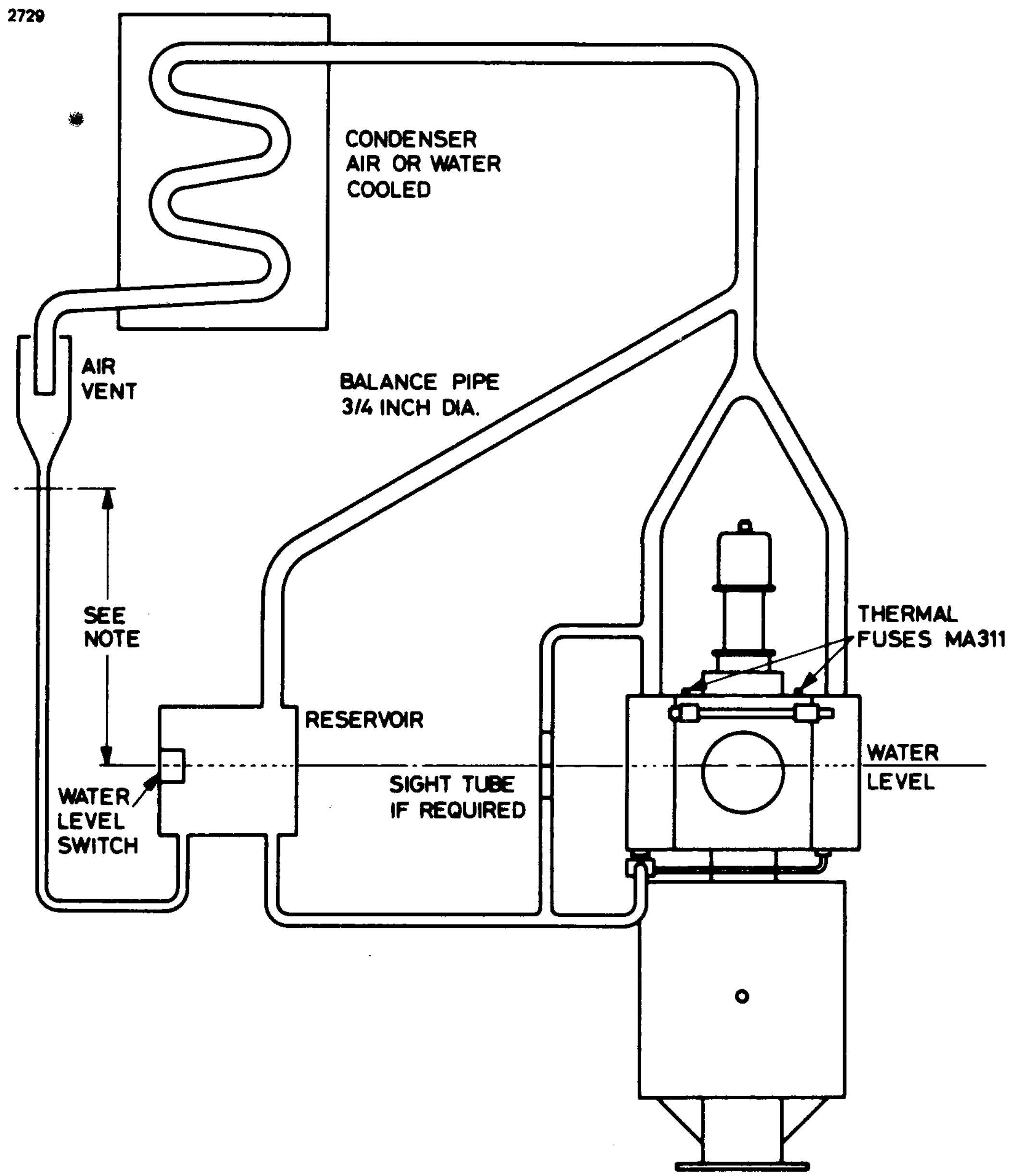
Detail of Tuner Cooling Air Inlet



Ref	Inches	Millimetres
AA	0.562 ± 0.005	14.27 ± 0.13
AB	0.365 ± 0.005	9.27 ± 0.13
AC	0.024 max	0.61 max
AD	1.375 ± 0.010	34.93 ± 0.25
AE	0.032 max 0.010 min	0.81 max 0.25 min
AF	0.375 ± 0.010	9.53 ± 0.25

Millimetre dimensions have been derived from inches.

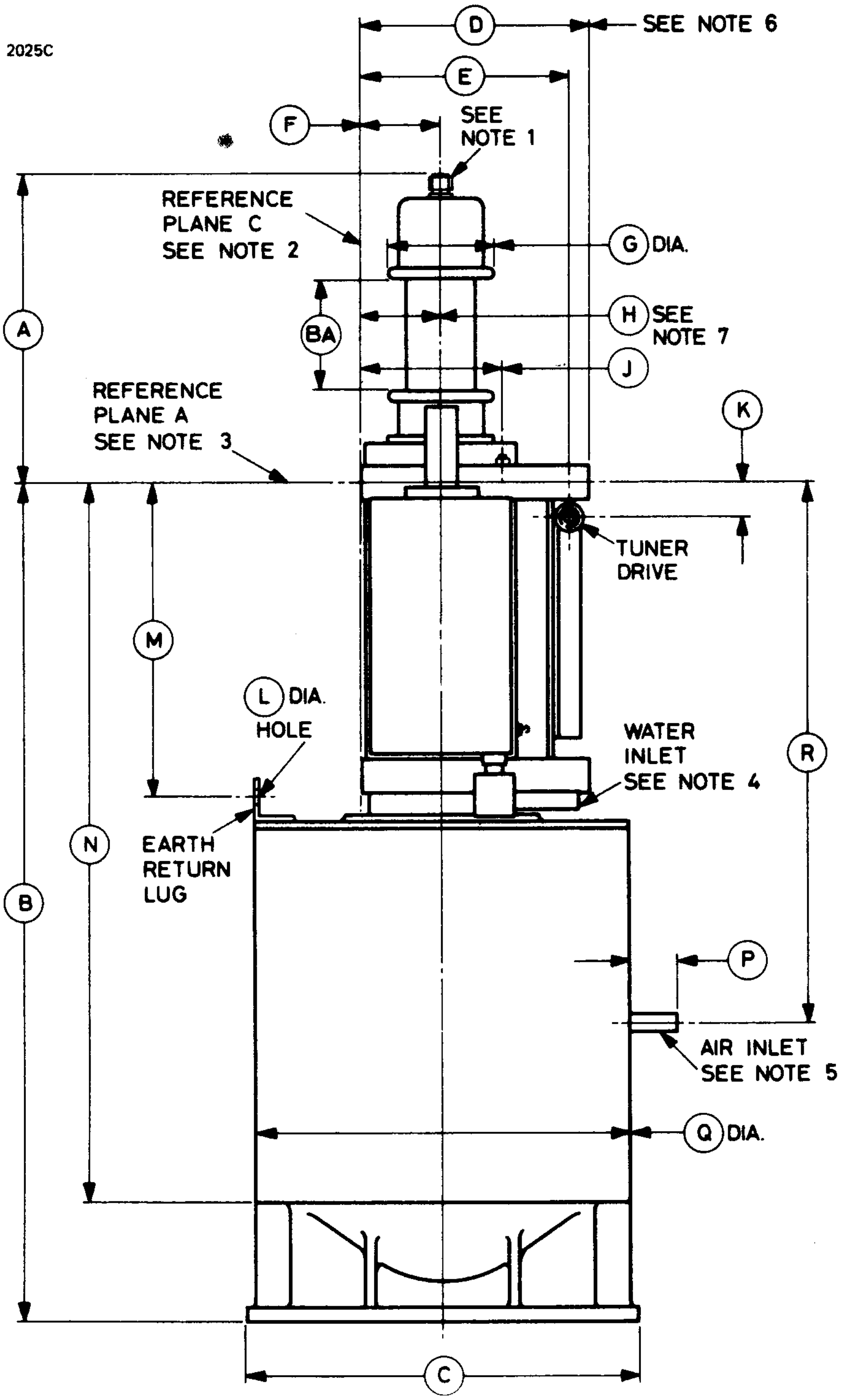
SUGGESTED COOLING CIRCUIT



Note This height may be 6 to 12 inches (150 to 300mm), depending on the condenser used.

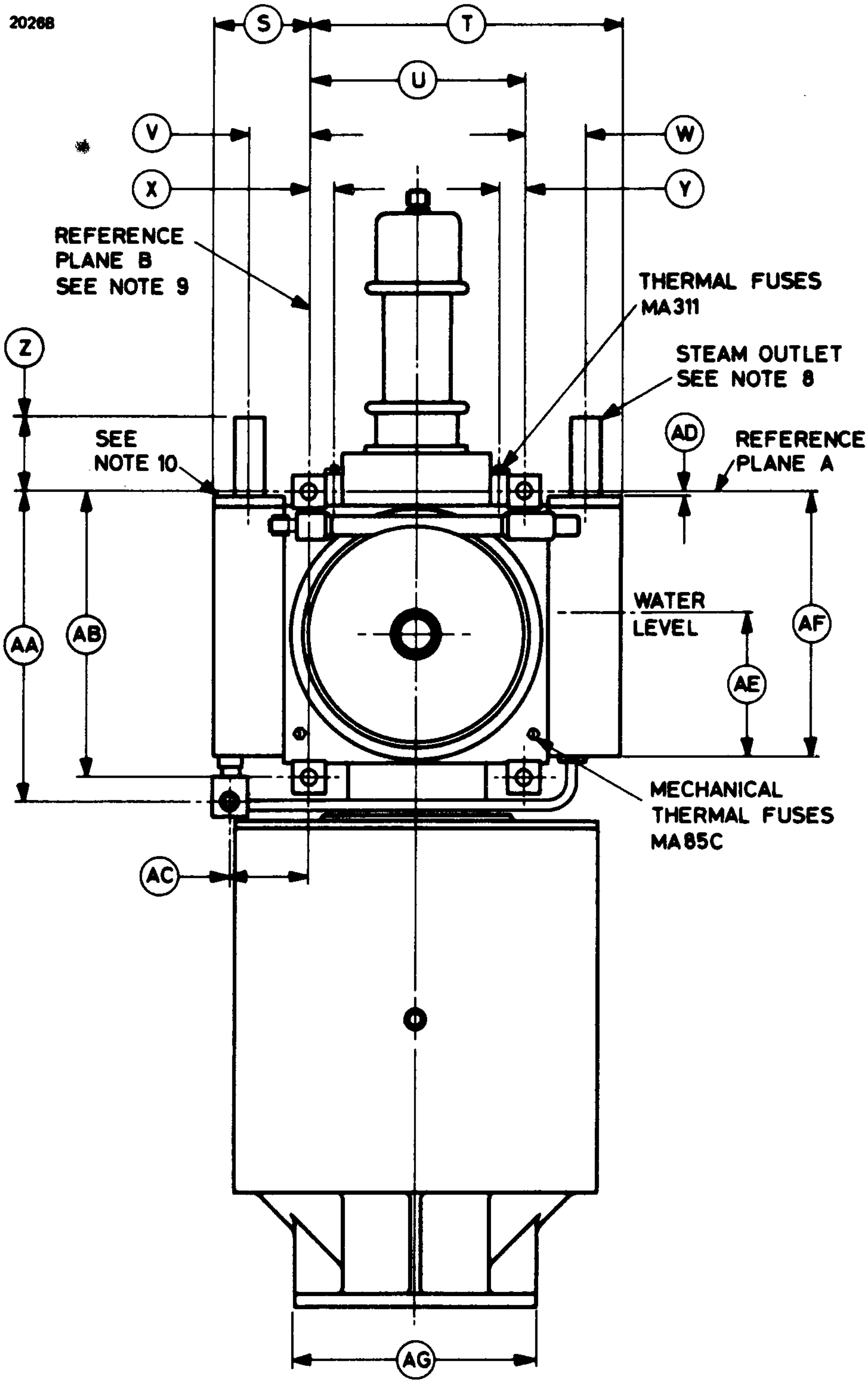
OUTLINE

2025C



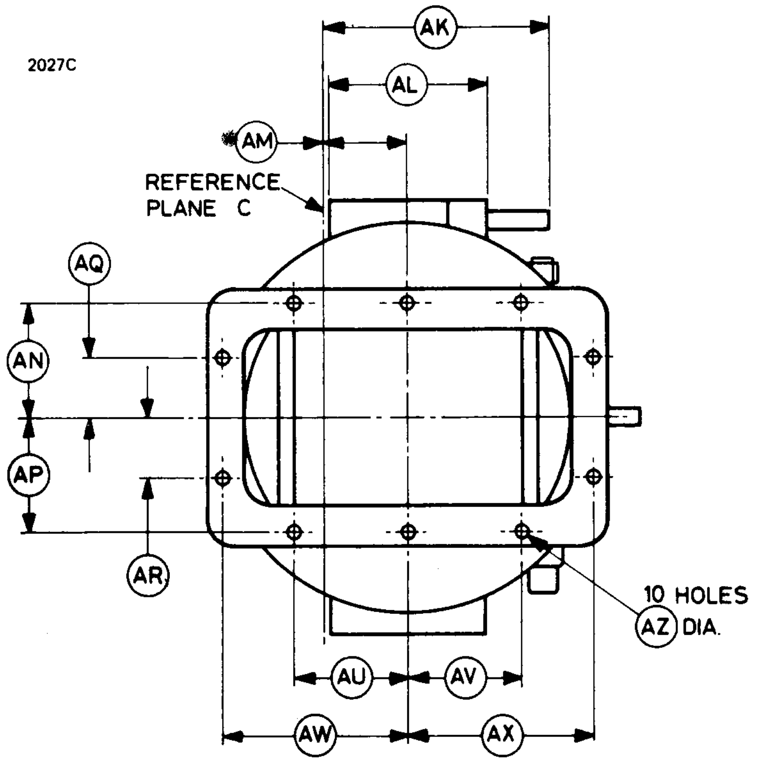
See page 11 for outline dimensions

OUTLINE



See page 11 for outline dimensions

OUTLINE



Outline Notes

1. Heater-cathode connector, J.S. Cat. no. 5935-99-932-5870.
2. Reference plane C is defined as the plane perpendicular to planes A and B and passing through the point of maximum protrusion of the suspension bars.
3. Reference plane A is defined as the plane passing through the axes of the upper suspension bars.
4. Water inlet 0.500 inch (12.70mm) diameter.
5. Air inlet to waveguide system, 0.500 inch (12.70mm) diameter, to be used for blowing dry, dust free air into the waveguide. With the output flange sealed and the waveguide pressurised to 6 lb/in^2 (0.42kg/cm^2) with air, the leakage will not exceed 0.1ft^3/min (2.8 l./min) at N.T.P.
6. No part of the anode shall project beyond these suspension bars, with the magnetron tuned to the lowest frequency specified.
7. This dimension refers to the steam outlet pipes.
8. Steam outlet, one each boiler, 0.750 inch (19.05mm) diameter.

9. Reference plane B is defined as the plane perpendicular to plane A and passing through the axis of the suspension hole as shown.
10. 4 holes threaded for no. 4-40 screws 0.125 inch (3.18mm) minimum depth, equally spaced on 1.375 inch (34.93mm) P.C. diameter.

Outline Dimensions (All dimensions without limits are nominal)

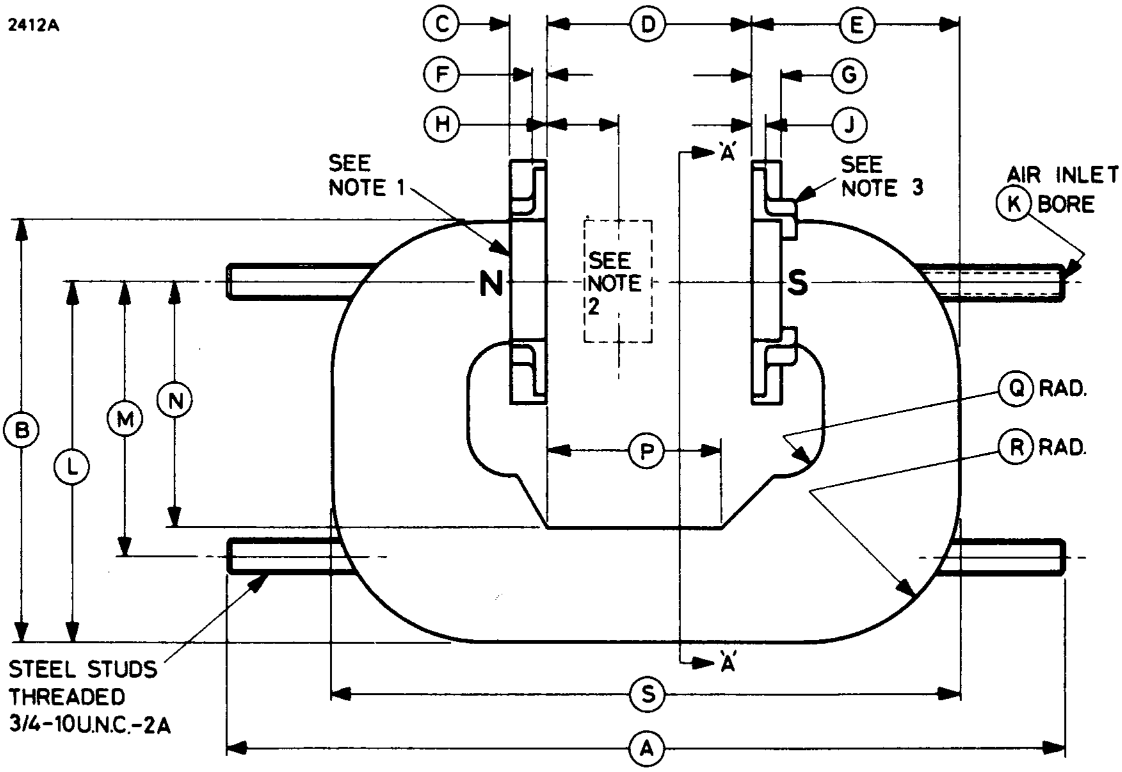
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	6.750 max	171.5 max	Y	0.562	14.27
B	18.530 ± 0.100	470.7 ± 2.5	Z	1.719 ± 0.060	43.66 ± 1.52
C	8.680	220.5	AA	7.080	179.8
D	5.035 max	127.9 max	AB	6.562 ± 0.010	166.67 ± 0.25
E	4.575	116.2	AC	1.812	46.02
F	1.765	44.83	AD	0.090	2.29
G	2.850 max	72.39 max	AE	3.250 ± 0.250	82.55 ± 6.35
H	1.765 ± 0.100	44.83 ± 2.54	AF	6.267	159.2
J	3.140	79.76	AG	5.440	138.2
K	0.840	21.34	AK	5.000	127.0
L	0.250 ± 0.005	6.35 ± 0.13	AL	3.550 max	90.17 max
M	6.850	174.0	AM	1.765 ± 0.100	44.83 ± 2.54
N	15.900	403.9	AN	2.311 ± 0.005	58.70 ± 0.13
P	1.000	25.40	AP	2.311 ± 0.005	58.70 ± 0.13
Q	8.500	215.9	AQ	1.249 ± 0.005	31.72 ± 0.13
R	11.900	302.3	AR	1.249 ± 0.005	31.72 ± 0.13
S	2.210 max	56.13 max	AU	2.374 ± 0.005	60.30 ± 0.13
T	7.090 max	180.1 max	AV	2.374 ± 0.005	60.30 ± 0.13
U	4.875 ± 0.010	123.83 ± 0.25	AW	3.937 ± 0.005	100.00 ± 0.13
V	1.375	34.93	AX	3.937 ± 0.005	100.00 ± 0.13
W	1.375	34.93	AZ	0.330	8.38
X	0.562	14.27	BA	2.125 ± 0.062	53.98 ± 1.57

Millimetre dimensions have been derived from inches.

PERMANENT MAGNET FOR M5051 AND M5052

The MA297 is a permanent magnet for use with the L-band magnetrons M5051 and M5052. It should be obtained from a supplier approved by English Electric Valve Company Ltd.

OUTLINE OF MA297

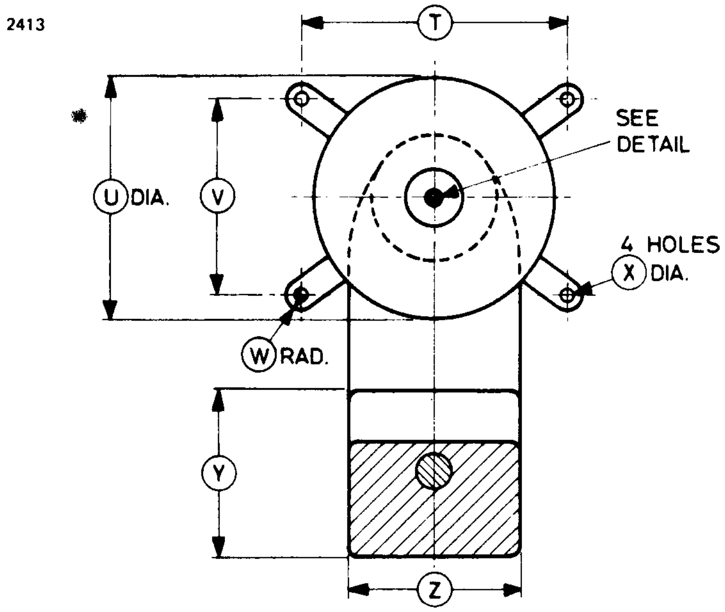


Outline Notes

1. Pole pieces bright nickel plated 0.0003 to 0.0005 inch (0.008 to 0.013mm) all over. The remainder of the magnet should be painted or otherwise treated to prevent corrosion.
2. Within a cylindrical volume 3.000 inch (76.2mm) diameter by 1.750 inch (44.45mm) long, located as shown, the magnetic field will be 925 $\pm$ 25 gauss.
3. Stainless steel lugs to support a weight of 75 pounds (34kg).

Net Weight . . . . 130 pounds (59kg) max

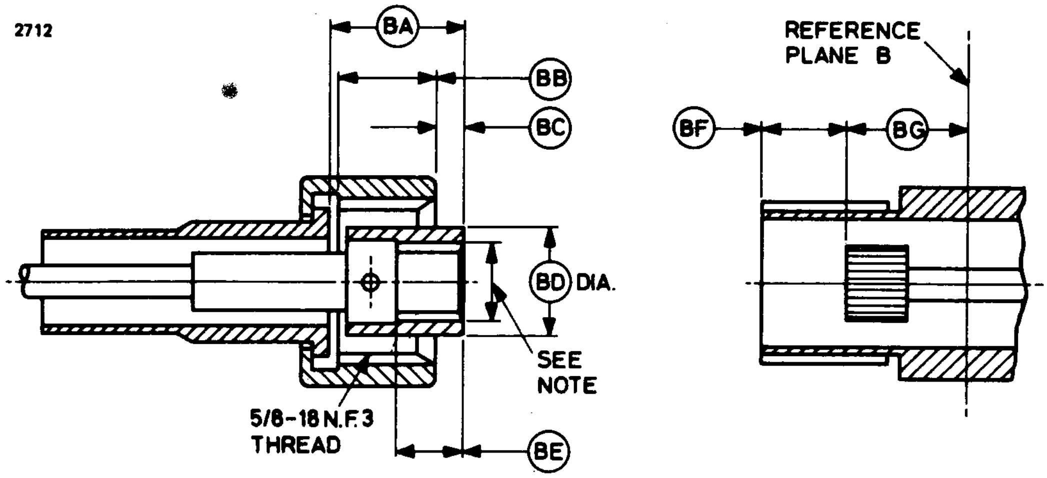
OUTLINE OF MA297



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	20.625 ± 0.031	523.9 ± 0.8	N	6.000 ± 0.125	152.4 ± 3.2
B	10.375 ± 0.031	263.5 ± 0.8	P	4.125 ± 0.125	104.8 ± 3.2
C	0.930 max	23.62 max	Q	1.000 ± 0.062	25.40 ± 1.57
D	5.062 ± 0.005	128.57 ± 0.13	R	3.750 ± 0.125	95.25 ± 3.18
E	5.125 ± 0.031	130.2 ± 0.8	S	15.460 ± 0.031	392.7 ± 0.8
F	0.300 ± 0.005	7.62 ± 0.13	T	6.562 ± 0.010	166.67 ± 0.25
G	0.780 max	19.81 max	U	6.000 ± 0.030	152.40 ± 0.76
H	1.750	44.45	V	4.875 ± 0.010	123.83 ± 0.25
J	0.375 ± 0.031	9.53 ± 0.79	W	0.375 ± 0.030	9.53 ± 0.76
K	0.500 ± 0.010	12.70 ± 0.25	X	0.343 ± 0.005	8.70 ± 0.13
L	8.875 ± 0.031	225.4 ± 0.8	Y	4.125 ± 0.031	104.8 ± 0.8
M	6.750 ± 0.031	171.5 ± 0.8	Z	4.250 ± 0.031	108.0 ± 0.8

Millimetre dimensions have been derived from inches except dimension X.

DETAIL OF TUNER DRIVE AND CONNECTOR
(All dimensions without limits are nominal)

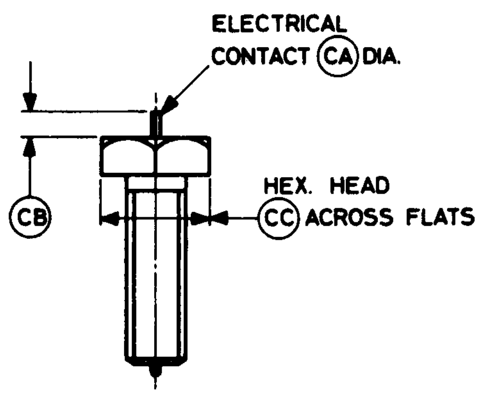


Ref	Inches	Millimetres
BA	0.500	12.70
BB	0.360	9.14
BC	0.112	2.84
BD	0.406	10.31
BE	0.250 min	6.35 min
BF	0.250 min	6.35 min
BG	0.456 ± 0.032	11.58 ± 0.81

Millimetre dimensions have been derived from inches.

Note Internal spline, 12 tooth 48 DP, 14½° pressure angle, involute form.

THERMAL FUSE MA311 (All dimensions nominal)



Ref	Inches	Millimetres
CA	0.040	1.02
CB	0.125	3.18
CC	0.525	13.34

Millimetre dimensions have been derived from inches.

Pulse Magnetrons, S-Band

4J31-4J35 inclusive

S-BAND MAGNETRONS

Service Types CV1914, CV1916, CV1897, CV1898, CV2744

The data should be read in conjunction with the Magnetron Preamble.

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	–	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:

$$P_i = i_{apk} \times v_{apk} \times D_u$$

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.

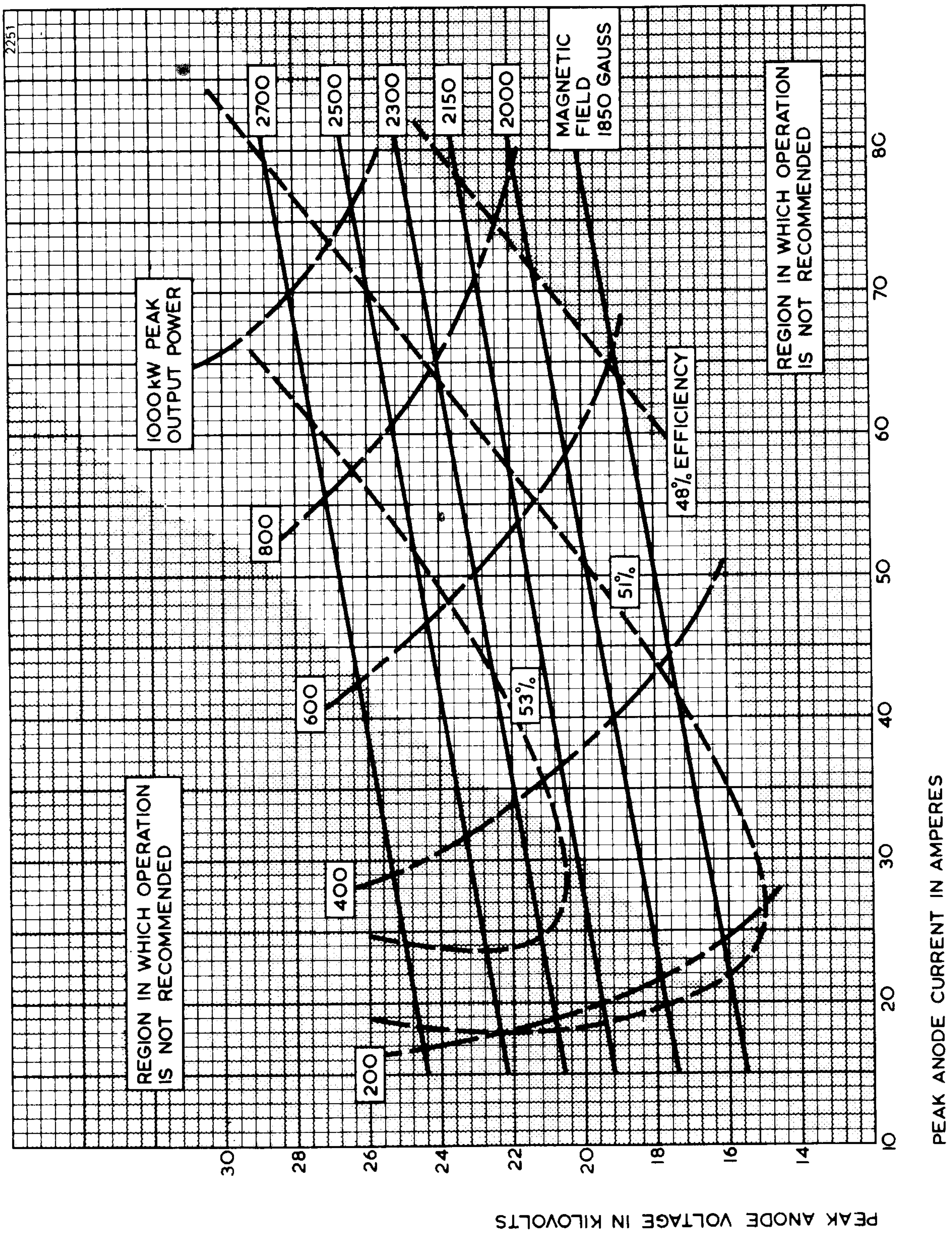
4. Tolerance $\pm$10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.
6. * The anode temperature must be kept below the limit specified by means of a suitable 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 –0.07MHz/°C.

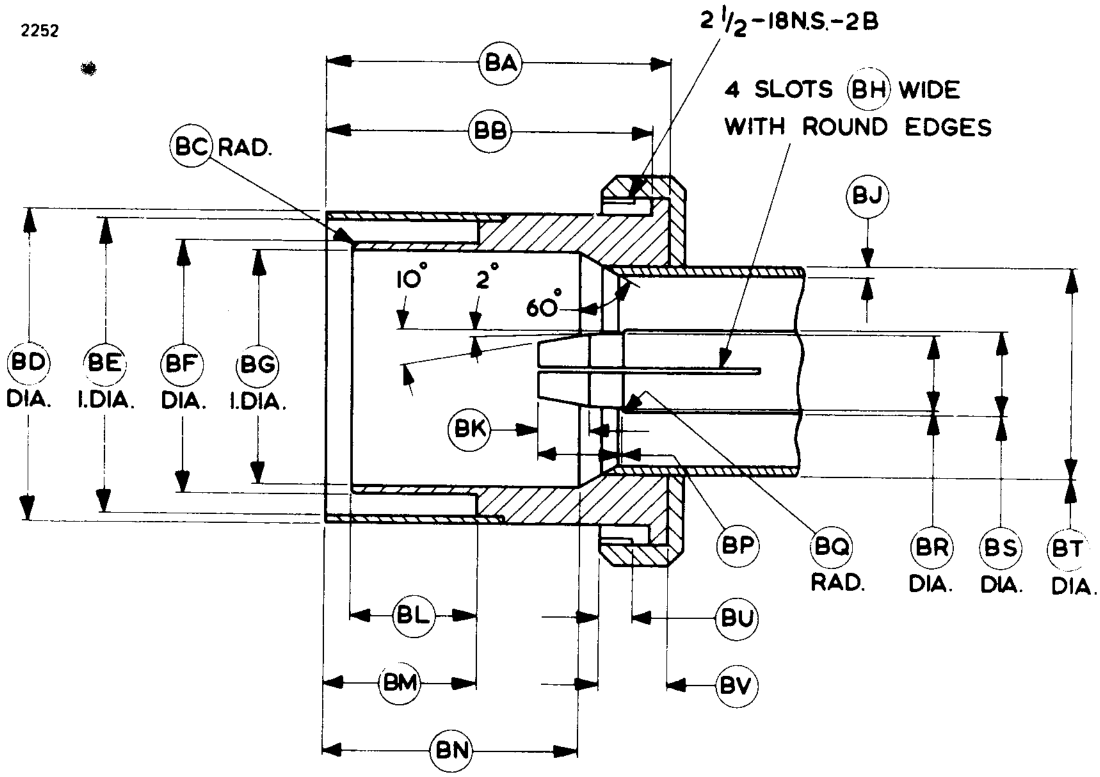
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



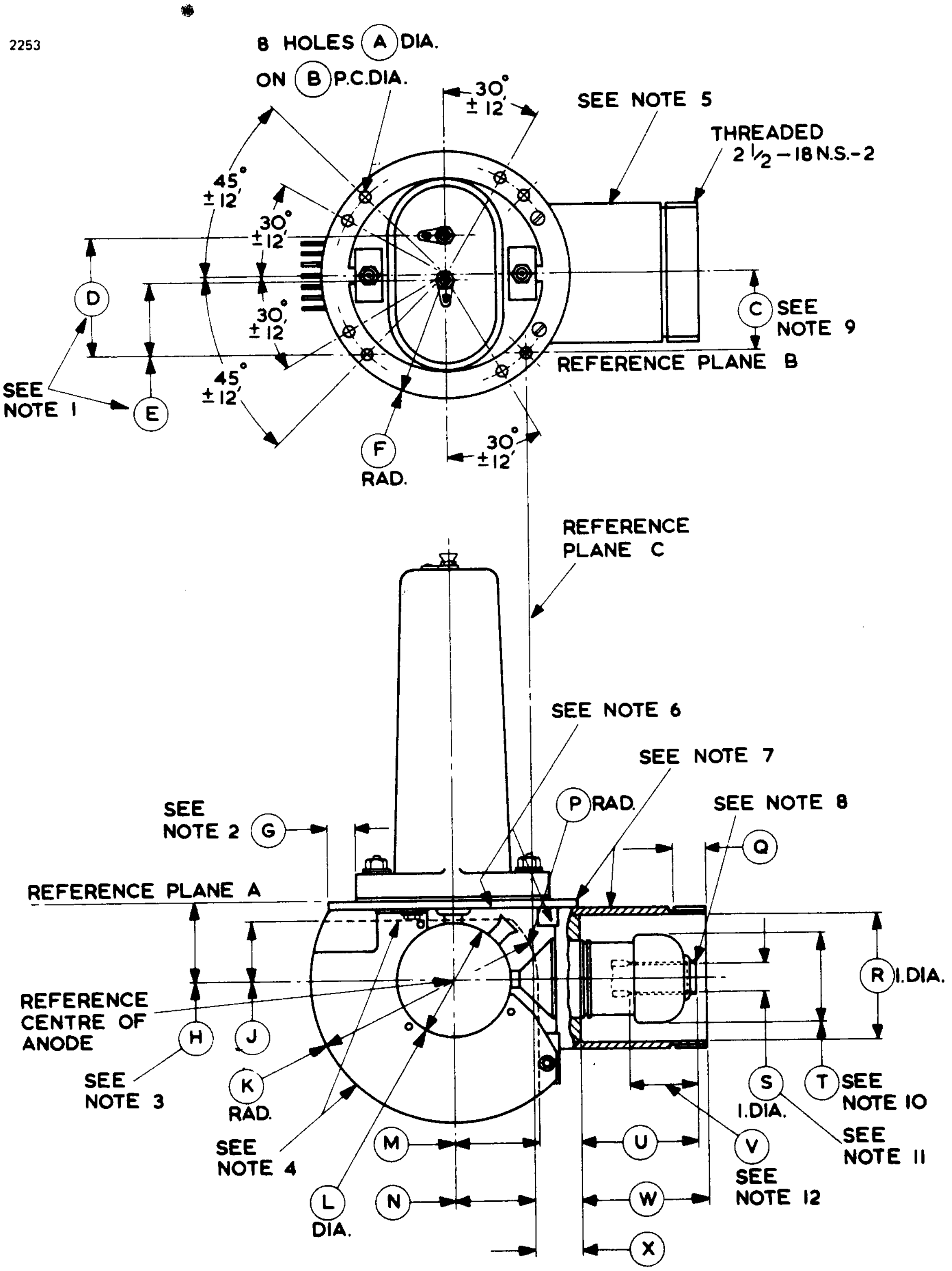
COUPLER (All dimensions without limits are nominal)



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)

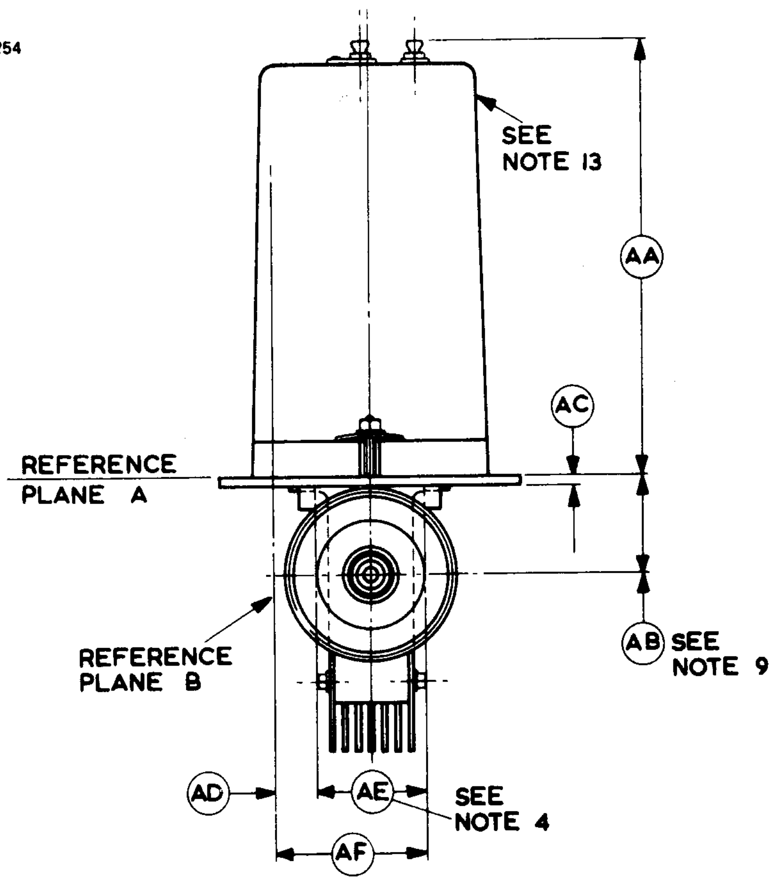


Outline Dimensions (All dimensions without limits are nominal)

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.

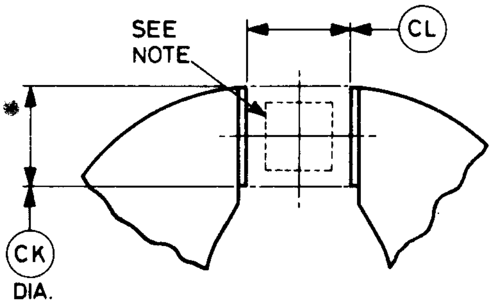
2254



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



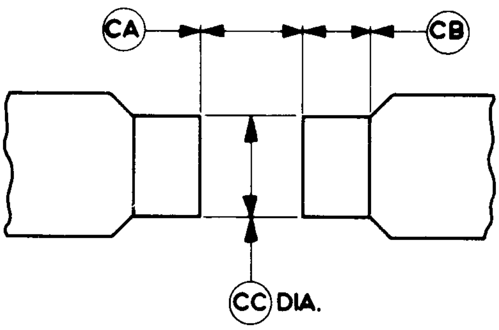
Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

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

The data should be read in conjunction with the Magnetron Preamble.

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

February 1970

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	–	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:

$$P_i = i_{apk} \times v_{apk} \times D_u$$

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% 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.

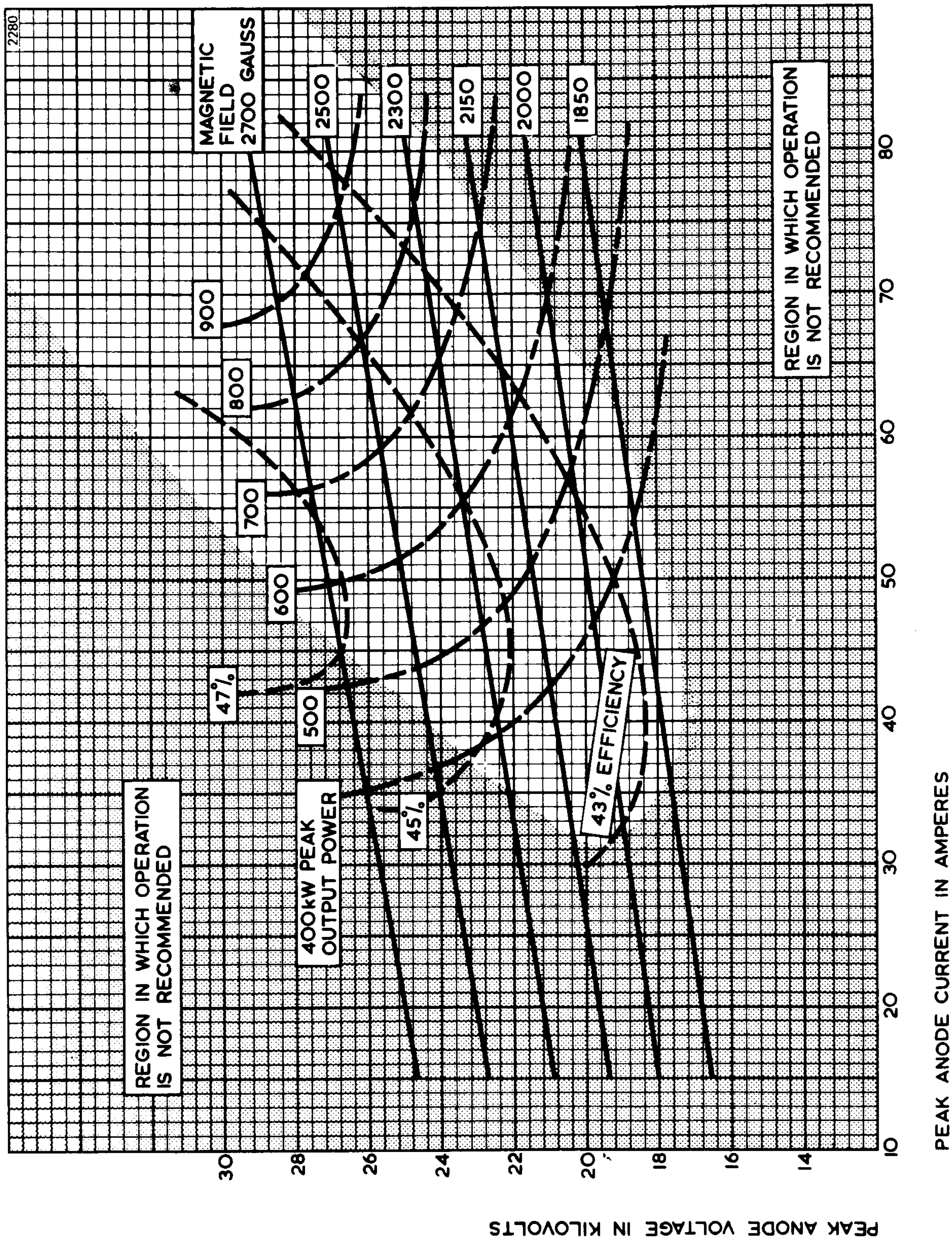
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.07 MHz/^\circ C$.

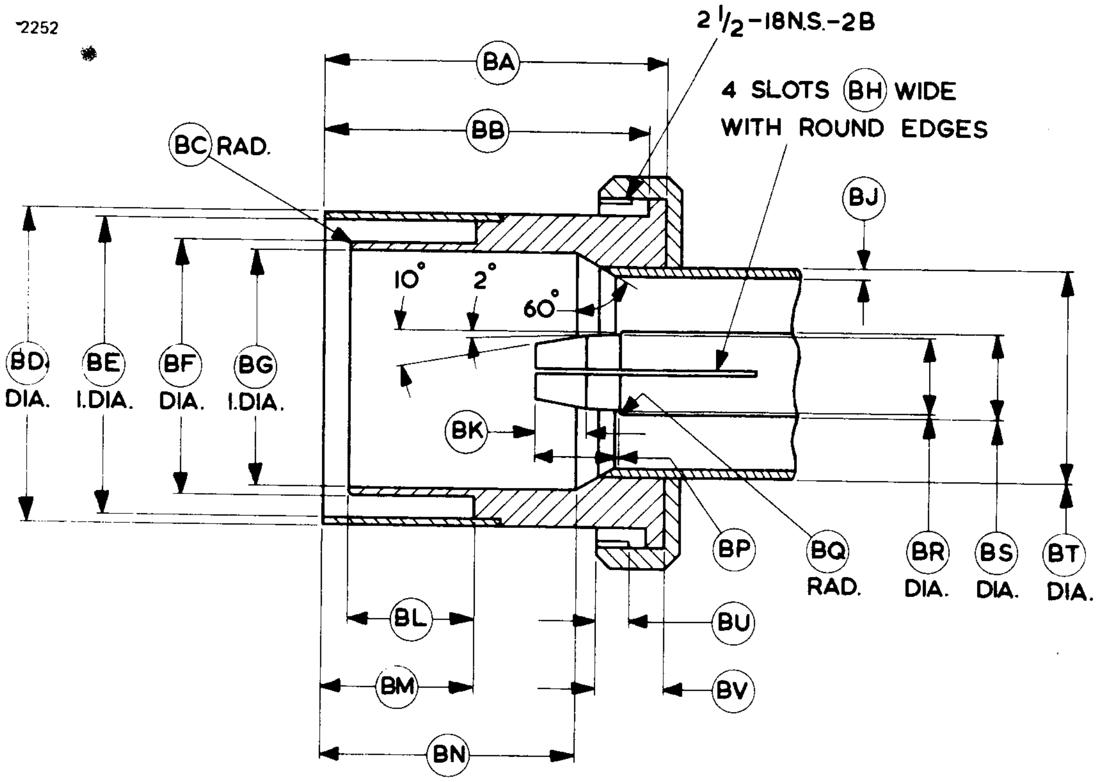
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



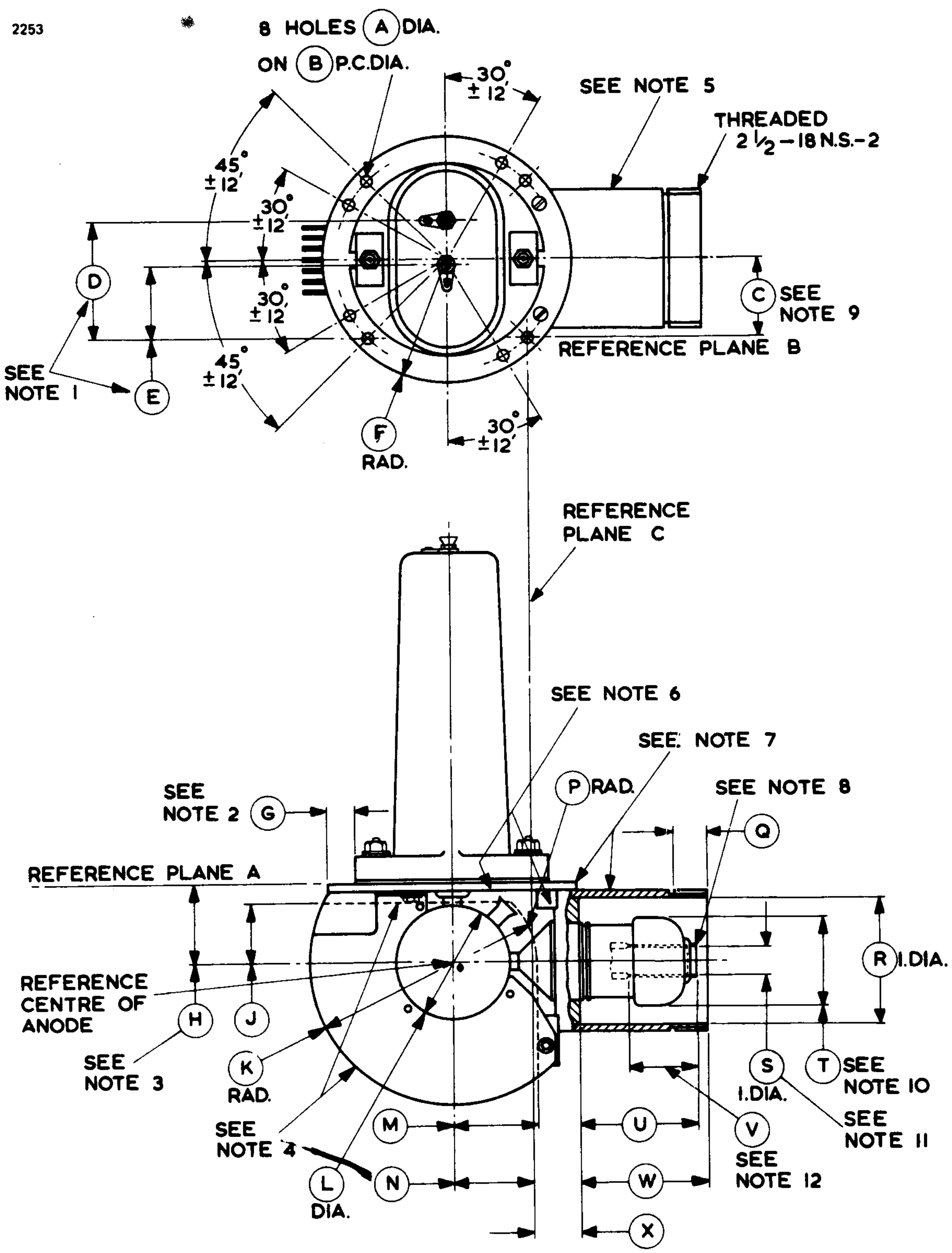
COUPLER (All dimensions without limits are nominal)



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)

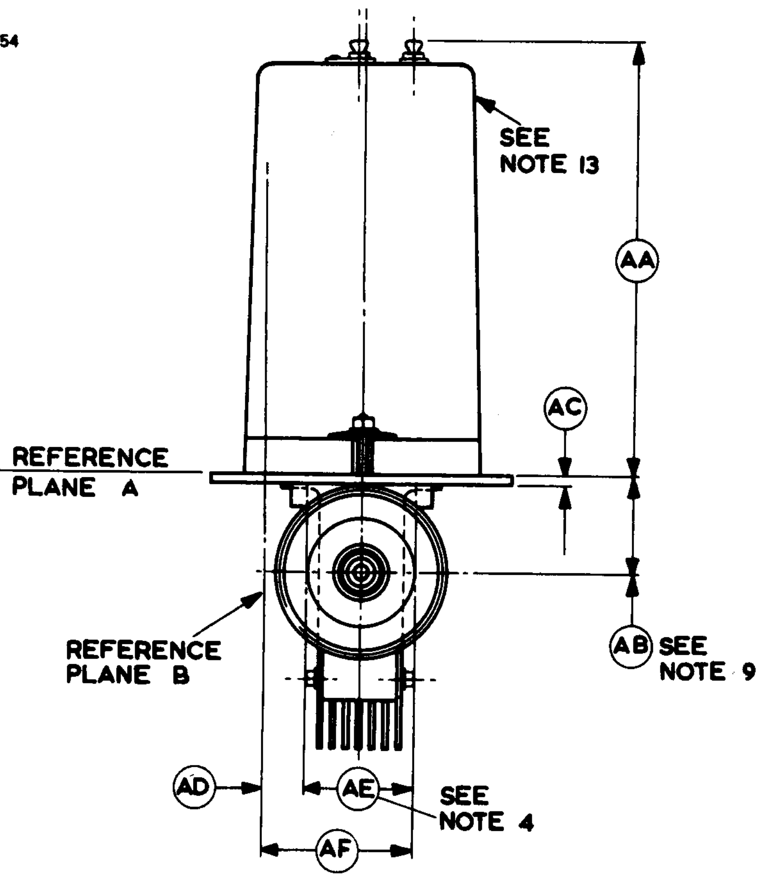


Outline Dimensions (All dimensions without limits are nominal)

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.

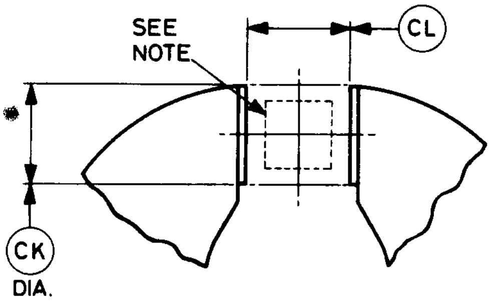
2254



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



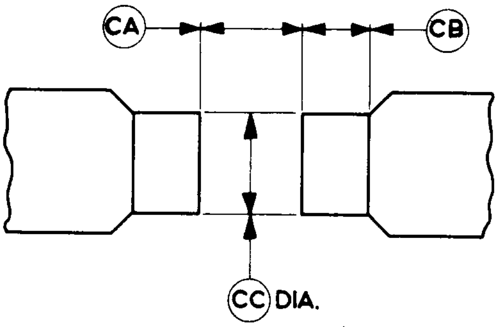
Ref	Inches	Millimetres
CK	1.500	38.10
CL	1.500 $^{+0.010}_{-0.000}$	38.10 $^{+0.25}_{-0.00}$

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.

4J53

S-BAND MAGNETRON

Service Type CV513

The data should be read in conjunction with the Magnetron Preamble.

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

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	–	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:

$$P_i = i_{apk} \times v_{apk} \times D_u$$

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.

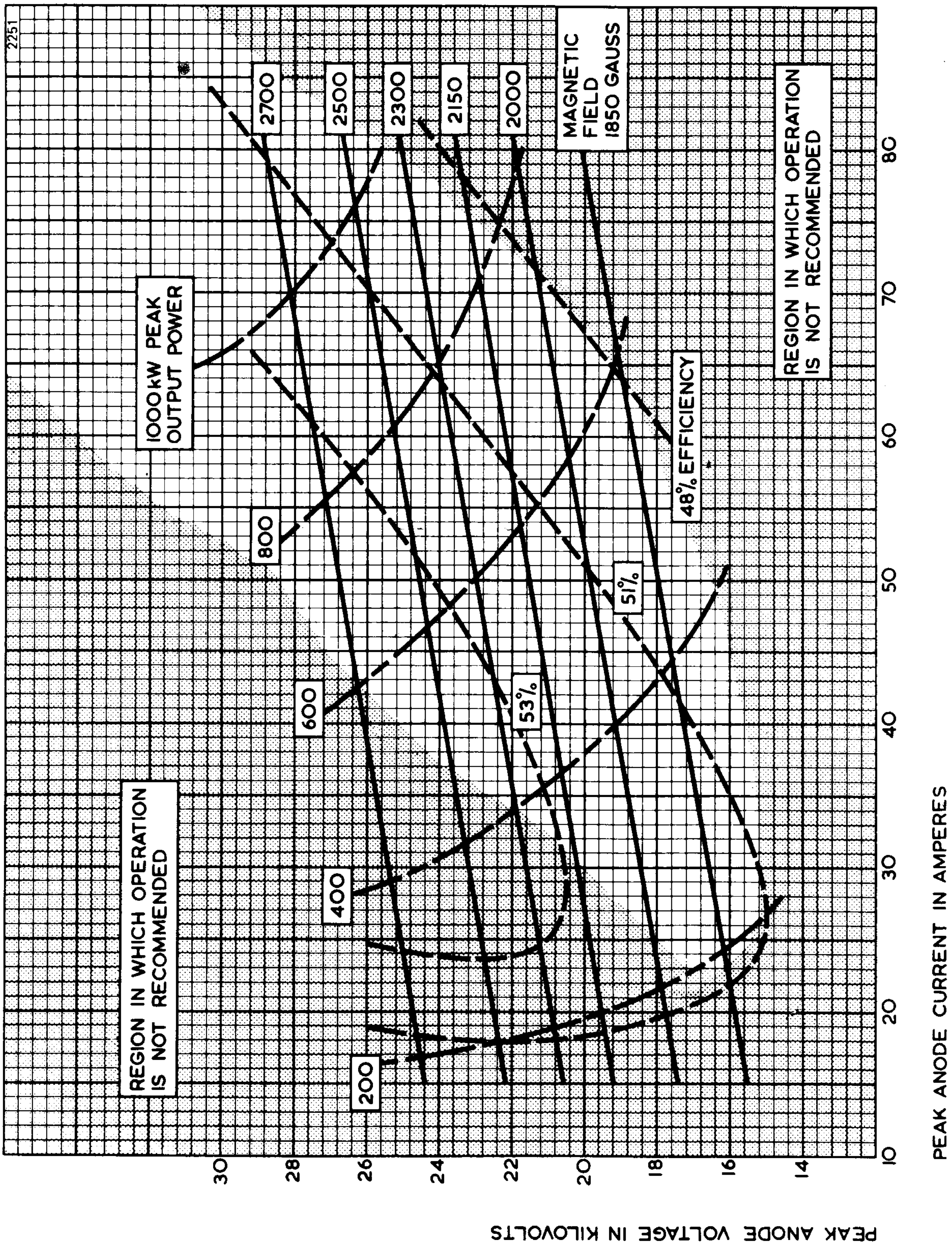
6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.
7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure 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. 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.

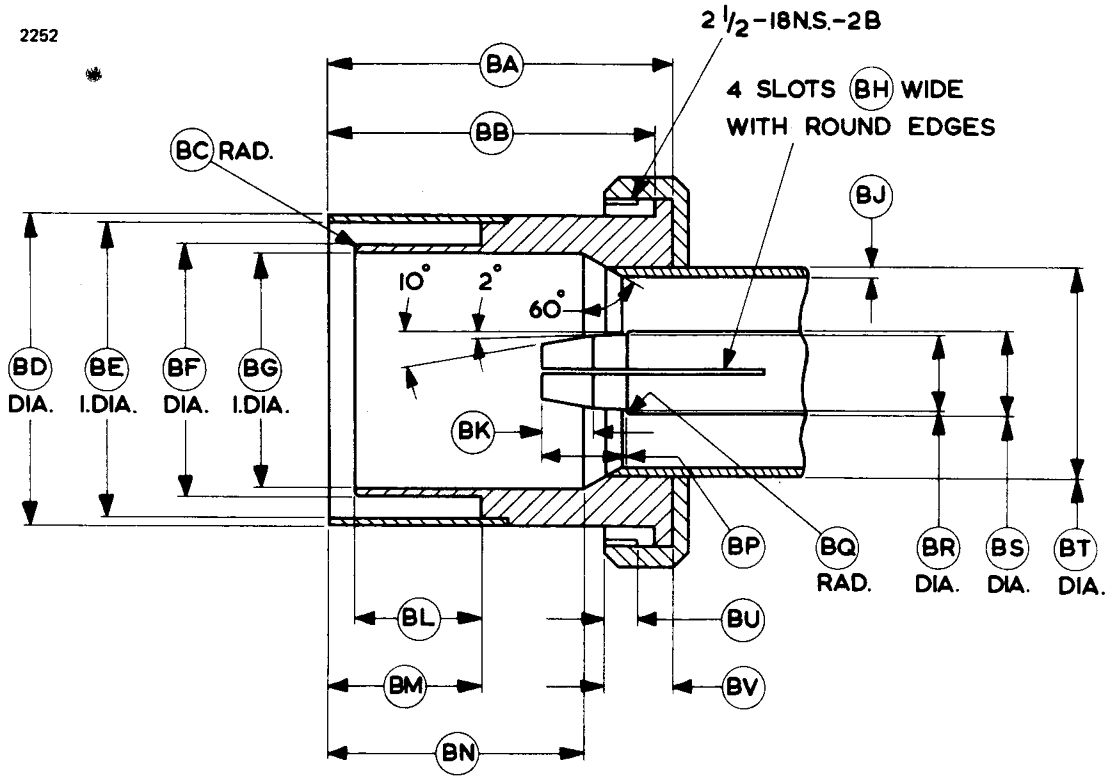
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



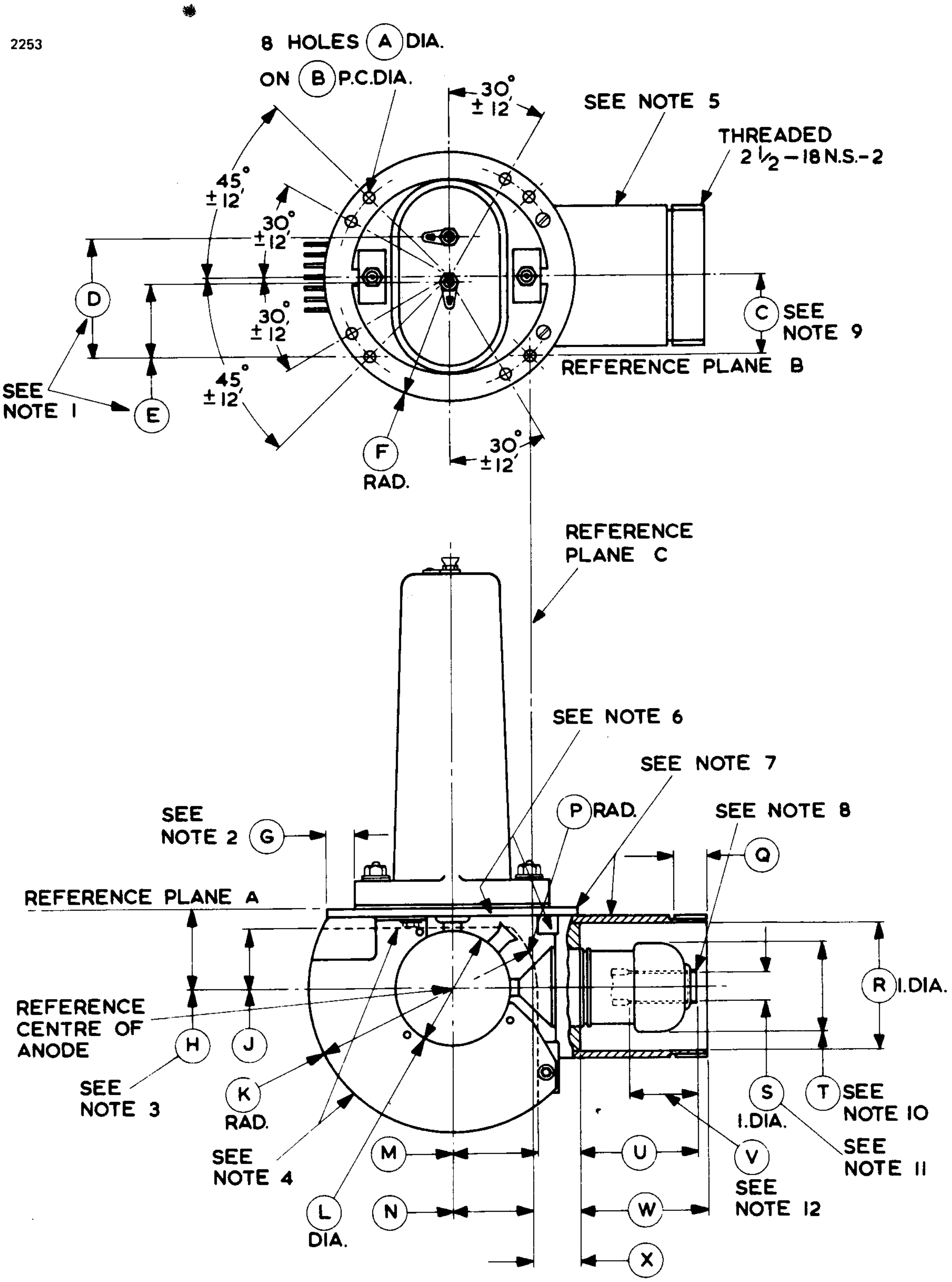
COUPLER (All dimensions without limits are nominal)



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)

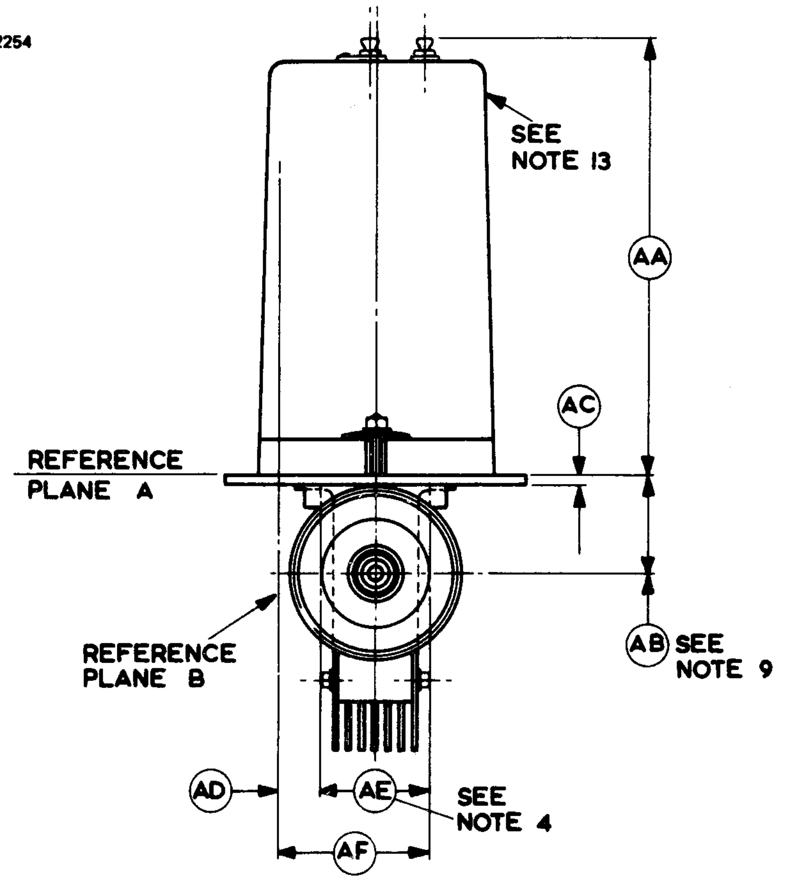


Outline Dimensions (All dimensions without limits are nominal)

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.

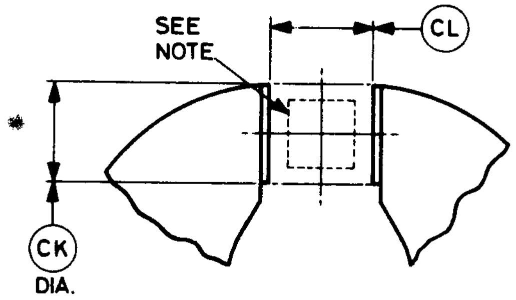
2254



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



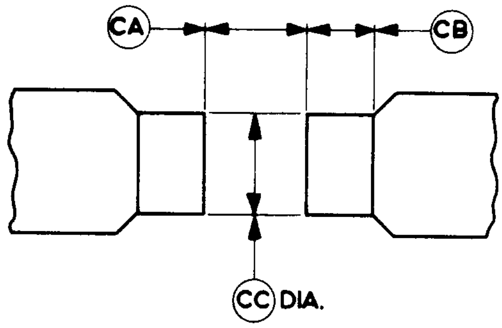
Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

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

The data should be read in conjunction with the Magnetron Preamble.

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	–	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	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 $\pm$10%.

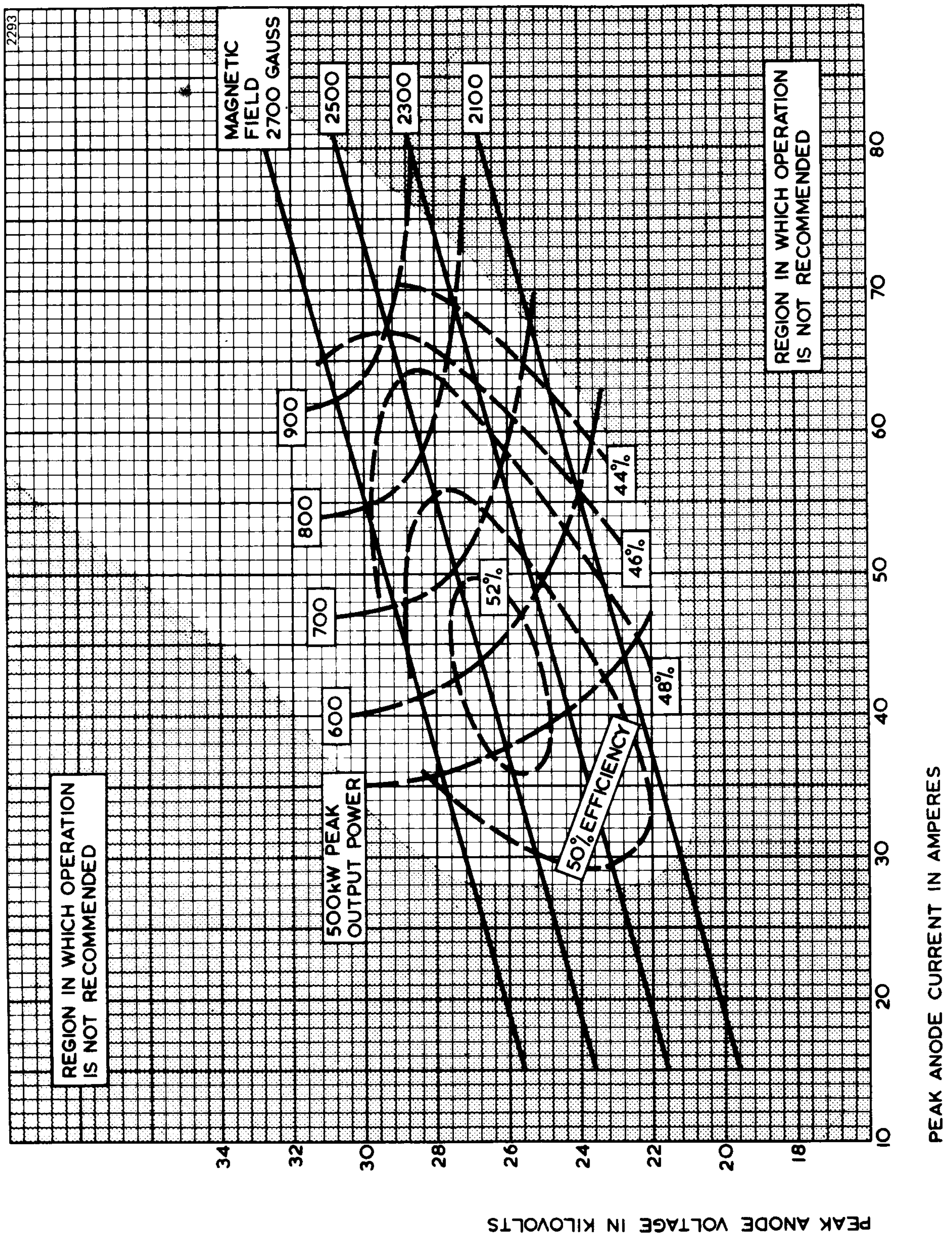
7. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.
8. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the 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 3 minutes of a test interval not to exceed 6 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.

X-RAY WARNING

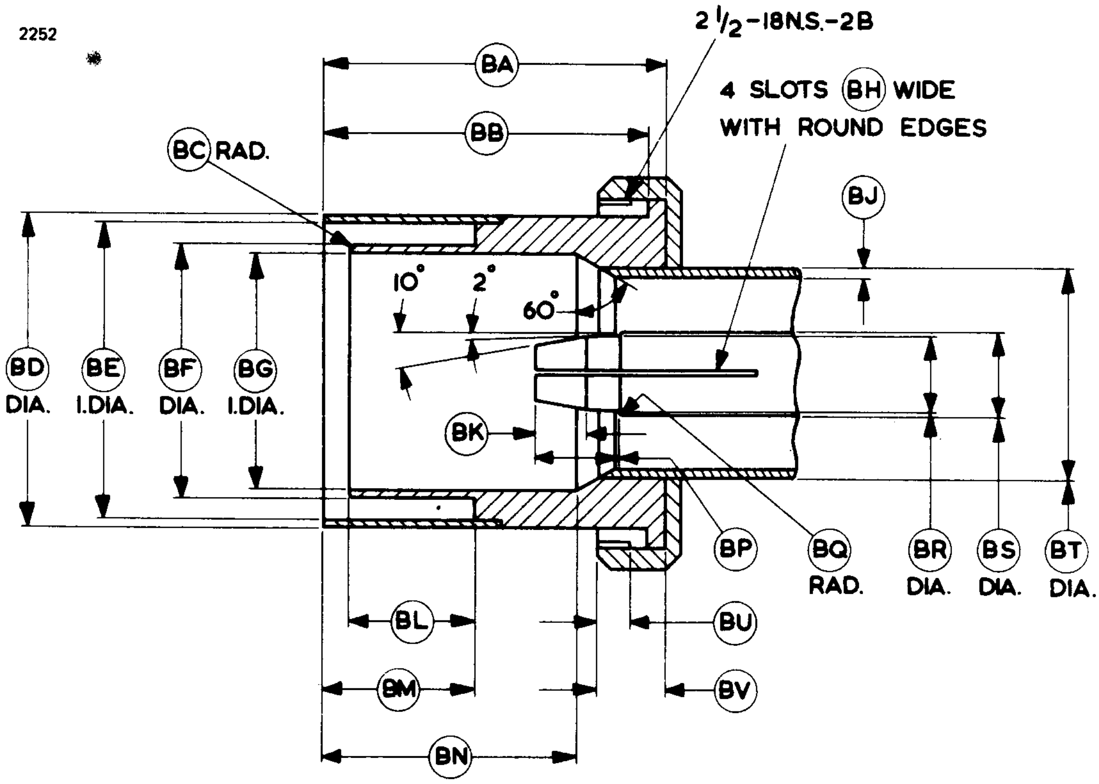
High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

TYPICAL PERFORMANCE CHART



COUPLER (All dimensions without limits are nominal)

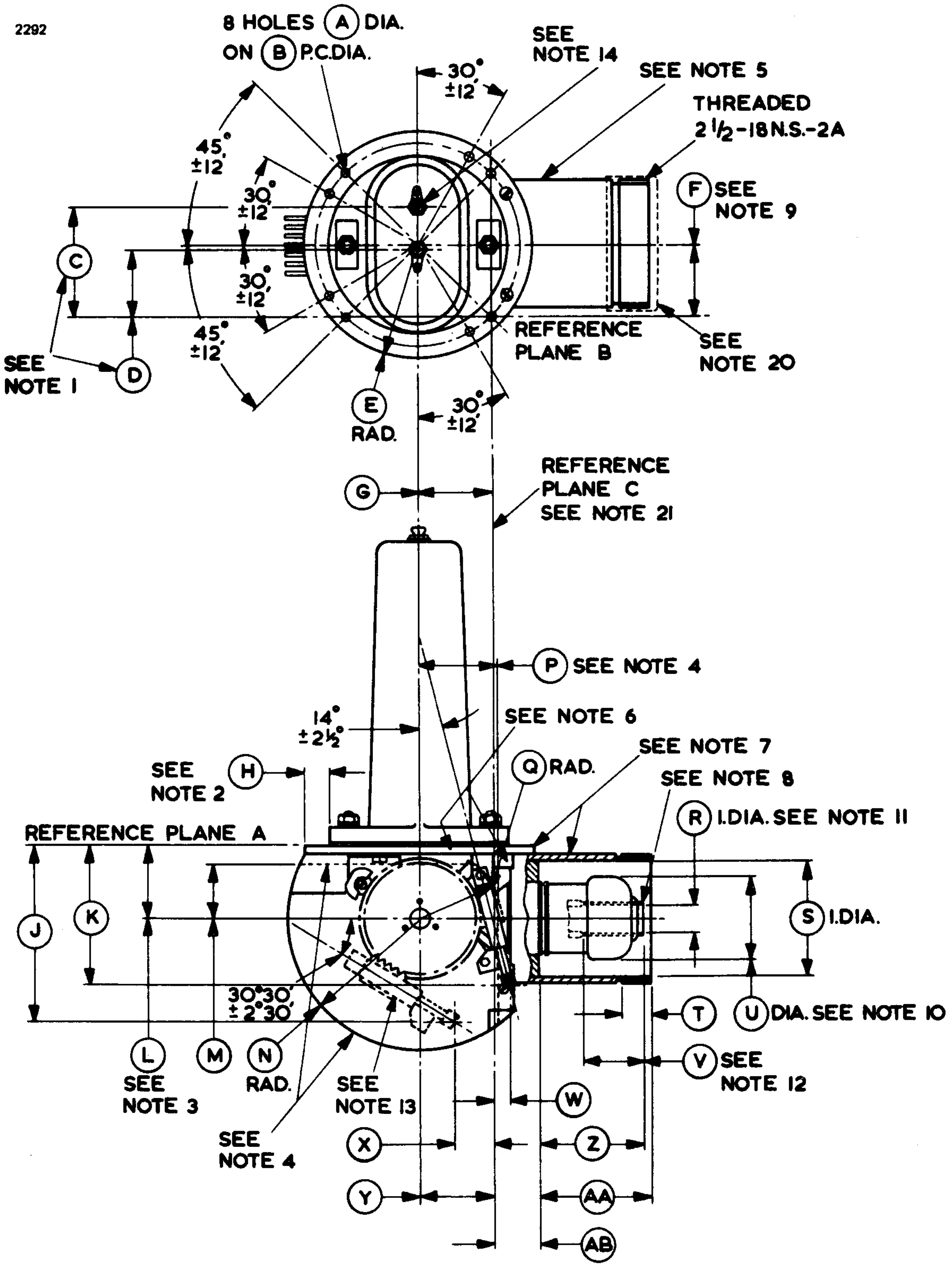
2252



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



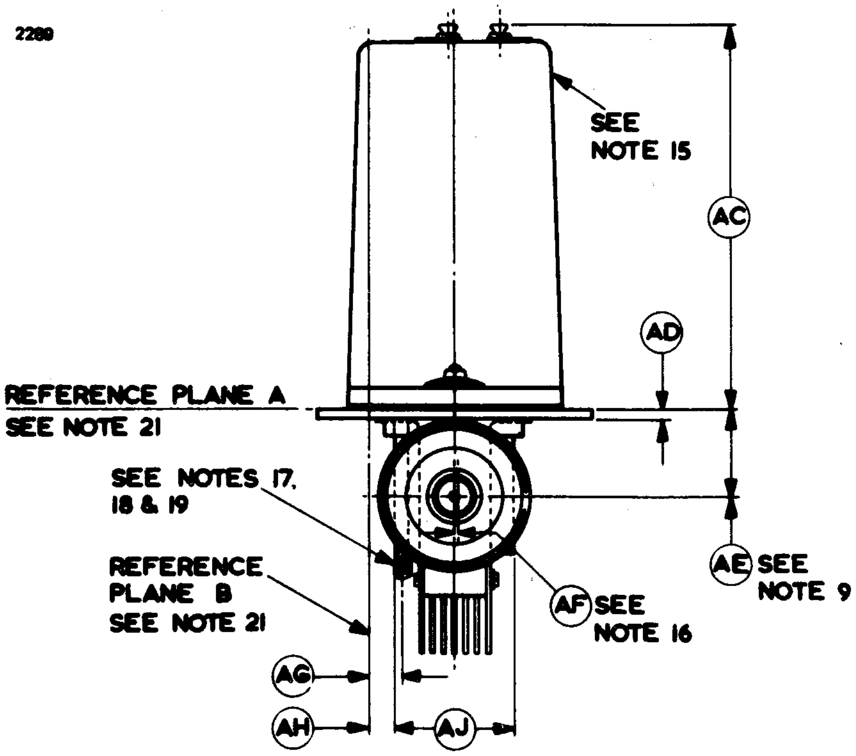
2292
8 HOLES (A) DIA.
ON (B) P.C.DIA.
SEE
NOTE 14
SEE NOTE 5
THREADED
2 1/2-18 N.S.-2A
(F) SEE
NOTE 9
30°
±12'
45°
±12'
(C)
(D)
SEE
NOTE 1
REFERENCE
PLANE B
SEE
NOTE 20
(E)
RAD.
REFERENCE
PLANE C
SEE NOTE 21
(G)
(P) SEE NOTE 4
14°
±2½°
SEE NOTE 6
(Q) RAD.
SEE NOTE 7
SEE NOTE 8
SEE
NOTE 2
(H)
REFERENCE PLANE A
(R) I.DIA. SEE NOTE 11
(S) I.DIA.
(J)
(K)
30°30'
±2°30'
(T)
(U) DIA. SEE NOTE 10
(V) SEE
NOTE 12
(L)
SEE
NOTE 3
(M)
(N)
RAD.
SEE
NOTE 13
SEE
NOTE 4
(W)
(X)
(Z)
(Y)
(AA)
(AB)

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13
B	4.064 ± 0.006	103.23 ± 0.15
C	2.156	54.76
D	1.359	34.52
E	2.281 ± 0.015	57.94 ± 0.38
F	1.437 ± 0.020	36.50 ± 0.51
G	1.437	36.50
H	0.500 min	12.70 min
J	3.500	88.90
K	2.812	71.42
L	1.440	36.58
M	1.063 min	27.00 min
N	2.656 max	67.46 max
P	1.500 min	38.10 min
Q	1.500 min	38.10 min
R	0.555 ± 0.005	14.10 ± 0.13
S	2.321 ± 0.007	58.95 ± 0.18
T	0.593 min	15.06 min
U	1.620 max	41.15 max
V	1.125 min	28.58 min
W	0.313	7.95
X	0.756	19.20
Y	1.437	36.50
Z	2.085 ± 0.025	52.96 ± 0.64
AA	2.297 ± 0.010	58.34 ± 0.25
AB	0.818 ± 0.015	20.78 ± 0.38
AC	6.313 ± 0.094	160.4 ± 2.4
AD	0.187	4.75
AE	1.440 ± 0.020	36.58 ± 0.51
AF	0.025	0.64
AG	0.563 ± 0.125	14.30 ± 3.18
AH	0.575 ± 0.050	14.61 ± 1.27
AJ	1.740 max	44.20 max

Millimetre dimensions have been derived from inches.

2289



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).

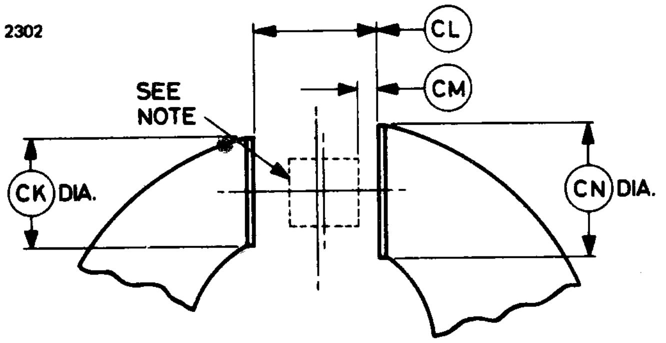
20. Protective guard for shipping purposes.

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
CK	1.625	41.28
CL	1.800 ± 0.005	45.72 ± 0.13

Ref	Inches	Millimetres
CM	0.270	6.86
CN	2.000	50.80

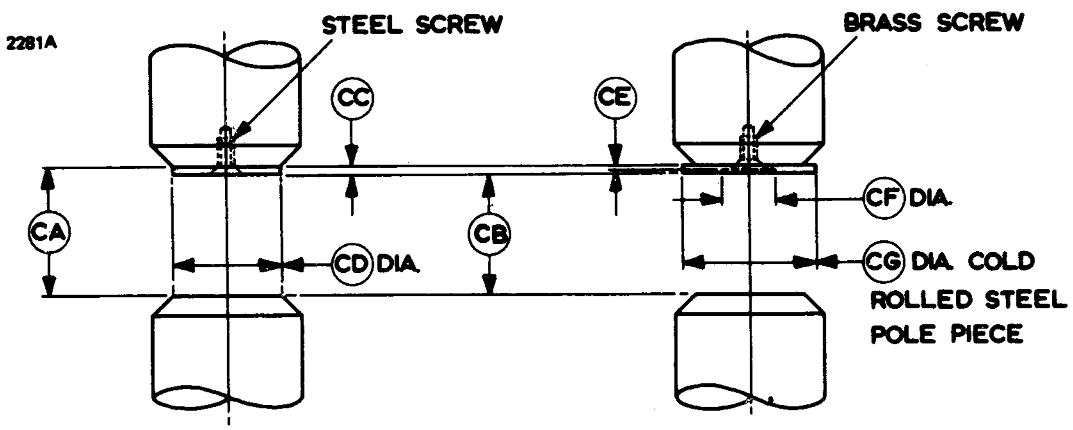
Millimetre dimensions have been derived from inches.

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
CA	1.925 ± 0.005	48.90 ± 0.13
CB	1.800 ± 0.005	45.72 ± 0.13
CC	0.125 ± 0.015	3.18 ± 0.38
CD	1.625 ± 0.015	41.28 ± 0.38

Ref	Inches	Millimetres
CE	0.031 ± 0.015	0.79 ± 0.38
CF	0.786 ± 0.005	19.96 ± 0.13
CG	2.000 ± 0.015	50.80 ± 0.38

Millimetre dimensions have been derived from inches.

5586A

TUNABLE S-BAND MAGNETRON

5586 with improved tuner mechanism

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Mechanically tuned pulse magnetron. It is identical in outline and electrical characteristics with type 5586 but incorporates an improved tuner mechanism with a life of at least 5000 complete tuning cycles over the frequency range of the tube.

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 at 16V	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	–	0.0012	
Pulse length	–	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
Tuner worm wheel temperature (see note 2)	15	120	°C
Torque at tuning range stops	–	3.0	lb-in
	–	3.46	kg-cm
Drive shaft speed	–	1000	rev/min
Tuning rate	–	25	MHz/s
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	8.0	V
Magnetic field (see note 9)	2700	2700	2700	gauss
Anode current (peak)	33	50	70	A
Pulse length	2.0	0.5	1.0	μs
Pulse repetition rate	600	1500	500	p.p.s.

Typical Performance

Anode voltage (peak)	27.5	30	30	kV
Output power (peak)	465	700	1000	kW
Output power (mean)	560	525	500	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 9)	2700	2700	2700	gauss
Heater voltage (for test)	10	10	8.0	V
Anode current (mean)	35	35	40	mA
Duty cycle	0.0005	0.0006	0.0012	
Pulse length (see note 6)	1.0	2.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 7)	200	200	150	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak) (see note 10)	27	32	–	–	–	–	kV
Output power (mean) (see note 10)	400	–	400	–	400	–	W
Frequency (see note 11)	2700	2900	–	–	2700	2900	MHz
R.F. bandwidth at ¼ power (see note 12)	–	2.5	–	–	–	1.25	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	–	–	MHz
Stability (see notes 10 and 13)	–	0.5	–	–	–	0.5	%
Frequency hysteresis (see note 14)	–	–	–	–	–	3.0	MHz
Backlash (see notes 10 and 15)	–	–	–	–	1.2	–	MHz
Drive torque (see note 16)	–	–	–	–	–	1.0	lb-in
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 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)	1.0	% 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. The valve must not be tuned if the temperature of the tuner mechanism is less than 15°C.

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%.

