Mullard

Technical handbook

BOOK

2

Valves and tubes

Part 5

Microwave tubes and components

March 1971

MICROWAVE TUBES & COMPONENTS

CONTENTS

Book 2 comprises the following parts—

Part 1 Receiving valves, television picture tubes.

Part 2 Electro-optical devices, radiation detectors.

Part 3 Gasfilled tubes.

Part 4 Transmitting and industrial heating tubes.

Part 5 Microwave tubes and components.

Made and printed in England by WIGHTMAN & CO. LTD

BOOK 2 (Part 5)

VALVES AND TUBES

Microwave tubes

and components

Issued by

CENTRAL TECHNICAL SERVICES

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DATA HANDBOOK SYSTEM

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

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

Book 1	(blue)	Semiconductor Devices and Integrated Circuits
Book 2	(orange)	Valves and Tubes
Book 3	(green)	Passive Components, Materials, and Assemblies

THESE BOOKS REPLACE THE OLD SYSTEM OF LOOSE-LEAF HANDBOOKS. New editions will be issued at approximately yearly intervals.

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

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

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

SELECTION GUIDE—BOOK 2, PART 5

Section B—RADAR MAGNETRONS

Low power tunable magnetrons

Output (W)	Description	Frequency (GHz)	Type No.
10 (c.w.)	C.W.	9·15 to 9·6	JPT9–01
25		9·15 to 9·6	JPT9–02
50	Miniature. Rugged	9·0 to 9·5	YJ1090
50	Miniature. Rugged	8·5 to 9·0	YJ1091
120	Miniature. Rugged, C band	5·4 to 5·9	YJ1030
180	Miniature. Rugged	9·0 to 9·5	YJ1100
180	Miniature. Rugged	8·5 to 9·0	YJ1101

Marine radar magnetrons

Output (kW)	Frequency (GHz)	Type No.
3·0	9·410 ± 0·065	JP9–2·5
3·0	9·255 ± 0·065	JP9–2·5B
3·0	9·55 ± 0·03	JP9–2·5C
3·0	9·445 ± 0·03	JP9–2·5D
3·0	9·445 ± 0·03	JP9–2·5E
3·0	9·445 ± 0·03	JP9–2·5F
3·0	9·375 ± 0·03	JP9–2·5H
3·0	9·445 ± 0·03	JP9–2·5L
3·0	9·445 ± 0·03	JP9–2·5M
7·0	9·375 ± 0·03	JP9–5M
7·0	9·41 ± 0·03	YJ1300
10	9·375 ± 0·03	2J42
10	9·24 ± 0·03	JP9–7A
10	9·55 ± 0·03	JP9–7B
10	9·375 ± 0·03	JP9–7D
10	9·41 ± 0·03	YJ1071
20	9·375 ± 0·03	YJ1110
20	9·445 ± 0·03	YJ1111
20	9·375 ± 0·03	JP9–15
20	9·445 ± 0·03	JP9–15B
21	9·41 ± 0·03	JP9–18
22	9·24 ± 0·03	YJ1050
25	9·41 ± 0·03	YJ1120
25	9·445 ± 0·03	YJ1121
40	33·05 ± 0·35 (Q band)	YJ1021
40	34·86 ± 0·35 (Q band)	JP35–30
50	9·375 ± 0·03	JP9–50A
60	8·5 to 9·6 (Tunable)	JPT9–60
65	9·445 ± 0·03	YJ1290
80	9·375 ± 0·03	JP9–75

Section B—RADAR MAGNETRONS (cont.)

Beacon and special purpose magnetrons

Output (kW)	Description	Frequency (GHz)	Type No.
0·015	Push rod tuning	9·3 to 9·5	JPT9–01K
0·025	Fixed frequency	8·8 ± 0·03	JP8–02B
20	Fixed frequency. High altitude	9·375 ± 0·03	YJ1060
50	Fixed frequency. Forced-air cooled	9·375 ± 0·03	2J55
90	Fixed frequency. Rugged	9·345 ± 0·03	YJ1250
225	Tunable calibration. Forced-air cooled	8·5 to 9·6	YJ1010

High power radar magnetrons

Output (kW)	Frequency (GHz)	Type No.
180	9·375 ± 0·05	JP9–180
250	9·375 ± 0·03	JP9–250
250	9·086 ± 0·083	JP9–250A
250	8·913 ± 0·083	JP9–250B
250	8·93 ± 0·065	JP9–250C
250	8·748 ± 0·083	JP9–250D
250	8·583 ± 0·083	JP9–250E
250	9·24 ± 0·03	JP9–250F
610	1·22 to 1·35 Tunable. Unpackaged L band	JNT1–500

Airborne radar magnetrons

Output (kW)	Frequency (GHz)	Type No.
15	9·375 ± 0·03	YJ1040
50	9·375 ± 0·03	YJ1200
50	9·375 ± 0·03	YJ1201
85	5·40 ± 0·02 (C band)	6521

Section B—RADAR MAGNETRONS (cont.)

Spin tuned magnetrons

Output (kW)	Description	Frequency (GHz)	Type No.
200	Spin tuned over 450MHz sweep in 500μs	8·7 to 9·5	YJ1180
200	As YJ1180 with optional frequency lock	8·7 to 9·5	YJ1181

Section C—HEATING MAGNETRONS

Output (kW)	Description	Frequency (GHz)	Type No.
0·2	For microwave therapy	2·45±0·025	7090
1·25	Fast warm-up for microwave cooking	2·45±0·025	YJ1280
2·5	Cooking and processing. Water cooled	2·45±0·025	YJ1160
2·5	Cooking and processing. Forced-air cooled	2·45±0·025	YJ1162
5·0	Industrial applications. Water cooled	2·45±0·025	YJ1191

Section D—KLYSTRONS

Low power klystrons

Output (mW)	Description	Frequency (GHz)	Type No.
35	Lightweight. Waveguide. Flying leads	9·16 to 9·34	YK1046
35	Micrometer tuning. Waveguide. 3-pin	8·5 to 9·6	KS9–30
40	Mechanically tuned. Coaxial	8·7 to 9·55	723A/B
45	Mechanically tuned. Coaxial	8·5 to 9·6	2K25
45	Mechanically tuned. Coaxial	9·32 to 9·55	KS9–20B
45	Mechanically tuned. Coaxial	9·3 to 9·5	KS9–20D
40	Mech. tuned. Waveguide. Octal base	9·3 to 9·5	KS9–40
45	Mech. tuned. Waveguide. Flying leads	9·35 to 9·55	KS9–40B
40	Mech. tuned. Waveguide	9·38 to 9·51	KS9–40D
45	Mech. tuned. Waveguide. Octal base	9·35 to 9·55	KS9–40G
100	Coaxial output	6·5 to 7·5	KS7–85
400	Waveguide. Forced-air cooled. Flying leads	10·5 to 12·2	YK1090
400	As YK1090 except 3-pin base	10·5 to 12·2	YK1091

Section D—KLYSTRONS (cont.)
U.H.F. high power klystrons

Output (kW)	Description	Frequency (MHz)	Type No.
11	Air cooled	470 to 860	YK1001
11	Air and water cooled	470 to 860	YK1002
11	Air cooled	470 to 860	YK1005

Section E—TRAVELLING WAVE TUBES
Radar travelling wave tubes

Frequency (GHz)	Minimum saturated power output (W)	Type No.
2·7 to 3·3	250 (pulsed)	LB3–250B
9·0 to 10	0·002	YH1060
7·0 to 11·5	0·004	LA9–3B

Communications travelling wave tubes

Frequency (GHz)	Minimum saturated power output (W)	Type No.
3·4 to 4·2	25	YH1090
5·8 to 8·5	22	YH1170
5·9 to 6·5	10	LB6–10
5·9 to 6·5	10	LB6–10B
5·9 to 6·5	25	LB6–25
6·4 to 7·2	20	LB6–25A
7·1 to 7·8	18	LB7–20E

Section F—MICROWAVE COMPONENTS
Gunn effect oscillators

Nominal centre frequency (GHz)	Description	Type No.
8·5	Mechanical tuning range $\pm$500MHz	CL8360
9·5	Typical power output 5mW	CL8370
10·5	Output coupling 50ΩOSM	CL8380
11·5		CL8390
10·69	Fixed frequency. Typical power output 8mW. Output coupling WG16	CL8630

Section F—MICROWAVE COMPONENTS (cont.)
Mixers

Band	Frequency (GHz)	Description	Type No.
S	2·5 to 4·1	Coaxial balanced type C	CL7311
S	2·5 to 4·1	Coaxial balanced type N	CL7312
X	7·0 to 11·5	Coaxial balanced type C	CL7300
X	7·0 to 11·5	Coaxial balanced type N	CL7301
X	8·0 to 11	Waveguide single ended	CL7309
Q	26·5 to 40	Waveguide single ended	CL7310

Note:—A range of microwave diodes will be found in Book 1 Part 3.

Coaxial circulators

Frequency (MHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
170 to 200	0·4	20	500	CL5191
200 to 230	0·4	20	500	CL5201
406 to 470	0·4	20	100	CL5151
406 to 470	0·5	23	100	CL5009
450 to 550	0·6	23	100	CL5014
470 to 590	0·35	22	100	CL5251
470 to 600	0·5	23	100	CL5007
470 to 600	0·35	22	500	CL5027
570 to 720	0·35	22	500	CL5028
590 to 720	0·35	22	100	CL5171
590 to 720	0·5	23	100	CL5008
608 to 785	0·5	23	100	CL5015
710 to 860	0·35	22	100	CL5181
710 to 860	0·5	23	100	CL5010
710 to 860	0·35	22	500	CL5029
1900 to 2300	0·5	25	50	CL5001
2200 to 3000	0·5	22	50	CL5005
3600 to 4300	0·5	25	50	CL5012

Section F—MICROWAVE COMPONENTS (cont.)

Waveguide 3-port circulators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
3·4 to 3·7	0·3	25	50	CL5031
3·6 to 3·9	0·3	25	50	CL5041
3·6 to 4·2	0·3	25	100	CL5075
5·925 to 6·425	0·3	25	100	CL5020
7·7 to 8·5	0·3	25	40	CL5021

Waveguide 4-port circulators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation Opposite Ports (dB)	Min. Isolation Adjacent Ports (dB)	C.W. Power Rating (W)	Type No.
5·925 to 6·175	0·1	30	20	150	CL5081
5·925 to 6·175	0·3	30	20	100	CL5057
6·125 to 6·425	0·3	30	20	100	CL5052
6·175 to 6·425	0·1	30	20	150	CL5091
6·575 to 6·875	0·35	30	20	100	CL5053
6·825 to 7·125	0·35	25	18	100	CL5051
7·125 to 7·425	0·3	25	19	100	CL5050
7·425 to 7·725	0·35	30	20	100	CL5054
10·7 to 11·7	0·3	30	18	25	CL5056
12·5 to 13·5	0·3	25	20	25	CL5055

Section F—MICROWAVE COMPONENTS (cont.)

Waveguide isolators

Frequency (GHz)	Max. Insertion Loss (dB)	Min. Isolation (dB)	C.W. Power Rating (W)	Type No.
3·65 to 3·95	0·5	30	15	CL6204
3·8 to 4·2	0·5	30	10	CL6240
3·8 to 4·2	0·8	30	10	CL6201
3·9 to 4·2	0·5	30	15	CL6205
4·2 to 4·6	0·5	30	10	CL6202
4·6 to 5·0	0·8	30	10	CL6203
5·925 to 6·425	0·5	30	20	CL6206
6·425 to 7·15	0·3	30	20	CL6251
6·875 to 7·425	0·5	30	20	CL6231
7·125 to 7·75	0·3	30	20	CL6291
7·25 to 7·75	0·5	30	20	CL6241
7·4 to 8·025	0·5	30	10	CL6210
7·7 to 8·5	0·5	30	15	CL6214
7·7 to 8·5	0·5	30	15	CL6216
8·5 to 9·6	0·5	30	10	CL6222
8·5 to 9·6	0·6	15	1	CL6221
10·7 to 11·7	0·8	30	5	CL6215
12·5 to 13·5	0·5	30	10	CL6217

GENERAL SECTION A

LIST OF SYMBOLS

These symbols are based on British Standard Specification No. 1409 : 1950, "Letter Symbols for Electronic Valves".

1. SYMBOLS FOR ELECTRODES

Anode	a	Fluorescent Screen or Target...	t
Cathode	k	External Metallisation	M
Grid	g	Internal Metallisation	m
Heater	h	Deflector Electrodes	x or y
Filament	f	Internal Shield	s
Beam Plates	bp	Resonator	Res

NOTE 1. In valves having more than one grid, the grids are distinguished by numbers—g_1, g_2, etc., g_1 being the grid nearest the cathode.

NOTE 2. In multiple valves, electrodes of the different sections may be distinguished by adding one of the following letters:

Diode	d	Hexode	h
Triode...	t	Heptode	h
Tetrode	q	Octode	h
Pentode	p	Rectifier	r

Thus, the grid of the triode section of a triode-hexode is denoted by g_t.

NOTE 3. Two or more similar electrodes which cannot be distinguished by any of the above means may be denoted by adding one or more primes to indicate to which electrode system the electrode forms a part.
Thus, the anode of the first diode in a double diode valve is denoted a′.

2. SYMBOLS FOR ELECTRIC MAGNITUDES

Voltages		Current	
Direct Voltage	V	Direct Current	I
Alternating Voltage (r.m.s.)	$V_{r.m.s.}$	Alternating Current (r.m.s.)	$I_{r.m.s.}$
Alternating Voltage (mean)	V_{av}	Alternating Current (mean)	I_{av}
Alternating Voltage (peak)	v_{pk}	Alternating Current (peak)	i_{pk}
Peak Inverse Voltage ...	P.I.V.	No Signal Current	I_o

Miscellaneous

Frequency	f	Anode Efficiency	η
Amplification Factor ...	μ	Sensitivity	S
Mutual Conductance ...	g_m	Brightness	B
Conversion Conductance...	g_c	Temperature	T
Distortion	D	Time	t

LIST OF SYMBOLS

	Inside Valve	Outside Valve
Resistance	r	R
Reactance	x	X
Impedance	z	Z
Admittance	y	Y
Mutual Inductance	m	M
Capacitance	c	C
Capacitance at Working Temperature	c_w	
Power	p	P

3. AUXILIARY SYMBOLS

Battery or other source of supply	b
Inverse (Voltage or Current)	inv
Ignition (Voltage)	ign
Extinction (Voltage)	ext
No Signal	o
Input	in
Output	out
Total	tot
Centre Tap	ct

4. COMPLEX SYMBOLS

Symbols in Sections 1 and 3 above may be used as subscripts to symbols in Section 2, to denote such magnitudes as Anode Current, Grid Volts, etc., e.g.:—

Anode Voltage ...	V_a	Anode Current (A.C. r.m.s.)	$I_{a(r.m.s.)}$
Control-Grid Voltage	V_{g1}	No Signal Anode Current ...	$I_{a(o)}$
Anode Supply Voltage	$V_{a(b)}$	Control-Grid Current ...	I_{g1}
Filament Voltage ...	V_f	Total Distortion	D_{tot}
Heater Voltage ...	V_h	3rd Harmonic Distortion ...	D_3
Anode Dissipation ...	p_a	Equivalent Noise Resistance	R_{eq}
Output Power ...	P_{out}	Limiting Resistor	R_{lim}
Drive Power	P_{drive}	Cathode Bias Resistor	R_k
Anode Current (D.C.)	I_a		

	Internal	External
Anode Resistance	r_a	R_a
Insulation Resistance (heater to cathode)	r_{h-k}	
Resistance between Control-Grid and Cathode ...	r_{g1-k}	R_{g1-k}
Capacitance (cold)—		
Anode to all other electrodes		c_{a-all}
Anode to control-grid		c_{a-g1}
Control-grid to cathode at working temperature		$c_{g1-k(w)}$
Control-grid to all other electrodes except anode (Input Capacitance)		c_{in}
Anode to all other electrodes except control-grid (Output Capacitance)		c_{out}
Inner Amplification Factor		μ_{g1-g2}

A new comprehensive type nomenclature system for transmitting and industrial valves and tubes has recently been introduced. In general, new Mullard devices will have type numbers in the 'new system', earlier devices will retain numbers in one of the 'old systems'.

NEW SYSTEM

The type number for valves or tubes used primarily in 'professional' applications (e.g. transmitters, navigation or communication equipment, industrial applications) consists of two letters followed by four figures. This system does not apply to receiving-type valves.

The first letter indicates a fundamental characteristic of the device:

X—photosensitive tube
Y—vacuum valve or tube (except photodevices)
Z—gasfilled valve or tube (except photodevices)

The second letter indicates the construction or application of the device:

A—diode
C—trigger tube
D—triode or double triode
G—miscellaneous
H—travelling wave tube
J—magnetron
K—klystron
L—tetrode, pentode, double tetrode or double pentode
M—cold cathode indicator or counter tube
P—photomultiplier tube or radiation counter tube
Q—camera tube
T—thyratron
X—ignitron, image intensifier or image converter
Y—rectifier
Z—voltage stabiliser or reference tube

The group of four figures is a serial number. The last figure is 0 for basic types; variants of the basic type are indicated by the figures 1 to 9.

Example

YL1030 Transmitting double tetrode

Receiving-type valves

The type number of receiving valves used primarily in 'professional' applications is similar to that for normal receiving valves except that there are four figures instead of two or three. The letters and first figure have the same significance as in the receiving valve type numbering system.

Example

EC1000 Triode for professional applications, special base, 6.3V heater

OLD SYSTEMS

Transmitting and large industrial valves and tubes

The type number generally consists of two or more letters followed by two sets of figures. These symbols provide information concerning the principal uses and ratings of the valves according to the following code.

The first letter indicates the general functional class of valve:

B—backward wave tube
J—magnetron
K—klystron
L—travelling wave tube
M—l.f. amplifying or modulator triode
P—r.f. power pentode
Q—r.f. power tetrode
R—power rectifier
T—r.f. power triode
X—large thyratron. (All hydrogen thyratrons and other thyratrons having max. mean anode current of 500mA or more.)

Note.—For valves having dual electrode systems, the code letters for both systems are used, e.g. 'QQ' for a double tetrode.

The second letter indicates some structural property in each class of valve:

(a) For transmitting valves and vacuum rectifiers, the type of cathode.
(b) For thyratrons and gasfilled rectifiers, the type of gas present.
(c) For microwave devices, a basic structural feature.

A—outputs up to 1W } In backward wave and travelling wave tubes
B—outputs of 1W and over } In backward wave and travelling wave tubes
D—disc-seal construction
G—mercury-vapour filled
H—hydrogen-filled
N—external magnet required (in magnetrons)
P—packaged construction (in magnetrons)
R—inert-gas filled
S—reflex (single resonator) construction (in klystrons)
T—multiple resonator construction (in klystrons)
V—indirectly heated oxide-coated cathode
X—directly heated tungsten filament
Y—directly heated thoriated-tungsten filament
Z—directly heated oxide-coated filament

The third letter

Transmitting valves with a silica envelope have a third letter 'S'.
Thyratrons with a shield grid (tetrode construction) have a third letter 'Q'.
Microwave devices that are tunable have a third letter 'T'.

The first group of figures, immediately following the letters, indicates:

(a) The approximate anode voltage in kV for transmitting valves and rectifiers:

Thus 05 represents 0.5kV = 500V
2 represents 2kV = 2000V

For valves intended for pulse operation this figure is the peak anode voltage in kV.

(b) The approximate peak inverse voltage in kV for thyratrons.

(c) The approximate frequency of operation in Gc/s for magnetrons, klystrons, backward wave tubes and travelling wave tubes:

Thus 9 represents 9Gc/s = 9000Mc/s.

The second group of figures indicates:

(a) For transmitting valves, the maximum permissible anode dissipation in W. For dissipations of 10kW or more the dissipation in kW is given.

(b) For transmitting valves primarily intended for pulse operation this group is prefixed by the letter 'P' and the figures indicate the maximum peak current in amps.

(c) For backward wave and travelling wave tubes, the output power in mW or W depending on the second letter ('A' or 'B').

(d) For magnetrons, the pulse power output in kW.

(e) For klystrons, the power output in mW.

(f) For rectifiers, the approximate rectifier output current in mA.

(g) For thyratrons, the approximate maximum permissible mean anode current in mA. This group consists of at least three digits, the first one being 0 if the current is between 10 and 100mA. For currents of 10A or more the current in amps is given.

Thus 045 represents 45mA
6400 represents 6400mA = 6.4A
12 represents 12A

A final letter occasionally follows the second group of figures. This is usually a serial letter to denote a particular design or development. Types designed for water cooling are indicated by the letter 'W' and if these types also have a forced air-cooled version this is indicated by the letter 'A'.

Examples

JP9-7	Magnetron with packaged construction for operation at a frequency of approximately 9000Mc/s with pulse power output of 7kW.
KS9-20	Klystron of reflex construction for operation at a frequency of approximately 9000Mc/s with a power output of 20mW.
LA4-250	Travelling wave tube for operation at a frequency of approximately 4000Mc/s with an output of 250mW.

QQV03-10 Double beam tetrode with indirectly heated oxide-coated cathode. Rated to work at 300V and to dissipate 10W continuously (5W at each anode).

QV20-P18 R.F. power tetrode with indirectly heated oxide-coated cathode. Designed for pulse operation with maximum peak anode voltage of 20kV and maximum peak anode current of 18A.

RG3-250 Mercury-vapour rectifier rated to work at 3kV and to give a maximum rectified output of 250mA.

XG5-500 Mercury-vapour thyratron having a rated peak inverse voltage of approximately 5kV and a maximum permissible mean anode current of approximately 500mA.

Cold cathode tubes

The type number for cold cathode tubes (excluding photocells and stabilisers) consists of one letter followed by a group of three figures which are followed by a second letter.

The first letter is always Z, indicating a cold cathode gasfilled tube.

The first figure indicates the type of base, the significance of the figure being the same as for Mullard receiving valves.

The second and third figures are serial numbers indicating a particular design or development.

The second letter indicates the function of the tube:

A—amplifier tube (continuous operation)
B—binary counter of switching tube
C—multistage counter tube
E—electrometer trigger or amplifier tube
G—gating tube
M—indicator (metering) tube
S—multistage switching tube
T—3-electrode trigger tube
U—4-electrode trigger tube
W—5-electrode trigger tube

Example

Z803U 4-electrode cold cathode trigger tube with B9A base.

1. GENERAL

Failure to observe these General Operational Recommendations may seriously reduce the life of a valve and in some instances could result in catastrophic failure.

Any enquiries should be addressed to the Government and Industrial Valve Division, Mullard Limited.

2. CHARACTERISTICS

The published characteristics are based upon averages of readings taken on a representative number of valves.

3. LIMITING VALUES

The limiting values whether maximum or minimum are absolute and the following definition of the absolute system has been based on that agreed by the International Electrotechnical Commission.

3.1. Absolute-maximum rating system

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

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

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

In some instances, such as with very short pulse durations or complex wave trains, it may be permitted to exceed the absolute values, but the desired operating conditions must be agreed with Mullard Limited.

4. TYPICAL OPERATING CONDITIONS

Typical operating conditions are given, some of which may incorporate one or more of the absolute ratings; in such cases the designer should take precautionary steps to ensure that these ratings are never exceeded.

Where several typical operating conditions are given, interpolation for intermediate conditions is generally permitted. There are exceptions to this rule and the operating conditions should be agreed with Mullard Limited.

5. INSTALLATION

Ferrous tools must not be used on permanent magnet valves, as this may cause deterioration in the performance of the valve. Any glass or ceramic insulation supporting the cathode terminal should be carefully cleaned when necessary since pulse current leakage could cause irregular transmission and damage through local heating. In addition the outlet flange must be clean in order to discourage arcing.

6. PRESENTATION OF VALVE DATA

The symbols, component and base references incorporated in the data are in accordance with the following British Standards:—

1409: 1950	Letter symbols for electronic valves.
1991: Part I: 1954	Letter symbols, signs and abbreviations.
530: 1948 (with supplements)	Graphical symbols for telecommunications.
448: 1953	Electronic-valve bases, caps and holders.
204: 1960	Glossary of terms used in telecommunications (including radio) and electronics.

RADAR MAGNETRONS

B

GENERAL OPERATIONAL RECOMMENDATIONS

The following recommendations should be interpreted in conjunction with British Standard Code of Practice No. CP1005: 'The Use of Electronic Valves', Part 9, upon which these notes have, in part, been based.

1. HEATER

1.1. General

A cathode temperature either too high or low may lead to unsatisfactory operation such as moding and arcing, involving short life and loss of efficiency.

During operation the cathode temperature is increased by electron bombardment ('back heating'). The data sheets for magnetrons, therefore, usually contain information relating the heater voltage to the average anode input power so that the cathode temperature can be maintained at the desired level.

The heater voltage should be at the stated nominal when the h.t. is first applied, and be subsequently reduced as recommended in the data. In the case of magnetrons having cathodes of small thermal capacity, it may be necessary to reduce the heater voltage immediately the anode voltage is applied.

With some valves it may be required to limit the filament or heater current when switching on the supply. Information on this will generally be included on individual data sheets.

1.2. Indirectly heated oxide-coated cathodes

To obtain maximum life the heater voltage must be within $\pm 5\%$ of the value recommended for a particular operation.

1.3. Directly heated cathodes

Reference should be made to the individual data sheets.

2. INPUT AND OUTPUT CONNECTIONS

2.1. Input connection

The negative input voltage should be applied to the common heater-cathode terminal to avoid the flow of anode current through the heater which might be damaged.
In applications where a bifilar pulse transformer is used a non-inductive capacitor should be connected between the heater-cathode and heater terminals to suppress any high transient voltages.

2.2. Output connection

It is important that the type of output connection should be as specified in the data. Use of flat coupling instead of choke coupling or vice versa may upset the matching and possibly cause breakdown of the output system. Connections to the output must be designed to be sufficiently tight to avoid arcing and other faults. It is also important to avoid undue stressing of the output section which would either deform the metal or break the glass or ceramic vacuum seals. It is, therefore, necessary that any mechanical pressure be applied uniformly.

3. H.T. SUPPLY AND MODULATORS

3.1. General

The dynamic impedance of magnetrons is in general low; thus small variations in the applied voltage can cause appreciable changes in operating current. In the equipment design it is necessary to ensure that such variations in operating current do not lead to operation outside the published limits.

Current changes result in variation of power frequency and frequency spectrum quality and consequent deterioration of equipment performance. This factor should determine the maximum current change inherent in the equipment design under the worst operating conditions.

3.2. C.W. types

For c.w. types the amount of smoothing required in the h.t. supply depends on the amount of modulation, resulting from operating current variation, which can be tolerated.

Under certain operational conditions a c.w. magnetron can develop a negative resistance characteristic and a minimum value of series resistance which should be adjacent to the magnetron is given in individual data sheets.

3.3. Pulse types

To ensure a constant operating condition with a pulsed valve the modulator design must provide a pulse, the amplitude of which does not vary to any significant extent from pulse to pulse. The necessary design precautions depend on the type of modulator employed, and cannot be generalised.

The performance of a magnetron is often a sensitive function of the shape of the pulse that it receives and it is necessary to control four distinct aspects: rate of rise, spike, flat and rate of fall. In this connection it is important that any observation of the shape of the pulse, either of voltage or of current, supplied by the modulator should be made with a magnetron load and not with a dummy load, because a magnetron acts as a non-linear impedance. Furthermore, a magnetron is likely to be more sensitive to a mismatched load.

3.3.1. Rate of rise

Both maximum and minimum rates of rise of voltage (and sometimes current) may be specified. The most critical value is that just before and during the initiation of oscillation. Too high or low a rate of rise may accentuate the tendency to moding.

Too high a rate of rise may cause operation in the wrong mode or even failure to oscillate, and either of these conditions may lead to arcing due to overheating or to excessive voltages.

Operation at too low a rate of rise may also cause oscillation in the wrong mode or oscillation in the normal mode for an appreciable period at less than full current and this will cause frequency pushing leading to a broad frequency spectrum.

The rate of rise of voltage should be measured above the 80% point of the peak voltage corresponding to the onset of oscillation. For accuracy it is advisable to measure the rate of rise by means of a differentiating circuit whose total capacitance does not exceed 5% of the total stray capacitance of the modulator output circuit. Direct observation on an oscilloscope can be misleading due to the limitation of the oscilloscope and sampling device.

3.3.2. Spike

It is important that the voltage pulse should not have a high spike on the leading edge. Such a spike may cause the valve to start in an undesired mode. Although this operation may not be sustained, the transient condition may lead to destructive arcing. Measures taken to reduce the spike must not also reduce the rate of rise below the specified minimum.

3.3.3. Flat

The top of the voltage pulse should be free from ripple or droop since small changes in voltage cause large current variations resulting in frequency pushing. This leads to frequency modulation of the r.f. pulse and consequent broadening of the spectrum or instability.

3.3.4. Rate of fall

The fall of voltage must be rapid at least to the point where oscillation ceases, to avoid appreciable periods of operation below full current, with the attendant frequency pushing. This point is normally reached when the voltage has fallen to about 80% of the peak value.

Beyond this point a lower rate of fall is generally permissible, but a significant amount of noise will be generated, which may be detrimental to radar systems with a very short minimum range. To prevent coherent noise being generated especially in short range radars the voltage tail must decay to zero before the radar receiver recovers.

A fast rate of fall is also important where valves are operated at a high pulse recurrence frequency since any diode current which occurs after oscillations have ceased will add appreciably to the mean current and dissipation of the valve.

In certain applications it is desirable to return the valve cathode to a positive d.c. bias in order to speed up the rate of fall and to prevent diode current being passed during the inter-pulse period.

4. LOADING

The anode current range shown in individual data sheets is related to a maximum standing wave ratio seen by the magnetron of 1.5 to 1. Incorrect loading beyond this may reduce the current range for stable operation and can cause arcing or moding.

5. GENERATOR LOAD CHART (Rieke diagram)

A chart showing typical output power and frequency change plotted on a modified impedance circle diagram against magnitude (v.s.w.r.) and phase of the load seen by the magnetron, provides information on the behaviour of the magnetron to different load conditions.

Such a chart is often referred to as a Rieke diagram.

6. PHASE OF SINK

From the generator load chart it is seen that with a load of bad mismatch and at a particular phase, there is a region on the chart which is characterised by high power output and convergence of the frequency contours. This region is known as 'the sink' and the phase of the load at which the magnetron behaves in this manner is known as 'the phase of sink'. Operation of the magnetron under this load condition will lead to instability and may cause failure of the magnetron. By matching the r.f. system such that the maximum permitted load v.s.w.r. is not exceeded, the sink will be avoided.

7. OPERATION IN DUPLEXER SYSTEMS

7.1. Position of t.r. cell

Where the r.f. systems incorporates a t.r. cell a bad load mismatch, which is unavoidable, is seen by the magnetron momentarily until the cell has been ionised. If the phase of this mismatch is such that it is in the phase of sink the build up of oscillation of the magnetron may be prevented. It is therefore essential that the t.r. cell is so positioned that its phase of mismatch as seen by the magnetron is remote from the sink region.

7.2. Position of minimum

In the non-oscillating condition the magnetron presents at its frequency of oscillation a bad mismatch of considerable magnitude to the r.f. system. This property is utilised in certain duplexer systems. In the design of such a system it is necessary to know the phase of the above load mismatch and this is designated at a position of minimum of the voltage standing wave in relation to a reference plane on the magnetron output system.

8. COOLING

8.1. General

The maximum temperature of the anode block, cathode terminal assembly and waveguide windows, where applicable, should on no account be exceeded. It may be necessary to provide additional cooling to prevent these temperature limits being exceeded. Where air or water cooling is necessary, interlock switches should be provided to prevent operation in the event of failure or reduction of cooling medium. In the development stage of an equipment the various temperatures should be measured with due regard to the ultimate environmental conditions. Special paints and lacquers are available for this purpose but any other suitable means may be used.

8.2. Air cooling

For the cooling of components such as input waveguide windows and output domes it is important that the air should not contain dust, moisture or grease.

8.3. Water cooling

The circulating cooling water should be as free as possible from all solid matter and the dissolved oxygen content should be low. Whenever possible a closed water system using distilled or demineralised water should be employed.

9. PRESSURISATION

The limiting values and operating conditions quoted in the data are given for a pressure of 650mm of mercury unless otherwise stated. In the case of high power magnetrons it may be necessary to pressurise the output waveguide in order to prevent electrical breakdown. Advice is given in the individual valve data sheets. Precautionary steps should be taken to prevent operation in the event of the failure of the pressurisation. In order to avoid dielectric breakdown, clean and dry air or gas must be used.

10. STORAGE

Valves should be stored in their original packing because this has been designed to protect the valve against reasonable vibration, and knocks. It also ensures that the spacing between permanent-magnet valves and other magnets or ferrous objects is adequate to avoid reduction of magnetisation. Despite this controlled spacing, magnetically-sensitive instruments such as compasses, electrical meters and watches should not be brought close to a bank of packaged magnetrons.

When a valve is protected by a moisture-proof container this fact is clearly stated on the outside. Unnecessary opening of the seal should be avoided so that the dessicant is not exhausted rapidly. When a magnetron is temporarily taken out of service it should be placed immediately in its proper container. This is a good practice which obviates the risk of damage to the magnet or to the glass or ceramic parts and prevents the entry of foreign matter into the output aperture.

Unpacked permanent-magnet valves should **NEVER** be placed on steel benches or shelves.

11. CONDITIONING

It is recommended that after transit or a long period of storage the anode voltage should be increased gradually or in several steps until normal operation is achieved. This treatment will clean up any traces of gases which could cause arcing or instability and this procedure is particularly important in high power magnetrons.

12. RADIATION HAZARDS

In general the shorter the wavelength of an r.f. radiation the greater the absorption by body tissues and hence for comparable power, the greater the hazard. With magnetrons the power may be sufficient to cause danger, particularly to the eyes.

If it is necessary to look directly into a magnetron output, this should be performed through an attenuating tube or through a small hole set in the wall of the waveguide at a bend. Alternatively r.f. screening such as copper gauze of mesh small compared with the wavelength must be provided.

With high power magnetrons precautions may also be necessary to reduce the stray r.f. radiation emitted through the cathode stem and other apertures, especially when the magnetron is functioning incorrectly.

High voltage magnetrons (as well as the high voltage rectifier and pulse modulator valves) can emit a significant intensity of X-rays and protection of the operator may be necessary. When magnetron behaviour is viewed through an aperture X-rays may be present. Protection of the eye is afforded by viewing through lead glass.

TUNABLE MAGNETRON

JNT1-500

Frequency: *'L' band, mechanically tunable.*
Power output: *600kW, pulsed.*
Construction: *Unpackaged, forced-air cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.	*Max.*	
Frequency			
Tunable over the range	1.22 to 1.35		Gc/s
Pulse voltage			
(I_{pulse} = 46A, H = 1.4kG)	26.5	31.5	kV
R.F. pulse power output			
(I_{pulse} = 46A, H = 1.4kG)	400	—	kW
Frequency pulling factor			
(v.s.w.r. = 1.5)	—	5.0	Mc/s
Frequency pushing factor	—	60	kc/s per A
Frequency temperature coefficient	—	−30	kc/s per °C

CATHODE

Indirectly heated

V_h	23.5	V
I_h	2.2	A
$I_{h(surge)}$ max.	4.0	A

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 3 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 5 minutes.
It is necessary to reduce the heater voltage immediately after the application of h.t. and if operation substantially different from that shown under typical operation is envisaged Mullard Ltd. should be consulted.

TYPICAL OPERATION

f	1.285	Gc/s
Heater voltage (running)	15.5	V
Pulse duration	1.0	µs
Pulse repetition frequency	1000	p/s
Duty cycle	0.001	
Pulse current	46	A
Pulse voltage	27.2	kV
Pulse input power	1.25	MW
R.F. pulse output power	610	kW
Mean input current	46	mA
Mean input power	1.25	kW
Mean r.f. output power	610	W
Frequency pulling (v.s.w.r. = 1.5)	4.0	Mc/s
Rate of rise of pulse voltage	60	kV/µs
Magnetic field strength	1.4	kG

OPERATING NOTES

1. The magnetron is designed to feed into a 50Ω, $1\frac{5}{8}$ inch coaxial transmission line.
2. The maximum torque to be applied to the driving gear wheel for tuning the magnetron should not exceed 8lb. in (9.2kg.cm).
3. The coaxial outlet should be protected by a dust cover when the magnetron is not in use.

JNT1-500

TUNABLE MAGNETRON

COOLING

It is necessary to direct a flow of cooling air between the radiator fins, and on the cathode and heater seals, in order to keep the temperature below the permitted maximum.

LIMITING VALUES (absolute ratings)

	Min.	Max.	
Pulse current	25	60	A
Pulse voltage	24	34	kV
Pulse duration	1.0	6.0	μs
Duty cycle	—	0.002	
Mean input power	—	1.8	kW
Rate of rise of voltage pulse			
$t_p \leqslant 1.0\mu s$	—	70	kV/μs
$t_p > 1.0 \leqslant 5.0\mu s$	—	30	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	125	°C

MOUNTING POSITION

Any

PRESSURISING

The output system may be pressurised up to a pressure of 1550torr.

PHYSICAL DATA

Weight of magnetron	19lb 13oz	9 kg
Weight of magnetron in carton	37lb 8oz	17 kg

ACCESSORY

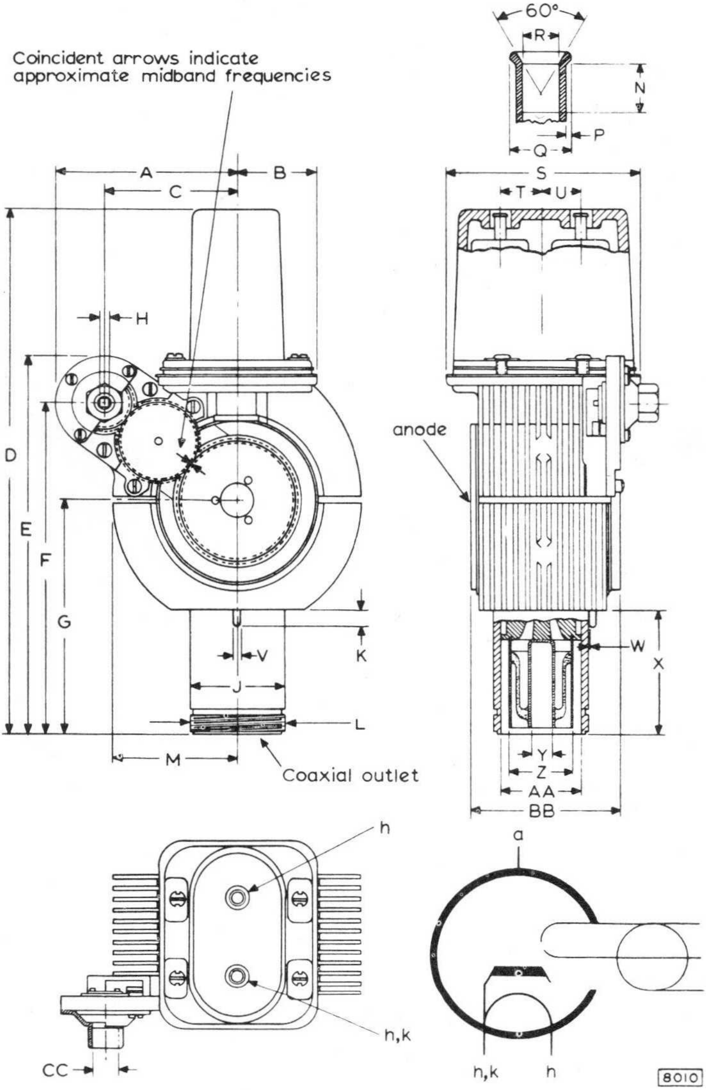
Permanent magnet 55302

DIMENSIONS

	Inches	Millimetres			Inches	Millimetres	
A	4.496	114.2	max.	P	0.012	0.31	min.
B	2.000	50.8	max.	Q	0.281±0.003	7.135±0.075	
C	3.374	85.7	max.	R	0.169±0.005	4.30±0.13	
D	12.500	317.5	max.	S	4.750	120.65	max.
E	9.185	233.3	max.	T	1.036	26.31	
F	8.000±0.185	203.2±4.7		U	0.904	22.96	
G	5.469±0.061	138.90±1.55		V	0.125±0.003	3.175±0.075	
H	0.250±0.002	6.35±0.05 (square hole)		W	0.010	0.25	max.
				X	3.055±0.007	77.585±0.185	
J	2.310±0.003	58.6625±0.0625		Y	0.564±0.010	14.325±0.255	
K	0.376±0.014	9.55±0.35		Z	1.577±0.010	40.05±0.25	
*L	2.312	58.7		AA	1.931±0.004	49.05±0.10	
M	3.000	76.2	max.	BB	3.505±0.055	89.025±1.395	
N	0.592±0.002	15.04±0.04	max.	CC	0.375±0.002	9.525±0.055	

*Thread specification—5 full threads minimum

Maximum major diameter = 58.75mm, 2.313in.
Minimum major diameter = 58.37mm, 2.298in.
Maximum pitch diameter = 57.69mm, 2.271in.
Minimum pitch diameter = 57.48mm, 2.263in.
Minimum minor diameter = 56.78mm, 2.235in.


60°
R
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Coincident arrows indicate approximate midband frequencies
A
B
C
S
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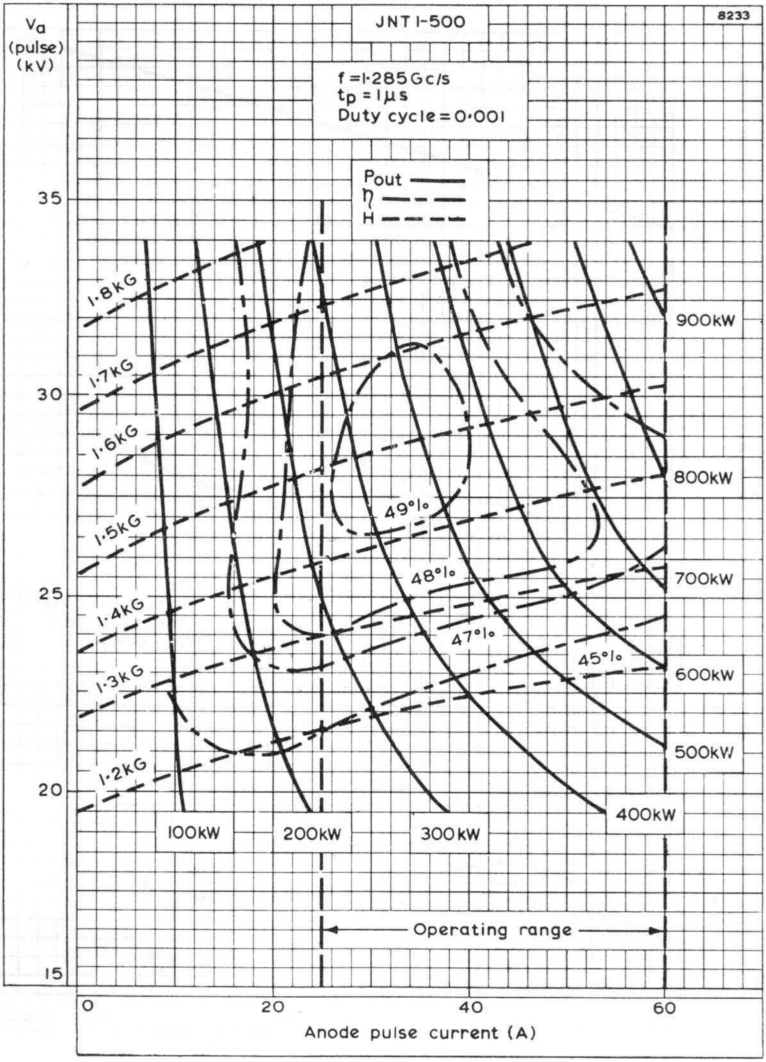
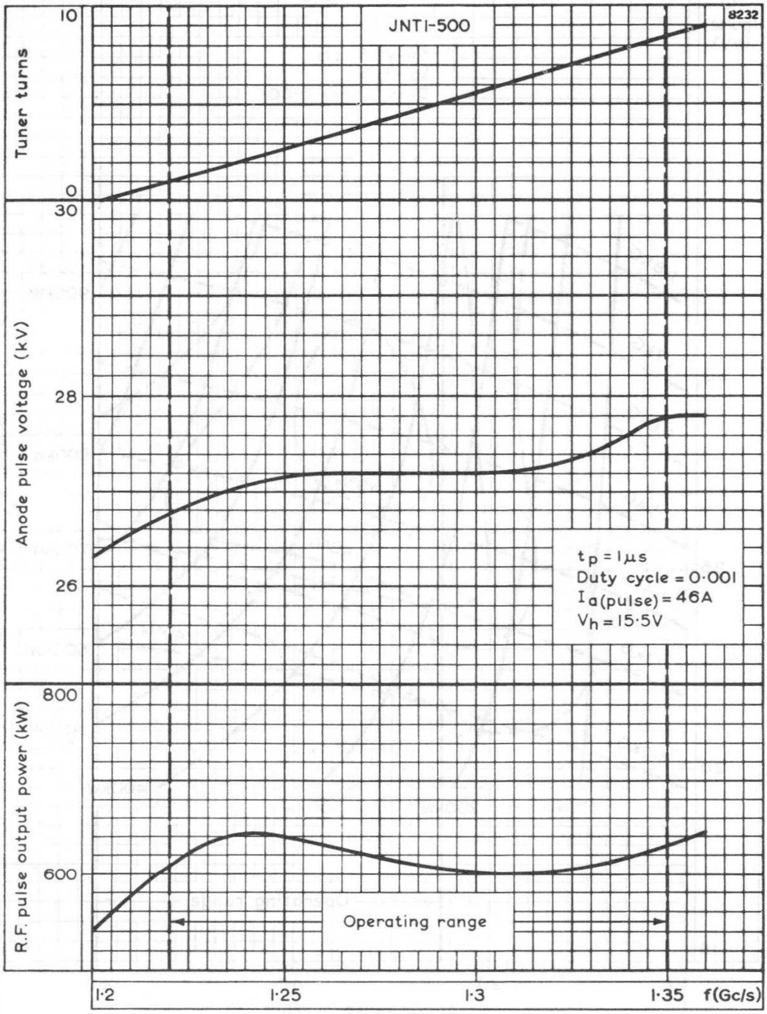


ANODE PULSE VOLTAGE PLOTTED AGAINST ANODE PULSE CURRENT WITH R.F. PULSE POWER OUTPUT, MAGNETIC FIELD STRENGTH AND EFFICIENCY AS PARAMETERS



TUNER TURNS, ANODE PULSE VOLTAGE AND R.F. PULSE OUTPUT POWER PLOTTED AGAINST FREQUENCY

QUICK REFERENCE DATA

Forced-air cooled fixed frequency 'X' band pulsed magnetron. with high duty ratio. Suitable for airborne doppler navigation equipment.

Frequency	8.80	Gc/s
Power output (pulsed)	25	W
Construction		Packaged

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.		Max.	
Frequency				
Fixed within the band	8.77	to	8.83	Gc/s
Pulse voltage (I_{pulse} = 150mA)	750		850	V
R.F. pulse power output (I_{pulse} = 150mA)	17		—	W
Frequency pulling factor (v.s.w.r. = 1.5)	—		15	Mc/s
Frequency pushing factor	—		0.125	Mc/s per mA
Frequency temperature coefficient	—		–0.25	Mc/s per °C
Input capacitance	—		9.0	pF

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.2	A

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

TYPICAL OPERATION

Heater voltage (running)	5.5	4.5	V
Pulse duration	4.0	4.0	µs
Pulse repetition frequency	100,000	100,000	p/s
Duty cycle	0.2	0.4	
Pulse current	150	150	mA
Pulse voltage	800	800	V
R.F. pulse output power	25	25	W
Mean input current	60	60	mA
Mean input power	48	48	W
Mean r.f. output power	10	10	W
Frequency pulling factor (v.s.w.r. = 1.5)	12	12	Mc/s
Rate of rise of pulse voltage	4.0	4.0	kV/µs

JP8-02B

MAGNETRON

COOLING

It is necessary to direct a flow of cooling air between the radiator fins, in order to keep the temperature below the permitted maximum.

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	110	180	mA
Pulse duration	—	5.0	μs
Duty cycle	—	0.5	
Mean input power	—	60	W
Rate of rise of voltage pulse	—	5.0	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	140	°C

END OF LIFE PERFORMANCE

	Min.		Max.	
R.F. pulse power output (I_{pulse} = 150mA)			15	W
Frequency Within the band	8.77	to	8.83	Gc/s
Pulse voltage (I_{pulse} = 150mA)	750		850	V

MOUNTING POSITION

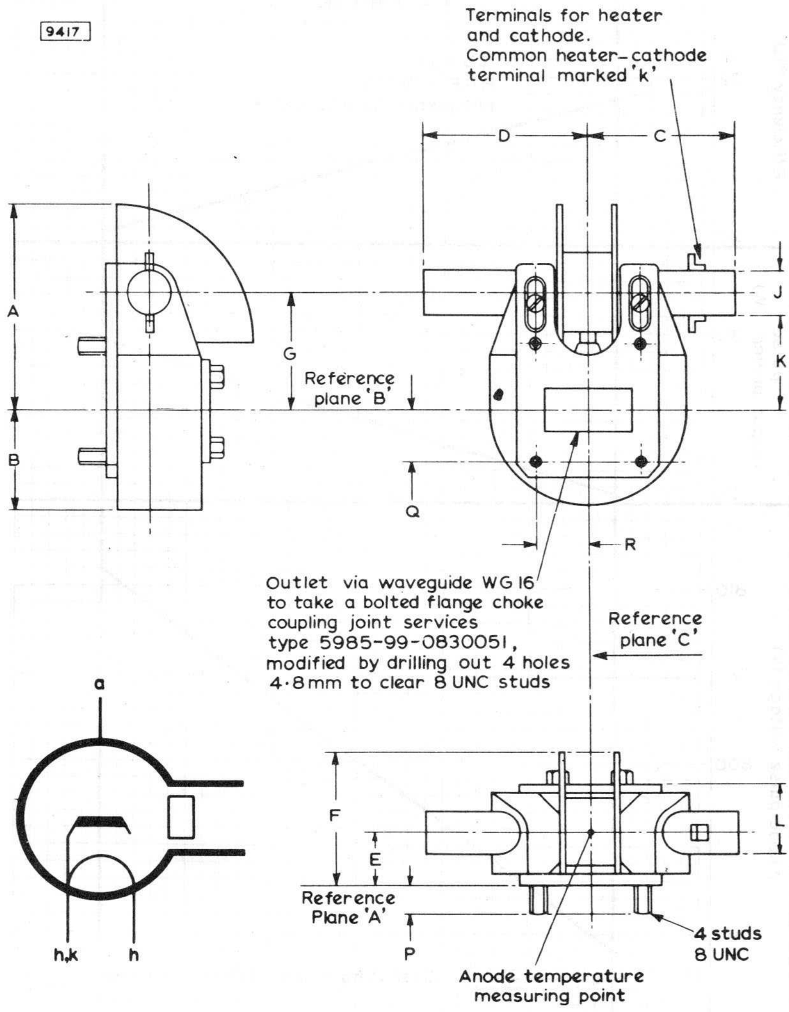
Any

PHYSICAL DATA

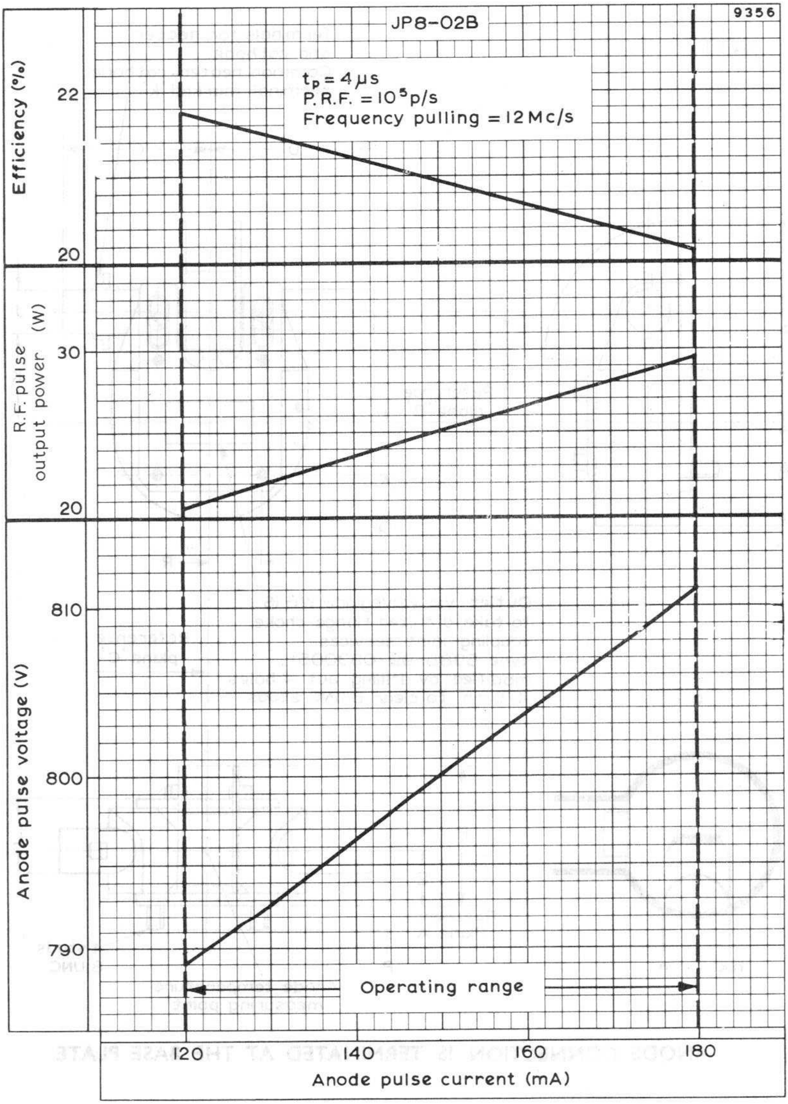
Weight of magnetron	1.0	lb
	454	g
Weight of magnetron in carton	2 lb	4 oz
	1.02	kg
Dimensions of storage carton	5.0 × 7.25 × 7.25	in
	127 × 184 × 184	mm

DIMENSIONS

	Inches	Millimetres	
A	2.36	60	max
B	1.26	32	max
C	1.73	44	max
D	1.73	44	max
E	1.53 ± 0.02	13.5 ± 0.5	
F	1.77	45	max
G	1.22 ± 0.08	31 ± 2	
J.	0.51	13	max
K	1.14	29	max
L	0.79	20	max
P	0.32 ± 0.04	8 ± 1	
Q	0.64	16.2	
R	0.61	15.5	



ANODE CONNECTION IS TERMINATED AT THE BASE PLATE



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT

QUICK REFERENCE DATA

Fixed frequency 'X' band magnetron with natural cooling.

Frequency JP9-2.5	9.410	Gc/s
JP9-2.5B	9.255	Gc/s
JP9-2.5C	9.550	Gc/s
Power output (pulsed)	3.0	kW
Construction		Packaged

Unless otherwise shown data is applicable to all types.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

		Min.		Max.	
Frequency					
Fixed within the band	JP9-2.5	9.345	to	9.475	Gc/s
	JP9-2.5B	9.190	to	9.320	Gc/s
	JP9-2.5C	9.520	to	9.580	Gc/s
Pulse voltage (I_{pulse} = 3.0A)		3.20		3.80	kV
R.F. pulse power output (I_{pulse} = 3.0A)		2.5		—	kW
Frequency pulling factor (v.s.w.r. = 1.5)		—		18	Mc/s
Frequency pushing factor		—		2.5	Mc/s per A
Frequency temperature coefficient		—		0.25	Mc/s per °C
Distance of v.s.w. minimum from face of mounting plate into valve					
	JP9-2.5	0		6	mm
	JP9-2.5B	0		6	mm
	JP9-2.5C	3		9	mm
Input capacitance		—		9.0	pF

TYPICAL OPERATION

Duty cycle	0.0002	
Heater voltage (running)	6.3	V
Pulse duration	0.1	μs
Pulse repetition frequency	2000	p/s
Pulse current	3.0	A
Pulse voltage	3.4	kV
Pulse input power	10	kW
R.F. pulse output power	3.0	kW
Mean input current	600	μA
Mean input power	2.0	W
Mean r.f. output power	600	mW
Frequency pulling (v.s.w.r. = 1.5)	15	Mc/s
Rate of rise of pulse voltage	50	kV/μs

JP9-2.5
JP9-2.5B
JP9-2.5C

MAGNETRON

CATHODE

Indirectly heated

V_h	6.3	V
I_h	500	mA

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	2.5	3.5	A
Pulse duration	0.02	1.0	μs
Duty cycle	—	0.001	
Mean input power	—	13	W
Rate of rise of voltage pulse	—	60	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	120	°C

END OF LIFE PERFORMANCE

		Min.		Max.	
R.F. pulse power output (I_{pulse} = 3.0A)				2.0	kW
Frequency					
Within the band	JP9-2.5	9.345	to	9.475	Gc/s
	JP9-2.5B	9.190	to	9.320	Gc/s
	JP9-2.5C	9.520	to	9.580	Gc/s
Pulse voltage (I_{pulse} = 3.0A)		3.2		3.8	kV

MOUNTING POSITION

Any

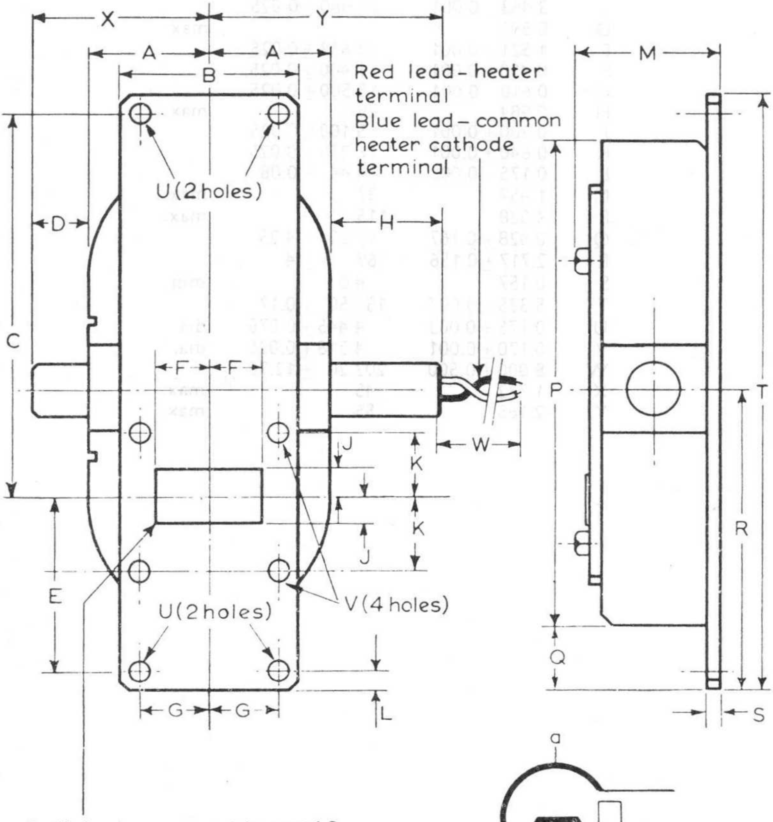
PHYSICAL DATA

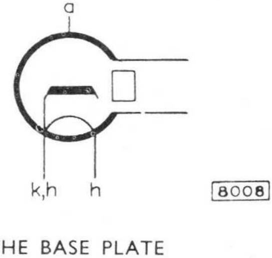
Weight of magnetron	2 lb	4 oz
	1.02	kg
Weight of magnetron in carton	4 lb	0 oz
	1.82	kg
Dimensions of storage carton	7.5 × 7.5 × 11	in
	190 × 190 × 280	mm

DIMENSIONS

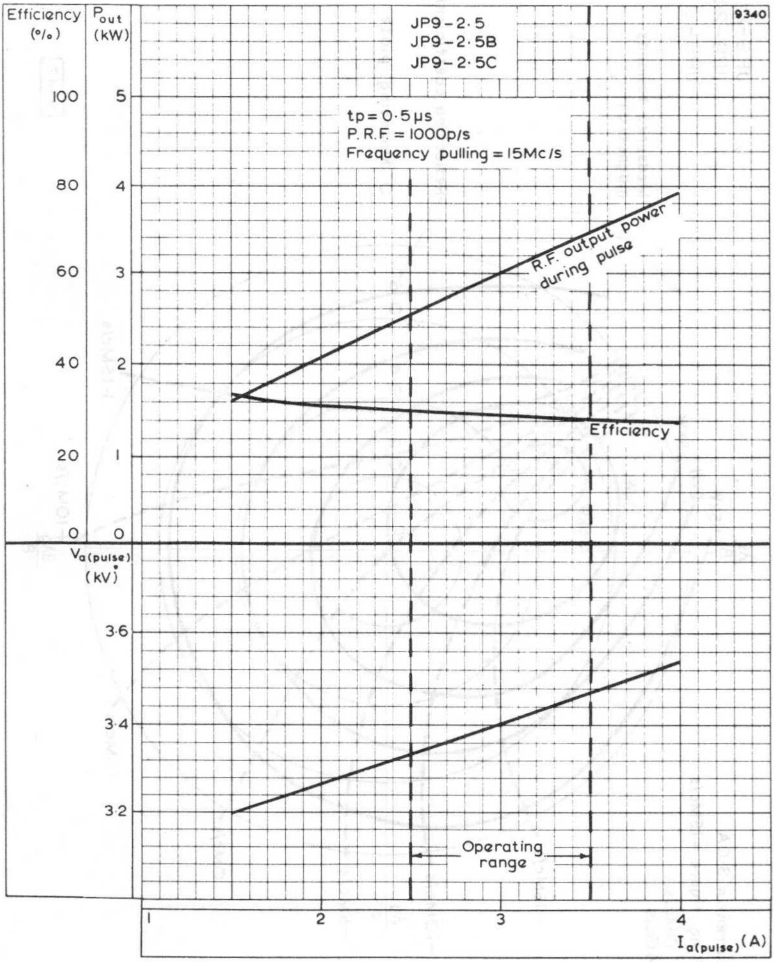
	Inches	*Millimetres*	
A	1.181	30	max.
B	1.625 ± 0.015	41.28 ± 0.38	
C	3.463 ± 0.001	87.960 ± 0.025	
D	0.591	15	max.
E	1.521 ± 0.001	38.633 ± 0.025	
F	0.450 ± 0.001	11.400 ± 0.025	
G	0.610 ± 0.001	15.500 ± 0.025	
H	0.984	25	max.
J	0.200 ± 0.001	5.100 ± 0.025	
K	0.640 ± 0.001	16.255 ± 0.025	
L	0.175 ± 0.003	4.44 ± 0.08	
M	1.457	37	max.
P	4.528	115	max.
Q	0.428 ± 0.167	12.25 ± 4.25	
R	2.717 ± 0.156	69 ± 4	
S	0.157	4.0	min.
T	5.335 ± 0.007	135.50 ± 0.17	
U	0.175 ± 0.003	4.445 ± 0.076	dia.
V	0.170 ± 0.001	4.318 ± 0.025	dia.
W	8.000 ± 0.500	203.20 ± 12.70	
X	1.772	45	max.
Y	2.165	55	max.

JP9-2.5
JP9-2.5B
JP9-2.5C

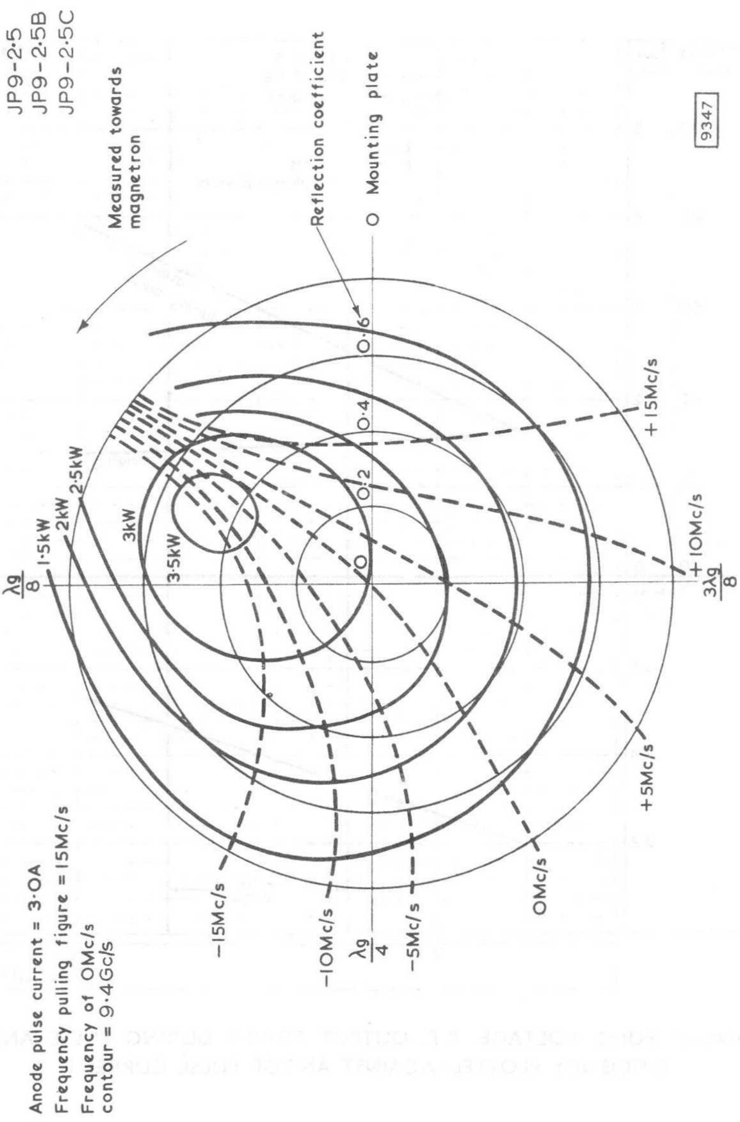




THE ANODE IS TERMINATED AT THE BASE PLATE



ANODE PULSE VOLTAGE, R.F. OUTPUT POWER DURING PULSE AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



RIEKE DIAGRAM

MAGNETRONS

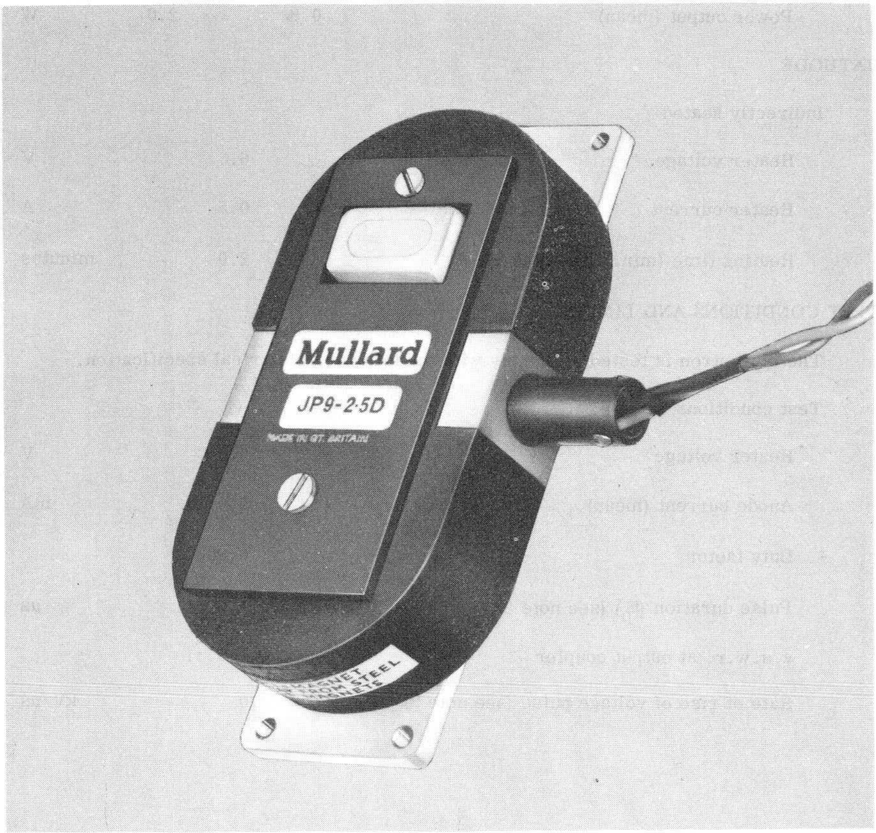
JP9-2·5D
JP9-2·5E
JP9-2·5F

QUICK REFERENCE DATA		
X-Band, fixed frequency, pulsed magnetron		
Frequency (fixed within the band)	9.415 to 9.475	GHz
Power output (peak)	4.0	kW
Output connection	Waveguide 16 flange	

Service type No. for JP9-2.5E is CV10758

Unless otherwise shown, data is applicable to all types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

Operating conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	3.0	3.0	A
Pulse duration (t_p)	0.1	0.5	μs
Pulse repetition rate	2000	1000	pulse/s
Rate of rise of voltage pulse	60	60	kV/μs

Typical performance

Anode voltage (peak)	3.6	3.6	kV
Power output (peak)	4.0	4.0	kW
Power output (mean)	0.8	2.0	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.5	A
Heating time (min.) (see note 1)	2.0	minutes

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage	6.3	V
Anode current (mean)	3.0	mA
Duty factor	0.001	
Pulse duration (t_p) (see note 2)	1.0	μs
v.s.w.r. at output coupler	<1.05:1	
Rate of rise of voltage pulse (see note 3)	70	kV/μs

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	3.2	3.8	kV
Power output (mean)	3.0	-	W
Frequency (see note 11)	9.415	9.475	GHz
R.F. Bandwidth at 1/4 power (see note 2)	-	$\frac{2.5}{t_p}$	MHz
Frequency pulling (v.s.w.r. ≮1.5:1)	-	18	MHz
Minor lobe level (v.s.w.r. ≮1.5:1)	6.0	-	dB
Stability (see note 4)	-	0.25	%
Frequency pushing	-	2.5	MHz/A
Cold impedance (see notes 5 and 12)			
Heater current (see note 6)			
Frequency temperature coefficient (see note 7)			
Input capacitance (see note 8)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see notes 1 and 9)	5.7	6.9	V
Anode current (peak)	2.5	3.5	A
Power input (peak)	-	13.5	kW
Power input (mean)	-	13.5	W
Duty factor	-	0.001	
Pulse duration (t_p) (see note 3)	0.02	1.0	μs
Rate of rise of anode voltage (see note 4)	-	70	kV/μs
Anode temperature	-	120	°C
v.s.w.r. at output coupler	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on page 2.

	Min.	Max.	
Anode voltage (peak)	3.2	3.8	kV
Power output (mean)	2.5	-	W
Frequency	9.415	9.445	GHz
R.F. Bandwidth at 1/4 power	-	$\frac{3.5}{t_p}$	MHz
Stability	-	0.5	%

MOUNTING POSITION (See note 10) Any

COOLING Natural

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.02	2.25
Weight of magnetron in storage carton	1.82	4.0
	mm	in
Dimensions of storage carton	190×190×280	7.5×7.5×11

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above $0^{o}C$ the cathode must be heated for at least 2 minutes before the application of h.t. For ambient temperatures between $0^{o}C$ and $-55^{o}C$ the cathode heating time is three minutes.

2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is ±10%.

NOTES (contd.)

3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

4. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 2.5 to 3.5mA mean. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.415 to 9.475GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of ten minutes operation.

5. The cold impedance of the magnetron is measured at the operating frequency and will give a v.s.w.r. of >6:1. The position of voltage minimum from the face of the output flange into the magnetron is 3 to 9mm for the JP9-2.5D and JP9-2.5F and 0 to 6mm for the JP9-2.5E.

6. Measured with heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.5 to 0.6Amps.

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

8. Design test only. The maximum input capacitance is 9pF.

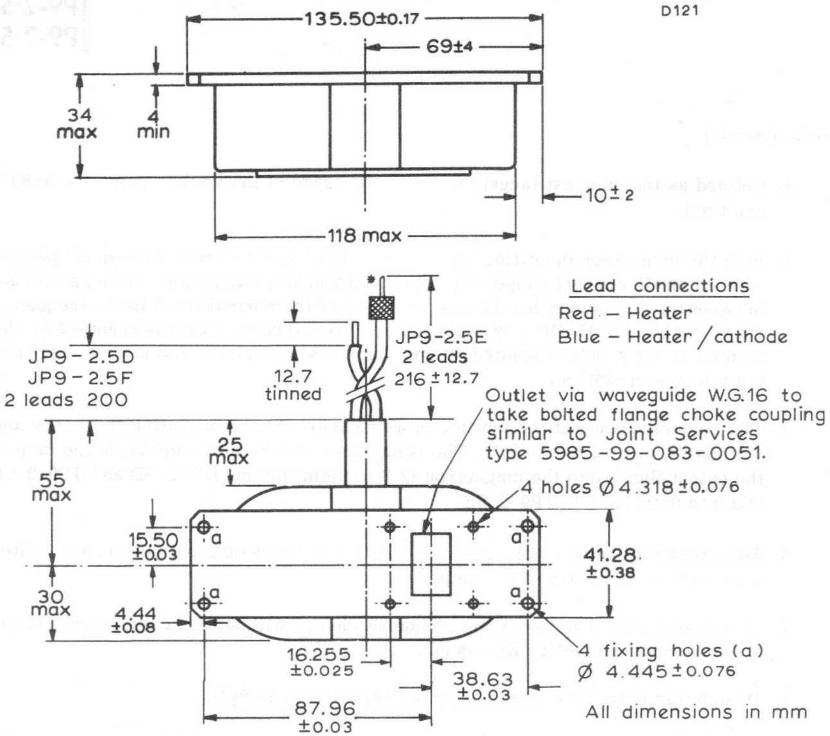
9. The magnetron is normally tested with a heater supply of 50Hz and is suitable for operation at 1kHz and 1.1kHz. Mullard Ltd., should be consulted if the magnetron is to be operated with a heater supply of any other frequency.

10. It is necessary to keep all magnetic material as far as possible, at least 50mm (2in), from the magnet and mounting plate. The inner polystyrene pack of the magnetron carton provides adequate separation between magnetrons, and it is recommended that magnetrons not in use be kept in these packs.

11. Magnetrons with other frequency ranges can be supplied to order.

12. The JP9-2.5D and JP9-2.5F are electrically and mechanically identical.

OUTLINE DRAWING OF JP9-2.5



*JP9-2.5E wander plugs:-

Belling Lee { 4mm single pin 378/4/Red – Red lead
3mm single pin 378A/3/Black-Blue lead

CONVERSION TABLE
(Rounded outwards)

Millimetres	Inches	Millimetres	Inches
4 min.	0.15 min.	34 max.	1.34 max.
Ø 4.318 ±0.076	Ø 0.170 ±0.003	38.63 ± 0.03	1.5209 ± 0.0012
4.44 ±0.08	0.1748 ±0.0032	41.28 ±0.38	1.625 ±0.015
Ø 4.445 ±0.076	Ø 0.175 ±0.003	55 max.	2.17 max.
10 ±2	0.393 ±0.079	69 ± 4	2.72 ±0.16
12.7	0.50	87.96 ±0.03	3.4630 ±0.0012
15.50 ±0.03	0.6102 ±0.0012	118 max.	4.65 max.
16.255 ±0.025	0.640 ±0.001	135.50 ±0.17	5.3347 ± 0.0067
25 max.	0.99 max.	200	7.87
30 max.	1.19 max.	216 ± 12.7	8.50 ±0.50

JP9-2·5H
JP9-2·5L
JP9-2·5M

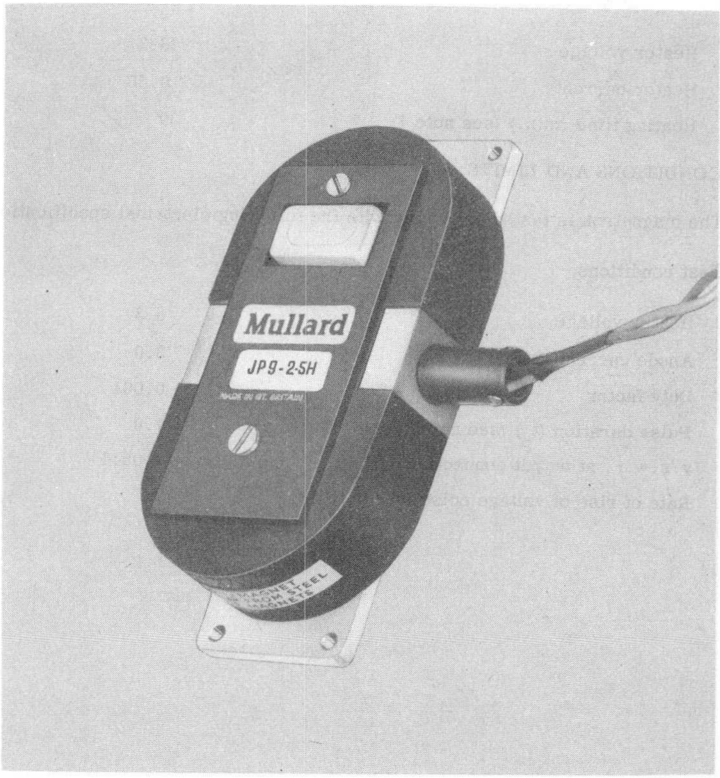
QUICK REFERENCE DATA

X-Band, fixed frequency, pulsed magnetron.

Frequency (fixed within the band)		
JP9-2.5H	9.345 to 9.405	GHz
JP9-2.5L and JP9-2.5M	9.415 to 9.475	GHz
Construction		Packaged
Output connection		Waveguide 16 flange

Unless otherwise stated, data is applicable to all types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

Operating conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	3.0	3.0	A
Pulse duration (t_p)	0.1	0.5	μs
Pulse repetition rate	2000	1000	pulse/s
Rate of rise of voltage pulse	60	60	kV/μs

Typical performance

Anode voltage (peak)	3.6	3.6	kV
Power output (peak)	4.0	4.0	kW
Power output (mean)	0.8	2.0	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.55	A
Heating time (min.) (see note 1)	30	s

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage	6.3	V
Anode current (mean)	3.0	mA
Duty factor	0.001	
Pulse duration (t_p) (see note 2)	1.0	μs
v.s.w.r. at output connection	<1.05:1	
Rate of rise of voltage pulse (see note 3)	70	kV/μs

TEST CONDITIONS AND LIMITS (contd.)

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	3.2	3.8	kV
Power output (mean)	3.0	-	W
Frequency (see note 4)			
JP9-2.5H	9.345	9.405	GHz
JP9-2.5L and JP9-2.5M	9.415	9.475	GHz
R.F. Bandwidth at 1/4 power (see notes 2 and 5)	-	$\frac{2.5}{t_p}$	MHz
Frequency pulling (v.s.w.r. = 1.5:1)	-	18	MHz
Minor lobe level (v.s.w.r. = 1.5:1)	6.0	-	dB
Stability (see note 6)	-	0.25	%
Frequency pushing (see note 7)	-	2.5	MHz/A
Cold impedance	see note 8		
Heater current	see note 9		
Frequency temperature coefficient	see note 10		
Input capacitance	see note 11		

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 12)	5.7	6.9	V
Anode voltage (peak)	3.2	3.8	kV
Anode current (peak)	2.5	3.5	A
Power input (peak)	-	13.5	kW
Power input (mean)	-	13.5	W
Duty factor	-	0.001	
Pulse duration (t_p) (see note 2)	0.05	1.0	μs
Rate of rise of voltage pulse (see note 3)	-	70	kV/μs
Anode temperature	-	120	^{o}C
v.s.w.r. at output connection	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from the stated test conditions, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when tested as on page 2.

	Min.	Max.	
Anode voltage (peak)	3.2	3.8	kV
Power output (mean)	2.5	-	W
Frequency			
JP9-2.5H	9.345	9.405	GHz
JP9-2.5L and M	9.415	9.475	GHz
R.F. Bandwidth at 1/4 power	-	$\frac{3.5}{t_p}$	MHz
Stability	-	0.5	%

MOUNTING POSITION AND STORAGE

Mounting position — Any

Mounting and storage precautions — see note 13

COOLING — Natural

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.02	2.25
Weight of magnetron in storage carton	1.82	4.0
	mm	in
Dimensions of storage carton	190×190×280	7.5×7.5×11

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above 0^oC the cathode must be heated for at least 30 seconds before the application of h.t. For ambient temperatures between 0 and -55^oC the cathode heating time is 45 seconds min.

2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is ± 10%.

3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

NOTES (contd.)

4. Magnetrons with other frequency ranges can be supplied to order.

5. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 2.5 to 3.5mA mean.

6. Measured as in note 5. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.345 to 9.405GHz for the JP9-2.5H and 9.415 to 9.475GHz for the JP9-2.5L and JP9-2.5M. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of five minutes of operation.

7. Design test only. Measured over the anode current range of 2.5 to 3.5mA mean.

8. The cold impedance of the magnetron is measured at the operating frequency and will give a v.s.w.r. of >6:1. The position of the voltage minimum from the face of the output flange into the magnetron shall be 3 to 9mm for the JP9-2.5H and L, and 0 to 6mm for the JP9-2.5M.

9. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.5 to 0.6A.

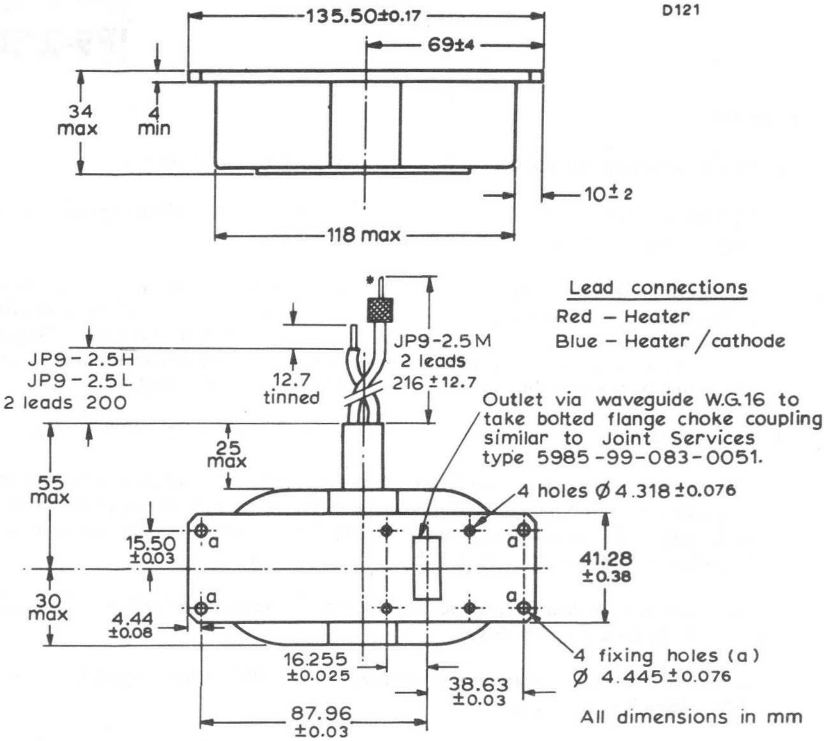
10. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/degC.

11. Design test only. The maximum input capacitance is 9pF.

12. The magnetron is normally tested with a heater supply of 50Hz and is suitable for operation at 1kHz and 1.1kHz. Mullard Ltd., should be consulted if the magnetron is to be operated with a heater supply of any other frequency.

13. When mounting and handling the magnetron, care must be taken to prevent demagnetisation. It is necessary to keep all magnetic materials as far as possible, at least 50mm (2 in), from the magnet. When storing, magnetrons should be kept as far apart as possible, at least 150mm (6 in). During shipment, adequate separation between magnetrons is provided by the dimensions of the inner pack of the storage carton, and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING OF JP9-2.5H, L AND M



*JP9-2.5M wander plugs:-

Belling Lee { 4mm single pin 378/4/Red – Red lead
3mm single pin 378A/3/Black – Blue lead

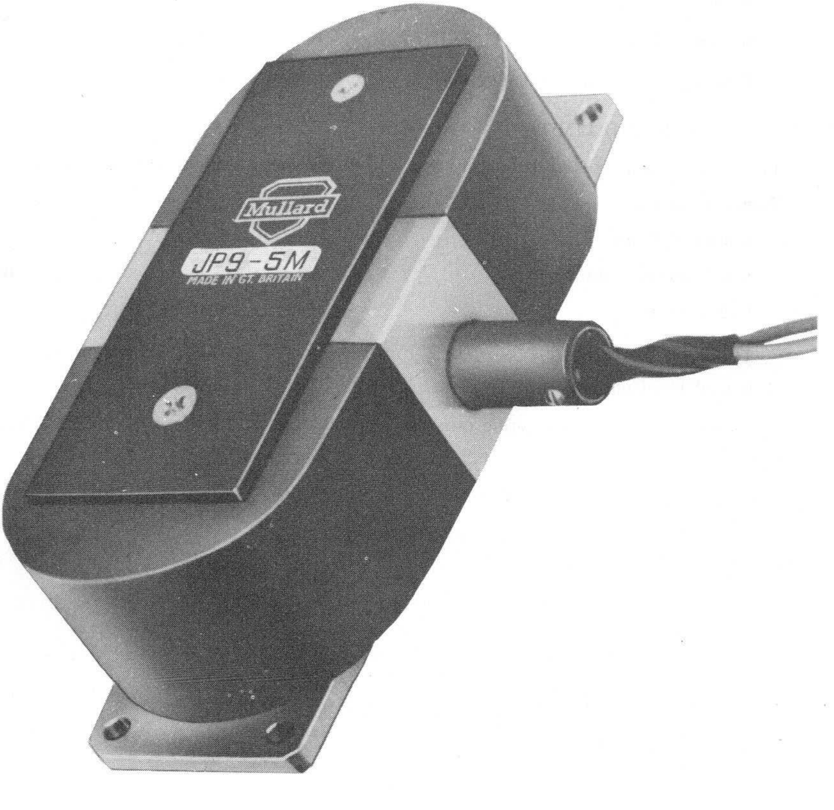
CONVERSION TABLE
(Rounded outwards)

Millimetres	Inches	Millimetres	Inches
4 min.	0.15 min.	34 max.	1.34 max.
Ø 4.318 ±0.076	Ø 0.170 ±0.003	38.63 ± 0.03	1.5209 ± 0.0012
4.44 ±0.08	0.1748 ±0.0032	41.28 ±0.38	1.625 ±0.015
Ø 4.445 ±0.076	Ø 0.175 ±0.003	55 max.	2.17 max.
10 ±2	0.393 ±0.079	69 ± 4	2.72 ±0.16
12.7	0.50	87.96 ±0.03	3.4630 ±0.0012
15.50 ±0.03	0.6102 ±0.0012	118 max.	4.65 max.
16.255 ±0.025	0.640 ±0.001	135.50 ±0.17	5.3347 ± 0.0067
25 max.	0.99 max.	200	7.87
30 max.	1.19 max.	216 ± 12.7	8.50 ±0.50

MAGNETRON JP9-5M

QUICK REFERENCE DATA		
X-Band, fixed frequency, pulsed magnetron.		
Frequency (fixed within the band)	9.345 to 9.405	GHz
Power output (peak)	7.0	kW
Output connection	Waveguide 16 flange	
Construction	Packaged	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



Mullard

TYPICAL OPERATION

Operating conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	5.0	5.0	A
Pulse duration (t_p)	0.1	1.0	μs
Pulse repetition rate	2000	1000	pulse/s
Rate of rise of voltage pulse	60	60	kV/μs

Typical performance

Anode voltage (peak)	4.25	4.25	kV
Power output (peak)	7.0	7.0	kW
Power output (mean)	1.4	7.0	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.55	A
Heating time (minimum) (see note 1)	30	s

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical test specification.

Test conditions

Heater voltage	6.3	V
Anode current (mean)	5.0	mA
Duty factor	0.001	
Pulse duration (t_p) (see note 2)	1.0	μs
v.s.w.r. at output coupler	1.05:1	
Rate of rise of voltage pulse (see note 3)	75	kV/μs

TEST CONDITIONS AND LIMITS (contd.)

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	4.0	4.5	kV
Power output (mean)	6.0	-	W
Frequency (see note 4)	9.345	9.405	GHz
R.F. bandwidth at 1/4 power (see note 4)	-	$\frac{2.5}{t_p}$	MHz
Minor lobe level (see note 4)	6.0	-	dB
Frequency pulling (see note 5)	-	18	MHz
Stability (see note 6)	-	0.25	%
Cold impedance (see note 7)			
Heater current (see note 8)			
Frequency temperature coefficient (see note 9)			
Input capacitance (see note 10)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 11)	5.7	6.9	V
Heater current (surge)	-	3.0	A
Anode current (peak)	4.0	6.0	A
Anode voltage (peak)	4.0	4.6	kV
Power input (peak)	-	25	kW
Power input (mean)	-	25	W
Duty factor	-	0.001	
Pulse duration (t_p) (see note 2)	-	1.0	μs
Rate of rise of anode voltage (see note 3)	-	75	kV/μs
Anode temperature	-	120	°C
v.s.w.r. at output coupler	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when operated under the specified test conditions.

	Min.	Max.	
Anode voltage (peak)	4.0	4.5	kV
Power output (mean)	5.0	-	W
Frequency	9.345	9.405	GHz

MOUNTING AND STORAGE

Mounting position	Any
Mounting and storage precautions	see note 12

COOLING

Natural

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.25	2.75
Weight of magnetron in storage carton	1.82	4.0

	mm	in
Dimensions of storage carton	190 × 190 × 280	7.5 × 7.5 × 11

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above 0^oC. For ambient temperatures between 0^oC and -55^oC the cathode heating time is 45 seconds.

2. The tolerance of pulse current duration (t_p) measured at 50% amplitude is ±10%.

3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

4. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 phase adjusted for maximum degradation. The anode current is varied over the range of 4.0 to 6.0A peak.

5. Measured at an anode current of 5A peak under matched conditions. A mismatch of 1.5:1 is then varied through all phases.

NOTES (contd.)

6. Measured with the mismatch conditions and most unfavourable current of note 4. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.345 to 9.405GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during a period of observation of three minutes after an initial operating period of not more than three minutes.

7. The cold impedance of the magnetron is measured at the operating frequency and will give a v.s.w.r. of >6:1. The position of voltage minimum from the face of the output flange into the magnetron is 3.0 to 9.0mm.

8. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.5 to 0.6A.

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

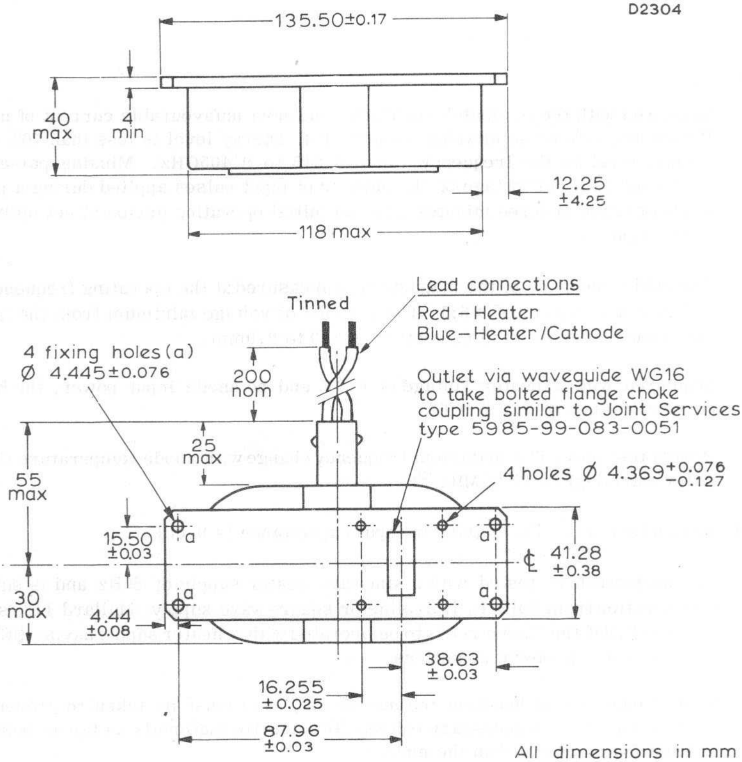
10. Design test only. The maximum input capacitance is 9.0pF.

11. The magnetron is tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 1kHz sine or square wave supply. Mullard Ltd. should be consulted if the magnetron is to be operated with a heater supply having different frequency or waveform conditions.

12. When mounting and handling the magnetron, care must be taken to prevent de-magnetisation. It is necessary to keep all magnetic materials as far as possible, at least 50mm (2 in) from the magnet.

    When storing, magnetrons should be kept as far apart as possible, at least 15cm (6 in). During shipment adequate separation is provided by the dimensions of the inner packs of the storage cartons and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING OF JP9-5M



CONVERSION TABLE
(Rounded outwards)

Millimetres	Inches	Millimetres	Inches
4 min.	0.16 min.	38.63 ±0.03	1.5209 ±0.0012
Ø 4.369 $^{+0.076}_{-0.127}$	Ø 0.172 $^{+0.003}_{-0.005}$	40 max.	1.58 max.
4.44 ±0.08	0.1748 ±0.0032	41.28 ±0.38	1.625 ±0.015
Ø 4.445 ±0.076	Ø 0.175 ±0.003	55 max.	2.17 max.
12.25 ±4.25	0.48 ± 0.17	69 ±4	2.72 ±0.16
15.50 ±0.03	0.6102 ±0.0012	87.96 ±0.03	3.4630 ±0.0012
16.255 ±0.025	0.640 ±0.001	118 max.	4.65 max.
25 max.	0.99 max.	135.50 ±0.17	5.3347 ±0.0067
30 max.	1.18 max.	200 nom.	7.87 nom.

MAGNETRON

JP9-7
JP9-7A
JP9-7B

Frequency: 'X' band, fixed.
Power output: 7.5kW, pulsed.
Construction: Packaged, forced-air cooled.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

		Min.		Max.	
Frequency (measured with the anode block at 45°C) Fixed within the band	JP9–7	9.345	to	9.405	Gc/s
	JP9–7A	9.210	to	9.270	Gc/s
	JP9–7B	9.525	to	9.585	Gc/s
Pulse voltage (I_{pulse} = 4.5A)		5.3		5.7	kV
R.F. pulse power output (I_{pulse} = 4.5A)		7.0			kW
Frequency pulling factor (v.s.w.r. = 1.5)				15	Mc/s
Frequency temperature coefficient				–0.25	Mc/s per °C
Distance of v.s.w. minimum from face of mounting plate into valve		16.5		22.5	mm
Input capacitance				8.0	pF

CATHODE

Indirectly heated

V_h	6.3	V
I_h	600	mA

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

For mean input powers greater than 25 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power-heating voltage rating chart on page C2.

TYPICAL OPERATION

Heater voltage (running)	6.3	V
Pulse duration	1.0	µs
Pulse repetition frequency	1000	p/s
Duty cycle	0.001	
Pulse current	4.5	A
Pulse voltage	5.5	kV
R.F. pulse output power	7.5	kW
Mean input current	4.5	mA
Mean input power	24.7	W
Mean r.f. output power	7.5	W
Frequency pulling (v.s.w.r. = 1.5)	14	Mc/s
Rate of rise of pulse voltage	50	kV/µs

COOLING

In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high a flow of cooling air between the radiator fins may be necessary to keep the block temperature below the permitted maximum.

JP9-7
JP9-7A
JP9-7B

MAGNETRON

ABSOLUTE MAXIMUM RATINGS

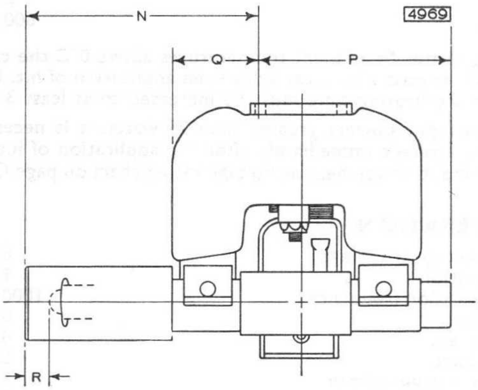
	Min.	Max.	
Pulse current	3.5	5.5	A
Pulse voltage	5.0	6.0	kV
Pulse duration		2.5	μs
Duty cycle		0.0025	
Mean input power		82.5	W
Rate of rise of voltage pulse		60	kV/μs
Load mismatch (v.s.w.r.)		1.5	
Temperature of anode block		120	°C

MOUNTING POSITION

Any

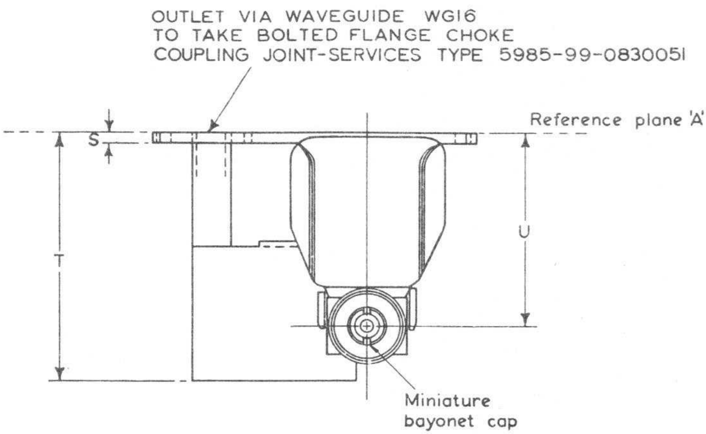
PHYSICAL DATA

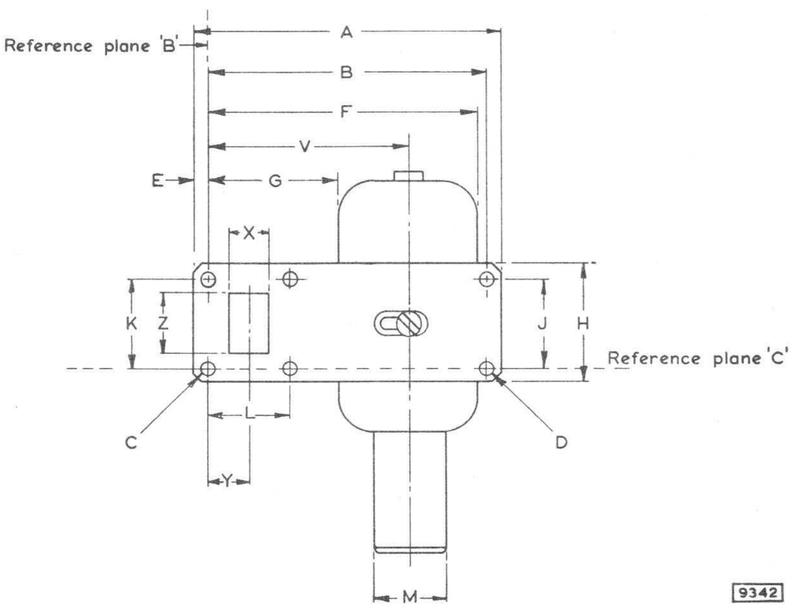
Weight of magnetron	3.0	lb
	1.4	kg
Weight of magnetron in carton	5.7	lb
	2.5	kg
Dimensions of storage carton	7.75 × 8.0 × 9.75	in
	200 × 210 × 250	mm



DIMENSIONS

	inches	mm	
A	4.47	113.5	max.
B	4.103 ± 0.004	104.2 ± 0.1	
C	0.17 ± 0.003	4.32 ± 0.08	
D	0.175 ± 0.003	4.45 ± 0.08	
E	0.19	4.8	max.
F	4.0	102	max.
G	1.93	49	min.
H	1 64	41.7	max.
J	1.22 ± 0.003	30.99 ± 0.08	
K	1.22 ± 0.004	30.99 ± 0.1	
L	1.28 ± 0.004	32.51 ± 0.1	
M	1.0	25.4	max.
N	3.19	81.0	max.
P	2.19	55.6	max.
Q	1.19	30.2	max.
R	0.25	6.4	max.
S	0.125 ± 0.01	3.18 ± 0.25	
T	3.25	82.6	max.
U	2.52 ± 0.13	64 ± 3	
V	3.0 ± 0.13	76 ± 3	
X	0.400 ± 0.003	10.16 ± 0.08	
Y	0.640 ± 0.004	16.25 ± 0.10	
Z	0.900 ± 0.003	22.86 ± 0.10	


OUTLET VIA WAVEGUIDE WG16
TO TAKE BOLTED FLANGE CHOKE
COUPLING JOINT-SERVICES TYPE 5985-99-0830051
Reference plane 'A'
S
T
U
Miniature
bayonet cap


Reference plane 'B'
A
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F
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E
G
X
K
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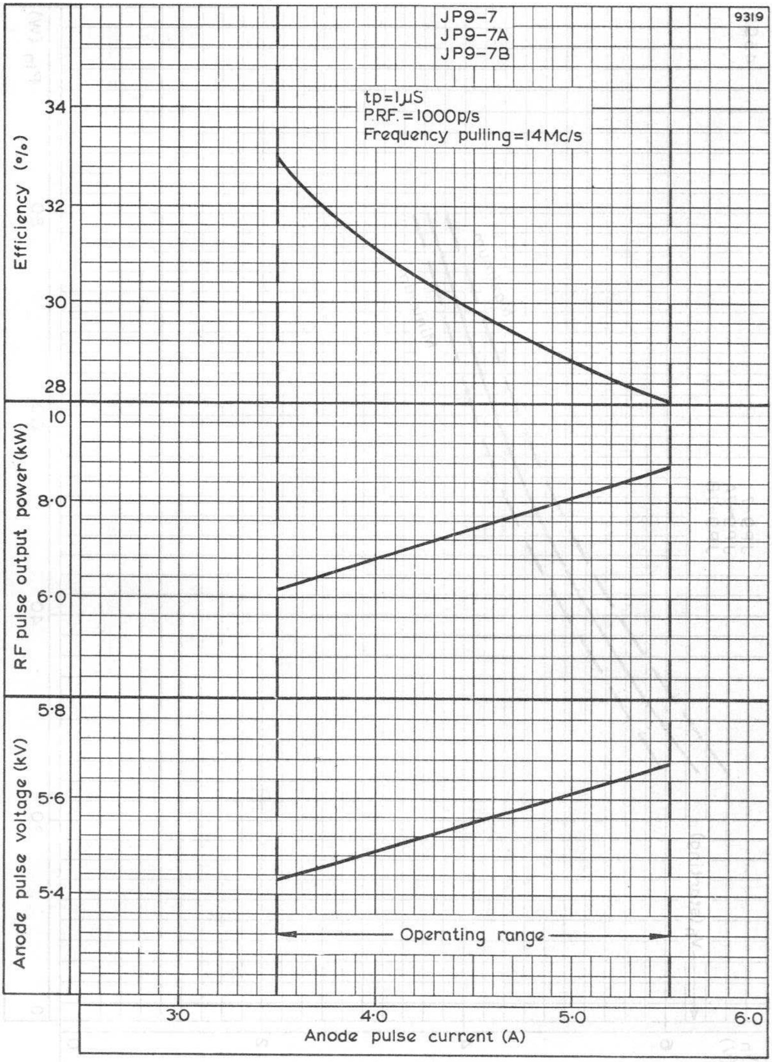
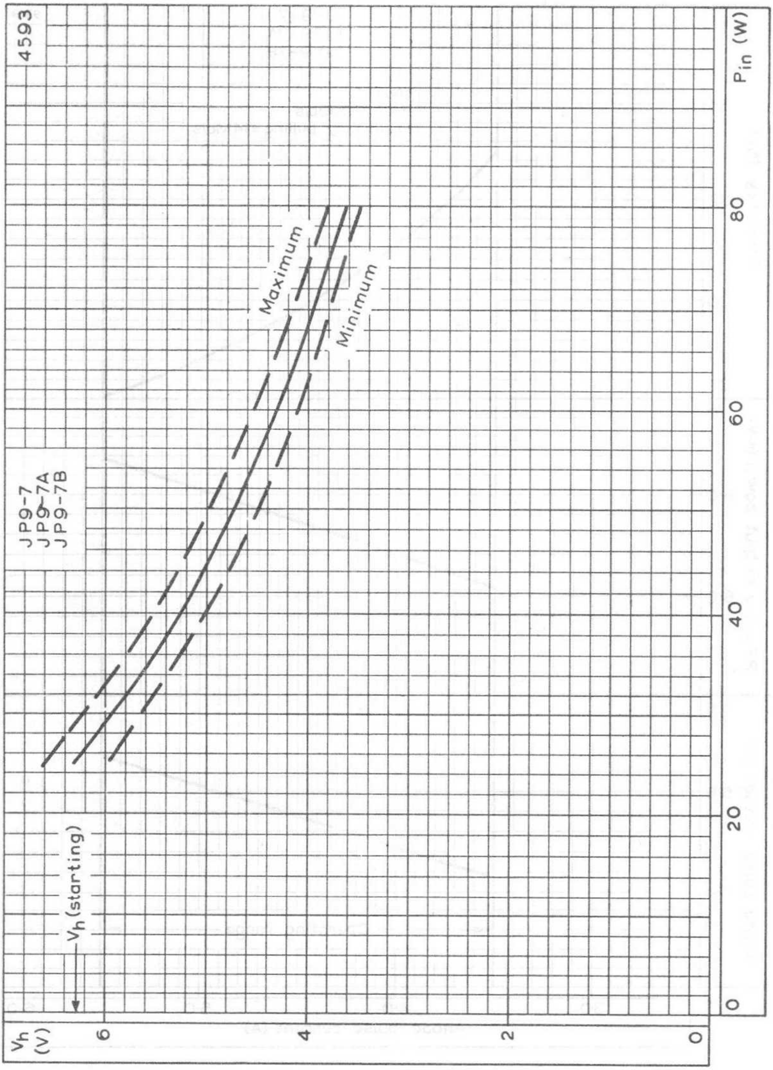
J
H
Reference plane 'C'
C
D
L
Y
M

9342



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER

QUICK REFERENCE DATA

Forced-air cooled fixed frequency 'X' band magnetron.

Frequency	9.375	Gc/s
Power output (pulsed)	10	kW
Construction	Packaged	

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

TYPICAL OPERATION

Heater voltage (running)	6.3	6.3	5.8	V
Pulse duration	0.05	0.1	1.0	μs
Pulse repetition frequency	4000	1000	1000	p/s
Duty cycle	0.0002	0.0001	0.001	
Pulse current	7.0	6.0	5.5	A
Pulse voltage	5.9	5.7	5.6	kV
Pulse input power	41.3	34.2	30.8	kW
R.F. pulse output power	10.5	9.5	9.0	kW
Mean input current	1.4	0.6	5.5	mA
Mean input power	8.3	3.4	31	W
Mean r.f. output power	2.1	0.95	9.0	W
Frequency pulling factor (v.s.w.r. = 1.5)	14	14	14	Mc/s
Rate of rise of pulse voltage	110	110	80	kV/μs

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current			
tp < 1.0μs	4.5	6.0	A
tp < 0.1μs	4.5	7.0	A
Pulse duration	0.05	1.0	μs
Duty cycle	—	0.002	
Mean input power	—	83	W
Rate of rise of voltage pulse	—	120	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	100	°C

JP9-7D

MAGNETRON

CATHODE

Indirectly heated

V_h	6.3	V
I_h	550	mA

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes. For mean input powers greater than 25 watts it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power/heater rating chart on page C2.

CHARACTERISTICS

	Min.		*Max.*	
Frequency (measured with the anode block at 45°C) Fixed within the band	9.345	to	9.405	Gc/s
Pulse voltage (I_{pulse} = 5.5A)	5.4		5.9	kV
R.F. pulse output power (I_{pulse} = 5.5A)	8.0		—	kW
Frequency pulling factor (v.s.w.r. = 1.5)	—		15	Mc/s
Distance of v.s.w. minimum from mounting plate into valve	16.5		22.5	mm
Input capacitance	—		8	pF

END OF LIFE PERFORMANCE

	Min.		*Max.*	
R.F. pulse output power (I_{pulse} = 5.5A)			7.0	kW
Frequency (measured with anode block at 45°C) Fixed within the band	9.345	to	9.405	Gc/s
Pulse voltage (I_{pulse} = 5.5A)	5.4		5.9	kV

COOLING

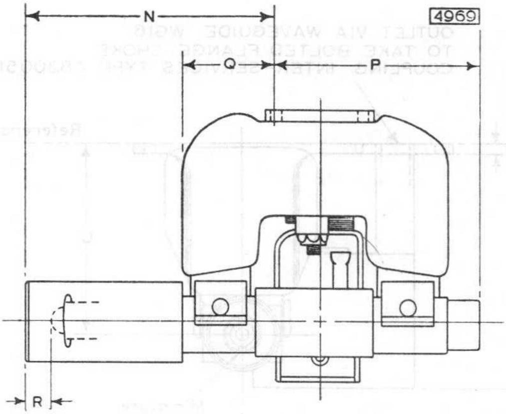
In normal circumstances natural cooling is adequate. but where the ambient temperature is abnormally high a flow of cooling air between the radiator pins may be necessary to keep the anode block temperature below the permitted maximum.

MOUNTING POSITION

Any

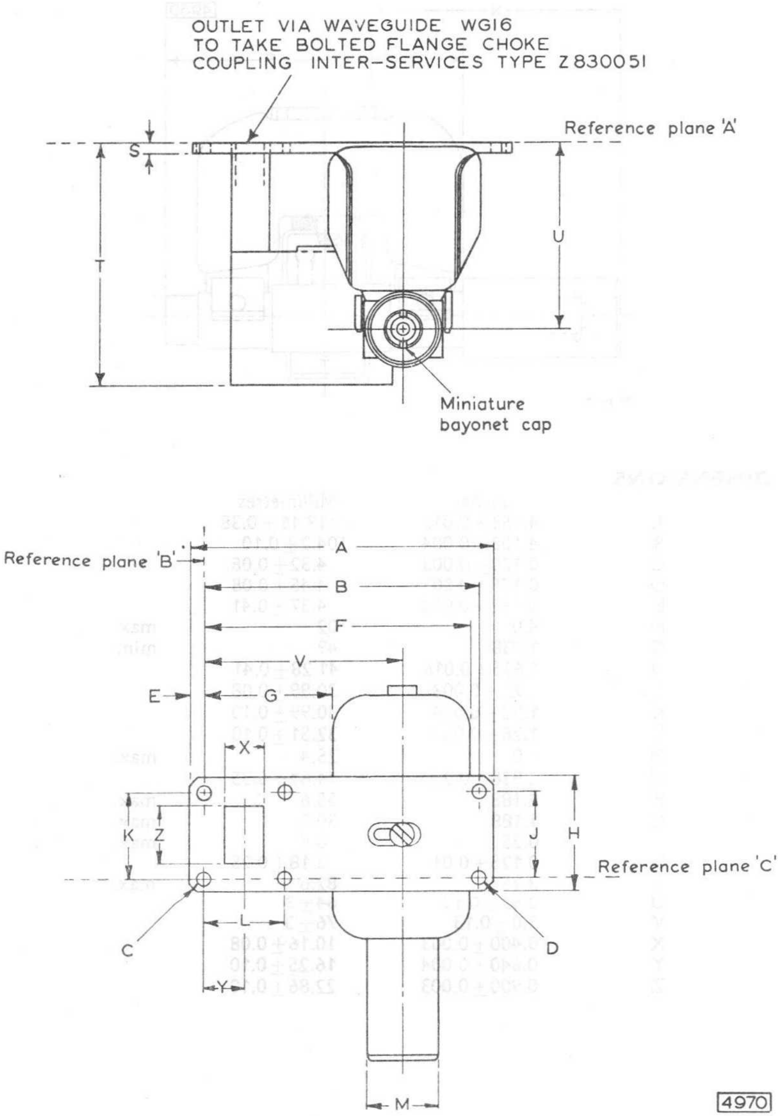
PHYSICAL DATA

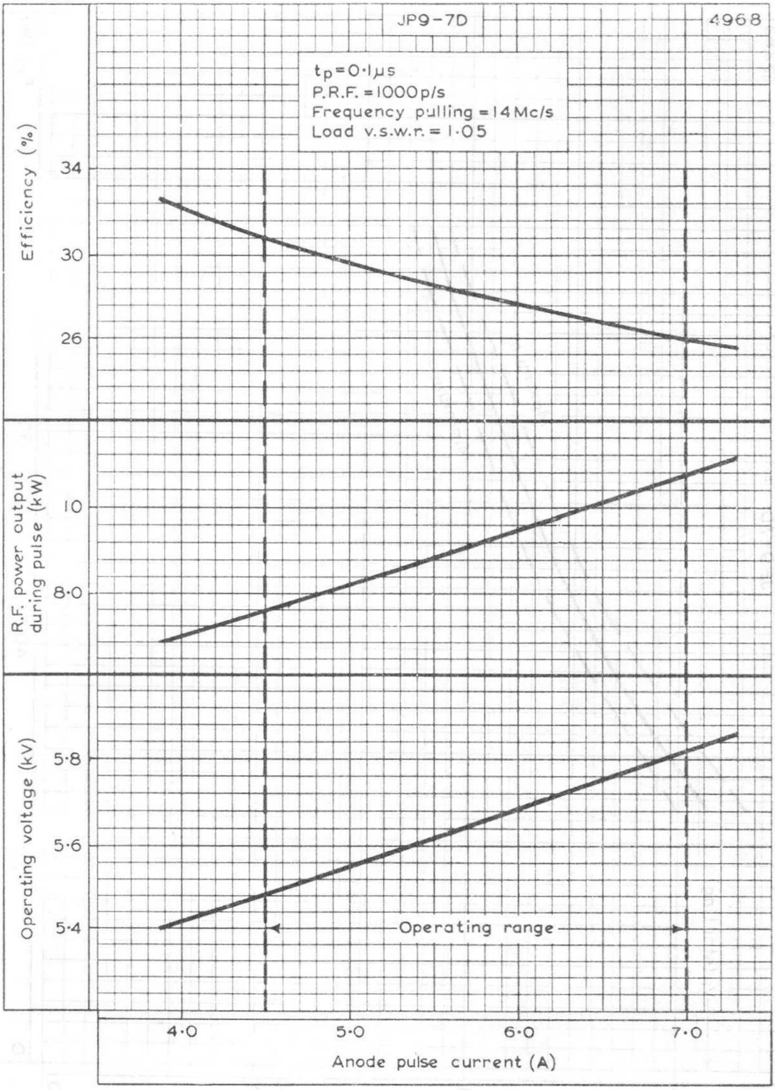
Weight of magnetron	3 lb 0 oz	
	1.4	kg
Weight of magnetron in carton	5 lb 11 oz	
	2.5	kg
Dimensions of storage carton	7.75 × 8.0 × 9.75	in
	200 × 210 × 250	mm



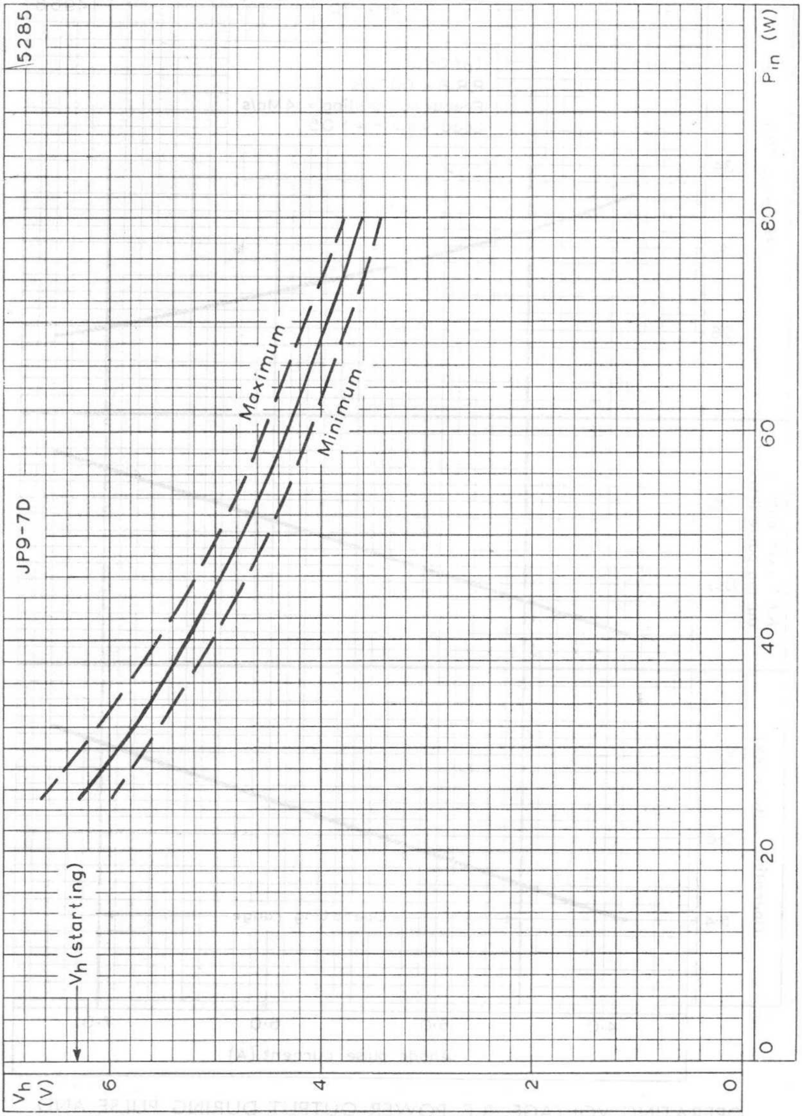
DIMENSIONS

	Inches	Millimetres	
A	4.453 ± 0.015	113.11 ± 0.38	
B	4.103 ± 0.004	104.2 ± 0.10	
C	0.170 ± 0.003	4.32 ± 0.08	
D	0.175 ± 0.003	4.45 ± 0.08	
E	0.172 ± 0.016	4.37 ± 0.41	
F	4.0	102	max.
G	1.938	49	min.
H	1.625 ± 0.016	41.28 ± 0.41	
J	1.22 ± 0.003	30.99 ± 0.08	
K	1.22 ± 0.004	30.99 ± 0.10	
L	1.28 ± 0.004	32.51 ± 0.10	
M	1.0	25.4	max.
N	2.938 ± 0.25	74.61 ± 6.35	
P	2.188	55.6	max.
Q	1.188	30.2	max.
R	0.25	6.4	max.
S	0.125 ± 0.01	3.18 ± 0.25	
T	3.25	82.6	max.
U	2.52 ± 0.13	64 ± 3	
V	3.0 ± 0.13	76 ± 3	
X	0.400 ± 0.003	10.16 ± 0.08	
Y	0.640 ± 0.004	16.25 ± 0.10	
Z	0.900 ± 0.003	22.86 ± 0.10	

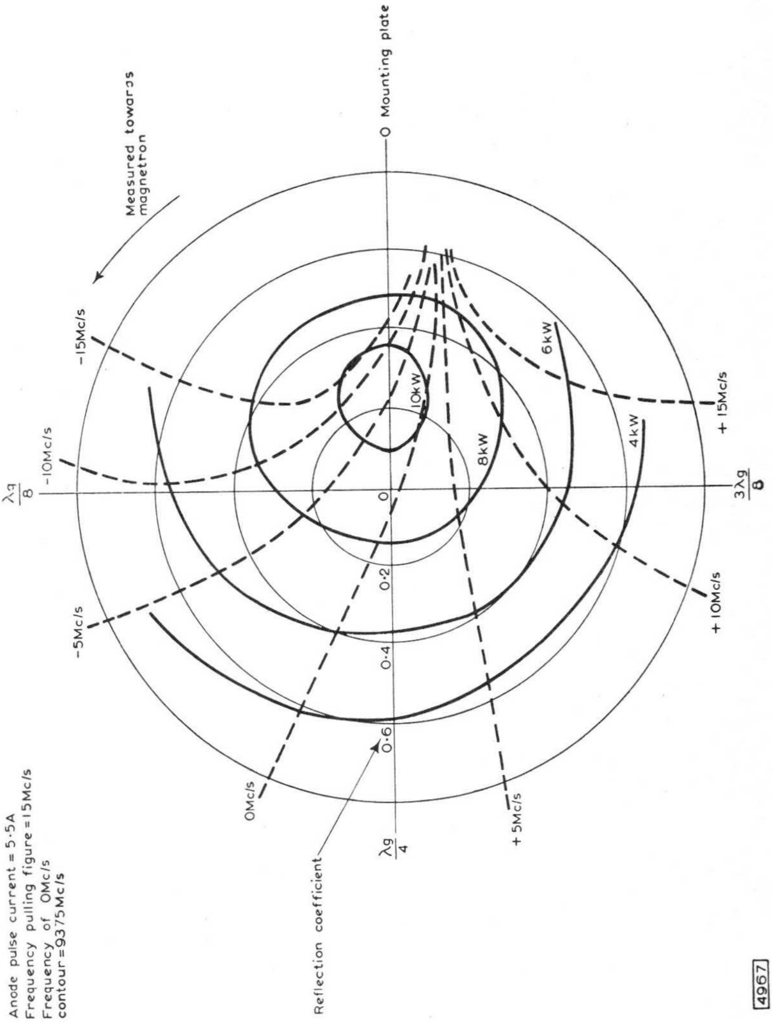

OUTLET VIA WAVEGUIDE WG16
TO TAKE BOLTED FLANGE CHOKE
COUPLING INTER-SERVICES TYPE Z830051
Reference plane 'A'
S
T
U
Miniature
bayonet cap
Reference plane 'B'
A
B
F
V
E
G
X
K
Z
J
H
Reference plane 'C'
L
C
D
Y
M
4970



OPERATING VOLTAGE, R.F. POWER OUTPUT DURING PULSE AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER



REIKE DIAGRAM

MAGNETRON

JP9-15
JP9-15B

QUICK REFERENCE DATA

Fixed frequency 'X' band magnetron with natural or forced-air cooling.

Frequency JP9-15	9.375	Gc/s
JP9-15B	9.445	Gc/s
Power output (pulsed)	18	kW
Construction	Packaged	

Unless otherwise shown data is applicable to both types.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES which precede this section of the handbook.

TYPICAL OPERATION

Pulse duration	0.05	0.1	1.0	μs
Pulse repetition frequency	2500	2000	500	p/s
Duty cycle	0.000125	0.0002	0.0005	
Pulse current	8.0	7.5	7.0	A
Pulse voltage	7.7	7.6	7.5	kV
Pulse input power	62	57	53	kW
R.F. pulse output power	22	21	20	kW
*Mean input current	1.2	1.6	3.5	mA
Mean input power	7.75	11.4	26.5	W
Mean R.F. output power	2.75	4.2	10.0	W
Heater voltage running	6.3	6.3	6.3	V
Frequency pulling factor (v.s.w.r. = 1.5)	17	17	17	Mc/s
Rate of rise of pulse voltage	95	90	80	kV/μs

*Includes pre-oscillation current

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current			
($t_p \leqslant 1.0\mu s$)	6.0	9.0	A
($t_p > 1.0$ to $2.5\mu s$)	6.0	7.5	A
Pulse duration		2.5	μs
Duty cycle	—	0.0015	
Mean input power	—	83	W
Rate of rise of voltage pulse	—	100	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	120	°C

JP9-15
JP9-15B

MAGNETRON

CATHODE

Indirectly heated

V_h	6.3	V
I_h	550	mA

Heating time. At ambient temperatures above 0°C, the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

In many applications involving short pulse lengths and high pulse repetition frequencies the mean current which would be calculated from the duty cycle is increased by a pre-oscillation current.

For mean input powers greater than 25 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power heater voltage rating chart on page C3.

CHARACTERISTICS

		Min.		Max.	
Frequency					
Fixed within the band	JP9-15	9.345	to	9.405	Gc/s
	JP9-15B	9.415	to	9.475	Gc/s
Pulse voltage (I_{pulse} = 7.5A)		7.0		8.2	kV
R.F. pulse power output (I_{pulse} = 7.5A)		17		—	kW
Frequency pulling factor (v.s.w.r. = 1.5)		—		18	Mc/s
Frequency pushing factor		—		1.5	Mc/s per A
Frequency temperature coefficient		—		−250	kc/s per °C
Distance of v.s.w. minimum from face of mounting plate into valve		16.5		22.5	mm
Input capacitance		—		8.0	pF

END OF LIFE PERFORMANCE

		Min.		Max.	
R.F. pulse power output (I_{pulse} = 7.5A)				15	kW
Frequency					
Within the band	JP9-15	9.345	to	9.405	Gc/s
	JP9-15B	9.415	to	9.475	Gc/s
Pulse voltage (I_{pulse} = 7.5A)		7.0		8.2	kV

COOLING

In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, a flow of cooling air between the radiator fins may be necessary to keep the block temperature below the permitted maximum.

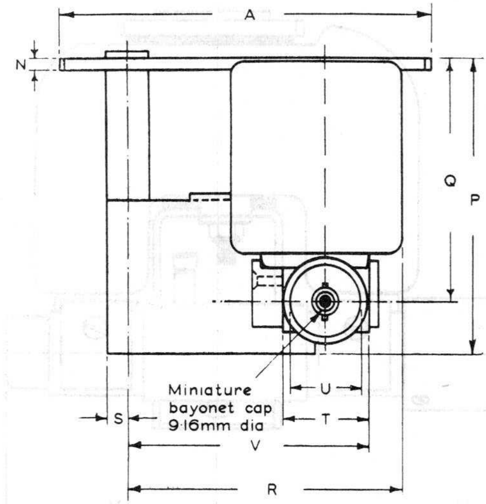
MOUNTING POSITION

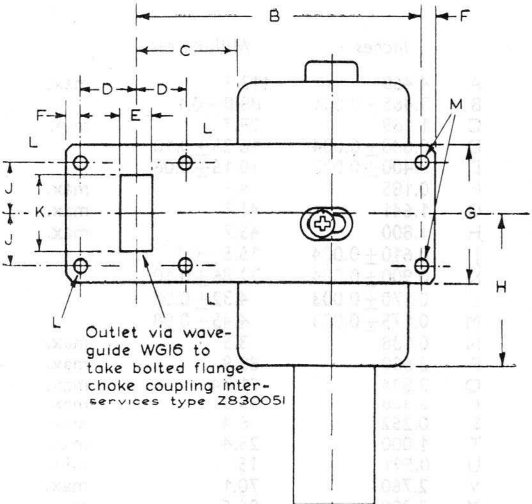
Any

PHYSICAL DATA

Weight of magnetron	3 lb 11 oz	1.7 kg
Weight of magnetron in carton	6 lb 6 oz	2.9 kg
Dimensions of storage carton	7.8 × 8.0 × 9.8 in	197 × 204 × 248 mm

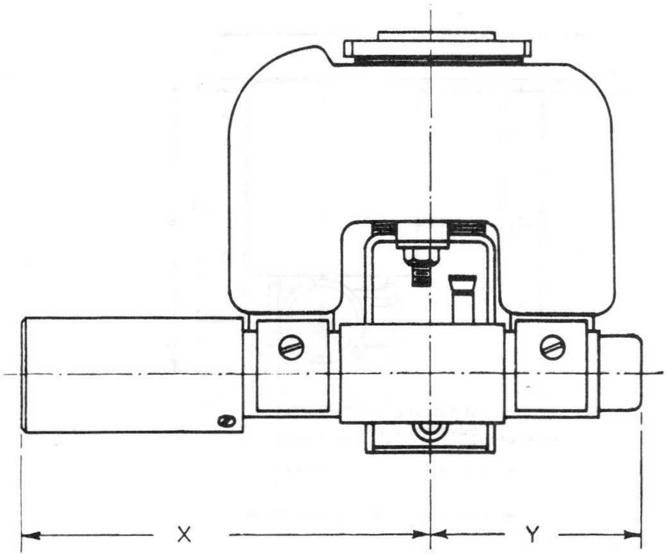
Mullard


A
N
Q
P
Miniature
bayonet cap
9·16mm dia
U
S
T
V
R


B
F
C
D
D
F
E
L
L
M
J
K
J
G
H
L
L
Outlet via wave-
guide WG16 to
take bolted flange
choke coupling inter-
services type Z830051
6815

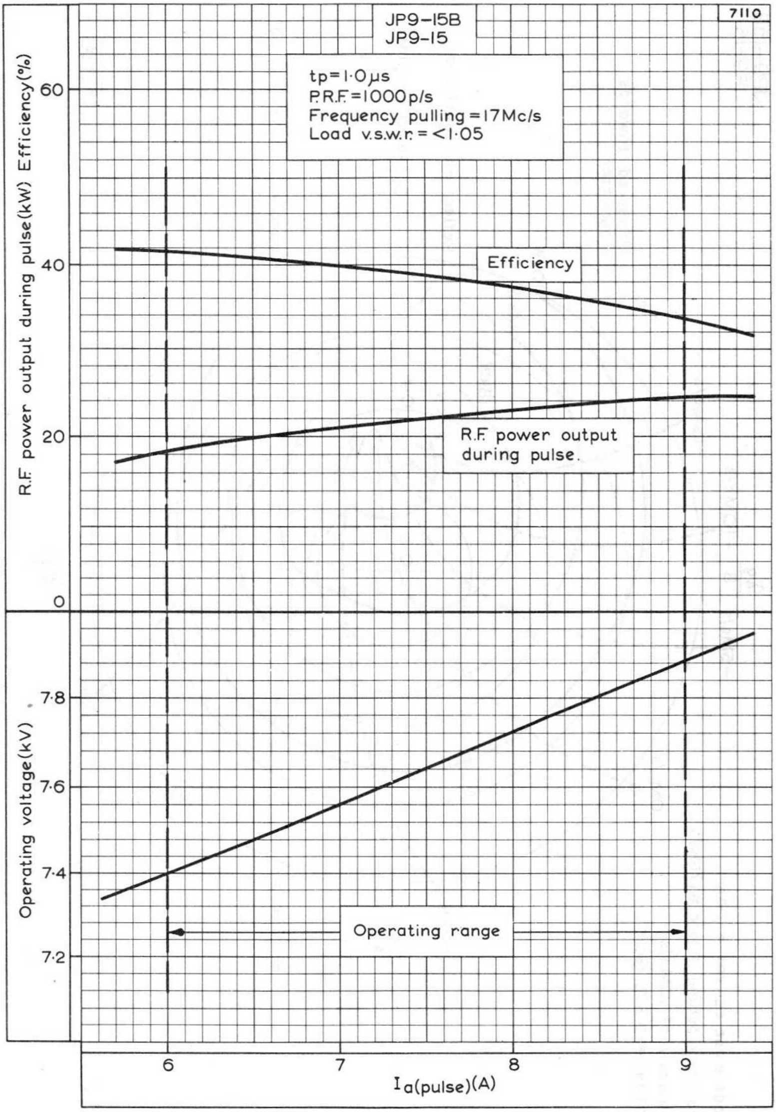
JP9-15
JP9-15B

MAGNETRON



6816

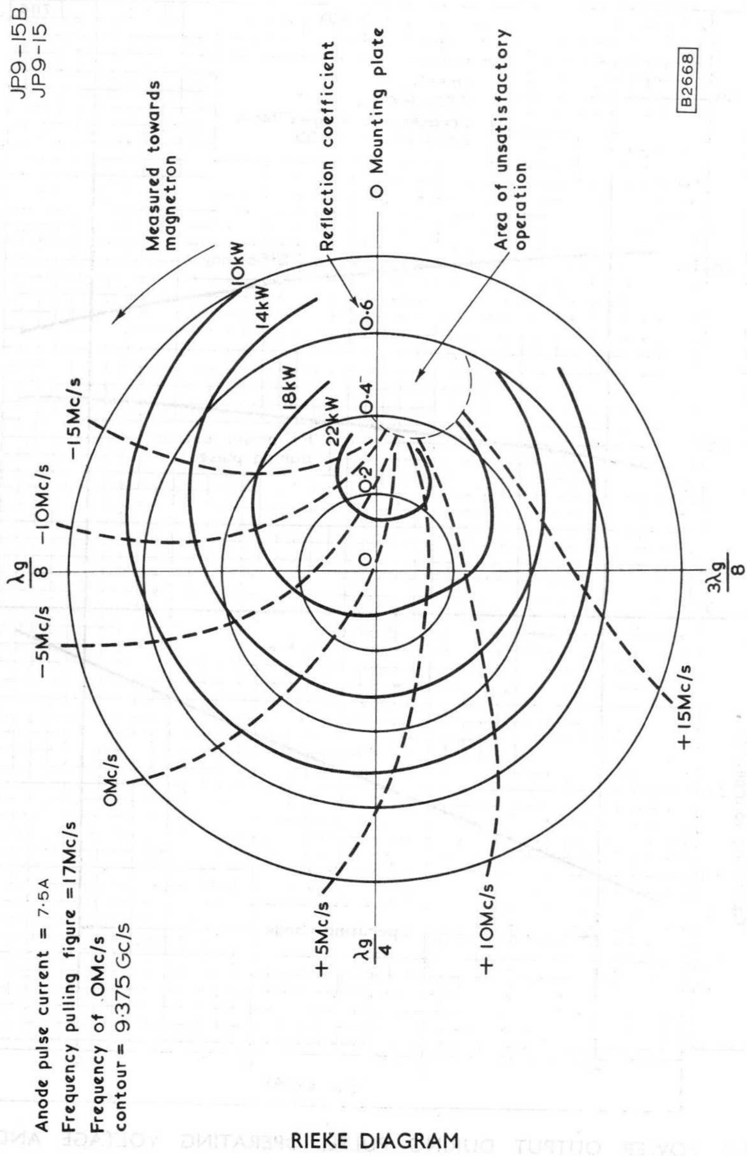
	Inches	Millimetres	
A	4.468	113.5	max.
B	3.465 ± 0.004	88.0 ± 0.1	
C	1.169	29.7	min.
D	0.640 ± 0.004	16.25 ± 0.10	
E	0.400 ± 0.003	10.16 ± 0.08	
F	0.185	4.7	max.
G	1.641	41.7	max.
H	1.800	45.7	max.
J	0.610 ± 0.004	15.5 ± 0.1	
K	0.900 ± 0.004	22.86 ± 0.10	
L	0.170 ± 0.003	4.32 ± 0.08	
M	0.175 ± 0.003	4.45 ± 0.08	
N	0.138	3.5	max.
P	3.500	88.9	max.
Q	2.824	71.74	max.
R	3.358	85.3	max.
S	0.252	6.4	max.
T	1.000	25.4	max.
U	0.591	15	min.
V	2.760	70.1	max.
X	3.799	96.5	max.
Y	1.575	40	max.



