

**Mullard
technical
handbook**



**Book two
Valves and tubes**

Part five

**Microwave tubes
and components**

December 1972

MICROWAVE TUBES & COMPONENTS

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Book 2 comprises the following parts—

- Part 1 Receiving valves, television picture tubes.
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BOOK 2 (Part 5)

VALVES AND TUBES

**Microwave tubes
and components**

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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. |

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 at the time of going to press. 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.

Requests for information on the data handbook system and for individual data sheets should be made to

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

SELECTION GUIDE

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 |
| 160 | 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. |
|-------------|-----------------------|----------|
| 1.4 | 9.41 ± 0.03 | YJ1390 |
| 3.0 | 9.41 ± 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 |
| 26 | 9.445 ± 0.03 | YJ1121 |
| 26 | 9.415 to 9.46 | YJ1123 |
| 26 | 9.65 ± 0.03 | YJ1124 |
| 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 | 5.4 ± 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 500 μ s | 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 \pm 0.025 | 7090 |
| 1.25 | Fast warm-up for microwave cooking | 2.45 \pm 0.025 | YJ1280 |
| 2.5 | Cooking and processing. Water cooled | 2.45 \pm 0.025 | YJ1160 |
| 2.5 | Cooking and processing. Forced-air cooled | 2.45 \pm 0.025 | YJ1162 |
| 5.0 | Industrial applications. Water cooled | 2.45 \pm 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 |
| 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 |
| 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 | 25 | LB6-25 |
| 6.4 to 7.2 | 20 | LB6-25A |
| 7.1 to 7.8 | 18 | LB7-20E |

Television transposer travelling wave tube

| Frequency (MHz) | Minimum saturated power output (W) | Type No. |
|-----------------|------------------------------------|----------|
| 470 to 860 | 220 | YH1210 |

Section F—MICROWAVE COMPONENTS

Mixers

| Band | Frequency (GHz) | Description | Type No. |
|------|-----------------|-----------------------------|----------|
| X | 9.0 to 10 | Schottky barrier microstrip | CL7330 |
| X | 10.7 to 11.7 | Schottky barrier microstrip | CL7331 |
| X | 11.7 to 12.7 | Schottky barrier microstrip | CL7332 |
| 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 | | C.W. Power Rating (W) | Type No. |
|--------------------|-----------------------------------|-------------------|-------------------|--------------------------------|----------|
| | | Opposite Ports | Adjacent Ports | | |
| | | (dB) | | | |
| 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 | |
| Tetrode | q | Octode | |
| Pentode | p | Rectifier | r |

Thus, the grid of the triode section of a triode-hexode is denoted by g_1 .

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

| | |
|------------------------------|--------------|
| Direct Voltage | V |
| Alternating Voltage (r.m.s.) | $V_{r.m.s.}$ |
| Alternating Voltage (mean) | V_{av} |
| Alternating Voltage (peak) | v_{pk} |
| Peak Inverse Voltage | P.I.V. |

Current

| | |
|------------------------------|--------------|
| Direct Current | I |
| Alternating Current (r.m.s.) | $I_{r.m.s.}$ |
| Alternating Current (mean) | i_{av} |
| Alternating Current (peak) | i_{pk} |
| No Signal Current | i_0 |

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 | Γ _a R _a |
| Insulation Resistance (heater to cathode) | Γ _{h-k} |
| Resistance between Control-Grid and Cathode | Γ _{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—thyatron
- 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
 - B—outputs of 1W and over
 - 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
- } In backward wave and travelling
wave tubes

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 $0.5\text{kV} = 500\text{V}$

2 represents $2\text{kV} = 2000\text{V}$

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 $9\text{Gc/s} = 9000\text{Mc/s}$.

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 $6400\text{mA} = 6.4\text{A}$

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 1: 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



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

JNTI-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 | 1.35 | Gc/s |
| Pulse voltage | | | |
| ($I_{\text{pulse}} = 46\text{A}$, $H = 1.4\text{kG}$) | 26.5 | 31.5 | kV |
| R.F. pulse power output | | | |
| ($I_{\text{pulse}} = 46\text{A}$, $H = 1.4\text{kG}$) | 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 |
| $I_{h(\text{surge})}$ 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, 1½ 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.



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 | μ s |
| Duty cycle | — | 0.002 | |
| Mean input power | — | 1.8 | kW |
| Rate of rise of voltage pulse | | | |
| $t_p \leq 1.0 \mu$ s | — | 70 | kV/ μ s |
| $t_p > 1.0 \leq 5.0 \mu$ s | — | 30 | kV/ μ s |
| Load mismatch (v.s.w.r.) | — | 1.5 | |
| Temperature of anode block | — | 125 | $^{\circ}$ C |

MOUNTING POSITION

Any

PRESSURISING

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

PHYSICAL DATA

| | |
|-------------------------------|---|
| Weight of magnetron | $\left\{ \begin{array}{l} 19\text{lb} \quad 13\text{oz} \\ 9 \quad \text{kg} \\ 37\text{lb} \quad 8\text{oz} \\ 17 \quad \text{kg} \end{array} \right.$ |
| Weight of magnetron in carton | |

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 \pm 0.003 | 7.135 \pm 0.075 |
| C | 3.374 | 85.7 | max. | R | 0.169 \pm 0.005 | 4.30 \pm 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 \pm 0.185 | 203.2 \pm 4.7 | | U | 0.904 | 22.96 |
| G | 5.469 \pm 0.061 | 138.90 \pm 1.55 | | V | 0.125 \pm 0.003 | 3.175 \pm 0.075 |
| H | 0.250 \pm 0.002 | 6.35 \pm 0.05 | | W | 0.010 | 0.25 max. |
| | | (square hole) | | X | 3.055 \pm 0.007 | 77.585 \pm 0.185 |
| J | 2.310 \pm 0.003 | 58.6625 \pm 0.0625 | | Y | 0.564 \pm 0.010 | 14.325 \pm 0.255 |
| K | 0.376 \pm 0.014 | 9.55 \pm 0.35 | | Z | 1.577 \pm 0.010 | 40.05 \pm 0.25 |
| *L | 2.312 | 58.7 | | AA | 1.931 \pm 0.004 | 49.05 \pm 0.10 |
| M | 3.000 | 76.2 | max. | BB | 3.505 \pm 0.055 | 89.025 \pm 1.395 |
| N | 0.592 \pm 0.002 | 15.04 \pm 0.04 | max. | CC | 0.375 \pm 0.002 | 9.525 \pm 0.055 |

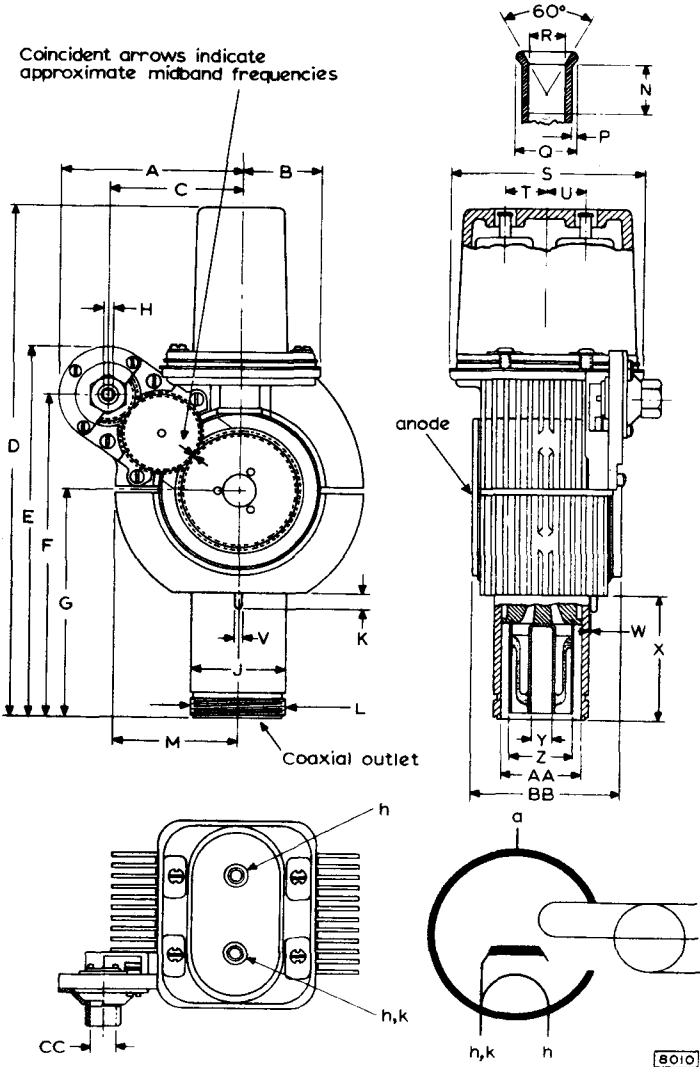
*Thread specification—5 full threads minimum

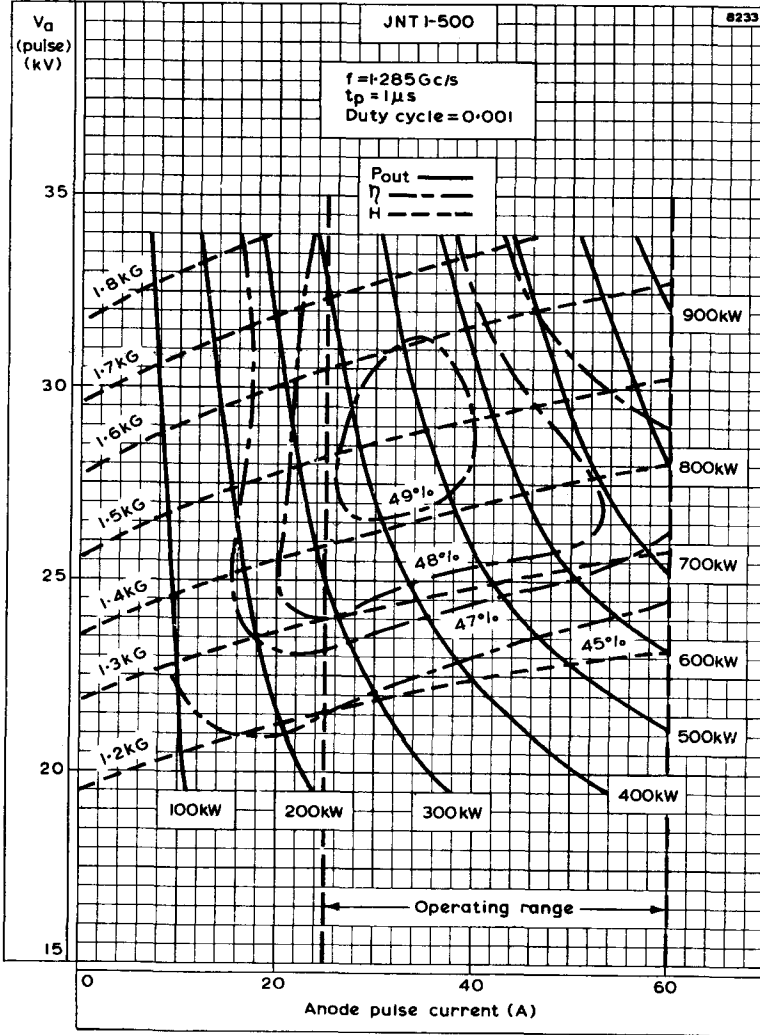
| | |
|------------------------|---------------------|
| Maximum major diameter | = 58.75mm, 2.313in. |
| Minimum major diameter | = 58.37mm, 2.298in. |
| Maximum pitch diameter | = 57.69mm, 2.271in. |
| Minimum pitch diameter | = 57.48mm, 2.263in. |
| Minimum minor diameter | = 56.78mm, 2.235in. |