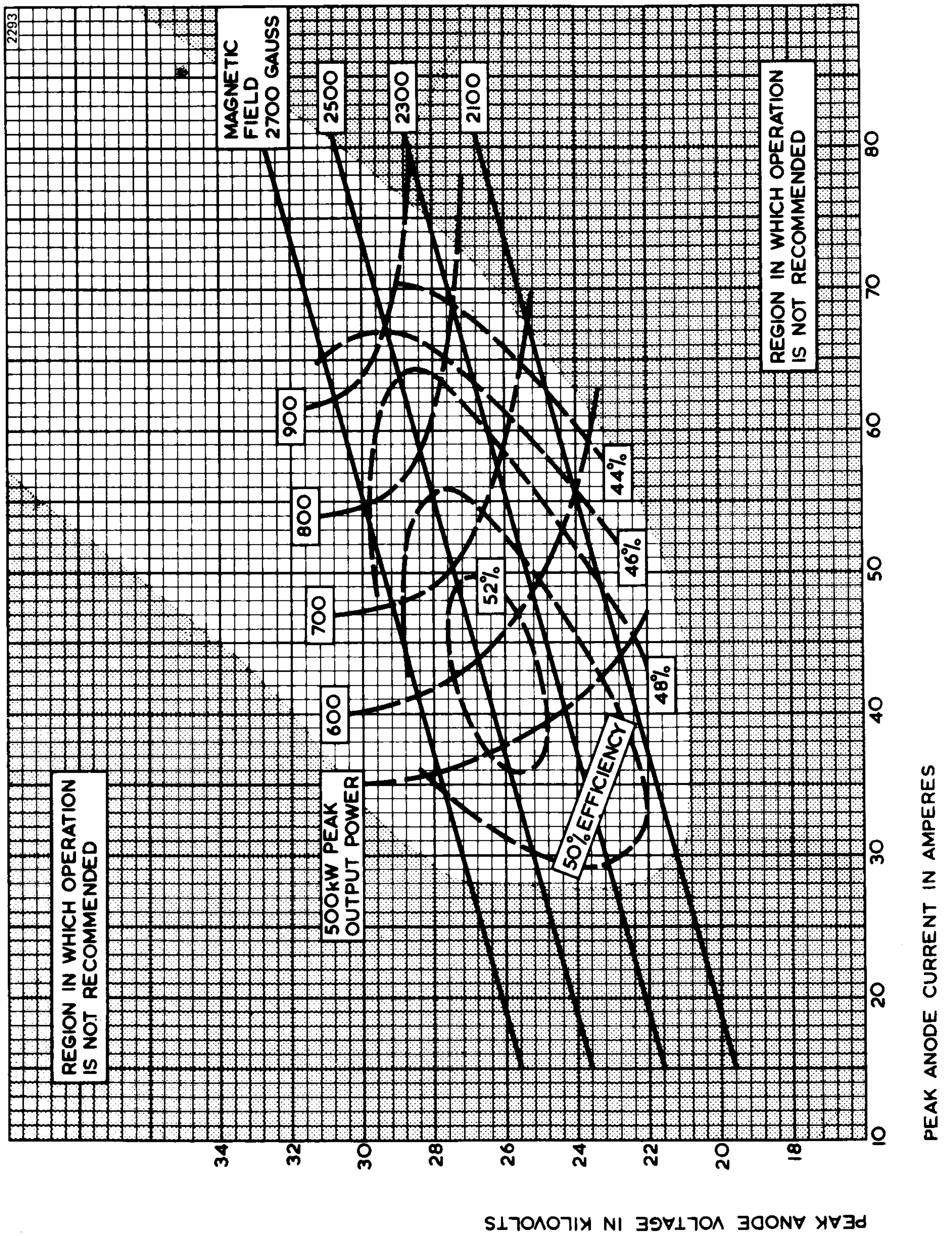
7. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.
8. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input and the output circuit of the valve At the maximum pressure of 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 3 minutes of a test interval not to exceed 6 minutes.
14. The frequency hysteresis is the difference in operating frequency when a particular tuner position is approached from different directions. The limit will not be exceeded at any point within the frequency range.
15. Backlash is defined as the frequency change produced when the mechanism is reversed one turn.
16. Measured statically in both directions with mechanism set up to operating frequencies of 2700, 2800 and 2900MHz.
17. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.
18. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.07\text{MHz}/^\circ\text{C}$.

X-RAY WARNING

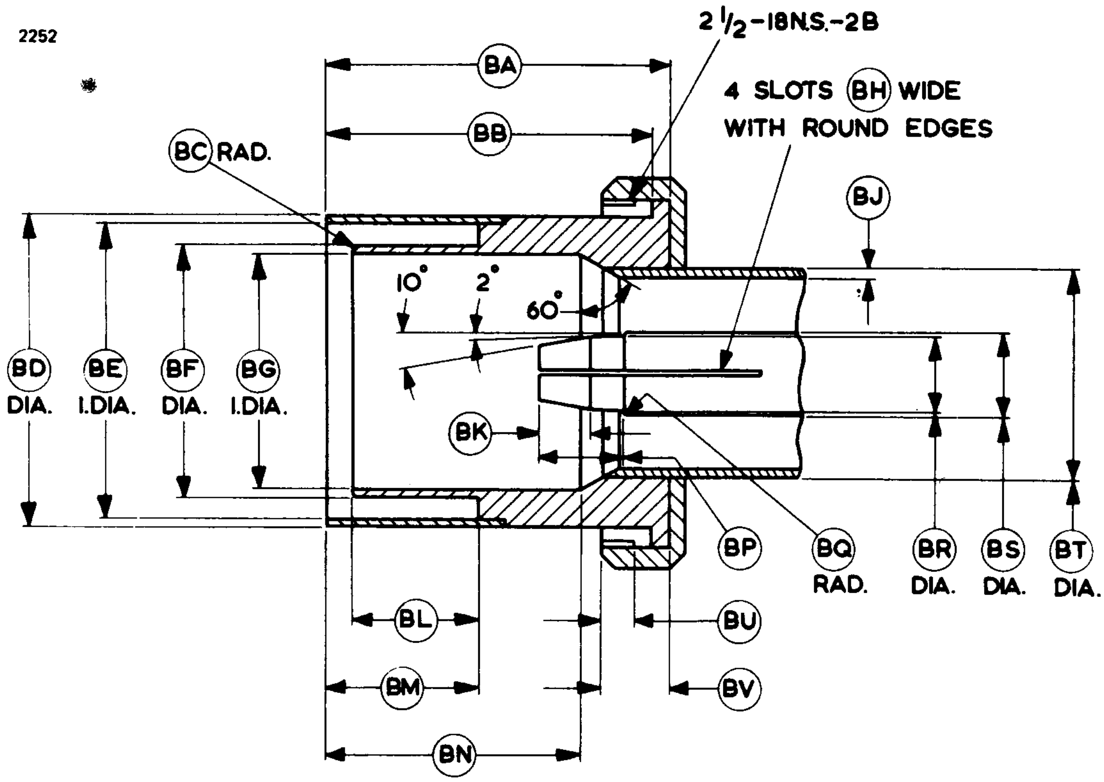
High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

TYPICAL PERFORMANCE CHART



COUPLER (All dimensions without limits are nominal)

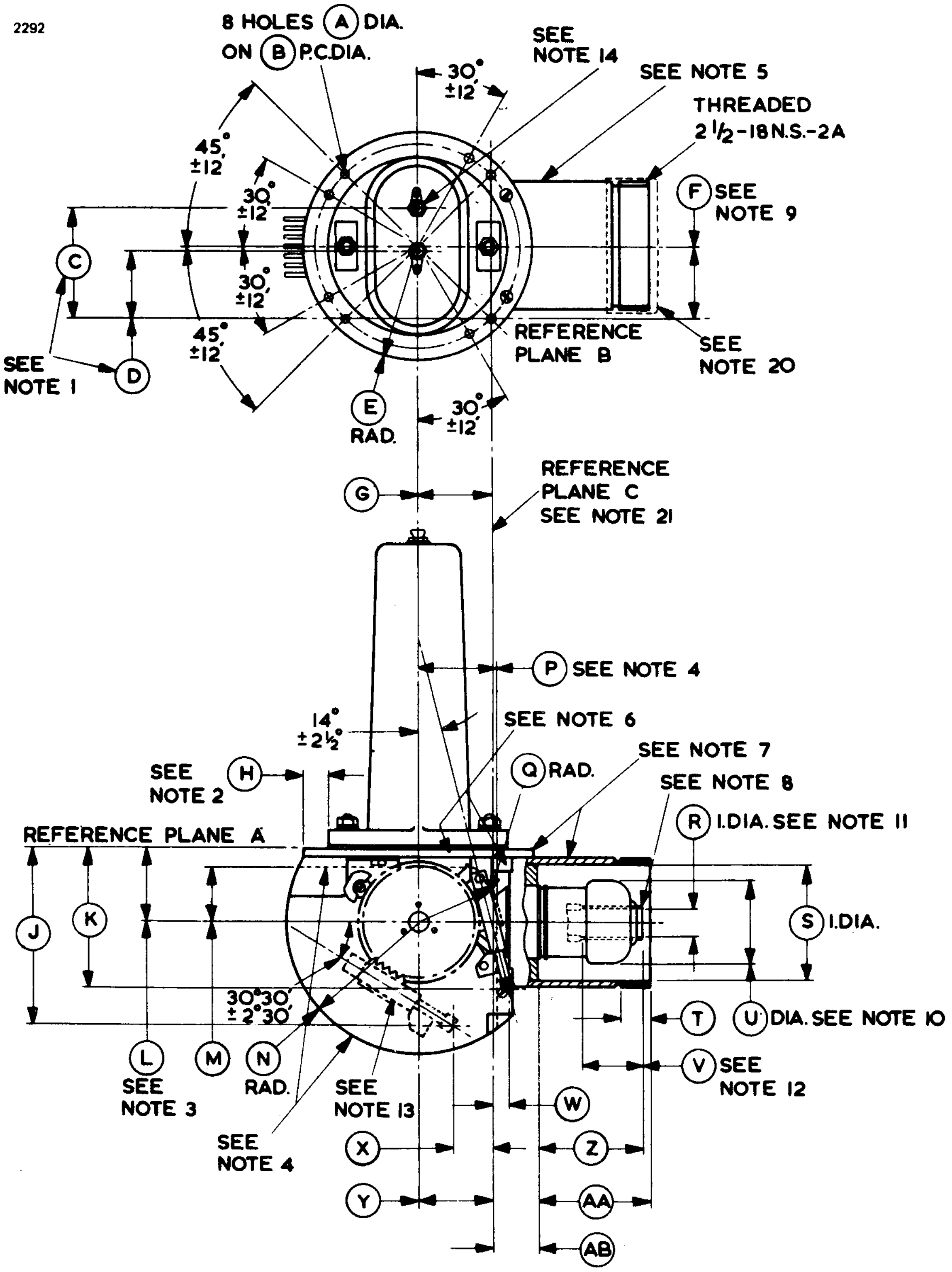
2252



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

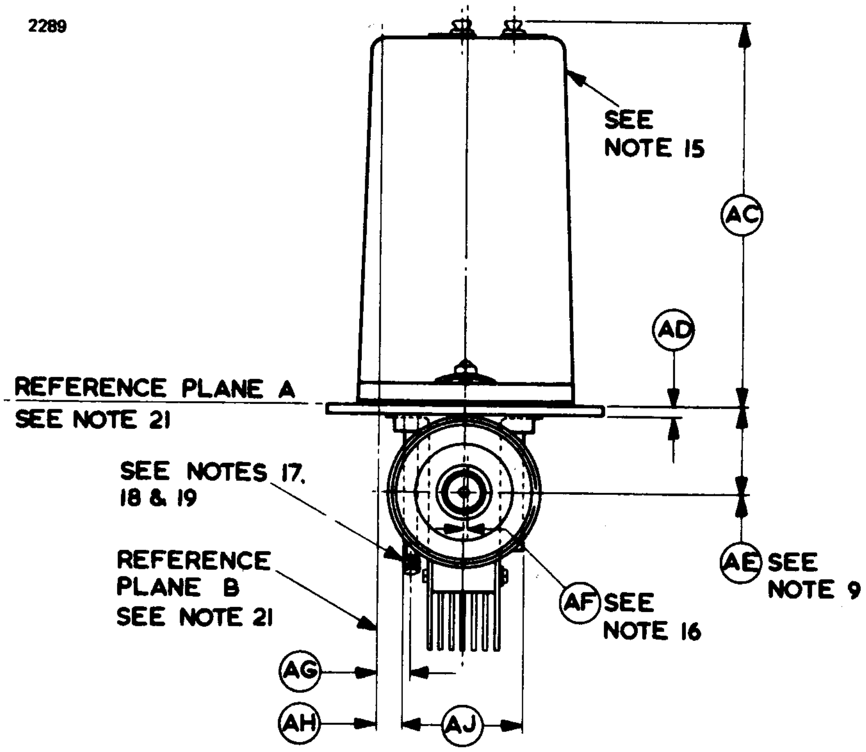

2292
8 HOLES A DIA.
ON B P.C.DIA.
SEE
NOTE 14
SEE NOTE 5
THREADED
2 1/2-18N.S.-2A
30°
±12'
45°
±12'
30°
±12'
30°
±12'
45°
±12'
C
F SEE
NOTE 9
SEE
NOTE 1
D
E
RAD.
REFERENCE
PLANE B
SEE
NOTE 20
30°
±12'
G
REFERENCE
PLANE C
SEE NOTE 21
P SEE NOTE 4
14°
±2½°
SEE NOTE 6
SEE NOTE 7
Q RAD.
SEE NOTE 8
SEE
NOTE 2
H
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
SEE
NOTE 3
M
N
RAD.
SEE
NOTE 13
V SEE
NOTE 12
W
SEE
NOTE 4
X
Z
Y
AA
AB

Outline Dimensions (All dimensions without limits are nominal)

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.

2289



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 ± 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.

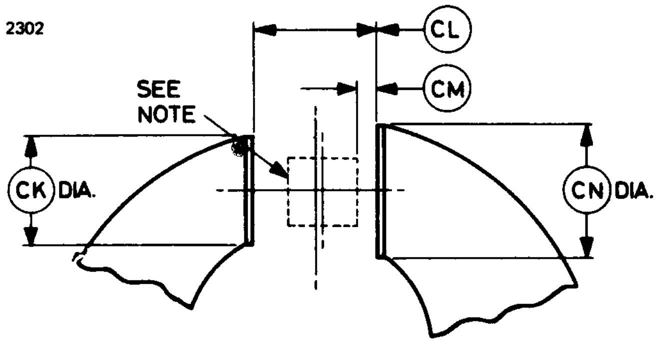
21. Reference plane A is defined as a plane passing along the face of the mounting plate.

    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

2302



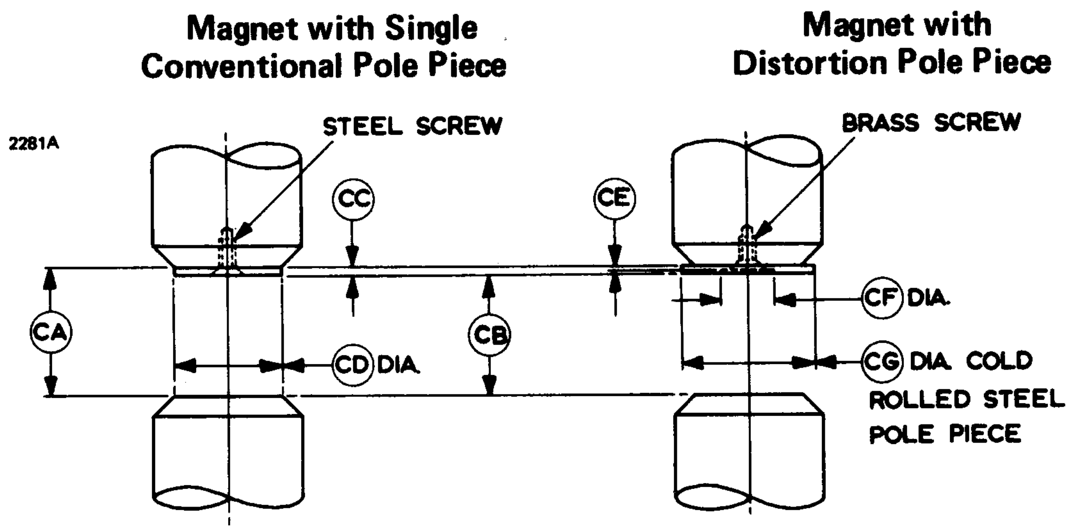
Ref	Inches	Millimetres	Ref	Inches	Millimetres
CK	1.625	41.28	CM	0.270	6.86
CL	1.800 ± 0.005	45.72 ± 0.13	CN	2.000	50.80

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

2281A



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.

5657

TUNABLE S-BAND MAGNETRON

Service Type CV3958

The data should be read in conjunction with the Magnetron Preamble.

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	–	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 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 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.

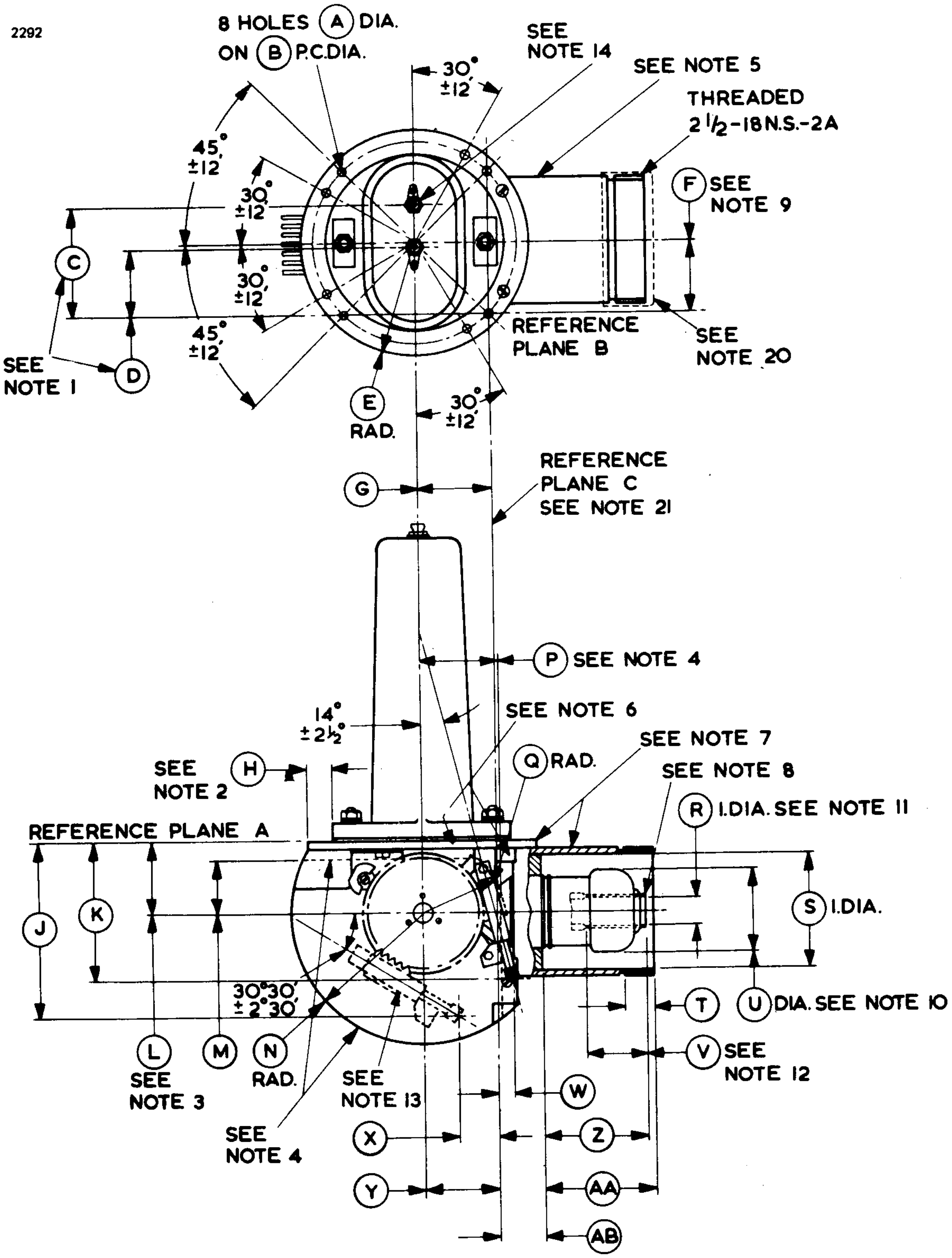
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.
10. These tests are carried out with the valve tuned to 2900, 3000 and 3100MHz.
11. The valve will tune over the indicated frequency range.
12. The specification limit for bandwidth applies over the whole tuning range.
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 3 minutes of a test interval not to exceed 6 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.

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

2292

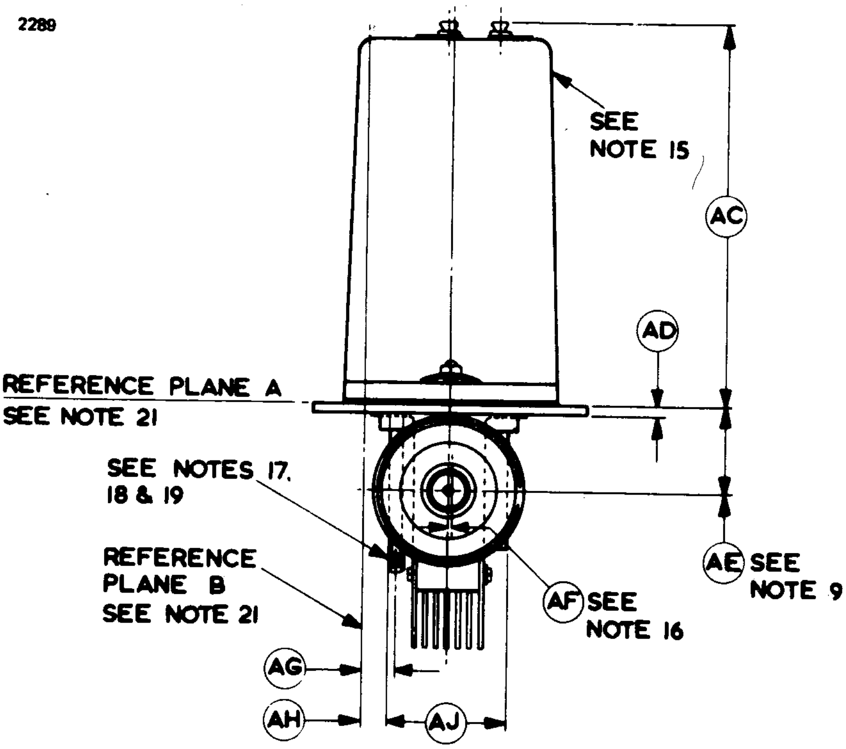


Outline Dimensions (All dimensions without limits are nominal)

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.

2289



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 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.

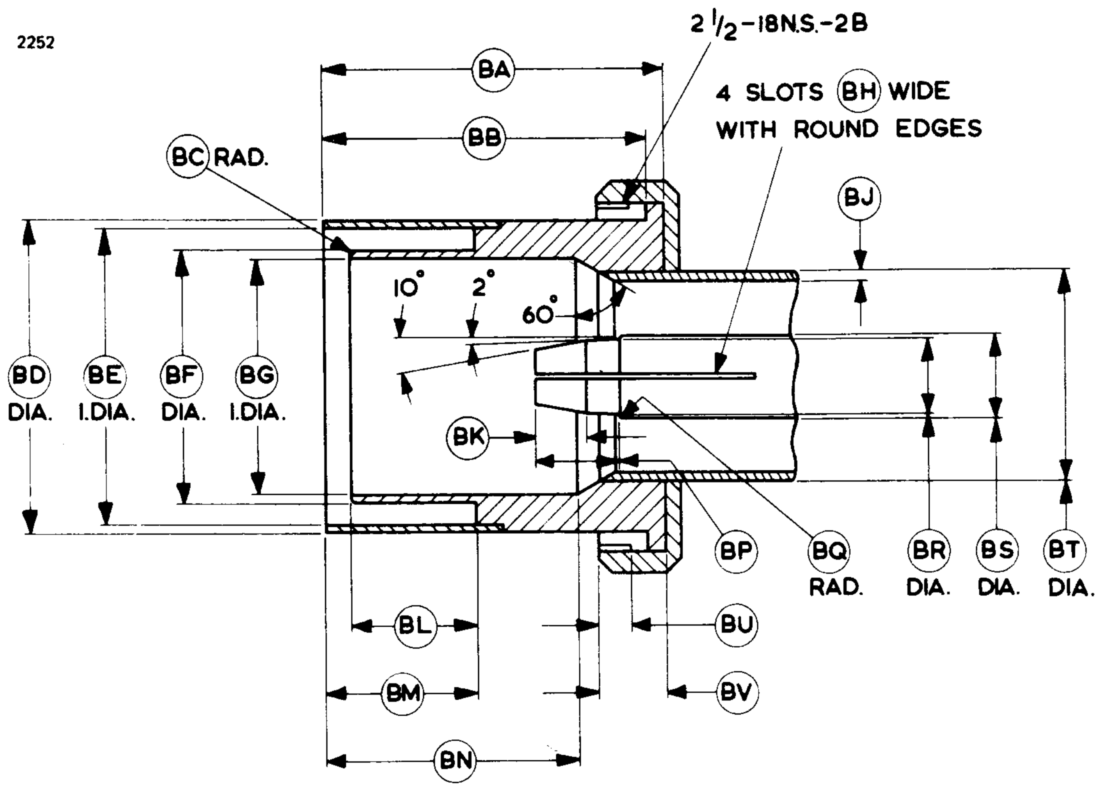
20. Protective guard for shipping purposes.

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.

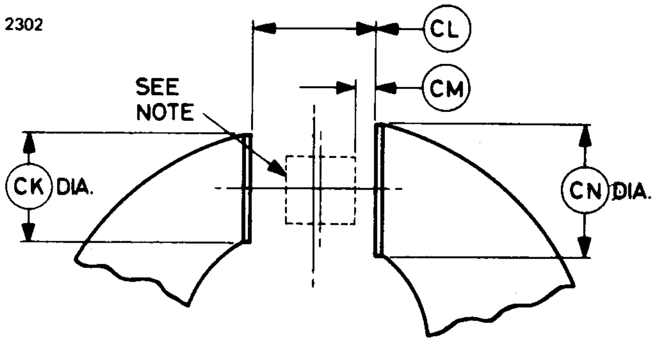
COUPLER (All dimensions without limits are nominal)



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



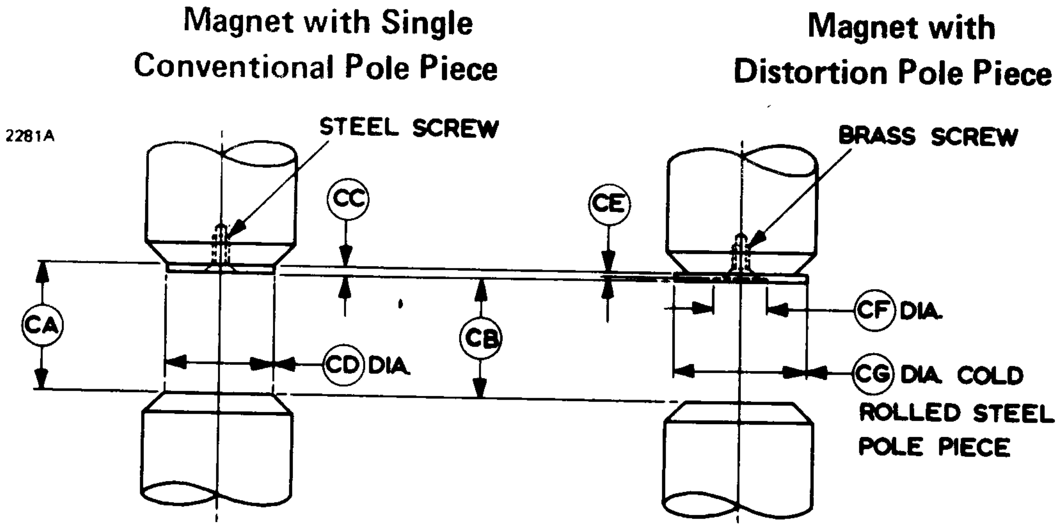
Ref	Inches	Millimetres
CK	1.625	41.28
CL	1.800 ± 0.005	45.72 ± 0.13

Ref	Inches	Millimetres
CM	0.270	6.86
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



Ref	Inches	Millimetres
CA	1.925 ± 0.005	48.90 ± 0.13
CB	1.800 ± 0.005	45.72 ± 0.13
CC	0.125 ± 0.015	3.18 ± 0.38
CD	1.625 ± 0.015	41.28 ± 0.38

Ref	Inches	Millimetres
CE	0.031 ± 0.015	0.79 ± 0.38
CF	0.786 ± 0.005	19.96 ± 0.13
CG	2.000 ± 0.015	50.80 ± 0.38

Millimetre dimensions have been derived from inches.

7182

S-BAND MAGNETRON

Frequency variant of M573, M574

The data should be read in conjunction with the Magnetron Preamble.

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	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	2750 to 2860	MHz
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:

   $V_h = 12.0 - 0.0010P_i$ for P_i less than 6000 watts

   $V_h = 30.0 - 0.0040P_i$ for P_i greater than 6000 watts

   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.

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 ±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 3000 and 3100MHz should not exceed 2.0:1.

7. 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.

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 35 lb/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 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.

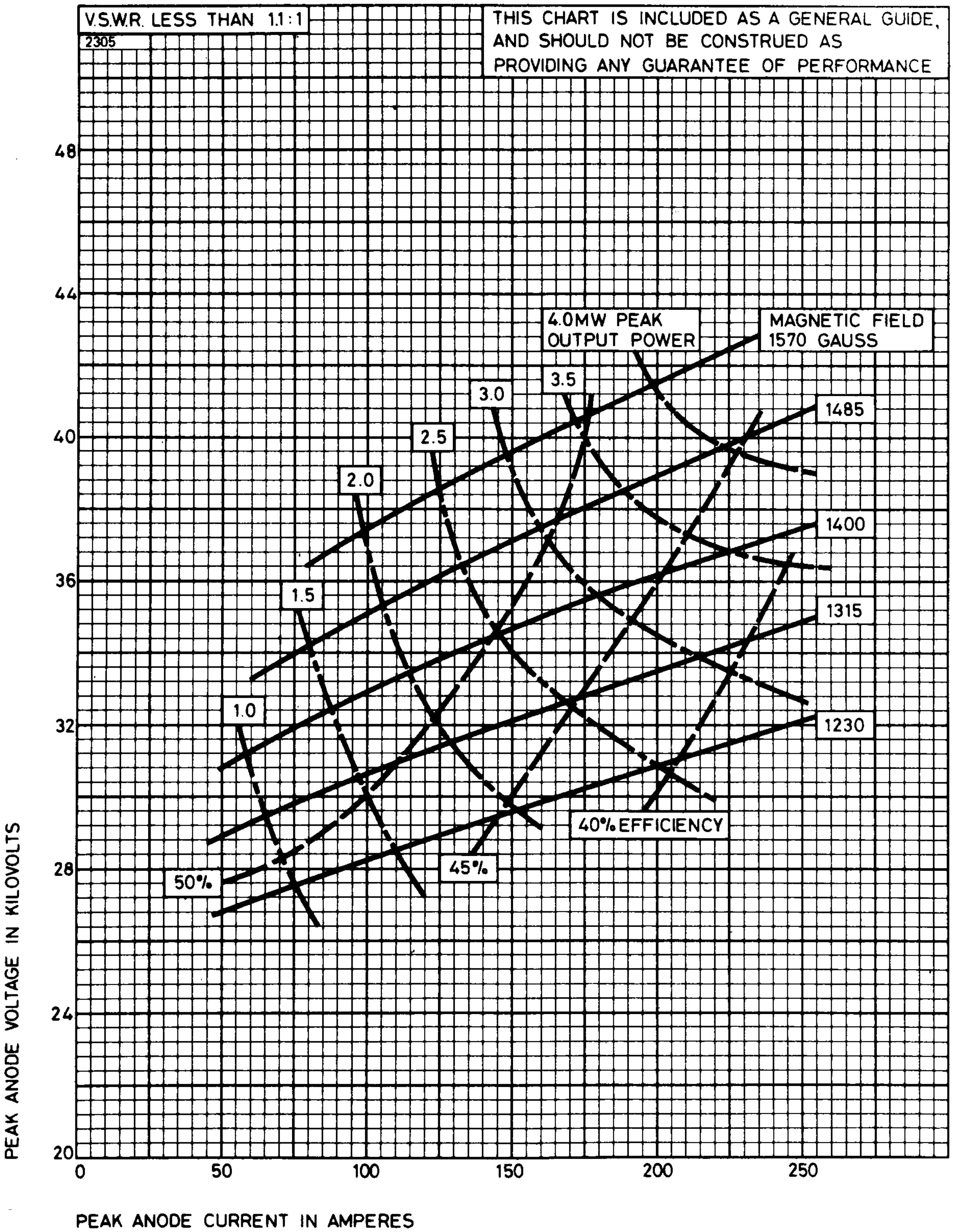
16. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

17. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.05MHz/°C.

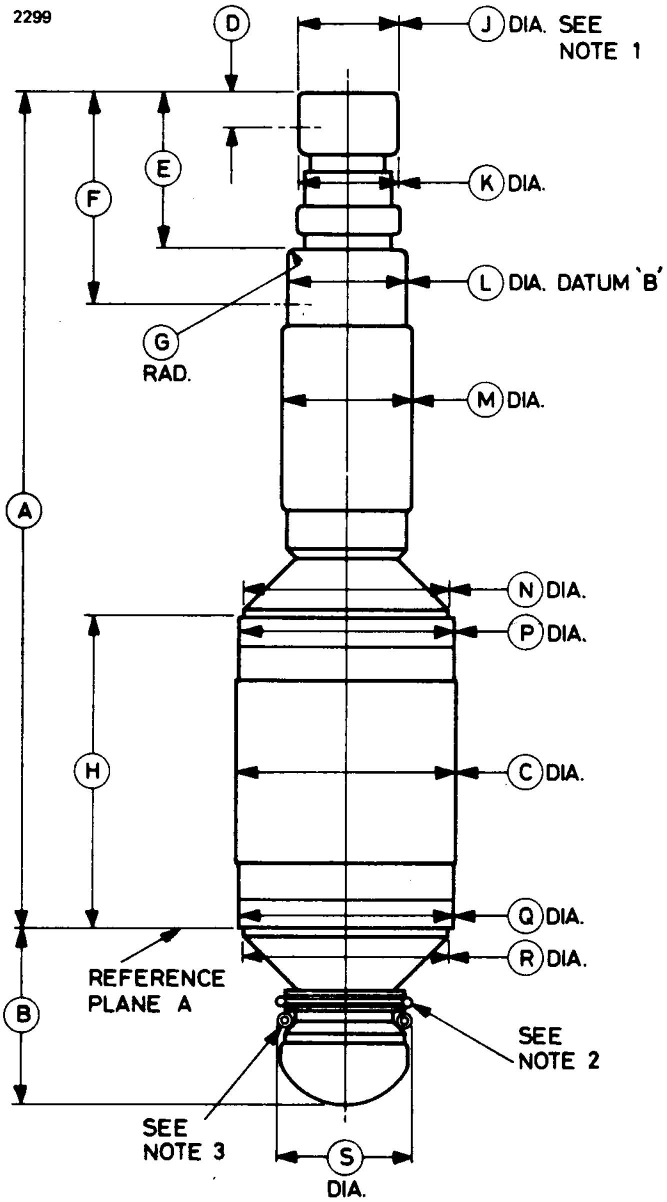
X-RAY WARNING

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.

TYPICAL 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

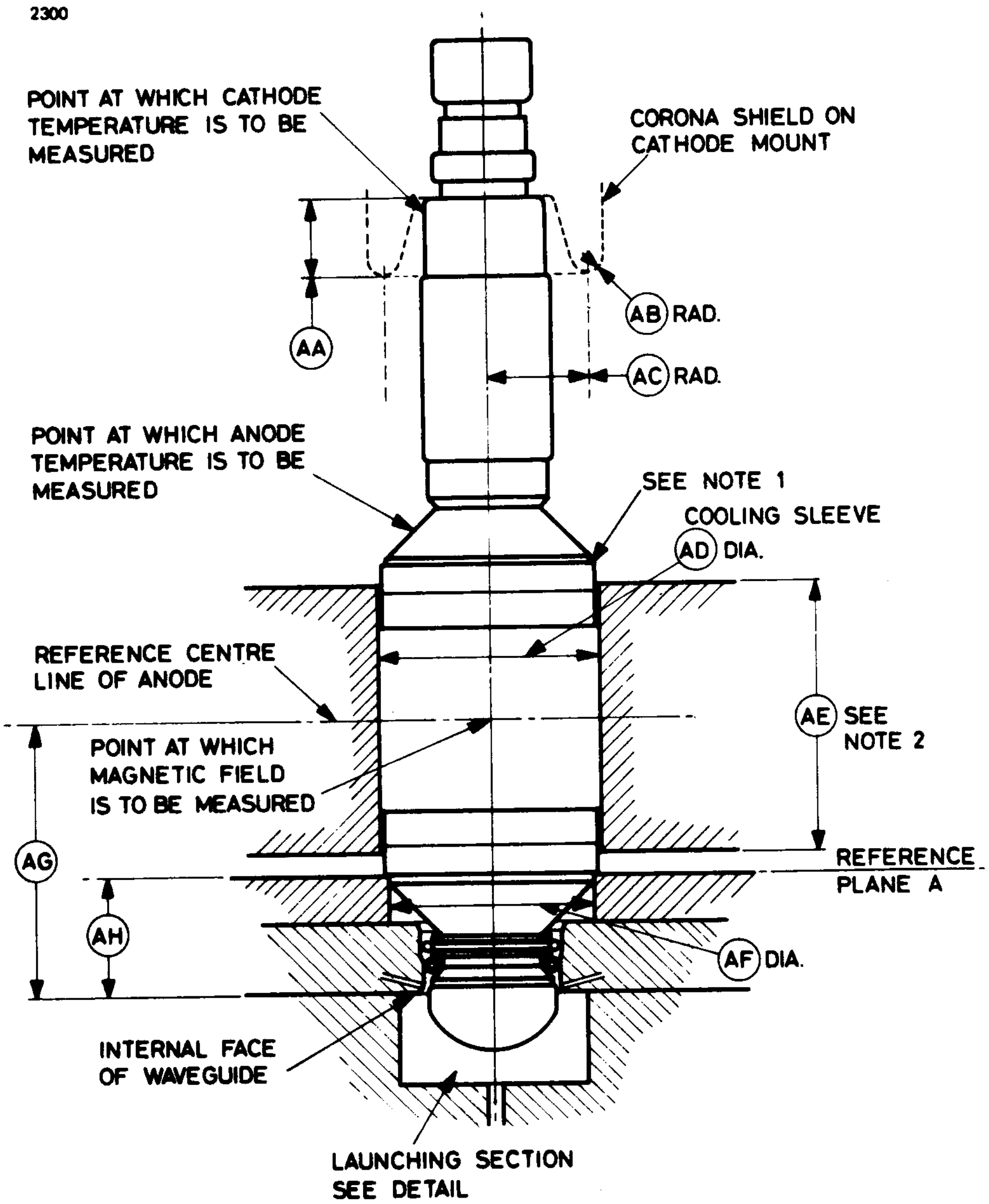
Millimetre dimensions have been derived from inches.

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
(All dimensions without limits are nominal)

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	1.57	AY	2.840 ± 0.004	72.136 ± 0.102

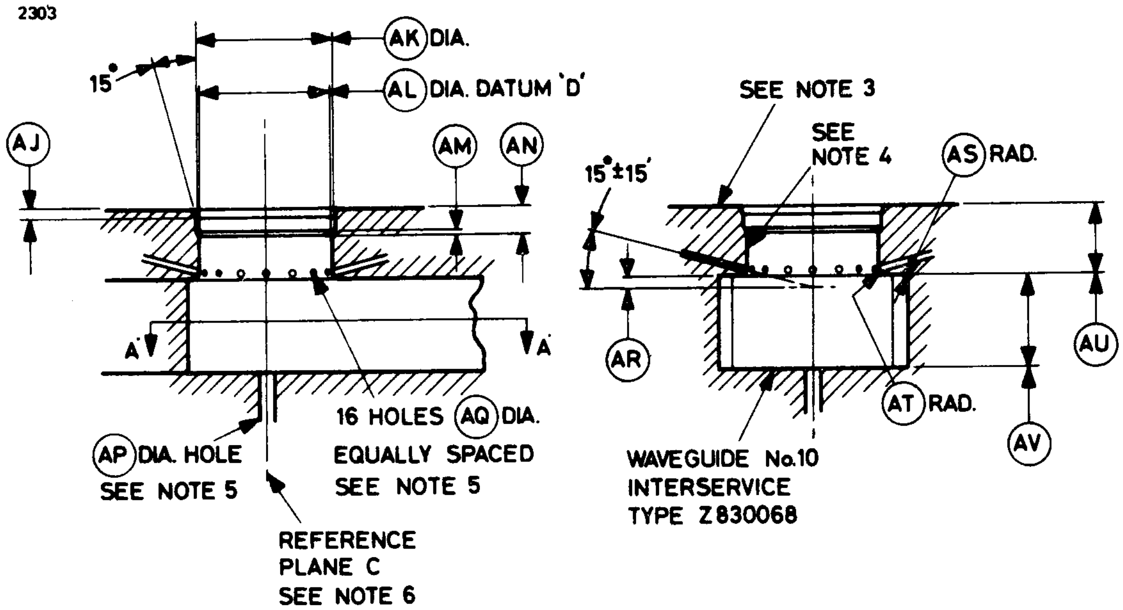
Millimetre dimensions have been derived from inches.

Notes for Electro-magnet and Launching Section

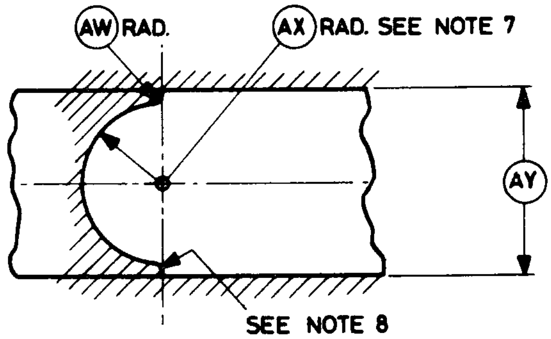
1. An adjustable device shall be used to bear on this shoulder and to ensure that the magnetron locates on reference plane A . It must be able to withstand the thrust on the magnetron due to a pressure of 65 lb/in^2 absolute in the waveguide.
2. The length of the water jacket centre line to be within 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



BM1003 BM1004 BM1005

S-BAND MAGNETRONS

The data should be read in conjunction with the Magnetron Preamble.

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	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	120	kV/μs
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/μs

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:

   $$P_i = i_{apk} \times v_{apk} \times D_u$$

   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 $\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.

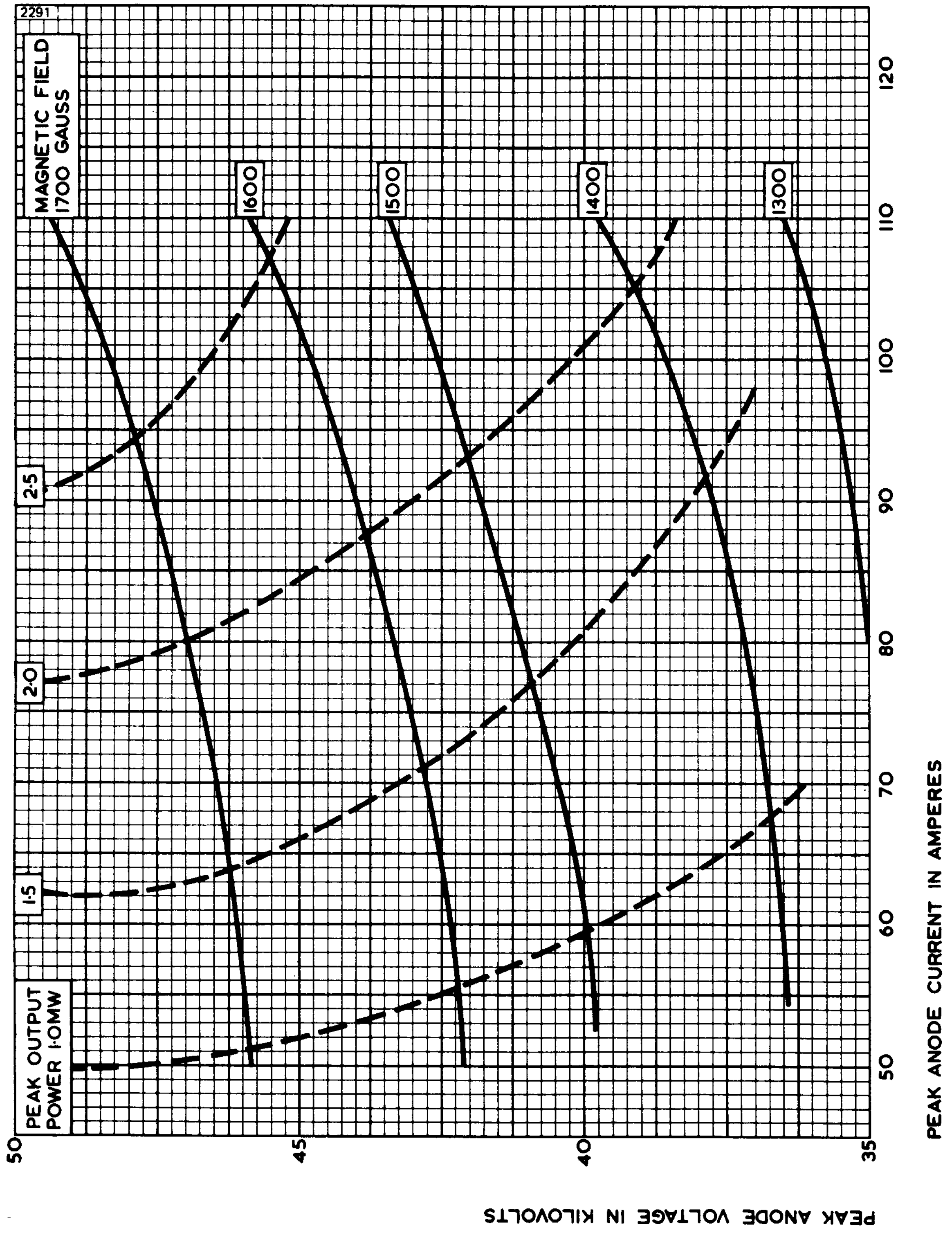
8. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 10A maximum.

9. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

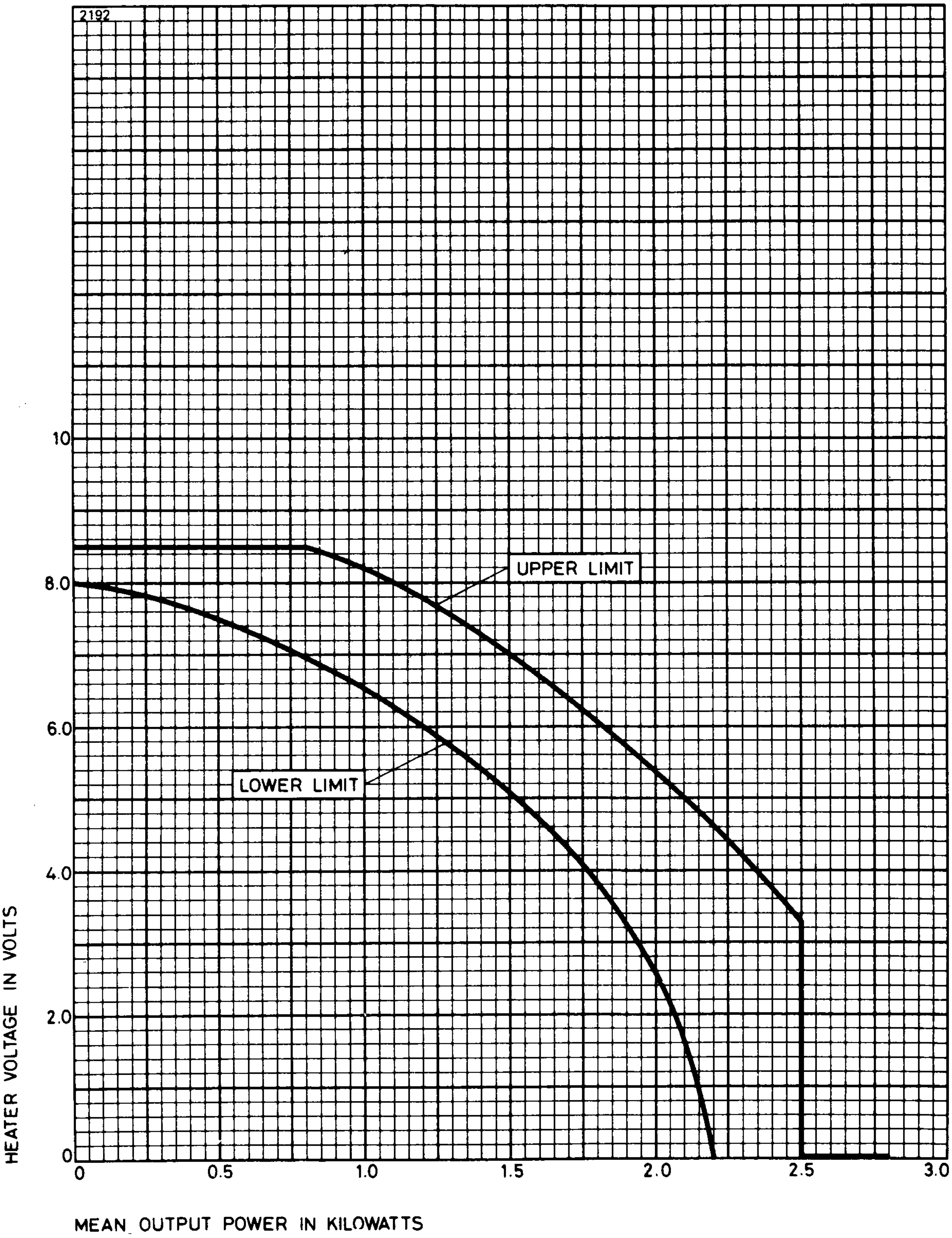
X-RAY WARNING

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.

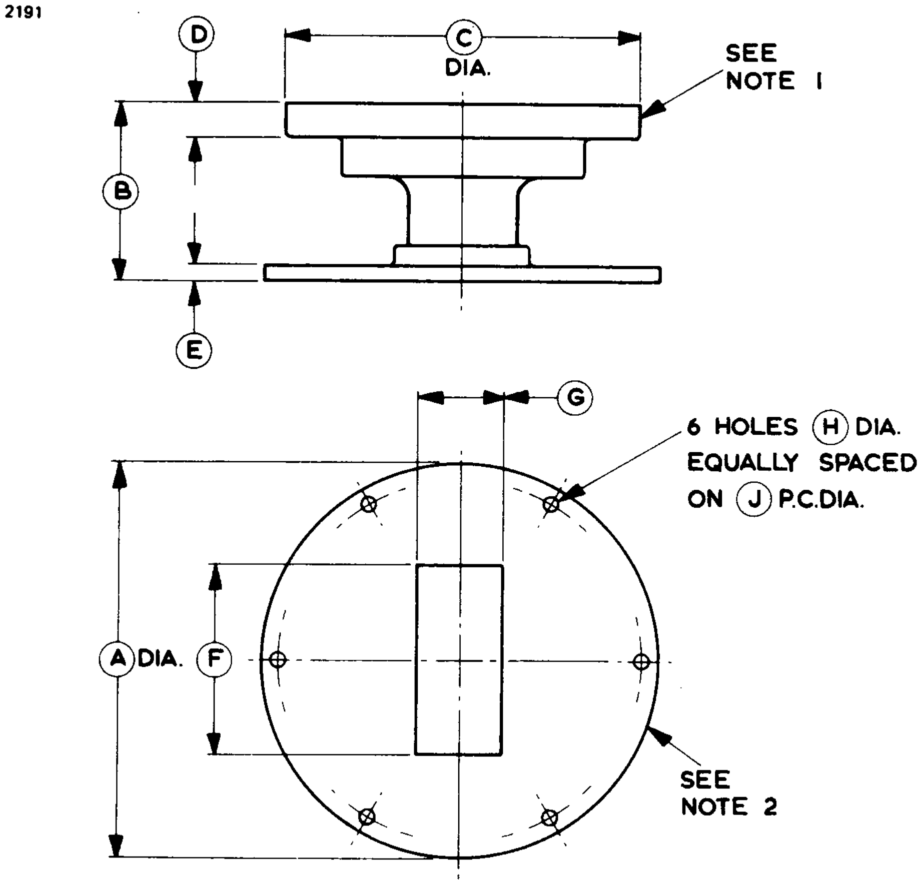
TYPICAL PERFORMANCE CHART



HEATER VOLTAGE ADJUSTMENT SCHEDULE



TRANSITION SECTION M4117 (All dimensions nominal)



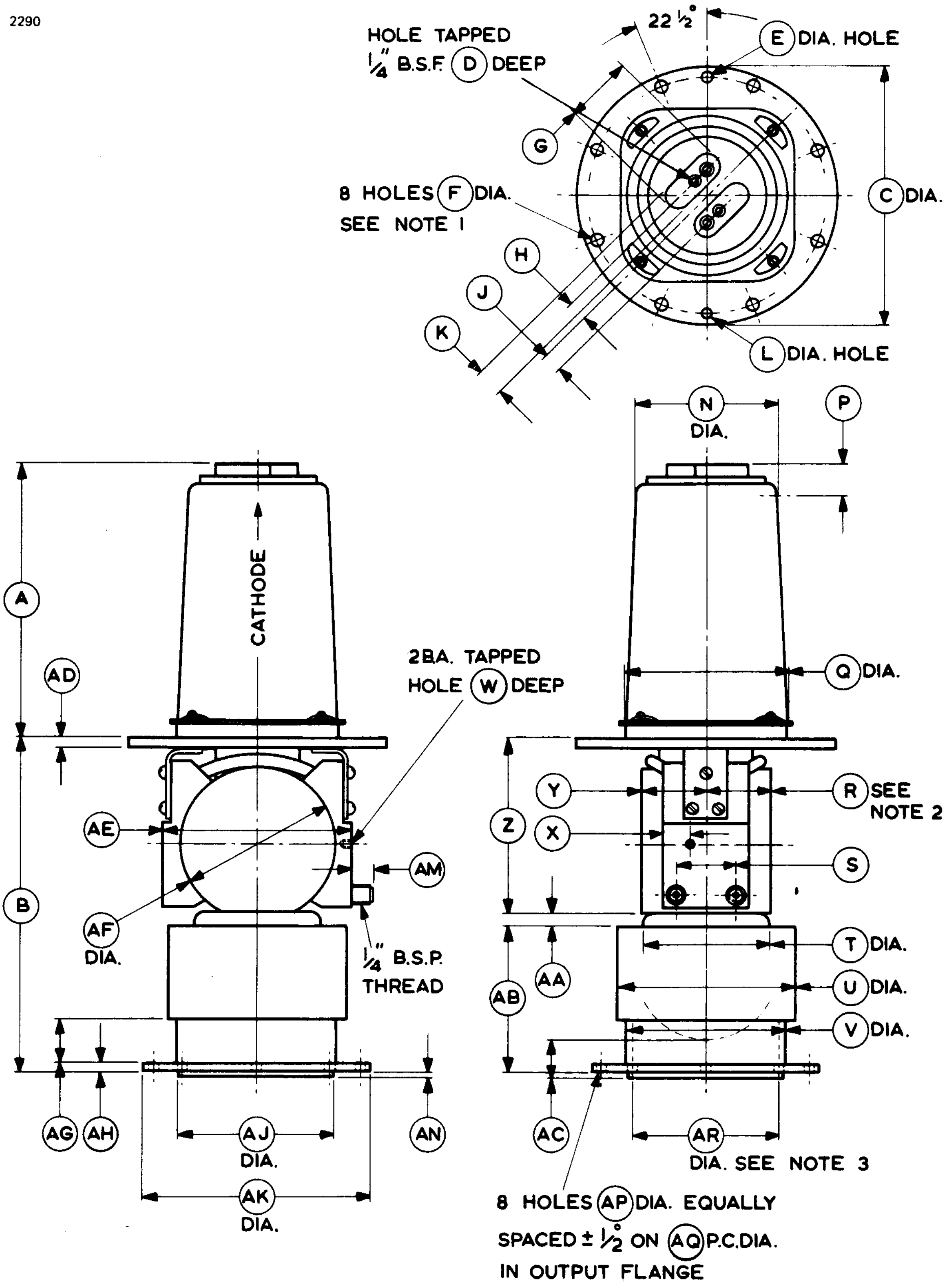
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875	149.2	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	5.375	136.5
E	0.250	6.35			

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 MS90064-17.
2. This flange is J.S.C. type No. 5985-99-083-1560.

OUTLINE (See page 10 for outline notes)



Outline Dimensions (All dimensions without limits are nominal)

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)	37.72 max (BM1003/4)
D	0.250	6.35		1.530 max (BM1005)	38.86 max (BM1005)
E	$0.312^{+0.005}_{-0.000}$	$7.92^{+0.13}_{-0.00}$	Z	4.035 ± 0.030	102.5 ± 0.76
F	0.312	7.92	AA	0.312	7.92
G	1.625	41.28	AB	3.437	87.30
H	0.437	11.10	AC	0.875	22.23
J	0.437	11.10	AD	0.250 ± 0.005	6.35 ± 0.13
K	0.625	15.88	AE	4.375	111.1
L	$0.250^{+0.005}_{-0.000}$	$6.35^{+0.13}_{-0.00}$	AF	3.625	92.08
			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			
R	1.485 max (BM1003/4)	37.72 max (BM1003/4)	AK	5.250 ± 0.062	133.4 ± 1.57
			AM	0.500	12.70
	1.530 max (BM1005)	38.86 max (BM1005)	AN	0.125 ± 0.005	3.18 ± 0.13
S	1.375	34.93	AP	$0.250^{+0.005}_{-0.000}$	$6.35^{+0.13}_{-0.00}$
T	2.937	74.60	AQ	4.750 ± 0.005	120.7 ± 0.13
U	4.125	104.8	AR	$3.375^{+0.005}_{-0.000}$	$85.73^{+0.13}_{-0.00}$
V	3.687	93.65			

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

The data should be read in conjunction with the Magnetron Preamble.

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	12 pounds (5.5kg) 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	–	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

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.

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.

2. 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.

3. Tolerance ± 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.

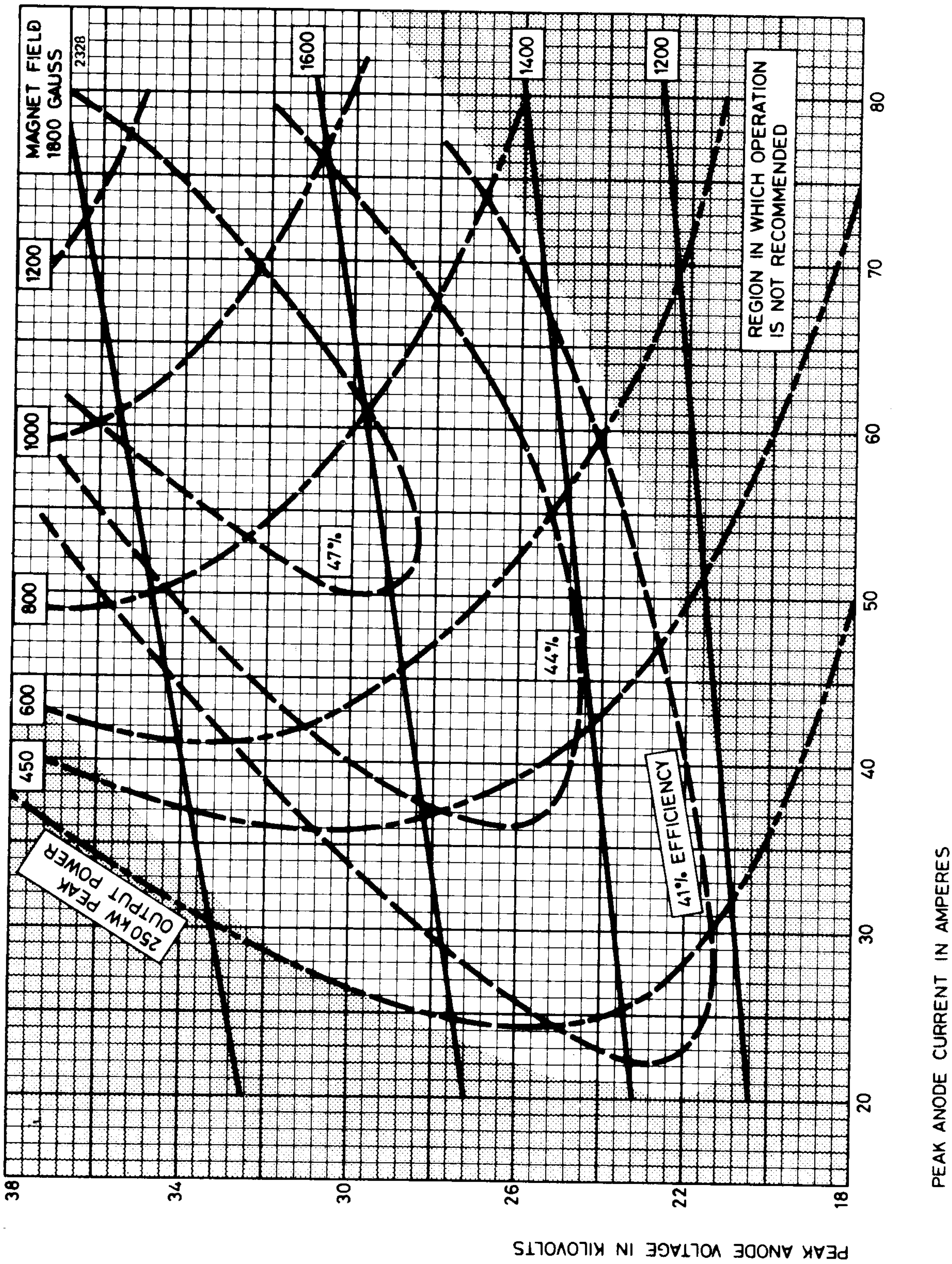
5. The variation of magnetic field within a cylinder 1½ inches (38.10mm) diameter and 1.125 inch (28.58mm) long, situated centrally and co-axially between the poles of the magnet should not exceed 10% overall. The position of the magnet must be adjusted so that the axis of the field is in line with the 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.

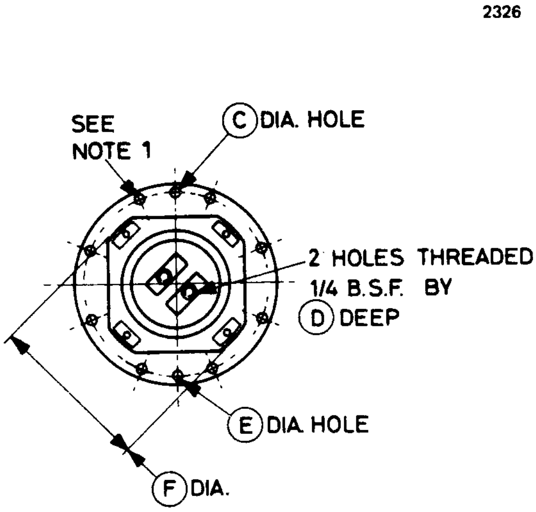
TYPICAL PERFORMANCE CHART

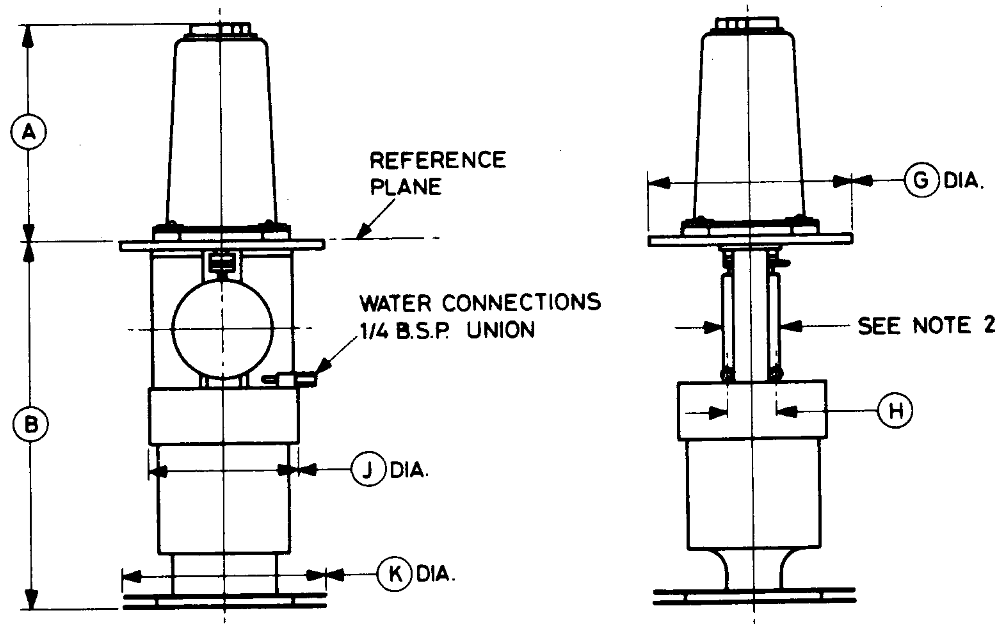


OUTLINE

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 ± 0.032	34.93 ± 0.81
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.

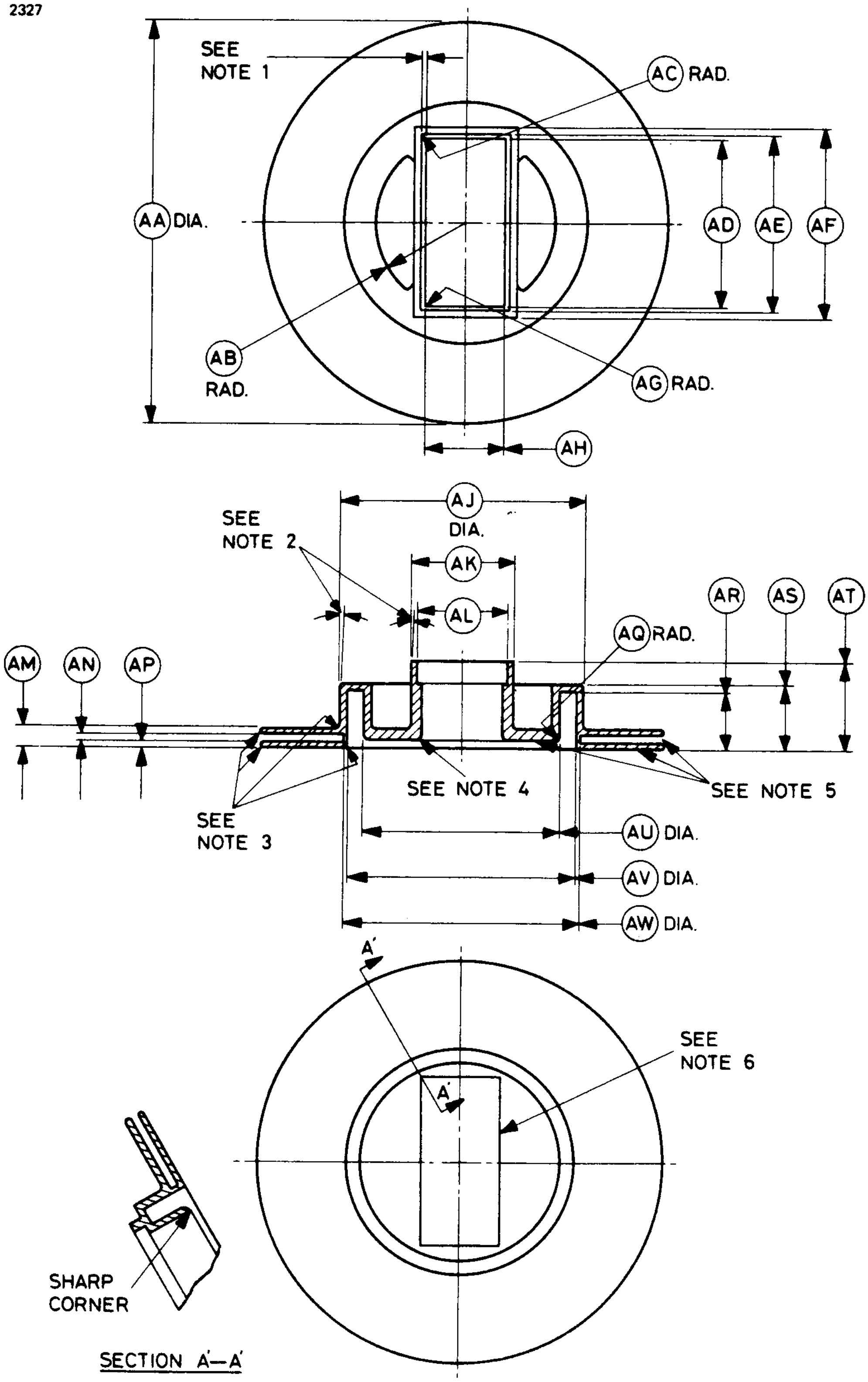




Outline Notes

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 (All dimensions without limits are nominal)

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

The data should be read in conjunction with the Magnetron Preamble.

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	–	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:

   $$V_h = 10.0 \left[1 - \frac{P_i}{900}\right] \text{ volts}$$

   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. 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% 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.

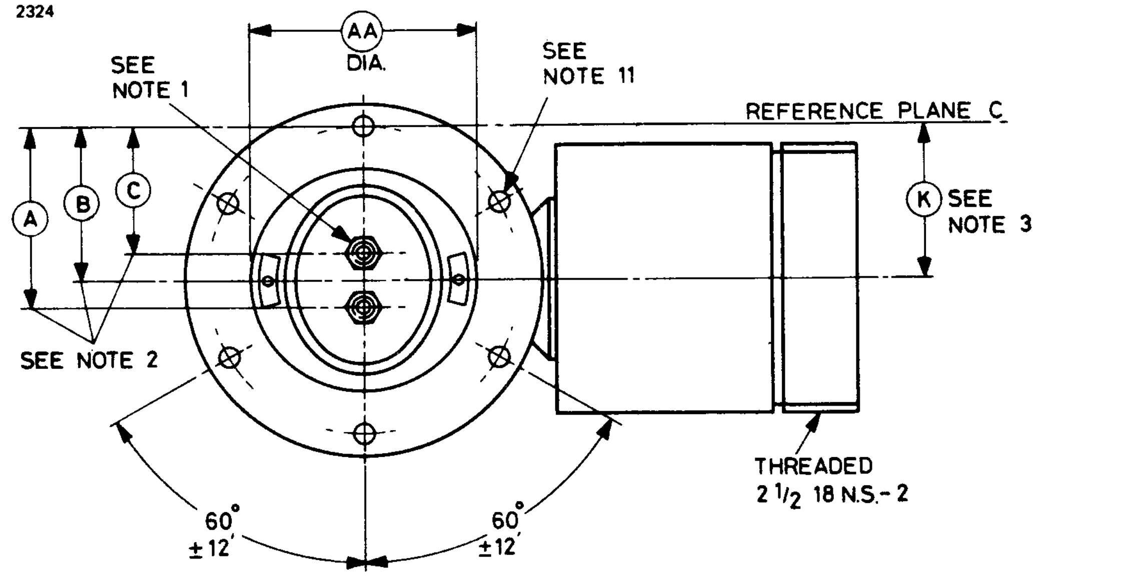
11. For the range 3040 to 3060MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 10:1 with a minimum 77 to 87mm from the reference plane shown on the outline drawing.

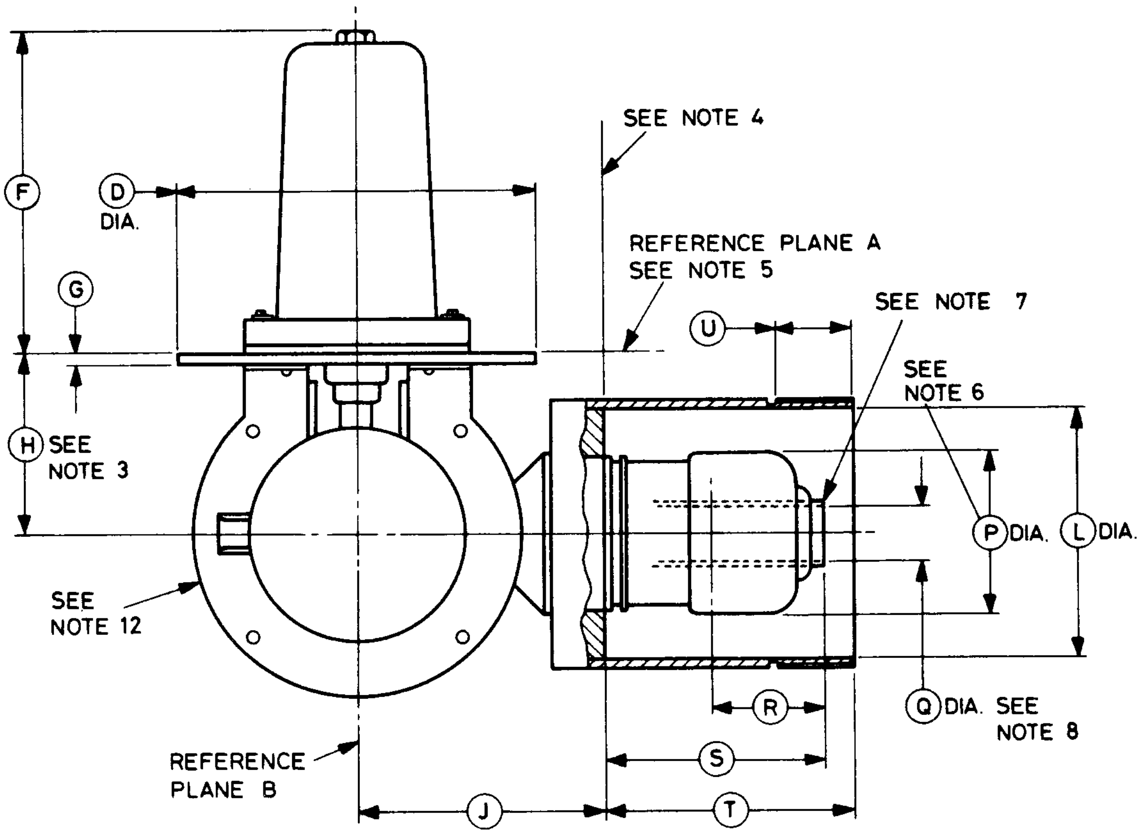
12. Measured with heater voltage of 10V and no anode input power, the heater current limits are 0.9A minimum, 1.3A maximum.

13. Design test only. The maximum frequency change with anode temperature change (after warm-up) is -0.07MHz/°C.

OUTLINE

2324

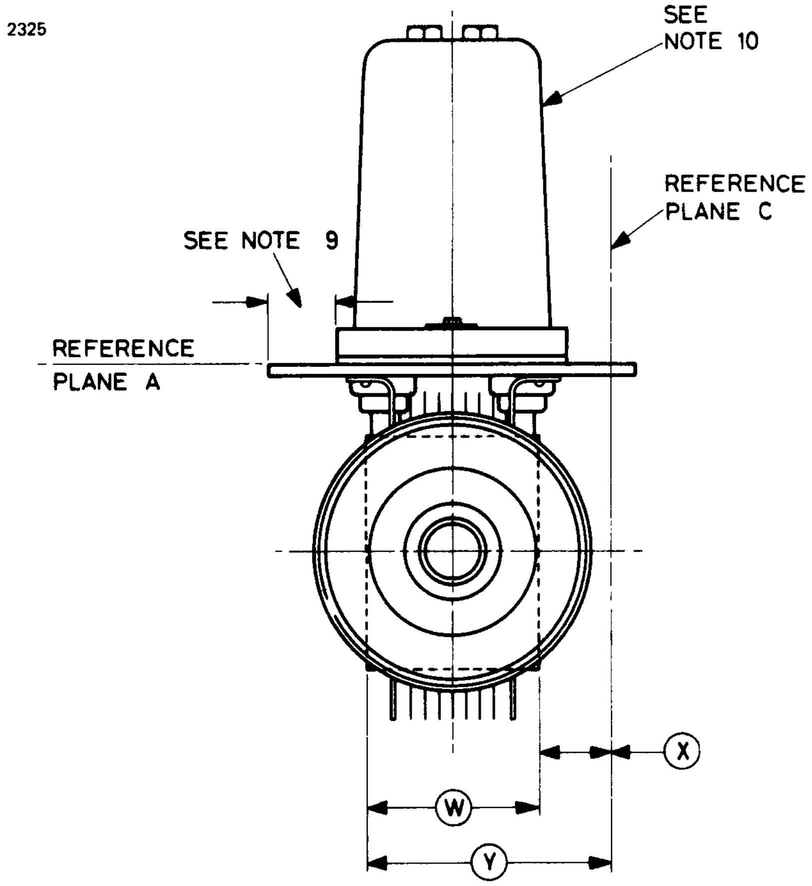




Outline Dimensions (All dimensions without limits are nominal)

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

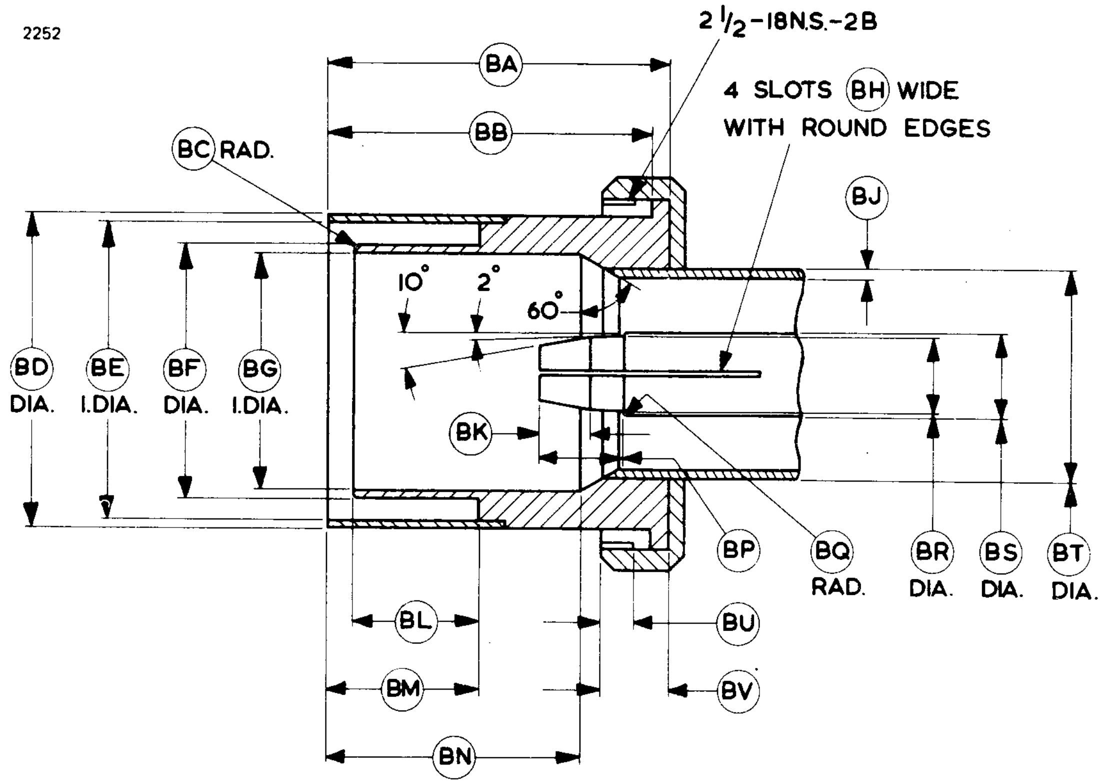
Millimetre dimensions have been derived from inches.



OUTLINE 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).

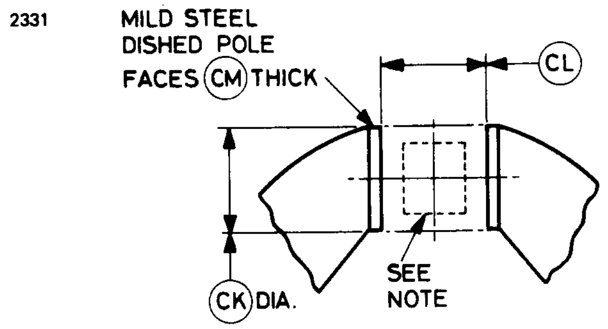
COUPLER (All dimensions without limits are nominal)



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

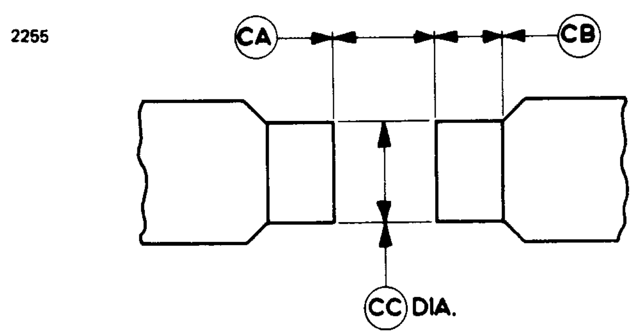


Ref	Inches	Millimetres
CK	1.500 ± 0.005	38.10 ± 0.13
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$
CM	0.187	4.75

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



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

The data should be read in conjunction with the Magnetron Preamble.

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	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	see note 11	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	see note 13	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:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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.

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 65 lb/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 35 lb/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 $\pm$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.

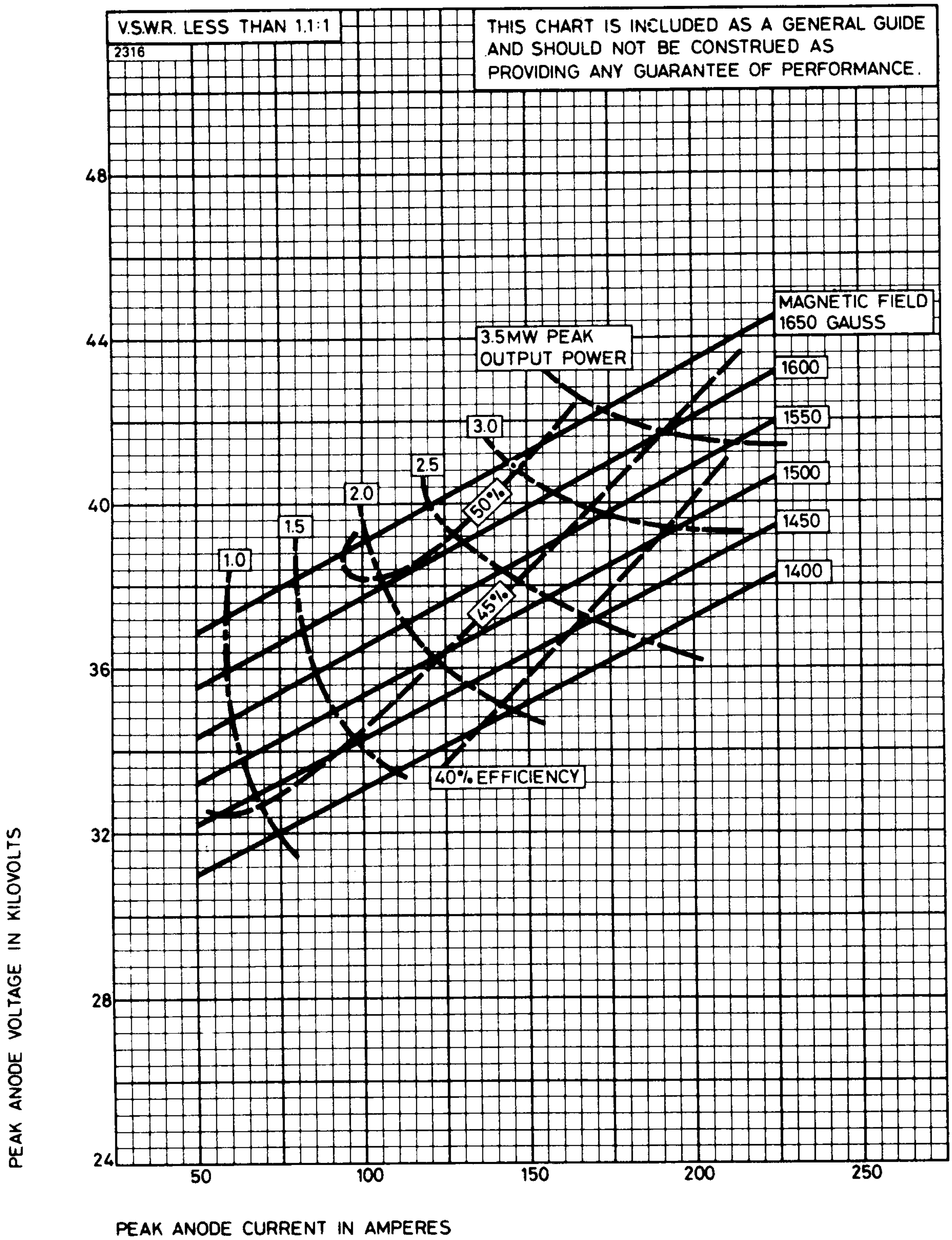
18. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

19. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.05MHz/$^\circ$C.