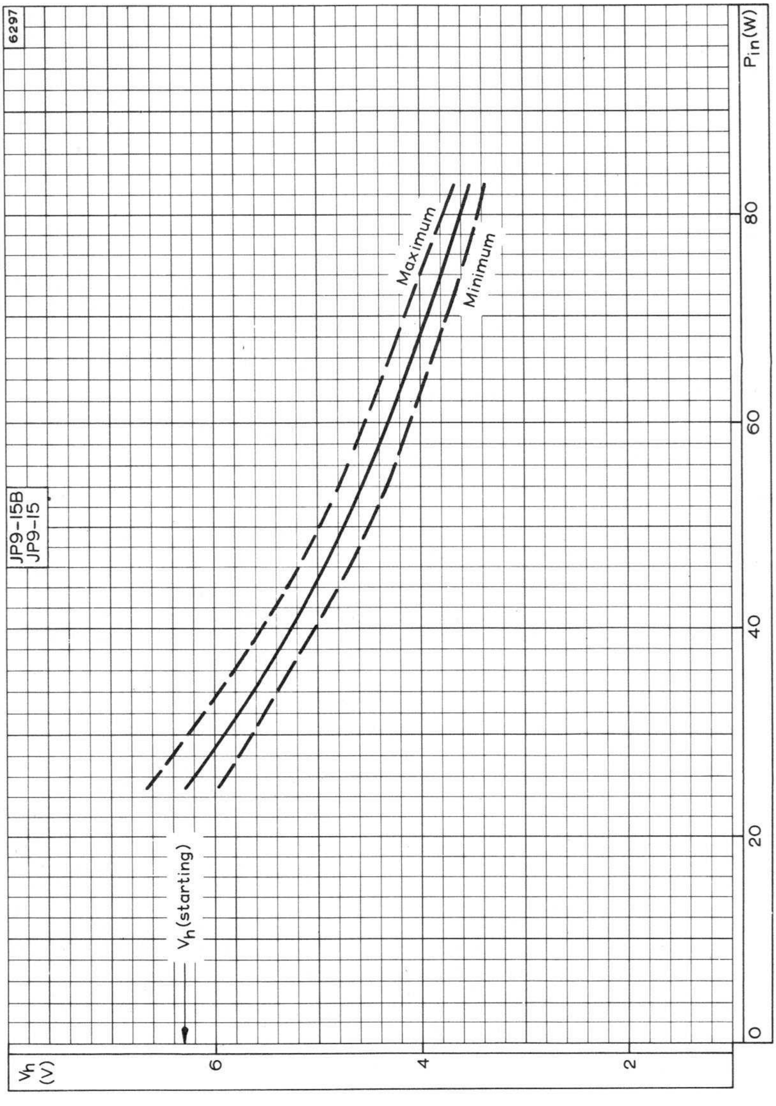
R.F. POWER OUTPUT DURING PULSE, OPERATING VOLTAGE AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT

JP9-15
JP9-15B

MAGNETRON



RIEKE DIAGRAM



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER

MAGNETRON JP9-18

QUICK REFERENCE DATA		
Fixed frequency 'X' band magnetron with natural cooling		
Frequency	9.41	GHz
Power output (pulsed)	21	kW
Construction		Packaged

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. pulse power output	21	21	kW
Duty factor	0.0002	0.0005	
Pulse duration	0.1	1.0	μs
Pulse repetition frequency	2000	500	p.p.s.
Heater voltage (running)	6.3	6.3	V
Pulse current	8.6	8.6	A
Pulse voltage	7.2	7.2	kV
Pulse input power	62	62	kW
Rate of rise of voltage pulse	90	90	kV/μs
*Mean input current	1.8	4.3	mA
Mean input power	13	31	W
Mean r.f. output power	4.2	10.5	W
Frequency pulling (v.s.w.r. = 1.5)	16	16	MHz

*Includes pre-oscillation current

CHARACTERISTICS

	Min.	Max.	
Frequency fixed within the band	9.38	9.44	GHz
Pulse voltage (I_{pulse} = 8.6A)	7.0	7.5	kV
R.F. pulse power output (I_{pulse} = 8.6A)	19	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	18	MHz
Frequency temperature coefficient	-	-0.25	MHz per degC
Distance for v.s.w. minimum from face of mounting plate into valve	16.5	22.5	mm
Input capacitance	-	8.0	pF
Frequency pushing	-	1.5	MHz per A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	7.0	10.	A
Pulse duration	-	2.5	μs
Duty factor	-	0.0015	
Mean input power	-	83	W
Rate of rise of voltage pulse	-	100	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	

CATHODE

Indirectly heated

V_h		6.3	V
I_h		0.55	A
$I_{h\ (surge)}$	max.	5.0	A
r_h (cold)		1.75	Ω

Heating time

At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

In many applications involving short pulse lengths and high pulse repetition frequencies the mean current which would be calculated from the duty cycle is increased by a pre-oscillation current.

For mean input powers greater than 25watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power-heater voltage rating chart on page C1.

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:

R.F. pulse power output (I_{pulse} = 8.6A)			17	kW
	Min.		Max.	
Frequency within the band	9.38	to	9.44	GHz
Pulse voltage (I_{pulse} = 8.6A)	7.0	to	7.5	kV

MOUNTING POSITION Any

PHYSICAL DATA

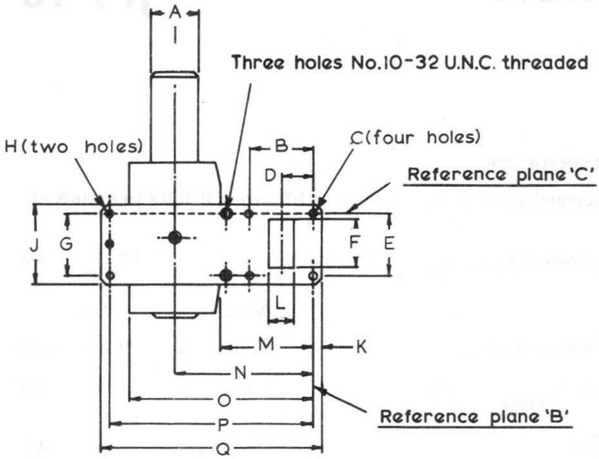
	kg	lb
Weight of magnetron	1.7	3.7
Weight of magnetron in carton	2.9	6.4
	cm	in
Dimensions of storage carton	19.7× 20.4× 24.8	7.8× 8.0× 9.8

COOLING

In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, a flow of cooling air between the radiator fins may be necessary to keep the anode block temperature below the permitted maximum.

Temperature

Anode block max.	120	^{o}C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Three holes No.10-32 U.N.C. threaded
H(two holes)
B
C(four holes)
D
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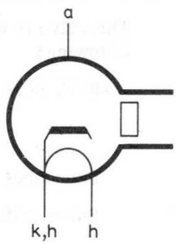
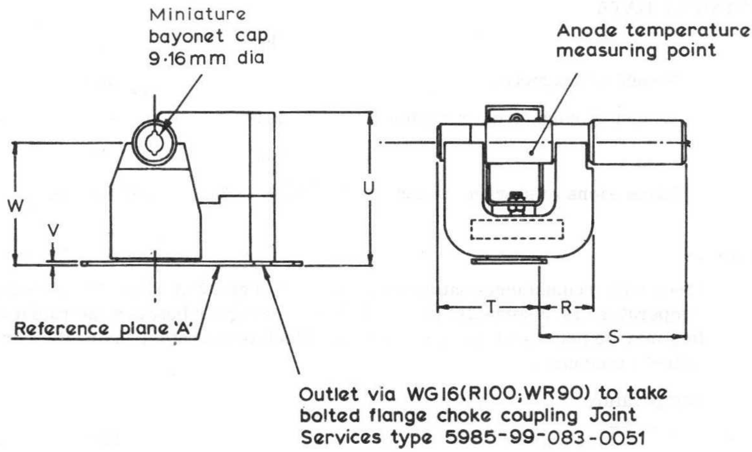
J
G
F
E
L
M
K
N
O
P
Q
Reference plane 'B'

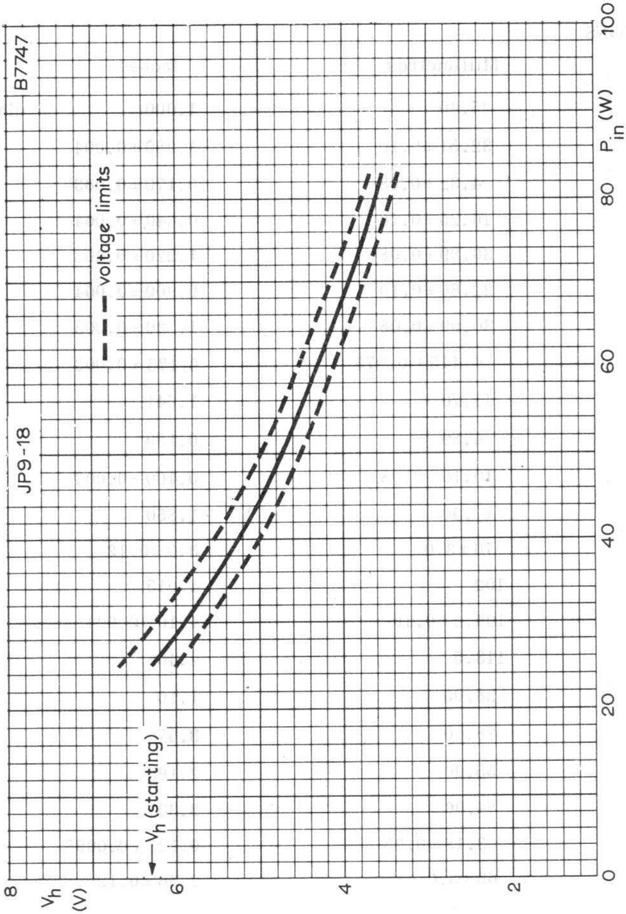

a
k,h
h


Miniature
bayonet cap
9·16mm dia
Anode temperature
measuring point
U
W
V
T
R
S
Reference plane 'A'
Outlet via WG16(R100;WR90) to take
bolted flange choke coupling Joint
Services type 5985-99-083-0051

DIMENSIONS

	Millimetres	Inches	
A	25.40	1.000	dia.max.
B	32.51 ± 0.10	1.280 ± 0.004	
C	4.32 ± 0.08	0.170 ± 0.003	dia.
D	16.25 ± 0.10	0.640 ± 0.004	
E	30.99 ± 0.08	1.220 ± 0.003	
F	22.86 ± 0.10	0.900 ± 0.004	
G	30.99 ± 0.08	1.220 ± 0.003	
H	4.445 ± 0.075	0.175 ± 0.003	dia.
J	41.70	1.641	max.
K	4.80	0.189	max.
L	10.16 ± 0.08	0.400 ± 0.003	
M	47.00	1.850	min.
N	76 ± 3.0	3.0 ± 0.12	
O	102	4.015	max.
P	104.2 ± 0.10	4.10 ± 0.004	
Q	113.5	4.468	max.
R	28.00	1.10	max.
S	78.00	3.07	max.
T	55.00	2.165	max.
U	84.00	3.307	max.
V	3.18 ± 0.25	0.125 ± 0.0098	
W	65 ± 3.0	2.56 ± 0.12	

Inch dimensions derived from original millimetre dimensions

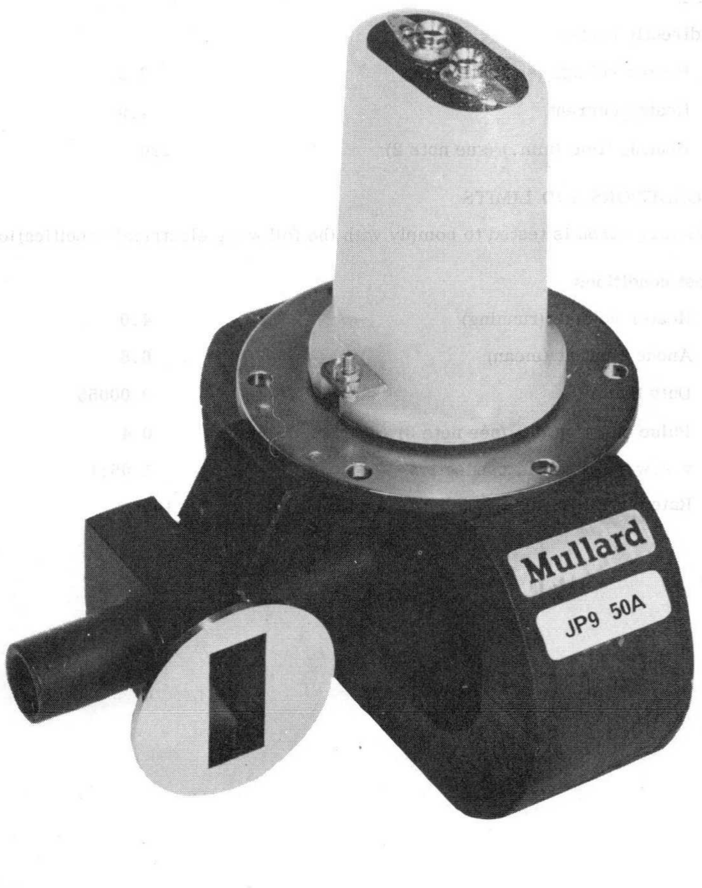


HEATER DERATING CHART

MAGNETRON JP9-50A

QUICK REFERENCE DATA	
X-band, fixed frequency, pulsed magnetron.	
Frequency (fixed within the band)	9.345 to 9.405 GHz
Power output (peak)	50 kW
Output connection	Special WG15 flange
Construction	Packaged

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

	Condition 1	Condition 2	
Operating conditions			
Heater voltage	5.6	4.0	V
Anode current (peak)	12	12	A
Pulse duration (t_p)	0.06	0.55	μs
Pulse repetition rate	4000	1000	pulse/s
Rate of rise of voltage pulse	150	150	kV/μs
Typical performance			
Anode voltage (peak)	12.5	12.5	kV
Power output (peak)	50	50	kW
Power output (mean)	12	27.5	W

CATHODE

Indirectly heated

Heater voltage (see note 1)	6.3	V
Heater current	1.0	A
Heating time (min.) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage (running)	4.0	V
Anode current (mean)	6.6	mA
Duty factor	0.00055	
Pulse duration (t_p) (see note 3)	0.4	μs
v.s.w.r. at output connection	1.05:1	
Rate of rise of voltage pulse (see note 4)	150	kV/μs

TEST CONDITIONS AND LIMITS (contd.)

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	11	13	kV
Power output (mean)	22	-	W
Frequency (see note 5)	9.345	9.405	GHz
R.F. Bandwidth at 1/4 power (see note 6)	-	$\frac{2.5}{t_p}$	MHz
Minor lobe level (see note 6)	6.0	-	dB
Frequency pulling (see note 7)	-	15	MHz
Stability (see note 8)	-	0.25	%
Heater current (see note 9)			
Frequency temperature coefficient (see note 10)			
Input capacitance (see note 11)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 1)	5.7	6.9	V
Heater current (surge)	-	5.0	A
Anode current (peak)	10	16	A
Anode voltage (peak)	-	16	kV
Power input (mean)	-	160	W
Duty factor (see note 12)	-	0.001	
Pulse duration (t_p) (see note 3)	-	1.0	µs
Rate of rise of voltage pulse (see note 4)	-	160	kV/µs
Anode temperature (see note 13)	-	120	^{o}C
v.s.w.r. at output connection	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when tested as on page 2.

	Min.	Max.	
Power output (mean)	16.5	-	W
Frequency	9.345	9.405	GHz
R.F. Bandwidth at 1/4 power	-	$\frac{3.0}{t_p}$	MHz
Stability	-	0.5	%

MOUNTING AND STORING

Mounting position (see note 14) Any

COOLING

Forced air, sufficient to ensure that the maximum specified anode temperature is never exceeded.

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.81	4.0
Weight of magnetron in storage carton	1.92	4.25
	mm	in
Dimensions of storage carton	204 × 241 × 266.7	8 × 9.5 × 10.5

NOTES

1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced in accordance with the heater derating chart on page 8.

2. For ambient temperatures above $0^{o}C$. For ambient temperatures between $0^{o}C$ and $-55^{o}C$ the cathode heating time is 180 seconds.

3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is ±10%.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

5. Measured with an anode temperature of approximately $80^{o}C$.

6. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 10 to 14A peak.

NOTES (contd.)

7. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 at an anode current of 12A peak.

8. Measured under the conditions described in note 6. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.345 to 9.405GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during a period of observation of three minutes after an initial operating period of not more than three minutes.

9. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.9 to 1.1A.

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

11. Design test only. The maximum input capacitance is 10pF.

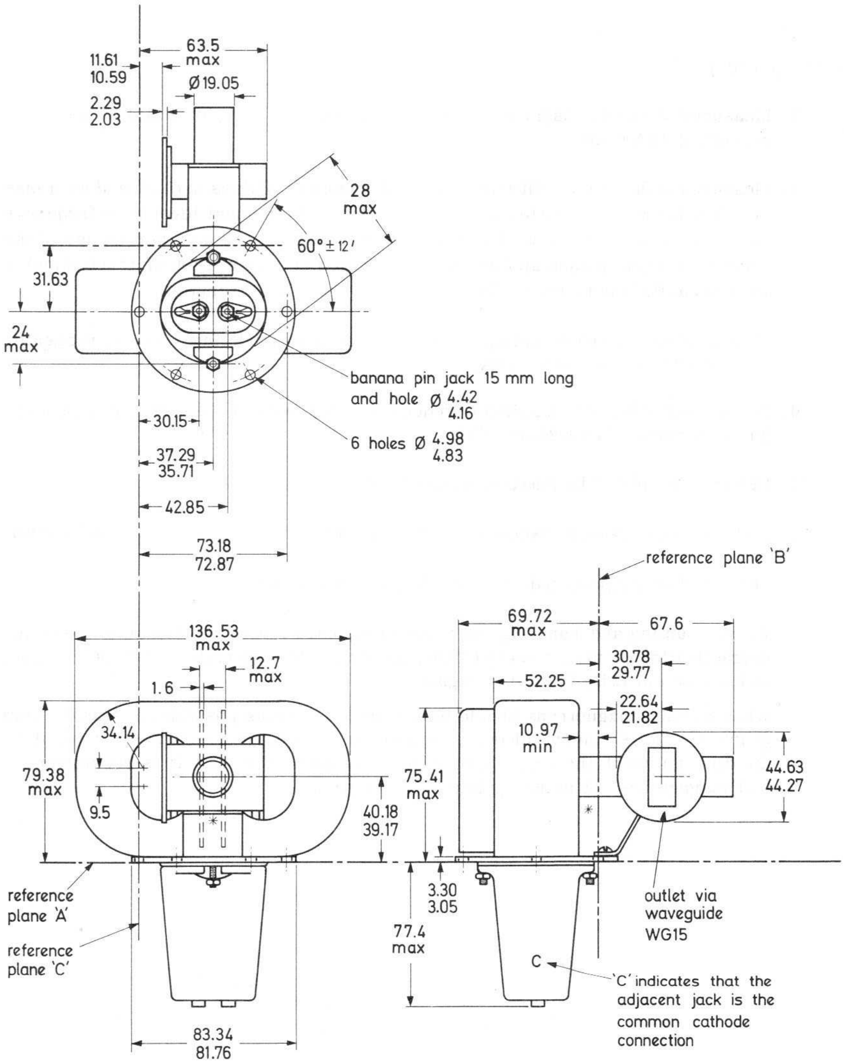
12. For peak input powers exceeding 150kW the duty factor must not exceed 0.0007.

13. Measured at the point indicated on the outline drawing.

14. When mounting and handling the magnetron, care must be taken to prevent demagnetisation. It is necessary to keep all magnetic materials as far as possible, at least 50mm (2 in) from the magnet.

    When storing, magnetrons should be kept as far apart as possible, at least 150mm (6 in). During shipment adequate separation between magnetrons is provided by the dimensions of the inner pack of the storage carton, and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING OF JP9-50A



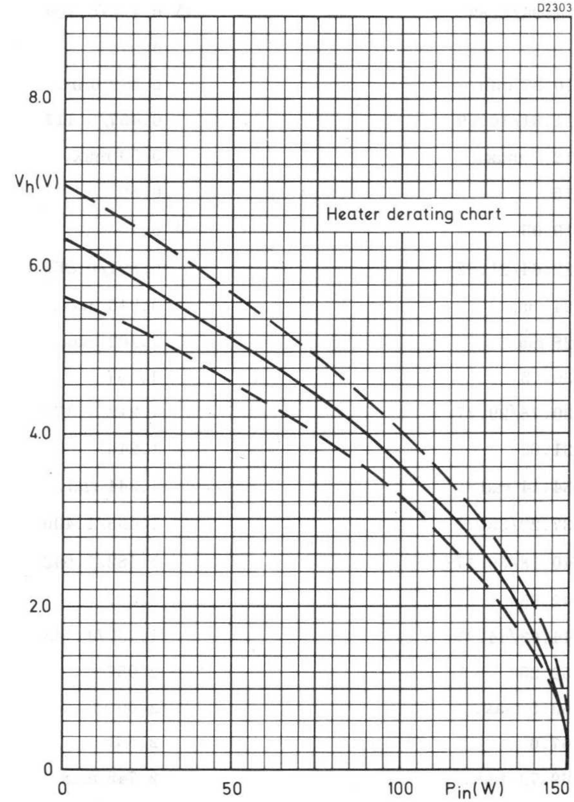
∗ Temperature measuring point

All dimensions in mm

D1519

CONVERSION TABLE
(Rounded outwards)

mm	in
1.6	0.063
2.29/2.03	0.090/0.080
3.30/3.05	0.130/0.120
Ø 4.42/4.16	0.174/0.164
Ø 4.98/4.83	Ø 0.196/0.190
9.5	0.374
10.97 min.	0.432 min.
11.61/10.59	0.457/0.417
12.7 max.	0.50 max.
15	0.59
Ø 19.05	Ø 0.75
22.64/21.82	0.891/0.859
24 max.	0.945 max.
28 max.	1.102 max.
30.15	1.187
30.78/29.77	1.212/1.172
31.63	1.245
34.14 rad.	1.344 rad.
37.29/35.71	1.468/1.406
40.18/39.17	1.582/1.542
42.85	1.687
44.63/44.27	1.757/1.743
52.25	2.057
63.5 max.	2.50 max.
67.6	2.661
69.72 max.	2.745 max.
73.18/72.87	2.881/2.869
75.41 max.	2.969 max.
77.4 max.	3.047 max.
79.38 max.	3.125 max.
83.34/81.76	3.281/3.219
136.53 max.	5.375 max.



HEATER VOLTAGE PLOTTED AGAINST MEAN ANODE INPUT POWER

MAGNETRON JP9-75

QUICK REFERENCE DATA

Forced-air cooled fixed frequency 'X' band pulsed magnetron

Frequency	9.375	Gc/s
Power output (pulsed)	80	kW
Construction	Packaged	

Unless otherwise shown, data are applicable to both types.

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES which precede this section of the handbook.

CHARACTERISTICS

	Min.		Max.	
Frequency Fixed within the band	9.345	to	9.405	Gc/s
Pulse voltage (I_{pulse} = 15A)	14		16	kV
R.F. pulse output power (I_{pulse} = 15A)	65		—	kW
Frequency pulling factor (v.s.w.r. = 1.5)	—		15	Mc/s
Frequence pushing factor	—		750	kc/s per A
Frequency temperature coefficient	—		–250	kc/s per °C
Distance of v.s.w. minimum from face of mounting plate into valve	10.8	to	17.8	mm
Input capacitance	—		12	pF

TYPICAL OPERATION

Duty cycle	0.0002	0.001	0.001	
Heater voltage (running)	10	7.5	7.5	V
Pulse duration	0.1	1.0	5.0	µs
Pulse repetition frequency	2000	1000	200	p/s
Pulse current	15	15	15	A
Pulse voltage	15	15	15	kV
Pulse input power	225	225	225	kW
R.F. pulse output power	80	80	80	kW
*Mean input current	3.5	15	15	mA
Mean input power	45	225	225	W
Mean r.f. output power	16	80	80	W
Frequency pulling (v.s.w.r. = 1.5)	10	10	10	Mc/s
Rate of rise of pulse voltage	140	70	60	kV/µs

*Includes pre-oscillation current

CATHODE

Indirectly heated

V_h	10	V
I_h	2.85	A
$I_{h(surge)}$ max.	11.5	A
r_h (cold)	0.4	Ω

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 3 minutes before the application of h.t.

In many applications involving short pulse lengths and high pulse repetition frequencies the mean current which would be calculated from the duty cycle is increased by the pre-oscillation current.

For mean input powers greater than 50 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power-heater voltage rating chart on page C2.

ABSOLUTE MAXIMUM RATINGS

	Min.	*Max.*	
Pulse current	11	17	A
Pulse duration	—	5.5	μs
Duty cycle	—	0.002	
Mean input power	—	400	W
Rate of rise of voltage pulse			
($t_p \leq 1\mu s$)	—	150	kV/μs
($t_p > 1\mu s$)	—	80	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	175	°C
Temperature of cathode and heater seals	—	150	°C

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:—

	Min		Max	
R.F. pulse power output ($I_{pulse} = 15A$)			60	kW
Frequency Within the band	9.345	to	9.405	Gc/s
Pulse voltage ($I_{pulse} = 15A$)	14	to	16	kV

MOUNTING POSITION

Any

PRESSURISING

The valve must not be operated at a pressure lower than 600mm of mercury. The waveguide output system can be pressurised up to a pressure of 2370mm of mercury.

PHYSICAL DATA

	lb	kg
Weight of magnetron	4.7	2.2
Weight of magnetron in carton	13	5.9
	in	cm
Dimensions of storage carton	13.25 x 12 x 9.375	33.7 x 30.5 x 23.8

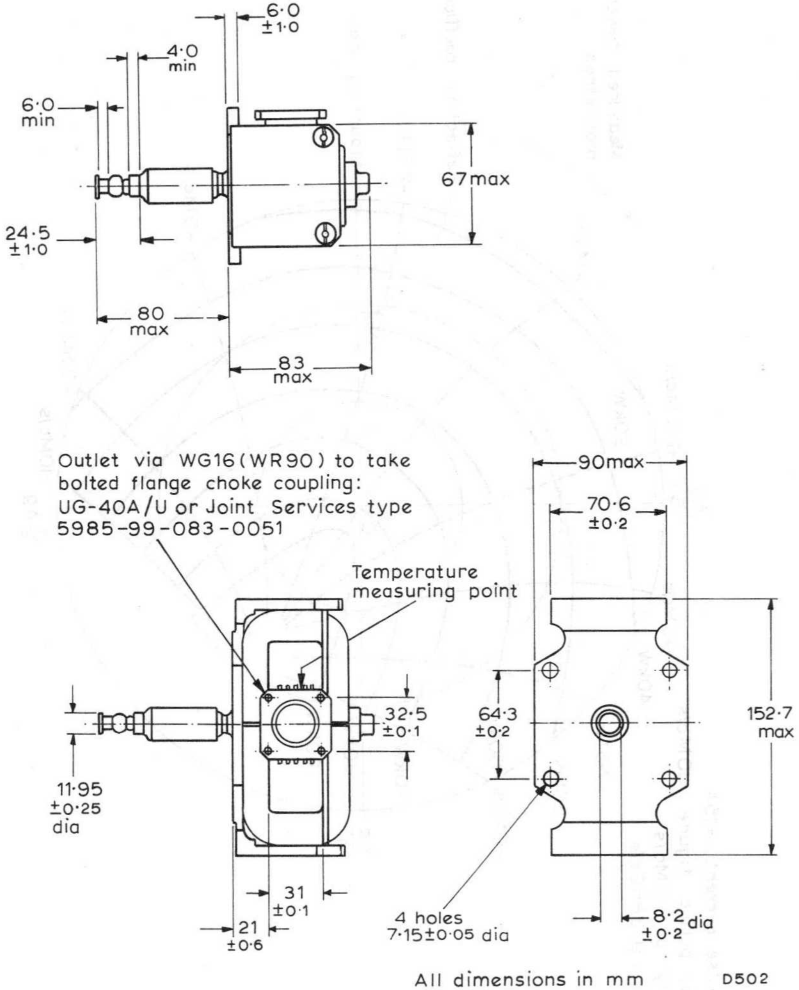
COOLING

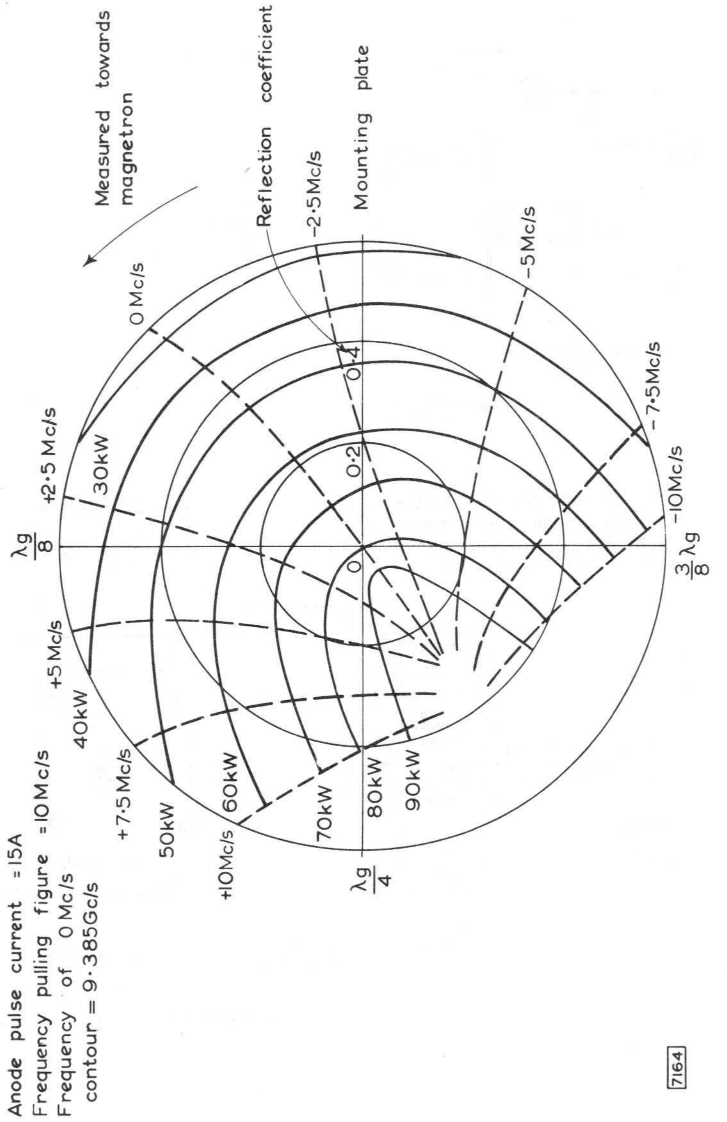
It is necessary to direct a flow of cooling air between the radiator fins, and on the cathode and heater seals, in order to keep the temperature below the permitted maximum.

CONVERSION TABLE
(rounded outwards)

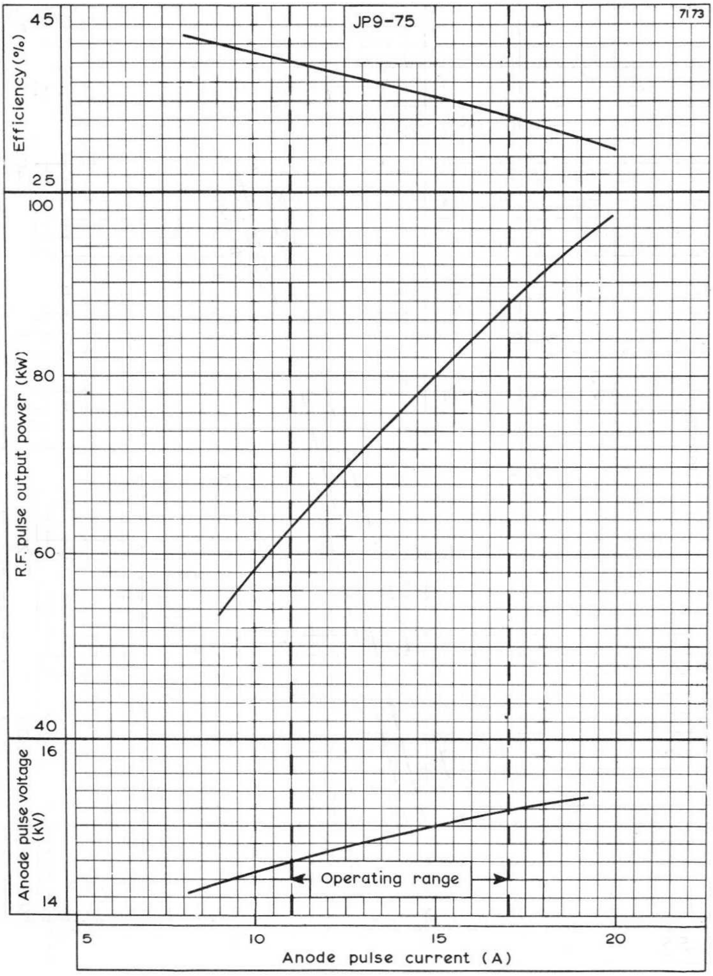
4.0 min.	0.157 min.
6.0 min.	0.236 min.
6.0 ± 1.0	0.236 ± 0.040
7.15 ± 0.05	0.2815 ± 0.0020
8.2 ± 0.2	0.3228 ± 0.0079
11.95 ± 0.25	0.470 ± 0.010
21 ± 0.6	0.827 ± 0.024
24.5 ± 1.0	0.965 ± 0.040
31 ± 0.1	1.220 ± 0.004
32.5 ± 0.1	1.280 ± 0.004
64.3 ± 0.2	2.5315 ± 0.0079
67 max.	2.638 max.
70.6 ± 0.2	2.7795 ± 0.0079
80 max.	3.150 max.
83 max.	3.268 max.
90 max.	3.544 max.
152.7 max.	6.012 max.

OUTLINE DRAWING

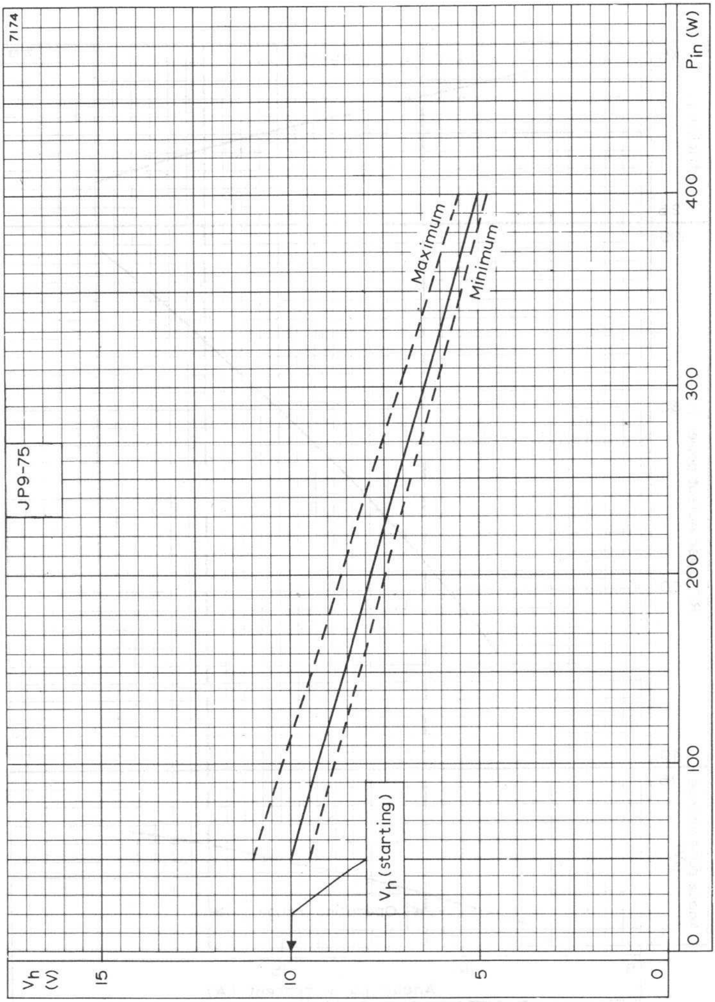




RIEKE DIAGRAM



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



REDUCTION OF HEATER VOLTAGE PLOTTED AGAINST
MEAN INPUT POWER

QUICK REFERENCE DATA		
Forced-air cooled fixed frequency 'X' band pulsed magnetron.		
Frequency JP9-80	9.375	Gc/s
Frequency JP9-80A	9.240	Gc/s
Power output (pulsed)	80	kW

To be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES.

Unless otherwise shown, data are applicable to both types.

CHARACTERISTICS

	Min.		Max.	
Frequency Fixed within the band JP9-80	9.345	to	9.405	Gc/s
Frequency Fixed within the band JP9-80A	9.210	to	9.270	Gc/s
Pulse voltage (I pulse = 15 A)	14		16	kV
R.F. pulse power output (I pulse = 15A)	70		-	kW
Frequency pulling (v.s.w.r. = 1.5)	-		13	Mc/s
Frequency temperature coefficient	-		-0.25	Mc/s per ^{o}C
Position of phase of sink from face of mounting plate towards load	0.26	to	0.40	λg
Input capacitance	-		14	pF
Frequency pushing (12A to 15A)	-		0.5	Mc/s per A

TYPICAL OPERATION

R.F. pulse power output	80	80	80	kW
Duty factor	0.0008	0.001	0.001	
Pulse duration	0.4	1.0	5.0	μs
Pulse repetition frequency	2000	1000	200	p.p.s.
Heater voltage (running)	8.5	7.8	7.8	V
Pulse current	15	15	15	A
Pulse voltage	15	15	15	kV
Pulse input power	225	225	225	kW
Rate of rise of voltage pulse	140	125	85	kV/μs
Mean input current	12	15	15	mA
Mean input power	180	225	225	W
Mean r.f. output power	64	80	80	W
Frequency pulling (v.s.w.r. = 1.5)	12	12	12	Mc/s

CATHODE

Indirectly heated

Vh	12.6	V
Ih	2.2	A
rh (cold)	0.65	Ω
Ih (surge) max.	10	A
Minimum warm up time	90	s

It is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power - heater voltage rating chart on page C2.

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	12	15	A
Pulse duration	-	5.0	μs
Duty factor	-	0.001	
Mean input power	-	240	W
Rate of rise of voltage pulse			
t_p 0.4μs	120	160	kV/μs
t_p 1.0μs	100	150	kV/μs
t_p 4.5μs	70	100	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	150	°C
Temperature of cathode and heater seals	-	175	°C

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following :-

R.F. pulse power output (I pulse = 15A)	60	kW

		Min.		Max.	
Frequency					
Within the band	JP9-80	9.345	to	9.405	Gc/s
	JP9-80A	9.210	to	9.270	Gc/s
Pulse voltage (I pulse = 15A)		14	to	16	kV

MOUNTING POSITION

Any

PRESSURISING

The valve can be operated in the pressure range 500 to 2,050mm of mercury.

PHYSICAL DATA

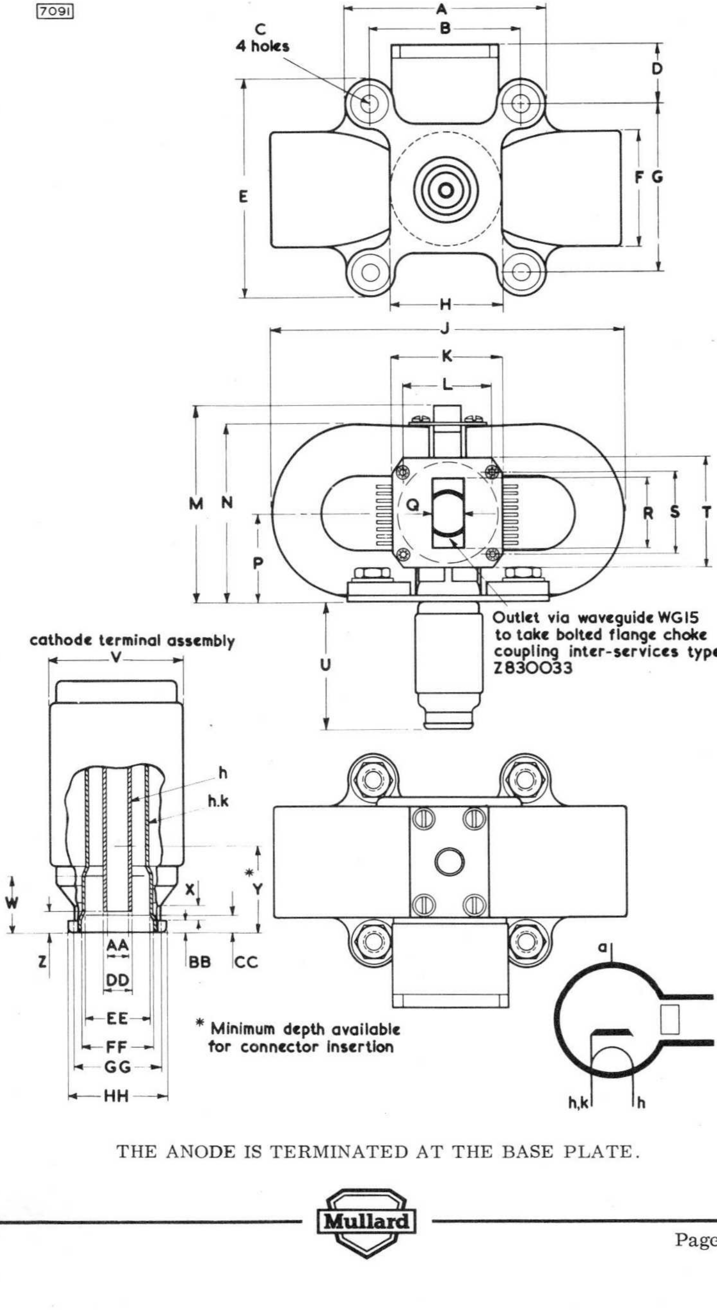
	lb	kg
Weight of magnetron	5.875	2.7
Weight of magnetron in carton	14.625	6.7
	in	cm
Dimensions of storage carton	7.5 x 8.7 x 10	19.1 x 22.3 x 25.4

COOLING

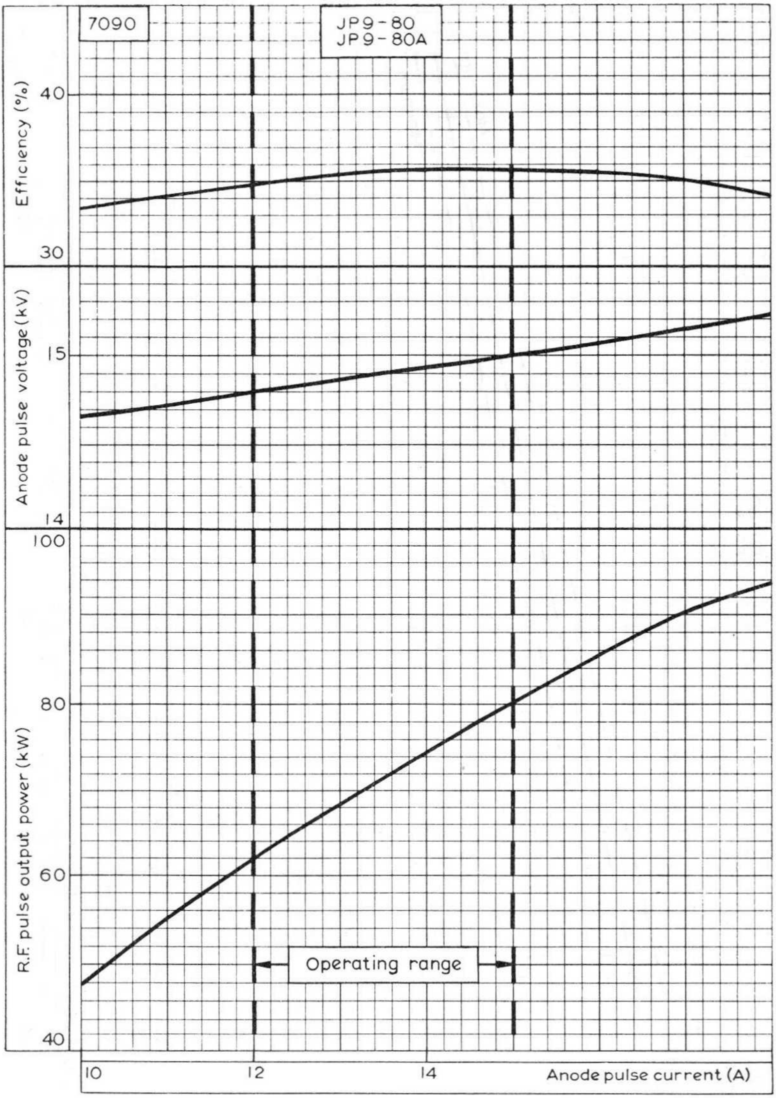
It is necessary to direct a flow of cooling air between the radiator fins, and on the cathode and heater seals, in order to keep the temperature below the permitted maximum.

DIMENSIONS

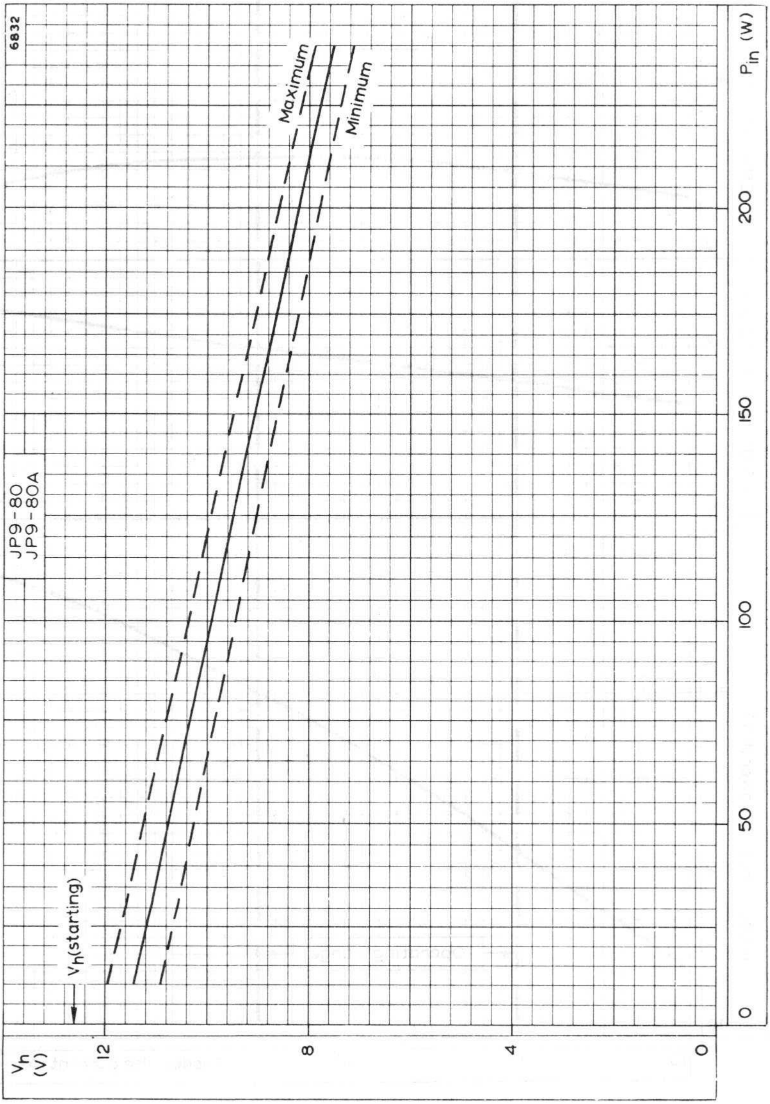
	Inches	Millimetres	
A	3.437	87.3	max
B	2.531±0.010	64.29±0.25	
C	0.281±0.005	7.14±0.12	
D	1.016±0.024	25.8±0.6	
E	3.622	92	max
F	1.937	49.2	max
G	2.781±0.010	70.64±0.25	
H	1.874	47.6	min
J	5.937	150.8	max
K	1.831	46.5	
L	1.474±0.004	37.44±0.1	
M	3.154	80.1	max
N	2.843	72.2	max
P	1.406±0.020	35.71±0.5	
Q	0.497	12.62	
R	1.122	28.5	
S	1.352±0.004	34.34±0.1	
T	1.831	46.5	
U	2.156±0.061	54.75±1.55	
V	1.126	28.6	
W	0.520	13.2	min
X	0.125	3.17	
Y	0.752	19.1	min
Z	0.156±0.030	3.95±0.75	
AA	0.169±0.005	4.29±0.12	
BB	0.126±0.008	3.2±0.2	
CC	0.201	5.1	max
DD	0.250±0.014	6.35±0.35	
EE	0.539±0.006	13.68±0.16	
FF	0.610	15.5	
GG	0.748	19	
HH	0.831±0.006	21.12±0.16	



THE ANODE IS TERMINATED AT THE BASE PLATE.



R.F. PULSE OUTPUT POWER, ANODE PULSE VOLTAGE AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



REDUCTION OF HEATER VOLTAGE PLOTTED AGAINST INPUT POWER

MAGNETRON JP9-180

QUICK REFERENCE DATA		
X-Band, fixed frequency magnetron.		
Frequency	9.375	GHz
Power output (pulsed)	180	kW
Construction	Packaged	

Services type: CV2373

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

CHARACTERISTICS

	Min.	Max.	
Frequency			
Fixed within the band	9.325	9.425	GHz
Pulse voltage (I_{pulse} =22.5A)	18	23	kV
R.F. pulse power output (I_{pulse} =22.5A)	150	-	kW
Frequency pulling (v.s.w.r. =1.5:1)	-	15	MHz
Frequency temperature coefficient	-	-0.25	MHz/degC

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	16	25	A
Pulse duration	-	2.25	μs
Duty factor	-	0.0005	
Mean input power	-	250	W
Rate of rise of voltage pulse	-	110	kV/μs
Load mismatch (v.s.w.r.)	-	1.5:1	

OPERATING CONDITIONS

R.F. pulse power output	180	kW
Duty factor	0.0004	
Pulse duration	1.0	μs
Pulse repetition frequency	400	pulse/s
Heater voltage (running)	8.0	V
Pulse current	22.5	A
Pulse voltage	20.5	kV
Pulse input power	460	kW
Rate of rise of voltage pulse	100	kV/μs
Mean input current	9.0	mA
Mean input power	184	W
Mean r.f. output power	72	W
Frequency pulling (v.s.w.r. =1.5:1)	13	MHz

CATHODE

Indirectly heated

V_h	12.6	V
I_h	2.25	A
I_h (surge) max.	7.5	A
r_h (cold)	0.67	Ω

Heating time. At ambient temperatures above $0^{o}C$ the cathode must be heated for at least 3 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 4 minutes. For mean input powers greater than 0 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the heater derating chart on page 6.

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:-

R.F. pulse power output (I_{pulse} =22.5A)	115		kW
	Min.	Max.	
Frequency (fixed within the band)	9.325	9.425	GHz
Pulse voltage (I_{pulse} =22.5A)	18	23	kV

MOUNTING POSITION

Any

PRESSURISING

The magnetron can be operated in the pressure range 80 to 315kN/m^2 (600 to 2370mm of mercury).

PHYSICAL DATA

	kg	lb
Weight of magnetron	4.5	10
Weight of magnetron in carton	6.0	13.3
	mm	in
Dimensions of storage carton	178×244×290	7×9.6×11.4

COOLING

It is necessary to direct a flow of cooling air between the radiator fins, and on the cathode and heater seals, in order to keep the temperature below the permitted maximum.

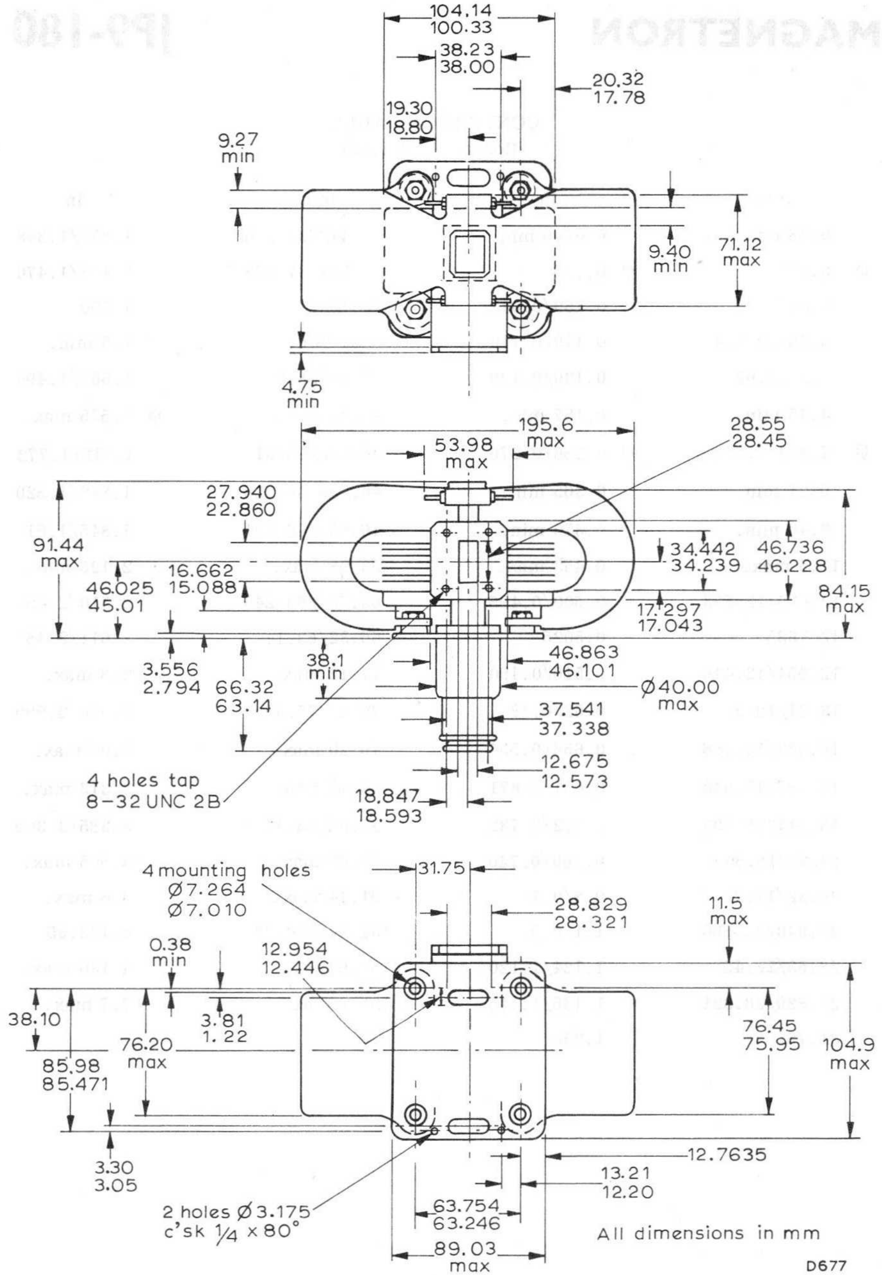
Temperatures

Anode block max.	140	^{o}C
Cathode and heater seals max.	200	^{o}C

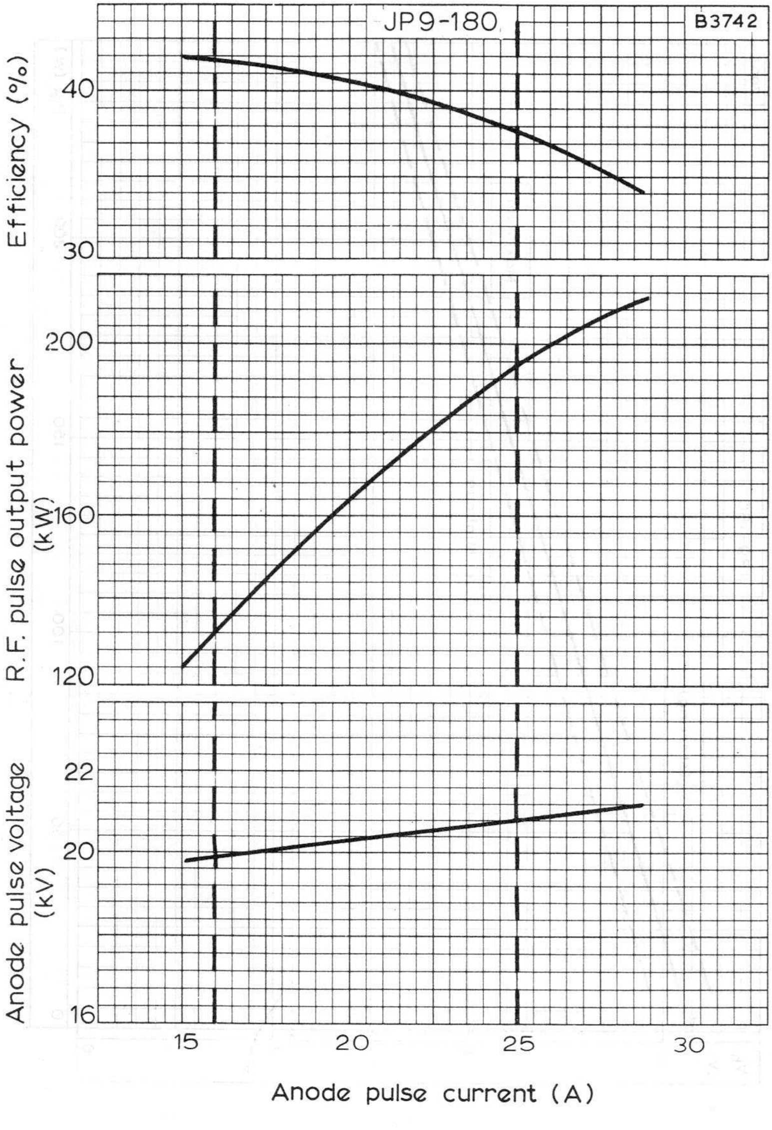
CONVERSION TABLE
(Rounded outwards)

mm	in	mm	in
0.38 min.	0.0149 min.	34.442/34.239	1.356/1.348
Ø 3.175	Ø 0.125	37.541/37.338	1.478/1.470
3.81/1.22	0.150/0.048	38.10	1.500
3.556/2.794	0.140/0.110	38.1 min.	1.5 min.
3.30/3.05	0.130/0.120	38.23/38.0	1.505/1.496
4.75 min.	0.187 min.	Ø 40.00 max.	Ø 1.575 max.
Ø 7.264/7.010	Ø 0.286/0.276	46.025/45.01	1.812/1.772
9.27 min.	0.365 min.	46.736/46.228	1.840/1.820
9.40 min.	0.370 min.	46.863/46.101	1.845/1.815
11.5 max.	0.453 max.	53.98 max.	2.125 max.
12.675/12.573	0.500/0.495	63.754/63.246	2.510/2.490
12.7635	0.5025	66.32/63.14	2.611/2.486
12.954/12.446	0.510/0.490	71.12 max.	2.8 max.
13.21/12.20	0.52/0.48	76.45/75.95	3.010/2.990
16.662/15.088	0.656/0.594	76.20 max.	3.00 max.
17.297/17.043	0.681/0.671	84.15 max.	3.313 max.
18.847/18.593	0.742/0.732	85.98/85.471	3.385/3.365
19.30/18.80	0.760/0.740	89.03 max.	3.505 max.
20.32/17.78	0.8/0.7	91.44 max.	3.6 max.
27.940/22.860	1.1/0.9	104.14/100.33	4.1/3.95
28.55/28.45	1.124/1.120	104.9 max.	4.130 max.
28.829/28.321	1.135/1.115	195.6 max.	7.7 max.
31.75	1.250		

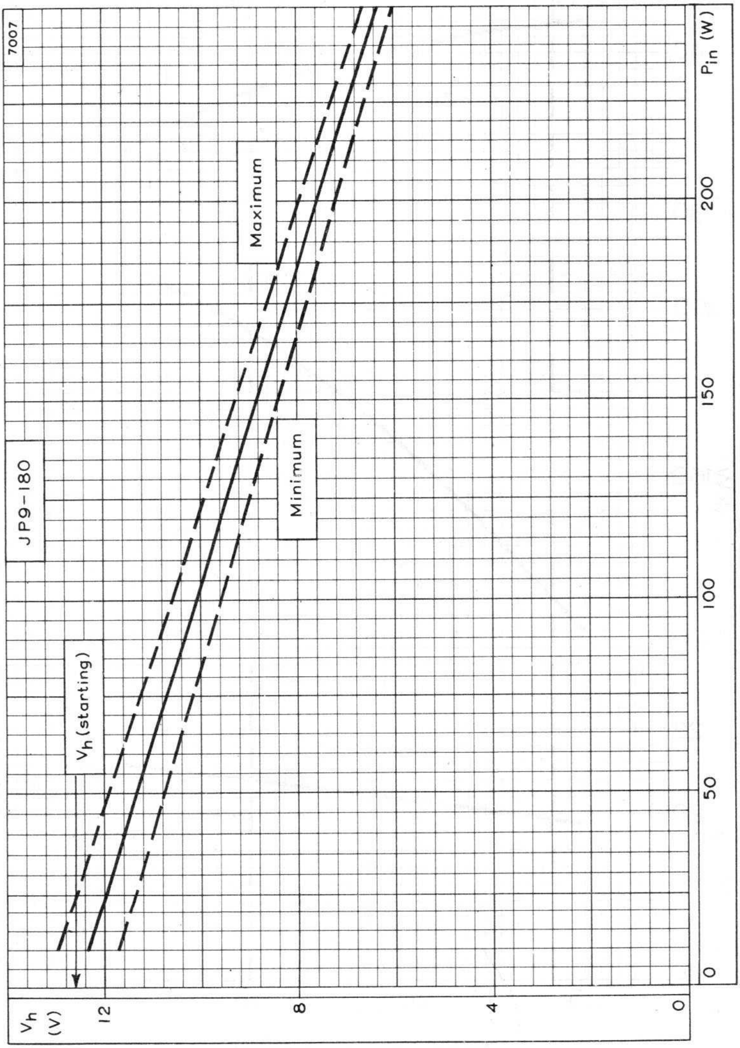
OUTLINE DRAWING OF JP9-180



Mullard



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



HEATER DERATING CHART

MAGNETRON

Frequency: *'X' band.*
Power output: *250kW pulsed.*
Construction: *Packaged, forced-air cooled.*

JP9-250 Series

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES which precede this section of the handbook.

CHARACTERISTICS

	Min.		Max.	
Frequency:				
Fixed within band				
JP9-250	9.345	to	9.405	Gc/s
JP9-250A	9.003	to	9.168	Gc/s
JP9-250B	8.830	to	8.995	Gc/s
JP9-250C	8.865	to	8.995	Gc/s
JP9-250D	8.665	to	8.830	Gc/s
JP9-250E	8.500	to	8.665	Gc/s
Pulse voltage ($I_{pulse} = 27.5A$)	20		23	kV
R.F. pulse power output ($I_{pulse} = 27.5A$)	225		—	kW
Frequency pulling factor (v.s.w.r. = 1.5)	—		15	Mc/s
Frequency temperature coefficient	—		–250	kc/s per °C
Position of phase of sink from face of mounting plate towards load	0.25	to	0.4	λg

CATHODE

Indirectly heated

V_h	13.75	V
I_h	3.25	A
$I_{h\,(surge)}$	15	A
$r_{h\,(cold)}$	0.58	Ω

Heating time. The cathode must be heated for at least 3 minutes before the application of h.t.

It is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power-heater voltage rating chart on page C2.

TYPICAL OPERATION

Duty cycle	0.001	0.001	0.001	
Heater voltage (running)	6.6	7.4	9.3	V
Pulse duration	0.5	2.0	5.0	µs
Pulse repetition frequency	2000	500	200	p/s
Pulse current	27.5	25	18	A
Pulse voltage	21.5	21.3	20.7	kV
Pulse input power	590	532	373	kW
R.F. pulse output power	250	225	155	kW
Mean input current	27.5	25	18	mA
Mean input power	590	532	373	W
Mean r.f. output power	250	225	155	W
Frequency pulling (v.s.w.r. = 1.5)	14	14	14	Mc/s
Rate of rise of pulse voltage	140	110	90	kV/µs

COOLING

It is necessary to direct a flow of cooling air between the radiator fins, and on the cathode and heater seals, in order to keep the temperature below the permitted maximum.

JP9-250 Series

MAGNETRON

LIMITING VALUES (absolute ratings)

	Min.	*Max.*	
Pulse current $\leq 1.2\mu s$	15	27.5	A
$= 6.0\mu s$	15	18	A
Pulse voltage	18.5	23	kV
Pulse duration	—	6.0	μs
Duty cycle	—	0.001	
Mean input power	—	750	W
Rate of rise of voltage pulse	70	160	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	150	°C
Temperature of cathode and heater seals	—	165	°C

MOUNTING POSITION

Any

PRESSURISING

The valve can be operated in the pressure range 600 to 2050mm of mercury.

PHYSICAL DATA

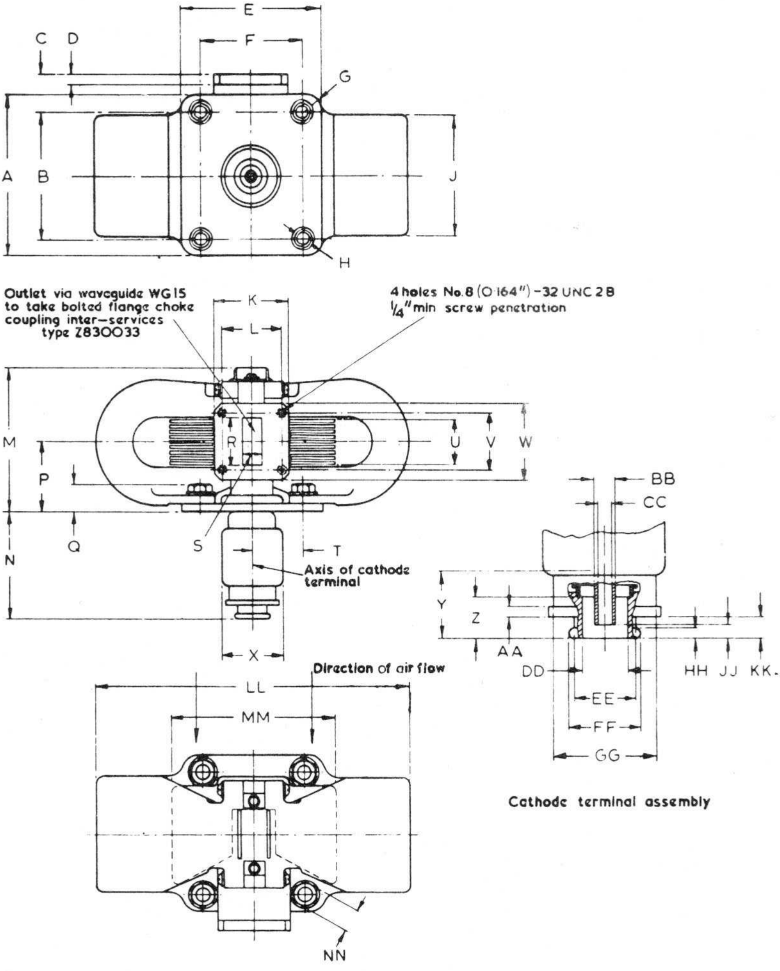
Weight of magnetron	10	lb
	4.5	kg
Weight of magnetron in carton	13	lb
	6.0	kg
Dimensions of storage carton	7.0 × 9.6 × 11.2	in
	178 × 244 × 284.5	mm

DIMENSIONS

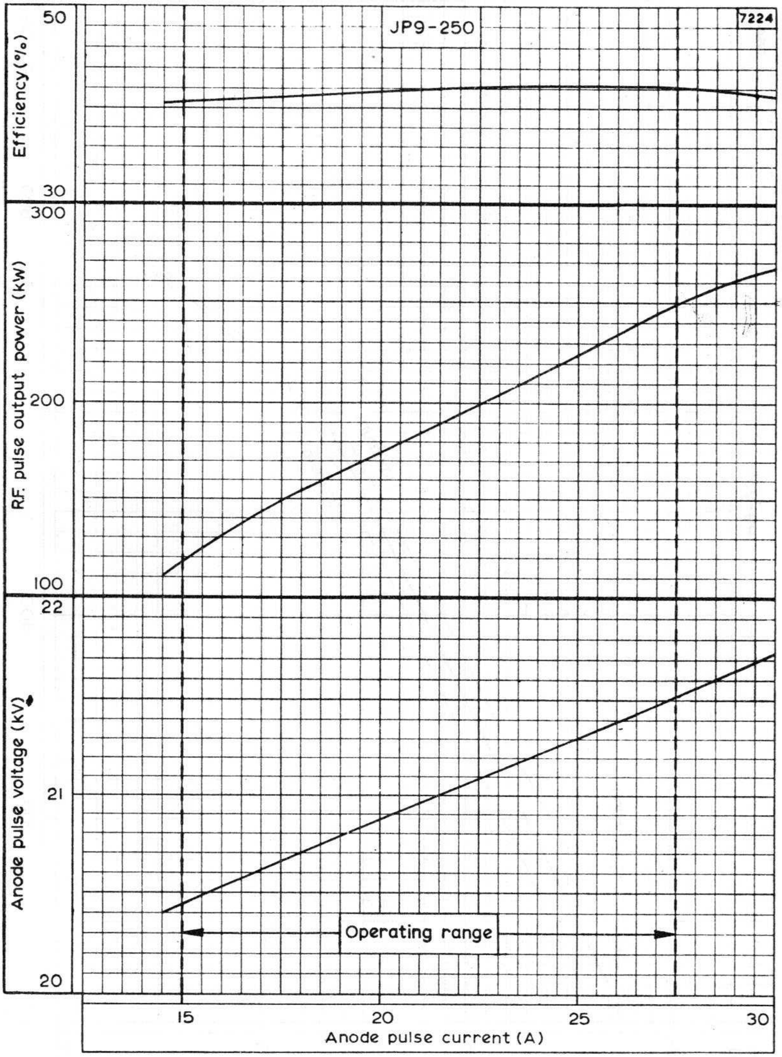
	Inches	*Millimetres*	
A	3.874	98.4	max.
B	3.000 ± 0.01	76.20 ± 0.25	
C	0.906 ± 0.02	23.0 ± 0.5	
D	0.250	6.35	
E	3.469	88.1	max.
F	2.500 ± 0.01	63.50 ± 0.25	
G	0.512	10.3R	
H	0.281	7.14	
J	2.874	73	max.
K	1.830	46.48	
L	1.474 ± 0.004	37.44 ± 0.10	
M	3.603	91.52	max.
N	2.680 ± 0.06	68.25 ± 1.50	
P	1.653 ± 0.02	41.99 ± 0.50	
Q	0.625 ± 0.03	15.88 ± 0.80	
R	1.122	28.50	
S	0.497	12.62	
T	1.250	31.75	
U	1.000 ± 0.04	25.4 ± 1.0	
V	1.352 ± 0.004	34.34 ± 0.10	

	Inches	*Millimetres*	
W	1.830 ± 0.01	46.48 ± 0.25	
X	1.500	38.1	max.
Y	0.750	19.05	min.
Z	0.516	13.1	min.
AA	0.115	3.175	
BB	0.250 ± 0.02	6.35 ± 0.40	
CC	0.169 ± 0.004	4.3 ± 0.1	
DD	$0.539^{+0.004}_{-0.008}$	$13.7^{+0.1}_{-0.2}$	
EE	0.750	19.05	
FF	$0.830^{+0.008}_{-0.004}$	$21.08^{+0.20}_{-0.10}$	
GG	1.252	31.8	
HH	0.125 ± 0.01	3.175 ± 0.250	
JJ	0.125	3.175	min.
	0.187	4.75	max.
KK	0.250	6.35	
LL	7.687	195.25	max.
MM	4.000	101.6	
NN	0.500	12.7	

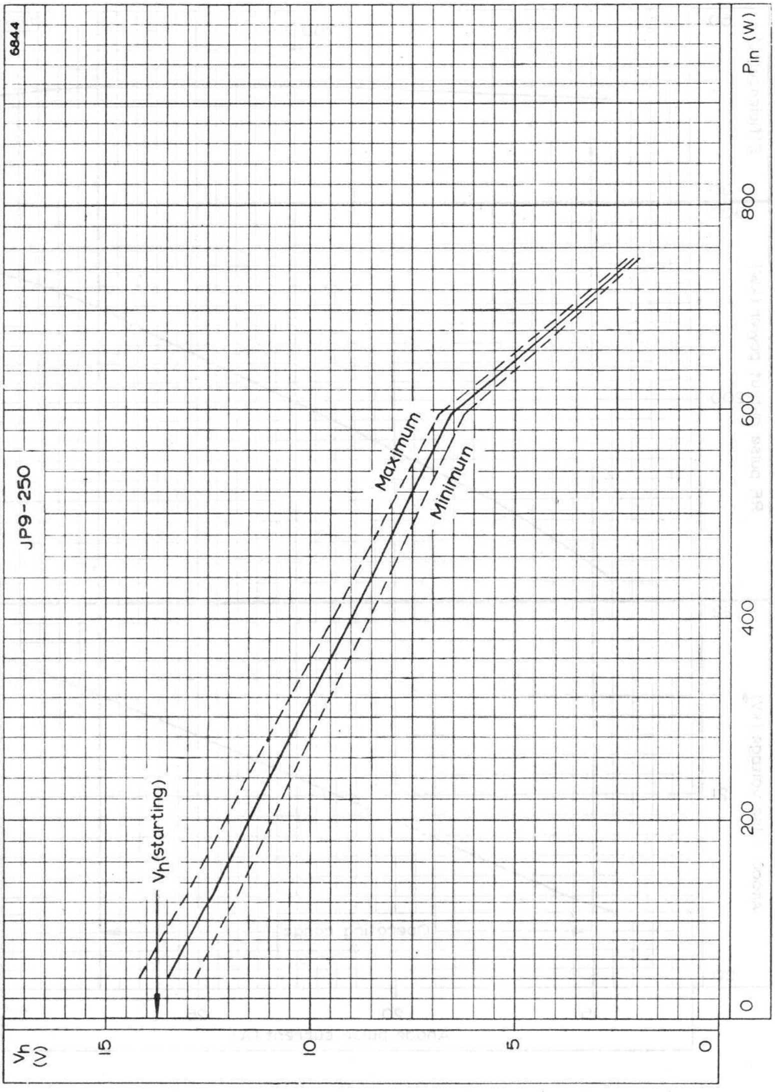
Mullard



The common heater cathode terminal is the sleeve of the cap, the other heater terminal is the centre contact. The anode connection is terminated at the base plate.



ANODE PULSE VOLTAGE R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER

MAGNETRON

JP35-30

QUICK REFERENCE DATA		
Air-cooled magnetron designed for very short pulse operation		
Frequency	34.86	Gc/s
Power output (pulsed)	40	kW
Construction	Packaged	

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES : INTRODUCTION and RADAR AND COMMUNICATIONS MAGNETRONS which precede this section of the handbook.

TYPICAL OPERATION

Heater voltage (running)	4.0	4.0	5.0	V
Pulse duration	0.3	0.1	0.02	μs
Pulse repetition frequency	670	2000	5000	p/s
Duty cycle	0.0002	0.0002	0.0001	
Pulse current	12.5	12.5	7.5	A
Pulse voltage	11.7	11.7	11.1	kV
Pulse input power	146	146	83	kW
R.F. pulse output power	40	40	30	kW
*Mean input current	2.5	2.5	1.55	mA
Mean input power	35	35	20	W
Mean r.f. output power	8.0	8.0	3.0	W
Frequency pulling factor (v.s.w.r. = 1.5)	35	35	35	Mc/s
Rate of rise of pulse voltage	250	250	600	kV/μs

*Includes pre-oscillation current.

ABSOLUTE MAXIMUM RATINGS

	Min.	*Max.*	
Pulse current	6.0	16	A
Pulse voltage	12.5	15.5	kV
Pulse duration	—	0.4	μs
Duty cycle	—	0.0003	
Mean input power	—	60	W
*Rate of rise of voltage pulse (hard valve modulator)			
pulse duration > 0.05μs	200	300	kV/μs
pulse duration = 0.02μs (at duty cycle = 1.0×10^{-4})	—	600	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	150	°C
Temperature of cathode and heater seals	—	150	°C
Pressurisation of waveguide output system	—	45	lb/in²
	—	2280	torr
Pressurisation of input system	8.7	—	lb/in²
	450	—	torr

*For pulse lengths between 0.05μs and 0.02μs rates of rise between 300kV/μs and 600kV/μs can be tolerated, depending on the operating conditions. Prior reference should be made to Mullard Ltd. in such instances.

JP35-30

MAGNETRON

CATHODE

Indirectly heated, dispenser type

V_h	5.0	V
I_h (at 5.0V)	3.9	A
$I_{h\ (surge)}$ max.	8.0	A
r_h (cold)	0.16	Ω

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 3 minutes before the application of h.t.
For mean input powers greater than 20 watts, it is necessary to reduce the heater voltage immediately after the application of h.t.

In many applications involving short pulse lengths and high pulse repetition frequencies the mean current which would be calculated from the duty cycle is increased by the pre-oscillation current.

In determining the heater reduction is it necessary to obtain the mean input power from the measured mean input current ×12,500. The correct value of nominal heater voltage is given by the curve on page C2.

CHARACTERISTICS

	Min.	*Max.*	
Frequency			
Fixed within the band	34.51	35.21	Gc/s
Pulse voltage (I pulse = 12.5A)	11.5	13.5	kV
R.F. pulse output power (I pulse = 12.5A)	30	—	kW
Frequency pulling factor (v.s.w.r. = 1.5)	—	50	Mc/s
Frequency pushing factor	—	4.0	Mc/s per A
Frequency temperature coefficient	—	−1.0	Mc/s per °C
Position of phase of sink from face of mounting plate out of valve	0.25	0.4	λg
Input capacitance	6.0		pF

COOLING

For normal operating conditions, a low velocity air-flow is sufficient to keep within the maximum temperature limits.

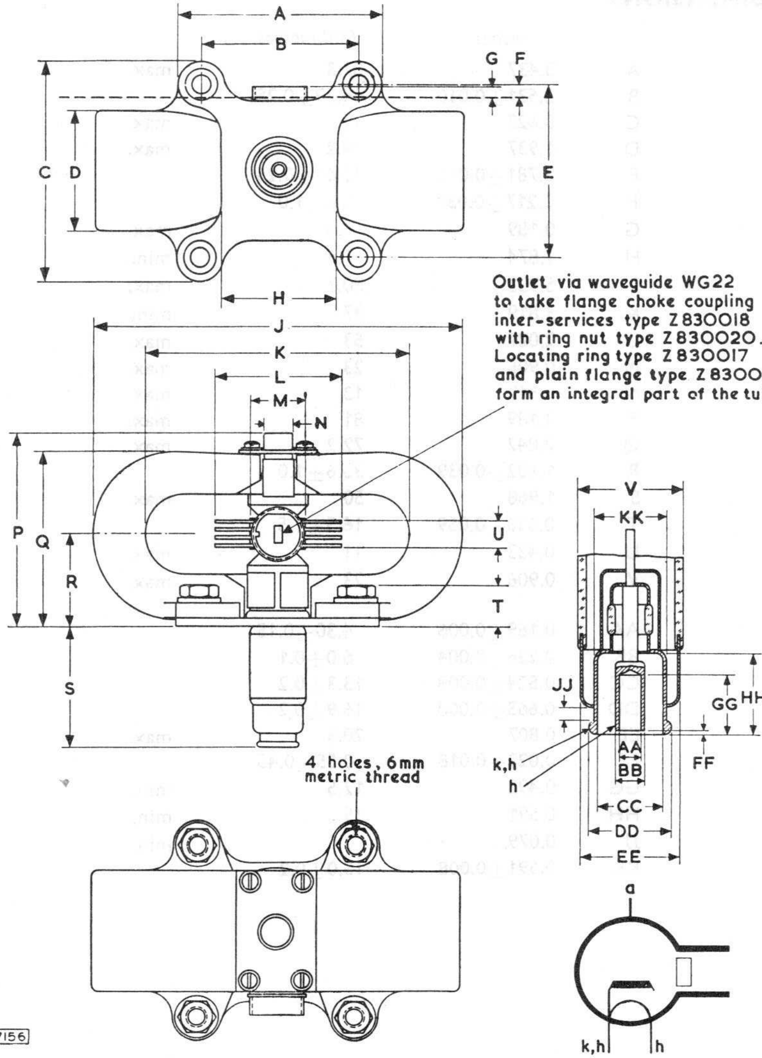
MOUNTING POSITION — Any

PHYSICAL DATA

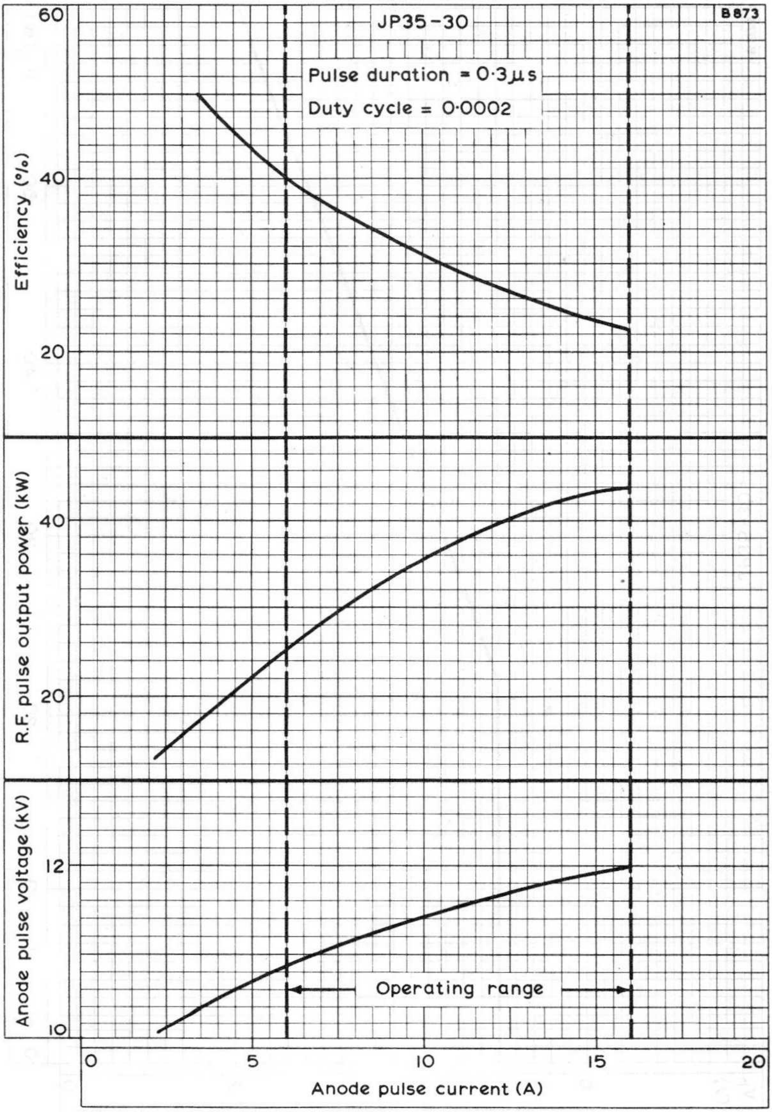
Weight of magnetron	4lb	3oz
	1.9	kg
Weight of magnetron in carton	12lb	13oz
	5.8	kg
Dimensions of storage carton	7.0×9.6×11.2	in
	178×244×284.5	mm

DIMENSIONS

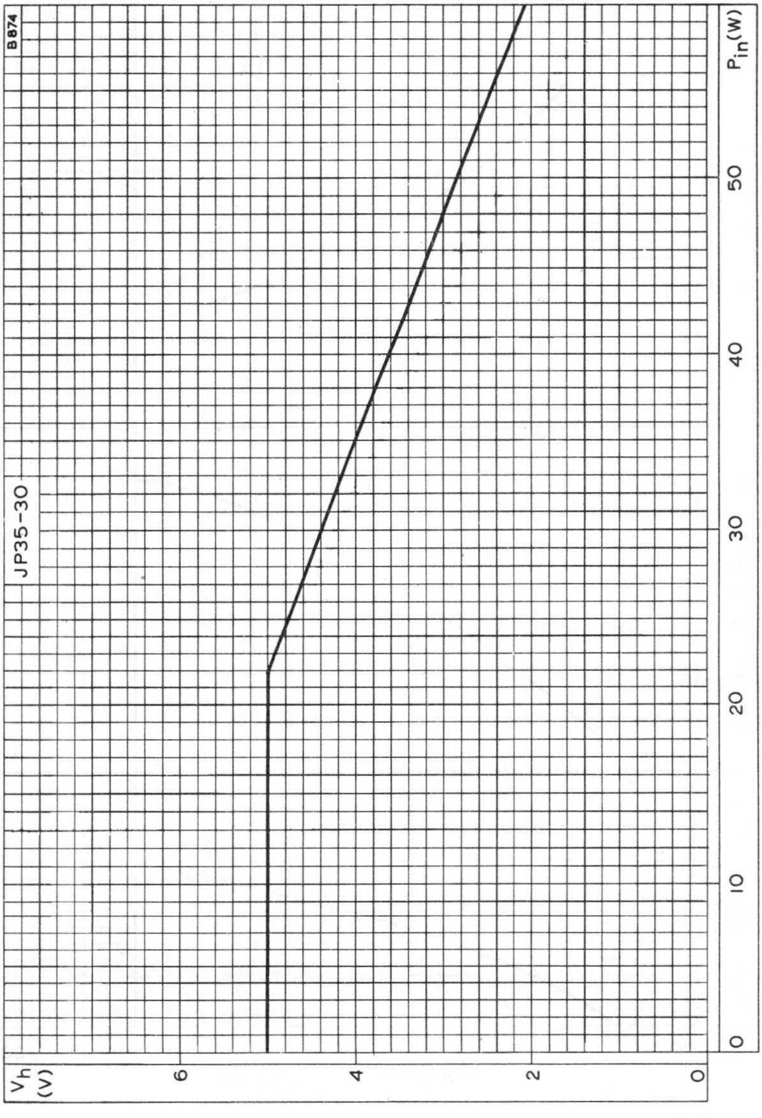
	Inches	Millimetres	
A	3.437	87.3	max.
B	2.531 ± 0.010	64.29 ± 0.25	
C	3.622	92	max.
D	1.937	49.2	max.
E	2.781 ± 0.010	70.64 ± 0.25	
F	0.217 ± 0.039	5.5 ± 1.0	
G	0.189	4.8	max.
H	1.874	47.6	min.
J	5.933	150.7	max.
K	3.819	97	min.
L	2.087	53	max.
M	0.906	23	max.
N	0.512	13	max.
P	3.189	81	max.
Q	2.842	72.2	max.
R	1.402 ± 0.039	35.6 ± 1.0	
S	1.968	50	max.
T	0.650 ± 0.059	16.5 ± 1.5	
U	0.433	11	max.
V	0.906	23	max.
AA	0.169 ± 0.006	4.30 ± 0.15	
BB	0.236 ± 0.004	6.0 ± 0.1	
CC	0.524 ± 0.008	13.3 ± 0.2	
DD	0.665 ± 0.008	16.9 ± 0.2	
EE	0.807	20.5	max.
FF	0.022 ± 0.018	0.55 ± 0.45	
GG	0.492	12.5	min.
HH	0.591	15	min.
JJ	0.079	2.0	min.
KK	0.591 ± 0.008	15.0 ± 0.2	


A
B
G F
C D
E
H
Outlet via waveguide WG22
to take flange choke coupling
inter-services type Z830018
with ring nut type Z830020.
Locating ring type Z830017
and plain flange type Z830019
form an integral part of the tube
J
K
L
M
N
P Q
R
U
T
S
V
KK
JJ
GG HH
AA
BB
FF
k,h
h
CC
DD
EE
4 holes, 6mm
metric thread
a
k,h
h

7156



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER
MEAN INPUT POWER = MEAN INPUT CURRENT × 12,500

TUNABLE MAGNETRON

JPG9-01
JPT9-01

Frequency: *'X' band, mechanically tunable.*
Power output: *10W, c.w.*
Construction: *Packaged, forced-air cooled.*

The only difference between the JPG9–01 and the JPT9–01 is in the mechanical tuning arrangement (see appropriate outline drawing)

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.		Max.	
Frequency				
Tunable over the range	9.15	to	9.6	Gc/s
Operating voltage (I = 50mA)	0.9	to	1.1	kV
R.F. power output (I = 50mA)	5.0		—	W
Frequency pulling factor (v.s.w.r. = 1.5)	—		20	Mc/s
Frequency pushing factor	—		1.0	Mc/s per mA
Frequency temperature coefficient	—		–0.5	Mc/s per °C

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.2	A

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes. For mean input powers greater than 20 watts it is necessary to reduce the heater voltage immediately after application of h.t. in accordance with the input power-heater voltage rating chart on page C3.

TYPICAL OPERATION

Frequency	9.2	9.4	9.55	Gc/s
Heater voltage (running)	4.5	4.5	4.5	V
Operating voltage	920	930	930	V
Operating current	50	50	50	mA
Input power	46	46	46	W
R.F. power output	10.5	10.5	9.8	W
Frequency pulling (v.s.w.r. = 1.5)	19	16	14	Mc/s

OPERATING NOTE

A limiting resistor of 1kΩ should be inserted in series with the magnetron.

COOLING

It is necessary to direct a flow of cooling air of at least 5 cu. ft. per minute between the radiator fins in order to keep the temperature below the permitted maximum.

JPG9-01
JPT9-01

TUNABLE MAGNETRON

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Operating current (unmodulated c.w.)	20	60	mA
Peak operating current (modulated c.w.)	—	100	mA
Operating voltage (modulated c.w.)	0.85	1.15	kV
Mean input power	—	60	W
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	140	°C

MECHANICAL CHARACTERISTICS

	Min.	Max.	
Number of turns to cover the tuning range	4	8	
Tuning torque			
JPG9–01	—	16	oz in
JPT9–01	—	32	oz in
Tuning backlash	—	5	Mc/s

There is no limit to the number of tuning sweeps which may be carried out within the stated frequency range.

The JPG9–01 is intended for motor tuning.

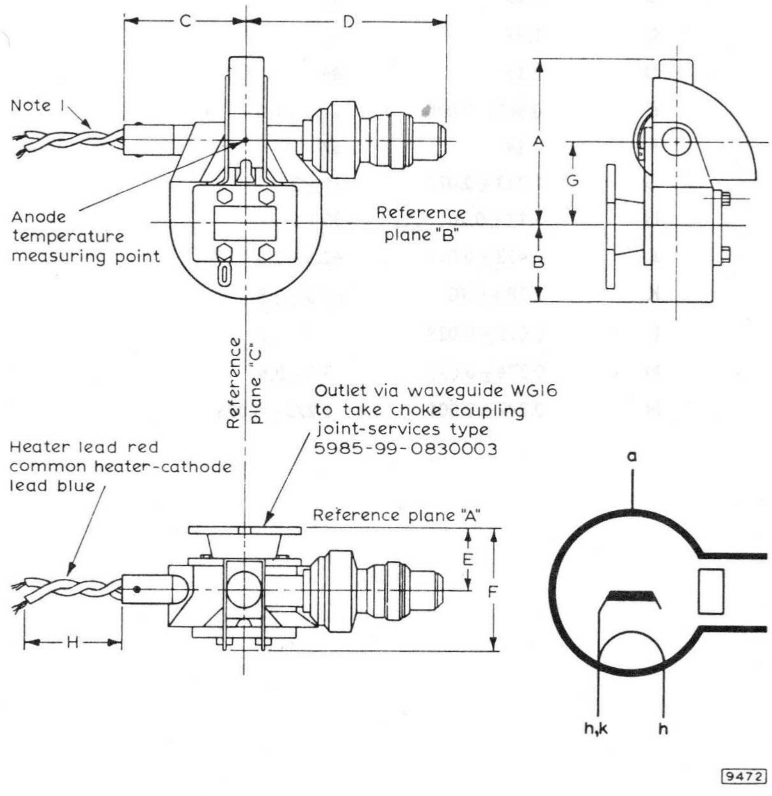
PHYSICAL DATA

Weight of magnetron	1 lb 8 oz 680 g	
Weight of magnetron in carton	2 lb 8 oz 1.13 kg	
Dimensions of storage carton	$5.0 \times 7.0 \times 7.5$ in $127 \times 178 \times 190$ mm	

DIMENSIONS OF JPT9–01

	Inches	Millimetres	
A	2.56	65	max.
B	1.26	32	max.
C	1.97	50	max.
D	2.39	86	max.
E	0.965 ± 0.040	24.5 ± 1.0	
F	2.24	57	max.
G	1.223 ± 0.075	31 ± 2	
H	5.12 ± 0.20	130 ± 5	

OUTLINE DRAWING OF JPT9–01

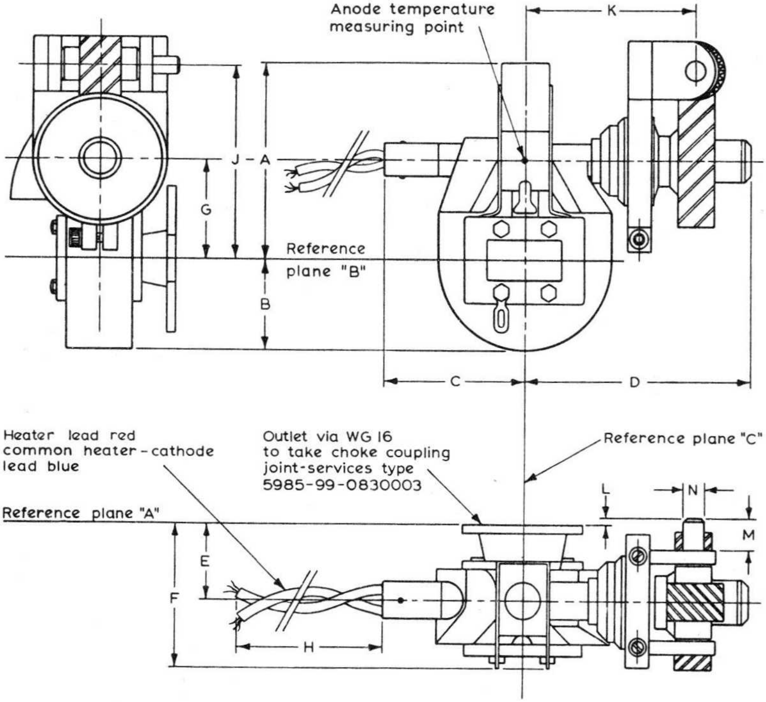


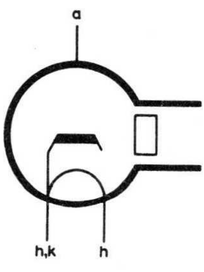
ANODE CONNECTION TERMINATED AT THE BASE PLATE

DIMENSIONS OF JPG9–01

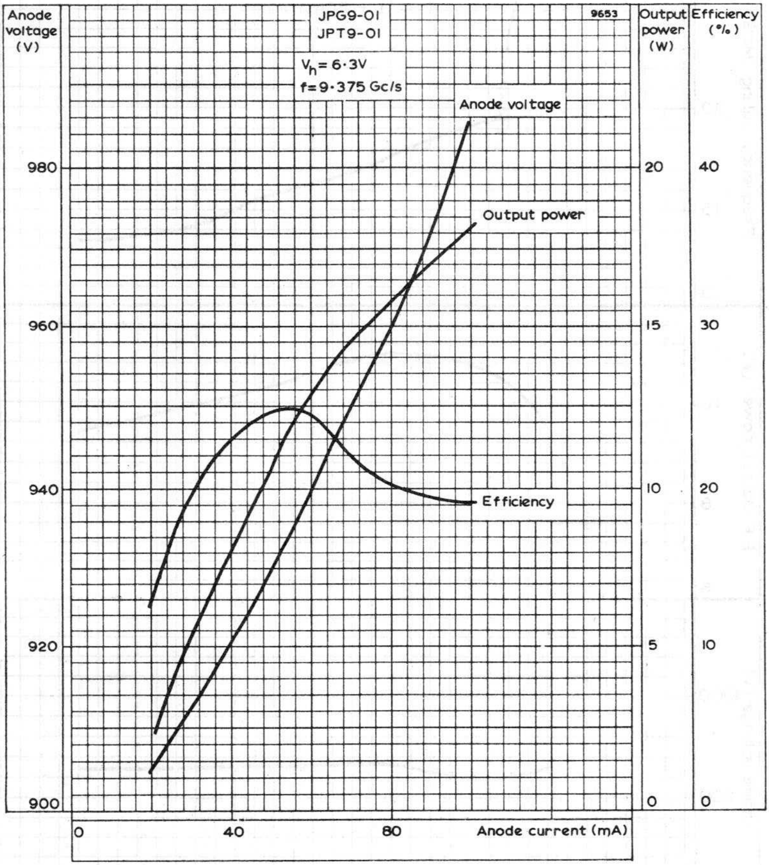
	Inches	*Millimetres*
A	2.56	65
B	1.26	32
C	1.97	50
D	2.39	86
E	0.965 ± 0.040	24.5 ± 1.0
F	2.24	57
G	1.223 ± 0.075	31 ± 2
H	5.12 ± 0.20	130 ± 5
J	2.463 ± 0.071	62.5 ± 2.0
K	2.38 ± 0.10	60.5 ± 2.5
L	0.098 ± 0.039	2.5 ± 1.0
M	0.374 ± 0.020	9.5 ± 0.5
N	0.247 ± 0.001	6.275 ± 0.025

OUTLINE DRAWING OF JPG9–01





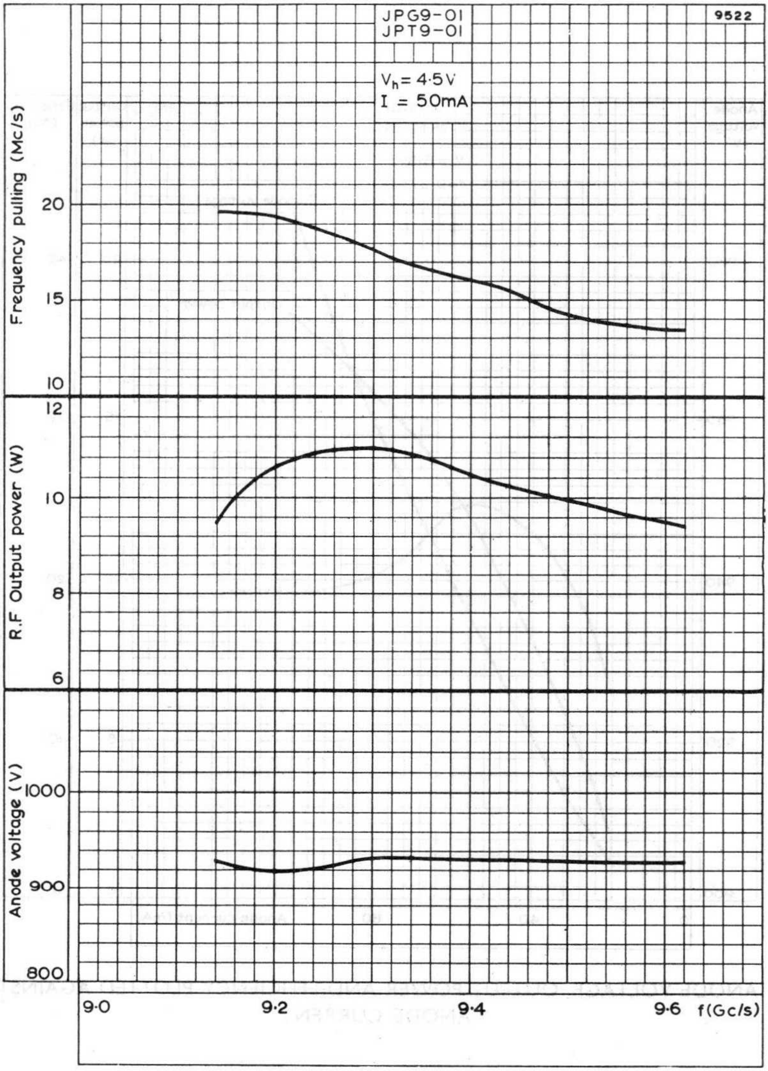
ANODE CONNECTION TERMINATED AT THE BASE PLATE



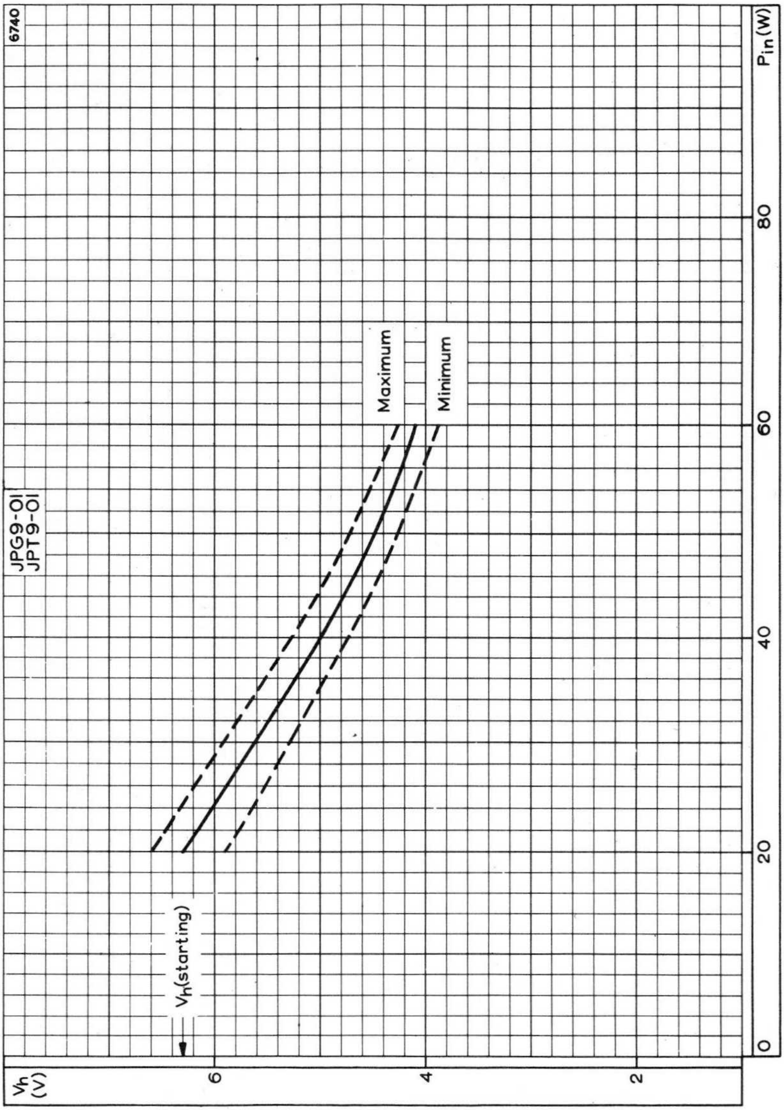
ANODE VOLTAGE, OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE CURRENT

JPG9-01
JPT9-01

TUNABLE MAGNETRON



ANODE VOLTAGE, R.F. OUTPUT POWER AND FREQUENCY PULLING PLOTTED AGAINST FREQUENCY



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER

TUNABLE MAGNETRON

JPG9-02
JPT9-02

Frequency: 'X' band, mechanically tunable.
Power output: 25W, pulsed.
Construction: Packaged.

The only difference between the JPG9-02 and the JPT9-02 is in the mechanical tuning arrangement (see appropriate outline drawing)

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.		*Max.*	
Frequency				
Tunable over the range	9.15	to	9.6	Gc/s
Pulse voltage (I_{pulse} = 120mA)	0.95		1.15	kV
R.F. pulse power output (I_{pulse} = 120mA)	18		—	W
Frequency pulling factor (v.s.w.r. = 1.5)	—		20	Mc/s
Frequency pushing factor (I_{pulse} = 140mA)	—		0.2	Mc/s per mA
Frequency temperature coefficient	—		–0.5	Mc/s per °C
Input capacitance	—		12	pF

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.2	A

Heating time At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

TYPICAL OPERATION

Frequency	9.2	9.4	9.55	Gc/s
Heater voltage (running)	6.3	6.3	6.3	V
Pulse duration	0.5	0.5	0.5	μs
Pulse repetition frequency	1000	1000	1000	p/s
Duty cycle	0.0005	0.0005	0.0005	
Pulse current	120	120	120	mA
Pulse voltage	0.97	1.0	1.0	kV
Pulse input power	120	120	120	W
R.F. pulse output power	22	25	24	W
Mean input current	60	60	60	μA
Mean input power	60	60	60	mW
Mean r.f. output power	11	12.5	12	mW
Frequency pulling (v.s.w.r. = 1.5)	19	16	14	Mc/s
Rate of rise of pulse voltage	5.0	5.0	5.0	kV/μs

JPG9-02
JPT9-02

TUNABLE MAGNETRON

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	50	150	mA
Pulse voltage	0.9	1.15	kV
Pulse duration	—	5.0	μs
Duty cycle	—	0.05	
Mean input power	—	6.0	W
Rate of rise of voltage pulse	—	6.0	kV/μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	—	140	°C

MECHANICAL CHARACTERISTICS

		Min.	Max.	
Number of turns to cover the tuning range		4	8	
Tuning torque	JPG9–02	—	16	oz in
	JPT9–02	—	32	oz in
Tuning backlash		—	5.0	Mc/s

There is no limit to the number of tuning sweeps which may be carried out within the stated frequency range .

The JPG9–02 is intended for motor tuning.

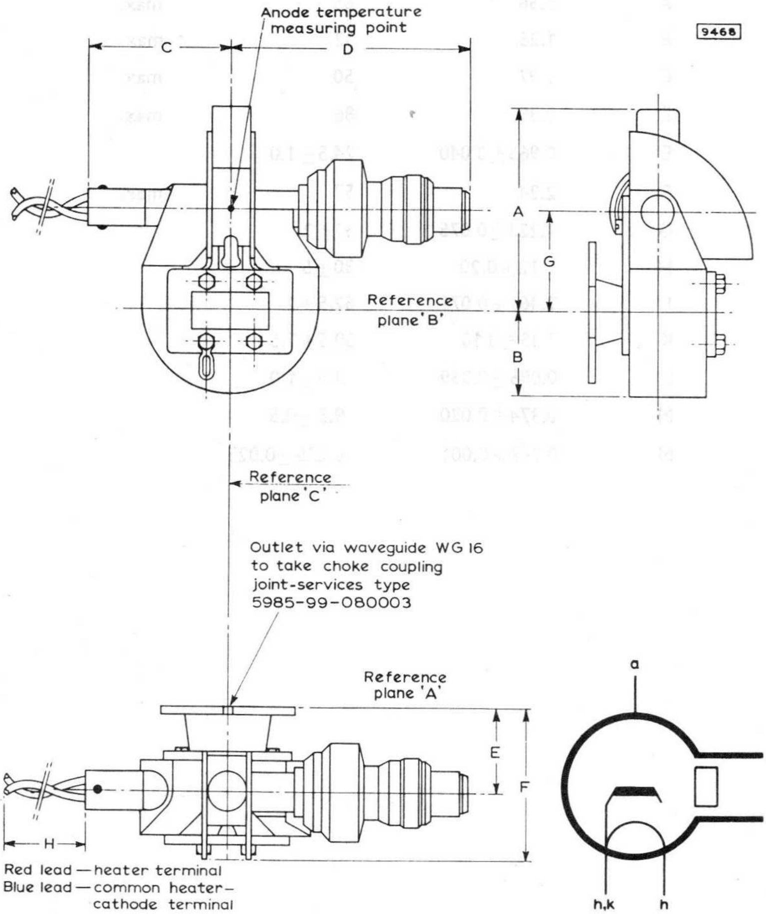
PHYSICAL DATA

Weight of magnetron	1 lb 8 oz	680 g
Weight of magnetron in carton	2 lb 8 oz	1.13 kg
Dimensions of storage carton	5.0 × 7.0 × 7.5 in	127 × 178 × 190 mm

DIMENSIONS OF JPT9–02

	Inches	Millimetres	
A	2.56	65	max.
B	1.26	32	max.
C	1.97	50	max.
D	2.39	86	max.
E	0.965 ± 0.040	24.5 ± 1.0	
F	2.24	57	max.
G	1.223 ± 0.075	31 ± 2	
H	5.12 ± 0.20	130 ± 5	

OUTLINE DRAWING OF JPT9–02

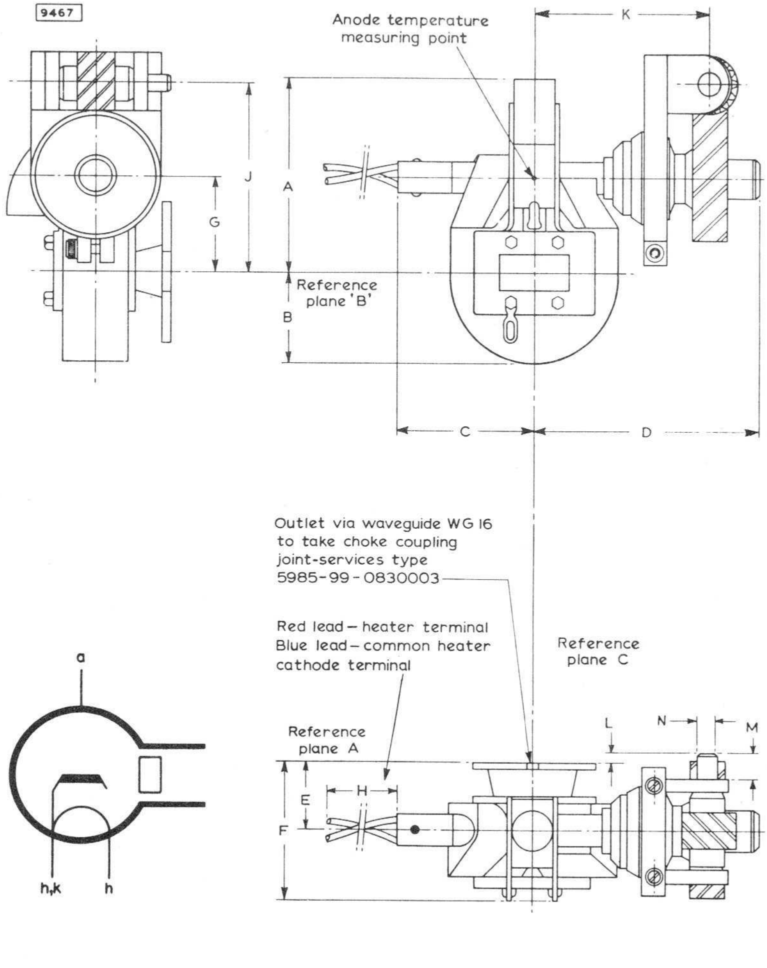


ANODE CONNECTION TERMINATED AT THE BASE PLATE

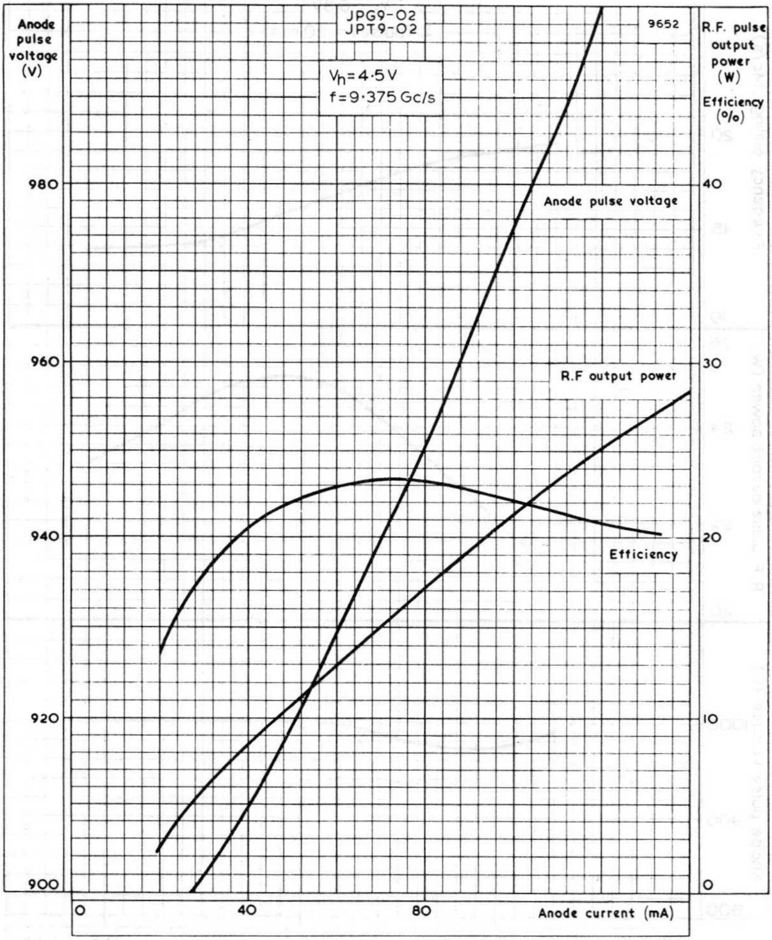
DIMENSIONS OF JPG9–02

	Inches	*Millimetres*	
A	2.56	65	max.
B	1.26	32	max.
C	1.97	50	max.
D	2.39	86	max.
E	0.965 ± 0.040	24.5 ± 1.0	
F	2.24	57	max.
G	1.223 ± 0.075	31 ± 2	
H	5.12 ± 0.20	130 ± 5	
J	2.463 ± 0.071	62.5 ± 2	
K	2.38 ± 0.10	60.5 ± 2.5	
L	0.098 ± 0.039	2.5 ± 1.0	
M	0.374 ± 0.020	9.5 ± 0.5	
N	0.247 ± 0.001	6.275 ± 0.025	

OUTLINE DRAWING OF JPG9–02



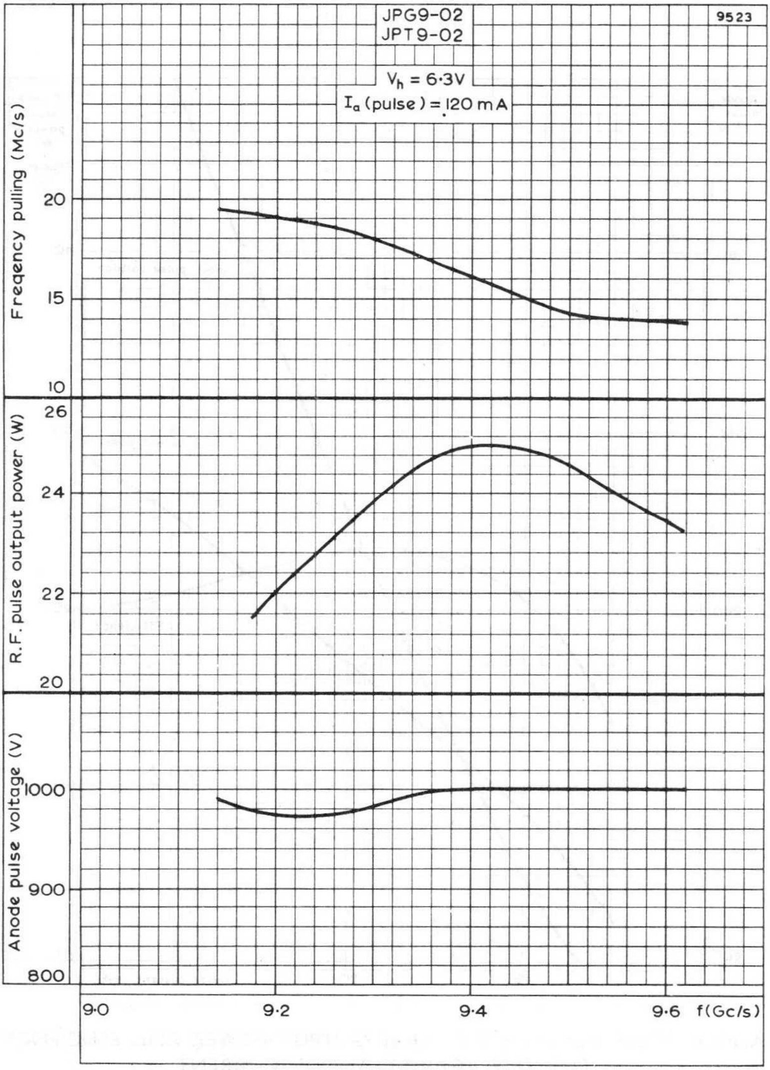
ANODE CONNECTION TERMINATED AT THE BASE PLATE



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE CURRENT

JPG9-02
JPT9-02

TUNABLE MAGNETRON



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND FREQUENCY PULLING PLOTTED AGAINST FREQUENCY

MAGNETRON JPT9-01K

QUICK REFERENCE DATA		
Packaged magnetron with push-rod tuning mechanism for rapid frequency sweeping.		
Frequency	9.32 to 9.5	GHz
Power output (pulsed)	15	W

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. pulse power output	15	W
Duty factor	0.11	
Pulse duration	45	μs
Pulse repetition frequency	2500	p.p.s.
Heater voltage (running)	6.3	V
Pulse current	100	mA
Pulse voltage	1.0	kV
Pulse input power	100	W
Rate of rise of voltage pulse	5.0	kV/μs
Mean r.f. output power	1.65	W
Frequency pulling (v.s.w.r. = 1.5)	16	MHz
Swept over the range	9.32 to 9.50	GHz

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.2	A

Heating time. At ambient temperatures above $0^{o}C$ the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

CHARACTERISTICS

	Min.	Typ.	Max.	
Frequency tunable over the range	9.32	-	9.50	GHz
Pulse voltage (I_{pulse} = 100mA)	0.9	-	1.1	kV
R.F. pulse power output (I_{pulse} = 100mA)	12	-	-	W
Frequency pulling (v.s.w.r. = 1.5)	-	-	20	MHz
Frequency temperature coefficient	-	-	-0.5	MHz per degC
Input capacitance	-	-	12	pF
Frequency pushing (I_{pulse} = 100mA)	-	0.3	-	MHz per A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	60	140	mA
Pulse duration	-	50	μs
Duty factor	-	0.25	
Mean input power	-	60	W
Rate of rise of voltage pulse	-	10	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	120	°C

MECHANICAL CHARACTERISTICS

	Min.	Max.	
Movement of push rod to cover tuning range	0.127	0.254	mm
	0.005	0.01	in

The tuning mechanism is designed for cam operation and may require 6.35kg (14lb) thrust for operation.

There is no limit to the number of tuning sweeps which may be carried out within the stated frequency range,

MOUNTING POSITION

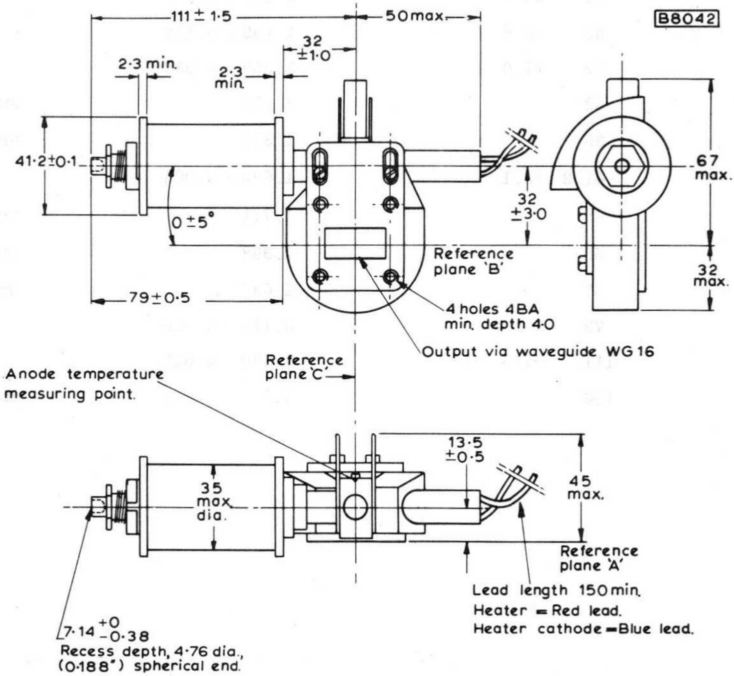
Any

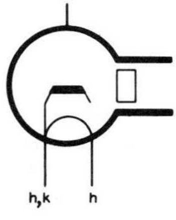
PHYSICAL DATA

	kg	lb
Weight of magnetron	0.74	1.63
Weight of magnetron in carton	1.19	2.63

	mm	in
Dimensions of storage carton	127 × 178 × 190	5.0×7.0×7.5

OUTLINE DRAWING





All dimensions in mm.
Conversion table overleaf.

DIMENSION CONVERSION TABLE

Millimetres		Inches	
2.3		0.090	min
7.14	$^{+0}_{-0.38}$	0.281 $^{+0}_{-0.015}$	
13.5	±0.5	0.531 ± 0.019	
32	±3.0	1.259 ± 0.118	
32	±1.0	1.259 ± 0.039	
32		1.259	max
35		1.377	max
41.2	±0.1	1.622 ± 0.003	
45		1.771	max
50		1.968	max
67		2.637	max
79	± 0.5	3.110 ± 0.019	
111	±1.5	4.370 ± 0.059	
150		5.9	min

MAGNETRON

JPT9-60

Frequency: *'X' band, tunable.*
Power output: *60kW, pulsed.*
Construction: *Packaged, forced-air cooled.*

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES: INTRODUCTION and RADAR AND COMMUNICATION MAGNETRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.		*Max.*	
Frequency: Tunable over the range	8.5	to	9.6	Gc/s
Pulse voltage (I_{pulse} = 14A)	13		15.5	kV
R.F. pulse power output (I_{pulse} = 14A)	50		—	kW
Frequency pulling factor (v.s.w.r. = 1.5)	—		18	Mc/s
Frequency temperature coefficient	—		−0.25	Mc/s per °C
Input capacitance	—		6.0	pF

CATHODE

Indirectly heated

V_h	6.3	V
I_h	1.0	A

Heating time. The cathode must be heated for at least 2 minutes before the application of h.t. The heater voltage must be reduced immediately after the application of h.t. in accordance with the input-power/heater-voltage rating chart on page C4.

TYPICAL OPERATION

Frequency	9.0	9.0	9.0	Gc/s
Heater voltage (running)	4.8	0	0	V
Pulse duration	0.1	1.0	3.4	μs
Pulse repetition frequency	3333	1000	324	p/s
Duty cycle	0.00033	0.001	0.0011	
Pulse current	14	14	14	A
Pulse voltage	13.5	13.5	13.5	kV
Pulse input power	190	190	190	kW
R.F. pulse output power	60	60	60	kW
Mean input current	4.7	14	15.4	mA
Mean input power	63	190	210	W
Mean r.f. output power	20	60	65	W
Frequency pulling (v.s.w.r. = 1.5)	10	10	10	Mc/s

JPT9-60

MAGNETRON

OPERATING NOTES

The valve is provided with four magnetic shunts. (See outline drawings, pages D3 and D4.) From examination of the performance charts the number required for a particular application may be determined. To remove shunts which are not required, grip the tabs firmly with suitable pliers and pull away from the valve.

COOLING

A flow of cooling air must be directed between the radiator fins, and on to cathode and heater seals, in order to keep the temperature below the permitted maximum.