TUNABLE MAGNETRON

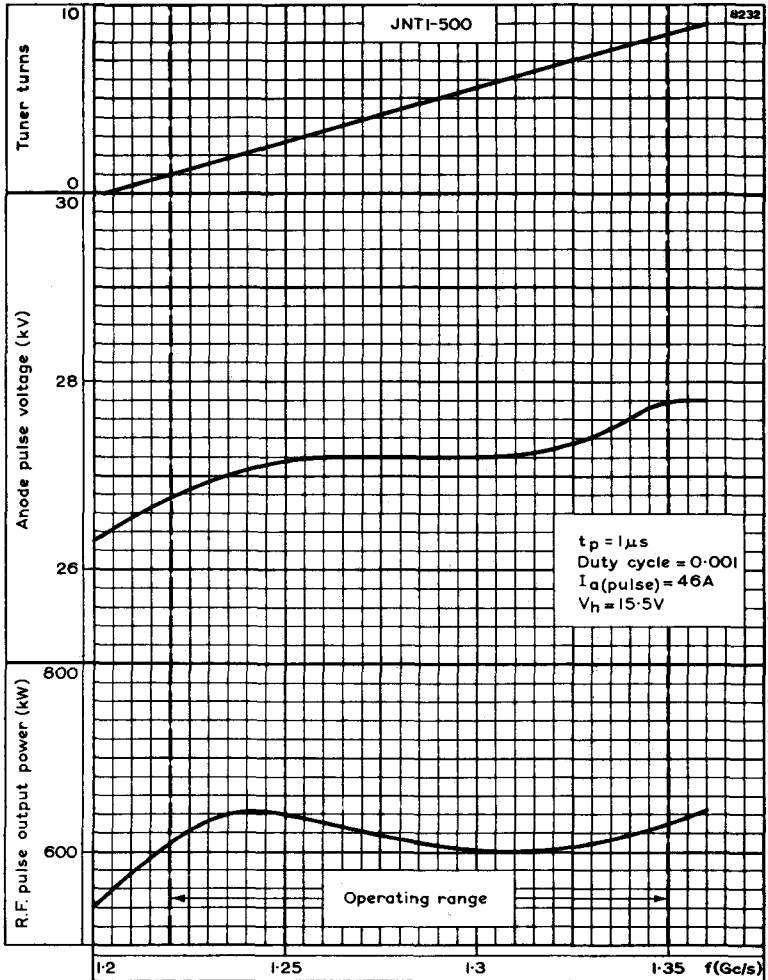
JNT I-500





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

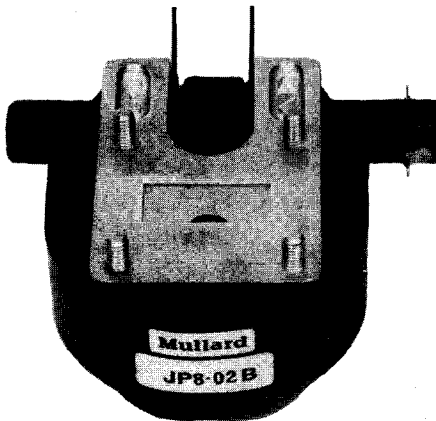
QUICK REFERENCE DATA

X-band, fixed frequency, pulsed magnetron.

| | | |
|-----------------------------------|---------------------|-----|
| Frequency (fixed within the band) | 8. 770 to 8. 835 | GHz |
| Power output (peak) | 25 | W |
| Output connection | Waveguide 16 flange | |
| Construction | Packaged | |

Services type: CV6072

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



TYPICAL OPERATION

Operating conditions

| | | |
|-------------------------------|--------|-------------|
| Heater voltage | 4.7 | V |
| Anode current (peak) | 150 | mA |
| Pulse duration (t_p) | 4.0 | μ s |
| Pulse repetition rate | 50 000 | pulse/s |
| Rate of rise of voltage pulse | 4.0 | kV/ μ s |

Typical performance

| | | |
|----------------------|-----|---|
| Anode voltage (peak) | 800 | V |
| Power output (peak) | 25 | W |
| Power output (mean) | 5.0 | W |

CATHODE

Indirectly heated

| | | |
|-------------------------------------|-----|---|
| Heater voltage (see note 1) | 6.3 | V |
| Heater current | 1.2 | A |
| Heating time (minimum) (see note 2) | 120 | s |

TEST CONDITIONS AND LIMITS

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

Test conditions

| | | |
|--|--------|-------------|
| Heater voltage | 4.5 | V |
| Anode current (mean) | 30 | mA |
| Duty factor | 0.2 | |
| Pulse duration (t_p) (see note 3) | 4.0 | μ s |
| v. s. w. r. at output coupler | 1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | 5.0 | kV/ μ s |

Limits and characteristics

| | Min. | Max. | |
|--|-------|-------------------|-----|
| Anode voltage (peak) | 750 | 850 | V |
| Power output (mean) | 3.5 | - | W |
| Frequency | 8.800 | 8.835 | MHz |
| R. F. bandwidth at 1/4 power (see note 5) | - | $\frac{2.5}{t_p}$ | MHz |

TEST CONDITIONS AND LIMITS (contd.)

| | Min. | Max. | |
|--|------|------|-----|
| Minor lobe level (see note 5) | 6.0 | - | dB |
| Frequency pulling (see note 6) | - | 15 | MHz |
| Stability (see note 7) | - | 0.5 | % |
| 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) | 5.9 | 6.7 | V |
| Heater current (surge) | - | 7.0 | A |
| Anode current (peak) | 110 | 180 | mA |
| Anode voltage (peak) | - | 850 | V |
| Power input (peak) | - | 160 | W |
| Power input (mean) | - | 60 | W |
| Duty factor | - | 0.5 | |
| Pulse duration (t_p) (see note 3) | - | 5.0 | μ s |
| Rate of rise of anode voltage (see note 4) | 2.5 | 5.0 | kV/ μ s |
| Anode temperature (see note 12) | - | 140 | $^{\circ}$ C |
| v. s. w. r. at output coupler | - | 1.3:1 | |

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) | 750 | 850 | V |
| Power output (mean) | 2.8 | - | W |
| Frequency | 8.765 | 8.835 | GHz |
| R. F. bandwidth at 1/4 power | - | $\frac{2.5}{t_p}$ | MHz |
| Stability | - | 1.0 | % |

MOUNTING AND STORAGE

| | |
|----------------------------------|-------------|
| Mounting position | Any |
| Mounting and storage precautions | see note 13 |

OUTPUT COUPLER

The output connection of the magnetron should be directly connected to a WG16 bolted flange as specified in DEF5352.

COOLING

Forced air is necessary to ensure that the temperature of the anode does not exceed the maximum stated in 'Ratings'.

PHYSICAL DATA

| | | |
|---------------------------------------|----|-----------------|
| Weight of magnetron | kg | 0.53 |
| Weight of magnetron in storage carton | | 1.258 |
| | mm | |
| Dimensions of storage carton | | 127 × 184 × 184 |

VIBRATION

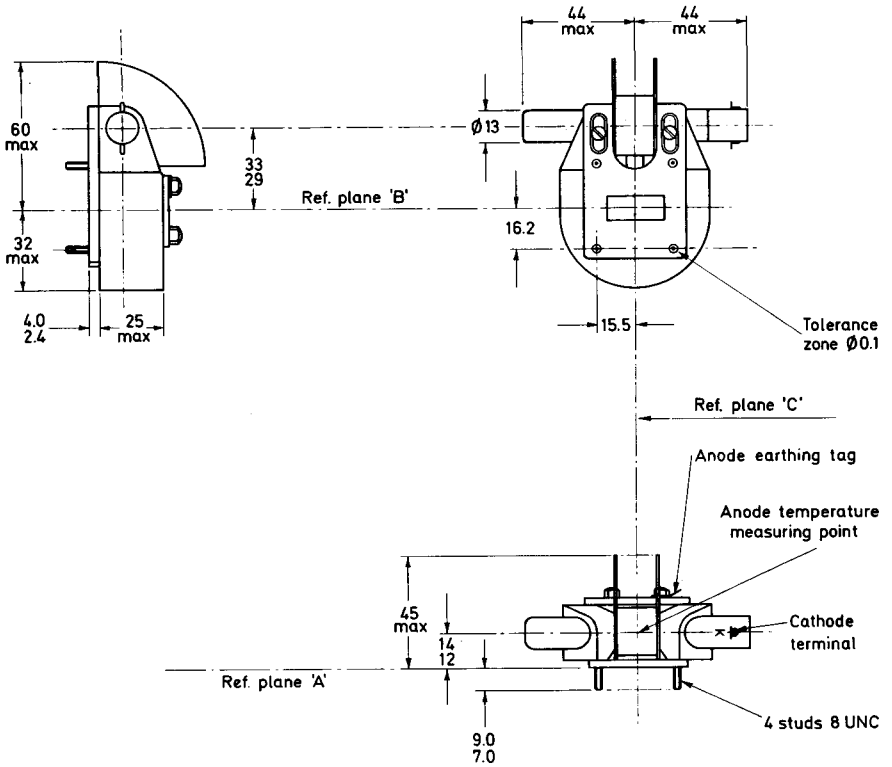
The magnetron is vibration tested in each of three mutually perpendicular directions one of which is perpendicular to the plane of the output flange. The vibration has accelerations of 2g from 100 to 200Hz and 0.5g from 200 to 500Hz. The maximum frequency modulation under these conditions does not exceed 500kHz.