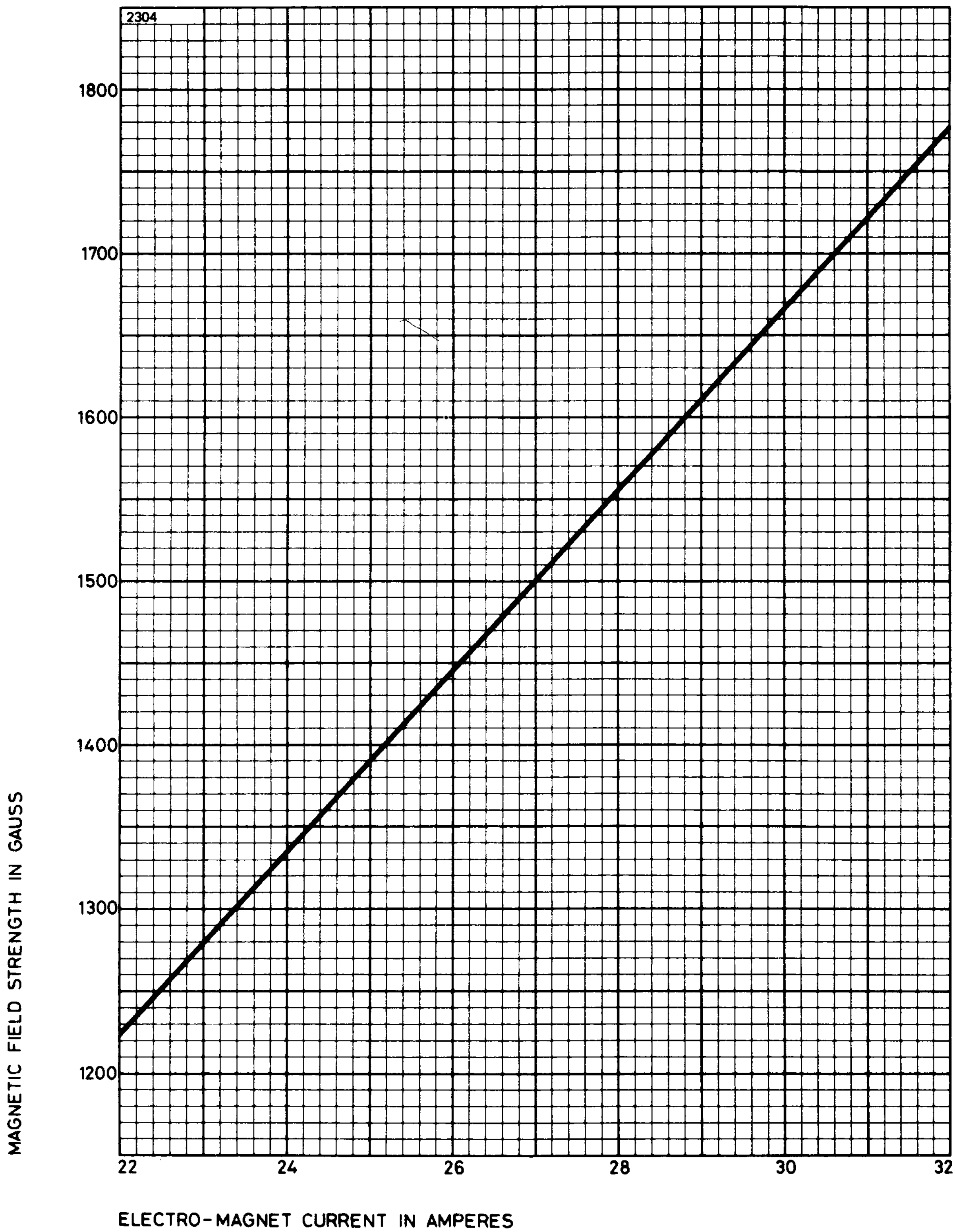
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART FOR M569

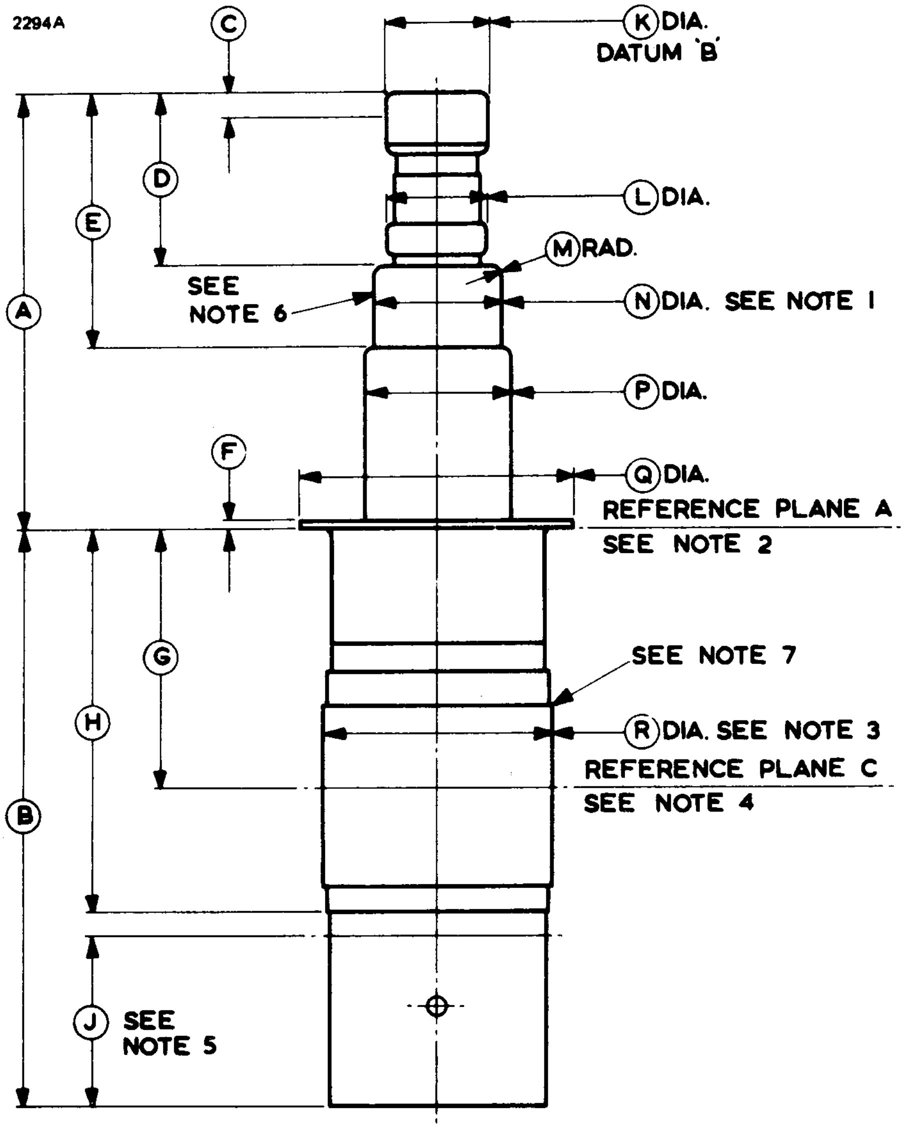


TYPICAL CURRENT CHARACTERISTIC FOR M4017



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 (All dimensions without limits are nominal)

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

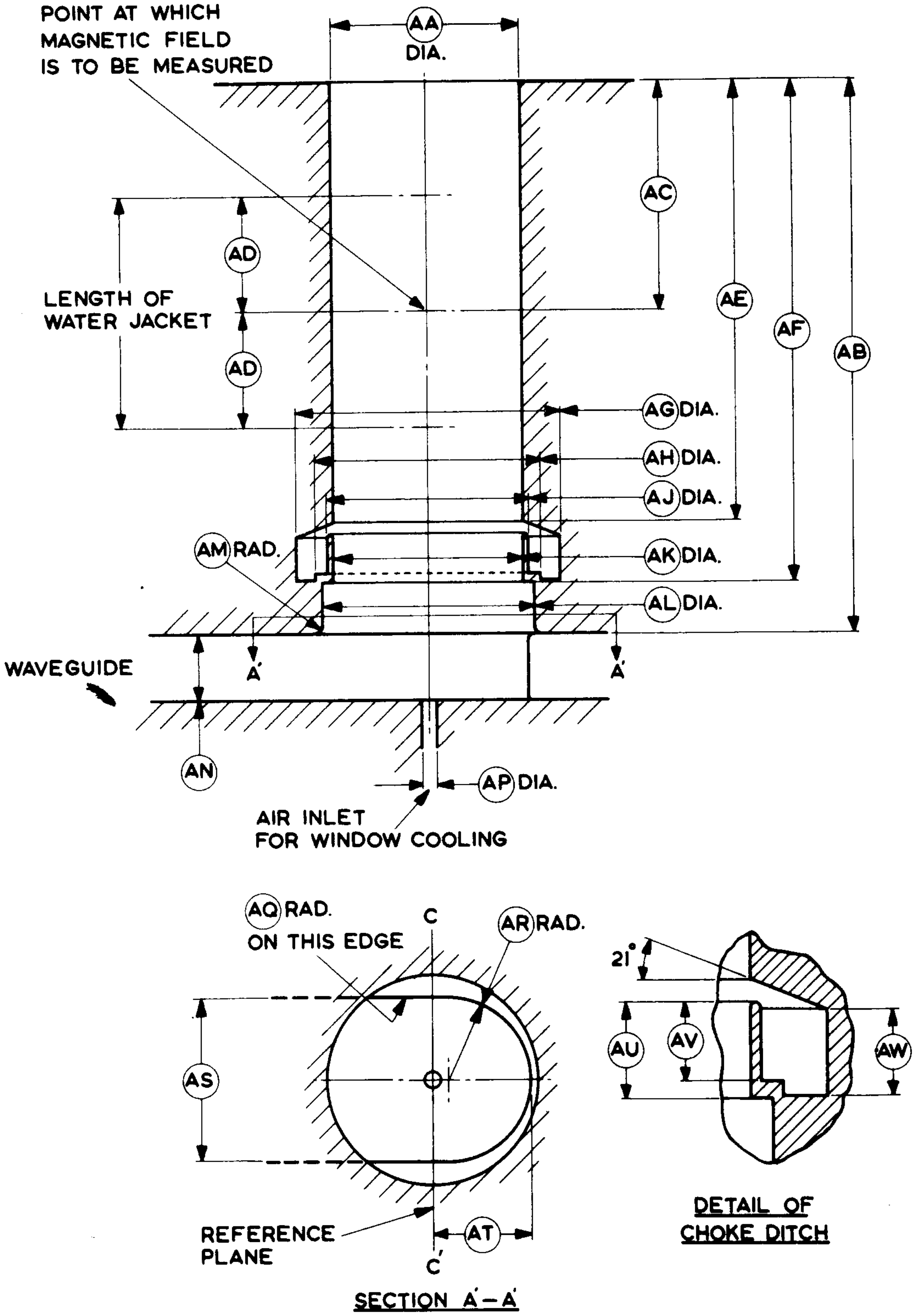
Millimetre dimensions have been derived from inches.

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

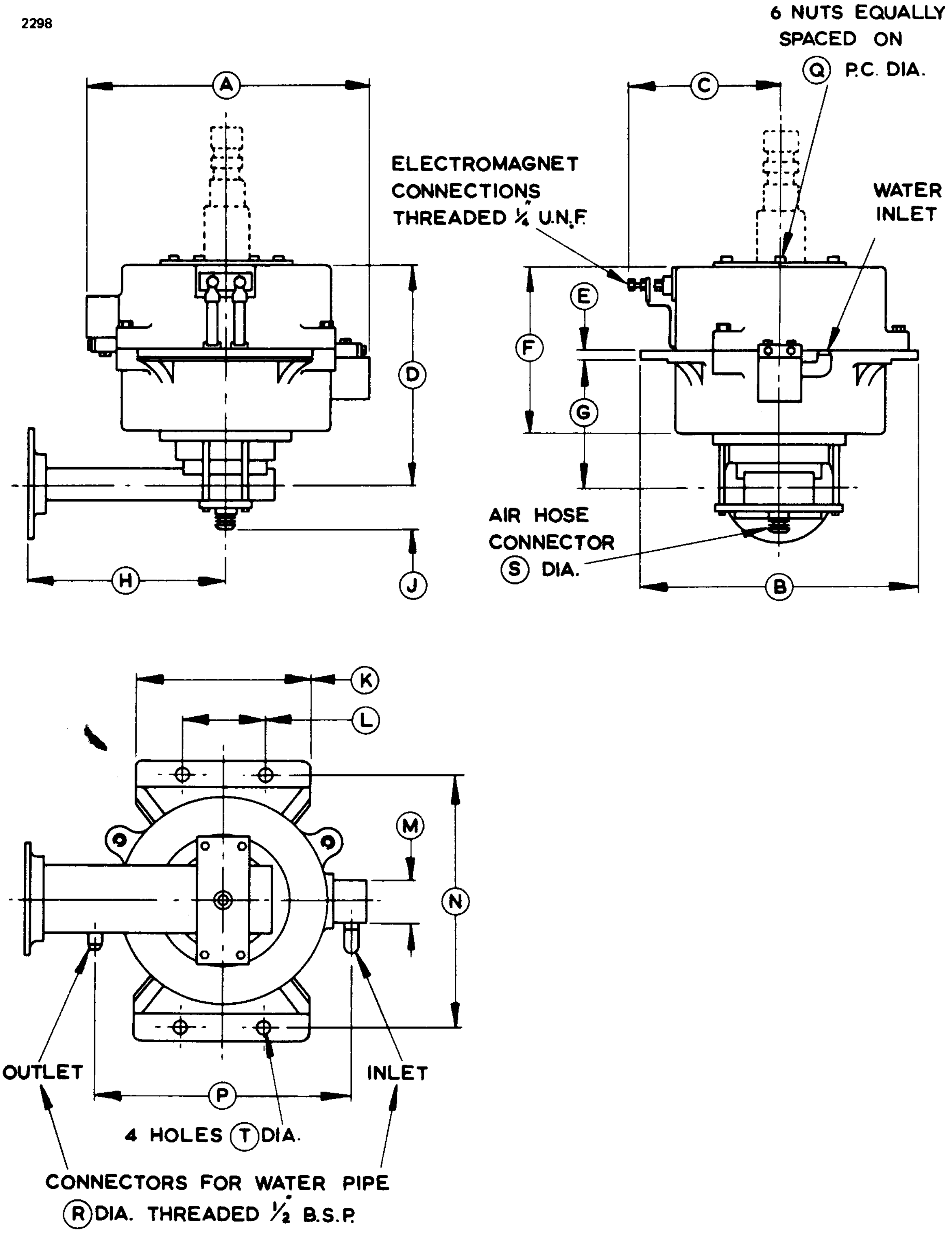


Dimensions for Electro-magnet and Launching Section
(All dimensions without limits are nominal)

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

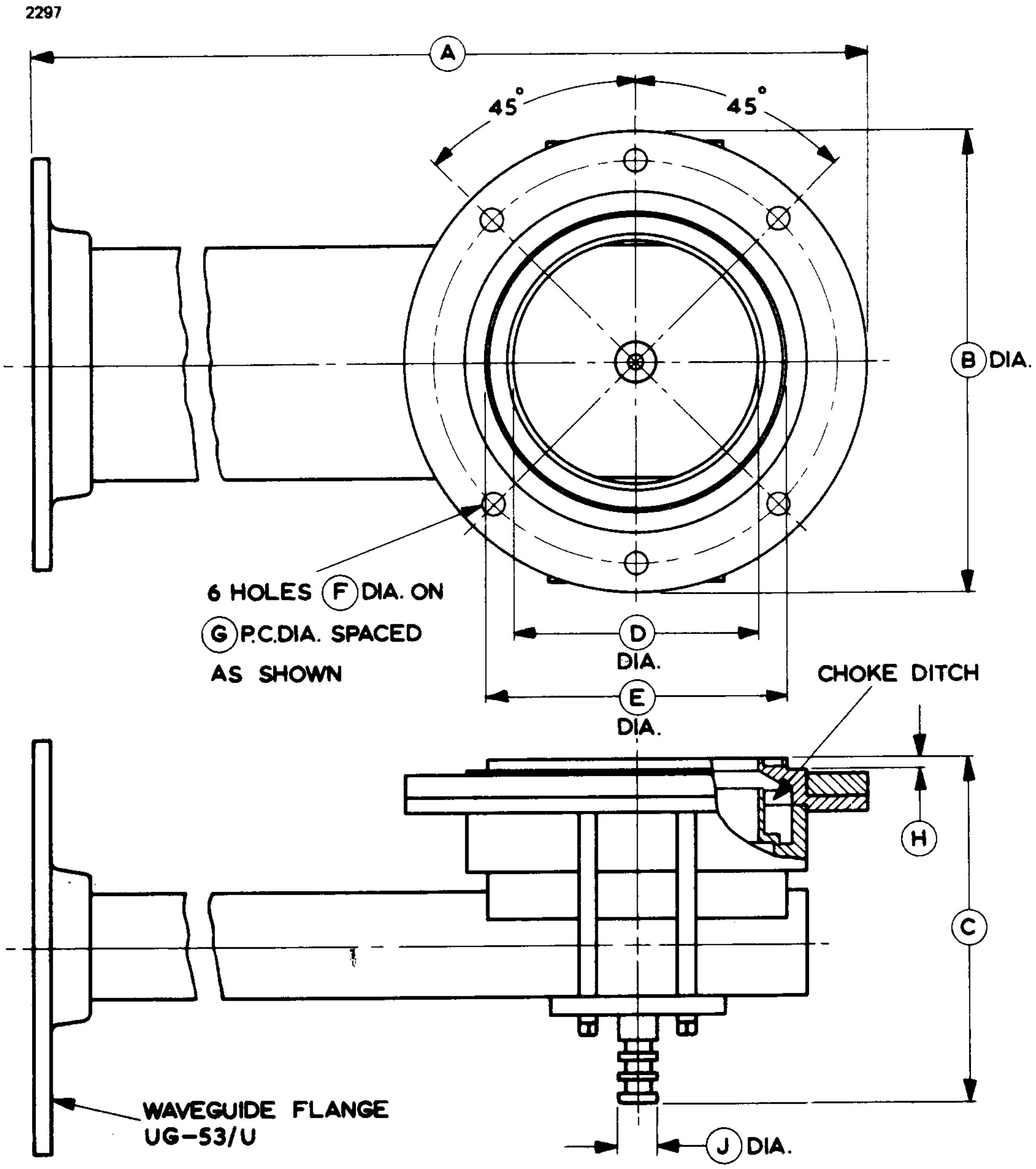


Outline Dimensions for M4011 (All dimensions without limits are nominal)

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 (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	11.969	304.0
B	5.938	150.8
C	4.406	111.9
D	3.255	82.68
E	3.865 ± 0.002	98.17 ± 0.25

Ref	Inches	Millimetres
F	0.265	6.73
G	5.250	133.4
H	$0.140^{+0.005}_{-0.000}$	$3.56^{+0.13}_{-0.00}$
J	0.500	12.70

Millimetre dimensions have been derived from inches.

M577B M578B

S-BAND MAGNETRONS

Service Type CV10210 (M577B)

The data should be read in conjunction with the Magnetron Preamble.

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	–	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/μs

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 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.

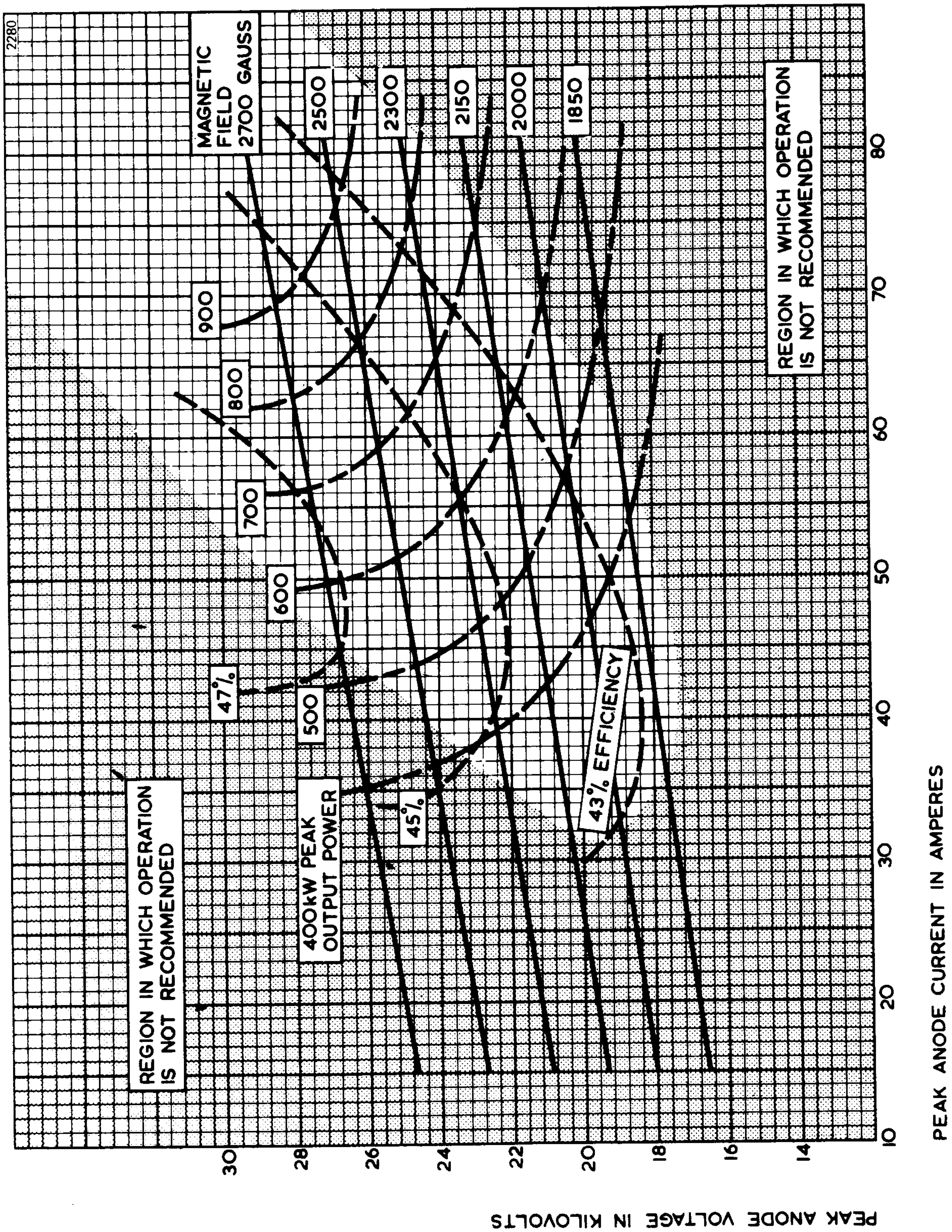
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.07MHz/°C.

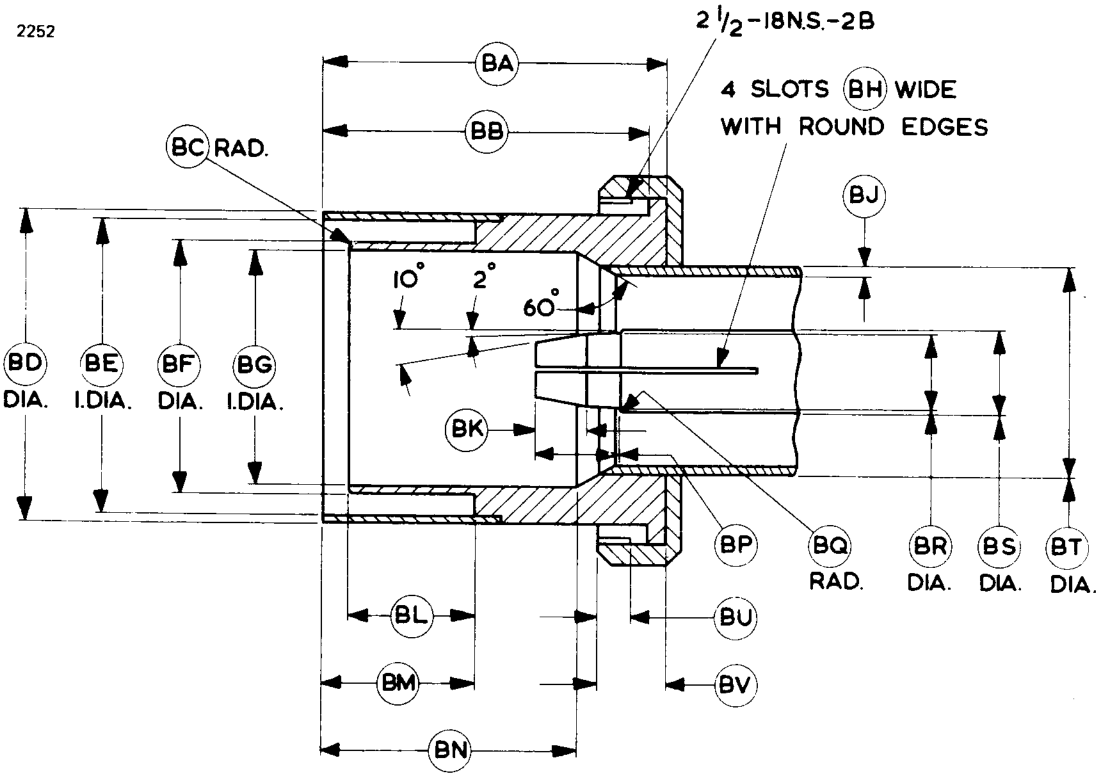
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



COUPLER (All dimensions without limits are nominal)

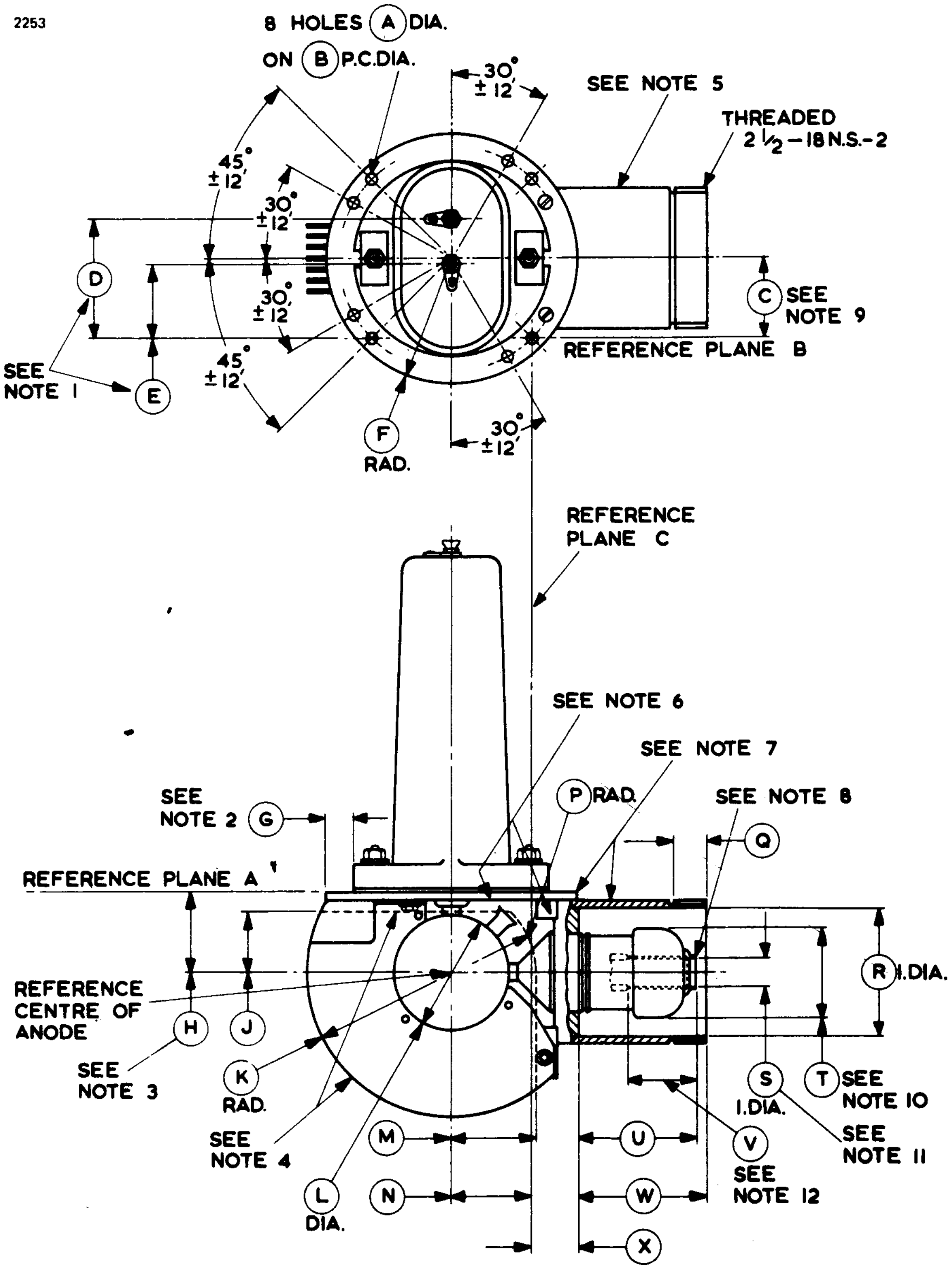


Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 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)

2253

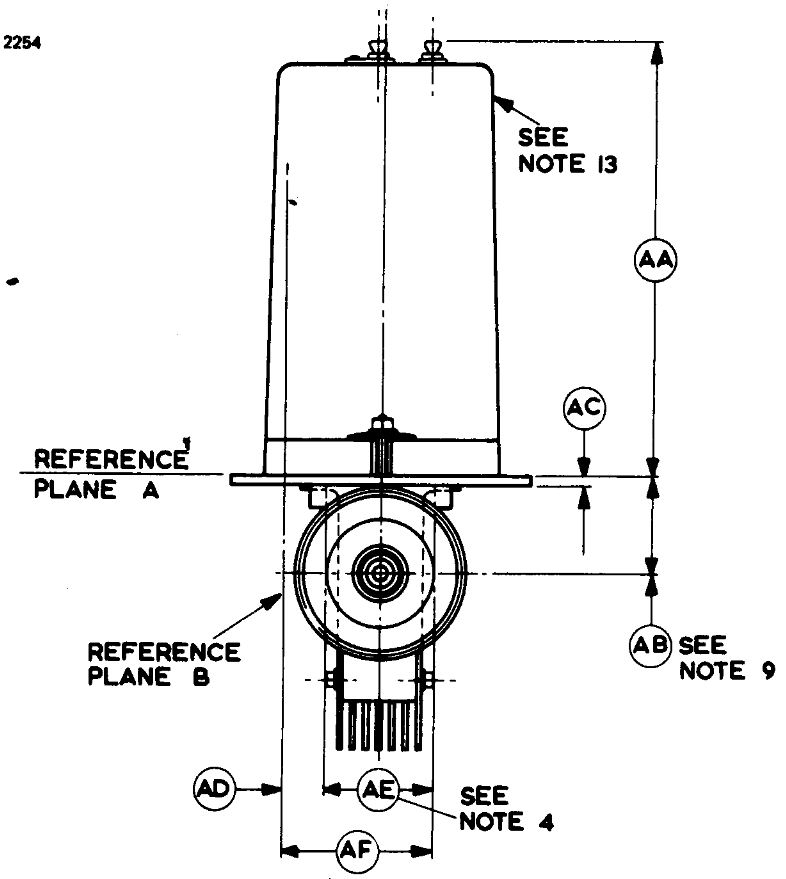


Outline Dimensions (All dimensions without limits are nominal)

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.

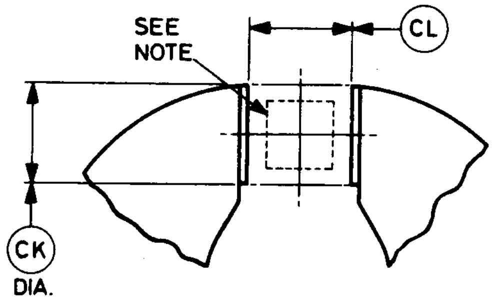
2254



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



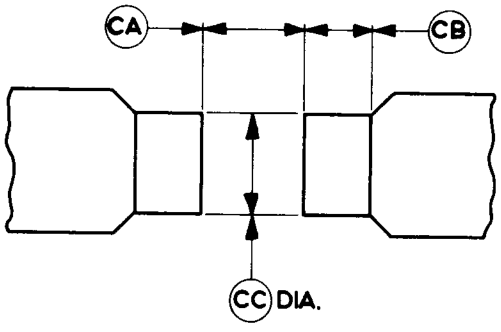
Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

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.

M579

S-BAND MAGNETRON

Frequency variant of M566, M569, M570

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	3050 to 3160	MHz
Typical peak output power	2.5	MW
Magnet and launching section	separate electro-magnet 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.

February 1970

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 waveguide; 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	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	see note 11	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	see note 13	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	3050 to 3160	MHz
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:

$$P_i = i_{apk} \times v_{apk} \times D_u$$

   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.

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 65 lb/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 35 lb/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 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.

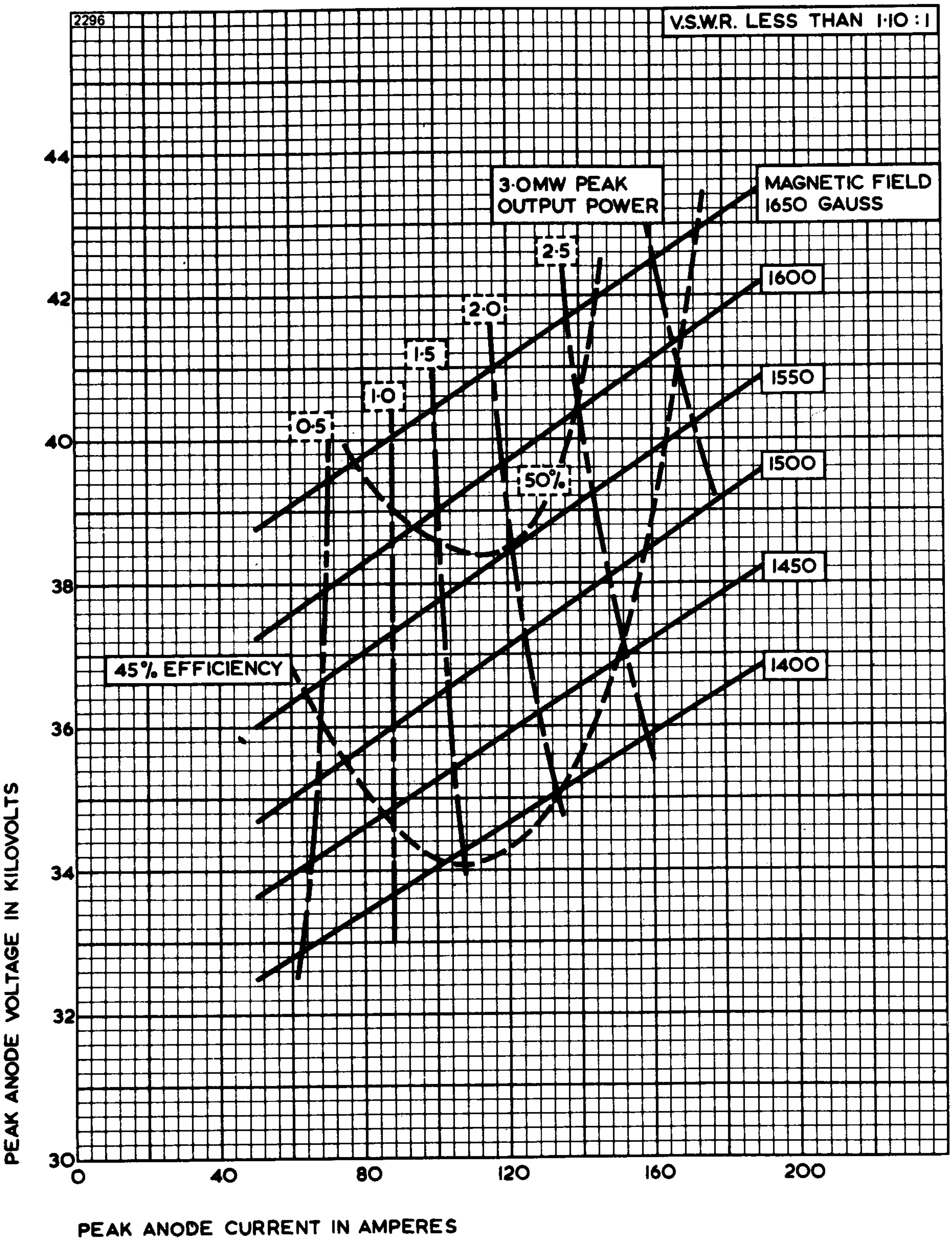
17. Measured with heater voltage of 12V and no anode input power, the heater current limits are 13A minimum, 15A maximum.

18. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.05MHz/°C.

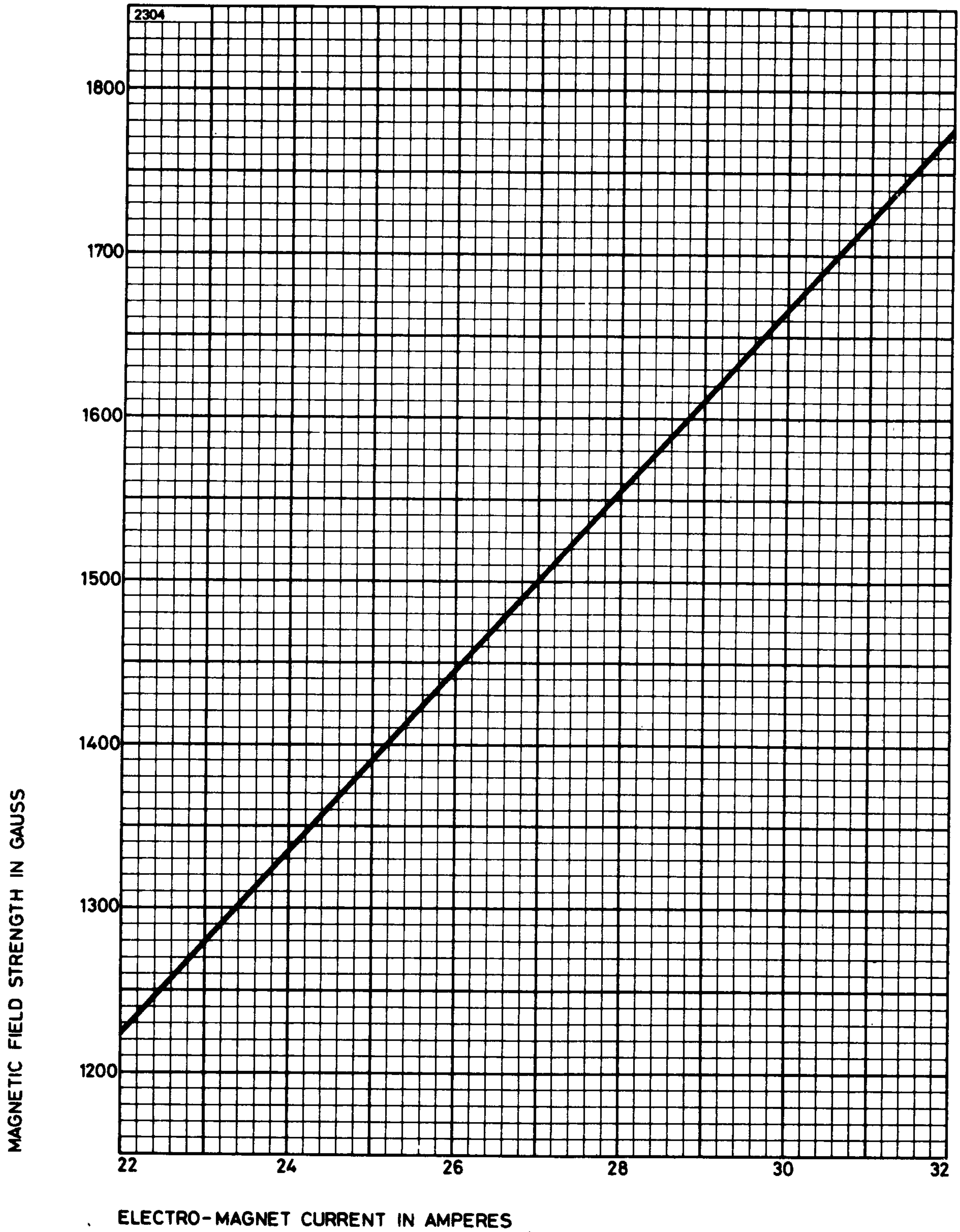
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART

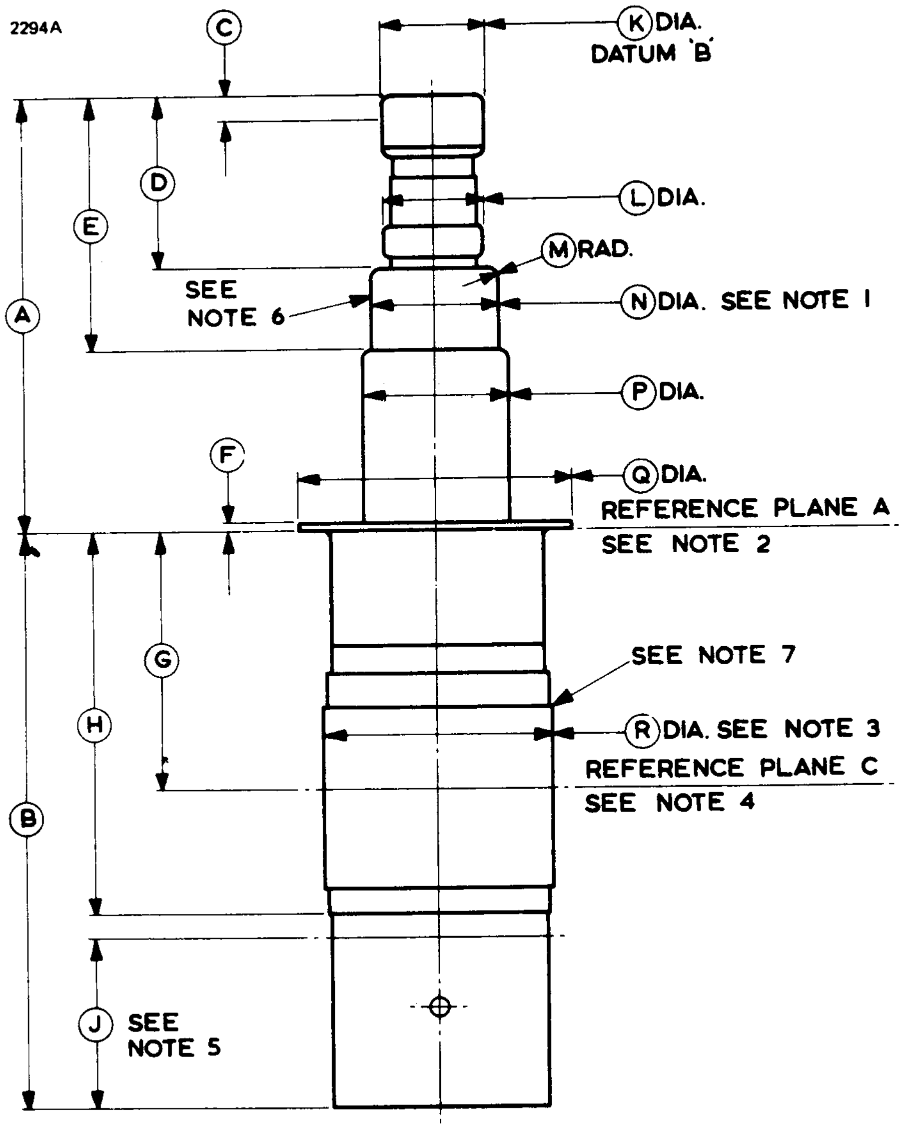


TYPICAL CURRENT CHARACTERISTIC FOR M4017



An individual calibration curve is supplied with each M4017 (see note 2 on page 6). 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
SEE NOTE 7
G
H
R DIA. SEE NOTE 3
REFERENCE PLANE C
SEE NOTE 4
B
J SEE
NOTE 5

Outline Dimensions (All dimensions without limits are nominal)

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

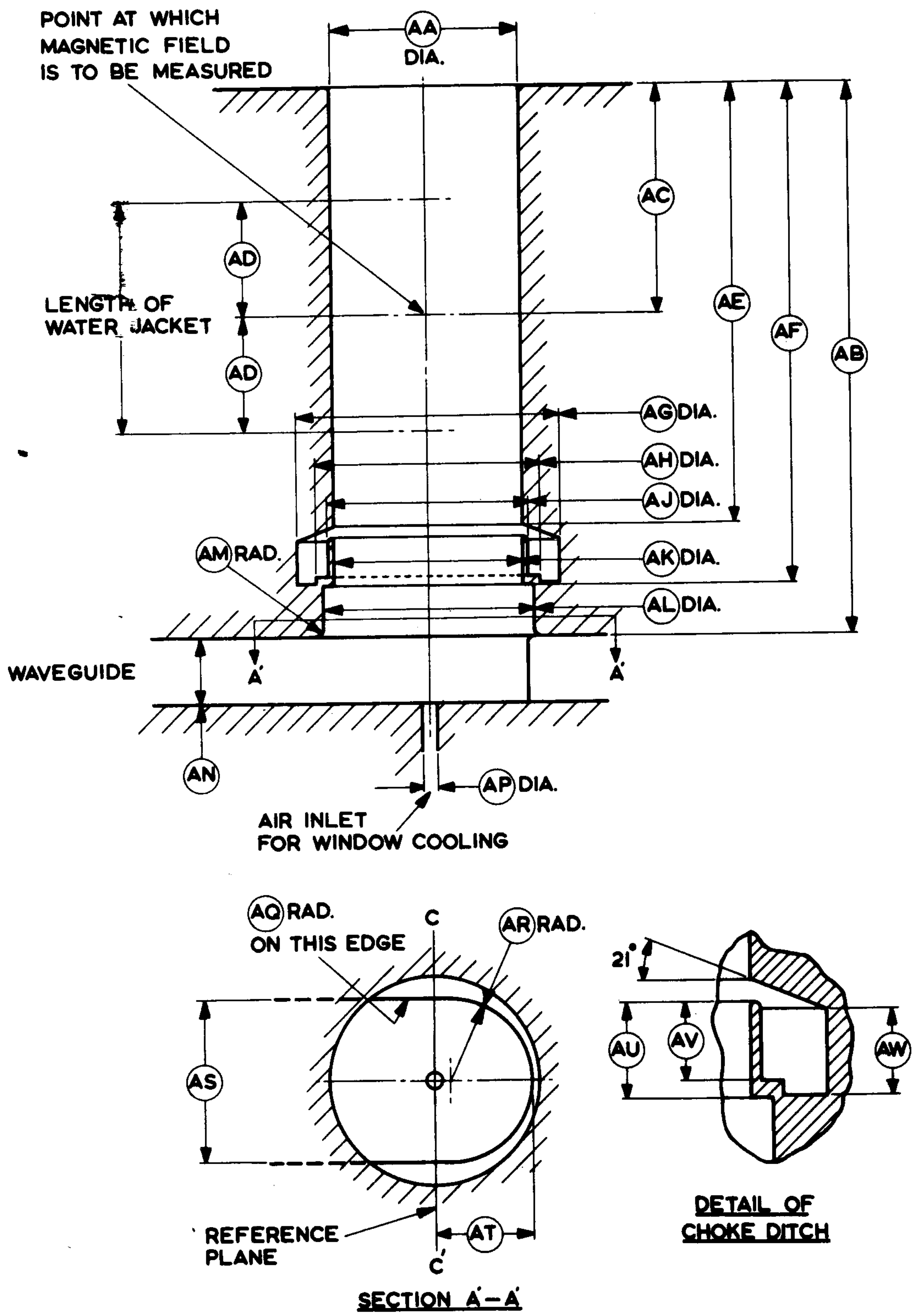
Millimetre dimensions have been derived from inches.

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

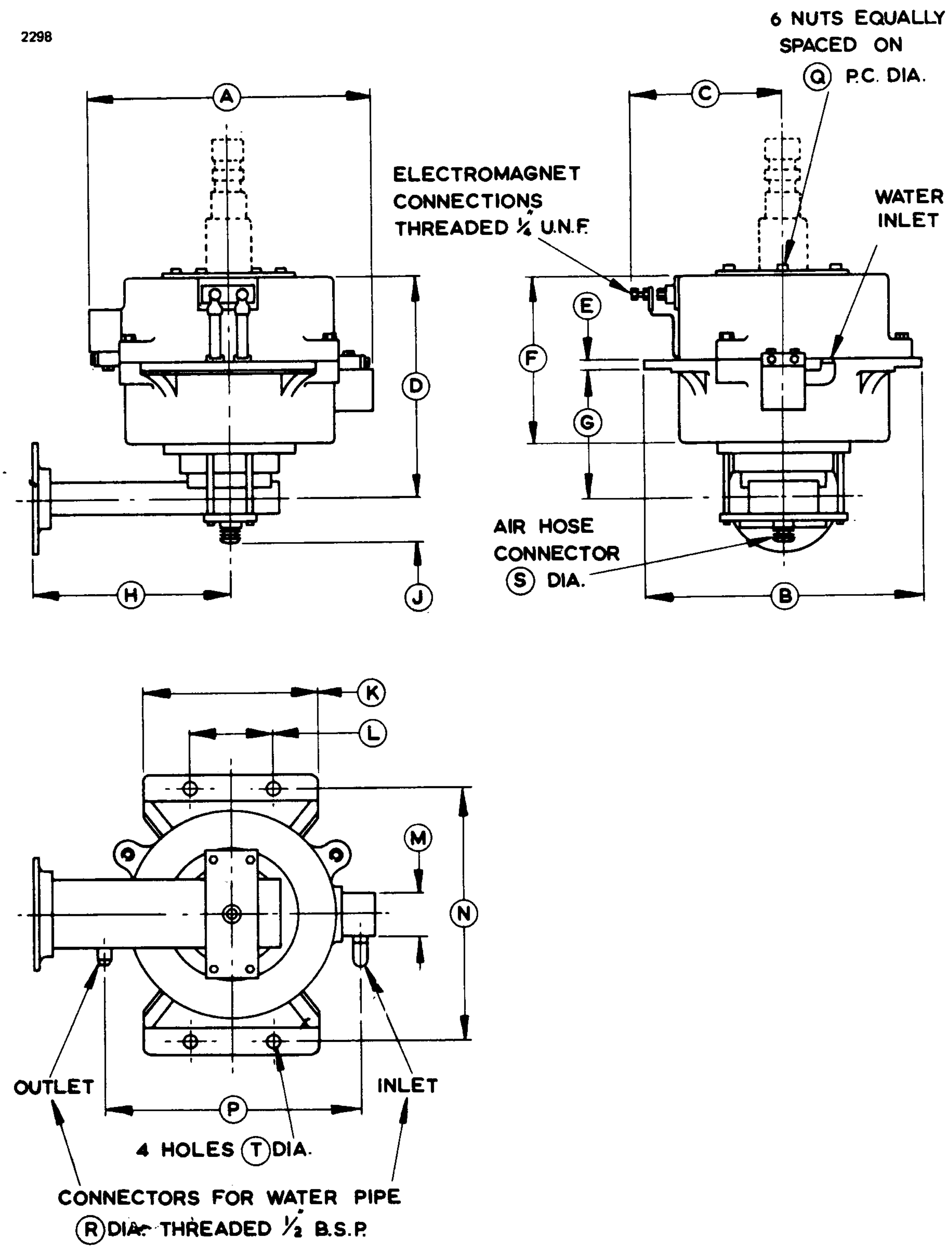


Dimensions for Electro-magnet and Launching Section
(All dimensions without limits are nominal)

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

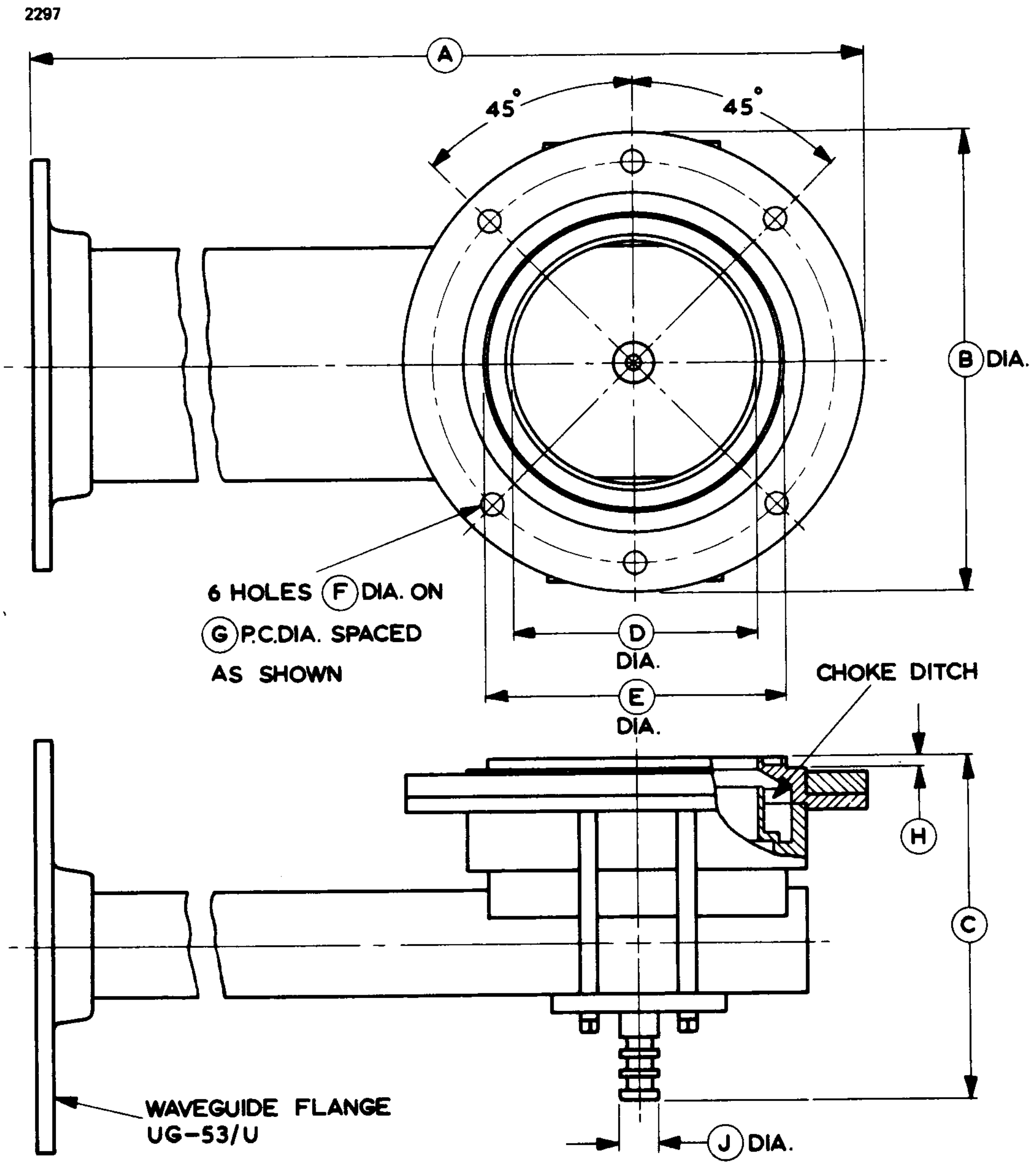


Outline Dimensions for M4011
(All dimensions without limits are nominal)

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 (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	11.969	304.0
B	5.938	150.8
C	4.406	111.9
D	3.255	82.68
E	3.865 ± 0.002	98.17 ± 0.25

Ref	Inches	Millimetres
F	0.265	6.73
G	5.250	133.4
H	$0.140^{+0.005}_{-0.000}$	$3.56^{+0.13}_{-0.00}$
J	0.500	12.70

Millimetre dimensions have been derived from inches.

M595B

S-BAND MAGNETRON

Service Type CV8905

The data should be read in conjunction with the Magnetron Preamble.

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

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	–	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/in²
output circuit	–	45	lb/in²

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:

$$Pi = i_{apk} \times v_{apk} \times Du$$

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% 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.

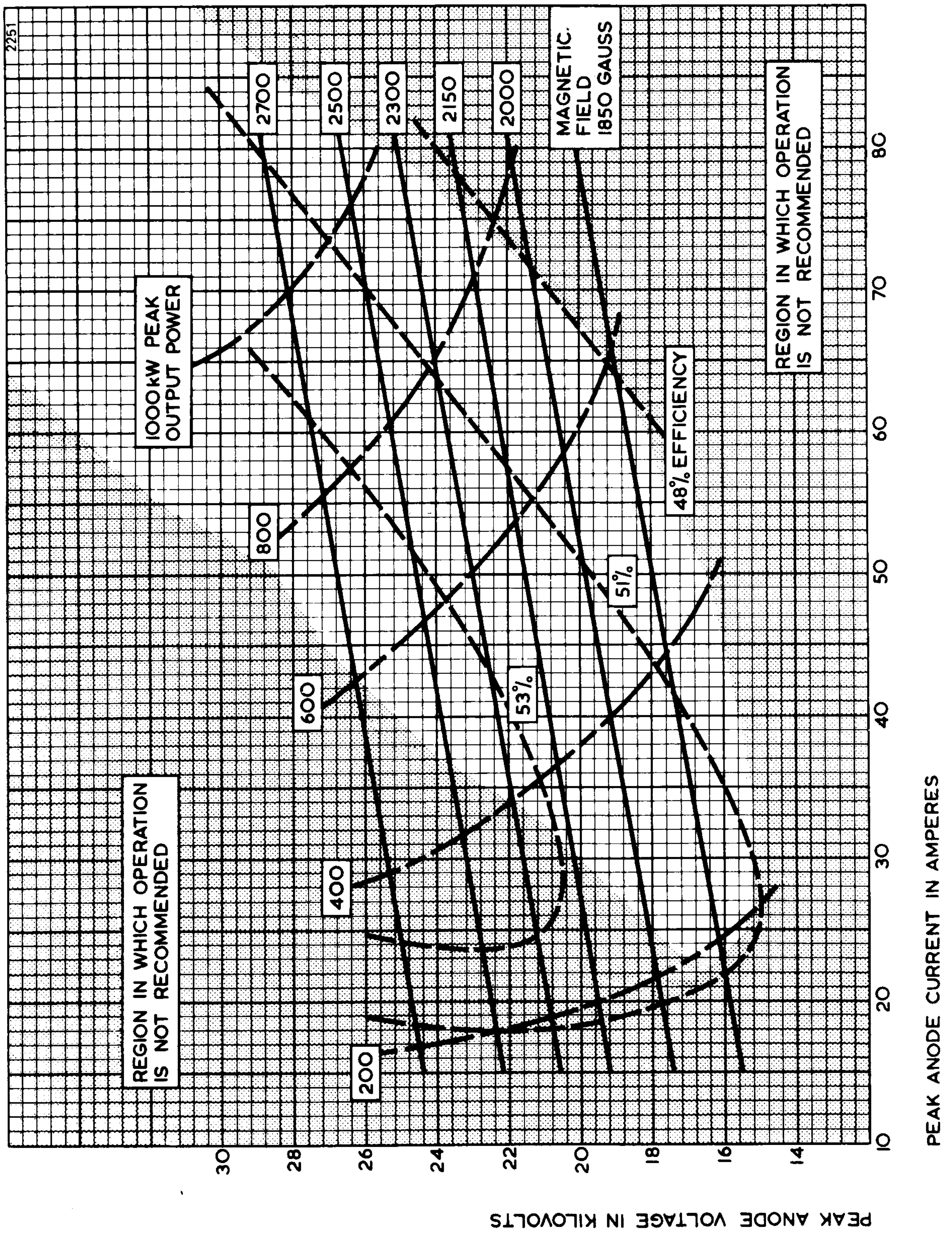
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07MHz/°C.

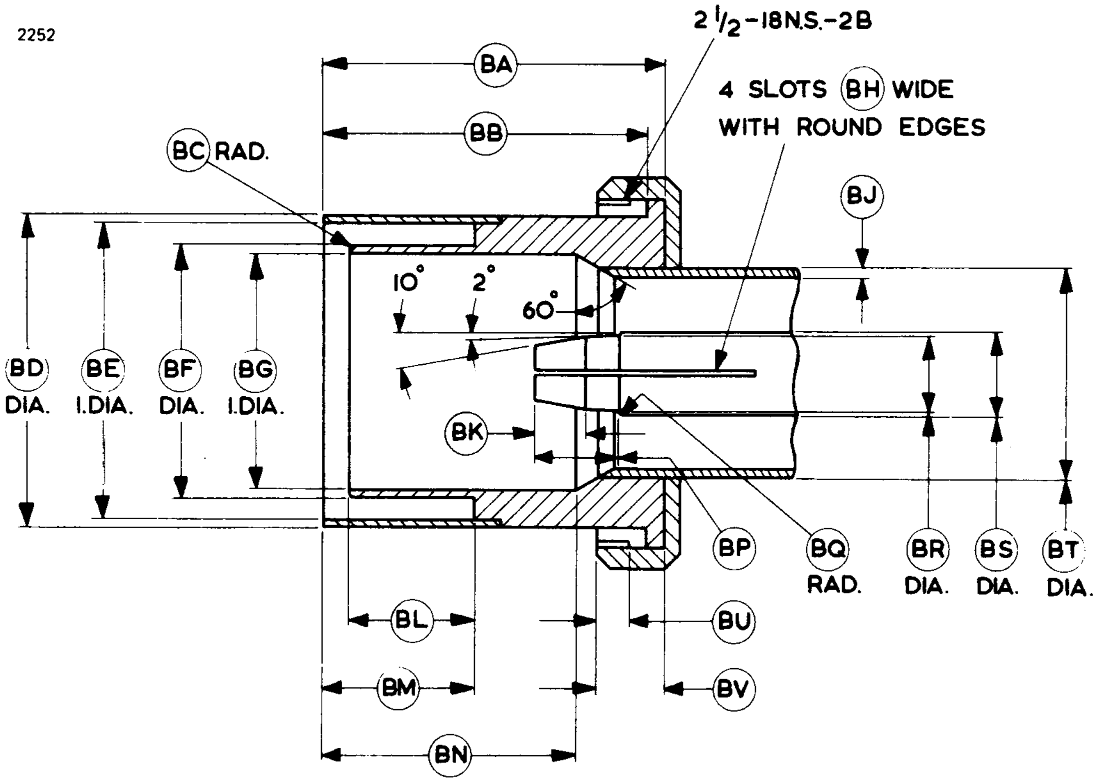
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART



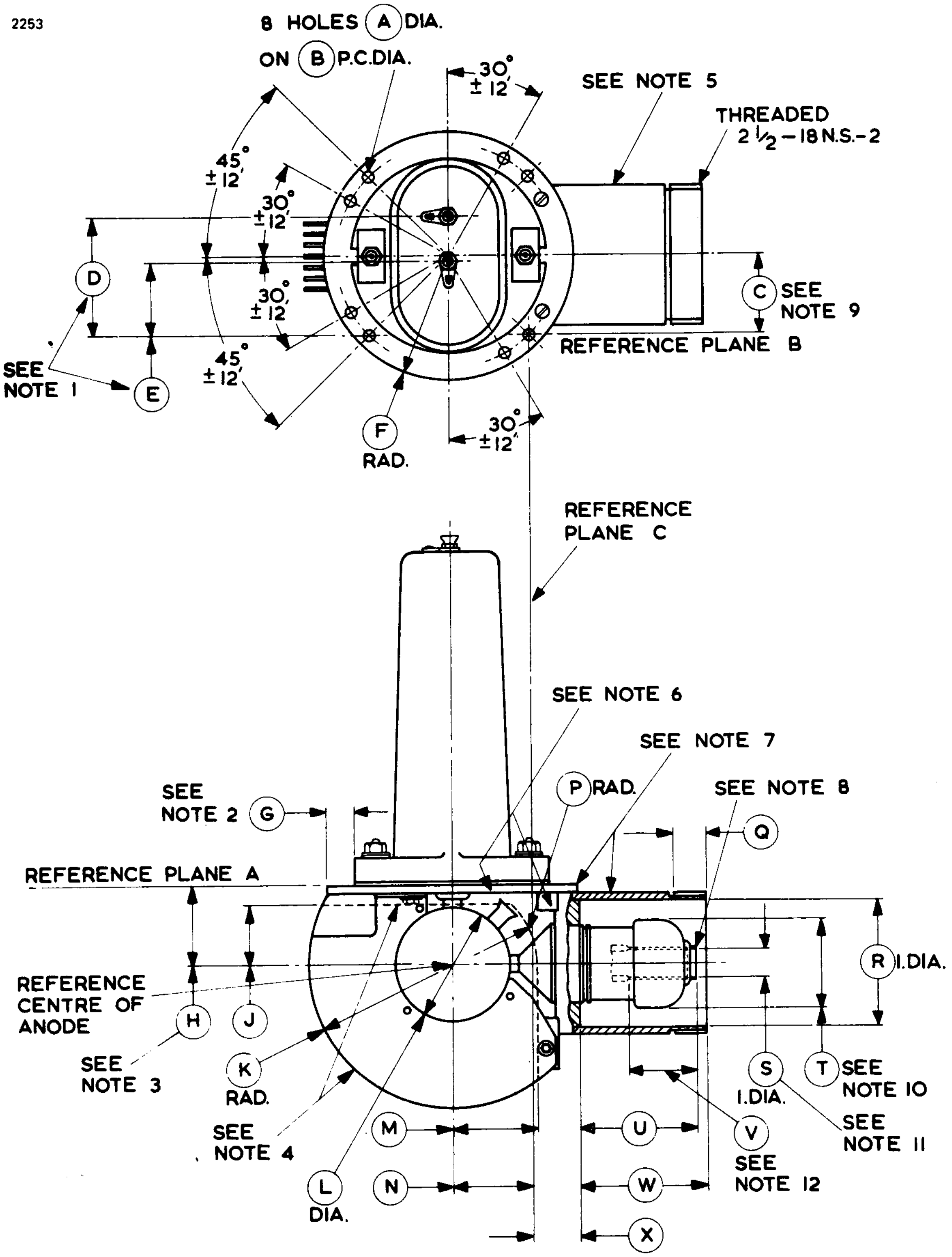
COUPLER (All dimensions without limits are nominal)



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)

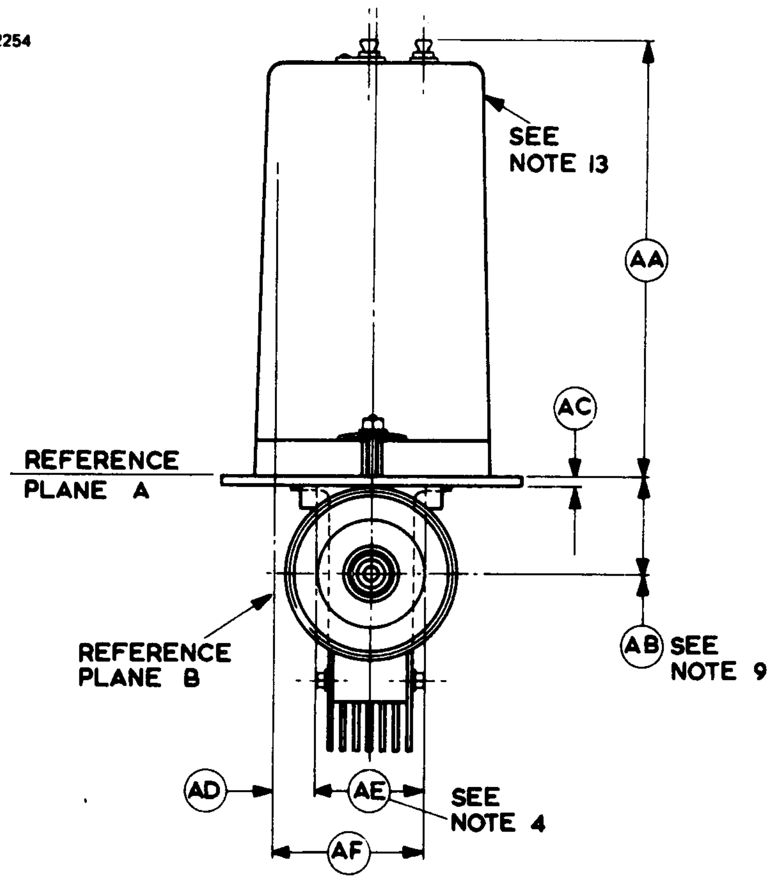


Outline Dimensions (All dimensions without limits are nominal)

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.

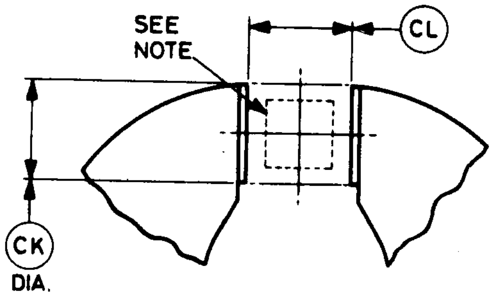
2254



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



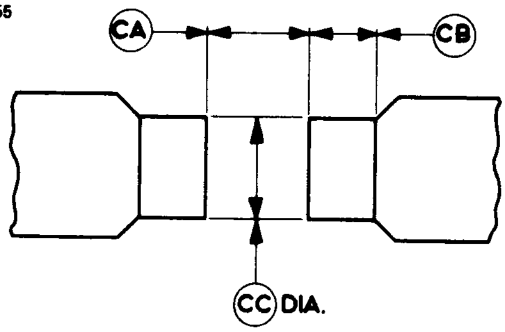
Ref	Inches	Millimetres
CK	1.500	38.10
CL	1.500 $^{+0.010}_{-0.000}$	38.10 $^{+0.25}_{-0.00}$

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

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.

M5015

TUNABLE S-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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.

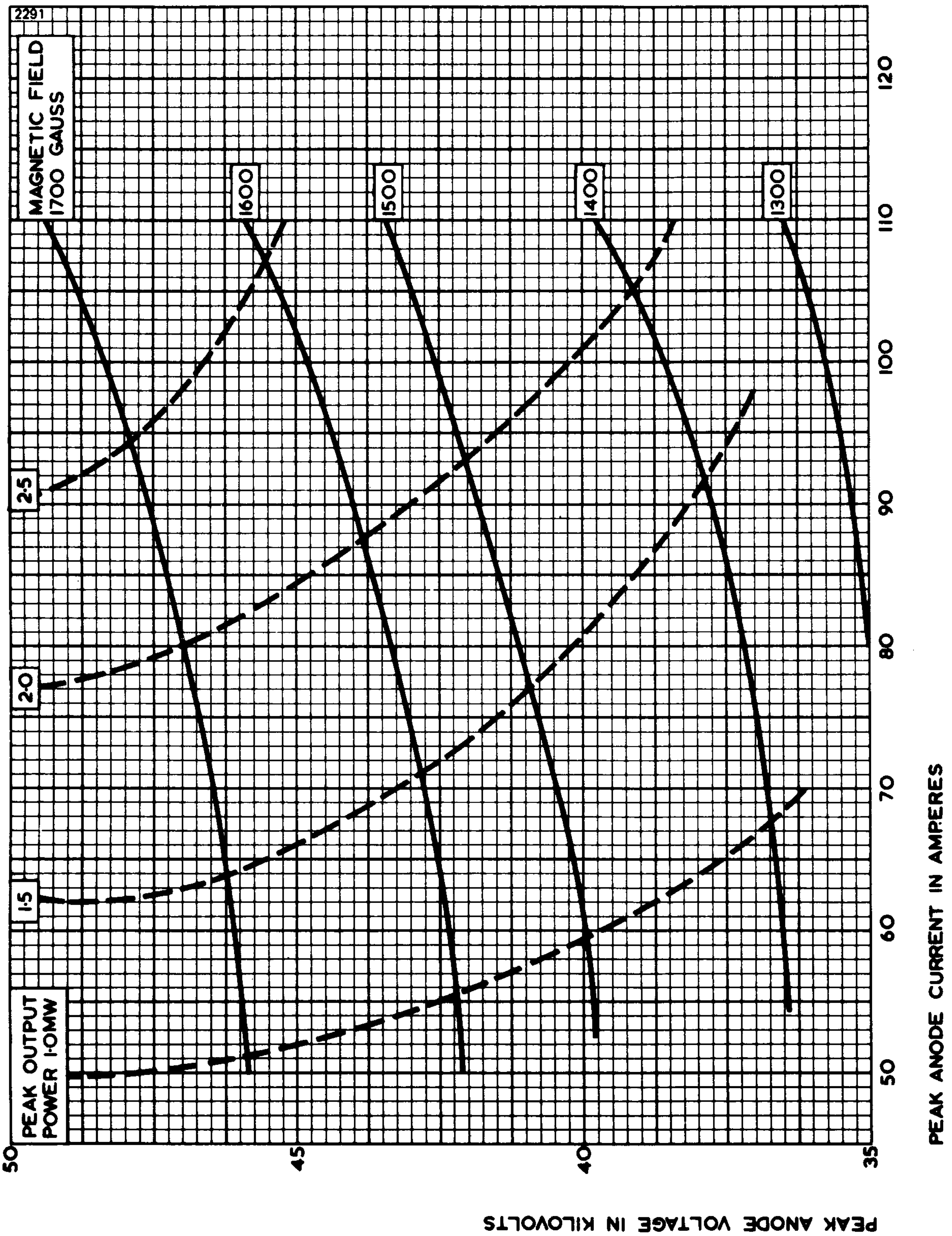
8. It is recommended that the magnetron should be isolated from the load by means of an isolator of approved design. Information on the characteristics of a suitable isolator may be obtained from English Electric Valve Company Ltd.

9. At the maximum pressure of 45 lb/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.

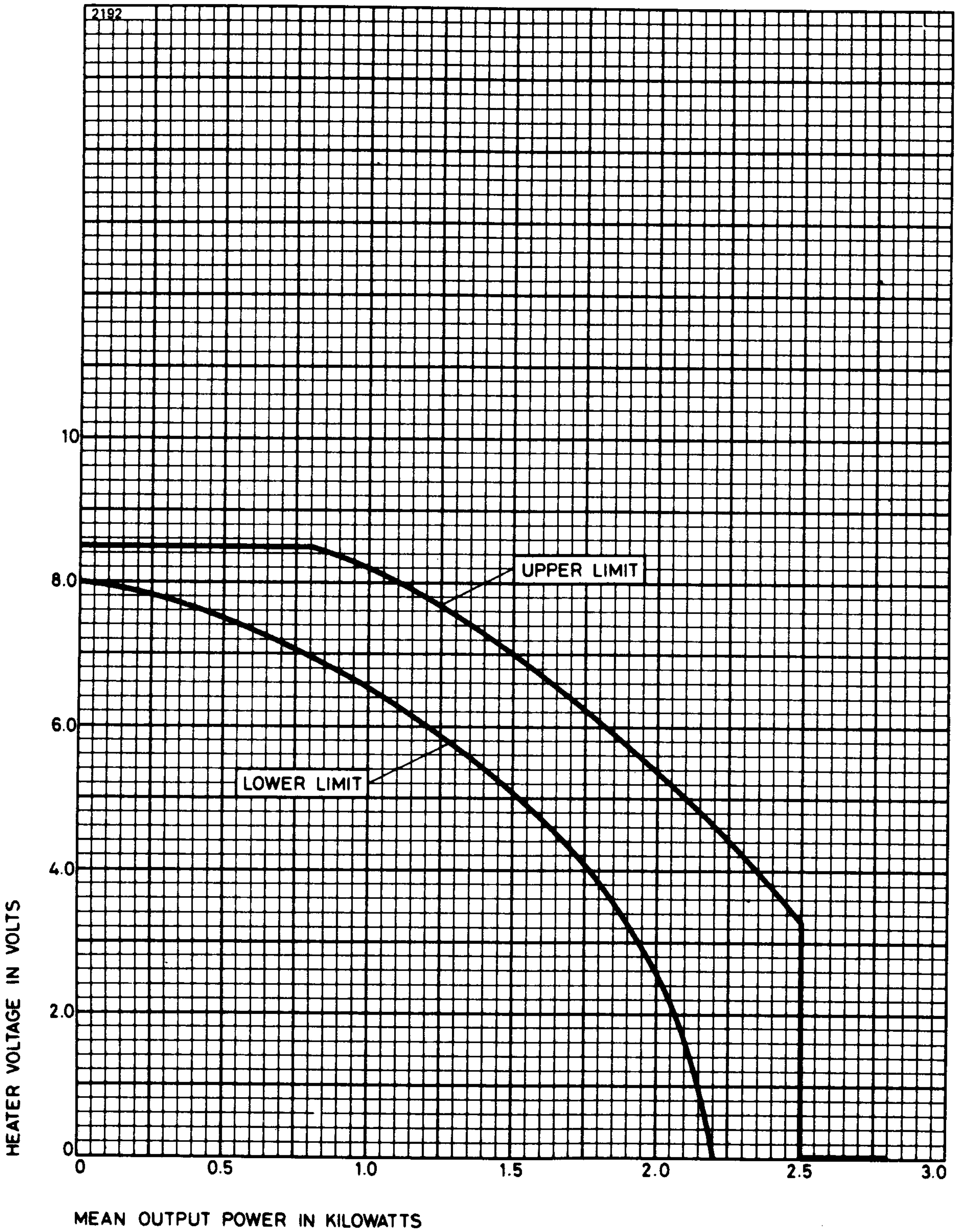
X-RAY WARNING

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.

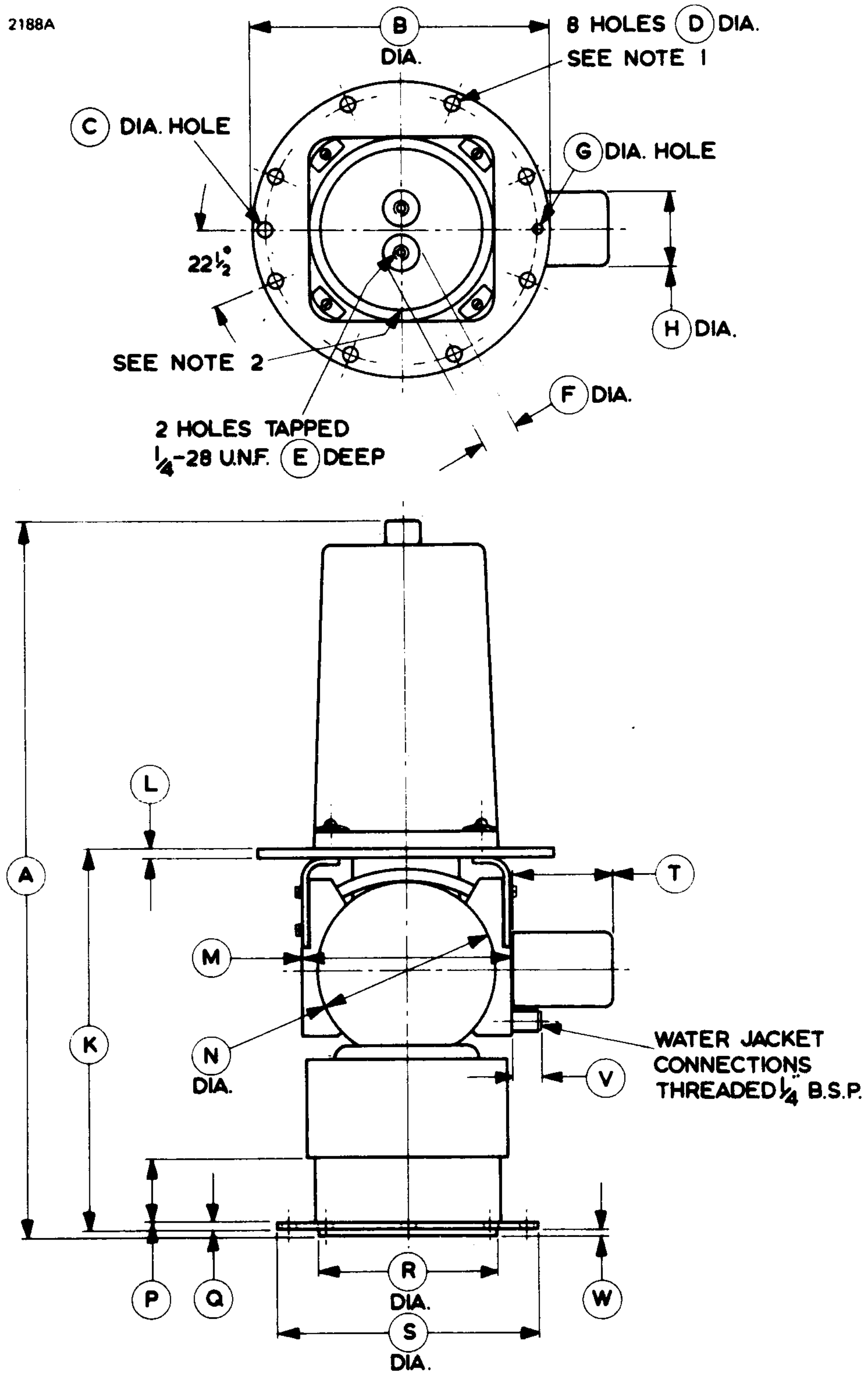
TYPICAL PERFORMANCE CHART



HEATER VOLTAGE REDUCTION SCHEDULE



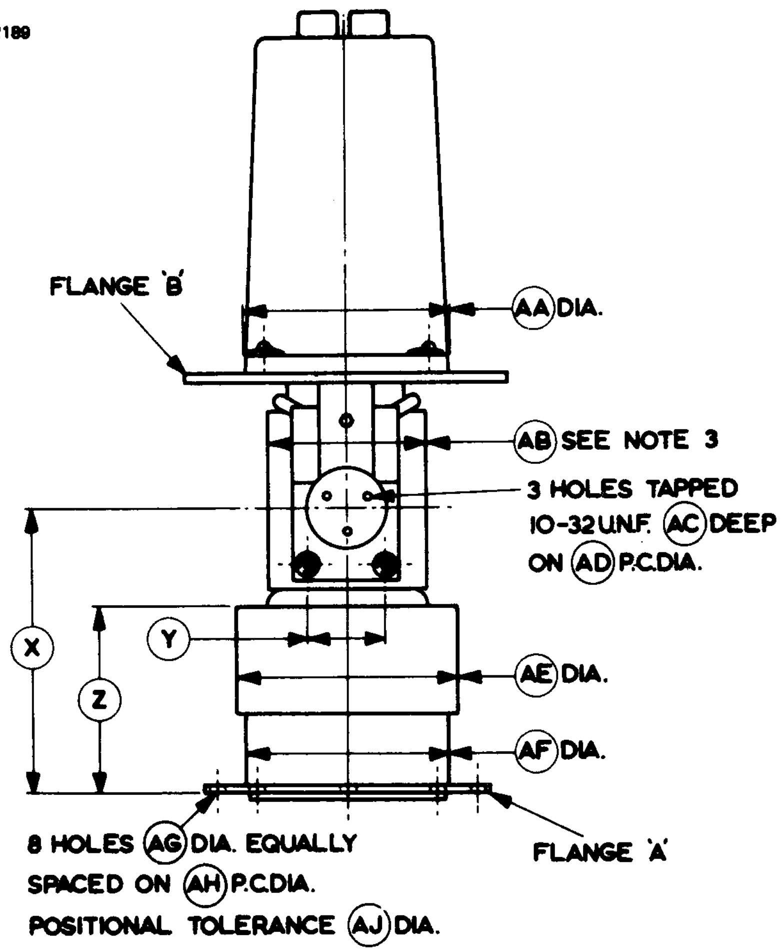
OUTLINE (See page 10 for dimensions)



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.

2189

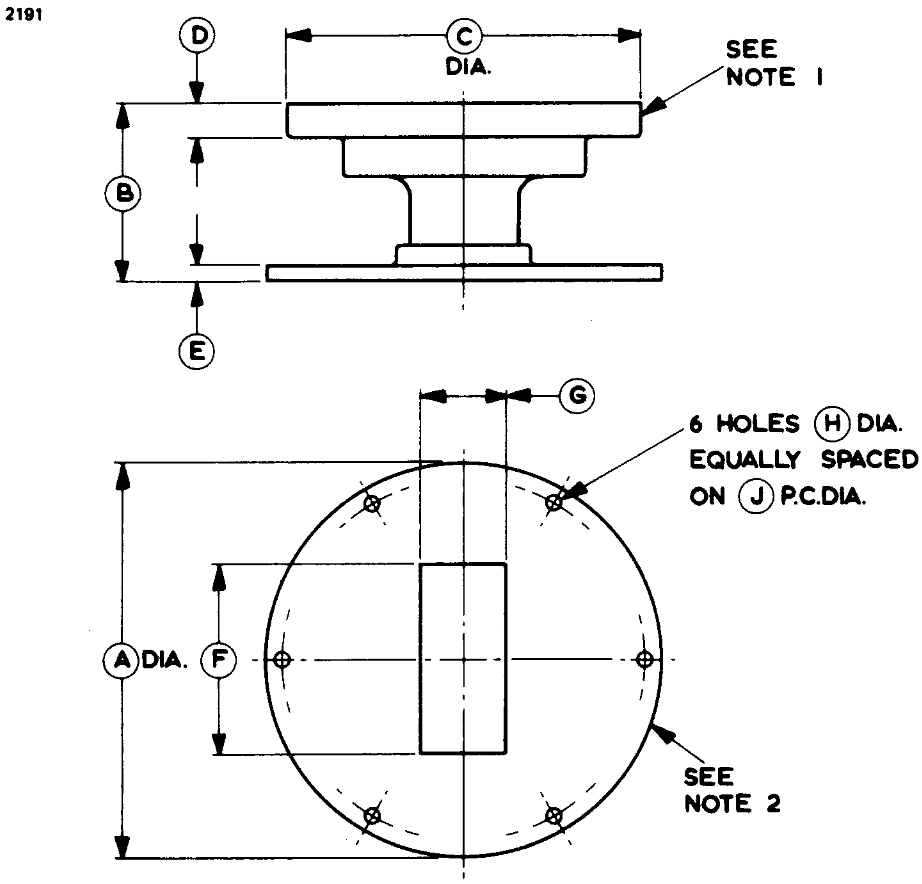


Outline Dimensions (All dimensions without limits are nominal)

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 (All dimensions nominal)



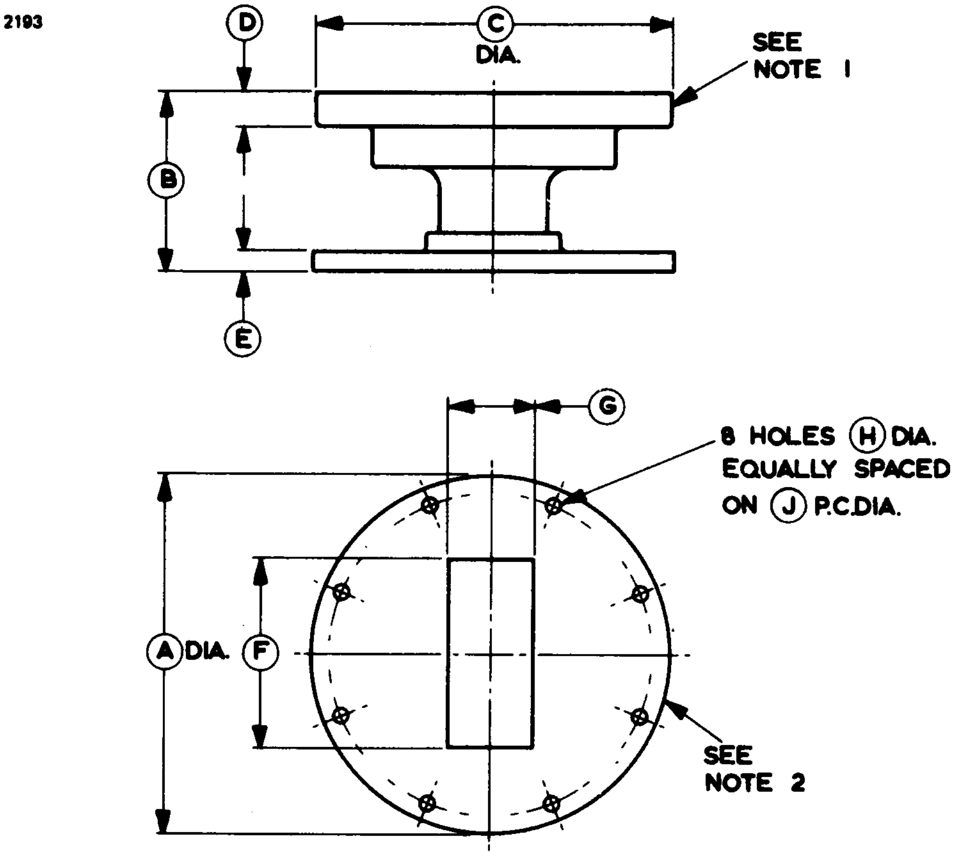
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875	149.2	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	5.375	136.5
E	0.250	6.35			

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 (All dimensions nominal)



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.