ABSOLUTE MAXIMUM RATINGS

	Min.	*Max.*	
Pulse current	—	15.5	A
Pulse voltage	—	16.0	kV
Pulse duration	—	3.6	μs
Duty cycle	—	0.0012	
Mean input power	—	230	W
Voltage pulse rise time			
$0.1\mu s \leqslant t_p \leqslant 1.0\mu s$	—	0.08	μs
$t_p = 3.6\mu s$	—	0.12	μs
Load mismatch (v.s.w.r.)	—	1.5	
Temperature of anode block	−60	150	°C
Pressurisation of waveguide output system	—	43	lb/in²
		2200	torr
Pressurisation of input system	11	—	lb/in²
	550	—	torr

MOUNTING POSITION

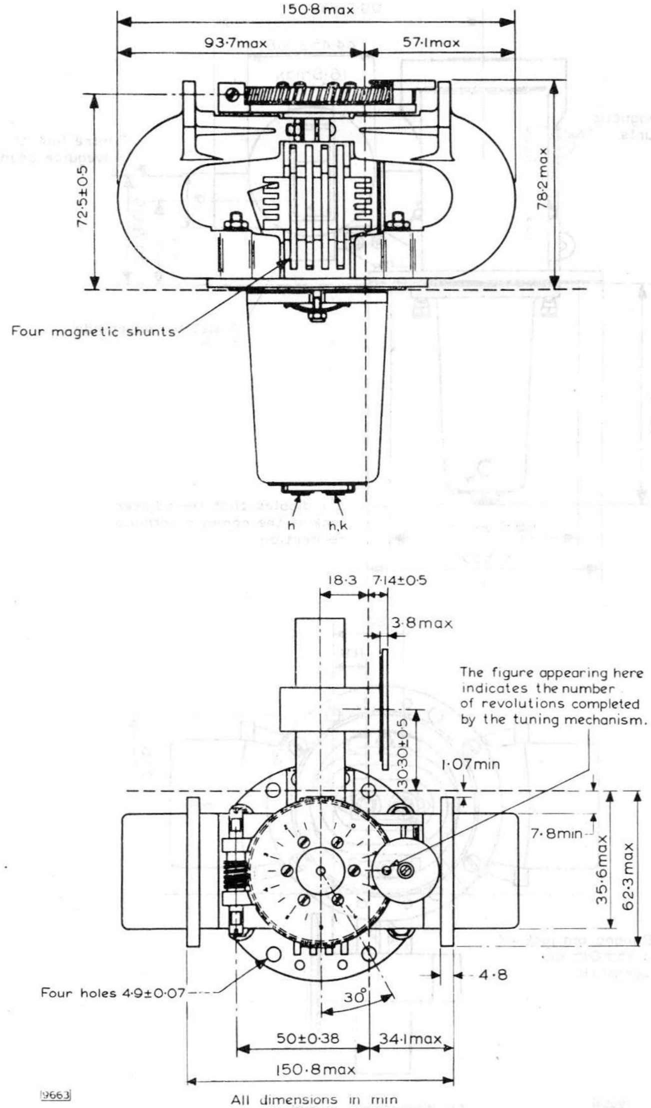
Any

MECHANICAL CHARACTERISTICS

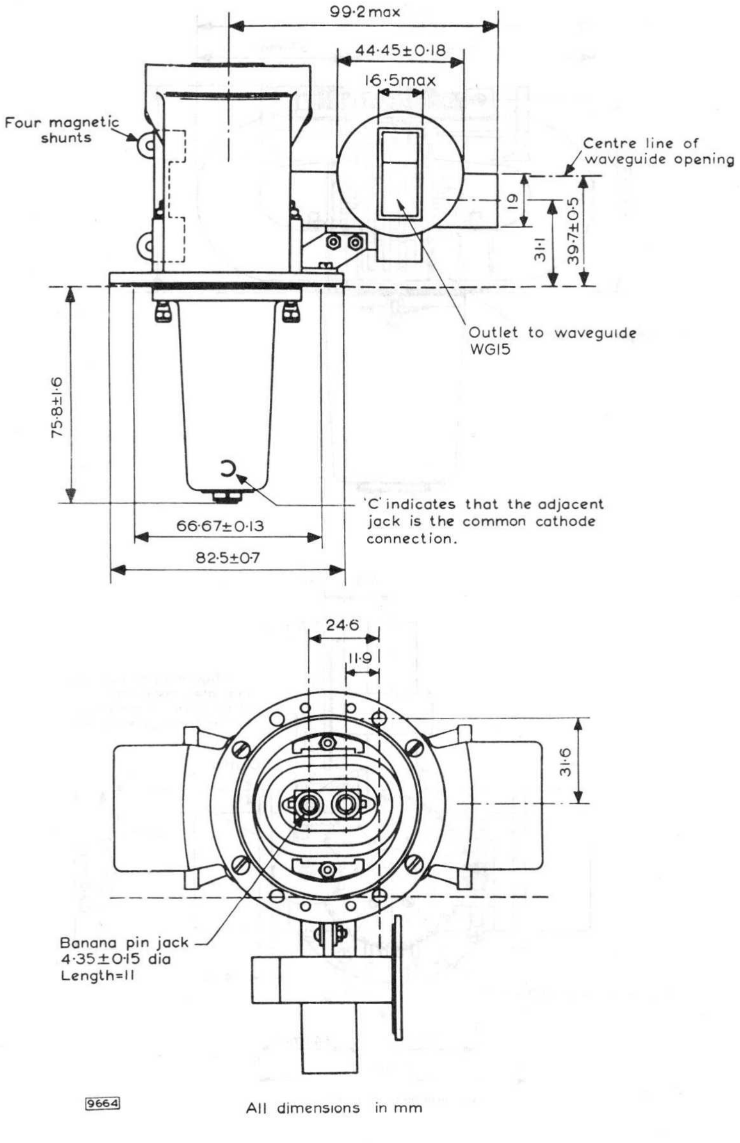
	Min.	*Max.*	
Number of turns of worm shaft to cover the tuning range	—	110	
Tuning torque	10	40	oz/in

PHYSICAL DATA

Weight of magnetron	4.8	lb
	2.2	kg
Weight of magnetron in carton	13.9	lb
	6.3	kg
Dimensions of storage carton	12.5 × 13 × 13	in
	318 × 330 × 330	mm

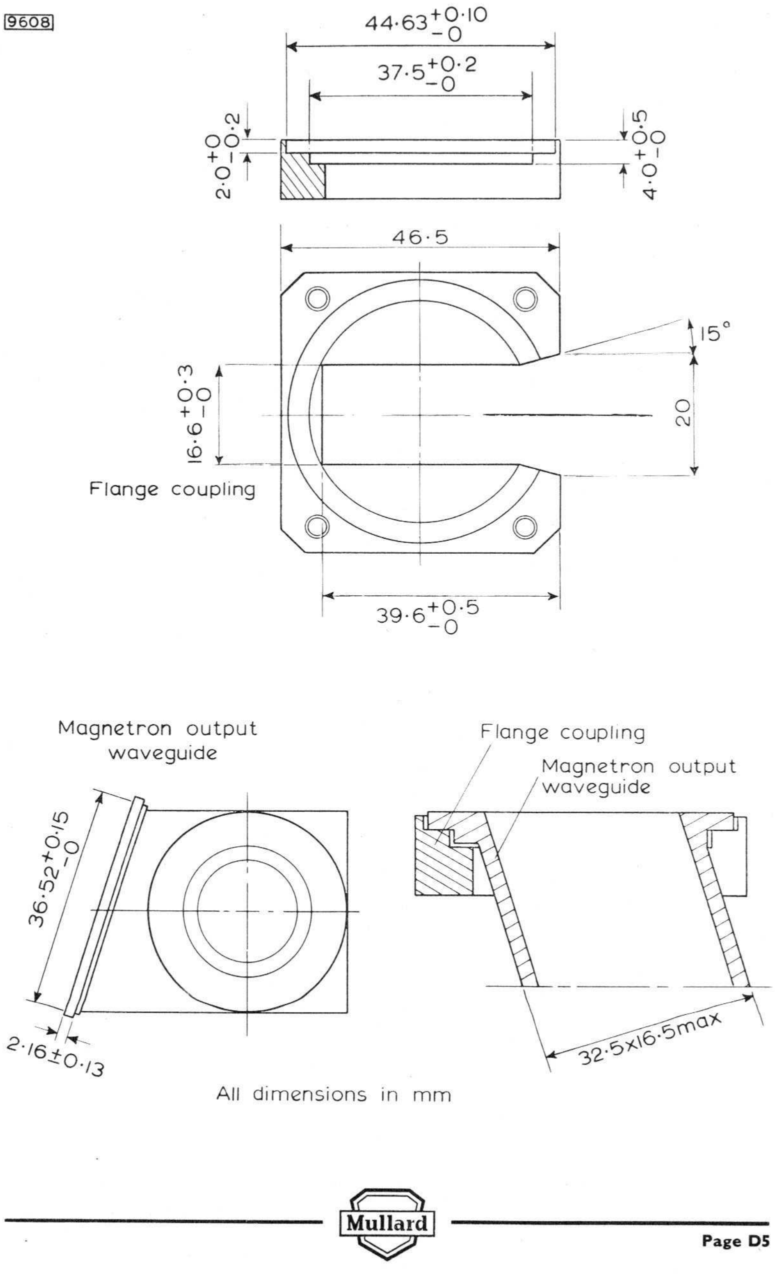


All dimensions in mm

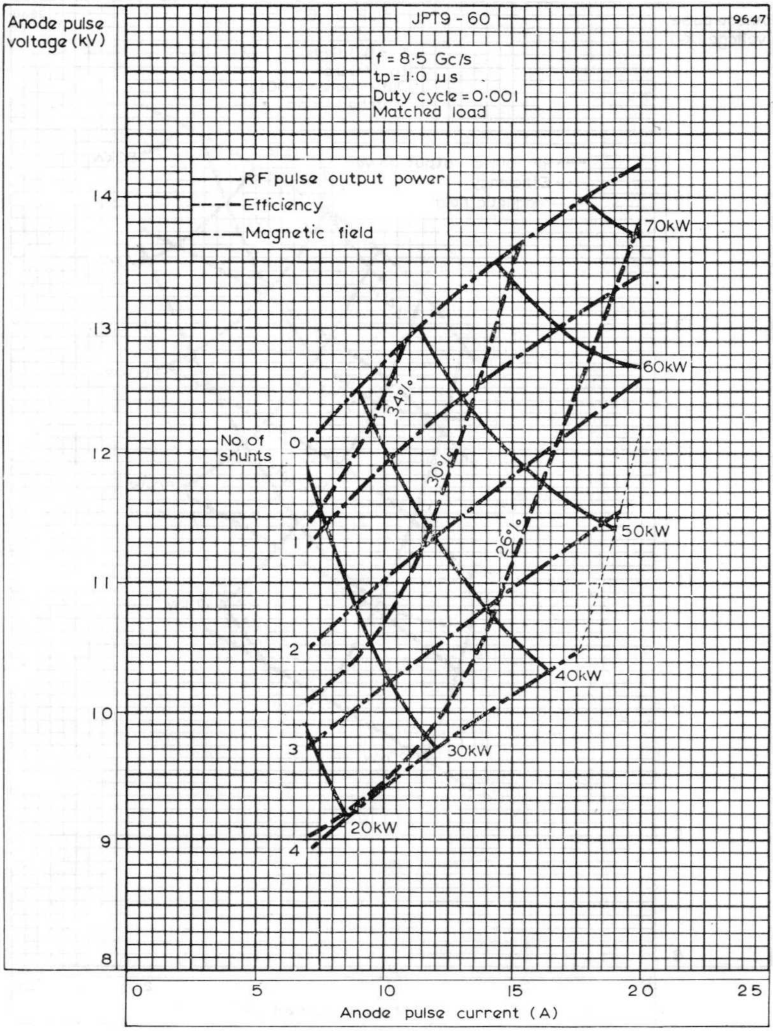


All dimensions in mm

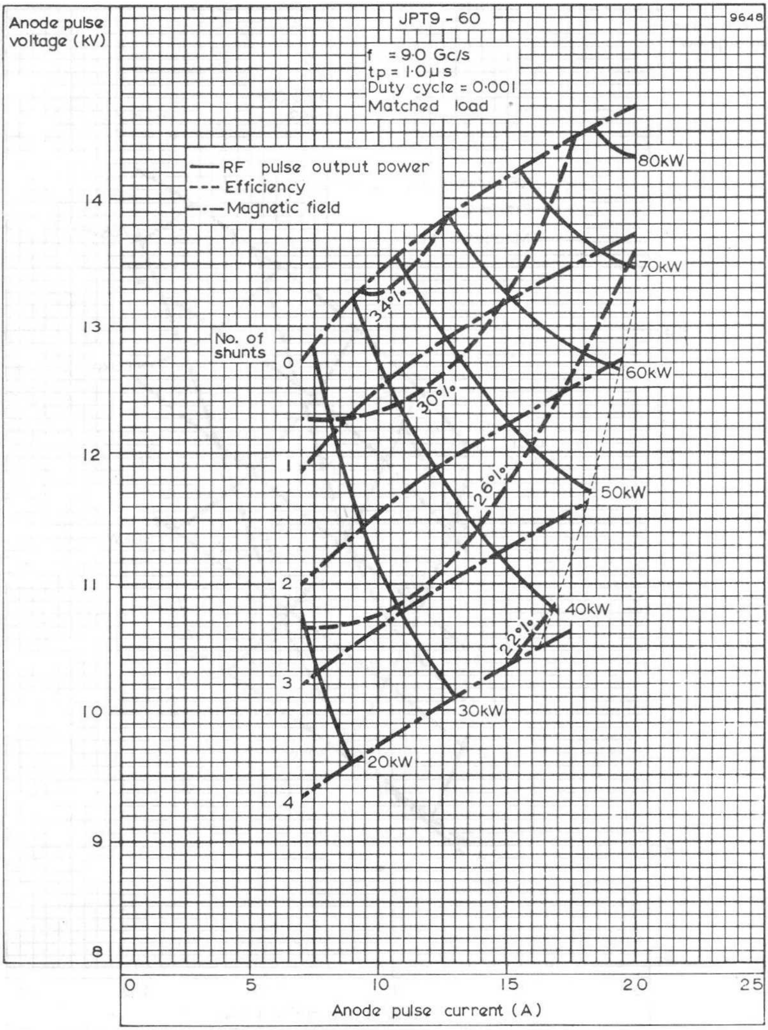
9608



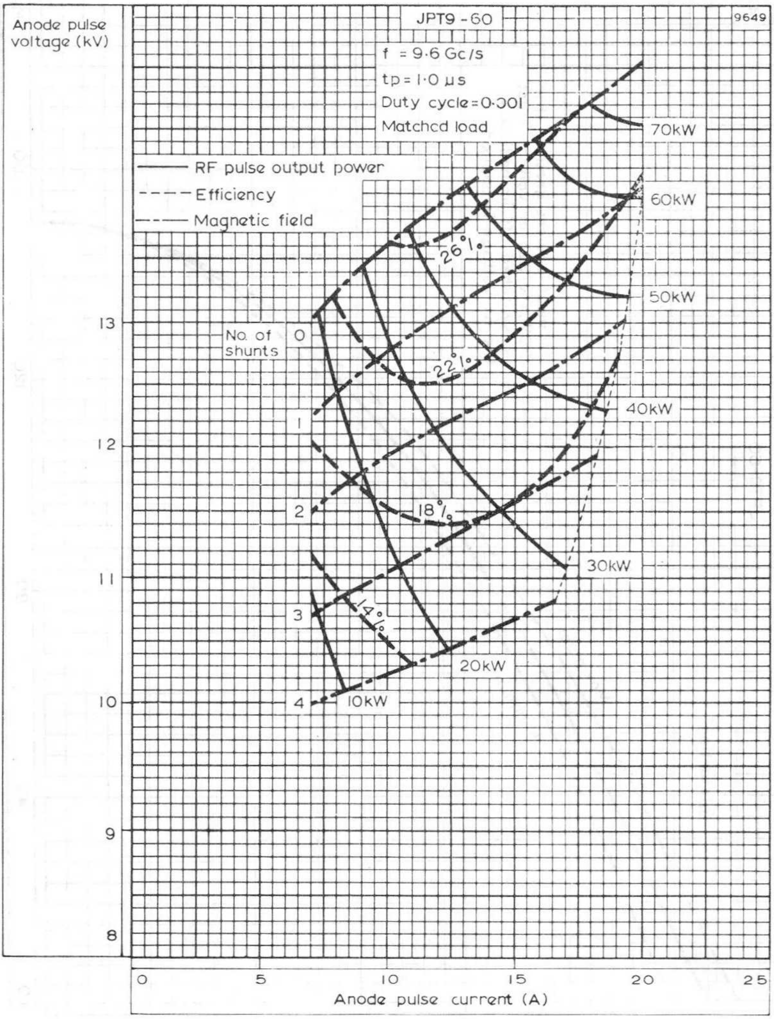
All dimensions in mm



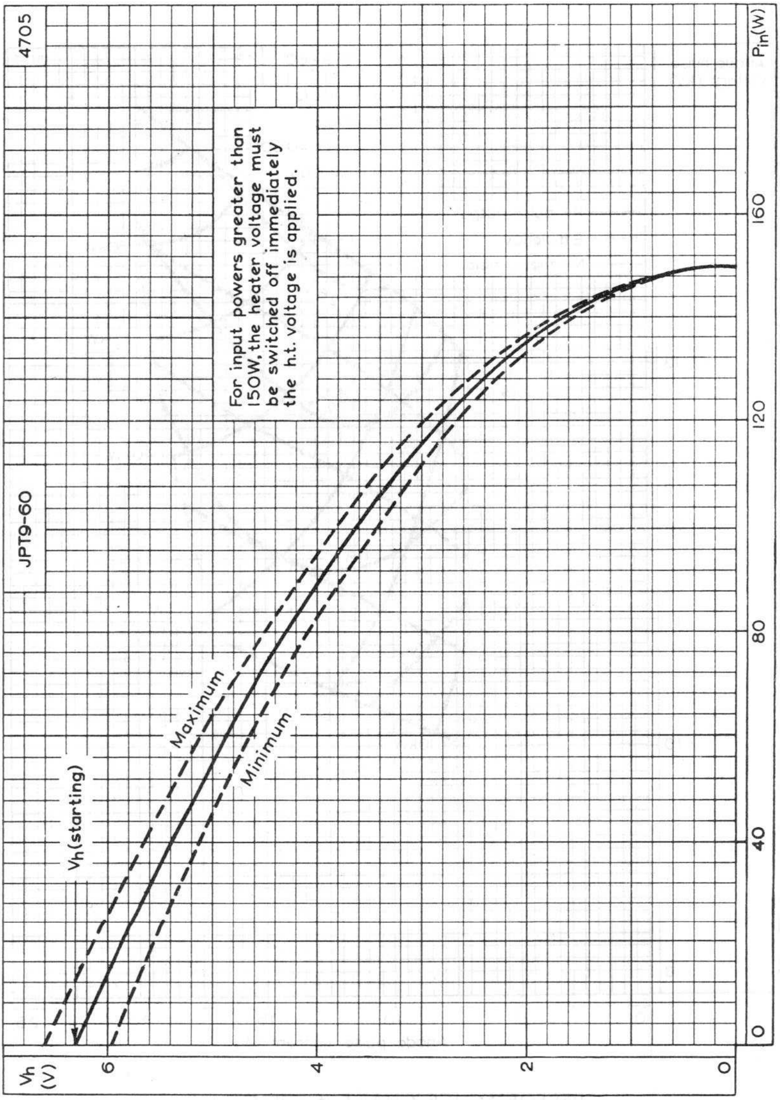
PERFORMANCE CHART (f = 8.5Gc/s)



PERFORMANCE CHART (f = 9.0Gc/s)



PERFORMANCE CHART (f = 9.6Gc/s)



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER

MAGNETRON YJ1010

QUICK REFERENCE DATA	
Servo-tunable 'X' band pulsed magnetron, suitable for use in navigational search and fine control radar systems, in either ground based or airborne installations.	
Frequency	8.5 to 9.6 GHz
Power output (pulsed)	225 kW
Construction	packaged

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. pulse power output	200	200	225	225	kW
Duty factor	0.00026	0.0007	0.001	0.001	
Pulse duration	0.13	0.34	0.6	1.0	μs
Pulse repetition frequency	2000	2080	1670	1000	p.p.s.
Heater voltage (running)	9.7	3.0	0	0	V
Pulse current	24	24	27.5	27.5	A
Pulse voltage	21	21	21.5	21.5	kV
Pulse input power	500	500	590	590	kW
Rate of rise of voltage pulse	200	200	200	200	kV/μs
Mean input current	6.2	16.8	27.5	27.5	mA
Mean input power	130	350	590	590	W
Mean r.f. output power	52	140	225	225	W
Frequency pulling (v.s.w.r.=1.5)	11	11	10	10	MHz

CHARACTERISTICS

	Min.		Max.	
Frequency. Tunable over the range	8.5	to	9.6	GHz
Pulse voltage (I_{pulse} =27.5A)	20		23	kV
R.F. pulse power output (I_{pulse} =27.5A)	200		-	kW
Frequency pulling (v.s.w.r. =1.5)	-		13.5	MHz
Input capacitance	9.0		13	pF

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	15	30	A
Pulse duration	-	2.75	µs
Duty factor	-	0.0011	
Mean input power	-	630	W
Rate of rise of voltage pulse ($t_p \leq 1.5\mu s$)	70	225	kV/µs
($t_p > 1.5\mu s$)	70	200	kV/µs
Load mismatch (v.s.w.r.)	-	1.5	

CATHODE

Indirectly heated

V_h	13.75 ± 10%	V
I_h	3.1 ± 0.2	A
I_h (surge)max.	12	A
r_h (cold)	0.53	Ω
Minimum warm up time	2.5	min

Heating time. At ambient temperatures above $0^{\circ}C$ the cathode must be heated for at least 2.5 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 4 minutes.
For mean input powers greater than 0 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power - heater voltage rating chart on page C1.

MOUNTING POSITION			Any

PRESSURISING

See operating notes

PHYSICAL DATA

Weight of magnetron	5.9kg	13lb

COOLING

Temperatures

Anode block	max.	150	^{o}C
Cathode and heater seals	max.	165	^{o}C

An adequate air flow should be forced through the cooling ducts on the magnetron to keep the anode block temperature below 150^{o}C under any condition of operation. The heater-cathode terminal should also be sufficiently cooled to keep its temperature below 165^{o}C.

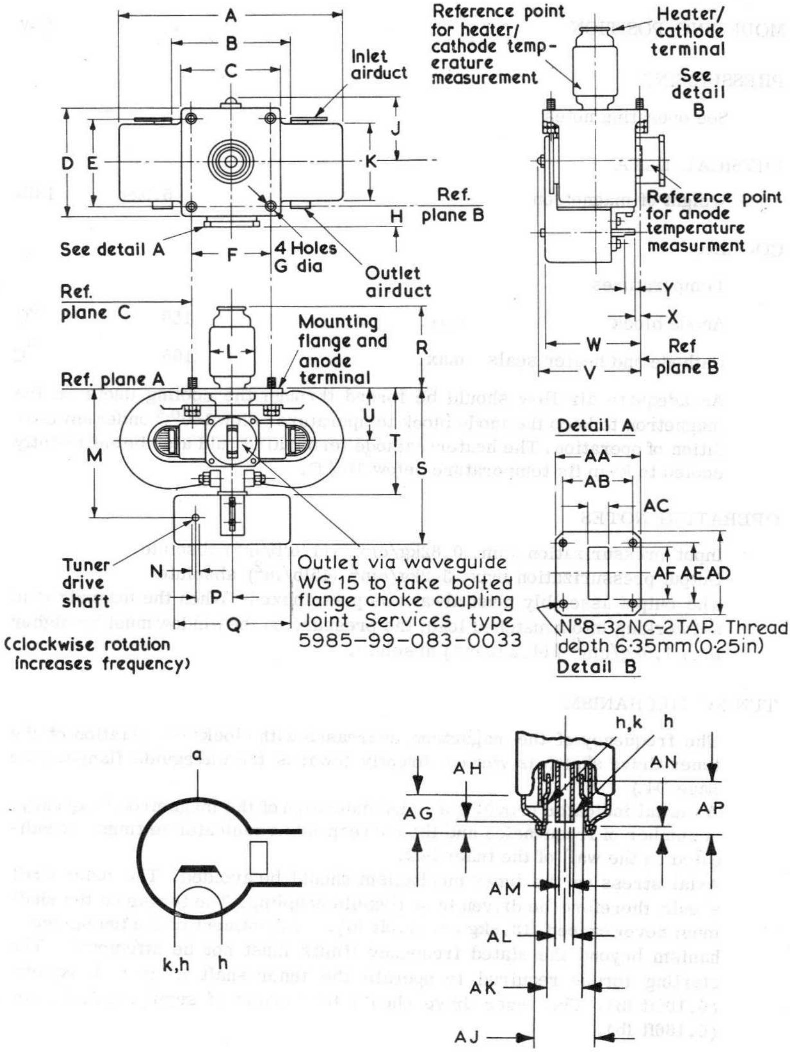
OPERATING NOTES

Input pressurization min. 0.82kg/cm^2 (11.6lb/in^2) absolute.
Output pressurization max. 3.2kg/cm^2 (45lb/in^2) absolute
The output assembly must always be pressurized. When the magnetron is not working into a matched load, the pressure on the window must be higher than 1.0kg/cm^2 (14.2lb/in^2) absolute.

TUNING MECHANISM

The frequency of the magnetron decreases with clockwise rotation of the tuner drive shaft, as viewed directly towards the waveguide flange. (See page D4.)
A digital indicator provides a visual indication of the magnetron frequency. A number of frequencies and the corresponding indicator settings are indicated on the wall of the tuner box.
Axial stress on the tuner mechanism should be avoided. The tuner shaft should therefore be driven by a flexible coupling. The torque on the shaft must never exceed 13.8kg cm (1.0ft lb). Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted. The starting torque required to operate the tuner shaft is max. 1.5kg cm (0.108ft lb). The tuner drive should be capable of supplying 2.3kg cm (0.166ft lb).

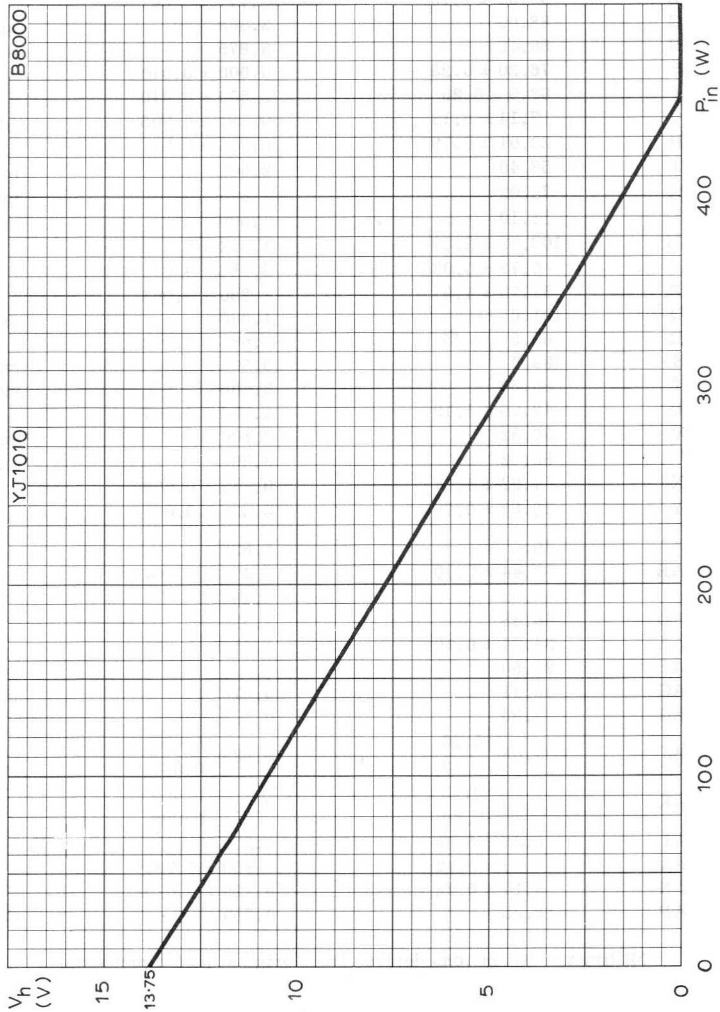
OUTLINE DRAWING OF YJ1010



DIMENSIONS

	mm	Inches	
A	195.25	7.687	max.
B	95.94 ± 1.19	3.777 ± 0.047	
C	88.09	3.468	max.
D	98.42	3.875	max.
E	76.20 ± 0.25	3.000 ± 0.010	
F	63.5 ± 0.25	2.500 ± 0.010	
G	7.14 ± 0.12	0.281 ± 0.005	dia.
H	23.01 ± 0.79	0.906 ± 0.031	
J	58.40	2.300	max.
K	73.02	2.875	max.
L	38.10	1.500	max.
M	109.52 ± 2.39	4.312 ± 0.094	
N	4.77 ± 0.025	0.188 ± 0.001	
P	31.75 ± 1.57	1.250 ± 0.062	
Q	101.6	4.000	max.
R	68.5 ±1.57	2.687 ± 0.062	
S	139.7	5.500	max.
T	86.50	3.406	max.
U	42.06 ± 1.19	1.656 ± 0.047	
V	96.52	3.800	max.
W	83.82	3.300	max.
X	7.92 ± 1.57	0.312 ± 0.062	
Y	15.88 ± 0.79	0.625 ± 0.031	
AA	46.48	1.830	
AB	37.44 ± 0.10	1.474 ± 0.004	
AC	12.62	0.497	
AD	46.48	1.830	
AE	34.34 ± 0.10	1.352 ± 0.004	
AF	28.50	1.122	
AG	13.11	0.516	min.
AH	3.96	0.156	max.
AJ	$21.08\,^{+0.20}_{-0.12}$	$0.830\,^{+0.008}_{-0.005}$	
AK	$13.72\,^{+0.12}_{-0.20}$	$0.540\,^{+0.005}_{-0.008}$	
AL	6.35 ± 0.38	0.250 ± 0.015	
AM	4.29 ± 0.12	0.169 ± 0.005	
AN	3.17 ± 0.25	0.125 ± 0.010	
AP	19.05	0.750	min.

Millimetre dimensions derived from original inch dimensions



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER

MAGNETRON YJ1021

QUICK REFERENCE DATA		
Fixed frequency magnetron suitable for use in high-definition short-range radar systems.		
Frequency	33	GHz
Power output (pulsed)	30	kW
Construction		Packaged

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. pulse power output	25	30	30	kW
Duty factor	0.0001	0.0002	0.0002	
Pulse duration	0.04	0.1	0.3	μs
Pulse repetition frequency	2500	2000	670	pulse/s
Heater voltage (running)	4.0	3.8	3.8	V
Pulse current	10.5	12.5	12.5	A
Pulse voltage	12.5	12.5	12.5	kV
Pulse input power	131	156	156	kW
Rate of rise of voltage pulse	300	250	250	kV/μs
Mean input current	1.6	2.5	2.5	mA
Mean input power	20	31.3	31.3	W
Mean r.f. output power	2.5	6.0	6.0	W
Frequency pulling (v.s.w.r. = 1.5)	40	40	40	MHz

CATHODE

Indirectly heated

V_h	3.8 to 4.4	V
I_h (at V_h = 4.0V)	2.7 to 4.1	A
I_h (surge) max.	8.0	A
r_h (cold) min.	0.16	Ω
t_{h-k} min.	180	s

For mean input powers greater than 22 watts, it is necessary to reduce the heater voltage immediately after application of h.t. in accordance with the input power-heater voltage rating chart on page 3.

CHARACTERISTICS

	Min.	Max.	
Frequency (fixed within the band)	32.7	33.4	GHz
Pulse voltage (I_{pulse} = 12.5A)	11.5	13.5	kV
R.F. pulse power output (I_{pulse} = 12.5A)	27.5	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	50	MHz
Frequency temperature coefficient	-	1.0	MHz/degC
Distance of v.s.w. minimum from face of mounting plate into valve	0.58	3.15	mm
Frequency pushing	-	4.0	MHz/A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	6.0	16	A
Pulse duration	-	0.5	μs
Duty factor	-	0.0003	
Mean input power	-	60	W
Rate of rise of voltage pulse $<0.1\mu s$	200	400	kV/μs
Rate of rise of voltage pulse $\geq 0.1\mu s$	-	300	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	

MOUNTING POSITION

Any

PRESSURISING

To prevent arcing the pressure must exceed 450 torr.

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.9	4.2
Weight of magnetron in carton	5.8	12.8
	mm	in
Dimensions of storage carton	178 x 244 x 285	7.0 x 9.6 x 11.2

COOLING

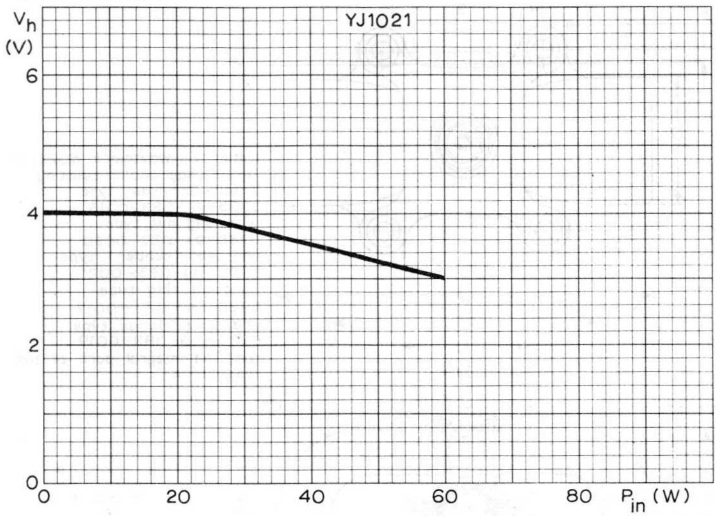
For normal operating conditions no additional cooling of the magnetron will be required to keep the temperature of the anode block and heater seals below the stated maximum ratings.

Temperatures

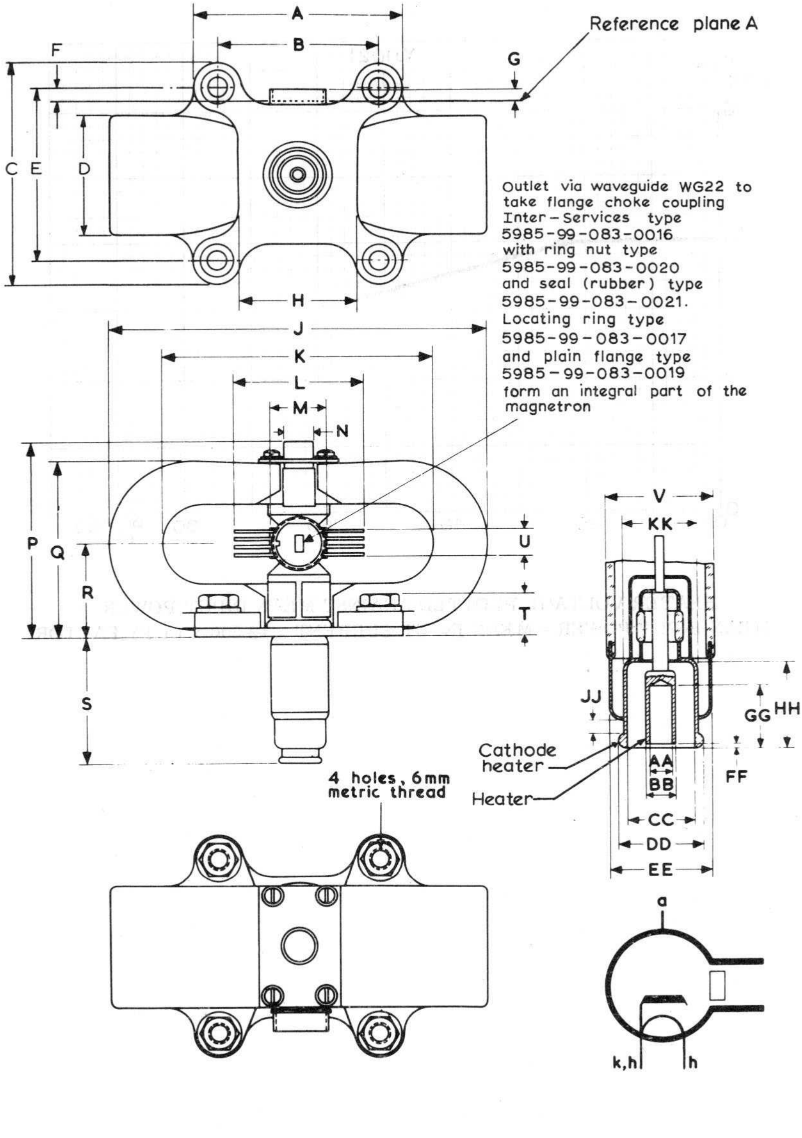
Anode block max. (between 2nd and 3rd fins)	150	^{o}C
Cathode and heater seals max.	150	^{o}C

ACCESSORY

Cathode connector 55356



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER
MEAN INPUT POWER = MEAN INPUT CURRENT x 12 500 x DUTY FACTOR


A
B
F
G
Reference plane A
C
E
D
H
J
K
L
M
N
Outlet via waveguide WG22 to take flange choke coupling Inter-Services type 5985-99-083-0016 with ring nut type 5985-99-083-0020 and seal (rubber) type 5985-99-083-0021. Locating ring type 5985-99-083-0017 and plain flange type 5985-99-083-0019 form an integral part of the magnetron
P
Q
R
S
U
T
V
KK
JJ
GG
HH
FF
Cathode heater
Heater
AA
BB
CC
DD
EE
4 holes, 6mm metric thread
a
k,h
h

DIMENSIONS

	Millimetres	Inches	
A	87.3	3.437	max.
B	64.29 ± 0.25	2.531 ± 0.010	
C	92	3.622	max.
D	49.2	1.937	max.
E	70.64 ± 0.25	2.781 ± 0.010	
F	5.5 ± 1.0	0.217 ± 0.039	
G	4.8	0.189	max.
H	47.6	1.874	min.
J	150.7	5.933	max.
K	97	3.819	min.
L	53	2.087	max.
M	23	0.906	max.
N	13	0.512	max.
P	81	3.189	max.
Q	72.2	2.842	max.
R	35.6 ± 1.0	1.402 ± 0.039	
S	50	1.968	max.
T	16.5 ± 1.5	0.650 ± 0.059	
U	11	0.433	max.
V	23	0.906	max.
AA	4.30 ± 0.15	0.169 ± 0.006	
BB	6.0 ± 0.1	0.236 ± 0.004	
CC	13.3 ± 0.2	0.524 ± 0.008	
DD	16.9 ± 0.2	0.665 ± 0.008	
EE	20.5	0.807	max.
FF	0.55 ± 0.45	0.022 ± 0.018	
GG	12.5	0.492	min.
HH	15	0.591	min.
JJ	2.0	0.079	min.
KK	15.0 ± 0.2	0.591 ± 0.008	

Inch dimensions derived from original millimetre dimensions.

MAGNETRON

YJ1030

QUICK REFERENCE DATA

Rugged magnetron with low frequency temperature coefficient, suitable for high altitude operation.

Frequency (Mechanically tunable)	5.65	Gc/s
Power output (pulsed)	120	W
Construction	Packaged, coaxial output	

To be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES.

CHARACTERISTICS

	Min.	Max.	
Frequency			
Tunable over the range	5.4	5.9	Gc/s
Pulse voltage (I pulse = 0.8 A)	1.00	1.35	kV
R.F. pulse power output (I pulse = 0.8 A)	70	-	W
Frequency pulling (v.s.w.r. = 1.5)	-	12	Mc/s
Frequency temperature coefficient	-	-0.1	Mc/s per ^{o}C
Frequency modulation under vibration of 12g (50-2000c/s)	-	2.0	Mc/s
Input capacitance	-	6.0	pF
Frequency pushing	-	15	Mc/s per A

TYPICAL OPERATION

R.F. pulse power output	160	W
Duty factor	0.002	
Pulse duration	1.0	µs
Pulse repetition frequency	2000	p.p.s.
Heater voltage (running)	5.0	V
Pulse current	0.8	A
Pulse voltage	1.2	kV
Pulse input power	944	W
Rate of rise of voltage pulse	6.0	kV/µs
Mean input current	1.6	mA
Mean input power	1.9	W
Mean r.f. output power	320	mW
Frequency pulling (v.s.w.r. = 1.5)	10	Mc/s

CATHODE

Indirectly heated

Vh	5.0	V
Ih	0.5	A

Heating time. At ambient temperatures above 0 ^{o}C the cathode must be heated for at least 0.5 minutes before the application of h.t.

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	0.6	1.0	A
Pulse duration	-	3.0	μs
Duty factor	-	0.002	
Mean input power	-	2.5	W
Rate of rise of voltage pulse	-	8.0	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	100	^{o}C

MOUNTING POSITION

Any

PHYSICAL DATA

	lb	kg
Weight of magnetron	0.45	0.2
Weight of magnetron in carton	9.0	4.1
	in	cm
Dimensions of storage carton	12.5 x 11.5 x 11.0	318 x 292 x 279

COOLING

In normal circumstances natural cooling is adequate but where the ambient temperature is abnormally high, or where convection cooling is restricted, provision for conduction cooling may be made by a clamp, of non-magnetic material, around the body.

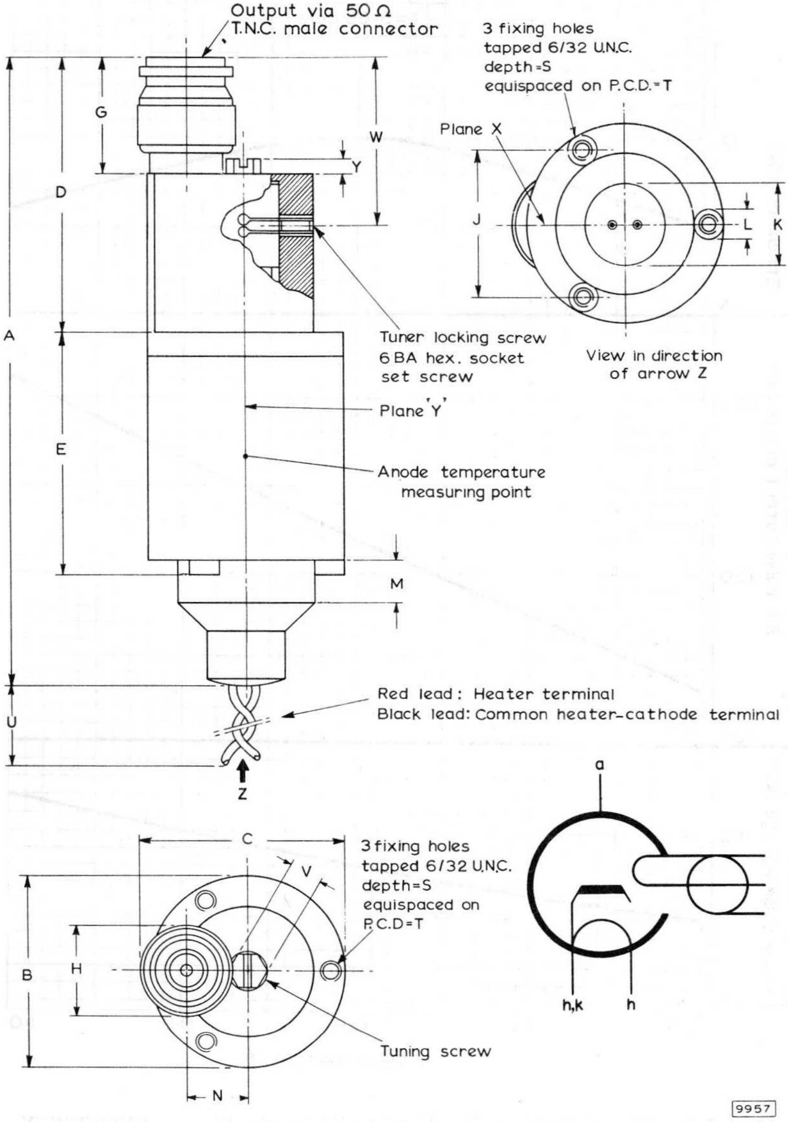
OUTPUT CONNECTION

Output via 50Ω T.N.C. Male Connector

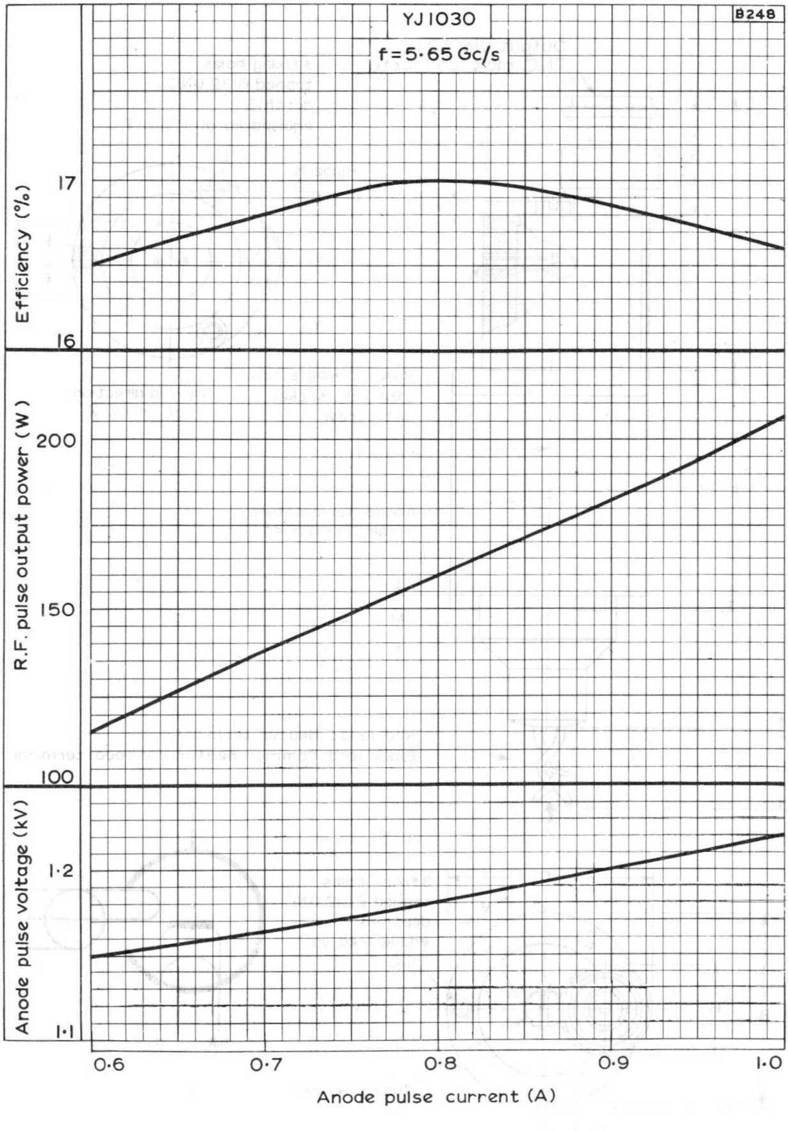
DIMENSIONS

	Inches	Millimetres	
A	4.006 ± 0.069	101.75 ± 1.75	
B	1.270 ± 0.010	32.25 ± 0.25	
C	1.348 ± 0.010	34.25 ± 0.25	
D	1.742 ± 0.030	44.25 ± 0.75	
E	1.545 ± 0.030	39.25 ± 0.75	
G	0.709 ± 0.008	18.0 ± 0.2	
H	0.640	16.25	max.
J	0.876 ± 0.010	22.25 ± 0.25	
K	0.502 ± 0.010	12.75 ± 0.25	
L	0.177 ± 0.004	4.5 ± 0.1	
M	0.295 ± 0.020	7.5 ± 0.5	
N	0.394 ± 0.010	10.00 ± 0.25	
S	0.167 ± 0.010	4.25 ± 0.25	
T	1.06	27.0	
U	8.0	203	min.
V	0.192 ± 0.001	4.875 ± 0.025	
W	1.024 ± 0.016	26.0 ± 0.4	
Y	0.077 ± 0.022	1.95 ± 0.55	

Inch dimensions derived from original millimetre dimensions.



Output via 50 Ω
T.N.C. male connector
3 fixing holes
tapped 6/32 U.N.C.
depth = S
equispaced on P.C.D. = T
Plane X
G
W
Y
D
J
L
K
A
Tuner locking screw
6 BA hex. socket
set screw
View in direction
of arrow Z
Plane 'Y'
E
Anode temperature
measuring point
M
Red lead: Heater terminal
Black lead: Common heater-cathode terminal
U
Z
C
V
3 fixing holes
tapped 6/32 U.N.C.
depth = S
equispaced on
P.C.D = T
B
H
Tuning screw
N
a
h,k
h
9957



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY
PLOTTED AGAINST ANODE PULSE CURRENT

MAGNETRON YJ1040

QUICK REFERENCE DATA		
X-Band, fixed frequency, pulsed magnetron		
Frequency (fixed within the band)	9.345 to 9.405	GHz
Power output (peak)	14	kW
Construction	Packaged	
Output connection	Waveguide 16 Flange	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

Operating conditions

Heater voltage	6.3	V
Anode current (peak)	5.75	A
Pulse duration (t_p)	2.2	μs
Pulse repetition rate	400	pulse/s
Rate of rise of voltage pulse	70	kV/μs

Typical performance

Anode voltage (peak)	6.5	kV
Power output (peak)	14	kW
Power output (mean)	12.3	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.55	A
Heater current (surge) max.	3.0	A
Heating time (min.) (see note 1)	2.0	minutes

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage	6.3	V
Anode current (mean)	5.75	mA
Duty factor	0.001	
Pulse duration (t_p) (see note 2)	2.0	µs
v.s.w.r. at output connection	1.05:1	
Rate of rise of voltage pulse (see note 3)	80	kV/µs

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	6.3	6.8	kV
Power output (mean)	12.5	-	W
Frequency	9.345	9.405	GHz
R.F. Bandwidth at 1/4 power (see note 2)	-	$\frac{2.5}{t_p}$	MHz
Frequency pulling (v.s.w.r. = 1.3:1)	-	15	MHz
Minor lobe level (v.s.w.r. = 1.3:1)	6.0	-	dB
Stability (see note 5)	-	0.25	%
Heater current (see note 6)			
Frequency temperature coefficient (see note 7)			
Input capacitance (see note 8)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 9)	5.7	6.9	V
Anode voltage (peak)	6.0	7.5	kV
Anode current (peak)	4.5	6.5	A
Power input (peak)	-	48	kW
Power input (mean)	-	70	W
Duty factor	-	0.0015	
Pulse duration (t_p)	-	2.5	µs
Rate of rise of voltage pulse (see note 3)	-	80	kV/µs
Anode temperature	-	120	^{o}C
v.s.w.r. at output connection	-	1.3:1	

Mullard

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on page 2.

	Min.	Max.	
Anode voltage (peak)	6.3	6.8	kV
Power output (mean)	10	-	W
Frequency	9.345	9.405	GHz
Stability	-	0.5	%

MOUNTING POSITION (see note 11) Any

COOLING Natural

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.7	3.75
Weight of magnetron in storage carton	1.82	4.0
	mm	in
Dimensions of storage carton	190×190×280	7.5×7.5×11

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above $0^{o}C$ the cathode must be heated for at least 90 seconds before the application of h.t. For ambient temperatures between 0 and $-55^{o}C$ the cathode heating time is 120 seconds minimum.
2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is ±10%.
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.
4. Magnetrons with other frequency ranges can be supplied to order.

NOTES (contd.)

5. With the magnetron operating into a v.s.w.r. of 1.3:1 varied through all phases over an anode current range of 4.5 to 6.5A peak. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.345 to 9.405GHz. 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.

6. Measured with heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.5 to 0.6A.

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

8. Design test only. The maximum input capacitance is 9pF.

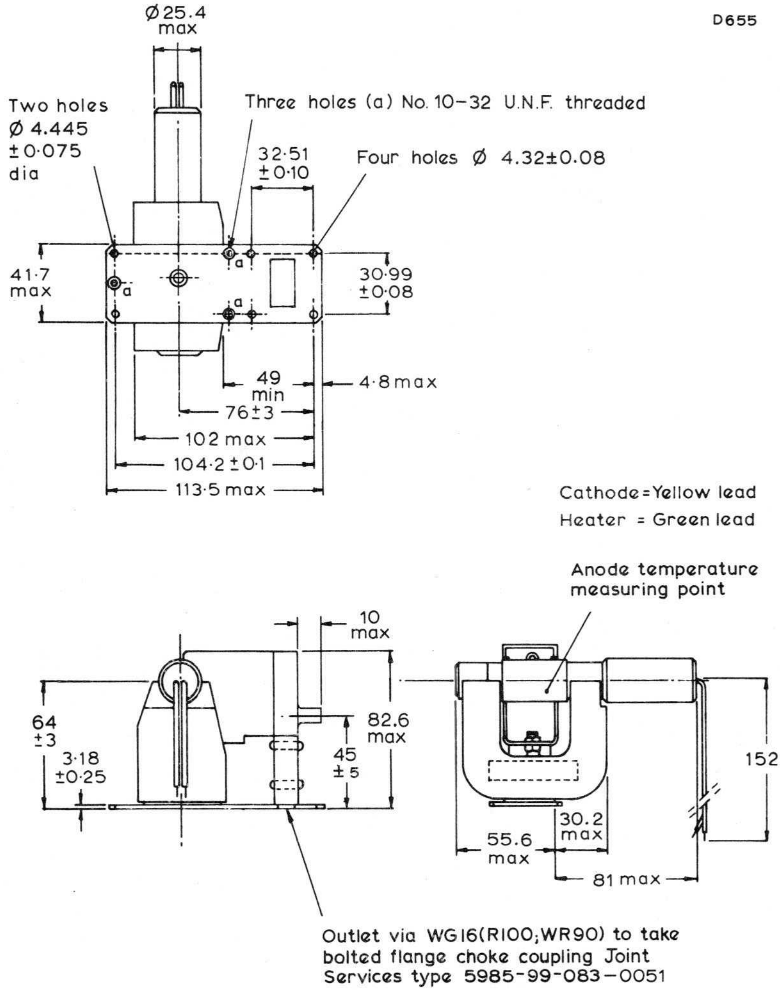
9. The magnetron is normally tested with a heater supply of 50Hz and is suitable for operation at 400Hz. Mullard Ltd., should be consulted if the magnetron is to be operated with a heater supply of any other frequency.

10. It is necessary to keep all magnetic material as far as possible, at least 50mm (2in), from the magnet. The inner polystyrene pack of the magnetron carton provides adequate separation between magnetrons, and it is recommended that magnetrons not in use be kept in these packs.

CONVERSION TABLE
(Rounded outwards)

mm	in	mm	in
3.18 ± 0.25	0.125 ± 0.010	49 min.	1.92 min.
Ø 4.32 ± 0.08	Ø 0.1701 ± 0.0032	55.6 max.	2.19 max.
Ø 4.445 ± 0.075	Ø 0.175 ± 0.003	64 ± 3	2.52 ± 0.12
4.8 max.	0.189 max.	76 ± 3	2.99 ± 0.12
10 max.	0.394 max.	81 max.	3.19 max.
Ø 25.4 max.	Ø 1.00 max.	82.6 max.	3.252 max.
30.2 max.	1.19 max.	102 max.	4.02 max.
30.99 ± 0.08	1.2201 ± 0.0032	104.2 ± 0.1	4.102 ± 0.004
32.51 ± 0.10	1.280 ± 0.004	113.5 max.	4.47 max.
41.7 max.	1.642 max.	152	5.98
45 ± 5	1.77 ± 0.20		

OUTLINE DRAWING OF YJ1040



All dimensions in mm

QUICK REFERENCE DATA		
Fixed frequency 'X' band pulsed magnetron. Suitable for high altitude operation.		
Frequency	9.24	GHz
Power output (pulsed)	22	kW
Construction	Packaged, flying leads	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. pulse power output	22	kW
Duty factor	0.0004	
Pulse duration	0.5	μs
Pulse repetition frequency	800	p.p.s.
Heater voltage (running)	6.3	V
Pulse current	7.5	A
Pulse voltage	7.5	kV
Pulse input power	56.25	kW
Rate of rise of voltage pulse	60	kV/μs
Mean input current	3.0	mA
Mean input power	22.5	W
Mean r.f. output power	8.8	W
Frequency pulling (v.s.w.r. = 1.2)	12	MHz

CATHODE

Indirectly heated

V_h	6.3	V
I_h	550	mA
Frequency of heater supply	400	Hz

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 45 seconds before the application of h.t. Below this temperature the heating time must be increased to at least 1.0 minute.

CHARACTERISTICS

	Min.		Max.	
Frequency fixed within the band	9.21	to	9.27	GHz
Pulse voltage (I_{pulse}=7.5A)	7.0		7.7	kV
R.F. pulse power output (I_{pulse}=7.5A)	20		-	kW
Frequency pulling (v.s.w.r.=1.2)	-		15	MHz
Frequency temperature coefficient	-		-0.25	MHz per degC
Frequency pushing	-		1.5	MHz per A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	6.0	9.0	A
Pulse duration	-	1.0	µs
Duty factor	-	0.0015	
Mean input power	-	85	W
Rate of rise of voltage pulse	-	100	kV/µs
Load mismatch (v.s.w.r.)	-	1.5	

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:-

	Min.		Max.	
R.F. pulse power output (I_{pulse}=7.5A)			16	kW
Frequency fixed within the band	9.21	to	9.27	GHz
Pulse voltage (I_{pulse}=7.5A)	7.0	to	7.9	kV

MOUNTING POSITION

Any

PRESSURISING

To meet the reduced atmospheric pressure during high altitude operation the output waveguide is sealed with a vacuum tight window. Operation up to 60 000ft is offered provided a choke coupling is used but on no account is pressurisation of the output window permitted. A protective cover for the window is supplied.

PHYSICAL DATA

Weight of magnetron	1.2	kg
Weight of magnetron in carton	2.3	kg
Dimensions of storage carton	19.7×20.3×24.8	cm

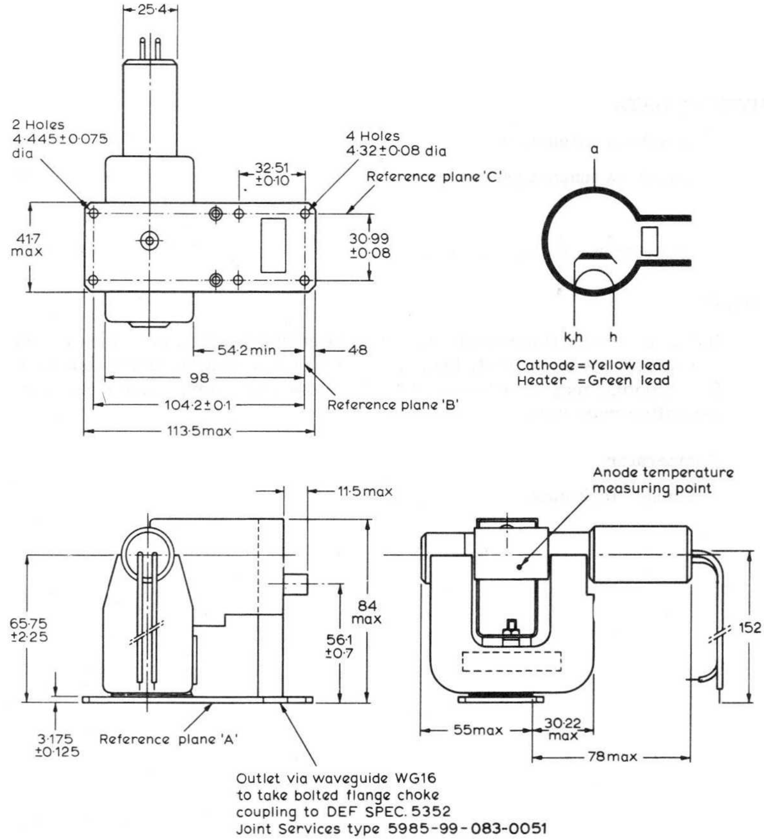
COOLING

In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, or convection cooling is restricted, artifical cooling may be necessary to keep the block temperature below the permitted maximum.

Temperature

Anode block max.	120	^{o}C

OUTLINE DRAWING OF YJ1050

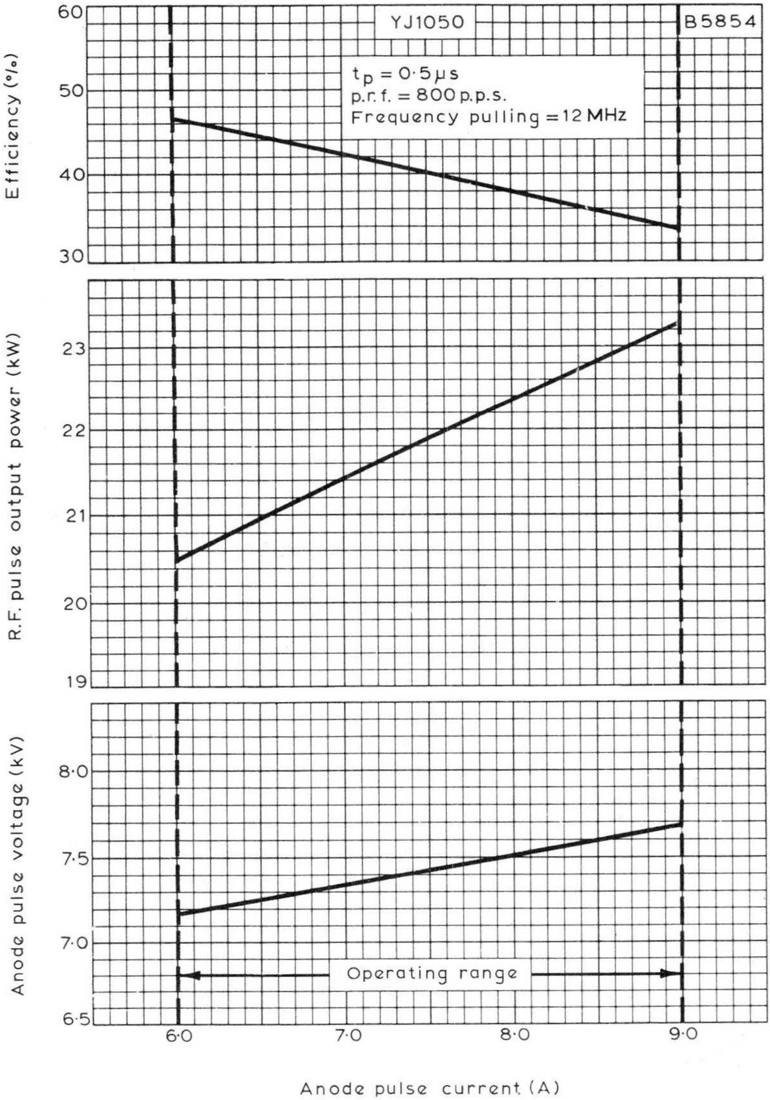


All dimensions in mm

B5851

DIMENSIONS

Millimetres	Inches		Millimetres	Inches	
152	5.98		41.7	1.641	max.
113.5	4.468	max.	32.51 ±0.10	1.280±0.004	
104.2 ±0.1	4.102±0.004		30.99 ±0.08	1.220±0.003	
98	3.86		30.22	1.189	max.
84	3.30	max.	25.4	1.000	
78	3.07		11.5	0.452	max.
65.75±2.25	2.588±0.088		4.8	0.189	
56.1 ±0.7	2.209±0.027		4.445±0.075	0.175±0.003	dia.
55	2.16	max.	4.32 ±0.08	0.170±0.003	dia.
54.2	2.134	min.	3.175±0.125	0.125±0.005	



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT

MAGNETRON

YJ1060

QUICK REFERENCE DATA		
Fixed frequency 'X' band pulsed magnetron. Suitable for high altitude operation.		
Frequency	9.375	Gc/s
Power output (pulsed)	20	kW

To be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES.

CHARACTERISTICS

	Min.	Max.	
Frequency			
Fixed within the band	9.345	9.405	Gc/s
Pulse voltage (I pulse = 7.5 A)	6.4	7.4	kV
R.F. pulse power output (I pulse = 7.5 A)	18	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	15	Mc/s
Frequency temperature coefficient	-	-0.25	Mc/s per ^{o}C
Input capacitance	-	8.0	pF

TYPICAL OPERATION

R.F. pulse power output	20	20	kW
Duty factor	0.0007	0.001	
Pulse duration	1.8	2.5	µs
Pulse repetition frequency	400	400	p.p.s.
Heater voltage (running)	5.4	4.6	V
Pulse current	7.5	7.5	A
Pulse voltage	7.2	7.2	kV
Pulse input power	54	54	kW
Rate of rise of voltage pulse	50	50	kV/µs
Mean input current	5.3	7.5	mA
Mean input power	38	54	W
Mean r.f. output power	14	20	W
Frequency pulling (v.s.w.r. = 1.5)	14	14	Mc/s

CATHODE

Indirectly heated

Vh	6.3	V
Ih	0.55	A

Heating time. At ambient temperatures above $0\ ^{o}C$ the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

For mean input powers greater than 25 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power-heater voltage rating chart on page C1.

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	5.0	8.0	A
Pulse duration	-	2.5	μs
Duty factor	-	0.002	
Mean input power	-	80	W
Rate of rise of voltage pulse	-	60	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	120	^{o}C

MOUNTING POSITION

Any

PRESSURISING

The valve is fitted with flying leads and the output waveguide is sealed with a vacuum tight window to allow operation at high altitude without pressurising. Operation to 60,000 ft can be achieved.

PHYSICAL DATA

	lb	kg
Weight of magnetron	3.25	1.5
Weight of magnetron in carton	5.5	2.5

	in	mm
Dimensions of storage carton	7.75 x 8.0 x 9.75	197 x 203 x 248

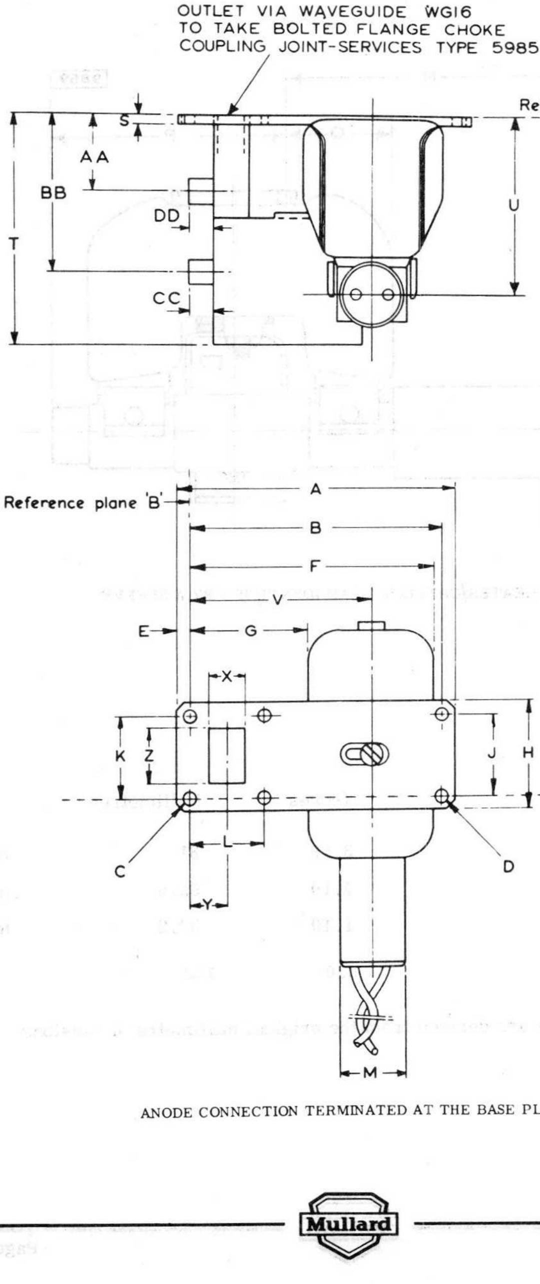
COOLING

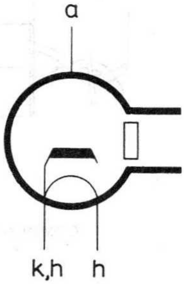
In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, or convection cooling is restricted artificial cooling may be necessary to keep the block temperature below the permitted maximum

DIMENSIONS

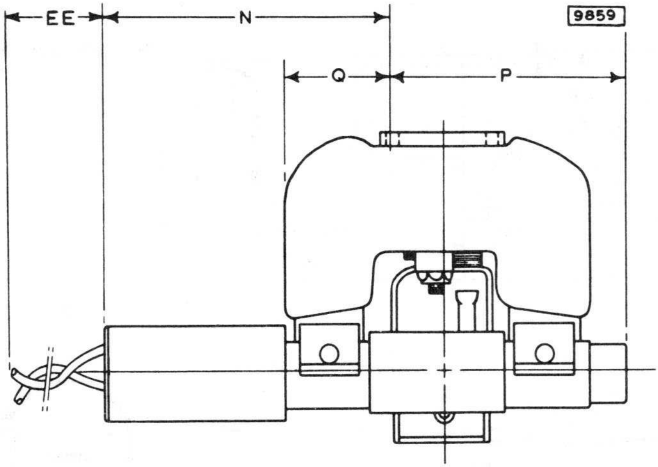
	Inches	Millimetres	
A	4.47	113.5	max
B	4.103 ± 0.004	104.2 ± 0.1	
C	0.17 ± 0.003	4.32 ± 0.08	
D	0.175 ± 0.003	4.45 ± 0.08	
E	0.19	4.8	max
F	4.0	102	max
G	1.93	49	min
H	1.64	41.7	max
J	1.22 ± 0.003	30.99 ± 0.08	
K	1.22 ± 0.004	30.99 ± 0.1	
L	1.28 ± 0.004	32.51 ± 0.1	
M	1.0	25.4	max.
S	0.125 ± 0.01	3.18 ± 0.25	
T	3.25	82.6	max
U	2.52 ± 0.118	64 ± 3	
V	3.0 ± 0.118	76 ± 3	
X	0.400 ± 0.003	10.16 ± 0.08	
Y	0.640 ± 0.004	16.25 ± 0.10	
Z	0.900 ± 0.004	22.86 ± 0.10	
AA	0.88 ± 0.118	22 ± 3	
BB	1.8 ± 0.197	53 ± 5	
CC	0.39	10	max
DD	0.38	9.5	max

Inch dimensions are derived from the original millimetre dimensions





ANODE CONNECTION TERMINATED AT THE BASE PLATE

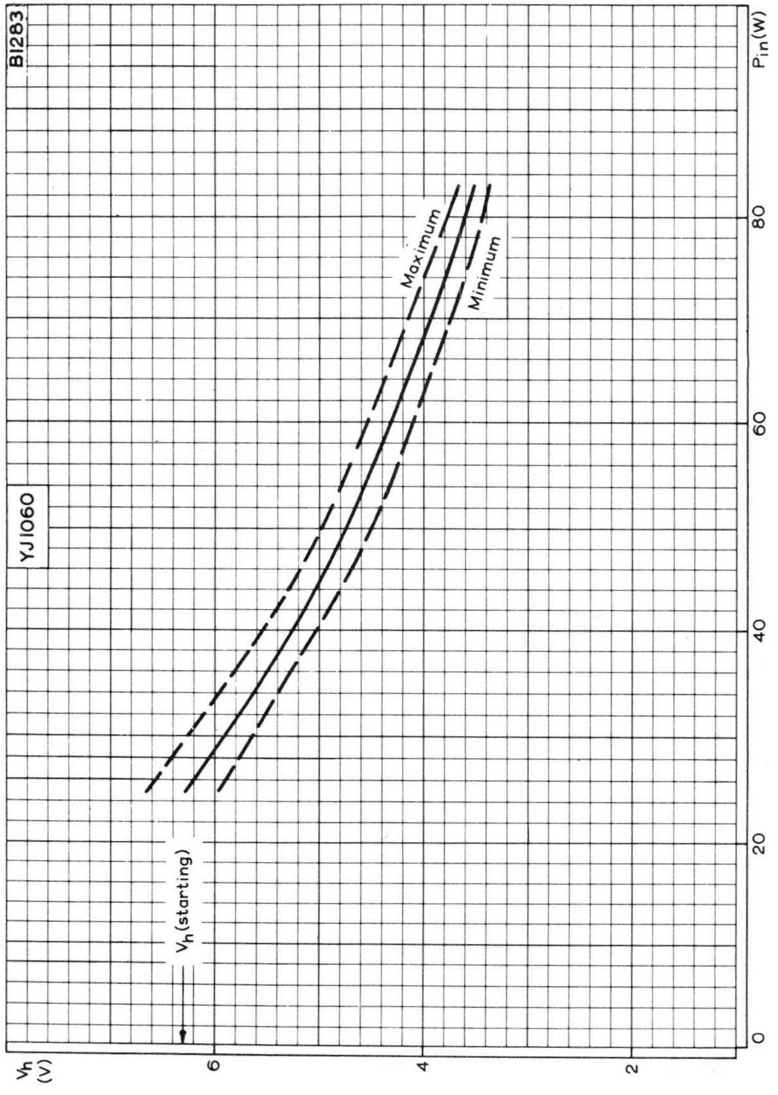


COMMON HEATER/CATHODE LEAD IDENTIFIED BY A SLEEVE

DIMENSIONS

	Inches	Millimetres	
N	3.19	81	max
P	2.19	55.6	max
Q	1.19	30.2	max
EE	6.0	152	

Inch dimensions are derived from the original millimetre dimensions



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER

QUICK REFERENCE DATA		
Fixed frequency 'X' band magnetron		
Frequency	9.41	Gc/s
Power output (pulsed)	10.5	kW
Construction	Packaged, flying leads	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

CHARACTERISTICS

	Min.	Max.	
Frequency fixed within the band	9.38	9.44	Gc/s
Pulse voltage (I_{pulse} = 6.0A)	5.5	5.9	kV
R.F. pulse power output (I_{pulse} = 6.0A)	9.0	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	15	Mc/s
Frequency temperature coefficient	-	-0.25	Mc/s per degC
Distance of v.s.w. minimum from face of mounting plate into valve	16.5	22.5	mm
Frequency pushing	-	2.0	Mc/s per A

OPERATING CONDITIONS

	Min.	Max.	
R.F. pulse power output	10.5	10.5	kW
Duty factor	0.0001	0.0005	
Pulse duration	0.1	0.5	µs
Pulse repetition frequency	1000	1000	p.p.s.
Heater voltage (running)	6.3	6.3	V
Pulse current	6.0	6.0	A
Pulse voltage	5.7	5.7	kV
Pulse input power	34.8	34.8	kW
Rate of rise of voltage pulse	110	100	kV/µs
Mean input current	0.65*	3.0	mA
Mean input power	3.48	17.4	W
Mean r.f. output power	1.1	5.5	W
Frequency pulling (v.s.w.r. = 1.5)	14	14	Mc/s

*This includes pre-oscillation current.

CATHODE

Indirectly heated

V_h	6.3	V
I_h	0.55	A

Heating time

At ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.
For mean input powers greater than 25 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power-heater voltage rating chart on page C2.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	4.5	7.0	A
Pulse duration	-	1.0	µs
Duty factor	-	0.002	
Mean input power	-	85	W
Rate of rise of voltage pulse	-	120	kV/µs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	120	$^{\circ}$C

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:

	Min.		Max.	
R.F. pulse power output (I_{pulse} = 6.0A)	7.0			kW
Frequency fixed within the band	9.38	to	9.44	Gc/s
Pulse voltage (I_{pulse} = 6.0A)	5.5	to	6.0	kV

MOUNTING POSITION

Any

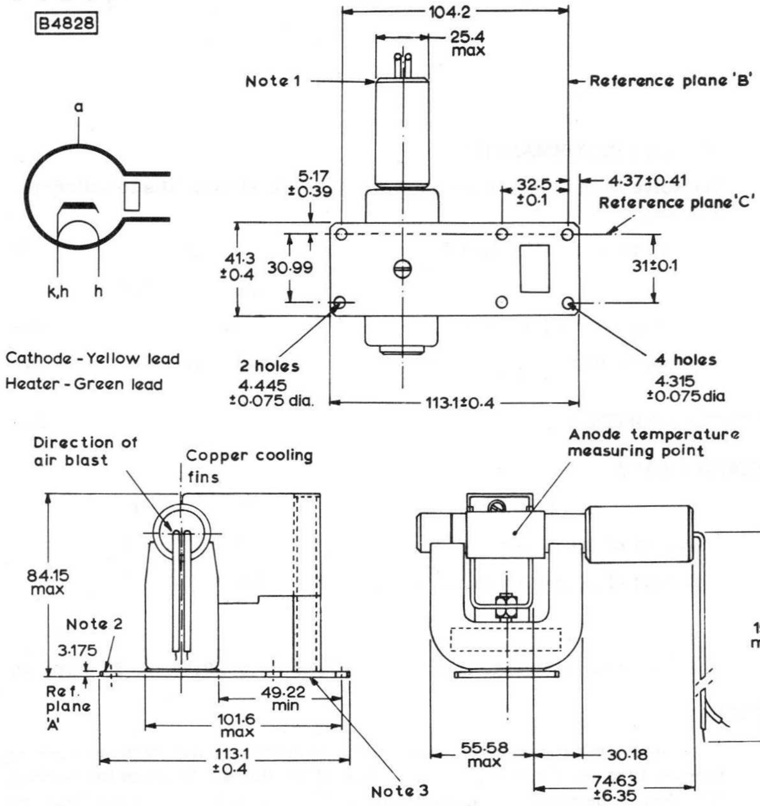
PHYSICAL DATA

	lb	kg
Weight of magnetron	3.0	1.4
Weight of magnetron in carton	5.7	2.5

	in	cm
Dimensions of storage carton	7.75 × 8.0 × 9.75	20 × 21 × 25

COOLING

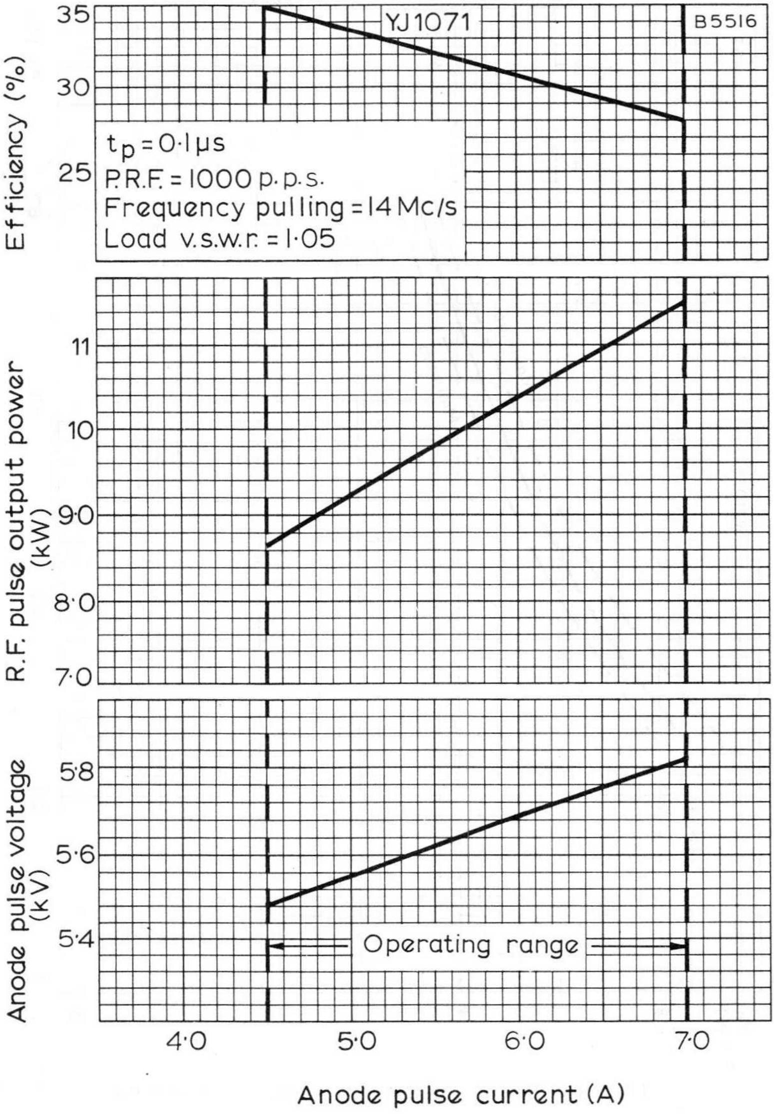
In normal circumstances natural cooling is adequate, but when the ambient temperature is abnormally high a flow of cooling air between the cooling fins may be necessary to keep the anode block temperature below the permitted maximum.



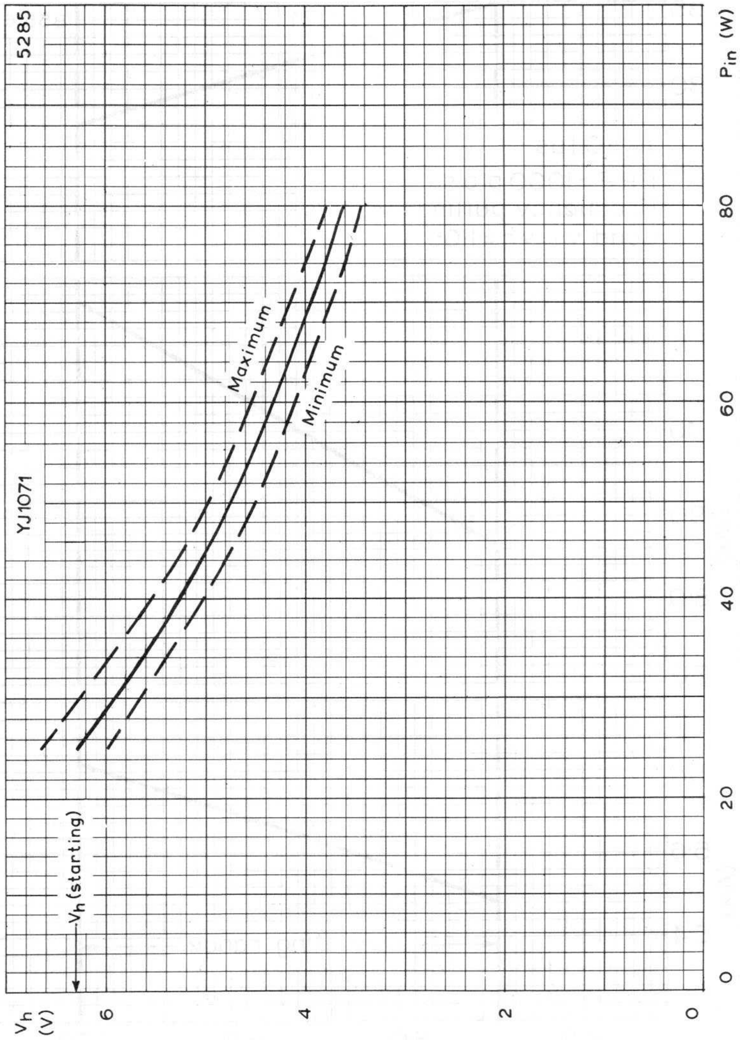
All dimensions in mm

NOTES

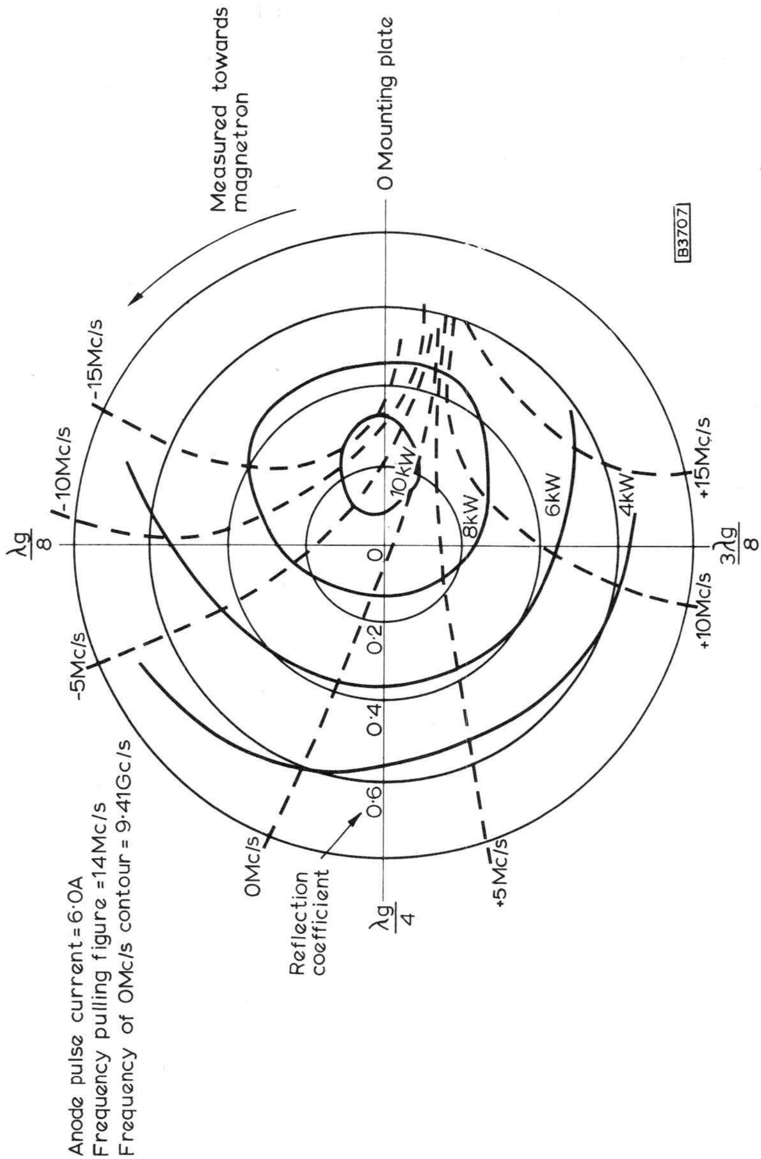
1. The protector sleeve shall be within 5^{0} of a normal to reference plane C.
2. A cylinder 0.33in (8.38mm) diameter centred in the holes shown shall clear the side of the magnet.
3. The outlet via the waveguide WG16 is to take a bolted flange choke coupling, Joint Services type 5985-99-0830051.



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER



RIEKE DIAGRAM

QUICK REFERENCE DATA			
Mechanically tunable rugged magnetron with low frequency temperature coefficient and pulling figure. Suitable for high altitude operation.			
Frequency	YJ1090	9.0 to 9.5	GHz
	YJ1091	8.5 to 9.0	GHz
Power output (pulsed)		50	W

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

Unless otherwise stated, data is applicable to both types

CHARACTERISTICS

		Min.	Max.	
Frequency (tunable over the range)	YJ1090	9.0	9.5	GHz
	YJ1091	8.5	9.0	GHz
Pulse voltage (I_{pulse} = 0.9A)		1.025	1.350	kV
R.F. pulse power output (I_{pulse} = 0.9A)		30	-	W
Frequency pulling (v.s.w.r. = 1.5:1)		-	3.0	MHz
Frequency temperature coefficient over the range T_{anode} = 60 to 100°C		-	0.1	MHz/degC
Frequency modulation under vibration of 12g (50 to 2000Hz)		-	3.0	MHz
Input capacitance		-	6.0	pF
Frequency pushing (I_{pulse} = 0.9A)		-	25	kHz/mA

TYPICAL OPERATION at f = 9.25GHz (YJ1090) and f = 8.75GHz (YJ1091)

R.F. pulse power output	50	W
Duty factor	0.002	
Pulse duration	1.0	μs
Pulse repetition frequency	2000	pulse/s
Heater voltage (running)	5.0	V
Pulse current	0.9	A
Pulse voltage	1.18	kV
Pulse input power	1.06	kW
Rate of rise of voltage pulse	8.0	kV/μs
Mean input current	1.8	mA
Mean input power	2.12	W
Mean r.f. output power	100	mW
Frequency pulling (v.s.w.r. = 1.5:1)	1.9	MHz
Frequency pushing	10	kHz/mA

CATHODE

Indirectly heated

V_h	5.0	V
I_h	0.5	A

Heating time. At ambient temperatures above $0^{\circ}C$ the cathode must be heated for at least 30 seconds before the application of h.t.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	0.7	1.1	A
Pulse duration	-	2.0	μs
Duty factor	-	0.004	
Mean input power	-	6.0	W
Rate of rise of voltage pulse	-	10	kV/μs
Load mismatch (v.s.w.r.)	-	1.5:1	
Temperature of anode block	-	100	°C

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:

R.F. pulse power output (I_{pulse} = 0.9A) 20 W

		Min.		Max.	
Over the frequency band	YJ1090	9.0	to	9.5	GHz
	YJ1091	8.5	to	9.0	GHz
Pulse voltage (I_{pulse} = 0.9A)		1.025	to	1.350	kV

MOUNTING POSITION

Any

COOLING

In normal circumstances natural cooling is adequate but where the ambient temperature is abnormally high, or where convection cooling is restricted, provision for conduction cooling may be made by a clamp, of non-magnetic material, around the body.

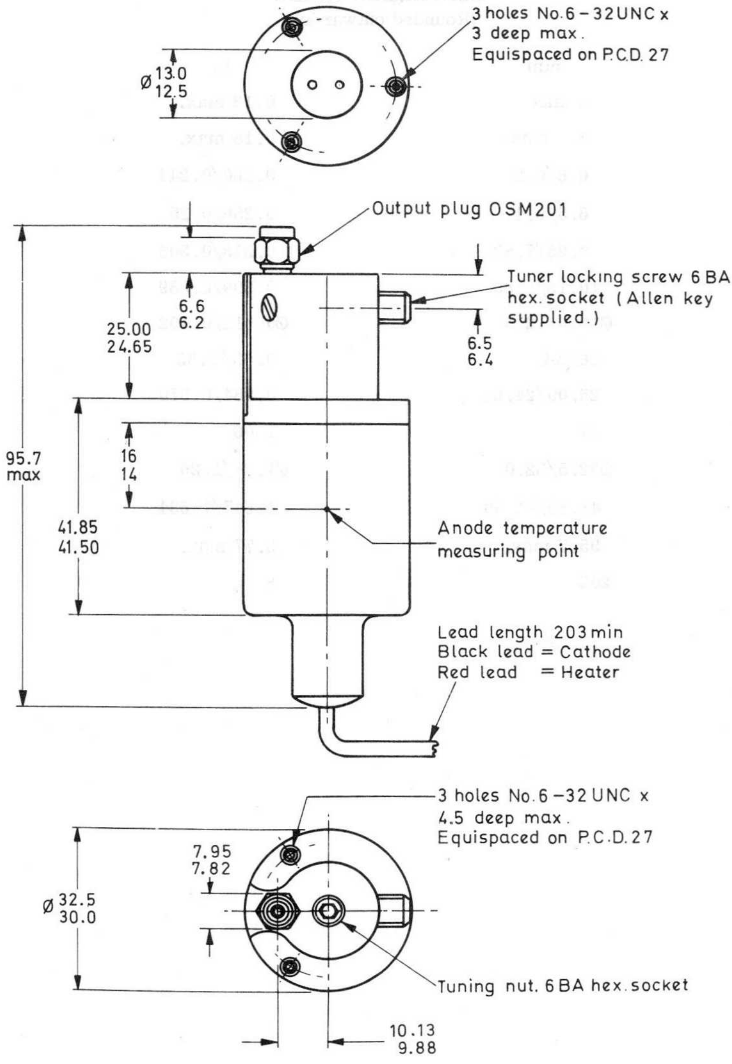
OPERATING NOTE

Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted.

PHYSICAL DATA

	kg	lb
Weight of magnetron	0.23	0.5

OUTLINE DRAWING OF YJ1090 AND YJ1091



All dimensions in mm

D648

For conversion table see Page 4

CONVERSION TABLE
(Rounded outwards)

mm	in
3 max.	0.12 max.
4.5 max.	0.18 max.
6.6/6.2	0.260/0.244
6.5/6.4	0.256/0.252
7.95/7.82	0.313/0.308
10.13/9.88	0.399/0.389
Ø13.0/12.5	Ø0.512/0.492
16/14	0.63/0.55
25.00/24.65	0.984/0.970
27	1.06
Ø32.5/32.0	Ø1.28/1.26
41.85/41.50	1.647/1.634
95.7 max.	3.77 max.
203	8

MAGNETRONS

YJ1100
YJ1101

QUICK REFERENCE DATA			
Mechanically tunable rugged magnetron with low frequency temperature coefficient, suitable for high altitude operation.			
Frequency	YJ1100	9.0 to 9.5	GHz
	YJ1101	8.5 to 9.0	GHz
Power output (pulsed)		180	W

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

Unless otherwise stated, data is applicable to both types

CHARACTERISTICS

		Min.	Max.	
Frequency (tunable over the range)	YJ1100	9.0	9.5	GHz
	YJ1101	8.5	9.0	GHz
Pulse voltage (I_{pulse}=0.9A)		1.025	1.350	kV
R.F. pulse power output (I_{pulse}=0.9A)		150	-	W
Frequency pulling (v.s.w.r. =1.5:1)		-	15	MHz
Frequency temperature coefficient over the range T_{anode}=60 to 100°C		-	0.1	MHz/degC
Frequency modulation under vibration of 12g (50 to 2000Hz)		-	3.0	MHz
Input capacitance		-	6.0	pF
Frequency pushing (I_{pulse}=0.9A)		-	25	kHz/mA

TYPICAL OPERATION at f=9.25GHz (YJ1100) and f=8.75GHz (YJ1101)

R.F. pulse power output	180	W
Duty factor	0.002	
Pulse duration	1.0	µs
Pulse repetition frequency	2000	pulse/s
Heater voltage (running)	5.0	V
Pulse current	0.9	A
Pulse voltage	1.18	kV
Pulse input power	1.06	kW
Rate of rise of voltage pulse	10	kV/µs
Mean input current	1.8	mA
Mean input power	2.12	W
Mean r.f. output power	0.36	W
Frequency pulling (v.s.w.r. =1.5:1)	10	MHz
Frequency pushing	10	kHz/mA

CATHODE

Indirectly heated

V_h	5.0	V
I_h	0.5	A

Heating time. At ambient temperatures above $0^{o}C$ the cathode must be heated for at least 30 seconds before the application of h.t.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	0.7	1.1	A
Pulse duration	-	2.0	μs
Duty factor	-	0.004	
Mean input power	-	6.0	W
Rate of rise of voltage pulse	-	12	kV/μs
Load mismatch (v.s.w.r.)	-	1.5:1	
Temperature of anode block	-	100	^{o}C

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:

R.F. pulse power output (I_{pulse} = 0.9A)	120	W
Pulse voltage (I_{pulse} = 0.9A)	1.025 to 1.350	kV

MOUNTING POSITION Any

COOLING

In normal circumstances natural cooling is adequate but where the ambient temperature is abnormally high, or where convection cooling is restricted, provision for conduction cooling may be made by a clamp, of non-magnetic material, around the body.

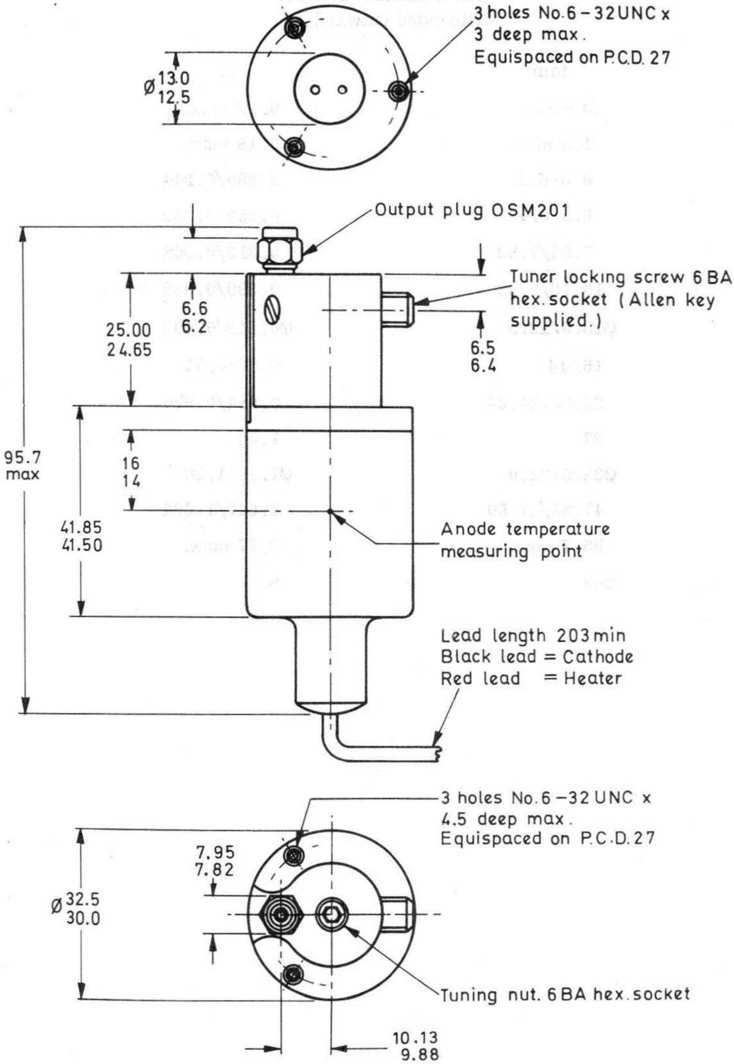
OPERATING NOTE

Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted.

PHYSICAL DATA

	kg	lb
Weight of magnetron	0.23	0.5

OUTLINE DRAWING OF YJ1100 AND YJ1101



All dimensions in mm D648

For conversion table see Page 4

CONVERSION TABLE
(Rounded outwards)

mm	in
3 max.	0.12 max.
4.5 max.	0.18 max.
6.6/6.2	0.260/0.244
6.5/6.4	0.256/0.252
7.95/7.82	0.313/0.308
10.13/9.88	0.399/0.389
Ø13.0/12.5	Ø0.512/0.492
16/14	0.63/0.55
25.00/24.65	0.984/0.970
27	1.06
Ø32.5/32.0	Ø1.28/1.26
41.85/41.50	1.647/1.634
95.7 max.	3.77 max.
203	8

QUICK REFERENCE DATA		
Fixed frequency'X'band magnetron		
Frequency YJ1110	9.345 to 9.405	Gc/s
YJ1111	9.415 to 9.475	Gc/s
Power output	20	kW
Construction	Packaged	

Unless otherwise shown, data is applicable to both types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

CHARACTERISTICS

	Min.		Max.	
Frequency YJ1110	9.345	to	9.405	Gc/s
YJ1111	9.415	to	9.475	Gc/s
Pulse voltage (I_{pulse} = 7.5A)	7.0		8.2	kV
R.F. pulse power output (I_{pulse} = 7.5A)	17		-	kW
Frequency pulling (v.s.w.r. = 1.5)	-		18	Mc/s
Frequency temperature coefficient	-		-0.25	Mc/s per degC
Distance of v.s.w. minimum from face of mounting plate into valve	16.5		22.5	mm
Input capacitance	-		8.0	pF
Frequency pushing	-		1.5	Mc/s per A

OPERATING CONDITIONS

R.F. pulse power output	20	20	20	kW
Duty factor	0.0005	0.0001	0.0005	
Pulse duration	0.5	0.1	0.05	µs
Pulse repetition frequency	1000	1000	1000	p.p.s.
Heater voltage (running)	6.3	6.3	6.3	V
Pulse current	7.5	7.5	7.5	A
Pulse voltage	7.8	7.8	7.8	kV
Pulse input power	58.5	58.5	58.5	kW
Rate of rise of voltage pulse	80	100	100	kV/µs
*Mean input current	3.75	0.8	0.425	mA
Mean input power	29	6.2	3.3	W
Mean r.f. output power	10	2.0	1.0	W
Frequency pulling (v.s.w.r. = 1.5)	16	16	16	Mc/s

*Includes pre-oscillation current.

CATHODE

Indirectly heated

V_h	6.3	V
I_h	0.55	A
r_h (cold)	1.75	Ω
$I_{h(surge)}$ max.	5.0	A

Heating time. At ambient temperatures above $0^{o}C$ the cathode must be heated for at least 2.0 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3.0 minutes.
For mean input powers greater than 25 watts, it is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the input power/heater voltage rating chart on page C3.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current ($t_p \leq 1.0\mu s$)	6.0	9.0	A
($t_p > 1.0\mu s$)	6.0	7.5	A
Pulse duration	0.05	2.5	μs
Duty factor	-	0.0015	
Mean input power	-	85	W
Rate of rise of voltage pulse	-	120	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	120	^{o}C

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:-

	Min.		Max.	
R.F. pulse power output (I_{pulse} = 7.5A)	14			kW
Frequency YJ1110	9.345	to	9.405	Gc/s
YJ1111	9.415	to	9.475	Gc/s
Pulse voltage (I_{pulse} = 7.5A)	7.0	to	8.4	kV

MOUNTING POSITION

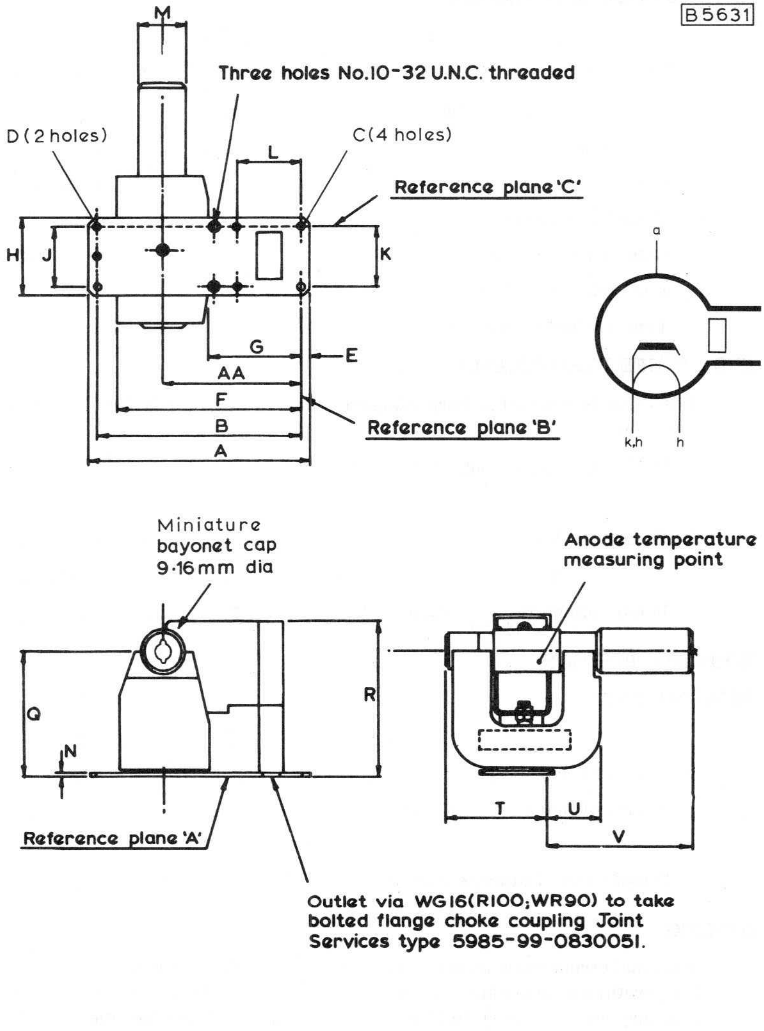
Any

PHYSICAL DATA

	lb	kg
Weight of magnetron	3.3	1.5
Weight of magnetron in carton	6.4	2.9
	in	cm
Dimensions of storage carton	7.8×8.0×9.8	19.7×20.4×24.8

COOLING

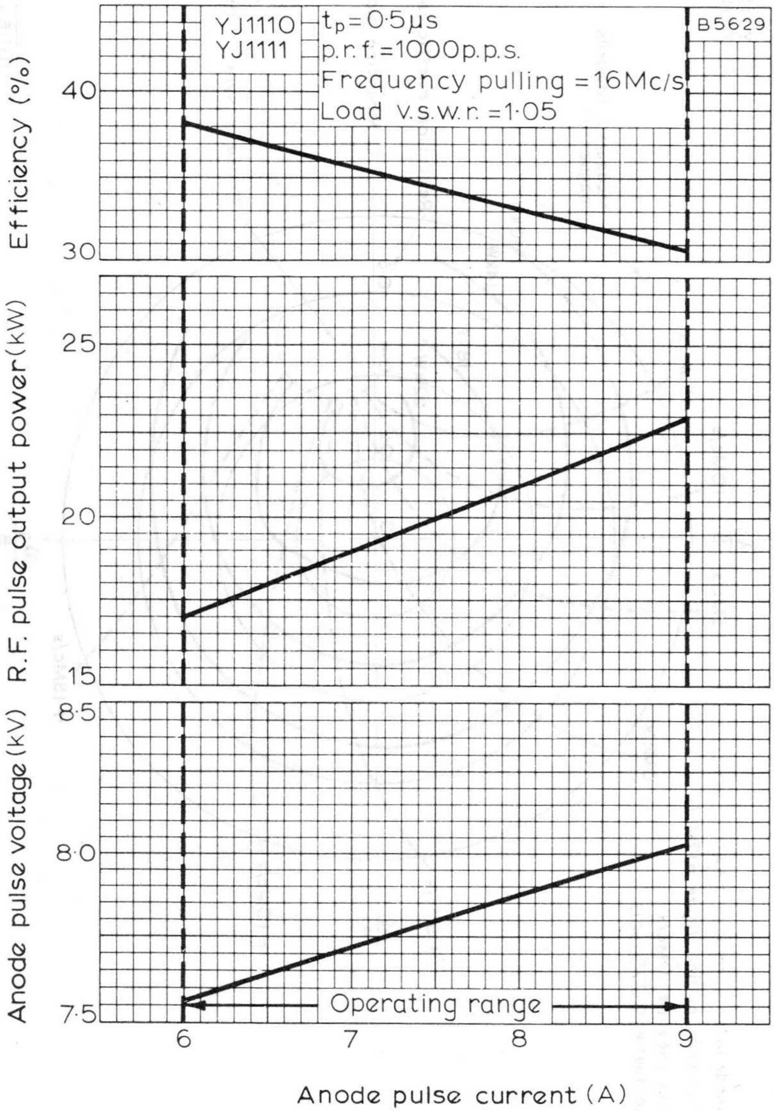
In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, a flow of cooling air between the radiator fins may be necessary to keep the block temperature below the permitted maximum.


B5631
M
Three holes No.10-32 U.N.C. threaded
D (2 holes)
C (4 holes)
L
Reference plane 'C'
H
J
K
G
E
AA
F
B
A
Reference plane 'B'
a
k,h
h
Miniature bayonet cap 9·16 mm dia
Anode temperature measuring point
R
Q
N
T
U
V
Reference plane 'A'
Outlet via WG16(R100;WR90) to take bolted flange choke coupling Joint Services type 5985-99-0830051.

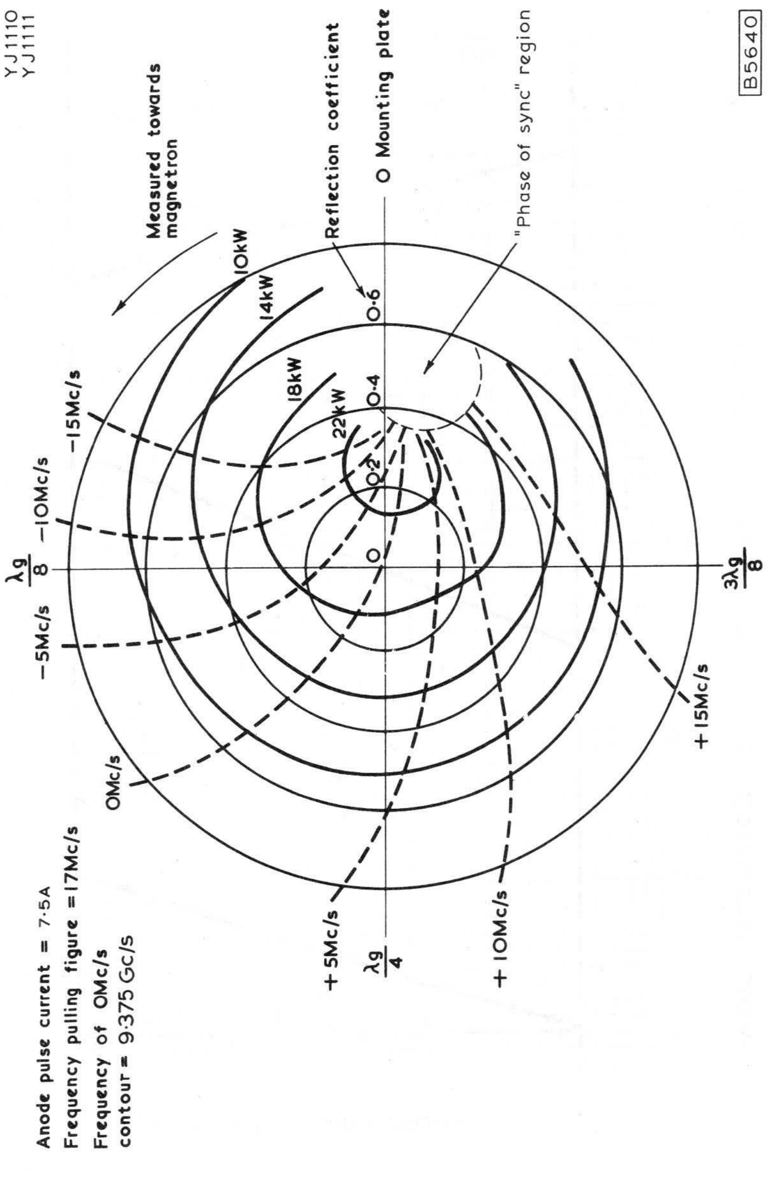
DIMENSIONS

	Inches	Millimetres	
A	4.468	113.5	max.
B	4.102 ± 0.004	104.2 ± 0.10	
C	0.170 ± 0.003	4.32 ± 0.08	dia.
D	0.175 ± 0.003	4.45 ± 0.08	dia.
E	0.188	4.80	max.
F	4.01	102	max.
G	1.851	47.00	min.
H	1.641	41.70	max.
J	1.220 ± 0.003	30.99 ± 0.08	
K	1.220 ± 0.003	30.99 ± 0.08	
L	1.280 ± 0.004	32.51 ± 0.10	
M	1.000	25.40	max. dia.
N	0.125 ± 0.009	3.18 ± 0.25	
Q	2.56 ± 0.12	65 ± 3.0	
R	3.307	84.00	max.
T	2.165	55.00	max.
U	1.102	28.00	max.
V	3.070	78.00	max.
AA	2.99 ± 0.12	76 ± 3.0	

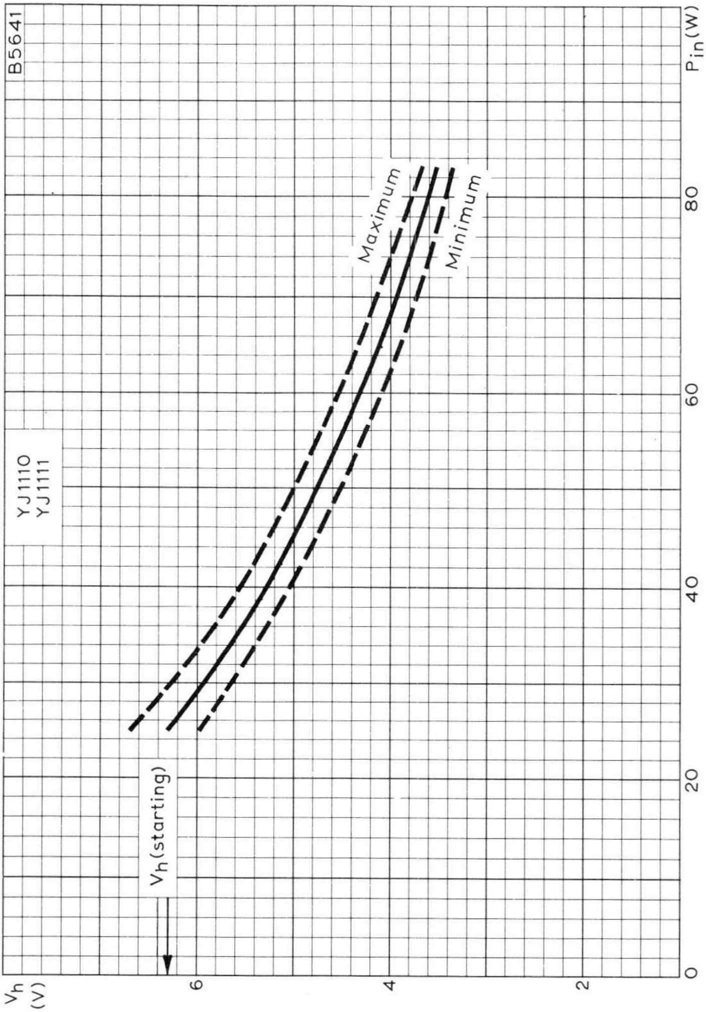
Inch dimensions derived from original millimetre dimensions



ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



RIEKE DIAGRAM



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER

QUICK REFERENCE DATA	
Fixed frequency 'X' band magnetron	
Frequency	9.380 to 9.440 Gc/s
Power output	25 kW
Construction	Packaged, flying leads

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

CHARACTERISTICS

	Min.	Max.	
Frequency fixed within the band	9.380	9.440	Gc/s
Pulse voltage (I_{pulse} = 8.0A)	7.5	8.5	kV
R.F. pulse power output (I_{pulse} = 8.0A)	20	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	18	Mc/s
Frequency temperature coefficient	-	-0.25	Mc/s per degC
Distance of v.s.w. minimum from face of mounting plate into valve	16.5	22.5	mm
Input capacitance	-	8.0	pF
Frequency pushing	-	1.5	Mc/s per A

OPERATING CONDITIONS

R.F. pulse power output	25	25	25	25	kW
Duty factor	0.0001	0.00015	0.0005	0.0006	
Pulse duration	0.05	0.15	0.5	1.2	μs
Pulse repetition frequency	2000	1000	1000	500	p.p.s.
Heater voltage (running)	6.3	6.3	6.3	6.3	V
Pulse current	8.0	8.0	8.0	8.0	A
Pulse voltage	8.2	8.2	8.2	8.2	kV
Pulse input power	66	66	66	66	kW
Rate of rise of voltage pulse	120	120	100	100	kV/μs
Mean input current	*0.85	*1.25	4.0	4.8	mA
Mean input power	6.4	9.6	32	38.4	W
Mean r.f. output power	2.5	3.75	12.5	15	W
Frequency pulling (v.s.w.r. = 1.5)	16	16	16	16	Mc/s

*Includes pre-oscillation current.

CATHODE

Indirectly heated

V_h	6.3	V
I_h	0.55	A
r_h (cold)	1.75	Ω
$I_{h(surge)}$ max.	5.0	A

Heating time. At ambient temperatures above $0^{\circ}C$ the cathode must be heated for at least 2.0 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3.0 minutes.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	6.0	9.5	A
Pulse duration	-	1.5	μs
Duty factor	-	0.0015	
Mean input power	-	85	W
Rate of rise of voltage pulse	-	120	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	
Temperature of anode block	-	120	$^{\circ}C$

END OF LIFE PERFORMANCE

The valve is deemed to have reached end of life when it fails to satisfy the following:

	Min.		Max.	
R.F. pulse power output (I_{pulse} = 8.0A)			16	kW
Frequency fixed within the band	9.380	to	9.440	Gc/s
Pulse voltage (I_{pulse} = 8.0A)	7.5	to	8.7	kV

MOUNTING POSITION

Any

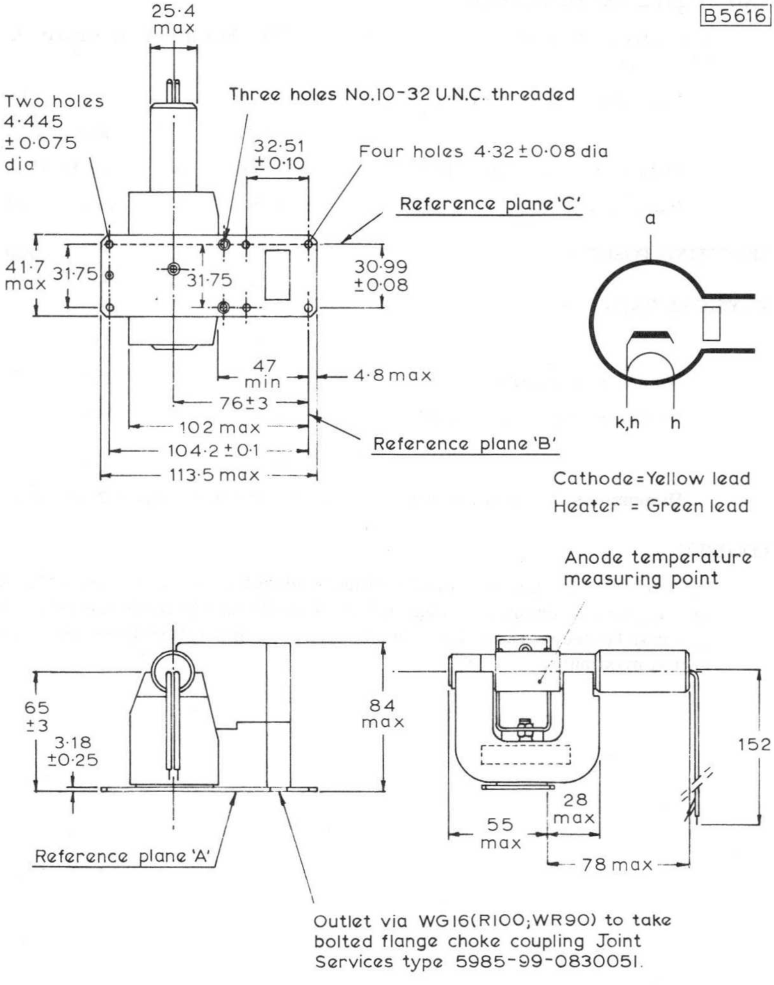
PHYSICAL DATA

	lb	kg
Weight of magnetron	3.3	1.5
Weight of magnetron in carton	6.4	2.9

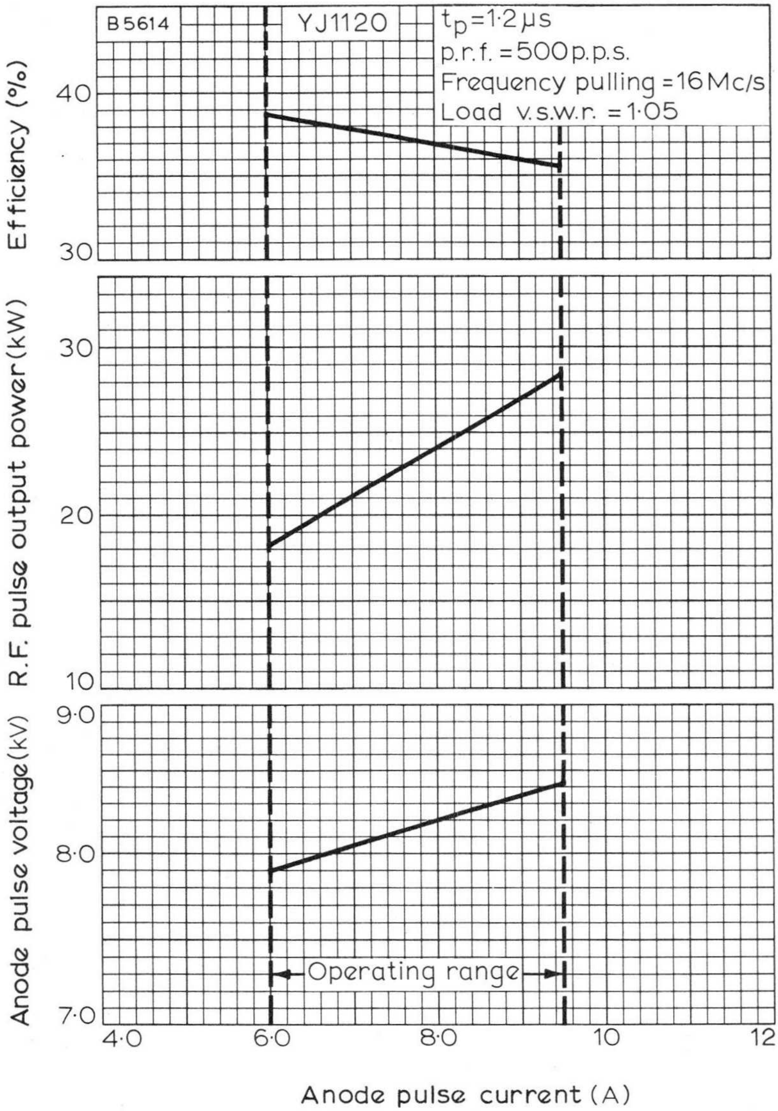
	in	cm
Dimensions of storage carton	7.8 × 8.0 × 9.8	19.7 × 20.4 × 24.8

COOLING

In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, a flow of cooling air between the radiator fins may be necessary to keep the anode block temperature below the permitted maximum.



All dimensions in mm



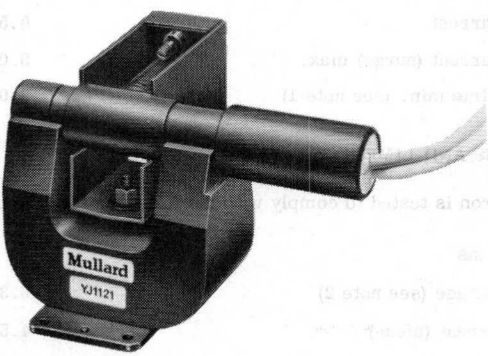
ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT

MAGNETRON

YJ1121

QUICK REFERENCE DATA		
X-Band, fixed frequency, pulsed magnetron		
Frequency (fixed within the band)	9.415 to 9.475	GHz
Power output (peak)	26	kW
Construction		Packaged
Output connection		Waveguide 16 flange

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

Operating conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	9.0	9.0	A
Pulse duration (t_p)	0.05	0.75	μs
Pulse repetition rate	2400	800	pulse/s
Rate of rise of voltage pulse	110	110	kV/μs

Typical performance

Anode voltage (peak)	8.3	8.3	kV
Power output (peak)	26	26	kW
Power output (mean)	3.12	15.6	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.55	A
Heater current (surge) max.	5.0	A
Heating time min. (see note 1)	2.0	minutes

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage (see note 2)	6.3	V
Anode current (mean)	4.5	mA
Duty factor	0.0005	
Pulse duration (t_p) (see note 3)	0.5	μs
v.s.w.r. at output connection	$\leq$1.05:1	
Rate of rise of voltage pulse (see note 4)	120	kV/μs

TEST CONDITIONS AND LIMITS (contd.)

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	7.5	8.5	kV
Power output (mean)	11	-	W
Frequency (see note 5)	9.415	9.475	GHz
R.F. Bandwidth at 1/4 power (see note 3)	-	$\frac{2.5}{t_p}$	MHz
Frequency pulling (v.s.w.r. = 1.5:1)	-	18	MHz
Minor lobe level (v.s.w.r. = 1.5:1)	6.0	-	dB
Stability (see note 6)	-	0.25	%
Cold impedance (see note 7)			
Heater current (see note 8)			
Frequency temperature coefficient (see note 9)			
Input capacitance (see note 10)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 11)	5.7	6.9	V
Anode voltage (peak)	7.5	8.5	kV
Anode current (peak)	6.0	10	A
Power input (peak)	-	75	kW
Power input (mean)	-	85	W
Duty factor	-	0.0015	
Pulse duration (t_p)	-	2.0	μs
Rate of rise of voltage pulse (see note 4)	-	120	kV/μs
Anode temperature	-	120	^oC
v.s.w.r. at output connection	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on pages 2 and 3.

	Min.	Max.	
Anode voltage (peak)	7.5	8.5	kV
Power output (mean)	9.0	-	W
Frequency (fixed within the band)	9.415	9.475	GHz

MOUNTING POSITION (see note 12) Any

COOLING

Natural or forced-air as necessary to ensure that the temperature of the anode does not exceed the maximum stated in "Ratings".

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.4	3.0
Weight of magnetron in storage carton	2.9	6.4
	mm	in
Dimensions of storage carton	199 × 203 × 249	7.8 × 8.0 × 9.8

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above $0^{o}C$ the cathode must be heated for at least 2 minutes before the application of h.t. For ambient temperatures between 0 and $-55^{o}C$ the cathode heating time is 3 minutes minimum.

2. With no anode input power. For mean values of input power greater than 45 watts the heater voltage should be reduced.

3. The tolerance of current pulse duration (t_p) measured at 50% amplitude is ±10%.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

5. Magnetrons with other frequency ranges can be supplied to order.

6. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 6.0 to 10mA mean. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.415 to 9.475GHz. 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 cold impedance is measured at the operating frequency and will give a v.s.w.r. of >6:1. The position of the voltage minimum from the face of the output flange into the magnetron is 16.5 to 22.5mm.

8. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.43 to 0.6A.

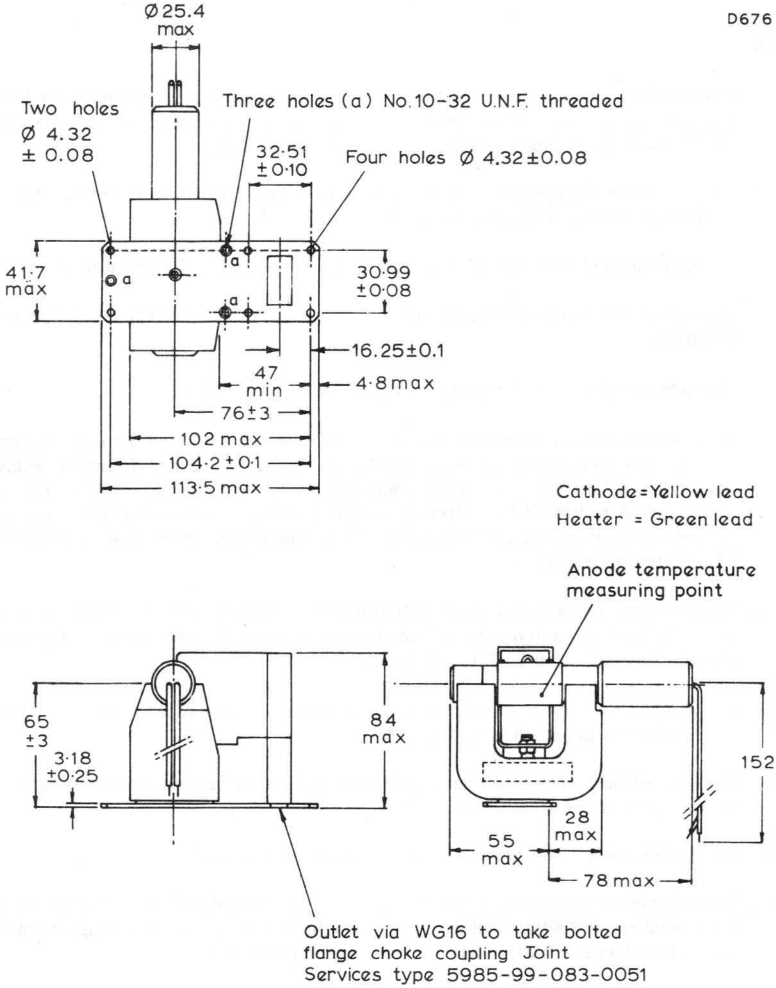
9. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/degC.

10. Design test only. The maximum input capacitance is 9pF.

11. The magnetron is normally tested with a heater supply of 50Hz and is suitable for operation at 800Hz. Mullard Ltd., should be consulted if the magnetron is to be operated with a heater supply of any other frequency.

12. It is necessary to keep all magnetic material as far as possible, at least 50mm (2 in), from the magnet. The inner polystyrene pack of the magnetron carton provides adequate separation between magnetrons, and it is recommended that magnetrons not in use be kept in these cartons.

OUTLINE DRAWING OF YJ1121



All dimensions in mm

CONVERSION TABLE
(Rounded outwards)

mm	in
3.18 ± 0.25	0.125 ± 0.010
Ø 4.32 ± 0.08	Ø 0.1701 ± 0.0032
4.8 max.	0.189 max.
16.25 ± 0.1	0.640 ± 0.004
Ø 25.4 max.	Ø 1.00 max.
28 max.	1.10 max.
30.99 ± 0.08	1.2201 ± 0.0032
32.51 ± 0.10	1.280 ± 0.004
41.7 max.	1.642 max.
47 min.	1.85 min.
55 max.	2.17 max.
65 ± 3	2.56 ± 0.12
76 ± 3	2.99 ± 0.12
78 max.	3.07 max.
84 max.	3.31 max.
102 max.	4.02 max.
104.2 ± 0.1	4.102 ± 0.004
113.5 max.	4.47 max.
152	5.98

QUICK REFERENCE DATA		
Pulsed magnetron tunable by means of an integral servo-motor over 450MHz sweep in 500μs.		
Frequency	8.7 to 9.5	GHz
Power output	205	kW

Unless otherwise shown, data is applicable to all types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS (at f = 9.075GHz centre ± 250MHz range)

R.F. pulse power output	205	205	kW
Duty factor	0.0007	0.001	
Pulse duration	0.2	1.0	μs
Pulse repetition frequency	3500	1000	p.p.s.
Heater voltage (running)	7.7	5.0	V
Pulse current	27.5	27.5	A
Pulse voltage	22.5	22.5	kV
Pulse input power	619	619	kW
Rate of rise of voltage pulse	200	180	kV/μs
Mean input current (I_{mean})	19.25	27.5	mA
Mean input power	433	619	W
Mean r.f. output power	143	205	W
Frequency pulling (v.s.w.r. = 1.5)	12	12	MHz

CATHODE

Indirectly heated

V_h	13.75 ± 10%	V
I_h	3.15 ± 10%	A
I_h (surge) max.	12	A

The valve heater shall be protected against arcing by the use of a connector that places a minimum capacitance of 4000pF across the heater directly at the input terminals.

Heating time. At ambient temperatures above 0°C the cathode must be heated for at least 2.5 minutes before the application of h.t.

It is necessary to reduce the heater voltage immediately after the application of h.t. in accordance with the formula:

$$V_h = 13.75\left(1 - \frac{I_{mean}}{43}\right)$$

CHARACTERISTICS

	Min.	Max.	
Frequency	8.7	9.5	GHz
*Frequency sweep	400	-	MHz
Pulse voltage (I_{pulse} = 27.5A)	21	24	kV
R.F. pulse power output (I_{pulse} = 27.5A)	180	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	15	MHz
Frequency temperature coefficient	-	-0.5	MHz/degC
Frequency pushing	-	0.5	MHz per A
Hot to cold frequency difference	9.0	16	MHz

*An alternative version (YJ1181) is available with an optional frequency lock. This allows the tube to be frequency locked to within 20MHz of any predetermined frequency. The external dimensions remain unchanged.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	-	27.5	A
Pulse duration	0.15	1.5	μs
Duty factor	-	0.0011	
Mean input power	-	660	W
Rate of rise of voltage pulse			
Short pulse operation - up to 1.0μs	-	200	kV/μs
Long pulse operation - up to 2.0μs	-	180	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	

TUNING

Tuning programme	16 full cycles per shaft revolution. One cycle consists of a quasi-sinusoidal scan through the entire tuning range and return.
Integral servo-motor	Navy Bu. Ord. Size 18 servo-motor N.A.T.O. number 6105-99-972-6555
Drive input	115V, 400Hz, fixed phase 115V, 400Hz, centre tapped control phase 9.2W/phase
Minimum drive speed	4000 r.p.m.

MOUNTING POSITION	Any

PRESSURISING

To prevent arcing the air pressure in the waveguide should not be less than 740 torr.

PHYSICAL DATA

	kg	lb
Weight of magnetron	6.8	15

COOLING

Forced-air cooling is required in order to keep the anode block temperature below the permitted maximum.
An air flow of approximately 0.85m^3/min. (30ft^3/min.) should be directed on the cooling fins.

Temperature

Anode block max.	120	^oC

OUTPUT CONNECTION

Suitable for connection to waveguide RG51/U (WG15, R84)

OPERATING NOTES

Tunable version with optional fixed frequency lock, YJ1181.

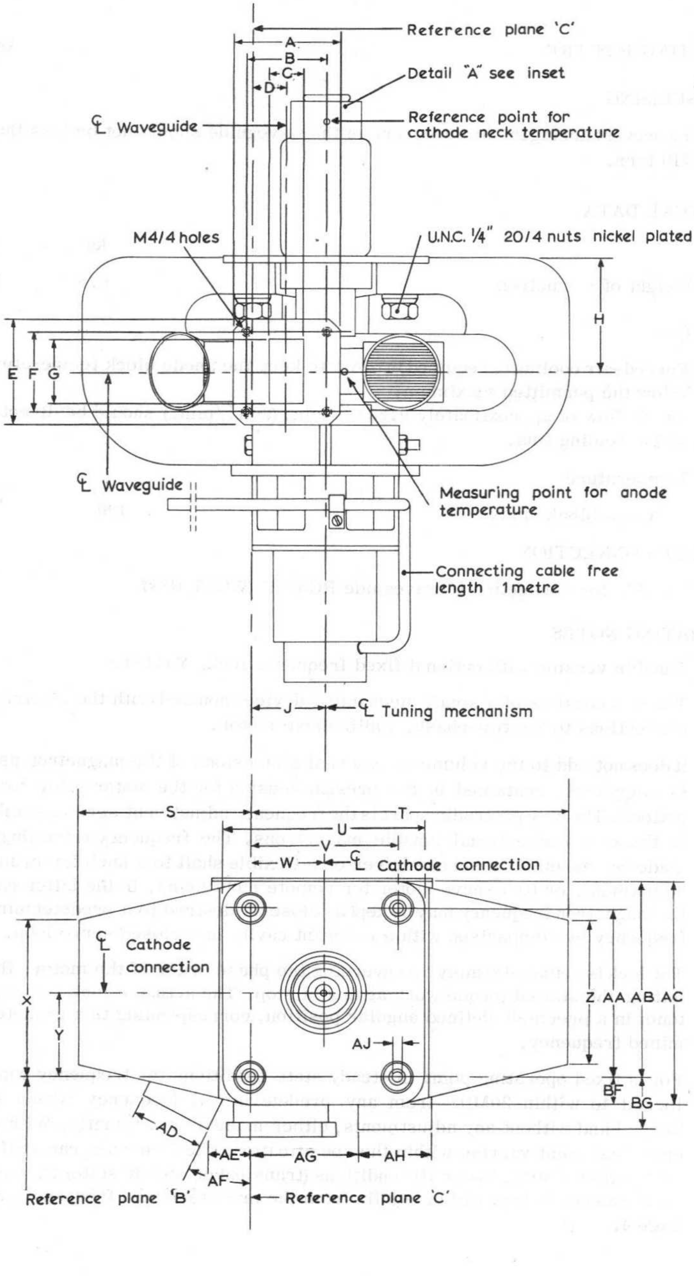
The lock consists of a small mechanical device mounted with the electrical connections to the two-phase, 400Hz drive motor.

It does not add to the volume or external dimensions of the magnetron as it is completely contained in the present housing for the motor cable connections. The only protruding part is the frequency adjustment screw, similar to those of conventional tunable magnetrons. The frequency trimming is made by means of a screw-driver or a flexible shaft to a knob for manual adjustment, or to a servo motor for remote monitoring. In the latter case the magnetron frequency may be kept as close as desired to a predetermined frequency by comparison with a resonant cavity in a closed servo loop.

The lock is actuated simply by reversing the phase order of the motor, thus letting the stalled torque work against a stop. The actuated lock keeps the tuner in a precisely defined angular position, corresponding to a predetermined frequency.

For a fixed operating point in steady state conditions the frequency can be locked to within 20MHz from any predetermined frequency within the tuning band without any adjustments, either manual or automatic. With the operating point varying within the specification, the frequency can still be kept within 35MHz. Under all conditions (transient or steady state) the locking frequency is kept within 60MHz from the predetermined frequency. See page 4.

OUTLINE AND DIMENSIONS OF YJ1180 AND YJ1181

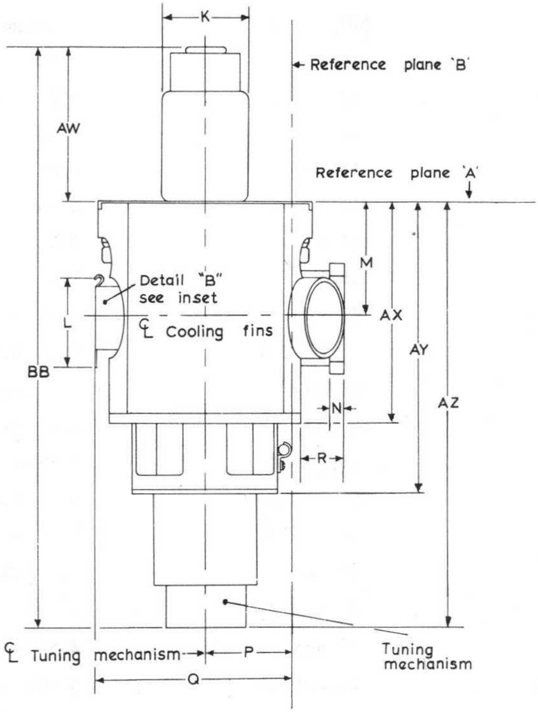


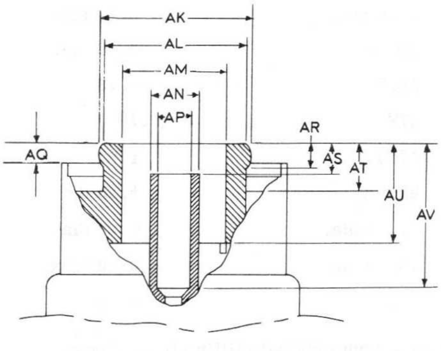
DIMENSIONS OF YJ1180 AND YJ1181

	Millimetres	Inches
A	46.5	1.83
B	37.4 ± 0.1	1.47 ± 0.004
C	12.6	0.49
D	14.75 ± 1.2	0.58 ± 0.05
E	46.5	1.83
F	34.3 ± 0.1	1.35 ± 0.004
G	28.5	1.12
H	47.1 ± 1.2	1.85 ± 0.05
J	31.75 ± 2.0	1.25 ± 0.08
S	75 max.	2.95 max.
T	138.5 max.	5.45 max.
U	88.1 max.	3.47 max.
V	63.5 ± 0.25	2.50 ± 0.01
W	31.75 ± 1.2	1.25 ± 0.05
X	75 max.	2.95 max.
Y	38.1 ± 1.2	1.50 ± 0.05
Z	73 max.	2.87 max.
AA	76.2 ± 0.25	3.00 ± 0.01
AB	86.9 max.	3.42 max.
AC	98.4 max.	3.87 max.
AD	32 dia.	1.26 dia.
AE	18.5	0.73
AF	27°	27°
AG	47.5	1.87
AH	32 dia.	1.26 dia.
AJ	7.15 dia.	0.28 dia.
BF	10.7 max.	0.42 max.
BG	22.5	0.89

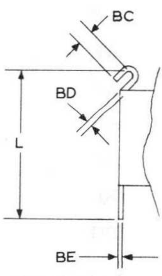
Inch dimensions derived from original millimetre dimensions

OUTLINE AND DIMENSIONS OF YJ1180 AND YJ1181





DETAIL "A"



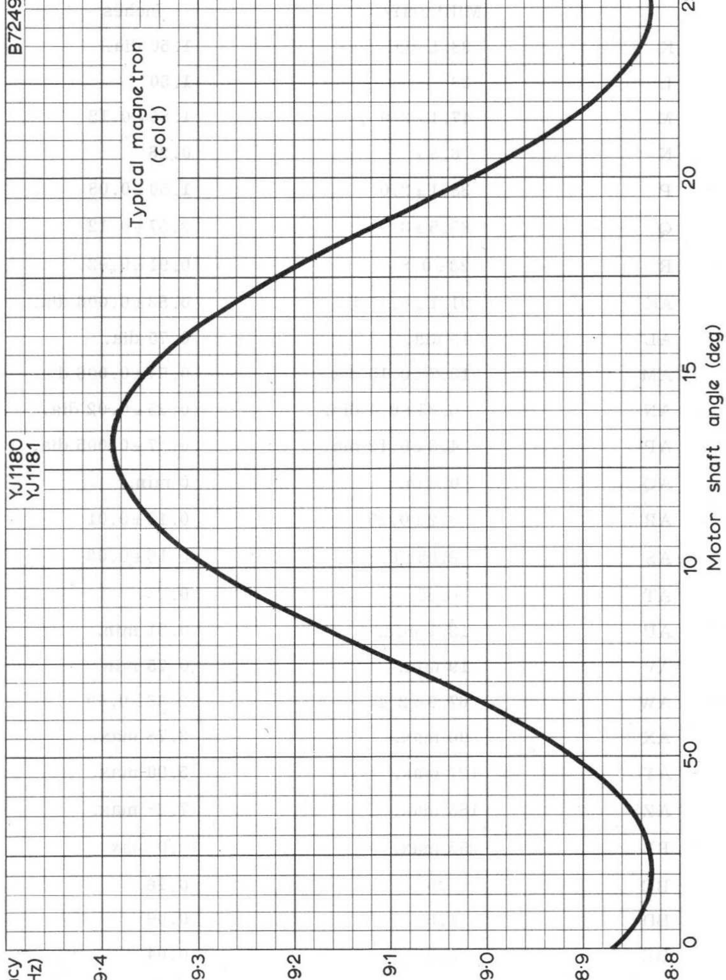
DETAIL "B"

B7248

DIMENSIONS OF YJ1180 AND YJ1181

	Millimetres	Inches
K	38.1 dia.	1.50 dia.
L	38	1.50
M	47.1 ± 3.0	1.85 ± 0.12
N	6.5	0.26
P	38.1 ± 2.0	1.50 ± 0.08
Q	85.5 ± 3.0	3.37 ± 0.12
R	23 ± 0.8	0.91 ± 0.03
AK	21.1 ± 0.15 dia.	0.83 ± 0.006 dia.
AL	19 dia.	0.75 dia.
AM	13.7 ± 0.15 dia.	0.54 ± 0.006 dia.
AN	6.35 ± 0.4 dia.	0.25 ± 0.02 dia.
AP	4.3 ± 0.12 dia.	0.17 ± 0.005 dia.
AQ	0 min.	0 min.
AR	3.2 ± 0.25	0.13 ± 0.01
AS	3.95 ± 0.8	0.16 ± 0.03
AT	6.35	0.25
AU	13.1 min.	0.51 min.
AV	19 min.	0.75 min.
AW	67.5 ± 2.4	2.66 ± 0.09
AX	96 max.	3.78 max.
AY	127 max.	5.00 max.
AZ	185 max.	7.28 max.
BB	255 max.	10.0 max.
BC	4.0	0.16
BD	1.6	0.06
BE	1.0	0.04

Inch dimensions derived from original millimetre dimensions



PASSIVE RESONANCE FREQUENCY AS A FUNCTION OF
THE MOTOR SHAFT ANGLE

MAGNETRON

YJ1200
YJ1201

TENTATIVE DATA

QUICK REFERENCE DATA	
High altitude magnetrons for X-band operation. Output coupling to type YJ1200 is WG16, and to type YJ1201 is WG15.	
Frequency	9.375 GHz
Power output	50 kW
Construction	Packaged with flying leads

Unless otherwise shown, data is applicable to both types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. pulse power output	50	kW
Duty factor	0.0016	
Pulse duration	4.0	μs
Pulse repetition frequency	400	p.p.s.
Heater voltage (running)	7.7	V
Pulse current	12	A
Pulse voltage	12	kV
Pulse input power	144	kW
Rate of rise of voltage pulse	60	kV/μs
Mean input current	19.2	mA
Mean input power	230	W
Mean r.f. output power	80	W
Frequency pulling (v.s.w.r. = 1.3)	10	MHz

CATHODE

Indirectly heated

V_h	12.4	V
I_h	2.2±0.2	A
$I_{h(surge)}$ max. starting	10	A

The cathode must be heated for at least 90 seconds before the application of h.t.