NOTES

1. With no anode power. Immediately after the application of anode power the heater voltage must be reduced. When the mean anode current is 30mA the heater voltage should be reduced to $4.7 \pm 5\%$.
2. For ambient temperatures above 0°C . For ambient temperatures between 0°C and -55°C the cathode heating time is 180 seconds.
3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is $\pm 10\%$.
4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.
5. Measured with the magnetron operating into a v. s. w. r. of 1.3:1 varied through all phases over an anode current range of 110 to 180mA peak.
6. Measured with the magnetron operating into a v. s. w. r. of 1.5:1 at an anode current of 150mA peak.
7. Measured with the conditions described 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 8.800 to 8.835GHz. 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 of operation.
8. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 1.1 to 1.3A.
9. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.25\text{MHz}/^{\circ}\text{C}$.
10. Design test only. The maximum input capacitance is 9pF.
11. The magnetron is normally tested with a sinewave heater supply of 50Hz and is suitable for operation from a 400Hz sinewave supply. Mullard Ltd. should be consulted if the magnetron is to be operated with a heater supply having different frequency or waveform conditions.
12. Measured at the point indicated on the outline drawing.
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 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 JP8-02B



All dimensions in mm

D3564

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 ($I_{\text{pulse}} = 3.0\text{A}$) | | 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 ($I_{\text{pulse}} = 3.0\text{A}$) | 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 |

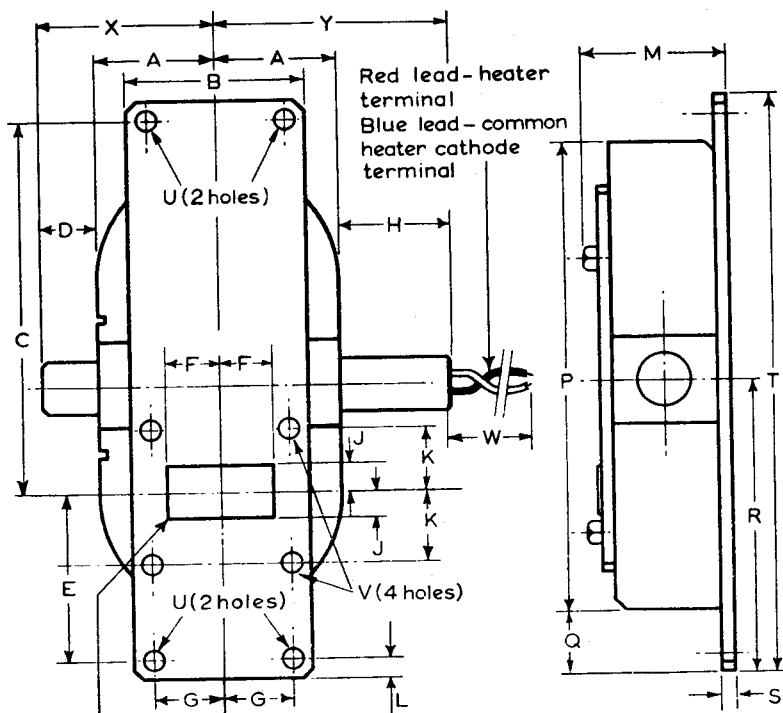


DIMENSIONS

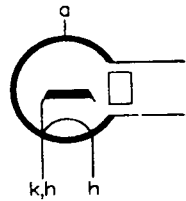
| | <i>Inches</i> | <i>Millimetres</i> | |
|---|---------------|--------------------|------|
| A | 1.181 | 30 | max. |
| B | 1.625 ± 0.015 | 41.28 ± 0.38 | |
| C | 3.463 ± 0.001 | 87.960 ± 0.025 | |
| D | 0.591 | 15 | max. |
| E | 1.521 ± 0.001 | 38.633 ± 0.025 | |
| F | 0.450 ± 0.001 | 11.400 ± 0.025 | |
| 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

MAGNETRON



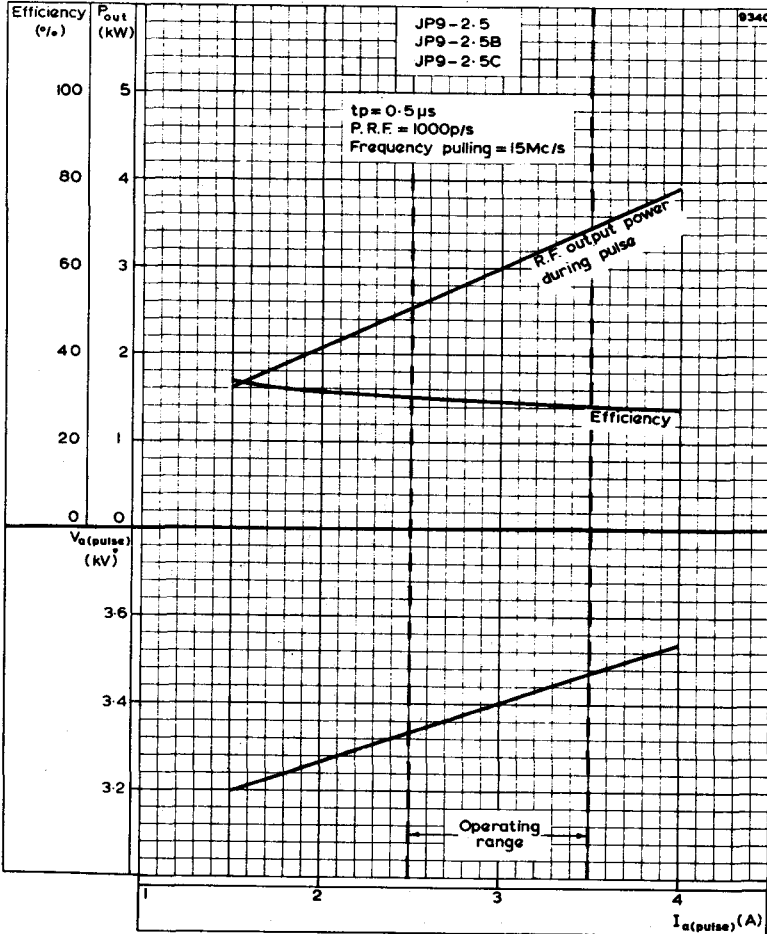
Outlet via waveguide WG16
to take bolted flange choke
coupling joint-services
type 5985-99-0830051



8008

THE ANODE IS TERMINATED AT THE BASE PLATE .





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



JP9-2.5 JP9-2.5B JP9-2.5C

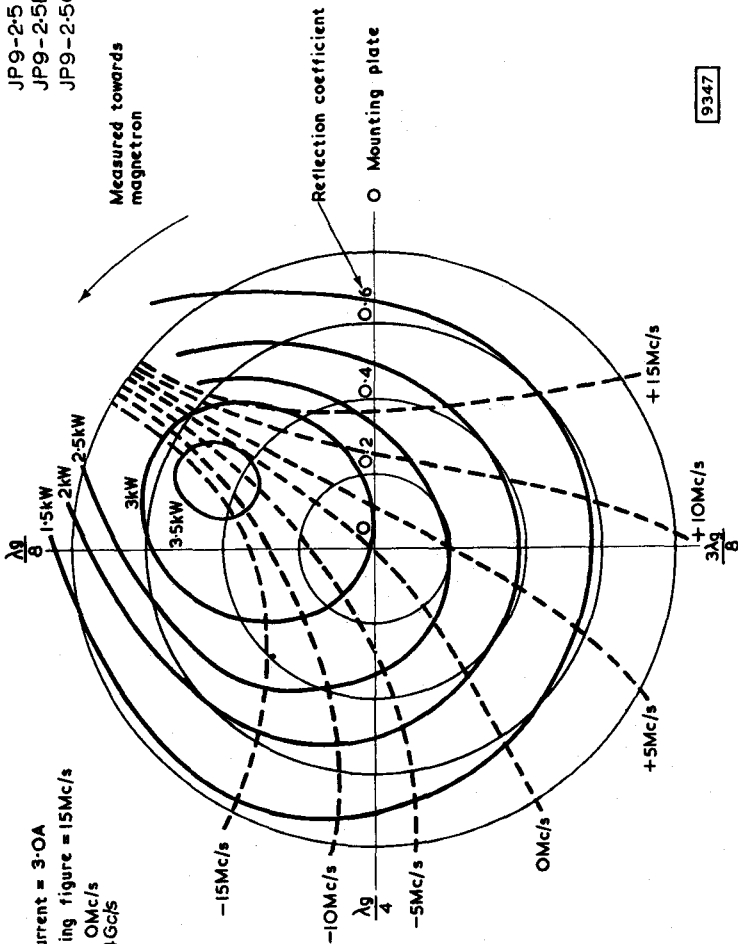
MAGNETRON

JP9-2.5
JP9-2.5B
JP9-2.5C

Measured towards
magnetron

Reflection coefficient
O Mounting plate

9347



Anode pulse current = 3.0A
Frequency pulling figure = 15Mc/s
Frequency of 0Mc/s
contour = 9.46Gcs

RIEKE DIAGRAM



MAGNETRONS

JP9-2.5D
JP9-2.5E
JP9-2.5F

QUICK REFERENCE DATA

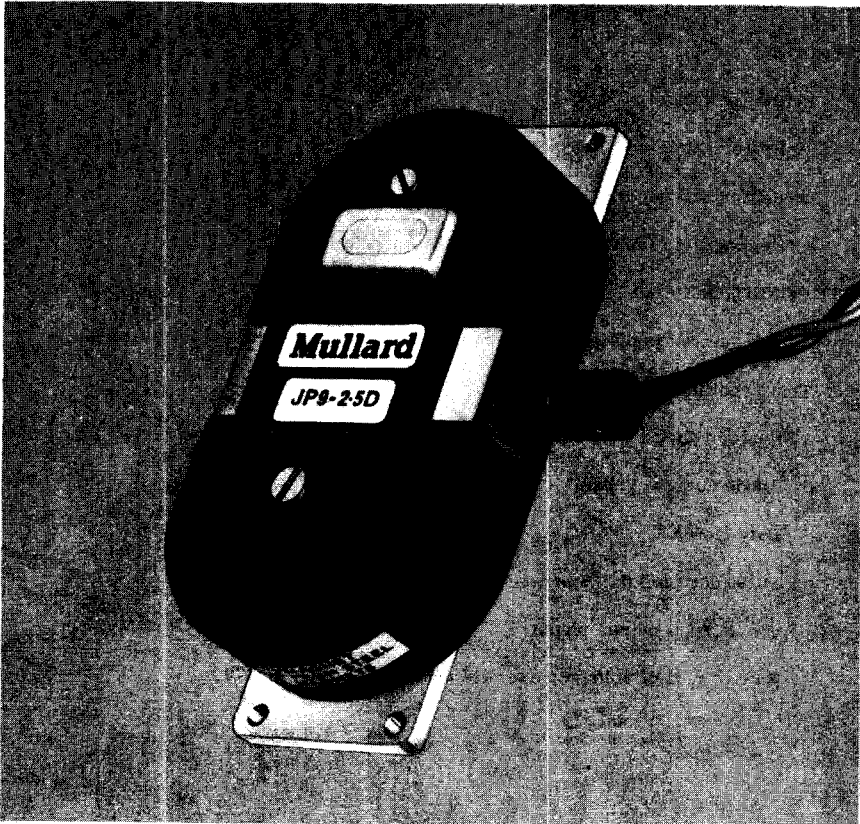
| | | |
|---|---------------------|-----|
| X-Band, fixed frequency, pulsed magnetron | | |
| Frequency (fixed within the band) | 9.415 to 9.475 | GHz |
| Power output (peak) | 4.0 | kW |
| Output connection | Waveguide 16 flange | |

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 | μ s |
| Pulse repetition rate | 2000 | 1000 | pulse/s |
| Rate of rise of voltage pulse | 60 | 60 | kV/ μ s |

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 | μ s |
| v.s.w.r. at output coupler | <1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 70 | kV/ μ s |

MAGNETRONS

JP9-2.5D
JP9-2.5E
JP9-2.5F

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. $\leq 1.5:1$) | - | 18 | MHz |
| Minor lobe level (v.s.w.r. $\leq 1.5:1$) | 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 2) | 0.02 | 1.0 | μ s |
| Rate of rise of anode voltage (see note 3) | - | 70 | kV/ μ s |
| Anode temperature | - | 120 | $^{\circ}$ 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 | 9.475 | GHz |
| R.F. Bandwidth at 1/4 power | - | $\frac{3.5}{t_p}$ | MHz |
| Stability | - | 0.5 | % |
| MOUNTING POSITION (See note 10) | | | Any |
| COOLING | | | Natural |
| PHYSICAL DATA | | | |
| | | | kg |
| Weight of magnetron | | | 1.02 |
| Weight of magnetron in storage carton | | | 1.82 |
| | | | mm |
| Dimensions of storage carton | | | 190 x 190 x 280 |