M5020

S-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	3040 to 3060	MHz
Typical peak output power	25	kW
Magnet		integral
Output		no. 10 waveguide (2.840 x 1.340 inch internal)
Coupler		J.S.C. no. 5985-99-083-0058
Cooling		natural or forced-air

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	1.25	A
Heater starting current, peak value, not to be exceeded	6.0	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	7.000 x 6.500 x 3.500 inches max 177.8 x 165.1 x 88.90mm max
Net weight	5½ pounds (2.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 2) . . . . 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)	–	6.0	A
Anode voltage (peak)	7.5	8.5	kV
Anode current (peak)	6.0	12	A
Anode input power (mean)	–	100	W
Duty cycle	–	0.001	
Pulse length	–	1.0	μs
Rate of rise of voltage pulse (see note 4)	–	150	kV/μs
Anode temperature (see note 2)	–	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	5.3	V
Anode current (peak)	8.0	8.0	A
Pulse length	0.07	0.55	μs
Pulse repetition rate	4000	1000	p.p.s.
Rate of rise of voltage pulse	150	150	kV/μs

Typical Performance

Anode voltage (peak)	8.0	8.0	kV
Output power (peak)	25	25	kW
Output power (mean)	7.0	13.75	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	5.3	V
Anode current (mean)	2.25	4.4	mA
Duty cycle	0.00028	0.00055	
Pulse length (see note 3)	0.07	0.55	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 4)	150	150	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.5	8.5	7.5	8.5	kV
Output power (mean)	7.0	–	13.75	–	W
Frequency (see note 5)	–	–	3040	3060	MHz
R.F. bandwidth at ¼ power (see note 6)	–	30	–	4.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	13	–	13	MHz
Frequency pushing (see note 6)	–	1.5	–	1.5	MHz/A
Stability (see note 7)	–	0.5	–	0.5	%
Cold impedance					see note 8
Heater current					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 oscillation 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

	Min	Max	
Output power (mean)	11	–	W
Frequency	3040	3060	MHz
R.F. bandwidth at ¼ power (see note 6)	–	4.5	MHz
Stability (see note 7)	–	1.0	%

NOTES

1. With no anode input power.

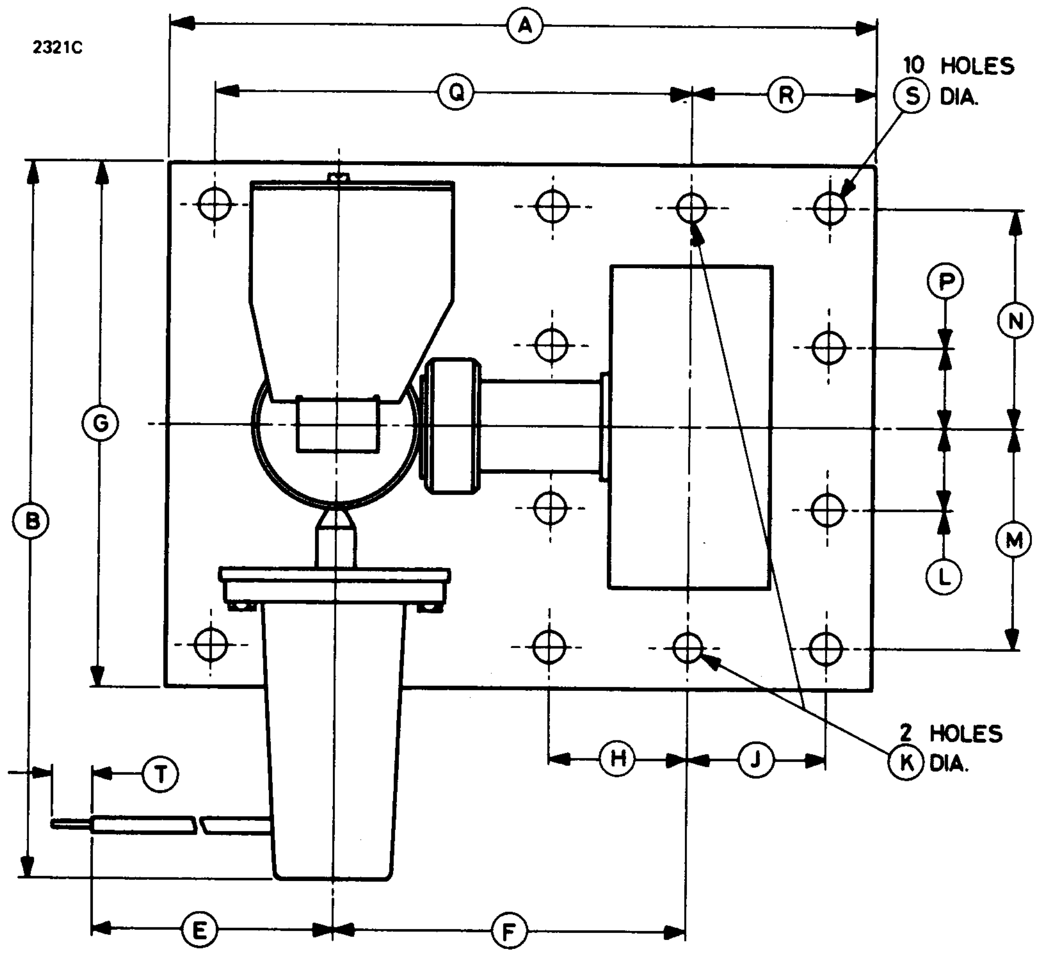
   On the application of anode power, the heater voltage must be reduced as follows:

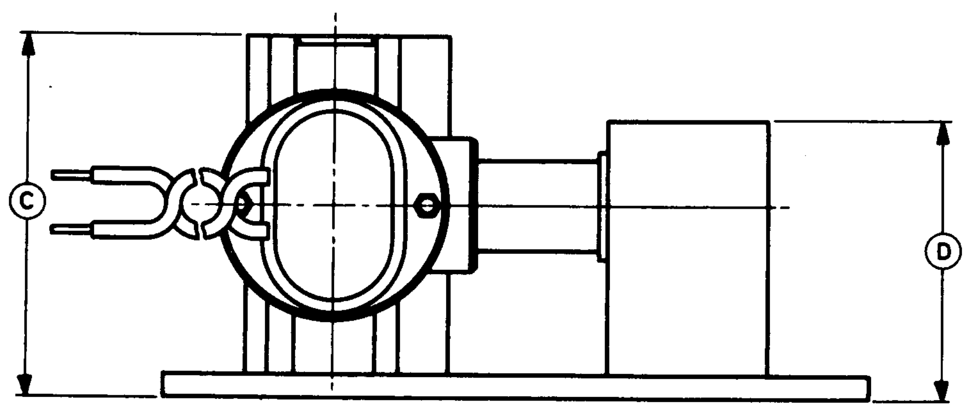
Mean input power (W)	Heater voltage ($V_{r.m.s.}$)
less than 25	6.3
25 to 62	5.3
62 to 100	4.5

   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.

2. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode body.
3. Tolerance $\pm$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. Measured as the peak anode current is varied between 6 and 12A.
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 3040 to 3060MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minutes of a 15 minute test period.
8. 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 43 to 61mm from the output flange away from the anode.
9. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 1.1A minimum, 1.4A maximum.

OUTLINE





See page 6 for outline dimensions

Outline Dimensions (All dimensions without limits are nominal)

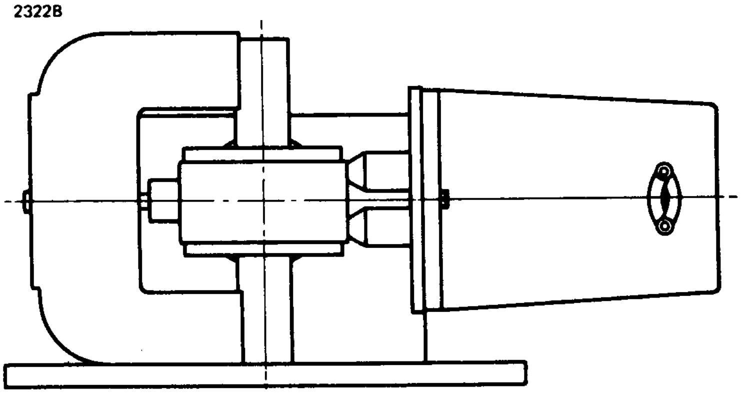
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	6.500 max	165.1 max	L	0.750 ± 0.002	19.050 ± 0.051
B	7.000 max	177.8 max	M	2.031 ± 0.002	51.587 ± 0.051
C	3.500 max	88.90 max	N	2.031 ± 0.002	51.587 ± 0.051
D	2.562 max	65.07 max	P	0.750 ± 0.002	19.050 ± 0.051
E	12.250 max 11.750 min	311.2 max 298.5 min	Q	4.375	111.1
			R	1.700	43.18
F	3.250 ± 0.250	82.55 ± 6.35	S	0.261 max 0.250 min	6.63 max 6.35 min
G	4.850 max	123.2 max			
H	1.281 ± 0.002	32.537 ± 0.051	T	0.500	12.70
J	1.281 ± 0.002	32.537 ± 0.051			
K	$0.250^{+0.001}_{-0.000}$	$6.350^{+0.025}_{-0.000}$			

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

2322B



M5028

PRECISION TUNED MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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 to 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

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 wave-guide. 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.

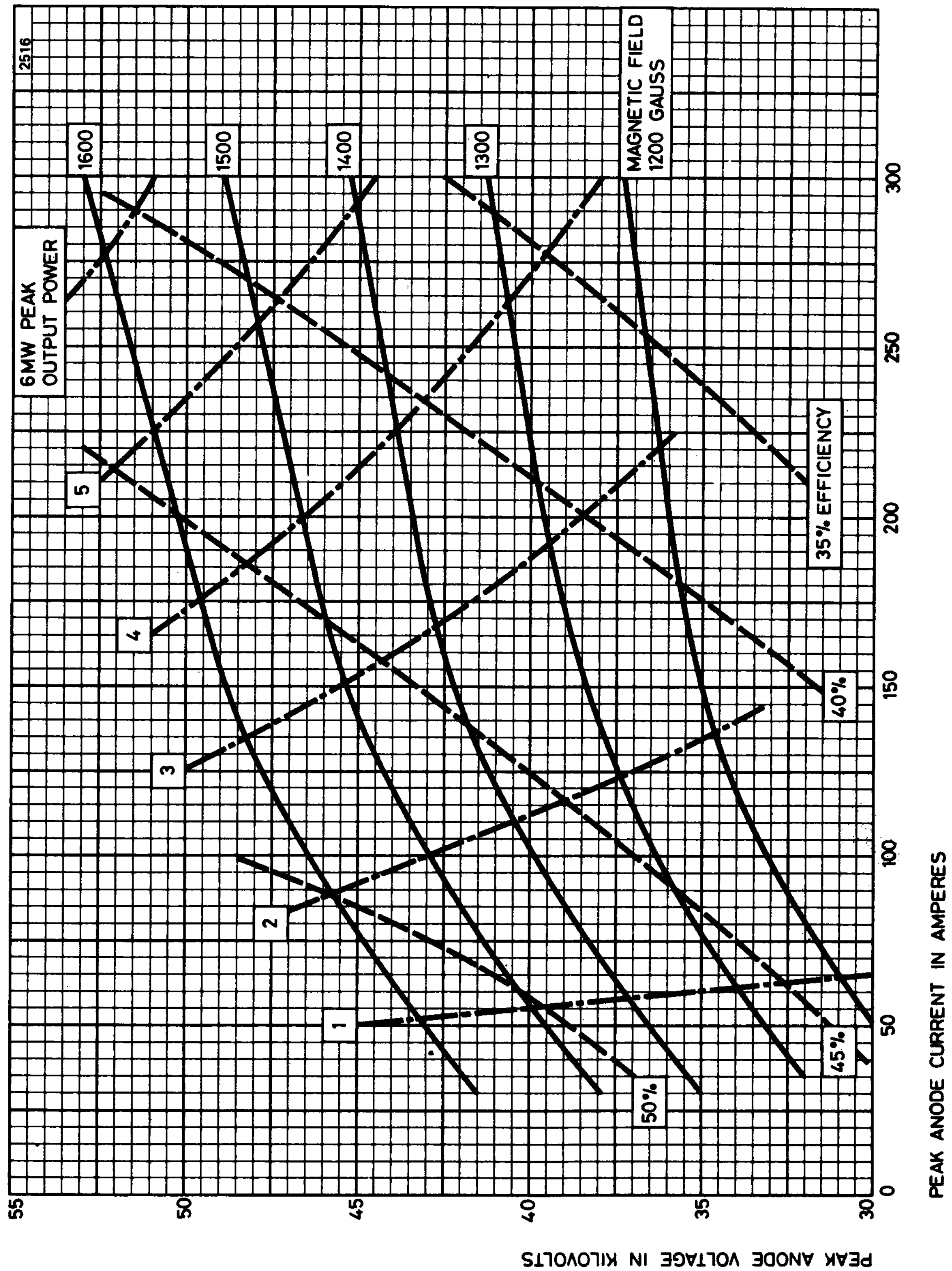
12. Measured with a v.s.w.r. of 1.3:1 at the frequency of oscillation, varied through all phases.

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.

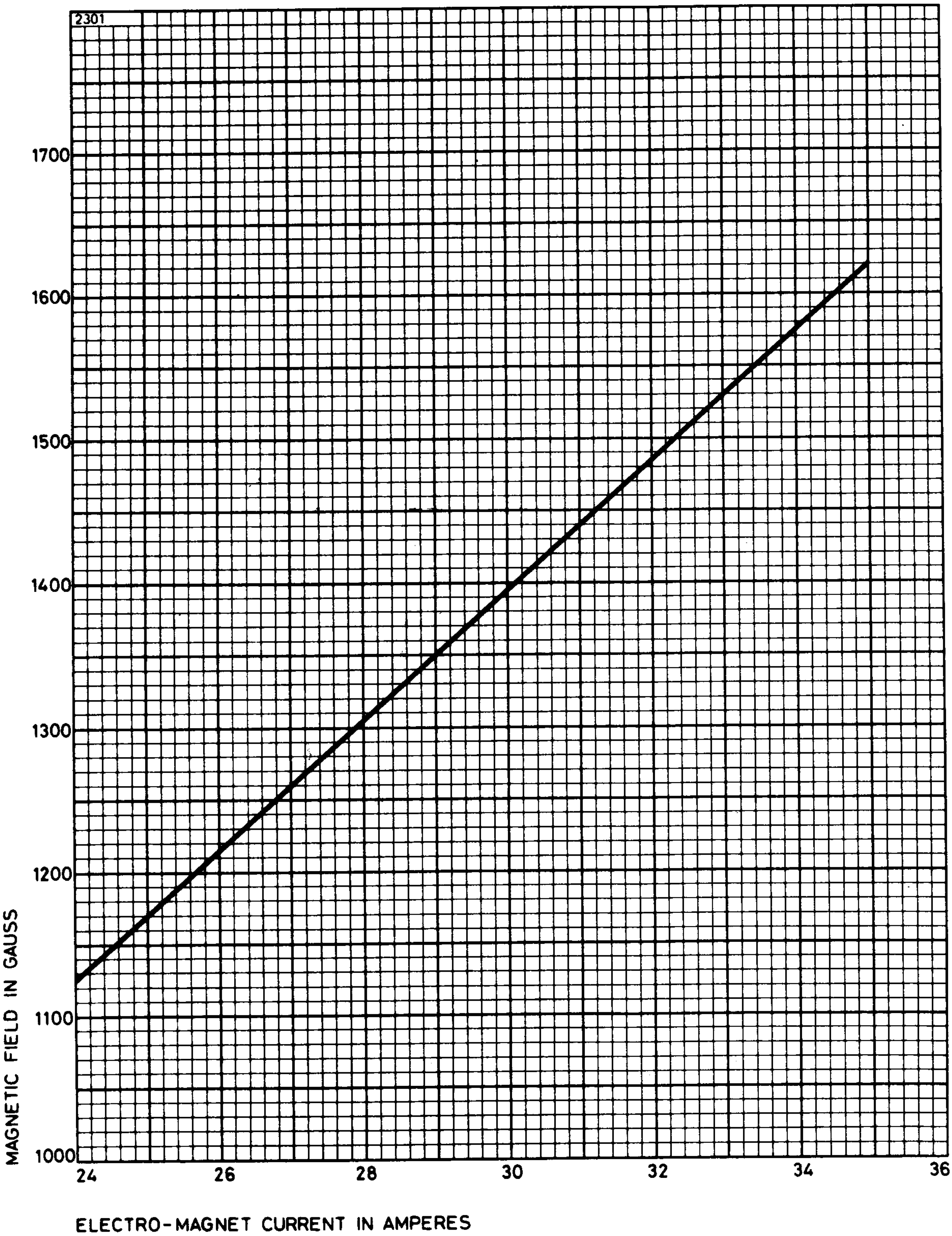
14. Measured with a heater voltage of 12 volts and no anode input power, the heater current limits are 13A minimum, 15A maximum.

15. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.05MHz/°C.

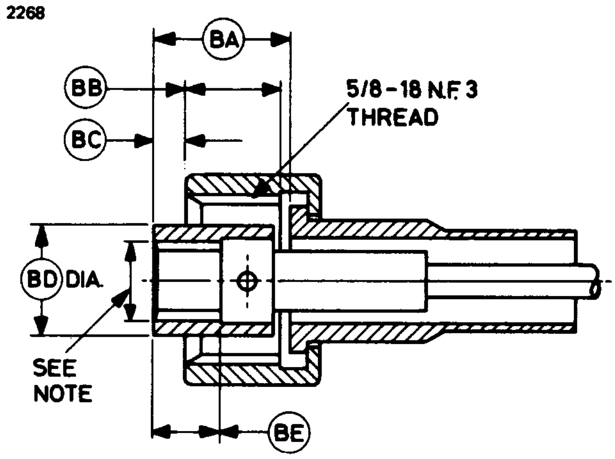
TYPICAL PERFORMANCE CHART



CURRENT-FIELD STRENGTH CHARACTERISTICS OF M4121



DETAIL OF FLEXIBLE DRIVE CONNECTOR (All dimensions nominal)

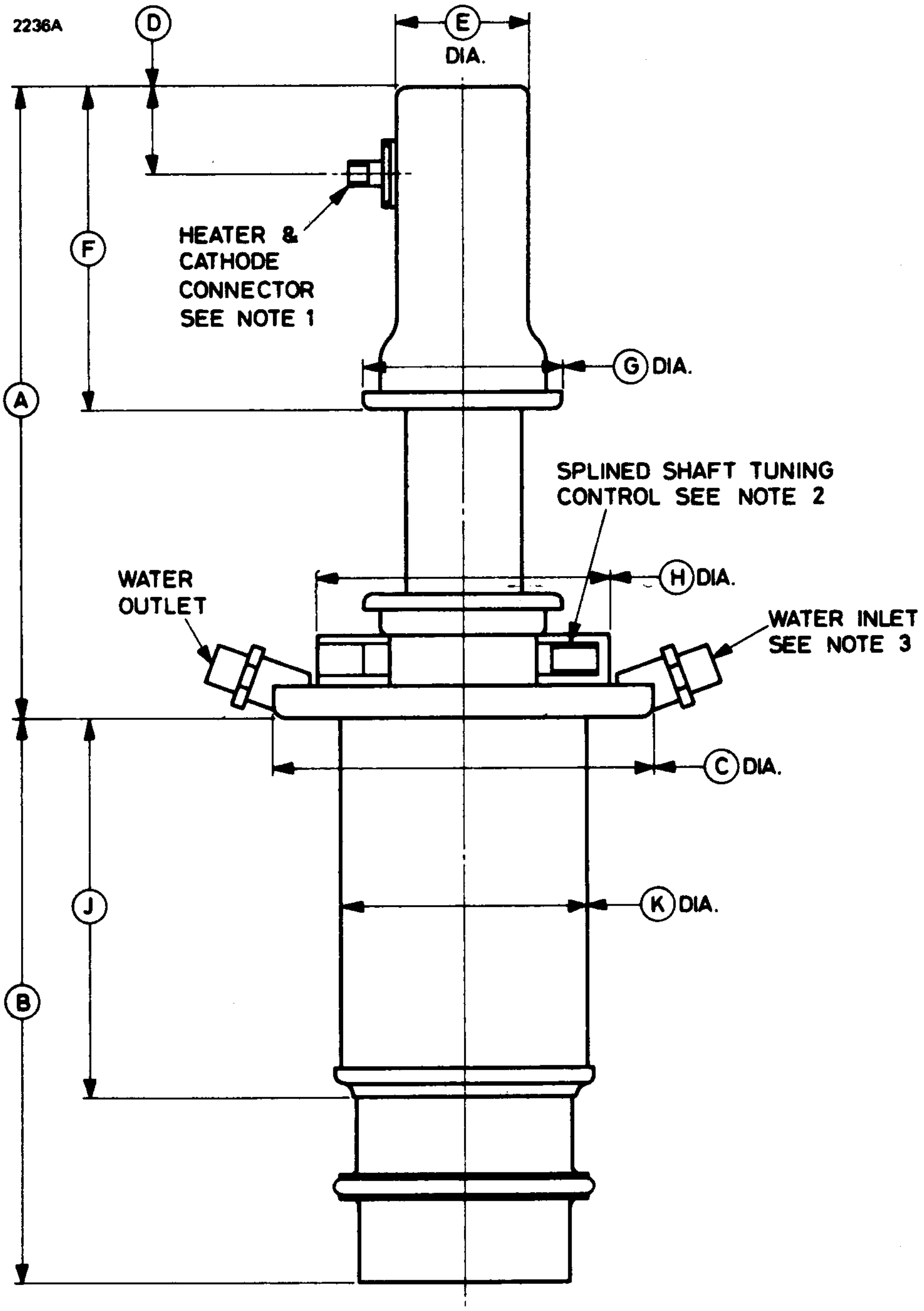


Ref	Inches	Millimetres
BA	0.500	12.70
BB	0.360	9.14
BC	0.112	2.84
BD	0.406	10.31
BE	0.250	6.35

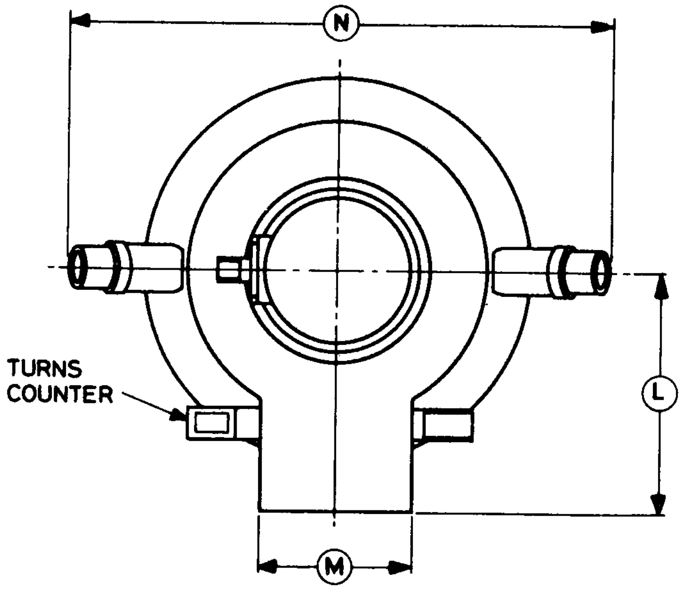
Millimetre dimensions have been derived from inches.

Note Internal spline, 12 tooth 48 DP, 14½° pressure angle, involute form.

OUTLINE OF M5028 (All dimensions without limits are nominal)



2237A



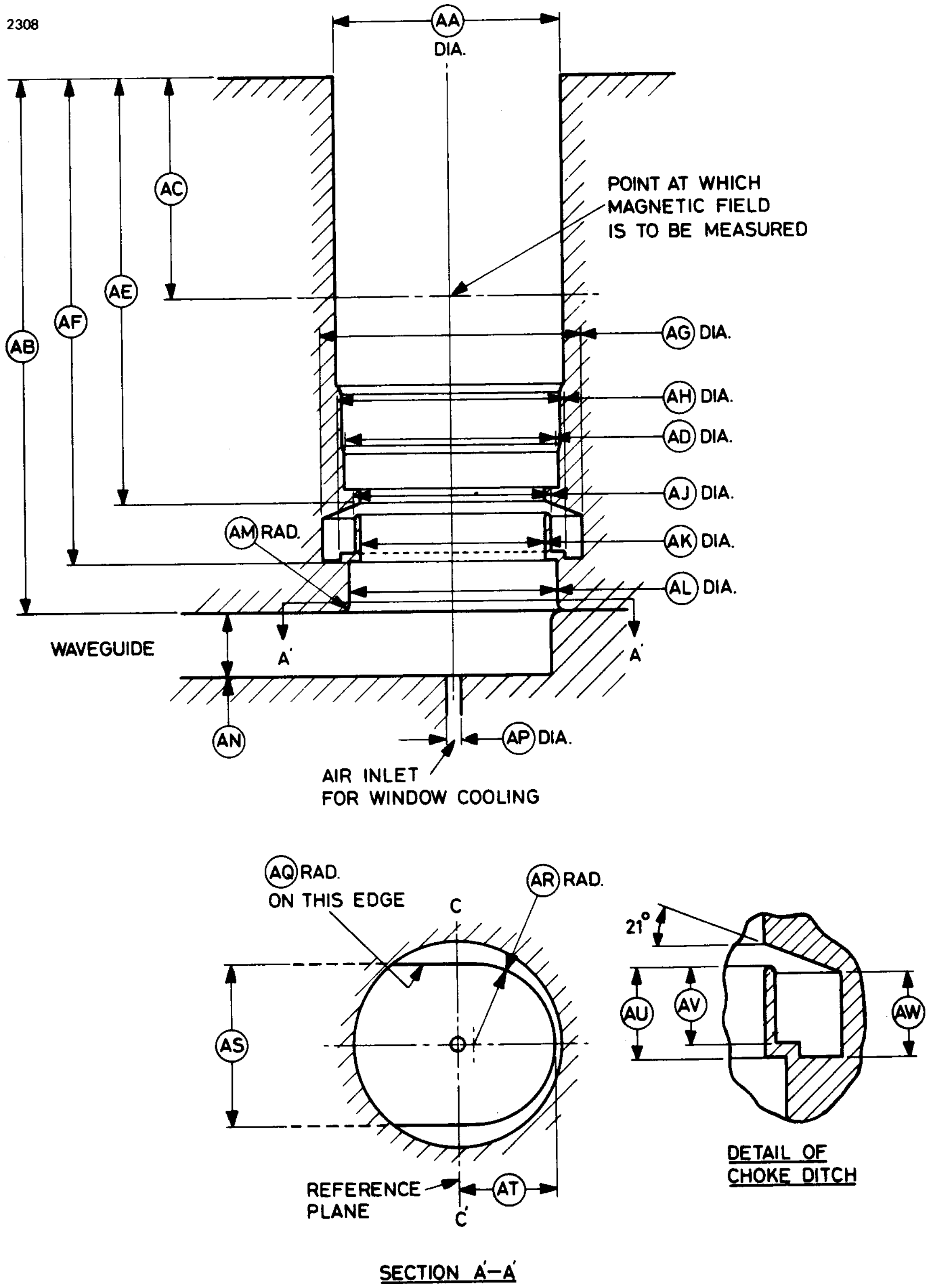
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.500	241.3	H	4.375	111.1
B	8.514	216.3	J	5.689	144.5
C	5.775 max	146.7 max	K	4.000 max	101.6 max
D	1.300	33.02	L	3.563	90.50
E	2.250 max	57.15 max	M	2.250	57.15
F	4.750	120.7	N	7.500	190.5
G	3.000 max	76.20 max			

Millimetre dimensions have been derived from inches.

Outline Notes

1. Heater-cathode connector, J.S.C. 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



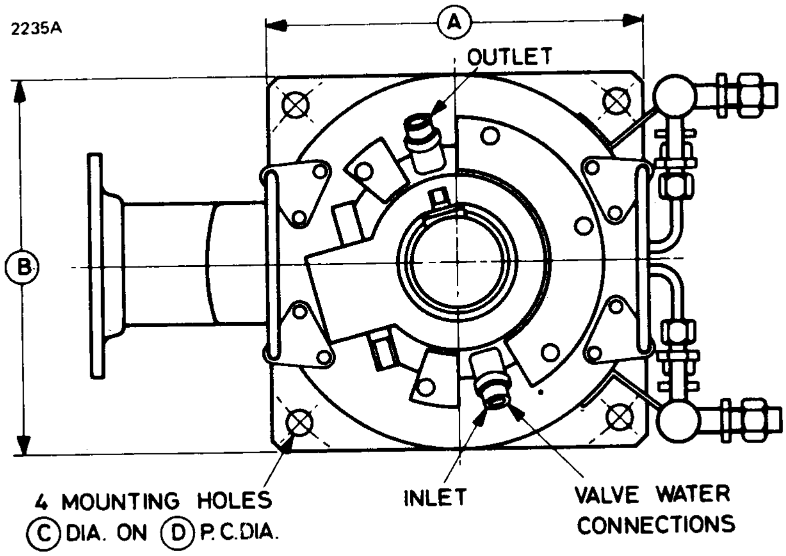
Dimensions for Electro-magnet and Launching Section
(All dimensions without limits are nominal)

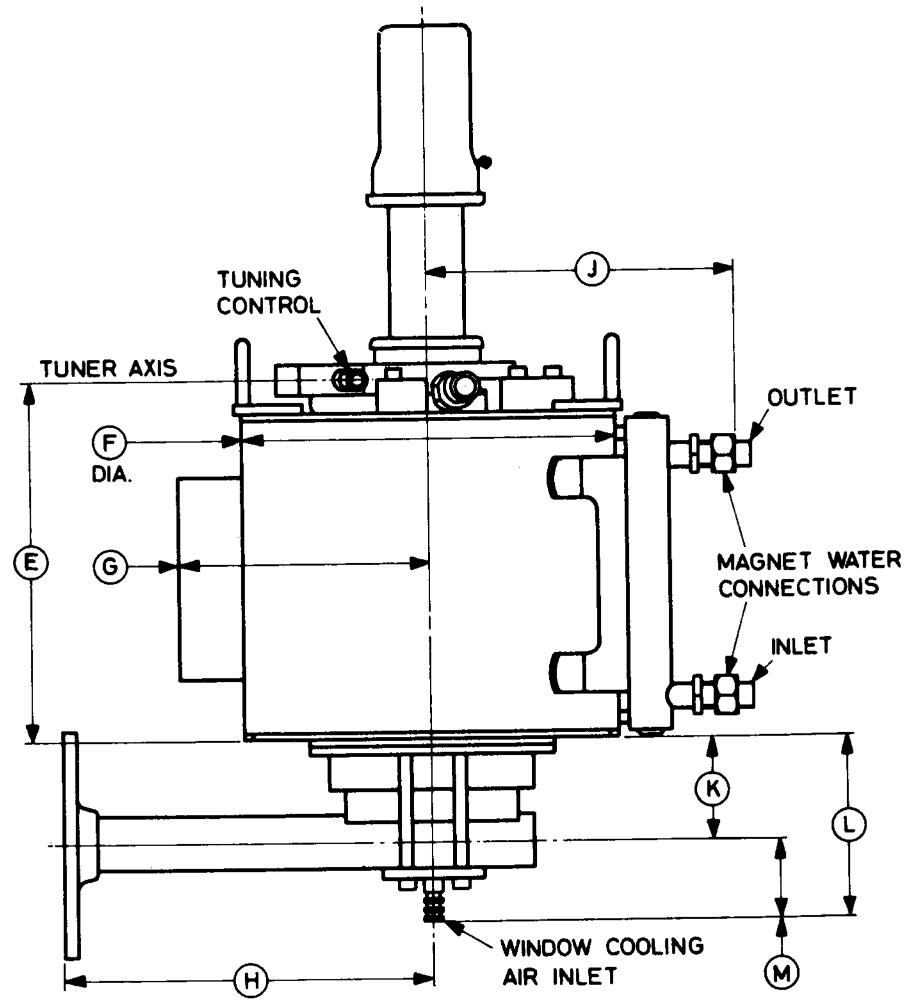
Ref	Inches	Millimetres
AA	$4.000^{+0.003}_{-0.000}$	$101.600^{+0.076}_{-0.000}$
AB	9.551	242.6
AC	3.939	100.1
AD	$3.750^{+0.002}_{-0.000}$	$95.250^{+0.051}_{-0.000}$
AE	7.637	194.0
AF	8.601	218.5
AG	4.340 ± 0.005	110.2 ± 0.13
AH	3.713 ± 0.003	94.310 ± 0.076
AJ	3.410 ± 0.005	86.61 ± 0.13
AK	3.250 ± 0.005	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

2235A

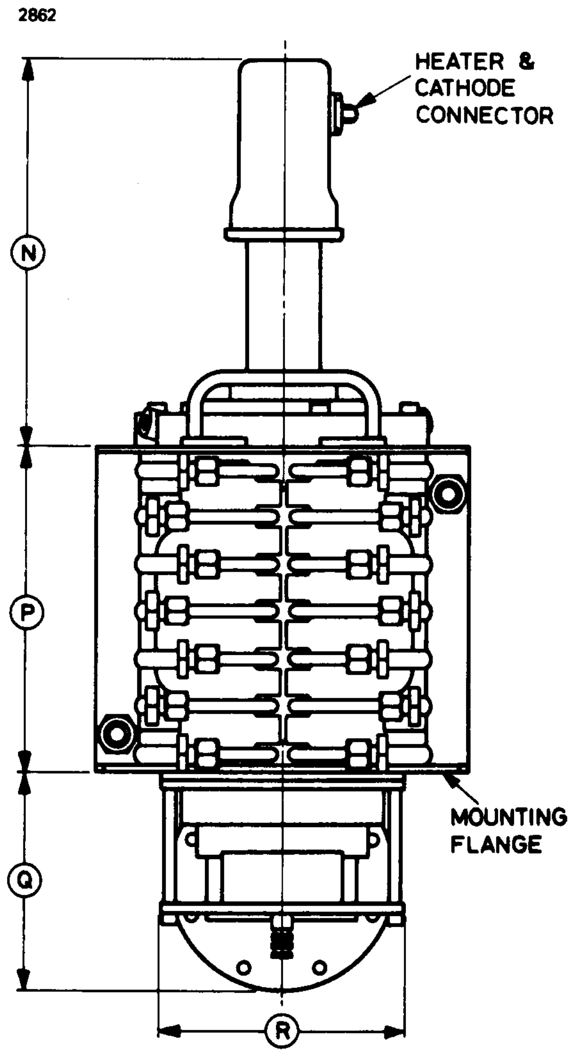




Outline Dimensions (All dimensions nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.250	235.0	J	7.312	185.7
B	9.250	235.0	K	2.530	64.26
C	0.513	13.03	L	4.530	115.1
D	11.000	279.4	M	2.000	50.80
E	9.062	230.2	N	9.500	241.3
F	9.250	235.0	P	8.000	203.2
G	6.125	155.6	Q	5.187	131.7
H	9.000	228.6	R	5.500	139.7

Millimetre dimensions have been derived from inches.



M5030 M5034

TUNABLE S-BAND MAGNETRONS

The data should be read in conjunction with the Magnetron Preamble.

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.

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 (see note 8)	–	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 11)	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 12)	–	0.25	%
Heater current			see note 13
Temperature coefficient of frequency			see note 14

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 EX977 (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. The pulse length may be increased to 6.0μs, and the duty cycle to 0.003, provided that the peak anode current does not exceed 50A and all other ratings are observed.
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. 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 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.

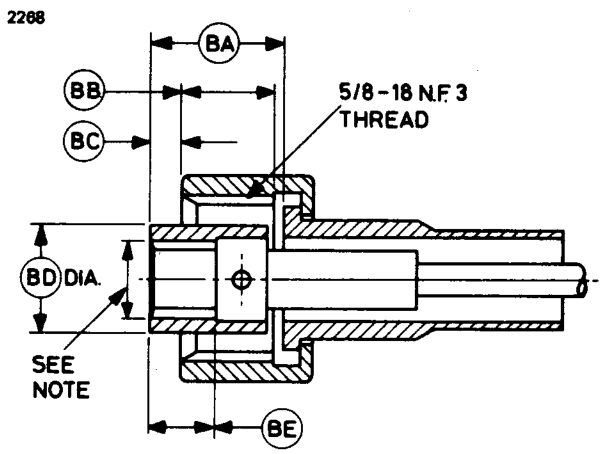
13. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 12A maximum.

14. Design test only. The maximum frequency change with anode temperature change (after warm-up) is –0.07MHz/°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.

DETAIL OF FLEXIBLE DRIVE CONNECTOR (All dimensions nominal)



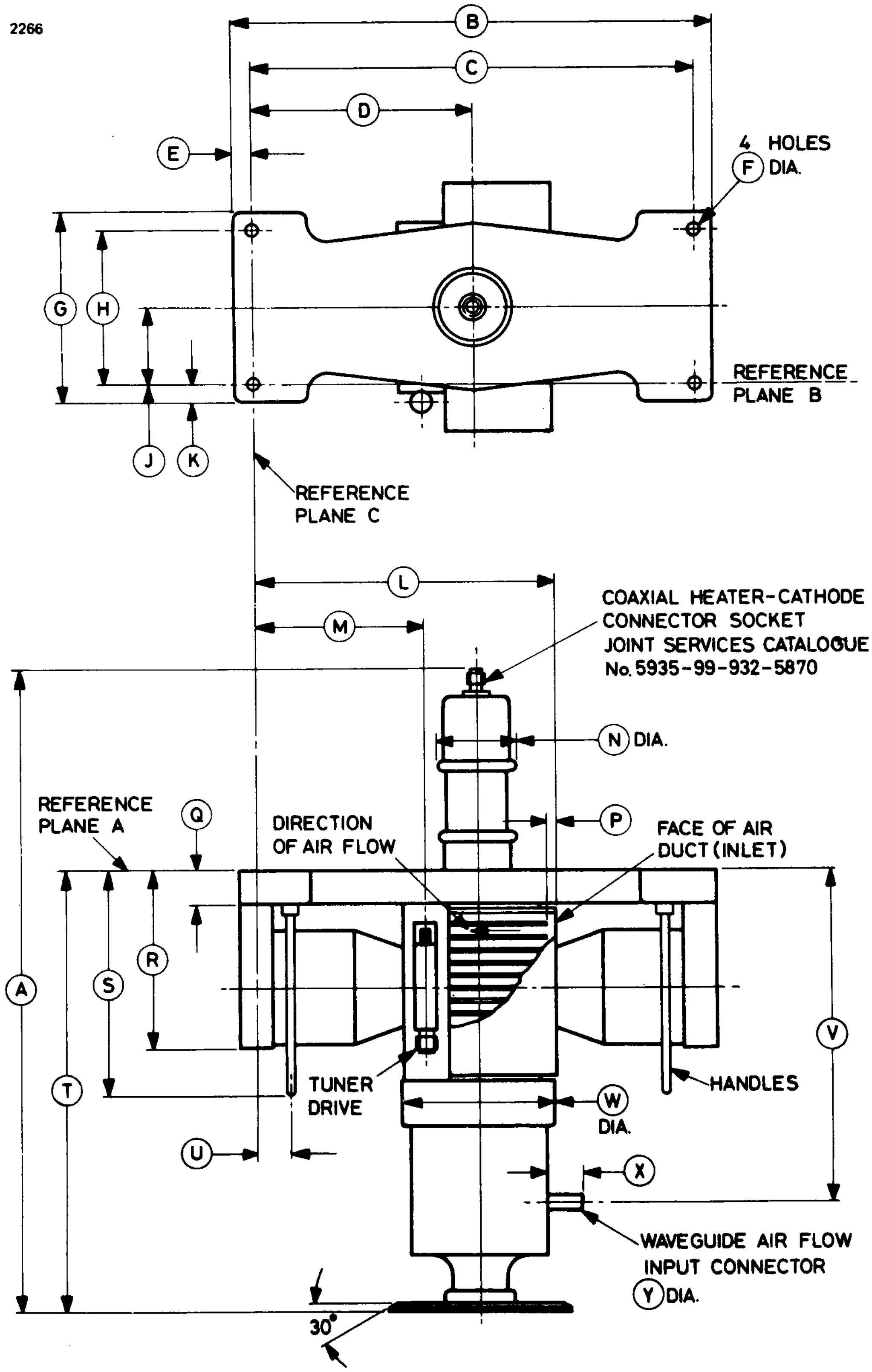
Ref	Inches	Millimetres
BA	0.500	12.70
BB	0.360	9.14
BC	0.112	2.84
BD	0.406	10.31
BE	0.250	6.35

Millimetre dimensions have been derived from inches.

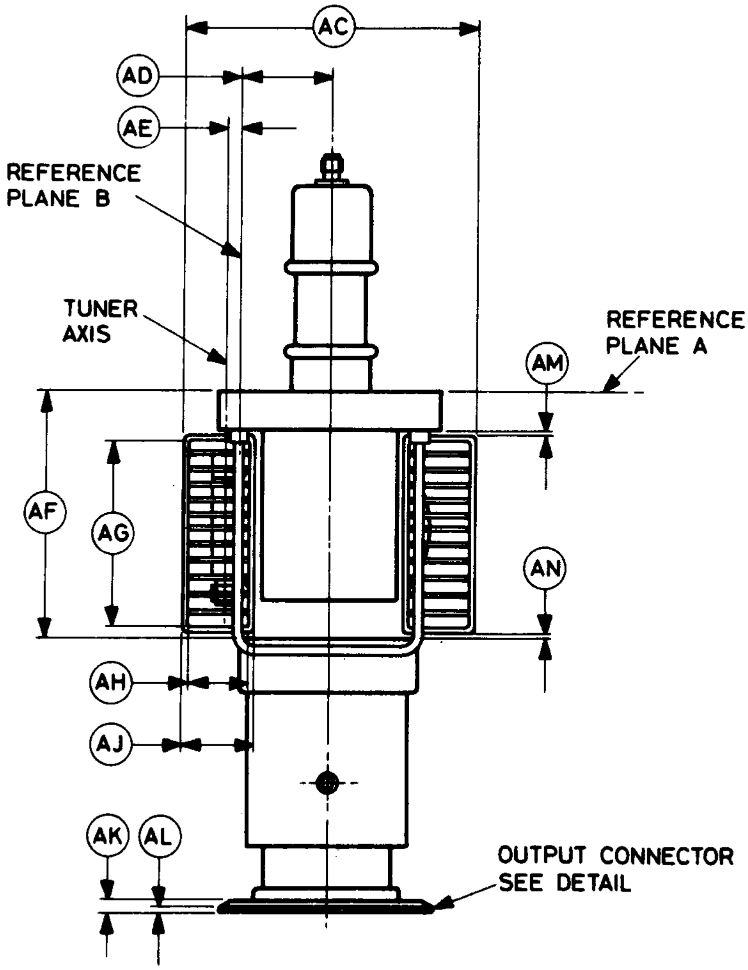
Note Internal spline, 12 tooth 48 DP, 14½° pressure angle, involute form.

OUTLINE

2266

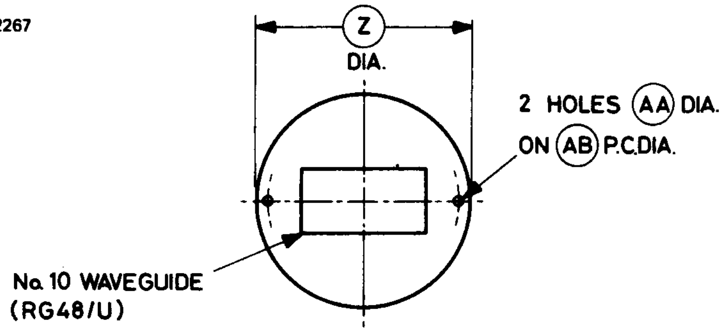


OUTLINE



Detail of Output Connector

2267



Outline Dimensions

Ref	Inches	Millimetres
A	18.500 max	469.9 max
B	13.750 max	349.3 max
C	12.720 ± 0.030	323.09 ± 0.76
D	6.360 ± 0.020	161.54 ± 0.51
E	0.500 ± 0.030	12.70 ± 0.76
F	0.375 ± 0.015	9.53 ± 0.38
G	5.530 max	140.5 max
H	4.500 ± 0.015	114.30 ± 0.38
J	2.250 ± 0.020	57.15 ± 0.51
K	0.500 ± 0.030	12.70 ± 0.76
L	8.623 ± 0.060	219.0 ± 1.5
M	4.865 ± 0.040	123.6 ± 1.0
N	2.280 max	57.91 max
P	0.250 ± 0.030	6.35 ± 0.76
Q	1.000 ± 0.020	25.40 ± 0.51
R	5.180 max	131.6 max
S	6.500 ± 0.125	165.1 ± 3.2
T	12.650 ± 0.040	321.3 ± 1.0
U	0.985 ± 0.030	25.02 ± 0.76

Ref	Inches	Millimetres
V	9.560 ± 0.050	242.8 ± 1.3
W	4.425 max	112.4 max
X	1.000 ± 0.060	25.4 ± 1.5
Y	0.500 ± 0.020	12.70 ± 0.51
Z	5.272 ± 0.030	133.91 ± 0.76
AA	0.207 ± 0.005	5.26 ± 0.13
AB	4.764 ± 0.004	121.006 ± 0.102
AC	7.252 ± 0.020	184.20 ± 0.51
AD	2.250 ± 0.020	57.15 ± 0.51
AE	0.326 ± 0.040	8.28 ± 1.02
AF	6.060 ± 0.030	153.92 ± 0.76
AG	4.862 ± 0.015	123.49 ± 0.38
AH	1.752 ± 0.010	44.50 ± 0.25
AJ	1.832 ± 0.015	46.53 ± 0.38
AK	0.275 ± 0.007	6.99 ± 0.18
AL	0.137 ± 0.015	3.48 ± 0.38
AM	0.060 ± 0.020	1.52 ± 0.51
AN	0.060 ± 0.020	1.52 ± 0.51

Millimetre dimensions have been derived from inches.

M5035

TUNABLE S-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Mechanically tuned pulse magnetron

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 at 16V	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

February 1970

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	–	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	8.0	V
Magnetic field (see note 9)	2700	2700	2700	gauss
Anode current (peak)	50	70	60	A
Pulse length	0.5	1.0	2.0	μs
Pulse repetition rate	1500	500	300	p.p.s.

Typical Performance

Anode voltage (peak)	30	30	30	kV
Output power (peak)	700	1000	800	kW
Output power (mean)	525	500	480	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 notes 11 and 12)	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:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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%.

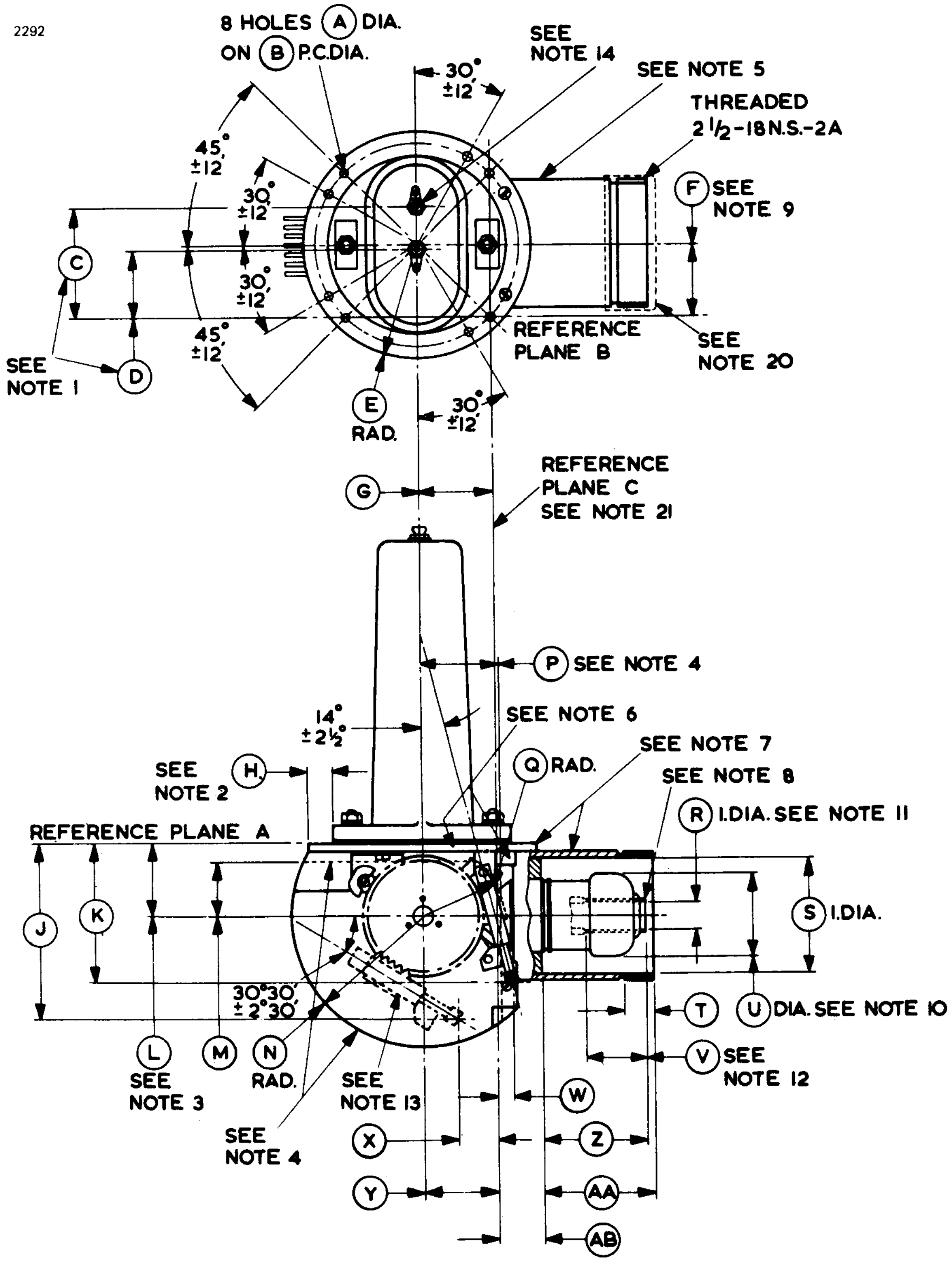
7. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.
8. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the 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 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 r.f. spectrum is checked under oscillation conditions 1 and 2 to ensure that there is no degeneration as the valve is tuned through the frequency range. The specification limit for bandwidth applies over the whole tuning range.
13. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level within a $\pm$1% frequency range of the normal operating frequency. 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.
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.

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.

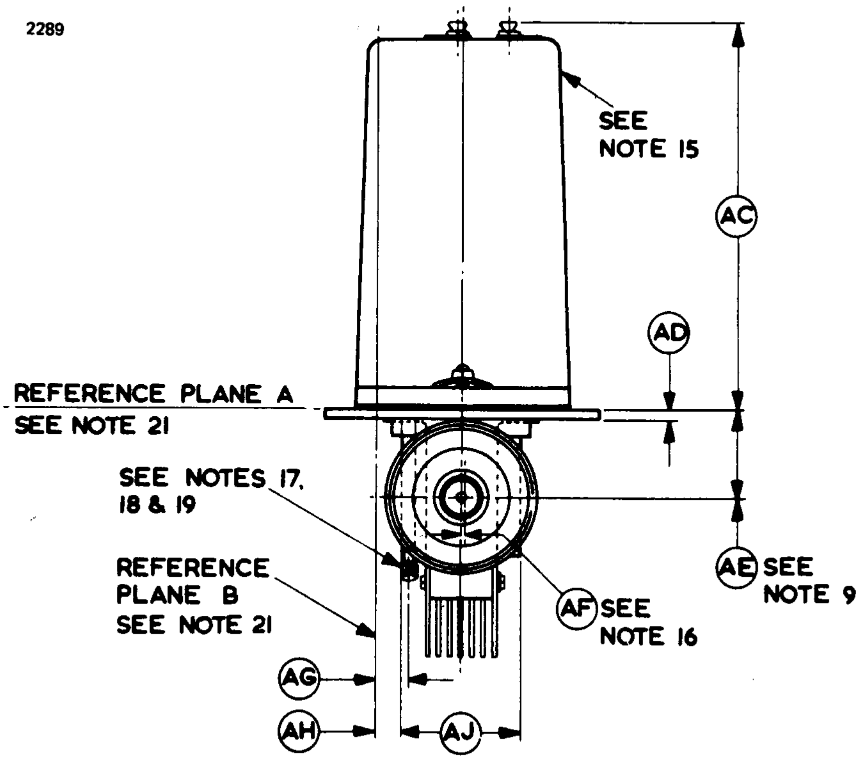
OUTLINE


2292
8 HOLES (A) DIA.
ON (B) P.C.DIA.
SEE
NOTE 14
SEE NOTE 5
THREADED
2 1/2-18 N.S.-2A
30°
±12'
45°
±12'
30°
±12'
30°
±12'
45°
±12'
(C)
(D)
SEE
NOTE 1
(F) SEE
NOTE 9
REFERENCE
PLANE B
SEE
NOTE 20
(E)
RAD.
30°
±12'
(G)
REFERENCE
PLANE C
SEE NOTE 21
(P) SEE NOTE 4
14°
±2½°
SEE NOTE 6
SEE NOTE 7
(Q) RAD.
SEE NOTE 8
SEE
NOTE 2
(H)
(R) I.DIA. SEE NOTE 11
REFERENCE PLANE A
(J)
(K)
(S) I.DIA.
30°30'
±2°30'
(T)
(U) DIA. SEE NOTE 10
(L)
SEE
NOTE 3
(M)
(N)
RAD.
SEE
NOTE 13
(V) SEE
NOTE 12
(W)
SEE
NOTE 4
(X)
(Z)
(Y)
(AA)
(AB)

Outline Dimensions (All dimensions without limits are nominal)

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 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 ± 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 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.

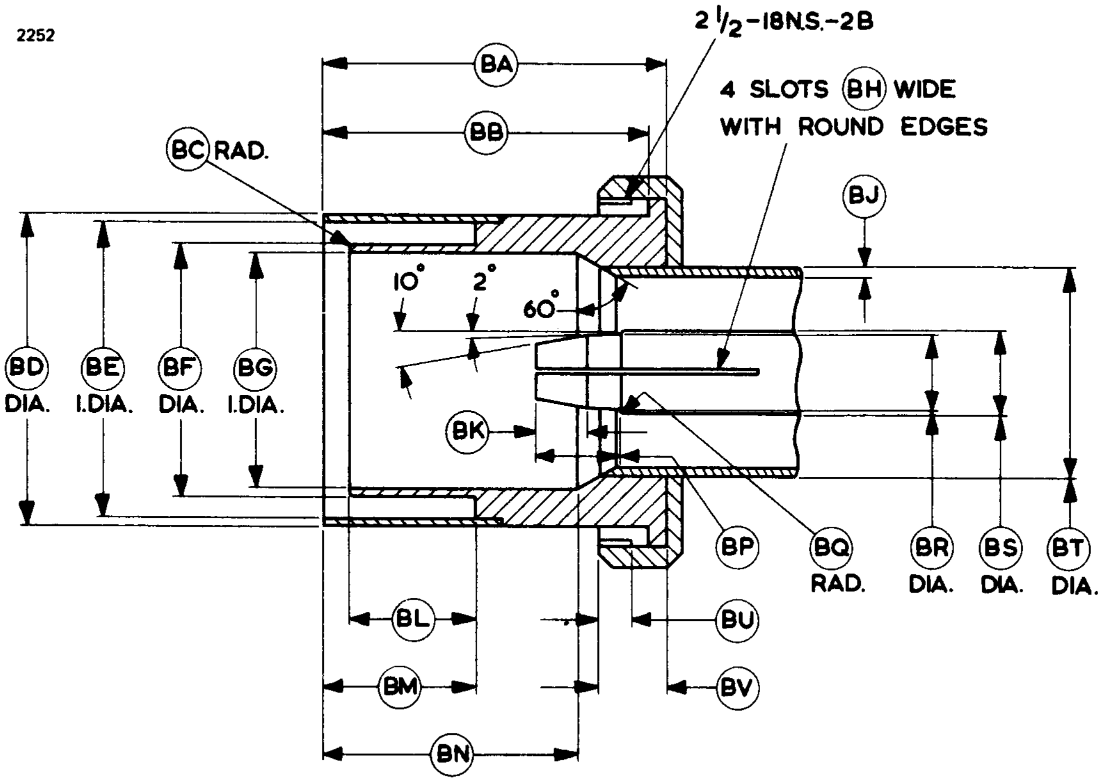
21. Reference plane A is defined as a plane passing along the face of the mounting plate.

    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 (All dimensions without limits are nominal)

2252

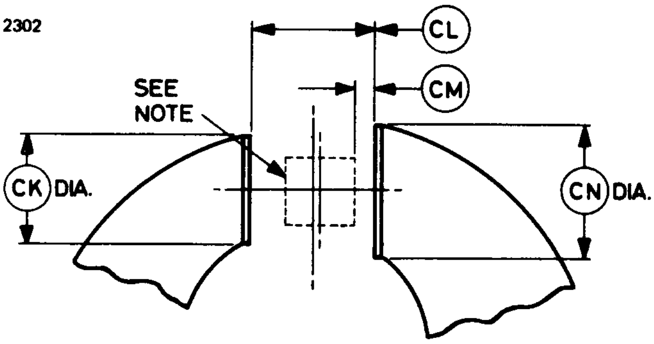


Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 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

2302



Ref	Inches	Millimetres
CK	1.625	41.28
CL	1.800 ± 0.005	45.72 ± 0.13
CM	0.270	6.86
CN	2.000	50.80

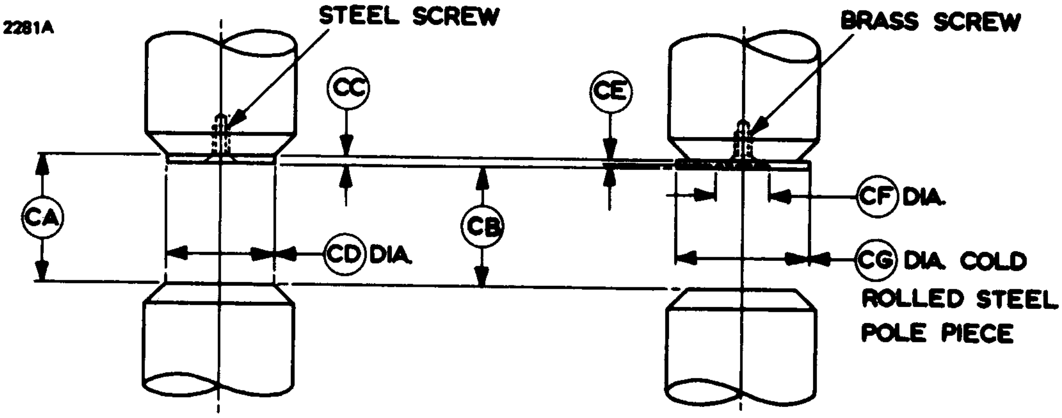
Millimetre dimensions have been derived from inches.

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**

2281A



Ref	Inches	Millimetres
CA	1.925 ± 0.005	48.90 ± 0.13
CB	1.800 ± 0.005	45.72 ± 0.13
CC	0.125 ± 0.015	3.18 ± 0.38
CD	1.625 ± 0.015	41.28 ± 0.38
CE	0.031 ± 0.015	0.79 ± 0.38
CF	0.786 ± 0.005	19.96 ± 0.13
CG	2.000 ± 0.015	50.80 ± 0.38

Millimetre dimensions have been derived from inches.

M5048

TUNABLE S-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Mechanically tuned, vapour cooled pulse magnetron for m.t.i. operation.

Frequency range	2900–3000	MHz
Typical peak output power	1.2	MW
Magnet		integral
Output (see note 1)		no. 10 waveguide (RG-48/U) (7.214 x 3.404cm internal)
Coupler		mates with coupler Z830058 (inter-service type 5985-99-083-0058)
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		17.665 x 12.040 x 9.000 inches max 448.7 x 305.8 x 228.6mm max
Net weight		60 pounds (27kg) max
Mounting position		cathode connector vertically downwards
Tuning (see note 3)		mechanical
Tuner turns to cover frequency range (see notes 4 and 5)	135	max

Cooling

The anode is vapour cooled by an integral boiler. The water level in the boiler must be as shown on the outline drawing to ensure safe, stable operation. Distilled water only must be used in the boiler.

A thermal fuse (part number MA85C) is fitted to give protection against anode overheating; it should be connected by a non-conducting cord to a suitable switching device. A tension of about 1lb (450g) should be applied to the cord. If the temperature exceeds a safe limit, the fuse core is pulled out; this should actuate the switching device and remove all electrical supplies from the valve. Replacement fuses can be supplied to order.

The waveguide is at atmospheric pressure; an airflow of 5.0ft^3/min must be passed into the waveguide air inlet (see Outline).

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)	–	75	A
Input power (peak)	–	2.3	MW
Input power (mean) (see note 6)	–	3.4	kW
Duty cycle	–	0.0015	
Pulse length	–	5.5	μs
Rate of rise of voltage pulse (see note 7)	–	100	kV/μs
Cathode terminal temperature	–	160	°C
V.S.W.R. at the output coupler	–	1.3:1	
Rate of airflow into output 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	5.0	μs
Pulse repetition rate	300	p.p.s.

Typical Performance

Anode voltage (peak)	33	kV
Output power (peak)	1.2	MW
Output power (mean)	1.8	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)	105	mA
V.S.W.R. at the output coupler	1.15:1	max
Pulse length (see note 8)	5.0	μs
Duty cycle	0.0015	
Rate of rise of voltage pulse (see note 7)	100	kV/μs min

Limits

	Min	Max	
Anode voltage (peak) (see note 9)	30	36	kV
Output power (mean) (see note 9)	1.5	–	kW
Frequency	2900	3000	MHz
R.F. bandwidth at ¼ power (see note 9)	–	0.5	MHz
Performance continuity	The spectrum shall be observed continuously over the specified frequency range.		
Frequeney pulling (v.s.w.r. not less than 1.5:1)	–	7.0	MHz
Stability (see notes 9 and 10)	–	0.25	%
Heater current (at 8.5V) (see note 11)	8.0	10	A
Temperature coefficient of frequency (see note 12)	–	–0.07	MHz/°C

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) . . .	100	135	turns
Tuning shaft torque (conditions 1 and 2) (see note 9)	–	35	oz-in
Backlash in tuning shaft	–	60	degrees rotation

END OF LIFE CRITERIA (under Test Conditions)

Output power (mean)	1.3	kW min
R.F. bandwidth at ¼ power	0.5	MHz max
Stability	0.5	% max
Backlash in tuning shaft	90	degrees rotation 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
over 3	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 of which 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 10).
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 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.

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. Tolerance $\pm$10%.

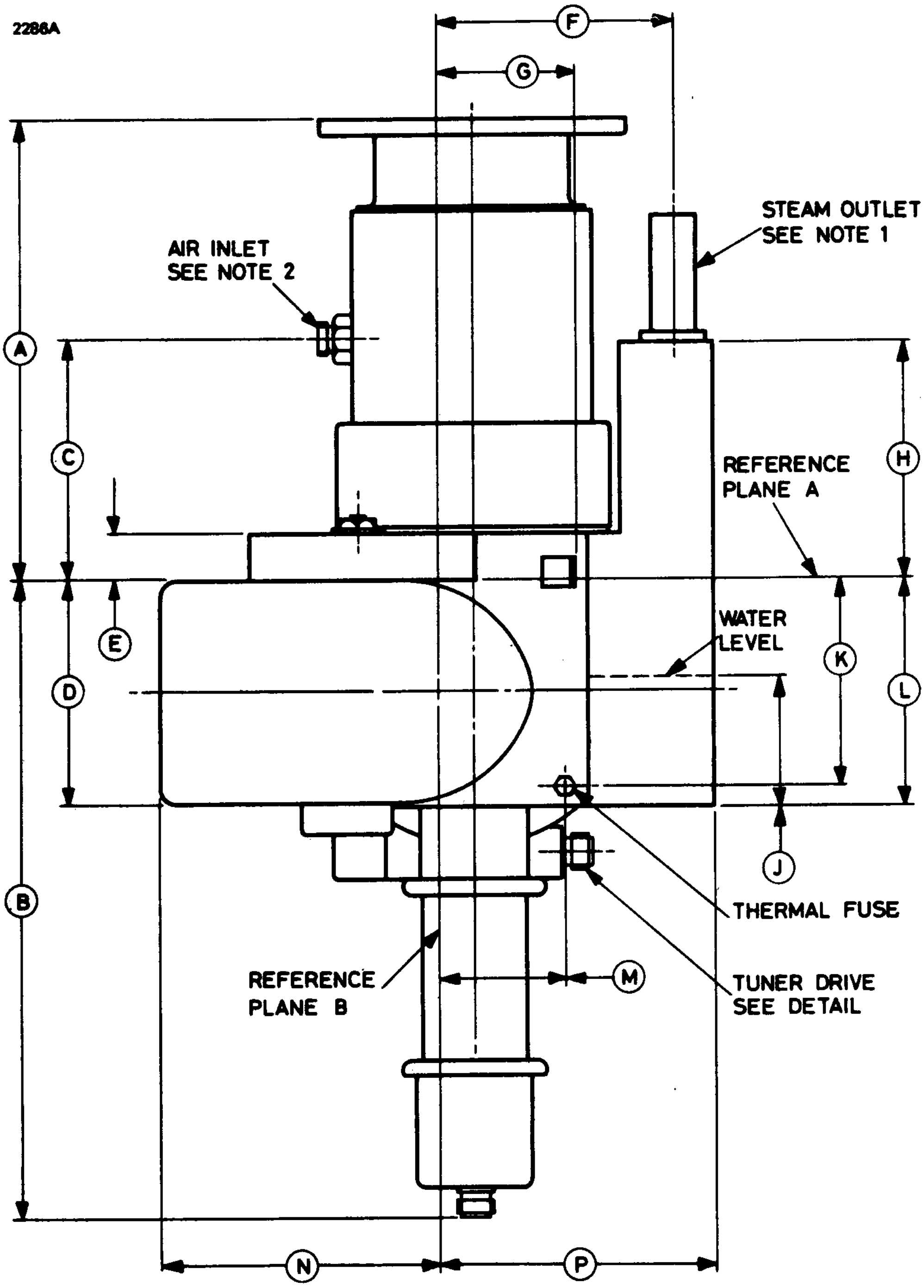
9. These tests are carried out at 2900, 2950 and 3000MHz.

10. 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 30s of a test interval not to exceed 5 minutes.

11. Measured with no anode input power.

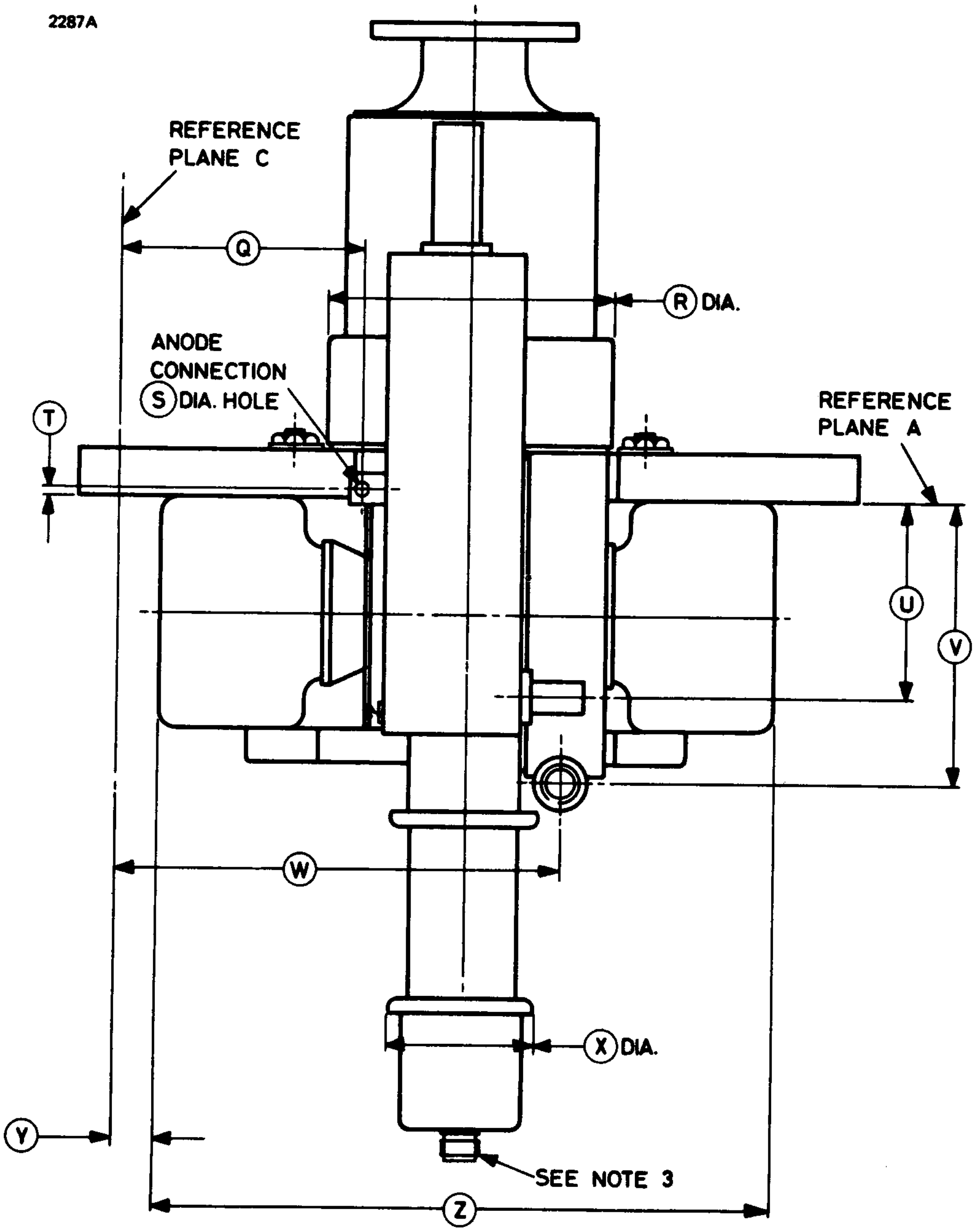
12. Design test only.

OUTLINE



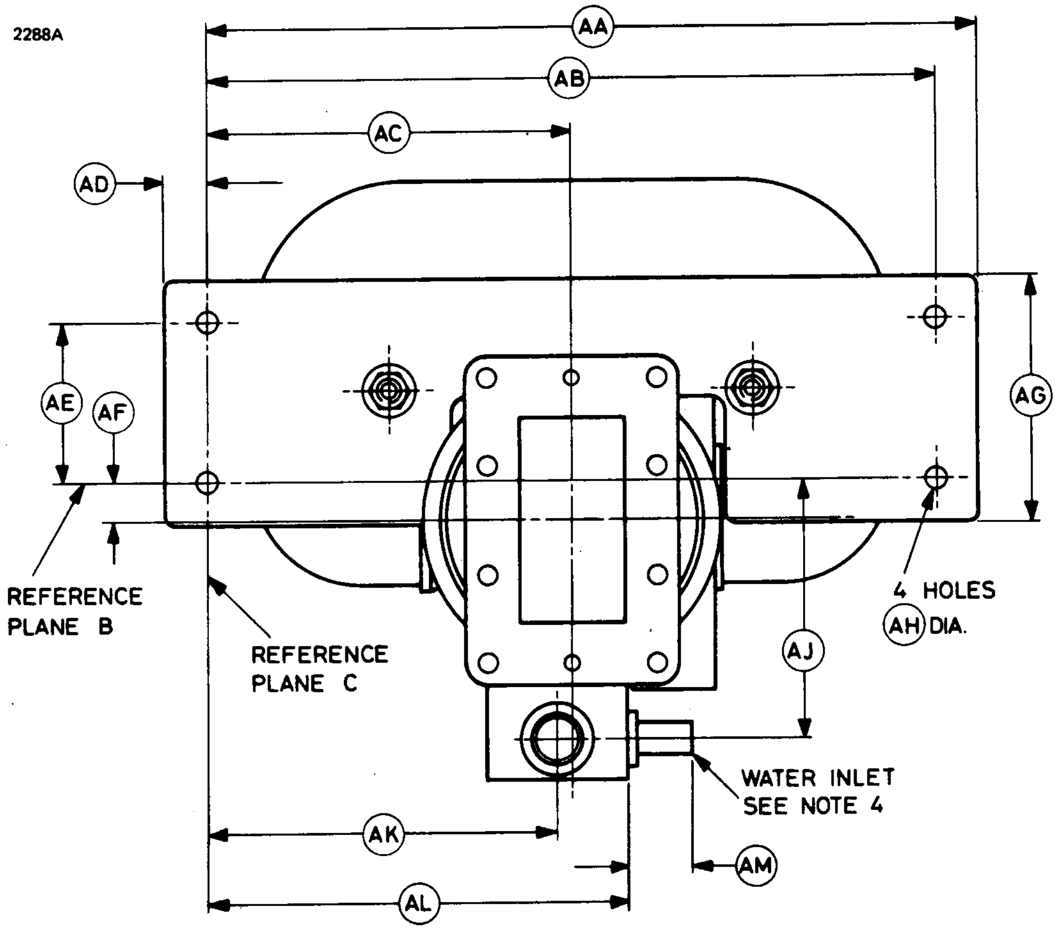
See page 9 for dimensions.

OUTLINE



See page 9 for dimensions.

OUTLINE



Outline Notes

1. Steam outlet, 0.750 inch (19.05mm) diameter x 2.000 ± 0.025 inch (50.80 ± 0.64mm) long.
2. Air inlet $^3/_8$ inch B.S.P. to $^3/_8$ inch Simplifix adaptor.
3. Heater-cathode connector J.S. Cat. No. 5935-99-932-5870.
4. Water inlet, 0.500 inch (12.7mm) diameter.
5. Reference plane C passes through the centres of two mounting plate holes as shown, and is perpendicular to plane A.
6. Reference plane B intersects plane C at the centre of the mounting plate hole as shown, and is perpendicular to planes A and C.

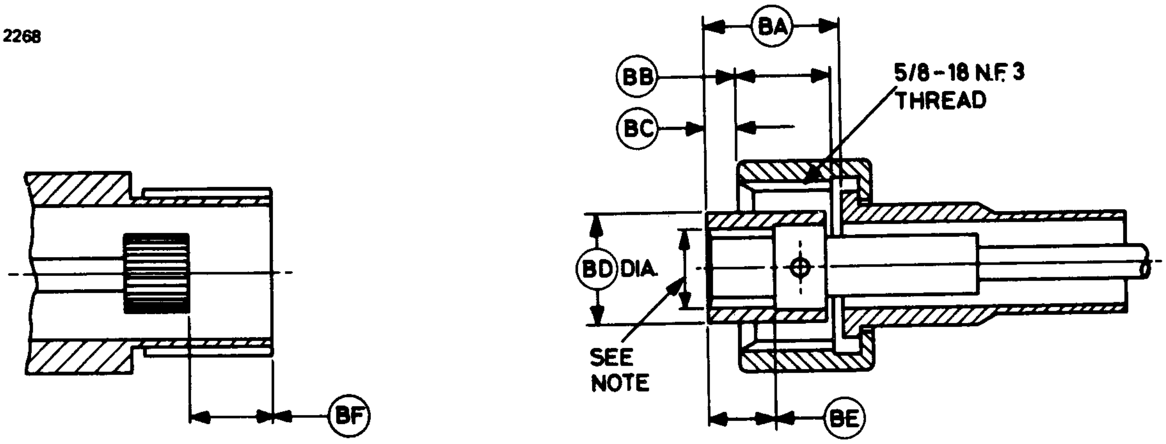
Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	7.355 ± 0.060	186.8 ± 1.5	U	3.048 ± 0.060	77.42 ± 1.52
B	10.250 max	260.4 max	V	4.311 ± 0.040	109.5 ± 1.0
C	4.265 ± 0.060	108.3 ± 1.5	W	6.870 ± 0.060	174.5 ± 1.5
D	3.550 max	90.17 max	X	2.280 max	57.91 max
E	0.750 ± 0.020	19.05 ± 0.51	Y	0.600 min	15.24 min
F	3.812 ± 0.080	96.82 ± 2.03	Z	9.500 max	241.3 max
G	2.312 ± 0.060	58.72 ± 1.52	AA	11.375 ± 0.020	288.9 ± 0.5
H	3.795 max	96.39 max	AB	10.750 ± 0.015	273.1 ± 0.4
J	1.805 ± 0.250	45.85 ± 6.35	AC	5.375 ± 0.060	136.5 ± 1.5
K	3.297 ± 0.060	83.74 ± 1.52	AD	0.625 ± 0.020	15.88 ± 0.51
L	3.610 ± 0.040	91.69 ± 1.02	AE	2.375 ± 0.010	60.33 ± 0.25
M	2.124 ± 0.060	53.95 ± 1.52	AF	0.562 ± 0.040	14.27 ± 1.02
N	4.500 max	114.3 max	AG	3.625 ± 0.030	92.08 ± 0.76
P	4.500 max	114.3 max	AH	0.344 ± 0.015	8.74 ± 0.38
Q	3.750 ± 0.060	95.25 ± 1.52	AJ	3.812 ± 0.100	96.82 ± 2.54
R	4.420 max	112.3 max	AK	5.188 ± 0.100	131.8 ± 2.5
S	0.218 ± 0.015	5.54 ± 0.38	AL	6.400 max	162.6 max
T	0.140 ± 0.060	3.56 ± 1.52	AM	1.000 ± 0.025	25.40 ± 0.64

Millimetre dimensions have been derived from inches.

DETAIL OF TUNER DRIVE AND 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
BF	0.250 min	6.35 min

Millimetre dimensions have been derived from inches.

Note Internal spline, 12 tooth 48 DP, 14½° pressure angle, involute form.

M5058

TUNABLE S-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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 45 lb/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

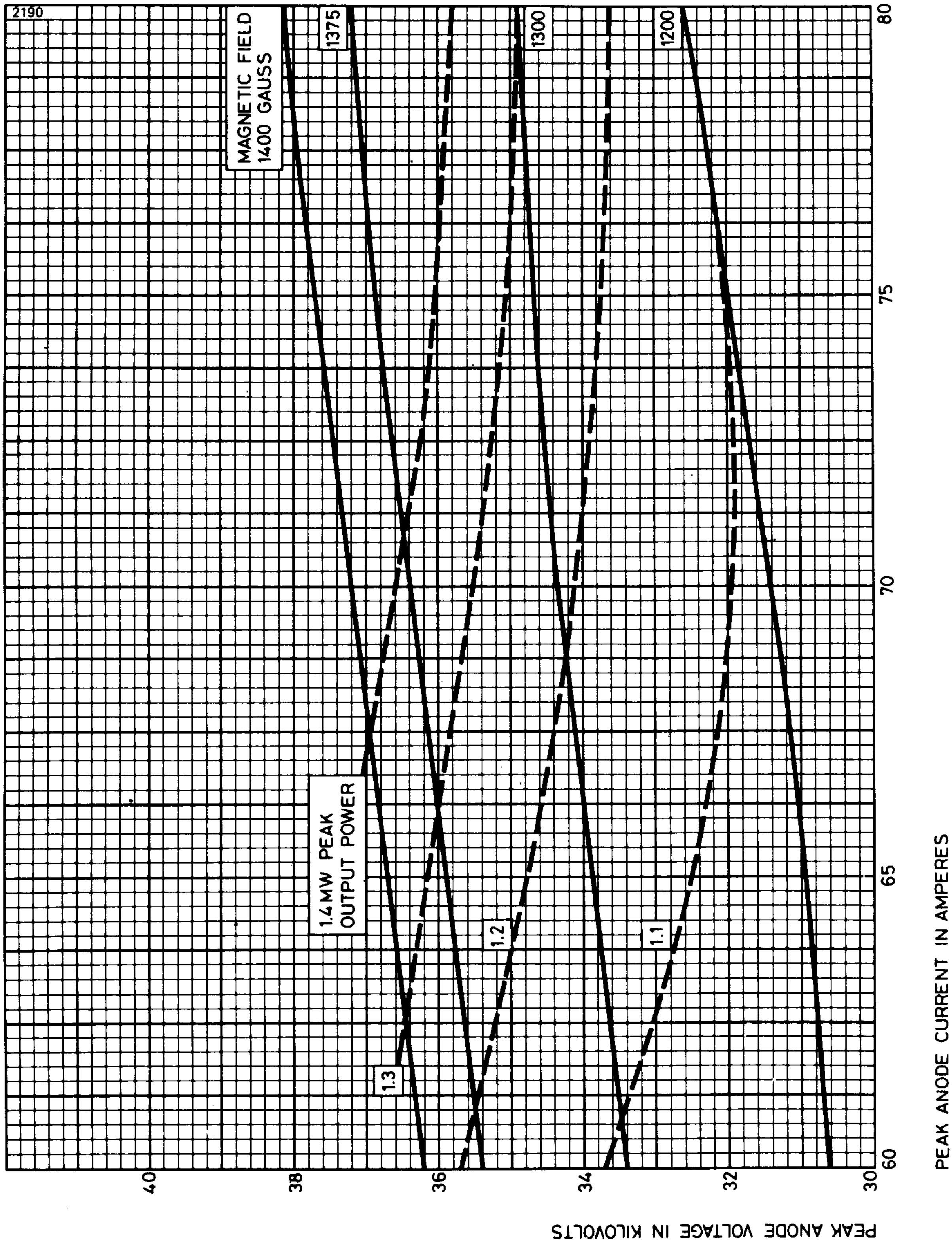
missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

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 $-0.25MHz/^{\circ}C$.

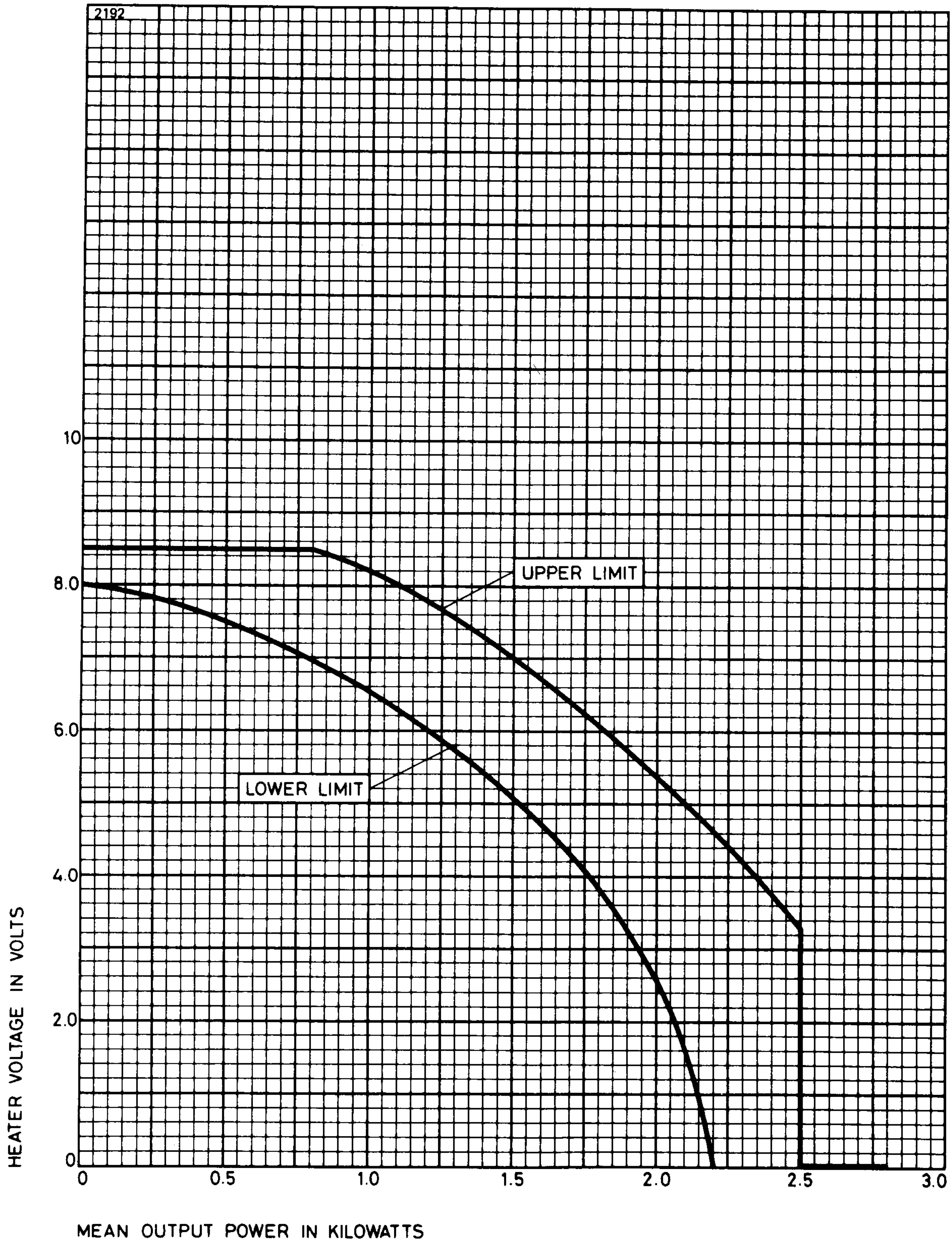
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART

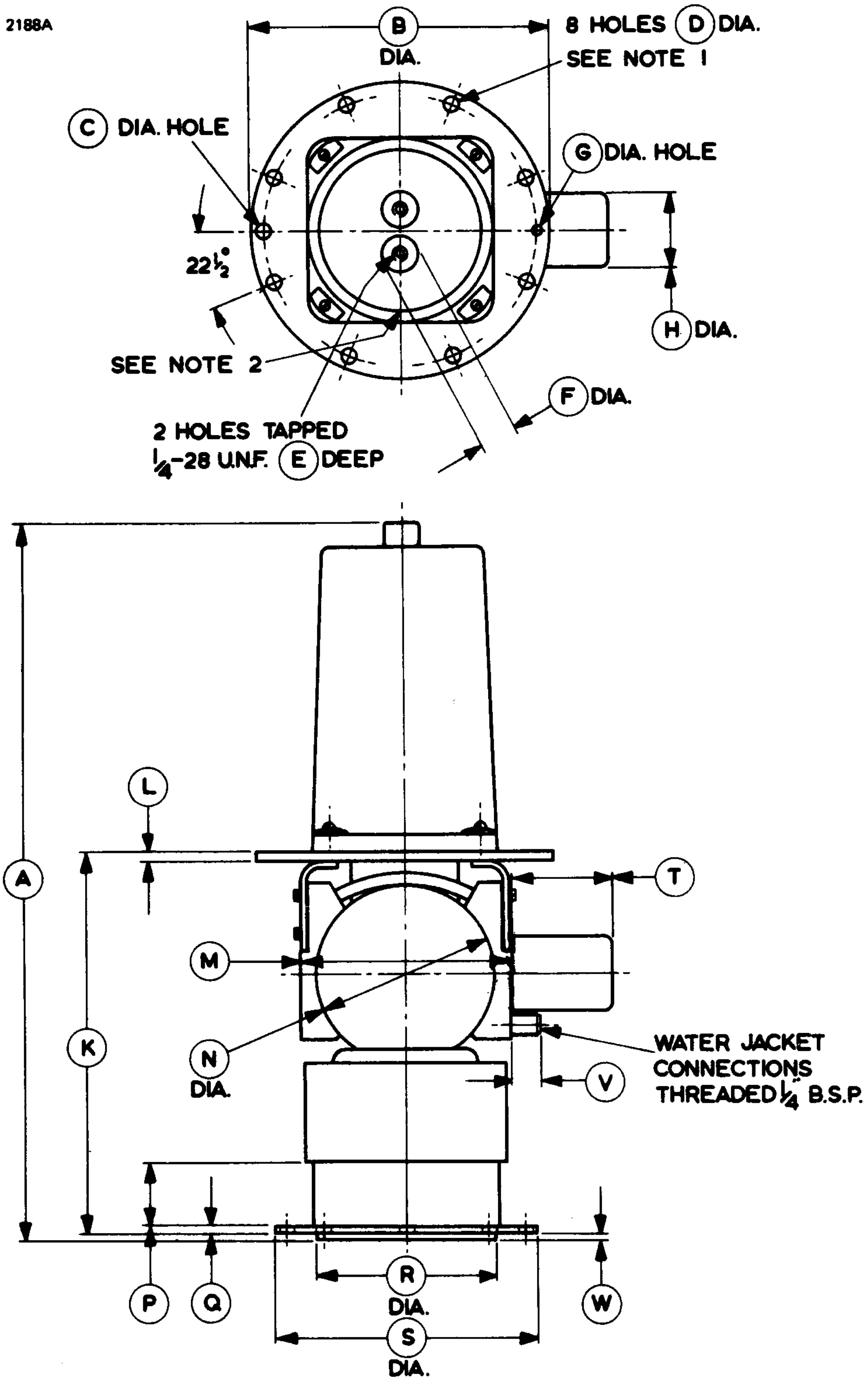


HEATER VOLTAGE ADJUSTMENT SCHEDULE



OUTLINE

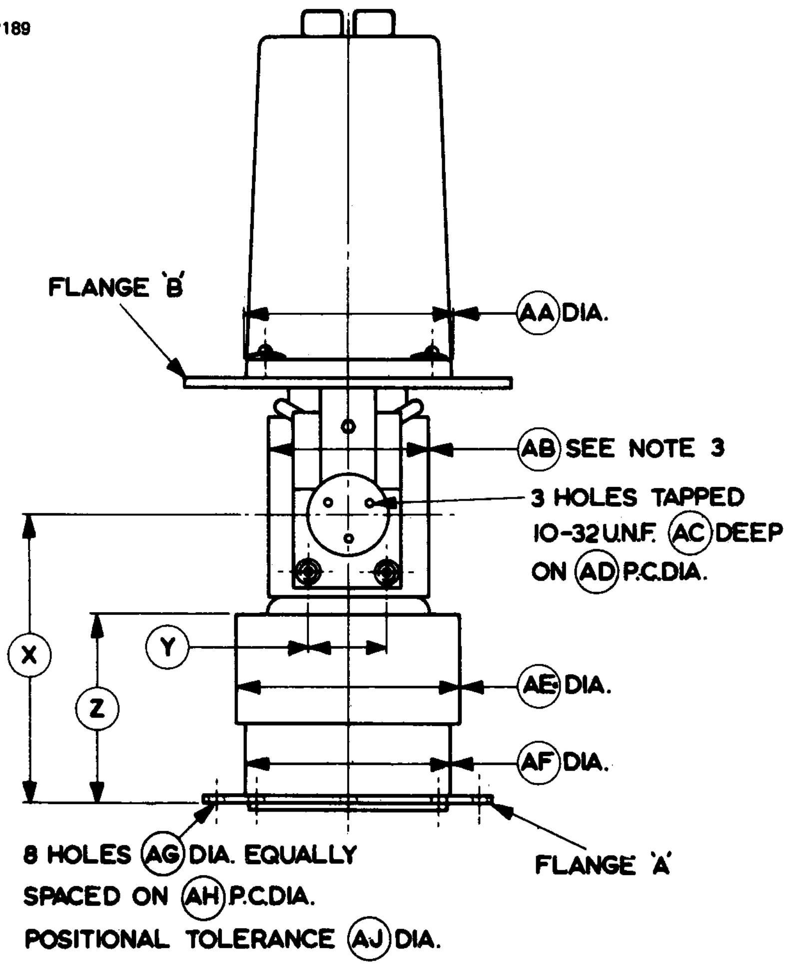
See page 10 for outline dimensions



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.