CHARACTERISTICS

	Min.	Max.	
Frequency fixed within the band	9.345	9.405	GHz
Pulse voltage (I_{pulse} = 12A)	11	12.5	kV
R.F. pulse power output (I_{pulse} = 12A)	40	-	kW
Frequency pulling (v.s.w.r. = 1.3)	-	15	MHz
Frequency temperature coefficient	-	-0.25	MHz/degC
Frequency pushing	-	0.5	MHz/A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	8.0	14	A
Pulse duration	-	5.0	μs
Duty factor	-	0.0025	
Mean input power	-	350	W
Rate of rise of voltage pulse	-	80	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	

END OF LIFE PERFORMANCE

The magnetron is deemed to have reached end of life when it fails to satisfy the following:-

	Min.	Max.	
R.F. pulse power output (I_{pulse} = 12A)		35	kW
Frequency fixed within the band	9.345	9.405	GHz
Pulse voltage (I_{pulse} = 12A)	11	13.5	kV

MOUNTING POSITION

Any

COOLING

Temperatures

Anode block max.	120	^{o}C
Cathode and heater seals max.	150	^{o}C

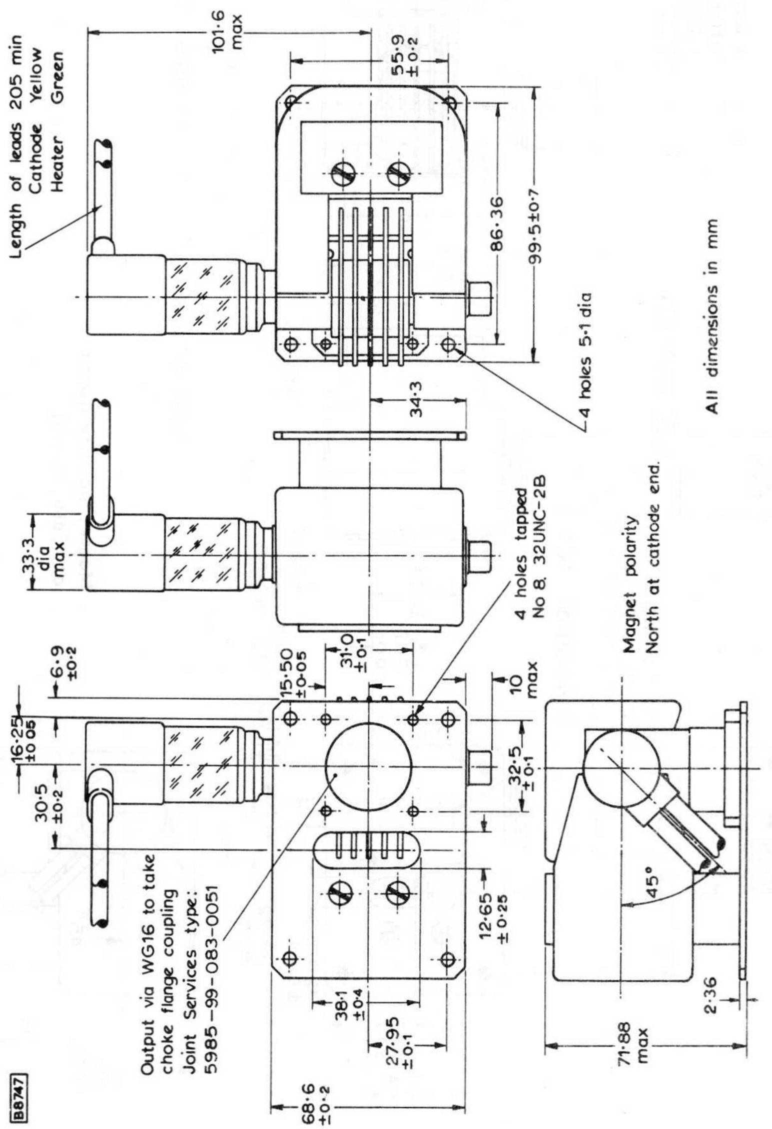
PRESSURISING

The magnetron is capable of unpressurised operation at altitudes up to 30 000ft for the YJ1200 and 40 000ft for the YJ1201.

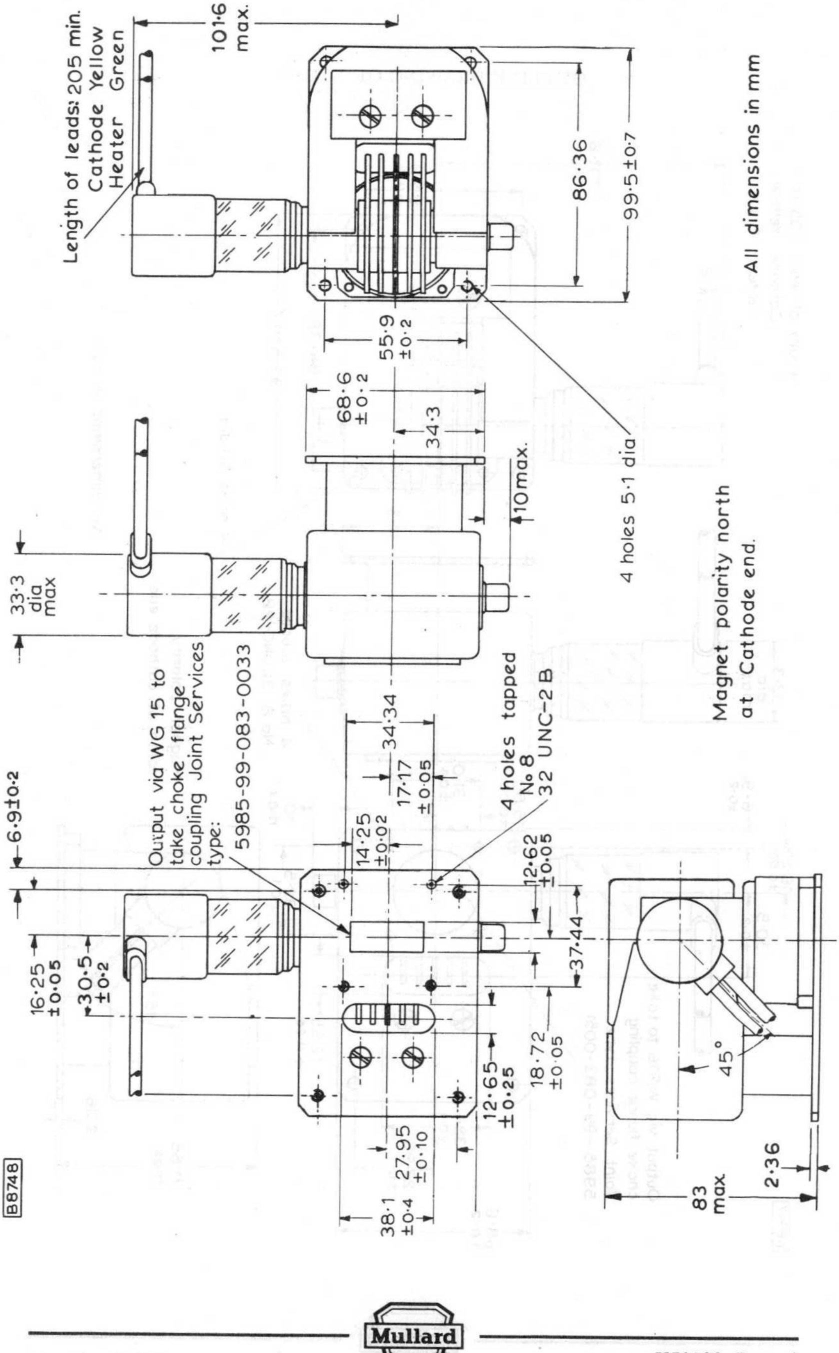
PHYSICAL DATA

Weight of magnetron	1.9	kg

OUTLINE DRAWING OF YJ1200



OUTLINE DRAWING OF YJ1201



MAGNETRON YJ1250

TENTATIVE DATA

QUICK REFERENCE DATA		
X-Band fixed frequency rugged magnetron		
Frequency	9.345	GHz
Power output (pk)	90	kW
Construction	Lightweight, packaged with flying leads	

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS-MICROWAVE DEVICES

OPERATING CONDITIONS

R.F. Pulse power output	90	kW
Duty factor	0.0012	
Pulse duration	6.0	μs
Pulse repetition frequency	200	p.p.s.
Heater voltage (running)	7.7	V
Pulse current	17.5	A
Pulse voltage	15.2	kV
Pulse input power	265	kW
Rate of rise of voltage pulse	50	kV/μs
Mean input current	21	mA
Mean input power	320	W
Mean r.f. output power	108	W
Frequency pulling (v.s.w.r. =1.3)	10	MHz

CATHODE

Indirectly heated

V_h	12.6	V
I_h	2.0 to 2.4	A
$I_{h(surge)}$ max.	10	A
r_h (cold)	0.65	Ω

The cathode must be heated for at least 90 seconds before the application of h.t.

CHARACTERISTICS

	Min.	Max.	
Frequency fixed within the band	9.315	9.375	GHz
Pulse voltage (I_{pulse} = 17.5A)	14	16	kV
R.F. Pulse power output (I_{pulse} = 17.5A)	85	120	kW
Frequency pulling (v.s.w.r. = 1.3)	-	15	MHz
Frequency temperature coefficient	-	−0.25	MHz per degC
Input capacitance	-	14	pF
Frequency pushing	-	0.5	MHz per A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Pulse current	15	20	A
Pulse duration	-	7.0	μs
Duty factor	-	0.0015	
Mean input power	-	400	W
Rate of rise of voltage pulse	-	90	kV/μs
Load mismatch (v.s.w.r.)	-	1.5	

END OF LIFE PERFORMANCE

The magnetron is deemed to have reached end of life when it fails to satisfy the following:-

	Min.	Max.	
R.F. Pulse power output (I_{pulse} = 17.5A)	75		kW
Frequency fixed within the band	9.315	9.375	GHz
Pulse voltage (I_{pulse} = 17.5A)	14	17	kV

MOUNTING POSITION

Any

PHYSICAL DATA

Weight of magnetron	1.9	kg

COOLING

Temperatures

Anode block max.	120	°C
Cathode and heater seals max.	150	°C

PRESSURISING

The cathode stem bushing will not arc over at a reduced atmospheric pressure equivalent to an altitude of 35 000ft. The output system will operate satisfactorily at a reduced atmospheric pressure equivalent to an altitude of 25 000ft with a load v.s.w.r. of 1.5:1 varied through all phases.

VIBRATION

The magnetron will operate normally when subjected to sinusoidal vibrations of amplitude ±0.5mm or 1.5g which ever is the smaller in the frequency range 5 to 150Hz in any plane and the total frequency deviation shall not exceed 100kHz.

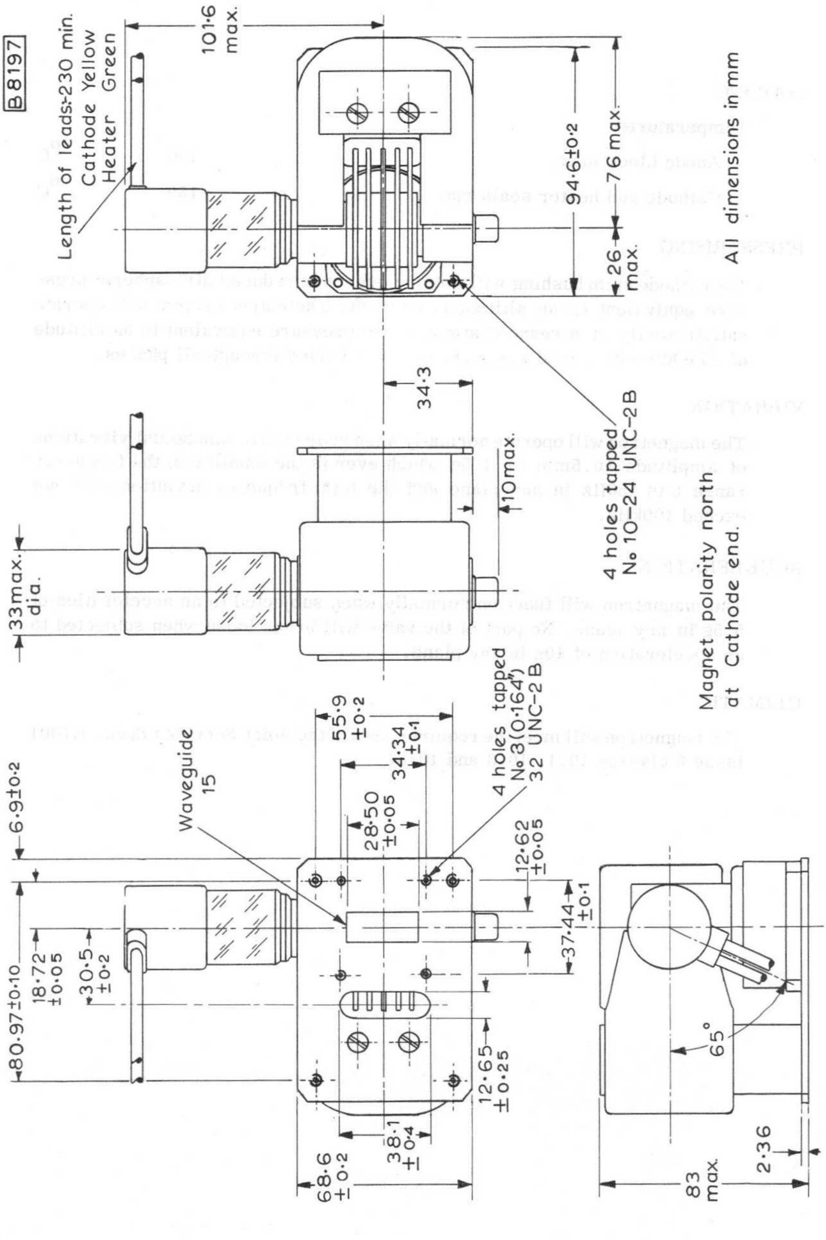
ACCELERATION

The magnetron will function normally when subjected to an acceleration of 5.5g in any plane. No part of the valve will break loose when subjected to an acceleration of 10g in any plane.

CLIMATIC

The magnetron will meet the requirements of the Joint Services Spec. K1001 issue 6 clauses 10.1, 10.3 and 10.8.

OUTLINE DRAWING OF YJ1250



MAGNETRON YJ1290

TENTATIVE DATA

QUICK REFERENCE DATA

X-band, fixed frequency, pulsed magnetron

Frequency (fixed within the band)	9.415 to 9.475	GHz
Power output (peak)	65	kW
Construction		Packaged
Output connection		Waveguide 16 flange

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

Operating conditions

Heater voltage	1.0		V
Anode current (peak)	14		A
Pulse duration (t_p)	0.5		μs
Pulse repetition rate	1250		pulse/s
Rate of rise of voltage pulse	145		kV/μs

Typical performance

Anode voltage	14		kV
Power output (peak)	65		kW
Power output (mean)	40.5		W

CATHODE

Indirectly heated

Heater voltage (see notes 1 and 9)	6.3	V
Heater current	1.0	A
Heater current (surge) max.	5.0	A
Heating time min. (see note 2)	2.0	minutes

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification:-

Test conditions

Heater voltage (for test)	0		V
Anode current (mean)	8.8		mA
Duty factor	0.00062		
Pulse duration (t_p) see note 3	0.5		μs
v.s.w.r. at output connection	$\ngtr$1.05:1		
Rate of rise of voltage pulse (see note 4)	$\nless$150		kV/μs

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	12.5	15	kV
Power output (mean)	34	-	W
Frequency	9.415	9.475	GHz
R.F. Bandwidth at 1/4 power (see note 3)	-	$\frac{2.5}{tp}$	
Frequency pulling (v.s.w.r. =1.5:1)	-	15	MHz
Minor lobe level (v.s.w.r. =1.5:1)	6.0	-	dB
Stability (see note 5)	-	0.25	%

Heater current (see note 6)

Frequency temperature coefficient (see note 7)

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.7	7.0	V
Anode voltage (peak)	-	16	kV
Anode current (peak)	12	16	A
Power input (mean)	-	160	W
Duty factor	-	0.001	
Pulse duration (t_p) (see note 3)	-	1.0	μs
Rate of rise of voltage pulse (see note 4)	100	150	kV/μs
Anode temperature (see note 8)	-	120	^{o}C
v.s.w.r. at output connection	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd. should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when tested as specified on page 2.

	Min.	Max.	
Power output (peak)	50	-	kW
Frequency	9.415	9.475	GHz
R.F. bandwidth at 1/4 power	-	$\frac{3.5}{t_p}$	MHz
Stability	-	0.5	%

MOUNTING POSITION (see note 10) Any

COOLING

Adequate cooling is provided at maximum mean input power by an airflow of 0.43m^3/min (15ft^3/min) at T_{amb} = 55^{o}C and standard pressure from an orifice of 31.75mm (1.250in) diameter located at 6.35mm (0.250in) from the cooling fins.

PHYSICAL DATA

	kg	lb	
Weight of magnetron	2.1	4.6	
Weight of magnetron in storage carton	2.75	6.0	
Dimensions of storage carton	215.9 × 247.65 × 266.7		mm
	8.5 × 9.75 × 10.5		in.

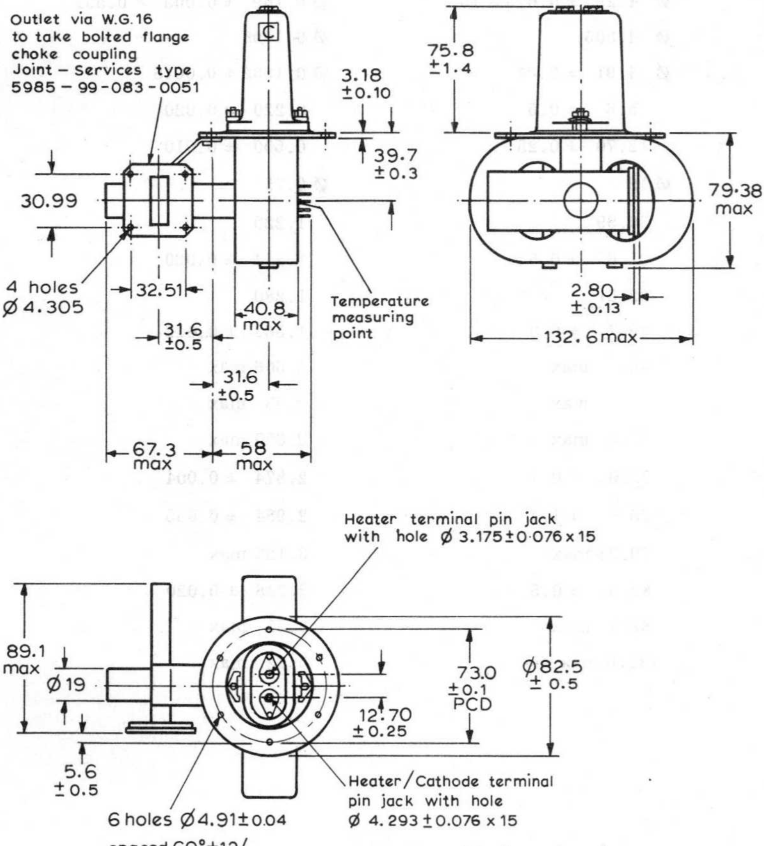
VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. With no anode input power. The heater voltage during operation is very dependant on the application and should be agreed with Mullard Ltd.
2. For ambient temperatures above $-15^{o}C$ the cathode must be heated for at least 2 minutes before the application of H.T. For ambient temperatures between $-15^{o}C$ and $-55^{o}C$ the cathode heating time is 3 minutes minimum.
3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is ±10%.
4. Defined as the steepest tangent to the leading edge of the anode voltage pulse above 80% amplitude.
5. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over the anode current range of 12A to 16A peak. Pulses are defined as missing when the r.f. energy level is < 70% of the normal level in the frequency range 9.415GHz to 9.475GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 3 minutes of operation.
6. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.9 and 1.1A.
7. Design test only. The maximum frequency change with anode temperature change, after warming, is -0.25MHz/degC.
8. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified.
9. The magnetron is normally tested with a heater supply of 50Hz and is suitable for operation at 1.1kHz. Mullard Ltd. should be consulted if the magnetron is to be operated with a heater supply of any other frequency.
10. It is necessary to keep all magnetic material as far as possible, at least 50mm (2in.) away from the magnet. The inner polystyrene pack of the magnetron carton provides adequate separation between magnetrons, and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING



All dimensions in mm

Millimetre to inch conversion table overleaf

Millimetre to inch conversion table (rounded outwards).

Millimetres	Inches
2.80 ± 0.13	0.110 ± 0.005
Ø 3.175 ± 0.076 × 15	Ø 0.125 ± 0.003 × 0.591
3.18 ± 0.10	0.1252 ± 0.0040
Ø 4.293 ± 0.076 × 15	Ø 0.169 ± 0.003 × 0.591
Ø 4.305	Ø 0.1695
Ø 4.91 ± 0.04	Ø 0.1932 ± 0.0015
5.6 ± 0.5	0.220 ± 0.020
12.70 ± 0.25	0.500 ± 0.010
Ø 19	Ø 0.75
30.99	1.220
31.6 ± 0.5	1.244 ± 0.020
32.51	1.280
39.7 ± 0.3	1.563 ± 0.012
40.8 max	1.606 max
58 max	2.28 max
67.3 max	2.650 max
73.0 ± 0.1	2.874 ± 0.004
75.8 ± 1.4	2.984 ± 0.055
79.38 max	3.125 max
82.5 ± 0.5	3.248 ± 0.020
89.1 max	3.51 max
132.6 max.	5.22 max

MAGNETRON

YJ1300

QUICK REFERENCE DATA		
X-Band, fixed frequency, pulsed magnetron.		
Frequency (fixed within the band)	9.380 to 9.440	GHz
Power output (peak)	7.0	kW
Output connection	Waveguide 16 flange	
Construction	Packaged	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

Mullard

TYPICAL OPERATION

Operating conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	5.0	5.0	A
Pulse duration (t_p)	0.1	1.0	μs
Pulse repetition rate	2000	1000	pulse/s
Rate of rise of voltage pulse	60	60	kV/μs

Typical performance

Anode voltage (peak)	4.25	4.25	kV
Power output (peak)	7.0	7.0	kW
Power output (mean)	1.4	7.0	W

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.55	A
Heating time (minimum) (see note 1)	30	s

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical test specification.

Test conditions

Heater voltage	6.3	V
Anode current (mean)	5.0	mA
Duty factor	0.001	
Pulse duration (t_p) (see note 2)	1.0	μs
v.s.w.r. at output coupler	1.05:1	
Rate of rise of voltage pulse (see note 3)	75	kV/μs

TEST CONDITIONS AND LIMITS (contd.)

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	4.0	4.5	kV
Power output (mean)	6.0	-	W
Frequency (see note 4)	9.380	9.440	GHz
R.F. bandwidth at 1/4 power (see note 5)	-	$\frac{2.5}{t_p}$	MHz
Minor lobe level (see note 5)	6.0	-	dB
Frequency pulling (see note 6)	-	18	MHz
Stability (see note 7)	-	0.25	%
Cold impedance (see note 8)			
Heater current (see note 9)			
Frequency temperature coefficient (see note 10)			
Input capacitance (see note 11)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 12)	5.7	6.9	V
Heater current (surge)	-	3.0	A
Anode current (peak)	4.0	6.0	A
Anode voltage (peak)	4.0	4.6	kV
Power input (peak)	-	20	kW
Power input (mean)	-	20	W
Duty factor	-	0.001	
Pulse duration (t_p) (see note 2)	-	1.0	μs
Rate of rise of anode voltage (see note 3)	-	75	kV/μs
Anode temperature	-	120	^{o}C
v.s.w.r. at output coupler	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above. Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when operated under the specified test conditions.

	Min.	Max.	
Anode voltage (peak)	4.0	4.5	kV
Power output (mean)	5.0	-	W ←
Frequency	9.380	9.440	GHz

MOUNTING AND STORAGE

Mounting position	Any
Mounting and storage precautions	see note 13

COOLING

Natural

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.25	2.75
Weight of magnetron in storage carton	1.82	4.0
	mm	in
Dimensions of storage carton	190 × 190 × 280	7.5 × 7.5 × 11

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. For ambient temperatures above 0^{o}C. For ambient temperatures between 0^{o}C and -55^{o}C the cathode heating time is 45 seconds.
2. The tolerance of pulse current duration (t_p) measured at 50% amplitude is ±10%.
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.
4. Magnetrons at other frequency ranges can be supplied to order.
5. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 phase adjusted for maximum degradation. The anode current is varied over the range of 4.0 to 6.0A peak.

NOTES (contd.)

6. Measured at an anode current of 5A peak under matched conditions. A mismatch of 1.5:1 is then varied through all phases.

7. Measured with the mismatch conditions and most unfavourable current of note 5. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.380 to 9.440GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during a period of observation of three minutes after an initial operating period of not more than three minutes.

8. The cold impedance of the magnetron is measured at the operating frequency and will give a v.s.w.r. of >6:1. The position of voltage minimum from the face of the output flange into the magnetron is 3.0 to 9.0mm.

9. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.5 to 0.6A.

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

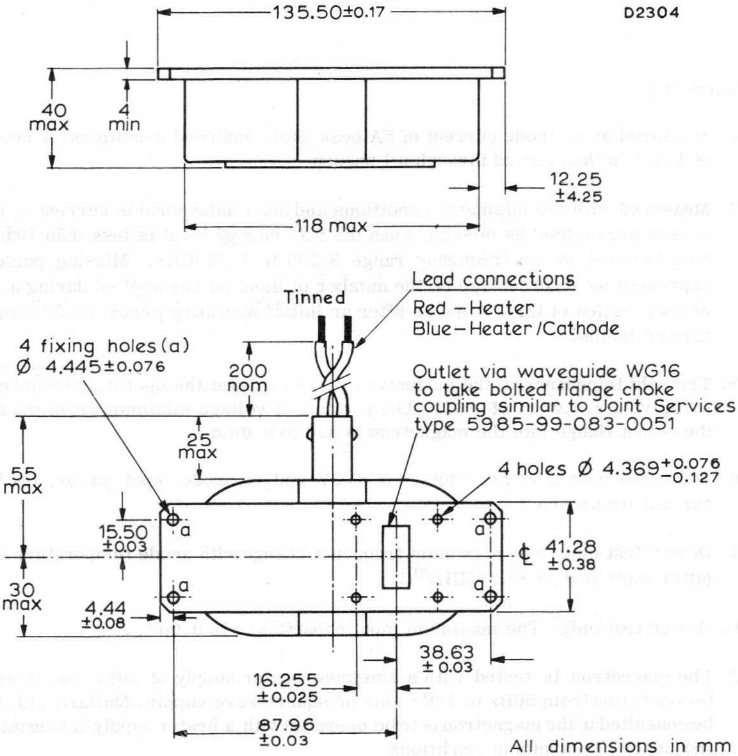
11. Design test only. The maximum input capacitance is 9.0pF.

12. The magnetron is tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 1kHz sine or square wave supply. Mullard Ltd. should be consulted if the magnetron is to be operated with a heater supply having different frequency or waveform conditions.

13. When mounting and handling the magnetron, care must be taken to prevent demagnetisation. It is necessary to keep all magnetic materials as far as possible, at least 50mm (2 in) from the magnet.

    When storing, magnetrons should be kept as far apart as possible, at least 15cm (6 in). During shipment adequate separation is provided by the dimensions of the inner packs of the storage cartons and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING OF YJ1300



CONVERSION TABLE
(Rounded outwards)

Millimetres	Inches	Millimetres	Inches
4 min.	0.16 min.	38.63 ±0.03	1.5209 ±0.0012
Ø 4.369 $^{+0.076}_{-0.127}$	Ø 0.172 $^{+0.003}_{-0.005}$	40 max.	1.58 max.
4.44 ±0.08	0.1748 ±0.0032	41.28 ±0.38	1.625 ±0.015
Ø 4.445 ±0.076	Ø 0.175 ±0.003	55 max.	2.17 max.
12.25 ±4.25	0.48 ±0.17	69 ±4	2.72 ±0.16
15.50 ±0.03	0.6102 ±0.0012	87.96 ±0.03	3.4630 ±0.0012
16.255 ±0.025	0.640 ±0.001	118 max.	4.65 max.
25 max.	0.99 max.	135.50 ±0.17	5.3347 ±0.0067
30 max.	1.18 max.	200 nom.	7.87 nom.

MAGNETRON

2J42
(MIL-E-1/667E)

QUICK REFERENCE DATA		
Fixed frequency 'X' band magnetron with natural or forced-air cooling.		
Frequency	9.345 to 9.405	Gc/s
Power output (pulsed)	7.5	kW

To be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES.

CHARACTERISTICS

	Min.	Max.	
Frequency			
Fixed within the band	9.345	9.405	Gc/s
Pulse voltage (I_{pulse} = 4.5A)	5.3	5.7	kV
R.F. pulse power output (I_{pulse} = 4.5A)	7.0	-	kW
Frequency pulling (v.s.w.r. = 1.5)	-	15	Mc/s
Frequency temperature coefficient	-	0.25	Mc/s per ^{o}C
Distance of v.s.w. minimum from face of mounting plate into valve	13.5	22.5	mm
Input capacitance	-	8.0	pF

TYPICAL OPERATION

R.F. pulse power output	7.5	kW
Duty factor	0.001	
Pulse duration	1.0	μs
Pulse repetition frequency	1000	p.p.s.
Heater voltage (running)	6.3	V
Pulse current	4.5	A
Pulse voltage	5.5	kV
Pulse input power	24.7	kW
Rate of rise of voltage pulse	50	kV/μs
Mean input current	4.5	mA
Mean input power	24.7	W
Mean r.f. output power	7.5	W
Frequency pulling (v.s.w.r. = 1.5)	14	Mc/s

CATHODE

Indirectly heated

Vh	6.3	V
Ih	600	mA

Heating time. At ambient temperatures above $0\,^{o}C$ the cathode must be heated for at least 2 minutes before the application of h.t. Below this temperature the heating time must be increased to at least 3 minutes.

For mean input powers greater than 25 watts, it is necessary to reduce the heater voltage within 3 seconds of applying h.t. in accordance with the formula:

$$V_h = 6.3\,(1 - \frac{P_{in}}{180})\,\text{Volts}$$

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
Pulse current	3.5	5.5	A
Pulse duration		2.5	μs
Duty factor		0.0025	
Mean input power		82.5	W
Rate of rise of voltage pulse		75	kV/μs
Load mismatch (v.s.w.r.)		1.5	
Temperature of anode block		120	^{o}C

MOUNTING POSITION Any

Mullard

PHYSICAL DATA

	lb	kg
Weight of magnetron	3.0	1.4
Weight of magnetron in carton	5.7	2.5
	in	mm
Dimensions of storage carton	7.75 x 8.0 x 9.75	200 x 210 x 250

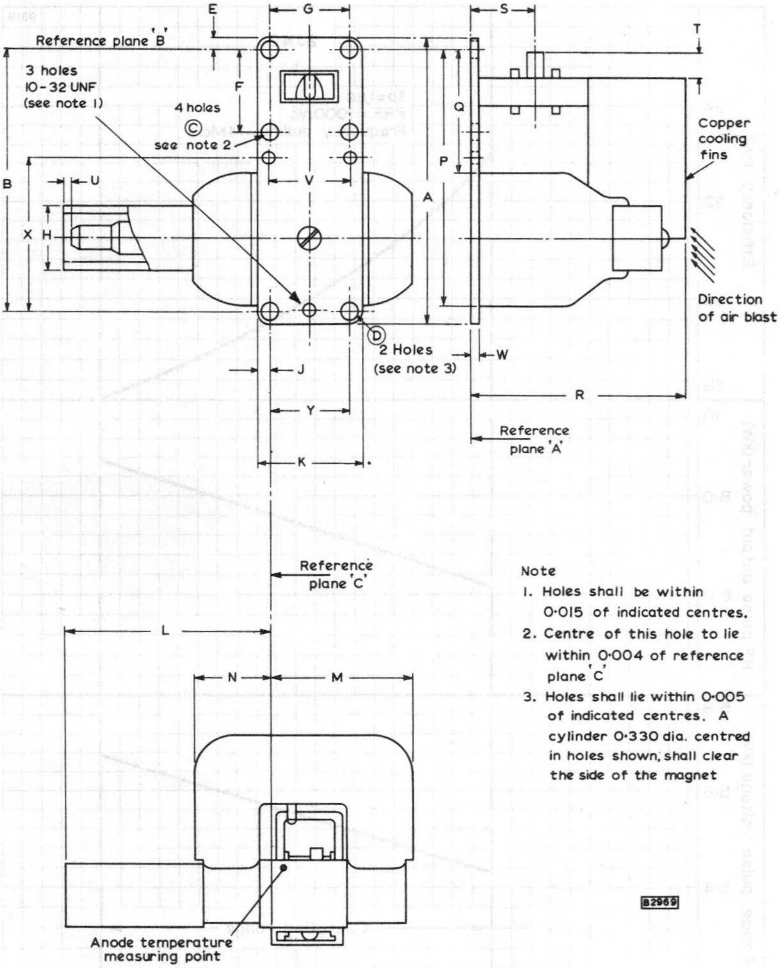
COOLING

In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, a flow of cooling air between the radiator fins may be necessary to keep the block temperature below the permitted maximum.

DIMENSIONS

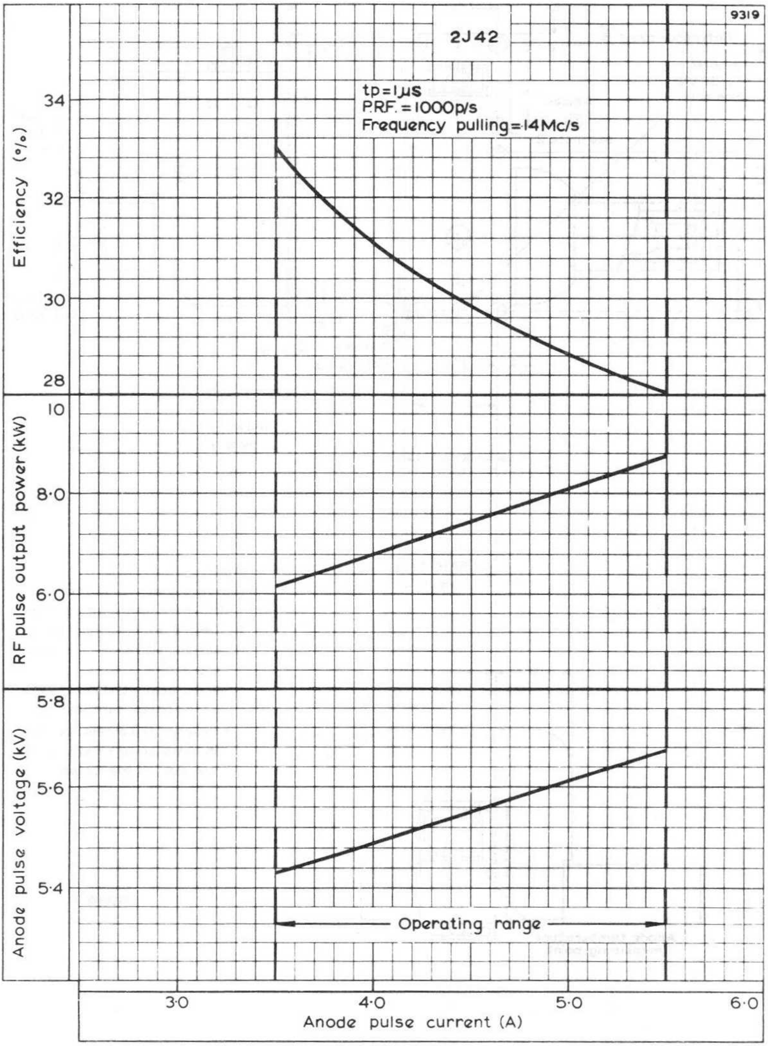
	Inches			Millimetres		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	4.438	-	4.469	112.7	-	113.5
B	-	4.103	-	-	104.2	-
C	0.167	-	0.173	4.24	-	4.39 dia.
D	0.172	-	0.178	4.37	-	4.52 dia.
E	0.156	-	0.188	3.96	-	4.78
F	1.276	-	1.284	32.4	-	32.5
G	1.216	-	1.224	30.9	-	31.1
H	-	-	1.0	-	-	25.4
J	0.188	-	0.219	4.78	-	5.56
K	1.609	-	1.641	40.9	-	41.7
L	2.688	-	3.188	68.28	-	80.98
M	-	-	2.188	-	-	55.58
N	-	-	1.188	-	-	30.18
P	-	-	4.0	-	-	101.6
Q	1.938	-	-	49.22	-	-
R	-	-	3.313	-	-	84.15
S	0.750	-	1.0	19.05	-	25.40
T	-	-	0.375	-	-	9.52
U	-	-	0.250	-	-	6.35
V	-	1.250	-	-	31.75	-
W	-	0.125	-	-	3.175	-
X	-	2.393	-	-	60.78	-
Y	-	1.220	-	-	30.99	-

Millimetre dimensions derived from original inch dimensions.



Note

1. Holes shall be within 0·015 of indicated centres.
2. Centre of this hole to lie within 0·004 of reference plane 'C'
3. Holes shall lie within 0·005 of indicated centres. A cylinder 0·330 dia. centred in holes shown, shall clear the side of the magnet

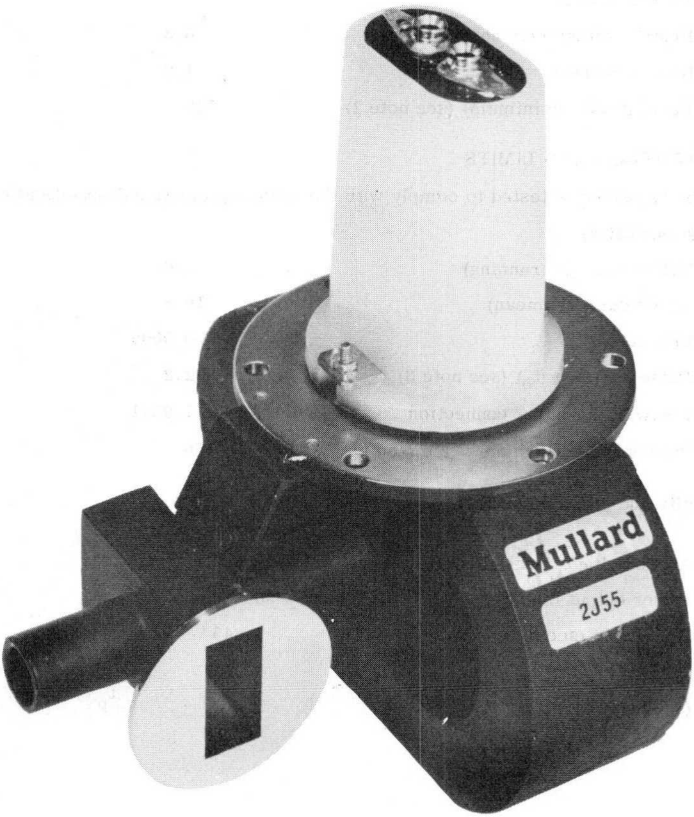


ANODE PULSE VOLTAGE. R.F. PULSE POWER OUTPUT AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT

MAGNETRON 2J55

QUICK REFERENCE DATA		
X-band, fixed frequency, pulsed magnetron.		
Frequency (fixed within the band)	9.345 to 9.405	GHz
Power output (peak)	50	kW
Output connection	Special WG15 flange	
Construction	Packaged	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

Operating conditions

	Condition 1	Condition 2	
Heater voltage	0	2.0	V
Anode current (peak)	12	12	A
Pulse duration (t_p)	1.0	2.25	μs
Pulse repetition rate	1000	400	pulse/s
Rate of rise of voltage pulse	150	150	kV/μs

Typical performance

Anode voltage (peak)	12.5	12.5	kV
Power output (peak)	50	50	kW
Power output (mean)	50	45	W

CATHODE

Indirectly heated

Heater voltage (see note 1)	6.3	V
Heater current	1.0	A
Heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage (running)	2.0	V
Anode current (mean)	10.8	mA
Duty factor	0.0009	
Pulse duration (t_p) (see note 3)	2.2	μs
v.s.w.r. at output connection	<1.05:1	
Rate of rise of voltage pulse (see note 4)	150	kV/μs

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	11	13	kV
Power output (mean)	36	-	W
Frequency (see note 5)	9.345	9.405	GHz
R.F. Bandwidth at 1/4 power (see note 6)	-	$\frac{2.5}{t_p}$	MHz

TEST CONDITIONS AND LIMITS (contd.)

	Min.	Max.	
Minor lobe level (see note 6)	6.0	-	dB
Frequency pulling (see note 7)	-	15	MHz
Stability (see note 8)	-	0.25	%
Heater current (see note 9)			
Frequency temperature coefficient (see note 10)			
Input capacitance (see note 11)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage (see note 1)	5.7	6.9	V
Heater current (surge)	-	5.0	A
Anode current (peak)	10	16	A
Anode voltage (peak)	-	16	kV
Power input (mean)	-	180	W
Duty factor (see note 12)	-	0.001	
Pulse duration (t_p) (see note 3)	-	2.5	μs
Rate of rise of voltage pulse (see note 4)	-	160	kV/μs
Anode temperature (see note 13)	-	120	^{o}C
v.s.w.r. at output connection	-	1.5:1	
Altitude	-	3.05	km
	-	10 000	ft
Pressurising (input and output)	-	313	kN/m^2
	-	3.2	kgf/cm^{-2}
	-	45	lbf/in^2

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above. Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when tested as on page 2.

	Min.	Max.	
Power output (mean)	27	-	W
Frequency	9.345	9.405	GHz
R.F. Bandwidth at 1/4 power	-	$\frac{3.0}{t_p}$	MHz
Stability		0.5	%

MOUNTING AND STORING

Mounting position (see note 14) — Any

COOLING

Forced air, sufficient to ensure that the maximum specified anode temperature is never exceeded.

PHYSICAL DATA

	kg	lb
Weight of magnetron	1.81	4.0
Weight of magnetron in storage carton	1.92	4.25

	mm	in
Dimensions of storage carton	204 × 241 × 266.7	8.0 × 9.5 × 10.5

NOTES

1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced in accordance with the heater derating chart on page 8.

2. For ambient temperatures above $0^{o}C$. For ambient temperatures between $0^{o}C$ and $-55^{o}C$ the cathode heating time is 180 seconds.

3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is ±10%.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

5. Measured with an anode temperature of approximately $80^{o}C$.

6. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 10 to 14A peak.

NOTES (contd.)

7. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 at an anode current of 12A peak.

8. Measured under the conditions described in note 6. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 9.345 to 9.405GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during a period of observation of three minutes after an initial operating period of not more than three minutes.

9. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.9 to 1.1A.

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

11. Design test only. The maximum input capacitance is 10pF.

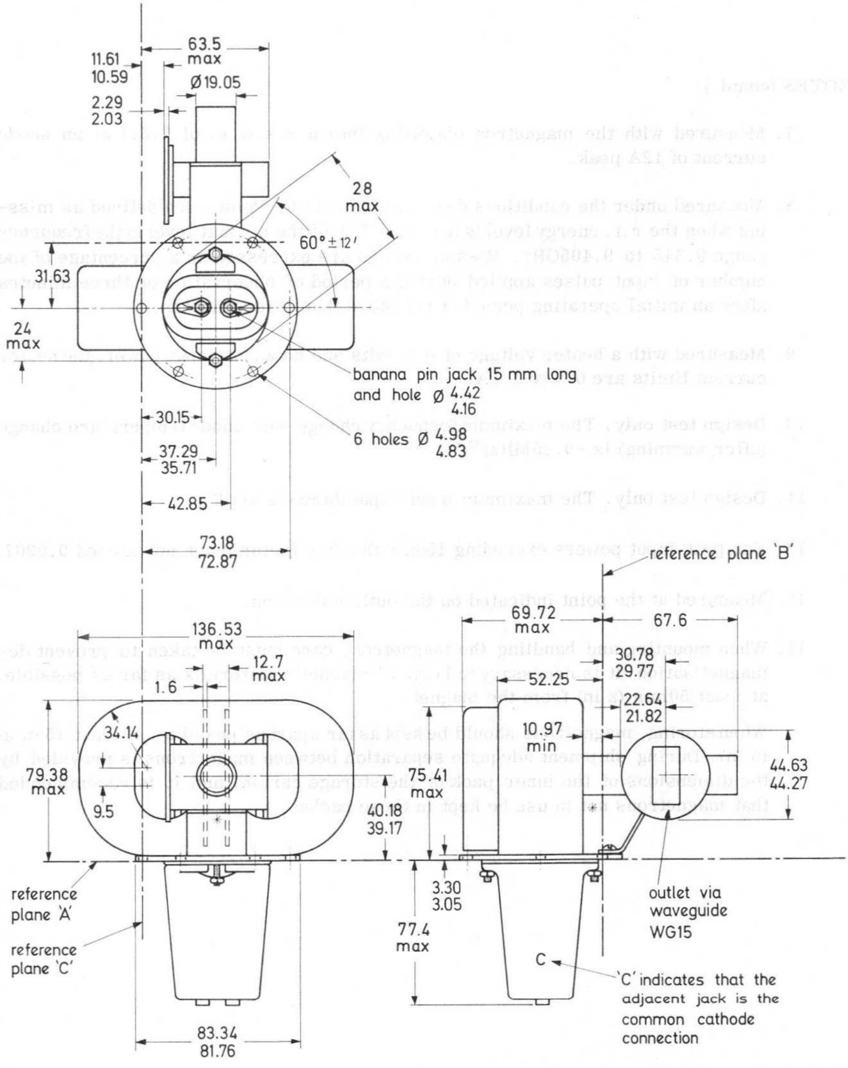
12. For peak input powers exceeding 150kW the duty factor must not exceed 0.0007.

13. Measured at the point indicated on the outline drawing.

14. When mounting and handling the magnetron, care must be taken to prevent demagnetisation. It is necessary to keep all magnetic materials as far as possible, at least 50mm (2 in) from the magnet.

    When storing, magnetrons should be kept as far apart as possible, at least 150mm (6 in). During shipment adequate separation between magnetrons is provided by the dimensions of the inner pack of the storage carton, and it is recommended that magnetrons not in use be kept in these packs.

OUTLINE DRAWING OF 2J55



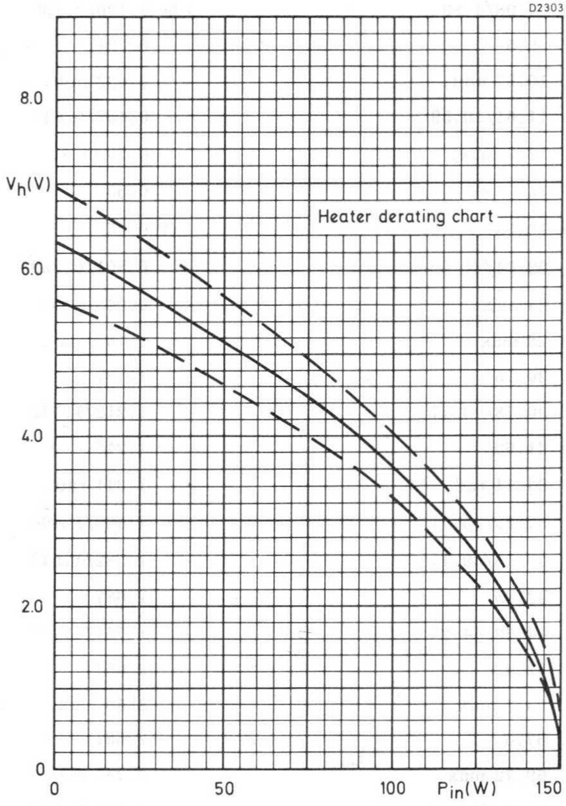
✳ Temperature measuring point

All dimensions in mm

D1519

CONVERSION TABLE
(Rounded outwards)

mm	in
1.6	0.063
2.29/2.03	0.090/0.080
3.30/3.05	0.130/0.120
Ø 4.42/4.16	0.174/0.164
Ø 4.98/4.83	Ø 0.196/0.190
9.5	0.374
10.97 min.	0.432 min.
11.61/10.59	0.457/0.417
12.7 max.	0.50 max.
15	0.59
Ø 19.05	Ø 0.75
22.64/21.82	0.891/0.859
24 max.	0.945 max.
28 max.	1.102 max.
30.15	1.187
30.78/29.77	1.212/1.172
31.63	1.245
34.14 rad.	1.344 rad.
37.29/35.71	1.468/1.406
40.18/39.17	1.582/1.542
42.85	1.687
44.63/44.27	1.757/1.743
52.25	2.057
63.5 max.	2.50 max.
67.6	2.661
69.72 max.	2.745 max.
73.18/72.87	2.881/2.869
75.41 max.	2.969 max.
77.4 max.	3.047 max.
79.38 max.	3.125 max.
83.34/81.76	3.281/3.219
136.53 max.	5.375 max.



HEATER VOLTAGE PLOTTED AGAINST MEAN ANODE INPUT POWER

MAGNETRON 6521

TENTATIVE DATA

QUICK REFERENCE DATA	
C-Band, fixed frequency, pulsed magnetron	
Frequency (fixed within the band)	5.38 to 5.42 GHz
Power output (peak)	85 kW
Construction	Packaged
Output connection	Waveguide 14 flange

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

Operating conditions

Heater voltage	9.5	V
Anode current (peak)	13.5	A
Pulse duration (t_p)	2.0	µs
Pulse repetition rate	400	pulse/s
Rate of rise of voltage pulse	100	kV/µs
v.s.w.r.	1.05:1	

Typical performance

Anode voltage (peak)	15	kV
Power output (peak)	85	kW
Power output (mean)	68	W

CATHODE

Indirectly heated

Heater voltage (see note 1)	10	V
Heater current	3.2	A
Heater current (surge) max.	12	A
Heating time (min.)	5.0	minutes

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test conditions

Heater voltage	9.5	V
Anode current (mean)	10.8	mA
Duty factor	0.0008	
Pulse duration (t_p) (see note 2)	2.0	µs
v.s.w.r. at output connection	1.05:1	
Rate of rise of voltage pulse (see note 3)	120	kV/µs

TEST CONDITIONS AND LIMITS (contd.)

Limits and characteristics

	Min.	Max.	
Anode voltage (peak)	14	16	kV
Power output (mean)	60	-	W
Frequency	5.38	5.42	GHz
R.F. Bandwidth at 1/4 power (see note 2)	-	$\frac{2.5}{t_p}$	MHz
Frequency pulling (v.s.w.r. = 1.5:1)	-	10	MHz
Minor lobe level (v.s.w.r. = 1.5:1)	6.0	-	dB
Stability (see note 4)	-	0.25	%
Heater current (see note 5)			
Frequency temperature coefficient (see note 6)			
Input capacitance (see note 7)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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
Anode voltage (peak)	-	16	kV
Anode current (peak)	10	16	A
Power input (peak) (see note 9)	-	256	kW
Power input (mean)	-	256	W
Duty factor	-	0.001	
Pulse duration (t_p) (see note 8)	-	2.2	μs
Rate of rise of voltage pulse (see note 3)	-	120	kV/μs
Anode temperature	-	150	°C
Cathode and heater seals temperature	-	165	°C
v.s.w.r. at output connection	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on page 2.

	Min.	Max.	
Anode voltage (peak)	14	16	kV
Power output (mean)	48	-	W
Frequency	5.38	5.42	GHz
Stability	-	0.5	%

MOUNTING POSITION (see note 10)

Any

COOLING

Forced-air

Air flow to fins: An air stream should be directed along the cooling fins towards the body of the magnetron. The stream may be obtained from a rectangular nozzle approximately 76mm × 38mm (3 in × 1.5 in) located so that the plane through the 76mm side is parallel with the plane of a cooling fin and so that the nozzle is centred on the body of the magnetron. Adequate air flow should be provided to ensure that the temperature of the anode does not exceed the maximum stated in "Ratings".

PHYSICAL DATA

	kg	lb
Weight of magnetron	5.2	11.5
Weight of magnetron in storage carton	8.0	17.5
	mm	in
Dimensions of storage carton	380×347×310	15×13.7×12.3

VIBRATION

The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. With no anode input power. For mean values of input power greater than 90W the heater voltage should be reduced after the application of h.t. according to the following table.

Mean input power (W)	Heater voltage (V)
90 to 130	9.9
130 to 180	9.5
180 to 220	9.1
220 to 256	8.9

2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is ±10%.

3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

4. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 8.0 to 12.8mA mean. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in the frequency range 5.38 to 5.42GHz. 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.

5. Measured with a heater voltage of 10V and no anode input power, the heater current limits are 2.8 to 3.6A.

6. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.15MHz/degC.

7. Design test only. The maximum input capacitance is 12pF.

8. The maximum operation time in any 100μs interval is 5μs.

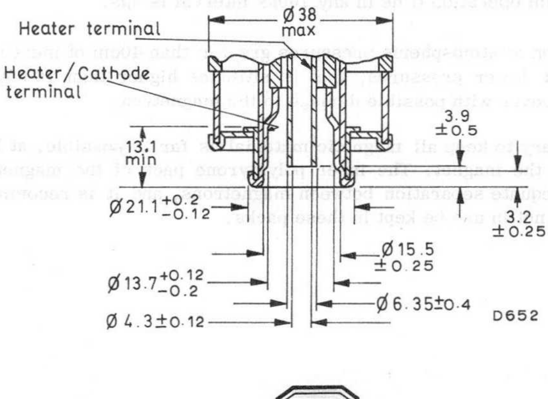
9. For operation at atmospheric pressures greater than 40cm of mercury at 25°C. Operation at lower pressures, that is altitudes higher than 16 000 feet, may result in arcover with possible damage to the magnetron.

10. It is necessary to keep all magnetic material as far as possible, at least 50mm (2in), from the magnet. The inner polystyrene pack of the magnetron carton provides adequate separation between magnetrons, and it is recommended that magnetrons not in use be kept in these packs.

CONVERSION TABLE
(Rounded outwards)

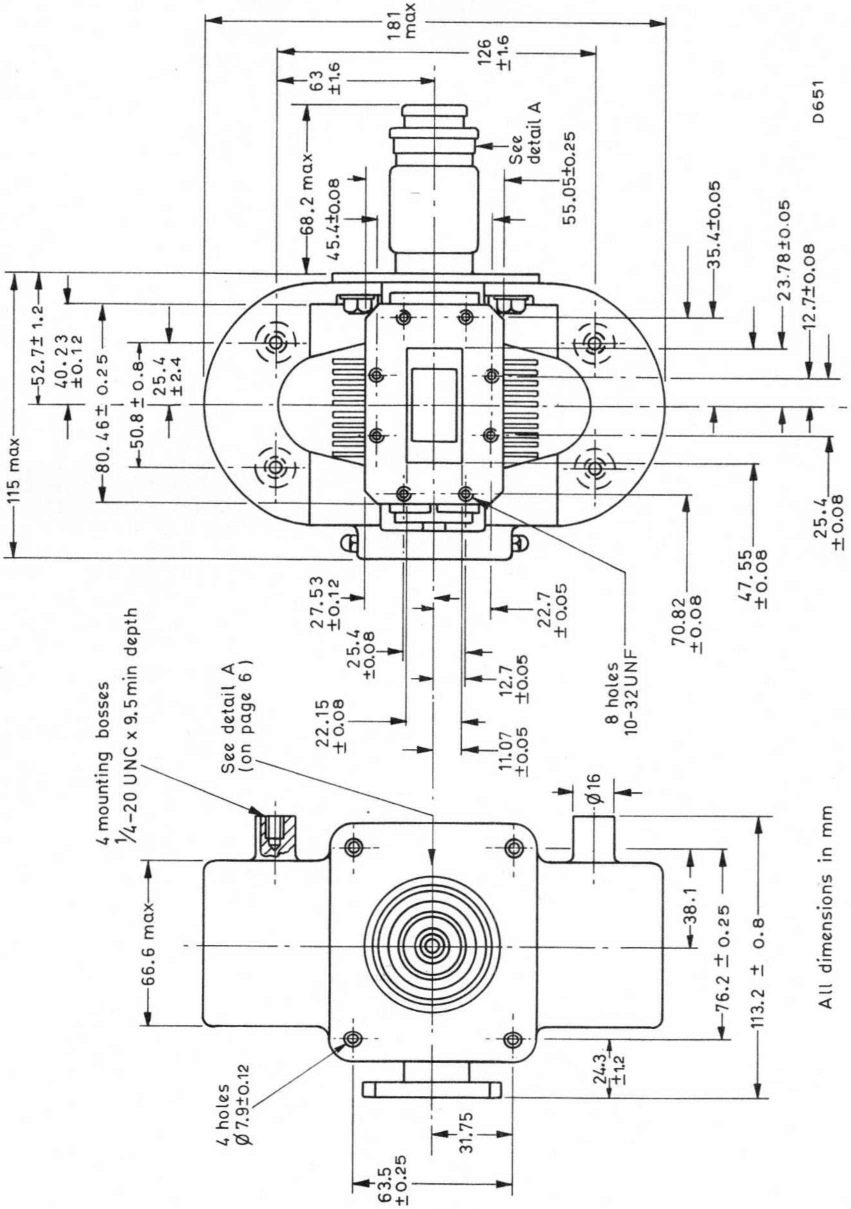
mm	in	mm	in
3.2 ± 0.25	0.126 ± 0.010	31.75	1.25
3.9 ± 0.5	0.154 ± 0.020	35.4 ± 0.05	1.40 ± 0.002
Ø 4.3 ± 0.12	Ø 0.169 ± 0.005	Ø 38 max.	Ø 1.50 max.
Ø 6.35 ± 0.4	Ø 0.25 ± 0.016	38.1	1.50
Ø 7.9 ± 0.12	Ø 0.311 ± 0.005	40.23 ± 0.12	1.584 ± 0.005
11.07 ± 0.05	0.436 ± 0.002	45.4 ± 0.08	1.787 ± 0.003
12.7 ± 0.05	0.50 ± 0.002	47.55 ± 0.08	1.872 ± 0.003
12.7 ± 0.08	0.50 ± 0.003	50.8 ± 0.8	2.00 ± 0.031
13.1 min.	0.515 min.	52.7 ± 1.2	2.075 ± 0.05
Ø 13.7 $^{+0.12}_{-0.2}$	Ø 0.540 $^{+0.005}_{-0.008}$	55.05 ± 0.25	2.167 ± 0.010
Ø 15.5 ± 0.25	Ø 0.610 ± 0.010	63 ± 1.6	2.480 ± 0.063
Ø 16	Ø 0.63	63.5 ± 0.25	2.5 ± 0.01
		66.6 max.	2.63 max.
Ø 21.1 $^{+0.2}_{-0.12}$	Ø 0.831 $^{+0.008}_{-0.005}$	68.2 max.	2.69 max.
22.15 ± 0.08	0.872 ± 0.003	70.82 ± 0.08	2.788 ± 0.003
22.7 ± 0.05	0.894 ± 0.002	76.2 ± 0.25	3.00 ± 0.01
23.78 ± 0.05	0.936 ± 0.002	80.46 ± 0.25	3.168 ± 0.010
24.3 ± 1.2	0.957 ± 0.047	113.2 ± 0.8	4.457 ± 0.031
25.4 ± 0.08	1.00 ± 0.003	115 max.	4.53 max.
25.4 ± 2.4	1.00 ± 0.095	126 ± 1.6	4.960 ± 0.063
27.53 ± 0.12	1.084 ± 0.005	181 max.	7.13 max.

DETAIL A



Mullard

OUTLINE DRAWING OF 6521



HEATING MAGNETRONS

C

GENERAL OPERATIONAL RECOMMENDATIONS

1. HEATER

1.1 GENERAL

Incorrect setting of the heater voltage and, in consequence, a cathode temperature too high or too low, may lead to unsatisfactory operation and cause the valve life to be shortened.

1.2 SURGE CURRENT

With some valves it may be required to limit the heater current when switching on the heater supply. Individual data sheets give information on this together with the cold heater resistance to assist in the design of a suitable surge current limiting circuit.

1.3 STARTING VOLTAGE

With indirectly heated cathodes the heater starting voltage should be set within ± 2.5 % at nominal supply input voltage.

In the case of directly heated cathodes reference should be made to the individual data sheets.

1.4 PRE-HEATING TIME

Before the application of the h.t. supply the heater starting voltage should be applied for a time not less than that stated in the individual data sheets. This ensures adequate electron density to start oscillation in the required mode.

1.5 RUNNING VOLTAGE

During operation the cathode temperature is increased by electron back bombardment ("back heating"). The individual data sheets, therefore, contain information relating the heater running voltage to the average anode current so that the cathode temperature can be maintained at the desired level. The heater voltage must be reduced to the appropriate value immediately the h.t. voltage is applied.

1.6 TEMPORARY FLUCTUATIONS

Unless otherwise stated in the individual data sheets, the cathode will accept temporary fluctuations of heater voltage within the range +5% to -10% of the nominal values

2. INPUT AND OUTPUT CONNECTIONS

2.1 INPUT CONNECTION

To prevent anode current flowing through the heater the negative h.t. voltage line should be connected to the common heater-cathode terminal.

2.2 OUTPUT CONNECTION

It is important that the type of output connection should be as specified in the data. Connections to the output must be designed to prevent misaligned surfaces which introduce reflecting discontinuities and must be sufficiently tight to avoid arcing. It is also important to avoid undue stressing of the output section which would either deform the metal or break the glass or ceramic vacuum seals. It is necessary therefore that any mechanical pressure be applied uniformly, when a uniform mechanical pressure is not certain a flexible mounting must be provided, e.g. rubber bushes for fixing screws.

3. H. T. SUPPLY

3.1 GENERAL

Usually the dynamic impedance of a magnetron is low, therefore small variations in the applied voltage can cause appreciable changes in operating current. In the equipment design it is necessary to ensure that such resultant variations in operating current do not lead to operation outside the published limits.

Changes in current cause changes in power and frequency and, consequently, change the equipment performance. Their effects should determine the maximum permissible change of current inherent in the equipment design under the worst operating conditions. Where these changes in performance are not acceptable, either manual control or automatic stabilisation of the average operating current must be incorporated in the power supply design.

3.2 MINIMUM OPERATING CURRENT

At a low operating current, above the threshold of oscillation, magnetrons can develop a negative resistance characteristic. When operated with an unregulated power supply, additional series resistance is necessary to prevent instability. With a regulated power supply the range of control should be limited to avoid hunting. For this reason a minimum operating current is given in the data sheets.

3.3 PEAK CURRENT LIMITATION

In certain applications an unfiltered power supply is used. In these circumstances care should be taken to ensure that the peak current rating cannot be exceeded. A resistance or inductance is usually needed in series with the power supply to augment the inherent regulation of the supply.

4. LOADING

4.1 GENERATOR LOAD CHART (RIEKE DIAGRAM)

A chart showing typical output power and frequency change plotted on a modified impedance circle diagram against magnitude (v.s.w.r.) and phase of the load seen by the magnetron provides information on the behaviour of the magnetron under various load conditions.

Such a chart is often referred to as a Rieke diagram.

With a load of bad mismatch and at a particular phase there is a region on the chart which is characterised by high power output and convergence of the frequency contours. This region is known as the "sink" and the phase of the load at which the magnetron behaves in this manner is known as "the phase of sink". Operation of the magnetron under this load condition will lead to instability and may cause failure.

The region opposite the sink indicates a low power output. A low power output leads to excessive anode dissipation and increased "back heating" of the cathode. These effects can be detrimental to the life of the magnetron and should be avoided.

4.2 MAXIMUM VOLTAGE STANDING WAVE RATIO OF LOAD

Information on the maximum standing wave ratio that can be withstood under continuous operation is given in individual data sheets. Incorrect loading (exceeding this value of v.s.w.r.) may cause unstable operation in the form of moding or arcing.

4.3 COLD LOAD MEASUREMENT

Before the h.t. is applied it must be established that the load condition is such that the v.s.w.r. presented to the magnetron at its output connection dies not exceed the limiting value. For this purpose low power measurements using a standing wave detector or reflectometer technique are necessary over an appropriate frequency range about the actual magnetron frequency. The frequency range must be adequate to cover operational frequency drift due to, current pushing, load pulling and magnetron temperature change.

When magnetrons are likely to be replaced in equipment without further measurement or adjustment of the coupling system, the low power measurements must cover a frequency range which embraces the whole frequency band of the magnetron together with an extension to cover operational frequency drift outside the band.

It should be noted that the value of v.s.w.r. will be vastly different when the load is removed from the applicator or heating chamber and that h.t. should never be applied under this condition. As a protection against this risk a suitable preload should be incorporated in the microwave circuit.

4.4 ON-LOAD MEASUREMENTS

It is possible to monitor the power reflected from the load to the magnetron by means of a reflectometer technique. If it is possible for the reflected power to become excessive so that the v.s.w.r. limit is approached, the magnetron should be safeguarded by means of an automatic h.t. switch-off.

4.5 INSTANTANEOUS LOAD CONDITION

Some equipments include a device which provides a varying field pattern, to produce a more uniform energy distribution. This device introduces a varying instantaneous load condition. Some relaxation of the maximum v.s.w.r. rating under continuous operation can be allowed for instantaneous load conditions outside the "sink" region provided that the average reflected power does not exceed that implied by the continuous v.s.w.r. rating. Any relaxation should be agreed with Mullard Limited. No relaxation can be permitted in the sink region.

5. COOLING

5.1 GENERAL

The cooling requirements given in the data sheets refer to magnetrons operated under open bench conditions. In order to keep within the limiting temperatures for anode block, cathode terminal assembly and output seal, where appropriate, it may be necessary in the practical equipment to provide additional coolant on account of high environmental temperatures due to restrictions imposed by the cabinet and to associated components within the cabinet, and to high ambient temperatures at the equipment location.

The residual heat of the cathode on switch-off may raise the seal temperature above its permitted maximum. This danger can be avoided either by continuing the airflow after removal of cathode heater power or by using sufficient air during operation to keep the temperature of the cathode so low that the rise in seal temperature on switch-off can be accommodated.

Having regard to the limiting temperatures, measurements should be made in the development stage of an equipment using special paints, lacquers, thermopapers or other suitable means.

Thermal cut out switches should be used to prevent operation with excessive anode block temperature in the event of reduction or failure of the cooling medium.

5.2 AIR COOLING

It is important that the air should not contain dust, moisture or oil. If an air filter is incorporated in the system, allowance must be made for the pressure drop across the filter when choosing an adequate blower.

5.3 WATER COOLING

Circulating cooling water should be as free as possible from all solid matter and its dissolved oxygen content should be low. A closed water system using demineralised or distilled water should be used whenever possible.

6. INSTALLATION

The magnetron should never be held by the cathode radiator.

Because the magnet produces a strong field, only non-magnetic tools may be used for installing the magnetron or adjacent components, this reduces the risk of collision between the tools and the glass parts of the magnetron.

7. MOUNTING

The minimum distance from other magnetic materials given on the data sheet must be maintained to prevent deterioration of the magnetron performance. Other devices which produce stray magnetic fields (Blower or stirrer motor) should be placed so that they do not influcence the operation of the magnetron.

The magnetron should be mounted by means of the mounting holes provided. It should NEVER be supported by the coupling to the magnetron output system.

8. STORAGE

Magnetrons should be stored in their original packing because this has been designed to protect them against reasonable vibration and knocks. It also ensures that the spacing between permanent magnet valves and other magnets and ferrous objects is adequate to avoid demagnetisation.

Magnetically sensitive instruments such as compasses, electric meters and watches should not be brought close to a bank of packaged magnetrons.

When a magnetron is temporarily taken out of service it should be placed immediately in its proper container. This is good practice and obviates the risk of damage to the magnets or the glass and ceramic parts and prevents the entry of foreign matter into the output aperture.

Unpacked permanent magnet valves should NEVER be placed on steel benches or shelves.

9. CONDITIONING

After transit or a long period of storage, the h.t. voltage should be increased gradually or in several steps until normal operation is achieved. This treatment will remove any traces of gases which could cause instability, it is particularly important in high power magnetrons.

10. STRAY MICROWAVE RADIATION

The document* entitled "Safety Precautions Relating To Intense Radio-Frequency Radiation" implies that a stray radiation field is a human hazard if the power density exceeds 10mW/cm^2. The power output of industrial magnetrons is such that, with improperly sealded or defective closures and connections in the transmission system, this power density can easily be exceeded. Serious attention should be given to this point in the manufacture of equipment with due regard to probable deterioration through its life.

* Published by H.M.S.O. 1960 S.O. Code No. 43-182.

QUICK REFERENCE DATA		
Magnetrons for microwave heating applications. YJ1160 is water cooled. YJ1162 is forced-air cooled		
Frequency	2.45	GHz
Power output	2.5	kW
Construction	Packaged, high stability ticonal magnet	

Unless otherwise shown data is applicable to both types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

CHARACTERISTICS

	Min.	Max.	
Frequency fixed within the band	2.425	2.475	GHz
Operating voltage range (d.c.), within the range (at I_a = 750mA d.c., v.s.w.r. < 1.05)	4.4	4.8	kV
Operating voltage range (d.c.), within the range (at I_a = 800mA d.c., v.s.w.r. = 3.0 in "phase of sink")	4.6	5.0	kV
"Phase of sink" from the reference plane (see drawings) towards load (nominal)	0.40		λ

OPERATION IN MICROWAVE OVEN WITH FIELD STIRRER, WITH SINGLE-PHASE FULL-WAVE RECTIFIER WITHOUT SMOOTHING FILTER

OPERATING CONDITIONS

For this condition the centre of the locus of the load impedance seen by the magnetron to be at v.s.w.r. = 3.0 in "phase of sink".

The impedance of the h.t. supply should be greater than 500Ω. In addition, a limiting resistor of 300Ω should be inserted in series with the magnetron.

Heater voltage (running)	1.7	V
Mean anode current	800	mA
Peak anode current	2.0	A
Load mismatch (v.s.w.r.)		
in the region of ±0.1λ		
about "phase of sink"	3.0	
instantaneous value*	5.0	
in the remaining region	2.5	
Power output (v.s.w.r. = 3.0 in "phase of sink")	2.5	kW

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.5	5.2	V
Mean anode current	100	850	mA
Peak anode current	-	2.1	A
Load mismatch (v.s.w.r.)			
in the region of ±0.1λ			
about "phase of sink"	-	4.0	
instantaneous value*	-	10	
in the remaining region	-	4.0	

*Maximum duration 20ms, maximum duty ratio 0.2. Moding must be avoided by the use of an appropriate coupling system.

OPERATION IN MICROWAVE OVEN WITHOUT FIELD STIRRER OR INDUSTRIAL APPLICATION WITH SINGLE-PHASE FULL-WAVE RECTIFIER WITHOUT SMOOTHING FILTER

OPERATING CONDITIONS

The impedance of the h.t. supply should be greater than 500Ω. In addition, a limiting resistor of 300Ω should be inserted in series with the magnetron.

Heater voltage (running)	2.0	V
Mean anode current	750	mA
Peak anode current	2.0	A
Load mismatch (v.s.w.r.)	3.0	
*Power output (matched load)	2.0	kW

*For the output power under conditions of mismatch, see the Rieke diagram on page 17.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.5	5.2	V
Mean anode current	100	800	mA
Peak anode current	-	2.1	A
Load mismatch (v.s.w.r.)			
in the region of ±0.03λ about "phase of sink"	-	4.0	
in the remaining region	-	5.0	

OPERATION IN MICROWAVE OVEN WITHOUT FIELD STIRRER FROM SINGLE-PHASE SUPPLY WITHOUT RECTIFIER

OPERATING CONDITIONS

A limiting inductance of 2.25H must be inserted in series with the magnetron.

Heater voltage (running)	3.4	V
Mean anode current	400	mA
Peak anode current	2.0	A
Load mismatch (v.s.w.r.)	2.0	
*Power output (matched load)	1.0	kW

*For the output power under conditions of mismatch, see the Rieke diagram on page 17.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.8	5.2	V
Mean anode current	-	500	mA
Peak anode current	-	2.1	A
Load mismatch (v.s.w.r.)			
in the region of $\pm 0.03\lambda$ about "phase of sink"	-	4.0	
in the remaining region	-	5.0	

OPERATION IN INDUSTRIAL APPLICATION WITH FIXED REFLECTION ELEMENT AND THREE-PHASE HALF-WAVE RECTIFIER WITHOUT SMOOTHING FILTER

To obtain optimum power output, it is necessary to insert between the magnetron and the load, a fixed reflection element (see page 9) giving a mismatch with v.s.w.r. of 1.5 in "phase of sink".

OPERATING CONDITIONS

The impedance of the h.t. supply should be greater than 350Ω.

Heater voltage (running)	1.5	V
Mean anode current	850	mA
Peak anode current	2.0	A
*Load mismatch (v.s.w.r.)	1.5	
*†Power output (matched load)	2.5	kW

†For the output power under conditions of mismatch, see the Rieke diagram on page 16.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.5	5.2	V
Mean anode current	100	900	mA
Peak anode current	-	2.1	A
*Load mismatch (v.s.w.r.)			
in the region of ±0.03λ in "phase of sink"	-	2.5	
in the remaining region	-	4.0	

*Excludes fixed reflection element

CATHODE

Indirectly heated, dispenser type

*V_h (starting)	5.0	V
I_h (at V_h = 5.0V)	35	A
r_h (cold)	0.02	Ω
$I_{h\ (surge)}$ max.	140	A

For a heater starting voltage in the range 5.0 to 5.2V the cathode must be heated for at least 2 minutes before the application of h.t. At a heater starting voltage of 4.5V the heating time must be increased to at least 3 minutes. For a heater starting voltage in the range 4.5 to 5.0V the minimum heating time can be determined by linear interpolation.

It is necessary to reduce the heater voltage immediately after the application of anode power to compensate for additional heating of the cathode by back bombardment. The correct value of the nominal heater voltage is given by the curve (full line) on page 18.

Where it is required to design a heating generator for several fixed output power levels, the heater voltage may be reduced in one or two steps depending on the anode current range. The appropriate nominal value of heater voltage is that which falls within the limit curves (dotted lines) for the appropriate operating currents. The deviation from the nominal should be kept to a minimum.

*Temporary fluctuations not exceeding +5% and -10% of the nominal heater voltage are permissible.

COOLING

Maximum temperatures

Anode block reference point (see page 9)	125	^{o}C
Cathode radiator	180	^{o}C

Cathode

Cooling clips 40634 and 40649 should be attached to the heater and cathode terminals respectively.

A flow of air should be directed at the cathode radiator in order to keep it below the stated maximum. This should not be allowed to cool the supporting glassware.

Due to the thermal capacity of the cathode if heater and air flow are switched off simultaneously the maximum temperature of the cathode radiator will be exceeded unless the cathode radiator is kept at approximately $100^{o}C$ during operation. This requires a minimum air flow of $0.22m^3/min$ ($8.0ft^3/min$). If after blowing is provided the minimum air flow may be reduced to $0.06m^3/min$ ($2.0ft^3/min$).

YJ1160

Water cooled (see curve on page 14)

A plate is provided on the anode block for the mounting of a thermal switch to protect the valve in the event of water failure. This switch should come into operation at a temperature not higher than $120^{o}C$.

YJ1162

Forced-air cooled (see curve on page 15)

Example:-

Under open bench conditions with a matched load, for operation from three-phase or single-phase supplies with rectifier $T_{in} = 25^{o}C$, the minimum air flow is $1.7m^3/min$ ($60ft^3/min$) at pressure of 15mm water.

When operating in a confined enclosure causing an increased ambient temperature around the magnetron and with conditions of load mismatch causing reduced efficiency the amount of forced-air cooling will need to be increased.

A plate is provided on the anode block for the mounting of a thermal switch to protect the tube in the event of failure of the cooling air. This switch should come into operation at a temperature not higher than $105^{o}C$.

MOUNTING POSITION

In equipment, the following minimum distances should be maintained between the magnet and magnetic materials (see outline drawings).

direction a	60	mm
direction b	100	mm
direction c	110	mm

OUTPUT CONNECTION

50Ω coaxial transmission line with 16mm inner conductor and 39mm outer conductor.

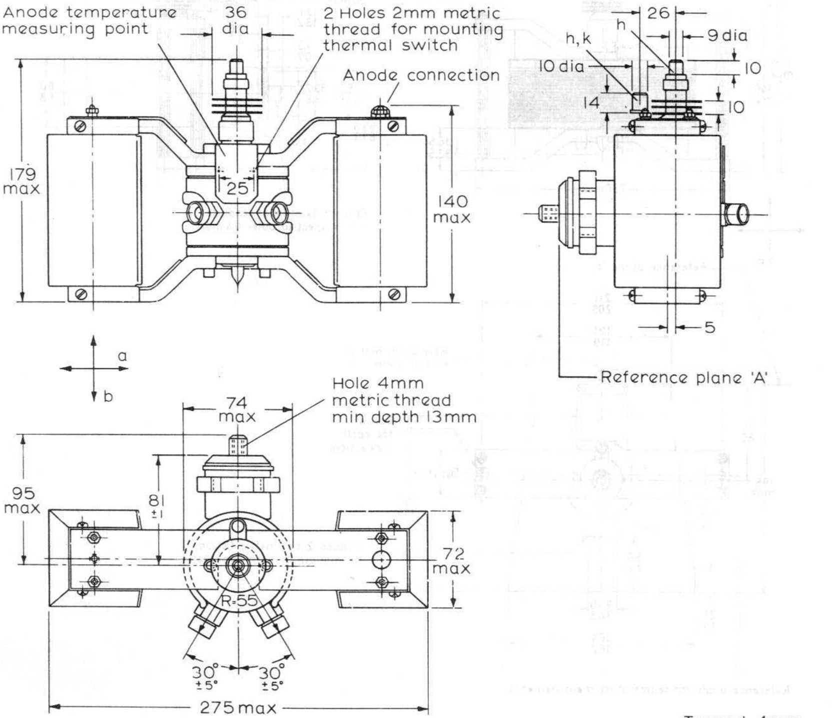
PHYSICAL DATA

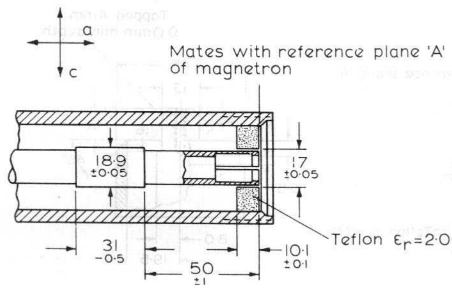
	YJ1160	YJ1162	
Net weight of magnetron	5.1	7.9	kg
	11.2	17.4	lb

ACCESSORIES

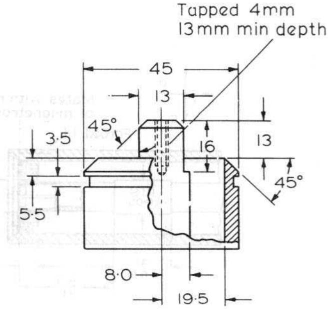
Cap nut	55312
Split spring ring	55313
Heater terminal cooling clip	40634
Cathode terminal cooling clip	40649

OUTLINE DRAWING OF YJ1160





Fixed reflection element

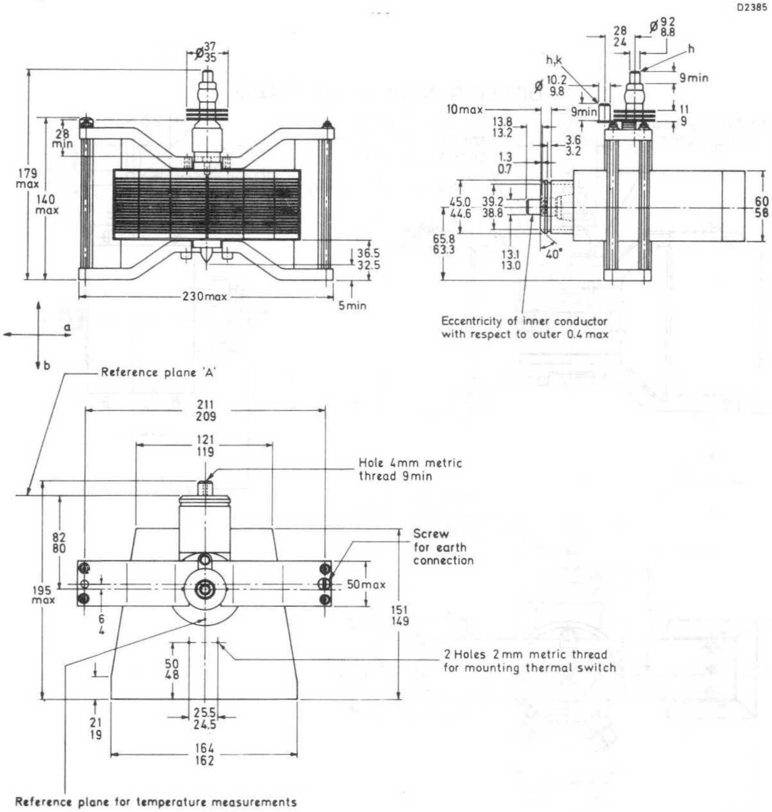


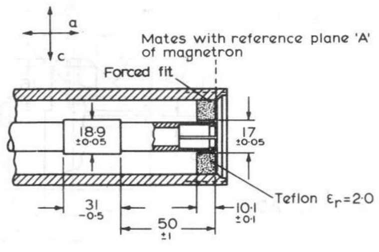
Output terminal

All dimensions in mm

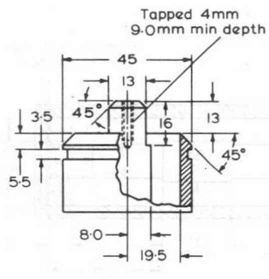
B5059

OUTLINE DRAWING OF YJ1162





Fixed reflection element

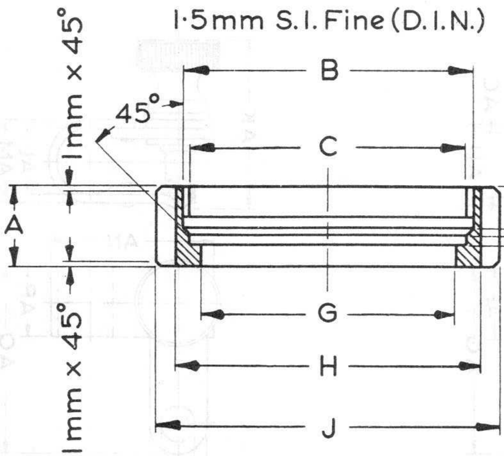


Output terminal

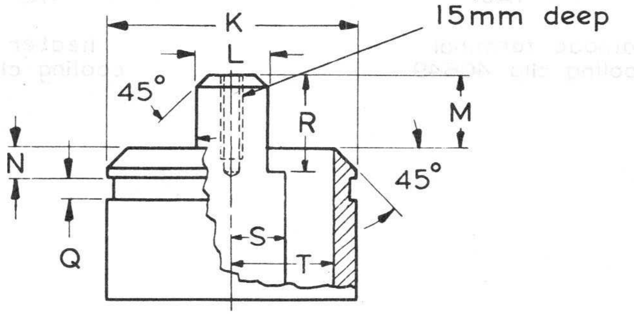
All dimensions in mm

OUTLINE AND DIMENSIONS OF CAP NUT AND COAXIAL OUTPUT

	Inches	*Millimetres*		*Inches*	*Millimetres*
A	0.5905±0.0078	15.0±0.2	K	1.77	45
B	2.05	52	L	0.51	13
C	1.9528±0.0020	49.6±0.05	M	0.51	13
D	0.3149±0.0039	8.0±0.1	N	0.217	5.5
E	0.3740±0.0039	9.5±0.1	Q	0.138	3.5
F	0.4330±0.0039	11.0±0.1	R	0.63	16
G	1.7913±0.0020	45.5±0.05	S	0.315	8.0
H	2.1653±0.0078	55.0±0.2	T	0.768	19.5
J	2.4409±0.0078	62.0±0.2			



Cap Nut 55312



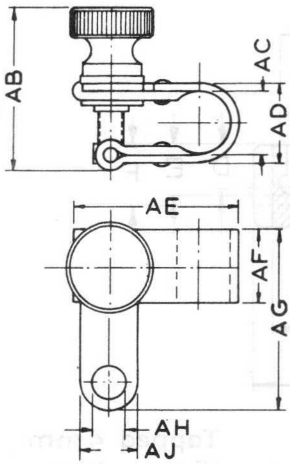
Output Terminal

9379

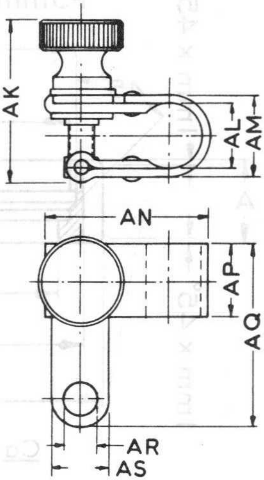
OUTLINE AND DIMENSIONS OF COOLING CLIPS

	Inches	*Millimetres*
AB	1.06	27
AC	0.41	10.5
AD	0.51	13
AE	1.10	28
AF	0.47	12
AG	1.18	30
AH	0.26	6.5
AJ	0.47	12

	Inches	*Millimetres*
AK	1.02	26
AL	0.35	9
AM	0.47	12
AN	1.10	28
AP	0.47	12
AQ	1.18	30
AR	0.26	6.5
AS	0.47	12

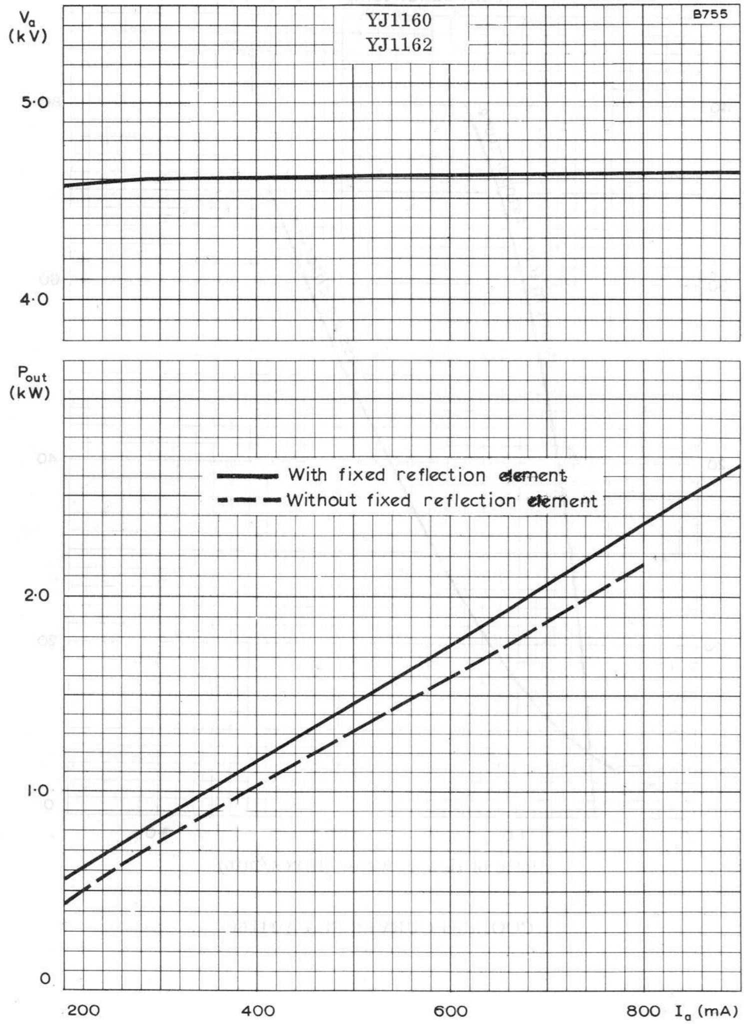


Cathode terminal cooling clip 40649

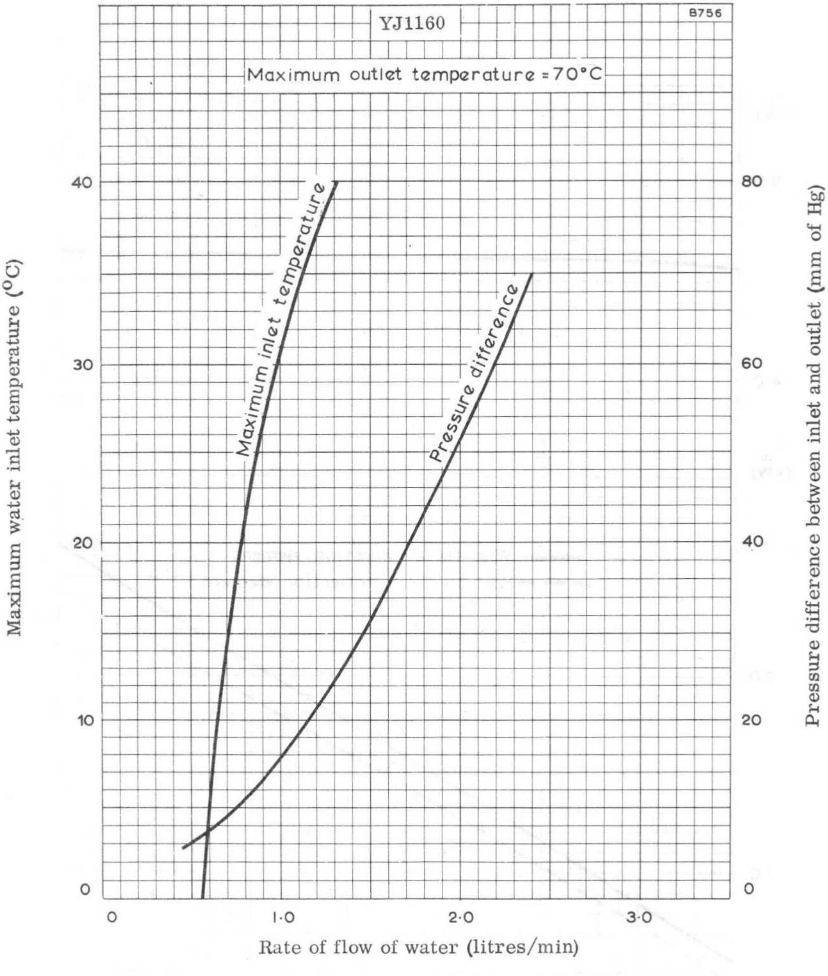


heater terminal cooling clip 40634

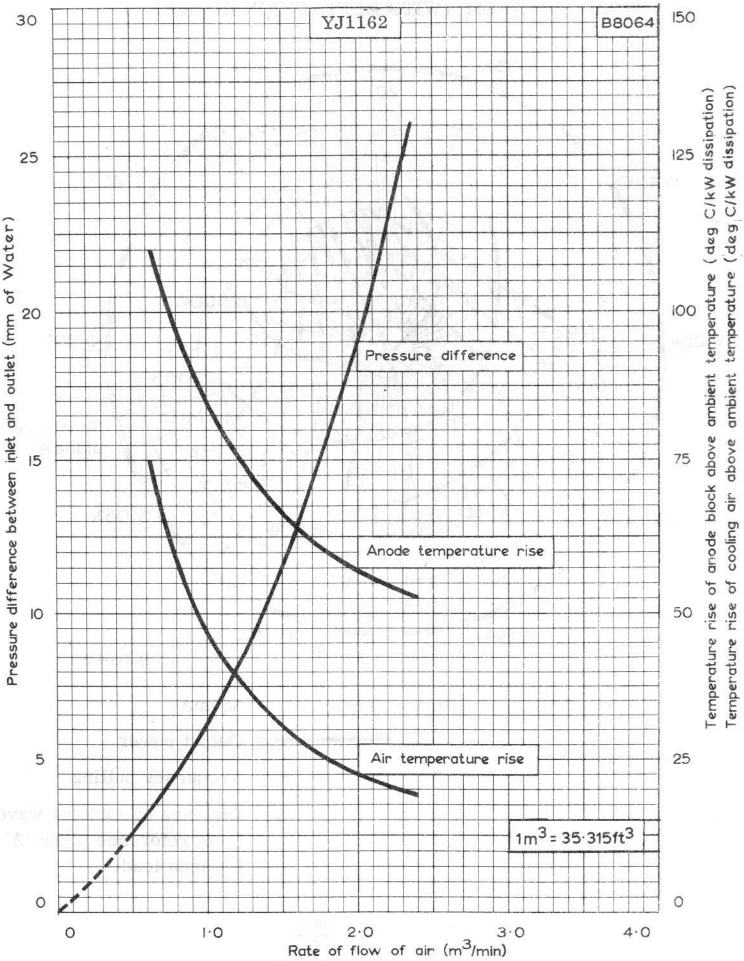
9177



OUTPUT POWER AND ANODE VOLTAGE PLOTTED AGAINST MEAN ANODE CURRENT

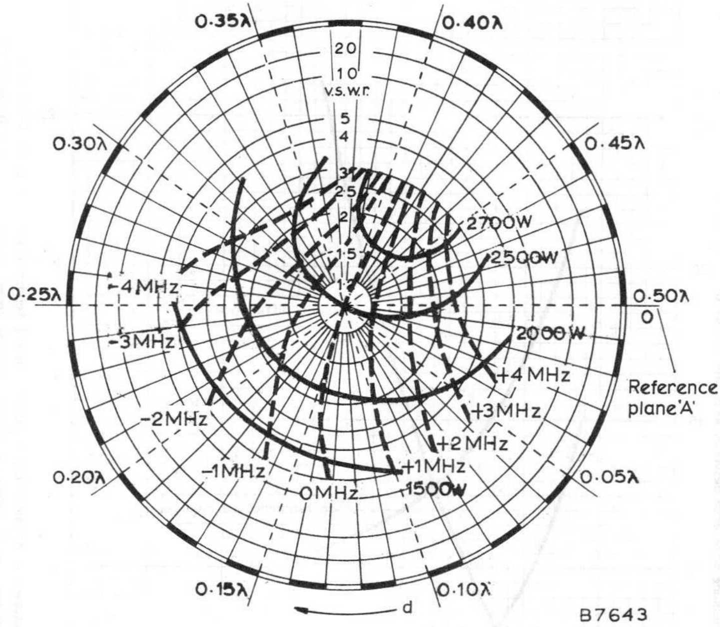


COOLING CURVES FOR YJ1160



COOLING CURVES FOR YJ1162

RIEKE DIAGRAM (WITH REFLECTION ELEMENT)

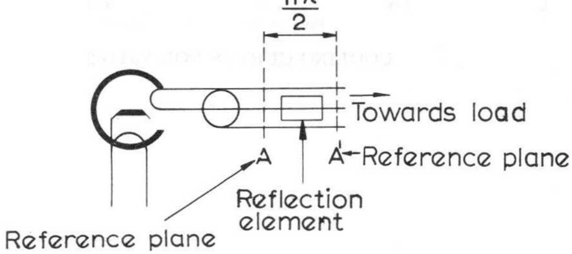


Measured with a.c. supply. I_a = 850mA

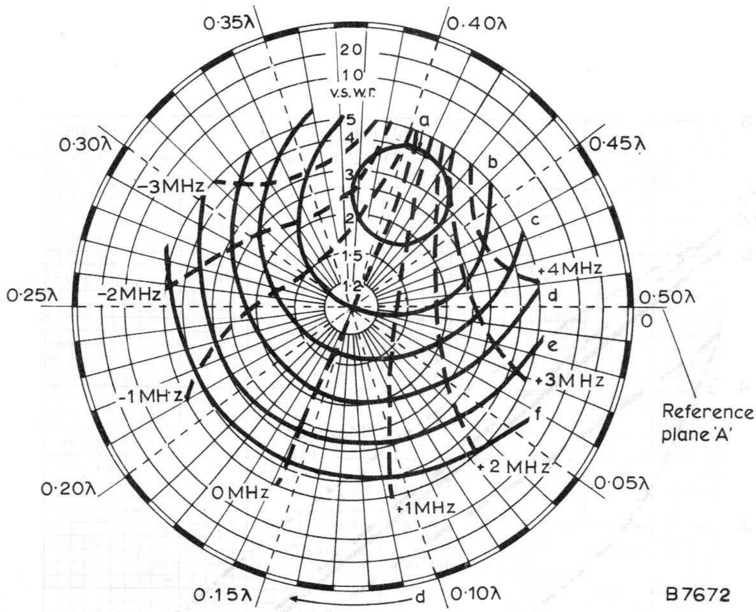
——— = Output power

– – – – = Frequency pulling

d = Distance of standing wave from reference plane 'A' towards load.



RIEKE DIAGRAM (WITHOUT REFLECTION ELEMENT)



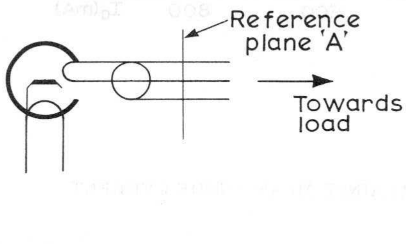
Measured with a.c. supply. $I_a = 750\text{mA}$

$i_{a(pk)} = 2.0\text{A}$

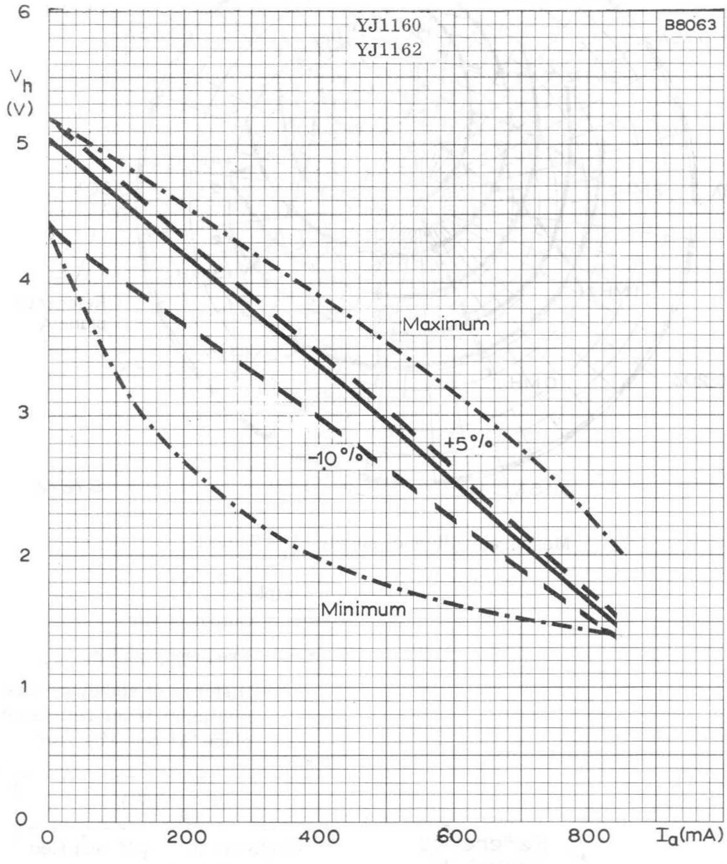
——— = Output power

– – – = Frequency pulling

d = Distance of standing wave minimum from reference plane 'A' towards load.



	P_{out} (kW)	
	Single phase unsmoothed full-wave	Self rectified a.c.
a	2.25	1.125
b	2.00	1.000
c	1.75	0.875
d	1.50	0.750
e	1.25	0.625
f	1.00	0.500



HEATER VOLTAGE PLOTTED AGAINST MEAN ANODE CURRENT

MAGNETRON

YJ1191

TENTATIVE DATA

QUICK REFERENCE DATA

Continuous wave air and water-cooled magnetron intended for microwave heating applications.

Frequency (fixed within the band)	2.425 to 2.475	GHz
Power output	5.0	kW
Construction	Packaged, ceramic and metal	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

Typical operation from d.c. or low peak current (L-C stabilised) supply.

Frequency (see note 1)	2.45	GHz
Power output	5.0	kW
Anode voltage	7.1	kV
Mean anode current (see note 2)	1.25	A
Peak anode current	1.5	A
Filament voltage (running)	1.0	V
Load v.s.w.r.	≤1.05	

CATHODE

Directly heated a.c. 50 or 60Hz or d.c. Thoriated tungsten.

V_f (starting and standby)		$5.5 \pm 10\%$	V
I_f (at $V_f = 5.5$V and $V_a = 0$)	nominal	46	A
	max	50	A
I_f (surge) max		120	A
r_f (cold)		0.015	Ω
Minimum waiting time before applying h.t.		30	s

The positive potential must be applied to the filament connector when the filament supply is d.c.

CHARACTERISTICS

	Min.	Max.	
Frequency (fixed within the band) (see note 1)	2.425	2.475	GHz
Anode voltage (at $I_a = 1.25A$) (see notes 1, 2, 3)	6.8	7.2	kV
Distance of voltage standing wave minimum (see note 4)	0.36	0.42	λguide
Power output (at $I_a = 1.25A$)	4.65	-	kW
Load v.s.w.r.	-	1.05	

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Anode voltage (see note 5)	-	±12	kV
Peak anode current	-	2.6	A
Mean anode current (see note 2)	0.3	1.3	A
Mean anode input power	-	9.6	kW
v.s.w.r. (from 0.3λ to 0.5λ)	-	2.5	
v.s.w.r. (remaining region)	-	1.5	

OPERATING NOTES

1. Measured with a matched load (v.s.w.r. ≤1.05)
2. Measured with a moving coil instrument.
3. The anode voltage should be measured with the magnetron operating on a filtered anode voltage obtained by three-phase full-wave rectification.
4. The distance is measured in the direction of the load, starting at the reference plane for electrical measurements using standard cold measurement techniques and a 16/39 coaxial line.
5. An 8mm spark gap near the input terminals is recommended to ensure that the maximum anode voltage is not exceeded.

COOLING

Anode block	Water

For required quantity of water and pressure drop see page 14.

Filament and filament/cathode connectors	Forced-air

A low-velocity air flow perpendicular to the cathode axis is required.

R.F. output system

A minimum air flow of $0.1m^3/min$ is required at room temperature (typical 18^oC).

Maximum temperatures

Anode block (see page 9 for reference point)	90	^oC
Cooling water outlet temperature	70	^oC
Filament and filament/cathode terminals and any other point	200	^oC

At standby with filament voltage = 5.5V water and forced-air cooling is required to prevent overheating.

A thermoswitch should be mounted at the point indicated on the outline drawing (see page 9). The switch should operate at a mounting disc temperature of 85 to 90^oC.

PHYSICAL DATA

Weight of magnetron (approx.)	6.0	kg
	13.2	lb

MOUNTING POSITION — Axis of cathode vertical

OUTPUT CONNECTION

The coaxial output system of the magnetron may be coupled by suitable means to a coaxial line or to a waveguide.

ACCESSORIES

Filament connector	55323
Filament/cathode connector	55324
Cap nut (for output coupling)	55312
Snap ring	55313
Mounting plate	55327
Washer	55328
Cap nut (for cooling system)	TE1051b
Hose nipple (for 9mm hose)	TE1051c

GENERAL

Whenever it is considered to operate the magnetron at conditions substantially different from those indicated, the magnetron manufacturer should be consulted.
Equipment design should be orientated around the magnetron specifications given in this data and not around one particular magnetron, since due to normal production variations, the design parameters (V_a, r_f(cold), f, P_{out}, etc.) will vary around the nominal values.

Anode supply

The magnetron can be operated from an unfiltered three-phase full-wave supply unit. The design of the unit should be such that the limiting values for the mean and peak anode currents are not exceeded.

Filament supply

The secondary of the filament transformer must be well insulated from the primary, since in normal magnetron operation the cathode will be at high negative potential and the anode will be earthed.
The transformer should be designed so that the filament voltage and surge current limits are not exceeded.
Immediately after applying the anode voltage the filament voltage must be reduced as a function of the anode current according to the diagram on page 14. The life of the magnetron will be greatest if the filament voltage is reduced to a value given by the fully drawn line 'a'. The filament voltage should be adjusted within 10% as given by the dashed lines which border the hatched area.
If it is intended to design the equipment for a predetermined number of steps in output power level, the reduced filament voltage for each step must be set to a value within the area bordered by the lines 'b' and 'c', and preferably within or close to the hatched area.
The filament voltage should be maintained within the limits given by the lines 'b' and 'c'.

Filament connections

It is important to ensure that the filament connections make good electrical and mechanical contact due to the high filament current. This will prevent the temperature of the filament connections rising due to the high contact resistance. Bad electrical contacts cause voltage drop and thus lower the filament voltage which may result in reduced efficiency of operation. The filament connectors (see page 10) have been designed to ensure effective electrical and mechanical contact. A high temperature resistant silicone grease is recommended to prevent oxidation of the filament contacts.
The electrical conductors to the cathode and filament connectors should be flexible in order to prevent undue stress on the terminals.

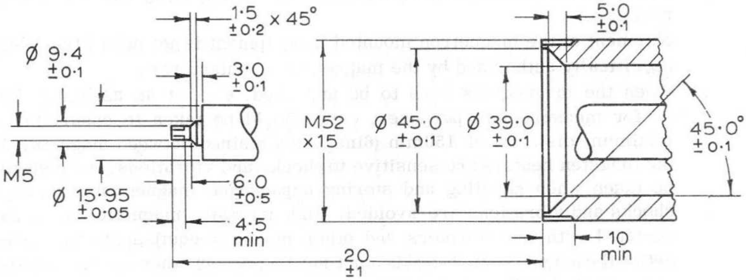
Load impedance

Optimum output power and life will be obtained when the magnetron is loaded with an impedance giving a v.s.w.r. of approximately 1.5 in the phase of sink region. This phase condition is reached when the position of the voltage standing wave minimum is at a distance of about 0.39λguide from the reference plane for electrical measurements (see outline drawing page 8) in the direction of the load.

GENERAL (cont'd)

Antenna

When an antenna is used, the coaxial coupling should be according to the figure below:-



All dimensions in mm

A soft copper washer of 0.5mm thickness is required between the antenna and the magnetron to ensure reliable r.f. contact. The maximum torque applied when screwing the antenna coupling into the magnetron is 15kg cm (13lb in).

Cooling

The r.f. output system of the magnetron is provided with air inlet and outlet holes for the application of at least $0.1m^3$/min of cooling air to the ceramic part inside. All air inlet holes must be used to obtain the required uniform cooling. The cooling air must be filtered to be free from dust, water and oil. For an example of a cooling device around the output system see the drawing on page 12.

To prevent the magnetron from overheating if the anode cooling fails, provision is made for mounting a thermoswitch which should operate within a mounting disc temperature of 85 to 90°C (see page 8)

A stream of cooling air should also be directed at the input connectors and should be perpendicular to the cathode axis.

The type TE1051c hose nipple is suitable for connecting a flexible hose or soldering to a metal water pipe.

Shielding

Where required, r.f. radiation from the filament terminals may be reduced by external filtering and/or shielding. A filter box of non-magnetic material may be mounted on the aluminium top cover plate of the magnetron. For drilling and tapping the cover plate must be removed. The filter box mounting screws **must not** penetrate through the top cover plate (thickness 6mm). When removing and re-mounting the cover plate, non-magnetic tools should be used.

GENERAL (cont'd)

Magnetron cleanliness

The ceramic insulation between the terminals of the magnetron must be kept clean. A protective cover of suitable material should be placed over the output terminal if the magnetron is inserted directly into a cavity.

The cooling air should be filtered and ducted to prevent deposits forming on the insulation during operation.

HANDLING, STORAGE, MOUNTING AND OPERATIONAL CHECKS

Handling and storage

The original packing should be used for transporting and storing the magnetron.

Shipment of the magnetron mounted in equipment is not permitted unless specifically authorised by the magnetron manufacturer.

When the magnetrons have to be unpacked, e.g. at an assembly line or for measurement purposes, care should be taken to ensure that a minimum distance of 150mm (6in) is maintained between magnets. As the tungsten heaters are sensitive to shocks and vibrations, care should be taken when handling and storing unpackaged magnetrons that such shocks and vibrations are avoided. High intensity magnetic fields associated with transformers and other magnetic equipment can demagnetise the magnets. Such fields must not be present when the magnetrons are stored, handled or serviced.

The user should be aware of the strong magnetic fields around the magnetron. When handling and mounting the magnetron, non-magnetic tools must be used and extreme care taken to avoid damage to watches and other precision instruments nearby.

Mounting

When magnetic materials are present in two or more planes, the minimum distance from the magnets is 130mm (5in) in all directions. Mounting holes may be drilled and tapped in the bottom cover plate when removed from the magnetron. The mounting screws **must not** penetrate through the bottom cover plate (thickness 6mm). A special mounting plate (type 55327) with 4 mounting holes as indicated in the drawing (see page 8), can be screwed to the bottom cover plate of the magnetron by removing the two existing M4 screws and replacing them by screws 15mm (0.6in) long.

For removing and re-mounting these plates non-magnetic tools should be used. When mounting the magnetron, all tools used close to or in contact with the magnetron must be made of non-magnetic material to avoid possible mechanical damage to ceramic parts as well as short-circuiting the magnetic flux by magnetic attraction.

The anode power supply lead should be connected to the terminal shown in the outline drawing (see page 8) or to one of the mounting screws.

HANDLING, STORAGE, MOUNTING AND OPERATIONAL CHECKS(cont'd)

Operational checks

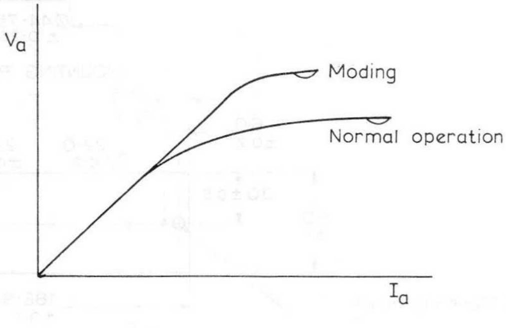
Excessive v.s.w.r. and/or current values may lead to moding of the magnetron which can be detected by displaying the V_a/I_a characteristic of the magnetron on an oscilloscope. This should be done for various load conditions and should be part of production line inspection and of field inspection before and after magnetron replacement.

For x-y display on a service oscilloscope the anode voltage can be sampled from a voltage divider chain connected between earth and the cathode connector, and the anode current from a sampling resistor of a few ohms which may be permanently connected to the earth terminal of the high voltage supply unit.

The normal characteristic should be a fairly straight loop. The appearance of a second loop or parts thereof showing distinctly above the first loop indicates undesired modes of oscillation that can rapidly lead to failure of the magnetron.

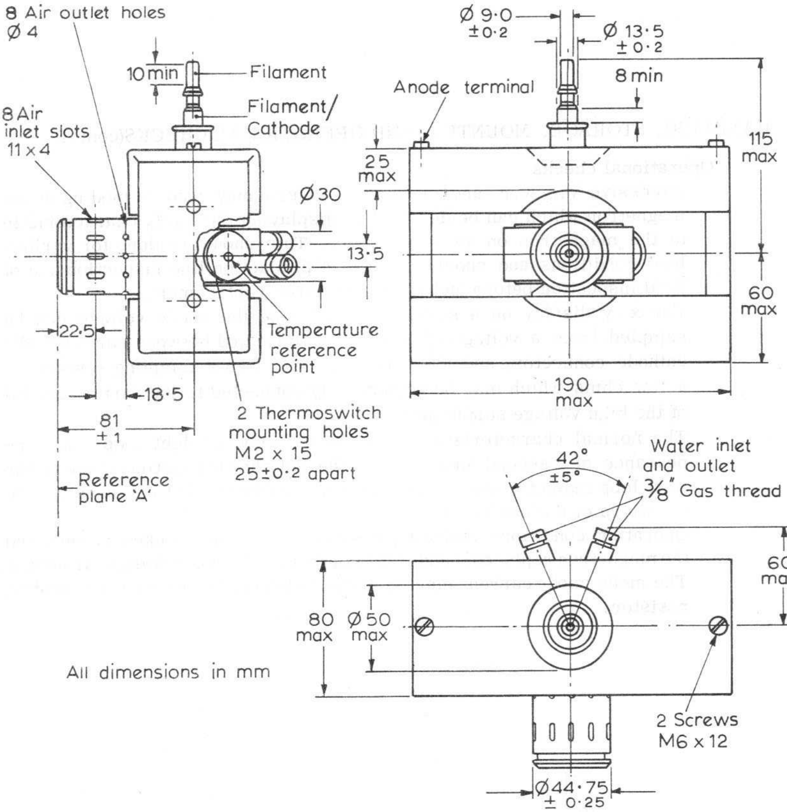
Operating conditions including v.s.w.r. must be checked at once and the magnetron replaced if under the correct conditions moding still occurs.

The mean anode current may be measured directly across the sampling resistor.



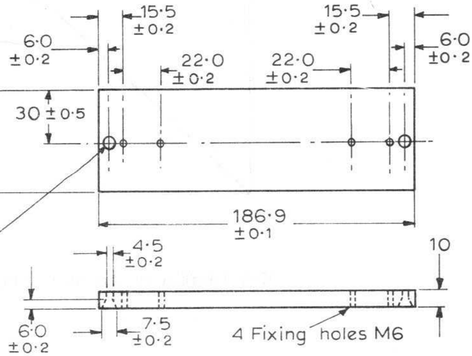
X-Y Display of magnetron characteristic

OUTLINE DRAWING



All dimensions in mm

MOUNTING PLATE 55327



2 Mounting holes

Material: Aluminium

All dimensions in mm

MILLIMETRE TO INCH CONVERSION TABLE FOR OUTLINE DRAWING

Rounded outwards

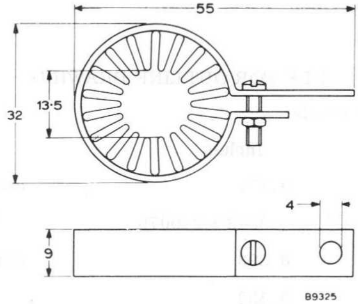
Millimetres	Inches	
8.0	0.314	min
9.0 ± 0.2	0.3543 ± 0.0079	Ø
10	0.393	min
13.5	0.532	
13.5 ± 0.2	0.5315 ± 0.0079	Ø
18.5	0.728	
22.5	0.886	
25	0.99	max
25 ± 0.2	0.9842 ± 0.0079	
30	1.18	Ø
44.75 ± 0.25	1.762 ± 0.010	Ø
50	1.97	max
60	2.37	max
80	3.15	max
81 ± 1	3.189 ± 0.040	
115	4.528	max
190	7.49	max

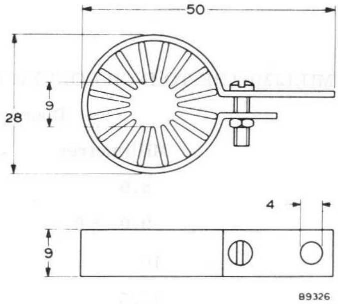
Mounting plate 55327

Millimetres	Inches	
4.5 ± 0.2	0.1772 ± 0.0079	Ø
6.0 ± 0.2	0.2362 ± 0.0079	
7.5 ± 0.2	0.2953 ± 0.0079	Ø
10	0.39	
15.5 ± 0.2	0.6102 ± 0.0079	
22 ± 0.2	0.8661 ± 0.0079	
30 ± 0.5	1.181 ± 0.020	
60 ± 1.0	2.362 ± 0.040	
186.9 ± 0.1	7.3582 ± 0.0040	

ACCESSORIES

Inch dimensions given in conversion tables below are derived from original millimetre dimensions



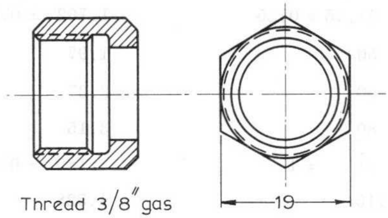


Filament/cathode connector
55324

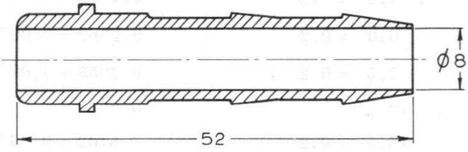
Millimetres	Inches
4 dia	0.16 dia
9	0.35
13.5 dia	0.532 dia
32 dia	1.26 dia
55	2.17

Filament connector
55323

Millimetres	Inches
4 dia	0.16 dia
9	0.35
9 dia	0.35 dia
28 dia	1.10 dia
50	1.97

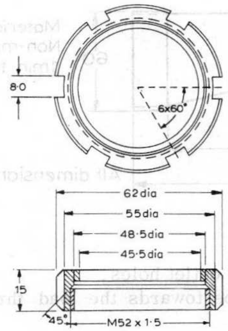


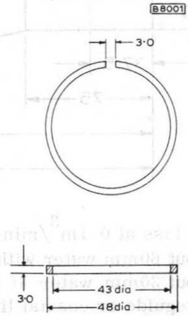
Cap nut
TE1051b



Connection for 9mm hose
TE1051c

Millimetres	Inches
8 dia	0.31 dia
19	0.75
52	2.05



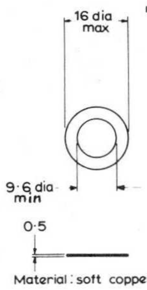


Cap nut
55312

Millimetres	Inches
8.0	0.315
15	0.59
45.5 dia	1.791 dia
48.5 dia	1.909 dia
55 dia	2.165 dia
62 dia	2.441 dia

Snap ring
55313

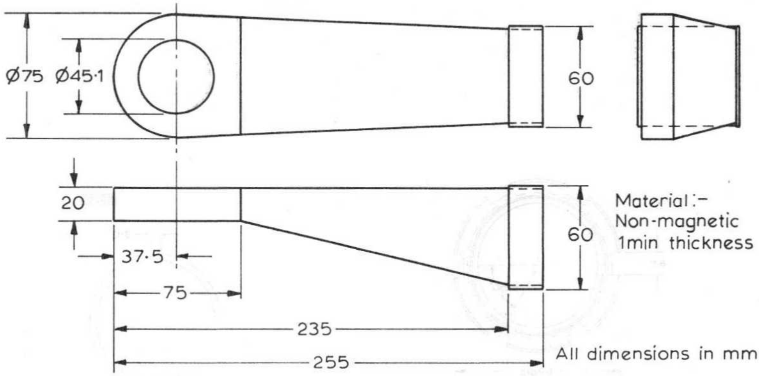
Millimetres	Inches
3.0	0.118
43 dia	1.69 dia
48 dia	1.89 dia



Washer
55328

Millimetres	Inches
0.5	0.020
9.6 dia min	0.377 dia min
16 dia max	0.63 dia max

Example of a cooling device for output system

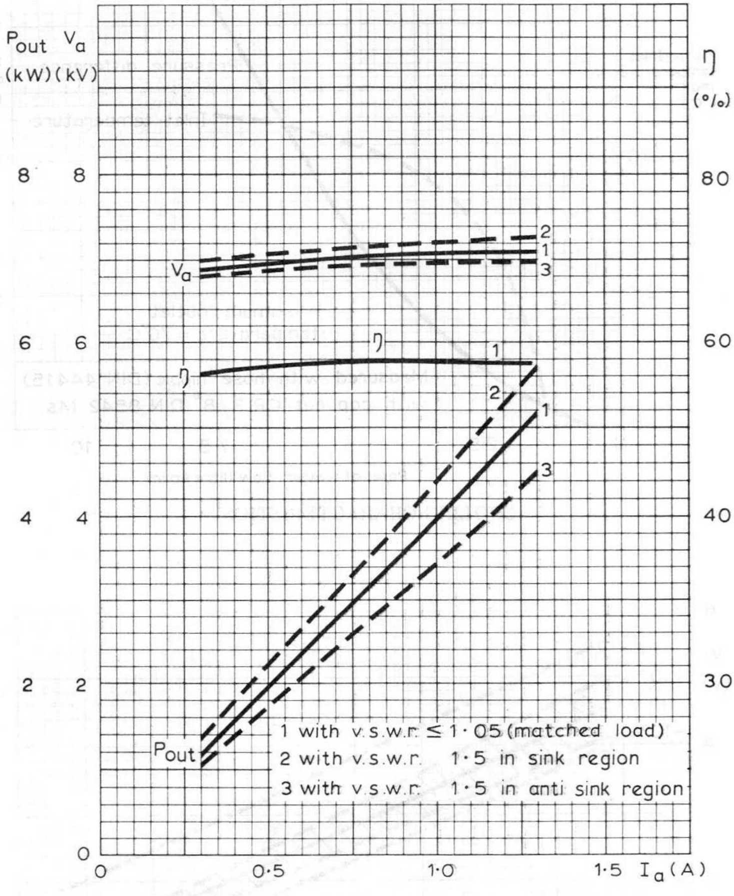


Pressure loss at 0.1m^3/min:

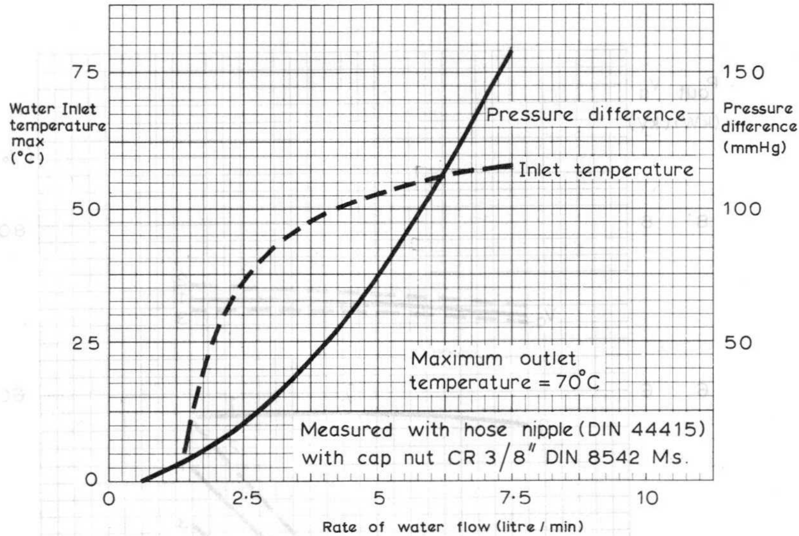
About 60mm water with air outlet only via outlet holes.

About 30mm water if air can also escape towards the load through the waveguide or coaxial line.

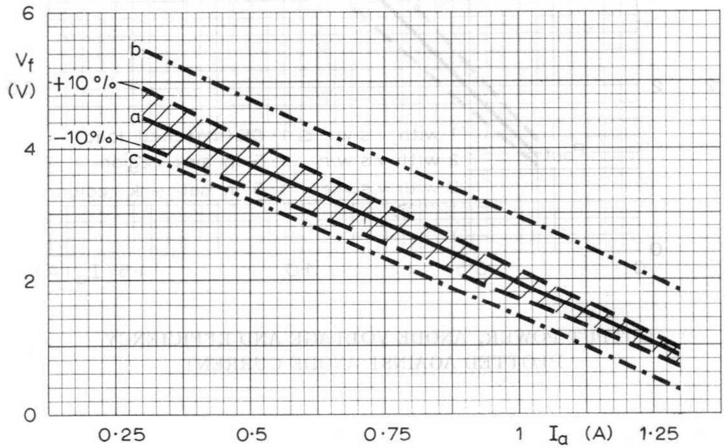
Millimetres	Inches
20	0.79
37.5	1.476
45.1 dia	1.776 dia
60	2.36
75	2.95
75 dia	2.95 dia
235	9.25
255	10.04



OUTPUT POWER, ANODE VOLTAGE AND EFFICIENCY
PLOTTED AGAINST ANODE CURRENT



COOLING CHARACTERISTICS



HEATER DERATING CHART

MAGNETRON YJ1280

QUICK REFERENCE DATA

The YJ1280 is an integral magnet c.w. magnetron designed for use in microwave heating applications. With an L-C stabilised power supply it can produce up to 1.5kW under typical operating conditions. The magnetron is air cooled and is of metal ceramic construction.

Frequency (fixed within the band)	2.425 to 2.475	GHz
Power output	1.3	kW
Construction	Packaged	
Output connection	Probe for coupling to waveguide, coaxial line or directly into a cavity	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION (see note 1)

Operating conditions (see note 2)

Filament voltage (starting and standby)	5.0	V
Filament voltage (operating)	3.5	V
Anode current (mean) (see note 3)	380	mA
Anode current (peak) (see note 4)	650	mA

Typical performance

	Load v.s.w.r. 2.5 in direction of sink	Matched load	
Anode voltage	5.7	5.7	kV
Power output	1.5	1.3	kW

CATHODE

Directly heated thoriated tungsten

Filament voltage (starting and standby) (see note 5)	5.0	V
Filament voltage, operating with anode current of 380mA (mean)	3.5	V
Filament current (nominal) with filament voltage of 5.0V	28	A
Filament resistance (cold) (approx.)	0.02	Ω
Pre-heating time (minimum)	10	s

TEST CONDITIONS AND LIMITS

Test conditions (see note 1)

Filament voltage (operating)	3.5	V
Anode current (mean) (see note 3)	380	mA
Load v.s.w.r.	1.05:1	

Limits and characteristics

	Min.	Max.	
Anode voltage (see note 6)	5.4	5.8	kV
Power output	1.15	-	kW
Frequency	2.425	2.475	GHz
Stability (see note 7)			
Filament current (see note 8)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Filament voltage (starting and standby)	4.5	5.5	V
Filament voltage (operating) (see note 9)	3.15	3.85	V
Filament starting current (peak)	-	70	A
Anode voltage positive and negative (see note 10)	-	10	kV
Anode current (peak) (see note 9)	-	800	mA
Anode current (mean) (see note 3)	100	450	mA
Anode input power (mean)	-	2.7	kW
Load v.s.w.r. (continuous) (see note 11)	-	4:1	
Load v.s.w.r. (peak) (see notes 11 and 12)	-	10:1	
Anode temperature (see note 13)	-	180	^{o}C
Temperature at any other point on the tube	-	200	^{o}C

MOUNTING POSITION

Axis of cathode (filament) vertical (see outline drawing) (see note 15).

COOLING (see note 15)

Anode block		forced air
Filament terminals		forced air
Typical cooling air flow		
Inlet temperature	35	^{o}C
Quantity	1.2	m^3/min
Pressure drop	10	mm (water gauge)

PHYSICAL DATA

	kg	lb
Weight of magnetron	2.3	5.1
Weight of magnetron in storage carton	3.45	7.6

	mm	in
Dimensions of storage carton	310 × 310 × 310	12.2 × 12.2 × 12.2

ACCESSORIES (see pages 10 and 11)

	Type No.
Filament cathode connector	55324
Filament connector	55323
R.F. gasket (supplied with tube)	55341
Washer (for antenna connection)	55328
Measuring probe (for cold measurements)	55336

NOTES

1. Operated from an L-C stabilised supply.
2. For operation at other load impedances and anode currents, see pages 12 and 13.
3. Measured with a moving coil instrument.
4. The design of the power supply should be such that the maximum ratings of mean and peak anode currents are not exceeded.
5. A.C. (50 or 60Hz) or d.c. If operated from d.c. the filament connector should be connected to the positive terminal of the supply. Tolerance, ±10% of the nominal voltage indicated.
6. Measured with a filtered anode voltage supply.
7. The magnetron shall operate without moding into a load v.s.w.r. of at least 4:1, phased in the region of "sink". The stability of the magnetron is defined as the highest value of the v.s.w.r. of the load in the "sink" region at which stable operation is achieved.
8. Measured with no anode power, with a filament supply of 5.0 volts, the current limits are 24 to 32A.
9. With a mean anode current of 380mA.
10. It is recommended that a suitable spark gap be connected between the filament connectors and the anode (earth) to prevent the maximum anode voltage being exceeded.
11. Measured with probe 55336.
12. This is the maximum v.s.w.r. which may be reached in an oven fitted "field stirrer", provided the maximum period is 0.02 second or 20% of the time whichever is the smaller. Any period in which the v.s.w.r. is between 4:1 and 10:1 must be followed by an interval four times as long, with a v.s.w.r. of not more than 4:1. When operated under these conditions the magnetron should not be permitted to mode.
13. Measured at the point indicated on the outline drawing.
14. It is recommended to mount a thermoswitch at the place indicated on the outline drawing to protect the magnetron from overheating.
15. During standby, when the filament supply is 5 volts some forced air is necessary to keep the temperature of the filament terminals below the stated maximum.

DESIGN AND OPERATING INFORMATION

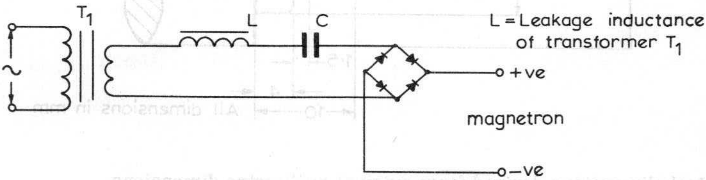
General

If it is required to operate the magnetron at conditions different from those indicated, Mullard Ltd. should be consulted.

Equipment design should be orientated around the magnetron specifications given in this data and not around one particular sample magnetron, since due to normal production variations, the design parameters of anode voltage, filament current, power output, etc. will vary around the nominal values.

Anode supply

The magnetron should be operated from a current stabilised anode supply unit. The design of the unit should be such that the limiting values for the mean and peak anode currents are not exceeded.



Basic series resonant ciruit of an L - C power supply

Filament supply

The secondary of the filament transformer must be well insulated from the primary since in normal magnetron operation the cathode will be at high negative potential and the anode will be earthed.

The transformer should be designed so that the filament voltage and starting current limits are not exceeded.

Filament connections

It is important to ensure that the filament connectors make good electrical and mechanical contact which will prevent the temperature of the filament connections rising due to high contact resistance. Bad electrical connections cause voltage drop and thus lower the filament voltage which may adversely affect the life of the magnetron. The filament connectors shown in the drawing (page 10), have been designed to ensure effective electrical and mechanical contact. A high temperature silicone grease is recommended to prevent oxidation of the filament contacts.

The electrical conductors to the filament and filament cathode terminals should be flexible in order to prevent undue stress on the terminals.

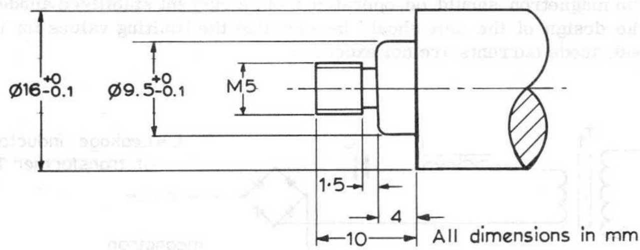
Load impedance measured with measuring probe

The use of type 55336 measuring probe enables the designer of microwave heating equipment to determine the value of the load impedance (v.s.w.r. and phase of reflection as seen by the magnetron) by standard cold measuring techniques. The probe simulates the r.f. output system of the magnetron; it may be coupled either to a waveguide or directly into a cavity in place of the magnetron, in both cases type 55341 gasket should be used.

In order to obtain efficient operation the magnetron should be loaded in the phase of "sink", however, the average mismatch should not be higher than a v.s.w.r. of approximately 4:1.

Antenna

When an antenna is used, the part of the antenna screwed into the magnetron should be according to the figure below:-



Inch dimensions derived from original millimetre dimensions

Millimetres	Inches	Millimetres	Inches
1.5	0.06	10	0.39
4	0.16	$Ø16^{+0}_{-0.1}$	$Ø0.63^{+0}_{-0.0078}$
$Ø9.5^{+0}_{-0.1}$	$Ø0.374^{+0}_{-0.0078}$		

A soft copper washer of 0.5mm thickness, type No. 55328, is required between the antenna and the magnetron to ensure reliable r.f. contact. The maximum torque applied when screwing the antenna into the magnetron is 1.5Nm (13 lbf in)

Standby operation

The anode voltage may be applied immediately after the initial pre-heating time (with filament voltage of 5V) of 10 seconds and full microwave energy is then immediately available. After the application of anode power the filament voltage should be reduced to 3.5V. During standby, that is, with no anode power, the filament supply should be 5V.