VIBRATION

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

NOTES

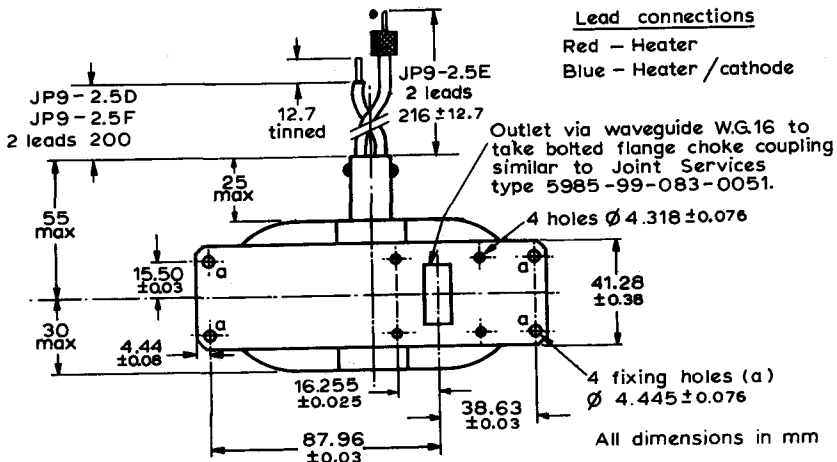
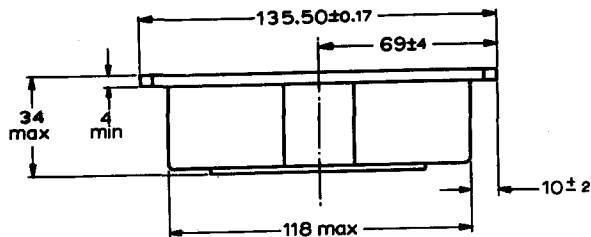
1. For ambient temperatures above 0°C the cathode must be heated for at least 2 minutes before the application of h.t. For ambient temperatures between 0°C and -55°C the cathode heating time is three minutes.
2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is $\pm 10\%$.

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 JP9-2.5D, E and F

D 4881



*JP9-2.5E wander plugs:-

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

MAGNETRONS

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 | μ s |
| Pulse repetition rate | 2000 | 1000 | pulse/s |
| Rate of rise of voltage pulse | 60 | 60 | kV/ μ s |

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 | μ s |
| v.s.w.r. at output connection | <1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 70 | kV/ μ s |

MAGNETRONS

JP9-2.5H
JP9-2.5L
JP9-2.5M

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 | μ s |
| Rate of rise of voltage pulse (see note 3) | - | 70 | kV/ μ s |
| Anode temperature | - | 120 | $^{\circ}$ 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 |
| Weight of magnetron | 1.02 |
| Weight of magnetron in storage carton | 1.82 |
| | mm |
| Dimensions of storage carton | 190 × 190 × 280 |

VIBRATION

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

NOTES

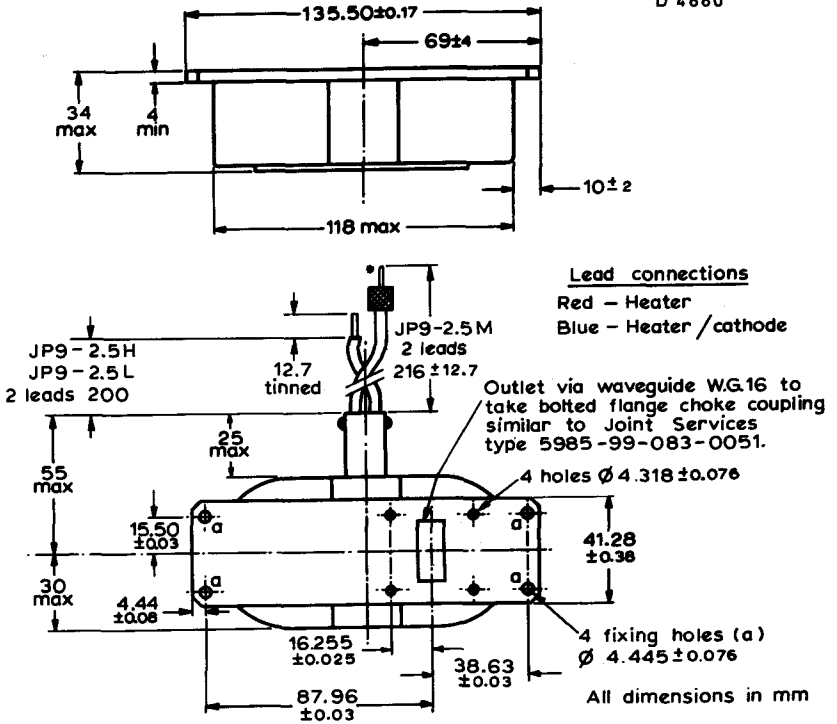
1. For ambient temperatures above 0°C the cathode must be heated for at least 30 seconds before the application of h.t. For ambient temperatures between 0 and -55°C the cathode heating time is 45 seconds min.
2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is ± 10%.
3. Defined 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

D 4880



* JP9-2.5M wander plugs:-

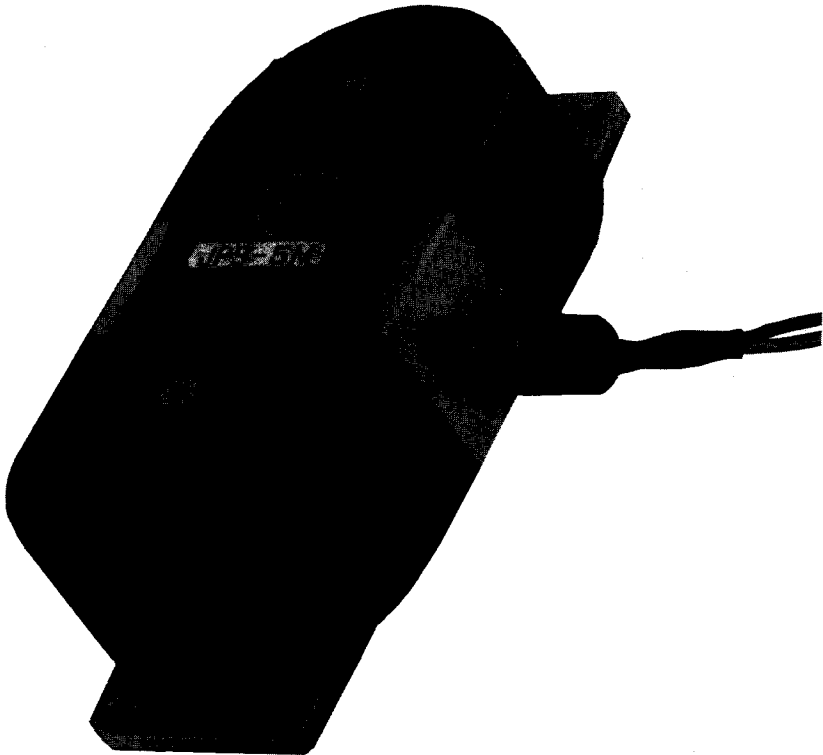
- Belling Lee { 4mm single pin 378/4/Red - Red lead
 3mm single pin 378A/3/Black-Blue lead

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



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 | μ s |
| Pulse repetition rate | 2000 | 1000 | pulse/s |
| Rate of rise of voltage pulse | 60 | 60 | kV/ μ s |
| 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 | μ s |
| v.s.w.r. at output coupler | 1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 75 | kV/ μ s |

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 | μ s |
| Rate of rise of anode voltage (see note 3) | - | 75 | kV/ μ s |
| Anode temperature | - | 120 | $^{\circ}$ 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°C. For ambient temperatures between 0°C and -55°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. 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 $-0.25\text{MHz}/^{\circ}\text{C}$.
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 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.

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) | JP9-7 9.345 | to 9.405 | Gc/s |
| Fixed within the band | JP9-7A 9.210 | to 9.270 | Gc/s |
| | JP9-7B 9.525 | to 9.585 | Gc/s |
| Pulse voltage ($I_{\text{pulse}} = 4.5\text{A}$) | 5.3 | 5.7 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 4.5\text{A}$) | 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

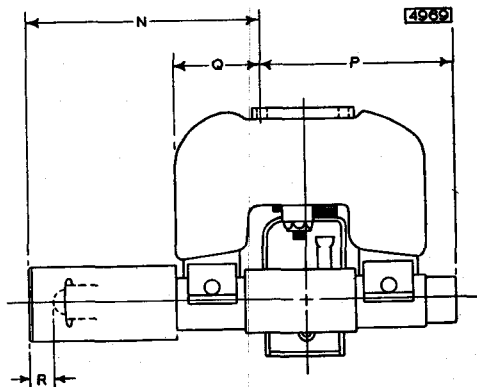
| | Min. | Max. | |
|-------------------------------|------|--------|--------------|
| Pulse current | 3.5 | 5.5 | A |
| Pulse voltage | 5.0 | 6.0 | kV |
| Pulse duration | | 2.5 | μ s |
| Duty cycle | | 0.0025 | |
| Mean input power | | 82.5 | W |
| Rate of rise of voltage pulse | | 60 | kV/ μ s |
| Load mismatch (v.s.w.r.) | | 1.5 | |
| Temperature of anode block | | 120 | $^{\circ}$ C |

MOUNTING POSITION

Any

PHYSICAL DATA

| | | |
|-------------------------------|---|----|
| Weight of magnetron | $\left. \begin{array}{l} 3.0 \\ 1.4 \end{array} \right\}$ | lb |
| | | kg |
| Weight of magnetron in carton | $\left. \begin{array}{l} 5.7 \\ 2.5 \end{array} \right\}$ | lb |
| | | kg |
| Dimensions of storage carton | $\left\{ \begin{array}{l} 7.75 \times 8.0 \times 9.75 \\ 200 \times 210 \times 250 \end{array} \right.$ | in |
| | | mm |

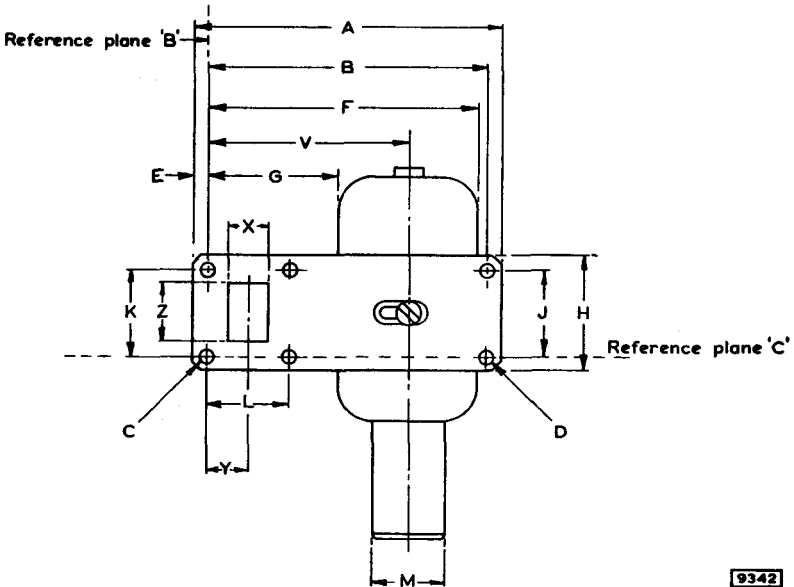
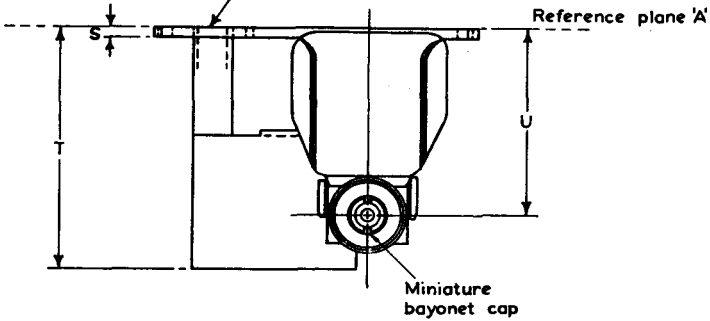