2189

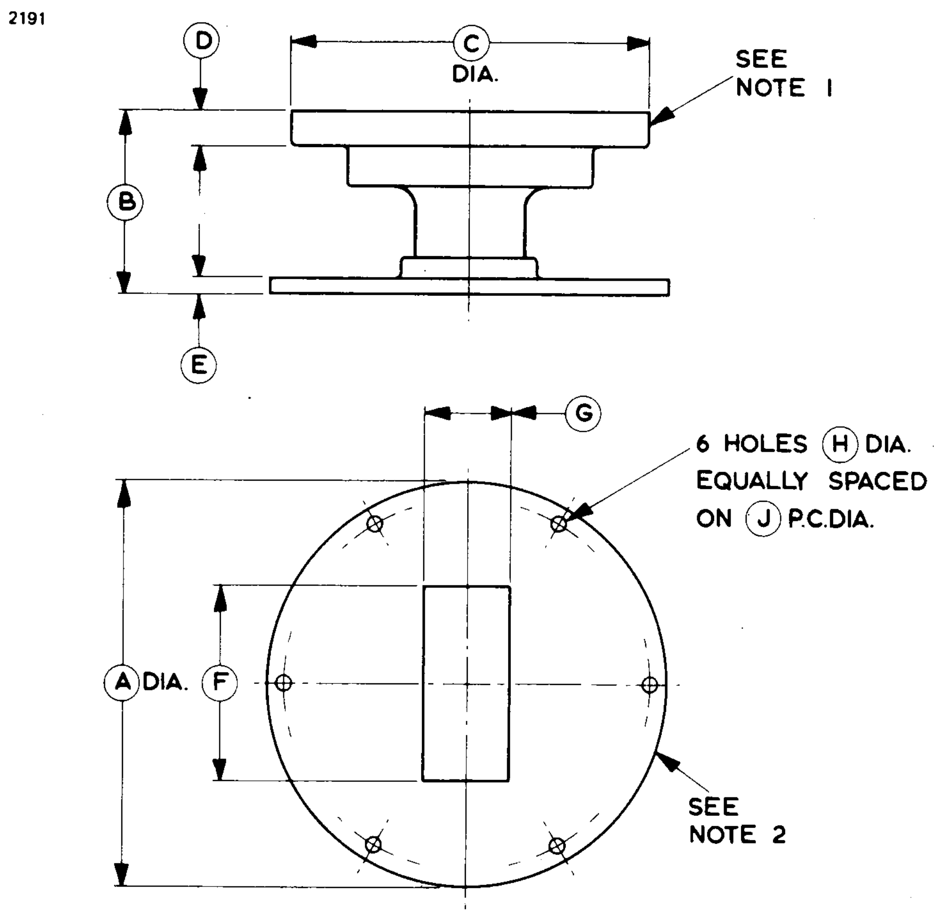


Outline Dimensions (All dimensions without limits are nominal)

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 (All dimensions nominal)



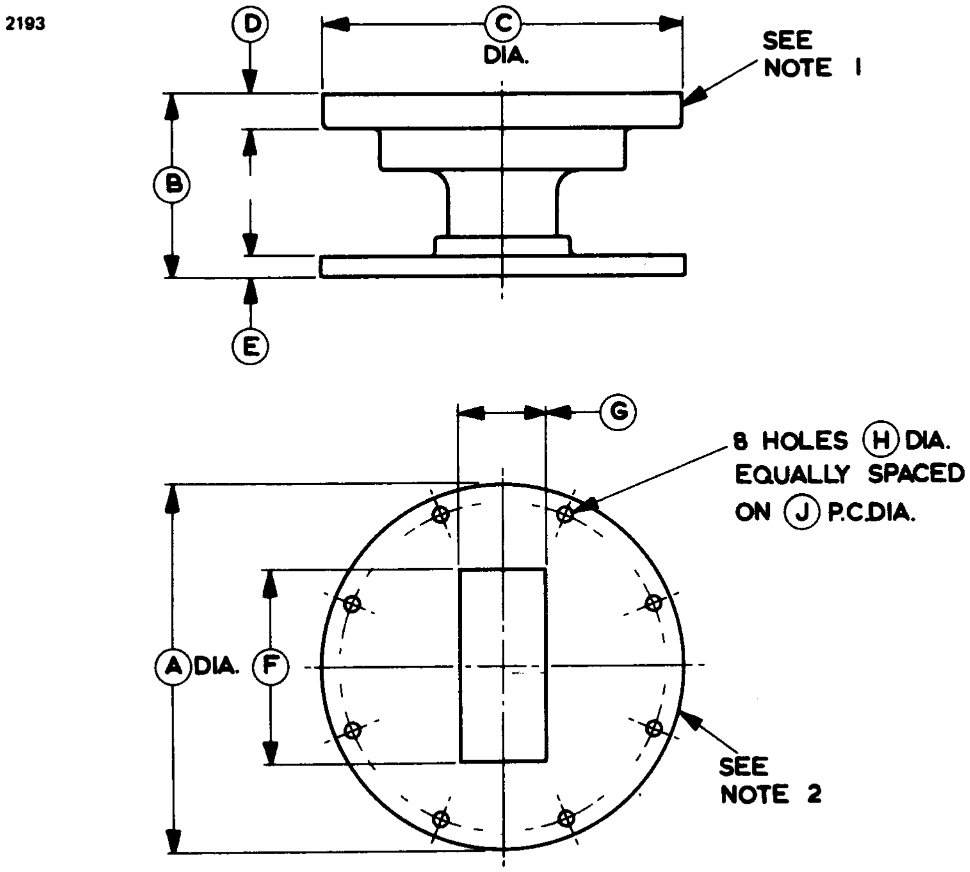
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875	149.2	F	2.840	72.14
B	2.643	67.13	G	1.340	34.04
C	5.250	133.4	H	0.257	6.53
D	0.500	12.70	J	5.375	136.5
E	0.250	6.35			

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 (All dimensions nominal)



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.

M5063/2J70B

S-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	3025 to 3075	MHz
Typical peak output power	50	kW
Magnet		integral
Output		probe radiating into wave-guide launching section
Launching section		not supplied (see page 5)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current	1.25	A
Heater starting current, peak value, not to be exceeded	6.0	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	7.172 x 5.500 x 3.625 inches max 182.2 x 139.7 x 92.08mm 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 (see note 2) . . . . 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	–	6.0	A
Anode voltage (peak)	8.5	9.5	kV
Anode current (peak)	10	16	A
Anode input power (mean)	–	140	W
Duty cycle	–	0.001	
Pulse length	–	1.0	μs
Rate of rise of voltage pulse (see note 4)	–	150	kV/μs
Anode temperature (see note 2)	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	5.0	5.0	V
Anode current (peak)	15	15	15	A
Pulse length	0.07	0.3	0.55	μs
Pulse repetition rate	4000	2000	1000	p.p.s.
Rate of rise of voltage pulse	150	150	150	kV/μs

Typical Performance

Anode voltage (peak)	9.0	9.0	9.0	kV
Output power (peak)	50	50	50	kW
Output power (mean)	14	30	27.5	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)	5.0	5.0	5.0	V
Anode current (mean)	4.2	9.0	8.25	mA
Duty cycle	0.00028	0.0006	0.00055	
Pulse length (see note 3)	0.07	0.3	0.55	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	1.15:1	
Rate of rise of voltage pulse	150	150	150	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	–	–	–	–	8.5	9.5	kV
Output power (peak)	–	–	–	–	50	–	kW
Frequency (see note 5)	–	–	–	–	3025	3075	MHz
R.F. bandwidth at ¼ power (see note 6)	–	30	–	7	–	4	MHz
Frequency pulling (v.s.w.r. 1.5:1)	–	13	–	13	–	13	MHz
Frequency pushing (see note 6)	–	1.5	–	1.5	–	1.5	MHz/A
Stability (see note 7)	–	0.5	–	0.5	–	0.5	%
Cold impedance						see note 8	
Heater current						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 Oscillation 3. 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

	Min	Max	
Output power (peak)	40	–	kW
Frequency	3025	3075	MHz
R.F. bandwidth at ¼ power (see note 6)	–	4.5	MHz
Stability (see note 7)	–	2.0	%

NOTES

1. With no anode input power.

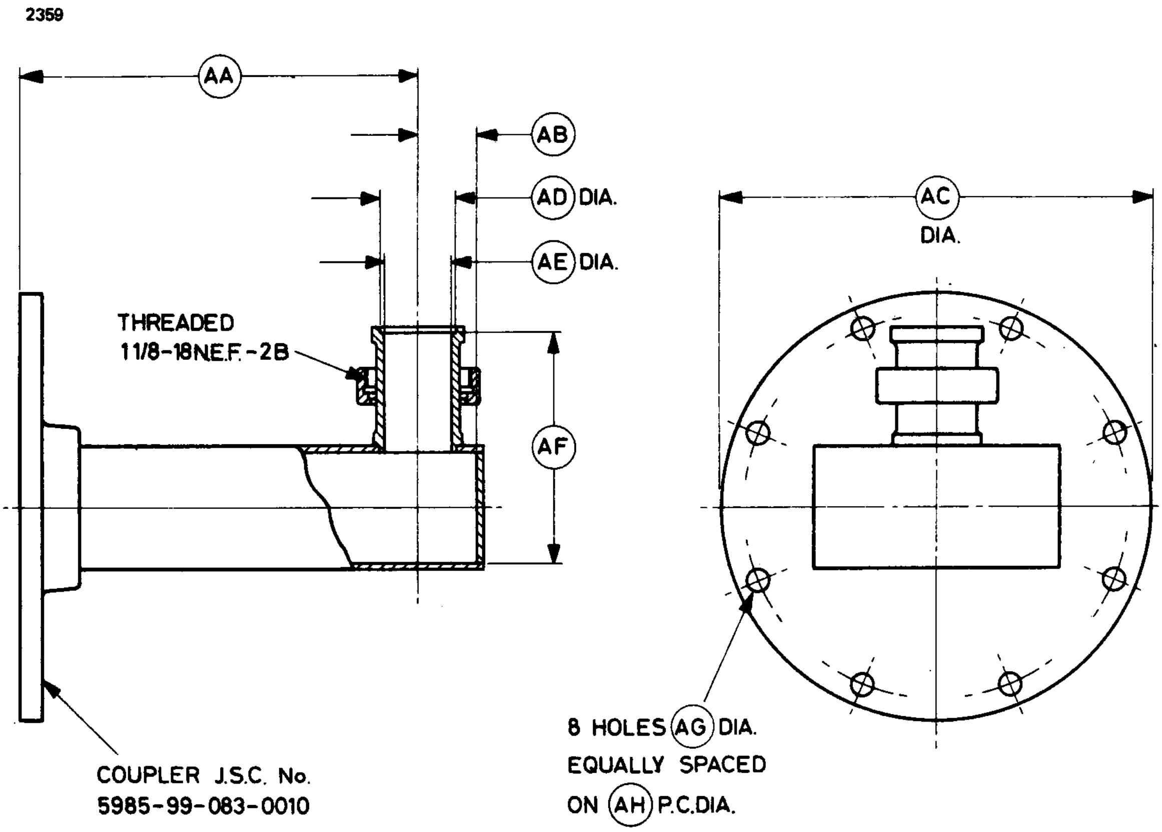
   On the application of anode power, the heater voltage must be reduced as follows:

Mean input power (W)	Heater voltage ($V_{r.m.s.}$)
less than 28	6.3
28 to 83	5.0
83 to 140	3.8

   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 anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode body and cooling fins.
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. Measured as the peak anode current is varied between 10 and 16A.
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 3025 to 3075MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minutes of a 15 minute test period.
8. 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 90 to 120mm from the output flange of the launching section away from the valve.
9. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 1.1A minimum, 1.4A maximum.

DETAILS OF LAUNCHING SECTION
(All dimensions without limits are nominal)

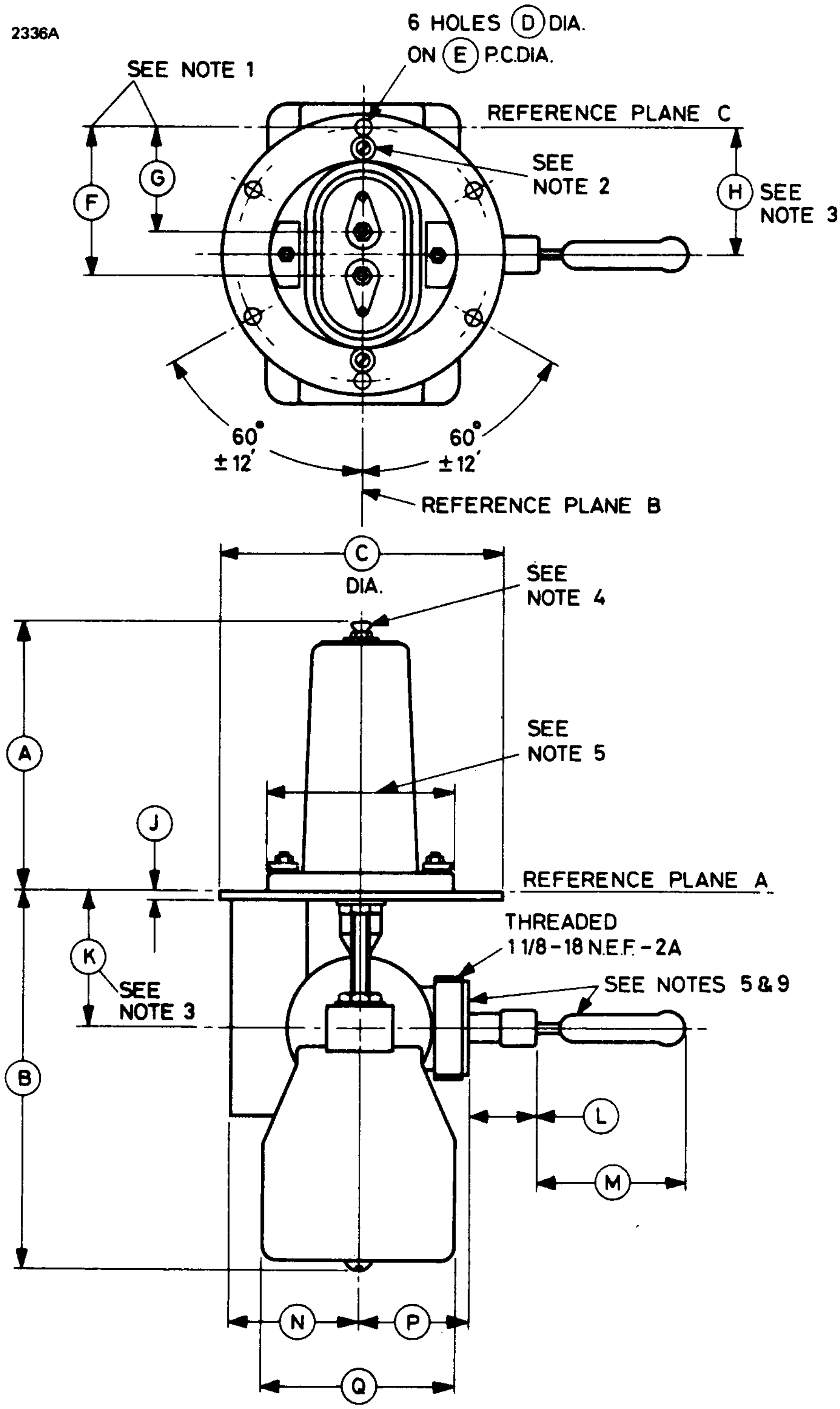


Ref	Inches	Millimetres
AA	4.905 ± 0.004	124.587 ± 0.102
AB	0.716 ± 0.002	18.186 ± 0.051
AC	5.313 ± 0.016	135.0 ± 0.4
AD	0.890 ± 0.002	22.606 ± 0.051
AE	0.811 ± 0.002	20.599 ± 0.051
AF	2.827 ± 0.005	71.81 ± 0.13
AG	0.260 ± 0.004	6.60 ± 0.10
AH	4.750	120.7

Millimetre dimensions have been derived from inches except dimension AG.

OUTLINE

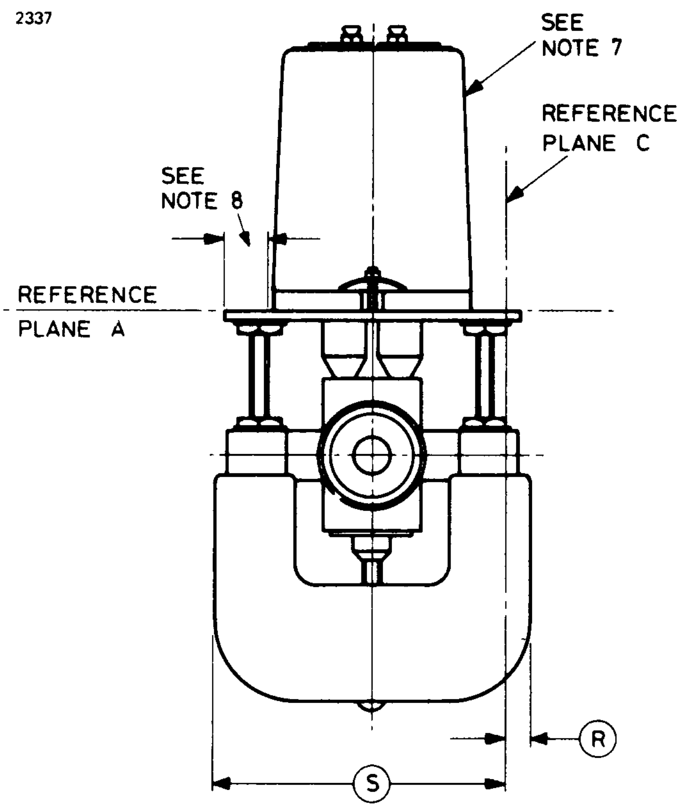
2336A



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.985 ± 0.062	75.82 ± 1.57	K	1.526 ± 0.031	38.76 ± 0.79
B	4.125 max	104.8 max	L	0.756 ± 0.062	19.20 ± 1.57
C	3.250 ± 0.031	82.55 ± 0.79	M	1.687	42.85
D	0.193 ± 0.003	4.902 ± 0.076	N	1.563 max	39.70 max
E	2.875 ± 0.006	73.03 ± 0.15	P	1.135 ± 0.045	28.83 ± 1.14
F	1.687	42.85	Q	2.125 max	53.98 max
G	1.187	30.15	R	0.375 max	9.53 max
H	1.438 ± 0.030	36.53 ± 0.76	S	3.125 max	79.38 max
J	0.125	3.18			

Millimetre dimensions have been derived from inches.



See page 8 for Outline Notes

Outline Notes

1. The centres of the jack holes will be within a radius of 0.023 inch (0.58mm) of the location specified, but spaced 0.500 ± 0.010 inch (12.70 ± 0.25mm) with respect to each other. The centre line of the holes will be perpendicular to reference plane A within 3°.
2. Periphery of countersunk hole or head of 8-32 screw may extend into holes on reference plane B.
3. Applies to the centre line of the output probe and threaded coupler.
4. Hexagon locking head banana pin jack, hole 0.169 ± 0.005 inch (4.29 ± 0.13mm) diameter x 0.593 inch (15.06mm) deep.
5. Any portion of the assembly extending above reference plane A shall be within a 1.109 inch (28.17mm) radius of the true centre of the mounting plate.
6. All metal surfaces below reference plane A except the output probe and the threaded portion will be painted with black, heat resisting non-corrosive paint.
7. The common cathode connection is marked with letter C.
8. This area will be flat to within 0.010 inch (0.25mm) for 0.500 inch (12.70mm) from the outer edge.
9. Axis of threaded coupler will be concentric with axis of output probe to within 0.020 inch (0.51mm).

Pulse Magnetrons, C-Band

M5032 M5033

C-BAND MAGNETRONS

The data should be read in conjunction with the Magnetron Preamble.

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)	
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	12	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	–	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 45 lb/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.

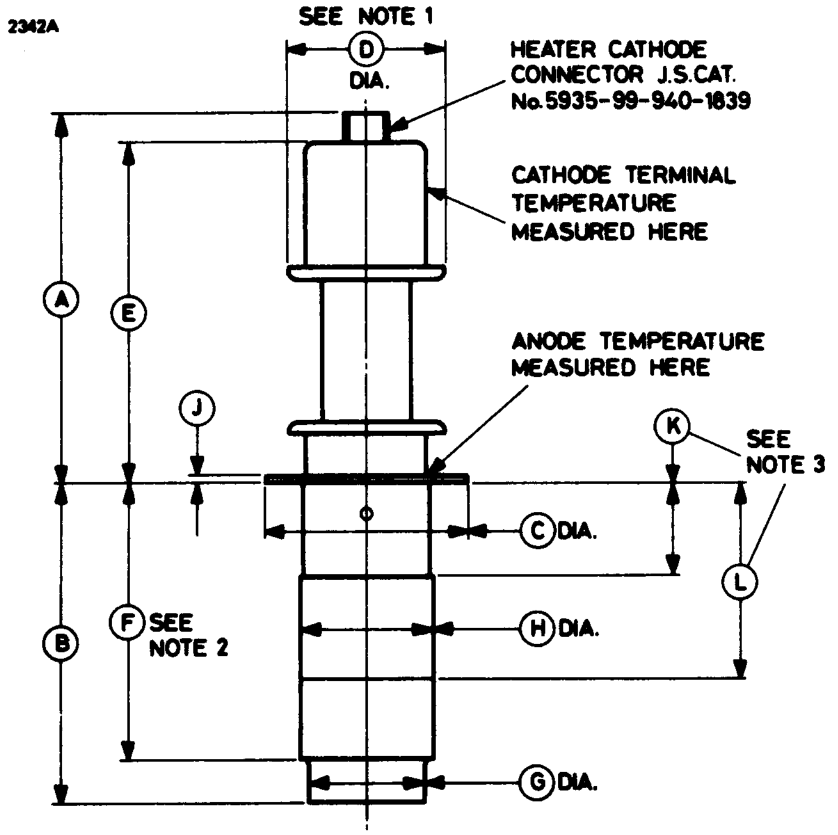
   1 cubic foot = 28.3 litres

   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 11A minimum, 13A 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



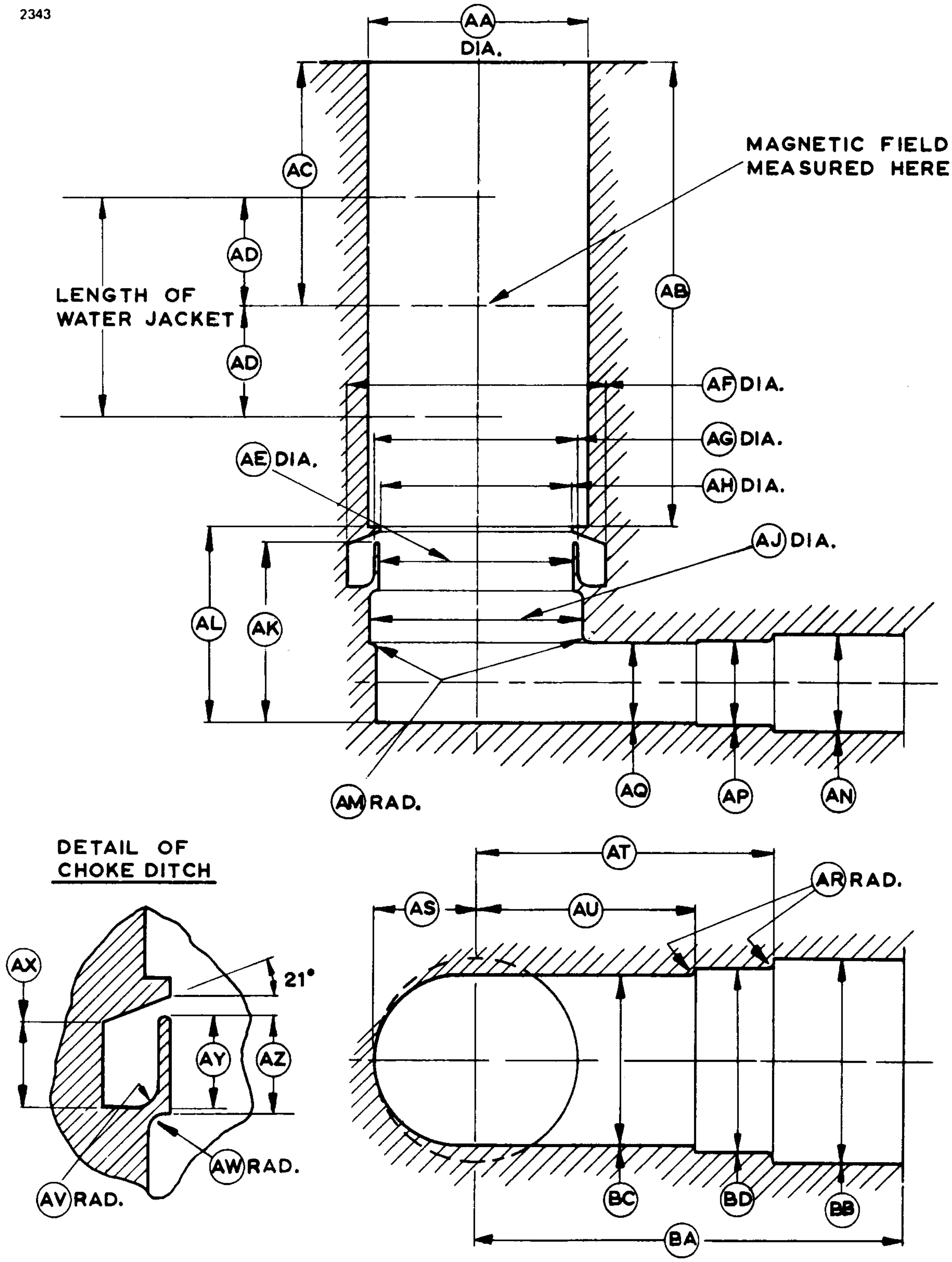
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.800 max	147.3 max	G	1.721 ± 0.010	43.71 ± 0.25
B	4.725 ± 0.032	120.02 ± 0.81	H	2.000 ± 0.001	50.800 ± 0.025
C	2.995 ± 0.005	76.07 ± 0.13	J	0.125 ± 0.005	3.18 ± 0.13
D	2.500 max	63.50 max	K	1.441 max	36.60 max
E	5.225 max	132.7 max	L	2.936 min	74.57 min
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



See page 8 for dimensions

Dimensions for Electro-magnet and Launching Section
(All dimensions without limits are nominal)

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.

Pulse Magnetrons, X-Band

2J42

X-BAND MAGNETRON

Service Type CV3676

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	8.3	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
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	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.313 inches max 133.4 x 113.5 x 84.15mm 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)	5.0	6.0	kV
Anode current (peak)	3.5	5.5	A
Input power (peak)	17.5	33	kW
Input power (mean) (see note 3)	–	82.5	W
Duty cycle	–	0.0025	
Pulse length	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	–	75	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

Heater voltage	4.5	6.3	V
Anode current (peak)	4.5	4.5	A
Pulse length	1.0	2.0	μs
Pulse repetition rate	2000	500	p.p.s.
Rate of rise of voltage pulse	60	60	kV/μs

Typical Performance

Anode voltage (peak)	5.5	5.5	kV
Output power (peak)	8.3	8.3	kW
Output power (mean)	16.6	8.3	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 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.1:1	1.1:1	
Rate of rise of voltage pulse (see note 5)	75	75	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	5.3	5.7	–	–	kV
Output power (mean)	14	–	–	–	W
Frequency (see note 8)	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	1.25	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 Oscillation 2 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 Oscillations 1 and 2)

Output power (mean)	11	W min
R.F. bandwidth at ¼ power	3.0	MHz max
Frequency	9345 to 9405	MHz
Stability (see note 9)	1.0	% 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:

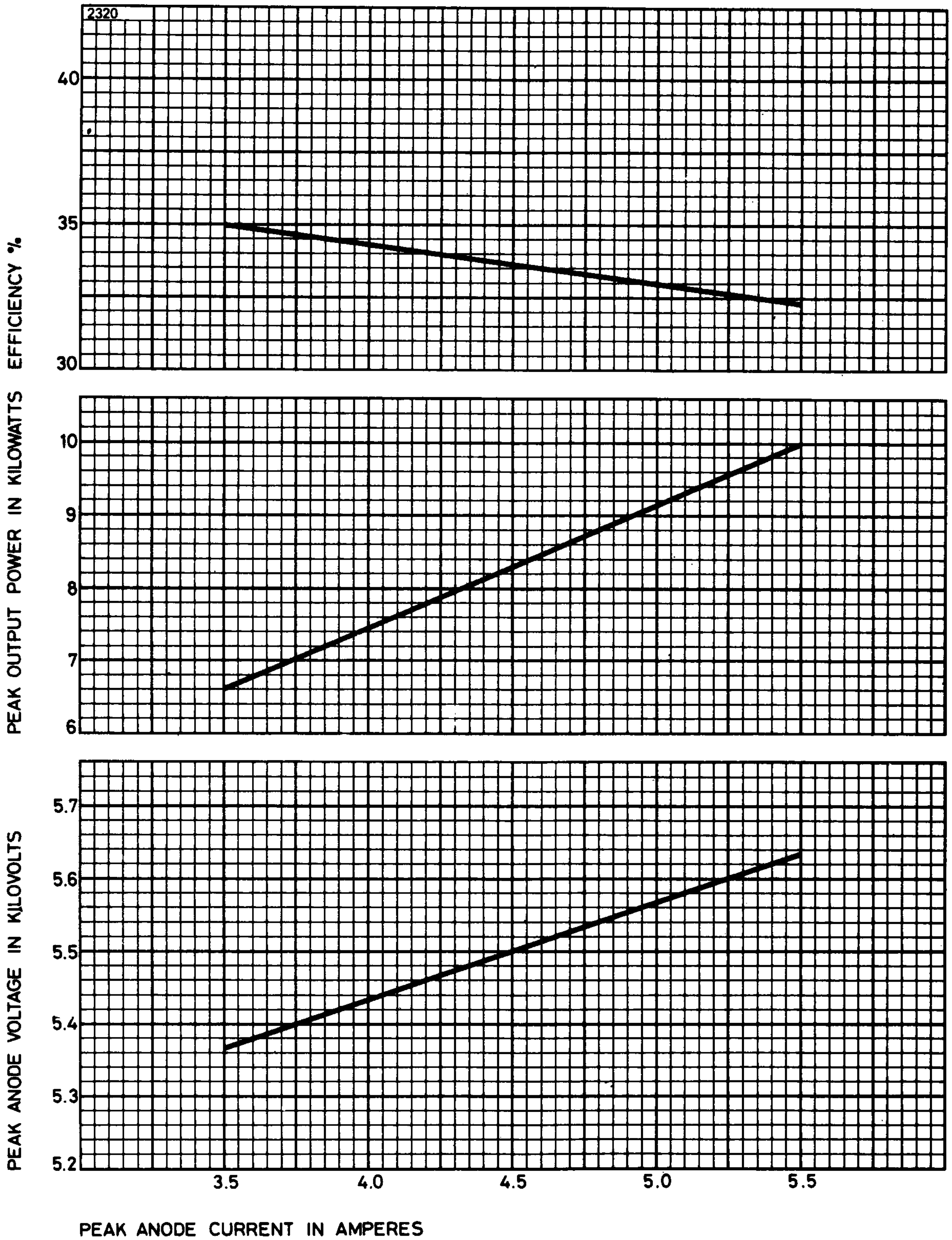
   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{ volts}$$

   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:

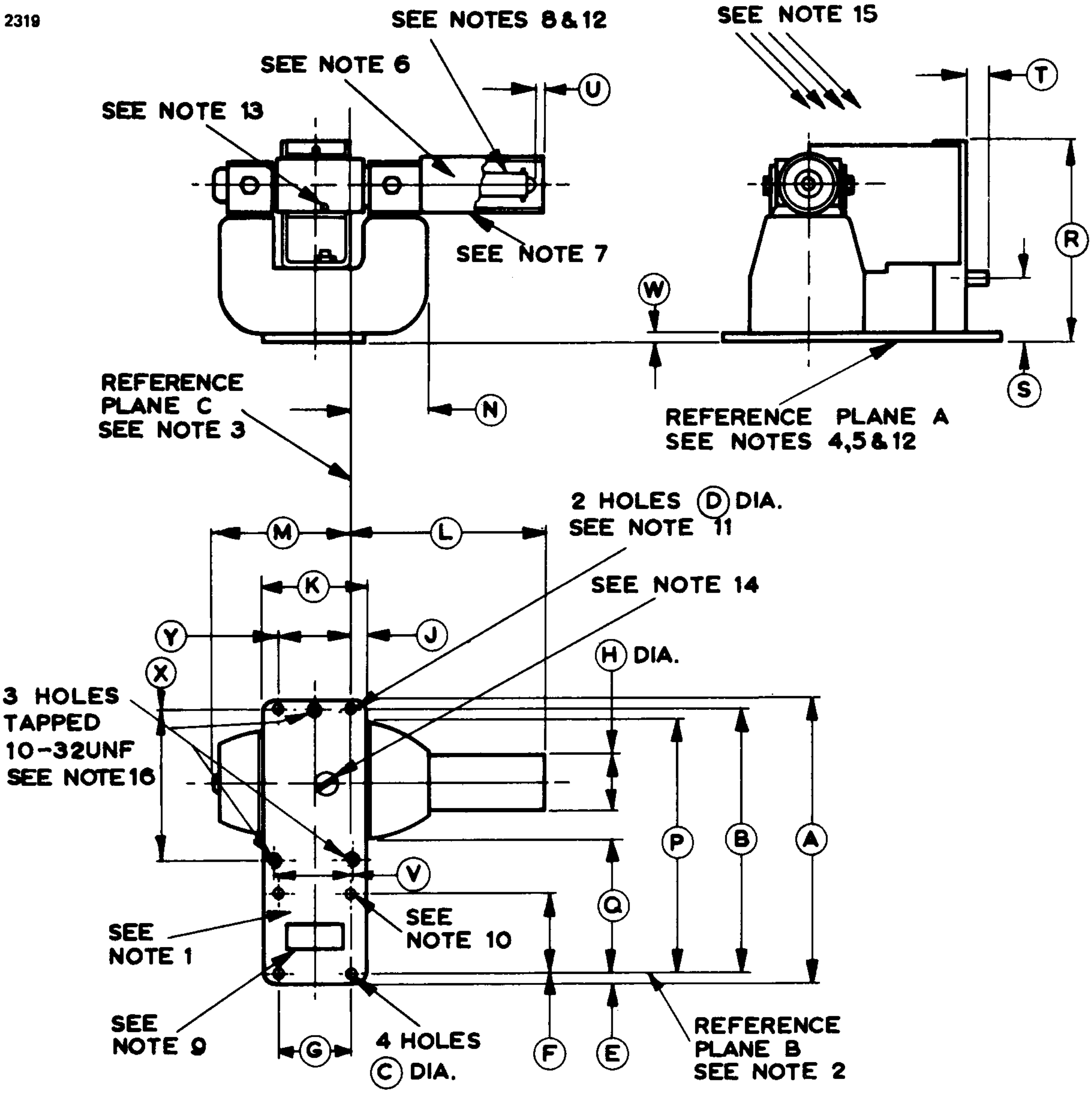
   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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. At the maximum pressure of 45 lb/in^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 1.1:1. 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 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 8:1 with a minimum 13.5 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.

TYPICAL PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End contact	Heater
Shell	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	N	1.188 max	30.18 max
B	4.103	104.2	P	4.000 max	101.6 max
C	0.170 ± 0.003	4.318 ± 0.076	Q	1.938 min	49.23 min
D	0.175 ± 0.003	4.445 ± 0.076	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	0.125 max	3.18 max
H	1.000 max	25.40 max	V	1.250	31.75
J	0.203 ± 0.015	5.16 ± 0.38	W	0.125	3.18
K	1.625 ± 0.015	41.28 ± 0.38	X	2.393	60.78
L	2.937 ± 0.125	74.60 ± 3.18	Y	1.220	30.99
M	2.188 max	55.58 max			

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurising waveguide output for use with coupler UG-40B/U (5985-99-083-0051).
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 $10mg/in^2$ of gold or $30mg/in^2$ silver but will not be plated if the parts are made out of monel or equivalent corrosion resistant materials.
6. The axis of the filament lead protector will be within 5° of a normal to reference plane C.
7. The heater lead protector should 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 lamp base will not be less than 0.157 inch (3.99mm).
9. The position of the waveguide hole is not specified on this drawing since tubes are tested and used into coupler UG-40B/U (see note 1).
10. The centre of this hole will be within 0.004 inch (0.102mm) of reference plane C.
11. Holes will lie within 0.005 inch (0.127mm) of indicated centres; a cylinder 0.330 inch (8.38mm) diameter, centred in holes shown, will clear the side of the magnet.
12. All metal surfaces except surface A and the bayonet base will be painted black.
13. Anode temperature measured at this point.
14. Tip of screw is soft-soldered.
15. Recommended direction of cooling air flow.
16. Holes will lie within 0.015 inch (0.38mm) of indicated centres.

2J42H

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron for airborne radar, complying with specification MIL-E-1/1002D.

Frequency range	9345 to 9405	MHz
Typical peak output power	8.3	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
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	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.313 inches max 133.4 x 113.5 x 84.15mm 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)	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	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	–	85	kV/μs
Anode temperature (see note 6)	–	120	°C
Pressurising of waveguide system and input terminals (see note 7)	0.97	45	lb/in²
	0.07	3.16	kg/cm²
Altitude:			
output system (see note 8)	–	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	μs
Pulse repetition rate	800	p.p.s.
Rate of rise of voltage pulse	60	kV/μs

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)	5.4	V
Anode current (mean)	4.5	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)	85	kV/μs min

Limits

	Min	Max	
Anode voltage (peak)	5.0	5.55	kV
Output power (mean)	7.0	11	W
Frequency (see note 9)	9345	9405	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	20	MHz
Stability (see note 10)	–	0.25	%
R.F. bandwidth at ¼ power (see note 11)	–	2.0	MHz
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 test conditions specified 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)

Output power (mean)	5.5	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	0.5	% max

NOTES

1. With no anode input power.

   The heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $V_h = 6.3\ (1 - 0.03 I_a)$ volts

   where I_a = mean anode current in milliamperes.

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. 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. The gas used for pressurisation must have properties at least equal to those of clean, dry air at the pressure indicated.

8. 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-40B/U (5985-99-083-0051).

9. Other frequency ranges can be supplied on request.

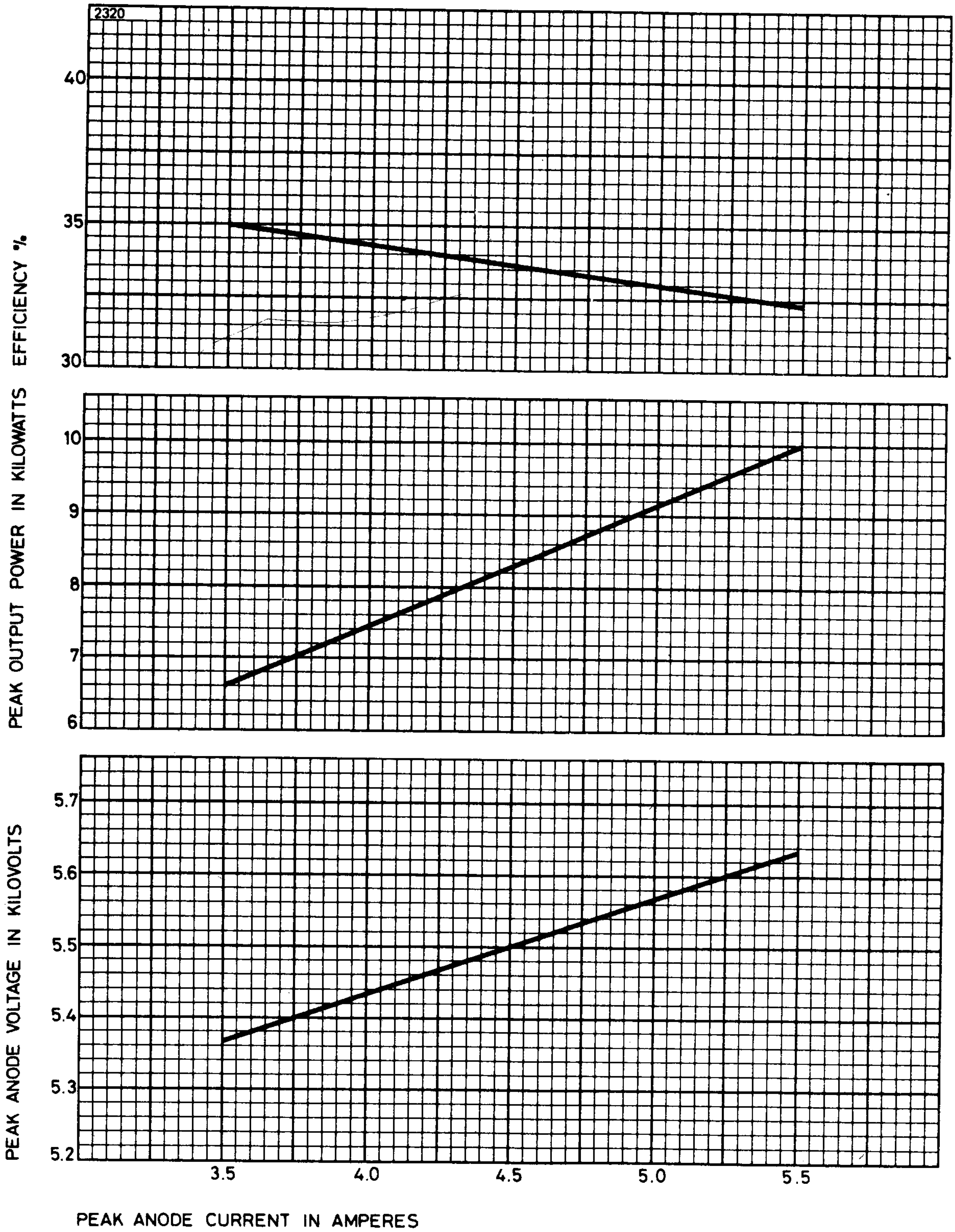
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 3 minutes of a test period not exceeding 6 minutes. This test must start within 1 minute of the application of h.t.

11. 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.

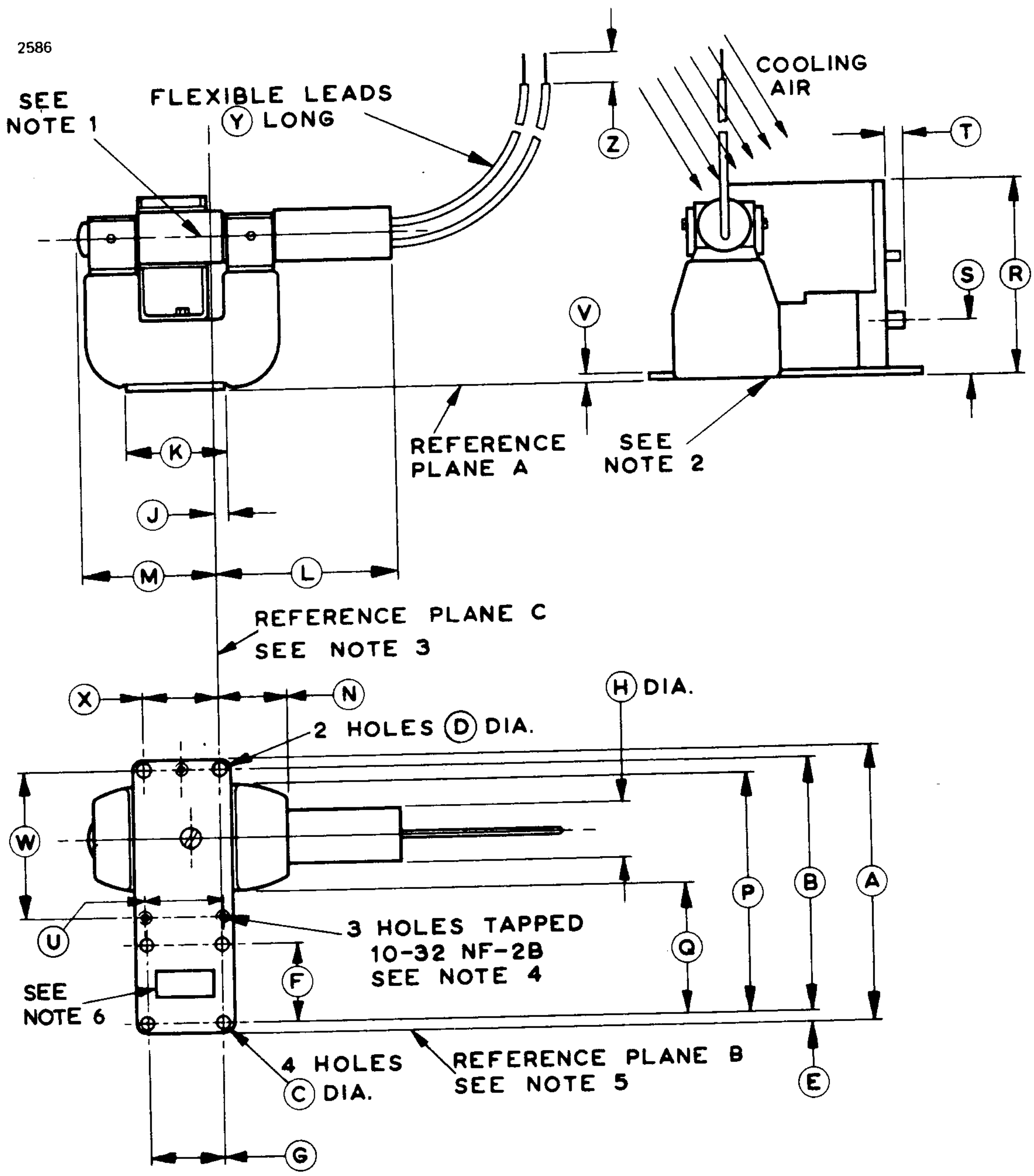
12. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

13. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 ± 0.015	113.11 ± 0.38	N	1.188 max	30.18 max
B	4.103	104.22	P	4.000 max	101.6 max
C	0.170 ± 0.003	4.318 ± 0.076	Q	1.938 min	49.23 min
D	0.175 ± 0.003	4.445 ± 0.076	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 ± 0.015	5.16 ± 0.38	W	2.393	60.78
K	1.625 ± 0.015	41.28 ± 0.38	X	1.220	30.988
L	2.937 ± 0.125	74.60 ± 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-40B/U (5985-99-083-0051).
7. Surface A and interior surfaces of the waveguide will be plated with 10mg/in^2 of gold or 30mg/in^2 silver but will not be plated if the parts are made out of monel or equivalent corrosion resistant materials.

2J55

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	50	kW
Magnet		integral
Output		no. 15 waveguide (1.122 x 0.497 inches internal)
Coupler		mates with UG-52B/U
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

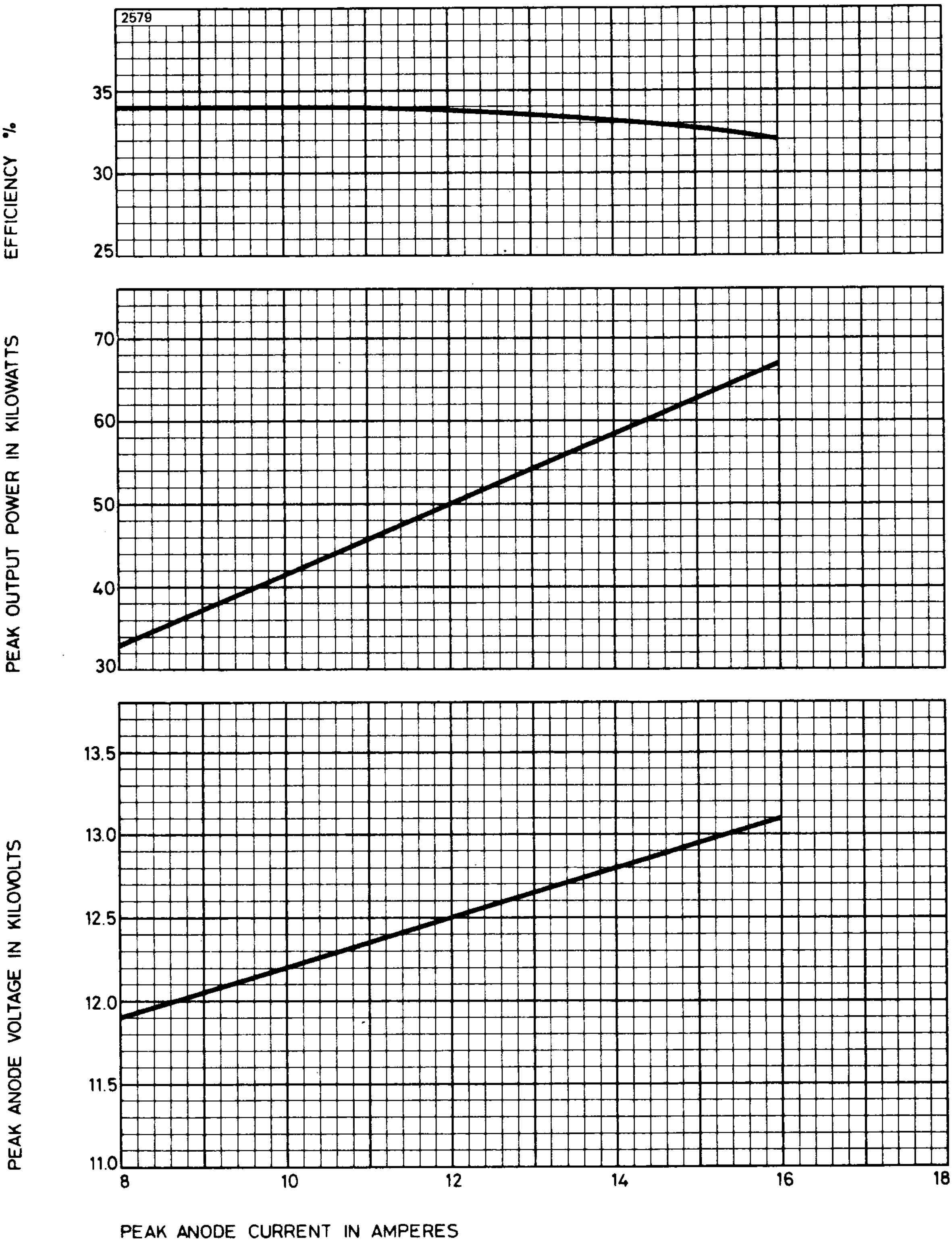
Mechanical

Overall dimensions	6.171 x 5.375 x 5.600 inches max 156.7 x 136.5 x 142.2mm max
Net weight	4 pounds (1.9kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 3) . . . . forced-air

TYPICAL 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 (peak)	–	230	kW
Input power (mean) (see note 4)	–	180	W
Duty cycle (see note 5)	–	0.001	
Pulse length	–	2.5	μs
Rate of rise of voltage pulse (see note 6):			
pulse length 0.5μs	–	150	kV/μs
pulse length 2.0μs	–	100	kV/μs
Anode temperature (see note 3)	–	150	°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/in^2
	–	3.2	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Anode current (peak)	12	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.
Rate of rise of voltage pulse	100	kV/μs

Typical Performance

Anode voltage (peak)	12.5	kV
Output power (peak)	50	kW
Output power (mean)	50	W

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)	μs
V.S.W.R. at the output coupler (maximum)	1.15:1	1.15:1	
Time of rise of voltage pulse (maximum)	0.2	0.2	μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	11	13	–	–	kV
Output power (mean)	40	–	–	–	W
Frequency (see note 9)	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power (see note 10)	–	3.0	–	1.25	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability:					
see note 11	–	–	–	0.5	%
see note 12	–	0.5	–	0.5	%
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 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)	30	W min
R.F. bandwidth at ¼ power	3.0	MHz max
Frequency	9345 to 9405	MHz
Stability (see note 12)	1.0	% max

NOTES

1. With no anode input power.

   For average values of pulse input power less than 150 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\sqrt{1 - \frac{Pi}{150}} \text{ volts}$$

   where Pi = mean input power in watts.

   For input powers greater than 150 watts the heater voltage shall be reduced to zero.

   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 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 65ft^3/min (1.84m^3/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:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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.

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 45 lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. Specification MIL-E-1/297B.

9. Other frequency ranges can be supplied on request.

10. The bandwidth shall remain within the specified limits as the peak anode current is varied between 11 and 13A.

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. As in note 11 but with v.s.w.r. of 1.5:1, phased to give maximum instability.

13. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.9A minimum, 1.1A maximum.

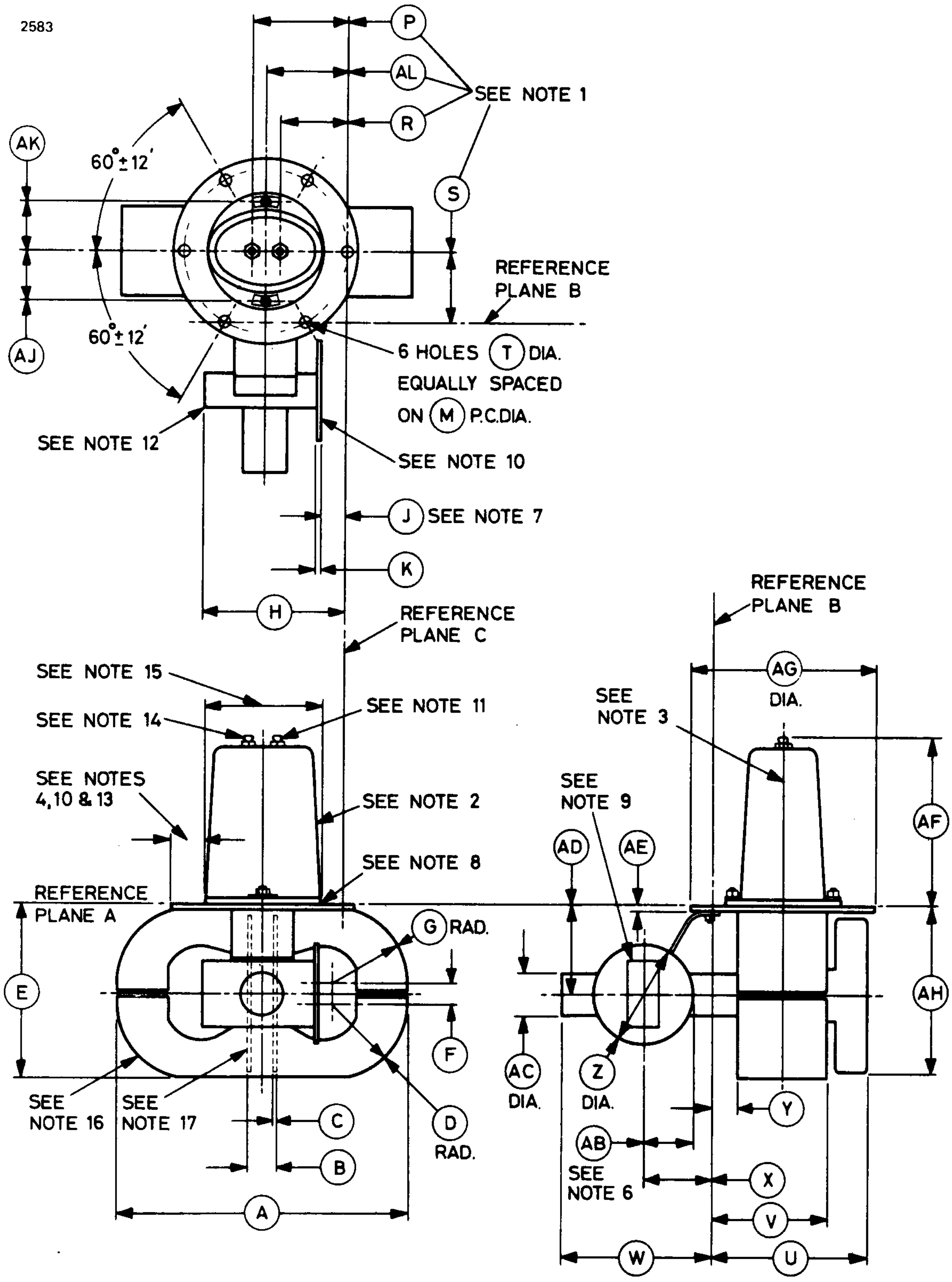
14. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.375 max	136.5 max
B	0.500 max	12.70 max
C	0.062	1.57
D	1.344	34.14
E	3.125 max	79.38 max
F	0.374	9.50
G	1.344	34.14
H	2.500 max	63.50 max
J	0.437 ± 0.020	11.10 ± 0.51
K	0.085 ± 0.005	2.16 ± 0.13
M	2.875 ± 0.006	73.03 ± 0.15
P	1.687	42.85
R	1.187	30.15
S	1.245	31.62
T	0.193 ± 0.003	4.902 ± 0.076
U	2.745 max	69.72 max
V	2.057	52.25
W	2.661 max	67.59 max
X	1.192 ± 0.020	30.28 ± 0.51
Y	0.432 min	10,97 min
Z	1.750 ± 0.007	44.45 ± 0.18
AB	0.875 ± 0.016	22.23 ± 0.41
AC	0.750	19.05
AD	1.562 ± 0.020	39.67 ± 0.51
AE	0.125 ± 0.005	3.18 ± 0.13
AF	2.984 ± 0.062	75.79 ± 1.57
AG	3.250 ± 0.031	82.55 ± 0.79
AH	2.969 max	75.41 max
AJ	0.906 ± 0.031	23.01 ± 0.79
AK	0.906 ± 0.031	23.01 ± 0.79
AL	1.437 ± 0.031	36.50 ± 0.79

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 $\pm$ 0.010 inch (12.70 $\pm$ 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 waveguide, 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 x 0.625 inch (31.75 x 15.88mm) external dimensions x 0.064 inch (1.63mm) wall commercial rectangular waveguide.
10. This surface will be free from paint.
11. Hexagon locking head banana pin jacks, hole 0.169 $\pm$ 0.005 inch (4.29 $\pm$ 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.

4J50A

X-BAND MAGNETRON

Service Type CV2284

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron; frequency variants are available

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	–	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	9345 to 9405	MHz
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:

Puise 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

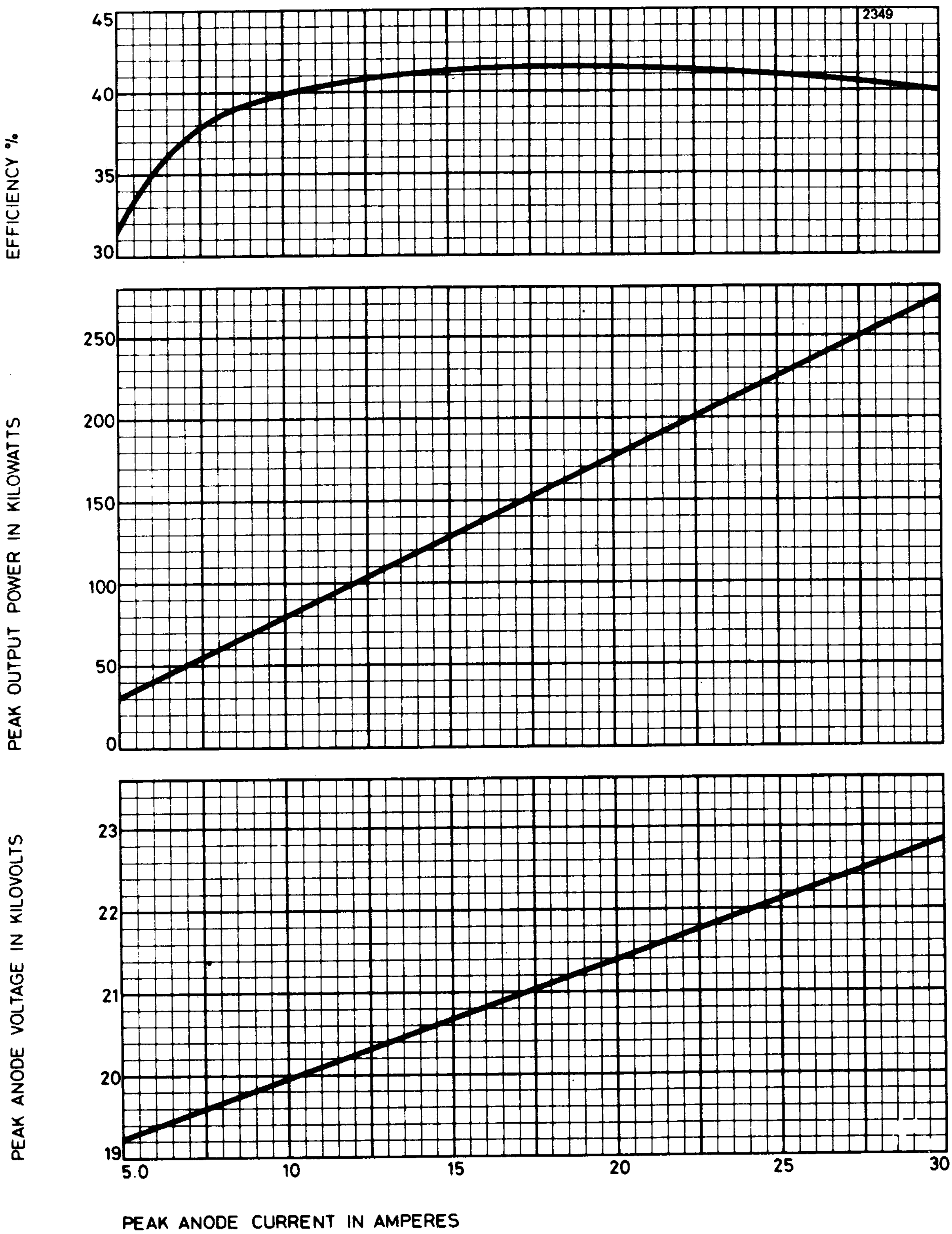
(108 x 31.8mm) will keep the temperature rise below 50°C.

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 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.

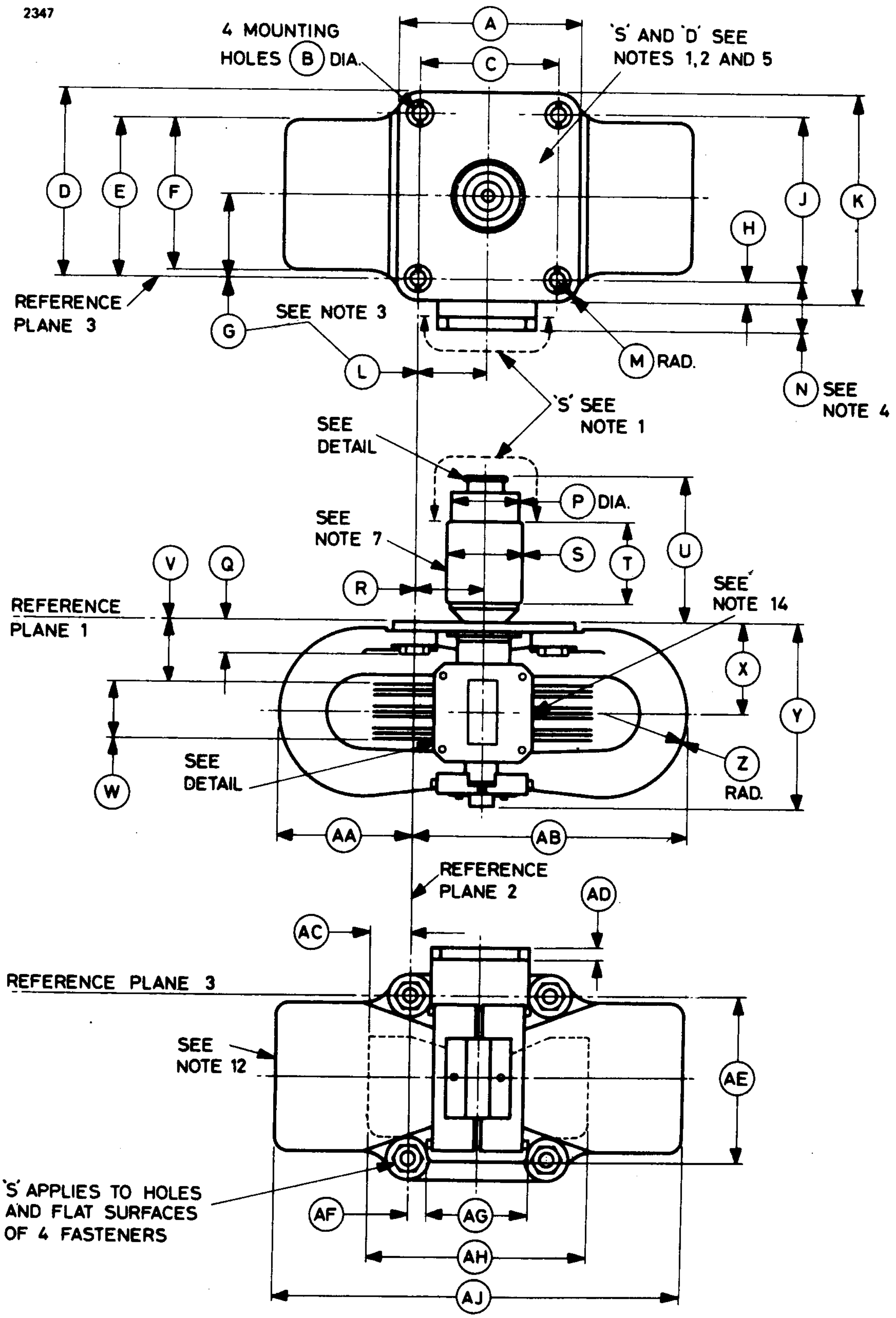
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART

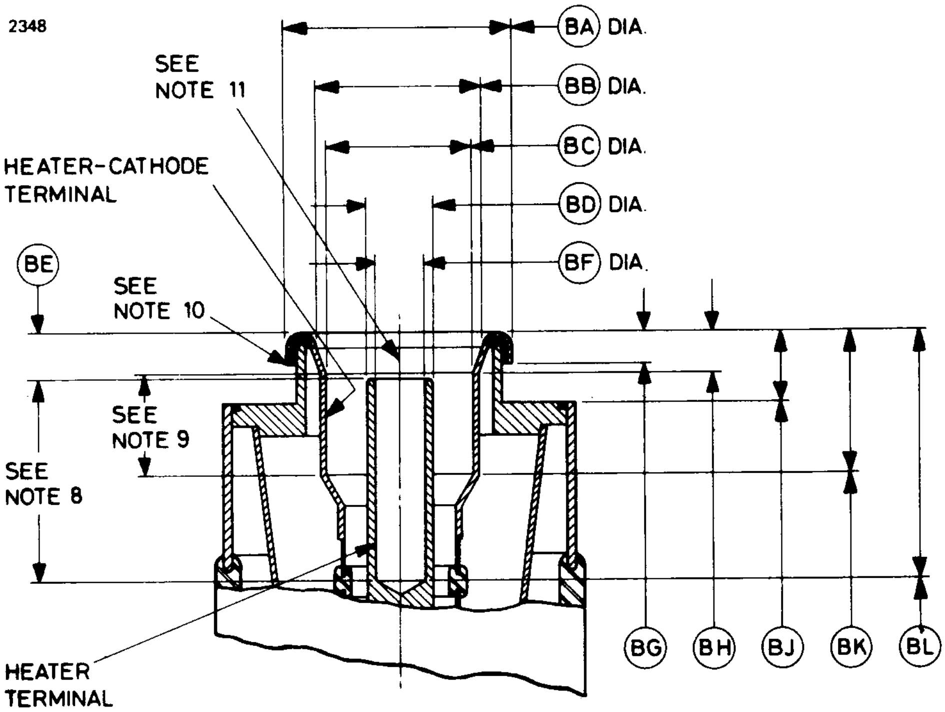


OUTLINE (See page 10 for Outline Notes)

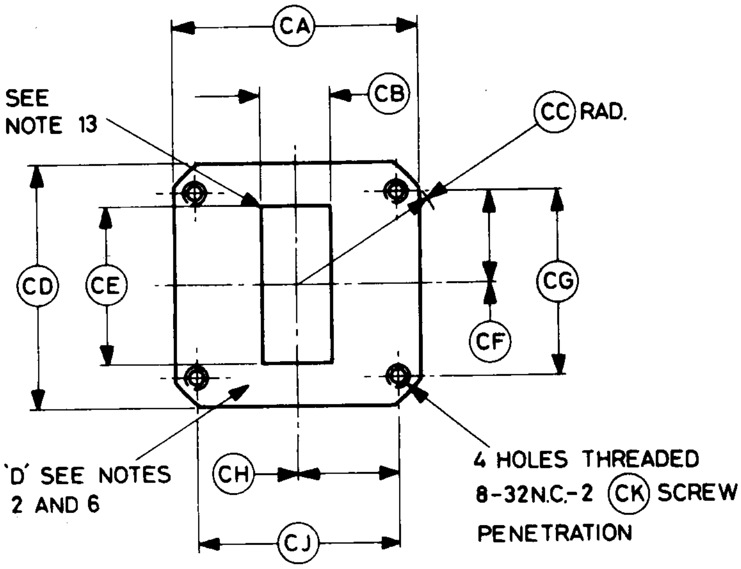


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



Outline Dimensions (All dimensions without limits are nominal)

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.

4J52A

X-BAND MAGNETRON

Service Type CV5018

The data should be read in conjunction with the Magnetron Preamble.

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)	90	s

Mechanical

Overall dimensions	5.938 x 5.374 x 4.243 inches max 150.8 x 136.5 x 107.8mm max
Net weight	5 pounds (2.3kg) 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	–	5	μs
Rate of rise of voltage pulse (see note 4):			
pulse length 0.4μs	120	170	kV/μs
pulse length 1.0μs	100	150	kV/μs
pulse length 5.0μs	70	110	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	7.9	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	9350 to 9400	MHz
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 40 lb/in^2 (2.8kg/cm^2) absolute, the leakage will not exceed 0.03 litre (N.T.P.) per minute.

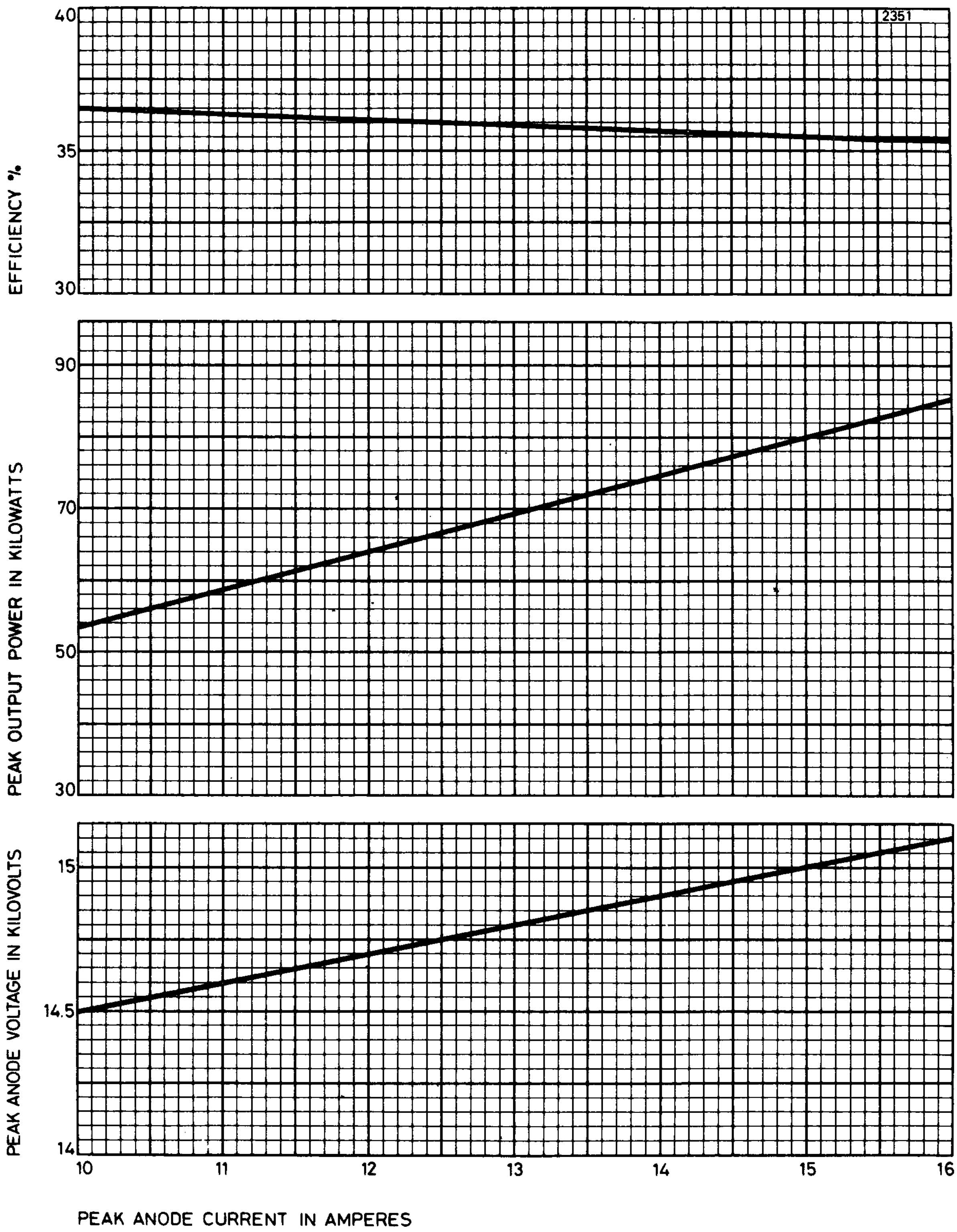
6. With anode temperature of 100°C ± 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

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:

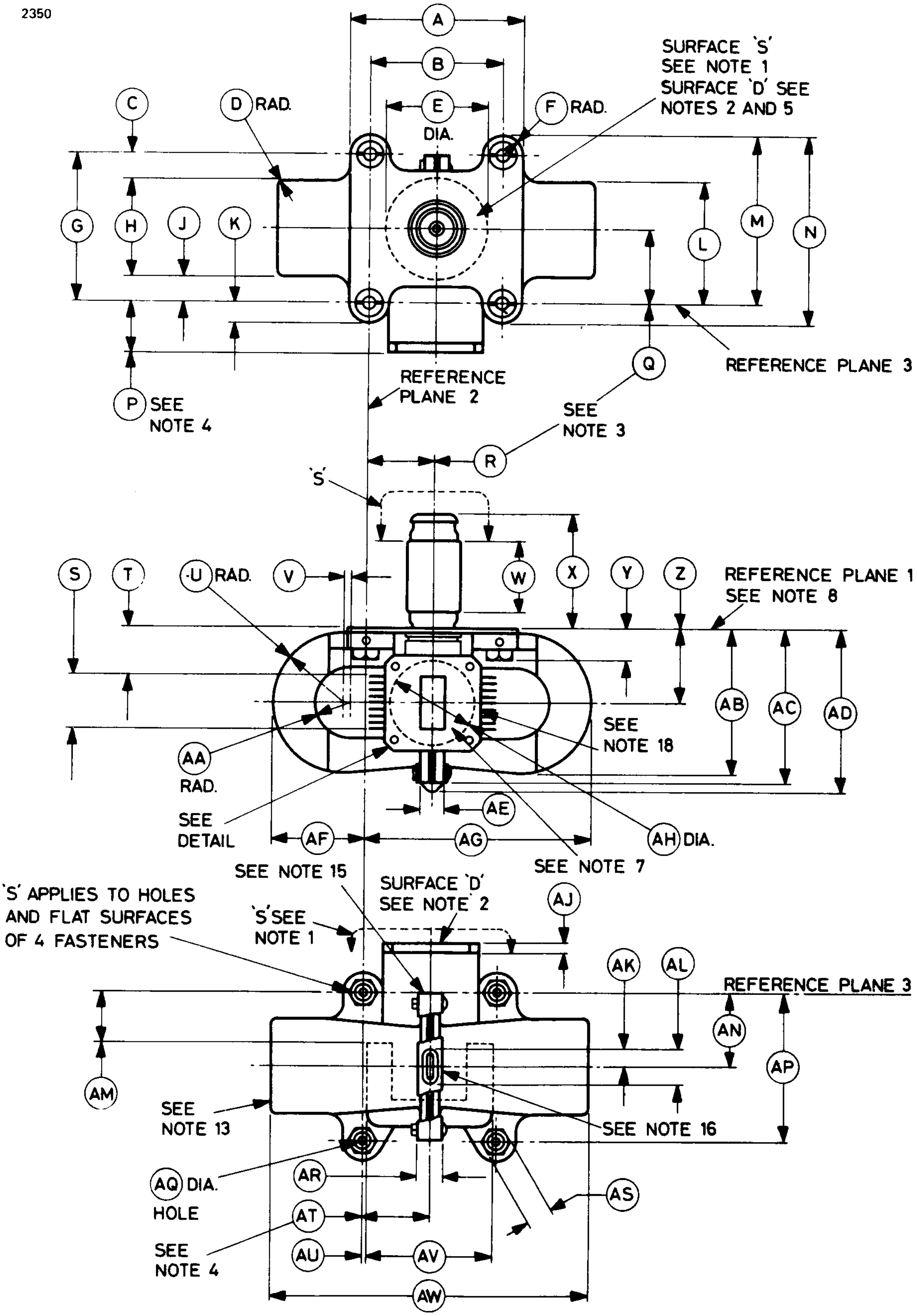
   Oscillation 1 – 11 and 15A
   Oscillation 2 – 12 and 15A

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.

TYPICAL PERFORMANCE CHART

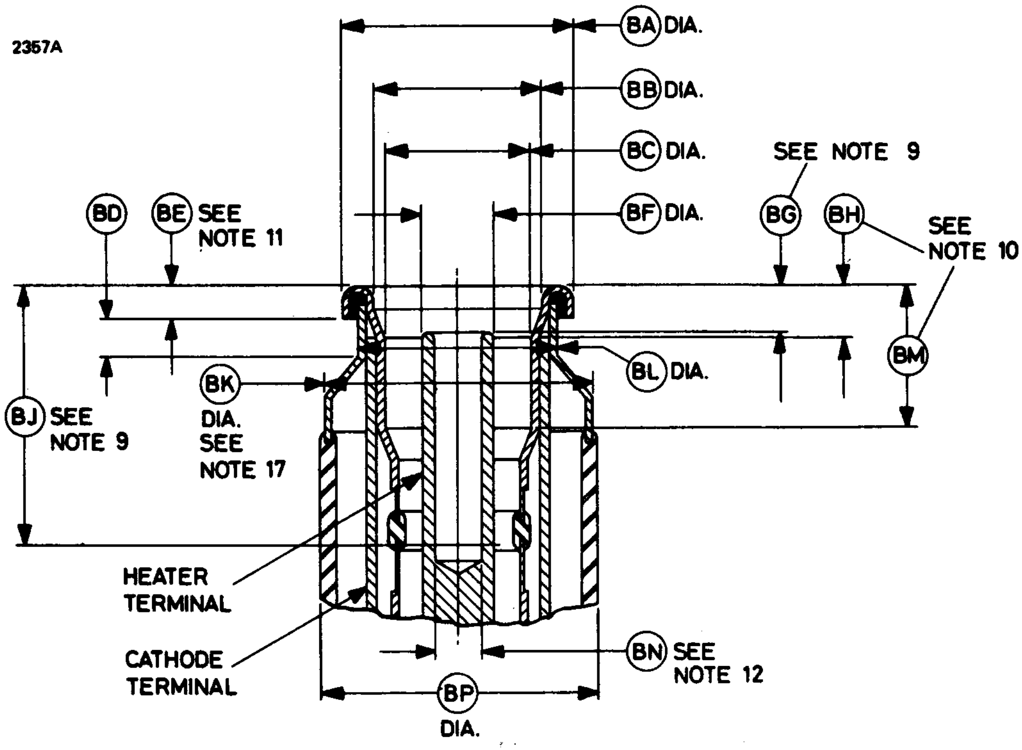


OUTLINE (See page 10 for Outline Notes)

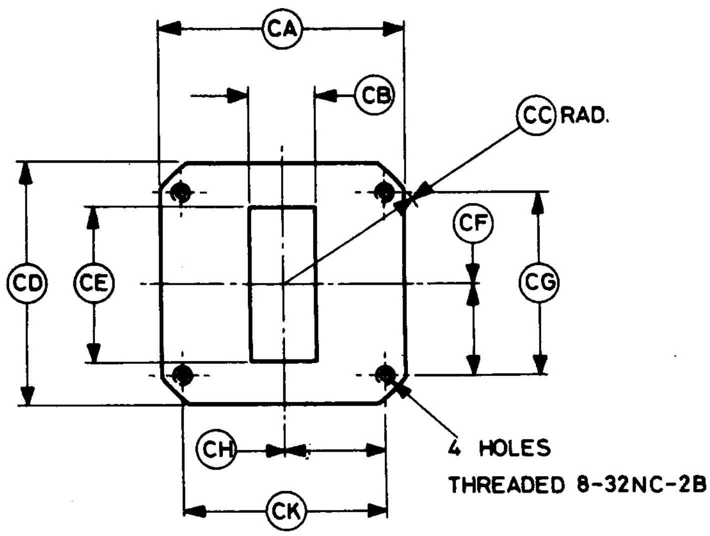


OUTLINE DETAILS (See page 10 for Outline Notes)

Heater and Cathode Terminals



Output Flange



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.438 max	87.33 max
B	2.531 ± 0.010	64.29 ± 0.25
C	0.594 max	15.09 max
D	0.031 min	0.79 min
E	1.875 min	47.63 min
F	0.375	9.53
G	2.781 ± 0.010	70.64 ± 0.25
H	1.938 max	49.23 max
J	0.594 max	15.09 max
K	0.422 max	10.72 max
L	2.375 max	60.33 max
M	3.203 max	81.36 max
N	3.625 max	92.08 max
P	1.015 ± 0.025	25.78 ± 0.64
Q	1.391	35.33
R	1.265	32.13
S	1.000	25.40
T	0.922	23.42
U	1.328	33.73
V	0.141	3.58
W	1.250 min	31.75 min
X	2.156 ± 0.062	54.76 ± 1.57
Y	0.625 ± 0.031	15.88 ± 0.79
Z	1.406 ± 0.020	35.71 ± 0.51
AA	0.625	15.88
AB	2.844 max	72.24 max
AC	2.938 max	74.63 max
AD	3.156 max	80.16 max
AE	0.625 max	15.88 max
AF	1.688 max	42.88 max
AG	4.250 max	108.0 max
AH	1.625	41.28
AJ	0.250	6.35
AK	0.406 max	10.31 max
AL	0.812 max	20.62 max
AM	0.797	20.24

Ref	Inches	Millimetres
AN	1.391 ± 0.047	35.33 ± 1.19
AP	2.875 max	73.03 max
AQ	0.281 ± 0.005	7.14 ± 0.13
AR	1.438 max	36.53 max
AS	0.500	12.70
AT	1.265 ± 0.015	32.13 ± 0.38
AU	0.078	1.98
AV	2.375	60.33
AW	5.938 max	150.83 max
BA	0.838 max 0.825 min	21.29 max 20.96 min
BB	0.650 max 0.610 min	16.51 max 15.49 min
BC	0.545 max 0.532 min	13.84 max 13.51 min
BD	0.125 min	3.18 min
BE	0.125 ± 0.010	3.18 ± 0.25
BF	0.250 ± 0.016	6.35 ± 0.41
BG	0.156 ± 0.031	3.96 ± 0.79
BH	0.200 max	5.08 max
BJ	0.750 min	19.05 min
BK	1.000	25.40
BL	0.750	19.05
BM	0.516 min	13.11 min
BN	0.169 ± 0.005	4.29 ± 0.13
BP	1.125	28.58
CA	1.830	46.48
CB	0.497	12.62
CC	1.156	29.36
CD	1.830	46.48
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
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 0.047 inch (1.19mm) 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 (15.88mm) 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.

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X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	20	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
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 5.250 x 4.468 inches max 136.5 x 133.4 x 113.5mm max
Net weight	5 pounds (2.3kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling (see note 3) . . . . 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	8.0	kV
Anode current (peak)	3.5	8.0	A
Input power (peak)	21	64	kW
Input power (mean) (see note 4)	–	80	W
Duty cycle	–	0.0025	
Pulse length (see note 5)	–	2.5	μs
Rate of rise of voltage pulse (see note 6)	–	60	kV/μs
Anode temperature (see note 3)	–	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

Heater voltage	4.6	V
Anode current (peak)	7.0	A
Pulse length	1.0	μs
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	V
Anode current (mean)	7.5	7.0	mA
Duty cycle	0.001	0.002	
Pulse length (see note 5)	1.0	1.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	max
Rate of rise of voltage pulse (see note 6)	60	60	kV/μs

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 8)	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	2.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.25	–	–	%
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 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	MHz max
Frequency	9345 to 9405	MHz
Stability (see note 9)	1.0	% 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.

3. 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.

4. 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.

5. Tolerance ±10%.

6. 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.

7. At the maximum pressure of 45 lb/in^2 (3.16kg/cm^2) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

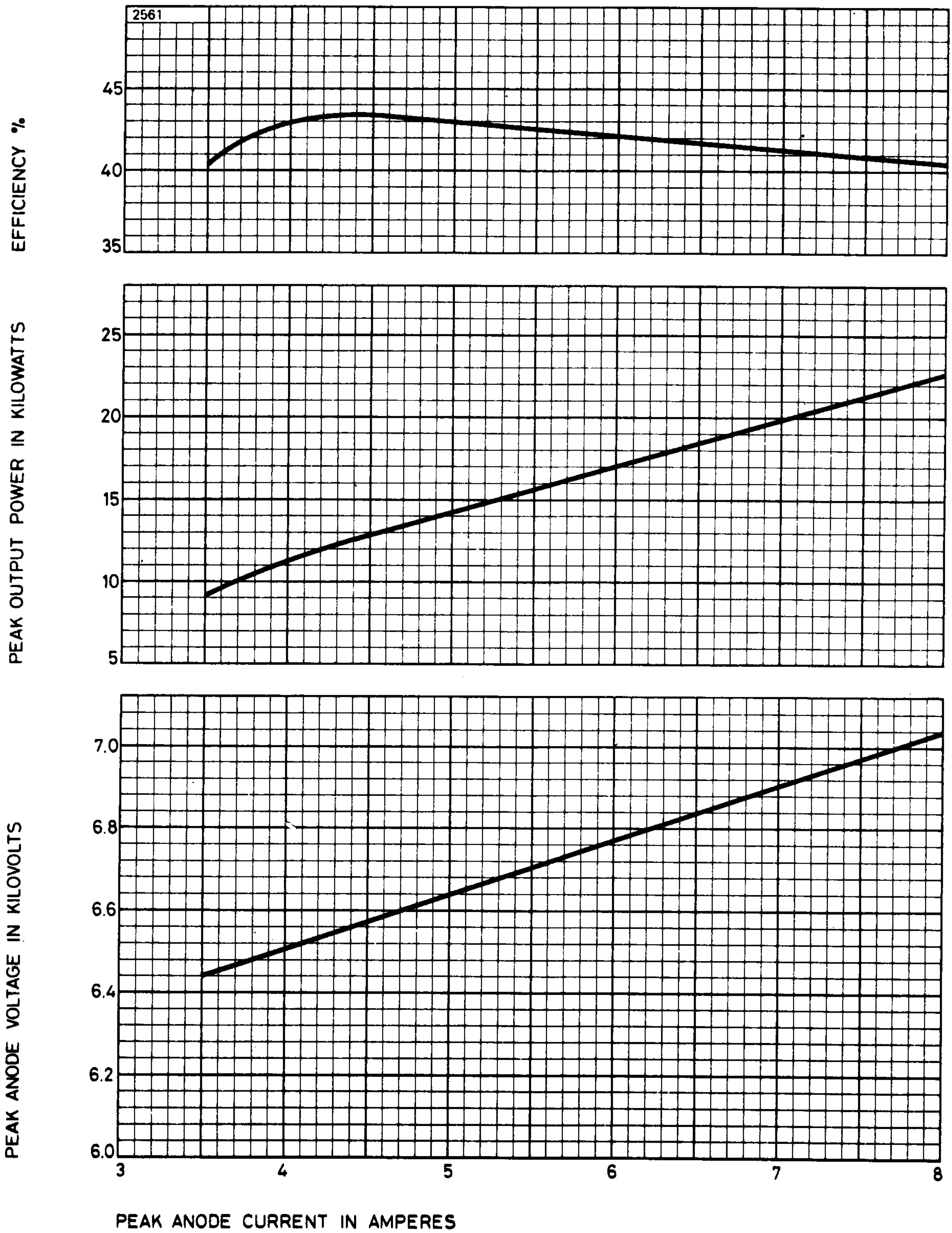
8. Temperature of anode block 40 ± 5°C, measured at the point indicated on the outline drawing. Other frequency ranges are available on request.