DESIGN AND OPERATION INFORMATION (contd.)

Shielding

The already low level of r.f. radiation from the filament terminals may be further reduced by filtering or shielding. Detailed information may be obtained from Mullard Ltd.

Magnetron cleanliness

The ceramic insulation of the r.f. output probe and filament input terminals must be kept clean. A protective cover of suitable material should be placed over the output terminal if the magnetron is inserted directly into a cavity.

The cooling air should be filtered and ducted to prevent deposits forming on the insulation during operation.

HANDLING, STORAGE, MOUNTING AND OPERATIONAL CHECKS

Handling and storage

The original packing should be used for transporting and storing the magnetron.

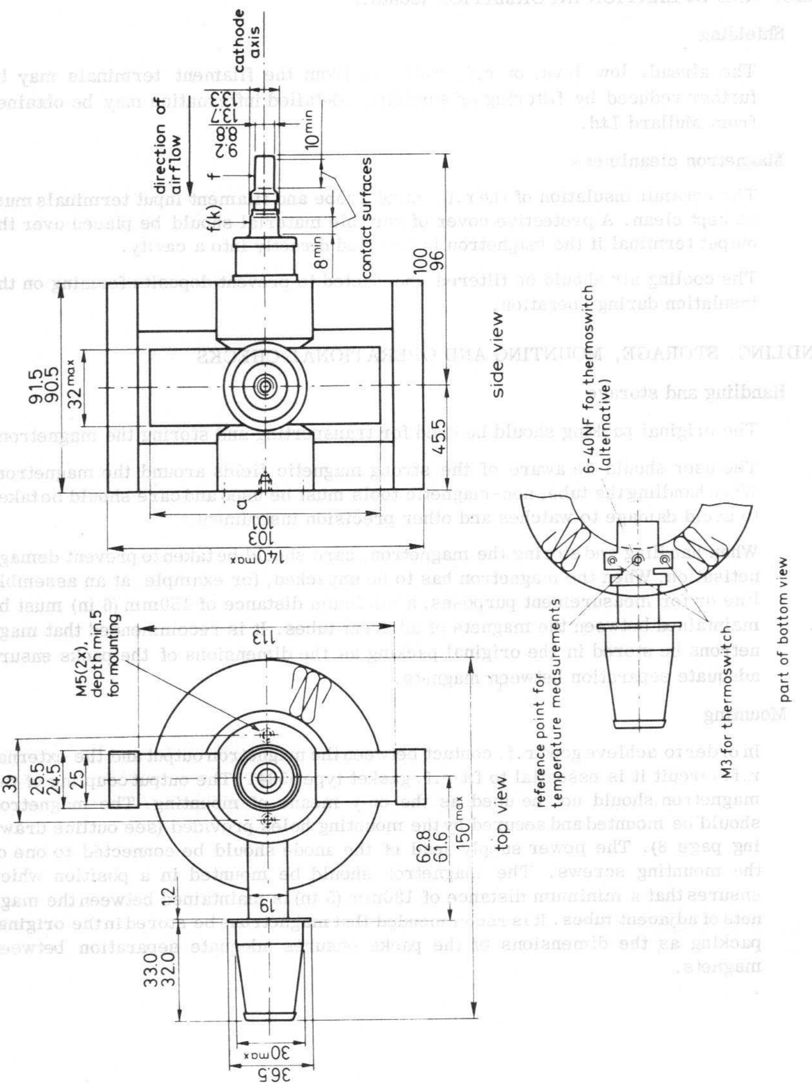
The user should be aware of the strong magnetic fields around the magnetron. When handling the tube, non-magnetic tools must be used and care should be taken to avoid damage to watches and other precision instruments.

When handling and storing the magnetron, care should be taken to prevent demagnetisation. When the magnetron has to be unpacked, for example, at an assembly line or for measurement purposes, a minimum distance of 150mm (6 in) must be maintained between the magnets of adjacent tubes. It is recommended that magnetrons be stored in the original packing as the dimensions of the packs ensure adequate separation between magnets.

Mounting

In order to achieve good r.f. contact between the magnetron output and the external r.f. circuit it is essential to fit r.f. gasket type 55341. The output coupling of the magnetron should not be used as the only means of mounting. The magnetron should be mounted and secured by the mounting holes provided (see outline drawing page 8). The power supply lead of the anode should be connected to one of the mounting screws. The magnetron should be mounted in a position which ensures that a minimum distance of 130mm (5 in) is maintained between the magnets of adjacent tubes. It is recommended that magnetrons be stored in the original packing as the dimensions of the packs ensures adequate separation between magnets.

OUTLINE DRAWING OF YJ1280



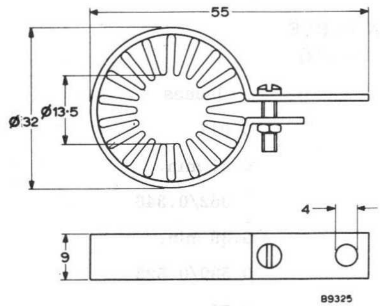
All dimensions in mm

CONVERSION TABLE
(Rounded outwards)

Millimetres	Inches
1.2	0.047
8 min.	0.31 min.
9.2/8.8	0.362/0.346
10 min.	0.39 min.
13.7/13.3	0.539/0.523
19	0.75
25	0.98
25.5/24.5	1.004/0.964
30 max.	1.18 max.
32 max.	1.26 max.
33/32	1.30/1.26
36.5	1.437
39	1.53
45.5	1.791
62.8/61.6	2.472/2.425
91.5/90.5	3.602/3.563
100/96	3.94/3.78
103/101	4.05/3.97
113	4.45
140 max.	5.5 max.
150 max.	5.9 max.

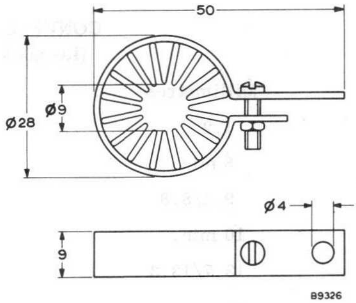
ACCESSORIES

Inch dimensions given in conversion tables below are derived from original millimetre dimensions



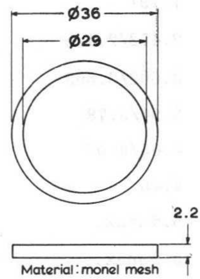
Filament/cathode connector
55324

Millimetres	Inches
Ø 4	Ø0.16
9	0.35
Ø13.5	Ø0.53
Ø32	Ø1.26
55	2.16



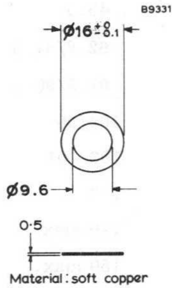
Filament connector
55323

Millimetres	Inches
Ø 4	Ø0.16
9	0.35
Ø 9	Ø0.35
Ø28	Ø1.10
50	1.97



R.F. gasket
55341

Millimetres	Inches
2.2	0.87
Ø29	Ø1.14
Ø36	Ø1.42

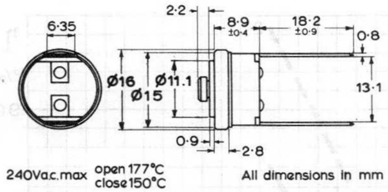


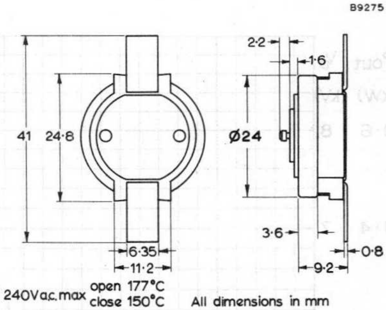
Washer
55328

Millimetres	Inches
0.5	0.02
Ø $9.6^{+0}_{-0.1}$	Ø$0.378^{+0}_{-0.0078}$
Ø$16^{+0}_{-0.1}$	Ø$0.63^{+0}_{-0.0078}$

ACCESSORIES (contd.)

Inch dimensions given in conversion tables below are derived from original millimetre dimensions



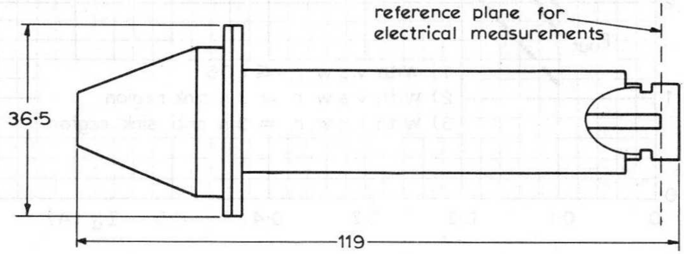


Thermoswitch 4.5A max
S-32997

Millimetres	Inches
0.8	0.031
0.9	0.035
2.2	0.086
2.8	0.110
6.35	0.25
8.9 ±0.4	0.350 ±0.015
Ø11.1	Ø0.437
13.1	0.515
Ø15	Ø0.59
Ø16	Ø0.63
18.2 ±0.9	0.716 ±0.035

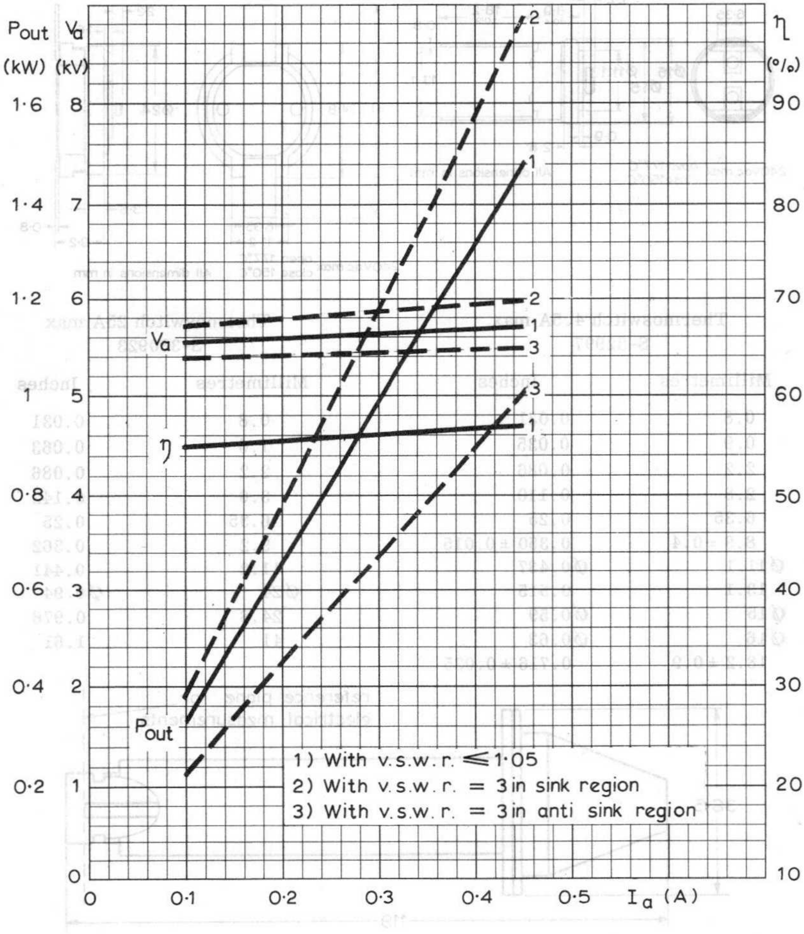
Thermoswitch 25A max
S-330923

Millimetres	Inches
0.8	0.031
1.6	0.063
2.2	0.086
3.6	0.142
6.35	0.25
9.2	0.362
11.2	0.441
Ø24	Ø0.94
24.8	0.976
41	1.61



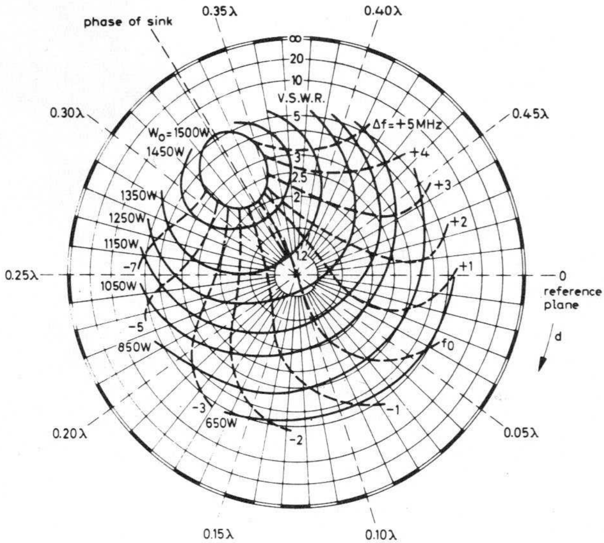
Measuring probe
55336

Millimetres	Inches
36.5	1.43
119	4.68



OUTPUT POWER, ANODE VOLTAGE AND EFFICIENCY
PLOTTED AGAINST ANODE CURRENT

LOAD DIAGRAM



Mean anode current I_a = 380mA

Frequency f_o = 2.45GHz

d = distance of voltage standing wave minimum from reference plane for electrical measurement (using measuring probe 55336) towards load

Constant air cooling

QUICK REFERENCE DATA		
Magnetron for use in microwave diathermy or as a laboratory source for gas ionisation.		
Frequency	2.45	GHz
Power output (c.w.)	200	W
Construction	Packaged	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

CHARACTERISTICS (measured at I_a = 200mA d.c., v.s.w.r. <1.05)

Frequency fixed within the band	2.425 to 2.475	GHz
Operating voltage range (d.c.)	1.55 to 1.7	kV

OPERATION FROM SINGLE-PHASE SUPPLY WITHOUT RECTIFIER

OPERATING CONDITIONS (using h.t. supply with Z > 250Ω)

*Heater voltage (running)	4.5	V
Mean anode current	200	mA
Peak anode current	1.3	A
Load mismatch (v.s.w.r.)	1.5	
Power output (matched load)	200	W

*For different values of anode current, the heater voltage should be adjusted in accordance with either curve 'a' or 'b' on page 11.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.8	5.6	V
Heater surge current	-	8.5	A
Mean anode current	-	230	mA
Peak anode current	-	1.4	A
Load mismatch (v.s.w.r.)	-	2.0	
Envelope temperature	-	125	°C

OPERATION FROM SINGLE-PHASE FULL-WAVE RECTIFIER WITHOUT SMOOTHING FILTER

OPERATING CONDITIONS (using h.t. supply with Z > 500Ω)

*Heater voltage (running)	4.6	V
Mean anode current	200	mA
Peak anode current	700	mA
Load mismatch (v.s.w.r.)	1.5	
Power output (matched load)	200	W

*For different values of anode current, the heater voltage should be adjusted in accordance with either curve 'a' or 'b' on page 11.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.8	5.6	V
Heater surge current	-	8.5	A
Mean anode current	-	230	mA
Peak anode current	-	800	mA
Load mismatch (v.s.w.r.)	-	2.0	
Envelope temperature	-	125	^{o}C

OPERATION FROM D.C. SUPPLY

To obtain optimum power output, it is necessary to insert between the magnetron and the load, a fixed reflection element (see page 8) giving a mismatch with v.s.w.r. of 2.0 in "phase of sink".

OPERATING CONDITIONS

*Heater voltage (running)	4.0	4.8	V
Mean anode current	150	100	mA
Peak anode current	220	150	mA
†Load mismatch (v.s.w.r.)	2.0	2.0	
†Power output (matched load)	150	100	W

*For different values of anode current, the heater voltage should be adjusted in accordance with curve 'c' on page 11.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
Heater voltage (starting)	4.4	5.0	V
Heater surge current	-	8.5	A
Mean anode current	-	200	mA
Peak anode current	-	400	mA
†Load mismatch (v.s.w.r.)	-	3.0	
Envelope temperature	-	125	^{o}C

†Excluding fixed reflection element

CATHODE

Indirectly heated

Anode supply	A.C. or rectified A.C.	D.C.	
**V_h (starting)	5.3	4.8	V
I_h	3.5	3.3	A
r_h (cold)	0.2	0.2	Ω
Preheat delay before applying h.t.	3.0	4.0	min.

**Temporary fluctuations not exceeding +5% and -10% of the nominal heater voltage are permissible.

The heater voltage must be reduced immediately after the application of h.t. in accordance with the curves on page 11.

OUTPUT CONNECTION

50Ω coaxial with 4.8mm inner conductor and 11mm outer conductor.

COOLING

Natural cooling is sufficient provided that the magnetron is effectively mounted on a heat conducting non-magnetic heatsink. It is desirable to mount the heatsink vertically.

MOUNTING POSITION Any (but see COOLING)

PHYSICAL DATA

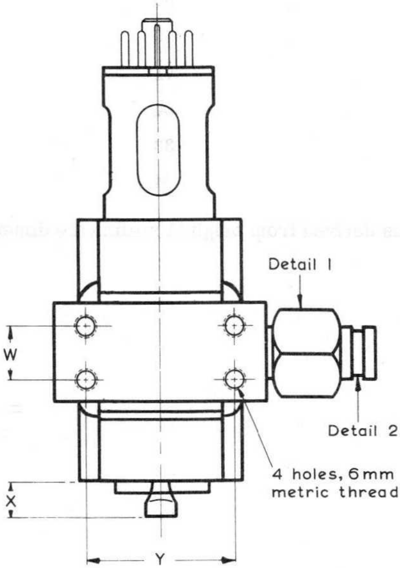
	kg	lb
Weight of magnetron	2.4	5.3
Weight of magnetron in carton	3.5	7.7

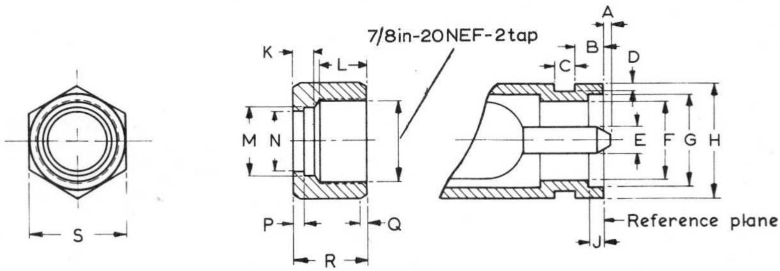
DIMENSIONS

	Millimetres	Inches	
A	1.5	0.059	
B	4.0±0.2	0.157±0.008	
C	2.8±0.2	0.110±0.008	
D	1.5	0.059	
E	3.8±0.05	0.150±0.002	dia.
F	11.1±0.15	0.437±0.006	dia.
G	12.8±0.15	0.504±0.006	dia.
H	16	0.63	dia.
J	2.0±0.15	0.079±0.006	
K	6.0	0.236	
L	13	0.51	
M	19	0.75	dia.
N	16.5	0.650	dia.
P	3.0	0.118	
Q	2.0	0.079	
R	21	0.83	
S	27	1.06	
W	16	0.63	
X	20	0.78	max
Y	45	1.77	

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING





Detail 1

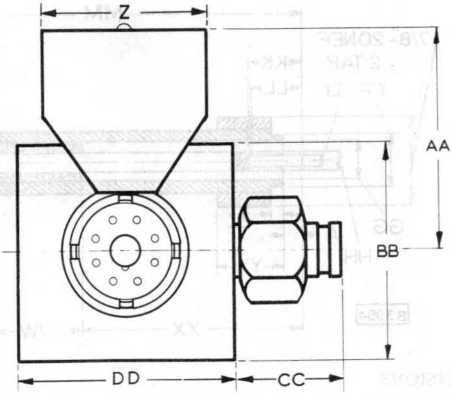
Detail 2

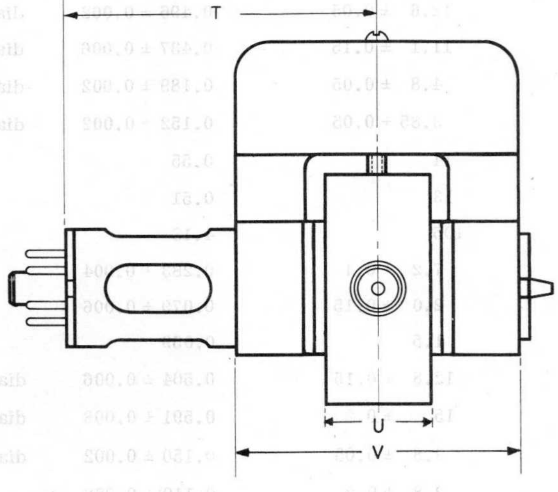
Note:
The inner conductor (E above) will always lie within a circle of diameter 5·5mm.

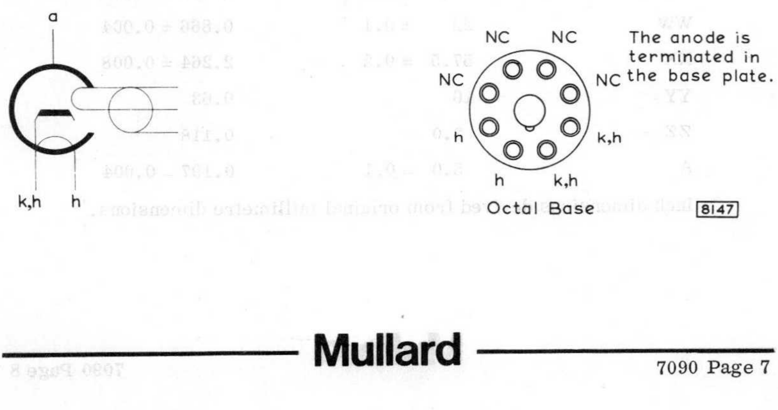
DIMENSIONS

	Millimetres	Inches
T	90	3.54
U	30	1.18
V	80	3.15
Z	50	1.97
AA	71	2.80
BB	64	2.52
CC	33	1.30
DD	64	2.52

Inch dimensions derived from original millimetre dimensions.

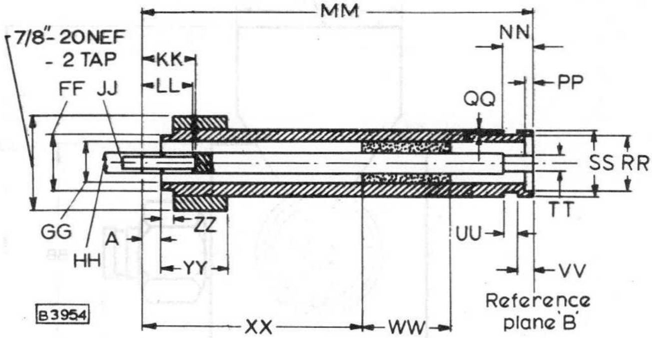

Z
AA
BB
DD
CC


T
U
V


a
k,h
h
NC
NC
NC
NC
h
k,h
h
k,h
Octal Base
The anode is terminated in the base plate.
8147

FIXED REFLECTION ELEMENT

TEFLON $\varepsilon_r = 2.0$ DRIVING FIT

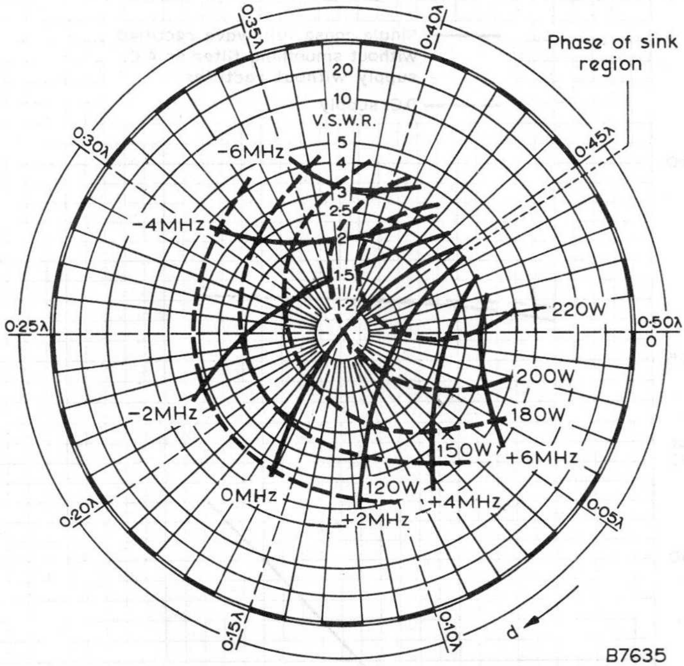


DIMENSIONS

	Millimetres	Inches	
FF	12.6 ± 0.05	0.496 ± 0.002	dia.
GG	11.1 ± 0.15	0.437 ± 0.006	dia.
HH	4.8 ± 0.05	0.189 ± 0.002	dia.
JJ	3.85 + 0.05	0.152 + 0.002	dia.
KK	14	0.55	
LL	13	0.51	
MM	105	4.13	
NN	7.2 + 0.1	0.283 + 0.004	
PP	2.0 ± 0.15	0.079 ± 0.006	
QQ	1.5	0.059	
RR	12.8 ± 0.15	0.504 ± 0.006	dia.
SS	15 ± 0.2	0.591 ± 0.008	dia.
TT	3.8 ± 0.05	0.150 ± 0.002	dia.
UU	2.8 ± 0.2	0.110 ± 0.008	
VV	4.0 ± 0.2	0.157 ± 0.008	
WW	22 ± 0.1	0.866 ± 0.004	
XX	57.5 ± 0.2	2.264 ± 0.008	
YY	16	0.63	
ZZ	3.0	0.118	
A	5.0 − 0.1	0.197 − 0.004	

Inch dimensions derived from original millimetre dimensions.

RIEKE DIAGRAM

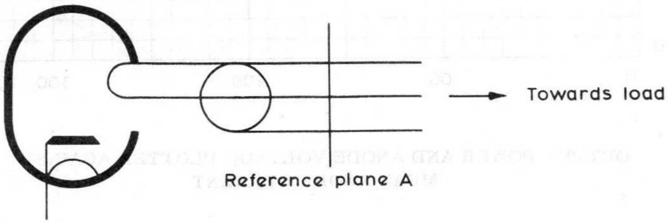


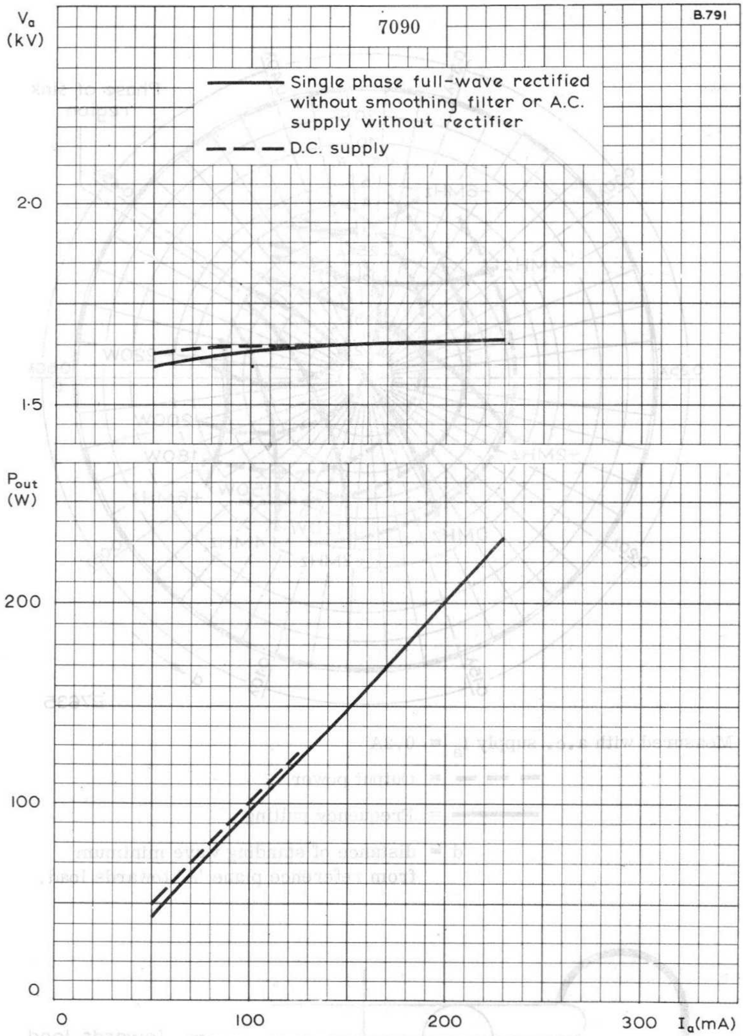
Measured with a.c. supply I_a = 0.2A

– – – = Output power

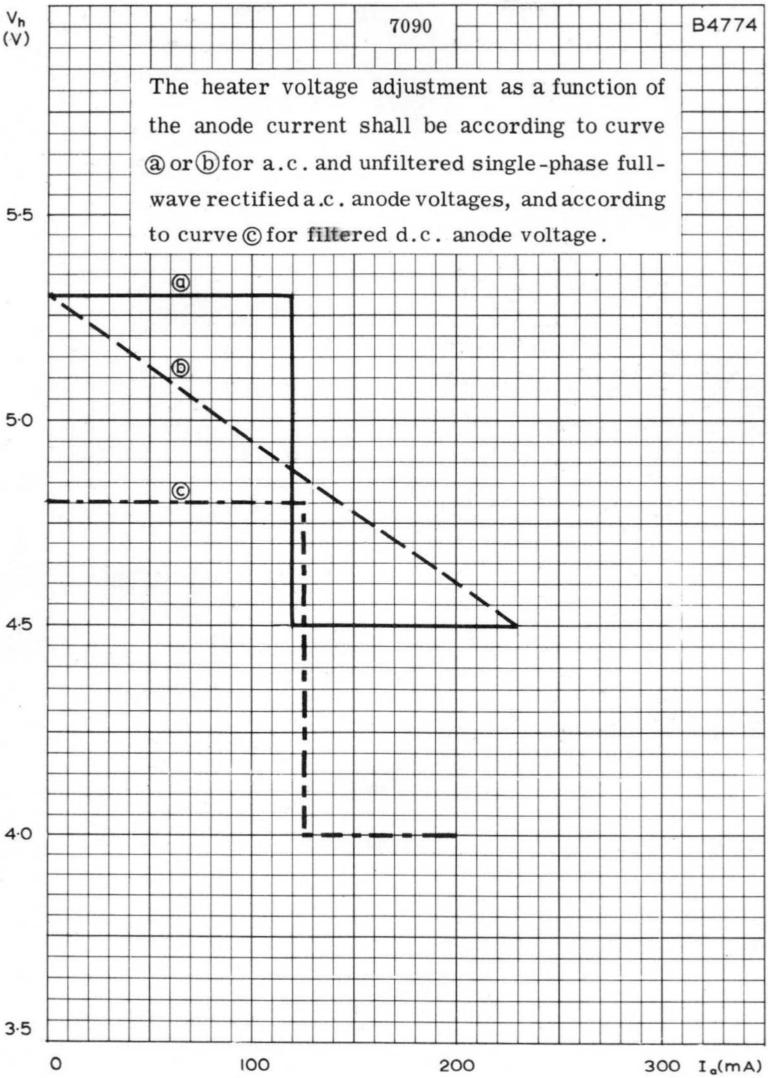
—— = Frequency pulling

d = distance of standing wave minimum from reference plane 'A' towards load.





OUTPUT POWER AND ANODE VOLTAGE PLOTTED AGAINST MEAN ANODE CURRENT



HEATER VOLTAGE PLOTTED AGAINST MEAN ANODE CURRENT

KLYSTRONS

D

1. HEATER

The heater voltage unless otherwise specified in individual data sheets must be set within ±7% of the nominal value and temporary fluctuations must be within ±10%. Where freedom from undesirable modulation is important a d.c. stabilised heater supply should be used.

2. CONTROL GRID

This electrode when incorporated is used to control the resonator current and the nominal voltage is specified in the data for individual types.

The control grid must never be allowed to become positive with respect to the cathode.

3. RESONATOR

This electrode is usually connected to the body of the valve and is normally operated at earth potential.

4. REFLECTOR

To avoid damage to the valve the reflector potential must never become positive with respect to the cathode and for this reason it is essential that the reflector connection be made at all times during operation.

If a high impedance reflector voltage supply is used, the time constant should be such that the resonator voltage is not applied before the reflector has become negative with respect to the cathode.

5. MODES OF OSCILLATION

A reflex klystron may be operated in several modes which are determined by transit time effects and are dependent upon the reflector voltage. The mode of operation is chosen for optimum power output and for the maximum electronic tuning range.

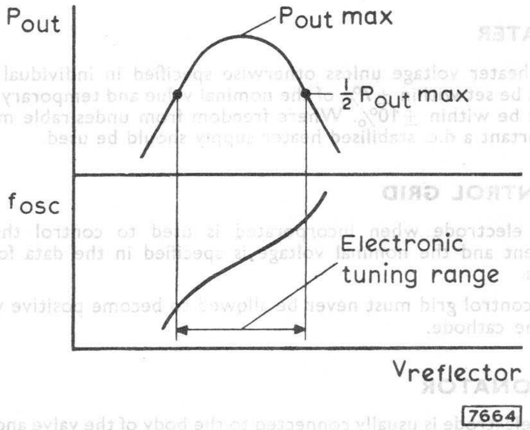
6. TUNING

6.1. Electronic tuning

The frequency of oscillation within a mode may be varied by adjusting the reflector voltage. The frequency change between the frequencies at which the power output has fallen to half the maximum value is defined as the electronic tuning range.

6.2. Mechanical tuning

Generally klystrons can be mechanically tuned over a wide frequency range but it is necessary to optimise the reflector voltage for maximum power output at the required frequency.



7. MODULATION

7.1. Frequency modulation

Frequency modulation may be achieved by applying a modulating voltage to the reflector electrode. To minimise distortion, the amplitude of the modulation signal should be small compared with the voltage required to achieve the electronic tuning range. The most linear frequency modulation characteristic is normally obtained with the reflector voltage optimised for maximum power output at the required carrier frequency.

7.2. Pulse modulation

The output of a reflex klystron may be pulsed by modulating the reflector or control electrode voltage. To minimise frequency modulation effects the modulating signal should be as near rectangular as possible.

The reflector voltage is adjusted so that the valve is not oscillating and the amplitude of the modulating signal should be the difference between this voltage and the reflector voltage required to give optimum power output at the required frequency. The amplitude of the modulating voltage must not cause the valve to oscillate in more than one mode and the static reflector voltage should be chosen accordingly.

8. FREQUENCY STABILITY

The frequency of oscillation is primarily dependent upon the applied voltage between the reflector and resonator and the valve should be operated from a well regulated power supply.

Variations of the ambient temperature, load, atmospheric pressure, and heater voltage have a secondary effect.

9. LOAD MISMATCH

Care must be taken to minimise load reflections, as a change of phase of the mismatch will cause frequency pulling and variation in the power output. A severe mismatch may cause the valve to cease oscillating over portions of the tuning range.

10. TUNING MECHANISM

Information on the number of turns of the tuning mechanism required to cover the prescribed tuning range is given in the individual data sheets.

Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted. Where the mechanical tuning is achieved by adjustment of a cavity within the evacuated envelope by means of a flexible diaphragm the number of tuning cycles may be limited to avoid damage to the diaphragm.

11. SHIELDING

The resonator and reflector leads should be screened to shield the valve from induced modulation.

12. COOLING

Adequate cooling to prevent the maximum temperature limits being exceeded is required particularly when the valve is enclosed in a protective shield.

13. MOUNT

The performance quoted in the individual data sheets for those valves which have a coaxial lead output is dependent upon the use of the specified coaxial to waveguide transition unit.

KLYSTRON

Frequency: *7Gc/s. band. Mechanical tuning.*
Power output: *50mW minimum.*
Construction: *All metal, coaxial output probe.*
Application: *Local oscillator, signal generator.*

KS7-85

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS—MICROWAVE DEVICES: INTRODUCTION and REFLEX KLYSTRONS which precede this section of the handbook.

CHARACTERISTICS

	Min.	*Max.*	
Mechanical tuning range	6.5	7.5	Gc/s
Electronic tuning range, between half power points at any frequency in the mechanical tuning range	25	—	Mc/s
Power output at 7Gc/s ± 20Mc/s (principal mode)	85	—	mW
Power output at any other frequency in the band	50	—	mW
Reflector voltage for maximum power output at 7Gc/s ± 20Mc/s	−100	−175	V
Reflector voltage range, inclusive of electronic tuning range	−60	−215	V
Frequency change with temperature	—	500	kc/s per °C

CATHODE

Indirectly heated

V_h	6.3	V
I_h	500	mA

OPERATING CONDITIONS IN SPECIFIED MOUNT

f	7.0	Gc/s
$V_{resonator}$	300	V
$I_{resonator}$	24	mA
$V_{reflector}$	−140	V
$I_{reflector}$	1.0	μA
Electronic tuning range between half power points	38	Mc/s
P_{out}	100	mW

COOLING

Natural

ABSOLUTE RATINGS

$V_{resonator}$ max.	350	V
$I_{resonator}$ max.	37	mA
$V_{reflector}$ max.	−1.0 to −400	V
V_{h-k} max.	−150	V
$T_{amb\ (shell)}$ max.	110	°C
$T_{coaxial\ line}$ max.	90	°C

OPERATING NOTE

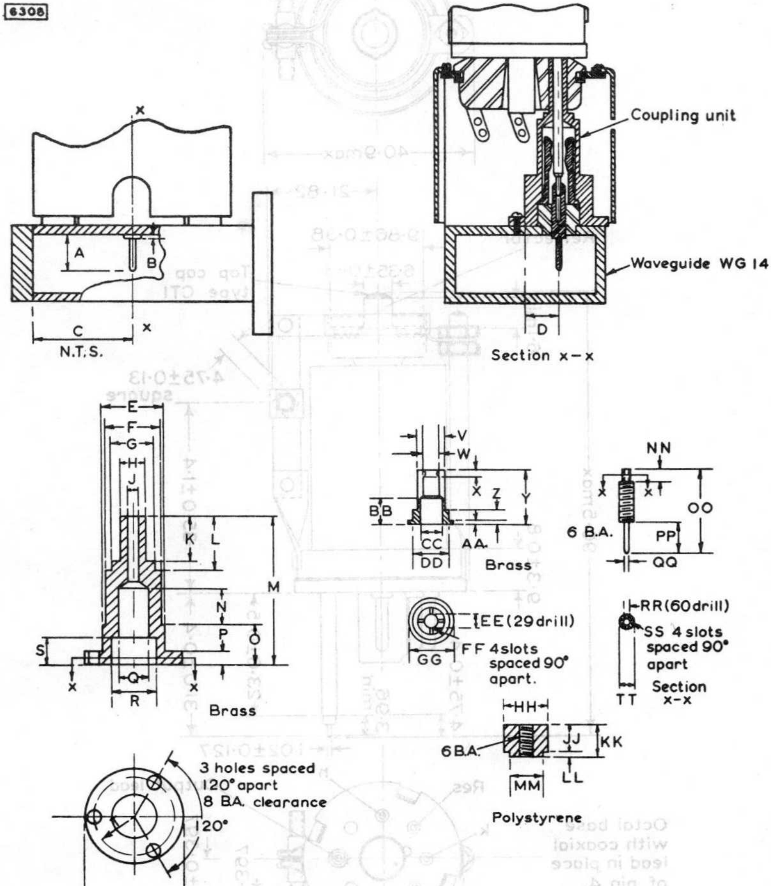
The prescribed tuning range is covered by five turns of the mechanical tuning screw.

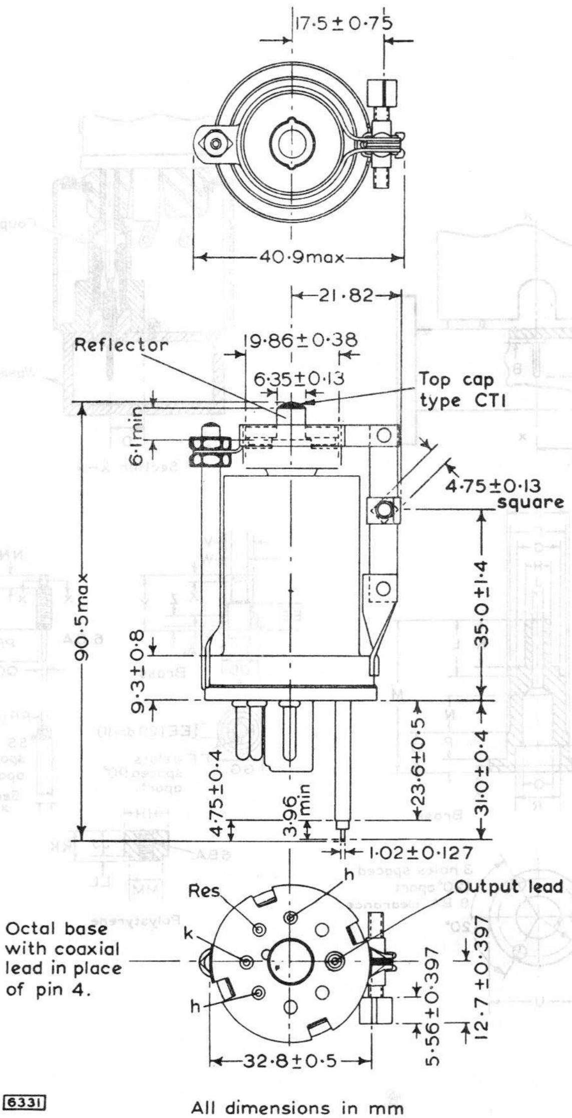
KS7-85

KLYSTRON

	Inches	Millimetres
A	0.370±0.005	9.398±0,127
B	0.045	1.143
C	0.315	8.001
D	0.333	8.458
E	0.5625	14.287
F	0.5	12.7
G	0.390	9.90
H	0.25	6.350
J	0.145	3.683
K	0.475	12.065
L	0.568	14.427
M	1.5	38.1
N	0.5	12.7
O	0.375	9.525
P	0.125	3.175
Q	0.314	7.976
R	0.468	11.887
S	0.250	6.350
T	0.375	9.525
U	1.000	25.4
V	0.281	7.137
W	0.15	3.81
X	0.1	2.54
Y	0.53	13.462
Z	0.125	3.175
AA	0.020	0.508
BB	0.250	6.350
CC	0.250	6.350
DD	0.312	7.925
EE	0.136	3.454
FF	0.015×0.313	0.381×7.950
GG	0.438	11.131
HH	0.468	11.887
JJ	0.230	5.842
KK	0.292	7.417
LL	0.062	1.575
MM	0.375	9.525
NN	0.088	2.235
OO	0.750	19.05
PP	0.325	8.255
QQ	0.040	1.016
RR	0.040×0.186	1.016×4.724
SS	0.010×0.180	0.254×4.572
TT	0.095	2.413

6308


x
A
B
C
x
N.T.S.
Coupling unit
Waveguide WG 14
D
Section x—x
E
F
G
H
J
K
L
M
N
P
O
S
Q
R
x
x
Brass
V
W
X
Z
Y
BB
CC
AA
DD
Brass
NN
X
X
OO
6 B.A.
PP
QQ
EE (29 drill)
FF 4 slots spaced 90° apart.
GG
RR (60 drill)
SS 4 slots spaced 90° apart
TT
Section x—x
HH
JJ
KK
6 B.A.
LL
MM
Polystyrene
3 holes spaced 120° apart 8 B.A. clearance
120°
U



All dimensions in mm

KLYSTRON KS9-20B

QUICK REFERENCE DATA	
X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.	
Frequency range	9.32 to 9.55 GHz
Power output	45 mW
Construction	Metal with I.O. base
Output connection	coaxial probe for insertion to standard W.G.16 launching section

Services type: CV9334

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

Operating Conditions (see notes 1 and 2)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 3)	-155	V
Load v.s.w.r.	1.1:1	

Typical Performance

Resonator current	22	mA
Power output	45	mW
Electronic tuning range to 1/2 power points	35	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.45	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage	Adjust	
Load v.s.w.r.	1.1:1	

Limits and Characteristics

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.41	0.47	A
Resonator current	-	-	25	mA
Reflector voltage (see note 3)				
Mode A	9.32	-135	-175	V
Mode A	9.55	-135	-175	V

TEST CONDITIONS AND LIMITS (contd.)

	Frequency (GHz)	Min.	Max.	
Power output: (see note 3)				
Mode A	9.32	30	-	mW
Mode A	9.55	30	-	mW
Electronic tuning range to 1/2 power points:				
Mode A	9.32	20	-	MHz
Mode A	9.55	20	-	MHz
Load effect (see note 4)	-	10	-	mW
Hysteresis (see note 5)	-	-	0.5	
Frequency temperature coefficient	-	-	-0.25	MHz/degC
Mechanical tuning range (see note 6)	-	9.32	9.55	GHz

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.8	6.8	V
Resonator voltage	-	330	V
Resonator current	-	37	mA
Reflector voltage (see note 7)	0	-400	V
Body temperature	-	110	°C
v.s.w.r.	-	1.5:1	
Impedance of reflector/cathode circuit	-	500	kΩ

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified above, Mullard Ltd. should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on pages 2 and 3.

	Min.	Max.	
Power output	10	-	mW

MOUNTING POSITION	Any
COOLING	Natural

PHYSICAL DATA

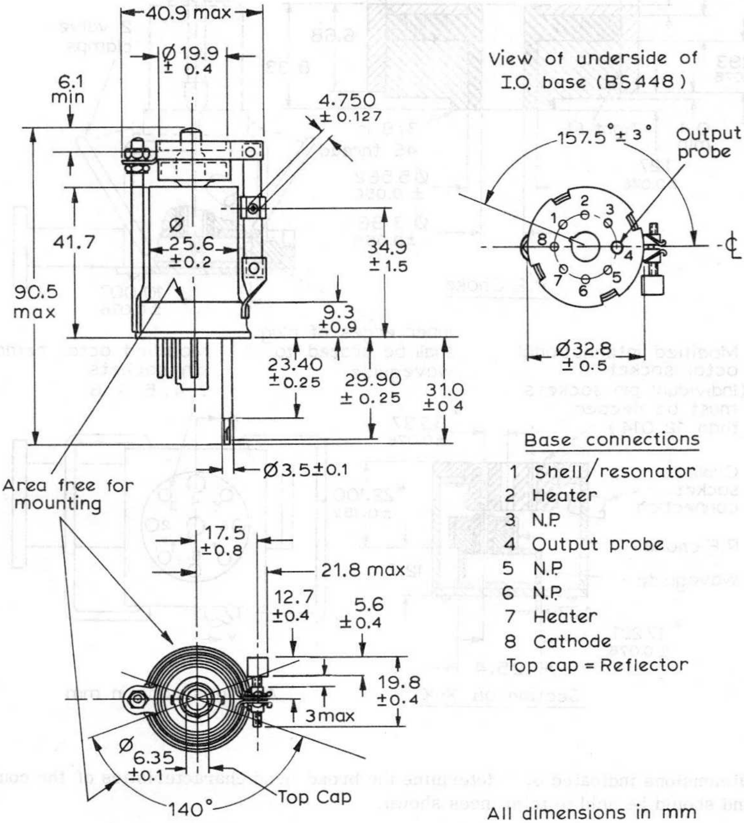
	g	oz
Weight of klystron	65	2.29
Weight of klystron in carton	130	4.59
	mm	in
Dimensions of storage carton	95 × 51 × 51	3.7 × 2 × 2

NOTES

1. With the klystron operated in a standard waveguide launching section as shown on page 6.
2. Operation in mode A at a frequency of 9.370GHz.
3. Reflector voltage adjusted for the maximum power point of the mode.
4. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by a v.s.w.r. of 2.5:1 is varied through all phases.
5. The ratio of the power at which hysteresis is present shall not exceed the limit specified.
6. Damage to the tuner may occur if it is adjusted beyond these frequency limits.
7. Care should be taken in the design of the power supply to ensure that the reflector potential never becomes positive with respect to the cathode.

OUTLINE DRAWING OF KS9-20B

D124

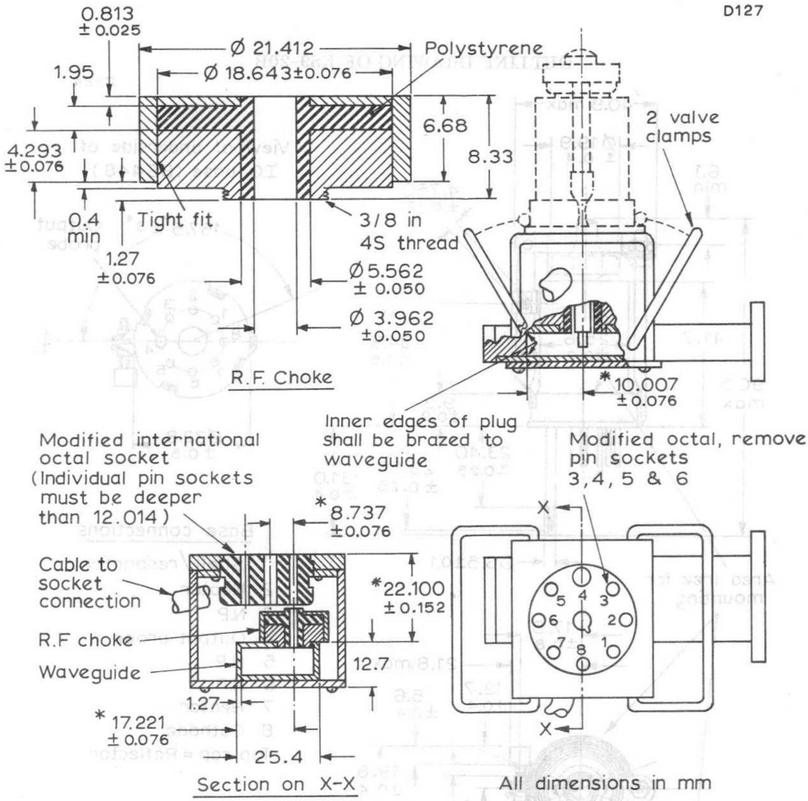


All dimensions in mm

DIMENSIONS
(Rounded outwards)

mm	in	mm	in
3.0 max.	0.118 max.	Ø 19.9 ± 0.4	Ø 0.783 ± 0.016
Ø 3.5 ± 0.1	Ø 0.138 ± 0.004	21.8 max.	0.86 max.
4.75 ± 0.127	0.187 ± 0.005	23.40 ± 0.25	0.921 ± 0.010
5.6 ± 0.4	0.220 ± 0.016	Ø 25.6 ± 0.2	Ø 1.008 ± 0.008
6.1 min.	0.24 min.	29.90 ± 0.25	1.178 ± 0.010
Ø 6.35 ± 0.1	Ø 0.25 ± 0.004	31.0 ± 0.4	1.22 ± 0.016
9.3 ± 0.9	0.366 ± 0.035	Ø 32.8 ± 0.5	Ø 1.29 ± 0.020
12.7 ± 0.4	0.50 ± 0.016	34.9 ± 1.5	1.374 ± 0.059
17.5 ± 0.8	0.689 ± 0.031	40.9 max.	1.61 max.
19.8 ± 0.4	0.78 ± 0.016	41.7	1.642
		90.5 max.	3.563 max.

Mullard



Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.

Millimetre to Inch conversion table
(Rounded outwards)

mm	in	mm	in
0.4 min.	0.015 min.	8.33	0.328
0.813 ± 0.025	0.032 ± 0.001	8.737 ± 0.076	0.344 ± 0.003
1.27	0.050	10.007 ± 0.076	0.394 ± 0.003
1.27 ± 0.076	0.050 ± 0.003	12.014	0.473
1.95	0.077	12.7	0.5
Ø 3.962 ± 0.050	Ø 0.156 ± 0.002	17.221 ± 0.076	0.678 ± 0.003
4.293 ± 0.076	0.169 ± 0.003	Ø 18.643 ± 0.076	Ø 0.734 ± 0.003
Ø 5.562 ± 0.050	Ø 0.219 ± 0.002	Ø 21.412	Ø 0.843
6.68	0.263	22.100 ± 0.152	0.870 ± 0.006
		25.4	1.0

Mullard

KLYSTRON KS9-20D

QUICK REFERENCE DATA	
X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.	
Frequency range	9.325 to 9.5 GHz
Power output	45 mW
Construction	Metal with I.O. base
Output connection	coaxial probe for insertion to standard W.G.16 launching section

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION (at 9.37GHz)

Operating Conditions (See note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	-155	V
Load v.s.w.r.	1.1:1	

Typical Performance

Resonator current	23	mA
Power output	45	mW
Electronic tuning range to 1/2 power points	35	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.5	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (See note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage	Adjust	
Load v.s.w.r.	1.1:1	

Limits and Characteristics

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.41	0.55	A
Resonator current	-	-	32	mA
Reflector voltage (see note 2)	9.325	-125	-	V
	9.5	-	-190	V
Power output (see note 2)	9.325	20	-	mW
	9.5	20	-	mW
Electronic tuning range to 1/2 power points	9.325	30	-	MHz
	9.5	30	-	MHz
Load effect (see note 3)	-	10	-	mW
Hysteresis (see note 4)	-	-	0.5	
Frequency temperature coefficient	-	-	-0.25	MHz/degC
Mechanical tuning range (see note 5)	-	9.325	9.5	GHz

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.8	6.8	V
Resonator voltage	-	330	V
Resonator current	-	37	mA
Reflector voltage (see note 6)	0	-400	V
Body temperature	-	110	^{o}C
v.s.w.r.	-	1.5:1	
Impedance of reflector/cathode circuit	-	500	kΩ

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on page 2.

	Min.	Max.	
Power output	10	-	mW

MOUNTING POSITION Any

COOLING Natural

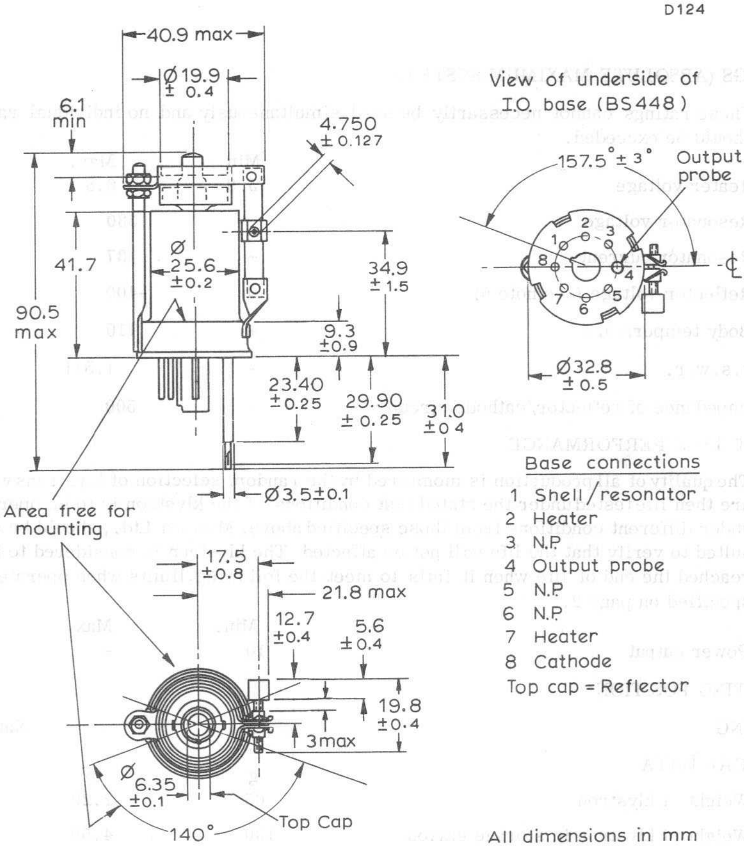
PHYSICAL DATA

	g	oz
Weight of klystron	65	2.29
Weight of klystron in storage carton	130	4.59
	mm	in
Dimensions of storage carton	95 × 51 × 51	3.7 × 2 × 2

NOTES

1. With the klystron operated in a standard waveguide launching section as shown on page 5.
2. Reflector voltage adjusted for the maximum power point of the mode.
3. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by a v.s.w.r. of 2.5:1 is varied through all phases.
4. The ratio of the power at which hysteresis is present shall not exceed the specified limit.
5. Damage to the tuner may occur if it is adjusted beyond these frequency limits.
6. The klystron must not be operated without the reflector supply while the resonator voltage is applied. Care must be taken to ensure that the reflector potential never becomes positive with respect to the cathode.

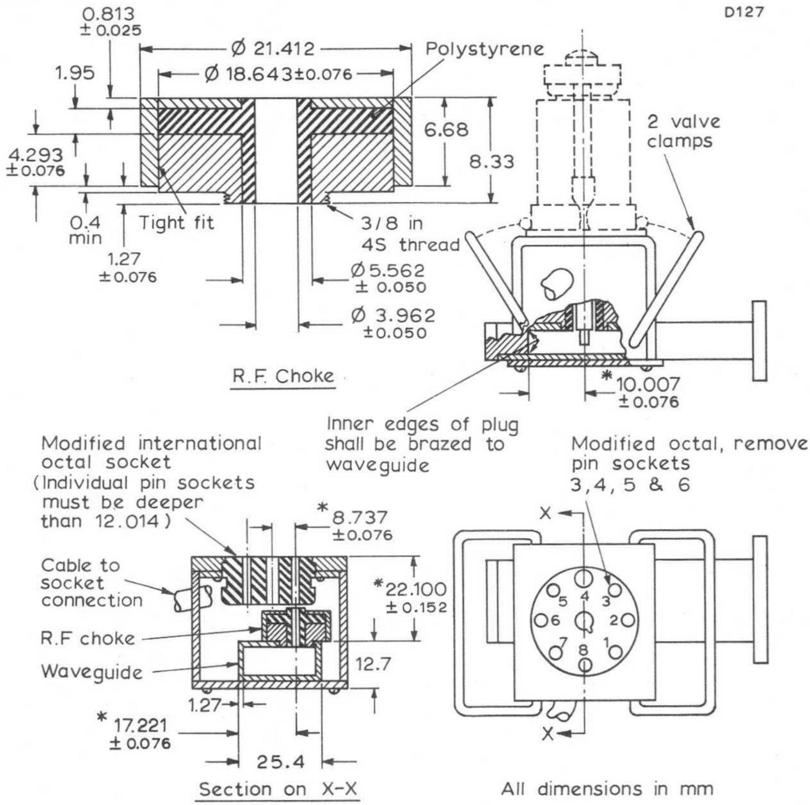
OUTLINE DRAWING OF KS9-20D



DIMENSIONS
(Rounded outwards)

mm	in	mm	in
3.0 max.	0.118 max.	Ø 19.9 ± 0.4	Ø 0.783 ± 0.016
Ø 3.5 ± 0.1	Ø 0.138 ± 0.004	21.8 max.	0.86 max.
4.75 ± 0.127	0.187 ± 0.005	23.40 ± 0.25	0.921 ± 0.010
5.6 ± 0.4	0.220 ± 0.016	Ø 25.6 ± 0.2	Ø 1.008 ± 0.008
6.1 min.	0.24 min.	29.90 ± 0.25	1.178 ± 0.010
Ø 6.35 ± 0.1	Ø 0.25 ± 0.004	31.0 ± 0.4	1.22 ± 0.016
9.3 ± 0.9	0.366 ± 0.035	Ø 32.8 ± 0.5	Ø 1.29 ± 0.020
12.7 ± 0.4	0.50 ± 0.016	34.9 ± 1.5	1.374 ± 0.059
17.5 ± 0.8	0.689 ± 0.031	40.9 max.	1.61 max.
19.8 ± 0.4	0.78 ± 0.016	41.7	1.642
		90.5 max.	3.563 max.

MOUNTING



Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.

Millimetre to Inch conversion table
(Rounded outwards)

mm	in	mm	in
0.4 min.	0.015 min.	8.33	0.328
0.813 ± 0.025	0.032 ± 0.001	8.737 ± 0.076	0.344 ± 0.003
1.27	0.050	10.007 ± 0.076	0.394 ± 0.003
1.27 ± 0.076	0.050 ± 0.003	12.014	0.473
1.95	0.077	12.7	0.5
Ø 3.962 ± 0.050	Ø 0.156 ± 0.002	17.221 ± 0.076	0.678 ± 0.003
4.293 ± 0.076	0.169 ± 0.003	Ø 18.643 ± 0.076	Ø 0.734 ± 0.003
Ø 5.562 ± 0.050	Ø 0.219 ± 0.002	Ø 21.412	Ø 0.843
6.68	0.263	22.100 ± 0.152	0.870 ± 0.006
		25.4	1.0

REFLEX KLYSTRON

KS9-30 (6975)

QUICK REFERENCE DATA		
Mechanically tunable 'X' band reflex klystron with integral external cavity.		
Frequency	8.5 to 9.6	GHz
Power output	35	mW
Construction	Waveguide output with coupled cavity	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS ($6\frac{3}{4}$ Mode)

f	8.5	9.6	GHz
V_{res}	300	300	V
I_{res}	30	30	mA
V_{refl}	-95	-145	V
*I_{refl}	1.0	1.0	μA
Electronic tuning range between half power points	50	45	MHz
P_{out}	35	30	mW
Electronic tuning rate	2.0	1.5	MHz per V

*The internal resistance of the reflector power supply should not exceed 1MΩ.

CATHODE

Indirectly heated

V_h	6.3	V
I_h max. (at V_h = 6.3V)	500	mA

COOLING

Natural

Shell temperature max.	200	°C

MOUNTING POSITION

Any

PHYSICAL DATA

	g	oz
Weight of klystron	140	5.0

CHARACTERISTICS

	Min.	Max.	
Mechanical tuning range	8.5	9.6	GHz
Mechanical tuning rate	190	275	MHz per turn
Electronic tuning range, between half-power points at any frequency in the mechanical tuning range	30	-	MHz
Output power at any frequency in the mechanical tuning range with reflector voltage optimised (V_{res} = 300V)	20	-	mW
Reflector voltage for maximum power output (V_{res} = 300V)	-85	-150	V
Frequency change with temperature	-	-200	kHz per degC rise
Frequency modulation under vibration of 10g applied to flange (50Hz to 1.0kHz)	-	1.0	MHz
Electronic tuning rate	1.0	2.0	MHz per volt

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

	Min.	Max.	
V_{res} max.	-	350	V
I_{res} max.	-	52	mA
V_{refl}	-20	-500	V

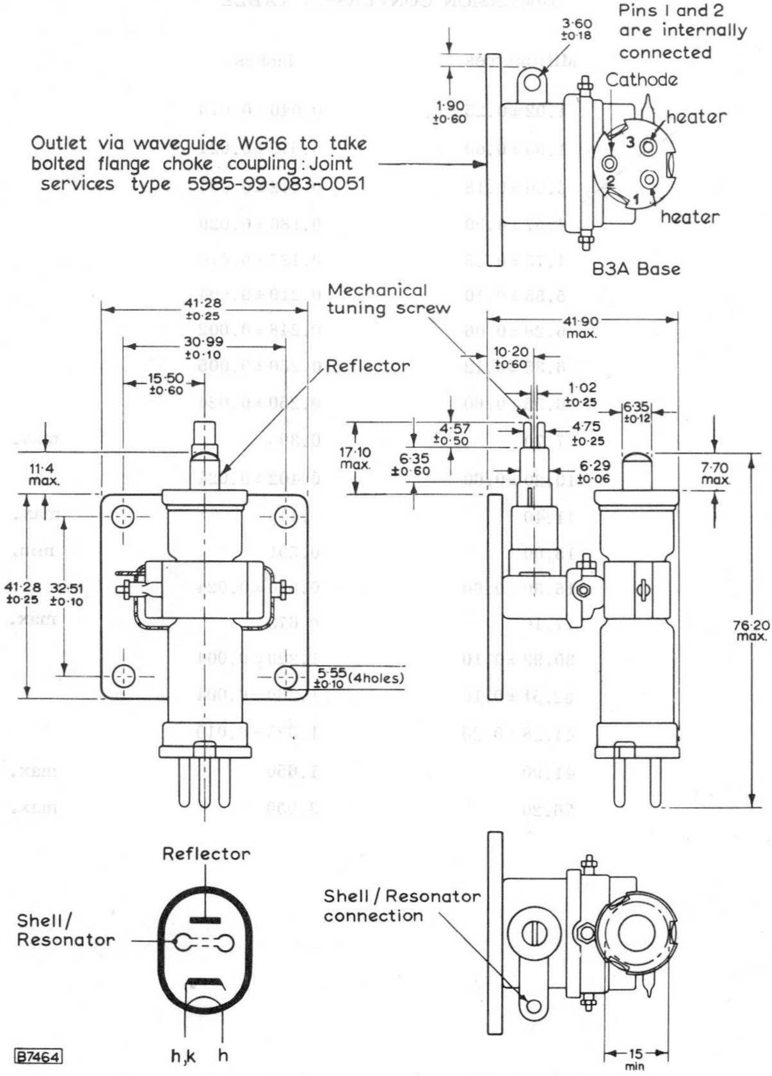
OPERATING NOTES

1. The mechanical tuning range is covered by 4 to 5$^3/_4$ turns of the tuning screw.
2. To avoid damage to the klystron the reflector potential must never become positive with respect to the cathode. The resonator voltage should be applied only after the reflector connection has been made.

ACCESSORIES

Socket	E2 555 37
Connector for reflector	55316

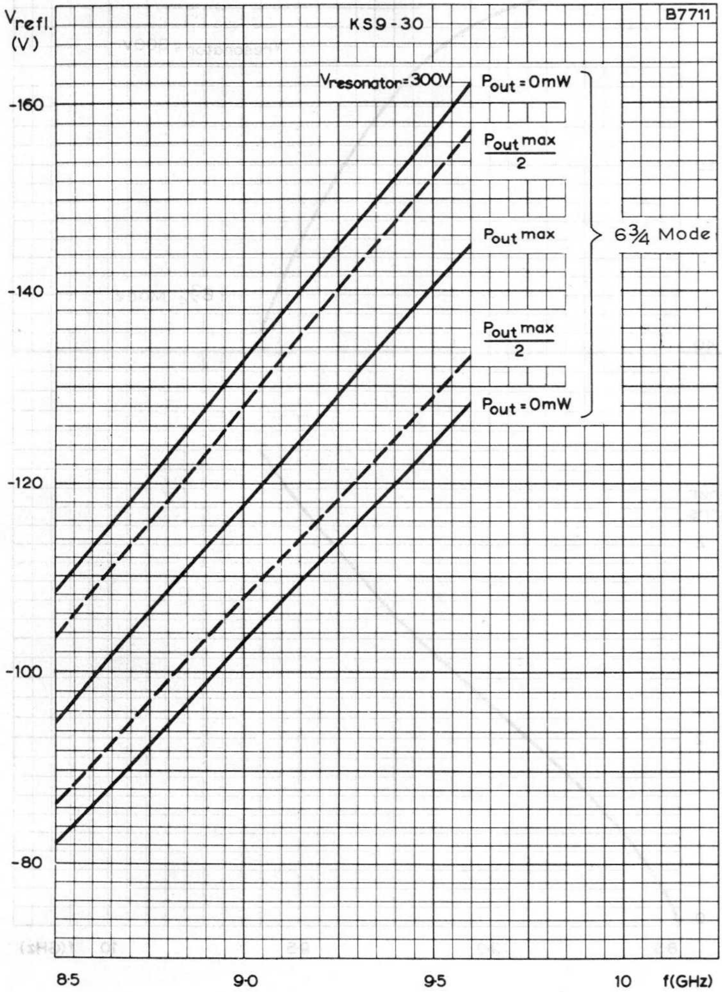
OUTLINE DRAWING



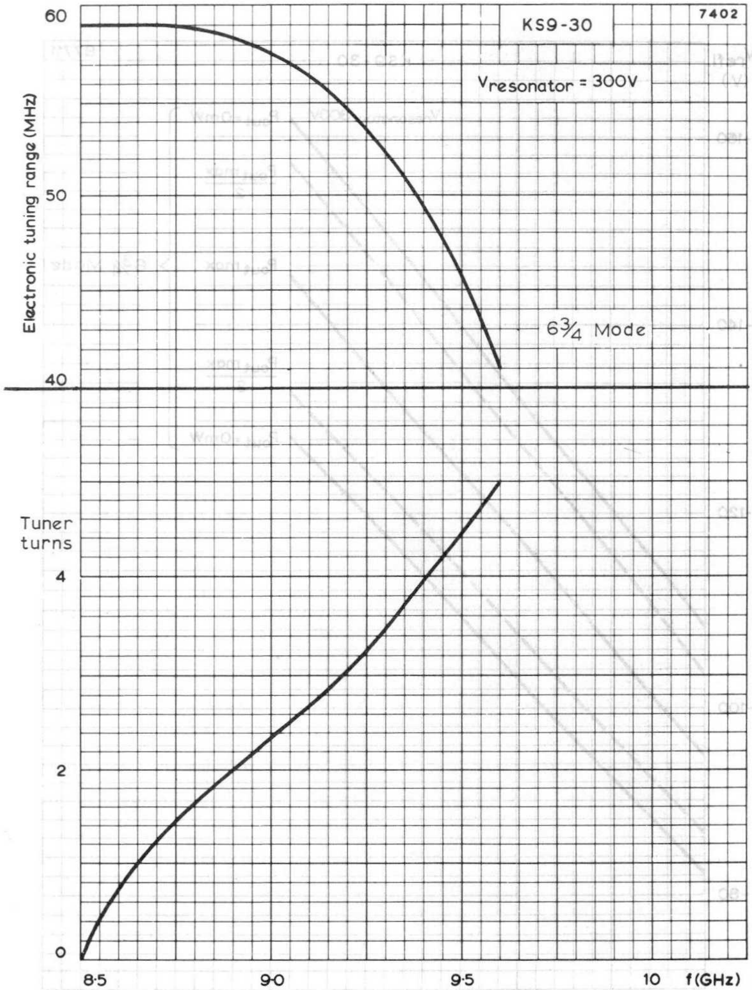
Millimetre dimensions derived from original inch dimensions
(conversions overleaf)

DIMENSION CONVERSION TABLE

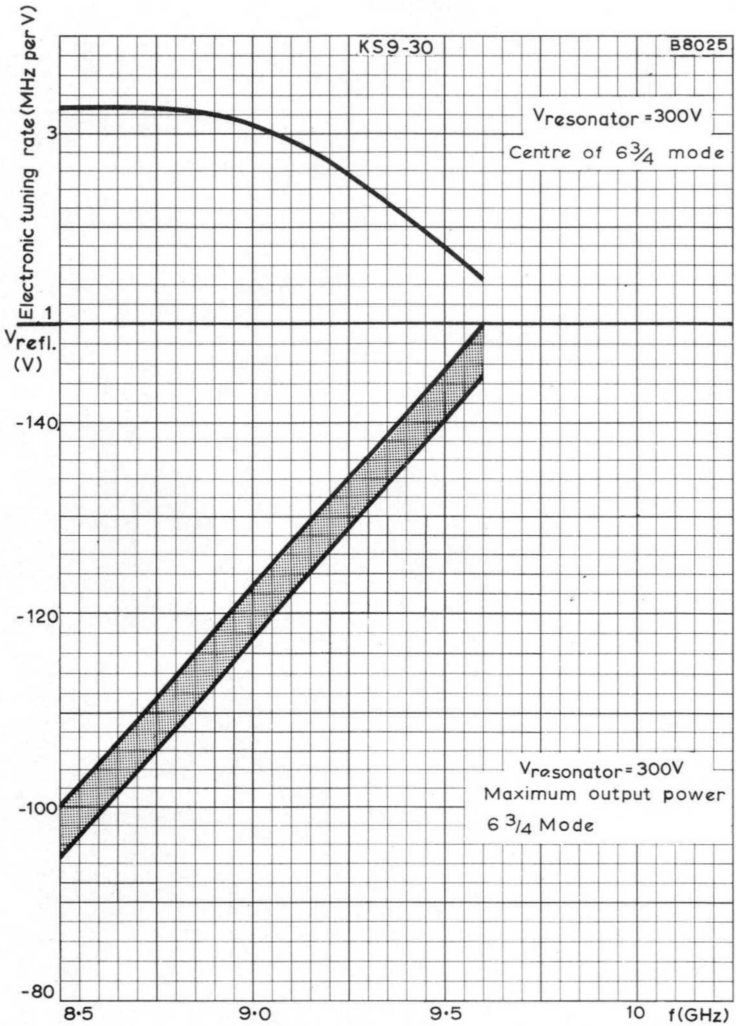
Millimetres	Inches	
1.02 ± 0.25	0.040 ± 0.010	
1.90 ± 0.60	0.075 ± 0.024	
3.60 ± 0.18	0.142 ± 0.007	
4.57 ± 0.50	0.180 ± 0.020	
4.75 ± 0.25	0.187 ± 0.010	
5.55 ± 0.10	0.219 ± 0.004	
6.29 ± 0.06	0.248 ± 0.002	
6.35 ± 0.12	0.250 ± 0.005	
6.35 ± 0.60	0.250 ± 0.024	
7.70	0.303	max.
10.20 ± 0.60	0.402 ± 0.024	
11.40	0.449	max.
15.00	0.591	min.
15.50 ± 0.60	0.610 ± 0.024	
17.10	0.673	max.
30.99 ± 0.10	1.220 ± 0.004	
32.51 ± 0.10	1.280 ± 0.004	
41.28 ± 0.25	1.625 ± 0.010	
41.90	1.650	max.
76.20	3.000	max.



REFLECTOR VOLTAGE PLOTTED AGAINST FREQUENCY



ELECTRONIC TUNING RANGE AND TUNER TURNS
PLOTTED AGAINST FREQUENCY



ELECTRONIC TUNING RATE AND REFLECTOR VOLTAGE RANGE FOR MAXIMUM OUTPUT POWER PLOTTED AGAINST FREQUENCY.

KLYSTRON

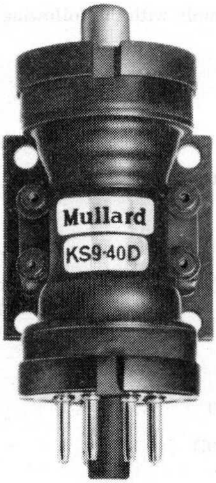
KS9-40
KS9-40D

QUICK REFERENCE DATA

X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.

Frequency range KS9-40	9.3 to 9.5	GHz
KS9-40D	9.38 to 9.51	GHz
Power output	40	mW
Construction	Metal with I.O. base	
Output connection	Waveguide 16 flange	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION (at 9.45GHz)

Operating Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	-90	V
Load v.s.w.r.	1.1:1	

Typical Performance

Resonator current	28	mA
Power output	40	mW
Electronic tuning range to 1/2 power points	40	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.5	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	Adjust	
Load v.s.w.r.	≤1.1:1	

Limits and Characteristics

		Frequency (GHz)	Min.	Max.	
Heater current		-	0.41	0.55	A
Resonator current	KS9-40	-	-	45	mA
	KS9-40D	-	-	40	mA
Reflector voltage (see note 2)					
	KS9-40	9.3 to 9.5	-65	-115	V
	KS9-40D	9.38 to 9.51	-70	-120	V

TEST CONDITIONS AND LIMITS (contd.)

		Frequency (GHz)	Min.	Max.	
Power output (see note 2)					
	KS9-40	9.3 to 9.5	25	50	mW
	KS9-40D	9.38 to 9.51	25	45	mW
Electronic tuning range to 1/2 power points					
	KS9-40	9.3 to 9.5	28	-	MHz
	KS9-40D	9.38 to 9.51	30	-	MHz
Load effect (see note 3)		-	10	-	mW
Hysteresis (see note 4)		-	-	0.5	
Frequency temperature coefficient		-	-	-200	kHz/degC
Peak frequency modulation with vibration at 10g from 30 to 1000Hz		-	-	200	kHz
Mechanical tuning range	KS9-40	-	9.3	9.5	GHz
	KS9-40D	-	9.38	9.51	GHz
Mechanical tuning rate (see note 5)		-	-	150	MHz/turn
Electronic tuning rate at mode centre		-	2.0	3.0	MHz/V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.7	6.9	V
Resonator voltage	-	350	V
Resonator current	-	45	mA
Reflector voltage (see note 6)	-10	-400	V
Body temperature (see note 7)	-	150	^{o}C
v.s.w.r.	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified above, Mullard Ltd. should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on pages 2 and 3.

Power output (min.)	20	mW

MOUNTING POSITION Any

COOLING Natural

PHYSICAL DATA

	g	oz
Weight of klystron	130	4.59
Weight of klystron in storage carton	150	5.3
	mm	in
Dimensions of storage carton	140×114×123	5.5×4.48×4.84

NOTES

1. With the klystron rigidly connected to and in good thermal contact with a UG-39/U flange on an appropriate RG-52/U (W.G.16) waveguide.

2. Reflector voltage adjusted for the maximum power point of the mode.

3. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by a v.s.w.r. of 1.5:1 is varied through all phases.

4. The ratio of the power at which hysteresis is present must not exceed the limit specified.

5. Average over the frequency range. The frequency is decreased when tuner is rotated in a clockwise direction.

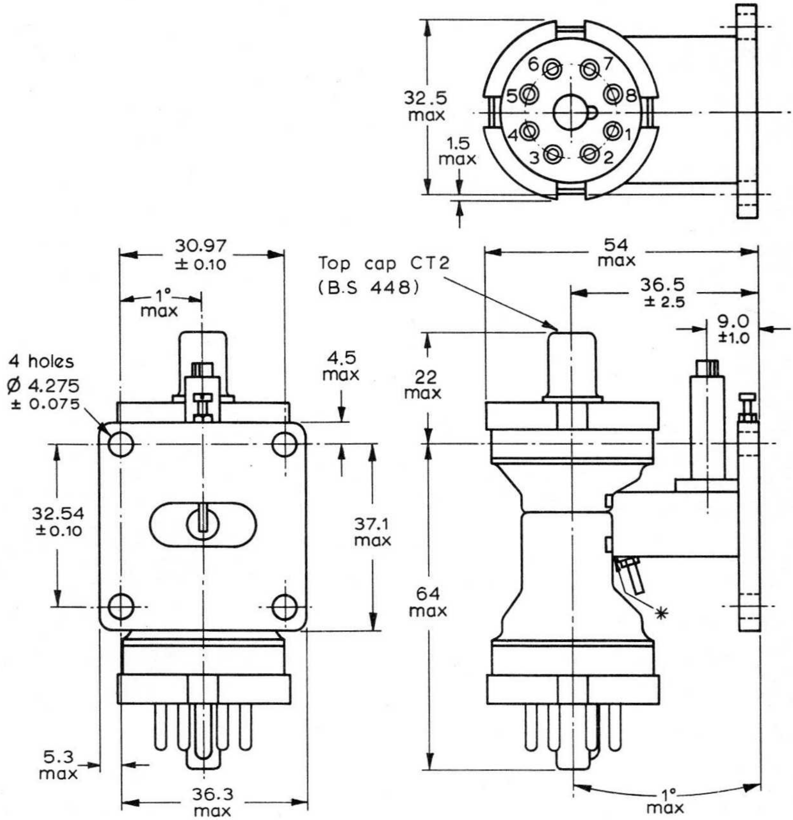
6. The klystron must not be operated without the reflector supply while the resonator voltage is applied. Care must be taken to ensure that the reflector potential never becomes positive with respect to the cathode.

7. Measured at the position indicated on the outline drawing.

DIMENSIONS (Rounded outwards)

mm	in.	mm	in
Ø4.275 ± 0.075	Ø0.1682 ± 0.003	32.5	1.28
4.5 max.	0.178 max.	32.54 ± 0.10	1.281 ± 0.004
5.3 max.	0.21 max.	36.3 max.	1.43 max.
9.0 ± 1.0	0.35 ± 0.04	36.5 ± 2.5	1.437 ± 0.099
22 max.	0.87 max.	37.1 max.	1.46 max.
30.97 ± 0.10	1.219 ± 0.004	54 max.	2.13 max.
		64 max.	2.52 max.

OUTLINE DRAWING OF KS9-40 AND KS9-40D



All dimensions in mm

* Temperature measuring point

D424

Base connections - International octal

1.	Shell/resonator	5.	N C
2.	Heater	6.	N C
3.	N C	7.	Heater
4.	N C	8.	Cathode

Top cap = Reflector

KLYSTRON

KS9-40B
KS9-40G

QUICK REFERENCE DATA

X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.

Frequency range	9.35 to 9.55 GHz
Power output	45 mW
Construction KS9-40B	Metal body with flying leads
KS9-40G	Metal with I.O. base
Output connection	Waveguide 16 flange

Unless otherwise shown data is applicable to both types

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION (at 9.45GHz)

Operating Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	-90	V
Load v.s.w.r.	1.1:1	

Typical Performance

Resonator current	21	mA
Power output	45	mW
Electronic tuning range to 1/2 power points	40	MHz
Mechanical tuning rate	100	MHz/turn

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.5	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	Adjust	
Load v.s.w.r.	≤1.1:1	

Limits and Characteristics

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.41	0.55	A
Resonator current	-	15	25	mA
Reflector voltage (see note 2)	9.35 to 9.55	-60	-115	V
Power output (see note 2)	9.35	30	-	mW
	9.55	30	-	mW
Electronic tuning range to 1/2 power points	9.35	20	50	MHz
	9.55	20	50	MHz
Load effect (see note 3)	-	10	-	mW
Hysteresis (see note 4)	-	-	0.5	

TEST CONDITIONS AND LIMITS (contd.)

	Frequency (GHz)	Min.	Max.	
Frequency temperature coefficient	-	-	-200	kHz/degC
Peak frequency modulation with vibration at 10g from 30 to 1000Hz	-	-	200	kHz
Mechanical tuning range	-	9.35	9.55	GHz
Mechanical tuning rate (see note 5)	-	-	150	MHz/turn
Electronic tuning rate at mode centre	-	2.0	3.0	MHz/V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.7	6.9	V
Resonator voltage	-	350	V
Resonator current	-	45	mA
Reflector voltage (see note 6)	-10	-400	V
Body temperature (see note 7)	-	150	^{o}C
v.s.w.r.	-	1.5:1	

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified above, Mullard Ltd., should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on pages 2 and 3.

Power output (min.)	20	mW

MOUNTING POSITION — Any

COOLING — Natural

PHYSICAL DATA

	g	oz
Weight of klystron	130	4.6
Weight of klystron in storage carton	150	5.6
	mm	in
Dimensions of storage carton	140×114×123	5.5×4.5×4.8

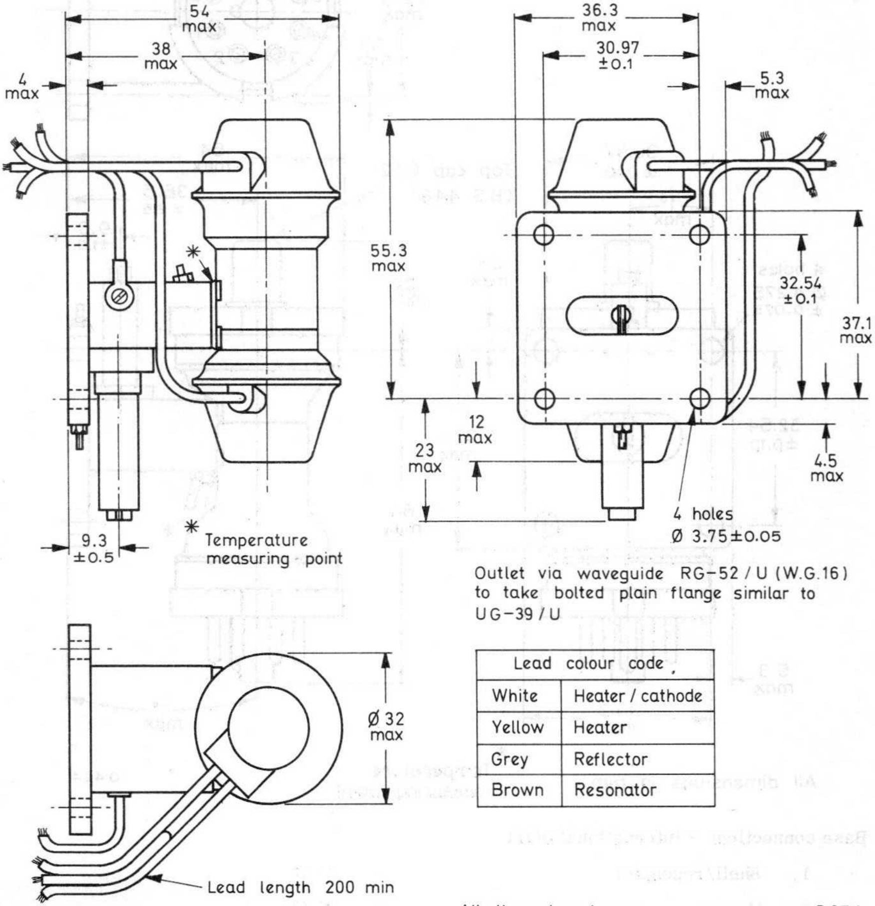
NOTES

1. With the klystron rigidly connected to and in good thermal contact with a UG-39/U flange on an appropriate RG-52/U (W.G.16) waveguide.
2. Reflector voltage adjusted for the maximum power point of the mode.
3. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by a v.s.w.r. of 1.5:1 is varied through all phases.
4. The ratio of the power at which hysteresis is present shall not exceed the limit specified.
5. Average over the frequency range. The frequency is decreased when the tuner is rotated in a clockwise direction.
6. The klystron must not be operated without the reflector supply while the resonator voltage is applied. Care must be taken to ensure that the reflector potential never becomes positive with respect to the cathode.
7. Measured at the position indicated on the outline drawing.

CONVERSION TABLE
(Rounded outwards)

mm	in	mm	in
1.5 max.	0.06 max.	Ø 32 max.	Ø 1.26 max.
Ø 3.75 ± 0.05	Ø 0.147 ± 0.002	32.5	1.28
4 max.	0.157 max.	32.54 ± 0.10	1.281 ± 0.004
Ø 4.35 max.	Ø 0.171 max.	36.3 max.	1.43 max.
4.5 max.	0.178 max.	36.5 ± 2.5	1.437 ± 0.099
5.3 max.	0.21 max.	37.1 max.	1.46 max.
9.0 ± 1.0	0.35 ± 0.04	38 max.	1.50 max.
9.3 ± 0.5	0.366 ± 0.020	54 max.	2.13 max.
12 max.	0.47 max.	55.3 max.	2.18 max.
22 max.	0.87 max.	64 max.	2.52 max.
23 max.	0.90 max.	200 min.	7.87 min.
30.97 ± 0.10	1.219 ± 0.004		

OUTLINE DRAWING OF KS9-40B

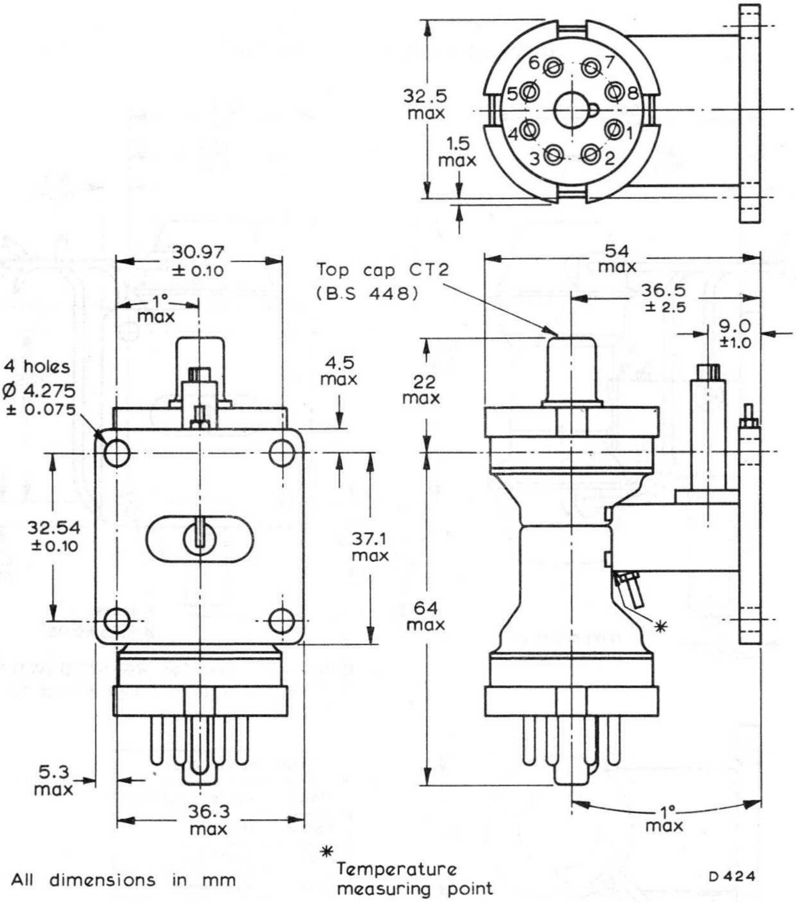


Lead colour code	
White	Heater / cathode
Yellow	Heater
Grey	Reflector
Brown	Resonator

All dimensions in mm

D654

OUTLINE DRAWING OF KS9-40G



Base connections - International octal

1.	Shell/resonator	5.	N C
2.	Heater	6.	N C
3.	N C	7.	Heater
4.	N C	8.	Cathode

Top cap = Reflector

POWER KLYSTRON

YK1001
YK1002

QUICK REFERENCE DATA

The YK1001 is a forced-air cooled power klystron for vision and sound transmitters at bands IV and V. The YK1002 is electrically identical but has a water-cooled collector.

f	470 to 790	Mc/s
P_{out}	10	kW
Construction: Permanent magnet focusing, unpackaged		

This data should be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS – MICROWAVE DEVICES which precede this section of the handbook.

Unless otherwise shown, data are applicable to both types.

TYPICAL OPERATION

Linear amplifier for television service (negative modulation)

	Normal collector voltage	*Depressed collector voltage*	
Collector voltage	18	13	kV
Collector current	1.85	1.85	A
Drift tube No. 5 voltage	18	18	kV
Drift tube current (total)	25	40	mA
Focusing electrode voltage	–300	–300	V
Drive power (sync)	10		W
Output power (sync)	11		kW
Gain	30		dB

Tuning of resonant cavities for C.C.I.R. system

Cavity 1	+2.0	Mc/s
Cavity 2	–0.5	Mc/s
Cavity 3	+4.5	Mc/s
Cavity 4	±0	Mc/s

Cavity damping at black level ($P_{out\ (sync)} = 11$kW)

Cavity 1	2.0	W
Cavity 2	50	W
Cavity 3	80	W

YK1001
YK1002

ABSOLUTE MAXIMUM RATINGS

Peak collector voltage ($I_{beam} = 0A$)	21	kV
Collector voltage max.	18.5	kV
Peak drift tube No. 5 voltage ($I_{beam} = 0A$)	21	kV
Drift tube No. 5 voltage max.	18.5	kV
Focusing electrode voltage max. (negative)	500	V
Collector current max.	2.0	A
Drift tube current max. (total)		
depressed collector operation ($V_{coll} < V_{cavity\ 5}$)	150	mA
normal collector operation ($V_{coll} = V_{cavity\ 5}$)	100	mA
Collector dissipation max.	35	kW
Cathode seal temperature max.	125	°C
First anode temperature max.	125	°C
Drift tubes Nos. 1, 2 and 3 temperature max.	80	°C
Drift tubes Nos. 4 and 5 temperature max.	150	°C
Output cavity temperature max.	125	°C
Collector temperature max.	260	°C
Ion pump voltage max.	4.0	kV
Ion pump current max.	10	mA

CATHODE

Indirectly heated, dispenser type

V_h	$7.5 \pm 3\%$	V
I_h	32	A
$I_{h\ surge}$ max.	80	A
$r_{h\ cold}$	28	mΩ
t_{h-k} min.	3.0	min

GETTER

Ion pump

Ion pump voltage	3.0	kV
Ion pump current	See curve on page 11	

COOLING

A low velocity airflow should be directed at the cathode and accelerating anode. A flow of air of $1m^3/min$ ($35.3ft^3/min$) directed at cavities Nos. 1, 2 and 3 and $2m^3/min$ ($70.6ft^3/min$) at cavity No. 4 is sufficient to keep the temperature below the permitted maximum.

Cavity No. 5 and output cavity should be cooled by a flow of air of $2m^3/min$ ($70.6ft^3/min$) at a pressure of 90mm H_2O.

The collector of YK1001 is forced-air cooled, see curve on page 8

The collector of YK1002 is water cooled, see curve on page 9

MOUNTING POSITION

Vertical, cathode uppermost

OPERATING NOTE

For optimum performance, the electron beam should be focused for minimum cavity current.

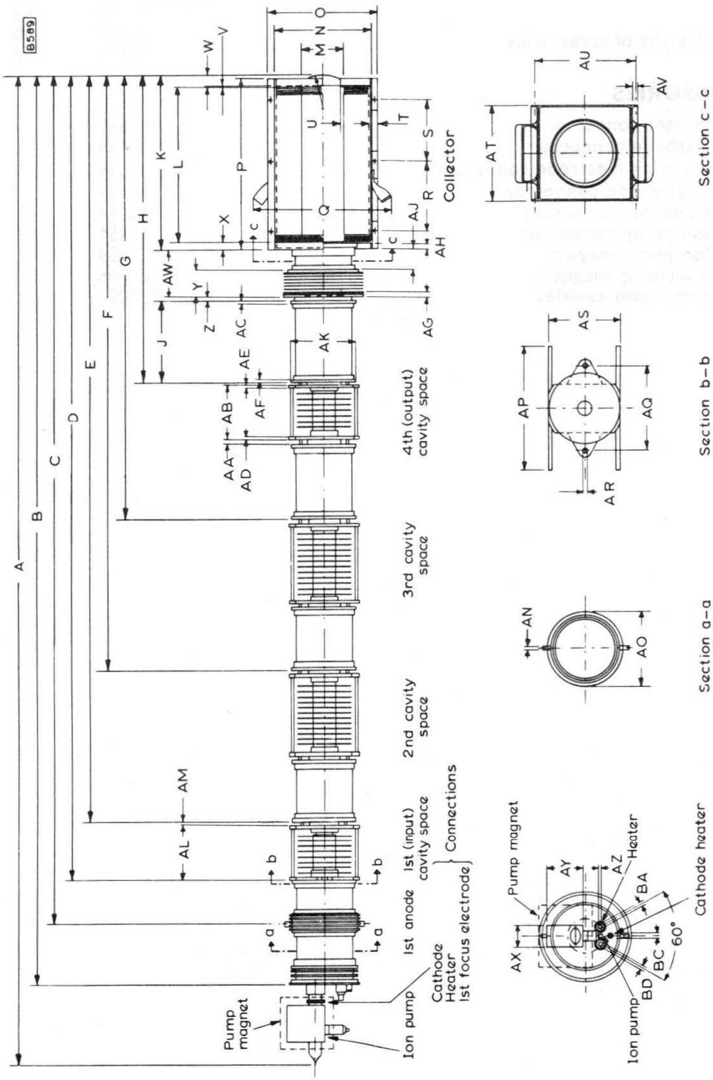
PHYSICAL DATA

Weight of klystron	YK1001	126	lb
		57	kg
	YK1002	126	lb
		57	kg
Weight of accessories		265	lb
		120	kg

ACCESSORIES

Heater connector	40649
Cathode connector	40649
Focusing electrode connector	40634
First anode connector	40634
Collector connector	40634
Ion pump connector	55351
Ion pump magnet	TE1053
5 focusing magnets	TE1065
4 resonant cavities	TE1066

OUTLINE DRAWING OF YK1001

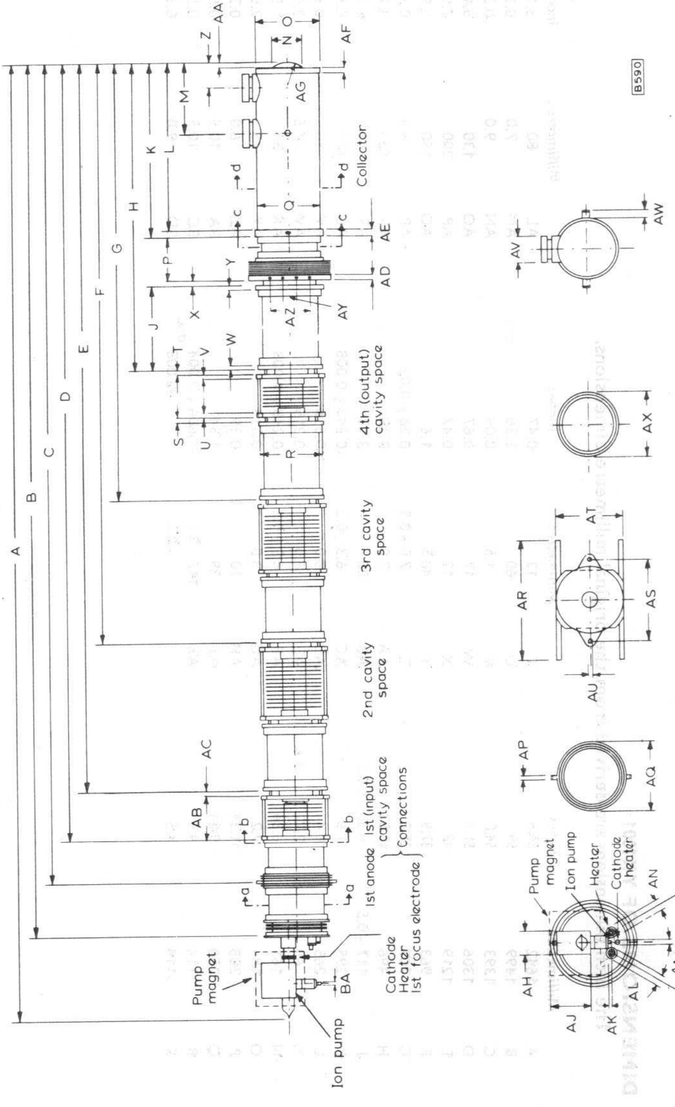


DIMENSIONS OF YK1001

The inch dimensions are derived from the original millimetre dimensions.

	Millimetres	Inches			Millimetres	Inches			Millimetres	Inches	
A	1642	64.6		T	12	0.47		AL	80	3.15	
B	1499	59		U	60	2.36	dia.	AM	7.0	0.28	
C	1393	54.8		V	1.5	0.06		AN	9.0	0.35	dia.
D	1306	51.4		W	17	0.67		AO	130	5.12	
E	1219	48		X	12	0.47		AP	200	7.9	
F	963	37.9		Y	40.5	1.6		AQ	150	5.9	
G	707	27.8		Z	7.0±0.5	0.28±0.02		AR	8.5	0.33	
H	496	19.53		AA	7.0	0.28		AS	120	4.7	
J	117±0.5	4.60±0.02		AB	80	3.15		AT	161	6.34	
K	295	11.6		AC	6.3±0.2	0.248±0.008		AU	174	6.85	
L	265	10.4		AD	8.0	0.315		AV	10	0.39	
M	69	2.72	dia.	AE	8.0	0.315		AW	77.5	3.05	
N	161	6.34		AF	6.3±0.2	0.248±0.008		AX	38	1.5	
O	184	7.2		AG	8.0	0.315		AY	75	2.95	
P	288	11.34		AH	10	0.39		AZ	6.0	0.24	
Q	250	9.84		AJ	39	1.54		BA	10.5	0.59	
R	114	4.5		AK	117 +0.1 −0.2	4.606 +0.004 −0.008	dia.	BC	10.5	0.59	
S	114	4.5						BD	9.0	0.35	

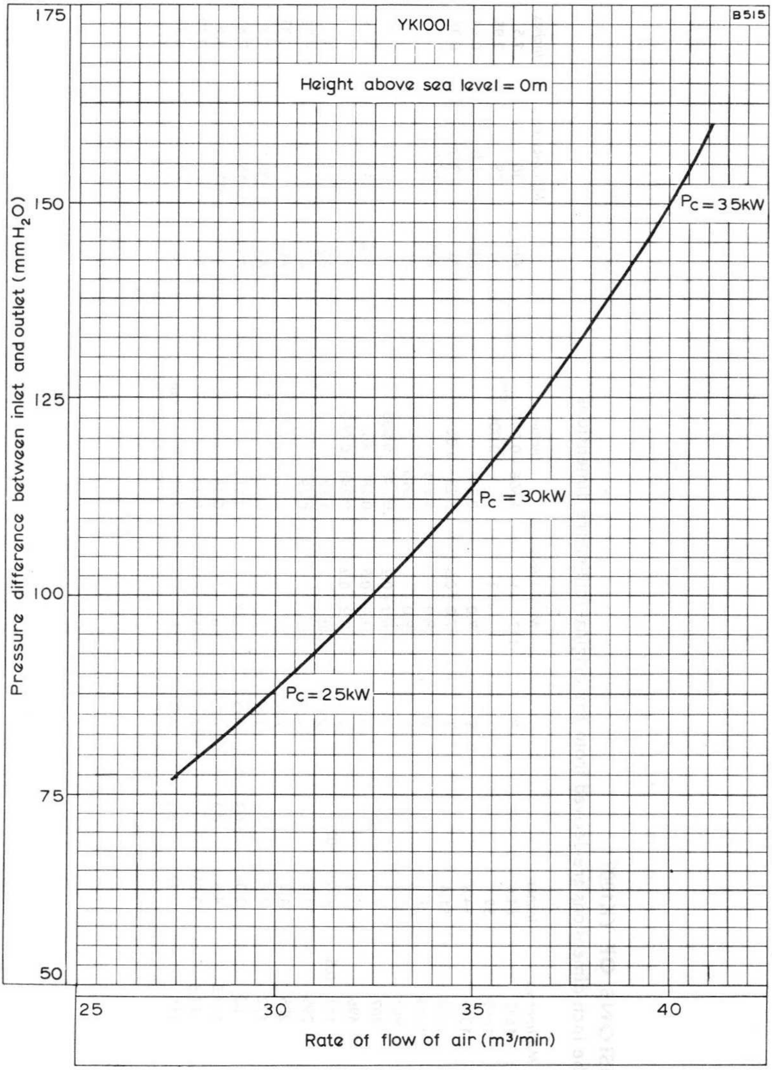
OUTLINE DRAWING OF YK1002



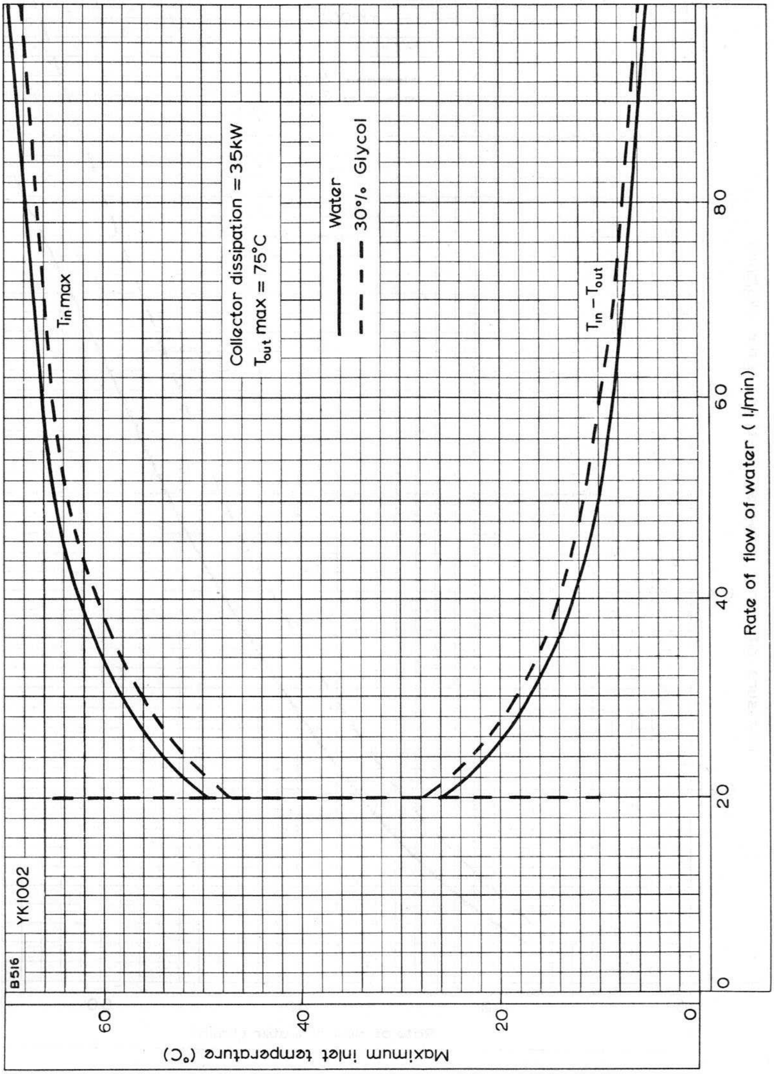
DIMENSIONS OF YK1002

The inch dimensions are derived from the original millimetre dimensions.

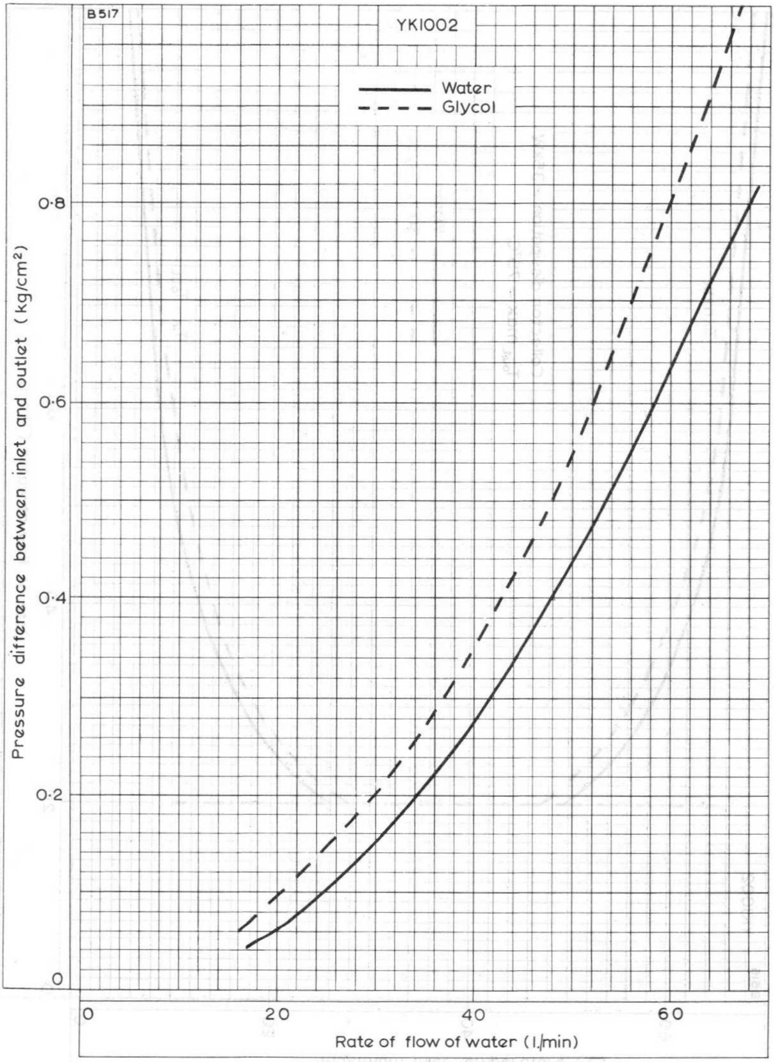
	Millimetres	*Inches*			*Millimetres*	*Inches*			*Millimetres*	*Inches*
A	1642	64.6		R	117 +0.1 −0.2	4.606 +0.004 −0.008	dia.	AH	38	1.5
B	1499	59						AJ	75	2.95
C	1393	54.8		S	7.0	0.28		AK	6.0	0.24
D	1306	51.4		T	7.0 ± 0.5	0.28 ± 0.02		AL	9.0	0.35
E	1219	48		U	8.0	0.315		AM	10.5	0.59
F	963	37.9		V	8.0	0.315		AN	10.5	0.59
G	707	27.8		W	6.3 ± 0.2	0.248 ± 0.008		AP	9.0	0.35
H	496	19.53		X	7.0 ± 0.5	0.28 ± 0.02		AQ	130	5.12
J	117 ± 0.5	4.60 ± 0.02		Y	6.3 ± 0.2	0.248 ± 0.008		AR	200	7.9
K	295	11.6		Z	40	1.58		AS	150	5.9
L	285	11.2		AA	10	0.39		AT	120	4.72
M	122	4.8		AB	80	3.15		AU	8.5	0.33
N	60	2.36	dia.	AC	7.0	0.28		AV	38.1	1.5
O	117.5	4.6	dia.	AD	8.0	0.315		AW	15	0.6
P	77.5	3.05		AE	10	0.39		AX	117	4.6
Q	115	4.53	dia.	AF	5.0	0.2		AY	20	0.79
				AG	55	2.17	rad.	AZ	60	2.36



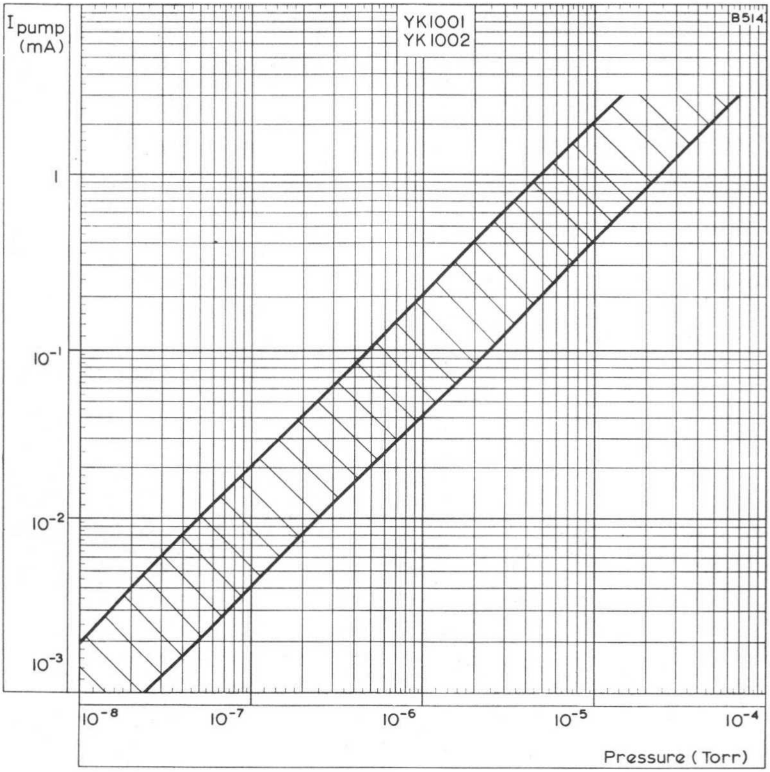
COOLING CURVE FOR YK1001



COOLING CURVE FOR YK1002



COOLING CURVE FOR YK1002



ION PUMP CHARACTERISTICS

POWER KLYSTRON YK1005

TENTATIVE DATA

QUICK REFERENCE DATA		
Permanent magnet focused power amplifier klystron, suitable for depressed collector operation. Intended for use as vision and sound amplifier for bands IV and V.		
Frequency	470 to 860	MHz
Power output	11	kW
Construction	Ceramic-metal, unpackaged	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

OPERATING CONDITIONS

Typical vision amplifier operation with depressed collector voltage C.C.I.R. system with negative modulation. Bandwidth (-1dB) = 6MHz.

Frequency	470	790	MHz
Cathode to collector voltage (see note 1)	-13.5	-16	kV
Collector to drift tube voltage	-4.0	-4.0	kV
Accelerator to drift tube voltage (see note 2)	0	0	V
Focus electrode to cathode voltage	-240	-600	V
Drift tube current			
static (focused for minimum)	30	30	mA
black level (see note 3)	80	60	mA
Cathode current	2.0	1.85	A
Output power	11	11	kW
Drive power (see curve page 8 and note 4)	2.0	1.0	W
Power gain	38	40	dB
Linearity (without compensation, see note 5)	80	80	%
Max. sync compression (see note 6)	45/25	45/25	
Max. sideband suppression (see note 7)	-20	-20	dB
Max. noise (referred to black level, see note 8)	-46	-46	dB
Differential phase (without compensation)	5.0	5.0	deg

OPERATING CONDITIONS (cont'd)

Typical operation as sound amplifier (with depressed collector)

Frequency	470	790	MHz
Cathode to collector voltage (see note 1)	-13.5	-13.5	kV
Collector to drift tube voltage	-5.0	-5.0	kV
Accelerator to drift tube voltage (see note 2)	-7.5	-5.5	kV
Focus electrode to cathode voltage	-400	-400	V
Drift tube current	50	70	mA
Cathode current	0.7	1.0	A
Output power	2.2	4.4	kW
Max. drive power	0.5	0.5	W

Tuning of cavities with respect to carrier frequency (approx.)

Cavity 1	+3.0	MHz
Cavity 2	-0.5	MHz
Cavity 3	-4.5	MHz
Cavity 4	0	MHz

Max. cavity damping at black level for P_{out} sync = 11kW

Cavity 1	5.0	W
Cavity 2	100	W
Cavity 3	200	W

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Max. drift tube to cathode voltage	22	kV
Max. drift tube to cathode voltage at zero current	25	kV
Max. drift tube to collector voltage	7.0	kV
Max. cathode to focus electrode voltage (see note 9)	700	V
Min. cathode to focus electrode voltage	100	V
Max. drift tube to accelerator voltage	25	kV
Max. accelerator voltage source resistance	20	kΩ
Min. accelerator voltage source resistance	10	kΩ
Max. drift tube current	150	mA
Max. cathode current	2.2	A
Max. collector dissipation	40	kW
Max. voltage standing wave ratio	1.5	

NOTES

1. In operation, a cathode voltage fluctuation of ±3% will not damage the tube, but should not exceed ±1% for good transmission quality.

2. If the accelerator electrode voltage is obtained by means of a potential divider from the cathode supply voltage, then the divider must pass a quiescent current of at least 3mA.

3. To be focused for minimum drift tube current at black level. A maximum deviation of 10% from the minimum current is permitted, if necessary, to obtain the required signal transfer quality but the limiting value must not be exceeded.

4. A circulator must be used between driver stage and input cavity. The drive power is measured between the circulator and first cavity at a 50Ω resistance and represents the sum of the forward and the reflected power in the first cavity. A pre-correction is required in the preamplifier for the level dependency of the band pass curve caused by non linearity of the klystron.

5. Measured with a sawtooth voltage of amplitude between 17 and 75% of the peak sync value, on which is superimposed a 4.43MHz sine wave with a 10% peak to peak value.

6. A picture/sync ratio of 75/25 for the outgoing signal of the klystron requires a ratio of 55/45 for the incoming signal.

7. Measured with a 10 to 75% modulation without compensation and a vestigial sideband filter between driver and klystron.

8. Produced by the klystron itself, without hum from power supplies.

9. The focus voltage power supply should be pre-loaded by a minimum current of 10mA at 700 volts.

Supply failure

In the case of a failure, all electrode voltages for the klystron except the pump and heater voltages should be switched off and reduced to less than 5% of the nominal value within 250ms after the failure has occured.

CATHODE

Indirectly heated, dispenser type

$^{*}V_h$	7.5 to 8.0	V
V_h (absolute max.)	9.0	V
I_h at 7.5V (approx.)	32	A
I_h max.	36	A
I_h surge max. (a.c. supply)	80	A
I_h surge max. (d.c. supply)	65	A
r_h cold	28	mΩ
t_{h-k} min.	180	s

*Maximum heater voltage fluctuation ±3% except during the first 300 hours of life when the heater voltage should be 8.5V.

GETTER ION PUMP

Ion pump supply voltage (unloaded)	4.0	kV
Supply internal resistance	300	kΩ
Max. ion pump voltage	4.0	kV
Max. ion pump current	15	mA

COOLING

Maximum air inlet temperature = 40 °C

Minimum air flow requirements:-

Cathode base and accelerator electrode	0.5	m^3/min
Drift tubes 1, 2 and 3	1.0	m^3/min
Drift tube 4	1.5	m^3/min
Drift tube 5 (pressure difference = 90mm water) forced air	1.5	m^3/min
Output resonator (pressure difference = 90mm water) forced air	2.0	m^3/min
Collector forced air	See graphs on pages 9 and 10	

COOLING (cont'd)

Maximum temperatures

Cathode base	125	°C
Accelerator electrode	125	°C
Drift tubes 1, 2 and 3	80	°C
Drift tubes 4 and 5	150	°C
Collector seal	200	°C
*Collector body	300	°C
Output resonator	125	°C

*To safeguard this temperature limit it is recommended to measure the air outlet temperature at least at two places, one at 50mm and the other at 150mm from the upper collector plate and at a distance of 50mm from the cooling fins.

PRESSURISING

Altitude max.	3000	m

MOUNTING POSITION Vertical, cathode uppermost

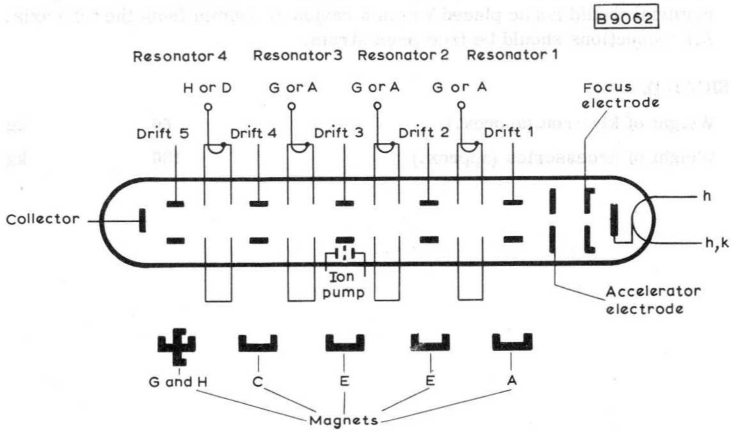
In order to prevent distortion of the magnetic focusing field ferromagnetic material should not be placed within a radius of 350mm from the tube axis. All connections should be free from strain.

PHYSICAL DATA

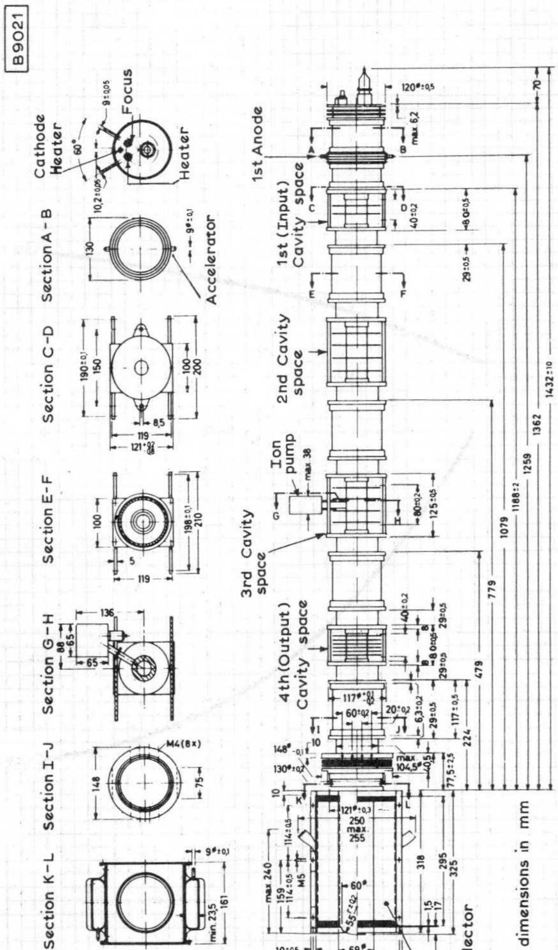
Weight of klystron (approx.)	60	kg
Weight of accessories (approx.)	130	kg

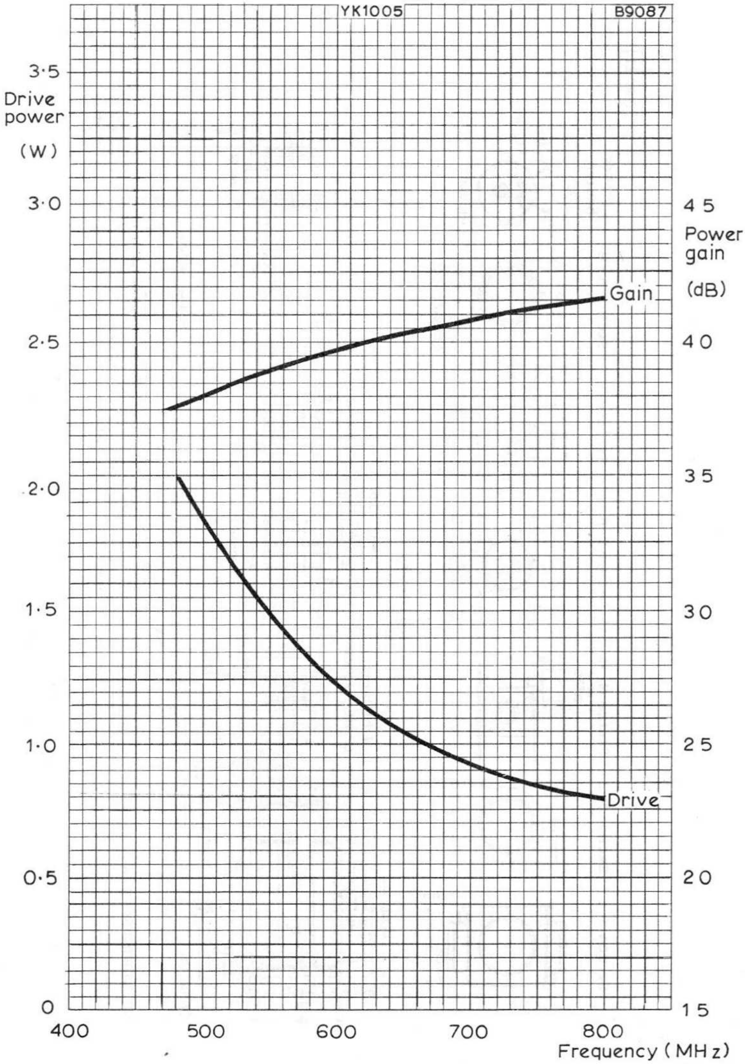
ACCESSORIES

Heater connector	40649
Heater/cathode connector	40649
Focusing electrode connector	40634
Accelerating electrode connector	40634
Collector connector	40634
Ion pump connector	55351
Resonators for 470 to 615MHz	3 × TE1056G 1 × TE1056H
Resonators for 615 to 860MHz	3 × TE1067A 1 × TE1067D
Permanent magnet assemblies	2 × TE1065A 2 × TE1065C 4 × TE1065E 2 × TE1065G 2 × TE1065H
Air duct	TE1071
Magnetic screen	TE1075
Circulators (temperature compensated)	
for 470 to 600MHz	4322 020 50090
for 590 to 720MHz	4322 020 50110
for 710 to 860MHz	4322 020 50120
for 608 to 790MHz	4322 020 50150

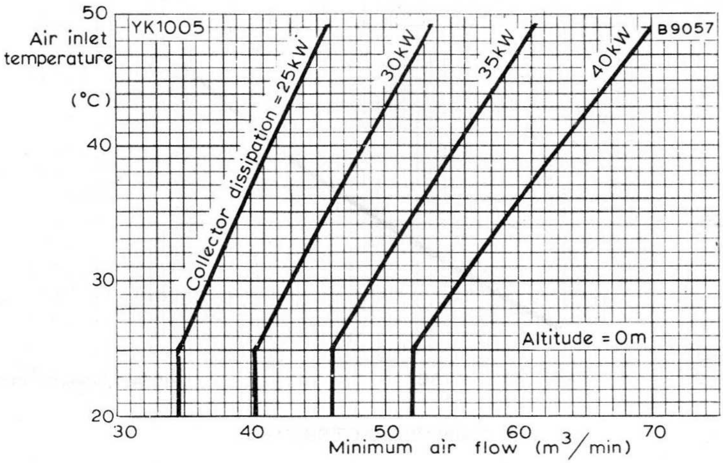


OUTLINE DRAWING

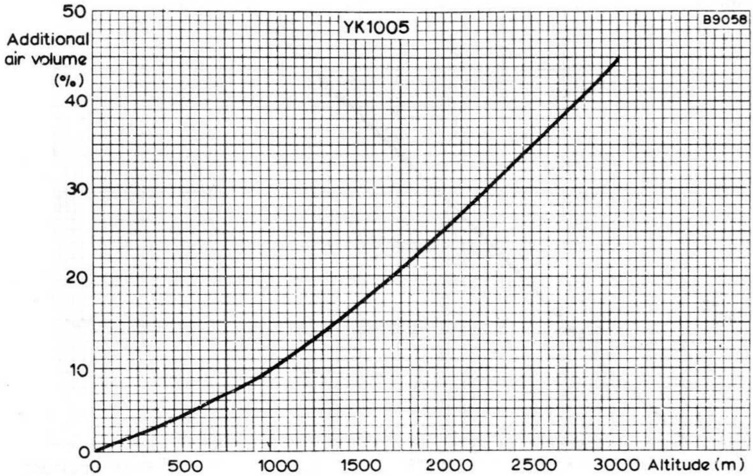




DRIVE POWER AND POWER GAIN PLOTTED AGAINST OPERATING FREQUENCY



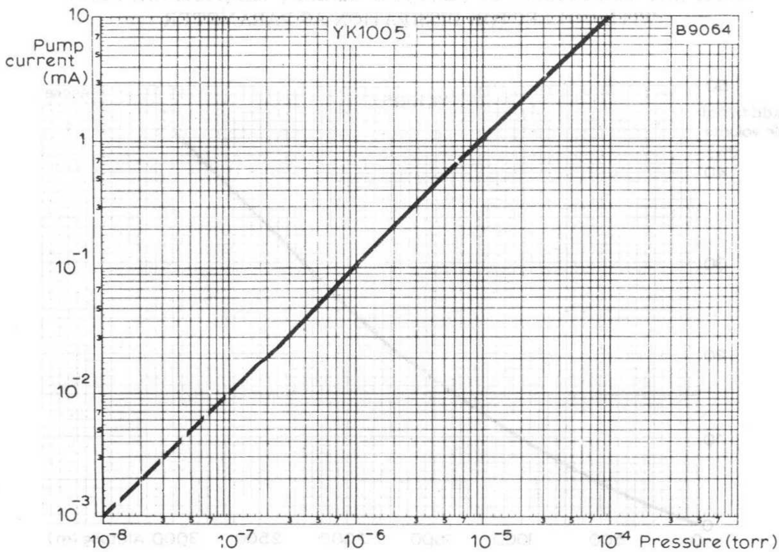
AIR INLET TEMPERATURE PLOTTED AGAINST MINIMUM AIR FLOW WITH COLLECTOR DISSIPATION AS PARAMETER



ADDITIONAL AIR VOLUME REQUIRED FOR INCREASED ALTITUDE

Mullard

AIR FLOW CHARACTERISTICS



PUMP CURRENT AS A FUNCTION OF PRESSURE

KLYSTRON YK1046

TENTATIVE DATA

QUICK REFERENCE DATA	
X-band, lightweight reflex klystron, with integral tuning cavity for local oscillator applications.	
Frequency range	9.16 to 9.34 GHz
Power output	35 mW
Construction	Aluminium body with flying leads
Output connection	Waveguide 16 flange

Services type: CV6195

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION (at 9.25GHz)

Operating Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	275	V
Reflector voltage	-85	V
Load v.s.w.r.	≤1.1:1	

Typical Performance

Resonator current	22	mA
Power output	35	mW
Electronic tuning range to 1/2 power points	30	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.45	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	275	V
Reflector voltage	Adjust	
Load v.s.w.r.	≤1.1:1	

Limits and Characteristics

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.4	0.5	A
Resonator current	-	-	40	mA
Reflector voltage (see note 2)	9.16	-75	-100	V
	9.25	-75	-100	V
	9.34	-75	-100	V
Power output (see note 2)	9.16	25	60	mW
	9.25	25	60	mW
	9.34	25	60	mW
Electronic tuning range to 1/2 power points	9.16	25	-	MHz
	9.25	25	-	MHz
	9.34	25	-	MHz

Limits and Characteristics (cont'd)

	Frequency (GHz)	Min.	Max.	
Reflector modulator sensitivity (see note 3)	-	0.5	1.5	MHz
Frequency pulling (see note 4)	-	-	6.0	MHz
Mechanical tuning rate	9.16 to 9.34	150	250	MHz/turn
Mechanical tuning torque	-	0.07	0.22	Nm
	-	0.7	2.2	(kg cm)
Mechanical tuning range	-	9.16	9.34	GHz
Frequency temperature coefficient (see note 5)	9.25	-50	-200	kHz/degC
Frequency modulation under vibration, peak acceleration = 10g at 30Hz to 1kHz	9.25	-	200	kHz peak
Mode separation (see note 6)	9.16 to 9.34	-50	-125	V

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.7	6.9	V
Resonator voltage	-	350	V
Resonator current	-	45	mA
Reflector voltage (see note 2)	-20	-500	V
Body temperature (see note 7)	-	150	^{o}C
Storage temperature	-55	+75	^{o}C
v.s.w.r.	-	1.5:1	
Impedance of reflector/cathode circuit	-	500	kΩ

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified, Mullard Ltd. should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified on pages 2 and 3.

	Min.	Max.	
Power output (at 9.25GHz)	15	-	mW
Electronic tuning range	20	-	MHz

MOUNTING POSITION	Any
COOLING	Natural

PHYSICAL DATA

	g	oz	
Weight of klystron	92	3.25	
Dimensions of storage carton	120 × 120 × 145		mm

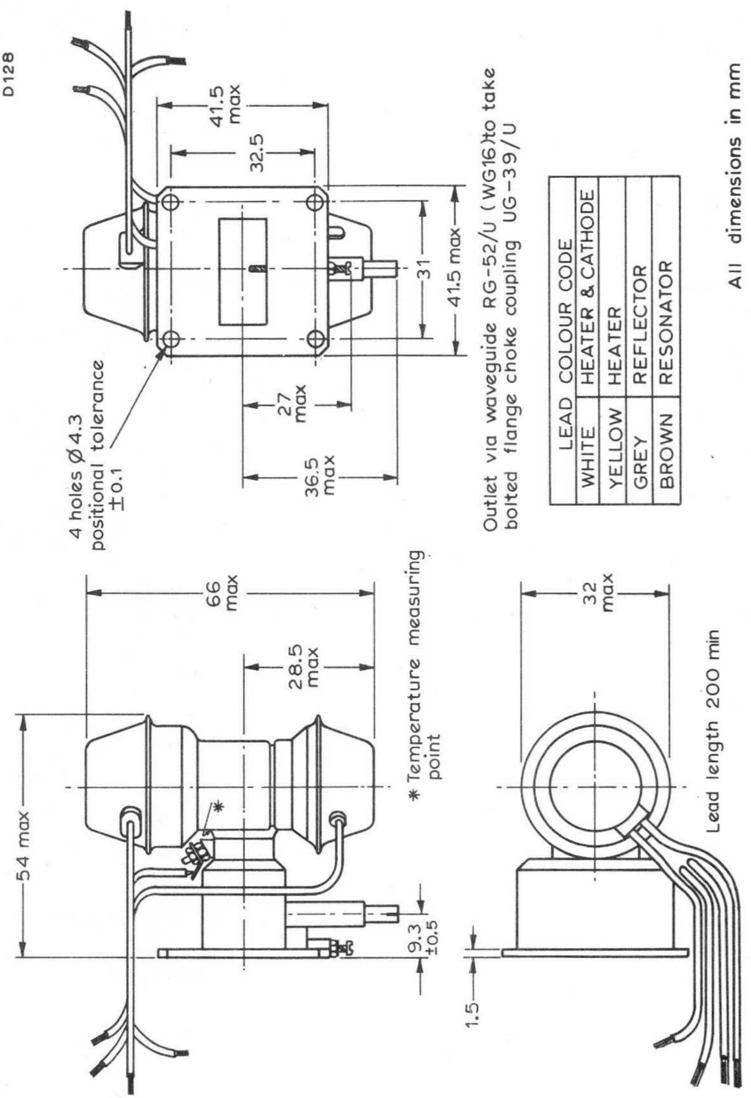
NOTES

1. Tests are made with the klystron rigidly connected to and in good thermal contact with a UG-39/U flange on an RG-52/U (WG16) waveguide.
2. Reflector voltage adjusted for the maximum power point of the mode. The reflector voltage must never be allowed to fall below the minimum value specified in the ratings.
3. Measured at mode optimum, 1 volt peak to peak deviation.
4. Measured with a v.s.w.r. of 1.5:1 varied through all phases. The power output must not be less than 10mW and the frequency versus reflector voltage must be continuous between the half power points.
5. Measured over the ambient temperature range -50 to +70°C.
6. No mode or part of a mode other than the required mode will exist within the specified reflector voltage range as the valve is mechanically tuned over the complete frequency range.
7. Measured at the point indicated on the outline drawing. For maximum valve life the klystron should be operated at temperatures below the specified maximum.

Dimensions
(Rounded outwards)

mm	in	mm	in
1.5	0.059	32.5	1.279
Ø 4.3	Ø 0.169	36.5 max.	1.437 max.
9.3 ± 0.5	0.366 ± 0.020	41.5 max.	1.634 max.
27 max.	1.06 max.	54 max.	2.13 max.
28.5 max.	1.122 max.	66 max.	2.60 max.
31	1.22	200 min.	7.87 min.
32 max.	1.26 max.		

OUTLINE DRAWING



LEAD	COLOUR CODE
WHITE	HEATER & CATHODE
YELLOW	HEATER
GREY	REFLECTOR
BROWN	RESONATOR

TENTATIVE DATA

QUICK REFERENCE DATA

Lightweight mechanically tunable reflex klystron. Suitable for high altitude operation. The YK1090 is a rugged version of the YK1091.