DIMENSIONS

| | inches | mm | | M | 1.0 | 25.4 | max. |
|---|-------------------|------------------|------|---|-------------------|------------------|------|
| A | 4.47 | 113.5 | max. | N | 3.19 | 81.0 | max. |
| B | 4.103 ± 0.004 | 104.2 ± 0.1 | | P | 2.19 | 55.6 | max. |
| C | 0.17 ± 0.003 | 4.32 ± 0.08 | | Q | 1.19 | 30.2 | max. |
| D | 0.175 ± 0.003 | 4.45 ± 0.08 | | R | 0.25 | 6.4 | max. |
| E | 0.19 | 4.8 | max. | S | 0.125 ± 0.01 | 3.18 ± 0.25 | |
| F | 4.0 | 102 | max. | T | 3.25 | 82.6 | max. |
| G | 1.93 | 49 | min. | U | 2.52 ± 0.13 | 64 ± 3 | |
| H | 1.64 | 41.7 | max. | V | 3.0 ± 0.13 | 76 ± 3 | |
| J | 1.22 ± 0.003 | 30.99 ± 0.08 | | X | 0.400 ± 0.003 | 10.16 ± 0.08 | |
| K | 1.22 ± 0.004 | 30.99 ± 0.1 | | Y | 0.640 ± 0.004 | 16.25 ± 0.10 | |
| L | 1.28 ± 0.004 | 32.51 ± 0.1 | | Z | 0.900 ± 0.003 | 22.86 ± 0.10 | |

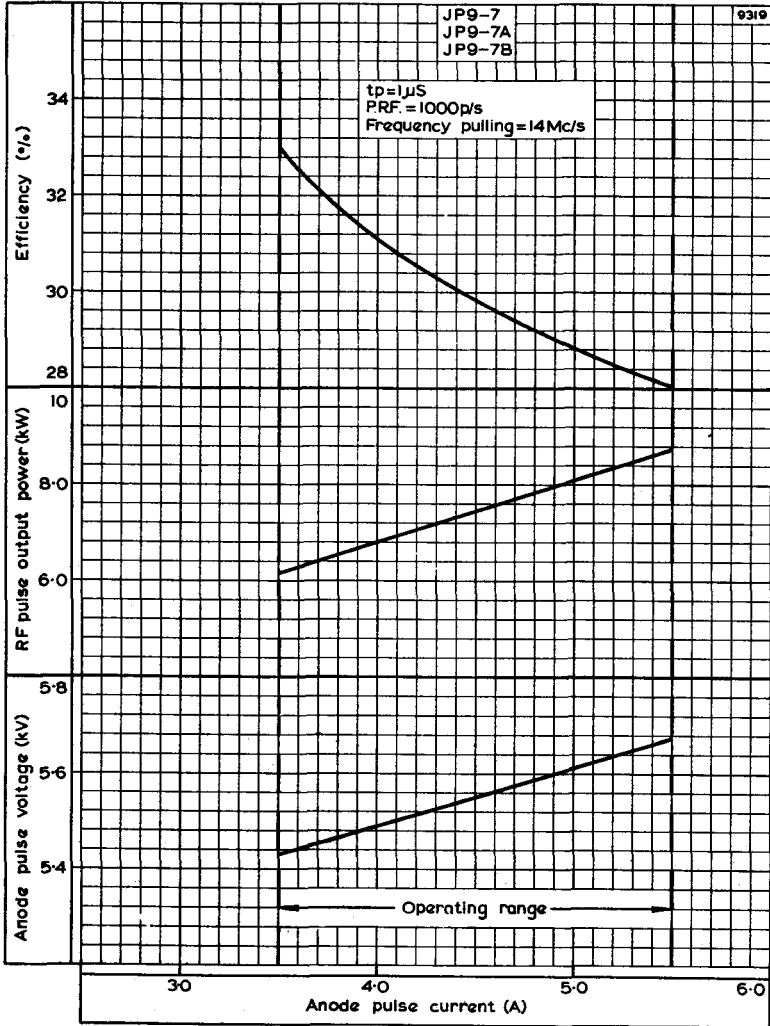


OUTLET VIA WAVEGUIDE WG16
TO TAKE BOLTED FLANGE CHOKE
COUPLING JOINT-SERVICES TYPE 5985-99-0830051



9342



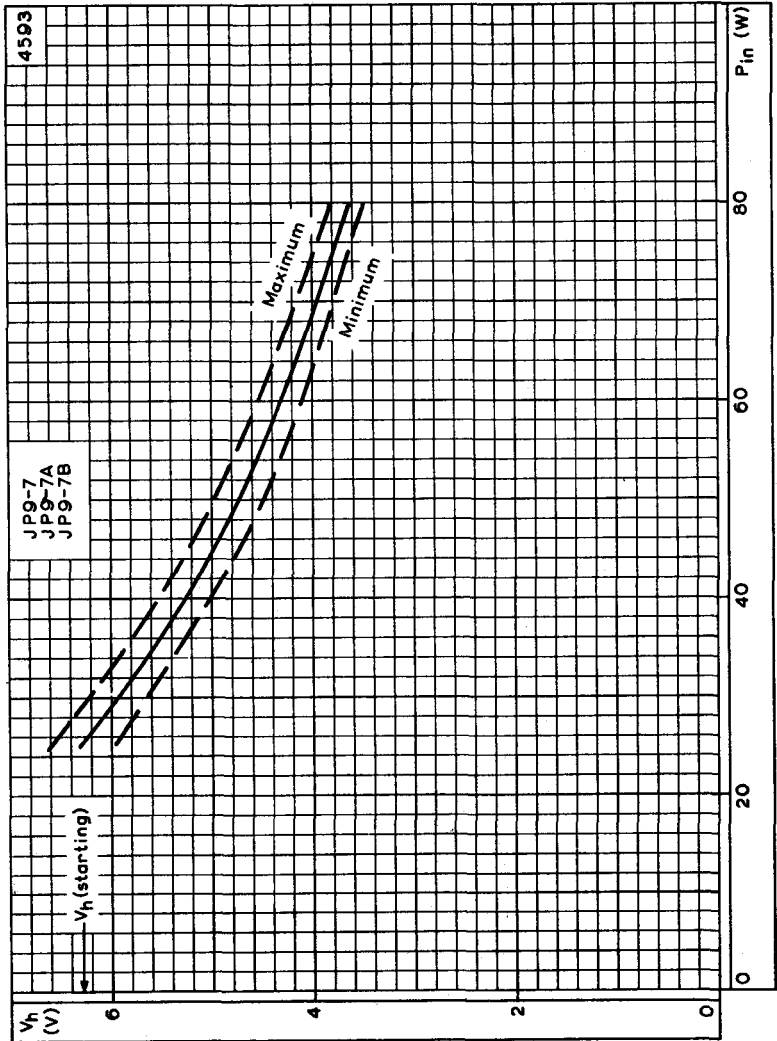


ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY
 PLOTTED AGAINST ANODE PULSE CURRENT



**JP9-7
JP9-7A
JP9-7B**

MAGNETRON



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 | μ s |
| 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/ μ s |

ABSOLUTE MAXIMUM RATINGS

| | Min. | Max. | |
|-------------------------------|------|-------|--------------|
| Pulse current | | | |
| $t_p < 1.0\mu$ s | 4.5 | 6.0 | A |
| $t_p < 0.1\mu$ s | 4.5 | 7.0 | A |
| Pulse duration | 0.05 | 1.0 | μ s |
| Duty cycle | — | 0.002 | |
| Mean input power | — | 83 | W |
| Rate of rise of voltage pulse | — | 120 | kV/ μ s |
| Load mismatch (v.s.w.r.) | — | 1.5 | |
| Temperature of anode block | — | 100 | $^{\circ}$ C |

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

| | | |
|--|-------|---------------|
| R.F. pulse output power ($I_{pulse} = 5.5A$) | | 7.0 kW |
| | Min. | Max. |
| 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

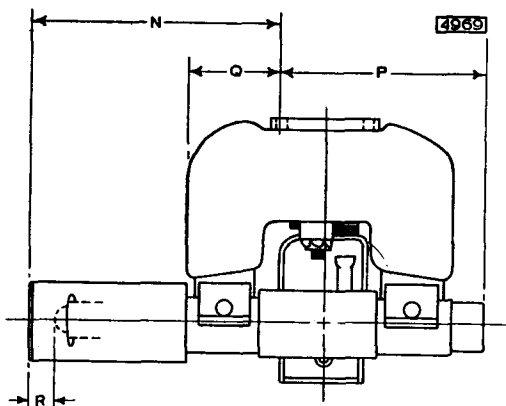
In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high a flow of cooling air between the radiator pins may be necessary to keep the anode block temperature below the permitted maximum.

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

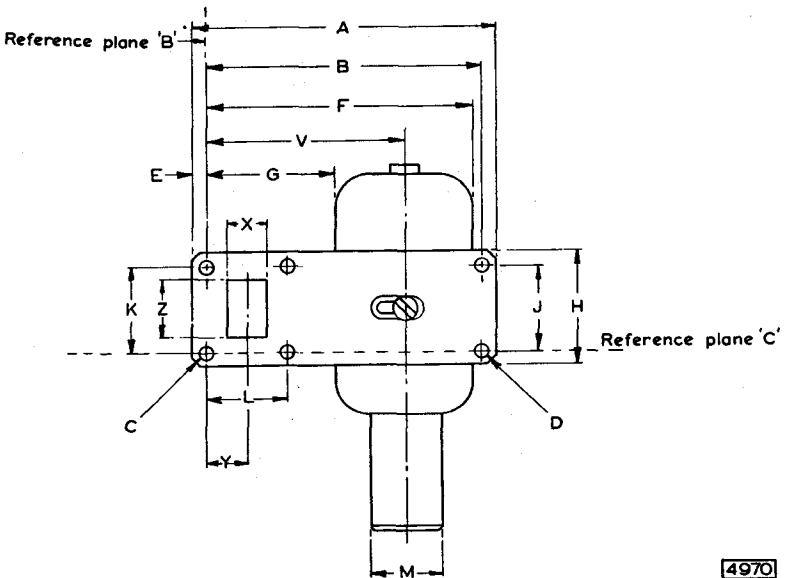
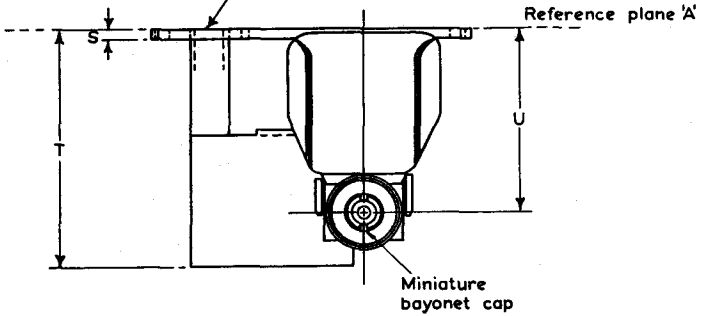
| | <i>Inches</i> | <i>Millimetres</i> | |
|---|---------------|--------------------|------|
| A | 4.453 ± 0.015 | 113.11 ± 0.38 | |
| B | 4.103 ± 0.004 | 104.2 ± 0.10 | |
| C | 0.170 ± 0.003 | 4.32 ± 0.08 | |
| D | 0.175 ± 0.003 | 4.45 ± 0.08 | |
| E | 0.172 ± 0.016 | 4.37 ± 0.41 | |
| F | 4.0 | 102 | 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 | |