9. 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 9405MHz. 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.

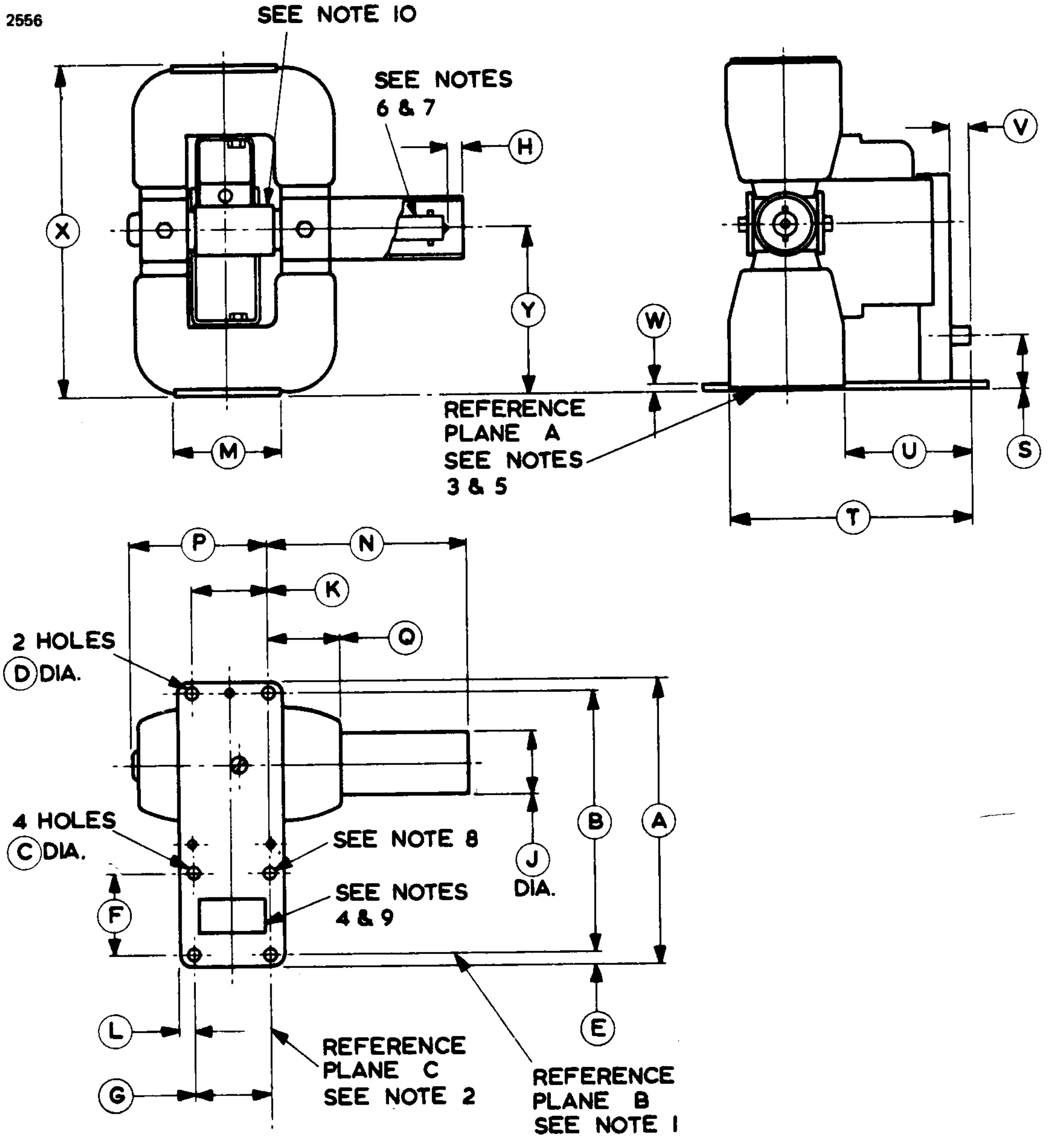
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
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	5.250 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.

Outline Notes

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 and fixing holes will be such that the valve operates into coupler type UG-40B/U (5985-99-083-0051).
5. Surface A and interior surfaces of 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.
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 coupler type UG-40B/U (5985-99-083-0051).
10. The anode temperature is measured at this point on the round anode surface between the radiator fin and pole piece.

6027H

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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	MHz
Typical peak output power	20	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
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

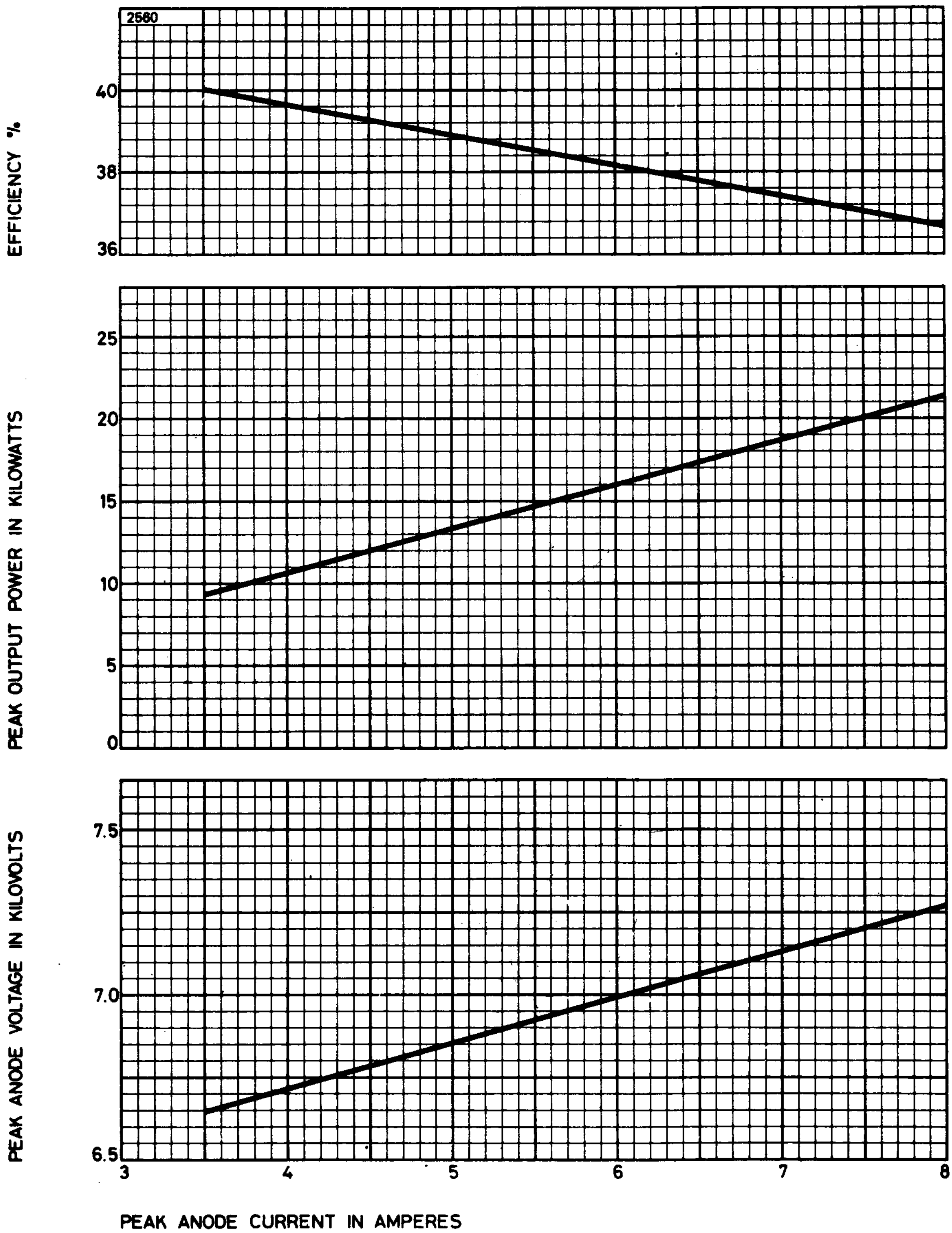
Mechanical

Overall dimensions	5.375 x 5.250 x 4.468 inches max 136.5 x 133.4 x 113.5mm max
Net weight	5 pounds (2.3kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling (see note 3) . . . . forced-air

TYPICAL 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 4)	–	80	W
Duty cycle	–	0.0025	
Pulse length	–	2.5	μs
Rate of rise of voltage pulse (see note 6)	–	60	kV/μs
Anode temperature (see note 3)	–	120	°C
Altitude:			
output system (see note 7)	–	45 000	ft
	–	13.5	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	4.5	V
Anode current (peak)	7.5	A
Pulse length	2.5	μs
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 5)	2.5	μs
V.S.W.R. at the output coupler	1.1:1	max
Rate of rise of voltage pulse (see note 6)	60	kV/μs min

Limits

	Min	Max	
Anode voltage (peak)	7.0	7.4	kV
Output power (mean)	18	–	W
Frequency (see note 8)	9345	9405	MHz
R.F. bandwidth at ¼ power (see note 9)	–	1.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	MHz
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 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)

Output power (mean)	13.5	W min
R.F. bandwidth at ¼ power	1.2	MHz max
Frequency	9345 to 9405	MHz
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 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°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes.

3. 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.

4. 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.

5. Tolerance ±10%.

6. 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.

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-40B/U (5985-99-083-0051).

8. Other frequency ranges can be supplied on request.

9. The peak current is varied over the range 6.0 to 7.5A for this measurement.

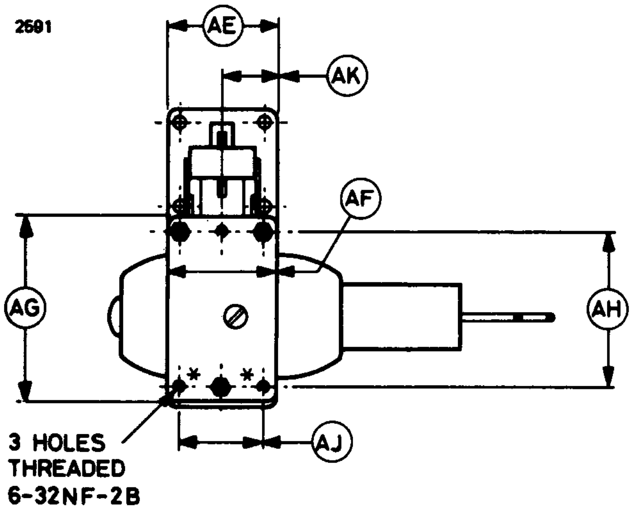
10. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during any consecutive 5 minute interval of a 15 minutes test period.
11. 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 warm-up) is –0.25MHz/°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.

Outline Dimensions (All dimensions without limits are nominal)

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

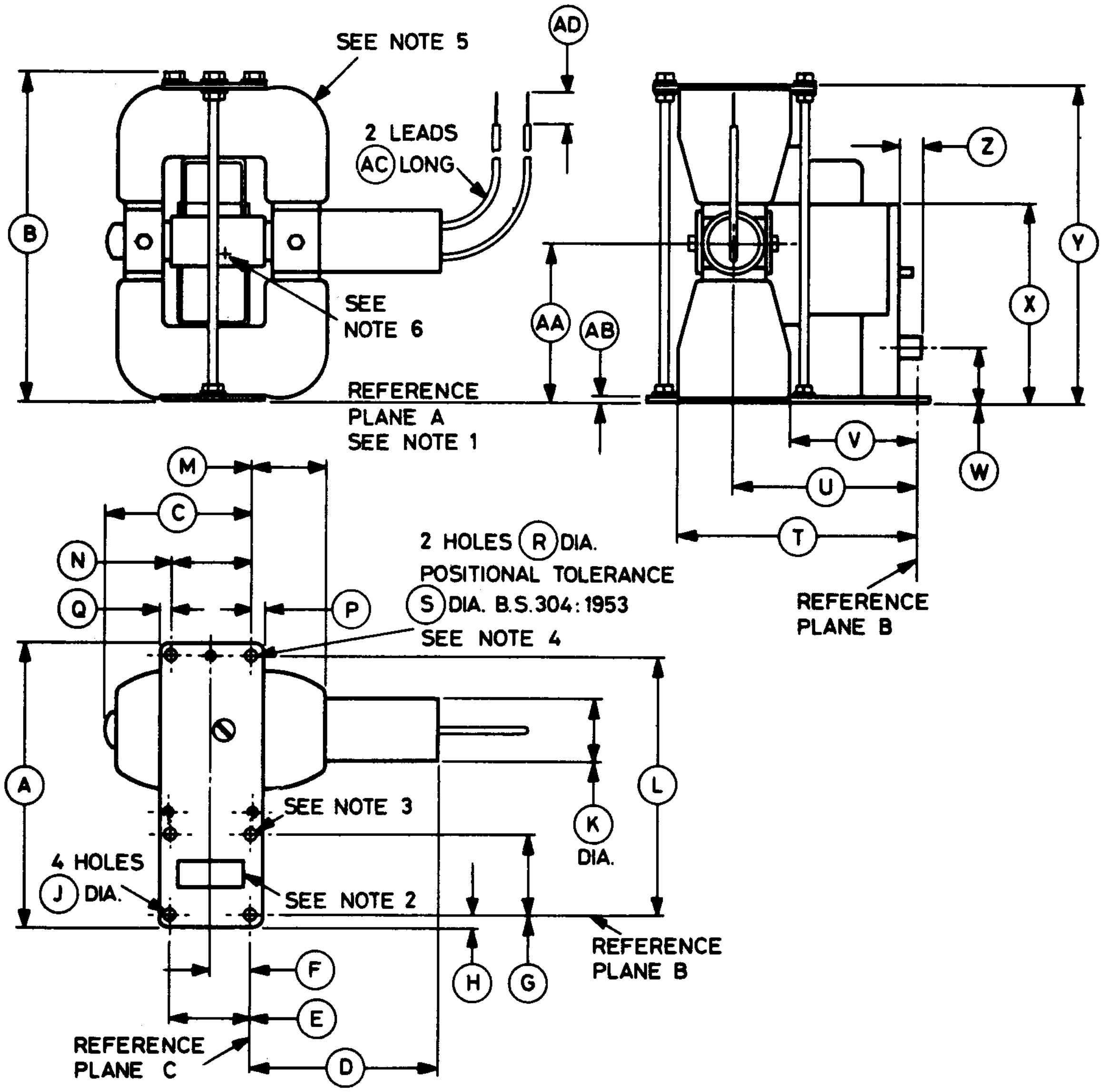
Millimetre dimensions have been derived from inches.

OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode



Outline Notes

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-40B/U (5985-99-083-0051).
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.
6. Anode temperature measured at this point.

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X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	20	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)

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		see note 2

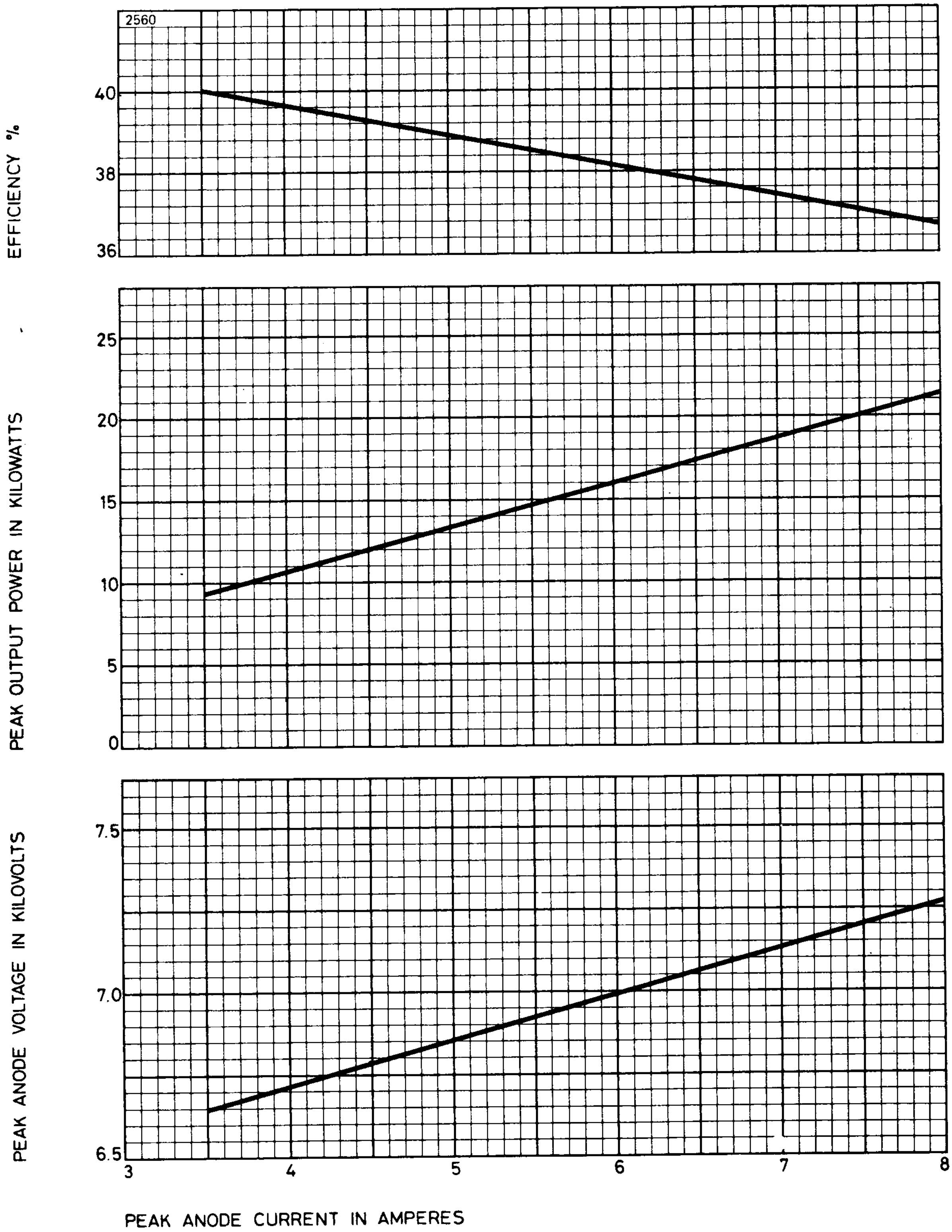
Mechanical

Overall dimensions (excluding leads)	5.375 x 4.468 x 3.313 inches max 136.5 x 113.5 x 84.15mm 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 3) . . . . natural or forced-air

TYPICAL 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 4)	–	80	W.
Duty cycle	–	0.0025	
Pulse length	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	–	100	kV/μs
Anode temperature	–	120	°C
Altitude:			
output system (see note 6)	–	45 000	ft
	–	13.5	km
input terminals	–	60 000	ft
	–	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	μs
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

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	4.5	V
Anode current (mean)	7.5	7.5	mA
Duty cycle	0.001	0.001	
Pulse length (see note 7)	1.0	2.5	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	max
Rate of rise of voltage pulse (see note 5)	100	100	kV/μs

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	–	–	MHz
R.F. bandwidth at ¼ power	–	2.5	–	1.0	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 9)	–	0.25	–	0.25	%
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)

Output power (mean)	13.5	W min
R.F. bandwidth at ¼ power	3.0	MHz max
Frequency	9345 to 9405	MHz
Stability (see note 9)	1.0	% 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:

   $$V_h = 6.3\left[1 - \frac{P_i}{180}\right] \text{ volts}$$

   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. The minimum cathode heating time for ambient temperatures above $-55°C$ is 20 seconds from the heater voltage reaching 5.7V. 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. 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.

4. 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

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. 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 standard coupler UG-40B/U.

7. Tolerance ±10%.

8. Temperature of anode block 40 ± 5°C, measured at the point indicated on the outline drawing.

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 9405MHz. 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.

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 Dimensions (All dimensions without limits are nominal)

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

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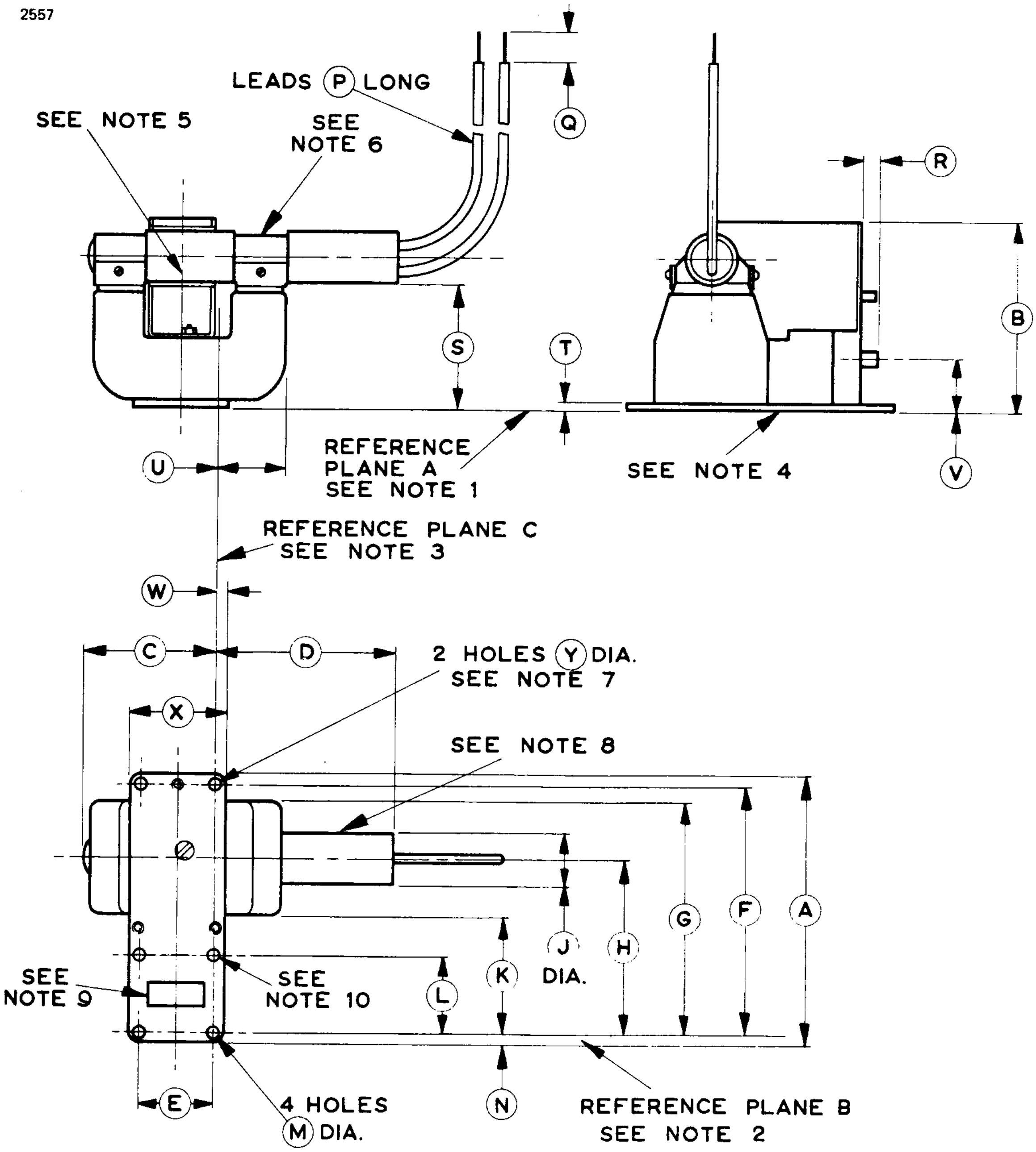


Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Notes

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 magnet pole 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-40B/U (5985-99-083-0051).
10. The centre of this hole will lie within 0.004 inch (0.102mm) of the reference plane C.

BM1002

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	5.250 x 4.468 x 3.313 inches max 133.4 x 113.5 x 84.15mm 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) . . . . 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	–	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	9415 to 9475	MHz
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 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.

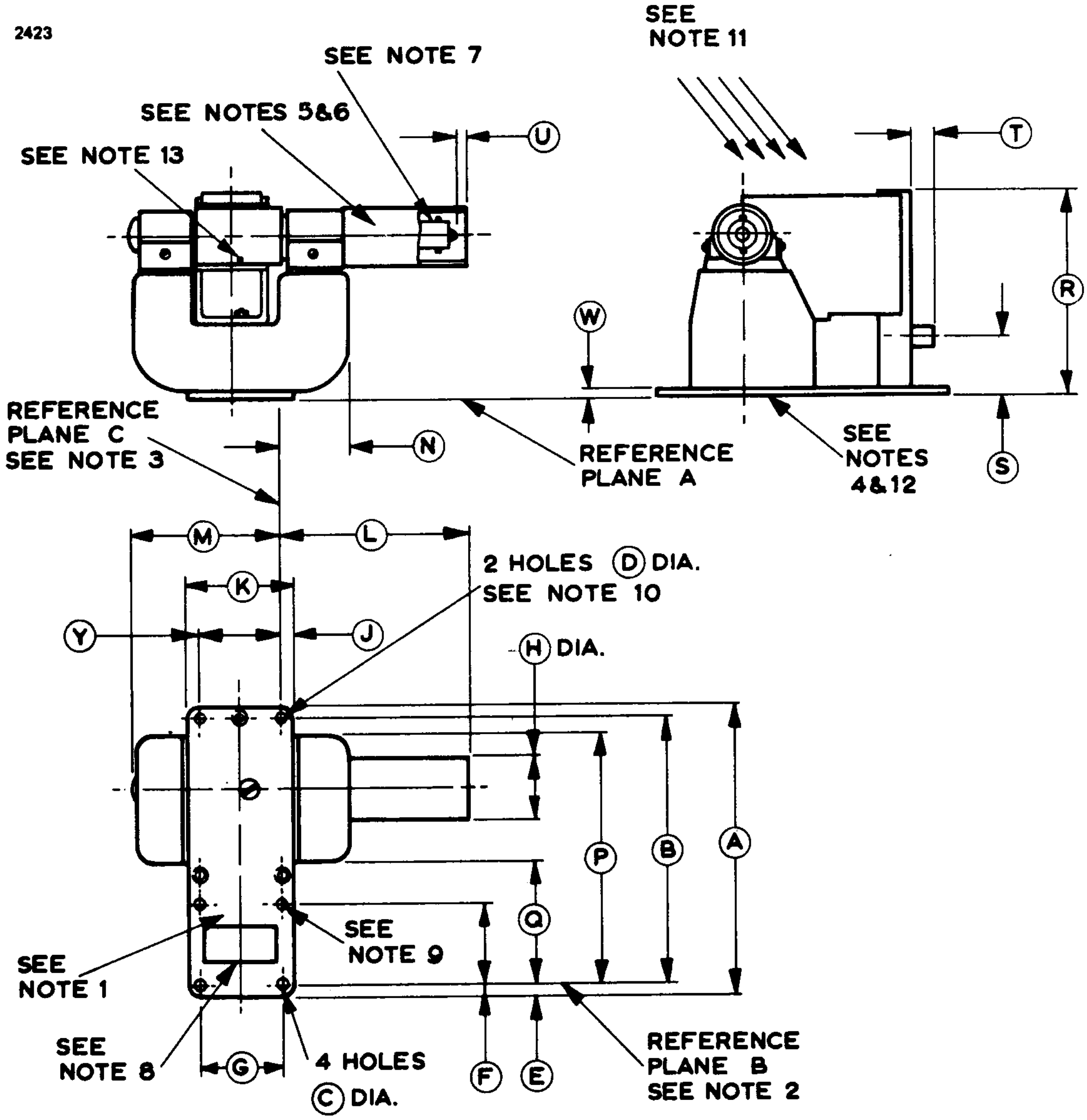
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after 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	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	3.313 max	84.15 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 UG-40B/U (5985-99-083-0051) 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 UG-40B/U (5985-99-083-0051) (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.

BM1031

X-BAND MAGNETRON

Service Type CV2186

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9420 to 9500	MHz
Typical peak output power	40	kW
Magnet		separate
Output		British X-band waveguide (1.000 x 0.500 inch internal)
Coupler		special
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.8	A
Heater starting current, peak value, not to be exceeded	2.5	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	9.077 x 3.400 x 3.240 inches max 230.6 x 86.36 x 82.30mm max
Net weight	1½ pounds (0.7kg) approx
Mounting position	any

Cooling (see note 2) . . . . forced-air

February 1970

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)	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 4)	–	140	W
Duty cycle	–	0.001	
Pulse length	–	1.0	μs
Rate of rise of voltage pulse (see note 6)	–	200	kV/μs
Anode temperature (see note 2)	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Magnetic field (see note 3)	4850 ± 50	4850 ± 50	gauss
Heater voltage	0	0	V
Anode current (peak)	10	10	A
Pulse length	1.0	0.25	μs
Pulse repetition rate	1000	1500	p.p.s.
Rate of rise of voltage pulse	200	200	kV/μs

Typical Performance

Anode voltage (peak)	13	13	kV
Output power (peak)	40	40	kW
Output power (mean)	40	15	W

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 5)	1.0	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 6)	150	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	11	14	kV
Output power (mean)	30	–	W
Frequency (see note 7)	9420	9500	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 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	MHz max
Frequency	9420 to 9500	MHz
Stability (see note 8)	0.5	% max

NOTES

1. With no anode input power.

   The heater voltage must be reduced within 5 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\sqrt{1 - \frac{P_i}{150}} \text{ volts}$$

   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. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

3. 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.

4. The various parameters are related by the following formula:

   $$P_i = i_{apk} \times v_{apk} \times D_u$$

   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.

5. Tolerance $\pm$10%.

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.

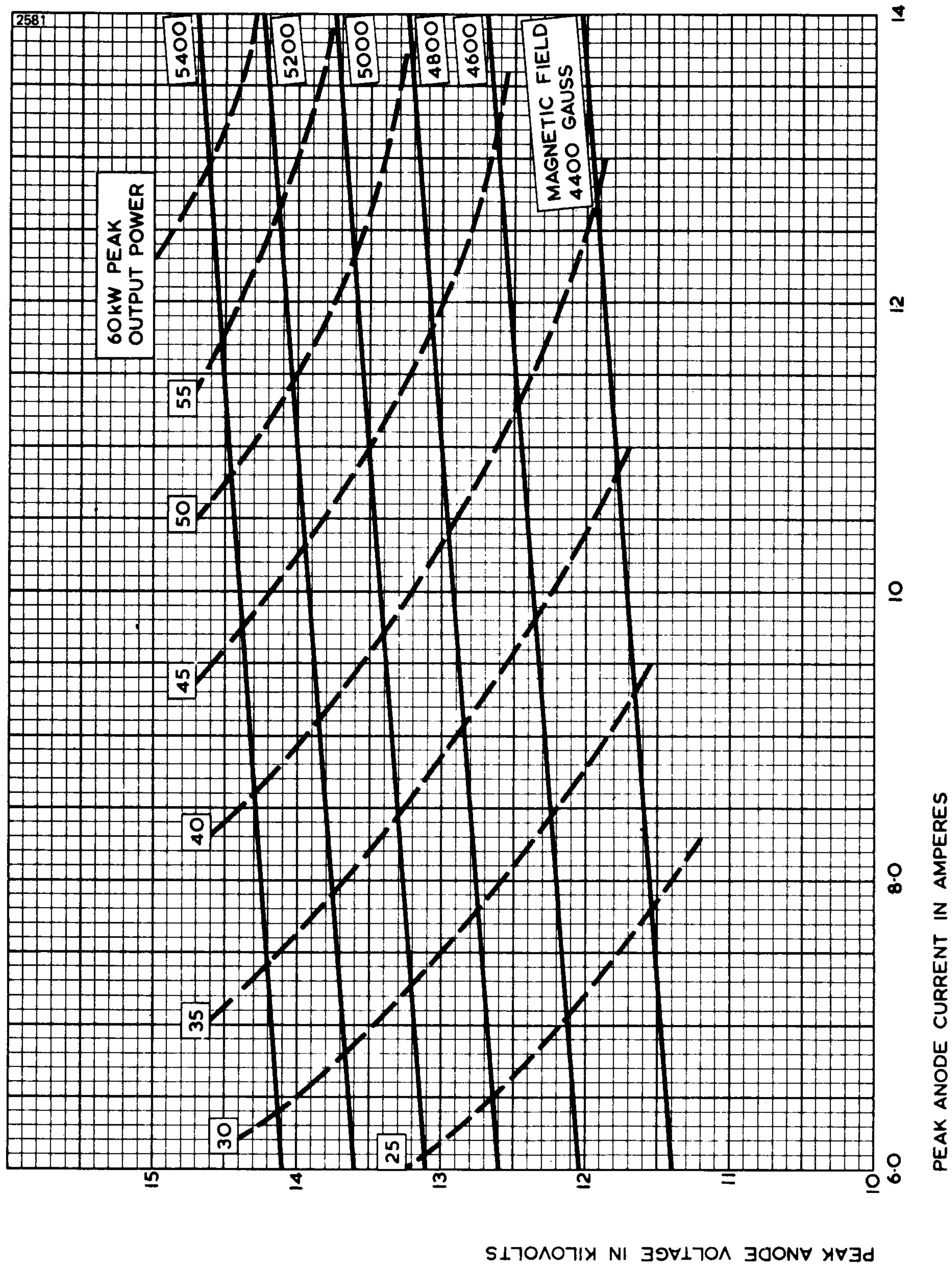
7. Other frequency ranges can be supplied on request.

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.

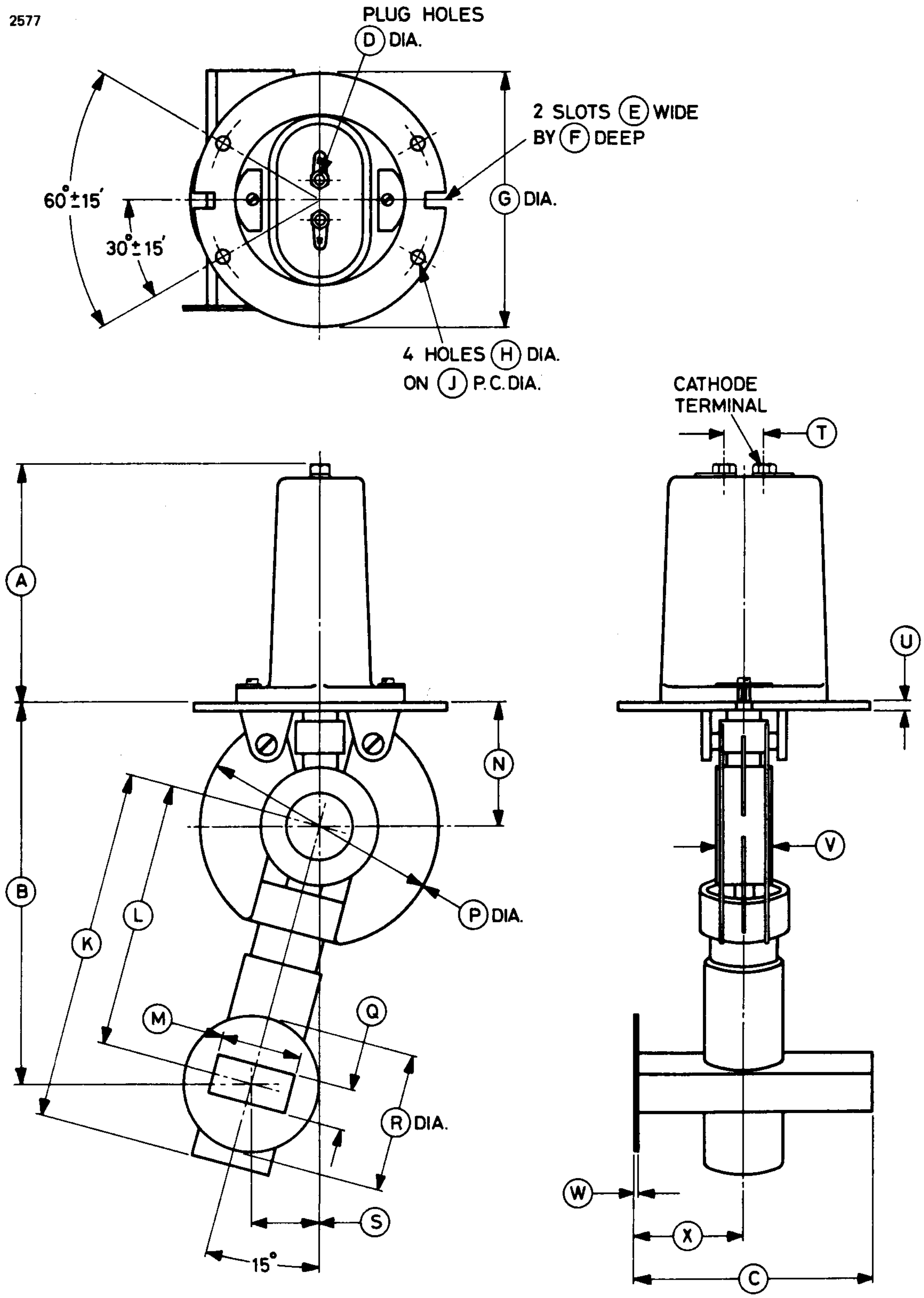
10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE

2577



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.000 ± 0.062	76.20 ± 1.57
B	4.800 ± 0.020	121.92 ± 0.51
C	3.062	77.77
D	0.169 ± 0.002	4.293 ± 0.051
E	0.188 ± 0.001	4.775 ± 0.025
F	0.312	7.92
G	3.240 ± 0.001	82.296 ± 0.025
H	0.201	5.11
J	2.875 ± 0.010	73.03 ± 0.25
K	4.437	112.7
L	3.355 ± 0.020	85.22 ± 0.51
M	1.000	25.40
N	1.562 ± 0.020	39.67 ± 0.51
P	3.000 ± 0.062	76.20 ± 1.57
Q	0.500	12.70
R	1.750	44.45
S	0.870 ± 0.020	22.10 ± 0.51
T	0.500 ± 0.010	12.70 ± 0.25
U	0.125	3.18
V	0.620 max	15.75 max
W	0.064	1.63
X	1.387 ± 0.020	35.23 ± 0.51

Millimetre dimensions have been derived from inches.

M503A

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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	MHz
Typical peak output power	9.5	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
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	min

Mechanical

Overall dimensions	5.250 x 4.468 x 3.313 inches max 133.4 x 113.5 x 84.15mm 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)	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	–	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

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	4.5	4.5	A
Pulse length	0.5	0.05	μs
Pulse repetition rate	1000	1000	p.p.s.
Rate of rise of voltage pulse	100	125	kV/μs

Typical Performance

Anode voltage (peak)	5.6	5.6	kV
Output power (peak)	9.5	8.5	kW
Output power (mean)	4.75	0.42	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)	2.5	0.25	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)	100	125	kV/μs

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	–	–	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 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.

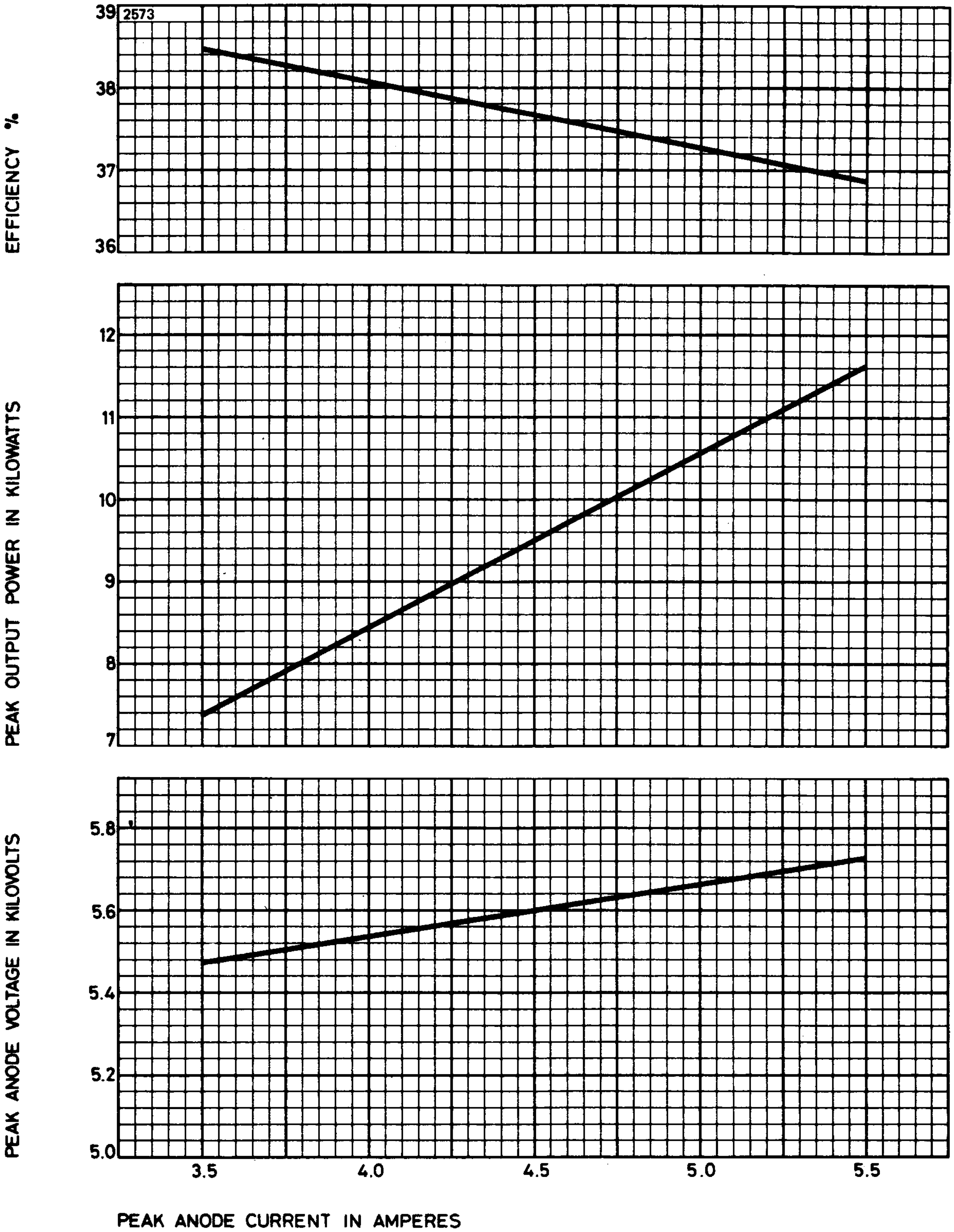
End of Life Criteria (under Test Conditions Oscillation 1)

Anode voltage (peak)	5.0	kV min
Output power (mean)	3.2	W min
Frequency	9345 to 9405	MHz
Stability (see note 8)	0.1	% max

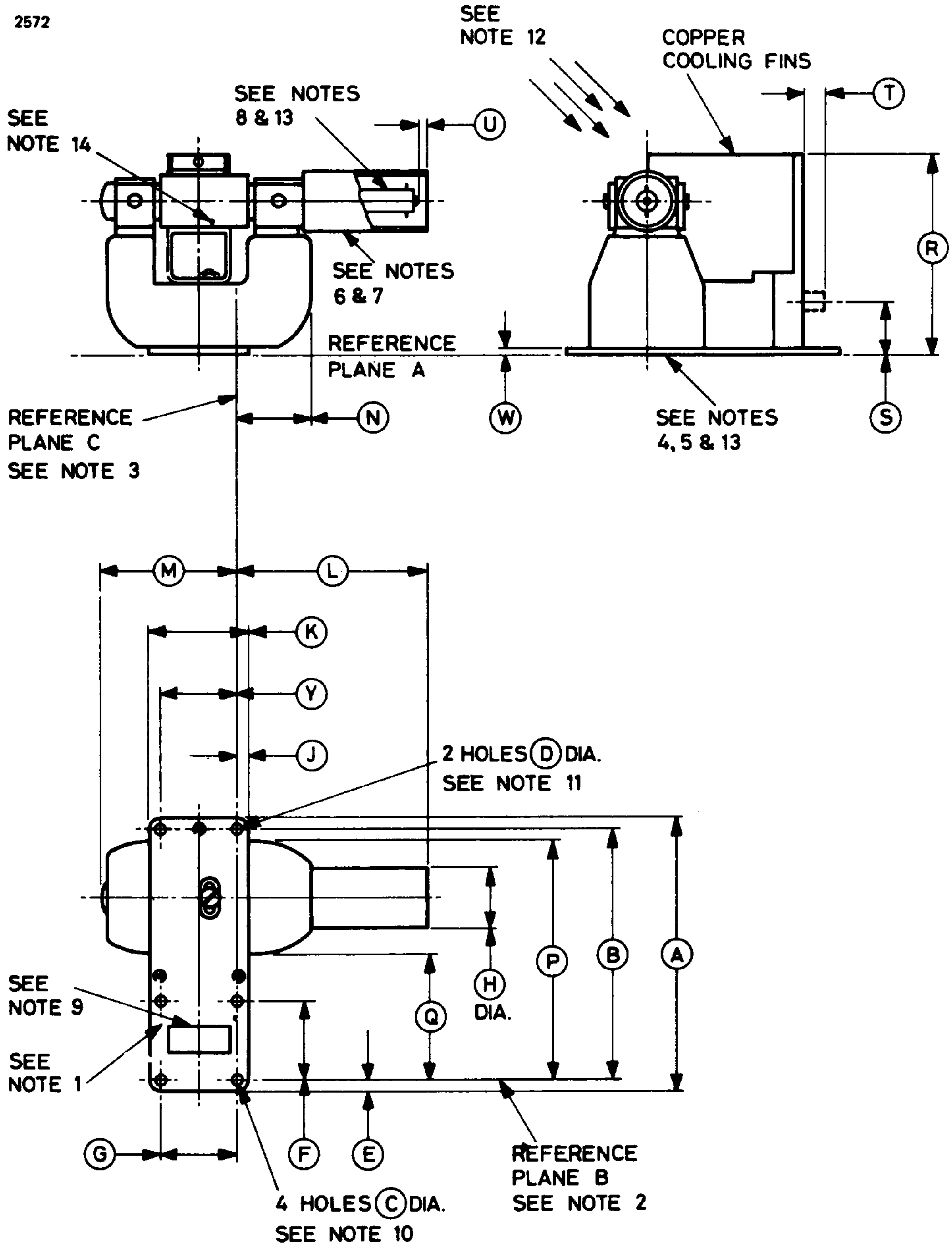
NOTES

1. With no anode input power.
   For average pulse input powers greater than 25 watts the heater voltage 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. 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 normal 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 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.
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.

TYPICAL PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End contact	Heater
Shell	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

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	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.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler UG-40B/U (5985-99-083-0051) 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 reference plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown, and is 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. 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 axis of the heater lead protector will be within 5° of a normal to reference plane C.

7. The heater lead protector must 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-40B/U (5985-99-083-0051) (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.

M504

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9325 to 9425	MHz
Typical peak output power	750	kW
Magnet	separate electro-magnet, see note 6 on page 4	
Output	no. 15 waveguide (1.122 x 0.497 inch internal)	
Coupler	UG-52A/U (Z830033)	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater current (see note 1)	40	A
Heater voltage at 40A	5.0	V
Heater starting current, peak value, not to be exceeded	175	A
Cathode heating time (minimum)	5.0	min

Mechanical

Overall dimensions (excluding flexible leads)	14.16 x 8.00 x 8.00 inches nom 360 x 203 x 203mm nom
Net weight	5½ pounds (2.5kg) approx
Mounting position	any

Cooling

Cooling	forced-air	
Air flow to anode	150	ft^3/min min
Air flow to output window	3	ft^3/min min

February 1970

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater current (see note 1)	–	40	A
Heater starting current (peak)	–	175	A
Anode voltage (peak)	32	38	kV
Anode current (peak)	–	50	A
Input power (peak)	–	1.9	MW
Input power (mean) (see note 2)	–	1.2	kW
Duty cycle	–	0.0006	
Pulse length	–	1.0	μs
Rate of rise of voltage pulse (see note 4)	–	200	kV/μs
Anode temperature	–	150	°C
Cathode terminal temperature	–	165	°C
V.S.W.R. at the output coupler	–	1.5:1	
Pressurising of output waveguide (see note 5)	35	–	lb/in^2
	2.46	–	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater current	30	A
Magnetic field (see note 6)	7000	gauss
Anode current (peak)	50	A
Pulse length	0.6	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	35	kV
Output power (peak)	750	kW
Output power (mean)	450	W

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.

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 6)	7000	6500	gauss
Heater current (for test)	30	30	A
Anode current (mean)	30	30	mA
Duty cycle	0.0006	0.0006	
Pulse length (see note 3)	0.6	0.6	μs
Voltage standing wave ratio at the output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 4)	150	150	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	32	38	–	–	kV
Output power (mean)	400	–	–	–	W
Frequency	9325	9425	–	–	MHz
R.F. bandwidth at ¼ power (see note 7)	–	4.1	–	4.1	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	15	–	–	MHz
Stability (see note 8)	–	1.0	–	1.0	%
Side lobes	6.0	–	6.0	–	db
Temperature coefficient of frequency	–	–	–	–0.25	MHz/°C

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)	310	W min
R.F. bandwidth at ¼ power	5.0	MHz max
Frequency	9325 to 9425	MHz
Stability (see note 8)	2.0	% max
Side lobes	6	db min

NOTES

1. With no anode input power.

   On stand-by the heater current must not exceed 40 amperes. On the application of anode power the heater current must be reduced according to the following formula:

   for input powers up to 1050 watts,

   $$I_h = 40 - 0.0095\ Pi$$

   and for input powers above 1050 watts,

   $$I_h = 80 - 0.0476\ Pi$$

   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. 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 $\pm 0.1\mu$s.

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.

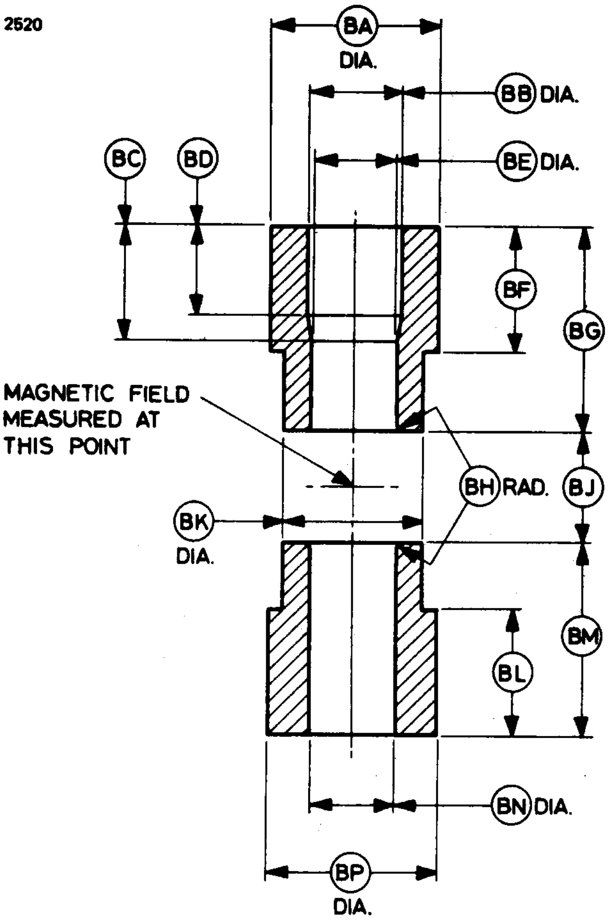
5. The waveguide must be pressurised to a minimum pressure of 35 lb/in^2 absolute to prevent waveguide breakdown and to provide cooling air across the valve output window.

6. The north pole of the electro-magnet must be adjacent to the cathode terminal and the position of the electro-magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The diagram on page 5 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 English Electric Valve Company Ltd. on the choice of magnets.

7. The r.f. bandwidth in MHz is given by 2.5/pulse length in microseconds.

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 five minute interval of a test period of fifteen minutes.

DUMMY POLE PIECE ASSEMBLY

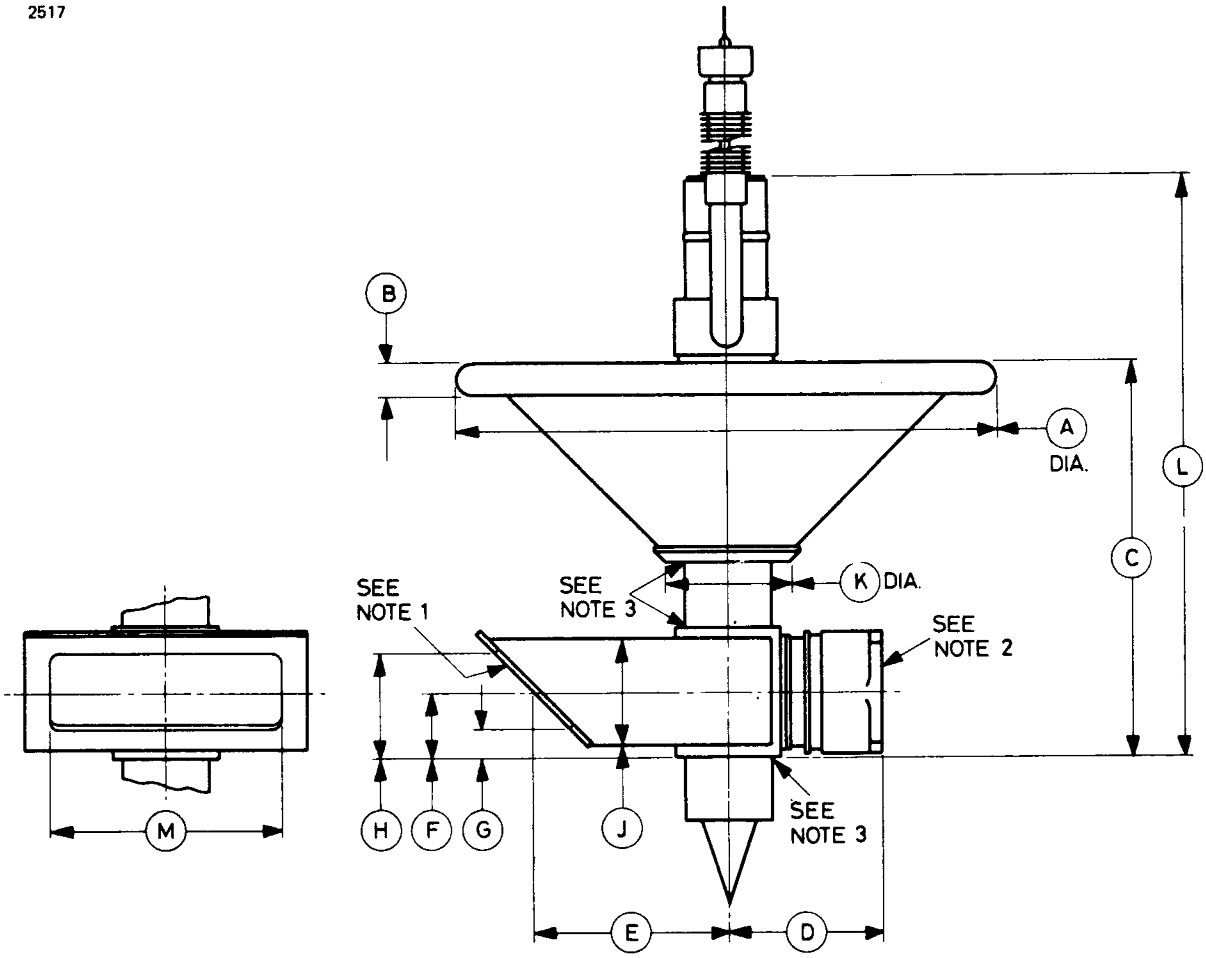


Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	1.250 ± 0.002	31.750 ± 0.051	BJ	0.800 ± 0.005	20.32 ± 0.13
BB	0.689 ± 0.002	17.501 ± 0.051	BK	1.059 $^{+0.000}_{-0.001}$	26.899 $^{+0.000}_{-0.025}$
BC	0.859 ± 0.005	21.82 ± 0.13			
BD	0.667 ± 0.005	16.94 ± 0.13	BL	0.935 ± 0.002	23.749 ± 0.051
BE	0.626 ± 0.002	15.900 ± 0.051	BM	1.428 ± 0.005	36.27 ± 0.13
BF	0.935 ± 0.002	23.749 ± 0.051	BN	0.626 ± 0.002	15.900 ± 0.051
BG	1.533 ± 0.005	38.94 ± 0.13	BP	1.250 ± 0.002	31.750 ± 0.051
BH	0.031	0.79			

Millimetre dimensions have been derived from inches.

OUTLINE (All dimensions without limits are nominal)

2517

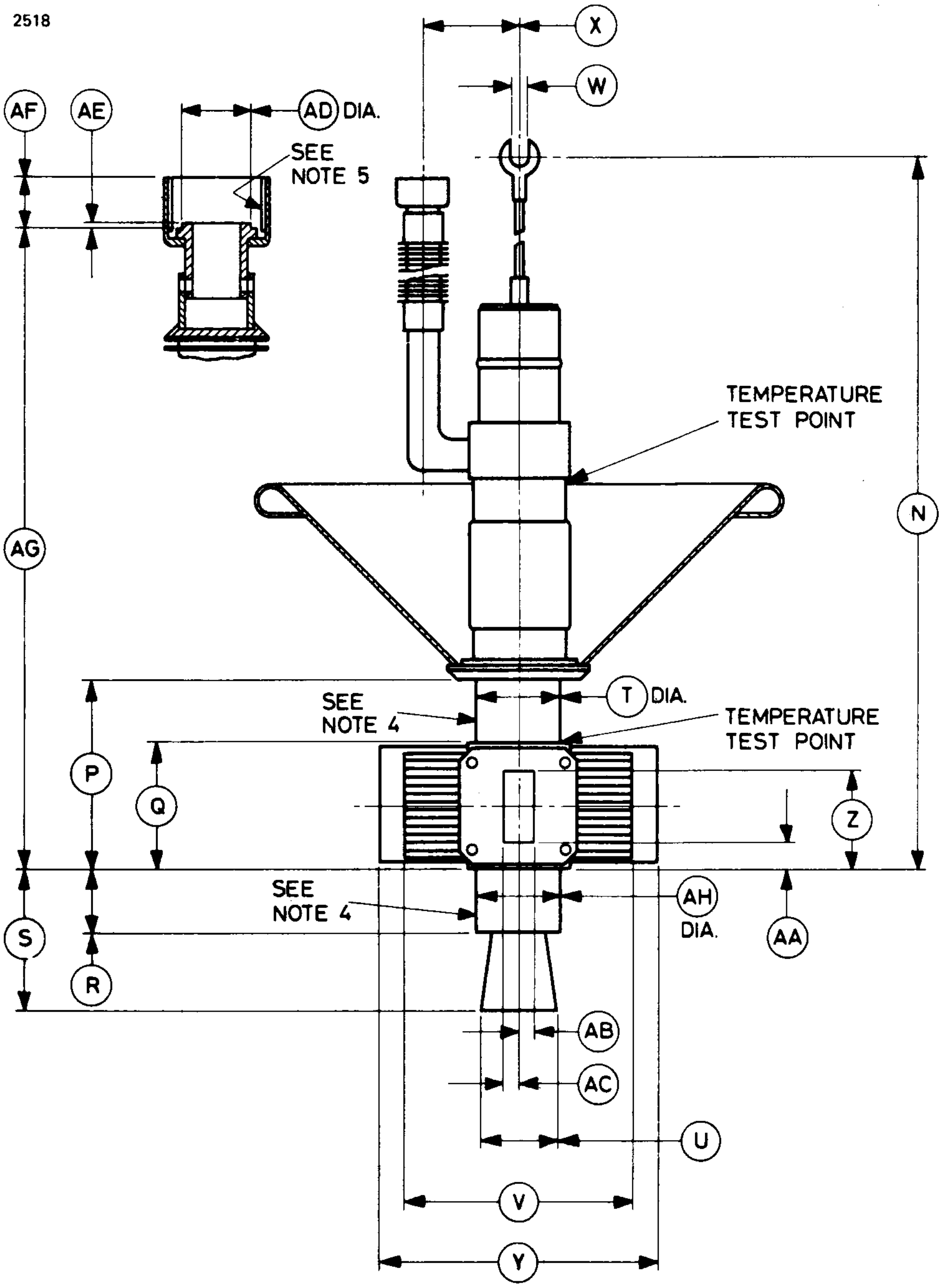


Ref	Inches	Millimetres
A	8.000	203.2
B	0.500 max	12.70 max
C	5.820	147.8
D	2.250 ± 0.063	57.15 ± 1.60
E	2.875 ± 0.031	73.03 ± 0.79
F	0.969	24.61
G	0.500 max	12.70 max
H	1.438 min	36.53 min
J	1.640 max	41.66 max
K	1.750 max	44.45 max
L	9.750 max	247.7 max
M	3.500 max	88.90 max
N	16.750	425.5
P	2.870 ± 0.007	72.90 ± 0.18
Q	1.938 ± 0.005	49.23 ± 0.13
R	0.937 max	23.80 max

Ref	Inches	Millimetres
S	2.156 max	54.76 max
T	1.250 ± 0.002	31.750 ± 0.051
U	1.188 max	30.18 max
V	3.500 max	88.90 max
W	0.255 min	6.48 min
X	1.437	36.50
Y	4.250 max	108.0 max
Z	1.510 min	38.35 min
AA	0.426 max	10.82 max
AB	0.230 min	5.84 min
AC	0.230 min	5.84 min
AD	0.500 max	12.70 max
AE	0.031	0.79
AF	0.375	9.53
AG	11.500 ± 0.125	292.1 ± 3.18
AH	1.250 ± 0.002	31.750 ± 0.051

Millimetre dimensions have been derived from inches.

OUTLINE


2518
X
W
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SEE
NOTE 5
TEMPERATURE
TEST POINT
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NOTE 4
TEMPERATURE
TEST POINT
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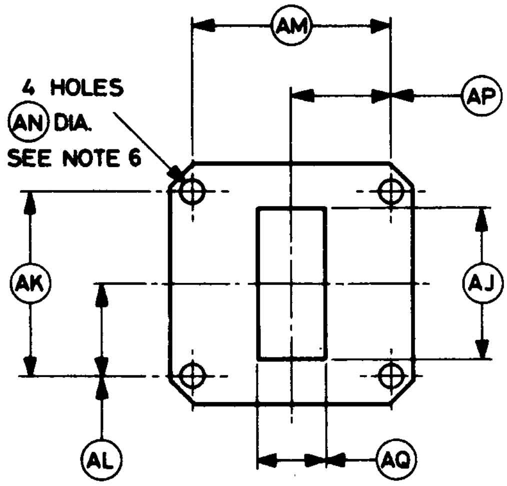
Output Flange (All dimensions without limits are nominal)

2519



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AJ	1.122 ± 0.002	27.499 ± 0.051	AN	$0.167\ {}^{+0.000}_{-0.001}$	$4.242\ {}^{+0.000}_{-0.025}$
AK	1.352	34.24	AP	0.737	18.72
AL	0.676	17.17	AQ	0.497 ± 0.002	12.624 ± 0.051
AM	1.474	37.44			

Millimetre dimensions have been derived from inches.

Outline Notes

1. With the valve mounted in an approved gauge a feeler 0.122 inch (3.10mm) thick and 0.125 inch (3.18mm) wide will not enter at any point between this flange and a surface plate brought into contact with it.
2. With the valve mounted in an approved gauge a feeler 0.122 inch (3.10mm) thick and 0.125 inch (3.18mm) wide will not enter at any point between this flange and a surface plate brought into contact with it.
3. Maximum radius of solder fillet 0.125 inch (3.18mm).
4. The pole pieces will be concentric to within 0.005 inch (0.13mm).
5. Threaded ¾-inch B.S.F. (medium fit).
6. Positional tolerance 0.002 inch (0.051mm) diameter.

M505

X-BAND MAGNETRON

Service Type CV1747

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9360 to 9460	MHz
Typical peak output power	45	kW
Magnet		separate
Output		British X-band waveguide (1.000 x 0.500 inch internal)
Coupler		A.S.R.E. drawing no. 37820
Cooling		forced-air

GENERAL

Electrical

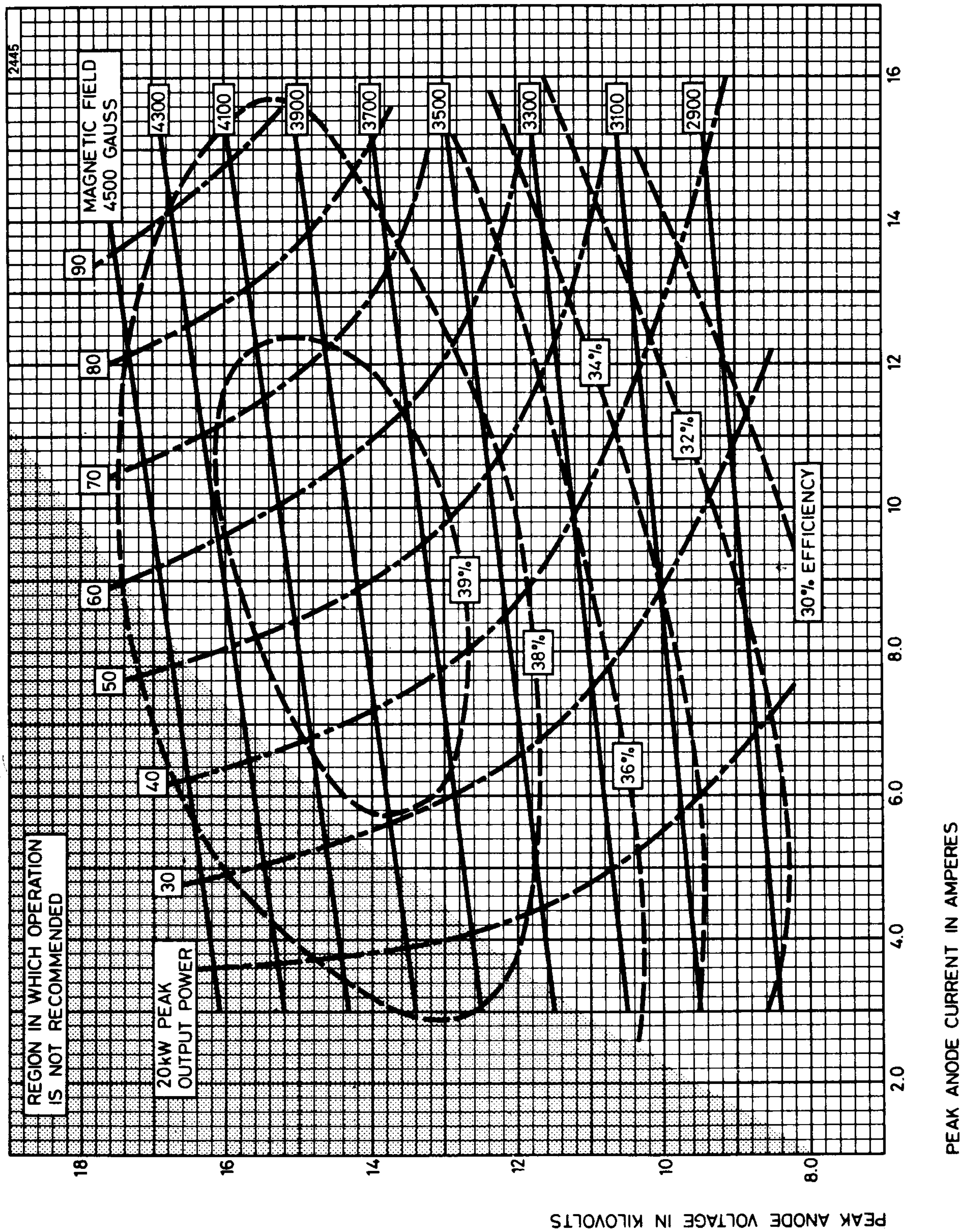
Cathode		indirectly heated
Heater voltage (see note 1)	3.0	V
Heater current at 3.0V	3.5	A
Cathode heating time (minimum)	90	s

Mechanical

Overall dimensions	8.250 x 3.343 x 3.281 inches max 209.6 x 84.91 x 83.34mm max
Net weight	1¾ pounds (0.8kg) approx
Mounting position	any

Cooling . . . . forced-air

TYPICAL 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	–	2.0	µs
Rate of rise of voltage pulse (see note 3)	–	150	kV/µs
Anode temperature (see note 4)	–	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 5)	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 5)	3250	3250	3250	gauss
Heater voltage (for test)	1.5	1.5	1.5	V
Anode current (mean)	12	12	12	mA
Duty cycle	0.001	0.001	0.001	
Pulse length (see note 6)	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 3)	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)	9360	9460	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see note 8)	–	–	–	3.0	–	–	MHz
Frequency pulling	–	–	–	15	–	–	MHz
Frequency pushing (see note 9)	–	5.0	–	–	–	–	MHz
Missing pulse count (see note 10)	–	–	–	0.25	–	–	%

Cold impedance . . . . see note 11
Mode change . . . . 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 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	9360 to 9460	MHz

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:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   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.

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 must not exceed 6.0pF.

4. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode fins.

5. Tolerance ±50 gauss. The north pole of the magnet must be adjacent to the cathode terminal.

6. Tolerance ±10%.

7. At anode temperature 25°C.

8. The maximum bandwidth in MHz is given by 3.0/(pulse length in μs).

9. The mean anode current is varied between 12 and 14mA.

10. 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 9460MHz.

11. 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.
12. 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.
13. Measured with heater voltage of 3.0V and no anode input power, the heater current limits are 3.0A minimum, 4.0A maximum.
14. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

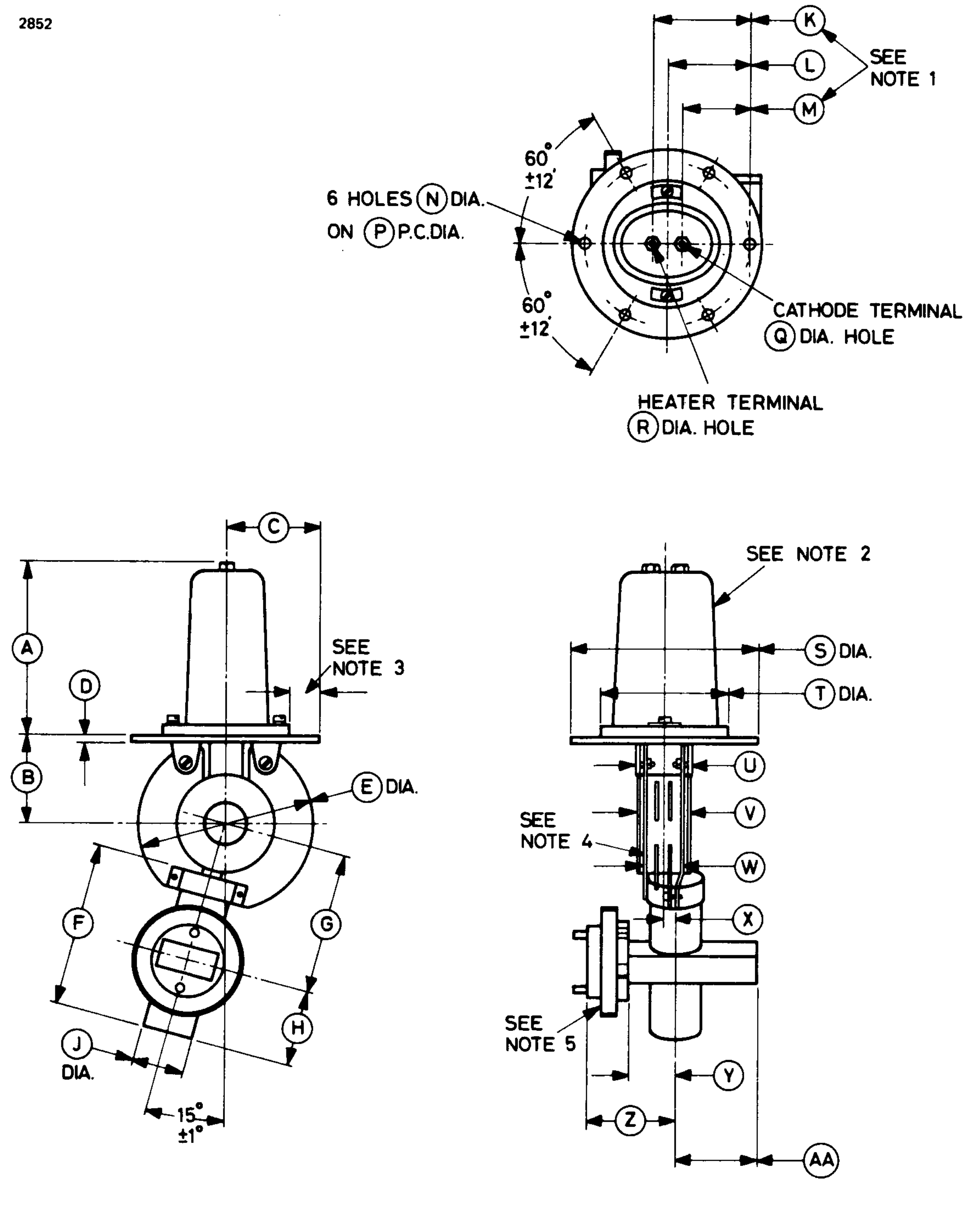
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.984 ± 0.062	75.79 ± 1.57	P	2.875 ± 0.006	73.03 ± 0.15
B	1.500 ± 0.020	38.10 ± 0.51	Q	0.169 ± 0.004	4.293 ± 0.102
C	1.625	41.28	R	0.125 ± 0.002	3.175 ± 0.051
D	0.125	3.175	S	3.250 ± 0.031	82.55 ± 0.79
E	3.062 max	77.77 max	T	2.218 max	56.34 max
F	2.812 max	71.42 max	U	1.107 max	28.12 max
G	2.437 ± 0.020	61.90 ± 0.51	V	0.974 max	24.74 max
H	1.281 max	32.54 max	W	$0.8070^{+0.0050}_{-0.0045}$	$20.498^{+0.127}_{-0.114}$
J	0.875 ± 0.010	22.23 ± 0.25			
K	1.687	42.85	X	0.219	5.56
L	1.437	36.50	Y	0.830 min	21.08 min
M	1.187	30.15	Z	1.500 ± 0.010	38.10 ± 0.25
N	0.193 ± 0.003	4.902 ± 0.076	AA	1.438 max	36.53 max

Millimetre dimensions have been derived from inches.

OUTLINE

2852



See page 8 for Outline Notes

Outline Notes

1. The centre line will be within 0.023 inch (0.58mm) of the nominal position and the spacing between the pin jacks will be 0.500 ± 0.010 inch (12.70 ± 0.25mm).
2. The common cathode connection is indicated by a letter 'C' on this surface.
3. This surface of the mounting flange will be flat to within 0.010 inch (0.25mm).
4. Position of radiator fin assembly may vary 0.020 inch (0.51mm) from centre line through valve.
5. The face of the flange may deviate 1° from the nominal position relative to the axis of the waveguide.

M506A

X-BAND
MAGNETRON

Service Type CV3982

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9360 to 9460	MHz
Typical peak output power	50	kW
Magnet		separate
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
Cooling		forced-air

GENERAL

Electrical

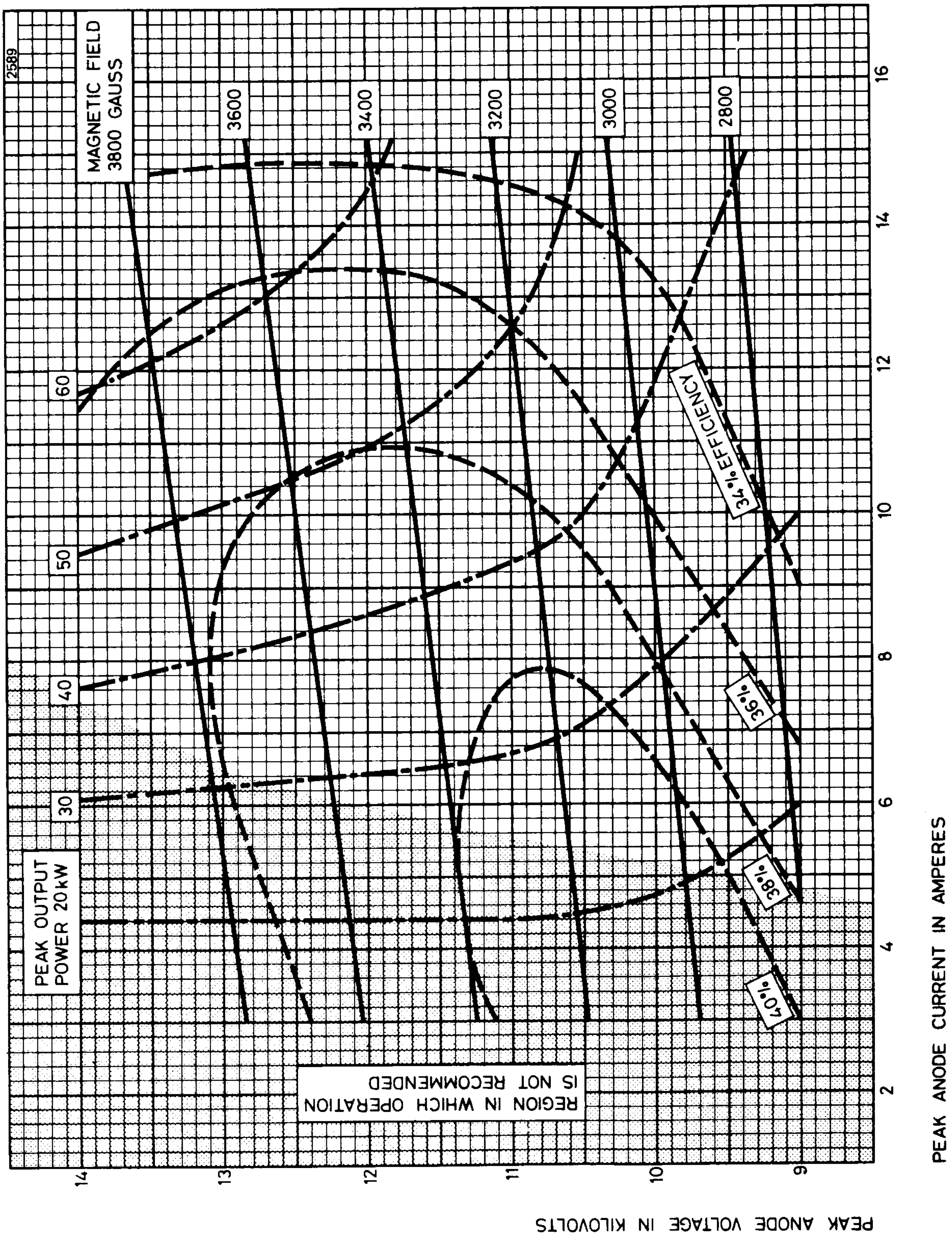
Cathode		indirectly heated
Heater voltage (see note 1)	3.0	V
Heater current at 3.0V	3.8	A
Cathode heating time (minimum)	2.0	min

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 . . . . forced-air

TYPICAL 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	15	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	–	2.0	μs
Rate of rise of voltage pulse (see note 3)	–	200	kV/μs
Anode temperature (see note 4)	–	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 5)	3800	3250	gauss
Anode current (peak)	12	12	A
Pulse length	0.4	1.0	μs
Pulse repetition rate	1100	1000	p.p.s.
Rate of rise of voltage pulse (see note 3)	200	150	kV/μs

Typical Performance

Anode voltage (peak)	14.2	11.5	kV
Output power (peak)	50	50	kW
Output power (mean)	22	50	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 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	0.00044	
Pulse length (see note 6)	1.0	1.0	0.4	μs
V.S.W.R. at the output coupler	1.05:1	1.5:1	1.05:1	
Rate of rise of voltage pulse (see note 3)	150	150	200	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	10.5	12.5	–	–	13	15.5	kV
Output power (mean)	35	–	–	–	20	–	W
Efficiency	27	–	–	–	–	–	%
Frequency (see note 7)	9360	9460	–	–	–	–	MHz
R.F. bandwidth at ¼ power (see note 8)	–	–	–	3.0	–	7.5	MHz
Frequency pulling	–	–	–	15	–	–	MHz
Frequency pushing (see note 9)	–	5.0	–	–	–	–	MHz
Missing pulse count (see note 10)	–	–	–	0.25	–	–	%

Cold impedance . . . . see note 11
Mode change . . . . 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 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	9360 to 9460	MHz

NOTES

1. With no anode input power.

   On the application of anode power, the heater voltage must be reduced according to the following schedule.

Mean input power (W)	Heater voltage (V)
up to 30	3.0
31 to 80	2.5
81 to 120	2.0
121 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.

   The M506A has been tested for satisfactory operation with sinusoidal heater voltages of 50, 1100 and 2000Hz. English Electric Valve Co. Ltd. should be consulted if other supply frequencies are to be used.

2. 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.

3. 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.

4. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode fins.

5. Tolerance ±50 gauss at 3250 gauss and ±100 gauss at 3800 gauss. The north pole of the magnet must be adjacent to the cathode terminal.

6. Tolerance ±10%.

7. At anode temperature 25°C.

8. The maximum bandwidth in MHz is given by 3.0/(pulse length in μs).

9. Mean anode current varied between 12 and 14mA.

10. 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 to 9470MHz.

11. 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.

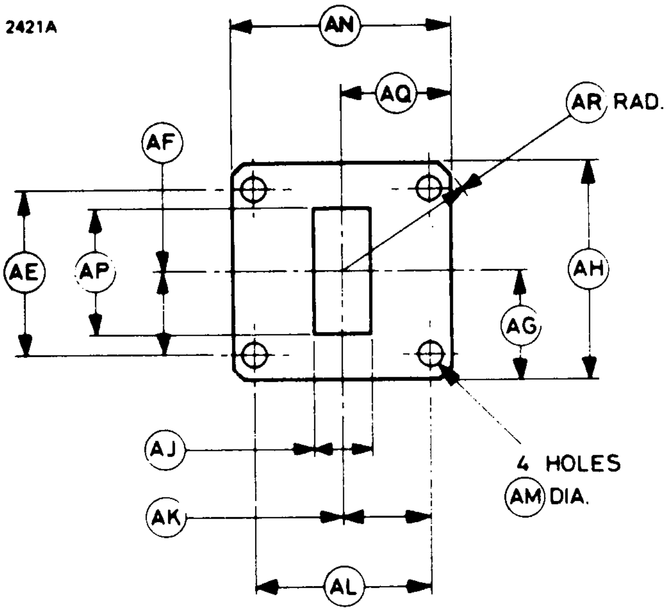
12. Over the range 8 to 15mA, no pulses shall be missing when viewed with a spectrum analyser, nor double traces of voltage or current observed on the oscilloscope.

13. Measured with heater voltage of 3.0V and no anode input power, the heater current limits are 3.5A minimum, 4.0A maximum.

14. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/$^{\circ}$C.

Output Flange (All dimensions without limits are nominal)

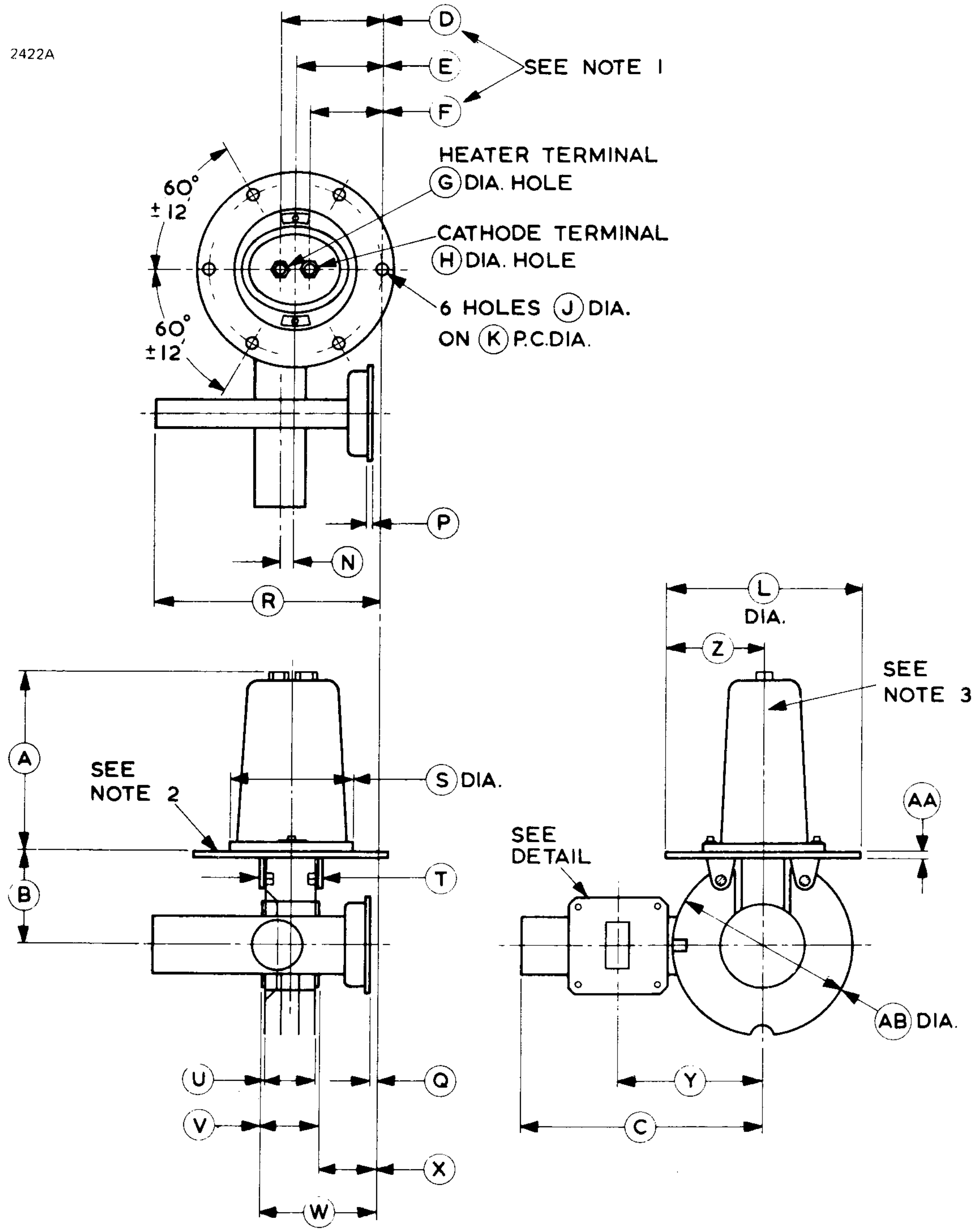
2421A



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AE	1.220 ± 0.004	30.988 ± 0.102	AL	1.280 ± 0.004	32.512 ± 0.102
AF	0.610	15.49	AM	0.1495 ± 0.003	3.797 ± 0.076
AG	0.812 ± 0.015	20.62 ± 0.38	AN	1.625 ± 0.015	41.28 ± 0.38
AH	1.625 ± 0.015	41.28 ± 0.38	AP	0.900	22.86
AJ	0.400	10.16	AQ	0.812 ± 0.015	20.62 ± 0.38
AK	0.640	16.26	AR	1.062	26.97

Millimetre dimensions have been derived from inches.

OUTLINE (See page 8 for outline dimensions and notes)



Outline Dimensions (All dimensions without limits are nominal)

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	$0.8070^{+0.0050}_{-0.0045}$	$20.498^{+0.127}_{-0.114}$
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 ± 0.015	61.90 ± 0.38
L	3.250 ± 0.031	82.55 ± 0.79	Z	1.625	41.28
N	0.219	5.56	AA	0.125	3.18
P	0.110 ± 0.005	2.79 ± 0.13	AB	3.062 max	77.77 max

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.