Frequency	10.5 to 12.2	Gc/s
Power output	400	mW
Construction	Integral cavity, waveguide output	
YK1090	Flying leads	
YK1091	Three pin base	

Unless otherwise stated data applies to both types.

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

f	10.5	11.5	12.2	Gc/s
V_{res}	400	400	400	V
I_{res}	65	65	65	mA
$-V_{refl}$	190	260	315	V
Electronic tuning range between half power points	58	52	47	Mc/s
Reflector modulation sensitivity	1.0	1.0	1.0	Mc/s per V
P_{out} (matched load)	150	270	370	mW
P_{out} (optimised load)	320	400	420	mW

f	10.5	11.5	12.2	Gc/s
V_{res}	200	200	200	V
I_{res}	23	23	23	mA
$-V_{refl}$	60	90	110	V
Electronic tuning range between half power points	60	50	38	Mc/s
P_{out} (matched load)	10	22	27	mW
P_{out} (optimised load)	25	30	27	mW

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	
V_{res}	-	450	V
I_{res}	-	70	mA
$-V_{refl}$	20	1000	V
T_{Body}	-	200	°C

CATHODE

Indirectly heated, oxide coated

V_h	6.3	V
I_h	1.2	A
t_{hk} min.	15	s

CHARACTERISTICS

	Min.	Typ.	Max.	
Electronic tuning range between half-power points at any frequency in the mechanical tuning range (V_{res} = 400V)	30		-	Mc/s
Reflector modulation sensitivity over complete frequency range	0.8		2.0	Mc/s per V
Power output at any frequency in the mechanical tuning range with reflector voltage optimised (V_{res} = 400V)	50		-	mW
Reflector negative voltage for maximum power output at centre frequency in principal mode (V_{res} = 400V)	-		260	V
Reflector negative voltage range for maximum power output over the mechanical tuning range (V_{res} = 400V)	100		400	V
Frequency drift after first 5 minutes of operation	-		0.5	Mc/s
Frequency change with temperature (T_{amb} = -10 to + 40°C)	-		0.25	Mc/s per deg C

	Min.	Typ.	Max.	
*Frequency change with atmospheric pressure change equivalent to operation 0 to 66 000ft		1.0	3.0	Mc/s
0 to 98 000ft		2.0	10	Mc/s
*Peak frequency deviation under vibration of 5g applied to the flange (50 to 5000c/s in all three planes)		-	4.0	Mc/s

*YK1090 only

COOLING

Natural and forced-air

Forced-air cooling is necessary for resonator input powers greater than 10W in order to maintain the body temperature below 200°C. For maximum life it is recommended that the temperature of the body should not exceed 100°C.

MOUNTING POSITION

Any

PHYSICAL DATA

	oz	g
Weight of klystron	7.0	200

CONNECTIONS

YK1090 Wire colour code

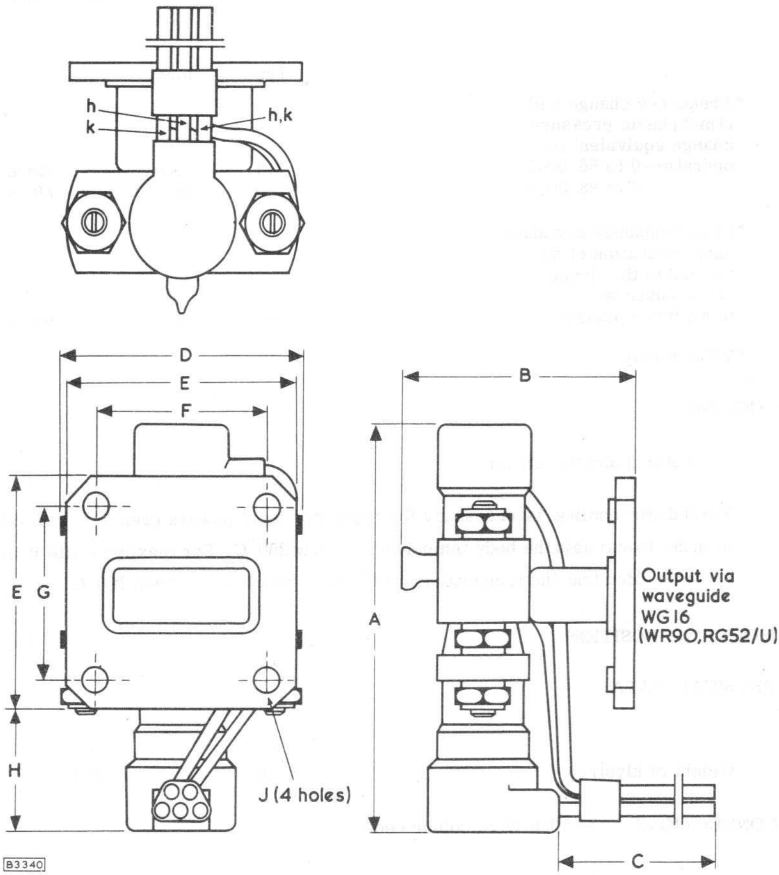
Colour	Coding
White	Heater and cathode
Yellow	Heater
Green	Cathode
Grey	Reflector
Red	Resonator

YK1091 Pin connections

See outline drawing on page D5.

The heater voltage must never be applied to the green (cathode) lead on the YK1090 or the cathode pin on the YK1091.

OUTLINE DRAWING OF YK1090

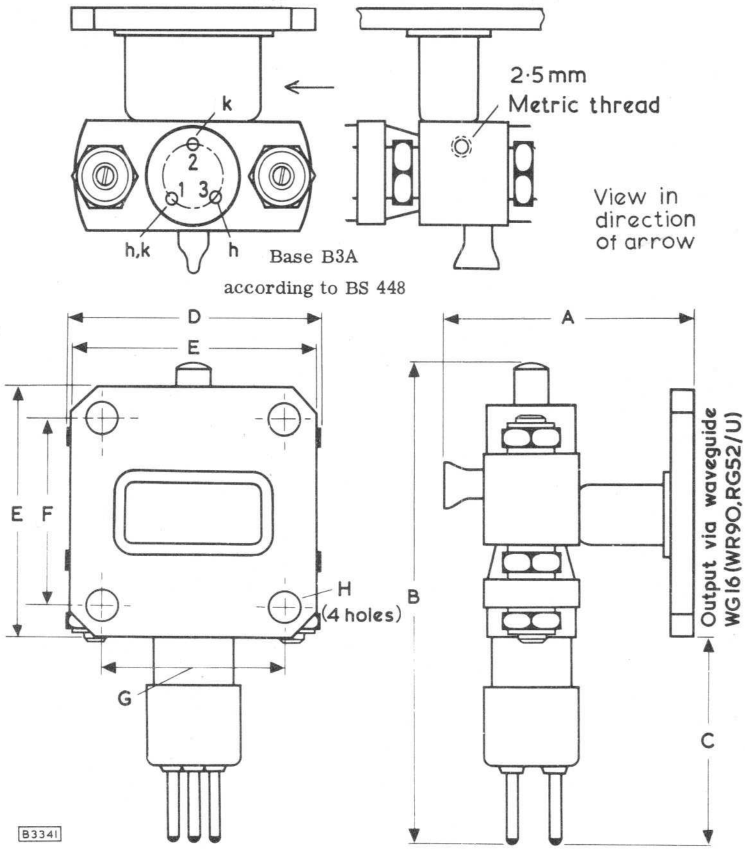


DIMENSIONS

	Inches	Millimetres	
A	2.992	76	max.
B	1.811	46	max.
C	15.748	400	min.
D	1.717 ± 0.094	43.6 ± 2.4	
E	1.657 ± 0.012	42.1 ± 0.3	
F	1.220 ± 0.004	31 ± 0.1	
G	1.280 ± 0.004	32.5 ± 0.1	
H	1.000	25.4	max.
J	0.185 ± 0.008	4.7 ± 0.2	dia.

Inch dimensions derived from original millimetre dimensions.

OUTLINE DRAWING OF YK1091



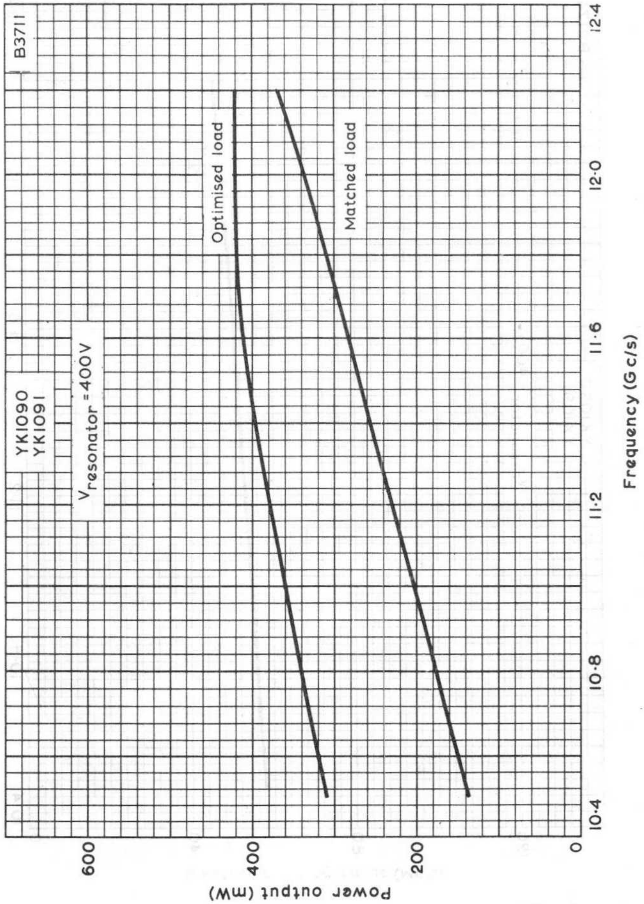
DIMENSIONS

	Inches	Millimetres	
A	1.811	46	max.
B	3.150	80	max.
C	1.378	35	max.
D	1.717 ± 0.094	43.6 ± 2.4	
E	1.651 ± 0.012	42.1 ± 0.3	
F	1.280 ± 0.004	32.5 ± 0.1	
G	1.220 ± 0.004	31 ± 0.1	
H	0.217 ± 0.004	5.5 ± 0.1	

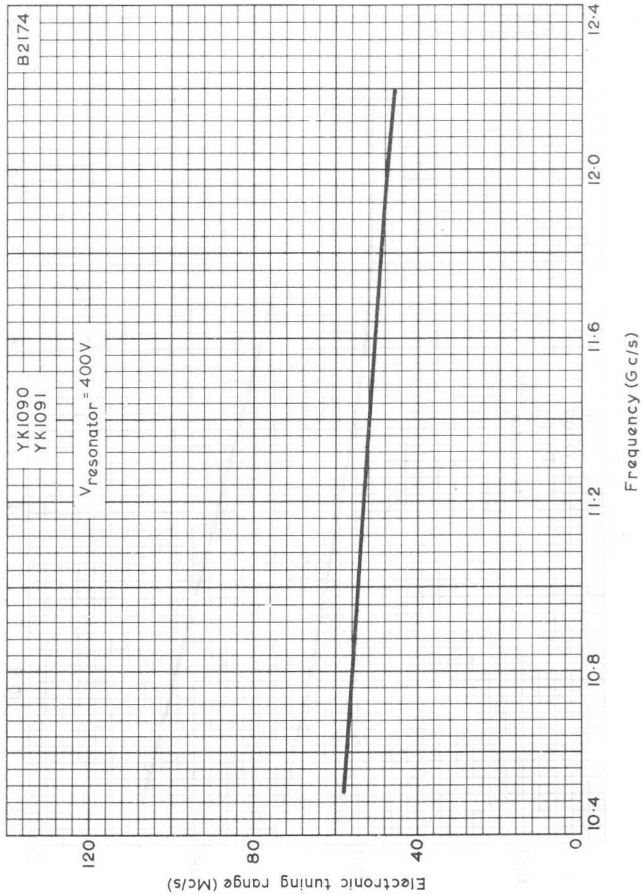
Inch dimensions derived from original millimetre dimensions.

KLYSTRON

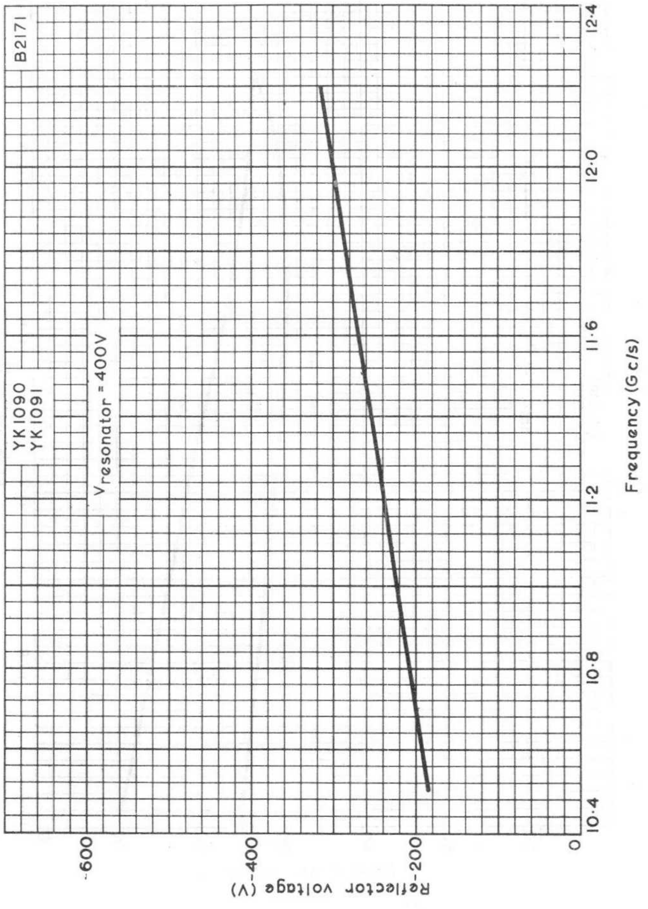
YK1090
YK1091



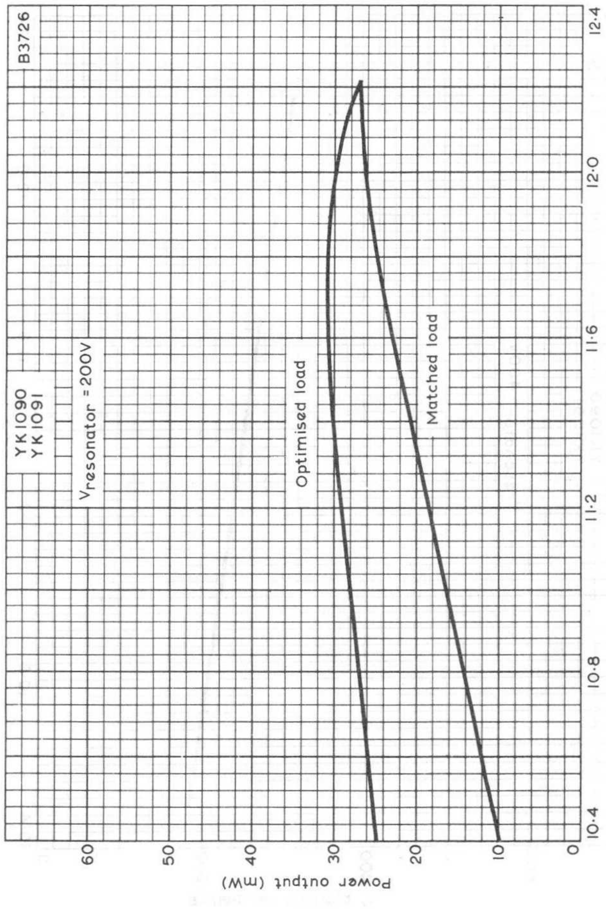
TYPICAL POWER OUTPUT FOR OPTIMISED AND MATCHED LOAD PLOTTED AGAINST FREQUENCY. $V_{resonator}$ =400V



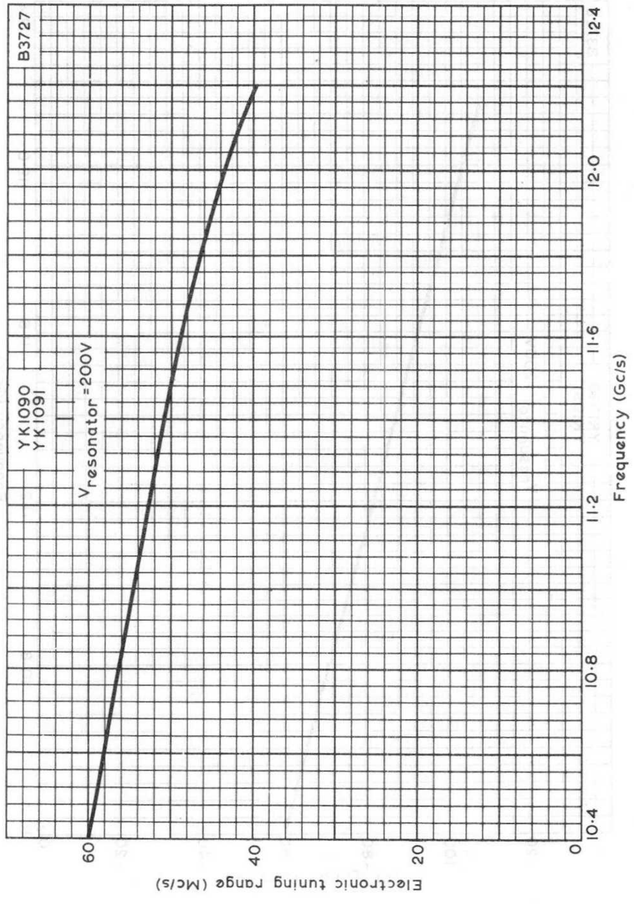
TYPICAL ELECTRONIC TUNING RANGE PLOTTED AGAINST FREQUENCY.
Vresonator = 400V.



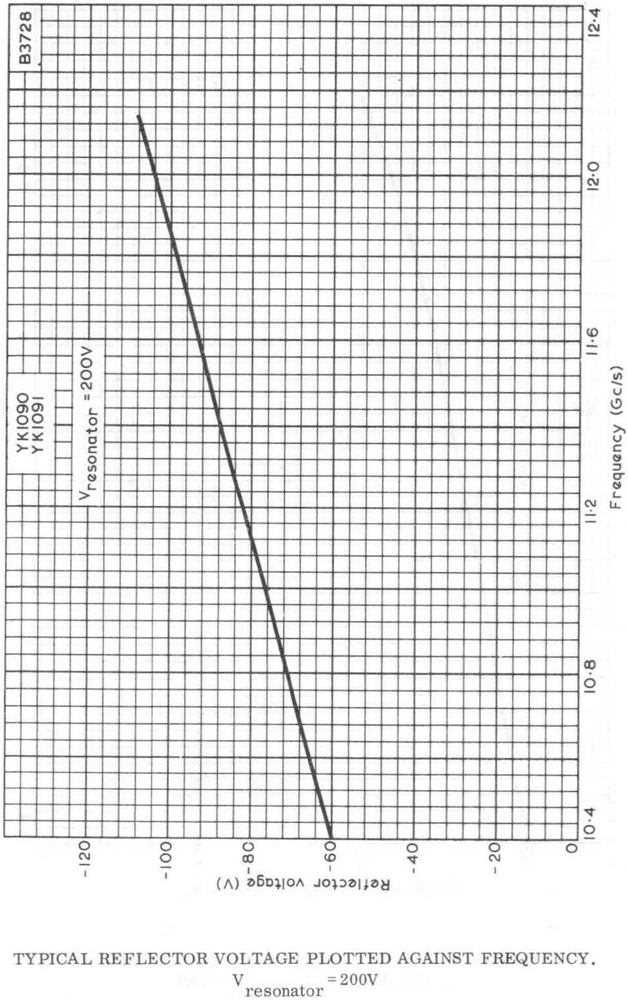
TYPICAL REFLECTOR VOLTAGE PLOTTED AGAINST FREQUENCY.
Vresonator = 400V.



TYPICAL POWER OUTPUT FOR OPTIMISED AND MATCHED LOAD PLOTTED AGAINST FREQUENCY. $V_{resonator} = 200V$



TYPICAL ELECTRONIC TUNING RANGE PLOTTED AGAINST FREQUENCY. $V_{resonator} = 200V$



TYPICAL REFLECTOR VOLTAGE PLOTTED AGAINST FREQUENCY.

$V_{resonator} = 200V$

KLYSTRON

2K25 (KS9-20A)

QUICK REFERENCE DATA		
X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.		
Frequency range	8.5 to 9.66	GHz
Power output	45	mW
Construction	Metal with I.O. base	
Output connection	coaxial probe for insertion to standard W.G 16 launching section	

Services type: CV2792. MIL-E-1/982

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION (Mode A at 9.370GHz)

Operating Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	-150	V
Load v.s.w.r.	<1.1:1	

Typical Performance

Resonator current	22	mA
Power output	45	mW
Electronic tuning range to 1/2 power points	38	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.45	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage	Adjust	
Load v.s.w.r.	<1.1:1	

Limits and Characteristics (see note 7)

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.41	0.47	A
Resonator current	-	-	32	mA
Reflector voltage: (see note 2)				
Mode A	8.5	-85	-135	V
Mode A	9.66	-143	-200	V
Mode B	9.37	-75	-120	V

TEST CONDITIONS AND LIMITS (contd.)

	Frequency (GHz)	Min.	Max.	
Power output: (see note 2)				
Mode A	8.5	20	-	mW
Mode A	9.66	20	-	mW
Mode A	9.37	35	-	mW
Mode B	9.37	15	-	mW
Electronic tuning range to 1/2 power points:				
Mode A	8.5	28	-	MHz
Mode A	9.37	35	-	MHz
Mode A	9.66	28	-	MHz
Load effect (see note 3)	-	10	-	mW
Hysteresis (see note 4)	-	-	0.5	
Frequency temperature coefficient	-	0	-0.2	MHz/deg C
Mechanical tuning range (see note 5)	-	8.5	9.66	GHz

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.8	6.8	V
Resonator voltage	-	330	V
Resonator current	-	37	mA
Reflector voltage (see note 6)	0	-400	V
Body temperature	-	110	^{o}C
v.s.w.r.	-	1.5:1	
Impedance of reflector/cathode circuit	-	500	kΩ

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified above, Mullard Ltd. should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified above.

Power output (min.)	10	mW

Mullard

MOUNTING POSITION	Any
COOLING	Natural

PHYSICAL DATA

	g	oz
Weight of klystron	65	2.29
Weight of klystron in storage carton	130	4.59
	mm	in
Dimensions of storage carton	95 × 51 × 51	3.7 × 2 × 2

NOTES

1. With the klystron operated in a standard waveguide launching section as shown on page 6.

2. Reflector voltage adjusted for the maximum power point of the mode. If it is required to operate the klystron over the entire width of either mode at the extreme frequency limits, it is recommended that the reflector voltage supply cover the range -55 to -220Volts.

3. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by a v.s.w.r. of 2.5:1 is varied through all phases.

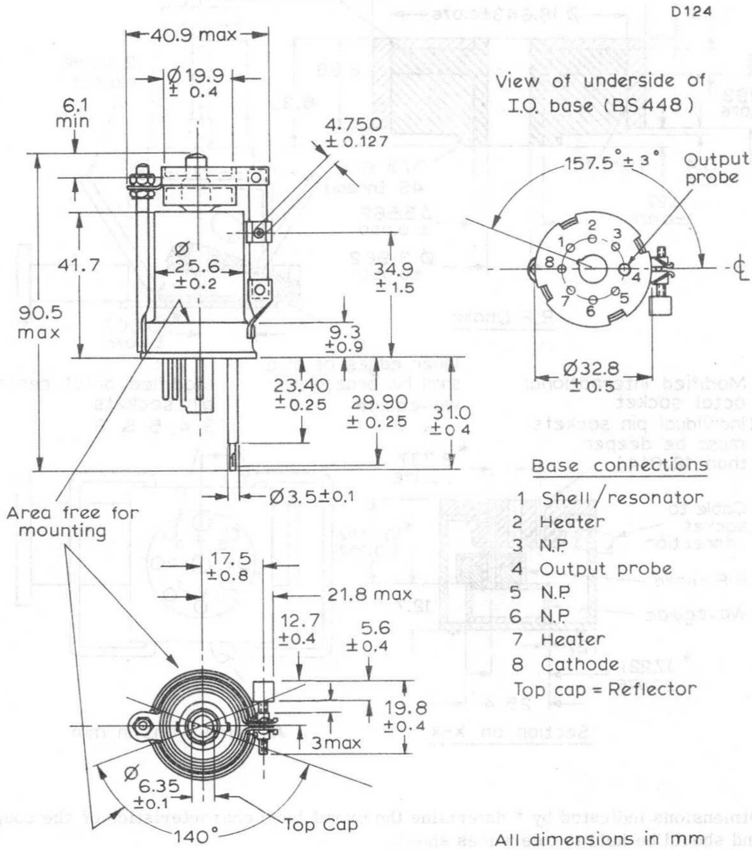
4. The ratio of the power at which hysteresis is present shall not exceed the limit specified.

5. Damage to the tuner may occur if it is adjusted beyond these frequency limits.

6. The klystron **must not** be operated without the reflector supply while the resonator voltage is applied. Care must be taken in the design of the power supply to ensure that the reflector potential never becomes positive with respect to the cathode.

7. Measurements are made 2 minutes after the application of heater voltage. The heater and H.T. supplies may be applied simultaneously.

OUTLINE DRAWING OF 2K25/KS9-20A

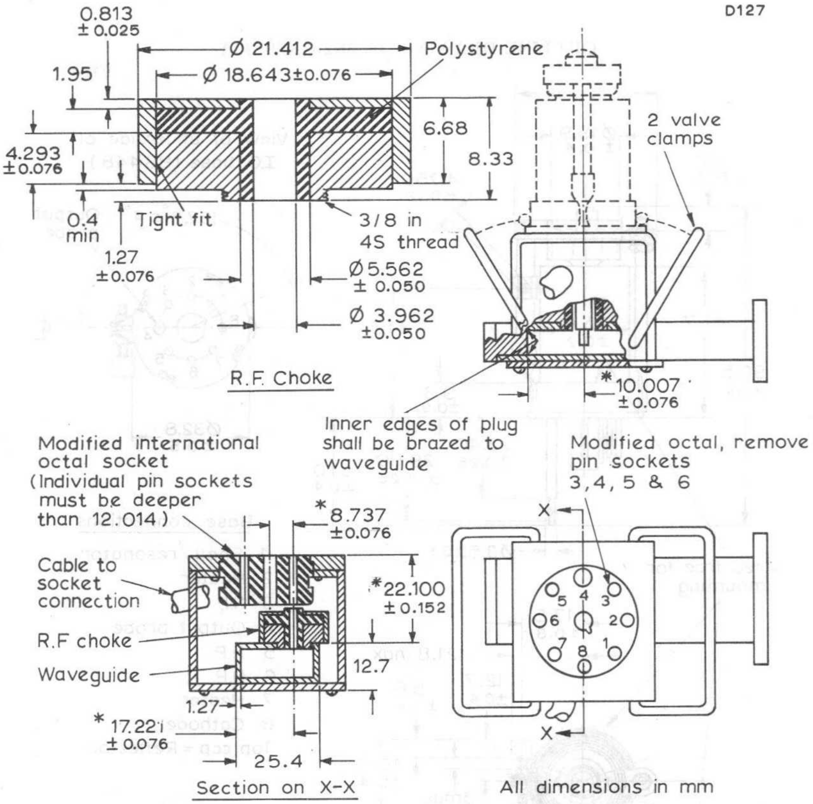


DIMENSIONS
(Rounded outwards)

mm	in	mm	in
3.0 max.	0.118 max.	Ø 19.9 ± 0.4	Ø 0.783 ± 0.016
Ø 3.5 ± 0.1	Ø 0.138 ± 0.004	21.8 max.	0.86 max.
4.75 ± 0.127	0.187 ± 0.005	23.40 ± 0.25	0.921 ± 0.010
5.6 ± 0.4	0.220 ± 0.016	Ø 25.6 ± 0.2	Ø 1.008 ± 0.008
6.1 min.	0.24 min.	29.90 ± 0.25	1.178 ± 0.010
Ø 6.35 ± 0.1	Ø 0.25 ± 0.004	31.0 ± 0.4	1.22 ± 0.016
9.3 ± 0.9	0.366 ± 0.035	Ø 32.8 ± 0.5	Ø 1.29 ± 0.020
12.7 ± 0.4	0.50 ± 0.016	34.9 ± 1.5	1.374 ± 0.059
17.5 ± 0.8	0.689 ± 0.031	40.9 max.	1.61 max.
19.8 ± 0.4	0.78 ± 0.016	41.7	1.642
		90.5 max.	3.563 max.

Mullard

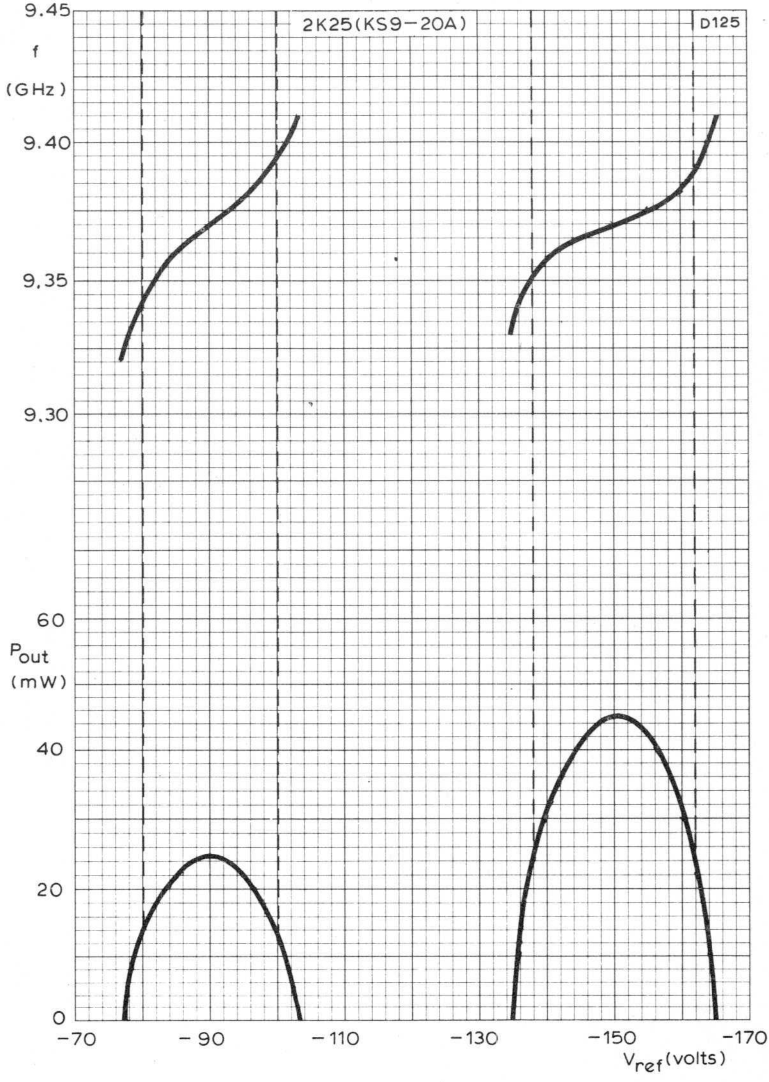
MOUNTING



Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.

Millimetre to Inch conversion table
(Rounded outwards)

mm	in	mm	in
0.4 min.	0.015 min.	8.33	0.328
0.813 ± 0.025	0.032 ± 0.001	8.737 ± 0.076	0.344 ± 0.003
1.27	0.050	10.007 ± 0.076	0.394 ± 0.003
1.27 ± 0.076	0.050 ± 0.003	12.014	0.473
1.95	0.077	12.7	0.5
Ø 3.962 ± 0.050	Ø 0.156 ± 0.002	17.221 ± 0.076	0.678 ± 0.003
4.293 ± 0.076	0.169 ± 0.003	Ø 18.643 ± 0.076	Ø 0.734 ± 0.003
Ø 5.562 ± 0.050	Ø 0.219 ± 0.002	Ø 21.412	Ø 0.843
6.68	0.263	22.100 ± 0.152	0.870 ± 0.006
		25.4	1.0



TYPICAL CURVES OF POWER AND FREQUENCY
AGAINST REFLECTOR VOLTAGE

KLYSTRON

723A/B (KS9-20)

QUICK REFERENCE DATA		
X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.		
Frequency range	8.702 to 9.548	GHz
Power output	40	mW
Construction	Metal with I.O. base	
Output connection	coaxial probe for insertion to standard W.G. 16 launching section.	

Services type: CV1795

To be read in conjunction with

GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION (Mode A at 9.370GHz)

Operating Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage (see note 2)	-150	V
Load v.s.w.r.	<1.1:1	

Typical Performance

Resonator current	20	mA
Power output	40	mW
Electronic tuning range to 1/2 power points	35	MHz

CATHODE

Indirectly heated

Heater voltage	6.3	V
Heater current	0.45	A

TEST CONDITIONS AND LIMITS

The klystron is tested to comply with the following electrical specification.

Test Conditions (see note 1)

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage	Adjust	
Load v.s.w.r.	<1.1:1	

Limits and Characteristics (see note 7)

	Frequency (GHz)	Min.	Max.	
Heater current	-	0.41	0.47	A
Resonator current	-	-	32	mA
Reflector voltage: (see note 2)				
Mode A	8.702	-90	-150	V
Mode A	9.548	-140	-200	V
Mode B	-	-75	-120	V

TEST CONDITIONS AND LIMITS (contd.)

	Frequency (GHz)	Min.	Max.	
Power output: (see note 2)				
Mode A	8.702	20	-	mW
Mode A	9.548	20	-	mW
Mode B	-	15	-	mW
Electronic tuning range to 1/2 power points:				
Mode A	9.370	35	-	MHz
Load effect (see note 3)	-	-	10	mW
Hysteresis (see note 4)	-	-	0.5	
Frequency temperature coefficient	-	0	-0.2	MHz/degC
Mechanical tuning range (see note 5)	-	8.702	9.548	GHz

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

	Min.	Max.	
Heater voltage	5.8	6.8	V
Resonator voltage	-	330	V
Resonator current	-	37	mA
Reflector voltage (see note 6)	0	-400	V
Body temperature	-	110	^{o}C
v.s.w.r.		1.5:1	
Impedance of reflector/cathode circuit	-	500	kΩ

END OF LIFE PERFORMANCE

The quality of all production is monitored by the random selection of klystrons which are then life tested under the stated test conditions. If the klystron is to be operated under different conditions from those specified above, Mullard Ltd. should be consulted to verify that the life will not be affected. The klystron is considered to have reached the end of life when it fails to meet the following limits when operated as specified above.

Power output (min.)	10	mW

MOUNTING POSITION	Any
COOLING	Natural

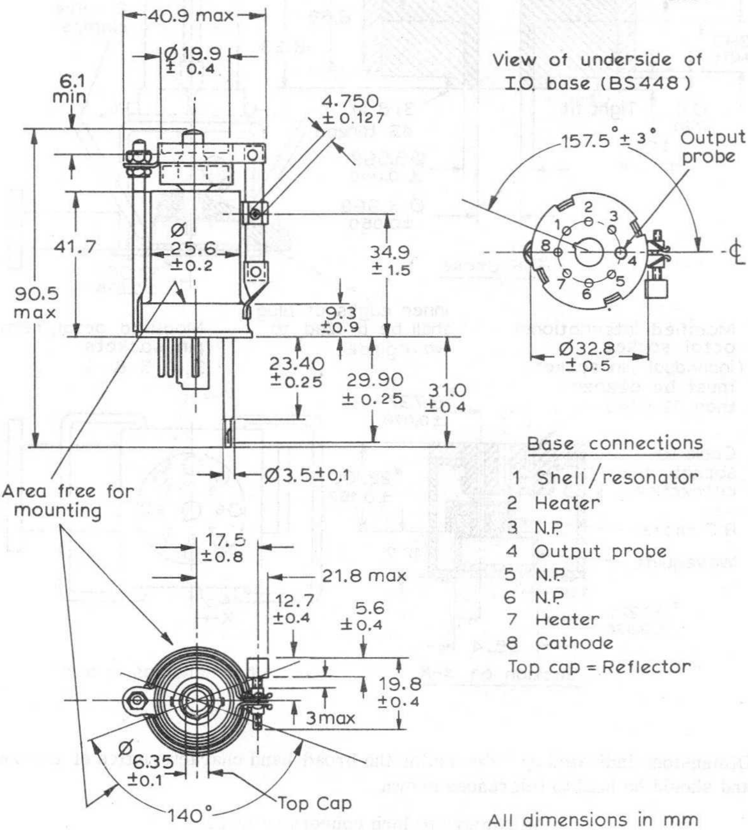
PHYSICAL DATA

	g	oz
Weight of klystron	65	2.3
Weight of klystron in storage carton	130	4.6
	mm	in
Dimensions of storage carton	95×51×51	3.7×2×2

NOTES

1. With the klystron operated in a standard waveguide launching section as shown on page 6.
2. Reflector voltage adjusted for the maximum power point of the mode. If it is required to operate the klystron over the entire width of either mode at the extreme frequency limits, it is recommended that the reflector voltage supply cover the range -55 to -220Volts.
3. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by a v.s.w.r. of 2.5:1 is varied through all phases.
4. The ratio of the power at which hysteresis is present shall not exceed the limit specified.
5. Damage to the tuner may occur if it is adjusted beyond these frequency limits.
6. The klystron **must not** be operated without the reflector supply while the resonator voltage is applied. Care must be taken in the design of the power supply to ensure that the reflector potential never becomes positive with respect to the cathode.
7. Measurements are made 2 minutes after the application of heater voltage. The heater and H.T. supplies may be applied simultaneously.

OUTLINE DRAWING OF 723A/B/KS9-20

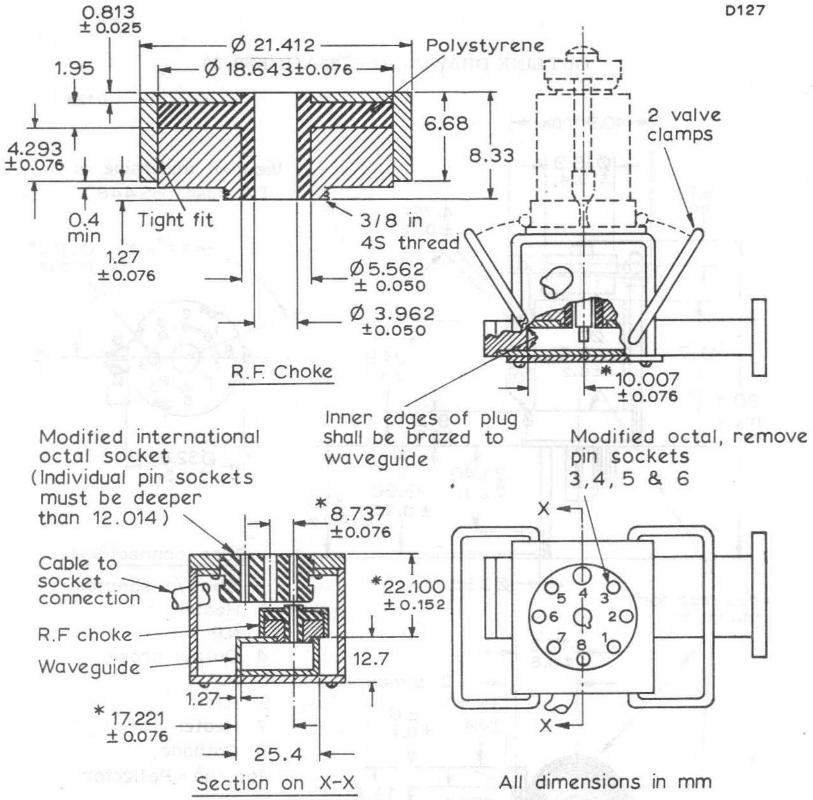


All dimensions in mm

DIMENSIONS
(Rounded outwards)

mm	in.	mm	in.
3.0 max.	0.118 max.	Ø 19.9 ± 0.4	Ø 0.783 ± 0.016
Ø 3.5 ± 0.1	Ø 0.138 ± 0.004	21.8 max.	0.86 max.
4.75 ± 0.127	0.187 ± 0.005	23.40 ± 0.25	0.921 ± 0.010
5.6 ± 0.4	0.220 ± 0.016	Ø 25.6 ± 0.2	Ø 1.008 ± 0.008
6.1 min.	0.24 min.	29.90 ± 0.25	1.178 ± 0.010
Ø 6.35 ± 0.1	Ø 0.25 ± 0.004	31.0 ± 0.4	1.22 ± 0.016
9.3 ± 0.9	0.366 ± 0.035	32.8 ± 0.5	1.29 ± 0.020
12.7 ± 0.4	0.50 ± 0.016	34.9 ± 1.5	1.374 ± 0.059
17.5 ± 0.8	0.689 ± 0.031	40.9 max.	1.61 max.
19.8 ± 0.4	0.78 ± 0.016	41.7	1.642
		90.5 max.	3.563 max.

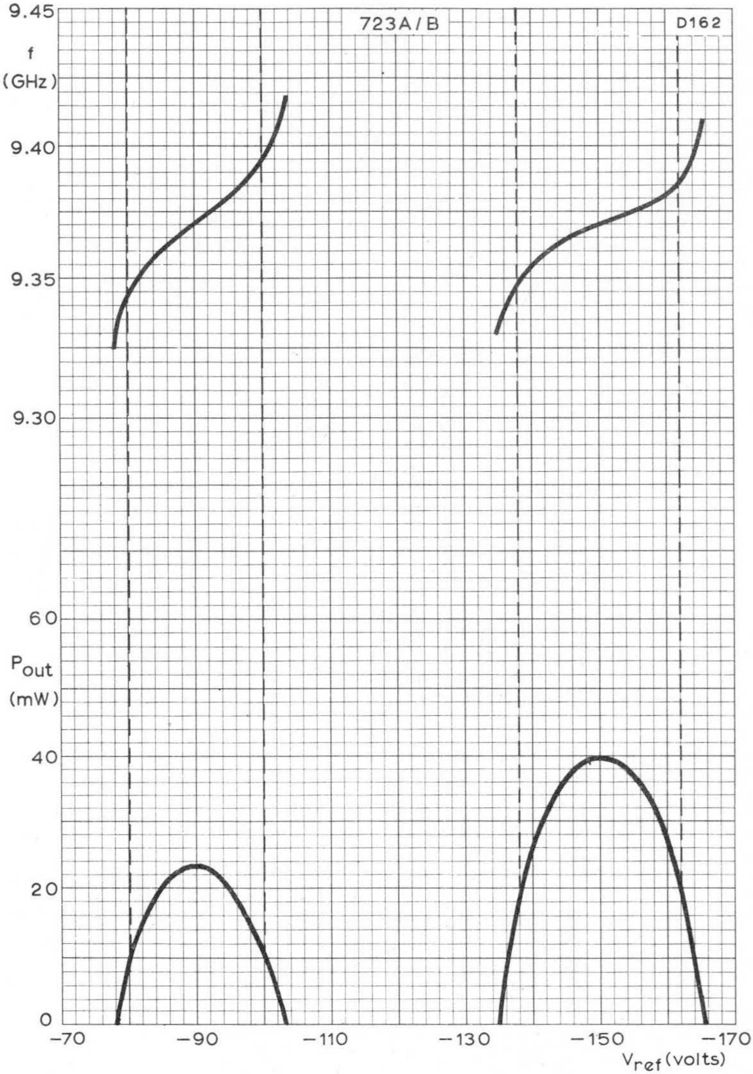
MOUNTING



Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.

Millimetre to Inch conversion table
(Rounded outwards)

mm	in	mm	in
0.4 min.	0.015 min.	8.33	0.328
0.813 ± 0.025	0.032 ± 0.001	8.737 ± 0.076	0.344 ± 0.003
1.27	0.050	10.007 ± 0.076	0.394 ± 0.003
1.27 ± 0.076	0.050 ± 0.003	12.014	0.473
1.95	0.077	12.7	0.5
Ø 3.962 ± 0.050	Ø 0.156 ± 0.002	17.221 ± 0.076	0.678 ± 0.003
4.293 ± 0.076	0.169 ± 0.003	Ø 18.643 ± 0.076	Ø 0.734 ± 0.003
Ø 5.562 ± 0.050	Ø 0.219 ± 0.002	Ø 21.412	Ø 0.843
6.68	0.263	22.100 ± 0.152	0.870 ± 0.006
		25.4	1.0



TYPICAL CURVES OF POWER AND FREQUENCY AGAINST REFLECTOR VOLTAGE

TRAVELLING WAVE TUBES

E

1. HEATER

1.1. Low noise values

To obtain the minimum noise figure the heater voltage must be within $\pm 2.5\%$ of the specified value and temporary fluctuations must be within $\pm 5\%$.

1.2. Intermediate and power values

To obtain the maximum life the heater voltage must be within $\pm 2.5\%$ of the nominal value and temporary fluctuations must be within $\pm 10\%$.

2. COOLING

It may be necessary to provide additional cooling to prevent the valve and focusing system temperature limits being exceeded.

Forced cooling of the collector terminal may be required and recommendations will be given in the individual valve data.

Normally cooling of electromagnetic focusing systems will be required.

3. FOCUSING MOUNTS

A suitable magnetic field is provided by the mounts available from Mullard Limited.

Designers who do not propose to use one of these mounts should consult the valve manufacturer as an unsuitable mount can impair the performance of the valve. In many instances, the focusing mount incorporates the radio frequency input and output connections with suitable matching devices.

Focus alignment screws are provided on the approved mounts and a presetting procedure for these has been established (see appropriate data sheets). This procedure will reduce the risk of damage to the valve due to excessive helix dissipation during the focusing operations.

4. SHIELDING

Any disturbance of the focusing field may impair the performance of the valve, and the valve must be protected from the effects of nearby ferrous material and stray magnetic fields.

The degree of susceptibility to such interference varies for different focusing systems and specific information will be given in the individual data sheets. Unless magnetic shielding or component orientation is adopted ferrous objects should be kept more than 9 inches away and other magnetic objects should be positioned 18 inches away from the valve.

5. POWER SUPPLIES

5.1. Protective devices

Protective devices are desirable to prevent damage to the valve if the power supply or cooling arrangements fail.

5.2. Regulation

The regulation requirements can be determined with reference to the typical curves of gain, phase shift and electrode voltages.

The change in gain with electrode voltage is usually greatest for the current controlling electrode (normally the first grid) and the helix.

Any ripple voltage on the helix will give rise to phase modulation of the signal.

With an electromagnetic focusing system the solenoid current must be stabilised.

6. INSTALLATION SEQUENCE

When putting a valve into operation the initial adjustments should be made in the following order:

Ensure that the control electrode voltage is set at zero and then apply simultaneously the remaining electrode voltages and adjust in accordance with recommended values. Increase the control electrode voltage until cathode current is drawn, ensuring that the maximum helix current limit is not exceeded. Adjust the focus alignment screws so that the helix current is a minimum and the collector current is a maximum. Repeat this procedure until the required collector current is achieved and the helix current is a minimum. A typical helix current is given in the valve data under operating conditions.

Inject a low level radio frequency signal at the desired operating frequency ensuring that the value is not saturated and observe the output level. Adjust the helix voltage until a maximum output level is achieved. Recheck for optimum focusing and lock focus alignment screws.

7. OPERATING SEQUENCE

The following sequence should be followed:

a. Apply the heater voltage and allow the specified heater warm up time.

b. Switch on the power supply of the electromagnetic focusing system.

c. The electrode voltages may be applied simultaneously but it is preferable that the control electrode voltage be delayed with respect to the other electrode voltages.

8. SWITCHING OFF

All the electrode voltages may be removed simultaneously but it is preferable for the control electrode voltage to decrease more rapidly than the other electrode voltages.

Where an electromagnetic focusing arrangement is used the valve electrode voltages must be removed before switching off the solenoid power supply.

9. STORAGE

The valve should be stored in its original packing, which is designed to give reasonable protection against vibration and knocks. This also ensures that the spacing between permanent magnet valves and other ferrous objects is adequate to avoid reduction of magnetisation.

Unpacked permanent magnet valves should **NEVER** be placed on steel benches or shelves.

RADAR TRAVELLING-WAVE TUBE

LA9-3B

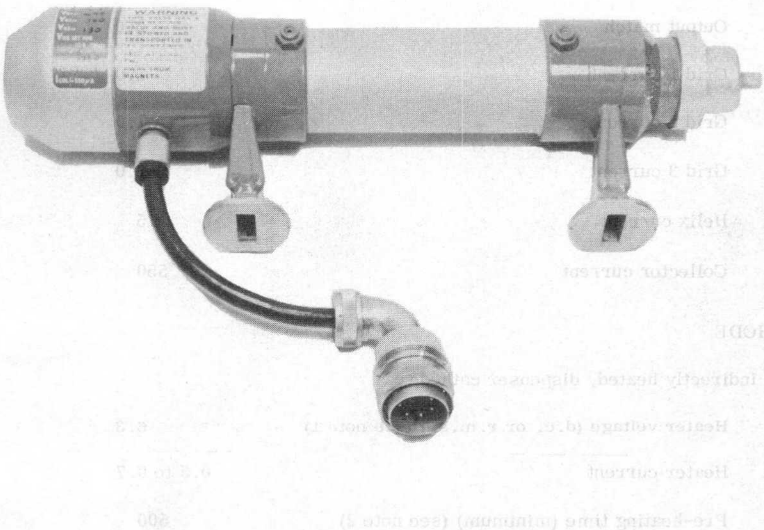
QUICK REFERENCE DATA

Forward wave amplifier for general purpose use.

Frequency range	7.0 to 11.5	GHz
Power output	10	mW
Gain	30	dB
Construction	Packaged	
Output connections	Waveguide WR90	

Services type: CV6087

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-100	V
Grid 2 voltage	150	V
Grid 3 voltage	100	V
Helix voltage	1.3	kV
Collector voltage	1.4	kV
Operating frequency	9.0	GHz

Typical performance

Gain	30	dB
Power output (saturated)	10	mW
Power output (working)	50	μW
Noise factor	22	dB
Input match	2.0	
Output match	2.0	
Grid 1 current	1.0	μA
Grid 2 current	1.0	μA
Grid 3 current	1.0	μA
Helix current	15	μA
Collector current	550	μA

CATHODE

Indirectly heated, dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.5 to 0.7	A
Pre-heating time (minimum) (see note 2)	500	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-100	V
*Grid 2 voltage range	0 to 250	V
*Grid 3 voltage range	0 to 400	V
*Helix voltage range	1.15 to 1.45	kV
Collector voltage	helix voltage +100V	
Collector current	550	μA
Frequency range (see note 3)	7.0 to 11.5	GHz

*Specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Gain	20	35	dB
Noise factor	-	24	dB
Power output	3.0	-	mW
Grid 1 current	-	10	μA
Grid 2 current	-	10	μA
Grid 3 current	-	10	μA
Helix current	-	50	μA
Attenuation (see note 4)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-200	0	V
Grid 2 voltage	-	450	V
Grid 3 voltage	-	450	V
Helix voltage	-	1.6	kV
Helix current	-	100	μA
Collector voltage	-	1.7	kV
Collector current	-	600	μA

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage	-100	-70	V
Grid 1 current	-	10	μA
Grid 2 voltage	0	200	V
Grid 2 current	-	10	μA
Grid 3 voltage	0	250	V
Grid 3 current	-	10	μA
Helix voltage	1.15	1.45	kV
Helix current	-	60	μA
Collector voltage (see note 5)			
Collector current	-	550	μA

MOUNTING POSITION

Any. The barrel of the mount must be protected from strong magnetic fields such as from isolators and should be several centimetres from steel plates.

COOLING

Horizontally or vertically mounted natural

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification	-10	+65	^{o}C

PHYSICAL DATA

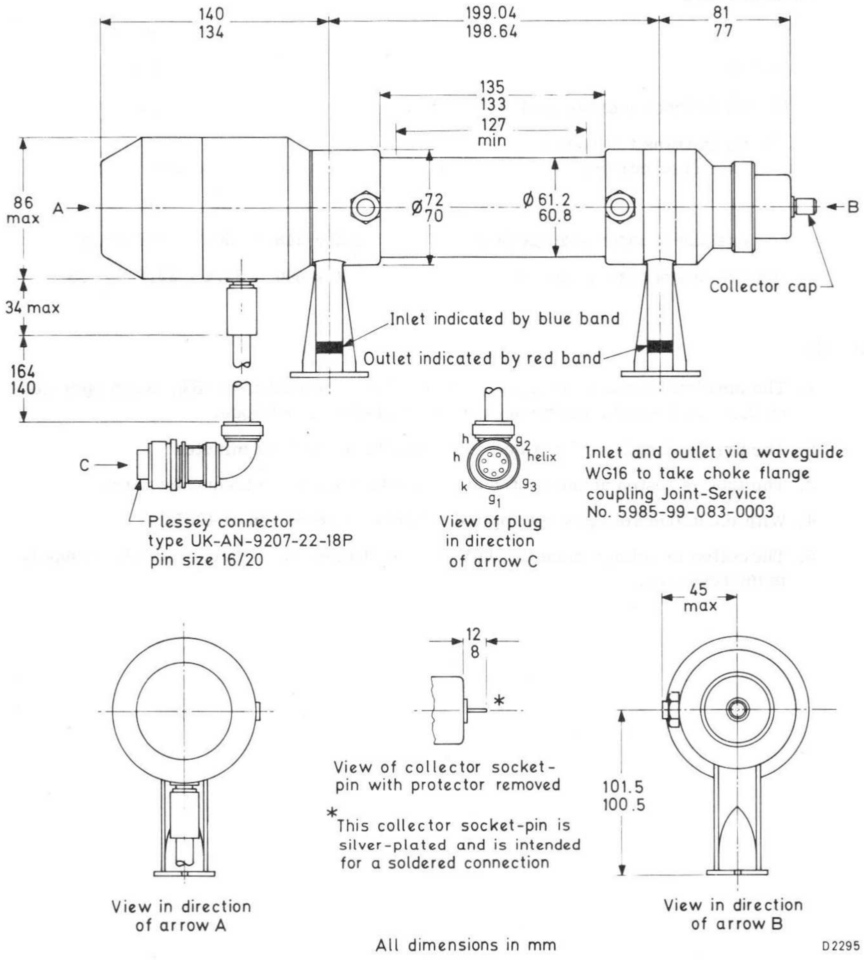
Packaged tube

	kg	lb
Weight	3.4	7.5
Weight in inner storage pack	3.9	8.5
Weight in transit carton (1 tube per carton)	58.5	129
	mm	in
Dimensions of inner storage pack	525 × 232 × 243	20.7 × 9.2 × 9.6
Dimensions of transit carton	900 × 560 × 600	35.4 × 22.3 × 23.5

NOTES

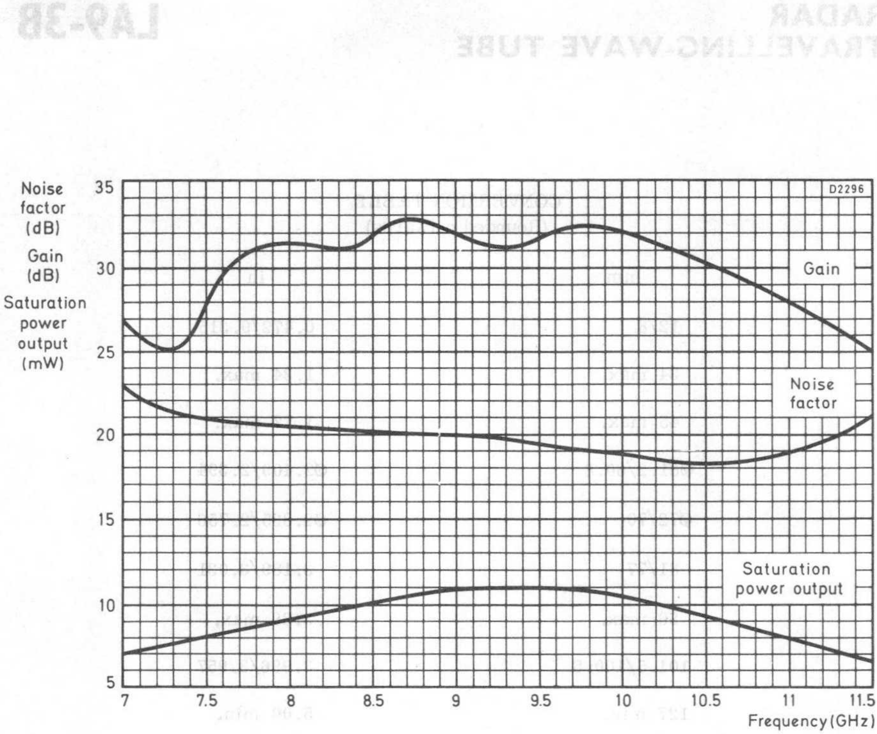
1. The absolute variation of heater voltage should be less than ±5%. When operated on d.c. the heater must be negative with respect to cathode.
2. The pre-heating time for a new tube must be at least 10 minutes.
3. The tube is tested at the centre and the extremes of the frequency range.
4. With electrode voltages not applied minimum attenuation is 40dB.
5. The collector voltage must be 100V greater than helix voltage. A stabilised supply is unnecessary.

OUTLINE DRAWING OF LA9-3B



CONVERSION TABLE
(Rounded outwards)

mm	in
12/8	0.472/0.315
34 max.	1.34 max.
45 max.	1.77 max.
Ø61.2/60.8	Ø2.409/2.394
Ø72/70	Ø2.835/2.756
81/77	3.189/3.031
86 max.	3.39 max.
101.5/100.5	3.996/3.957
127 min.	5.00 min.
135/133	5.315/5.236
140/134	5.512/5.276
164/140	6.456/5.512
199.04/198.64	7.836/7.820



TYPICAL SATURATION POWER OUTPUT, GAIN AND NOISE FACTOR
PLOTTED AGAINST FREQUENCY

RADAR TRAVELLING-WAVE TUBE

LB3-250B

QUICK REFERENCE DATA		
Forward wave amplifier for use in pulsed radar systems.		
Frequency range	2.7 to 3.3	GHz
Saturation power output	600	W
Working power output	250	W
Gain at working power	32	dB
Construction	Unpackaged, pre-focused	
Output connections	Type C coaxial	

Services type: CV6223

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

Mullard

TYPICAL OPERATION

As a power amplifier focused in a focusing mount type S3L1.
Tubes are fully interchangeable in mounts and tube replacement is a simple operation.

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	5.0	kV
Helix voltage	5.0	kV
Collector voltage	5.0	kV
Operating frequency	3.0	GHz
Pulse duration	20	μs
Pulse repetition frequency	275	pulse/s
Solenoid current	21	A

Typical performance

Gain	32	dB
Power output	250	W
Grid 1 current (pulsed)	20	mA
Helix current (pulsed)	125	mA
Collector current (pulsed)	800	mA

CATHODE

Indirectly heated, dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.75 to 1.0	A
Pre-heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is focused in mount type S3L1 and tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
*Grid 1 voltage range	4.5 to 6.5	kV
Helix voltage (see note 3)		
Collector voltage (see note 3)		
Frequency range (see note 4)	2.7 to 3.3	GHz
Solenoid current	21	A

*Specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Gain (at 250W output)	27.5	35	dB
Power output	250	-	W
Cold input match (v.s.w.r.) (see note 5)	-	3.0	
Cold output match (v.s.w.r.) (see note 5)	-	3.0	
Grid 1 current (pulsed)	-	25	mA
Helix current	-	200	mA
Collector current (pulsed)	-	1.0	A
Attenuation (see note 6)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

Grid 1 voltage	7.5	kV
Helix voltage (see note 3)	7.5	kV
Helix current (pulsed)	250	mA
Collector voltage (see note 3)	7.5	kV
Collector current (pulsed)	1.5	mA
Pulse duration	22	μs
Duty cycle	0.005	

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage (pulsed)	4.5	6.5	kV
Grid 1 current (pulsed)	-	25	mA
Helix voltage (see note 3)			
Helix current	-	200	mA
Collector voltage (see note 3)			
Collector current	-	1.0	A
Solenoid current	20.5	21.5	A
Solenoid resistance	-	1.0	Ω

MOUNTING POSITION

Any

COOLING

Tube installed in water-cooled mount type S3L1. Both the capsule and mount require water cooling. The cooling systems may be connected in series.

Minimum rate of water flow	1.0	l/min
Back pressure of capsule	120	mm of mercury
Back pressure of mount	300	mm of mercury
Inlet water temperature	50	^{o}C

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification	-10	+65	^{o}C

PHYSICAL DATA

	kg	lb
Weight of capsule	2.3	5.0
Weight of mount	21	46

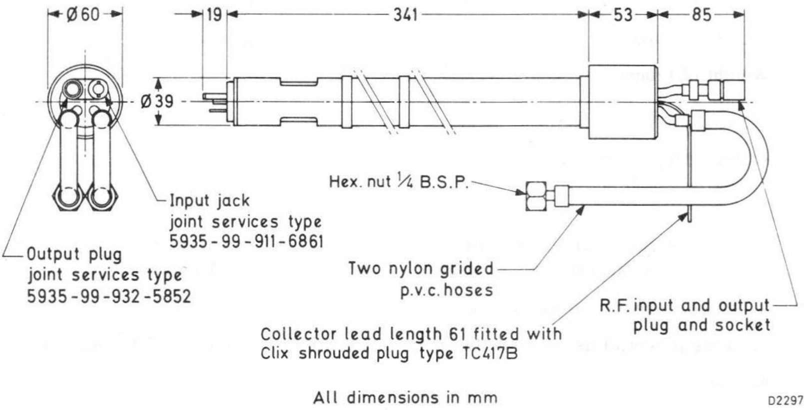
R.F. CONNECTIONS

Coaxial plugs: type C

NOTES

1. The absolute variation of heater voltage should be less than ±5%. When operated on d.c. the heater must be negative with respect to cathode.
2. The pre-heating time for a new tube must be at least 5 minutes.
3. Same potential as grid 1. Maximum potential with respect to tube body 100V.
4. The tube is tested at the centre and the extremes of the frequency range.
5. Obtained without adjustment at each frequency ("plug-in" match).
6. With electrode voltages not applied minimum attenuation is 45dB.

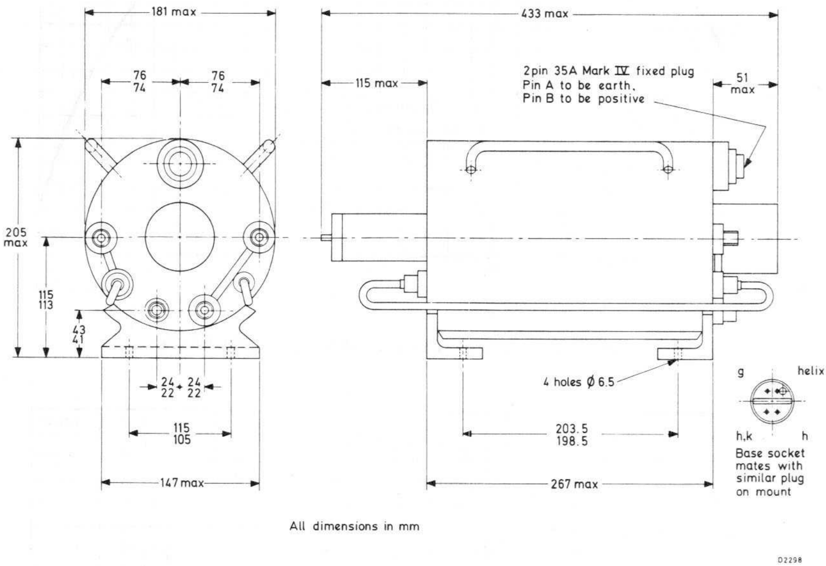
OUTLINE DRAWING OF LB3-250B

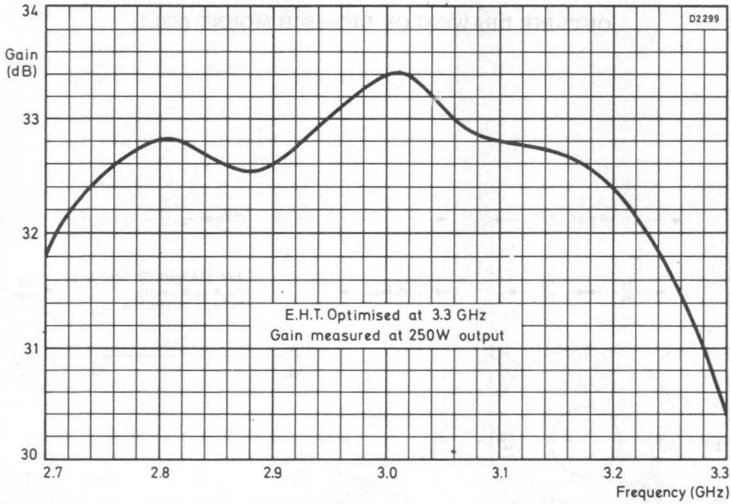


CONVERSION TABLE
(Rounded outwards)

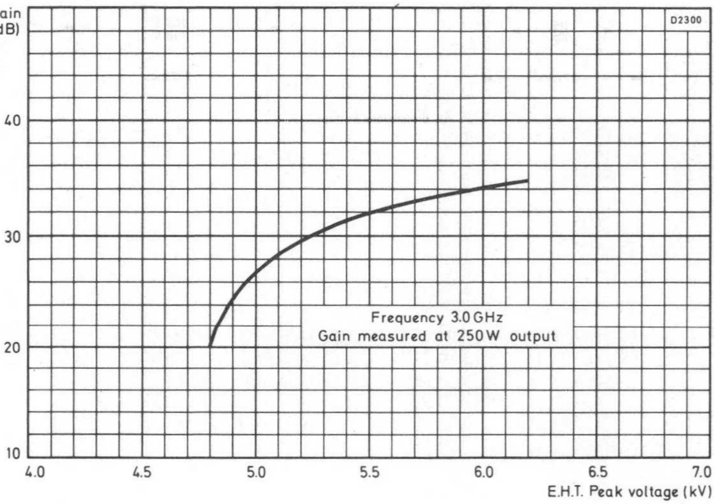
LB3-250B mm	in	LB3-250B MOUNT (S3L1) mm	in
19	0.75	Ø6.5	Ø0.238
Ø39	Ø1.54	24/22	0.945/0.866
53	2.09	43/41	1.693/1.614
Ø60	Ø2.36	51 max.	2.0 max.
61	2.40	76/74	2.992/2.913
85	3.35	115 max.	4.53 max.
341	13.42	115/105	4.53/4.13
		115/113	4.527/4.448
		147 max.	5.79 max.
		181 max.	7.12 max.
		203.5/198.5	8.012/7.815
		205 max.	8.07 max.
		267 max.	10.51 max.
		433 max.	17.05 max.

OUTLINE DRAWING OF LB3-250B MOUNT (S3L1)

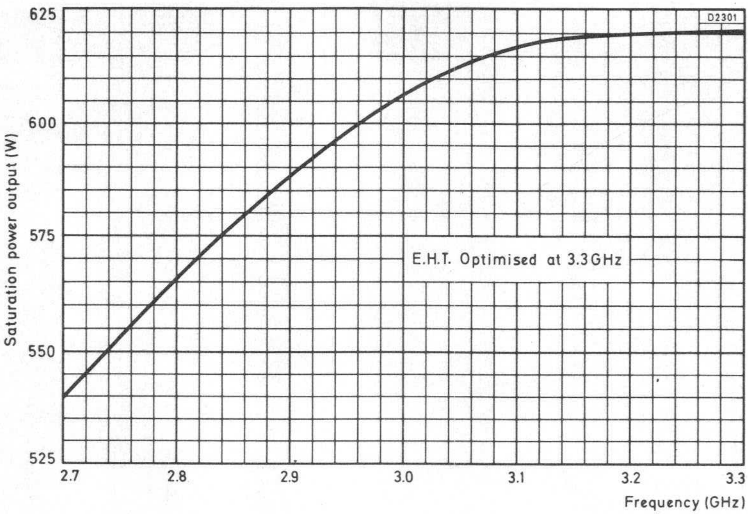




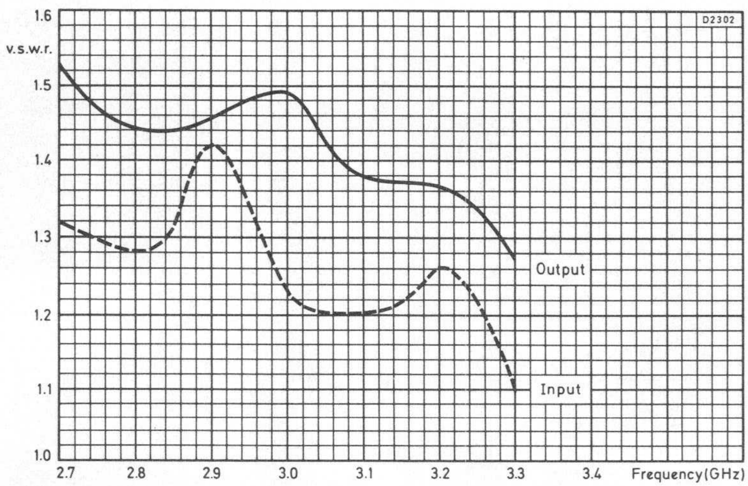
TYPICAL GAIN PLOTTED AGAINST FREQUENCY



TYPICAL GAIN PLOTTED AGAINST PEAK VOLTAGE



TYPICAL SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



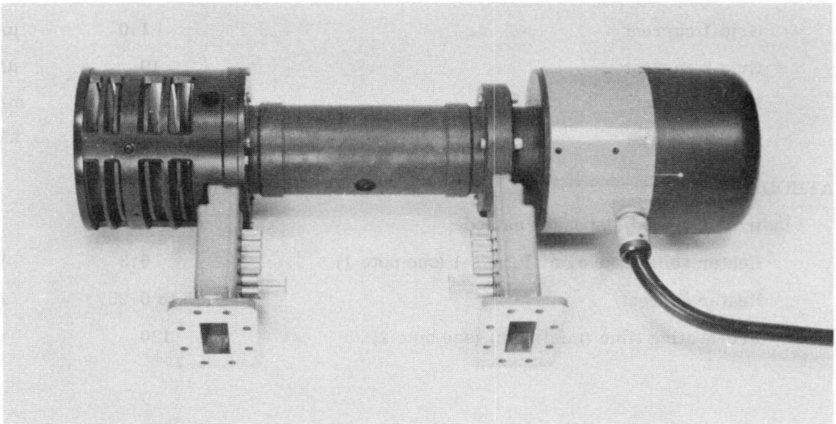
TYPICAL INPUT AND OUTPUT V.S.W.R. PLOTTED AGAINST FREQUENCY

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-10

QUICK REFERENCE DATA		
Forward wave amplifier for use in the power output stages of wide band multi-channel microwave links.		
Frequency range	5.9 to 6.5	GHz
Saturation power output	10	W
Working power output	5.0	W
Gain at working power	35	dB
Construction		Unpackaged
Output connections		Waveguide WR137

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

As a power amplifier focused in a focusing mount type P6L4. Tubes are fully interchangeable in mounts and tube replacement is a simple operation.

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-8.0	V
Helix voltage	2.6	kV
Collector voltage (earth)	1.8	kV
Operating frequency	6.0	GHz
Collector current	40	mA

Typical performance

Gain	35	dB
Power output	5.0	W
Noise factor (including gas noise)	25	dB
Hot input match (v.s.w.r.)	1.08	
Hot output match (v.s.w.r.)	1.15	
Grid 1 current	1.0	μA
Grid 2 current	10	μA
Helix current	0.25	mA
Grid 2 voltage	1.9	kV

CATHODE

Indirectly heated dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.75 to 0.95	A
Pre-heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is focused in mount type P6L4 and tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-8.0	V
Grid 2 voltage (see notes 3 and 8)		
Helix voltage (see note 4)		
Collector voltage	1.7	kV
*Collector current range	35 to 42	mA
Power output	5.0	W
Frequency range (see note 5)	5.925 to 6.475	GHz

*Specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Gain (at 5W output)	34	37	dB
**Noise factor (at 5W output)	-	30	dB
Saturation power output (see note 6)	10	-	W
Hot input match (v.s.w.r.) (see note 7)	-	1.08	
Hot output match (v.s.w.r.) (see note 7)	-	1.15	
Grid 2 voltage	1.6	2.3	kV
Helix voltage	2.4	2.9	kV
Grid 1 current	-	100	μA
Grid 2 current	-	250	μA
Helix current (see note 8)	-	1.5	mA
**A.M./P.M. conversion (at 5W output) (see note 9)	-	2.0	deg/dB
Attenuation (see note 10)			

**Design test only

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-250	0	V
Grid 2 voltage	-	3.0	kV
Helix voltage	-	4.0	kV
Helix current (see note 8)	-	1.5	mA
Collector voltage	1.7	1.9	kV
Collector current	-	50	mA
Collector power dissipation	-	110	W
R.F. power input (see note 11)	-	0.25	W
Voltage between heater and cathode	-	50	V

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage (see note 12)			
Grid 1 current	-	100	μA
Grid 2 voltage (see note 13 and 14)	1.6	2.3	kV
Grid 2 current	-250	+250	μA
Helix voltage	2.4	2.9	kV
Helix current (see notes 8 and 14)	-	1.5	mA
Collector voltage (see note 15)			
Collector current	-	45	mA

MOUNTING POSITION

Any (but see cooling). The barrel of the mount must be protected from strong magnetic fields such as from isolators, and **should** be several centimetres from steel plates.

COOLING

Tube installed in convection-cooled mount type P6L4.

Horizontally mounted	natural
Vertically mounted	assisted by convection duct or low velocity air flow

Temperatures

Collector seal max.	200	°C
Reference point on mount cooler max.	140	°C

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification (see note 16)	-10	+65	°C
Switch-on	-20	+65	°C
Storage (see note 17)	-60	+85	°C

PHYSICAL DATA

Tube

	kg	lb
Weight	0.14	0.31
Weight in inner storage pack	0.25	0.55
Weight in transit carton (4 inner packs per carton)	4.5	10.5

	mm	in
Dimensions of inner storage pack	75 × 57 × 502	3 × 2.3 × 19.8
Dimensions of transit carton	375 × 325 × 715	14.8 × 13 × 28.3

Mount

	kg	lb
Weight	5.0	11
Weight in inner storage pack	5.3	11.7
Weight in transit carton	25.4	55.9

	mm	in
Dimensions of inner storage pack	255 × 140 × 495	10 × 5.5 × 19.5
Dimensions of transit carton	520 × 410 × 640	20.5 × 16.3 × 25.3

NOTES

1. The absolute variation of the heater voltage must be less than ± 3%. When operated on d.c. the heater must be negative with respect to the cathode.

2. The pre-heating time for a new tube must be at least 5 minutes.

3. Grid 2 voltage should be adjusted to give the specified collector current while cyclically adjusting focusing screws for minimum helix current.

4. The helix voltage should be adjusted to give the maximum gain at the specified power output. Focusing should then be re-optimised.

5. The tube is tested at the centre and the extremes of the frequency range.

6. Measured pulsed at a duty ratio of 1:2. If necessary the helix voltage is readjusted to give maximum power output as the input power is increased and the focusing re-optimised.

7. This is obtained over a bandwidth of ± 25MHz after adjustment of the matching screws.

8. During the focusing operation the helix current may (transiently) be allowed to reach 2.5mA. It may be useful to set the focusing screws on a new mount 1.5 turns back from fully home before commencing the switch-on operation.

9. The value given for A.M. to P.M. conversion is that obtained under the stated conditions. Improved values may be obtained with other settings of helix voltage and input power.

10. With electrode voltages not applied minimum attenuation is 65dB.

11. The output power reflected back into the tube by the load (for example the output isolator) should also not exceed this rating.

12. The grid 1 voltage is normally fixed at -8V.

13. For adjustment of focus it is also necessary for the grid 2 voltage to be variable in the range 0 to 1.6kV without stabilisation. As an alternative the negative voltage on grid 1 may be increased within certain limits to reduce the collector current (see ratings).

14. The power supply should be designed so that any automatic switching allows the correct cathode warm-up period (which may be reduced or eliminated for momentary breaks of 5 seconds), followed by establishment of all electrode voltages except grid 2. The grid 2 voltage may then be applied. All supplies should usually be stabilised to ± 2% except where otherwise stated. A protective device to reduce the grid 2 voltage should operate if the helix current exceeds the figure in the ratings (but see note 8).

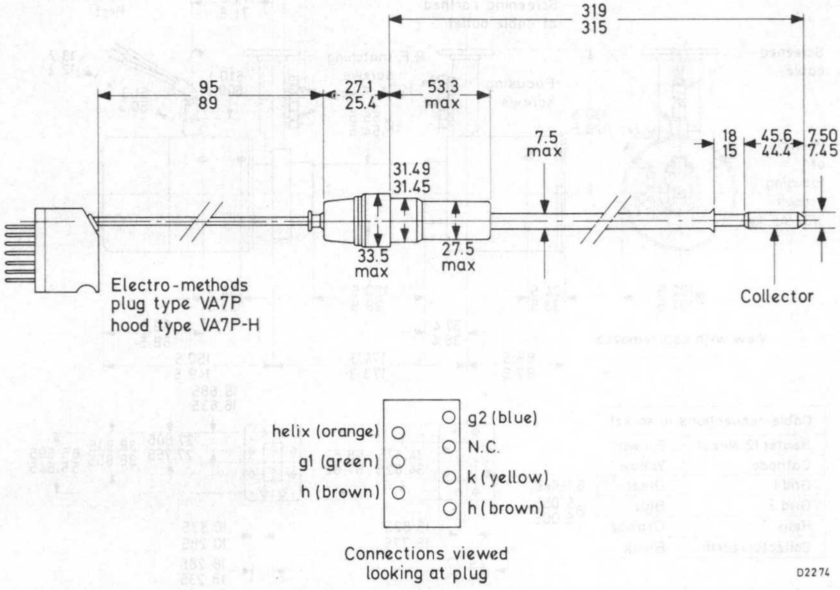
15. The collector voltage is usually fixed at 1.8kV. This supply need not be stabilised provided that it remains in the range 1.7 to 1.9kV.

16. The magnetic circuit is fully temperature-compensated in this range, and the operation of the tube will not change as the temperature is varied.

17. If the temperature of the mount is lowered below -60°C the magnets will suffer an irreversible change.

OUTLINE DRAWING OF LB6-10

Note tube is fragile. It should be inserted carefully into mount and then pushed home axially. Rotation is also necessary to negotiate the withdrawl check lugs.



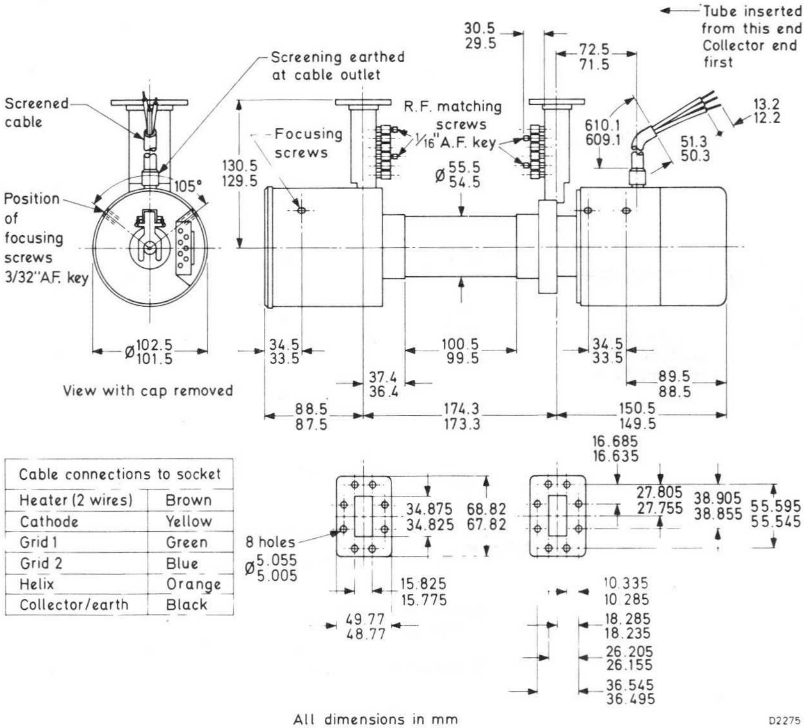
All dimensions in mm

CONVERSION TABLE
(Rounded outwards)

mm	in
7.50/7.45	0.2953/0.2933
7.5 max.	0.295 max.
18/15	0.71/0.59
27.1/25.4	1.067/1.000
27.5 max.	1.082 max.
31.49/31.45	1.2397/1.2382
33.5 max.	1.319 max.
45.6/44.4	1.795/1.748
53.3 max.	2.098 max.
95/89	3.74/3.50
319/315	12.56/12.40

OUTLINE DRAWING OF P6L4 MOUNT

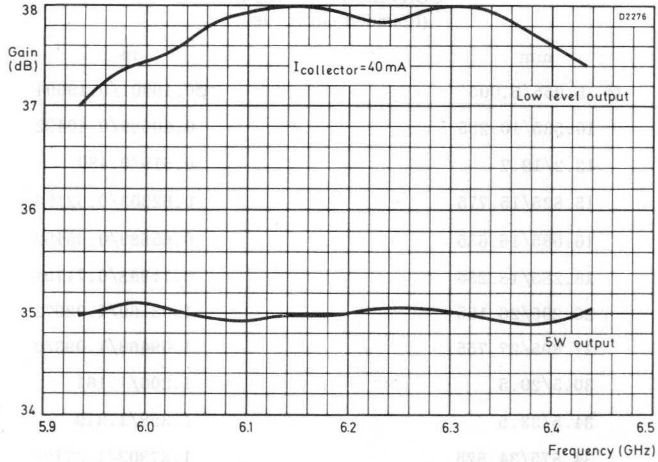
Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6N m (2kgf m). The cooling fins are movable and require about 3mm clearance. The mount should be handled with special care during installation to avoid damage to the cooling fins.



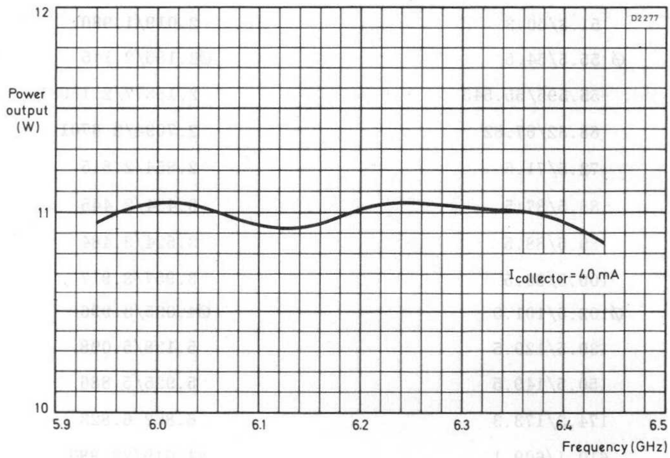
Cable connections to socket	
Heater (2 wires)	Brown
Cathode	Yellow
Grid 1	Green
Grid 2	Blue
Helix	Orange
Collector/earth	Black

CONVERSION TABLE
(Rounded outwards)

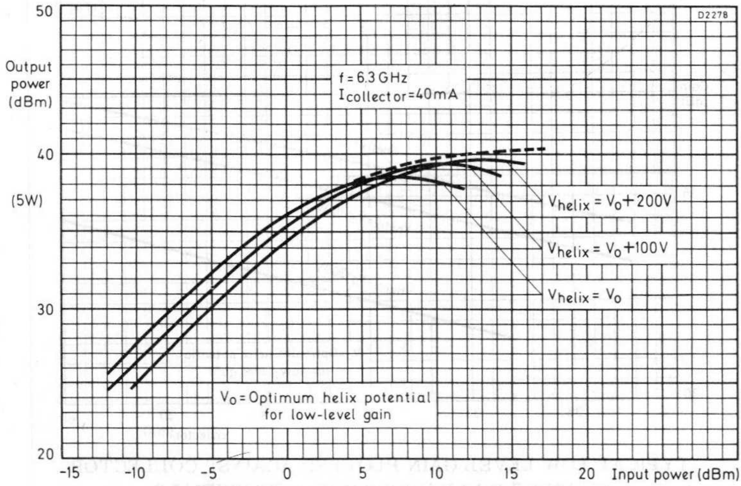
mm	in
Ø 5.055/5.005	Ø0.19901/0.19694
10.335/10.285	0.40689/0.40492
13.2/12.2	0.519/0.480
15.825/15.775	0.62303/0.62106
16.685/16.635	0.65689/0.65492
18.285/18.235	0.71988/0.71791
26.205/26.155	1.03169/1.02972
27.805/27.755	1.09468/1.09350
30.5/29.5	1.200/1.161
34.5/33.5	1.358/1.319
34.875/34.825	1.37303/1.37106
36.545/36.495	1.43877/1.43681
37.4/36.4	1.472/1.433
38.905/38.855	1.53169/1.5297
49.77/48.77	1.9594/1.9201
51.3/50.3	2.019/1.980
Ø 55.5/54.5	Ø2.185/2.145
55.595/55.545	2.18877/2.18681
68.82/67.82	2.7094/2.6701
72.5/71.5	2.854/2.815
88.5/87.5	3.484/3.445
89.5/88.5	3.524/3.484
100.5/99.5	3.957/3.917
Ø102.5/101.5	Ø4.035/3.996
130.5/129.5	5.138/5.098
150.5/149.5	5.925/5.886
174.3/173.3	6.862/6.823
610.1/609.1	24.019/23.980



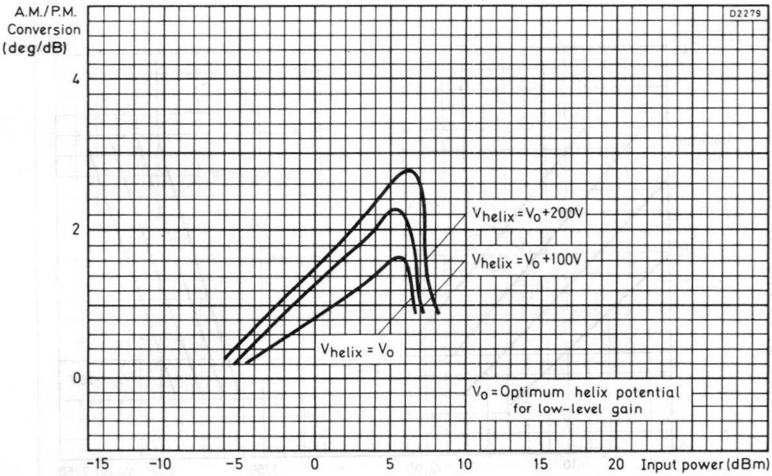
TYPICAL GAIN PLOTTED AGAINST FREQUENCY



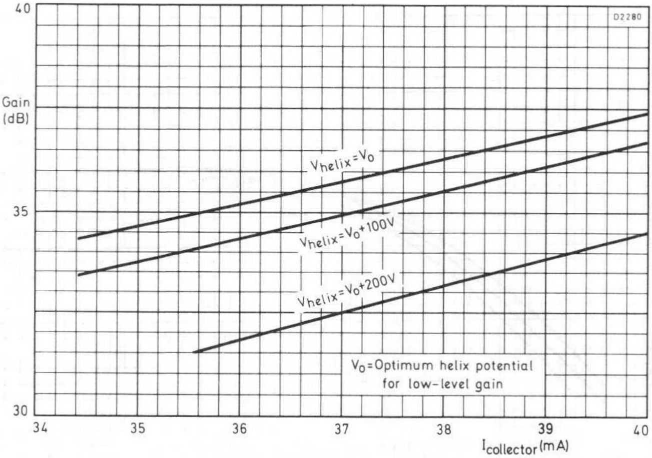
TYPICAL SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



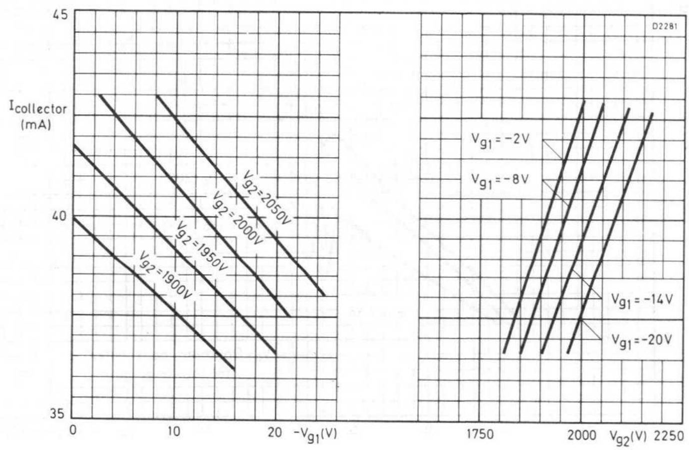
TYPICAL OUTPUT POWER PLOTTED AGAINST INPUT POWER FOR VARIOUS HELIX POTENTIALS



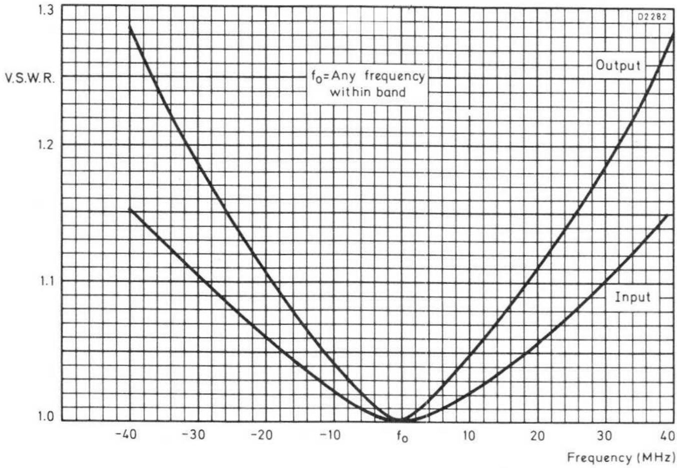
TYPICAL A.M./P.M. CONVERSION FIGURES PLOTTED AGAINST INPUT POWER FOR VARIOUS HELIX POTENTIALS



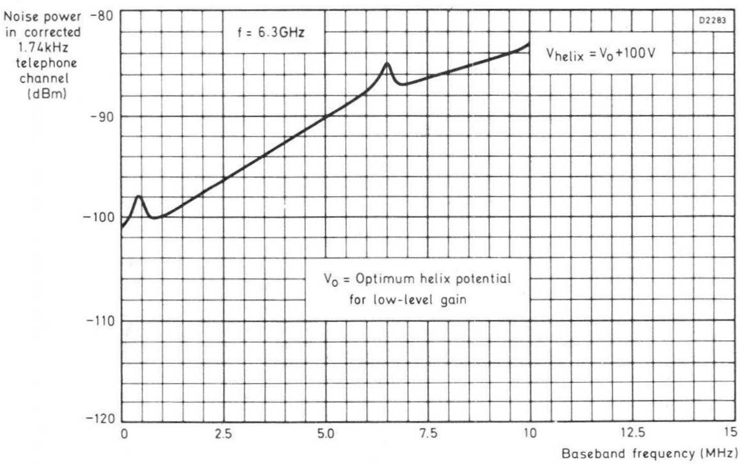
TYPICAL LOW LEVEL GAIN PLOTTED AGAINST COLLECTOR CURRENT FOR VARIOUS HELIX POTENTIALS



TYPICAL COLLECTOR CURRENT PLOTTED AGAINST GRID 1 AND GRID 2 POTENTIALS



TYPICAL INPUT AND OUTPUT HOT MATCH PLOTTED AGAINST FREQUENCY



TYPICAL DISTRIBUTION OF CHANNEL NOISE IN F.M. TELEPHONY

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-10B

QUICK REFERENCE DATA		
Forward wave amplifier for use in the power output stages of wideband multi-channel microwave links.		
Frequency range	5.9 to 6.5	GHz
Saturation power output	10	W
Working power output	5.0	W
Gain at working power	35	dB
Construction		Unpackaged
Output connections		Waveguide WR137

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

As a power amplifier focused in a focusing mount type P6L4. Tubes are fully interchangeable in mounts and tube replacement is a simple operation.

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-8.0	V
Helix voltage	2.6	kV
Collector voltage (earth)	1.8	kV
Operating frequency	6.0	GHz
Collector current	40	mA

Typical performance

Gain	35	dB
Power output	5.0	W
Noise factor (including gas noise)	25	dB
Hot input match (v.s.w.r.)	1.7	
Hot output match (v.s.w.r.)	2.0	
Grid 1 current	1.0	μA
Grid 2 current	10	μA
Helix current	0.25	mA
Grid 2 voltage	1.9	kV

CATHODE

Indirectly heated dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.75 to 0.95	A
Pre-heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is focused in mount type P6L4 and tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-8.0	V
Grid 2 voltage (see notes 3 and 8)		
Helix voltage (see note 4)		
Collector voltage	1.7	kV
*Collector current range	35 to 42	mA
Power output	5.0	W
Frequency range (see note 5)	5.925 to 6.475	GHz

*Specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Gain (at 5W output)	34	37	dB
**Noise factor (at 5W output)	-	30	dB
Saturation power output (see note 6)	10	-	W
Hot input match (v.s.w.r.) (see note 7)	-	1.7	
Hot output match (v.s.w.r.) (see note 7)	-	2.0	
Grid 2 voltage	1.6	2.3	kV
Helix voltage	2.4	2.9	kV
Grid 1 current	-	100	μA
Grid 2 current	-	250	μA
Helix current (see note 8)	-	1.5	mA
**A.M./P.M. conversion (at 5W output) (see note 9)	-	2.0	deg/dB
Attenuation (see note 10)			

**Design test only

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-250	0	V
Grid 2 voltage	-	3.0	kV
Helix voltage	-	4.0	kV
Helix current (see note 8)	-	1.5	mA
Collector voltage	1.7	1.9	kV
Collector current	-	50	mA
Collector power dissipation	-	110	W
R.F. power input (see note 11)	-	0.25	W
Voltage between heater and cathode	-	50	V

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage (see note 12)			
Grid 1 current	-	100	μA
Grid 2 voltage (see notes 13 and 14)	1.6	2.3	kV
Grid 2 current	-250	+250	μA
Helix voltage	2.4	2.9	kV
Helix current (see notes 8 and 14)	-	1.5	mA
Collector voltage (see note 15)			
Collector current	-	45	mA

MOUNTING POSITION

Any (but see cooling). The barrel of the mount must be protected from strong magnetic fields such as from isolators, and should be several centimetres from steel plates.

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-10B

COOLING

Tube installed in convection-cooled mount type P6L4.

Horizontally mounted	natural
Vertically mounted	assisted by convection duct or low velocity air flow

Temperatures

Collector seal max.	200	^{o}C
Reference point on mount cooler max.	140	^{o}C

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification (see note 16)	-10	+65	^{o}C
Switch-on	-20	+65	^{o}C
Storage (see note 17)	-60	+85	^{o}C

PHYSICAL DATA

Tube

	kg	lb
Weight	0.14	0.31
Weight in inner storage pack	0.25	0.55
Weight in transit carton (4 inner packs per carton)	4.5	10.5

	mm	in
Dimensions of inner storage pack	75 × 57 × 502	3 × 2.3 × 19.8
Dimensions of transit carton	375 × 325 × 715	14.8 × 13 × 28.3

Mount

	kg	lb
Weight	5.0	11
Weight in inner storage pack	5.3	11.7
Weight in transit carton	25.4	55.9

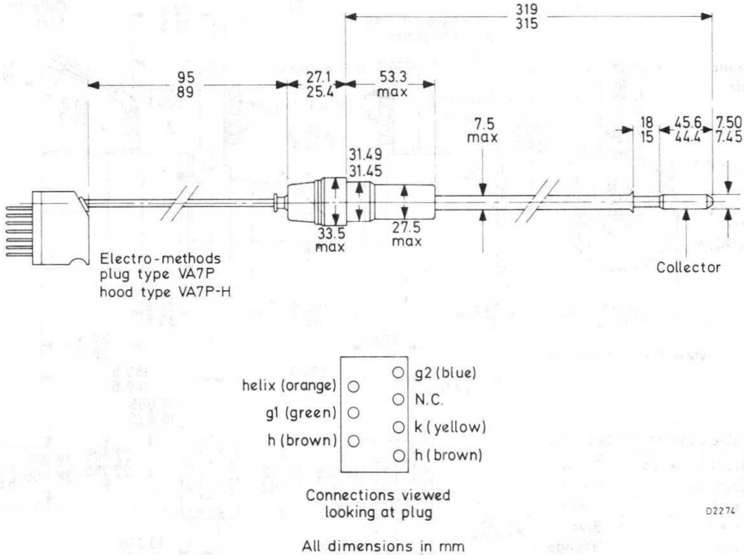
	mm	in
Dimensions of inner storage pack	255 × 140 × 495	10 × 5.5 × 19.5
Dimensions of transit carton	520 × 410 × 640	20.5 × 16.3 × 25.3

NOTES

1. The absolute variation of the heater voltage must be less than ± 3%. When operated on d.c. the heater must be negative with respect to the cathode.
2. The pre-heating time for a new tube must be at least 5 minutes.
3. Grid 2 voltage should be adjusted to give the specified collector current while cyclically adjusting focusing screws for minimum helix current.
4. The helix voltage should be adjusted to give the maximum gain at the specified power output. Focusing should then be re-optimised.
5. The tube is tested at the centre and the extremes of the frequency range.
6. Measured pulsed at a duty ratio of 1:2. If necessary the helix voltage is readjusted to give maximum power output as the input power is increased and the focusing re-optimised.
7. This is obtained without adjustment at each frequency ("plug-in" match)
8. During the focusing operation the helix current may (transiently) be allowed to reach 2.5mA. It may be useful to set the focusing screws on a new mount 1.5 turns back from fully home before commencing the switch-on operation.
9. The value given for A.M. to P.M. conversion is that obtained under the stated conditions. Improved values may be obtained with other settings of helix voltage and input power.
10. With electrode voltages not applied minimum attenuation is 65dB.
11. The output power reflected back into the tube by the load (for example the output isolator) should also not exceed this rating.
12. The grid 1 voltage is normally fixed at -8V.
13. For adjustment of focus it is also necessary for the grid 2 voltage to be variable in the range 0 to 1.6kV without stabilisation. As an alternative the negative voltage on grid 1 may be increased within certain limits to reduce the collector current (see ratings).
14. The power supply should be designed so that any automatic switching allows the correct cathode warm-up period (which may be reduced or eliminated for momentary breaks of 5 seconds), followed by establishment of all electrode voltages except grid 2. The grid 2 voltage may then be applied. All supplies should usually be stabilised to ± 2% except where otherwise stated. A protective device to reduce the grid 2 voltage should operate if the helix current exceeds the figure in the ratings (but see note 8).
15. The collector voltage is usually fixed at 1.8kV. This supply need not be stabilised provided that it remains in the range 1.7 to 1.9kV.
16. The magnetic circuit is fully temperature-compensated in this range, and the operation of the tube will not change as the temperature is varied.
17. If the temperature of the mount is lowered below -60°C the magnets will suffer an irreversible change.

OUTLINE DRAWING OF LB6-10B

Note tube is fragile. It should be inserted carefully into mount and then pushed home axially. Rotation is also necessary to negotiate the withdrawal check lugs.

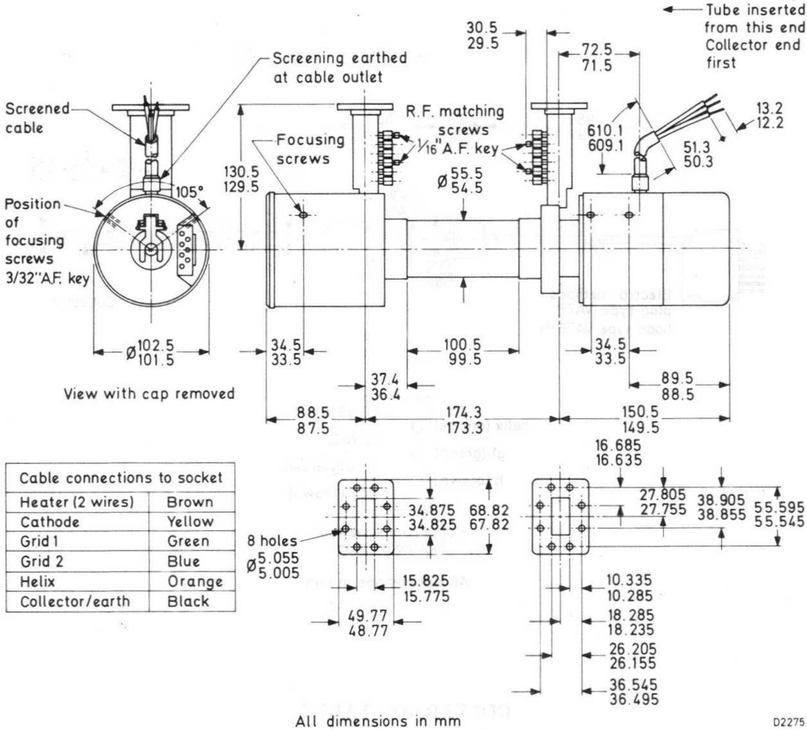


CONVERSION TABLE
(Rounded outwards)

mm	in
7.50/7.45	0.2953/0.2933
7.5 max.	0.295 max.
18/15	0.71/0.59
27.1/25.4	1.067/1.000
27.5 max.	1.082 max.
31.49/31.45	1.2397/1.2382
33.5 max.	1.319 max.
45.6/44.4	1.795/1.748
53.3 max.	2.098 max.
95/89	3.74/3.50
319/315	12.56/12.40

OUTLINE DRAWING OF P6L4 MOUNT

Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6N m (2kgf m). The cooling fins are movable and require about 3mm clearance. The mount should be handled with special care during installation to avoid damage to the cooling fins.



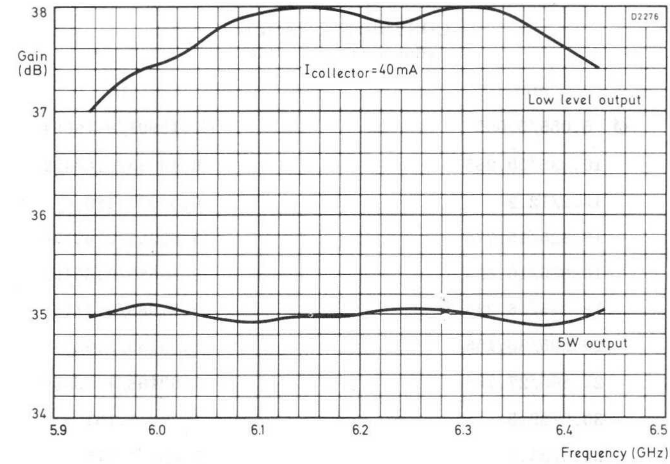
Cable connections to socket	
Heater (2 wires)	Brown
Cathode	Yellow
Grid 1	Green
Grid 2	Blue
Helix	Orange
Collector/earth	Black

All dimensions in mm

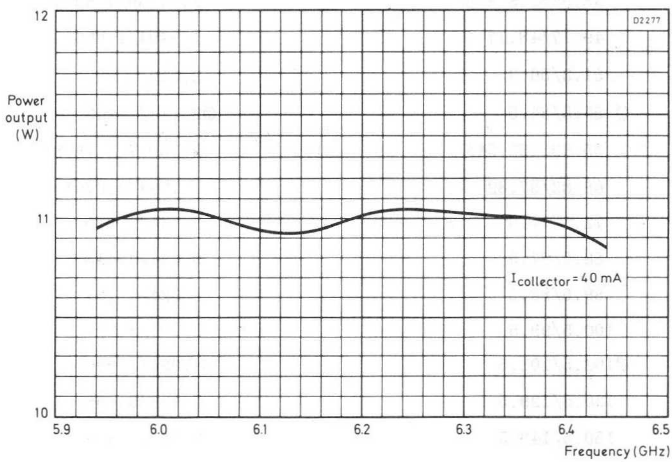
D2275

CONVERSION TABLE
(Rounded outwards)

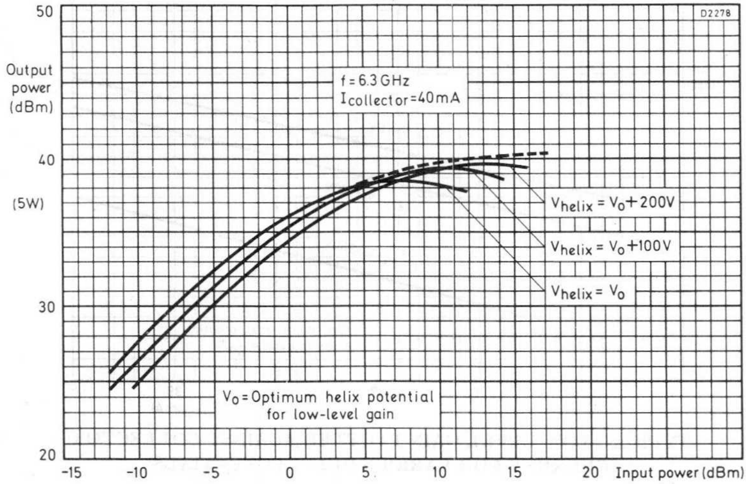
mm	in
Ø 5.055/5.005	Ø0.19901/0.19694
10.335/10.285	0.40689/0.40492
13.2/12.2	0.519/0.480
15.825/15.775	0.62303/0.62106
16.685/16.635	0.65689/0.65492
18.285/18.235	0.71988/0.71791
26.205/26.155	1.03169/1.02972
27.805/27.755	1.09468/1.09350
30.5/29.5	1.200/1.161
34.5/33.5	1.358/1.319
34.875/34.825	1.37303/1.37106
36.545/36.495	1.43877/1.43681
37.4/36.4	1.472/1.433
38.905/38.855	1.53169/1.5297
49.77/48.77	1.9594/1.9201
51.3/50.3	2.019/1.980
Ø 55.5/54.5	Ø2.185/2.145
55.595/55.545	2.18877/2.18681
68.82/67.82	2.7094/2.6701
72.5/71.5	2.854/2.815
88.5/87.5	3.484/3.445
89.5/88.5	3.524/3.484
100.5/99.5	3.957/3.917
Ø102.5/101.5	Ø4.035/3.996
130.5/129.5	5.138/5.098
150.5/149.5	5.925/5.886
174.3/173.3	6.862/6.823
610.1/609.1	24.019/23.980



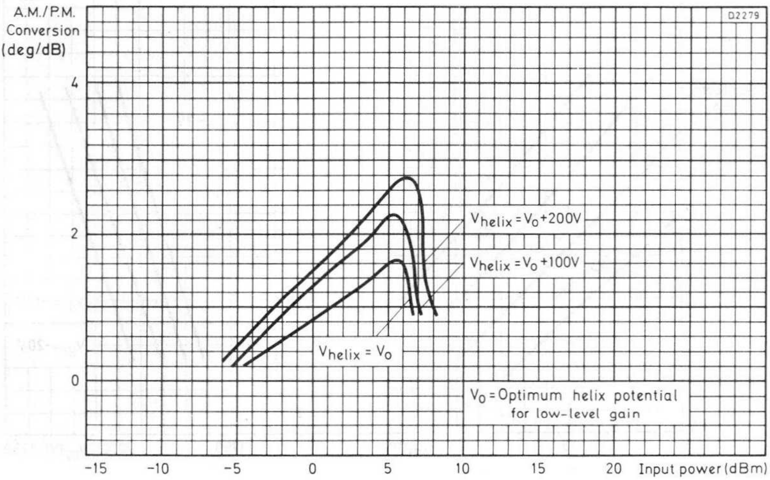
TYPICAL GAIN PLOTTED AGAINST FREQUENCY



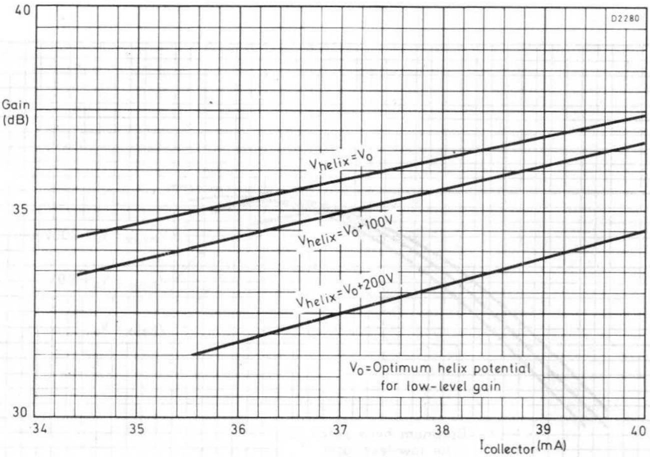
TYPICAL SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



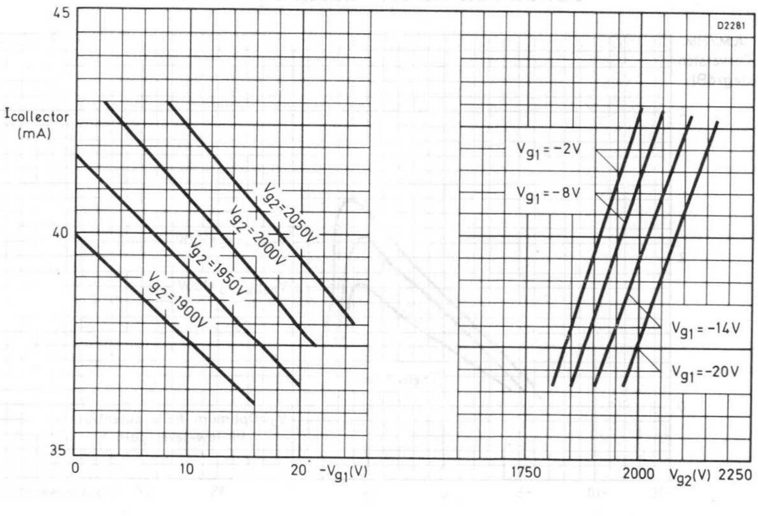
TYPICAL OUTPUT POWER PLOTTED AGAINST INPUT POWER FOR VARIOUS HELIX POTENTIALS



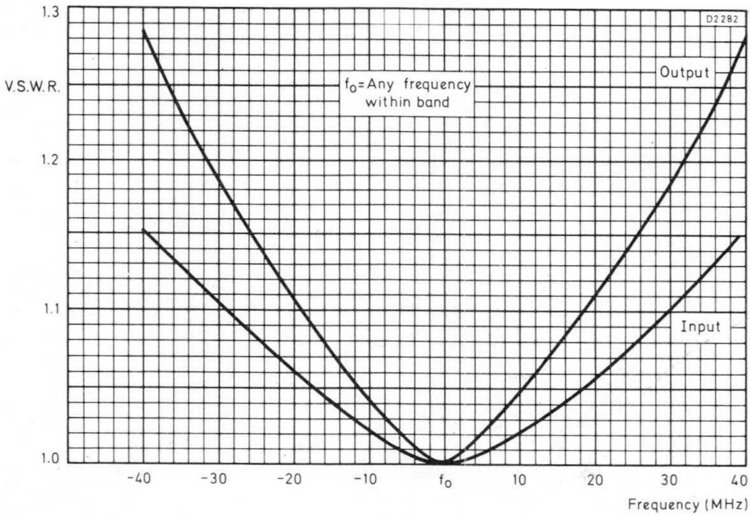
TYPICAL A.M./P.M. CONVERSION FIGURES PLOTTED AGAINST INPUT POWER FOR VARIOUS HELIX POTENTIALS



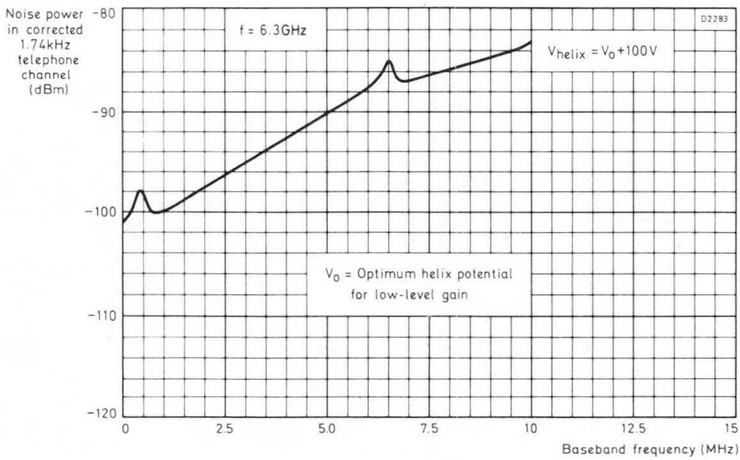
TYPICAL LOW LEVEL GAIN PLOTTED AGAINST COLLECTOR CURRENT FOR VARIOUS HELIX POTENTIALS



TYPICAL COLLECTOR CURRENT PLOTTED AGAINST GRID 1 AND GRID 2 POTENTIALS



TYPICAL INPUT AND OUTPUT HOT MATCH
PLOTTED AGAINST FREQUENCY



TYPICAL DISTRIBUTION OF CHANNEL NOISE IN
F.M. TELEPHONY

COMMUNICATIONS TRAVELLING-WAVE TUBE

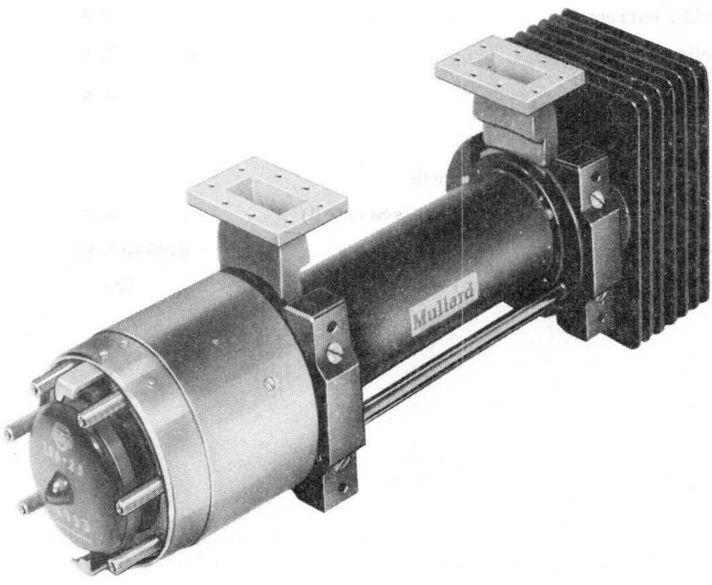
LB6-25

QUICK REFERENCE DATA

Forward wave amplifier for use in the power output stages of wideband multi-channel microwave links.

Frequency range	5.9 to 6.5	GHz
Saturation power output	25	W
Working power output	15	W
Gain at working power	38	dB
Construction		Unpackaged
Output connections		Waveguide WR137

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



LB6-25 in mount P6L11 with end cap removed

TYPICAL OPERATION

As a power amplifier focused in a focusing mount type P6L11. Tubes are fully interchangeable in mounts and tube replacement is a simple operation.

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-15	V
Helix voltage	3.4	kV
Collector voltage (earth)	2.0	kV
Operating frequency	6.0	GHz
Collector current	45	mA

Typical performance

Gain	38	dB
Power output	15	W
Noise factor (including gas noise)	28	dB
Hot input match (v.s.w.r.)	1.2	
Hot output match (v.s.w.r.)	1.4	
Grid 1 current	1.0	μA
Grid 2 current	5.0	μA
Helix current	0.5	mA
Grid 2 voltage	2.2	kV

CATHODE

Indirectly heated, dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.85 to 1.05	A
Pre-heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is focused in mount type P6L11 and tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-15	V
Grid 2 voltage (see notes 3 and 8)		
Helix voltage (see note 4)		
Collector voltage	1.9	kV
*Collector current range	40 to 50	mA
Power output	15	W
Frequency range (see note 5)	5.925 to 6.475	GHz

*Specified on data sheet enclosed with tube

Limits and characteristics

	Min.	Max.	
Gain (at 15W output)	37	40	dB
**Noise factor (at 15W output)	-	30	dB
Saturation power output (see note 6)	23	-	W
Hot input match (v.s.w.r.) (see note 7)	-	1.5	
Hot output match (v.s.w.r.) (see note 7)	-	2.0	
Grid 2 voltage	1.9	2.7	kV
Helix voltage	3.2	3.9	kV
Grid 1 current	-	100	μA
Grid 2 current	-	250	μA
Helix current (see note 8)	-	1.3	mA
**A.M./P.M. conversion (at 15W output) (see note 9)	-	2.0	deg/dB
Attenuation (see note 10)			

**Design test only

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-250	0	V
Grid 2 voltage	-	3.0	kV
Helix voltage	-	4.0	kV
Helix current (see note 8)	-	1.3	mA
Collector voltage	1.9	2.1	kV
Collector current	-	50	mA
Collector power dissipation	-	110	W
R.F. power input (see note 11)	-	250	mW

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage (see note 12)			
Grid 1 current	-	100	μA
Grid 2 voltage (see notes 13 and 14)	1.9	2.7	kV
Grid 2 current	-250	+250	μA
Helix voltage	3.2	3.9	kV
Helix current (see notes 8 and 14)	-	1.5	mA
Collector voltage (see note 15)			
Collector current	-	50	mA

MOUNTING POSITION

Any (but see cooling). The barrel of the mount must be protected from strong magnetic fields such as from isolators, and should be several centimetres from steel plates.

COOLING

1. Tube installed in convection-cooled mount type P6L11

Horizontally mounted	natural
Vertically mounted	assisted by convection duct or low velocity air flow

2. Tube installed in conduction-cooled mount type P6L11A

Heatsink temperature max.	90	°C

Temperatures

Collector seal max.	200	°C
Reference point on mount cooler max.	140	°C

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification (see note 16)	-10	+65	°C
Switch-on	-20	+65	°C
Storage (see note 17)	-60	+85	°C

PHYSICAL DATA

Tube	kg	lb
Weight	0.15	0.33
Weight in inner storage pack (2 tubes per inner pack)	0.55	1.2
Weight in transit carton	4.5	9.9
	mm	in
Dimensions of inner storage pack	150 × 115 × 505	6 × 4.5 × 20
Dimensions of transit carton	375 × 325 × 715	14.8 × 13 × 28.3

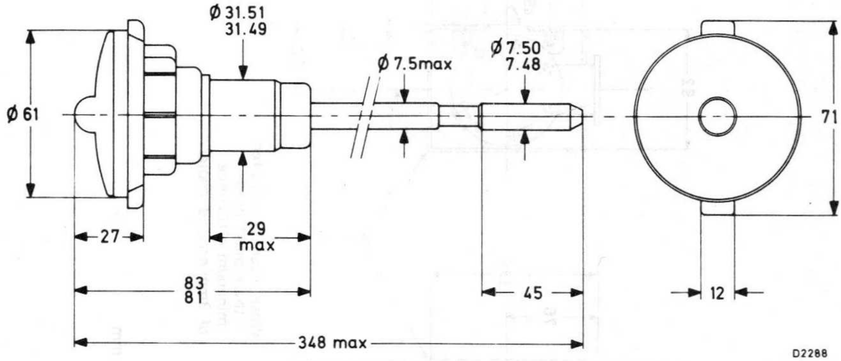
Mount	kg	lb
Weight	4.9	10.7
Weight in inner storage pack	5.2	11.4
Weight in transit carton (2 inner packs per carton)	25.3	55.6
	mm	in
Dimensions of inner storage pack	255 × 140 × 495	10 × 5.5 × 19.5
Dimensions of transit carton	520 × 410 × 640	20.5 × 16.3 × 25.3

NOTES

1. The absolute variation of the heater voltage must be less than ± 2%. When operated on d.c. the heater must be negative with respect to the cathode.
2. The pre-heating time for a new tube must be at least 5 minutes.
3. Grid 2 voltage should be adjusted to give the specified collector current while cyclically adjusting focusing screws for minimum helix current.
4. The helix voltage should be adjusted to give the maximum gain at the specified power output. Focusing should then be re-optimised.
5. The tube is tested at the centre and the extremes of the frequency range.
6. Measured pulsed at a duty ratio of 1:2. If necessary the helix voltage is readjusted to give maximum power output as the input power is increased and the focusing re-optimised.
7. This is obtained without adjustment at each frequency ("plug-in" match).
8. During the focusing operation the helix current may (transiently) be allowed to reach 2mA. It may be useful to set the focusing screws on a new mount 1.5 turns back from fully home before commencing the switch-on operation.
9. The value given for A.M. to P.M. conversion is that obtained under the stated conditions. Improved values may be obtained with other settings of helix voltage and input power.
10. With electrode voltages not applied minimum attenuation is 60dB.
11. The output power reflected back into the tube by the load (for example the output isolator) should also not exceed this rating.
12. The grid 1 voltage is normally fixed at -15V.
13. For adjustment of focus it is also necessary for the grid 2 voltage to be variable in the range 0 to 1.9kV without stabilisation. As an alternative the negative voltage on grid 1 may be increased within certain limits to reduce the collector current (see ratings).
14. The power supply should be designed so that any automatic switching allows the correct cathode warm-up period (which may be reduced or eliminated for momentary breaks of 5 seconds), followed by establishment of all electrode voltages except grid 2. The grid 2 voltage may then be applied. All supplies should usually be stabilised to ± 2% except where otherwise stated. A protective device to reduce the grid 2 voltage should operate if the helix current exceeds the figure in the ratings (but see note 8).
15. The collector voltage is usually fixed at 2kV. This supply need not be stabilised provided that it remains in the range 1.9 to 2.1kV.
16. The magnetic circuit is fully temperature-compensated in this range, and the operation of the tube will not change as the temperature is varied.
17. If the temperature of the mount is lowered below $-60^{o}C$ the magnets will suffer an irreversible change.

OUTLINE DRAWING OF LB6-25

Note tube is fragile. It should be inserted carefully into the mount and then pushed home axially. Rotation is also necessary to negotiate the withdrawal check lugs.



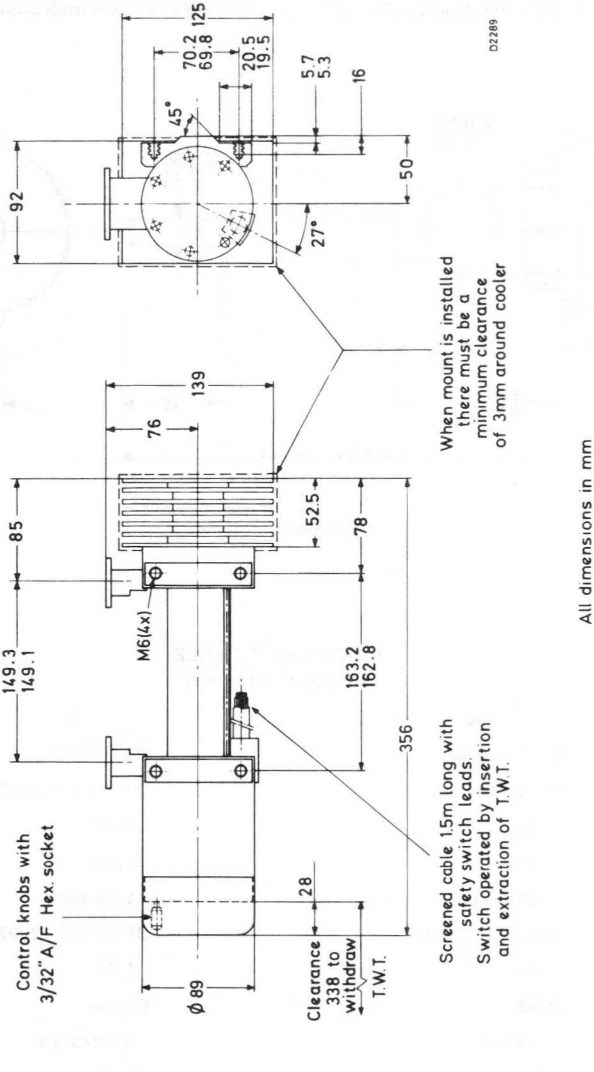
All dimensions in mm

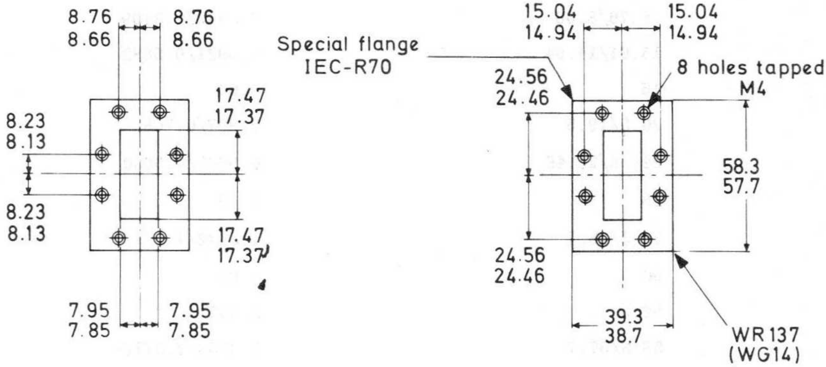
CONVERSION TABLE
(Rounded outwards)

mm	in
Ø 7.5 max.	Ø0.295 max.
Ø 7.50/7.48	Ø0.2953/0.2945
12	0.47
27	1.06
29 max.	1.14 max.
Ø 31.51/31.49	Ø1.2405/1.2398
45	1.77
Ø 61	Ø2.40
83/81	3.27/3.19
348 max.	13.7 max.

OUTLINE DRAWING OF P6L11 MOUNT

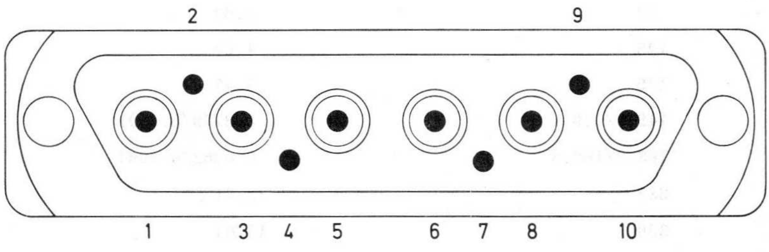
Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6N m (2kgf m). The cooling fins are movable and require about 3mm clearance. The mount should be handled with special care during installation to avoid damage to the cooling fins.





All dimensions in mm

AMPHENOL PLUG 17-801

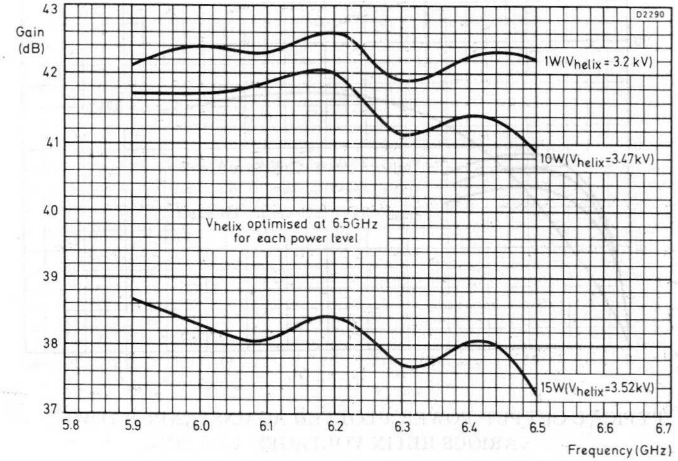


Plug connections to mount

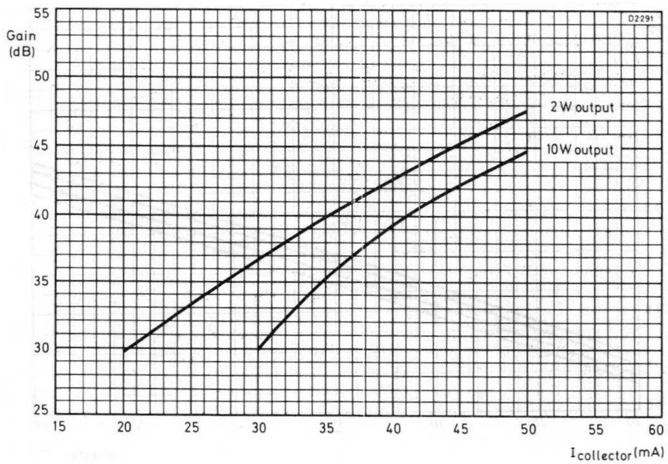
1. Helix
2. Collector (earth)
3. Grid 2
4. -
5. Grid 1
6. Cathode
7. Safety circuit
8. Heater
9. Safety circuit
10. Heater

CONVERSION TABLE
(Rounded outwards)

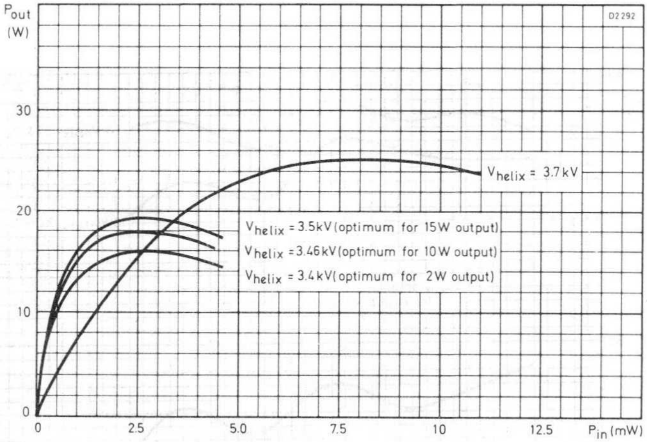
mm	in
5.7/5.3	0.2244/0.2087
7.95/7.85	0.3130/0.3091
8.23/8.13	0.3240/0.3201
8.76/8.66	0.3449/0.3409
15.04/14.94	0.5921/0.5882
16	0.63
20.5/19.5	0.807/0.768
24.56/24.46	0.9669/0.9630
28	1.10
39.3/38.7	1.5472/1.5236
50	1.97
52.5	2.067
58.3/57.7	2.2953/2.2716
70.2/69.8	2.7638/2.7480
76	2.99
78	3.07
85	3.35
Ø 89	Ø 3.50
92	3.62
125	4.92
139	5.47
149.3/149.1	5.8779/5.8701
163.2/162.8	6.4252/6.4094
338	13.31
356	14.01
1500	59.05



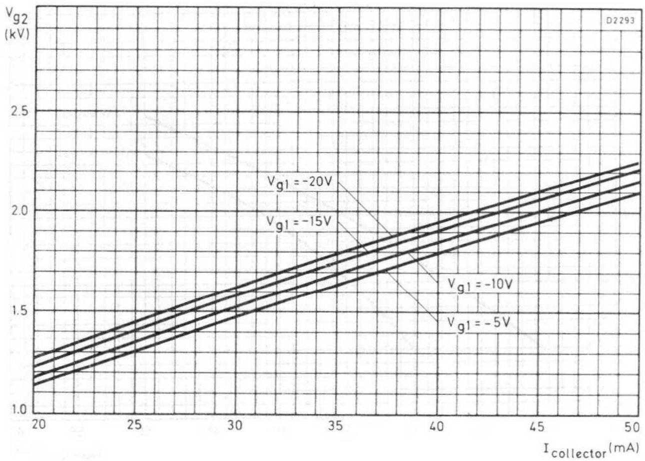
TYPICAL GAIN PLOTTED AGAINST FREQUENCY AT VARIOUS POWER LEVELS



TYPICAL GAIN PLOTTED AGAINST COLLECTOR CURRENT AT 6.2GHz



TYPICAL OUTPUT POWER PLOTTED AGAINST INPUT POWER AT VARIOUS HELIX VOLTAGES AT 6.2GHz



TYPICAL GRID 2 VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT

COMMUNICATIONS TRAVELLING-WAVE TUBE

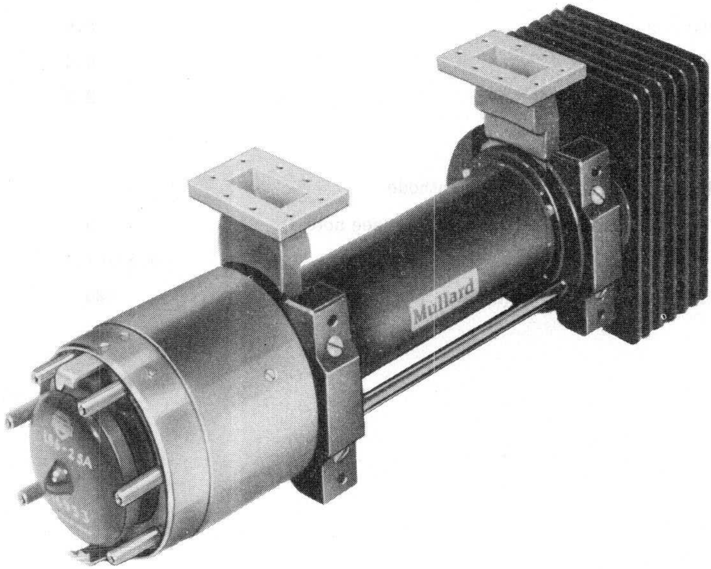
LB6-25A

QUICK REFERENCE DATA

Forward wave amplifier for use in the power output stages of wideband multi-channel microwave links.

Frequency range	6.4 to 7.2	GHz
Saturation power output	20	W
Working power output	10	W
Gain at working power	38	dB
Construction		Unpackaged
Output connections		Waveguide WR137

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



LB6-25A in mount P6L11 with end cap removed

TYPICAL OPERATION

As a power amplifier focused in a focusing mount type P6L11A. Tubes are fully interchangeable in mounts and tube replacement is a simple operation.