JP9-7D

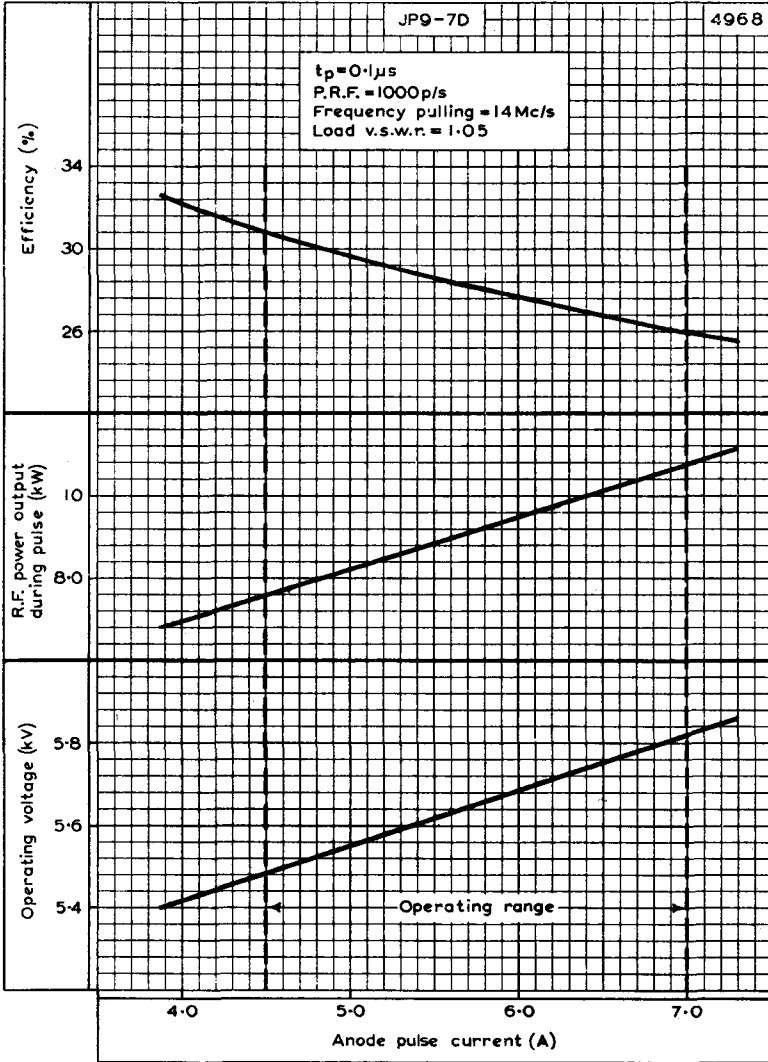
MAGNETRON

OUTLET VIA WAVEGUIDE WG16
TO TAKE BOLTED FLANGE CHOKE
COUPLING INTER-SERVICES TYPE Z 830051



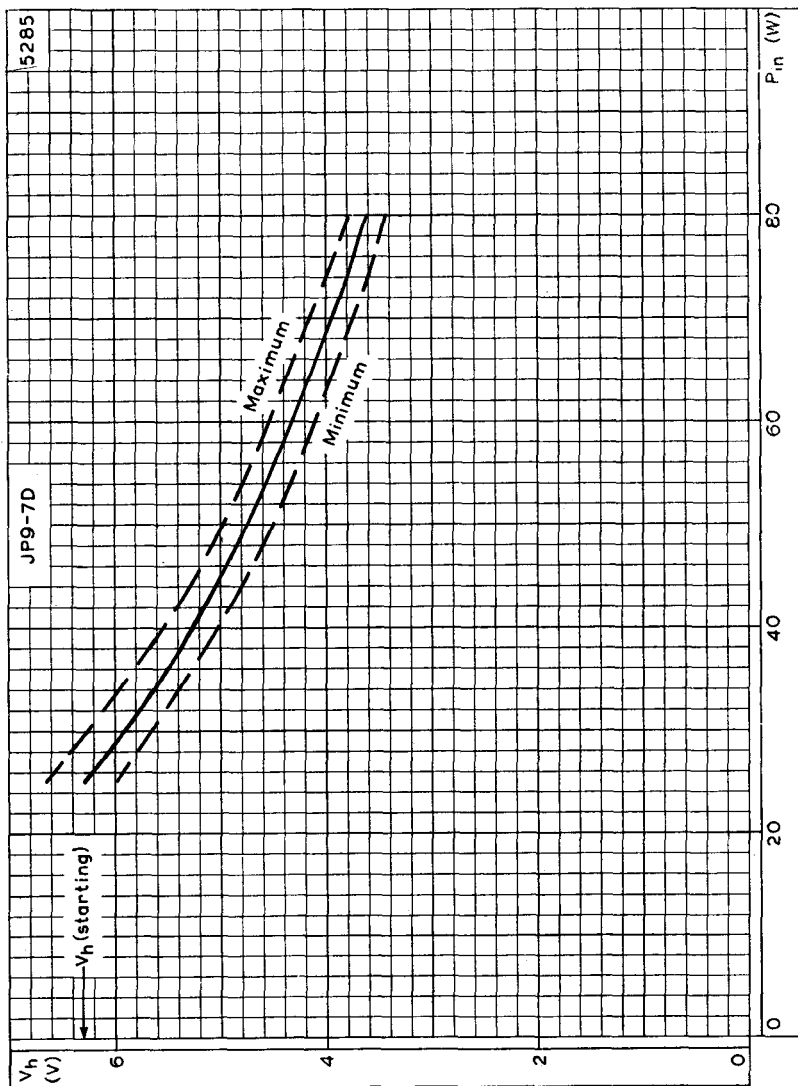
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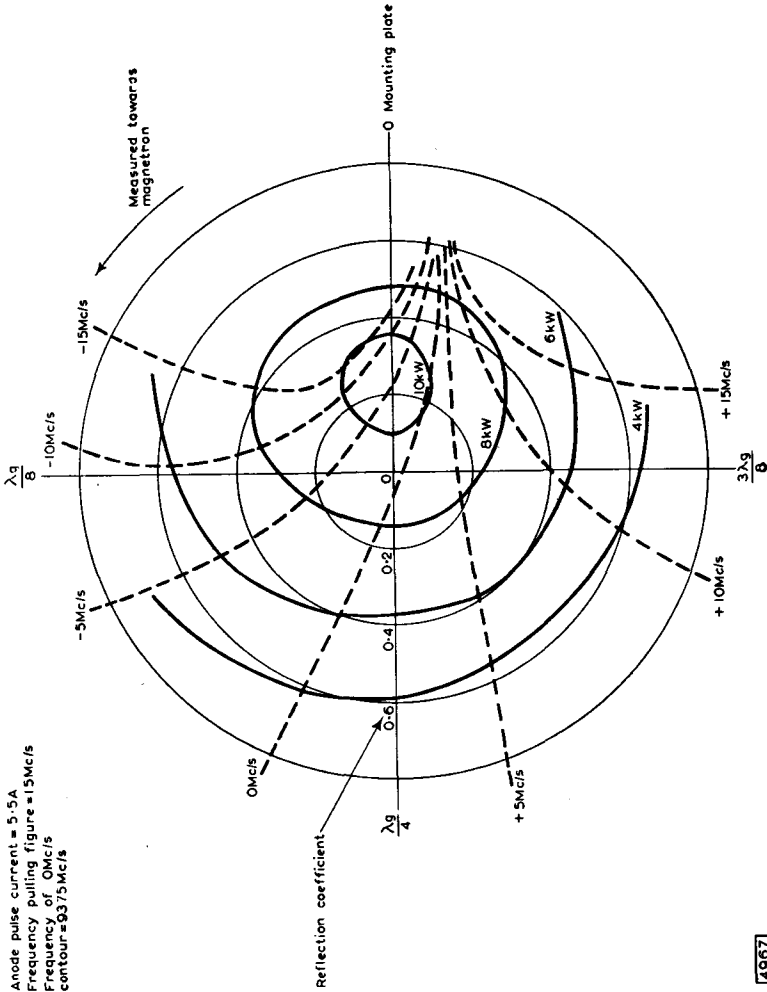
OPERATING VOLTAGE, R.F. POWER OUTPUT DURING PULSE AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT





HEATER VOLTAGE PLOTTED AGAINST INPUT POWER





Anode pulse current = 5.5A
 Frequency pulling figure = 15 Mc/s
 Frequency of 0 Mc/s contour = 937.5 Mc/s

REIKE DIAGRAM



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 | μ s |
| 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/ μ s |

*Includes pre-oscillation current

ABSOLUTE MAXIMUM RATINGS

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

| | | | | |
|--|---------|----------|-------|-------------|
| Frequency | | Min. | Max. | |
| 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

| | | | | |
|--|---------|----------|-------|------|
| R.F. pulse power output ($I_{pulse} = 7.5A$) | | | 15 | kW |
| Frequency | | Min. | Max. | |
| 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.

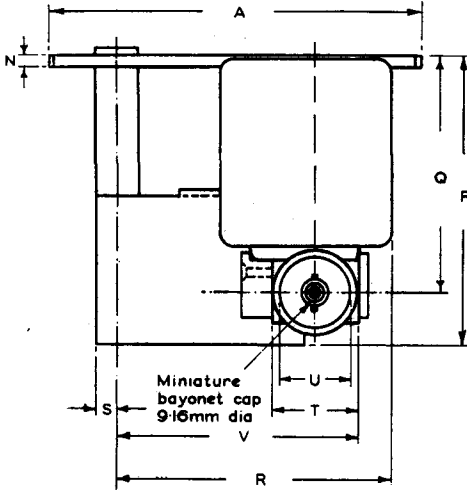
MOUNTING POSITION

Any

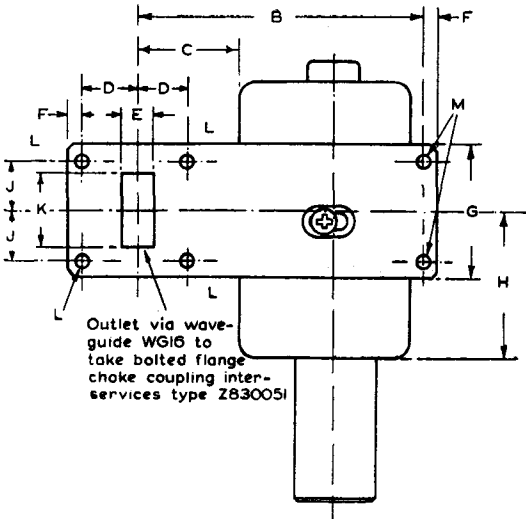
PHYSICAL DATA

| | | |
|-------------------------------|--------------------------------------|----------|
| 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 × 9.8 197 × 204 × 248 | in mm |