M513A

X-BAND MAGNETRON

Service Type CV3528

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	22	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
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	min

Mechanical

Overall dimensions	5.375 x 5.031 x 4.468 inches max 136.5 x 127.8 x 113.5mm max
Net weight	5 pounds (2.3kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 5) . . . . natural or forced-air

January 1970

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	–	2.0	μs
Rate of rise of voltage pulse (see note 4)	–	100	kV/μs
Anode temperature (see note 5)	–	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 6)	–	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 7)	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 4)	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 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	–	MHz max
Frequency	9345 to 9405	–	MHz
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:

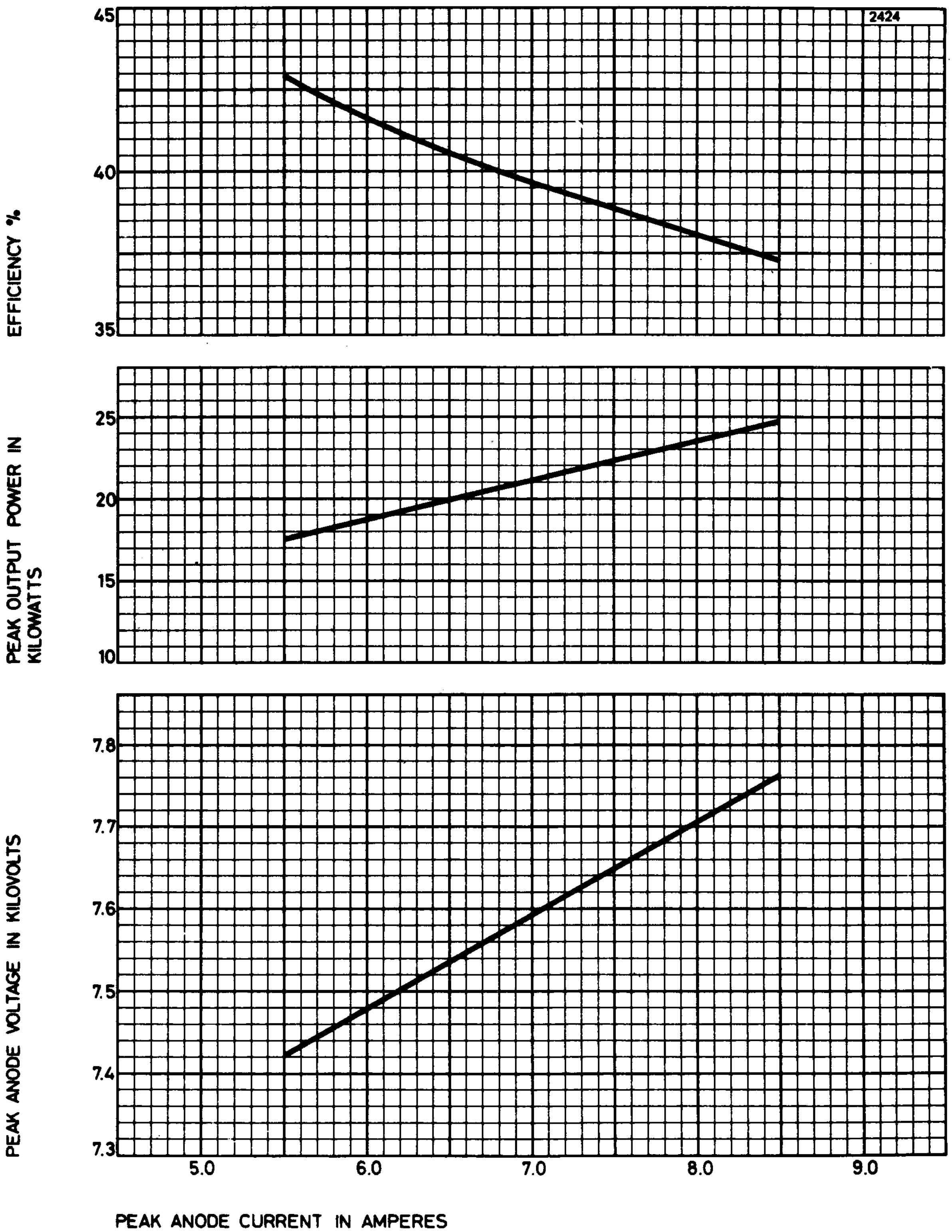
   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{volts}$$

   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:

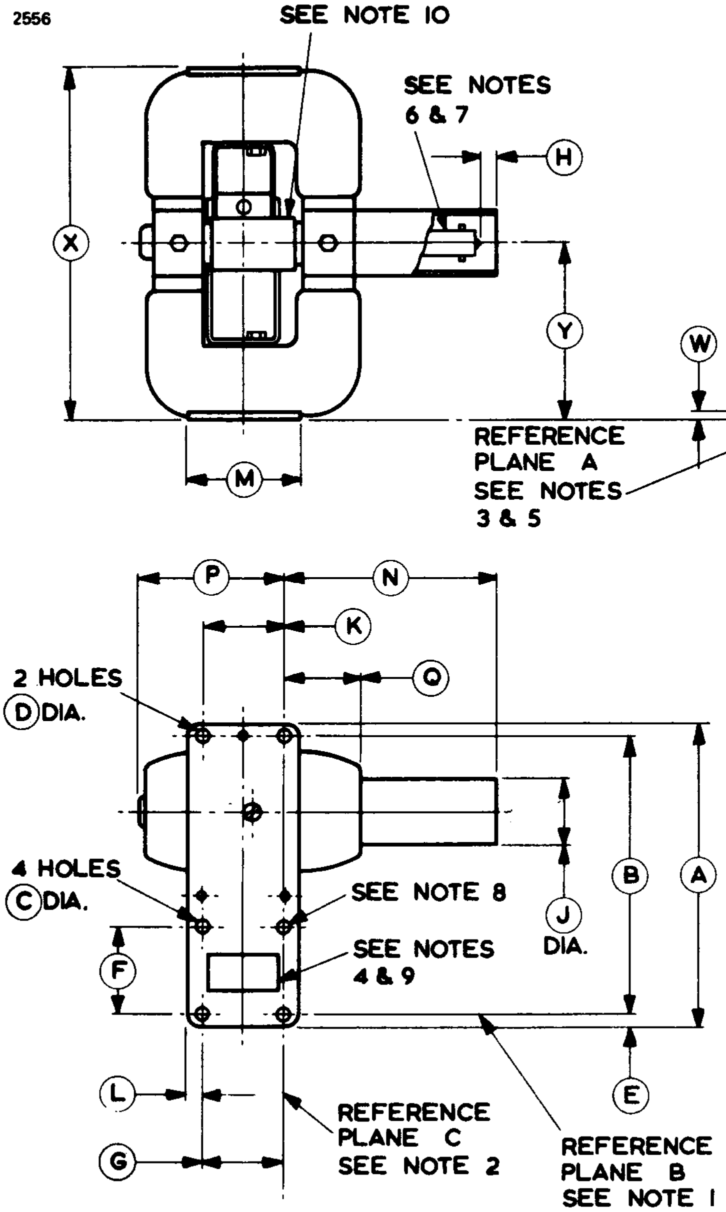
   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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. Defined as steepest tangent to leading edge of voltage pulse above 80% amplitude. Any capacitance in 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. At the maximum pressure of 45 lb/in² (3.16kg/cm²) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.
7. Tolerance ±10%.
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 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 frequency change with anode temperature change after warm-up will not exceed −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
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.

Outline Notes

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 UG-40B/U (5985-99-083-0051).
5. Surface A and interior surfaces of 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.

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 coupler UG-40B/U (5985-99-083-0051).
10. The anode temperature is measured at this point.

M513B

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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 3.313 inches max 133.4 x 113.5 x 84.15mm 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	–	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 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 45 lb/in² (3.16kg/cm²) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. Other frequency ranges can be supplied on request.

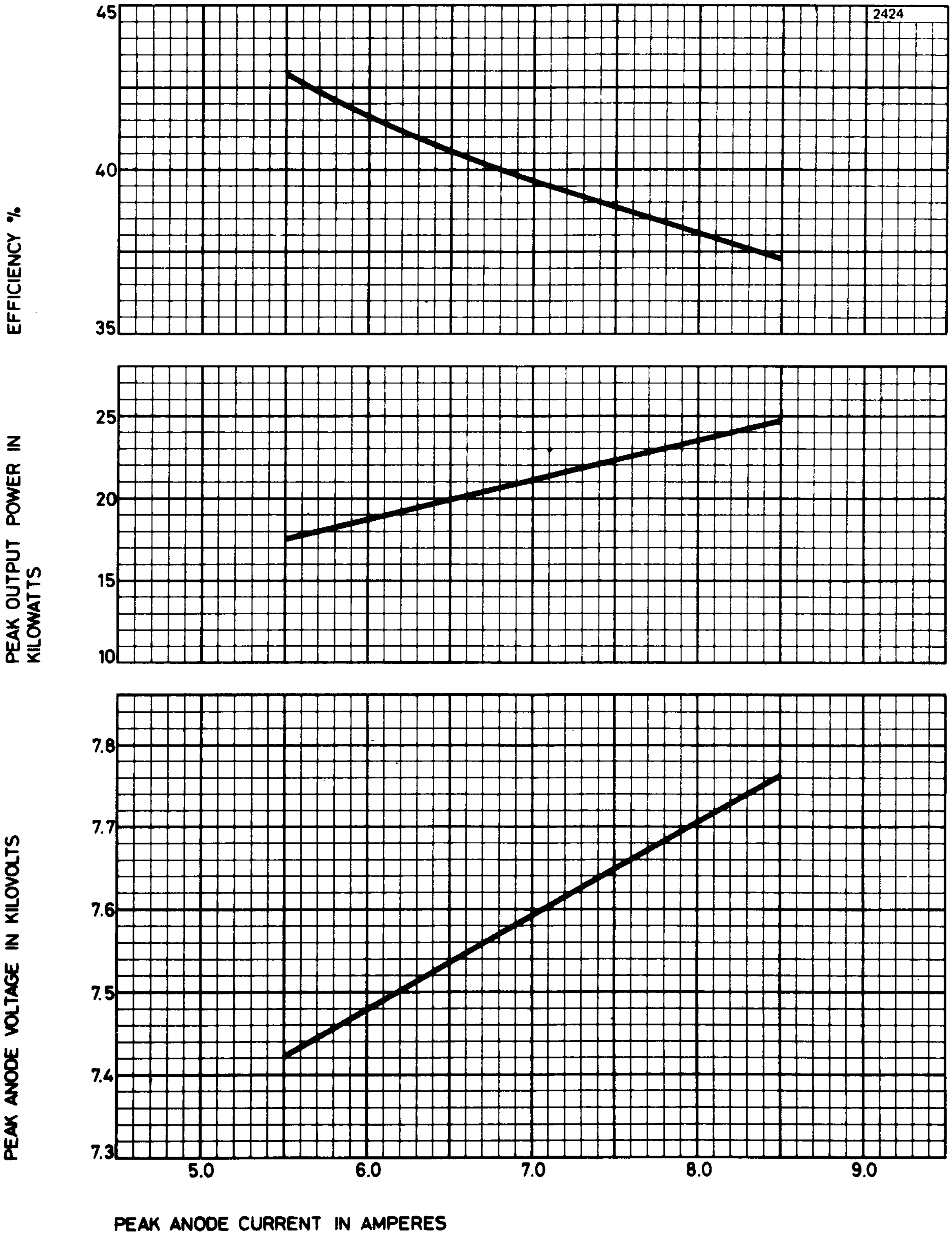
9. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after 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.

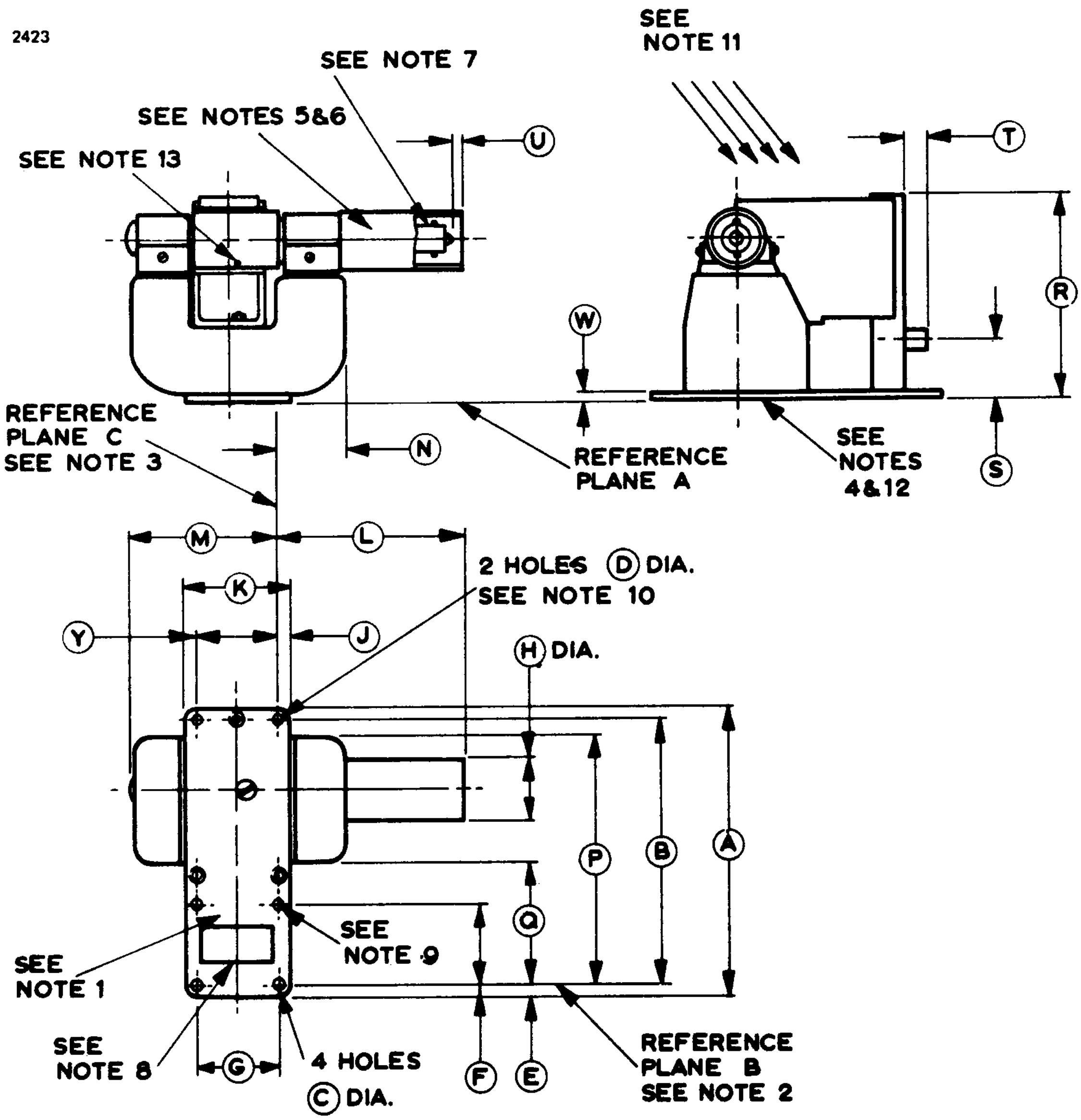
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL 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	3.313 max	84.15 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 UG-40B/U (5985-99-083-0051) 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 UG-40B/U (5985-99-083-0051) (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 Magnetron Preamble.

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-40B/U (5985-99-083-0051)

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	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	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

	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)	170	170	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	9380 to 9440	MHz
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.

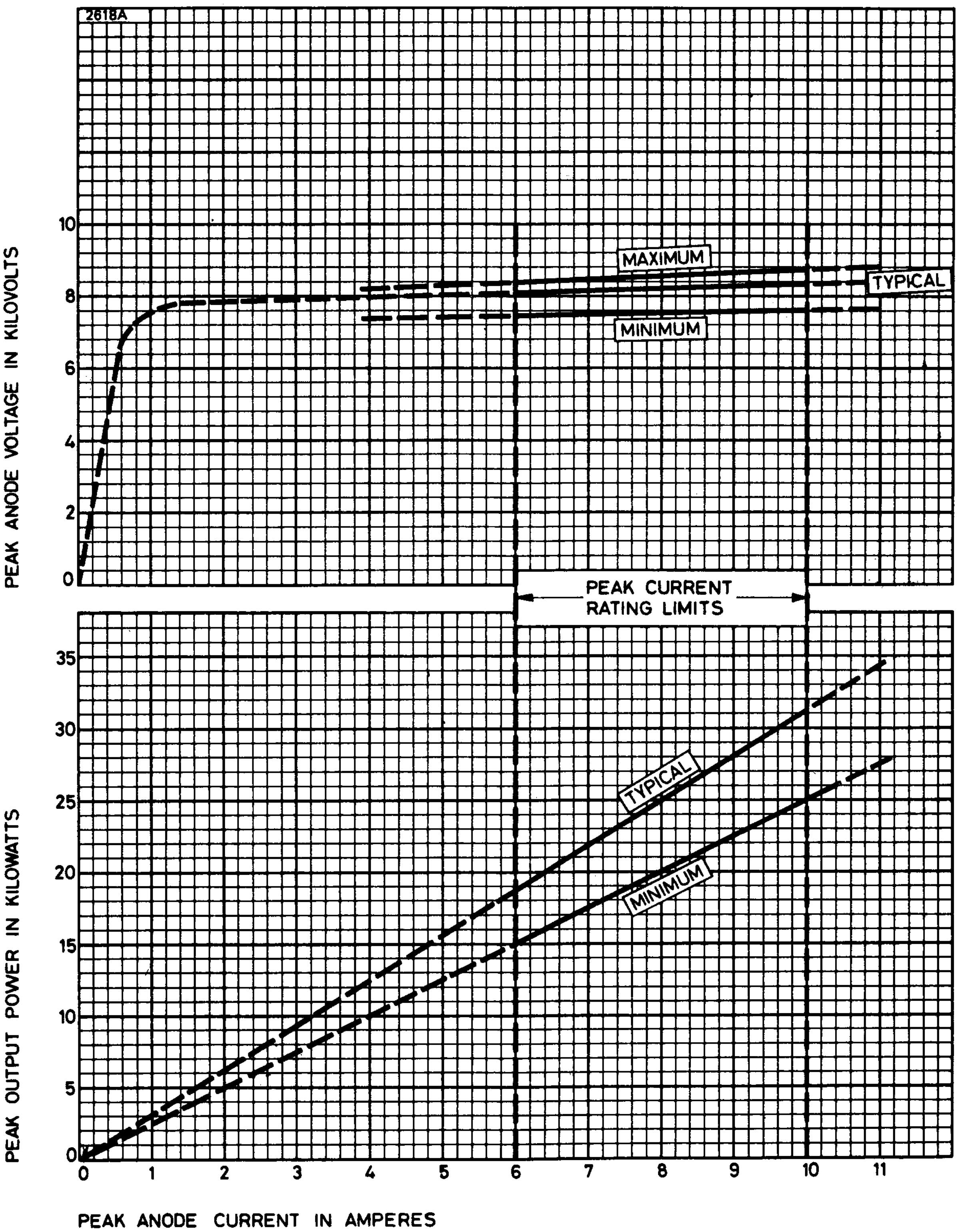
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after 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.

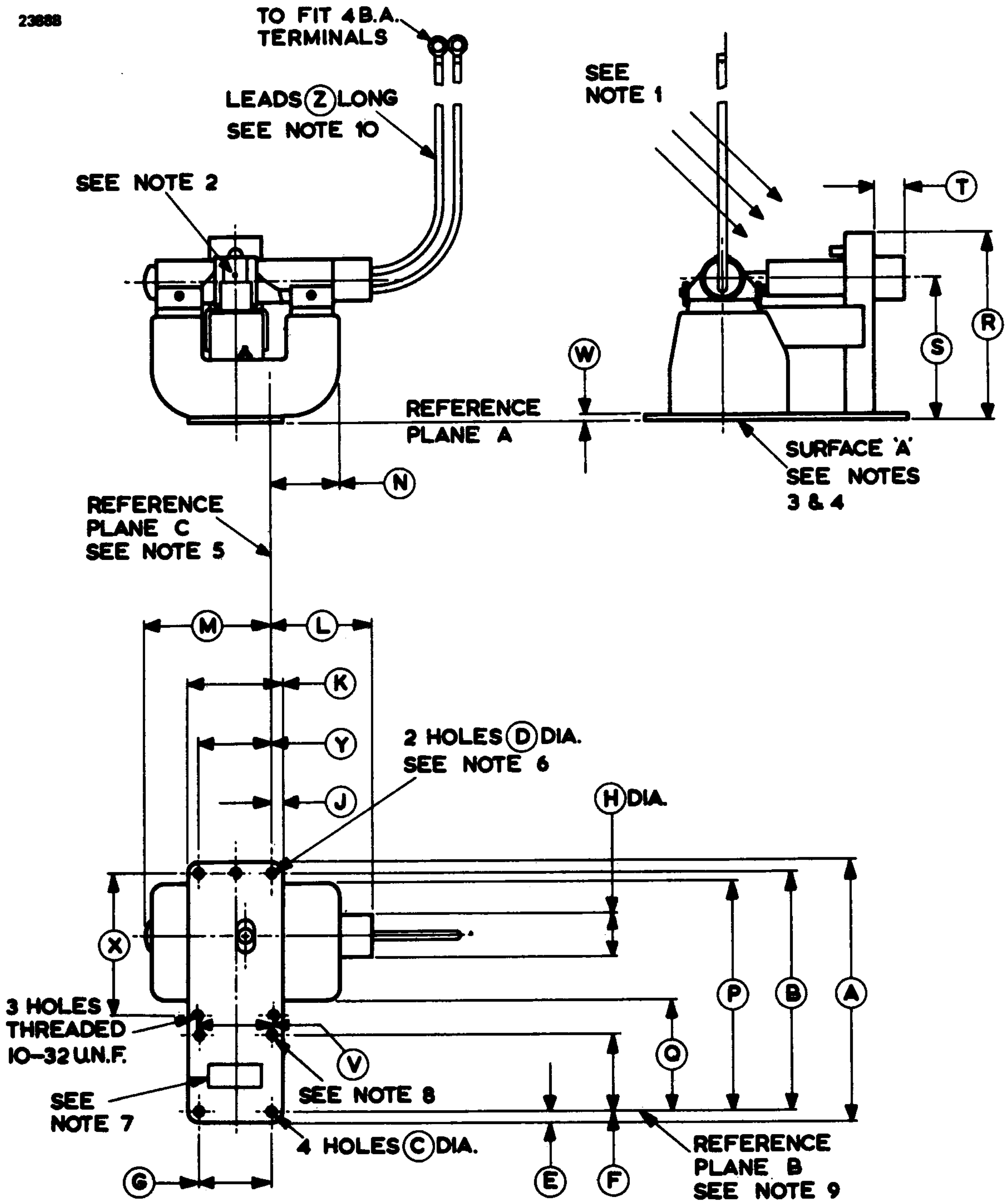
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

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	V	1.250	31.75
H	1.000 max	25.40 max	W	0.125	3.18
J	0.204 ± 0.015	5.18 ± 0.38	X	2.393	60.78
K	1.625 ± 0.016	41.28 ± 0.41	Y	1.220 ± 0.004	30.99 ± 0.10
L	2.063 max	52.40 max	Z	12.250 ± 0.500	311.2 ± 12.7
M	2.187 max	55.55 max			

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.

10. Length of flying leads measured from the centre line of anode block.

M521

X-BAND MAGNETRON

Service Type CV2376

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
Cooling		forced-air

GENERAL

Electrical

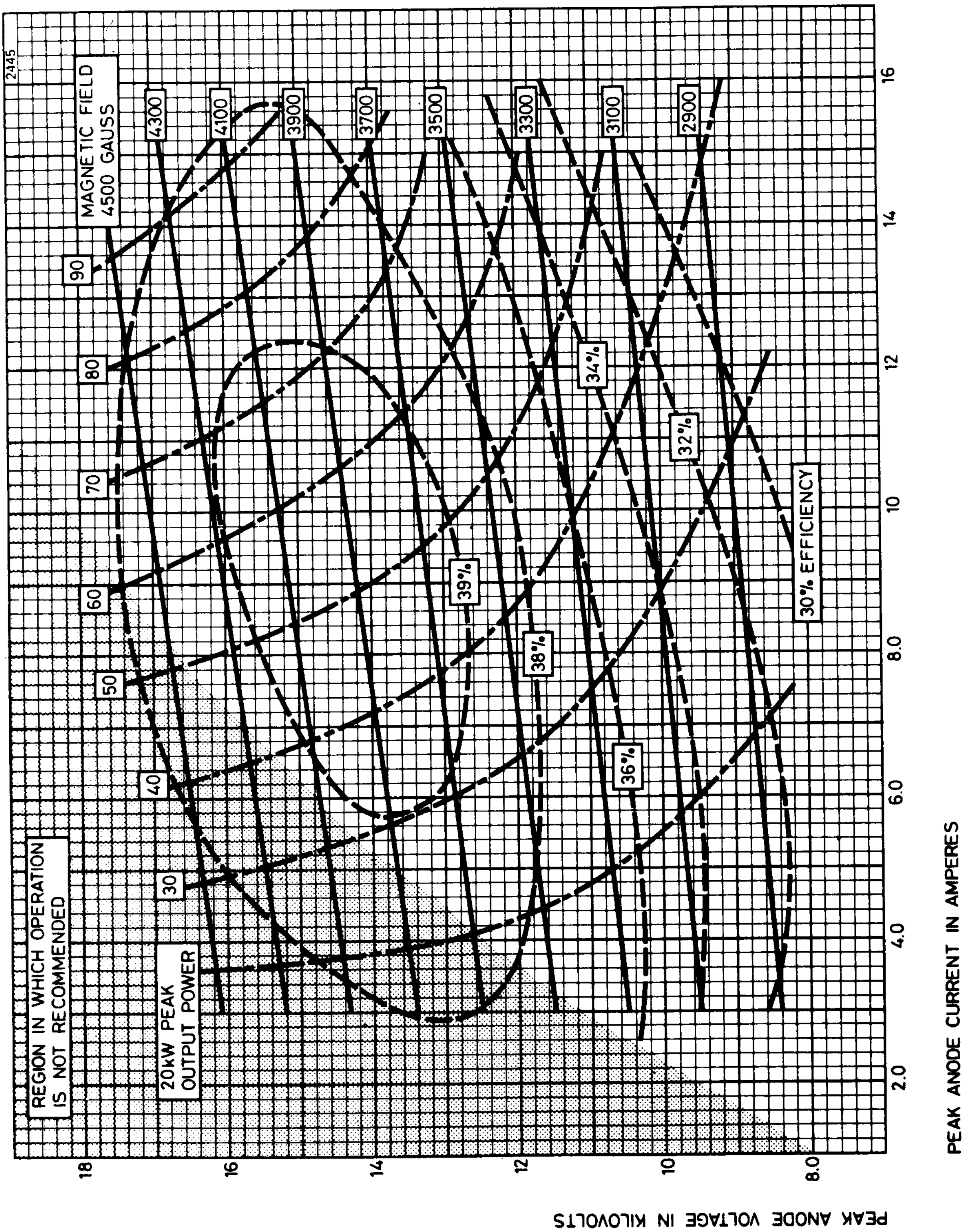
Cathode		indirectly heated
Heater voltage (see note 1)	3.0	V
Heater current at 3.0V	3.5	A
Cathode heating time (minimum)	2.0	min

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

TYPICAL 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	–	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	9600 to 9700	MHz

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:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

   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.

3. Tolerance ±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 ±50 gauss. The north pole of the magnet must be adjacent to the cathode terminal.

7. At anode temperature 25°C.

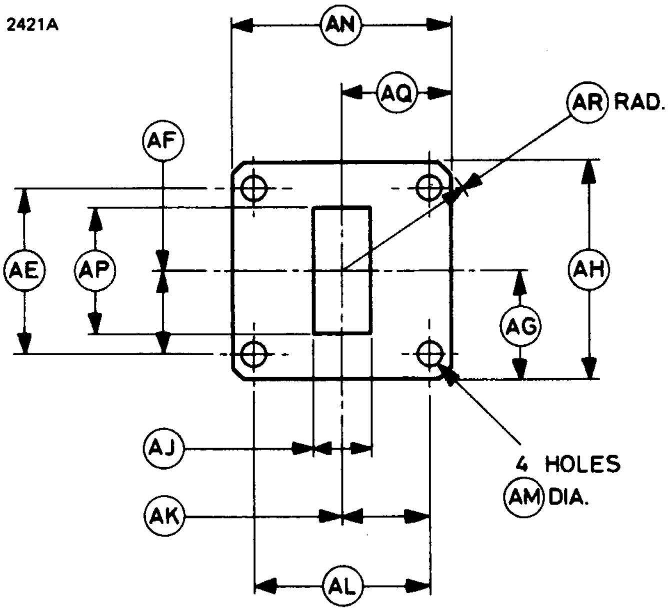
8. The maximum bandwidth in MHz is given by 3.0/(pulse length in μs).

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/°C.

Output Flange (All dimensions without limits are nominal)

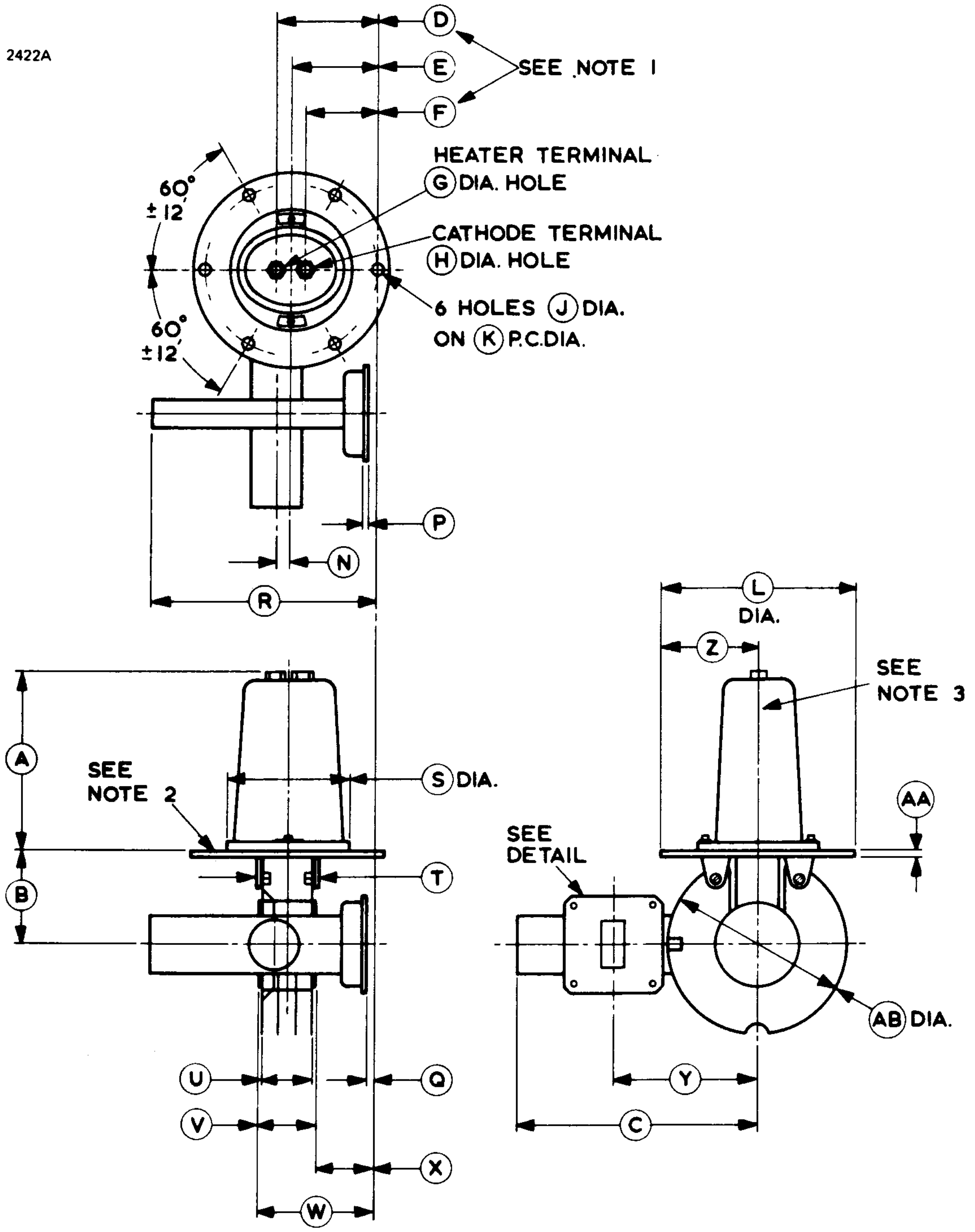


Ref	Inches	Millimetres
AE	1.220 ± 0.004	30.988 ± 0.102
AF	0.610	15.49
AG	0.812 ± 0.015	20.62 ± 0.38
AH	1.625 ± 0.015	41.28 ± 0.38
AJ	0.400	10.16
AK	0.640	16.26
AL	1.280 ± 0.004	32.512 ± 0.102
AM	0.170 ± 0.003	4.318 ± 0.076
AN	1.625 ± 0.015	41.28 ± 0.38
AP	0.900	22.86
AQ	0.812 ± 0.015	20.62 ± 0.38
AR	1.062	26.97

Millimetre dimensions have been derived from inches.

OUTLINE (See page 8 for outline dimensions and notes)

2422A



Outline Dimensions (All dimensions without limits are nominal)

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	$0.8070^{+0.0050}_{-0.0045}$	$20.498^{+0.127}_{-0.114}$
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
N	0.219	5.56	AA	0.125	3.18
P	0.110 ± 0.005	2.79 ± 0.13	AB	3.062 max	77.77 max

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.

M537A

X-BAND MAGNETRON

Service Type CV6108

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	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 7) . . . . 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 note 4)	–	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.

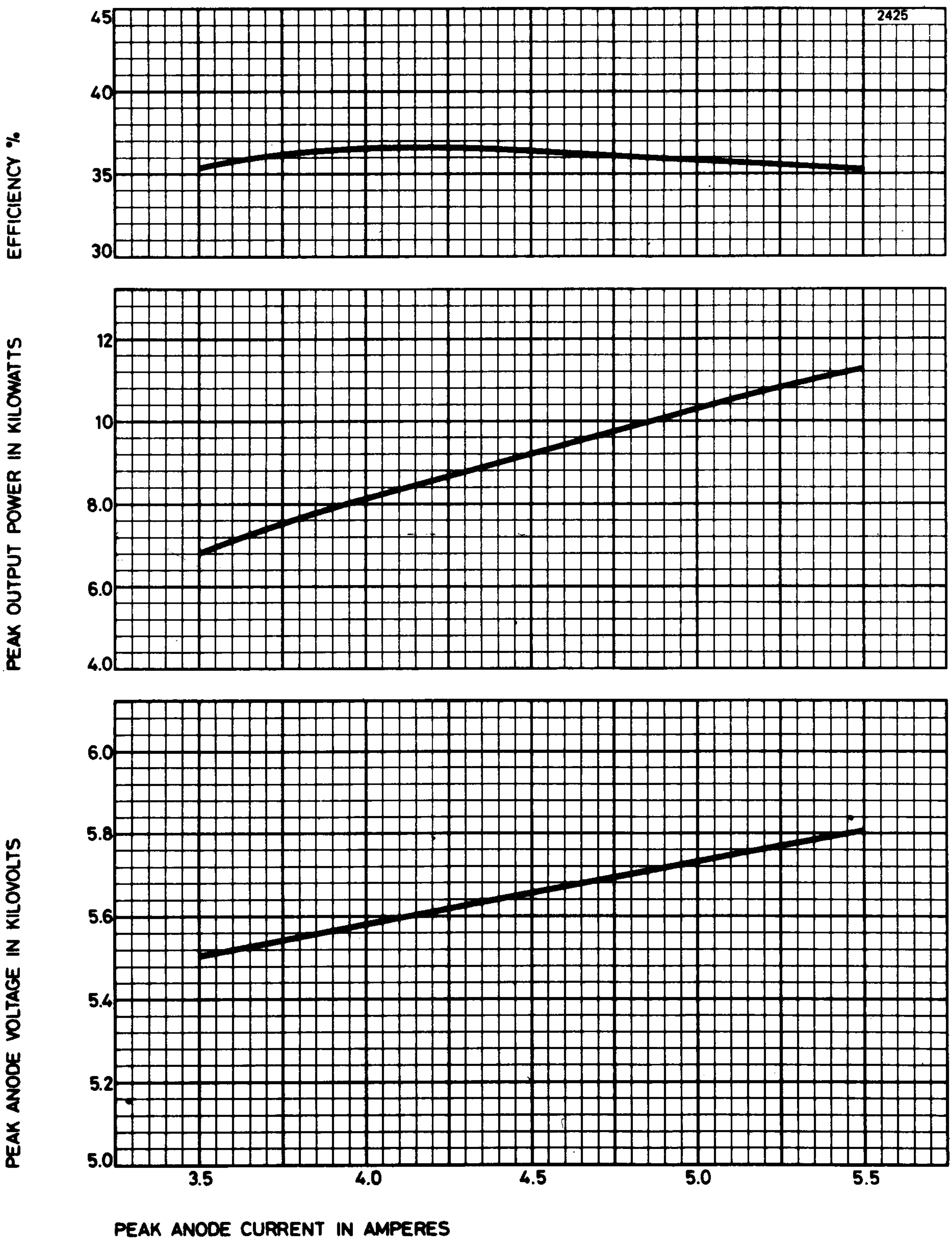
9. The bandwidth is measured at ¼ power points. The side lobes will be at least 6db down.

10. Measured with a v.s.w.r. greater than 1.5:1 in all phases of the mis-

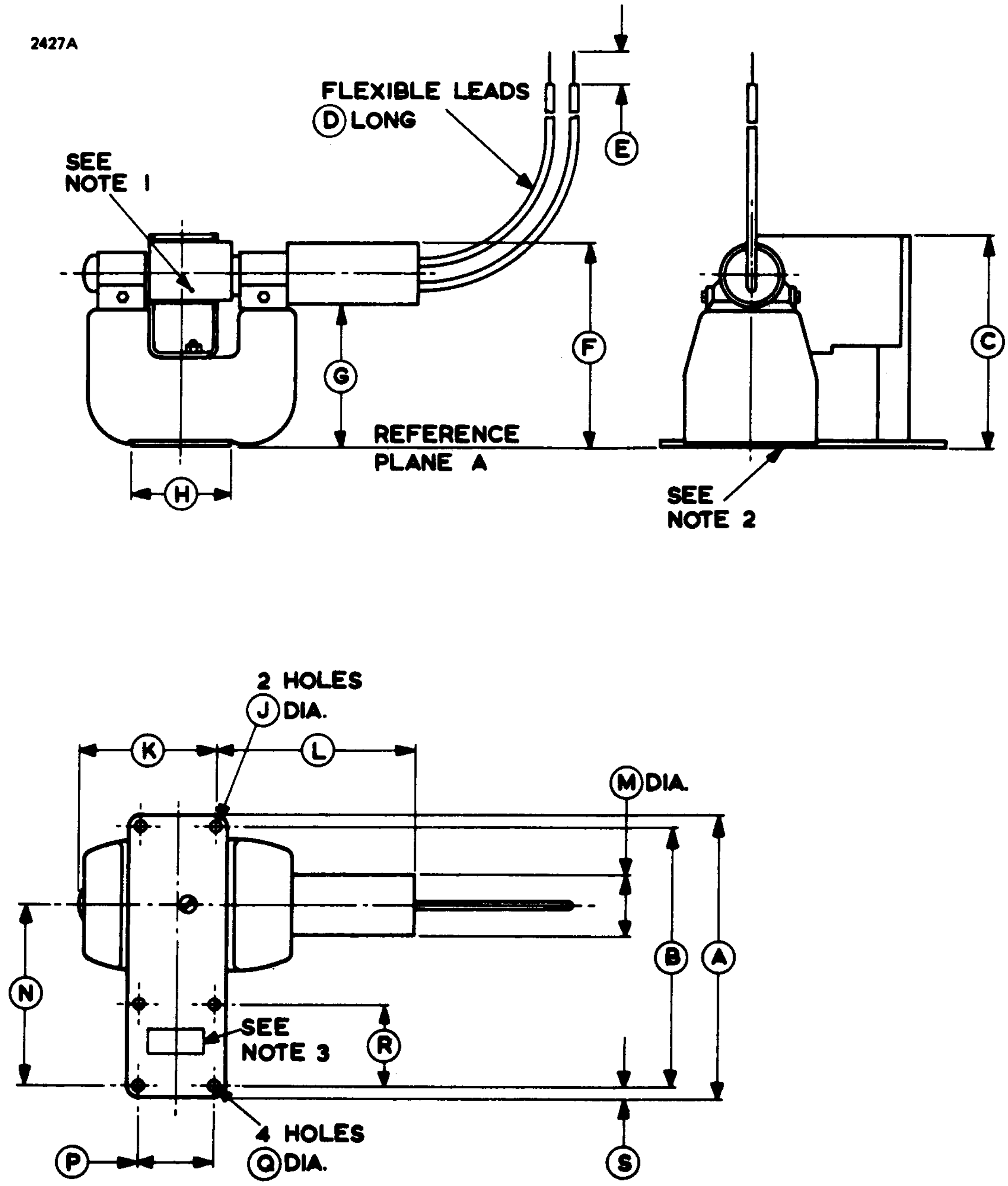
match. Frequency pulling is the maximum variation in frequency as the mismatch is varied through all phases.

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 to 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.

TYPICAL PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Yellow	Heater
Green	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

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-40B/U (5985-99-083-0051).

M538A

X-BAND MAGNETRON

Service Type CV2473

The data should be read in conjunction with the Magnetron Preamble.

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	–	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/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

	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	9210 to 9270	MHz
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 ±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

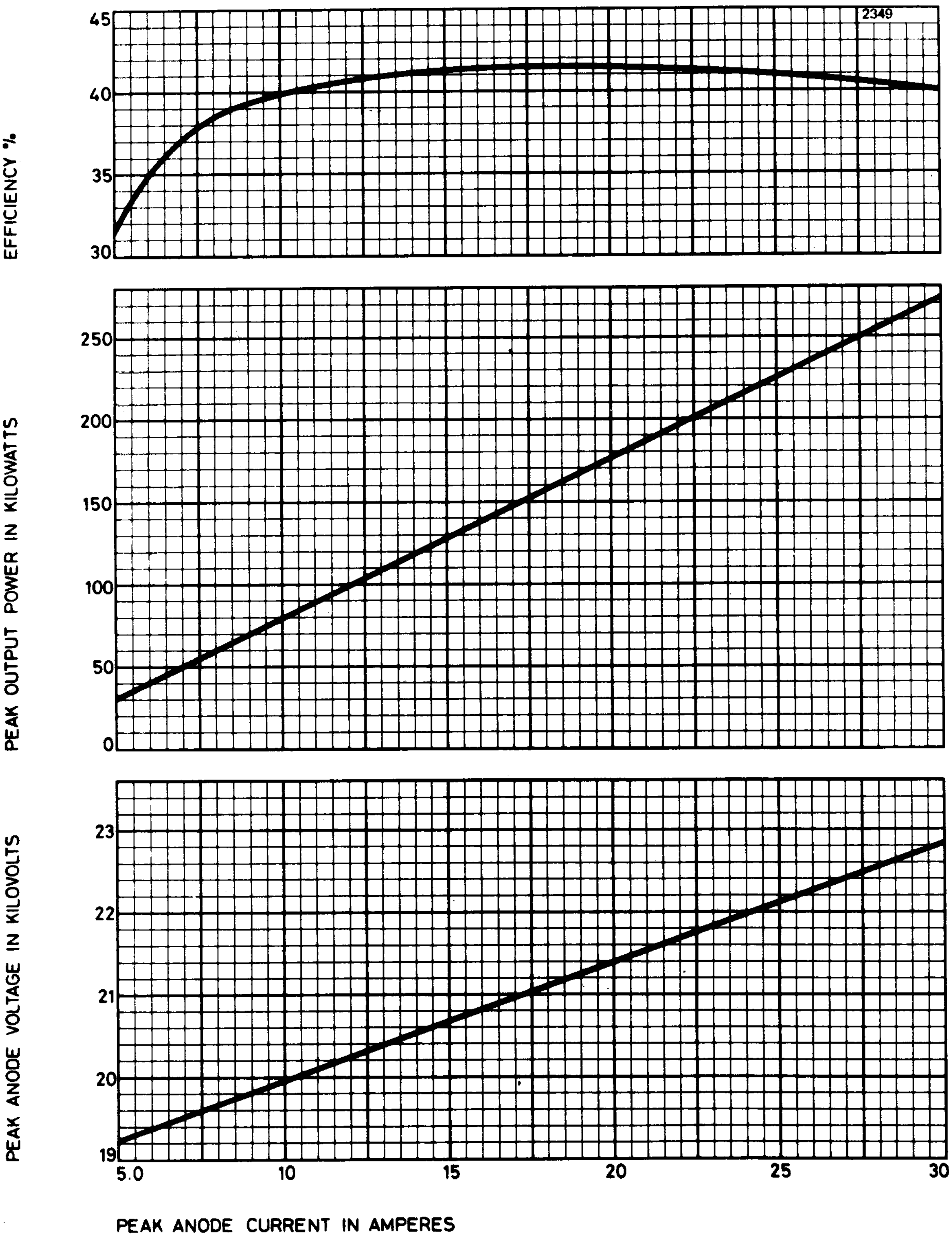
(108 x 31.8mm) will keep the temperature rise below 50°C.

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 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.

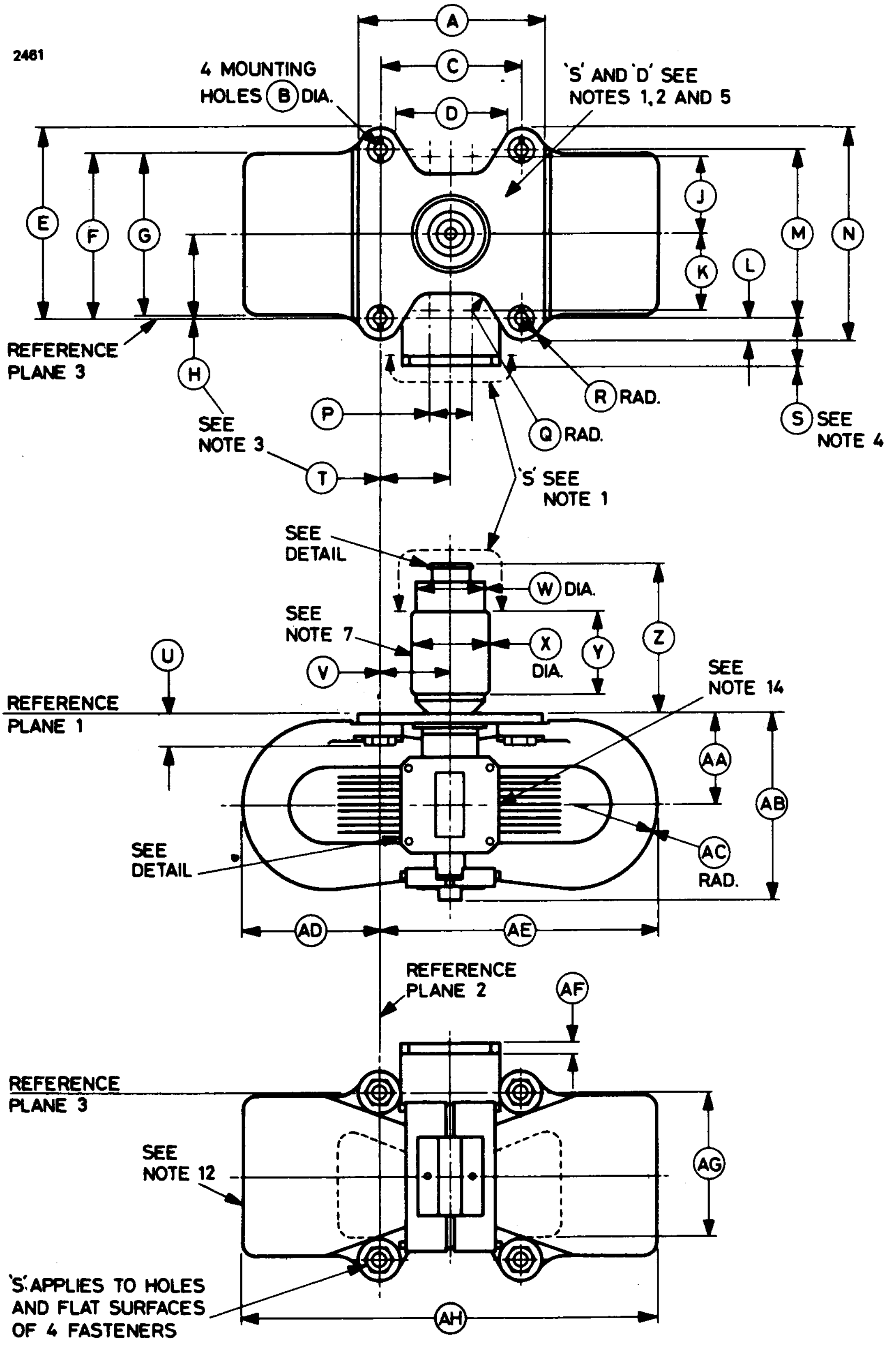
X-RAY WARNING

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.

TYPICAL PERFORMANCE CHART

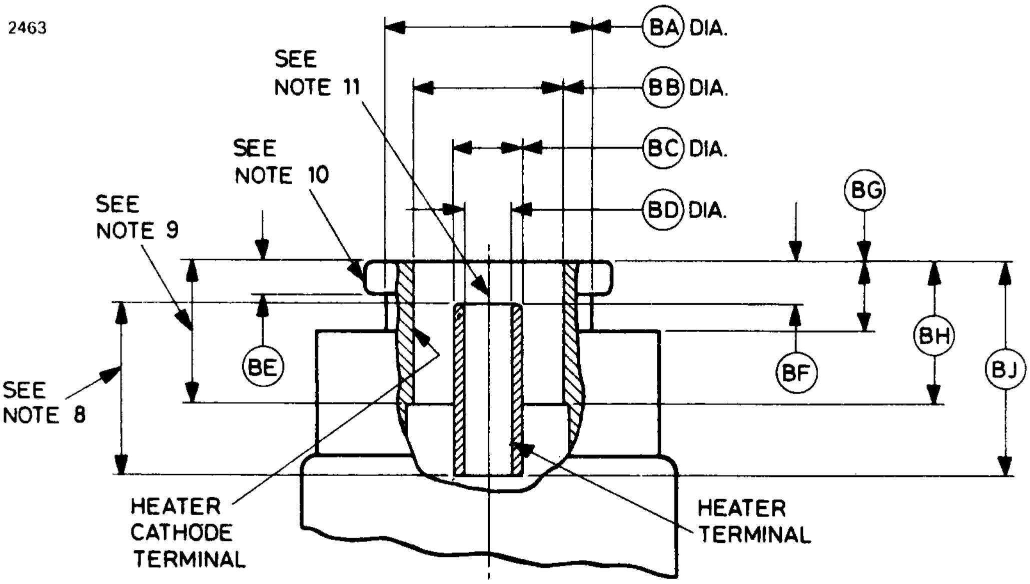


OUTLINE (See page 10 for Outline Notes)

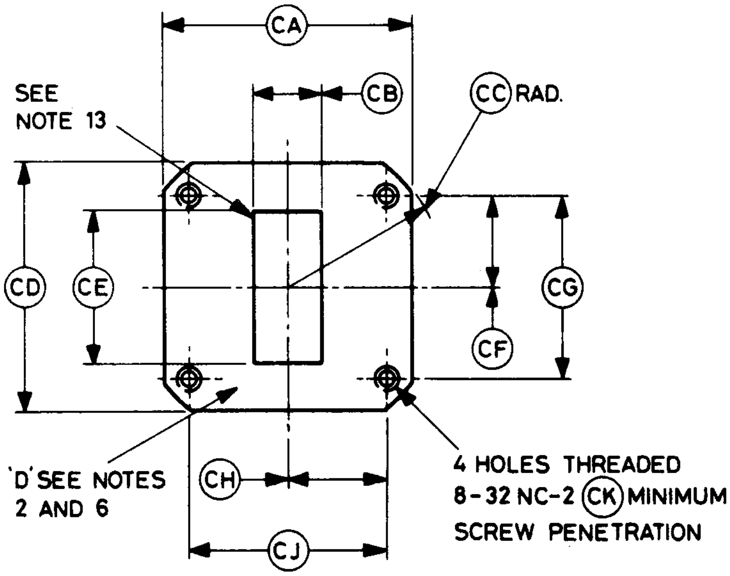


OUTLINE DETAILS (See page 10 for Outline Notes)

Terminal Assembly



Waveguide Flange



Outline Dimensions (All dimensions without limits are nominal)

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.

M540B

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

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-40B/U (5985-99-083-0051)
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 3.313 inches max 133.4 x 113.5 x 84.15mm 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	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	250	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	250	250	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)	250	250	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:

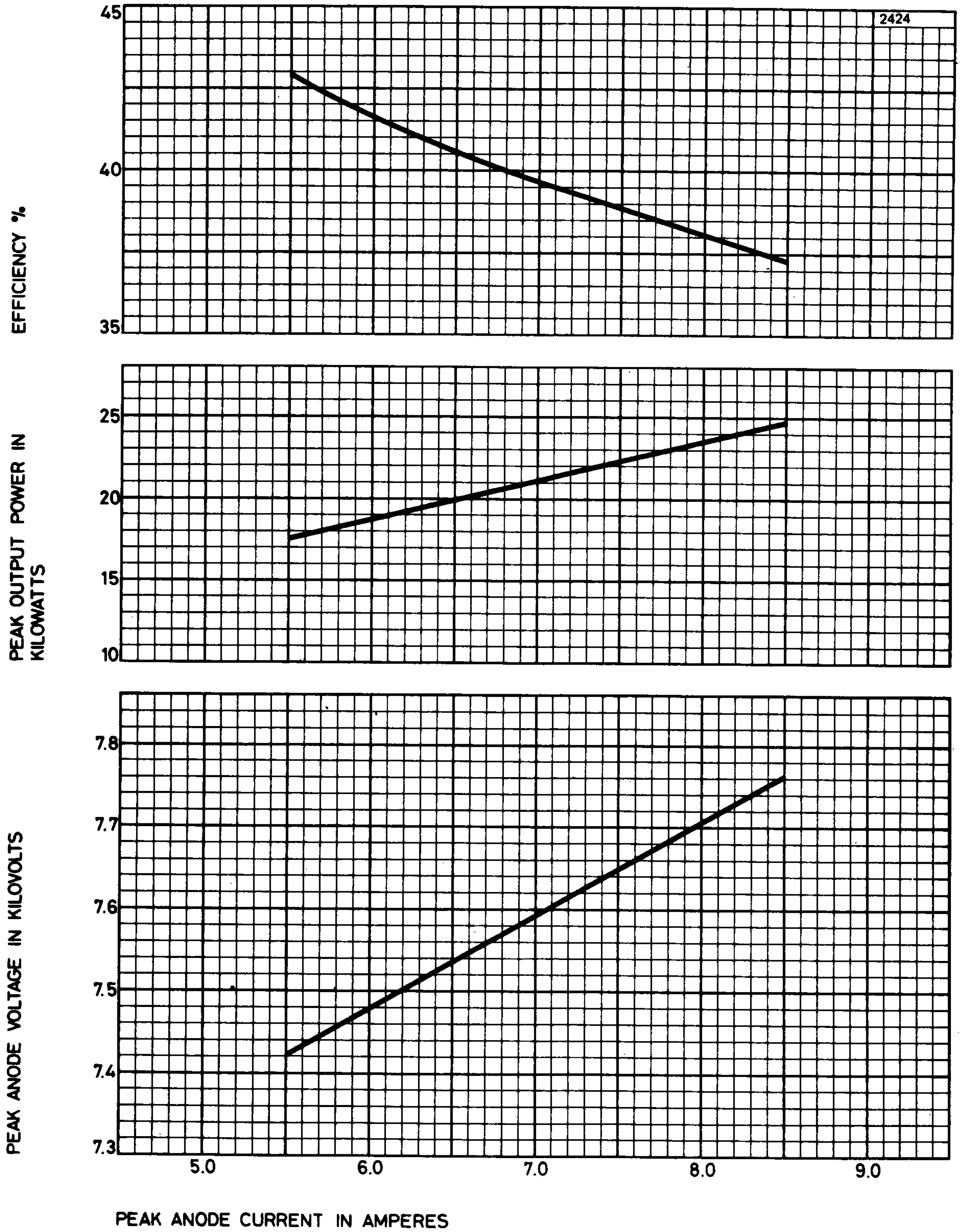
   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{volts}$$

   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 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:

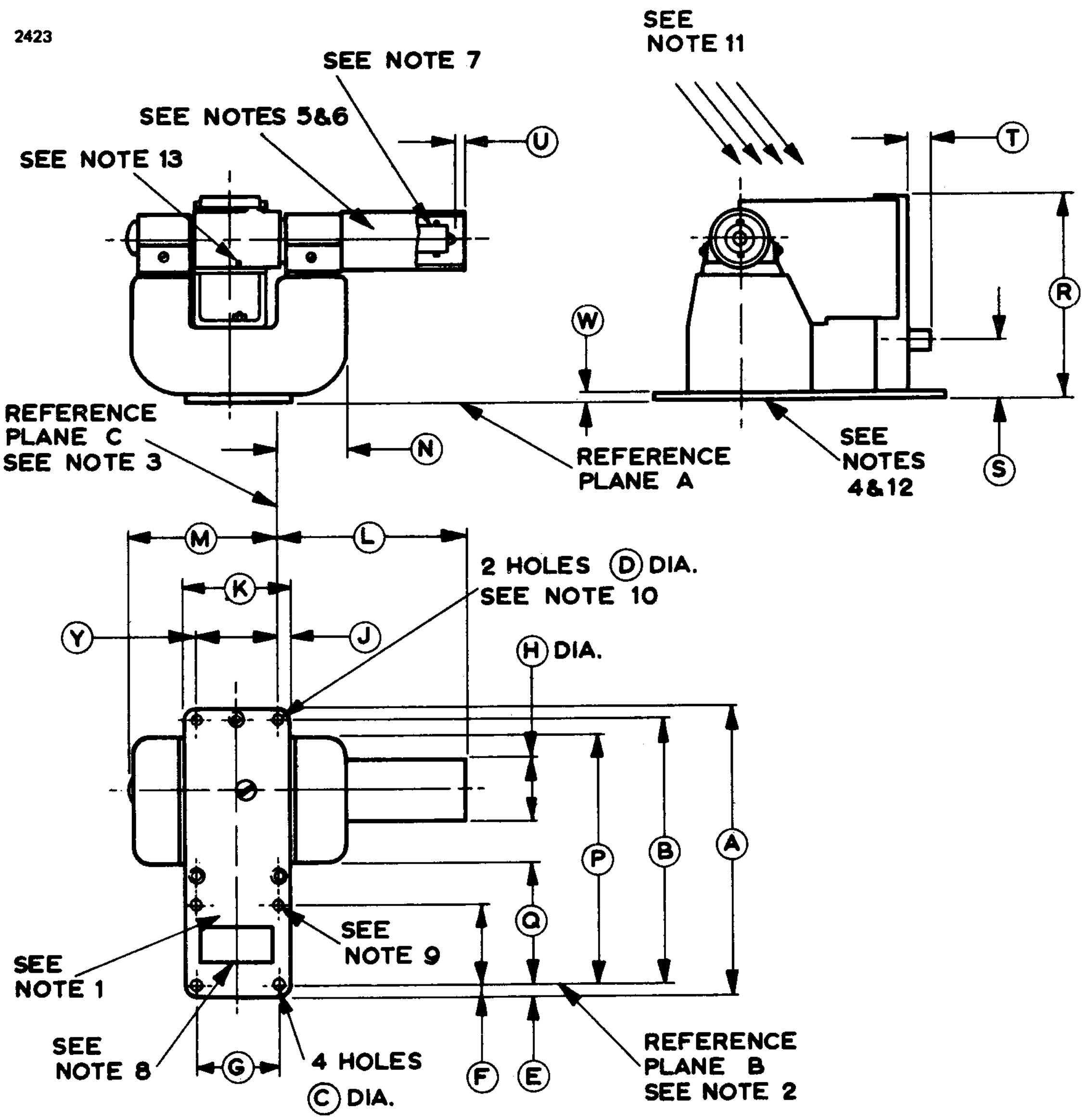
   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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 45 lb/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 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 −0.25MHz/°C.

TYPICAL 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	3.313 max	84.15 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 UG-40B/U (5985-99-083-0051) 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 UG-40B/U (5985-99-083-0051) (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.

M575

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	–	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	9345 to 9405	MHz
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:

   $$V_h = 10.0 \left[1 - \frac{Pi}{900} \right] \text{volts}$$

   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; 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:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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, ±50% for pulse length 0.1μs.

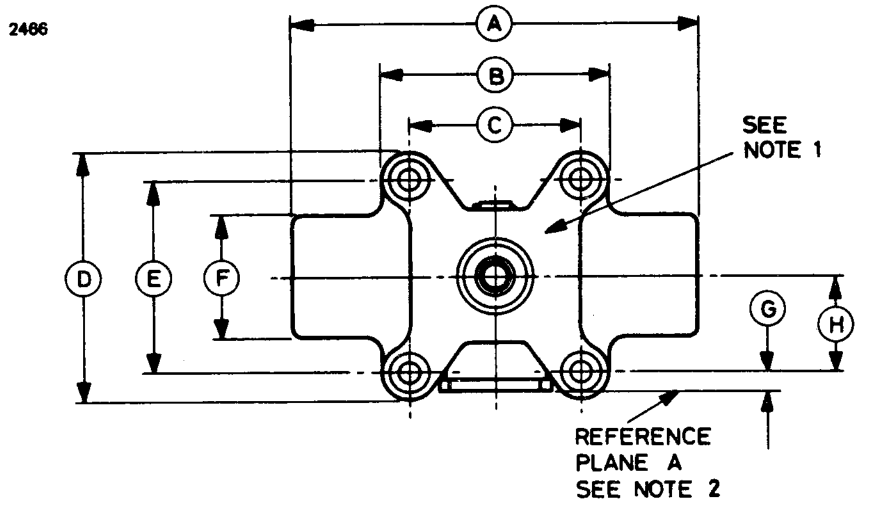
5. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

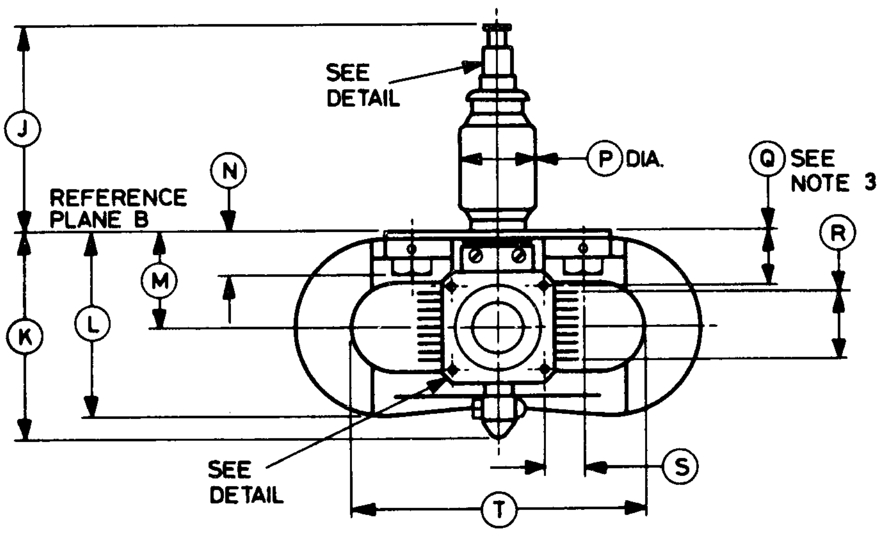
6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode fins.

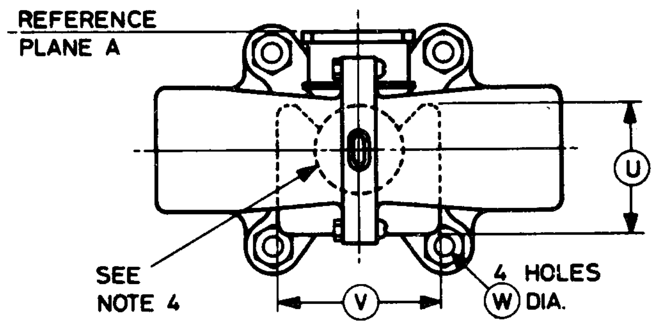
7. With the valve operating into a v.s.w.r. of 1.5:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after 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 (All dimensions without limits are nominal)

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

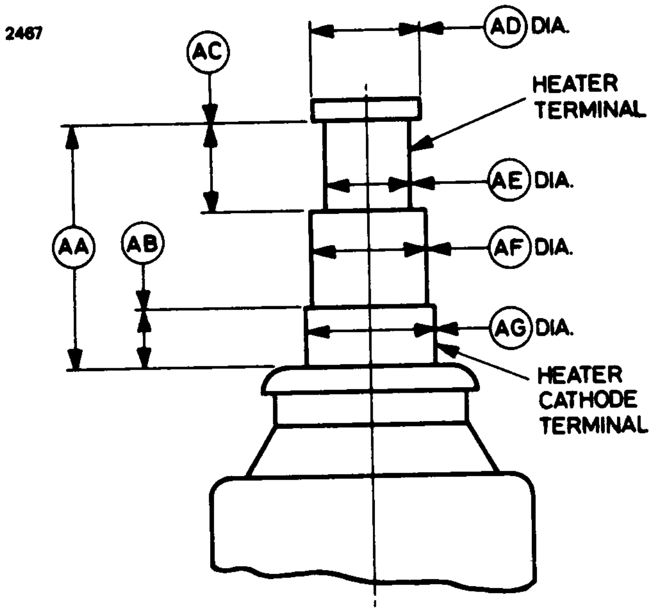
Millimetre dimensions have been derived from inches.

Outline Notes

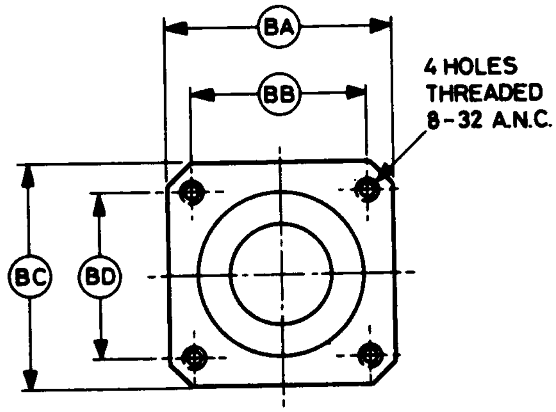
1. The flatness of the mounting flange will be such that with reference plane B resting on a flat surface a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) between reference plane B and the surface at any point.
2. With reference plane 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 Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	–	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

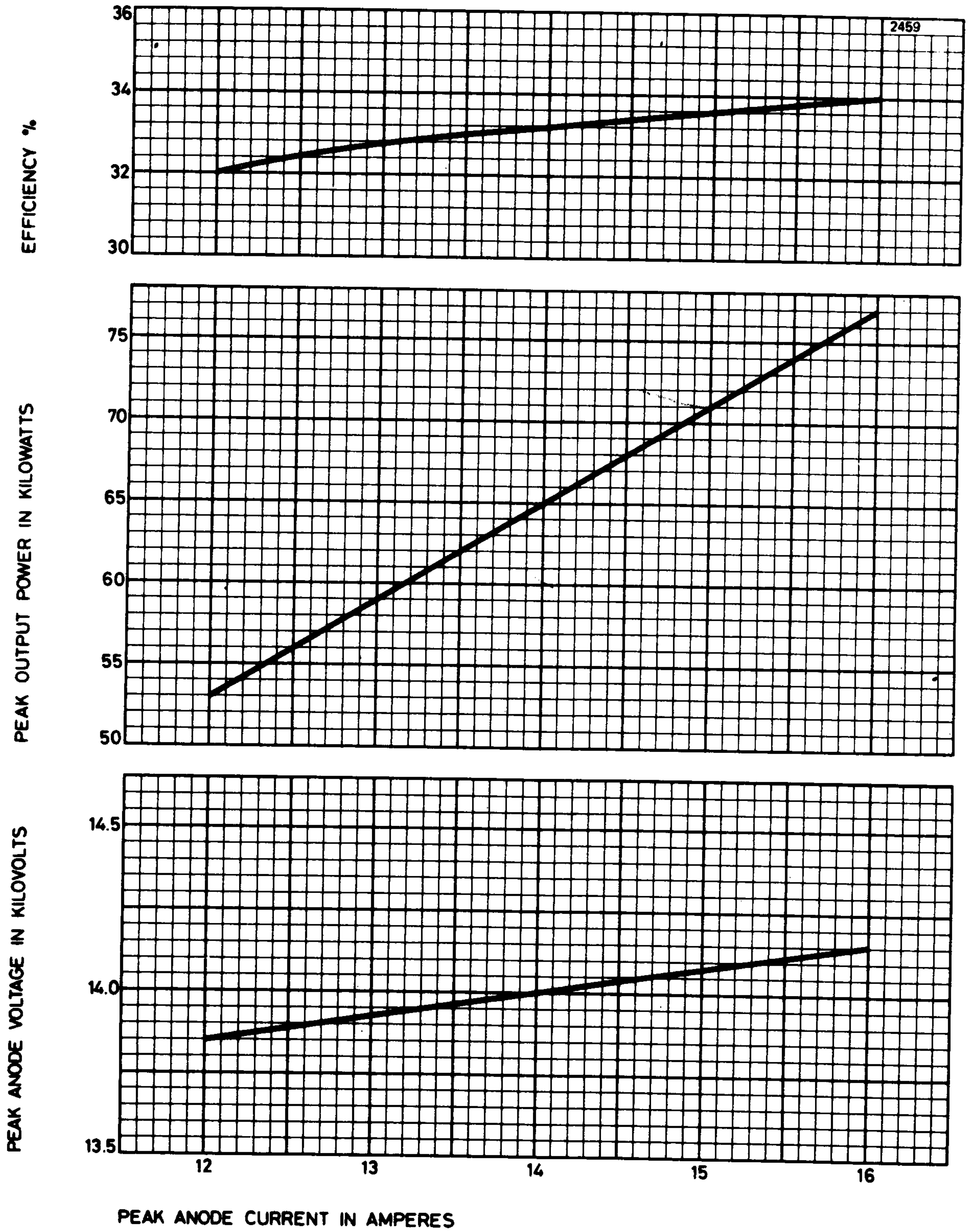
NOTES

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:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

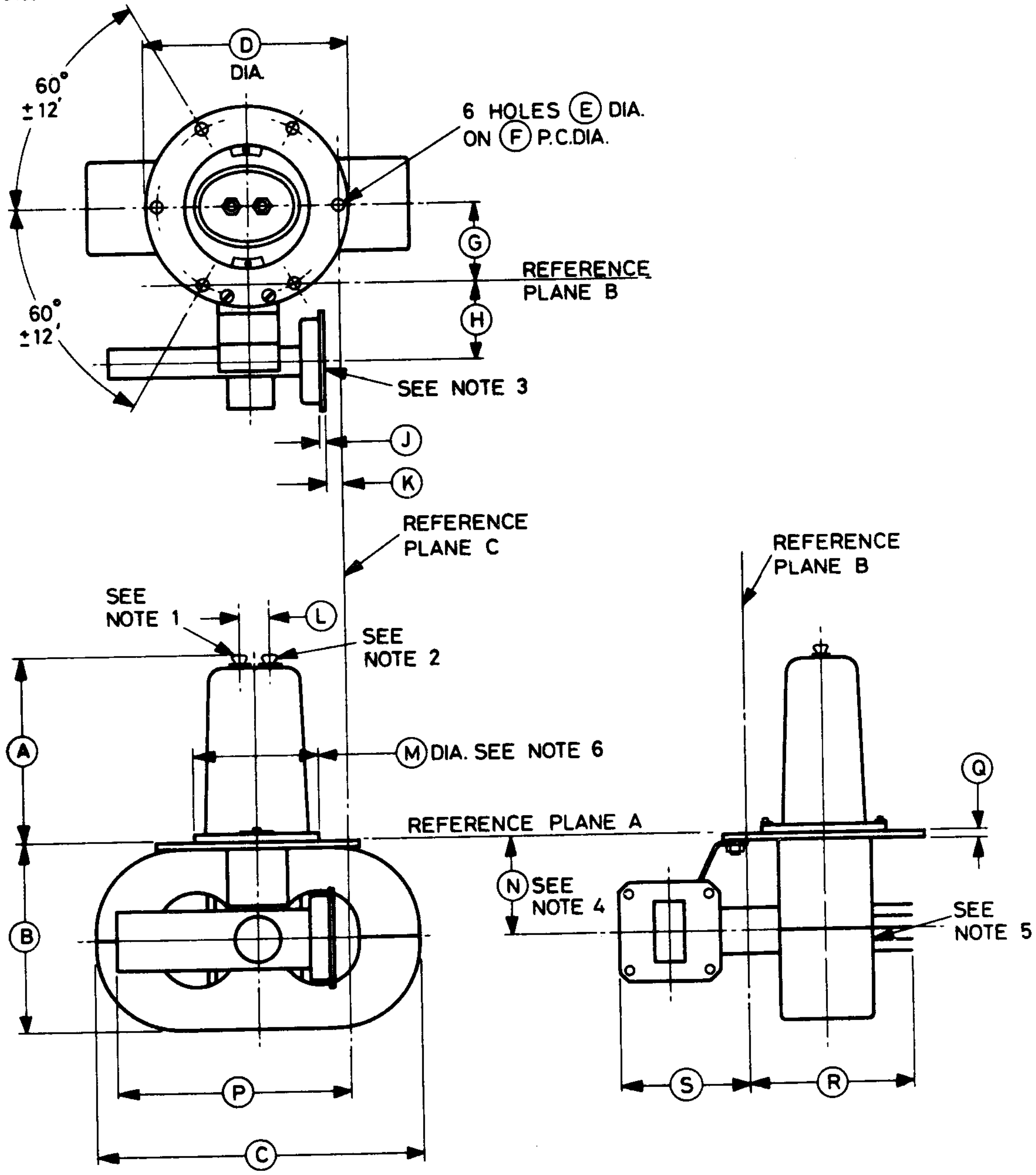
   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Tolerance ±10%.
5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance 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/°C.

TYPICAL PERFORMANCE CHART



OUTLINE (See page 8 for Output Flange Details)

2460



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

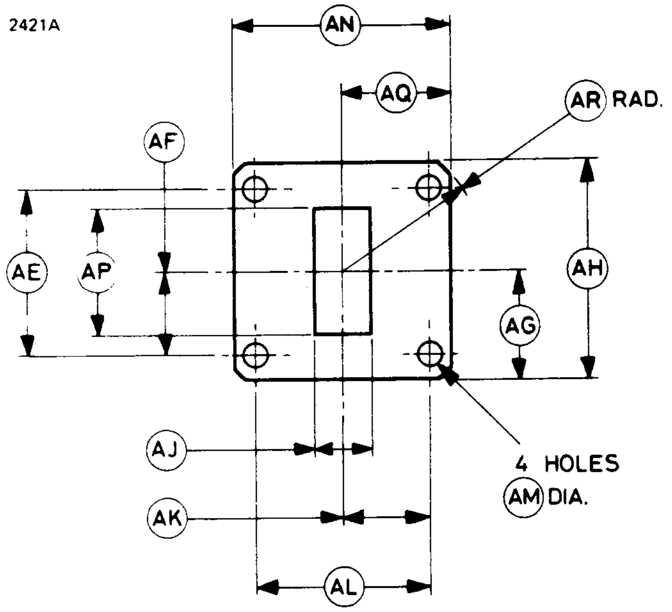
Millimetre dimensions have been derived from inches.

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
(All dimensions without limits are nominal)

2421A



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.

M592

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron, frequency variant of 4J52A

Frequency range	8925 to 8995	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)	90	s

Mechanical

Overall dimensions	5.938 x 5.374 x 4.243 inches max 150.8 x 136.5 x 107.8mm max
Net weight	5 pounds (2.3kg) 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	–	5	μs
Rate of rise of voltage pulse (see note 4):			
pulse length 0.4μs	120	170	kV/μs
pulse length 1.0μs	100	150	kV/μs
pulse length 5.0μs	70	110	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	7.9	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	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)	–	–	8925	8995	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	8920 to 9000	MHz
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 40 lb/in^2 ($2.8kg/cm^2$) absolute, the leakage will not exceed 0.03 litre (N.T.P.) per minute.

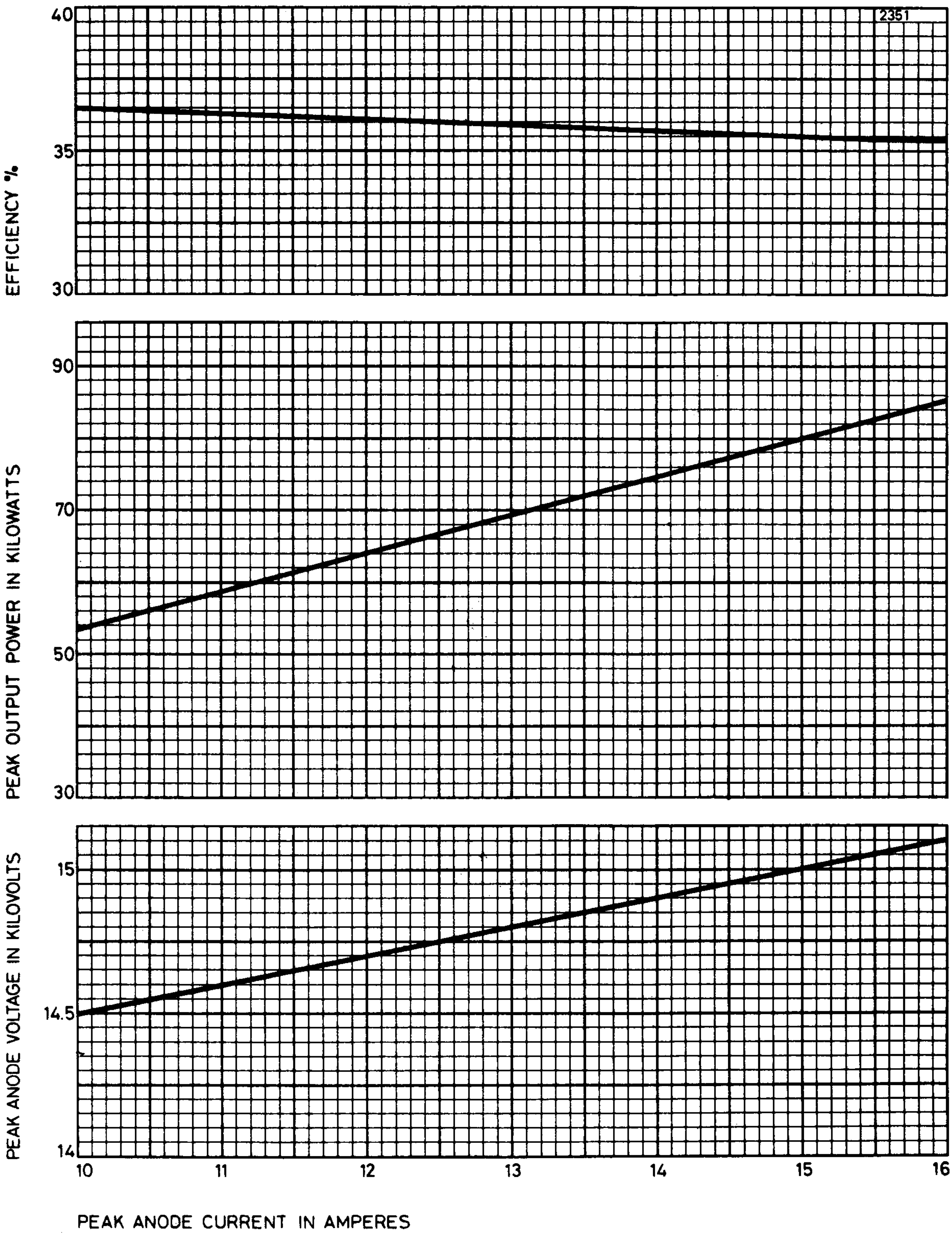
6. With anode temperature of 100°C ± 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

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

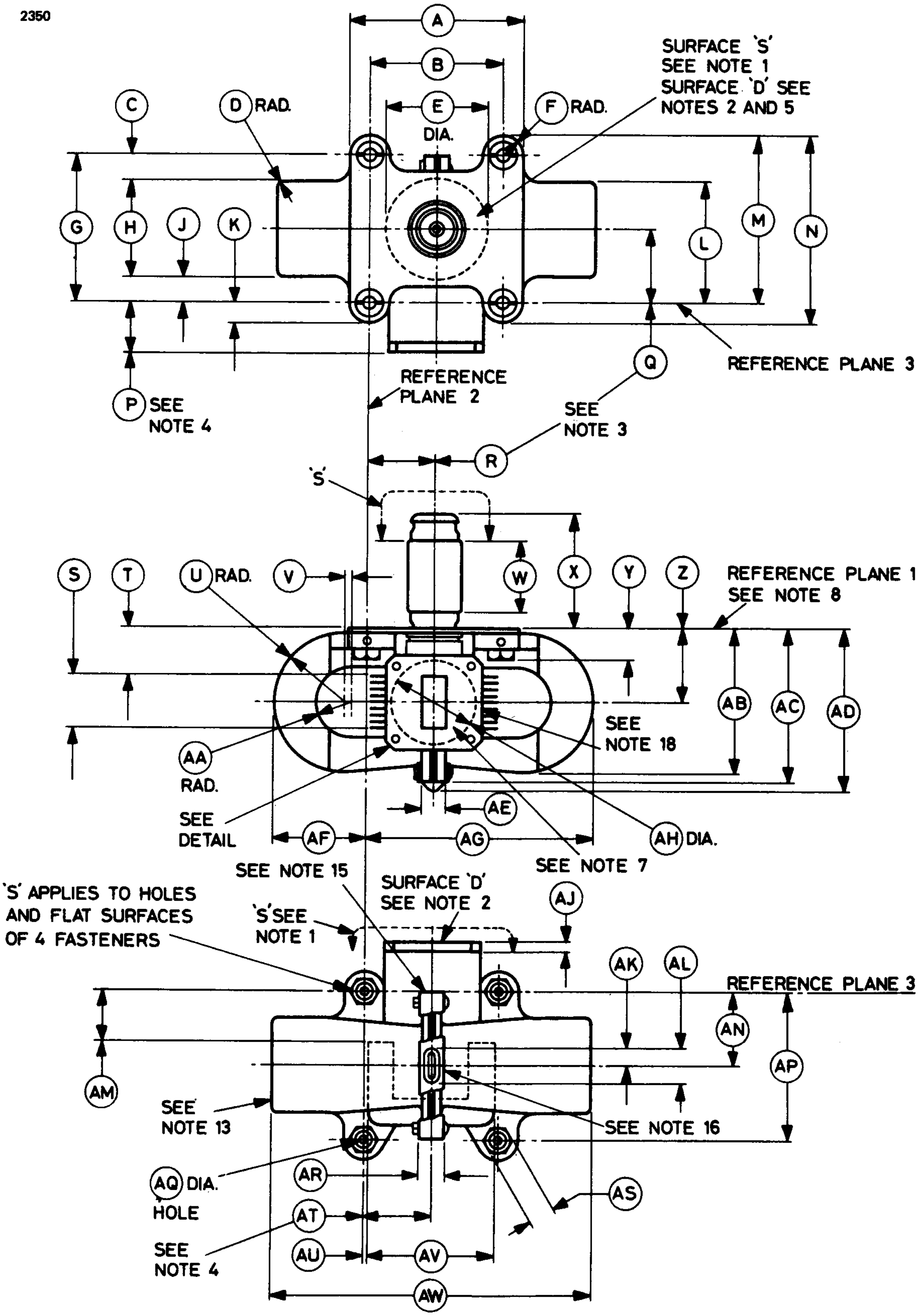
8. With the valve operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during 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.

TYPICAL PERFORMANCE CHART



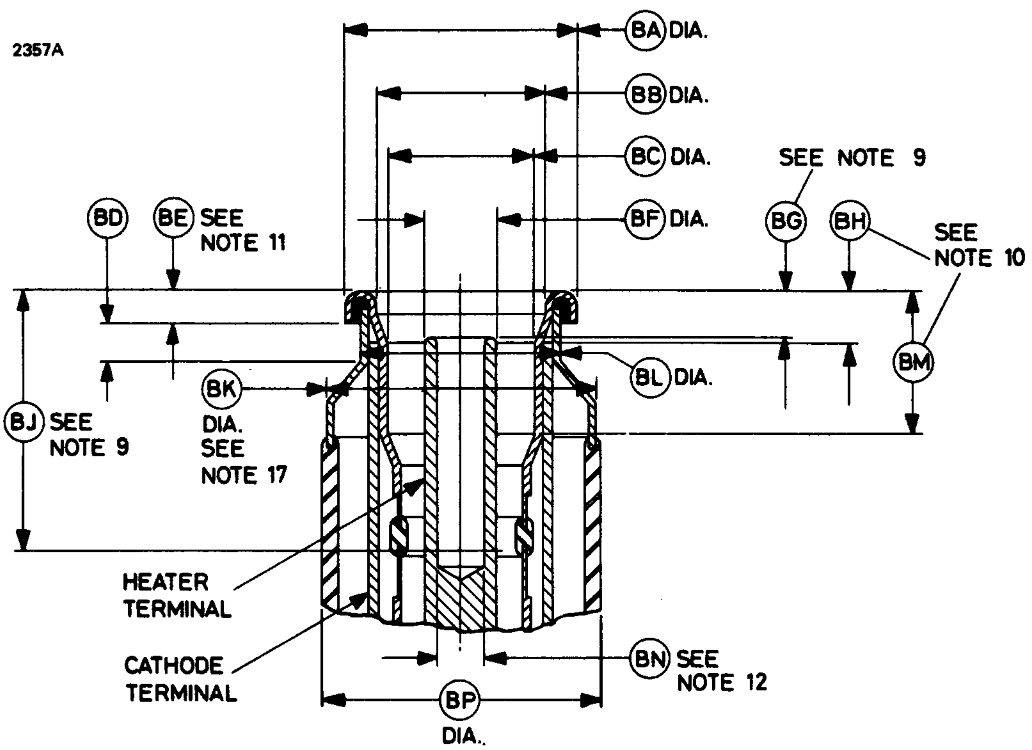
OUTLINE (See page 10 for Outline Notes)

2350

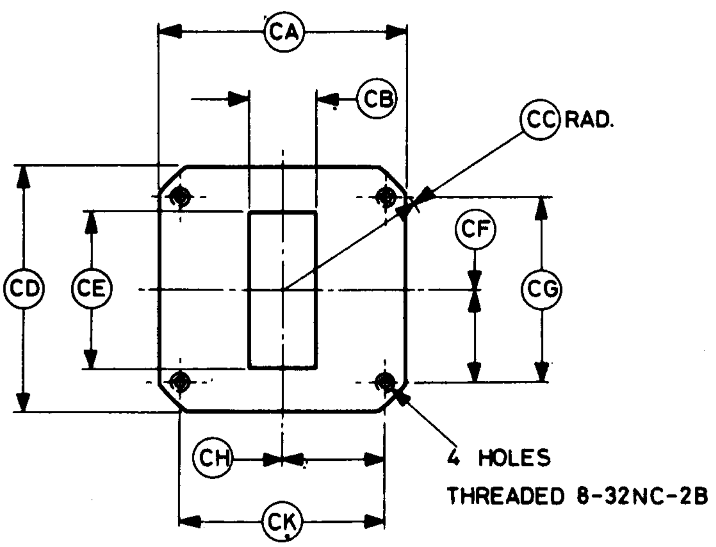


OUTLINE DETAILS (See page 10 for Outline Notes)

Heater and Cathode Terminals



Output Flange



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.438 max	87.33 max
B	2.531 ± 0.010	64.29 ± 0.25
C	0.594 max	15.09 max
D	0.031 min	0.79 min
E	1.875 min	47.63 min
F	0.375	9.53
G	2.781 ± 0.010	70.64 ± 0.25
H	1.938 max	49.23 max
J	0.594 max	15.09 max
K	0.422 max	10.72 max
L	2.375 max	60.33 max
M	3.203 max	81.36 max
N	3.625 max	92.08 max
P	1.015 ± 0.025	25.78 ± 0.64
Q	1.391	35.33
R	1.265	32.13
S	1.000	25.40
T	0.922	23.42
U	1.328	33.73
V	0.141	3.58
W	1.250 min	31.75 min
X	2.156 ± 0.062	54.76 ± 1.57
Y	0.625 ± 0.031	15.88 ± 0.79
Z	1.406 ± 0.020	35.71 ± 0.51
AA	0.625	15.88
AB	2.844 max	72.24 max
AC	2.938 max	74.63 max
AD	3.156 max	80.16 max
AE	0.625 max	15.88 max
AF	1.688 max	42.88 max
AG	4.250 max	108.0 max
AH	1.625	41.28
AJ	0.250	6.35
AK	0.406 max	10.31 max
AL	0.812 max	20.62 max
AM	0.797	20.24

Ref	Inches	Millimetres
AN	1.391 ± 0.047	35.33 ± 1.19
AP	2.875 max	73.03 max
AQ	0.281 ± 0.005	7.14 ± 0.13
AR	1.438 max	36.53 max
AS	0.500	12.70
AT	1.265 ± 0.015	32.13 ± 0.38
AU	0.078	1.98
AV	2.375	60.33
AW	5.938 max	150.83 max
BA	0.838 max 0.825 min	21.29 max 20.96 min
BB	0.650 max 0.610 min	16.51 max 15.49 min
BC	0.545 max 0.532 min	13.84 max 13.51 min
BD	0.125 min	3.18 min
BE	0.125 ± 0.010	3.18 ± 0.25
BF	0.250 ± 0.016	6.35 ± 0.41
BG	0.156 ± 0.031	3.96 ± 0.79
BH	0.200 max	5.08 max
BJ	0.750 min	19.05 min
BK	1.000	25.40
BL	0.750	19.05
BM	0.516 min	13.11 min
BN	0.169 ± 0.005	4.29 ± 0.13
BP	1.125	28.58
CA	1.830	46.48
CB	0.497	12.62
CC	1.156	29.36
CD	1.830	46.48
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
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 0.047 inch (1.19mm) 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 (15.88mm) 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.