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-15	V
Helix voltage	3.5	kV
Collector voltage (earth)	2.0	kV
Operating frequency	6.8	GHz
Collector current	45	mA

Typical performance

Gain	38	dB
Power output	10	W
Noise factor (including gas noise)	28	dB
Hot input match (v.s.w.r.)	1.2	
Hot output match (v.s.w.r.)	1.4	
Grid 1 current	1.0	μA
Grid 2 current	5.0	μA
Helix current	0.5	mA
Grid 2 voltage	2.2	kV

CATHODE

Indirectly heated, dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.8 to 1.1	A
Pre-heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is focused in mount type P6L11A and tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-15	V
Grid 2 voltage (see notes 3 and 8)		
Helix voltage (see note 4)		
Collector voltage	1.9	kV
*Collector current range	40 to 50	mA
Power output	10	W
Frequency range (see note 5)	6.425 to 7.175	GHz

*Specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Gain (at 10W output)	37	40	dB
**Noise factor (at 10W output)	-	30	dB
Saturation power output (see note 6)	20	-	W
Hot input match (v.s.w.r.) (see note 7)	-	1.5	
Hot output match (v.s.w.r.) (see note 7)	-	2.0	
Grid 2 voltage	1.9	2.7	kV
Helix voltage	3.2	3.9	kV
Grid 1 current	-	100	μA
Grid 2 current	-	250	μA
Helix current (see note 8)	-	1.3	mA
**A.M./P.M. conversion (at 10W output) (see note 9)	-	2.0	deg/dB
Attenuation (see note 10)			

**Design test only

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-250	0	V
Grid 2 voltage	-	3.0	kV
Helix voltage	-	4.0	kV
Helix current (see note 8)	-	1.3	mA
Collector voltage	1.9	2.1	kV
Collector current	-	50	mA
Collector power dissipation	-	110	W
R.F. power input (see note 11)	-	250	mW

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage (see note 12)			
Grid 1 current	-	100	μA
Grid 2 voltage (see notes 13 and 14)	1.9	2.7	kV
Grid 2 current	-250	+250	μA
Helix voltage	3.2	3.9	kV
Helix current (see notes 8 and 14)	-	1.5	mA
Collector voltage (see note 15)			
Collector current	-	50	mA

MOUNTING POSITION

Any (but see cooling). The barrel of the mount must be protected from strong magnetic fields such as from isolators, and should be several centimetres from steel plates.

COOLING

1. Tube installed in convection-cooled mount type P6L11.

Horizontally mounted	natural
Vertically mounted	assisted by convection duct or low velocity air flow

2. Tube installed in conduction-cooled mount type P6L11A

Heatsink temperature max.	90	°C

Temperatures

Collector seal max.	200	°C
Reference point on mount cooler max.	140	°C

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification (see note 16)	-10	+65	°C
Switch-on	-20	+65	°C
Storage (see note 17)	-60	+85	°C

PHYSICAL DATA

Tube

	kg	lb
Weight	0.15	0.33
Weight in inner storage pack (2 tubes per inner pack)	0.55	1.2
Weight in transit carton	4.5	9.9

	mm	in
Dimensions of inner storage pack	150 × 115 × 505	6 × 4.5 × 20
Dimensions of transit carton	375 × 325 × 715	14.8 × 13 × 28.3

Mount

	kg	lb
Weight	4.9	10.7
Weight in inner storage pack	5.2	11.4
Weight in transit carton (2 inner packs per carton)	25.3	55.6

	mm	in
Dimensions of inner storage pack	255 × 140 × 495	10 × 5.5 × 19.5
Dimensions of transit carton	520 × 410 × 640	20.5 × 16.3 × 25.3

NOTES

1. The absolute variation of the heater voltage must be less than ± 2%. When operated on d.c. the heater must be negative with respect to the cathode.

2. The pre-heating time for a new tube must be at least 5 minutes.

3. Grid 2 voltage should be adjusted to give the specified collector current while cyclically adjusting focusing screws for minimum helix current.

4. The helix voltage should be adjusted to give the maximum gain at the specified power output. Focusing should then be re-optimised.

5. The tube is tested at the centre and the extremes of the frequency range.

6. Measured pulsed at a duty ratio of 1:2. If necessary the helix voltage is readjusted to give maximum power output as the input power is increased and the focusing re-optimised.

7. This is obtained without adjustment at each frequency ("plug-in" match).

8. During the focusing operation the helix current may (transiently) be allowed to reach 2mA. It may be useful to set the focusing screws on a new mount 1.5 turns back from fully home before commencing the switch-on operation.

9. The value given for A.M. to P.M. conversion is that obtained under the stated conditions. Improved values may be obtained with other settings of helix voltage and input power.

10. With electrode voltages not applied minimum attenuation is 60dB.

11. The output power reflected back into the tube by the load (for example the output isolator) should also not exceed this rating.

12. The grid 1 voltage is normally fixed at -15V.

13. For adjustment of focus it is also necessary for the grid 2 voltage to be variable in the range 0 to 1.9kV without stabilisation. As an alternative the negative voltage on grid 1 may be increased within certain limits to reduce the collector current (see ratings).

14. The power supply should be designed so that any automatic switching allows the correct cathode warm-up period (which may be reduced or eliminated for momentary breaks of 5 seconds), followed by establishment of all electrode voltages except grid 2. The grid 2 voltage may then be applied. All supplies should usually be stabilised to ± 2% except where otherwise stated. A protective device to reduce the grid 2 voltage should operate if the helix current exceeds the figure in the ratings (but see note 8).

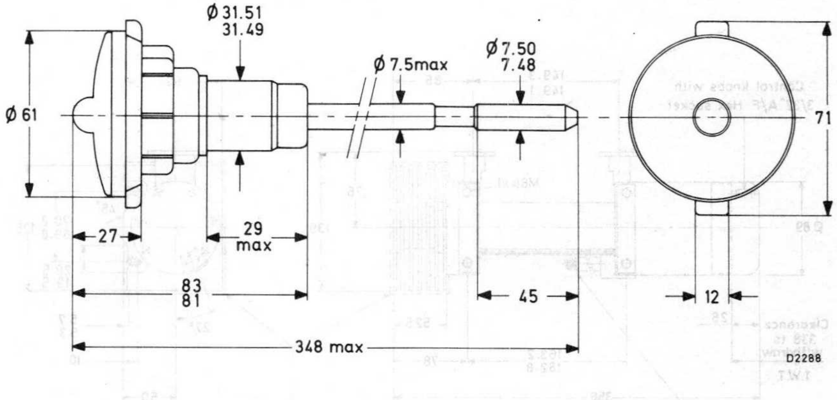
15. The collector voltage is usually fixed at 2kV. This supply need not be stabilised provided that it remains in the range 1.9 to 2.1kV.

16. The magnetic circuit is fully temperature-compensated in this range, and the operation of the tube will not change as the temperature is varied.

17. If the temperature of the mount is lowered below -60°C the magnets will suffer an irreversible change.

OUTLINE DRAWING OF LB6-25A

Note tube is fragile. It should be inserted carefully into the mount and then pushed home axially. Rotation is also necessary to negotiate the withdrawal check lugs.



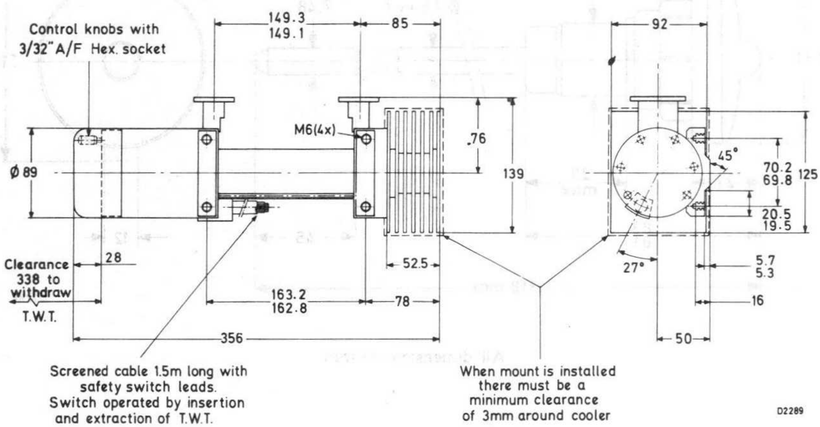
All dimensions in mm

CONVERSION TABLE
(Rounded outwards)

mm	in
Ø 7.5 max.	Ø 0.295 max.
Ø 7.50/7.48	Ø 0.2953/0.2945
12	0.47
27	1.06
29 max.	1.14 max.
Ø 31.51/31.49	Ø 1.2405/1.2398
45	1.77
61	Ø 2.40
83/81	3.27/3.19
348 max.	13.7 max.

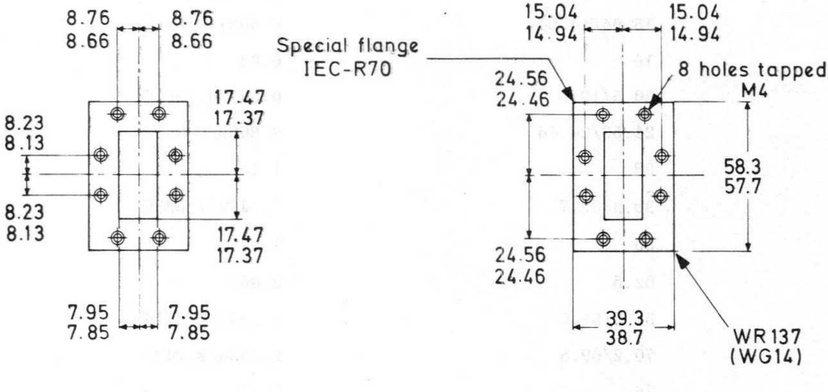
OUTLINE DRAWING OF P6L11A MOUNT

Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6N m (2kgf m). The cooling fins are movable and require about 3mm clearance. The mount should be handled with special care during installation to avoid damage to the cooling fins.



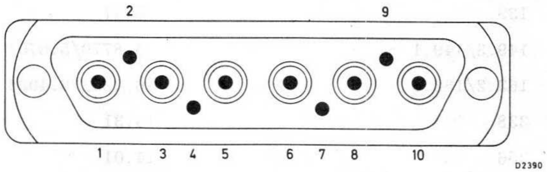
All dimensions in mm

Mullard



All dimensions in mm

AMPHENOL PLUG NO. 17-801

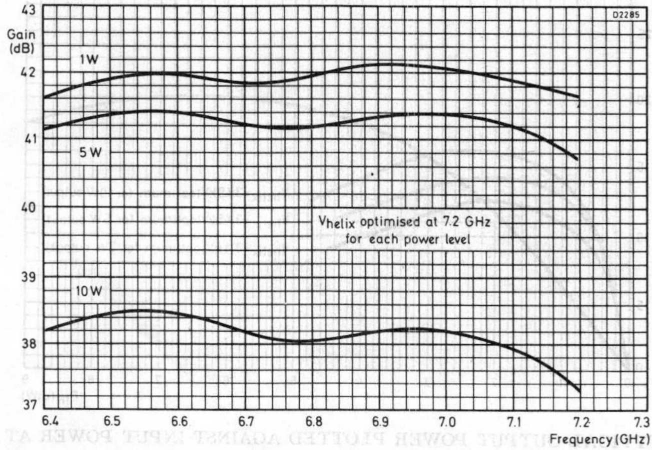


Plug connections to mount

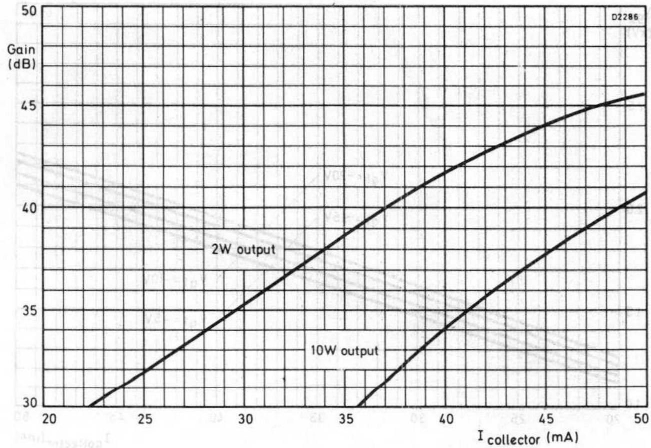
1. Helix
2. Collector (earth)
3. Grid 2
4. -
5. Grid 1
6. Cathode
7. Safety circuit
8. Heater
9. Safety circuit
10. Heater

CONVERSION TABLE
(Rounded outwards)

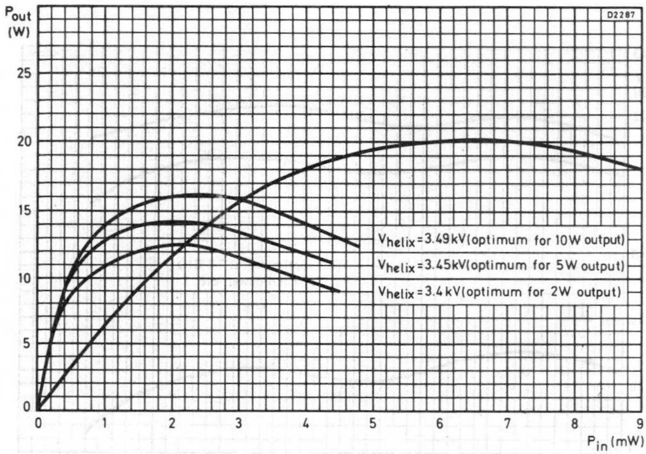
mm	in
5.7/5.3	0.2244/0.2087
7.95/7.85	0.3130/0.3091
8.23/8.13	0.3240/0.3201
8.76/8.66	0.3449/0.3409
15.04/14.94	0.5921/0.5882
16	0.63
20.5/19.5	0.807/0.768
24.56/24.46	0.9669/0.9630
28	1.10
39.3/38.7	1.5472/1.5236
50	1.97
52.5	2.067
58.3/57.7	2.2953/2.2716
70.2/69.8	2.7638/2.7480
76	2.99
78	3.07
85	3.35
Ø 89	Ø 3.50
92	3.62
125	4.92
139	5.47
149.3/149.1	5.8779/5.8701
163.2/162.8	6.4252/6.4094
338	13.31
356	14.01
1500	59.05



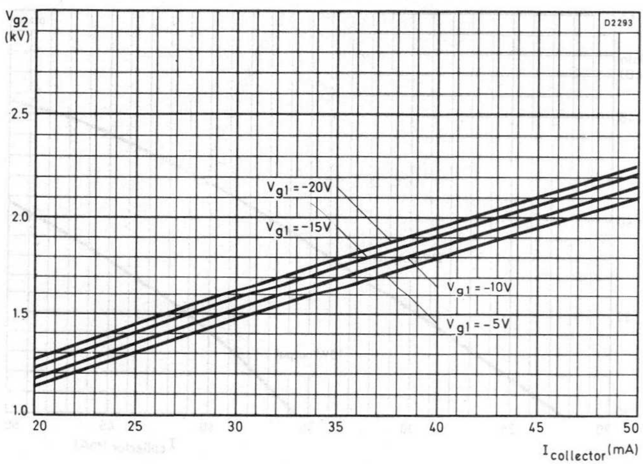
TYPICAL GAIN PLOTTED AGAINST FREQUENCY AT
VARIOUS POWER LEVELS



TYPICAL GAIN PLOTTED AGAINST COLLECTOR CURRENT
AT 6.8GHz



TYPICAL OUTPUT POWER PLOTTED AGAINST INPUT POWER AT VARIOUS HELIX VOLTAGES AT 6.8GHz



TYPICAL GRID 2 VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB7-20E

TENTATIVE DATA

QUICK REFERENCE DATA

Forward wave amplifier for use in the power output stages of wideband multi-channel microwave links.

Frequency range	7.1 to 7.8	GHz
Saturation power output	18	W
Working power output	10	W
Gain at working power	38	dB
Construction	Unpackaged	
Output connections	Waveguide WR112	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

As a power amplifier in a focusing mount type P6L12. Tubes are fully interchangeable in mounts and tube replacement is a simple operation.

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-15	V
Helix voltage	3.4	kV
Collector voltage (earth)	2.0	kV
Operating frequency	7.5	GHz
Collector current	40	mA

Typical performance

Gain	38	dB
Power output	10	W
Noise factor (including gas noise)	28	dB
Hot input match (v.s.w.r.)	1.2	
Hot output match (v.s.w.r.)	1.4	
Grid 1 current	1.0	μA
Grid 2 current	5.0	μA
Helix current	0.5	mA
Grid 2 voltage	1.9	kV

Mullard

CATHODE

Indirectly heated dispenser cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.7 to 0.9	A
Pre-heating time (minimum) (see note 2)	120	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is focused in mount type P6L12 and tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
Grid 1 voltage	-15	V
Grid 2 voltage (see notes 3 and 8)		
Helix voltage (see note 4)		
Collector voltage	1.9	kV
*Collector current range	38 to 45	mA
Power output	10	W
Frequency range (see note 5)	7.125 to 7.75	GHz

*Specified on data sheet enclosed with tube

Limits and characteristics

	Min.	Max.	
Gain (at 10W output)	37	40	dB
**Noise factor (at 10W output)	-	30	dB
Saturation power output (see note 6)	17	-	dB
Hot input match (v.s.w.r.) (see note 7)	-	1.5	
Hot output match (v.s.w.r.) (see note 7)	-	2.0	
Grid 2 voltage	1.7	2.3	kV
Helix voltage	3.2	3.8	kV
Grid 1 current	-	100	μA
Grid 2 current	-	250	μA
Helix current (see note 8)	-	1.5	mA
A.M./P.M. conversion (at 10W output) (see note 9)	-	2.0	deg/dB
Attenuation (see note 10)			

**Design test only

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-250	0	V
Grid 2 voltage	-	3.0	kV
Helix voltage	-	4.0	kV
Helix current (see note 8)	-	1.5	mA
Collector voltage	1.9	2.1	kV
Collector current	-	50	mA
Collector power dissipation	-	110	W
R.F. power input (see note 11)	-	0.25	W

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage (see note 12)			
Grid 1 current	-	100	μA
Grid 2 voltage (see notes 13 and 14)	1.7	2.3	kV
Grid 2 current	-250	+250	μA
Helix voltage	3.2	3.8	kV
Helix current (see notes 8 and 14)	-	1.5	mA
Collector voltage (see note 15)			
Collector current	-	45	mA

MOUNTING POSITION

Any (but see cooling). The barrel of the mount must be protected from strong magnetic fields such as from isolators, and should be several centimetres from steel plates.

COOLING

1. Tube installed in convection-cooled mount type P6L12.

Horizontally mounted	natural
Vertically mounted	assisted by convection duct or low velocity air flow

2. Tube installed in conduction-cooled mount type P6L12H.

Heatsink temperature max.	90	^{o}C

Temperatures

Collector seal max.	200	^{o}C
Reference point on mount cooler max.	140	^{o}C

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification (see note 16)	-10	+65	^{o}C
Switch-on	-20	+65	^{o}C
Storage (see note 17)	-60	+85	^{o}C

PHYSICAL DATA

Tube	kg	lb
Weight	0.15	0.33
Weight in inner storage pack (2 tubes per inner pack)	0.55	1.2
Weight in transit carton	4.5	9.9
	mm	in
Dimensions of inner storage pack	150 × 115 × 505	6 × 4.5 × 20
Dimensions of transit carton	375 × 325 × 715	14.8 × 13 × 28.3

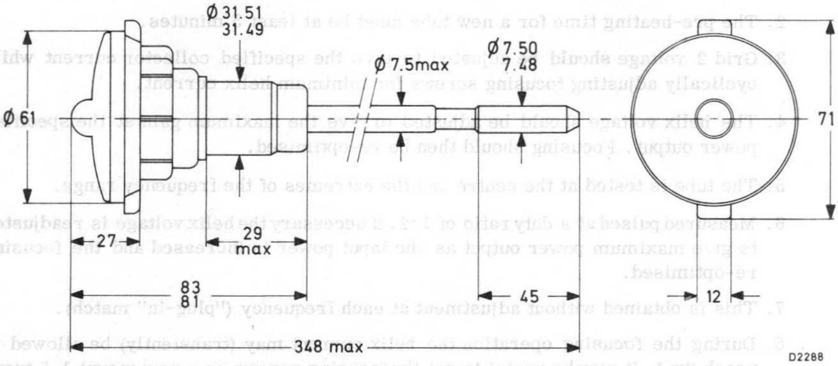
Mount	kg	lb
Weight	4.9	10.7
Weight in inner storage pack	5.2	11.4
Weight in transit carton (2 inner packs per carton)	25.3	55.6
	mm	in
Dimensions of inner storage pack	255 × 140 × 495	10 × 5.5 × 19.5
Dimensions of transit carton	520 × 410 × 640	20.5 × 16.3 × 25.3

NOTES

1. The absolute variation of the heater voltage must be less than ± 2%. When operated on d.c. the heater must be negative with respect to the cathode.
2. The pre-heating time for a new tube must be at least 5 minutes.
3. Grid 2 voltage should be adjusted to give the specified collector current while cyclically adjusting focusing screws for minimum helix current.
4. The helix voltage should be adjusted to give the maximum gain at the specified power output. Focusing should then be re-optimised.
5. The tube is tested at the centre and the extremes of the frequency range.
6. Measured pulsed at a duty ratio of 1:2. If necessary the helix voltage is readjusted to give maximum power output as the input power is increased and the focusing re-optimised.
7. This is obtained without adjustment at each frequency ("plug-in" match).
8. During the focusing operation the helix current may (transiently) be allowed to reach 2mA. It may be useful to set the focusing screws on a new mount 1.5 turns back from fully home before commencing the switch-on operation.
9. The value given for A.M. to P.M. conversion is that obtained under the stated conditions. Improved values may be obtained with other settings of helix voltage and input power.
10. With electrode voltages not applied minimum attenuation is 65dB.
11. The output power reflected back into the tube by the load (for example the output isolator) should also not exceed this rating.
12. The grid 1 voltage is normally fixed at -15V.
13. For adjustment of focus it is also necessary for the grid 2 voltage to be variable in the range 0 to 1.7kV without stabilisation. As an alternative the negative voltage on grid 1 may be increased within certain limits to reduce the collector current (see ratings).
14. The power supply should be designed so that any automatic switching allows the correct cathode warm-up period (which may be reduced or eliminated for momentary breaks of 5 seconds), followed by establishment of all electrode voltages except grid 2. The grid 2 voltage may then be applied. All supplies should usually be stabilised to ± 2% except where otherwise stated. A protective device to reduce the grid 2 voltage should operate if the helix current exceeds the figure in the ratings (but see note 8).
15. The collector voltage is usually fixed at 2kV. This supply need not be stabilised provided that it remains in the range 1.9 to 2.1kV.
16. The magnetic circuit is fully temperature-compensated in this range, and the operation of the tube will not change as the temperature is varied.
17. If the temperature of the mount is lowered below -60°C the magnets will suffer an irreversible change.

OUTLINE DRAWING OF LB7-20E

Note tube is fragile. It should be inserted carefully into mount and then pushed home axially. Rotation is also necessary to negotiate the withdrawal check lugs.



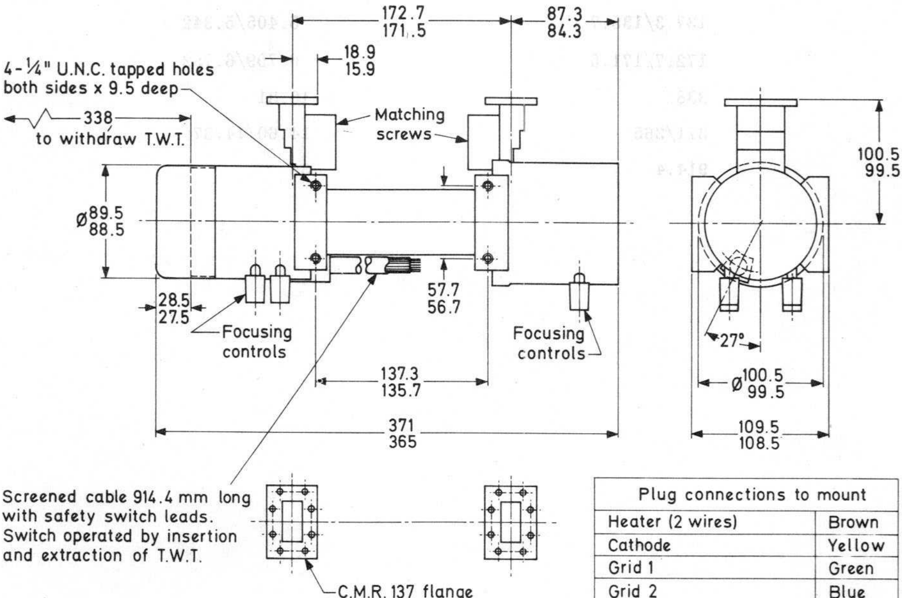
All dimensions in mm

CONVERSION TABLE
(Rounded outwards)

mm	in
Ø 7.5 max.	Ø 0.295 max.
Ø 7.50/7.48	0.2953/0.2945
12	0.47
27	1.06
29 max.	1.14 max.
Ø 31.51/31.49	Ø 1.2405/1.2398
45	1.77
Ø 61	Ø 2.40
83/81	3.27/3.19
348 max.	13.7 max.

OUTLINE DRAWING OF P6L12 MOUNT

Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6N m (2kgf m). The cooling fins are movable and require about 3mm clearance. The mount should be handled with special care during installation to avoid damage to the cooling fins.



Plug connections to mount	
Heater (2 wires)	Brown
Cathode	Yellow
Grid 1	Green
Grid 2	Blue
Helix	Orange
Safety switch (2 wires)	Red
Collector/earth	Black

All dimensions in mm

D2481

CONVERSION TABLE
(Rounded outwards)

mm	in
18.9/15.9	0.744/0.626
28.5/27.5	1.1220/1.0827
57.5/56.7	2.272/2.232
87.3/84.3	3.4370/3.3189
Ø 89.5/88.5	Ø 3.5236/3.4842
100.5/99.5	3.9567/3.9173
Ø 100.5/99.5	Ø 3.9567/3.9173
109.5/108.5	4.3110/4.2716
137.3/135.7	5.405/5.342
172.7/171.5	6.799/6.752
338	13.31
371/365	14.60/14.37
914.4	36

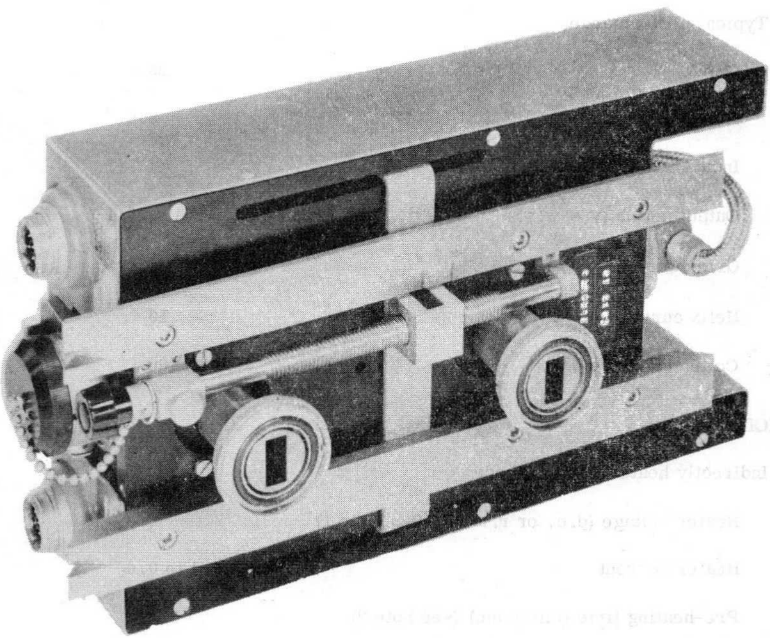
RADAR TRAVELLING-WAVE TUBE

YH1060

QUICK REFERENCE DATA		
Low-noise forward wave amplifier for use in broad-band radar systems.		
Frequency range	9 to 10	GHz
Gain at low level	25	dB
Construction		Packaged
Output connections		Waveguide WR90

Services type: CV6183

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES



TYPICAL OPERATION

As a low-noise amplifier

Operating conditions (electrode potentials measured with respect to cathode)

Heater voltage	6.3	V
Grid 1 voltage	-35	V
Grid 2 voltage	25	V
Grid 3 voltage	450	V
Grid 4 voltage	800	V
Grid 5 voltage	900	V
Helix voltage	1.2	kV
Collector voltage	1.3	kV
Operating frequency	9.5	GHz

Typical performance

Gain	25	dB
Noise factor	8.0	dB
Input match (v.s.w.r.)	1.5:1	
Output match (v.s.w.r.)	1.5:1	
Grid currents	1.0	μA
Helix current	10	μA
Collector current	400	μA

CATHODE

Indirectly heated oxide cathode

Heater voltage (d.c. or r.m.s.) (see note 1)	6.3	V
Heater current	0.4 to 0.6	A
Pre-heating time (minimum) (see note 2)	300	s

TEST CONDITIONS AND LIMITS

The travelling-wave tube is tested to comply with the following electrical conditions.

Test conditions

Heater voltage	6.3	V
*Electrode voltages		
Frequency range (see note 3)	9 to 10	GHz

*As specified on data sheet enclosed with tube.

Limits and characteristics

	Min.	Max.	
Low level gain	22	28	dB
Noise factor	-	95	dB
Saturation power output	2.0	-	mW
Input match (v.s.w.r.) (see note 4)	-	2.5:1	
Output match (v.s.w.r.) (see note 4)	-	2.5:1	
Grid currents	-	10	μA
Helix current	-	30	μA
Attenuation (see note 5)			

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (electrode potentials measured with respect to cathode)

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

	Min.	Max.	
Grid 1 voltage	-100	0	V
Grid 2 voltage	-	100	V
Grid 3 voltage	-	100	V
Grid 4 voltage	-	1.0	kV
Grid 5 voltage	-	1.5	kV
Helix voltage	-	1.6	kV
Helix current	-	50	μA
Collector voltage	1.6	1.7	kV
Collector current	-	600	μA

DESIGN RANGES FOR POWER SUPPLY (electrode potentials with respect to cathode)

Normal operation

	Min.	Max.	
Grid 1 voltage	-100	-20	V
Grid 1 current	0	10	μA
Grid 2 voltage	0	100	V
Grid 2 current	0	10	μA
Grid 3 voltage	30	100	V
Grid 3 current	-	10	μA
Grid 4 voltage	0.3	1.0	kV
Grid 4 current	-	10	μA
Grid 5 voltage	0.7	1.5	kV
Grid 5 current	-	10	μA
Helix voltage	1.0	1.1	kV
Helix current	-	30	μA
Collector voltage (see note 6)			
Collector current	350	600	μA

MOUNTING POSITION

Any

COOLING

Horizontally or vertically mounted natural

AMBIENT TEMPERATURE RANGE

	Min.	Max.	
Operation to full specification	-10	+65	°C

NOTES

1. The absolute variation of heater voltage should be less than ±2%. When operated on d.c. the heater must be negative with respect to cathode.

2. The pre-heating time for a new tube must be at least 10 minutes.

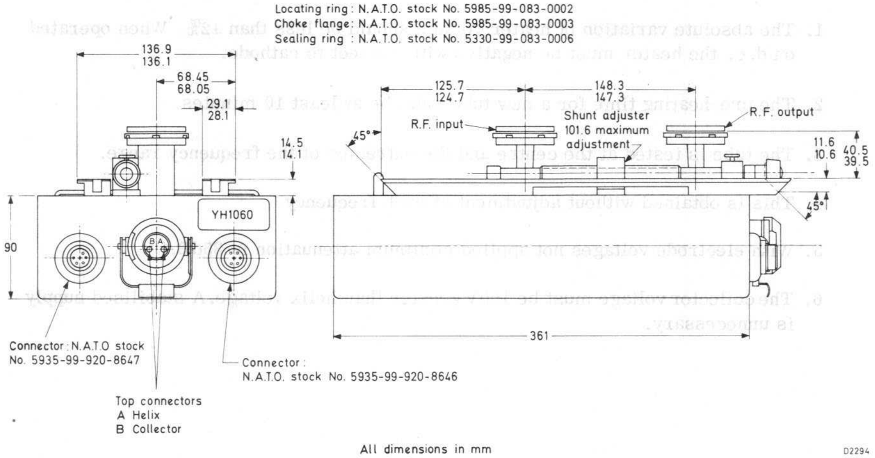
3. The tube is tested at the centre and the extremes of the frequency range.

4. This is obtained without adjustment at each frequency.

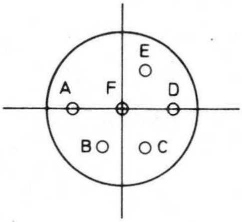
5. With electrode voltages not applied minimum attenuation is 35dB.

6. The collector voltage must be 100V greater than helix voltage. A stabilised supply is unnecessary.

OUTLINE DRAWING OF YH1060

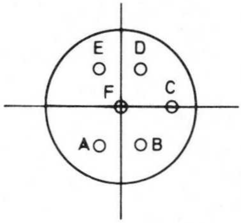


Pin details of connector N.A.T.O. Stock No. 5935-99-920-8647



A G4
B –
C G5
D –
E G6
F –

Pin details of connector N.A.T.O. Stock No. 5935-99-920-8646



A Heater
B Heater
C Cathode
D G1
E G2
F G3

D2388

CONVERSION TABLE
(Rounded outwards)

mm	in
11.6/10.6	0.456/0.417
14.5/14.1	0.571/0.555
29.1/28.1	1.145/1.106
40.5/39.5	1.594/1.555
68.45/68.05	2.6949/2.6791
90	3.54
125.7/124.7	4.949/4.910
136.9/136.1	5.389/5.358
148.3/147.3	5.838/5.799
361	14.21

QUICK REFERENCE DATA

The YH1090 travelling-wave tube has a periodic permanent magnet mount designed for wide-band microwave link applications.

Frequency	3.4 to 4.2	GHz
Saturation power output (at mid-band)	25	W
Gain (low-level)	42	dB
Construction: Tube	Glass to metal envelope and metal to ceramic base	
Mount	Periodic permanent magnet	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

Operating conditions

Frequency	3.6	3.6	3.6	4.0	4.0	4.0	GHz
Collector voltage	1.5	1.3	1.1	1.5	1.3	1.1	kV
Collector current	60	60	60	60	60	60	mA
*Helix voltage	2.25	2.2	2.15	2.15	2.1	2.05	kV
Helix current (plug-in focus)	0.3	0.3	0.2	0.3	0.3	0.2	mA
Focusing electrode voltage	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	V
Accelerator voltage	1.55	1.55	1.55	1.55	1.55	1.55	kV
Accelerator current	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mA
Gain	38	40	41	38	40	41	dB
Power output	15	10	5.0	15	10	5.0	W
Thermal noise factor	24	21.5	20.5	24	21.5	20.5	dB
AM to PM conversion	3.0	2.5	1.5	3.0	2.5	1.5	deg/dB

*Adjusted for optimum gain

CHARACTERISTICS

Frequency	3.4 to 4.2	GHz
Gain ($P_{out} = 15W$)	38	dB
Low-level gain	42	dB
Thermal noise factor ($P_{out} = 15W$)	24	dB
Saturation power output (CW)	25	W
Cold match at input and output v.s.w.r. max.	1.5:1	
AM to PM conversion ($P_{out} = 15W$)	3.0	deg/dB

CATHODE

Indirectly heated, dispenser type		
Heater voltage	6.3 ± 2%	V
Heater current ($V_h = 6.3V$)	1.0	A
Heating time min.	2.0	minutes

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Collector to helix voltage max.	2.5	kV
Collector dissipation ($T_{amb} = 65^{o}C$) max.	90	W
Cathode current max.	65	mA
Helix voltage max.	2.7	kV
Helix current max.	3.0	mA
*Focusing electrode voltage max.	-50	V
Accelerator voltage max.	2.0	kV
Accelerator current max.	0.3	mA
R.F. input level max.	200	mW
Power reflected from load max.	2.0**	W
Cooler temperature at reference point max.		
mount type 55329	140	^{o}C
mount type 55332	150	^{o}C

*Care must be taken to ensure that the focusing electrode potential never becomes positive with respect to the cathode.

**Overheating of the helix will occur if the maximum stated value is exceeded.

MOUNTING POSITION — Any

COOLING — Natural

Two mounts are available for either convection or conduction.
See under "Accessories".

TRAVELLING-WAVE TUBE YH1090

PHYSICAL DATA

Weight of tube approx.	60	g
Weight of mount approx.	4.5	kg

ACCESSORIES

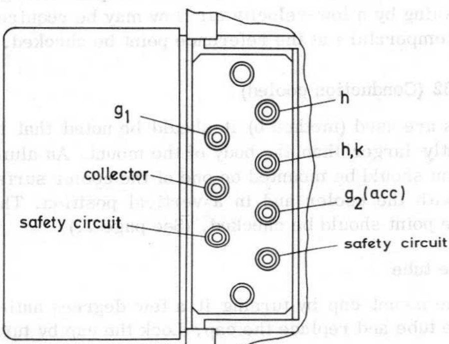
PPM mount for convection cooling	55329
PPM mount for conduction cooling	55332
Waveguide taper to waveguide IEC-R40 (WG11A.WR229) with flange IEC-UER40)	2 × 55330
Waveguide taper to waveguide IEC-F40 with flange IEC-UGF40	2 × 55333
Clamp for fastening of mount	2 × 55331

CONNECTIONS

The mount is supplied with coloured flying leads.

Heater	Brown
Heater/cathode	Yellow
Focusing electrode	Green
Accelerator	Blue
Helix	Earthed via mount
Collector	Red
Safety circuit (opened or closed when removing or replacing the mount cap)	2 Violet leads

Connections in the cable housing



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OPERATING NOTES

Due to normal production spreads the design parameters will vary around the nominal values stated.

1. **Safety recommendations**

The supply voltages are applied to the tube via the mount cap. When the cap is unlocked all voltages are isolated from the tube.
The mount must be earthed.
The two violet leads can be incorporated into an additional safety circuit which switches off the applied voltages at the power supply if the cap is unlocked. Thus the mount may also be isolated.

2. **Magnetic shielding**

No additional measures are necessary to prevent the magnetic properties of the mount from being affected by external magnetic fields. Several mounts may be placed side by side without disturbing the focusing quality.

WARNING: The mount shielding should not be removed as this may permanently affect the focusing.

3. **Installing the mount**

Two methods may be employed:

(a) Attaching the mount to the microwave circuitry by the waveguide tapers alone.

(b) Using method (a) plus establishing additional support by fastening the mount to the rack with two 55331 clamps. When using this method, insert a short piece of flexible waveguide at the input and output side to prevent excessive strain on the mount via the tapers, unless the waveguide components are accurately aligned. Forces on the mount must not give a moment at the flanges greater than 2kgf m.

3.1 **Mount 55329 (Convection cooled)**

The mount must not rest on parts A or B of the cooler (see page 7). Part A should always be freely moveable and must be handled carefully.
Under conditions of operation at ambient temperatures greater than 65^{o}C additional cooling by a low-velocity air flow may be required. It is recommended that the temperature at the reference point be checked. (See page 7.)

3.2 **Mount 55332 (Conduction cooled)**

If clamps are used (method b) it should be noted that the cooler dimensions are slightly larger than the body of the mount. An aluminium heatsink 300 × 300 × 6mm should be mounted on one of the cooler surfaces with its centre in contact with the cooler and in a vertical position. The temperature at the reference point should be checked. (See page 7.)

4. **Installing the tube**

Unlock the mount cap by turning it a few degrees anti-clockwise. Carefully insert the tube and replace the cap. Lock the cap by turning it clockwise.

OPERATING NOTES (contd.)

5. **Application of voltages**

Apply the heater voltage for the specified waiting time.
Apply the rated voltage to the collector, approximately 2.2kV to the helix and 1.5kV to the accelerator simultaneously. (See note.)
Adjust the accelerator voltage to obtain a collector current of 60mA.
Apply the r.f. input signal, adjust the level to obtain the required output power while simultaneously adjusting the helix voltage for optimum gain.

5.1 **Switching-off**

All voltages should be switched off simultaneously. (See note.)

5.2 **Switching-on after interruption of voltage**

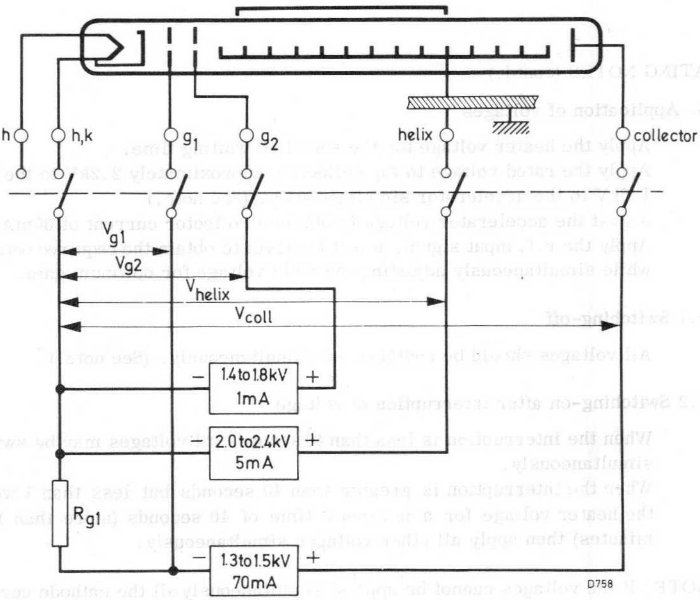
When the interruption is less than 40 seconds all voltages may be switched on simultaneously.
When the interruption is greater than 40 seconds but less than 1 week apply the heater voltage for a minimum time of 40 seconds (more than 1 week, 2 minutes) then apply all other voltages simultaneously.

NOTE: If the voltages cannot be applied simultaneously all the cathode current may flow to the accelerator or the helix. This condition must not last for more than 10ms, otherwise permanent damage will be caused to the tube. To avoid such damage, switch the accelerator voltage on after the other electrode voltages, or off before the other electrode voltages.

6. **Power supply**

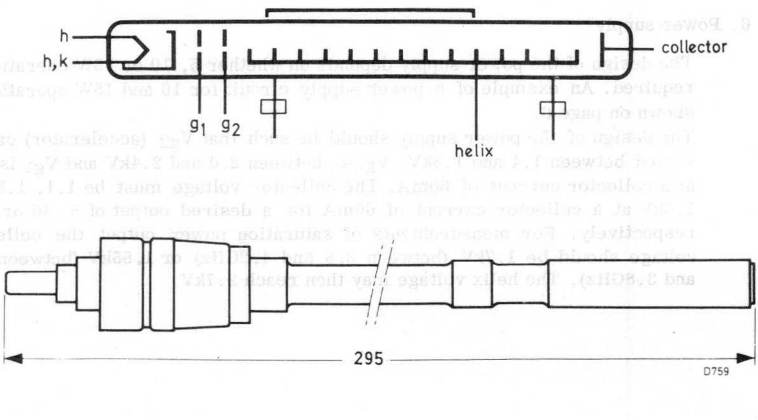
The design of the power supply depends on whether 5, 10 or 15W operation is required. An example of a power supply circuit for 10 and 15W operation is shown on page 6.
The design of the power supply should be such that V_{g2} (accelerator) can be varied between 1.4 and 1.8kV, V_{helix} between 2.0 and 2.4kV and V_{g1} is -5V at a collector current of 60mA. The collector voltage must be 1.1, 1.3, or 1.5kV at a collector current of 60mA for a desired output of 5, 10 or 15W respectively. For measurements of saturation power output the collector voltage should be 1.7kV (between 3.8 and 4.2GHz) or 1.85kV (between 3.4 and 3.8GHz). The helix voltage may then reach 2.7kV.

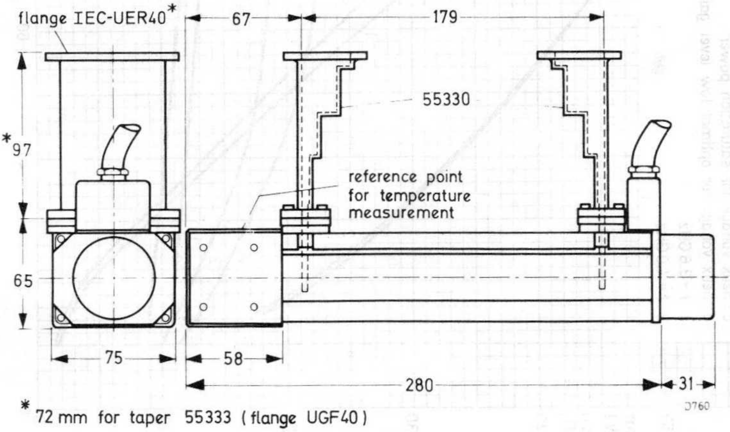
CIRCUIT DIAGRAM OF POWER SUPPLY FOR 10 AND 15W OPERATION



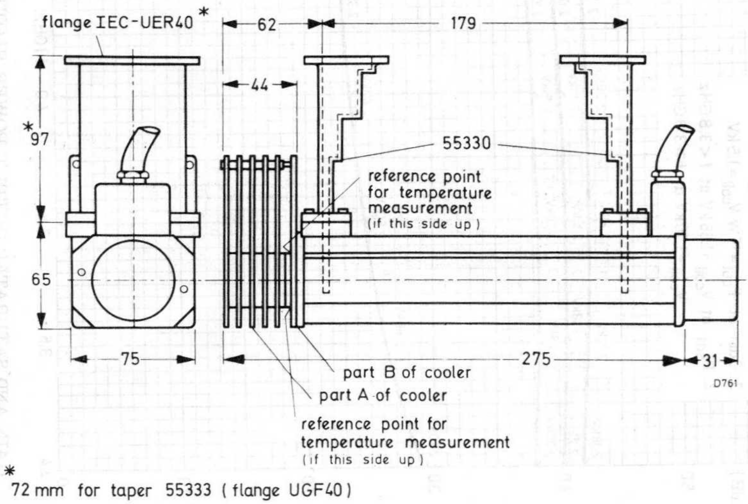
* For 5W operation a minimum of 1.1kV is required.

OUTLINE DRAWING OF YH1090

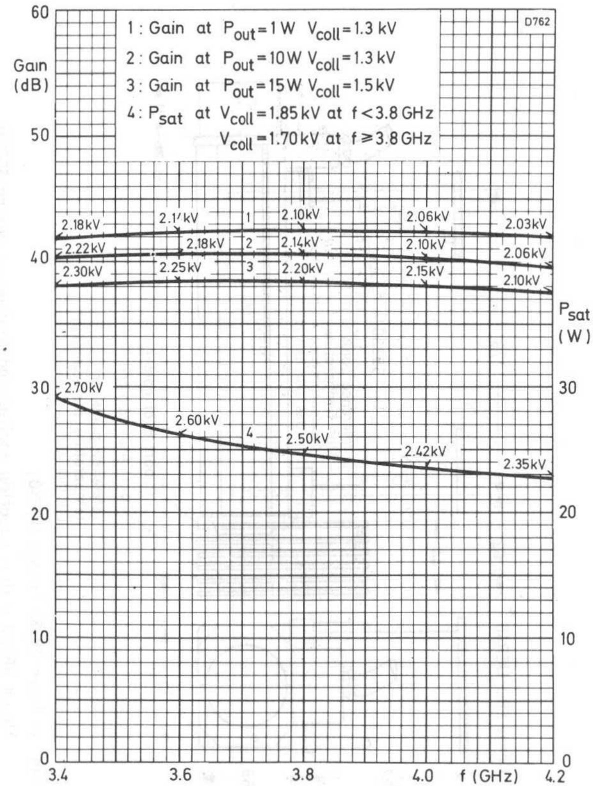




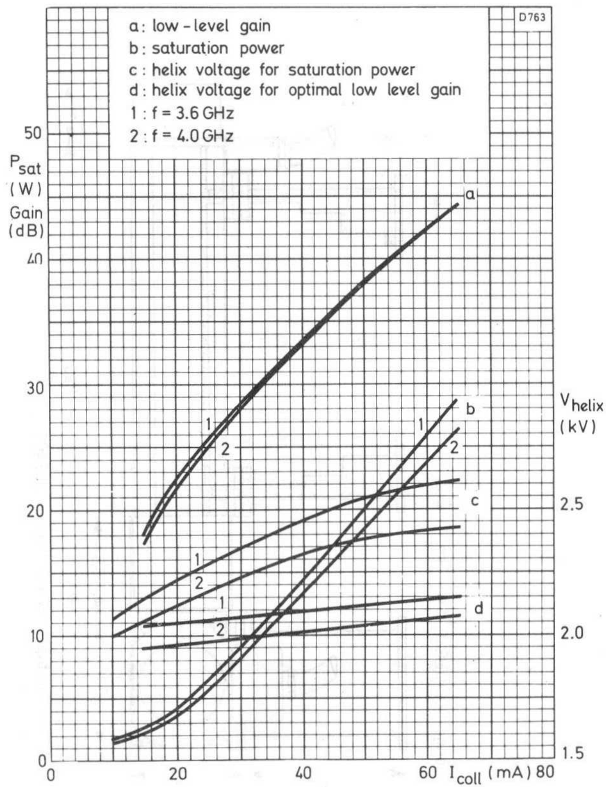
Mount 55332 with conduction cooling and waveguide tapers 55330



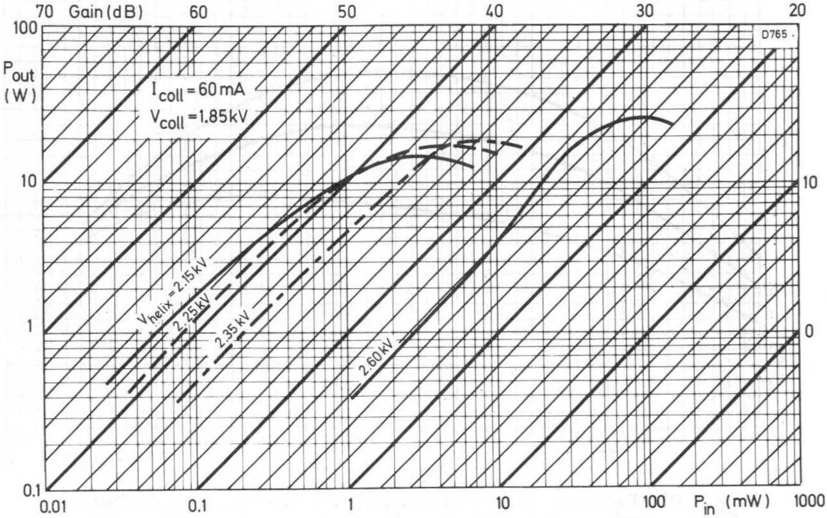
Mount 55329 with convection cooling and waveguide tapers 55330



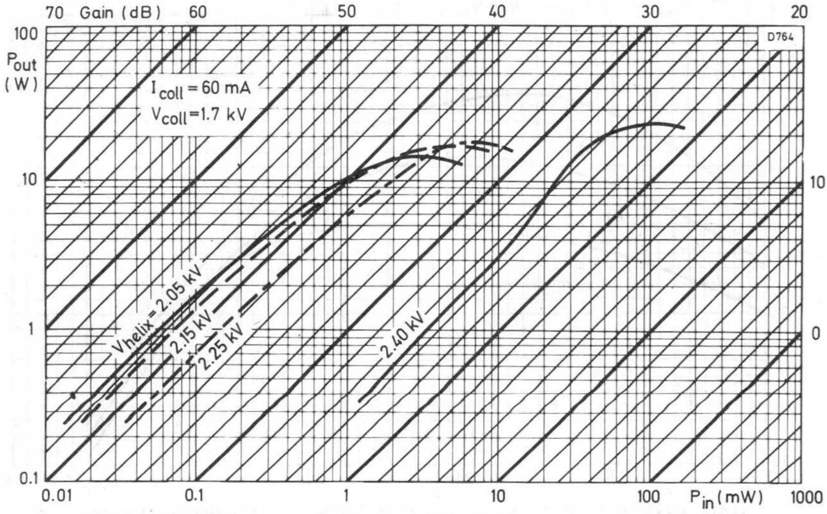
GAIN AND SATURATED OUTPUT POWER PLOTTED AGAINST FREQUENCY FOR VARIOUS OPERATING CONDITIONS



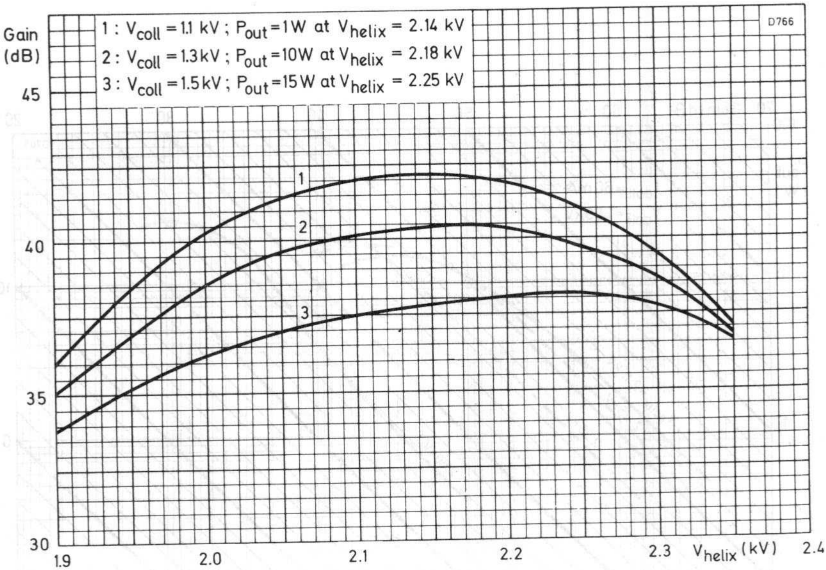
GAIN, SATURATED OUTPUT POWER AND HELIX VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT AT TWO SPECIFIC FREQUENCIES



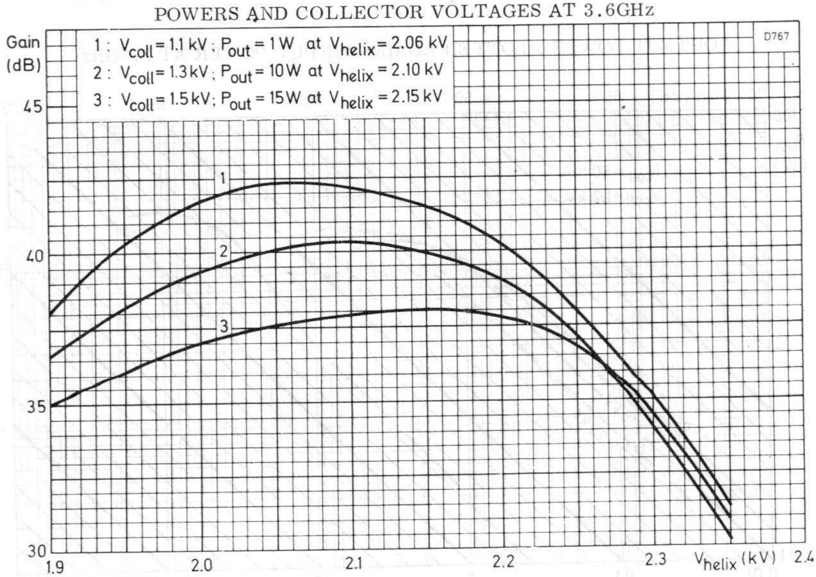
OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 3.6GHz



OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 4GHz

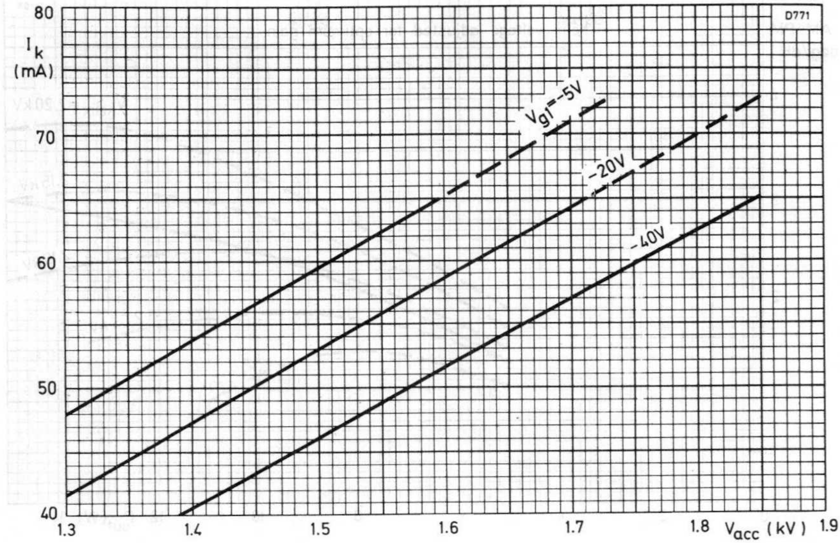


GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 3.6GHz

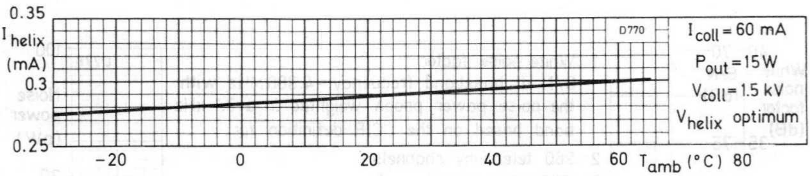


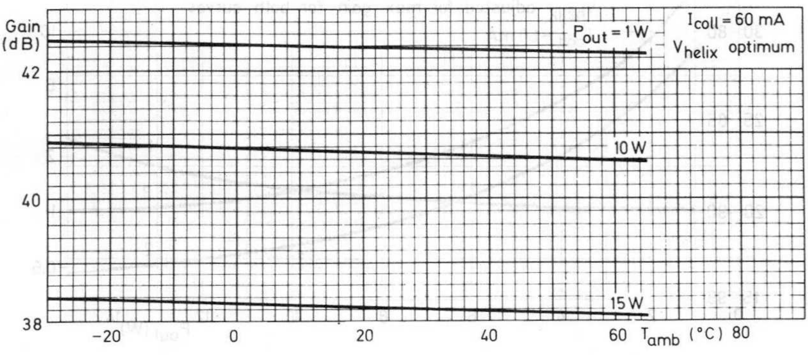
GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 4GHz

TRAVELLING-WAVE TUBE YH1090



CATHODE CURRENT PLOTTED AGAINST ACCELERATOR VOLTAGE WITH GRID VOLTAGE AS PARAMETER





HELIX CURRENT AND GAIN PLOTTED AGAINST AMBIENT TEMPERATURE WITH OUTPUT POWER AS PARAMETER. FREQUENCY=4GHz

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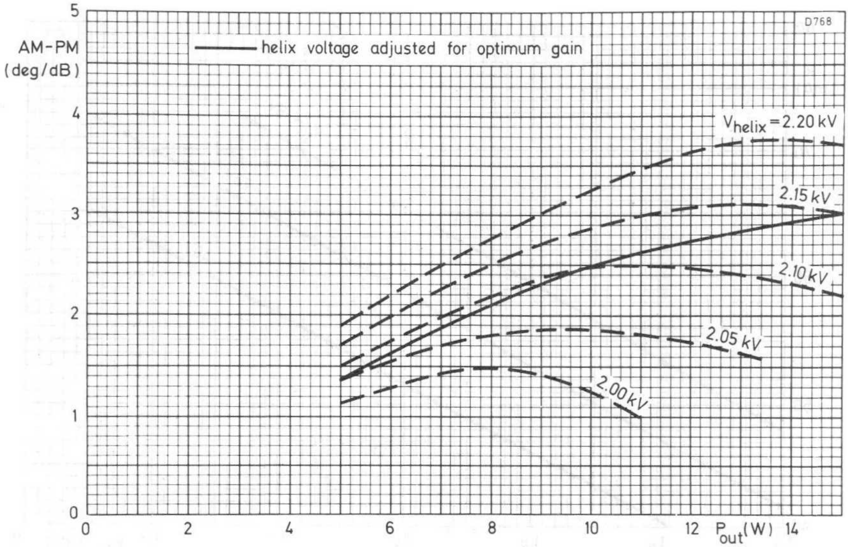
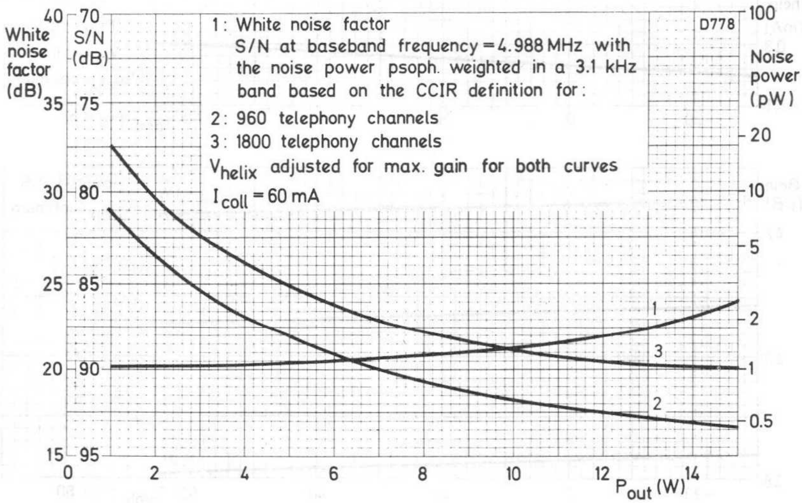
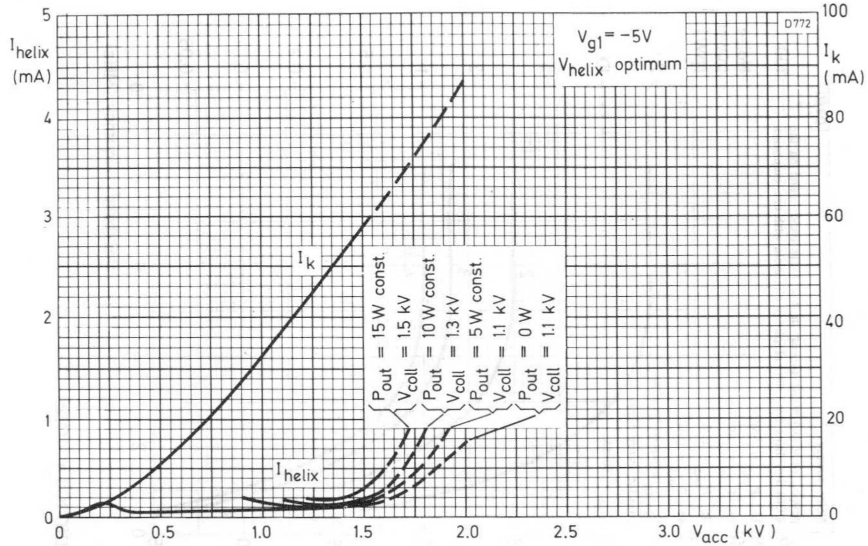


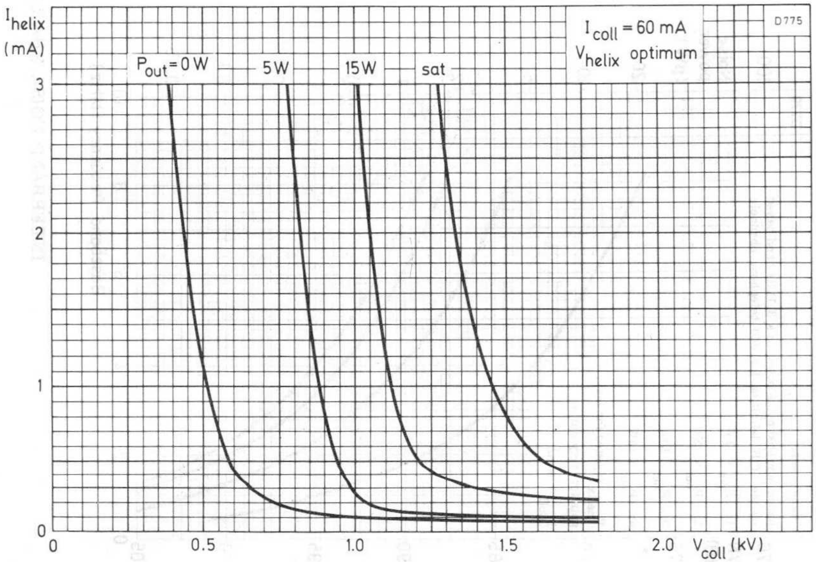
AM TO PM CONVERSION PLOTTED AGAINST POWER OUTPUT
WITH HELIX VOLTAGE AS PARAMETER. FREQUENCY=4GHz



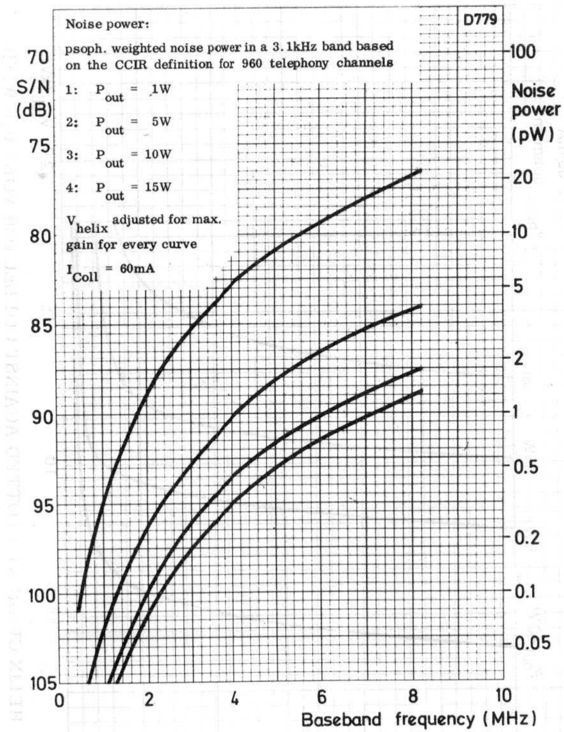
SIGNAL TO NOISE RATIO AND WHITE NOISE FACTOR
PLOTTED AGAINST POWER OUTPUT AT 4GHz

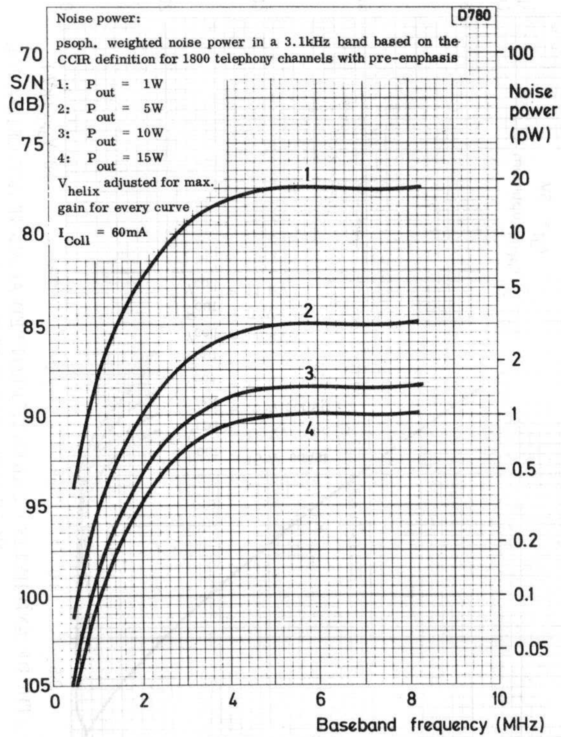


CATHODE AND HELIX CURRENTS PLOTTED AGAINST ACCELERATOR VOLTAGE. FREQUENCY = 4GHz



HELIX CURRENT PLOTTED AGAINST COLLECTOR VOLTAGE WITH POWER OUTPUT AS PARAMETER. FREQUENCY = 4GHz





INTERBAND NOISE CHARACTERISTICS at 4GHz

TRAVELLING-WAVE TUBE YH1170

TENTATIVE DATA

QUICK REFERENCE DATA

The YH1170 travelling-wave tube has a periodic permanent magnet mount designed for wide-band microwave link applications.

Frequency	5.8 to 8.5	GHz
Saturation power output (at mid-band)	22	W
Gain (low-level)	42	dB
Construction: Tube	Glass to metal envelope and metal to ceramic base	
Mount	Periodic permanent magnet	

To be read in conjunction with
GENERAL OPERATIONAL RECOMMENDATIONS - MICROWAVE DEVICES

TYPICAL OPERATION

Operating conditions

Frequency	6.0	6.0	6.0	7.2	7.2	7.2	GHz
Collector voltage	1.35	1.3	1.1	1.35	1.3	1.1	kV
Collector current	55	55	55	55	55	55	mA
*Helix voltage	2.85	2.8	2.8	2.8	2.75	2.75	kV
Helix current (plug-in focus)	1.0	1.0	0.8	1.0	1.0	0.8	mA
Focusing electrode voltage	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	V
Accelerator voltage	2.1	2.1	2.1	2.1	2.1	2.1	kV
Accelerator current	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mA
Gain	41	43	44	39	41	42	dB
Power output	15	10	5.0	15	10	5.0	W
Thermal noise factor	27	24.5	24	27	24.5	24	dB
AM to PM conversion	3.0	2.5	1.5	3.0	2.5	1.5	deg/dB

*Adjusted for optimum gain

Operating conditions (contd.)

Frequency	8.0		GHz
Collector voltage	1.3	1.1	kV
Collector current	55	55	mA
*Helix voltage	2.75	2.75	kV
Helix current (plug-in focus)	1.0	0.8	mA
Focusing electrode voltage	-5.0	-5.0	V
Accelerator voltage	2.1	2.1	kV
Accelerator current	<0.1	<0.1	mA
Gain	37	39	dB
Power output	10	5.0	W
Thermal noise factor	27	24	dB
AM to PM conversion	2.5	1.5	deg/dB

*Adjusted for optimum gain

CHARACTERISTICS

Frequency	5.8 to 8.5	GHz
Gain (P_{out} = 15W)	39	dB
Low-level gain	42	dB
Thermal noise factor (P_{out} = 15W)	27	dB
Saturation power output (CW)	22	W
Cold match at input and output v.s.w.r. max.	1.5:1	
AM to PM conversion (P_{out} = 15W)	3.0	deg/dB

CATHODE

Indirectly heated, dispenser type

Heater voltage	6.3 ± 2%	V
Heater current (V_h = 6.3V)	1.0	A
Heating time min.	2.0	minutes

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Collector to helix voltage max.	2.5	kV
Collector dissipation ($T_{amb}=65^{o}C$) max.	90	W
Cathode current max.	60	mA
Helix voltage max.	3.2	kV
Helix current max.	3.0	mA
*Focusing electrode voltage max.	− 50	V
Accelerator voltage max.	2.7	kV
Accelerator current max.	0.3	mA
R.F. input level max.	200	mW
Power reflected from load max.	2.0**	W
Cooler temperature at reference point max.	150	^{o}C

*Care must be taken to ensure that the focusing electrode potential never becomes positive with respect to the cathode.

**Overheating of the helix will occur if the maximum stated value is exceeded.

MOUNTING POSITION Any

COOLING (See under "Accessories" and note 6) Natural

PHYSICAL DATA

Weight of tube	60	g
Weight of mount	4.5	kg

ACCESSORIES

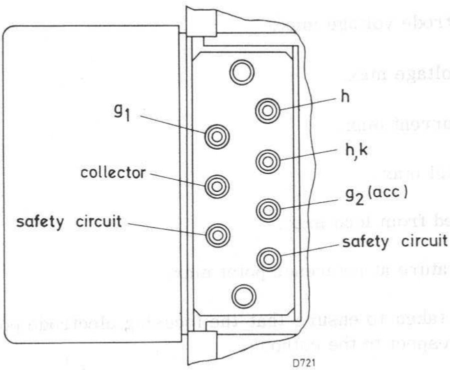
PPM mount for conduction cooling	55337
Waveguide taper to waveguide IEC-R70 (WR137.WG 14) with flange mating IEC-PDR70	2 × 55338

CONNECTIONS

The mount is supplied with coloured flying leads.

Heater	Brown
Heater/cathode	Yellow
Focusing electrode	Green
Accelerator	Blue
Helix	Earthed via mount
Collector	Red
Safety circuit (opened or closed when removing or replacing the mount cap)	2 violet leads

Connections in the cable housing



OPERATING NOTES

Due to normal production spreads the design parameters will vary around the nominal values stated.

1. **Safety recommendations**

   The supply voltages are applied to the tube via the mount cap. When the cap is unlocked all voltages are isolated from the tube.
   The mount must be earthed.
   The two violet leads can be incorporated into an additional safety circuit which switches off the applied voltages at the power supply if the cap is unlocked. Thus the mount may also be isolated.

2. **Magnetic shielding**

   No additional measures are necessary to prevent the magnetic properties of the mount from being affected by external magnetic fields. Several mounts may be placed side by side without disturbing the focusing quality.

   WARNING: The mount shielding should not be removed as this may permanently affect the focusing.

OPERATING NOTES (contd.)

3. **Installing the mount**

Two methods may be employed :

(a) Attaching the mount to the microwave circuitry by the waveguide tapers alone.

(b) Using method (a) plus establishing additional support by fastening the mount to the rack with clamps. When using this method insert a short piece of flexible waveguide at the input and output side to prevent excessive strain on the mount via the tapers, unless the waveguide components are accurately aligned. Forces on the mount must not give a moment at the flanges greater than 2kg fm.

3.1. Mount

If clamps are used (method b), it should be noted that the cooler dimensions are slightly larger than the body of the mount.

4. **Installing the tube**

Unlock the mount cap by turning it a few degrees anti-clockwise. Carefully insert the tube and replace the cap. Lock the cap by turning it clockwise.

5. **Application of voltages**

Apply the heater voltage for the specified waiting time.
Apply the rated voltages to the collector, helix and the accelerator simultaneously. (See note.)
Adjust the accelerator voltage to obtain a collector current of 55mA.
Apply the r.f. input signal, adjust the level to obtain the required output power while simultaneously adjusting the helix voltage for optimum gain.

5.1 **Switching-off**

All voltage should be switched-off simultaneously. (See note.)

5.2 **Switching-on after interruption of voltage**

When the interruption is less than 40 seconds all voltages may be switched-on simultaneously.
When the interruption is more than 40 seconds but less than 1 week apply the heater voltage for a minimum time of 40 seconds (more than 1 week, 2 minutes), then apply all other voltages simultaneously.

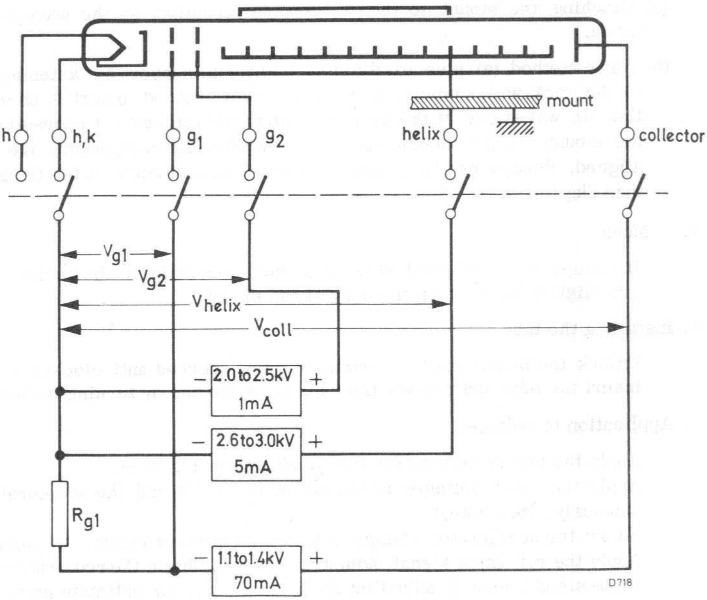
6. **Cooling**

Under typical operating conditions and at an ambient temperature of not more than $65^{o}C$, the cooler temperature at the reference point (see page 7) is well below the limit, provided an aluminium heatsink of $300 \times 300 \times 6$mm is mounted on one of the cooler surfaces. The heatsink is best fixed with its centre coinciding with that of the cooler, and in a vertical position.

NOTE: If the voltages cannot be applied simultaneously all the cathode current may flow to the accelerator or the helix. This condition must not last for more than 10ms, otherwise permenent damage will be caused to the tube. To avoid such damage, switch the accelerator voltage on after the other electrode voltages, or off before the other electrode voltages.

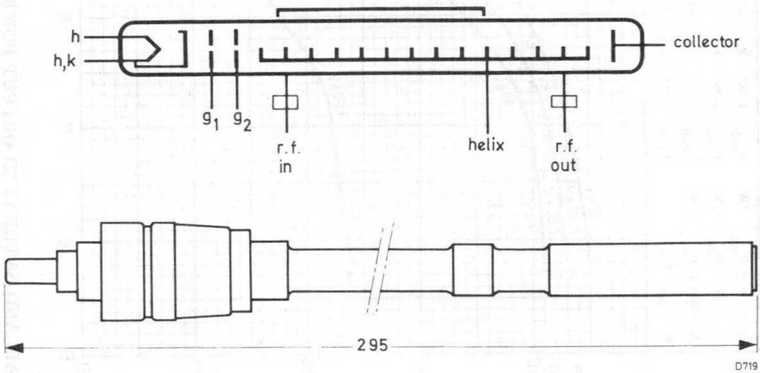
7. Power supply

The design of the power supply for 5, 10 and 15W operation is shown below.

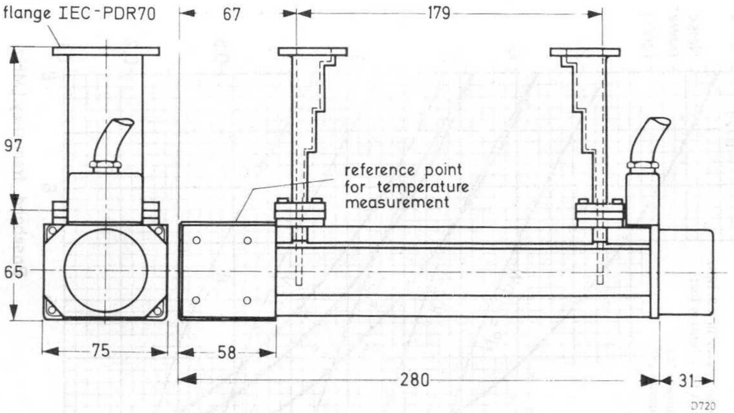


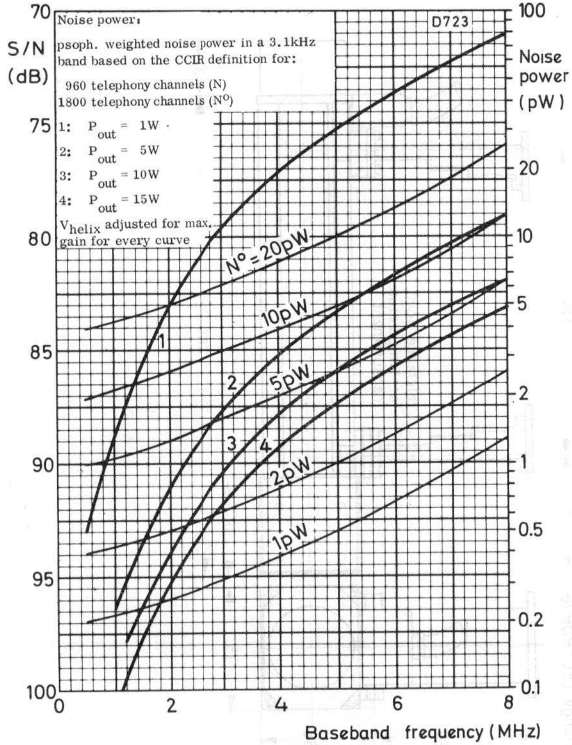
The design of the power supply should be such that V_{g2} (accelerator) can be varied between 2 and 2.5kV, V_{helix} between 2.6 and 3kV and V_{g1} is -5V at a collector current of 55mA. The collector voltage must be 1.1, 1.3, or 1.5kV at a collector current of 55mA for a desired output of 5, 10 or 15W respectively. For measurements of saturation power output the collector voltage should be 1.5kV. The helix voltage may then reach 3.2kV.

OUTLINE DRAWING OF YH1170 SHOWING MOUNT

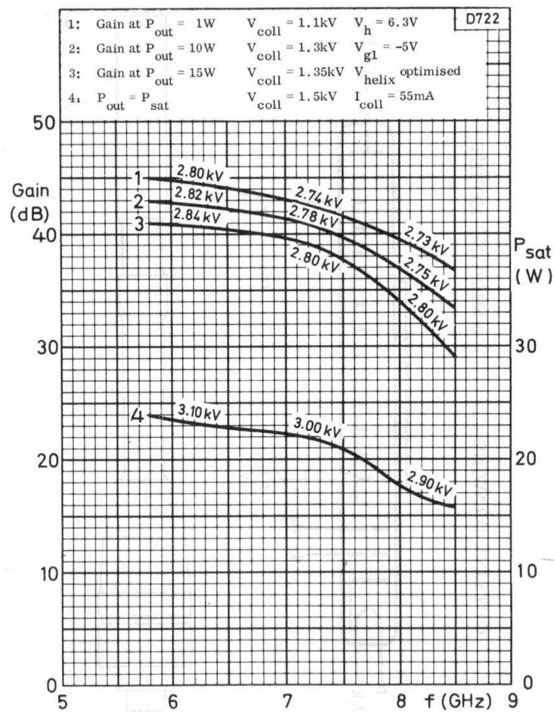


Mount with conduction (heatsink) cooling and waveguide tapers.

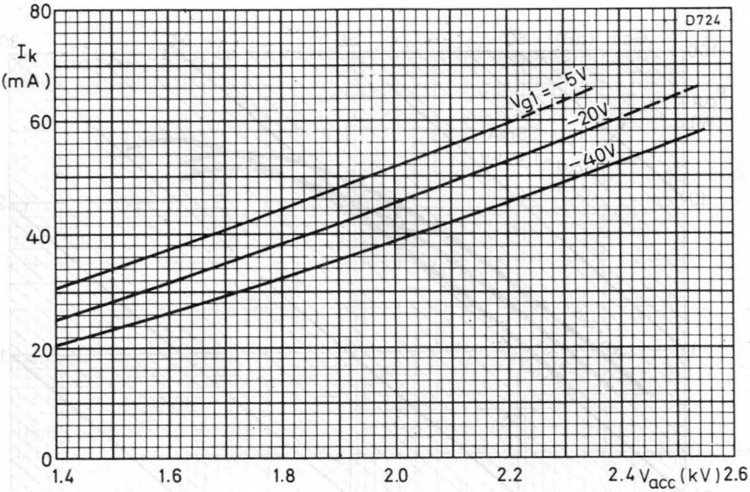




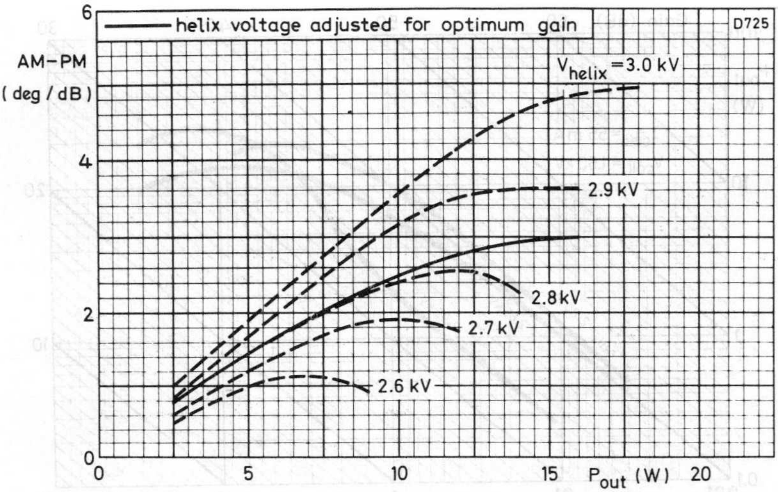
INTERBAND NOISE CHARACTERISTICS



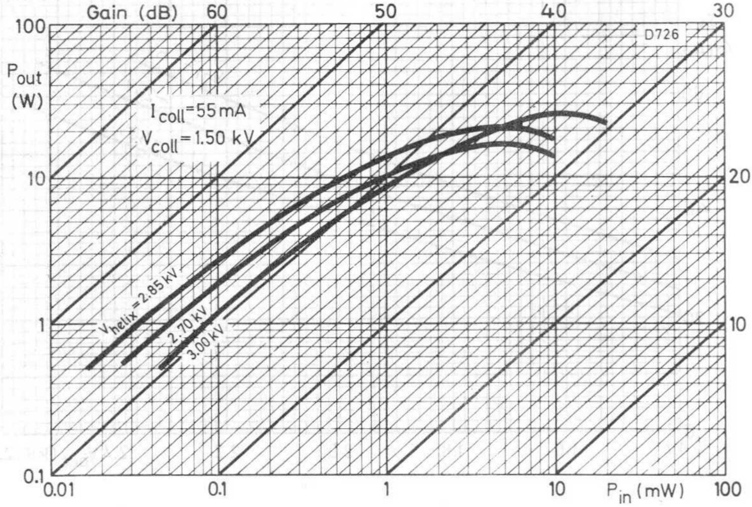
GAIN AND SATURATED OUTPUT POWER PLOTTED AGAINST FREQUENCY FOR VARIOUS OPERATING CONDITIONS



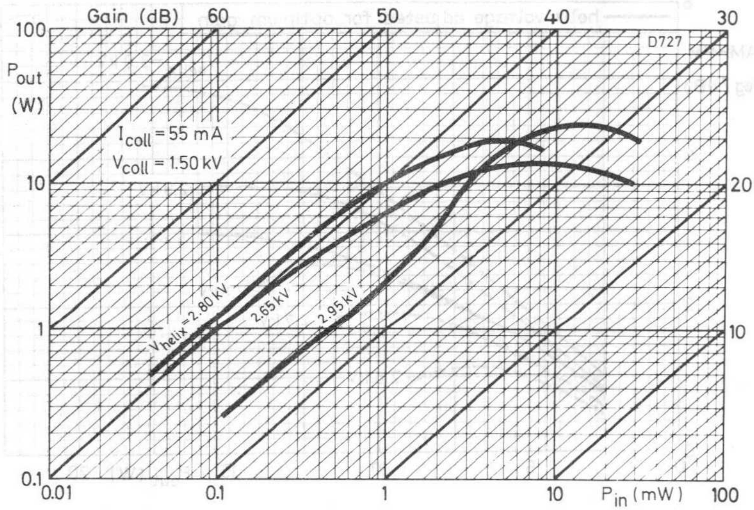
CATHODE CURRENT PLOTTED AGAINST ACCELERATOR VOLTAGE WITH GRID VOLTAGE AS PARAMETER



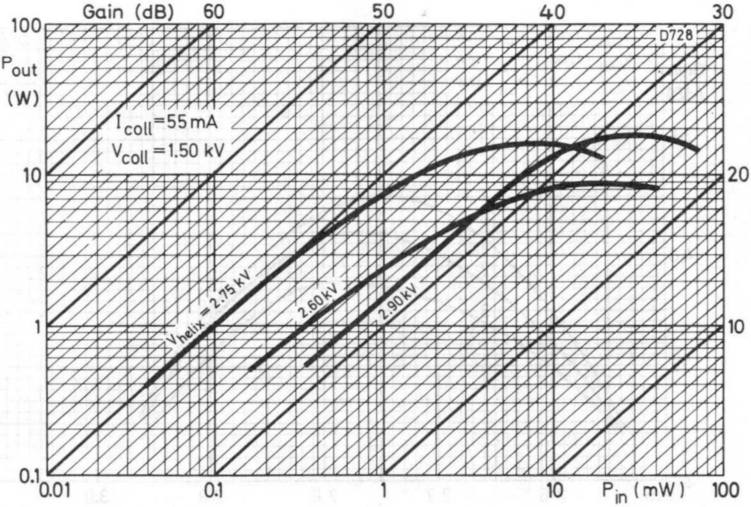
AM TO PM CONVERSION PLOTTED AGAINST POWER OUTPUT WITH HELIX VOLTAGE AS PARAMETER. FREQUENCY = 6GHz



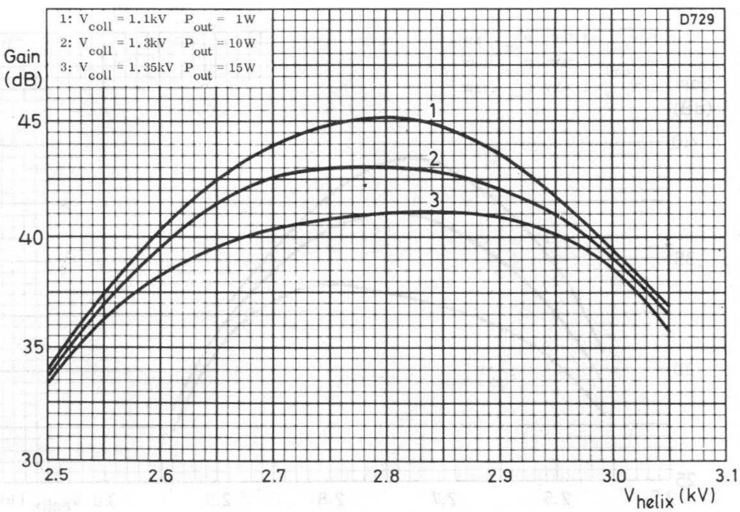
OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 6GHz



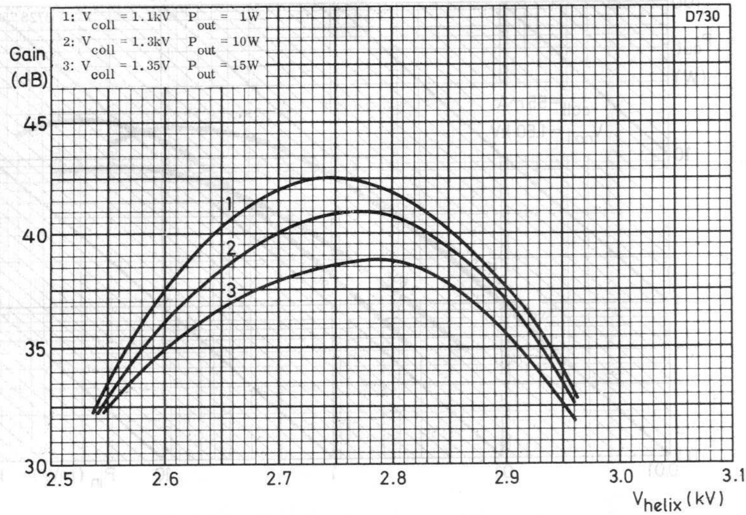
OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 7.2GHz



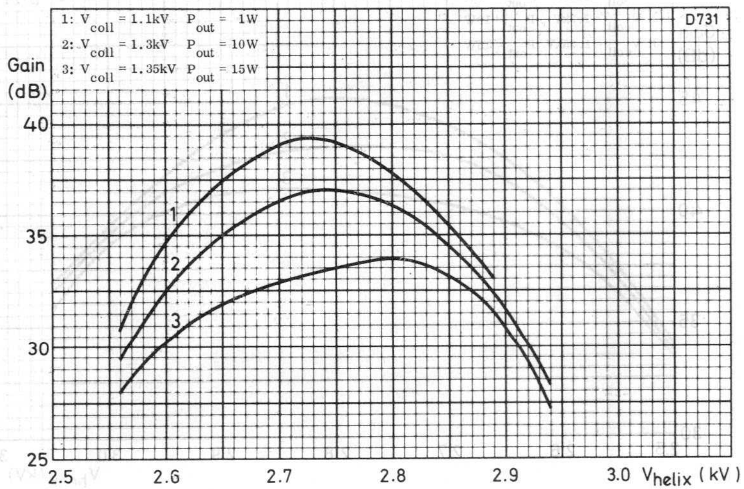
OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 8GHz



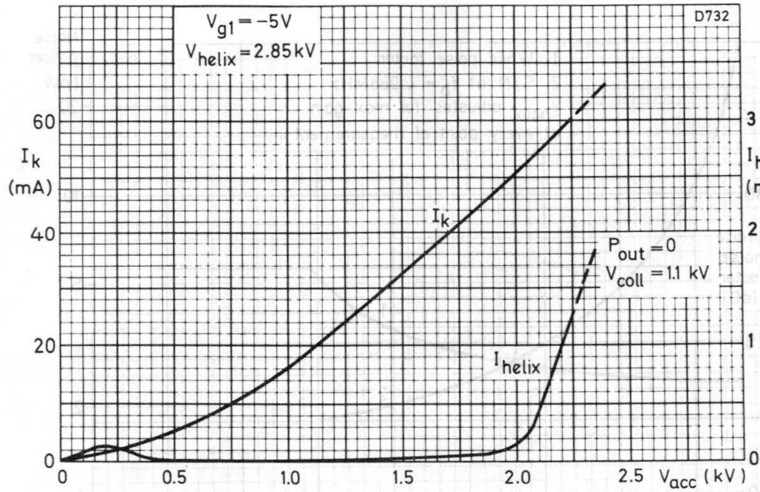
GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS COLLECTOR VOLTAGES AND OUTPUT POWERS AT 6GHz



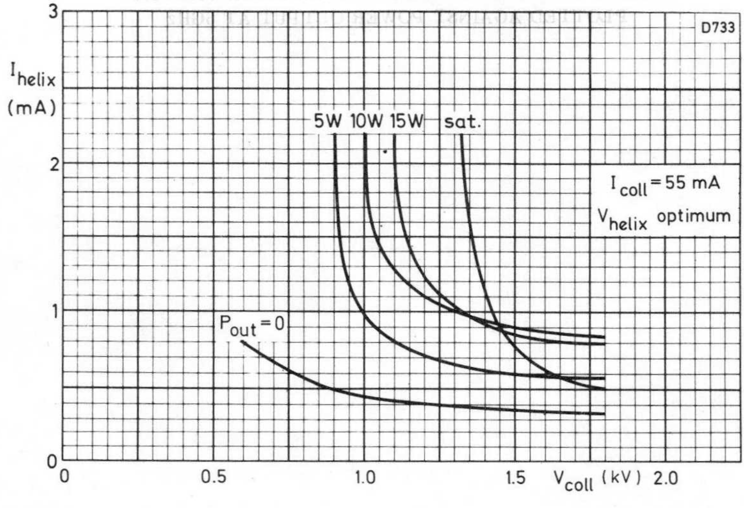
GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 7.2GHz



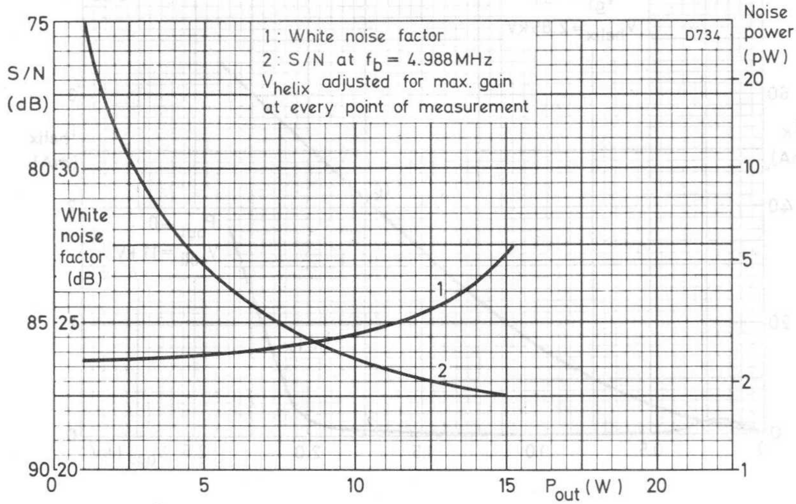
GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 8GHz



CATHODE AND HELIX CURRENTS PLOTTED AGAINST ACCELERATOR VOLTAGE



HELIX CURRENT PLOTTED AGAINST COLLECTOR VOLTAGE WITH POWER OUTPUT AS PARAMETER. FREQUENCY = 6GHz



SIGNAL TO NOISE RATIO AND WHITE NOISE FACTOR
PLOTTED AGAINST POWER OUTPUT AT 6GHz

Mullard

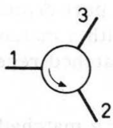
MICROWAVE COMPONENTS

F

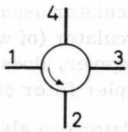
INTRODUCTION

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

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



symbols



3 port circulator
Fig.1

4 port circulator
Fig.2

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

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

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

APPLICATION

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

Fig.3
Duplexing of one receiver and one transmitter

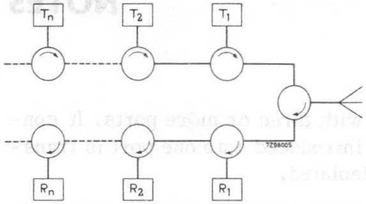


Fig.4
Duplexing of a number of transmitters and receivers

R = receiver; T = transmitter

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

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

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

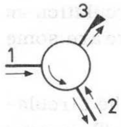


fig.5

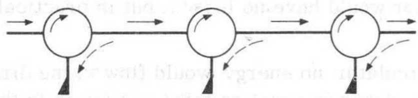
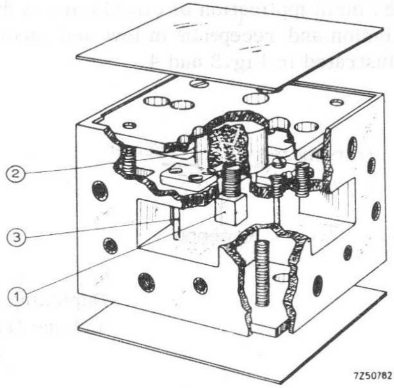


fig.6

CONSTRUCTION

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

Waveguide circulators



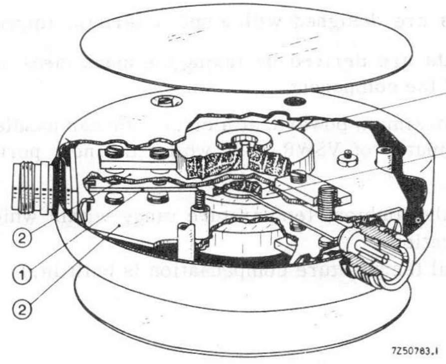
Construction of a waveguide circulator
Fig.7

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

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

Coaxial circulators

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



Construction of a coaxial circulator
Fig.8

Mounting

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

TERMS AND DEFINITIONS

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

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

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

Insertion loss is the attenuation resulting from the insertion of a circulator into a transmission system, expressed in dB, of the power delivered to a matched load before insertion of the circulator, to the power delivered to that load after insertion of the circulator.

Voltage standing wave ratio (VSWR) is the ratio of the maximum to the minimum voltages along the line. It is measured with all other ports terminated with a matched load.

The coaxial circulators are designed with a characteristic impedance of 50 ohms.

Typical data. These data are derived by taking the mean measured values of several production runs of the component.

Nominal power is the maximum power that a circulator can handle when one port is terminated with a mismatch of VSWR = 2, whilst the next port is matched with VSWR $\leq$ 1.2.

Temperature range is the ambient temperature range within which the circulators will function to specification.
(When necessary special temperature compensation is built in.)

TEST SPECIFICATION

The circulators can withstand the following tests:

A. Temperature-cycling test according to method 102 A-D of MIL-STD-202B.
B. Moisture test according to methods 106, fig.106-1 of MIL-STD-202.
C. Bumping test, 4000 bumps at 40 g, 6 ms.
D. Vibration test, 5-60 Hz, 28 cm/s.

CAUTION

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

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

ISOLATORS

GENERAL EXPLANATORY NOTES

INTRODUCTION

An isolator is a passive non-reciprocal device which permits microwave energy to pass through it in one direction whilst absorbing energy in the reverse direction.

In the forward direction, that is the direction in which the energy is passed, the insertion loss is usually 0.3 to 0.5 dB in the frequency range for which the isolator has been designed. In the opposite direction the isolation is normally 30 dB but for certain applications isolation can be made as high as 55 to 60 dB.

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

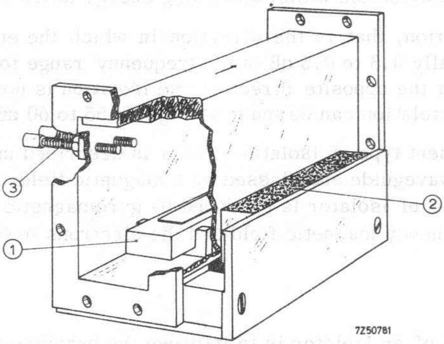
APPLICATION

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

The isolators, provided with matching screws, offer the possibility to match the isolator so that over a certain frequency range the VSWR is minimum. It is therefore possible to optimise the efficiency of waveguide runs by matching the isolator to minimum reflection. This means that long line effects can be drastically reduced.

CONSTRUCTION

In the fig. below a field displacement isolator is shown. In the waveguide the ferrite bar (1) can be seen, flanked by two sets of magnets (2) outside the waveguide. These magnets bias the ferrite bar.



Field displacement type of isolator

The screws (3) protruding into the waveguide are used to match the isolator for minimum voltage standing wave ratio.

TERMS AND DEFINITIONS

Frequency range is the range within which the isolator meets the guaranteed specification.
Outside this range the electrical properties deteriorate rapidly.

Isolation is the ratio, expressed in dB, of the input power to the output power in the reverse direction, measured with matched source and matched load.

Insertion loss is the attenuation resulting from the insertion of an isolator into a transmission system, expressed in dB, of the power delivered to a matched load before insertion of the isolator, to the power delivered to that load after insertion of the isolator.

Voltage standing wave ratio (VSWR) is the ratio of the maximum to the minimum voltages along the line.

Typical data. These data are derived by taking the mean measured values of several production runs of the component.

Nominal power is the maximum power that may be passed through the isolator in forward direction into a load with a VSWR of 2.

Temperature range is the ambient temperature range within which the isolators function to specification.
The isolator will continue to function outside the given temperature range, but some of its characteristics may change.
The storage temperature of the isolators may be from $-40\ ^{o}C$ to $+125\ ^{o}C$.

TEST SPECIFICATION

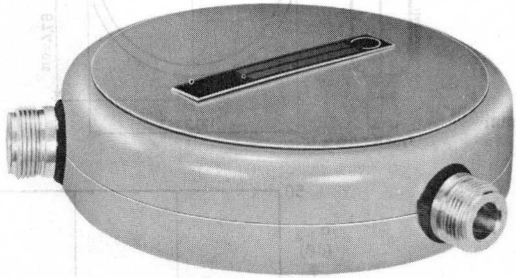
The isolators can withstand the following tests:

A. Temperature cycling test according to method 102A-D of MIL-STD-202B.
B. Moisture test according to method 106, fig. 106-1 of MIL-STD-202.
C. Bumping test, 4000 bumps at 40 g, 6 ms.
D. Vibration test, 5-60 Hz, 28 cm/s.

CAUTION

The isolators have rather strong internal magnetic fields which are carefully adjusted for optimal operation. They are not to be subjected to strong external magnetic fields.

CIRCULATOR CL5001

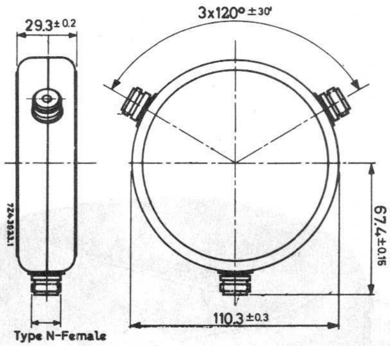


ELECTRICAL DATA

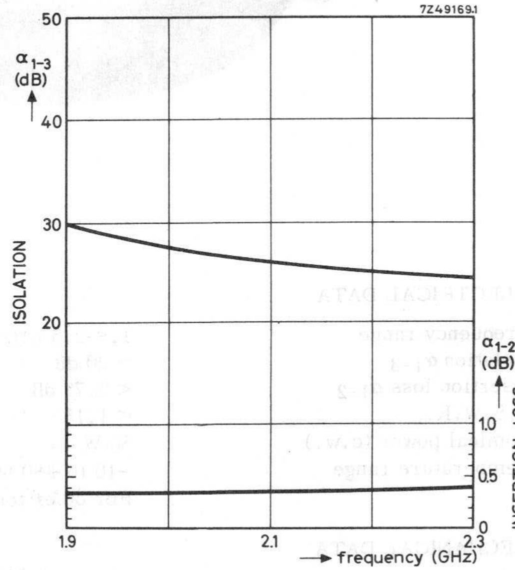
Frequency range	1.9-2.3 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.75 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	50 W
Temperature range	-10 to +80 ^{o}C For other temperature ranges please inquire

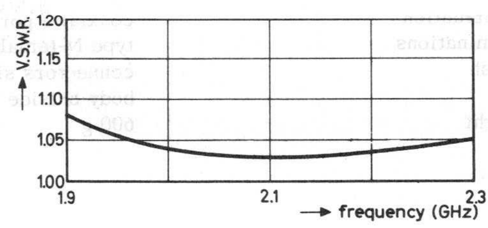
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	600 g



Dimensions in mm

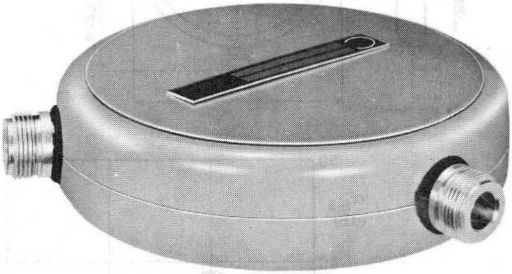




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5005



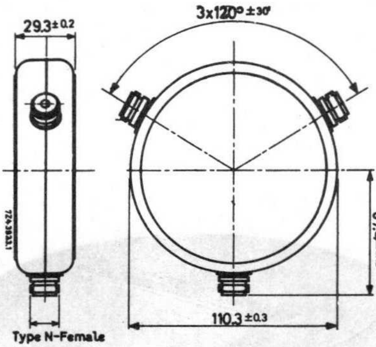
ELECTRICAL DATA

Frequency range	2.2-3.0 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	50 W
Temperature range	−10 to +80 °C For other temperature ranges please inquire

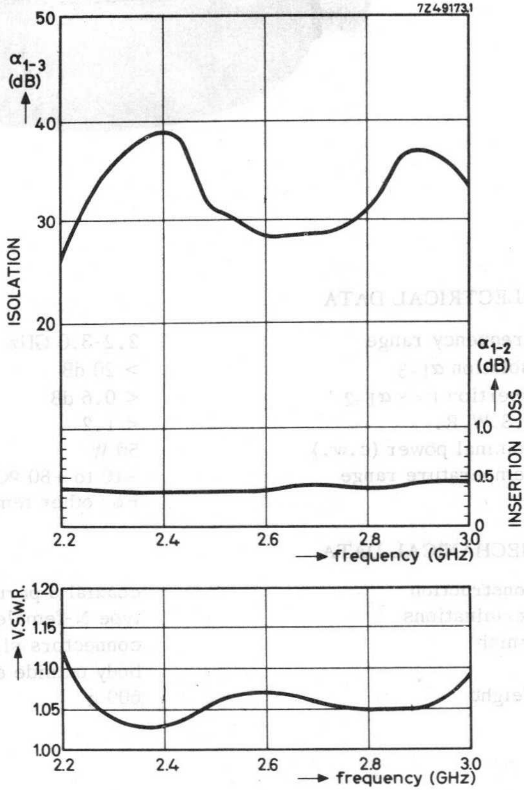
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	600 g

Mullard



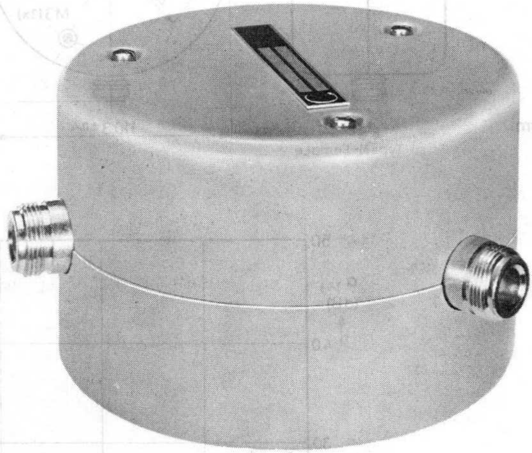
Dimensions in mm



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

CIRCULATOR

CL5007



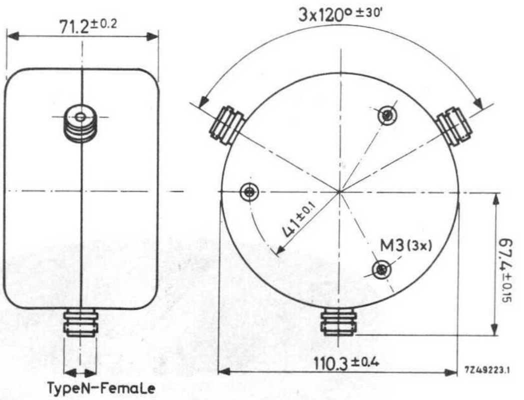
ELECTRICAL DATA

Frequency range	0.47-0.60 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C For other temperature ranges please inquire

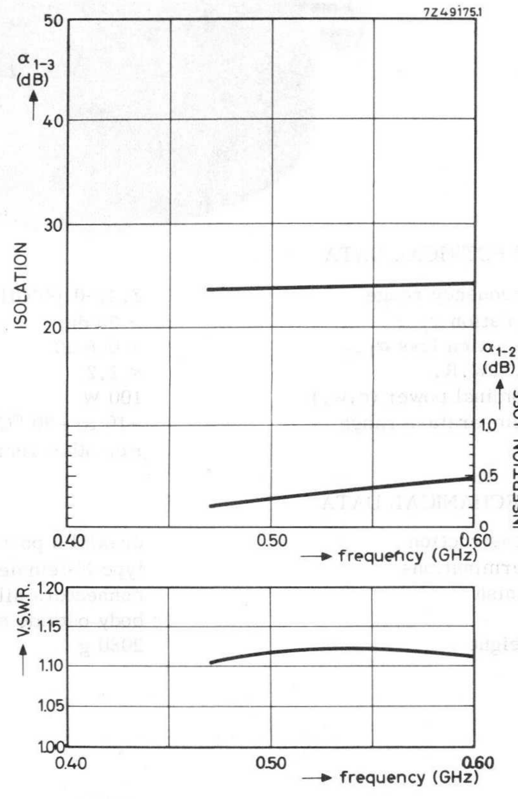
MECHANICAL DATA

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

CL5007



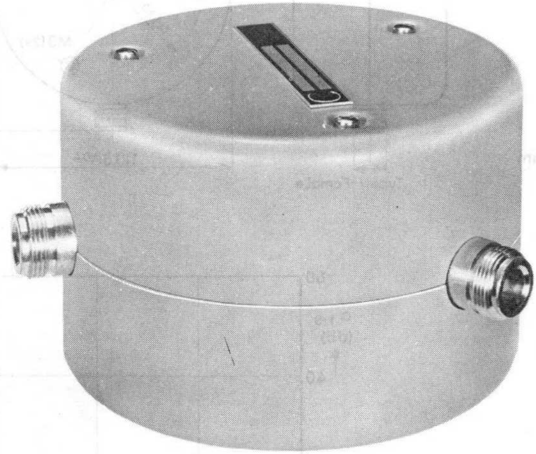
Dimensions in mm



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

CIRCULATOR

CL5008

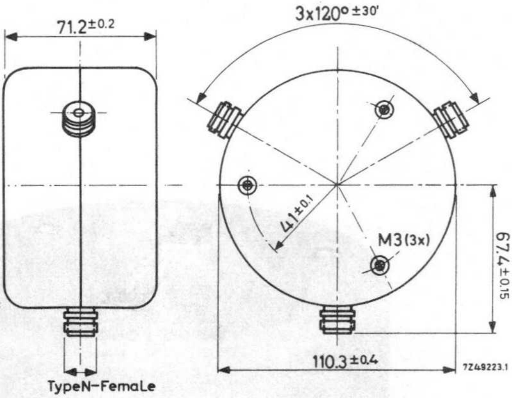


ELECTRICAL DATA

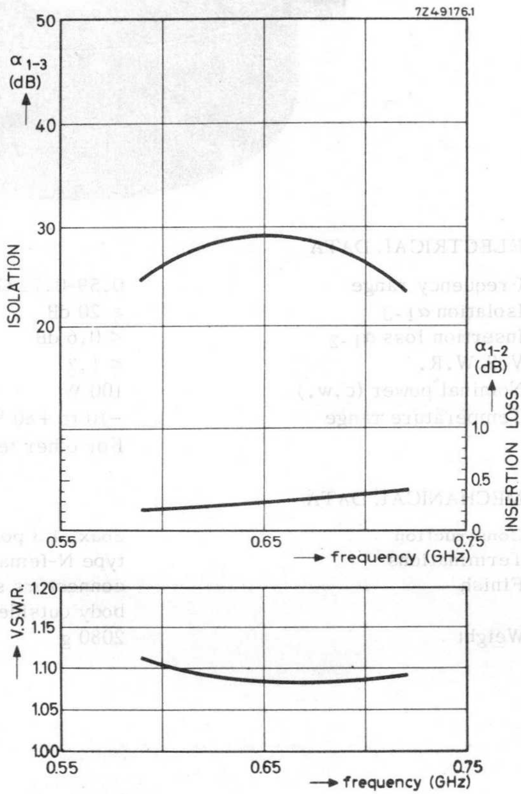
Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C
	For other temperature ranges please inquire

MECHANICAL DATA

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



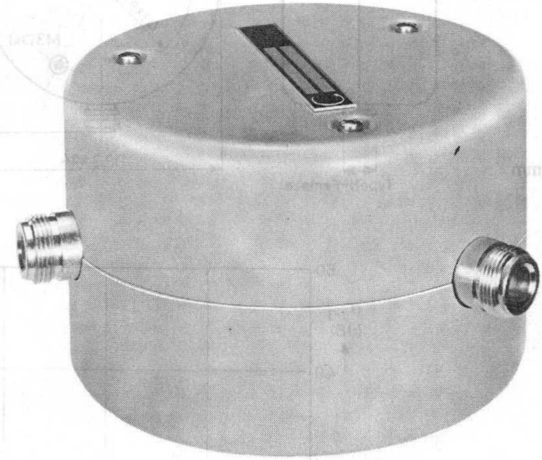
Dimensions in mm



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

CIRCULATOR

CL5009



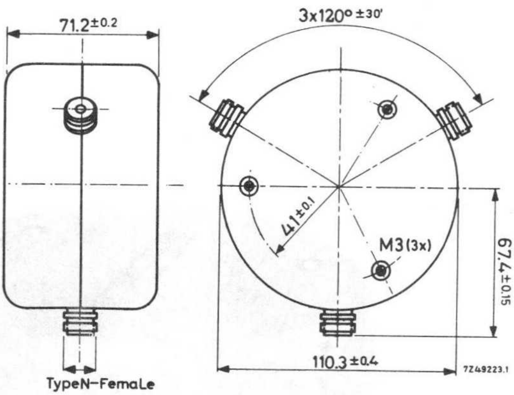
ELECTRICAL DATA

Frequency range	0.406-0.470 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 °C
	For other temperature ranges please inquire

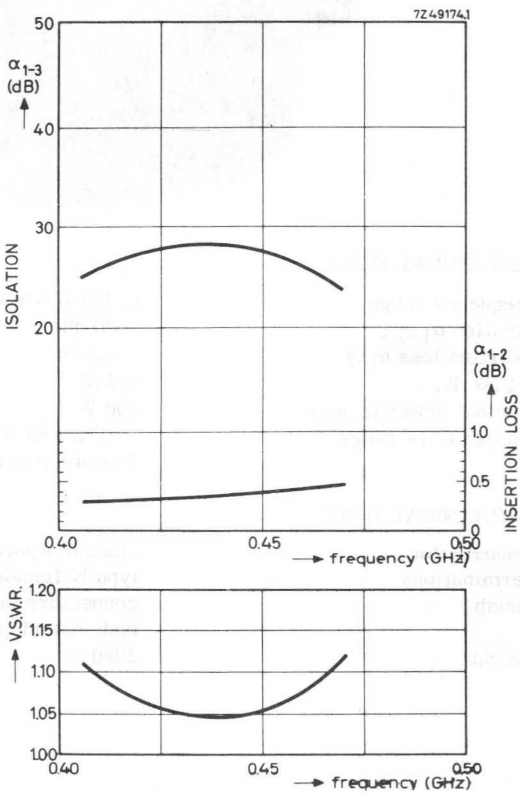
MECHANICAL DATA

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

CL5009



Dimensions in mm

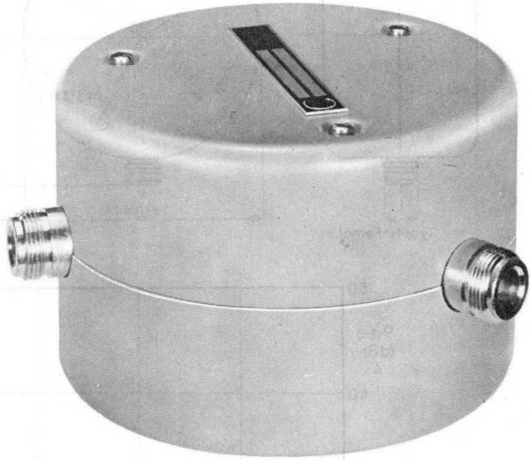


Typical performance as a function of frequency at a working temperature of 20 °C.

Mullard

CIRCULATOR

CL5010



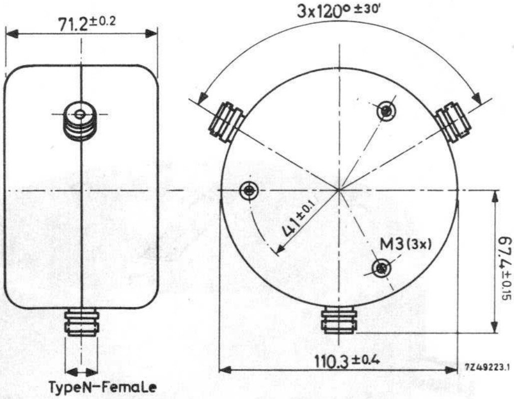
ELECTRICAL DATA

Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 ^{o}C For other temperature ranges please inquire

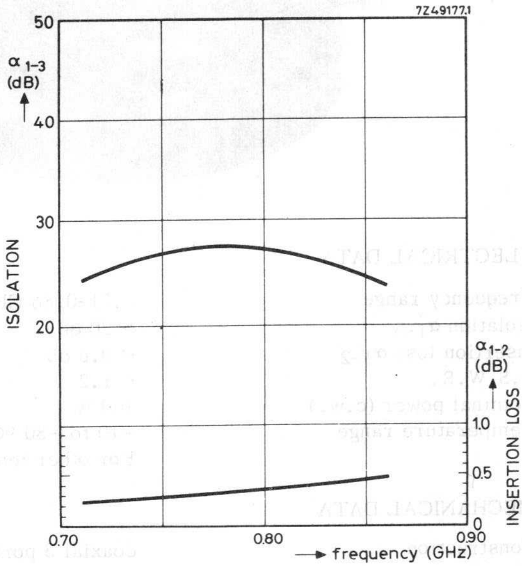
MECHANICAL DATA

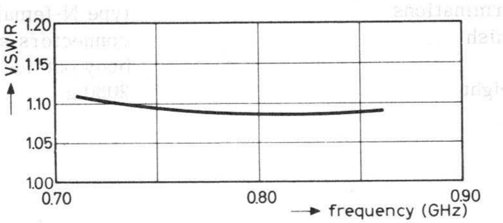
Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated, body outside enamelled grey
Weight	2080 g

CL5010



Dimensions in mm

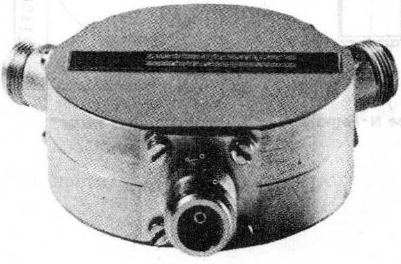




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5012



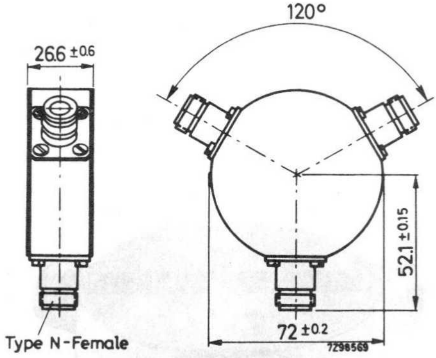
ELECTRICAL DATA

Frequency range	3.6-4.2 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.5 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	50 W
Temperature range	+10 to +70 ^{o}C For other temperature ranges please inquire

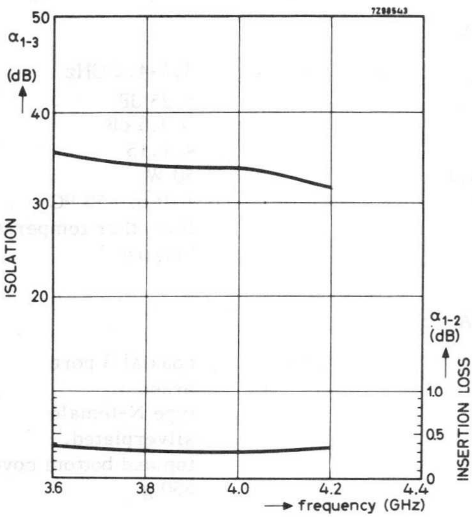
MECHANICAL DATA

Construction	coaxial 3 port
Material	brass
Terminations	type N-female
Finish	silverplated, top and bottom cover black
Weight	550 g

CL5012



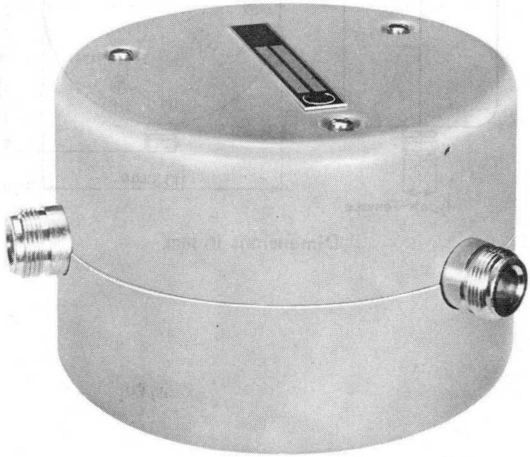
Dimensions in mm



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

CIRCULATOR

CL5014



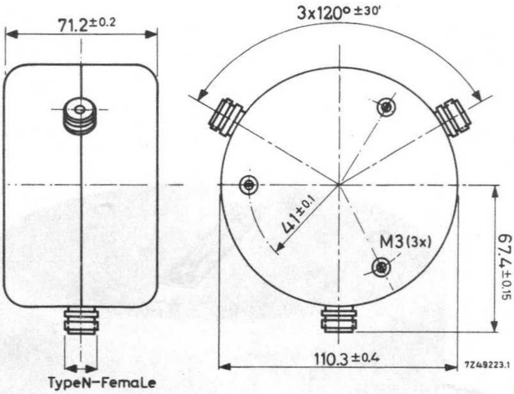
ELECTRICAL DATA

Frequency range	0.45-0.55 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.6 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

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

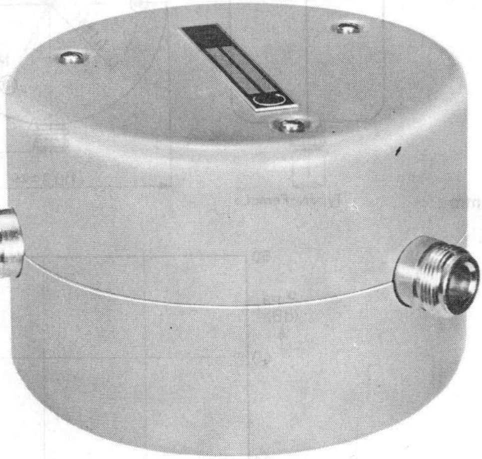
CL5014



Dimensions in mm

CIRCULATOR

CL5015



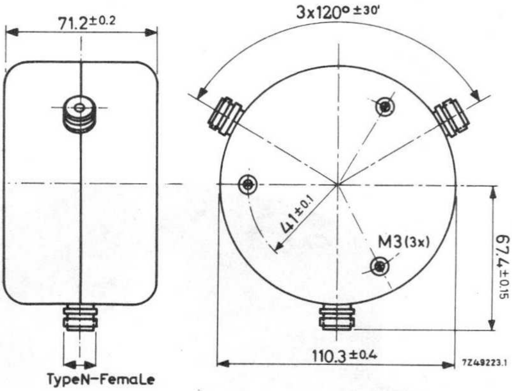
ELECTRICAL DATA

Frequency range	0.608-0.783 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.75 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	-10 to +80 $^{\circ}$C
	For other temperature ranges please inquire

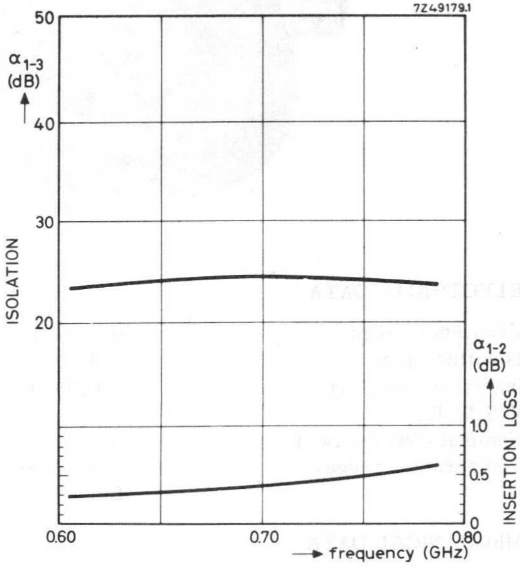
MECHANICAL DATA

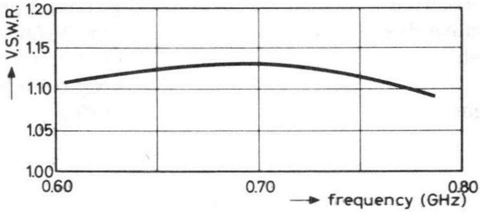
Construction	coaxial 3 port
Terminations	type N-female
Finish	connectors silverplated
	body outside enamelled grey
Weight	2080 g

CL5015



Dimensions in mm





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

CIRCULATOR

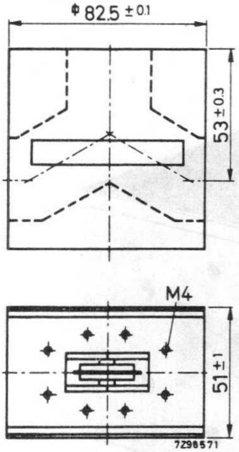
CL5020

ELECTRICAL DATA

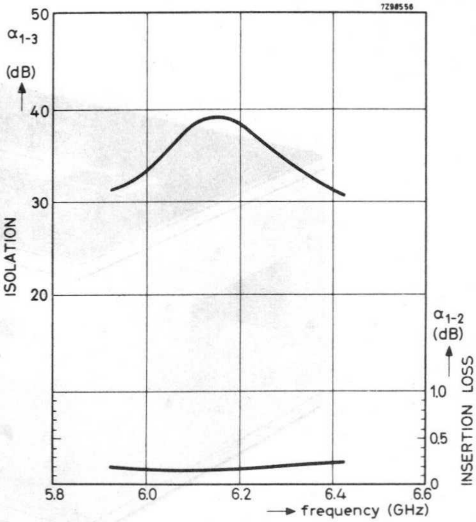
Frequency range	5.925-6.425 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.12
Nominal power (c.w.)	100 W
Temperature range	+10 to +40 °C For other temperature ranges please inquire

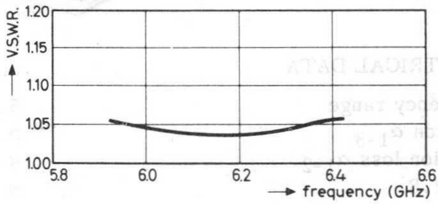
MECHANICAL DATA

Construction	waveguide 3 port
Material	aluminium
Flange type	UER70 (I.E.C.)
Finish	alodine, covers black
Weight	950 g



Dimensions in mm

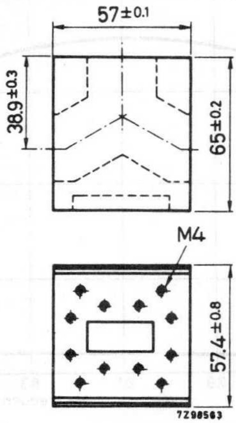




Typical performance as a function of frequency at a working temperature of 20 $^{\circ}$C.

CIRCULATOR

CL5021



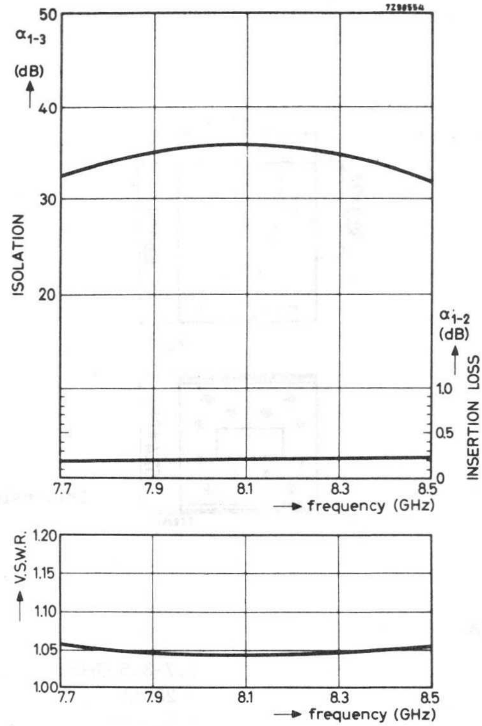
Dimensions in mm

ELECTRICAL DATA

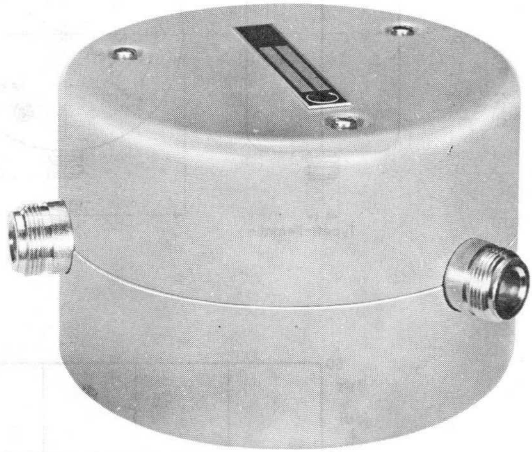
Frequency range	7.7-8.5 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	50 W
Temperature range	+10 to +40 °C . For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 3 port
Material	brass
Flange type	UER84/UBR84 (I.E.C.)
Finish	goldplated upon silverplated outside enamelled grey



Typical performance as a function of frequency at a working temperature of 20 ^{o}C.