Miniature bayonet cap 9.16mm dia



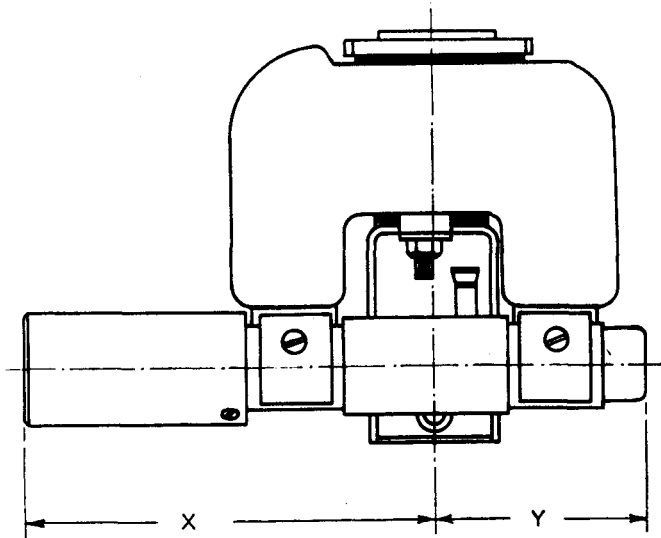
Outlet via waveguide WG16 to take bolted flange choke coupling interservices type Z830051

6819



JP9-15 JP9-15B

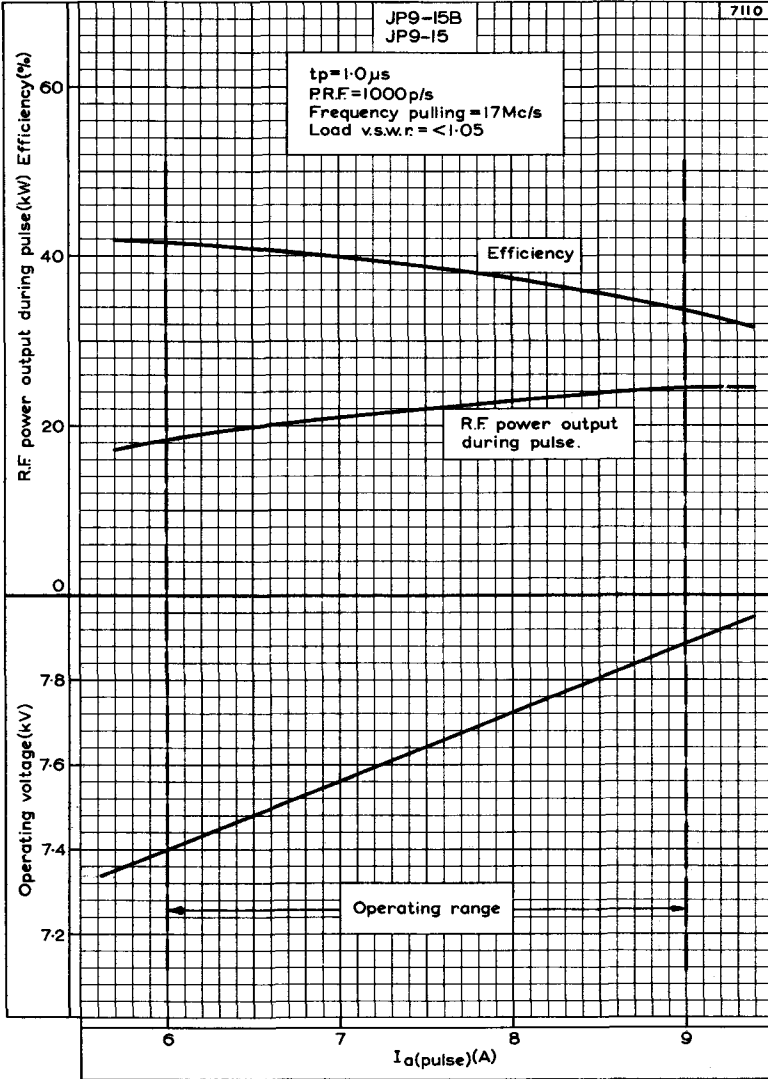
MAGNETRON



6816

| | <i>Inches</i> | <i>Millimetres</i> | |
|---|-------------------|--------------------|------|
| 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. |





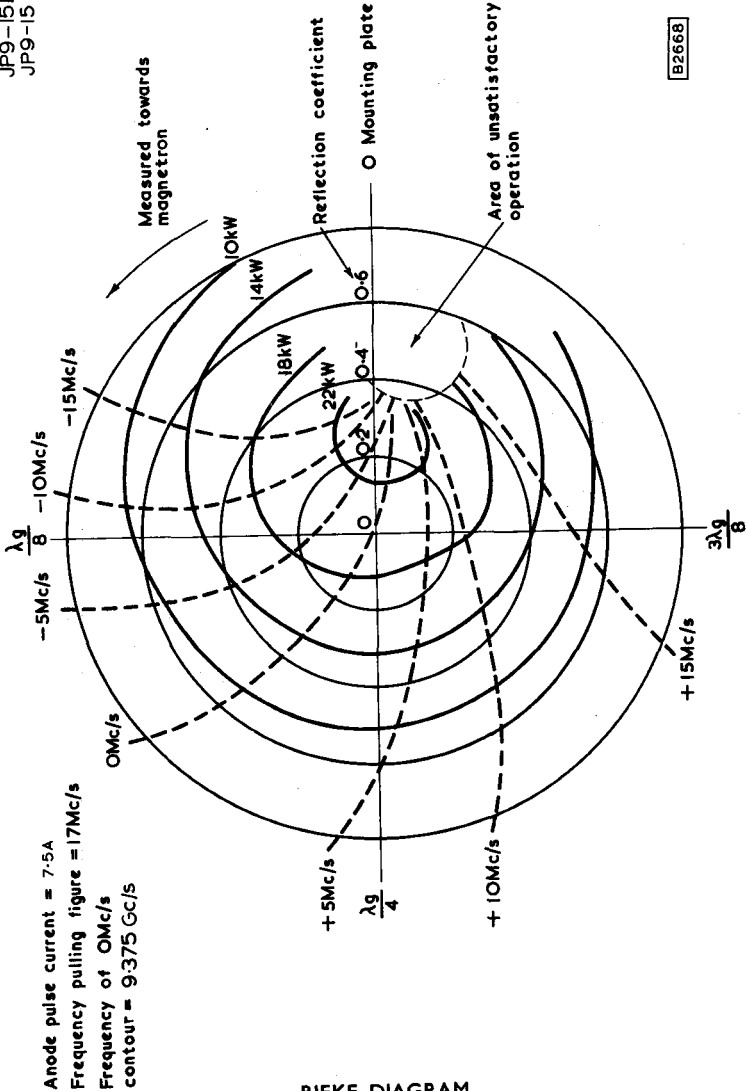
R.F. POWER OUTPUT DURING PULSE, OPERATING VOLTAGE AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



JP9-15 JP9-15B

MAGNETRON

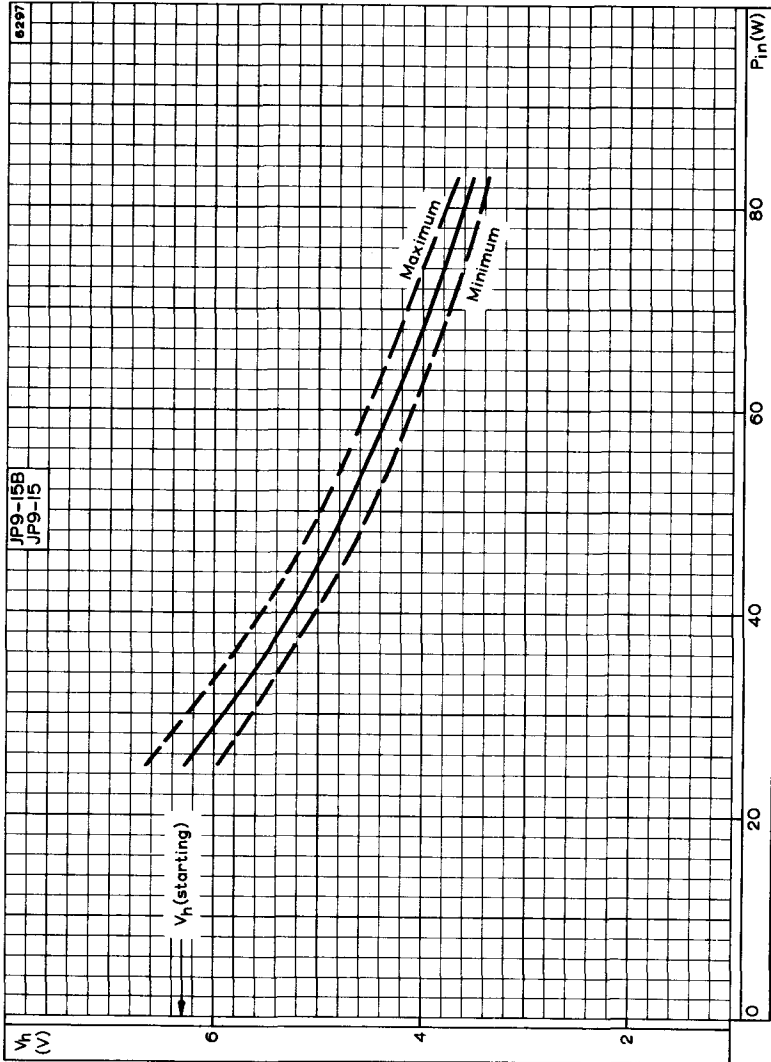
JP9-15B
JP9-15



B2668

RIEKE DIAGRAM





HEATER VOLTAGE PLOTTED AGAINST INPUT POWER



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 | μ s |
| 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/ μ s |
| *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 ($I_{\text{pulse}} = 8.6\text{A}$) | 7.0 | 7.5 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 8.6\text{A}$) | 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 ($I_{\text{pulse}} = 8.6\text{A}$) | | | 17 | kW |
| | Min. | | Max. | |
| Frequency within the band | 9.38 | to | 9.44 | GHz |
| Pulse voltage ($I_{\text{pulse}} = 8.6\text{A}$) | 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 |

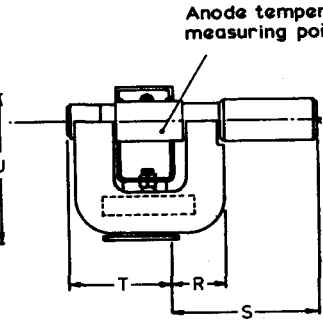
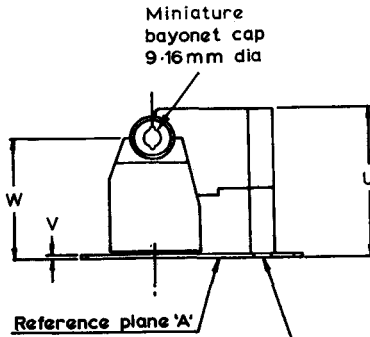
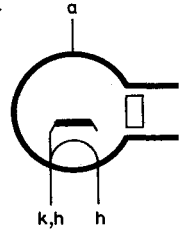
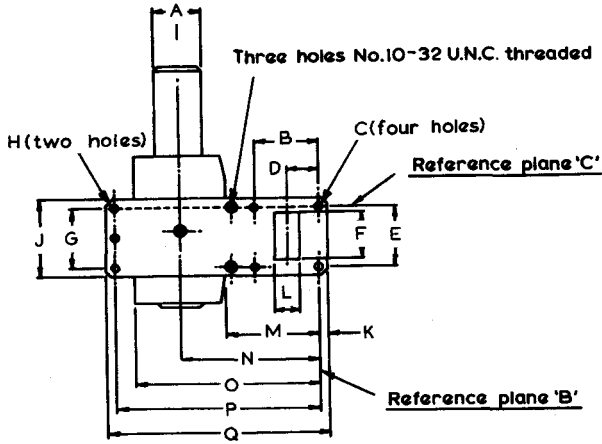
COOLING