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X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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)	90	s

Mechanical

Overall dimensions	5.938 x 5.374 x 4.243 inches max 150.8 x 136.5 x 107.8mm max
Net weight	5 pounds (2.3kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnets and any magnetic materials.

Cooling . . . . 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 (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	–	5.0	μs
Rate of rise of voltage pulse (see note 4):			
pulse length 0.4μs	120	170	kV/μs
pulse length 1.0μs	100	150	kV/μs
pulse length 5.0μs	70	110	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	7.9	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	9370 to 9430	MHz
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 40 lb/in^2 (2.8kg/cm^2) absolute, the leakage will not exceed 0.03 litre (N.T.P.) per minute.

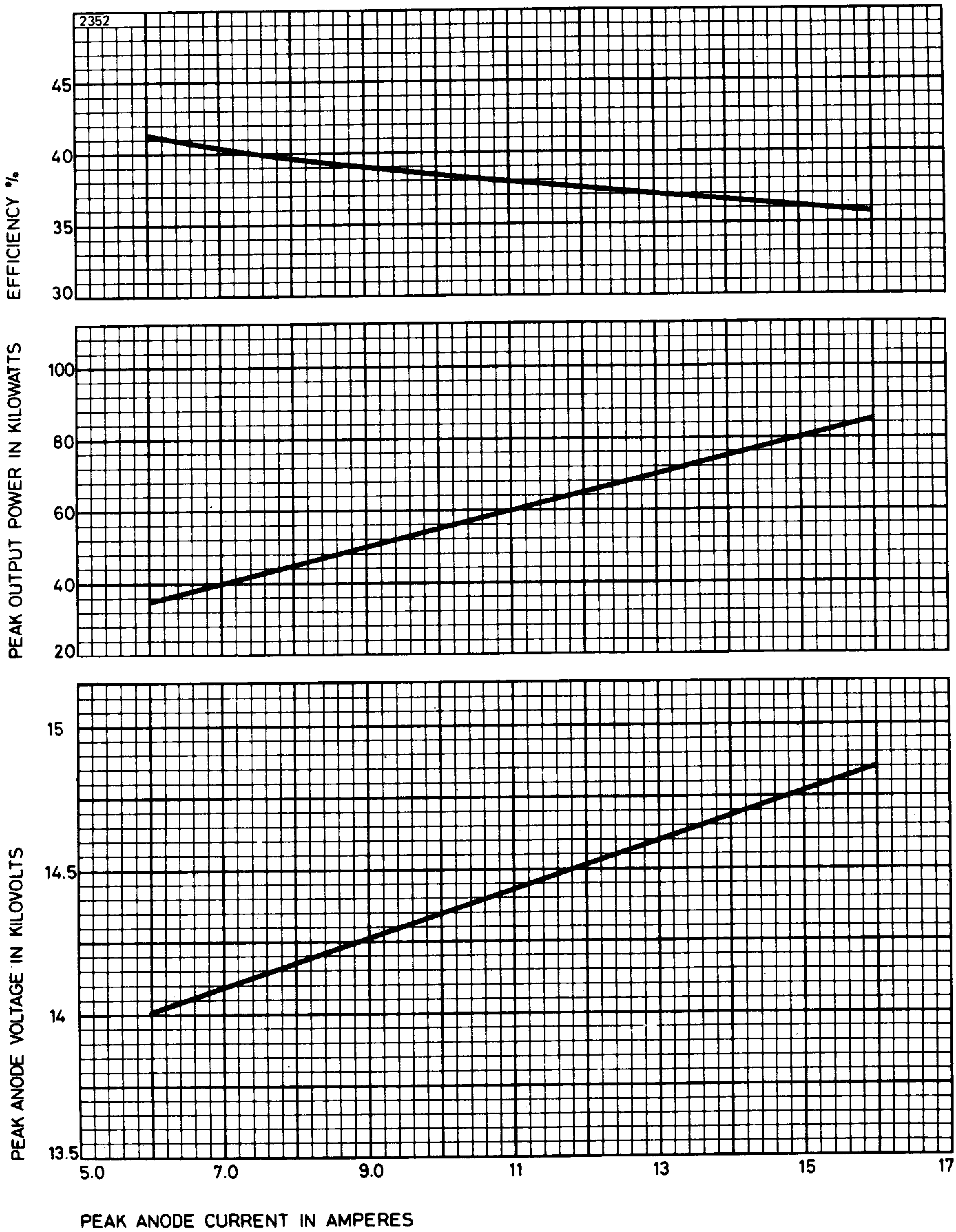
6. With anode temperature of 100°C ± 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

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:

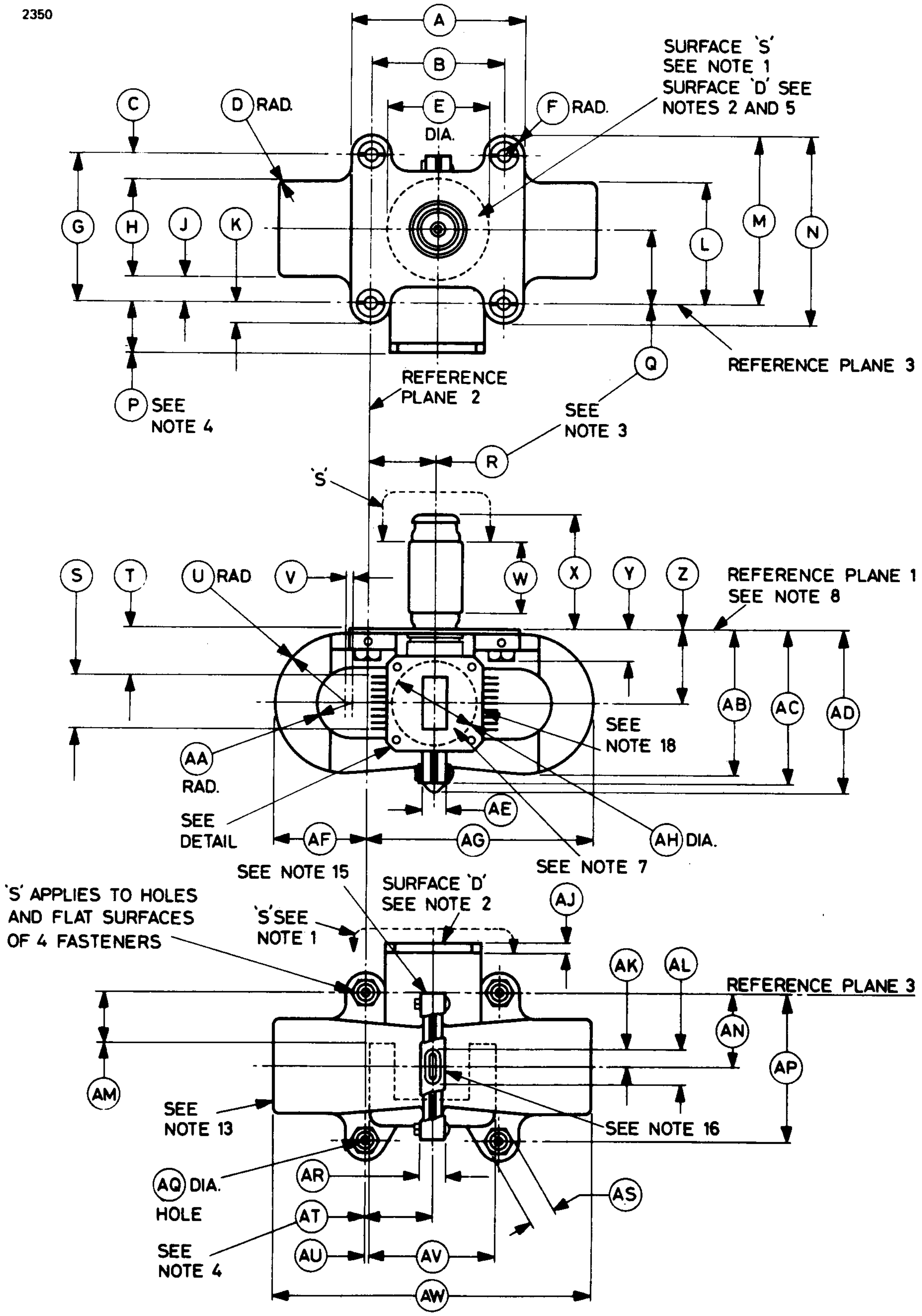
   Oscillation 1 — 11 and 15A
   Oscillation 2 — 12 and 15A

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.

TYPICAL PERFORMANCE CHART

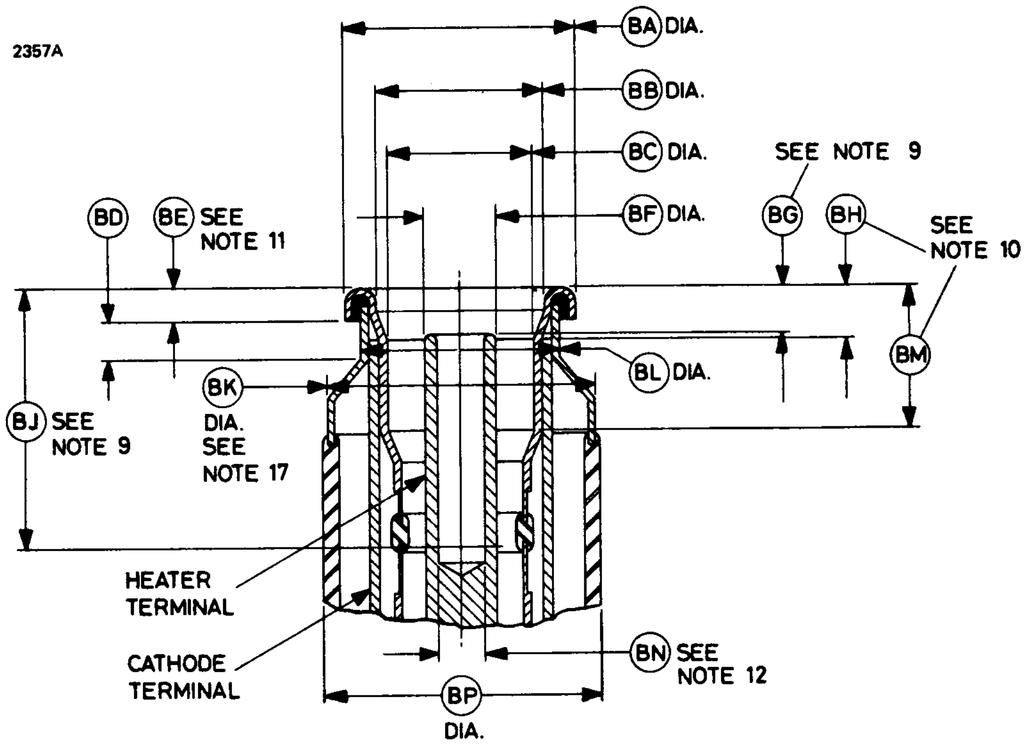


OUTLINE (See page 10 for Outline Notes)

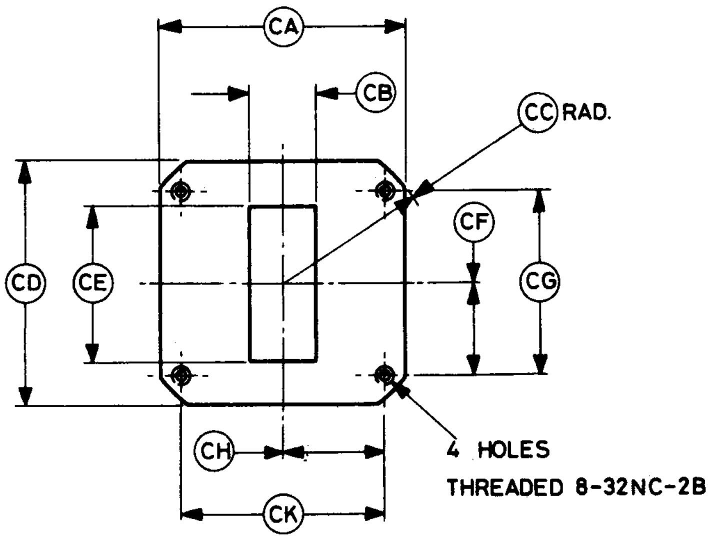


OUTLINE DETAILS (See page 10 for Outline Notes)

Heater and Cathode Terminals



Output Flange



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.438 max	87.33 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	1.438 max	36.53 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	1.938 max	49.23 max	AV	2.375	60.33
J	0.594 max	15.09 max	AW	5.938 max	150.83 max
K	0.422 max	10.72 max	BA	0.838 max	21.29 max
L	2.375 max	60.33 max		0.825 min	20.96 min
M	3.203 max	81.36 max	BB	0.650 max	16.51 max
N	3.625 max	92.08 max		0.610 min	15.49 min
P	1.015 ± 0.025	25.78 ± 0.64	BC	0.545 max	13.84 max
Q	1.391	35.33		0.532 min	13.51 min
R	1.265	32.13	BD	0.125 min	3.18 min
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	2.938 max	74.63 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	1.688 max	42.88 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	CK	1.474 ± 0.004	37.440 ± 0.102
AM	0.797	20.24			

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 0.047 inch (1.19mm) 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 (15.88mm) 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.

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X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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 3.313 inches max 133.4 x 113.5 x 84.15mm 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)	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	–	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	9380 to 9440	MHz
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:

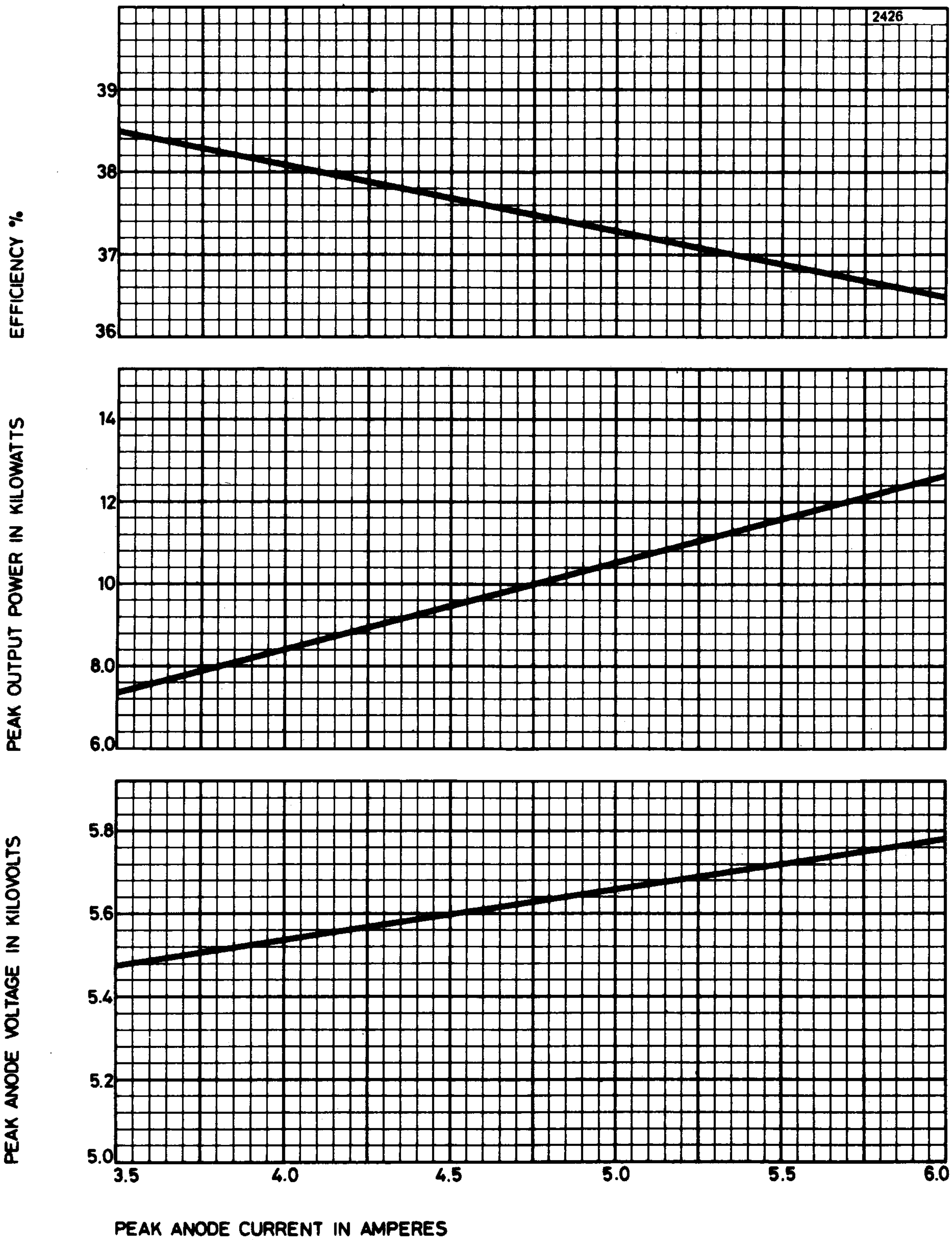
$$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{volts}$$

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:

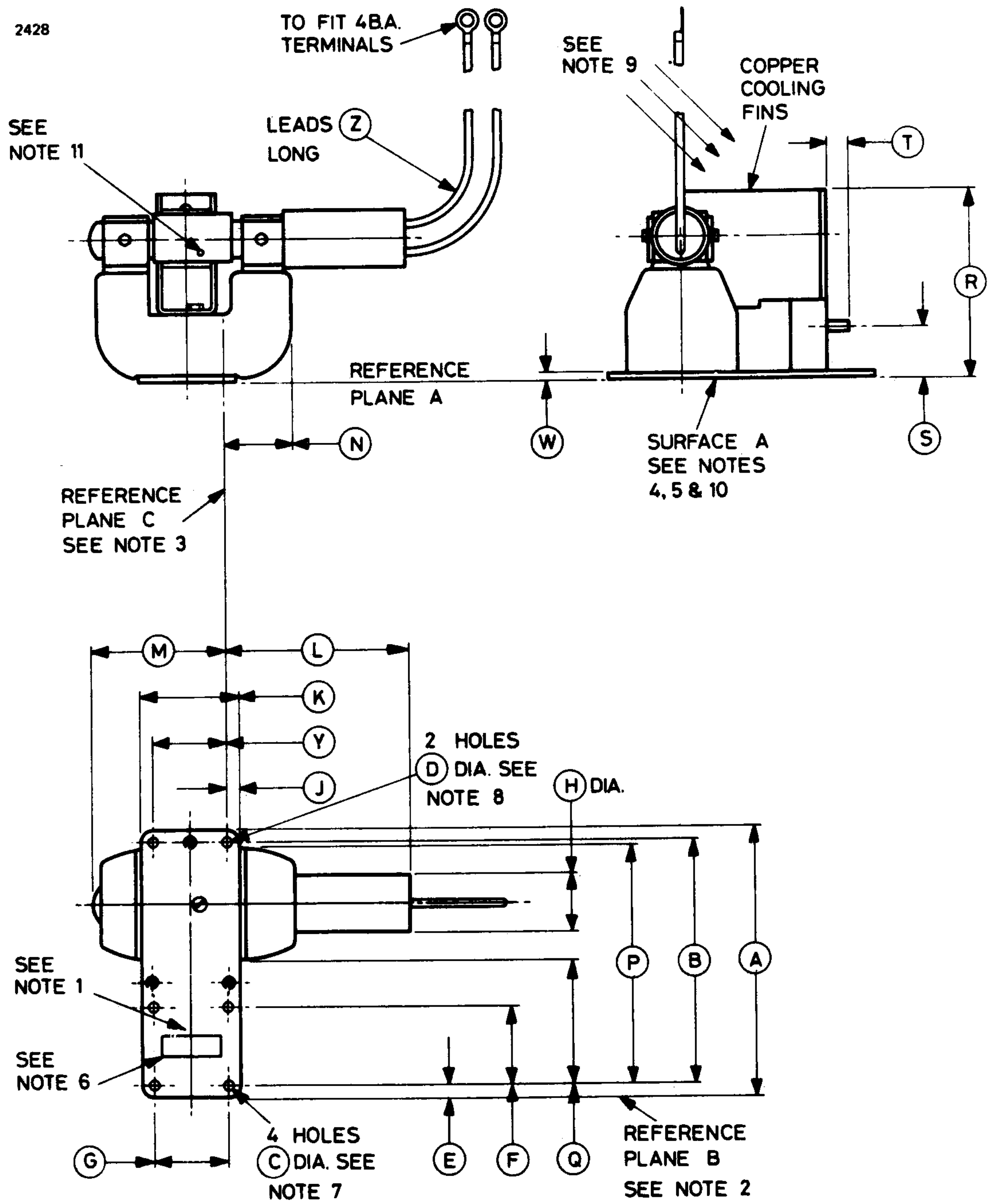
$$Pi = i_{apk} \times v_{apk} \times Du$$

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.

TYPICAL PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.453 $\pm$ 0.015	113.11 $\pm$ 0.38	M	2.188 max	55.58 max
B	4.103	104.2	N	1.188 max	30.18 max
C	0.170 $\pm$ 0.003	4.318 $\pm$ 0.076	P	4.000 max	101.6 max
D	0.175 $\pm$ 0.003	4.445 $\pm$ 0.076	Q	1.938 min	49.23 min
E	0.172 $\pm$ 0.016	4.37 $\pm$ 0.41	R	3.313 max	84.15 max
F	1.280 $\pm$ 0.004	32.512 $\pm$ 0.102	S	0.875 $\pm$ 0.125	22.23 $\pm$ 3.18
G	1.220 $\pm$ 0.004	30.988 $\pm$ 0.102	T	0.375 max	9.53 max
H	1.000 max	25.40 max	W	0.125	3.18
J	0.203 $\pm$ 0.015	5.16 $\pm$ 0.38	Y	1.220	30.99
K	1.625 $\pm$ 0.016	41.28 $\pm$ 0.41	Z	9.000	228.6
L	2.937 $\pm$ 0.125	74.60 $\pm$ 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-40B/U (5985-99-083-0051) 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-40B/U (5985-99-083-0051) (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 Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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 3.313 inches max 133.4 x 113.5 x 84.15mm 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

February 1970

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	–	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

	Oscillatio 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 45 lb/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.

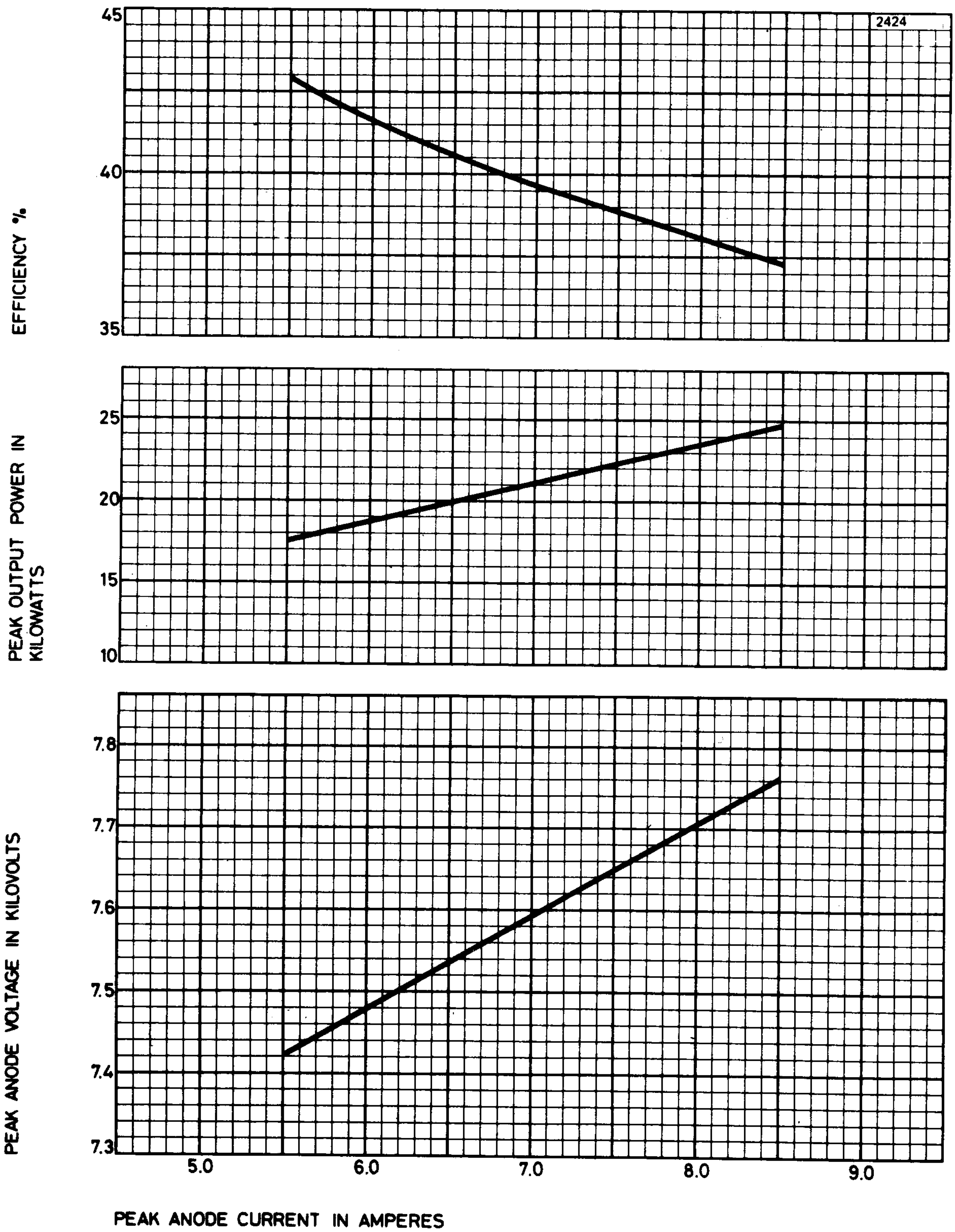
9. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after 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.

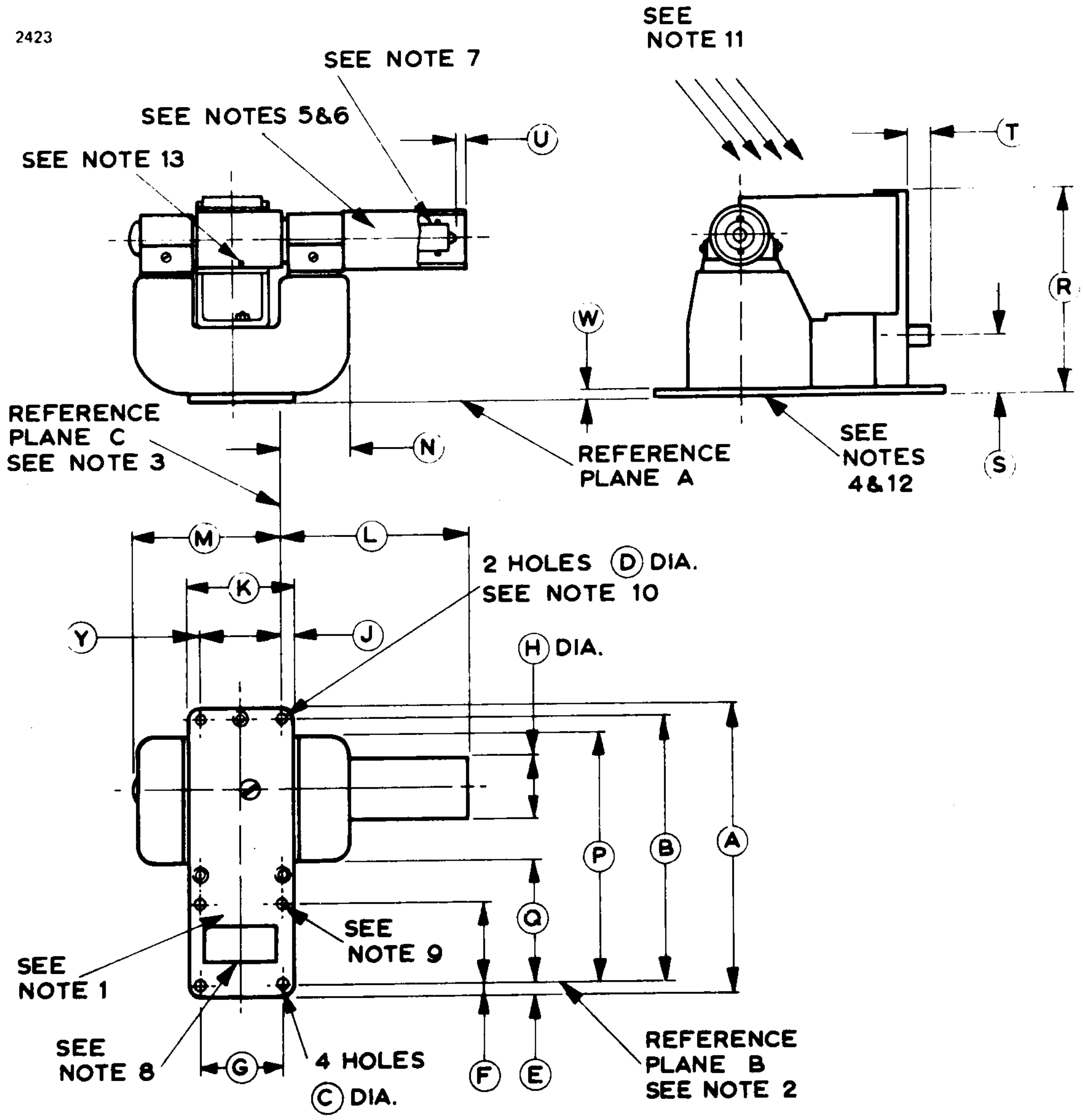
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.50A minimum, 0.60A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL 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	3.313 max	84.15 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 UG-40B/U (5985-99-083-0051) 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 UG-40B/U (5985-99-083-0051) (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

Service Type (M599B) CV10758

The data should be read in conjunction with the Magnetron Preamble.

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	4.0	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 1.339 inches max 135.7 x 100.0 x 34.0mm 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

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
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	0.02	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	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	60	kV/μs

Typical Performance

Anode voltage (peak)	3.6	kV
Output power (peak)	4.0	kW
Output power (mean)	0.8	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)	3.0	mA
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)	70	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	3.2	3.8	kV
Output power (peak)	3.0	–	kW
Frequency (see note 5)	9415	9475	MHz
R.F. bandwidth at ¼ power (see note 6)	–	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 notes 6 and 7)	–	0.25	%
Cold impedance			see note 8
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 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)	2.5	–	kW
Frequency	9415	9475	MHz
R.F. bandwidth at ¼ power (see note 6)	–	3.5	MHz

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 1.5:1 varied through all phases over the mean anode current range of 2.5 to 3.5mA.

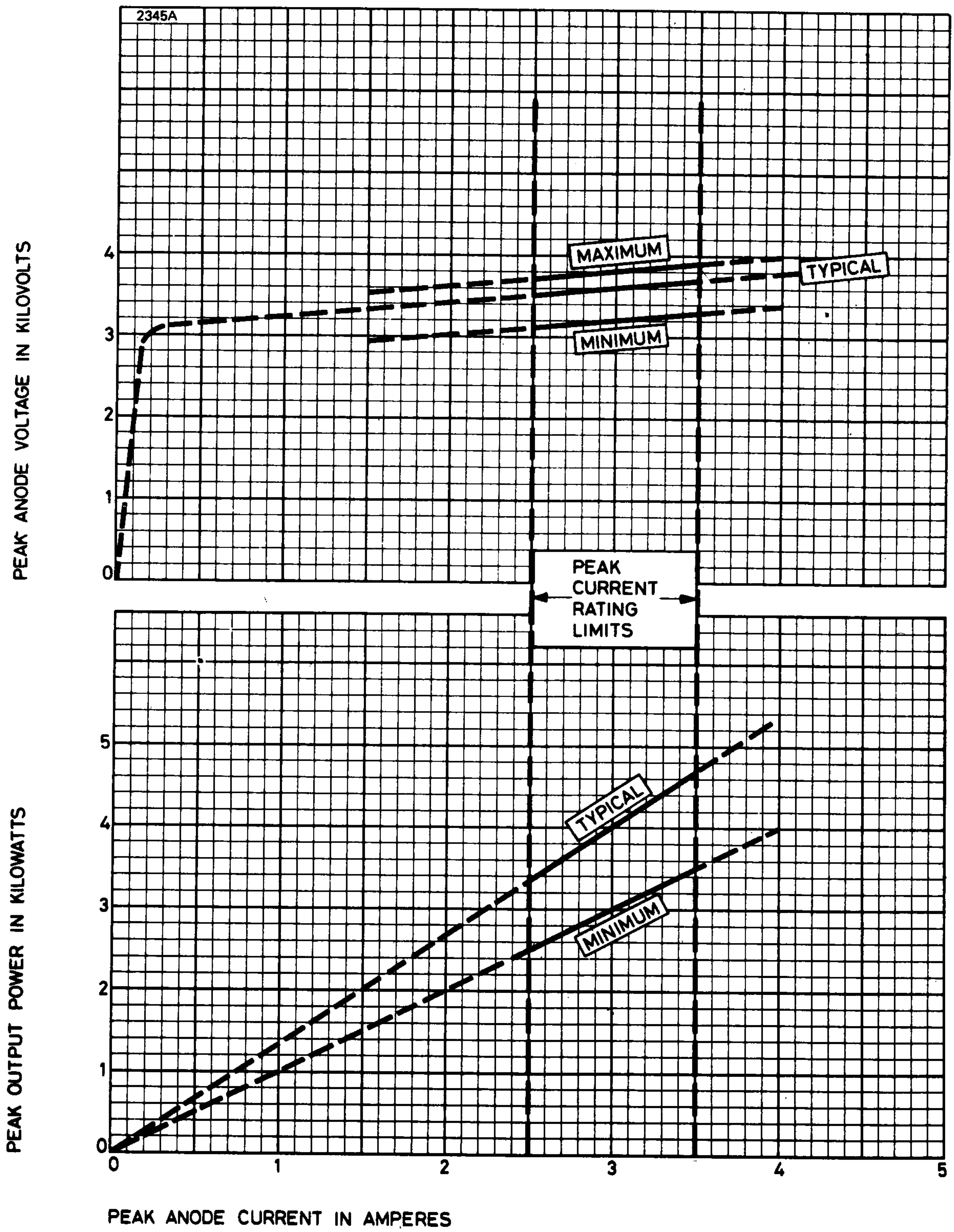
7. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

8. 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.

9. The heater current, measured with heater voltage of 6.3V and no anode input power, will be within the range 0.5A and 0.6A.

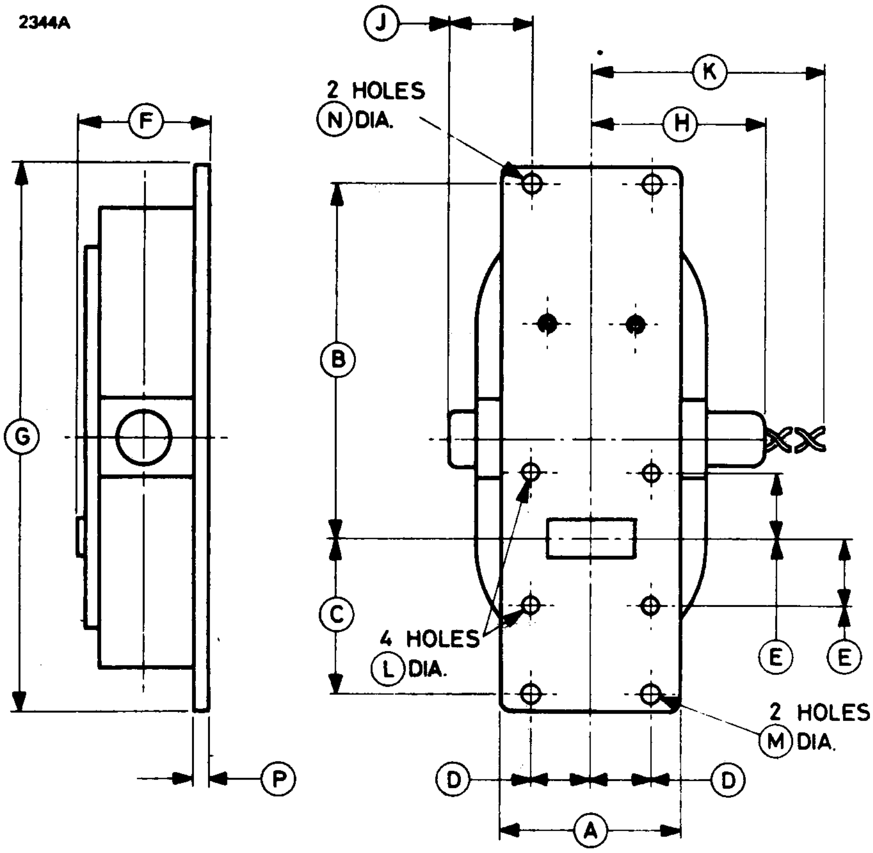
10. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.25MHz/°C.

PERFORMANCE CHART

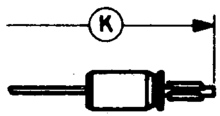


OUTLINE

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	378/4/Red	Heater
Blue	378A/4/Black	Heater, Cathode

* By Belling Lee

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	1.339 max	34.0 max
G	5.335 ± 0.007	135.51 ± 0.18
H	2.165 max	54.99 max
J	0.720 max	18.29 max
K	9.625 min (M599A)	244.5 min (M599A)
	10.250 ± 0.500 (M599B)	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 Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	–	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/in^2
	–	2.8	kg/cm^2
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	9345 to 9405	MHz
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

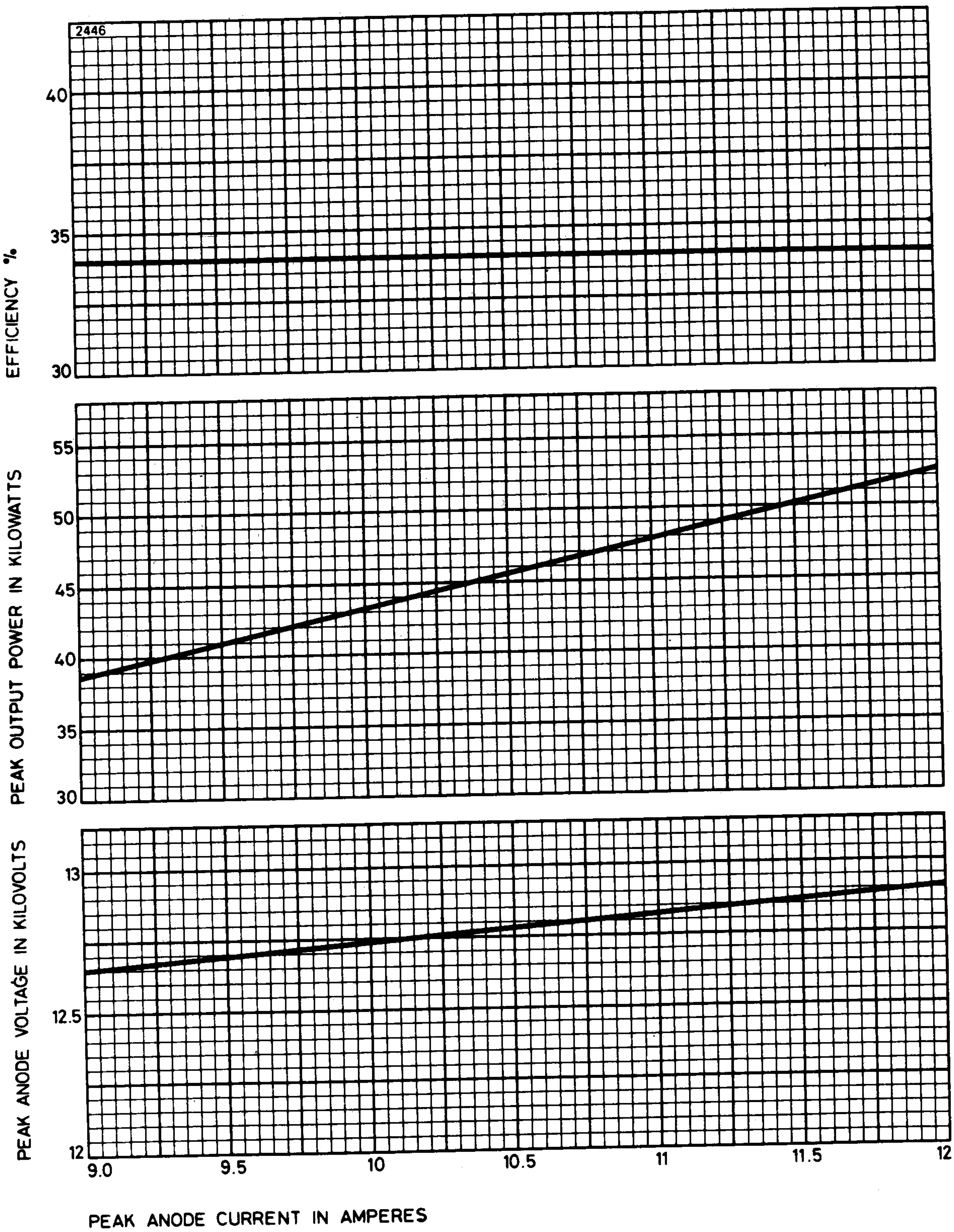
The phase of the mismatch is adjusted to present a voltage maximum at the output flange of the magnetron.

The altitude is computed from pressure readings by means of the I.C.A.O. Standard Atmosphere.

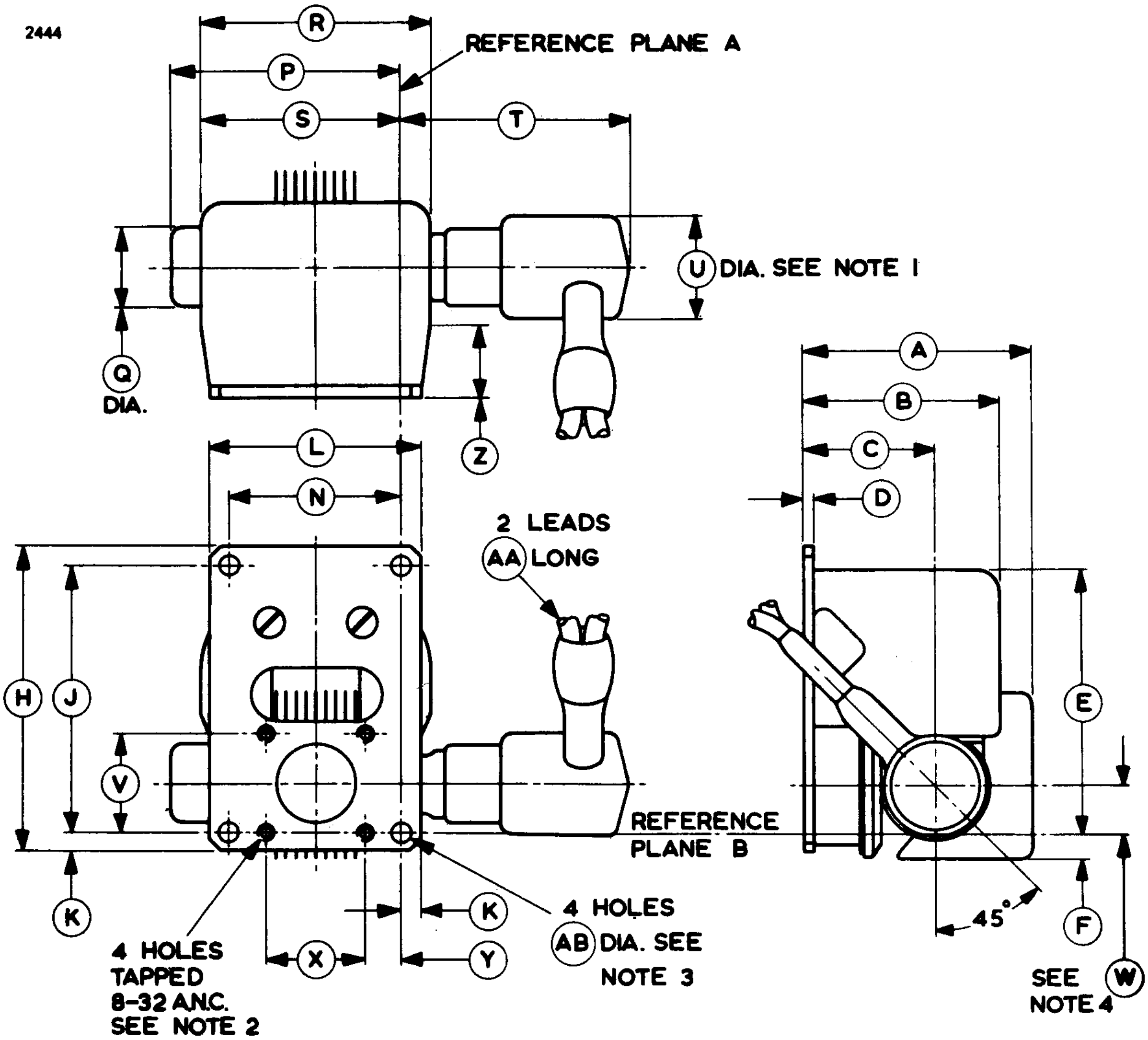
9. Measured with heater voltage of 12.6V and no anode input power, the heater current limits are 1.6A minimum, 2.0A maximum.

10. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE (All dimensions without limits are nominal)



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 sidearm, 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 sidearm.

Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

M5019

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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 3.313 inches max 133.4 x 113.5 x 84.15mm 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	–	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	9345 to 9405	MHz
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.

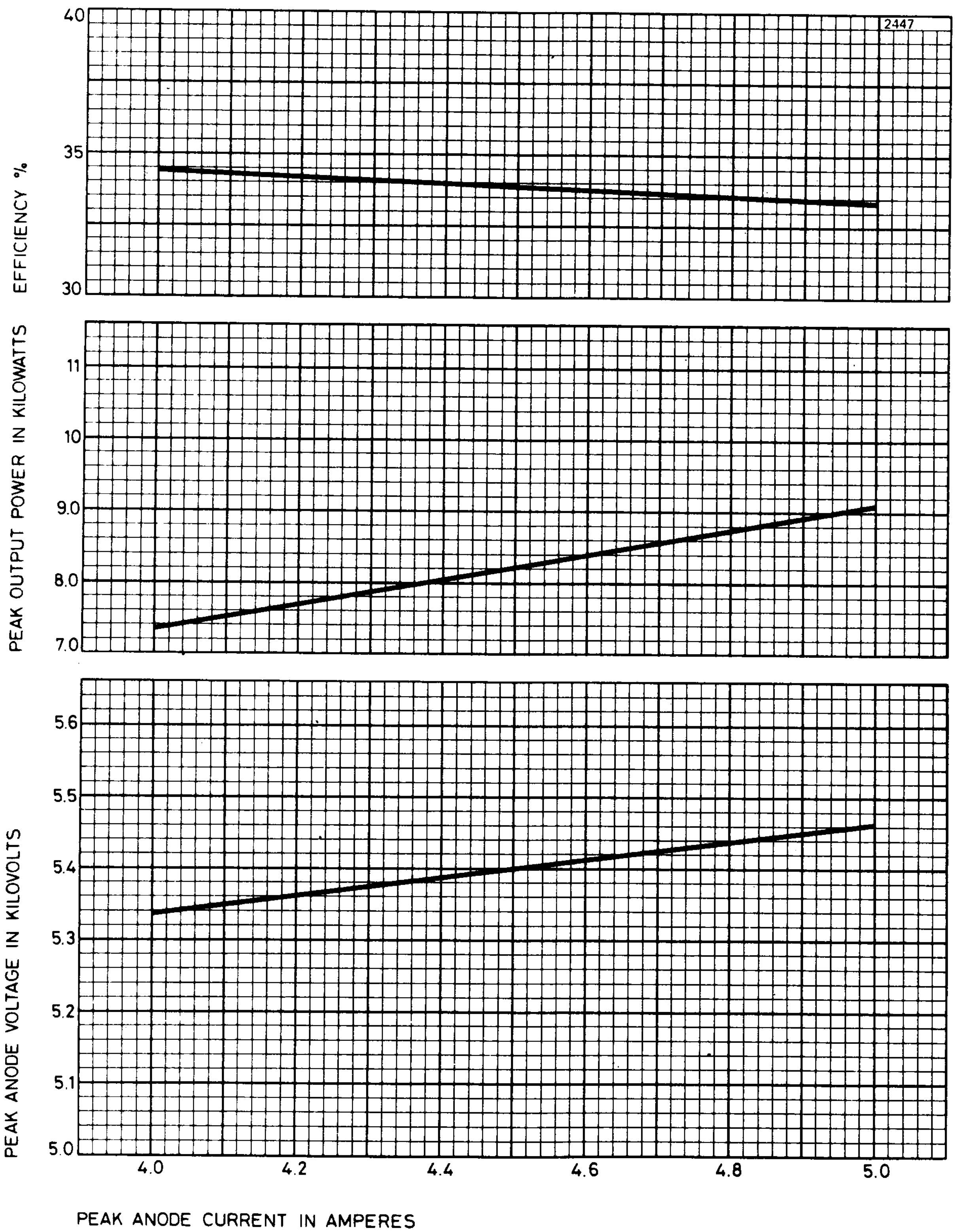
8. The peak current is varied between 4A and 6A. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a 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.

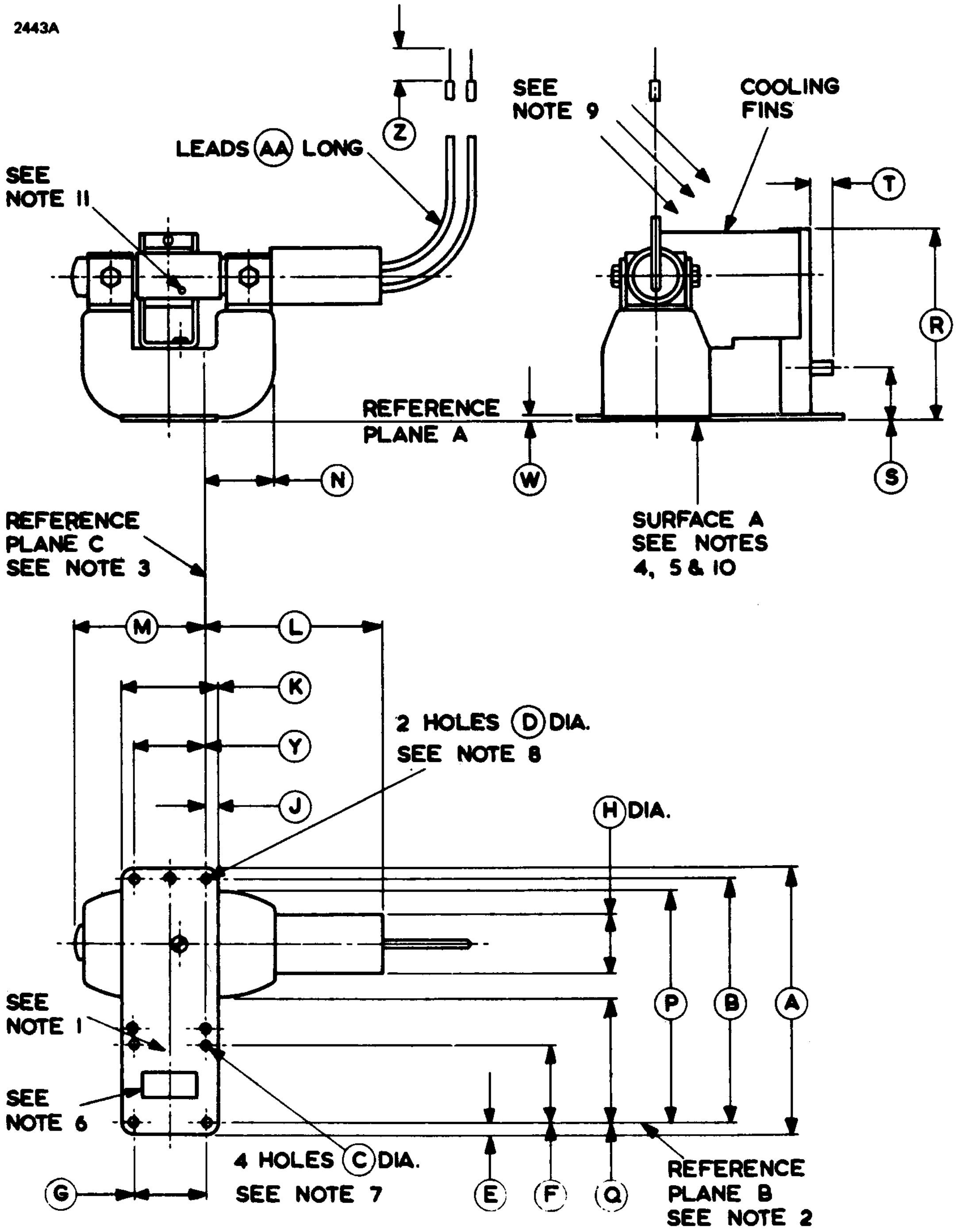
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.5A minimum, 0.6A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is –0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

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	3.313 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 ± 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	AA	3.000	76.2

Millimetre dimensions have been derived from inches.

Outline Notes

1. This area is gasketed for pressurizing the waveguide output as with the coupler UG-40B/U (5985-99-083-0051) 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 $10 mg/in^2$ ($1.55 mg/cm^2$) of gold or $30 mg/in^2$ ($4.65 mg/cm^2$) 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-40B/U (5985-99-083-0051) (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.

M5022

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	–	2.0	μs
Rate of rise of voltage pulse (see note 5)	–	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

	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)	170	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	9415 to 9475	MHz
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.

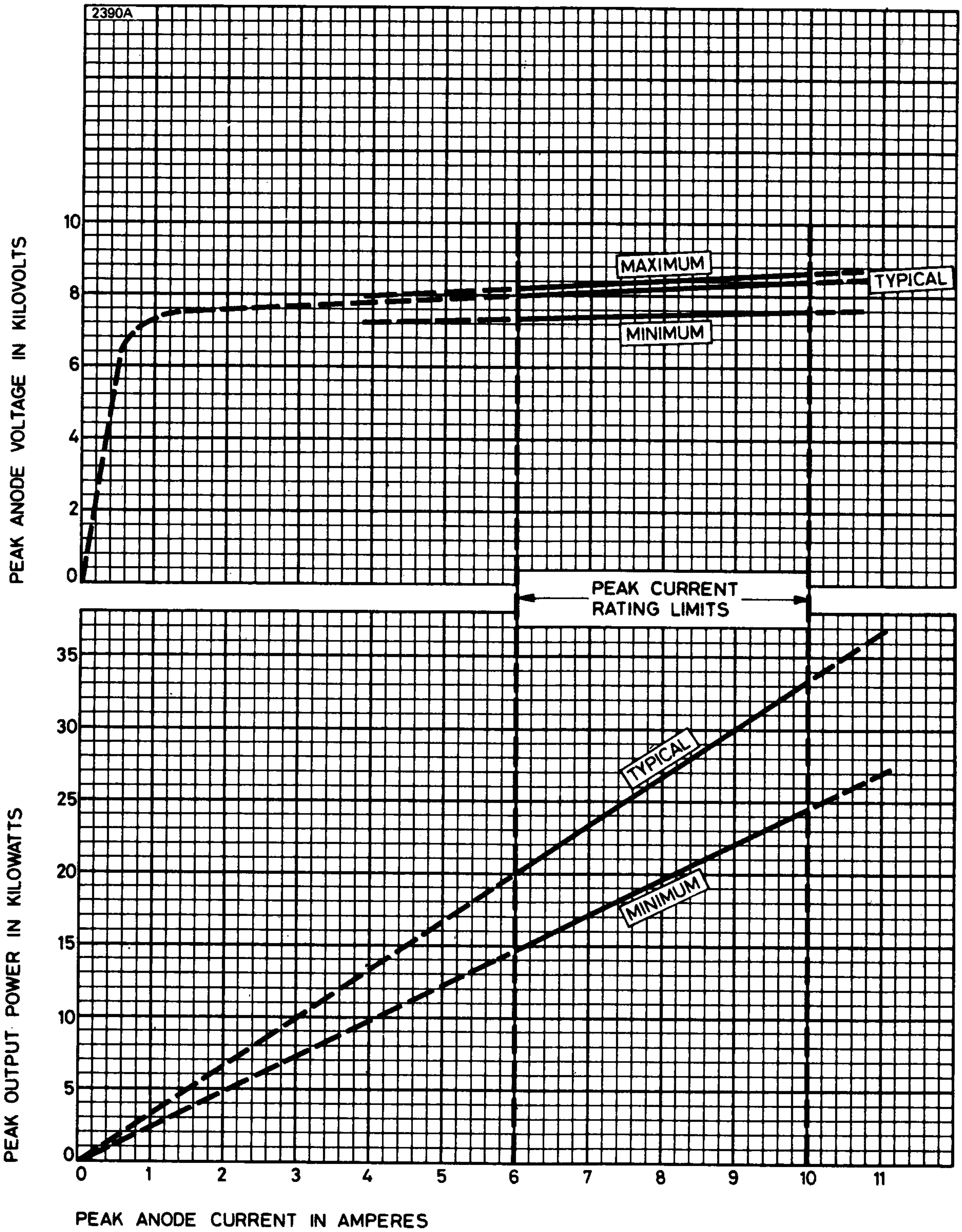
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after 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.

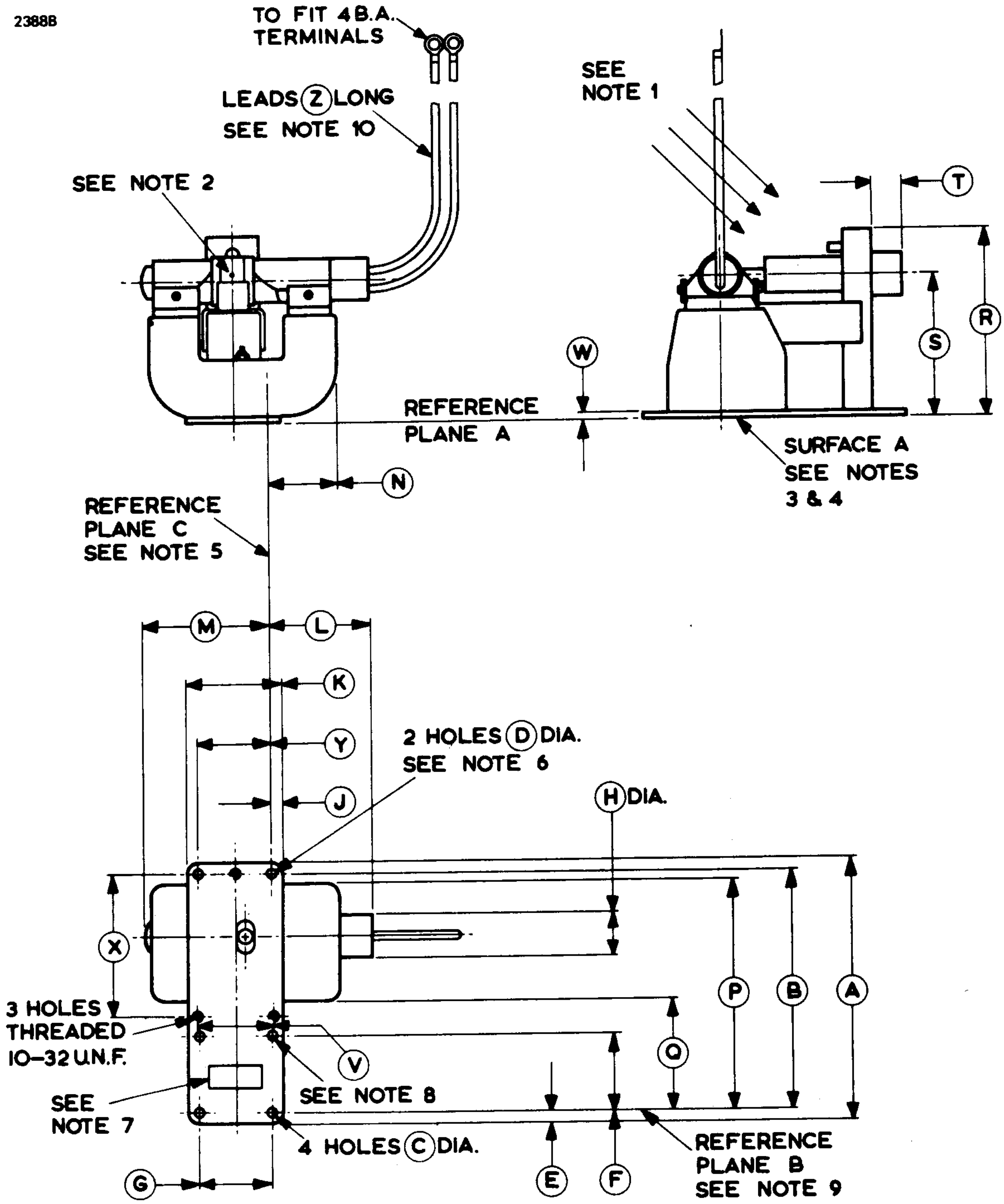
10. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

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	V	1.250	31.75
H	1.000 max	25.40 max	W	0.125	3.18
J	0.204 ± 0.015	5.18 ± 0.38	X	2.393	60.78
K	1.625 ± 0.016	41.28 ± 0.41	Y	1.220 ± 0.004	30.99 ± 0.10
L	2.063 max	52.40 max	Z	12.250 ± 0.500	311.2 ± 12.7
M	2.187 max	55.55 max			

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 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.
10. Length of flying leads measured from the centre line of anode block.

M5023 M5024 M5025

X-BAND MAGNETRONS

The data should be read in conjunction with the Magnetron Preamble.

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-40B/U (5985-99-083-0051)
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	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	8.2	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	–	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)	120	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:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   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.

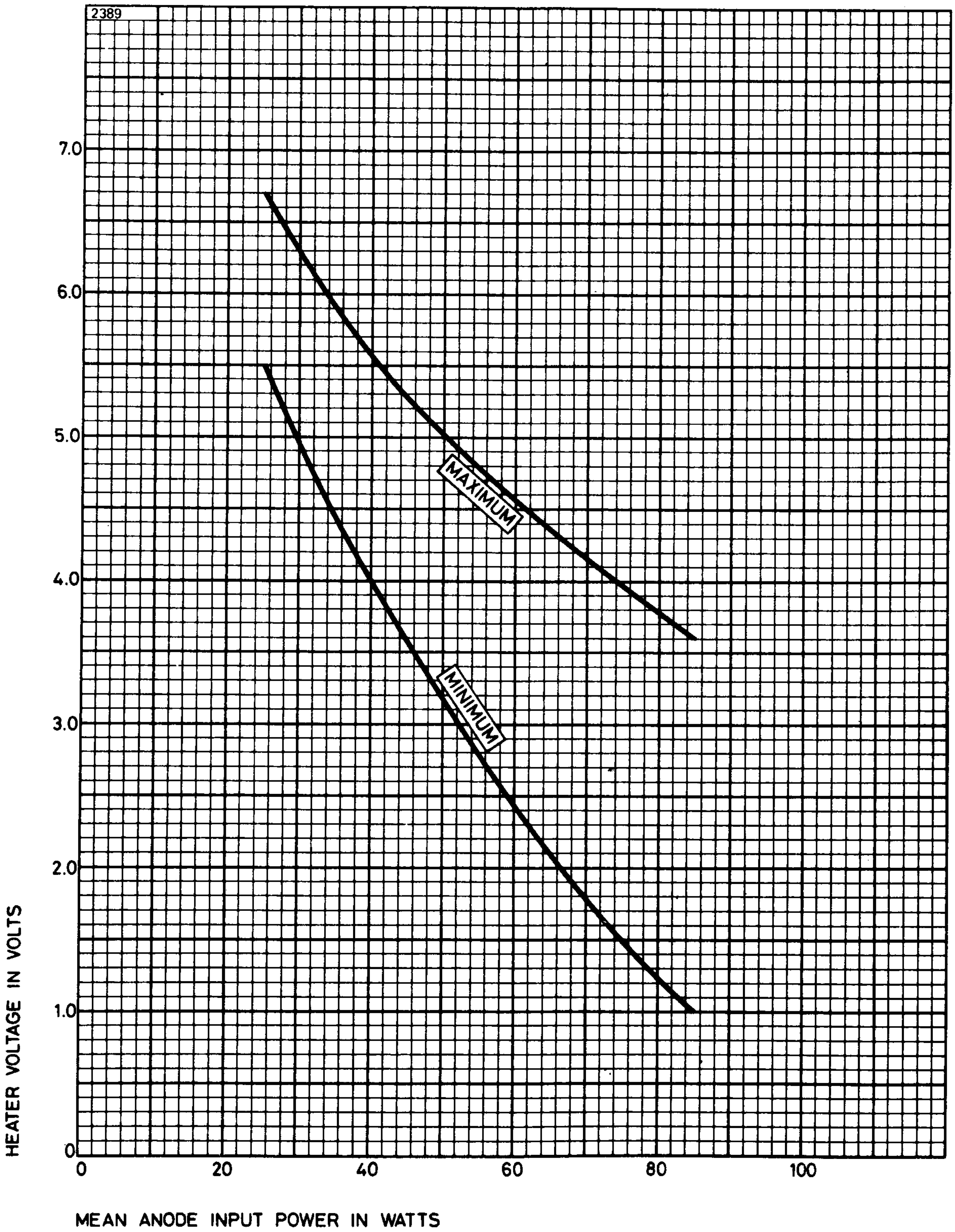
8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

9. For the range 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

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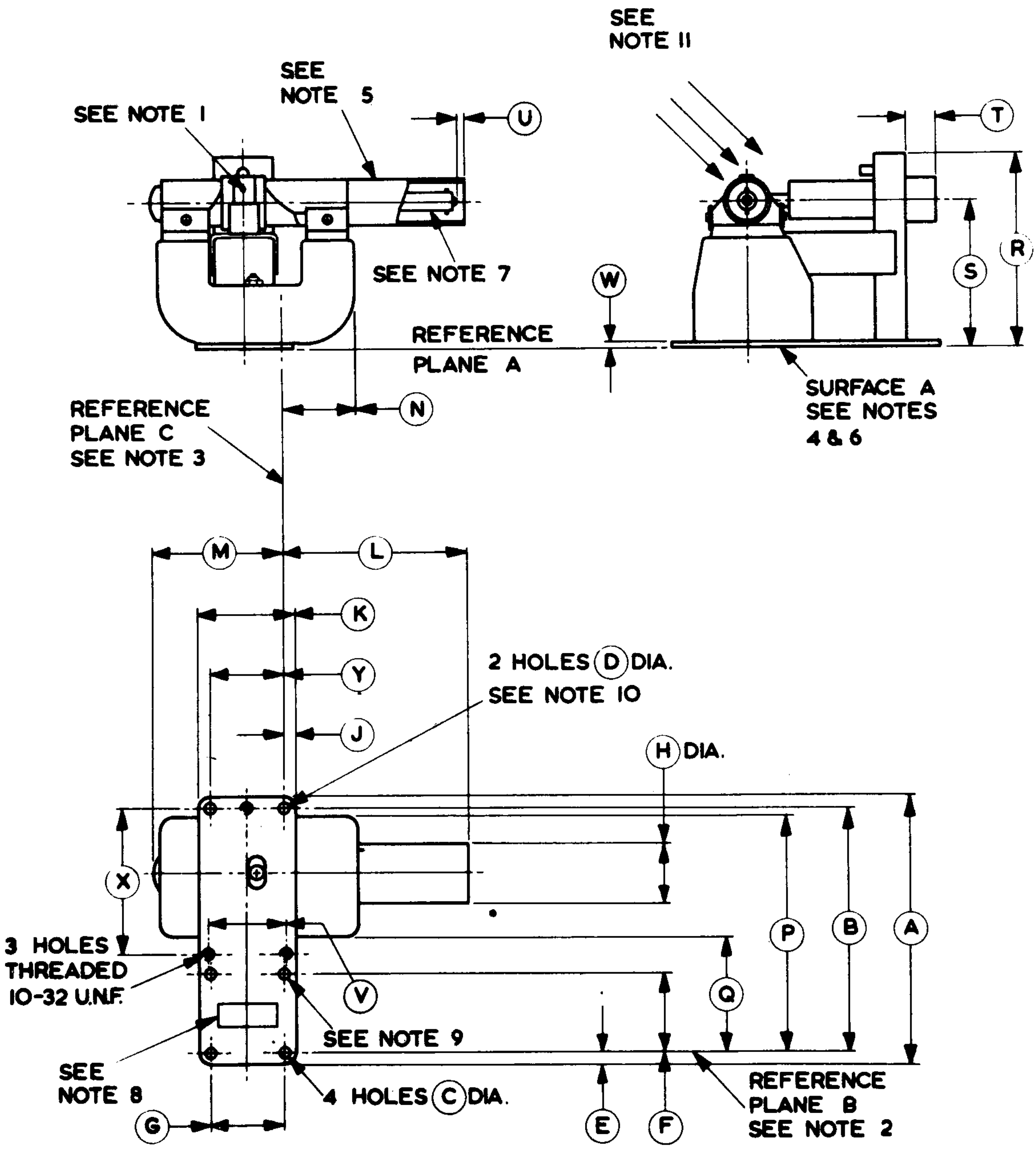


Bayonet Cap Connections

Contact	Element
End contact	Heater
Shell	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

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	4.318 ± 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-40B/U (5985-99-083-0051).

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.

M5039

X-BAND MAGNETRON

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	22.5	kW
Magnet	integral	
Output	no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-40B/U (5985-99-083-0051)	
Cooling	natural or forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current	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	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 . . . . 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	–	2.0	μs
Rate of rise of voltage pulse (see note 4)	–	170	kV/μs
Anode temperature (see note 5)	–	140	°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	170	170	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	Oscillation 3	
Heater voltage (for test)	6.3	6.3	6.3	V
Anode current (mean)	0.8	4.0	8.0	mA
Duty cycle	0.0001	0.0005	0.001	
Pulse length (see note 6)	0.05	0.5	1.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 4)	190	190	190	kV/μs min

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	–	–	7.5	8.5	7.5	8.5	kV
Output power (mean)	–	–	10	–	20	–	W
Frequency (see note 7)	–	–	9345	9405	–	–	MHz
R.F. bandwidth at ¼ power	–	–	–	5.0	–	2.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	–	–	18	–	–	MHz
Stability (see note 8)	–	–	–	0.05	–	0.05	%

Moding . . . . see note 9
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 Test Conditions Oscillation 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 2)

Anode voltage (peak)	7.5 to 8.5	kV
Output power (peak)	16	kW min
R.F. bandwidth at ¼ power	5.0	MHz max
Frequency	9345 to 9405	MHz
Stability (see note 8)	0.1	% 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. 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. Tolerance ±10%.

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.

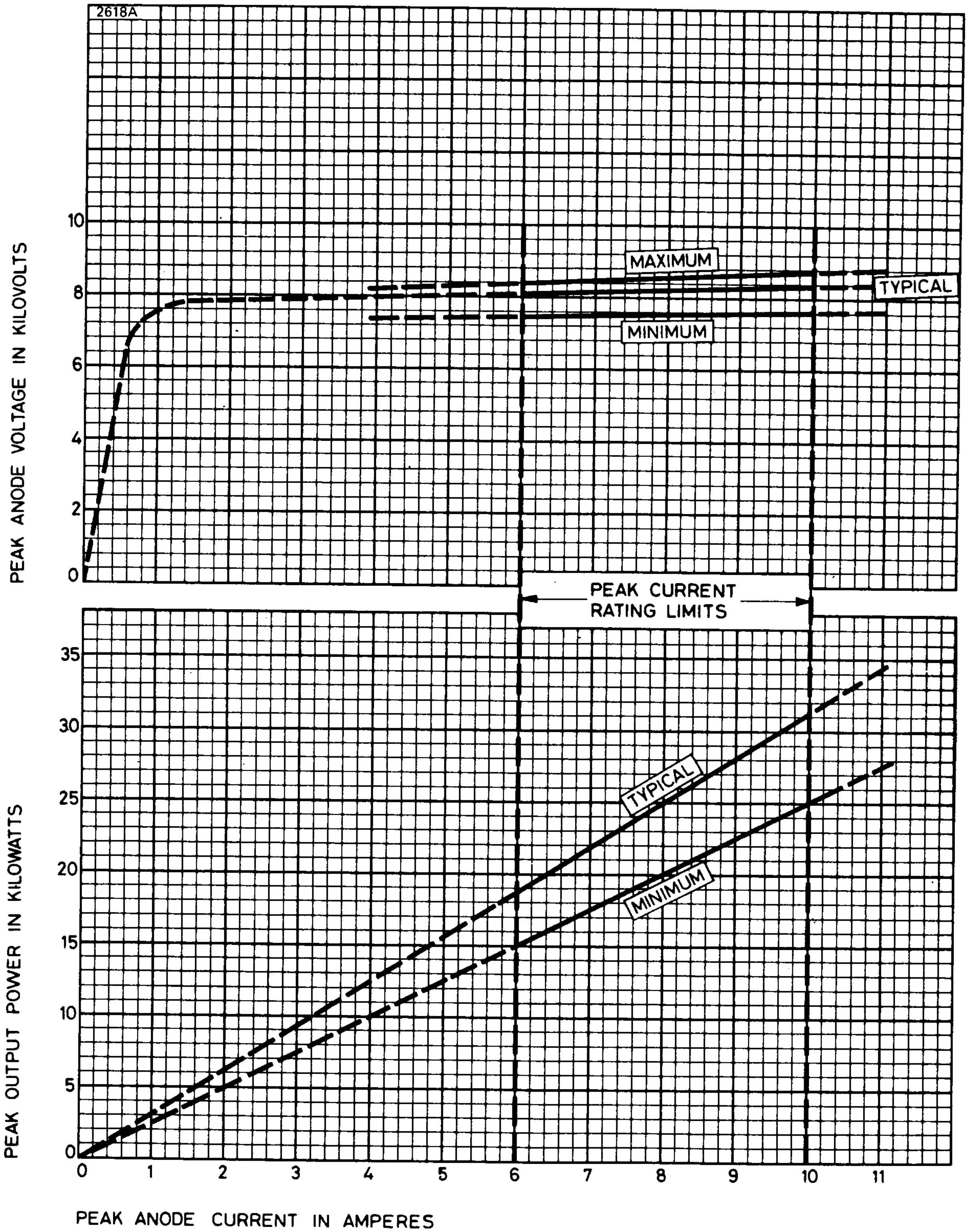
9. In addition to missing pulse count measurements the tube is checked for possible moding using a monitor diode.

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 8:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.

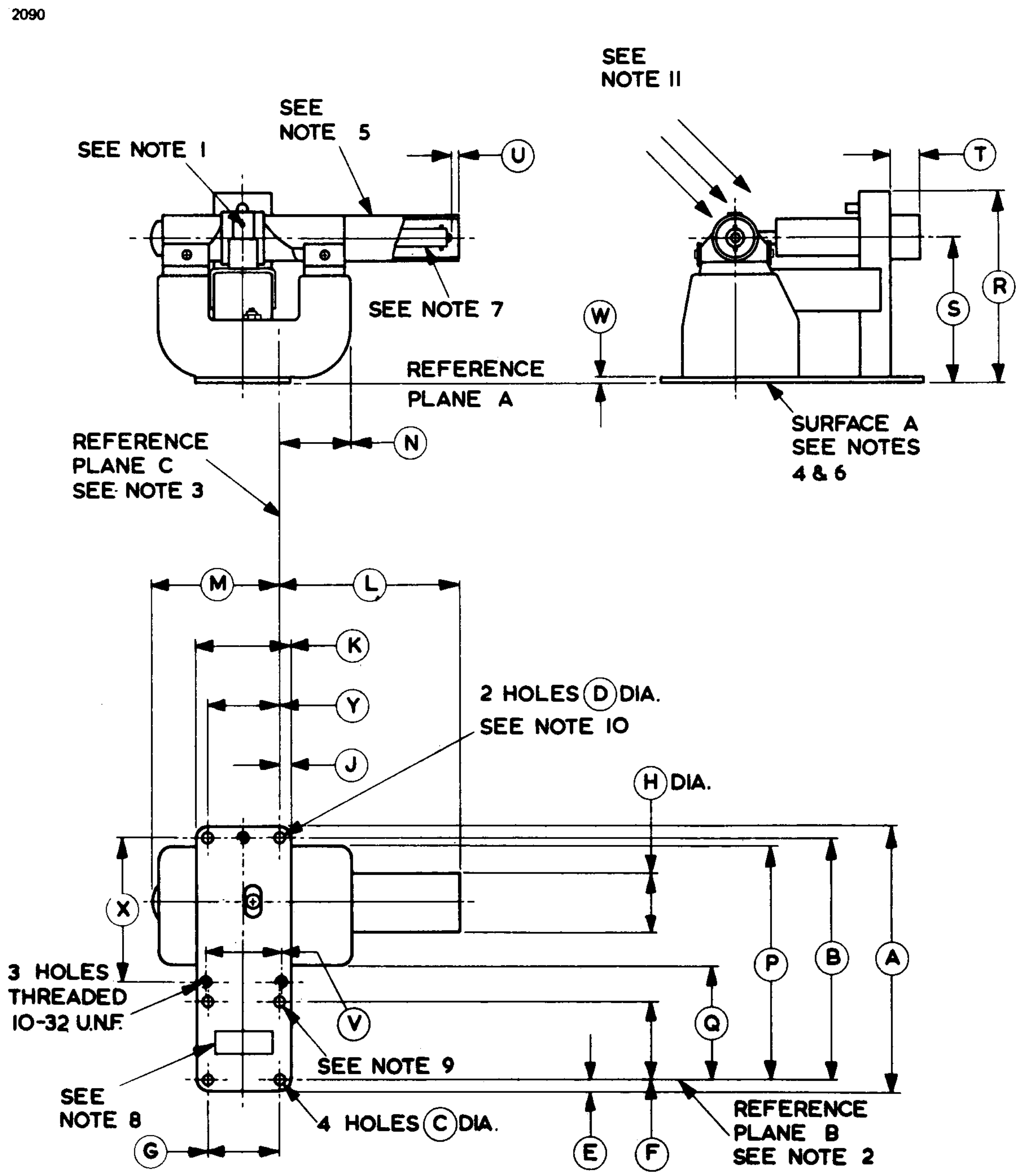
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End contact	Heater
Shell	Heater, cathode

Outline Dimensions (All dimensions without limits are nominal)

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 UG-40B/U (5985-99-083-0051).

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 Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:

M5043	9380 to 9440	MHz
M5044	9415 to 9475	MHz
Typical peak output power	7.5	kW
Magnets		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

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

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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	5.7	6.9	V
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	–	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)	7.5	7.5	kW
Output power (mean)	3.0	6.0	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)	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)	3.0	–	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)	2.5	–	W
Frequency:			
M5043	9380	9440	MHz
M5044	9415	9475	MHz

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:

   $$P_i = i_{apk} \times v_{apk} \times Du$$

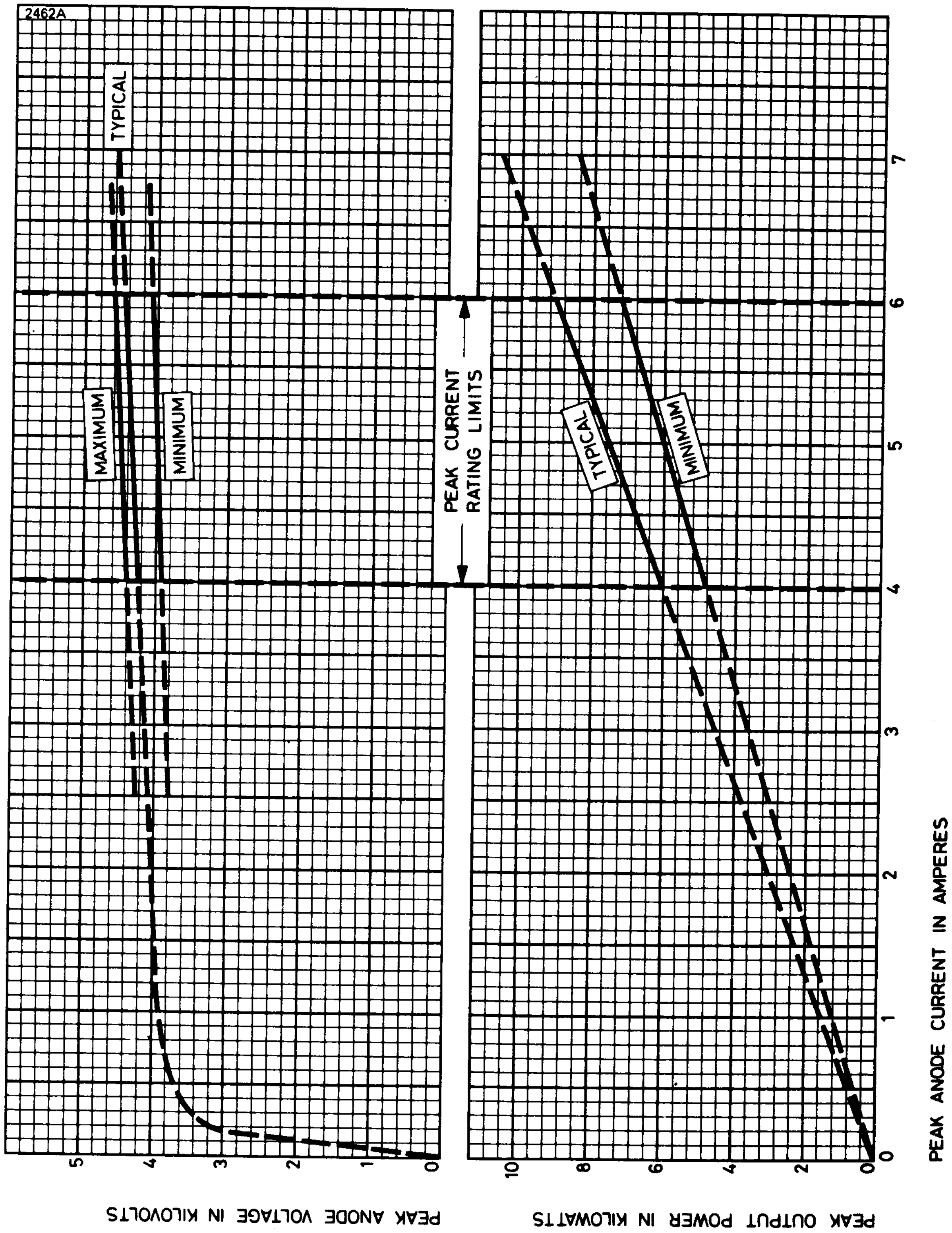
   where P_i = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.
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 over a peak anode current range of 4.0 to 6.0A. 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 0.5A minimum, 0.6A 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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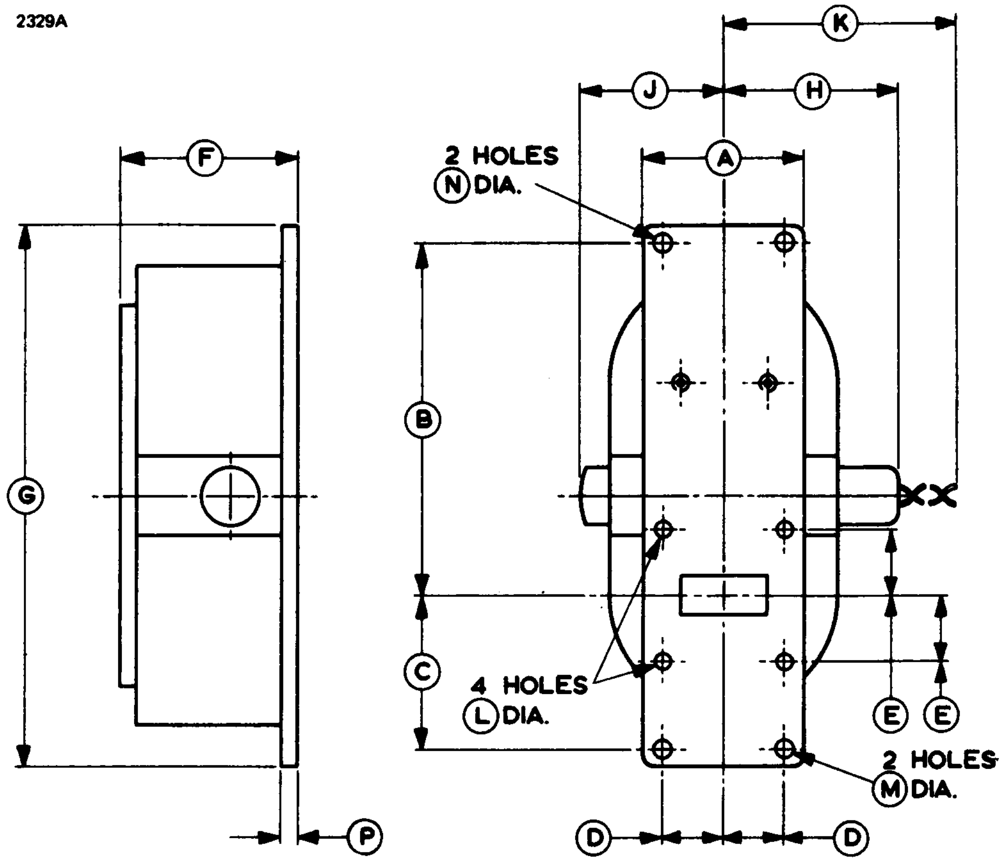

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38	J	1.772 max	45.01 max
B	3.463 ± 0.004	87.960 ± 0.102	K	9.625 min	244.5 min
C	1.521 ± 0.004	38.633 ± 0.102	L	$0.172^{+0.003}_{-0.005}$	$4.369^{+0.076}_{-0.127}$
D	0.610 ± 0.002	15.494 ± 0.051			
E	0.640 ± 0.004	16.256 ± 0.102	M	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

GENERAL SECTION

C.W. MAGNETRONS

PULSE MAGNETRONS, L-BAND

PULSE MAGNETRONS, S-BAND

PULSE MAGNETRONS, C-BAND

PULSE MAGNETRONS, X-BAND