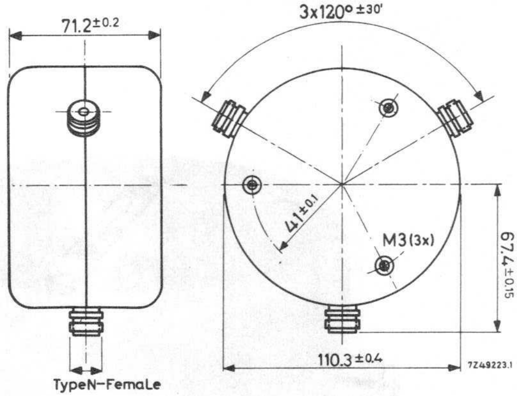


ELECTRICAL DATA

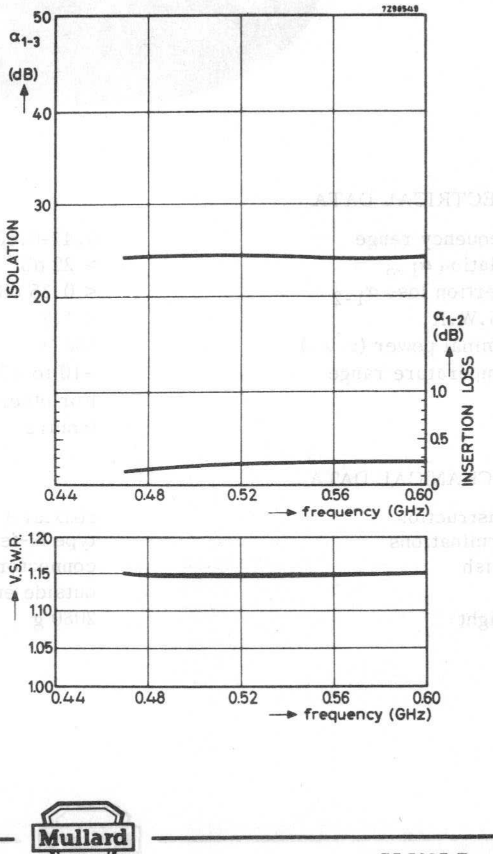
Frequency range	0.47-0.60 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

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

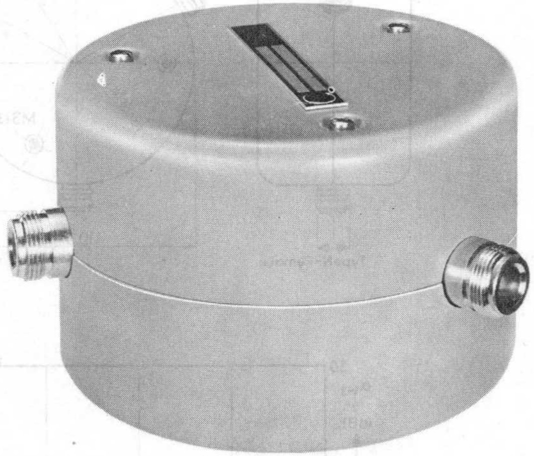


Dimensions in mm



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

CIRCULATOR CL5028

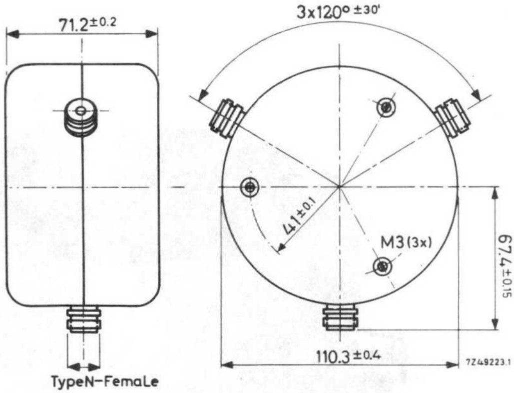


ELECTRICAL DATA

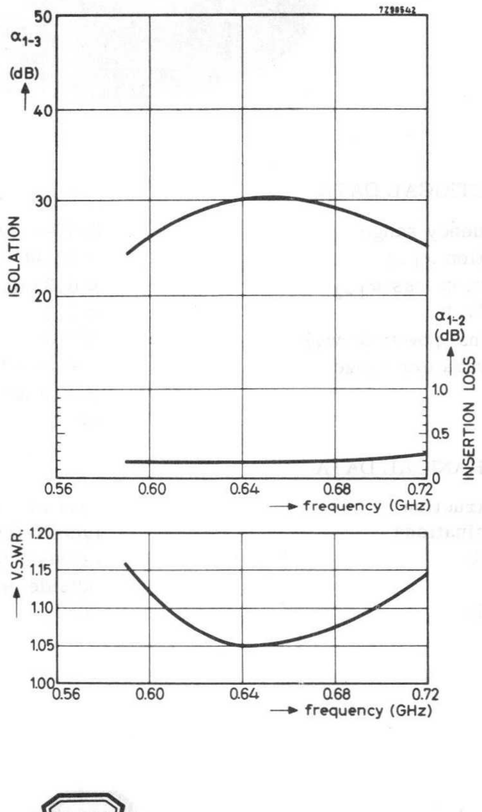
Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

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

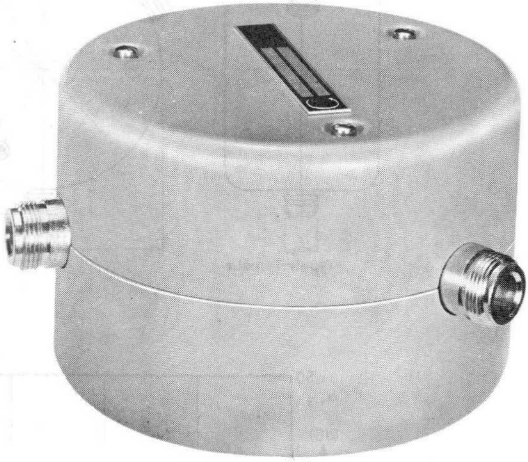


Dimensions in mm



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

CIRCULATOR CL5029

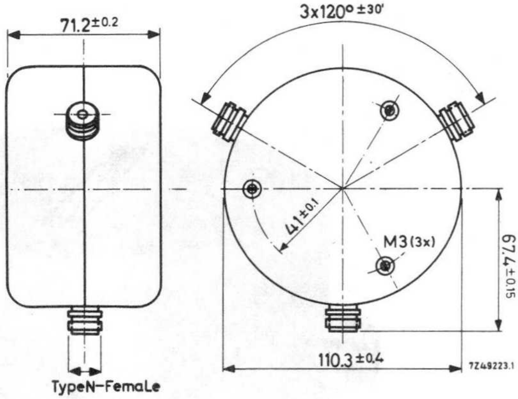


ELECTRICAL DATA

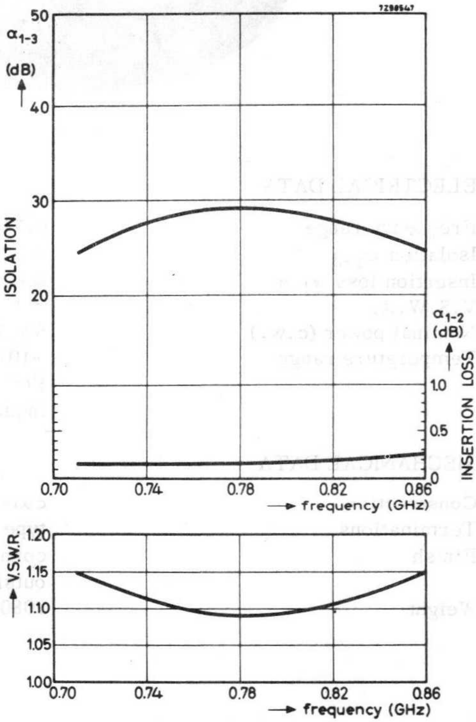
Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	-10 to +70 $^{\circ}$C For other temperature ranges please inquire

MECHANICAL DATA

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



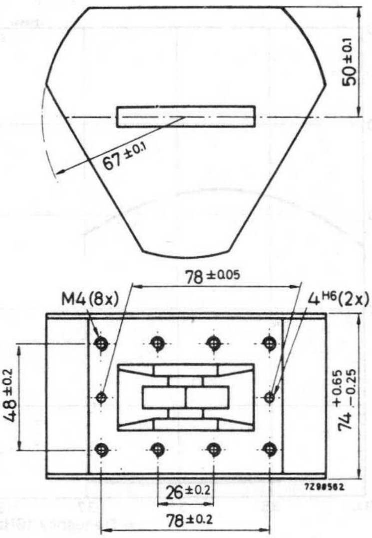
Dimensions in mm



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

CIRCULATOR

CL5031



Dimensions in mm

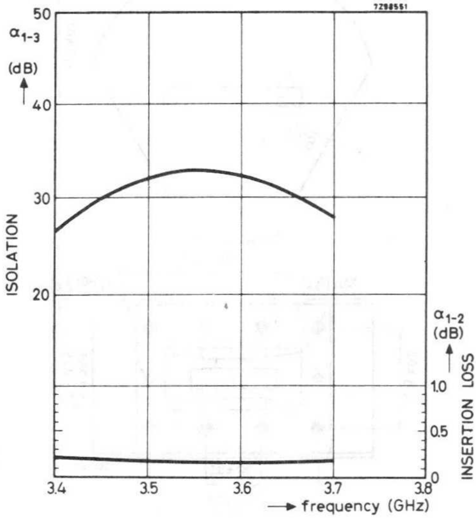
ELECTRICAL DATA

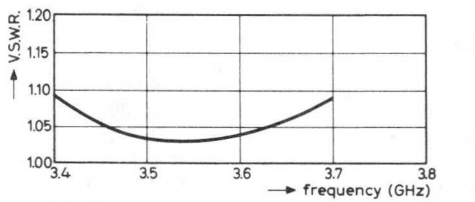
Frequency range	3.4-3.7 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	50 W
Temperature range	+5 to +45 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 3 port
Material	aluminium
Flange type	C.C.T.U. No.6 *)
Finish	alodine outside enamelled grey

*) UER40 available on request

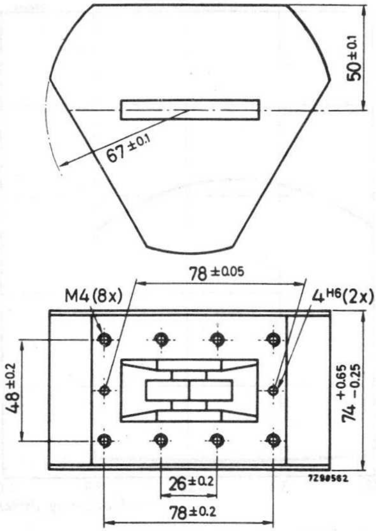




Typical performance as a function of frequency at a working temperature of 20 $^{\circ}$C.

CIRCULATOR

CL5041



Dimensions in mm

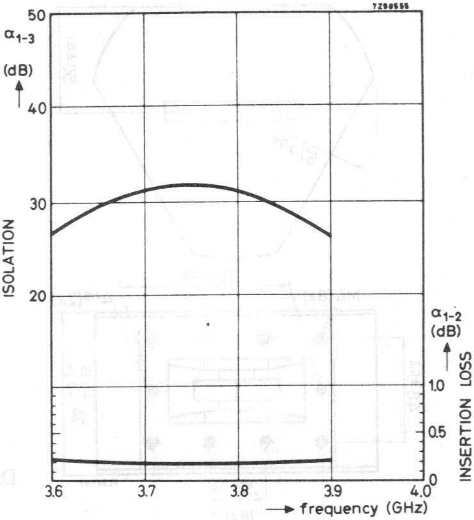
ELECTRICAL DATA

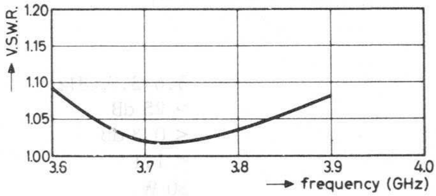
Frequency range	3.6-3.9 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	50 W
Temperature range.	+5 to +45 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 3 port
Material	aluminium
Flange type	C.C.T.U. No.6 *)
Finish	alodine, outside enamelled grey

*) UER40 available on request

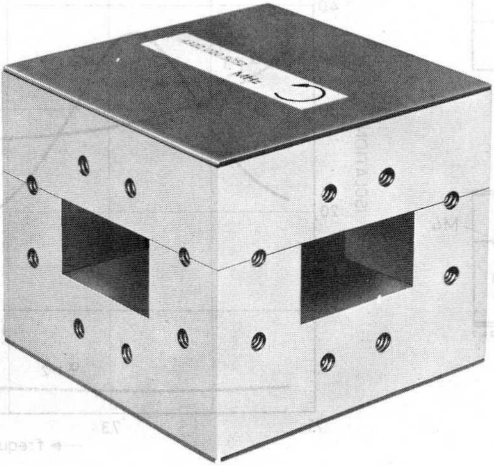




Typical performance as a function of frequency at a working temperature of 20 ^{o}C.

CIRCULATOR

CL5050

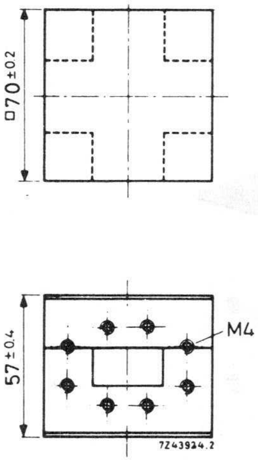


ELECTRICAL DATA

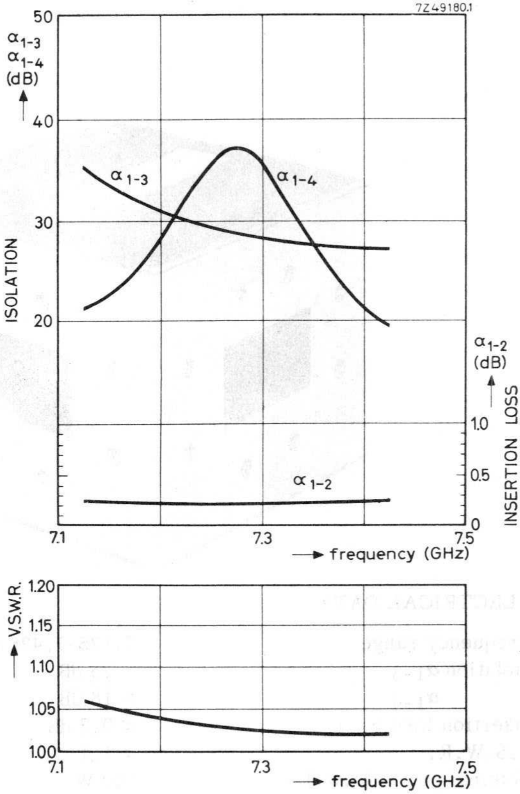
Frequency range	7.125-7.425 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C
	For other temperature ranges please inquire

MECHANICAL DATA

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



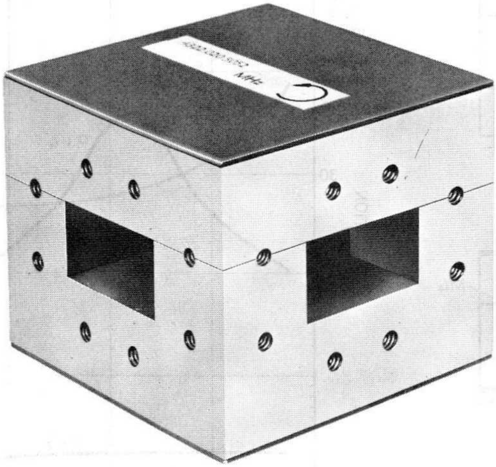
Dimensions in mm.



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

CIRCULATOR

CL5051

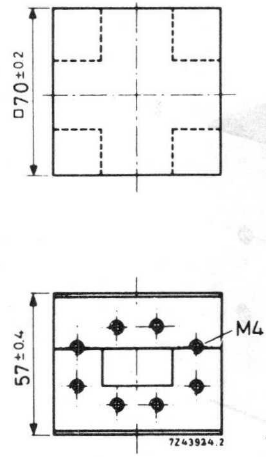


ELECTRICAL DATA

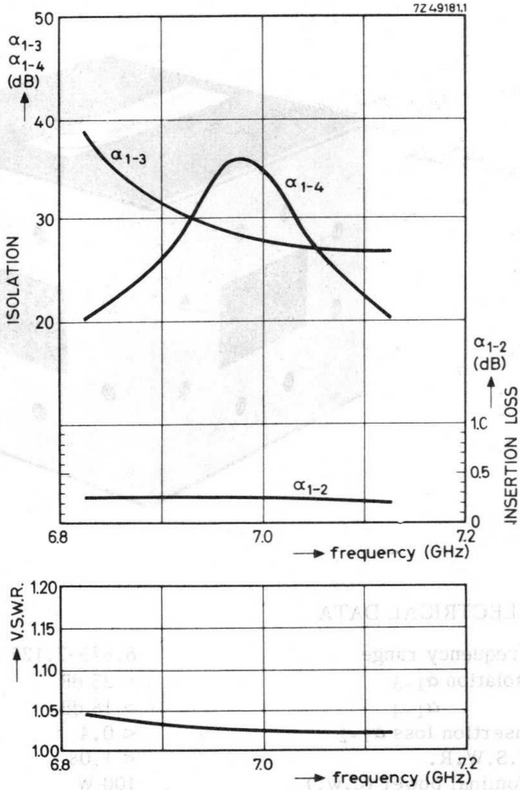
Frequency range	6.825-7.125 GHz
Isolation α_1-3	> 25 dB
α_1-4	> 18 dB
Insertion loss α_1-2	< 0.4
V.S.W.R.	< 1.08
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



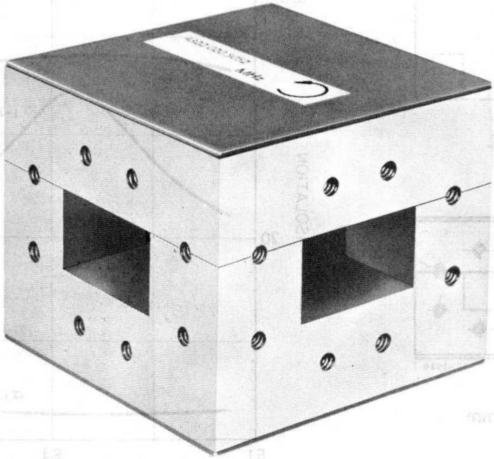
Dimensions in mm.



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

CIRCULATOR

CL5052



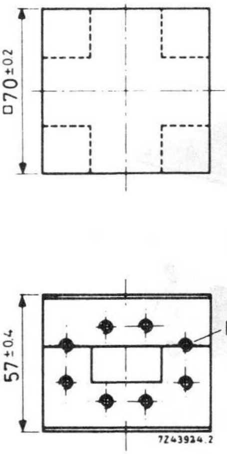
ELECTRICAL DATA

Frequency range	6.125-6.425 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

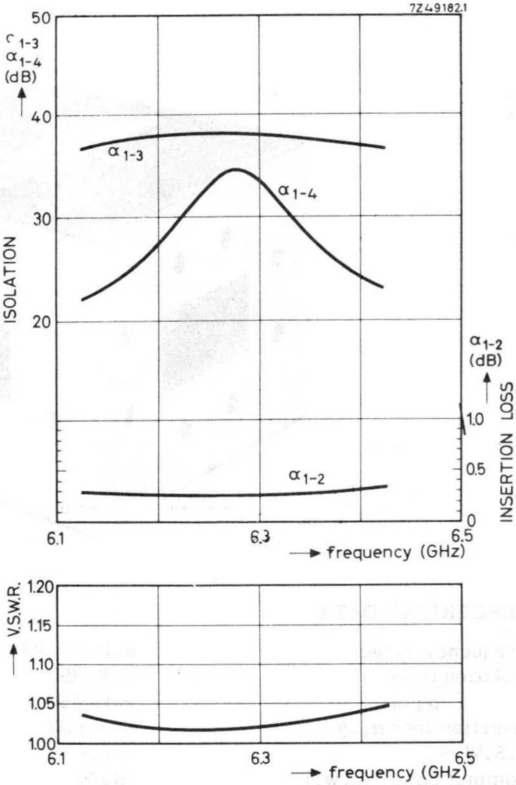
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g

CL5052

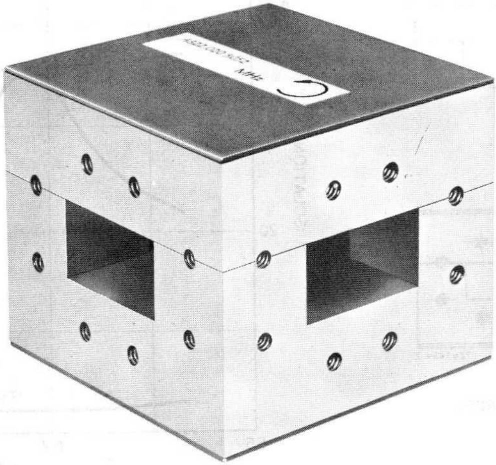


Dimensions in mm



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

CIRCULATOR CL5053

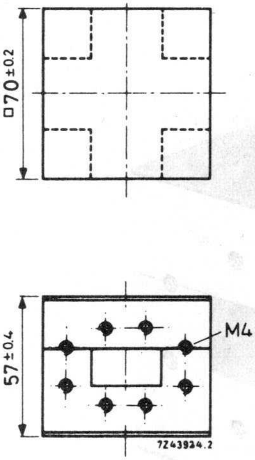


ELECTRICAL DATA

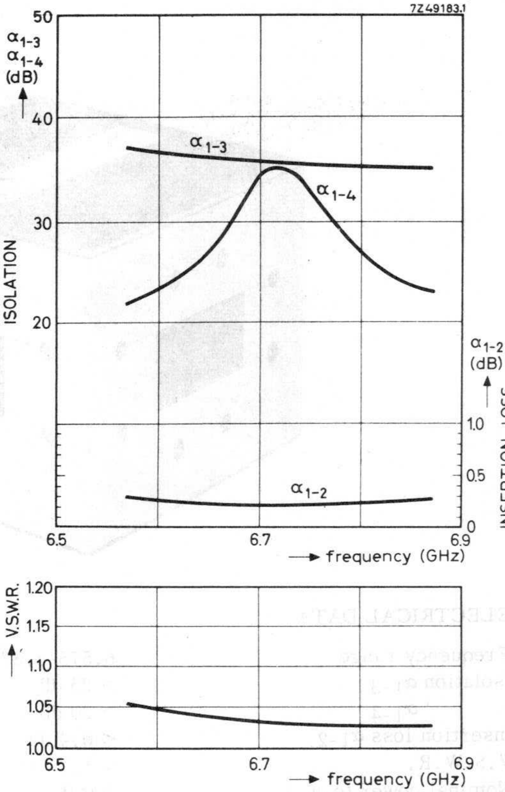
Frequency range	6.575-6.875 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C
	For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g



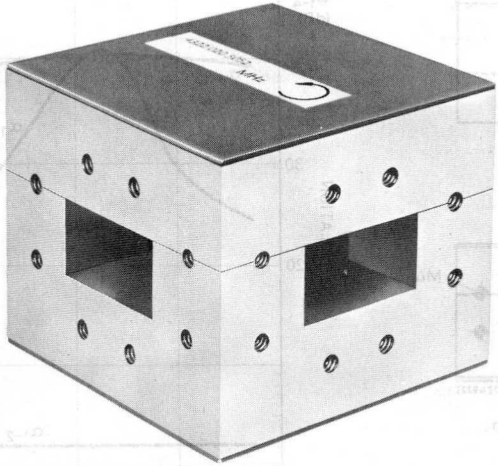
Dimensions in mm.



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

CIRCULATOR

CL5054



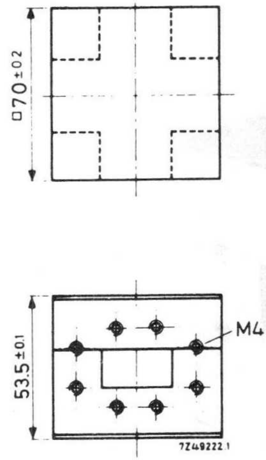
ELECTRICAL DATA

Frequency range	7.425-7.725 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C
	For other temperature ranges please inquire

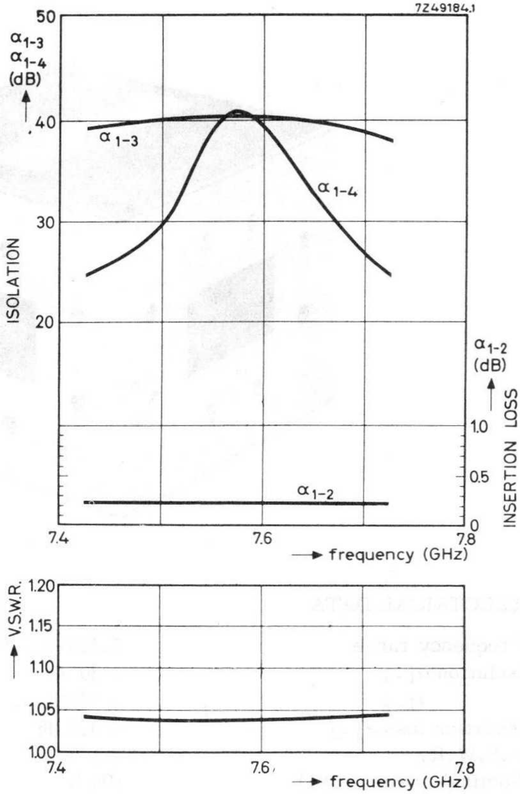
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g

CL5054



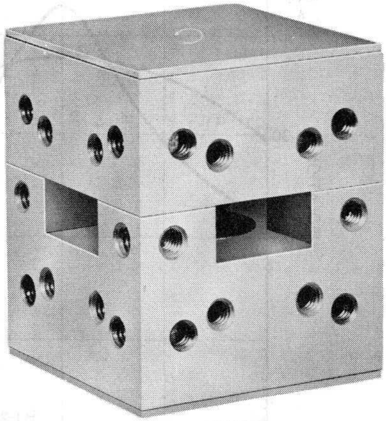
Dimensions in mm.



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

CIRCULATOR

CL5055



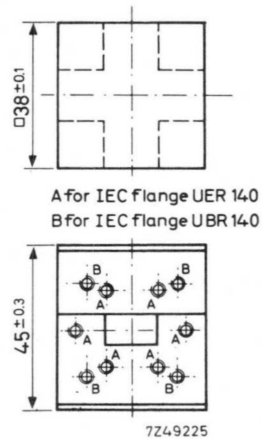
ELECTRICAL DATA

Frequency range	12.5 - 13.5 GHz
Isolation α_{1-3}	> 25 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	25 W
Temperature range	+ 10 to + 60 °C
	For other temperature ranges please inquire

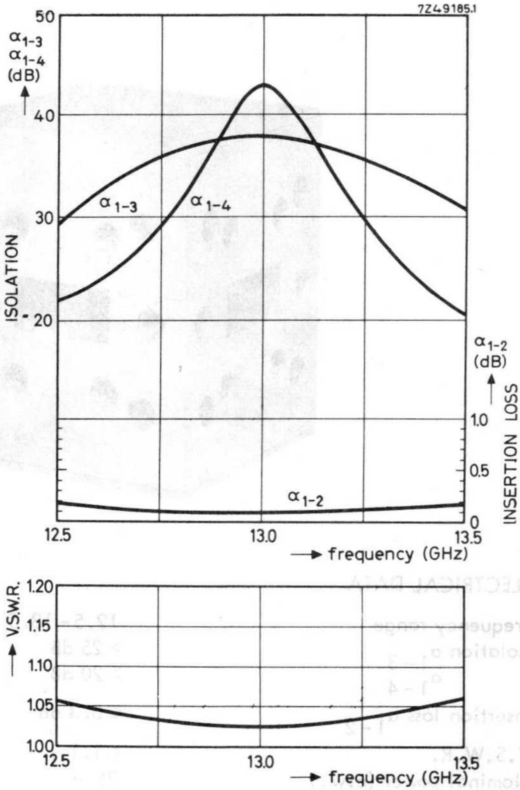
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER140 and UBR140 (I.E.C.)
Finish	goldplated upon silverplated
	outside enamelled grey
Weight	320 g

CL5055

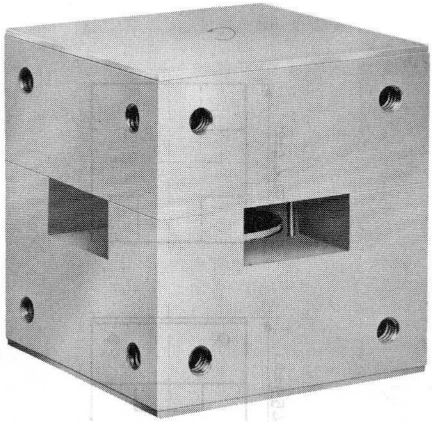


Dimensions in mm.



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

CIRCULATOR CL5056

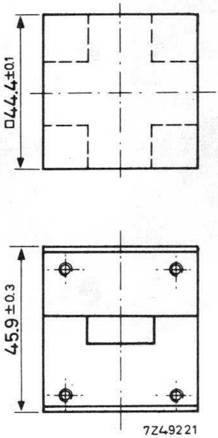


ELECTRICAL DATA

Frequency range	10.7-11.7 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 18 dB
Insertion loss α_{1-2}	< 0.3 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	25 W
Temperature range	+10 to +60 °C
	For other temperature ranges please inquire

MECHANICAL DATA

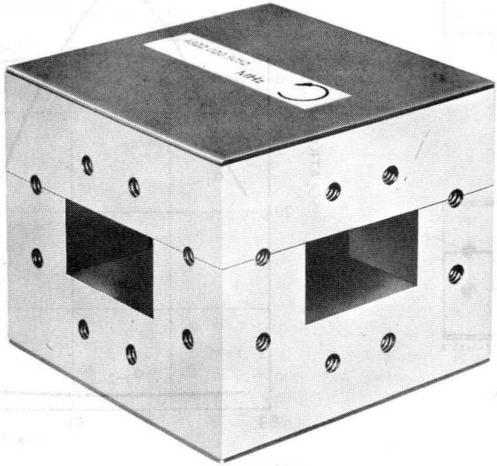
Construction	waveguide 4 port
Material	brass
Flange type	UBR 100 (I.E.C.)
Finish	goldplated upon silverplated
	outside enamelled grey
Weight	390 g



Dimensions in mm.

CIRCULATOR

CL5057

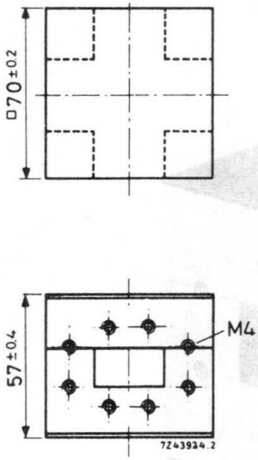


ELECTRICAL DATA

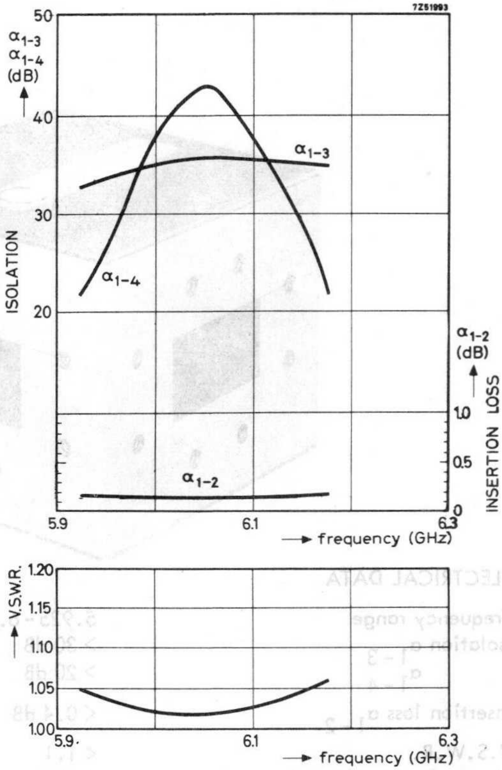
Frequency range	5.925 - 6.175 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.1
Nominal power (c.w.)	100 W
Temperature range	+ 10 to + 60 °C
	For other temperature ranges please inquire

MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated
	outside enamelled grey
Weight	920 g



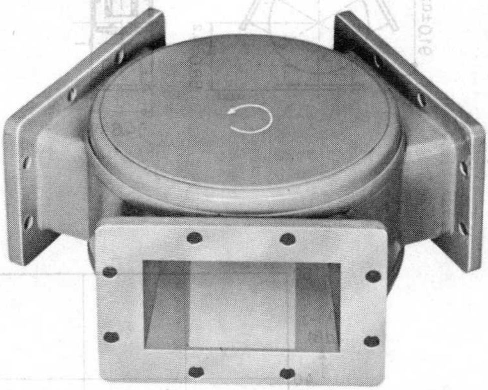
Dimensions in mm.



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

CIRCULATOR

CL5075



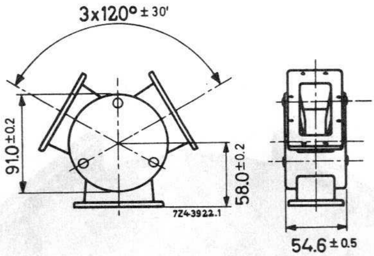
ELECTRICAL DATA

Frequency range	3.6-4.2 GHz
Isolation α_{1-3}	> 25 dB
Insertion loss α_{1-2}	< 0.4 dB
V.S.W.R.	< 1.12
Nominal power (c.w.)	100 W
Temperature range	+10 to +60 °C
	For other temperature ranges please inquire

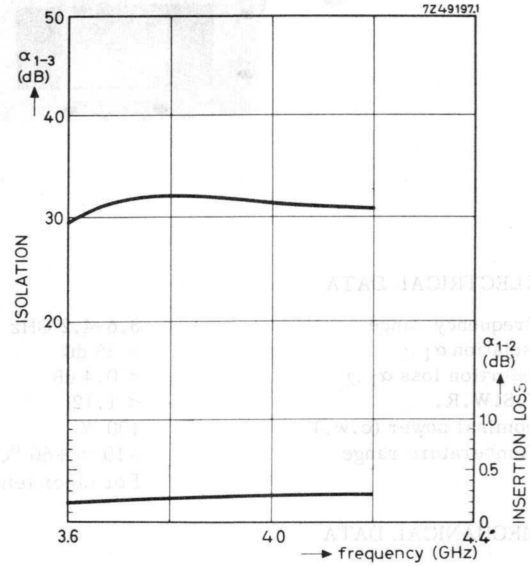
MECHANICAL DATA

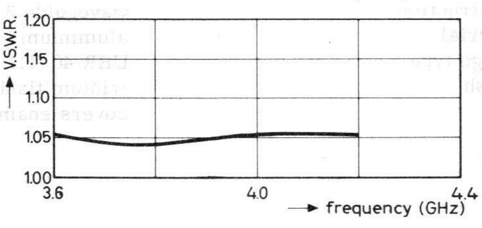
Construction	waveguide 3 port
Material	aluminium
Flange type	UER 40 (I.E.C.)
Finish	iridium flashed,
	covers enamelled grey

Mullard



Dimensions in mm.

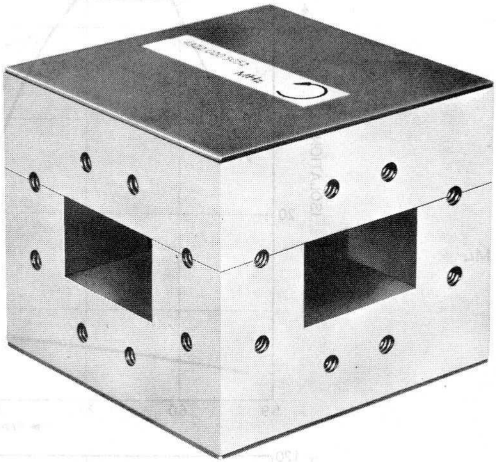




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5081



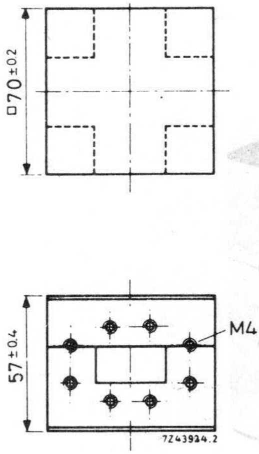
ELECTRICAL DATA

Frequency range	5.925-6.175 GHz
Isolation α_{1-3}	> 33 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.1 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	150 W
Temperature range	+10 to +60 ^{o}C
	For other temperature ranges please inquire

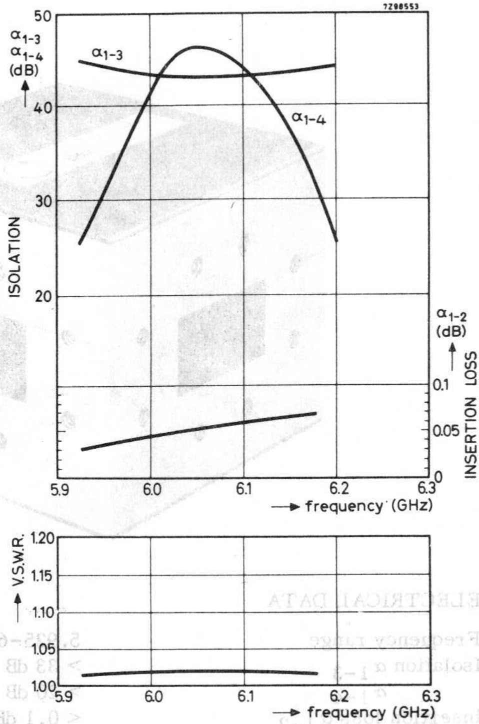
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g

Mullard



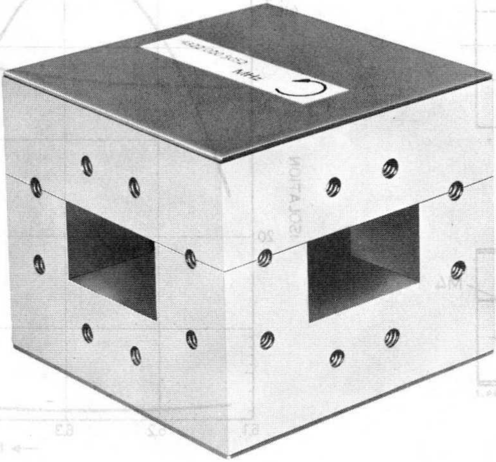
Dimensions in mm



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

CIRCULATOR

CL5091



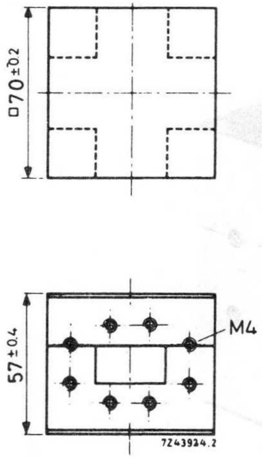
ELECTRICAL DATA

Frequency range	6.125–6.425 GHz
Isolation α_{1-3}	> 30 dB
α_{1-4}	> 20 dB
Insertion loss α_{1-2}	< 0.1 dB
V.S.W.R.	< 1.06
Nominal power (c.w.)	150 W
Temperature range	+10 to +60 °C For other temperature ranges please inquire

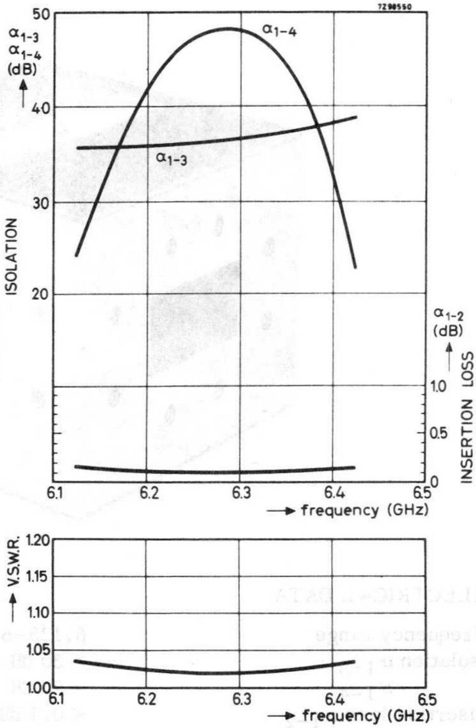
MECHANICAL DATA

Construction	waveguide 4 port
Material	brass
Flange type	UER 70 (I.E.C.)
Finish	goldplated upon silverplated, covers black
Weight	920 g

CL5091



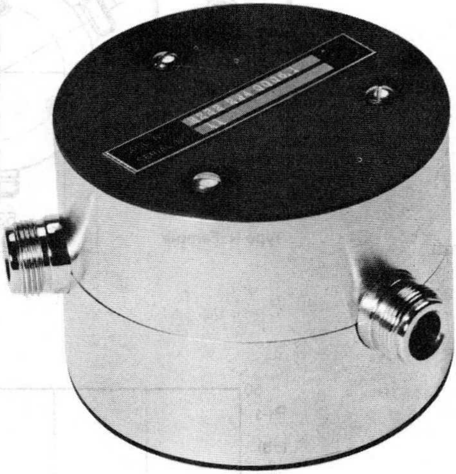
Dimensions in mm



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

CIRCULATOR

CL5151

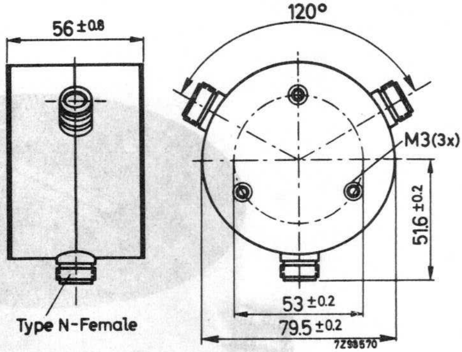


ELECTRICAL DATA

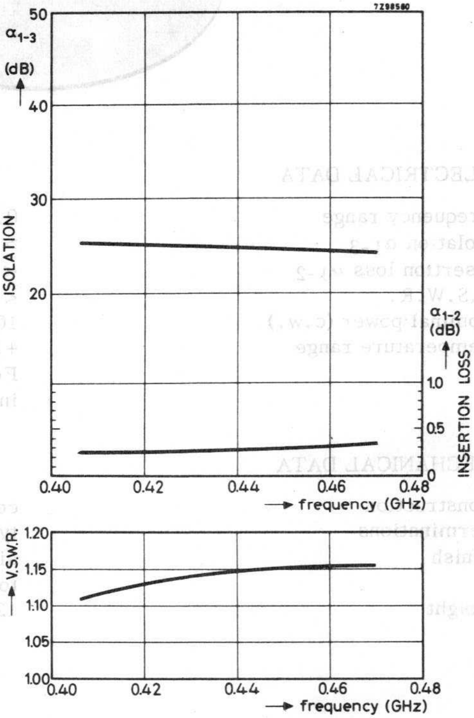
Frequency range	0.406-0.470 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.40 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 ^{o}C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g



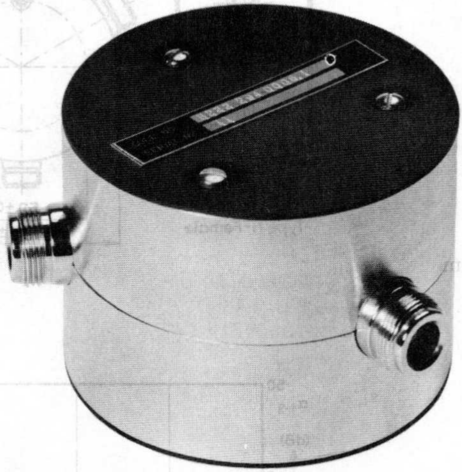
Dimensions in mm



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

CIRCULATOR

CL5171

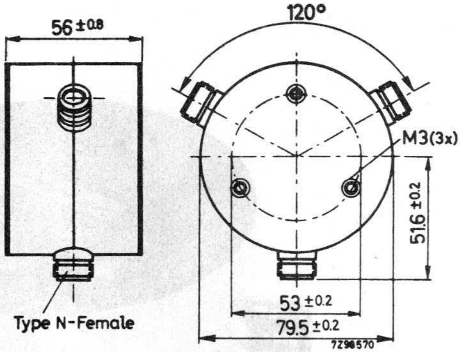


ELECTRICAL DATA

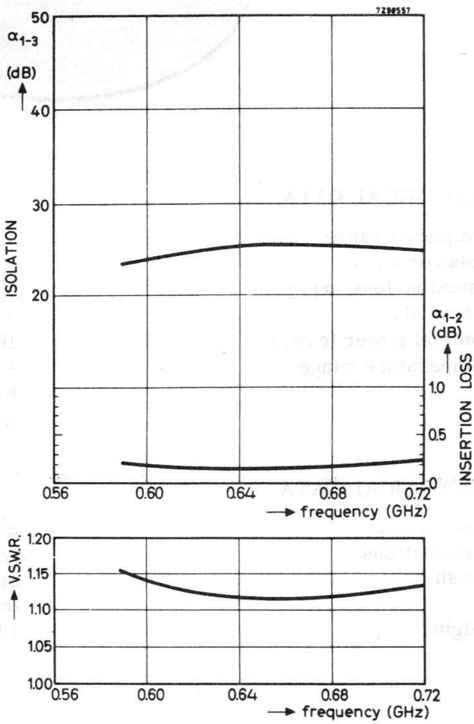
Frequency range	0.59-0.72 GHz
Isolation α_{1-3}	$\geq$ 22 dB
Insertion loss α_{1-2}	$\leq$ 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g



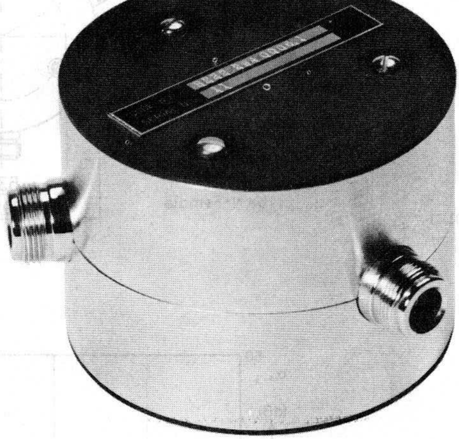
Dimensions in mm



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

CIRCULATOR

CL5181

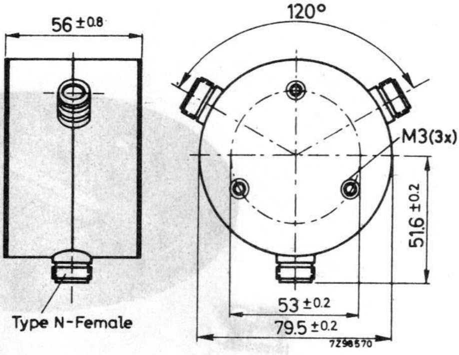


ELECTRICAL DATA

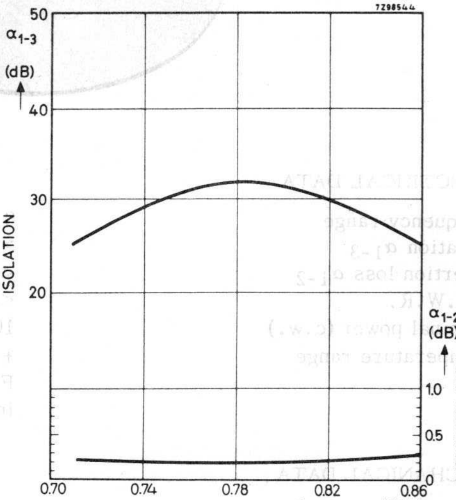
Frequency range	0.71-0.86 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

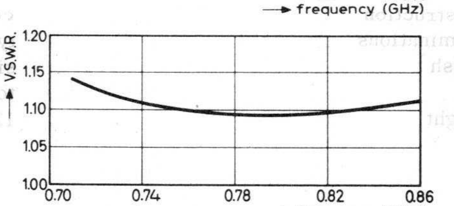
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g



Dimensions in mm

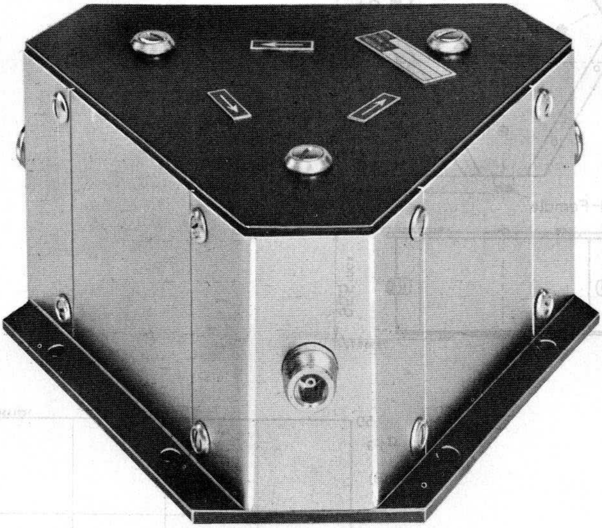




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5191

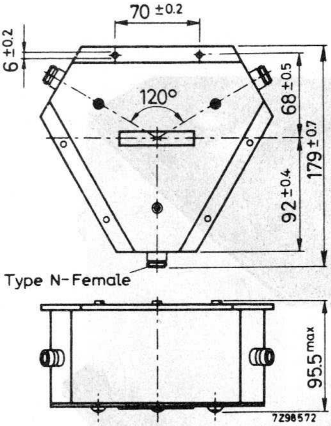


ELECTRICAL DATA

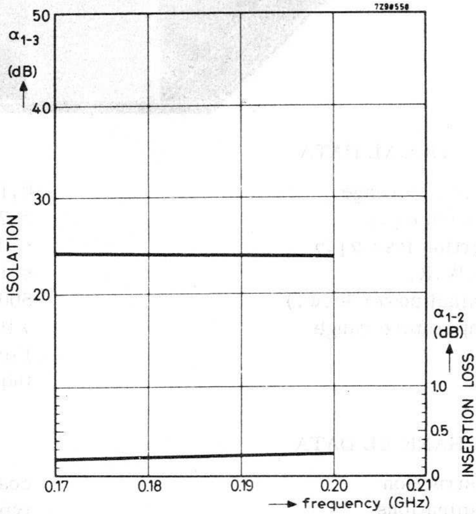
Frequency range	0.17-0.20 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.40 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	+10 to +100 °C For other temperature ranges please inquire

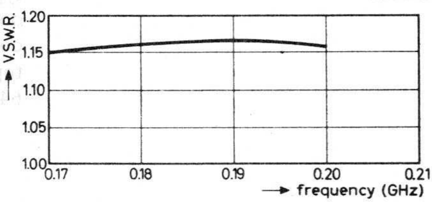
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	body nickelplated connectors silverplated top and bottom cover black
Weight	6400 g



Dimensions in mm

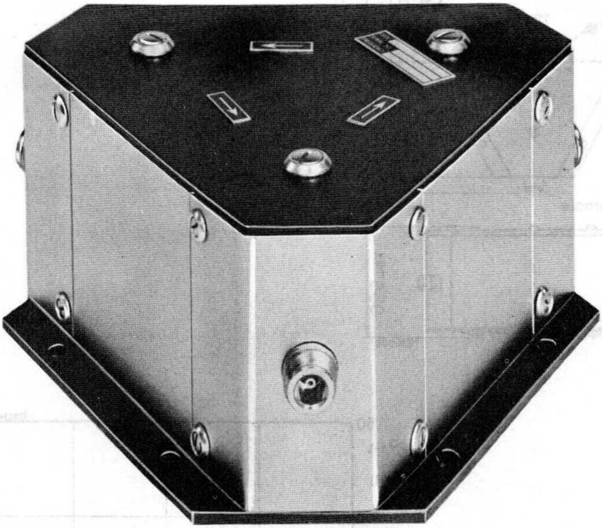




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5201

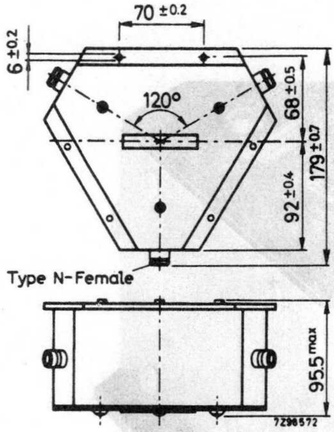


ELECTRICAL DATA

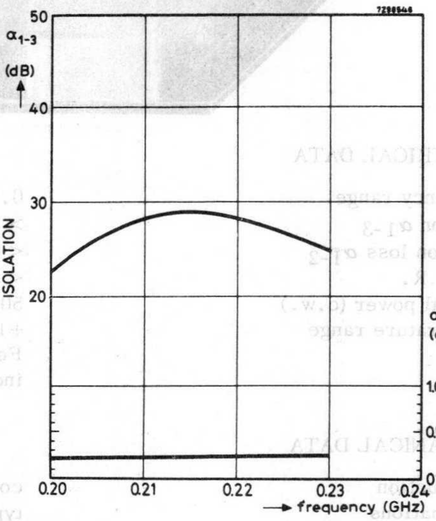
Frequency range	0.20-0.23 GHz
Isolation α_{1-3}	> 20 dB
Insertion loss α_{1-2}	< 0.40 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	500 W
Temperature range	+10 to +100 °C For other temperature ranges please inquire

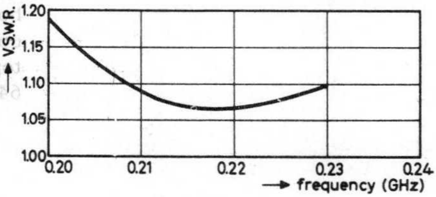
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	body nickelplated connectors silverplated top and bottom cover black
Weight	6400 g



Dimensions in mm

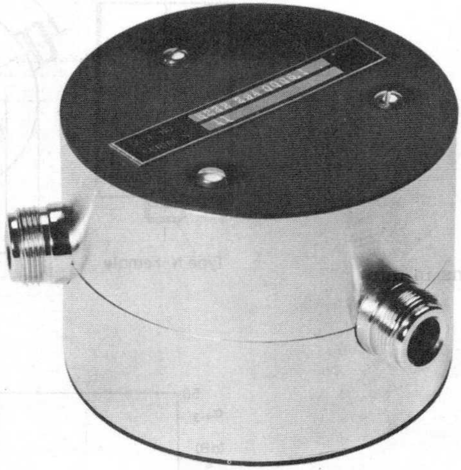




Typical performance as a function of frequency at a working temperature of 20 °C.

CIRCULATOR

CL5251



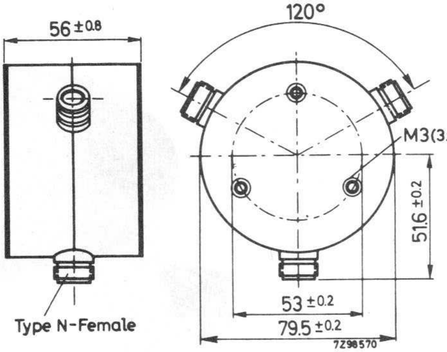
ELECTRICAL DATA

Frequency range	0.47-0.59 GHz
Isolation α_{1-3}	> 22 dB
Insertion loss α_{1-2}	< 0.35 dB
V.S.W.R.	< 1.2
Nominal power (c.w.)	100 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

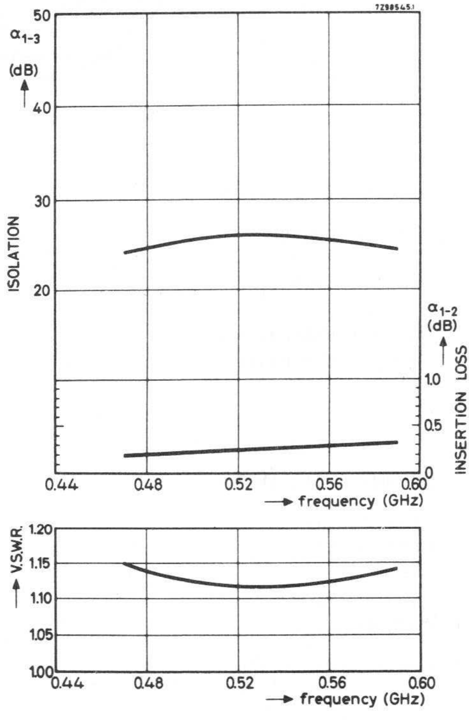
MECHANICAL DATA

Construction	coaxial 3 port
Terminations	type N-female
Finish	silverplated top and bottom cover black
Weight	1200 g

CL5251

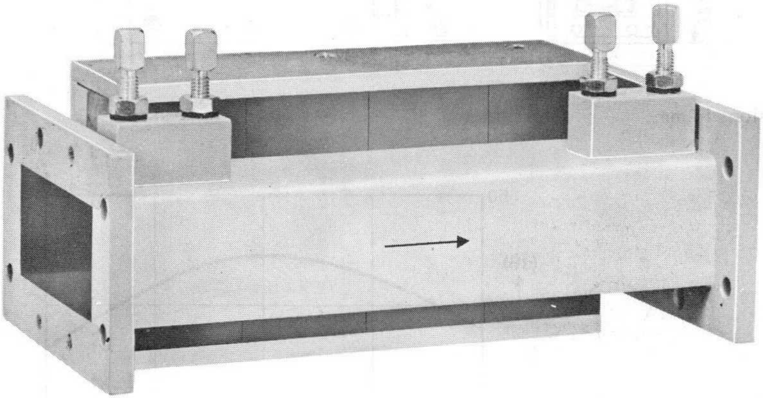


Dimensions in mm



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

ISOLATOR CL6201

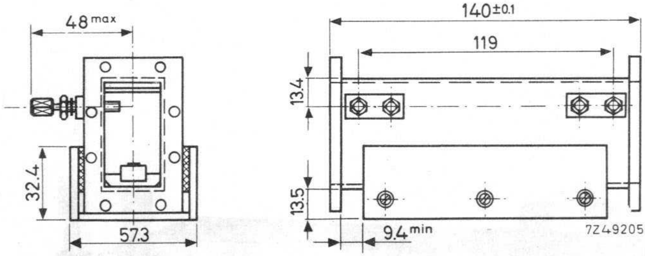


ELECTRICAL DATA

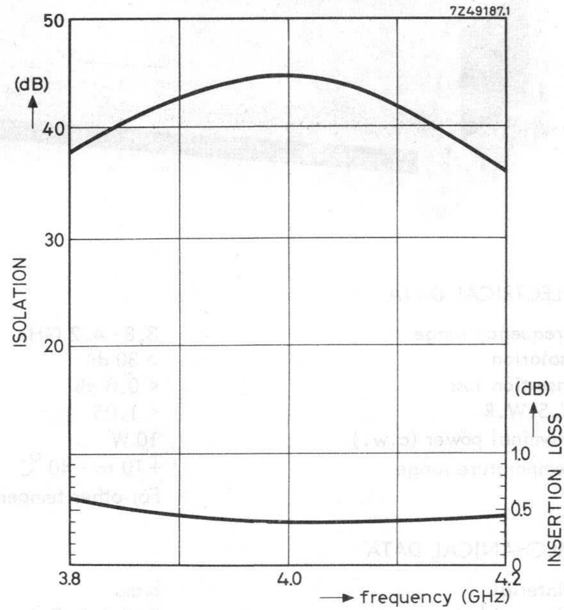
Frequency range	3.8 - 4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C
	For other temperature ranges please inquire

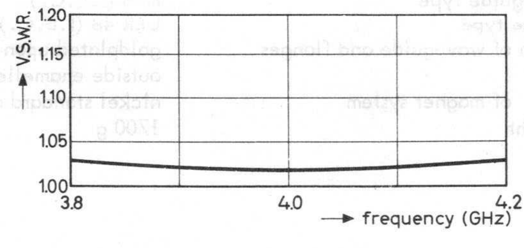
MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated
	outside enamelled grey
of magnet system	nickel standard mat
Weight	1700 g



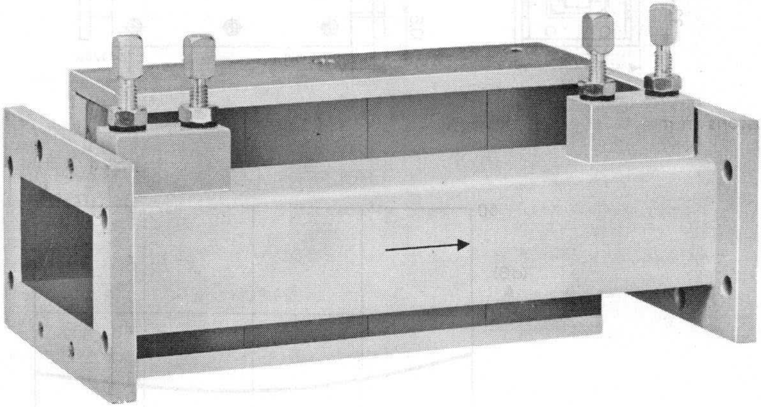
Dimensions in mm.





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

ISOLATOR CL6202

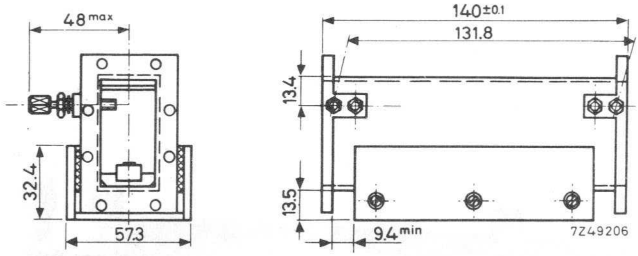


ELECTRICAL DATA

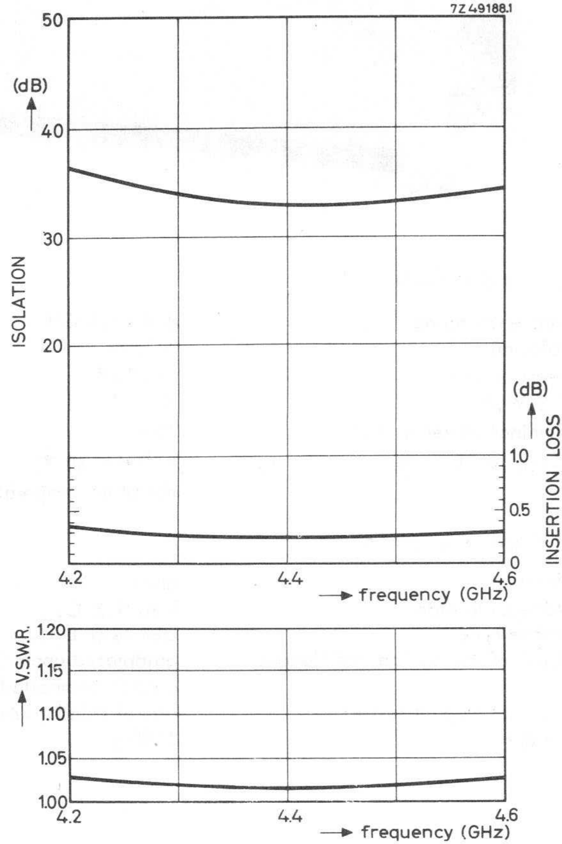
Frequency range	4.2 - 4.6 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C
	For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated
	outside enamelled grey
of magnet system	nickel standard mat
Weight	1680 g

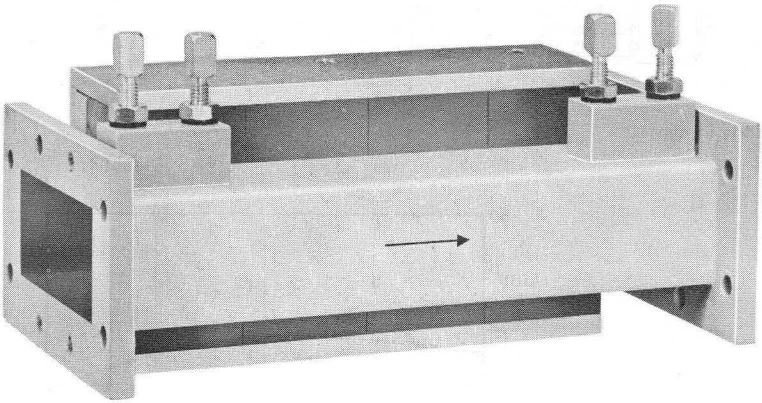


Dimensions in mm.



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

ISOLATOR CL6203

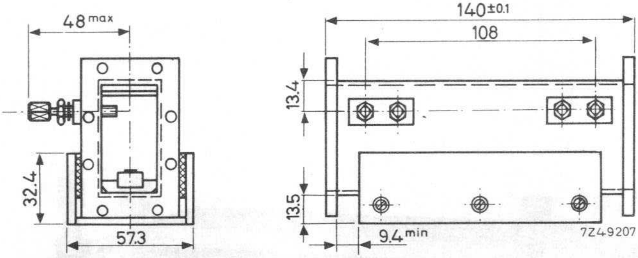


ELECTRICAL DATA

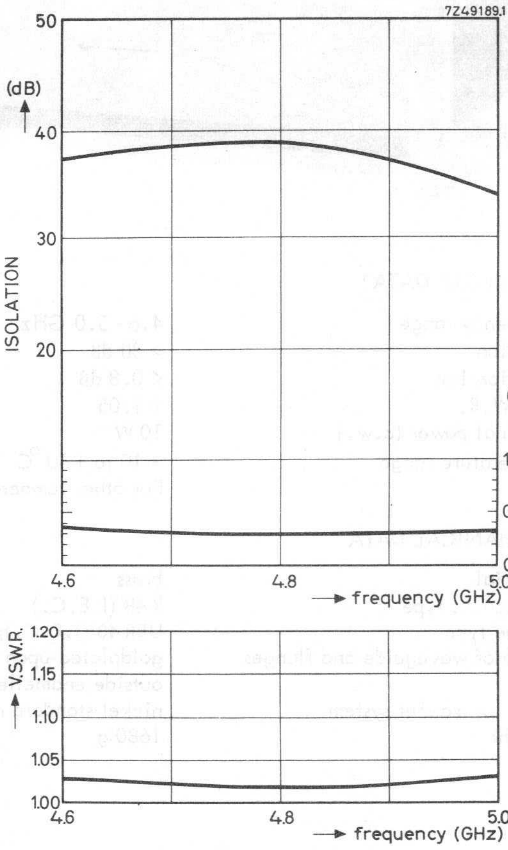
Frequency range	4.6 - 5.0 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 40 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 48 (I.E.C.)
Flange type	UER 48 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1680 g



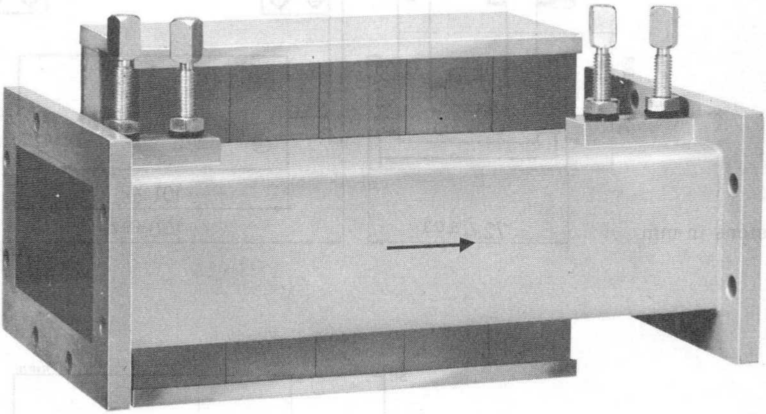
Dimensions in mm.



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

ISOLATOR

CL6204

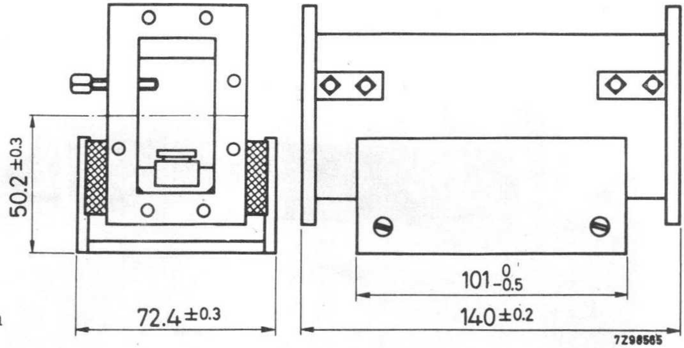


ELECTRICAL DATA

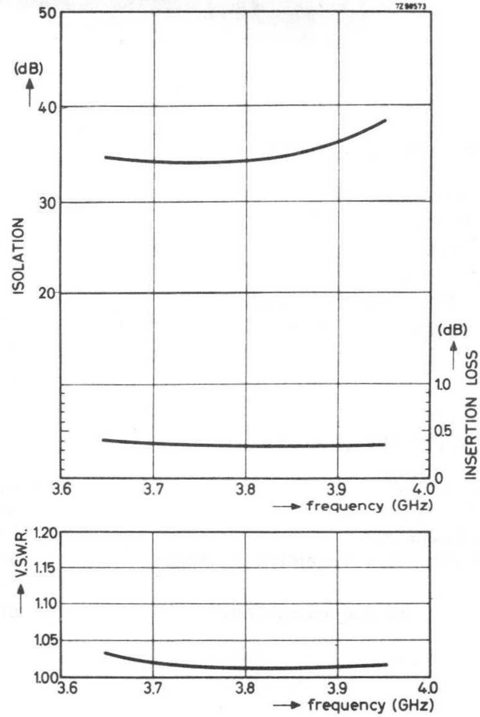
Frequency range	3.65-3.95 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	15 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R40 (I.E.C.)
Flange type	UER40 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat

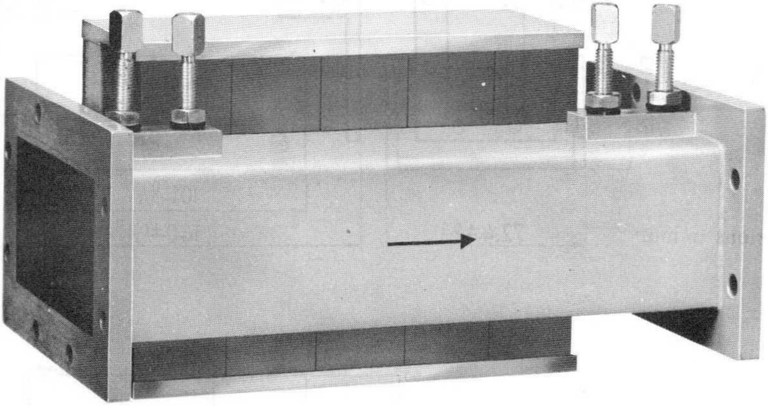


Dimensions in mm



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

ISOLATOR CL6205



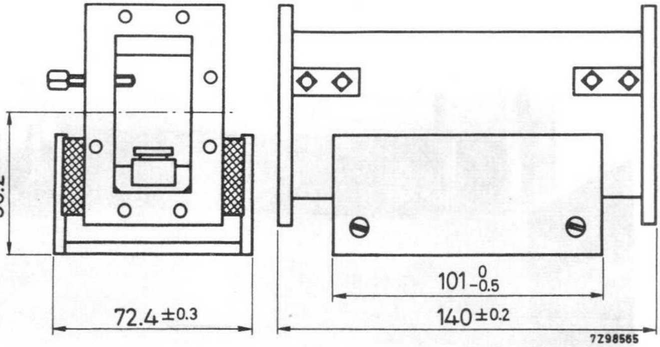
ELECTRICAL DATA

Frequency range	3.9-4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	15 W
Temperature range	+10 to +80 ^{o}C For other temperature ranges please inquire

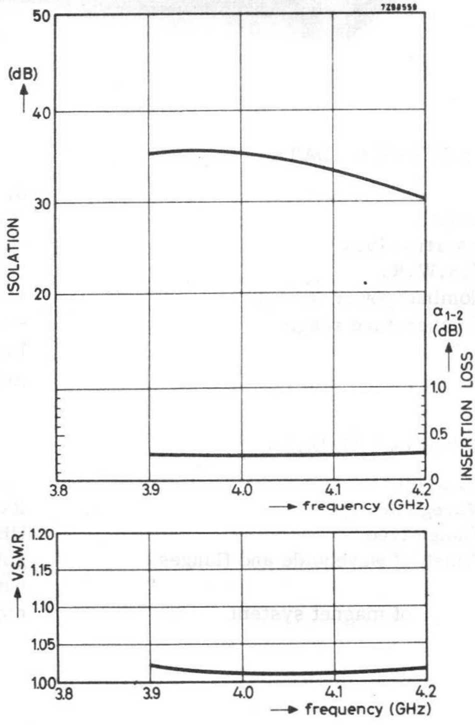
MECHANICAL DATA

Material	brass
Waveguide type	R40 (I.E.C.)
Flange type	UER40 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat

CL6205



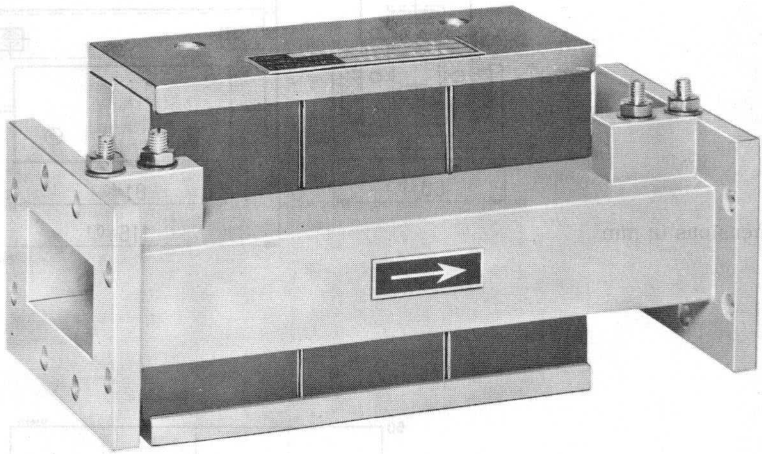
Dimensions in mm



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

ISOLATOR

CL6206

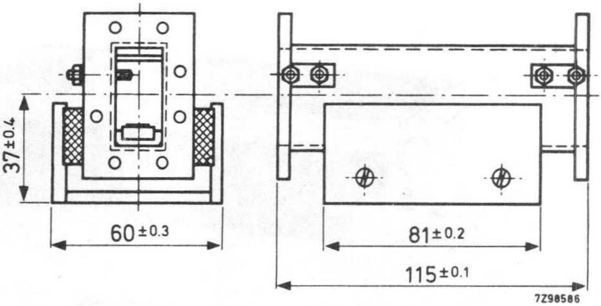


ELECTRICAL DATA

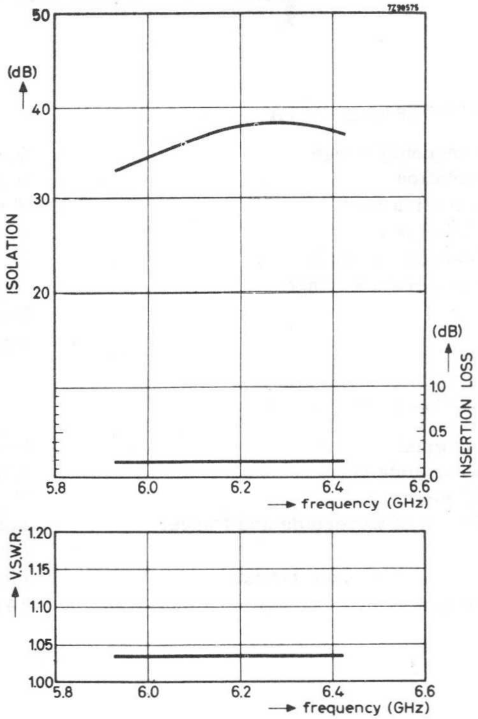
Frequency range	5.925-6.425 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

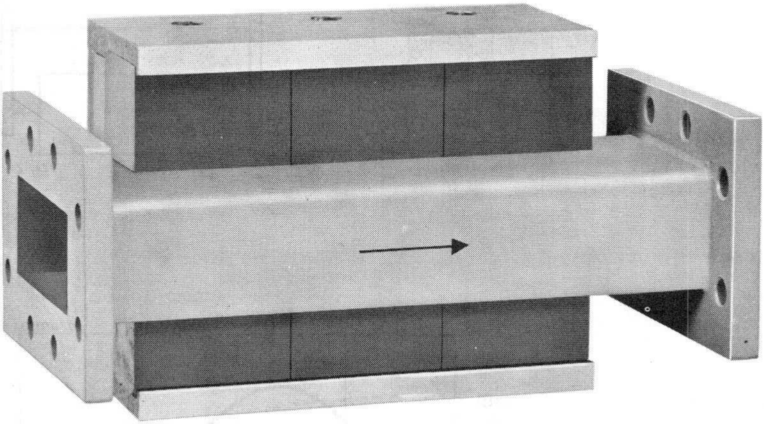


Dimensions in mm



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

ISOLATOR CL6210



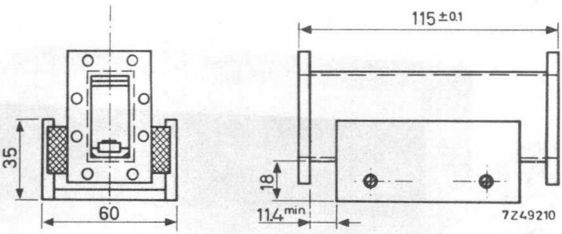
ELECTRICAL DATA

Frequency range	7.4-8.025 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

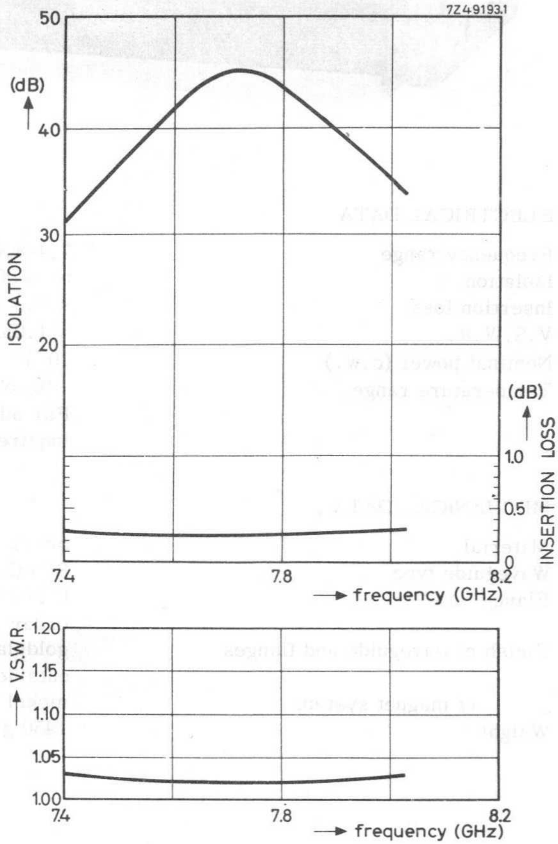
MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

CL6210

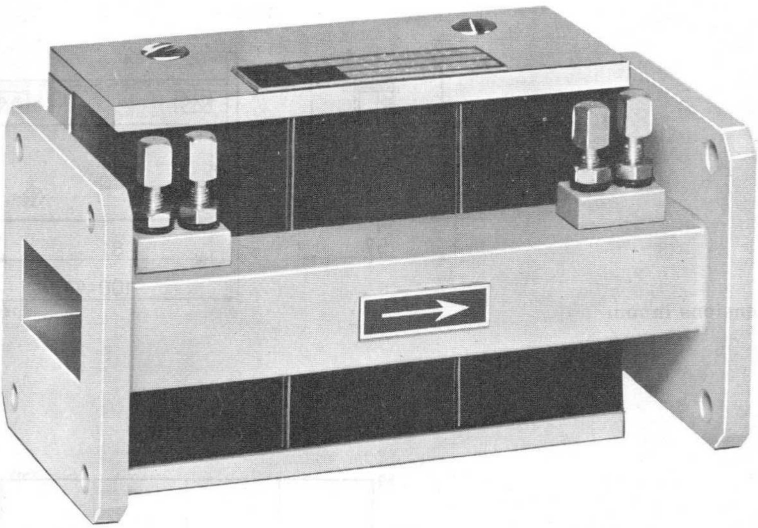


Dimensions in mm



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

ISOLATOR CL6214

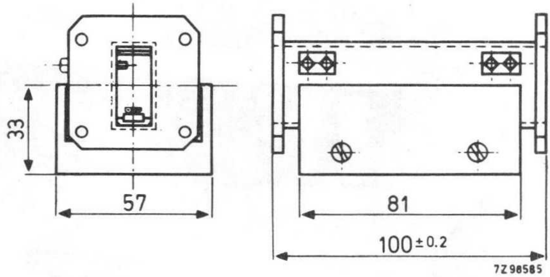


ELECTRICAL DATA

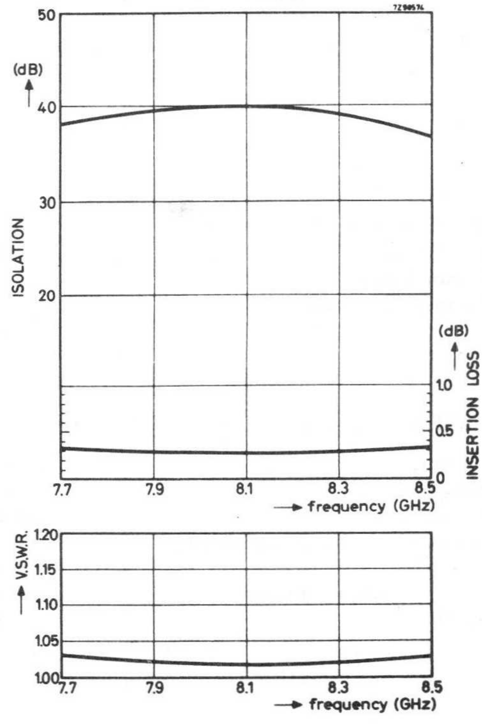
Frequency range	7.7-8.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R84 (I.E.C.)
Flange type	UBR84 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1260 g

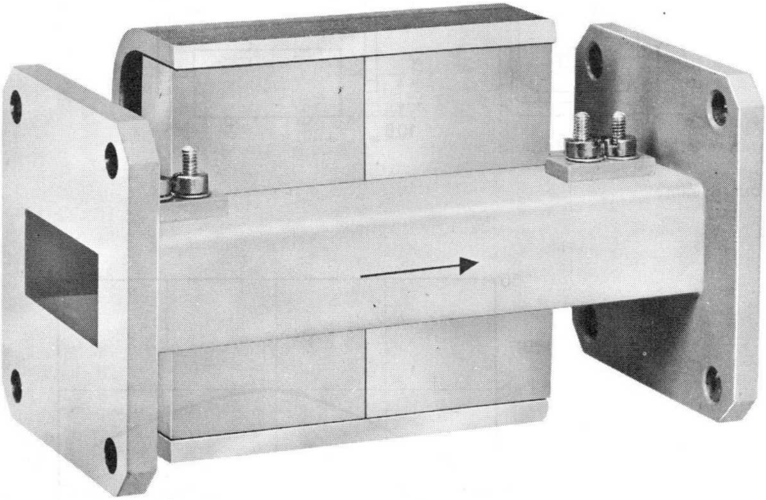


Dimensions in mm



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

ISOLATOR CL6215

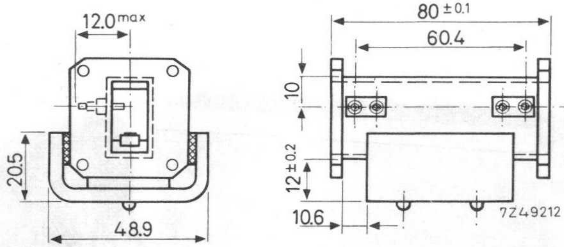


ELECTRICAL DATA

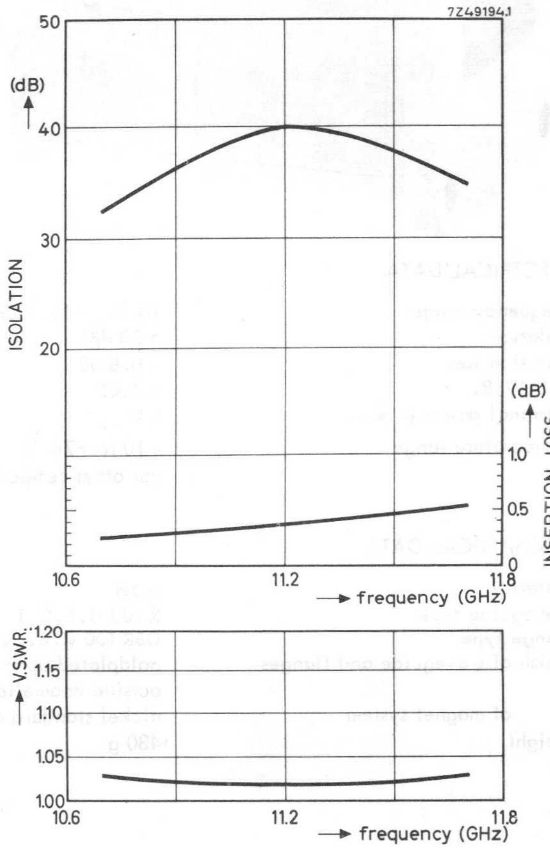
Frequency range	10.7 - 11.7 GHz
Isolation	> 30 dB
Insertion loss	< 0.8 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	5 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 100 (I.E.C.)
Flange type	UBR 100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	430 g

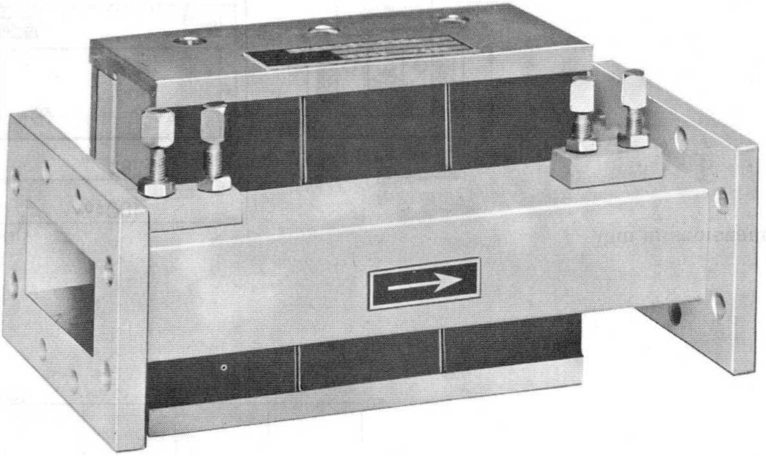


Dimensions in mm.



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

ISOLATOR CL6216

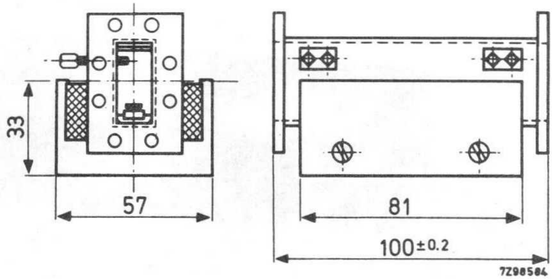


ELECTRICAL DATA

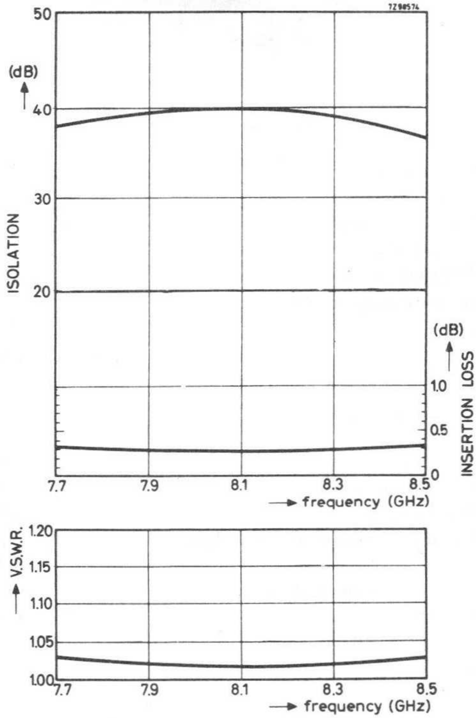
Frequency range	7.7-8.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R84 (I.E.C.)
Flange type	UER84 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1260 g



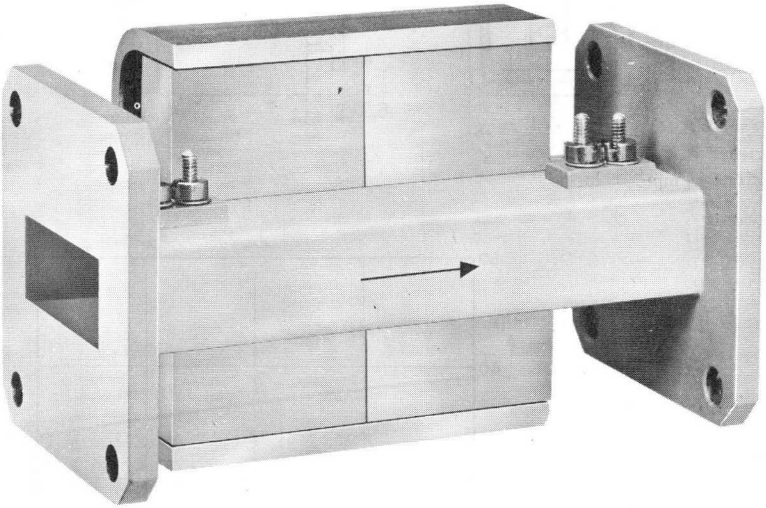
Dimensions in mm



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

ISOLATOR

CL6217

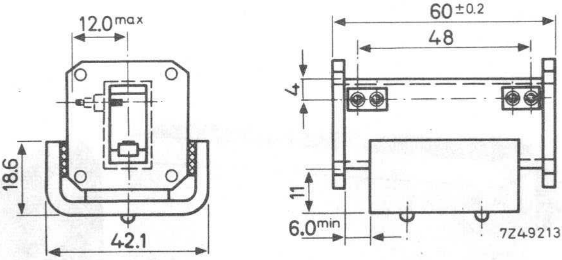


ELECTRICAL DATA

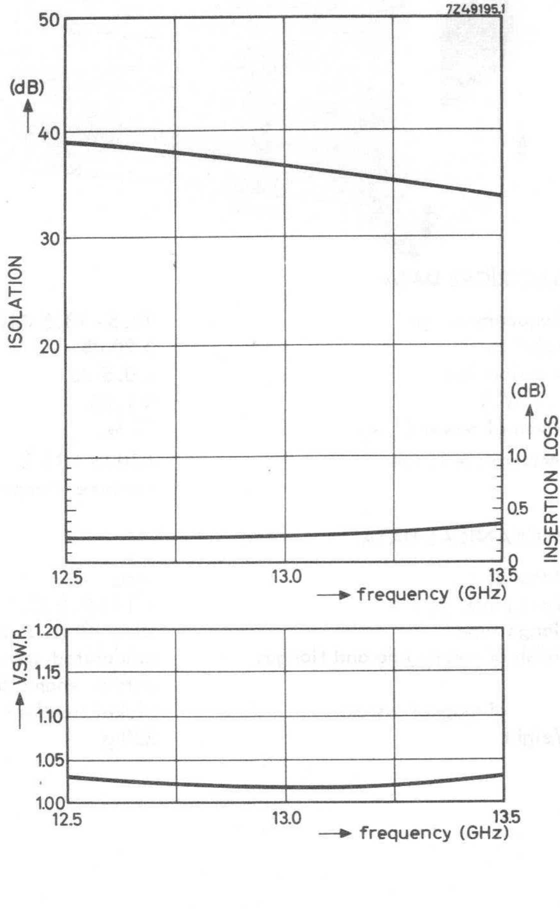
Frequency range	12.5 - 13.5 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 140 (I.E.C.)
Flange type	UBR 140 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	220 g

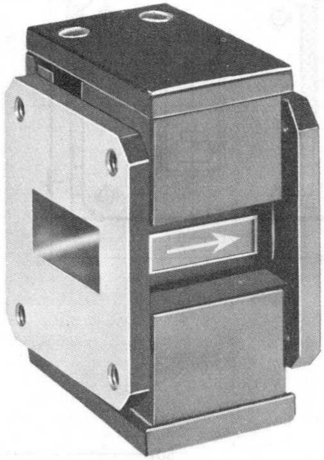


Dimensions in mm.



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

ISOLATOR CL6221



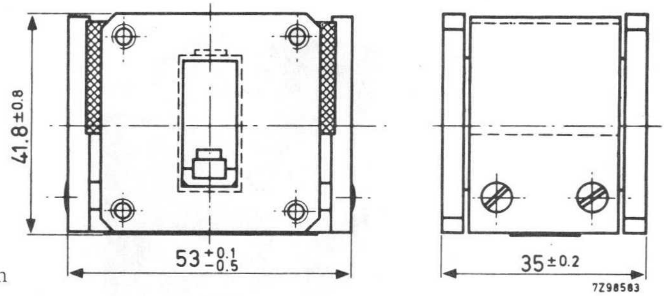
ELECTRICAL DATA

Frequency range	8.5-9.6 GHz
Isolation	> 15 dB
Insertion loss	< 0.6 dB
V.S.W.R.	< 1.15
Nominal power (c.w.)	1 W
Temperature range	+10 to +70 °C For other temperature ranges please inquire

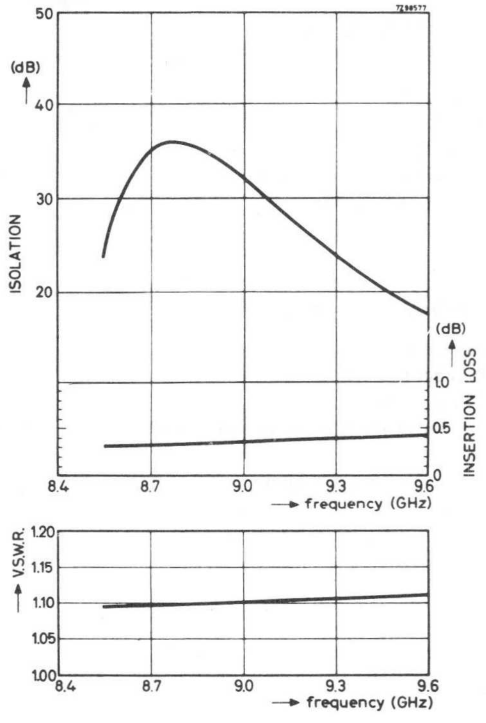
MECHANICAL DATA

Material	brass
Waveguide type	R100 (I.E.C.)
Flange type	UBR100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	nickelplated outside enamelled black
of magnet system	nickel standard mat
Weight	400 g

CL6221

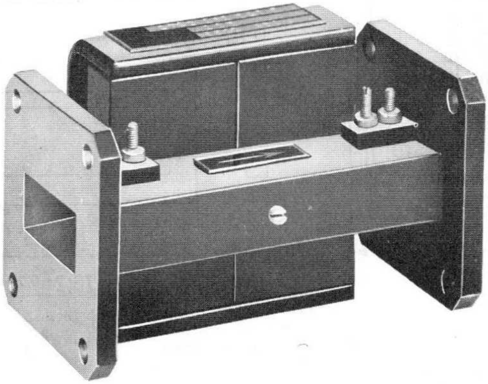


Dimensions in mm



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

ISOLATOR CL6222

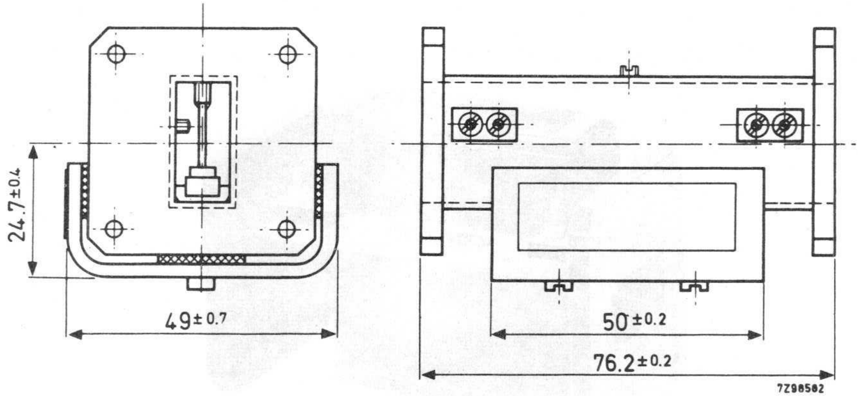


ELECTRICAL DATA

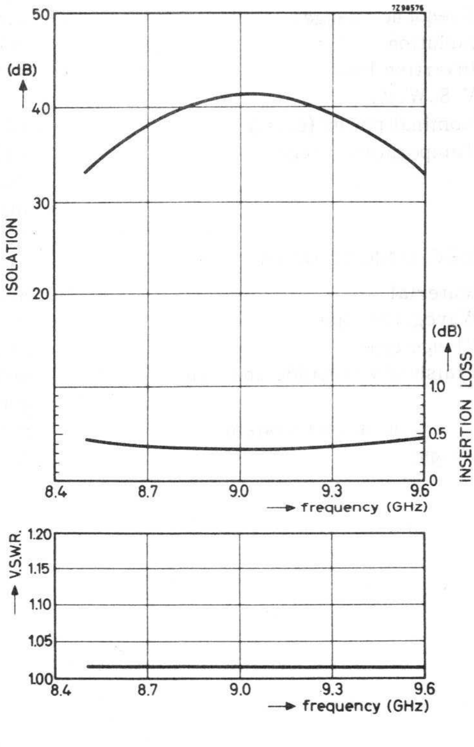
Frequency range	8.5-9.6 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R100 (I.E.C.)
Flange type	UBR100 (I.E.C.); other flanges to order
Finish of waveguide and flanges	nickelplated outside enamelled black
of magnet system	nickel standard mat
Weight	420 g

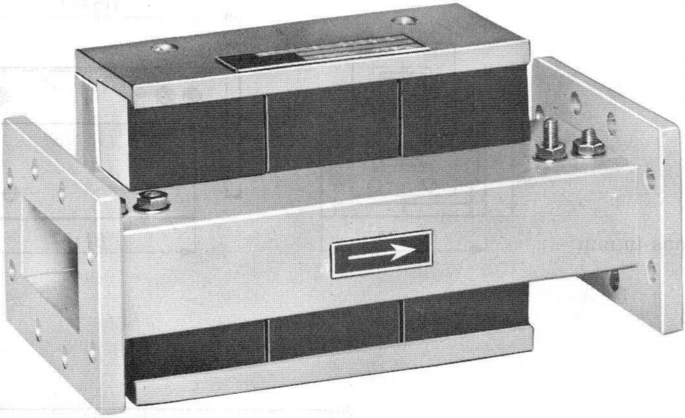


Dimensions in mm



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

ISOLATOR CL6231

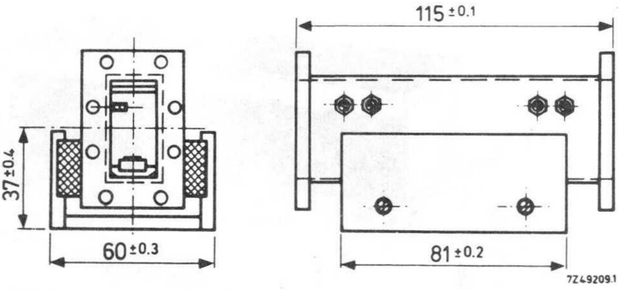


ELECTRICAL DATA

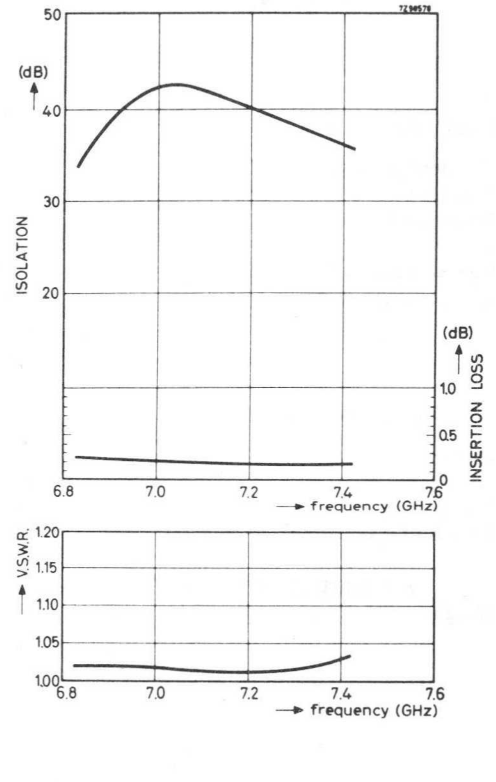
Frequency range	6.825-7.425 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

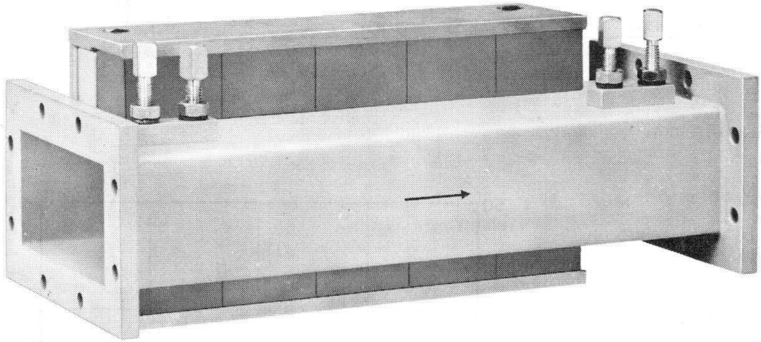


Dimensions in mm



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

ISOLATOR CL6240

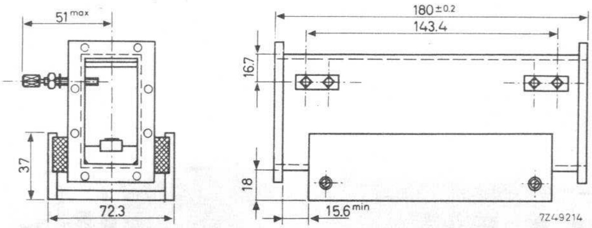


ELECTRICAL DATA

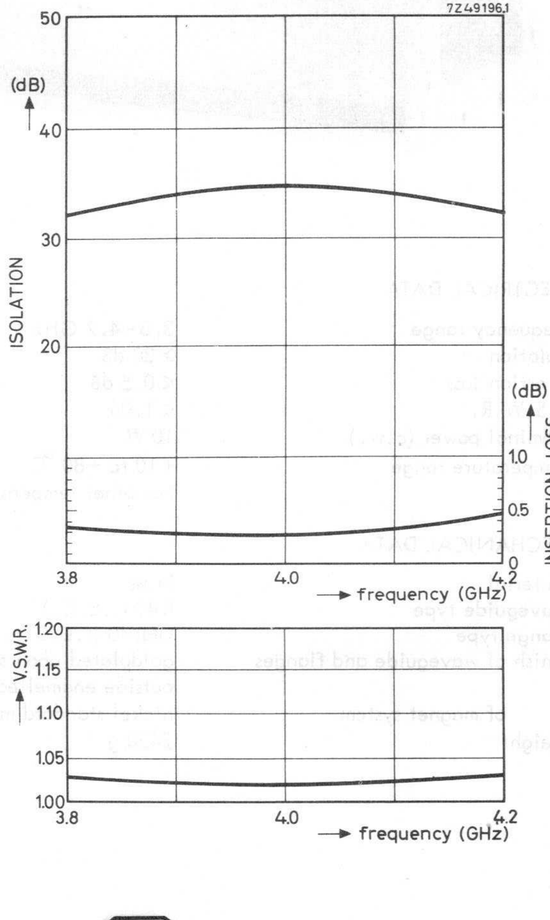
Frequency range	3.8 - 4.2 GHz
Isolation	> 30 dB
Insertion loss	< 0.5 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	10 W
Temperature range	+ 10 to + 80 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R 40 (I.E.C.)
Flange type	UER 40 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	2450 g



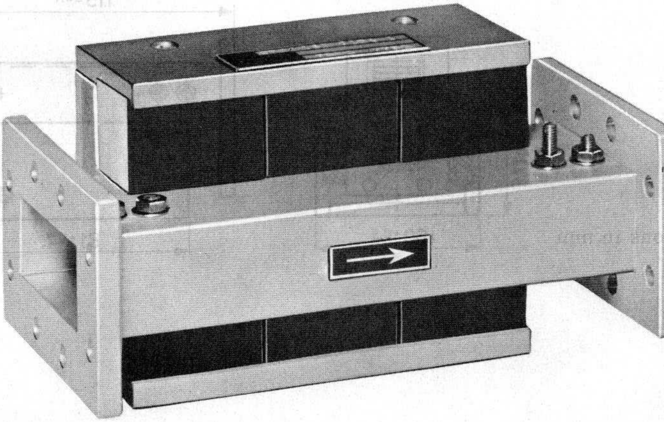
Dimensions in mm.



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

ISOLATOR

CL6241

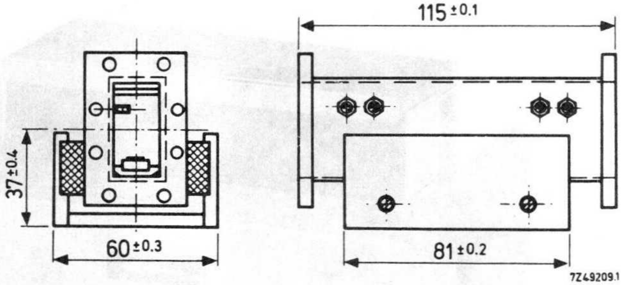


ELECTRICAL DATA

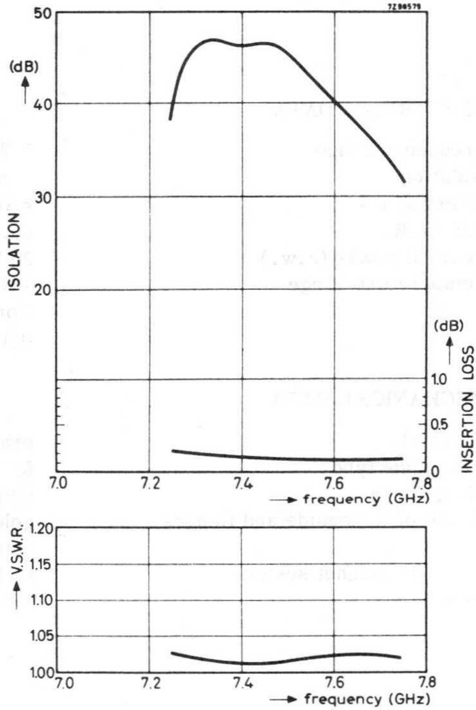
Frequency range	7.25-7.75 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	-10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g



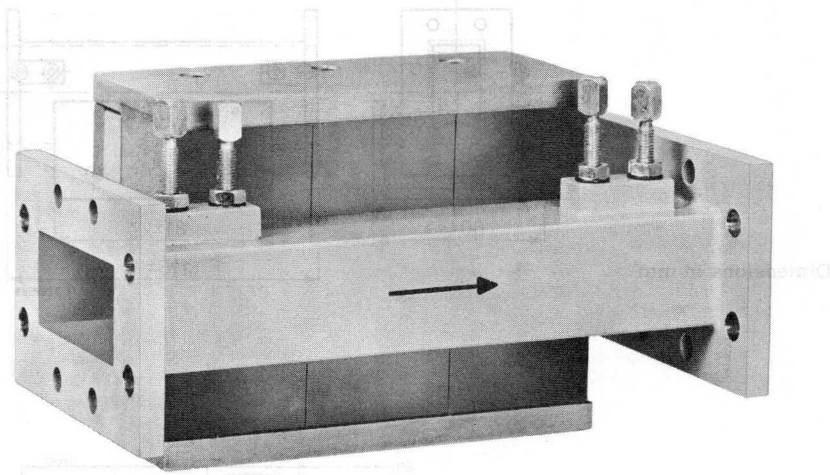
Dimensions in mm



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

ISOLATOR

CL6251



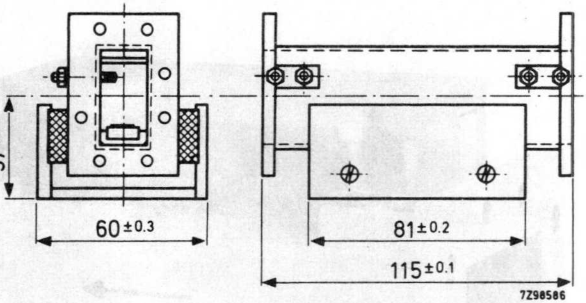
ELECTRICAL DATA

Frequency range	6.425-7.150 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

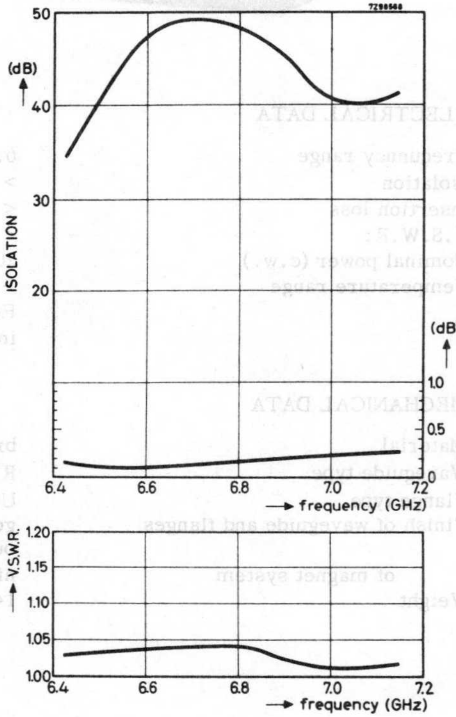
MECHANICAL DATA

Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

CL6251

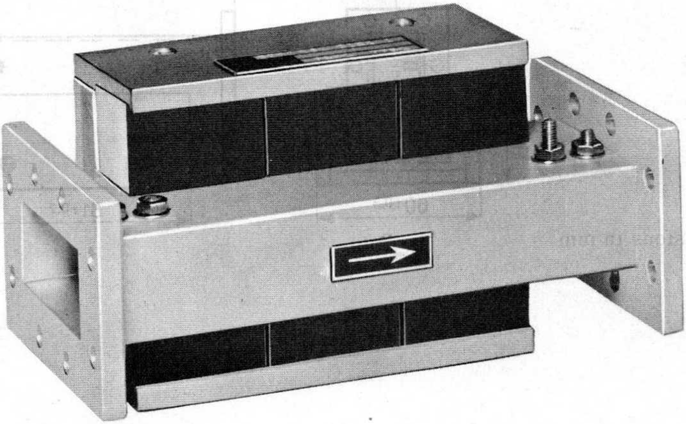


Dimensions in mm



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

ISOLATOR CL6291



ELECTRICAL DATA

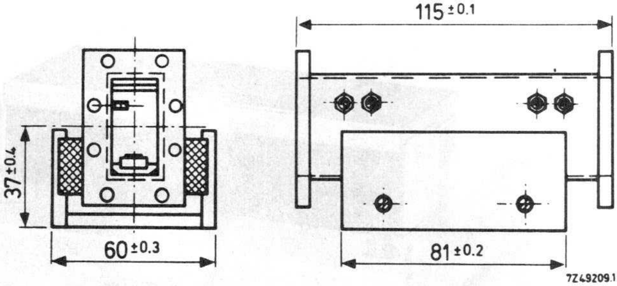
Frequency range	7.125-7.750 GHz
Isolation	> 30 dB
Insertion loss	< 0.3 dB
V.S.W.R.	< 1.05
Nominal power (c.w.)	20 W
Temperature range	−10 to +70 °C For other temperature ranges please inquire

MECHANICAL DATA

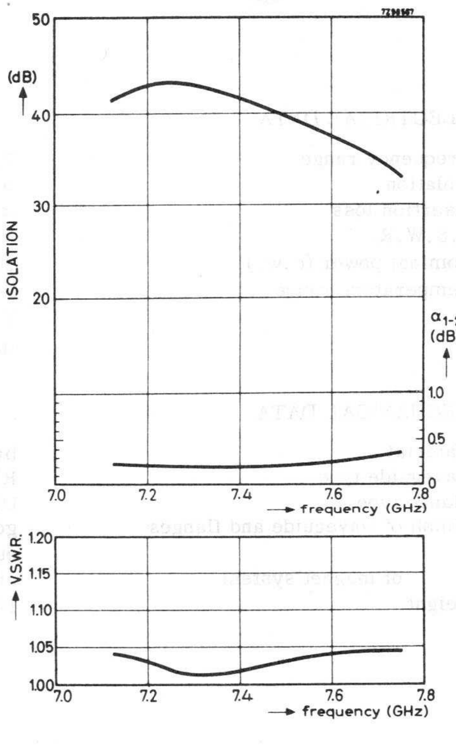
Material	brass
Waveguide type	R70 (I.E.C.)
Flange type	UER70 (I.E.C.); other flanges to order
Finish of waveguide and flanges	goldplated upon silverplated outside enamelled grey
of magnet system	nickel standard mat
Weight	1450 g

Mullard

CL6291



Dimensions in mm



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

MIXER ACCESSORIES

Crystal contacts and retaining covers for coaxial balanced mixers

CL 7050
CL 7051
CL 7052

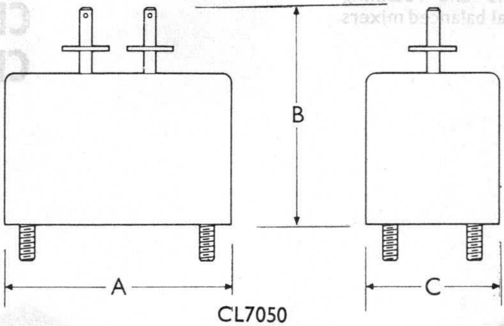
CL7050 For CL7300 Series

CL7051 For CL7311 Series

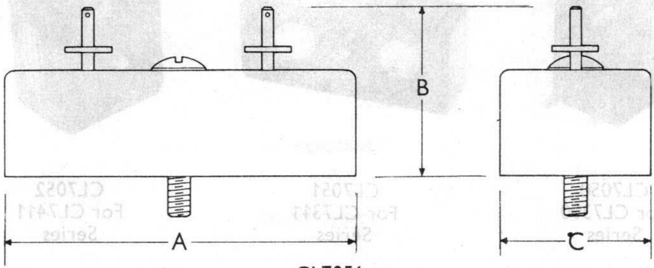
CL7052 For CL7411 Series

The covers are machined from solid blocks of Paxolin and their spring-loaded contacts are silver plated to DTD 919B. The CL7050 and CL7051 covers, fitted to their respective mixers, are shown below.

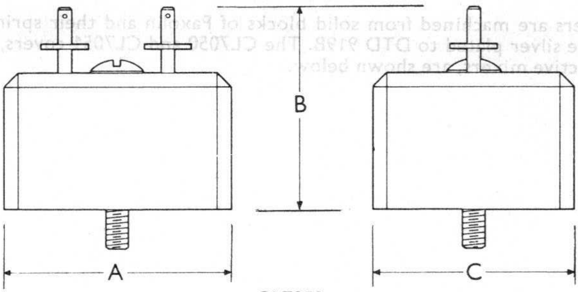
TP388B



CL7050



CL7051



CL7052

DIMENSIONS AND WEIGHTS

	CL7050		CL7051		CL7052	
	Inches	*Millimetres*	*Inches*	*Millimetres*	*Inches*	*Millimetres*
A	$1\frac{1}{2}$	38	$2\frac{5}{16}$	58	$1\frac{1}{2}$	38
*B	$1\frac{7}{16}$	37	$1\frac{1}{8}$	28	$1\frac{5}{16}$	33
C	$\frac{7}{8}$	22	1	25	$1\frac{1}{3}$	32
Weight	1 oz (28g)		1 oz (28g)		1 oz (28g)	

*With crystals fitted in mixer.

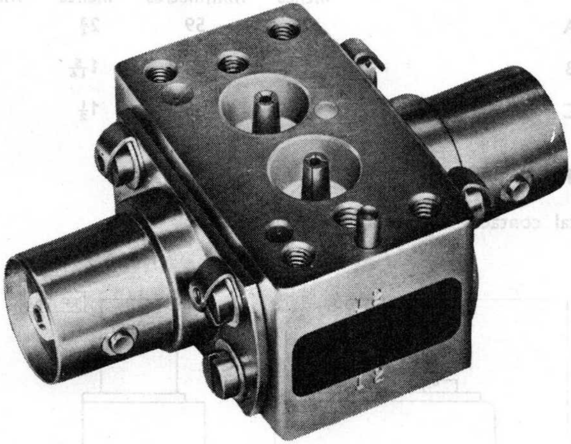
X-BAND COAXIAL BALANCED MIXER

CL 7300
CL 7301

QUICK REFERENCE DATA

Unless otherwise shown data is applicable to both types

Type	Coaxial balanced mixer
Frequency	7.0 to 11.5 Gc/s



ELECTRICAL CHARACTERISTICS

Frequency range	7.0 to 11.5 Gc/s
Isolation	>10 dB
Out of balance	< 1.5 dB
Input v.s.w.r.	> 0.2
Total output capacitance	14pF ± 1.5 pF

MECHANICAL DATA

Construction	Coaxial Balanced Mixer
Terminations	Input } CL7300 – Type C, 50Ω Output } CL7301 – Type N, 50Ω
External finish	Silver plated to DTD919B and Rhodium flashed
Weight	$5\frac{1}{2}$ oz (156g)

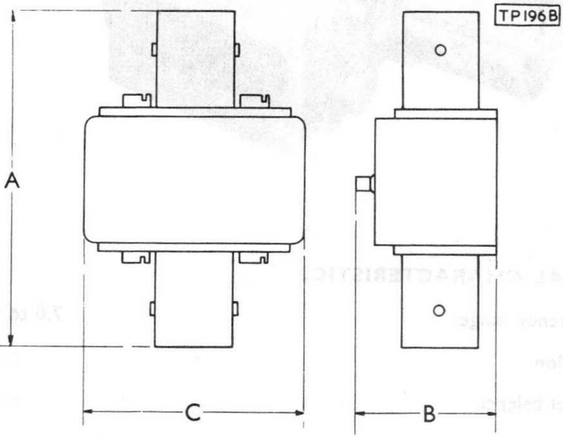
OUTLINE DRAWING

Dimensions

	CL7300		CL7301	
	Inches	*Millimetres*	*Inches*	*Millimetres*
A	$2\frac{5}{16}$	59	$2\frac{3}{4}$	70
B	$1\frac{5}{16}$	34	$1\frac{5}{16}$	34
C	$1\frac{1}{2}$	38	$1\frac{1}{2}$	38

ACCESSORIES

Crystal contacts and retaining cover CL7050

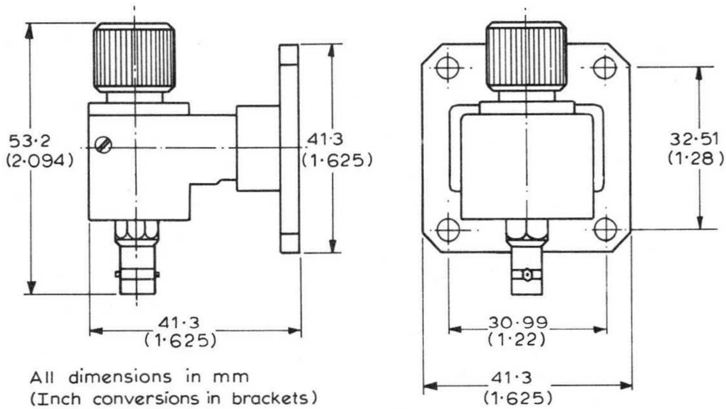


MIXER CL7309

QUICK REFERENCE DATA		
X-Band single-ended mixer for AAY39 diode. The X-Band mixer is specifically designed to accept the Mullard type AAY39 sub-miniature germanium point-contact mixer diode which has a typical noise figure of 6dB.		
Frequency range	9.0 to 11.8	GHz
Output connector type	BNC	

Waveguide size	R100 (I.E.C.) WG16 (U.K.) WR90 (U.S.)	
Frequency range	9.0 to 11.8	GHz
Output capacitance	< 10	pF
v.s.w.r. (typ.)	> 2.5 : 1	
Flanges	American plain square: UG39/U Joint-Services specification: 5985 - 99 - 083 - 0052	
External finish	Nickel plated with rhodium flash	

OUTLINE DRAWING



All dimensions in mm
(Inch conversions in brackets)

QUICK REFERENCE DATA		
The mixer is designed for the AAY34 diode which is held in a collet for correct positioning of the diode in the waveguide. A stepped transition is employed to match the diode to WG22 waveguide.		
Frequency	26.5 to 40	GHz
Noise figure	9.0	dB

ELECTRICAL CHARACTERISTICS ($T_{amb} = 20^{o}C$)

Typical figures obtained with AAY34 diode fitted

Frequency (Fixed within the band)	26.5 to 40	GHz
V_b (forward)	150	mV
I (d.c.)	0.5	mA
Local oscillator power	0.6	mW
v.s.w.r.	2.0 : 1	
*Noise figure (image matched)	9.0	dB
*Noise temperature ratio of diode	1.6:1	
I.F. impedance	500 to 1000	Ω
**Output capacitance	6.0	pF

*At 45MHz intermediate frequency: amplifier noise figure 1.5dB

**Capacitance of diode = 0.2pF approximately

MECHANICAL DATA

Waveguide number

WG22 (WR28, R320, RG-96/U)

Waveguide coupling

The block is drilled and tapped to accept a UG-599/U mating flange. Alternatively, 6BA tapped holes may be provided on request. A suitable mating flange or adaptors to the plain round flange 5985-99-083-0061 (Brass WG26) can be supplied.

MECHANICAL DATA (cont'd)

I.F. output connection

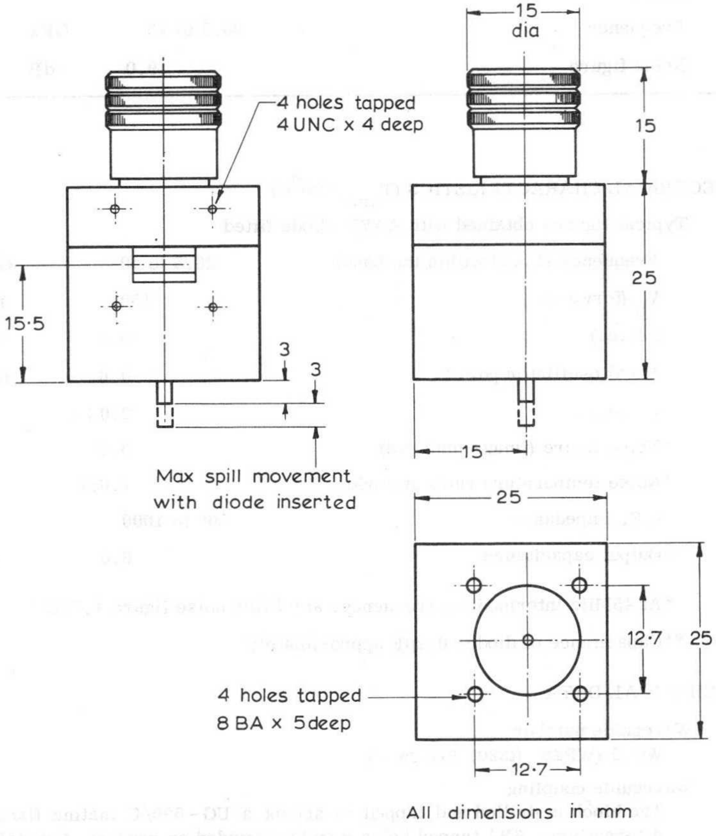
Solder spill. Four 8BA tapped holes are provided for bolting the i.f. amplifier to the mixer mount.

Weight	135	g

Finish

Gold plate, including the i.f. solder spill.

OUTLINE DRAWING OF CL7310



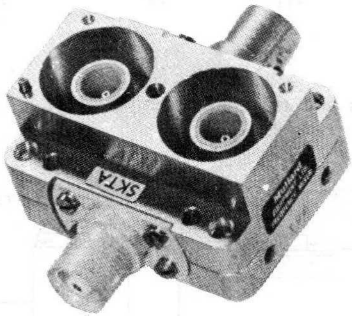
S-BAND COAXIAL BALANCED MIXER

CL 7311 CL 7312

QUICK REFERENCE DATA

Unless otherwise shown data is applicable to both types

Type	Coaxial balanced mixer
Frequency	2.5 to 4.1 Gc/s



ELECTRICAL CHARACTERISTICS

Frequency range	2.5 to 4.1	Gc/s
Isolation	> 15	dB
Out of balance	< 1.5	dB
Input v.s.w.r.	> 0.48	
Total output capacitance	14.5pF ± 1.0	pF

MECHANICAL DATA

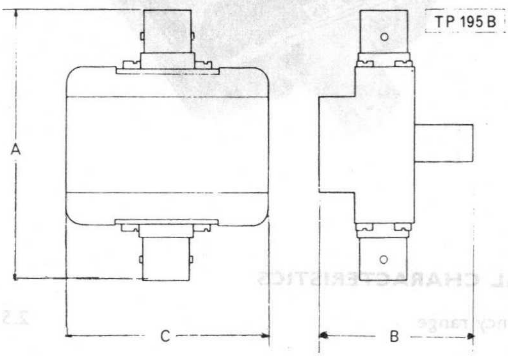
Construction	Coaxial Balanced Mixer
Terminations	Input / Output } CL 7311—Type C, 50Ω; CL 7312—Type N, 50Ω
External finish	Silver plated to DTD919B and Rhodium flashed
Weight	15oz (425g)

OUTLINE DRAWING

Dimensions	CL 7311		CL 7312	
	Inches	*Millimetres*	*Inches*	*Millimetres*
A	$3\frac{1}{16}$	78	$3\frac{1}{2}$	89
B	2	51	2	51
C	$2\frac{5}{16}$	59	$2\frac{5}{16}$	59

ACCESSORIES

Crystal contacts and retaining cover CL 7051



X-BAND GUNN OSCILLATORS

CL8360 CL8380 CL8370 CL8390

QUICK REFERENCE DATA

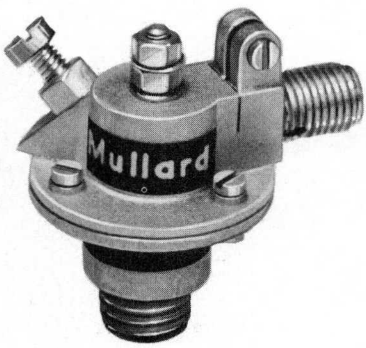
A range of four Gunn oscillators covering the X-band. Compact solid state oscillators for general purpose use.

Frequency range	CL8360	8 to 9	GHz
	CL8370	9 to 10	GHz
	CL8380	10 to 11	GHz
	CL8390	11 to 12	GHz
Power output (typ.)		5.0	mW
Operating voltage		-7.0	V

Unless otherwise shown, data is applicable to all types

OPERATING CONDITIONS

Operating voltage	-7.0	V
Operating current	120	mA
P_{out}	5.0	mW



CHARACTERISTICS (at 25 °C)

Nominal centre frequency	CL8360		8.5		GHz
	CL8370		9.5		GHz
	CL8380		10.5		GHz
	CL8390		11.5		GHz
	Min.	Typ.	Max.		
Mechanical tuning range	±500	±550	-		MHz
P_{out} over tuning range	2.0	5.0	-		mW
Variation in P_{out} over tuning range	-	-	3.0		dB

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Operating voltage max.	-8.0	V

TEMPERATURE

Range max.	-25 to +85	°C

OUTPUT CONNECTOR

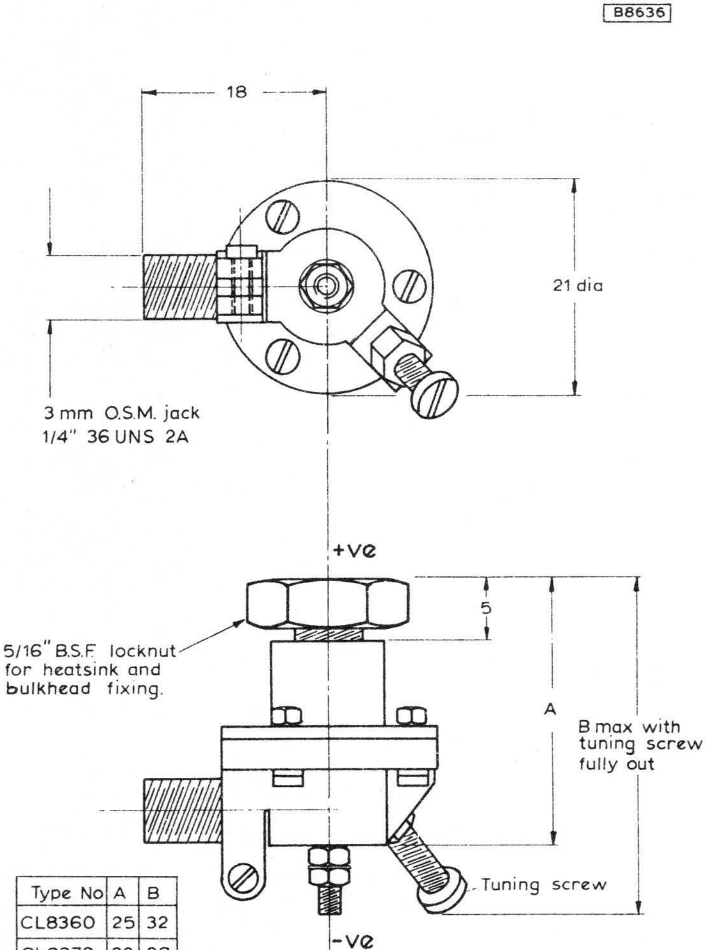
50Ω O.S.M.

OPERATING NOTES

1. The output probe may be adjusted for maximum power at any frequency in the tuning range.

2. The active element will be damaged if the supply voltage is reversed. See outline drawing on page 3.

OUTLINE DRAWING



Type No	A	B
CL8360	25	32
CL8370	22	29
CL8380	20	27
CL8390	20	27

All dimensions in mm.

X-BAND GUNN OSCILLATOR

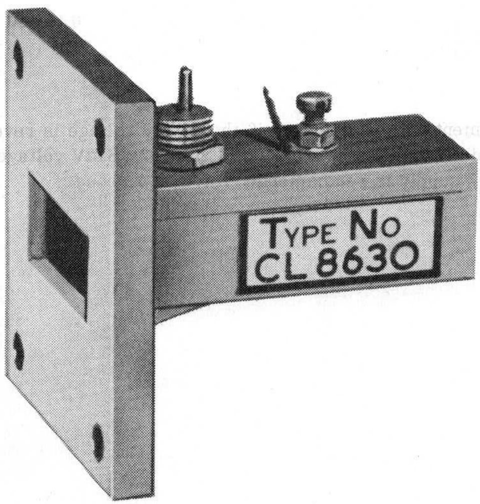
CL8630

TENTATIVE DATA

QUICK REFERENCE DATA		
Fixed frequency Gunn oscillator for operation in the 10.7GHz band. Applications include all forms of miniature radar systems.		
Centre frequency	10.69	GHz
Power output (at 7V) typical	8.0	mW
Supply voltage	7.0	V
Output via square plain flange WG16. WR90. 5985-99-083-0052		

OPERATING CONDITIONS

Supply voltage (see operating note)	+7.0	V
Supply current (at 7.0V)	140	mA
Power output (at 7.0V)	8.0	mW



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

Supply voltage max.	+7.0	V
Supply current max. running	200	mA
starting	250	mA
Load v.s.w.r. max.	1.5:1	

CHARACTERISTICS at 25°C

Centre frequency		10.69		GHz
	Min.	Typ.	Max.	
Power output (at 7.0V)	5.0	8.0	-	mW
Frequency (fixed)	10.675	10.69	10.7	GHz
Frequency temperature coefficient	-	-0.25	-0.4	MHz/degC
Frequency pushing	-	1.5	-	MHz/V

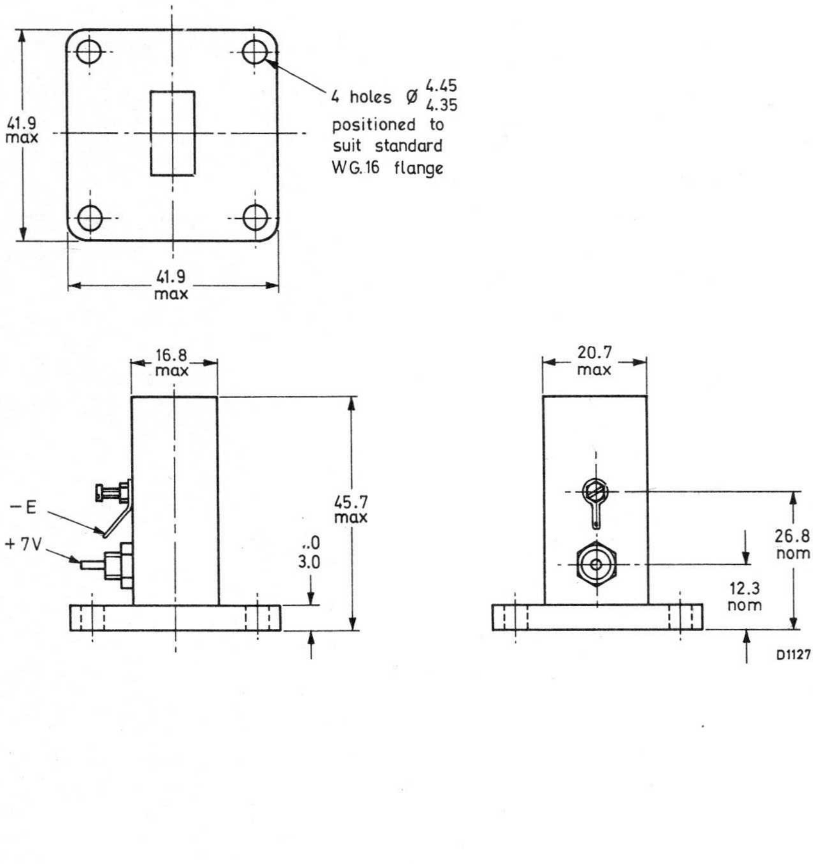
TEMPERATURE

Range max.	0 to +40	°C

OPERATING NOTE

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

OUTLINE DRAWING



ABRIDGED DATA FOR EARLIER TYPES AND INDEX

G

ABRIDGED DATA FOR EARLIER TYPES

BOOK 2 PART 5—MICROWAVE TUBES AND COMPONENTS

Abridged data only are given in this table.
Full data for these types are available on request.

Disc seal triodes

Type No.	Description	Typical Power Output (W)	At Frequency (GHz)	Max. Frequency (GHz)	$p_a$max. (W)	$V_a$max. (V)	I_a or I_k max. (mA)	g_m (mA/V)	†I_f or I_h (A)
TD03-10	Oscillator or Amplifier	2·8	1·0	3·0	10	350	50	6·0	0·4
TD03-10F	Oscillator	2·8	1·0	3·1	10	350	50	6·0	0·4
TD1-100C	Oscillator or Amplifier Forced-air cooled	27	0·5	2·5	100	1000	125	25	1·0
TD2-500A	Oscillator or Amplifier Forced-air cooled	580	0·625	1·0	500	2700	575	14	19 (3·4V)
TD2-400A	Oscillator or Amplifier Forced-air cooled	600	0·470	0·9	400	2200	520	10	19 (3·4V)

†V_f or V_h=6·3V unless otherwise stated.

INDEX TO BOOK 2, PART 5

MICROWAVE TUBES AND COMPONENTS

*Not recommended for the design of new equipment.
Full data for these types are available on request.

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Full data for these types are available on request.

MICROWAVE TUBES & COMPONENTS

CONTENTS

Technical Publications Department.

MULLARD LIMITED
MULLARD HOUSE, TORRINGTON PLACE, LONDON, WC1E 7HD

Printed in England

TP1225