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 | °C |
|------------------|-----|----|





Outlet via WG16(R100,WR90) to take bolted flange choke coupling Joint Services type 5985-99-083-0051

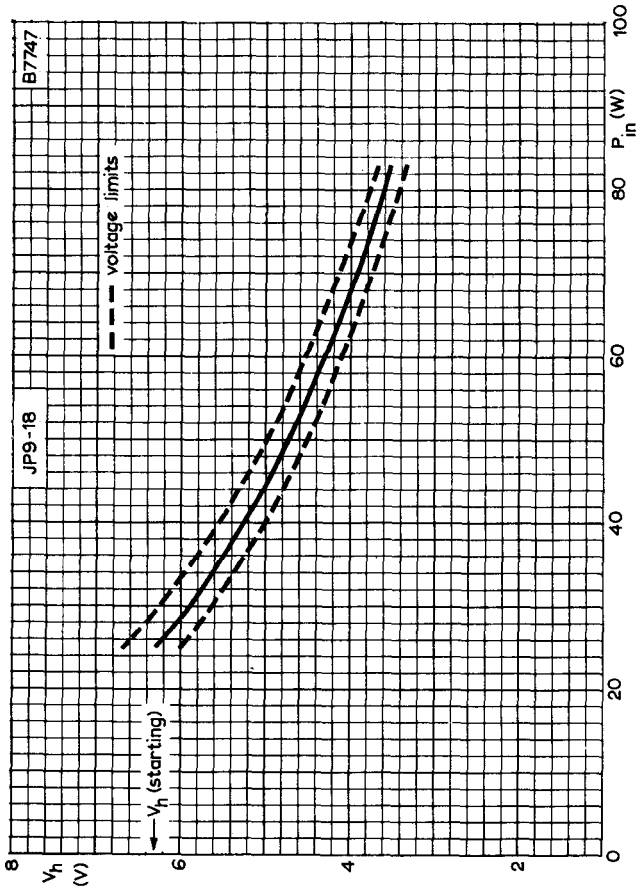
DIMENSIONS

| | 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



MAGNETRON



HEATER DERATING CHART



QUICK REFERENCE DATA

X-band, fixed frequency, pulsed magnetron.

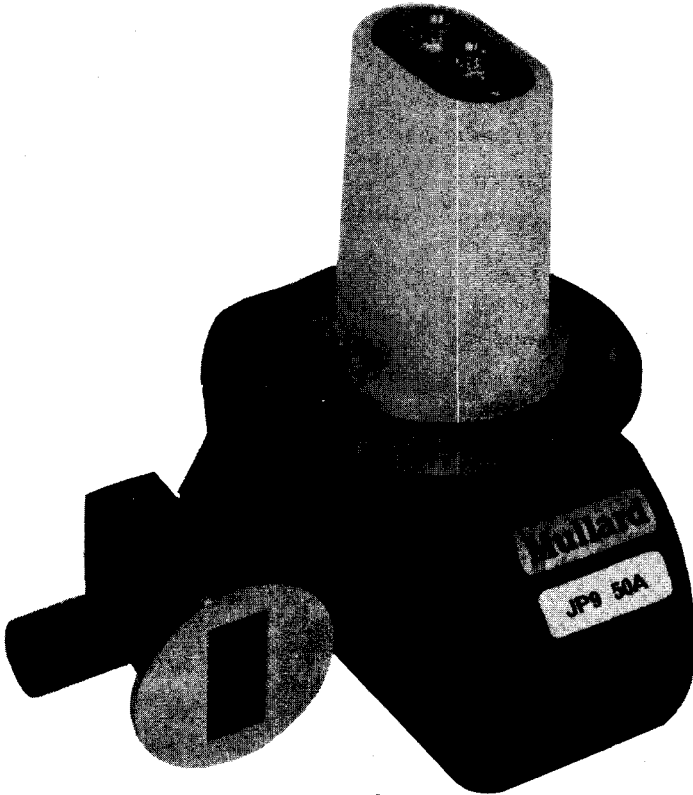
Frequency (fixed within the band) 9.345 to 9.405 GHz

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 | μ s |
| Pulse repetition rate | 4000 | 1000 | pulse/s |
| Rate of rise of voltage pulse | 150 | 150 | kV/ μ s |
| 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 | μ s |
| v.s.w.r. at output connection | 1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | 150 | kV/ μ s |

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 | μ s |
| Rate of rise of voltage pulse (see note 4) | - | 160 | kV/ μ s |
| Anode temperature (see note 13) | - | 120 | $^{\circ}$ 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

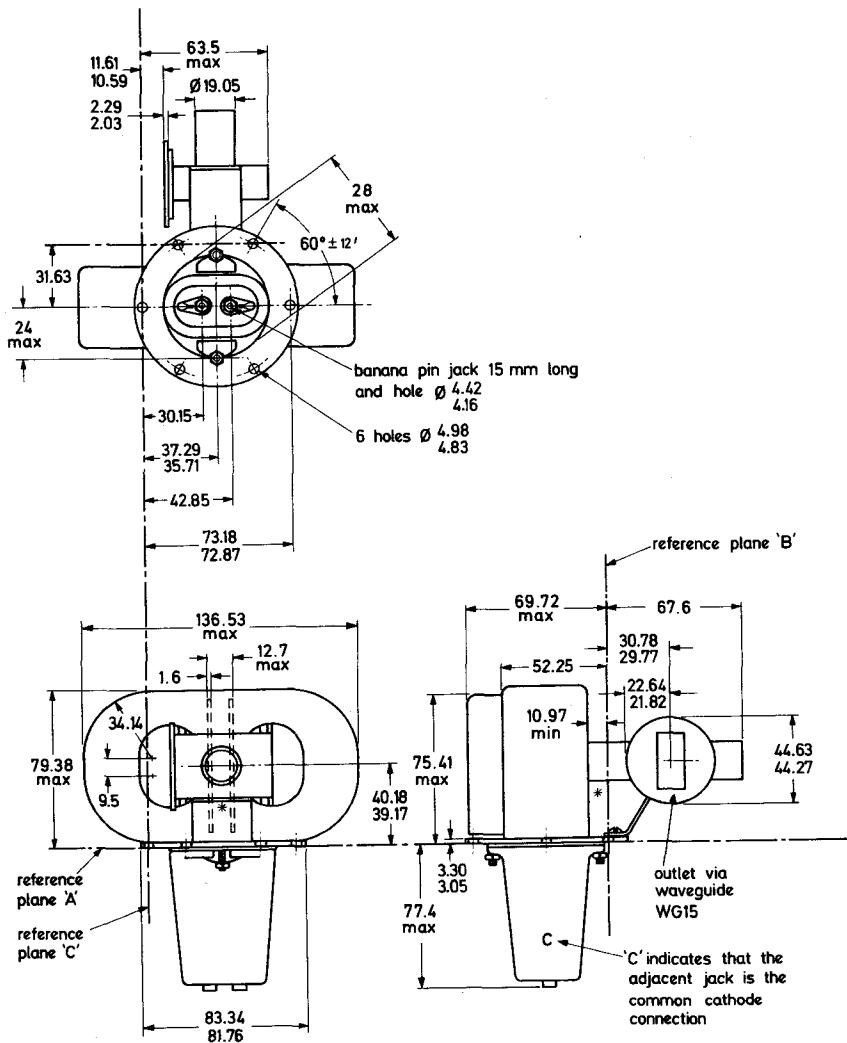
1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced in accordance with the heater derating chart on page 8.
2. For ambient temperatures above 0°C. For ambient temperatures between 0°C and -55°C the cathode heating time is 180 seconds.
3. The 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°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 $-0.25\text{MHz}/^{\circ}\text{C}$.
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

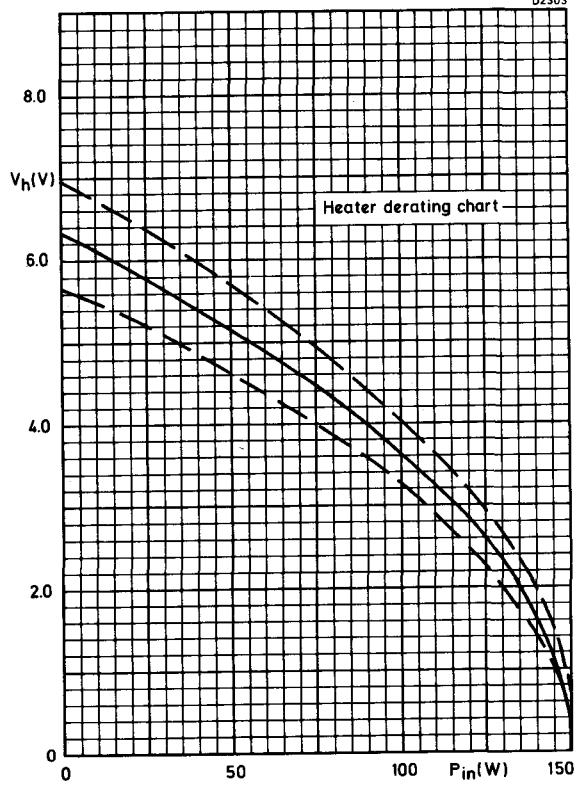
D1519

Mullard

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 |
| ∅ 4.42/4.16 | 0.174/0.164 |
| ∅ 4.98/4.83 | ∅ 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 |
| ∅ 19.05 | ∅ 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. |

D2303



HEATER VOLTAGE PLOTTED AGAINST MEAN ANODE INPUT POWER

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 | 9.345 | to | 9.405 | Gc/s |
| Fixed within the band | | | | |
| Pulse voltage ($I_{\text{pulse}} = 15\text{A}$) | 14 | | 16 | kV |
| R.F. pulse output power | | | | |
| ($I_{\text{pulse}} = 15\text{A}$) | 65 | | — | kW |
| Frequency pulling factor (v.s.w.r. = 1.5) | — | | 15 | Mc/s |
| Frequency 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 |
| $I_{h(\text{surge}) \text{ max.}}$ | 11.5 | A |
| $r_h \text{ (cold)}$ | 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 | | | |
| ($t_r \leq 1\mu\text{s}$) | — | 150 | kV/ μs |
| ($t_r > 1\mu\text{s}$) | — | 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:—

| | | | |
|---|-------|----------|------|
| R.F. pulse power output ($I_{\text{pulse}} = 15\text{A}$) | | 60 | kW |
| Frequency | Min | Max | |
| Within the band | 9.345 | to 9.405 | Gc/s |
| Pulse voltage ($I_{\text{pulse}} = 15\text{A}$) | 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 upto a pressure of 2370mm of mercury.

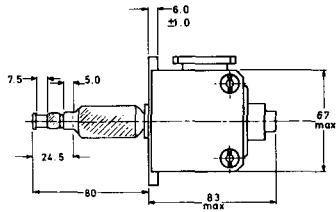
PHYSICAL DATA

| | |
|-------------------------------|--------------------|
| | kg |
| Weight of magnetron | 2.2 |
| Weight of magnetron in carton | 5.9 |
| | cm |
| Dimensions of storage carton | 33.7 x 30.5 x 23.8 |

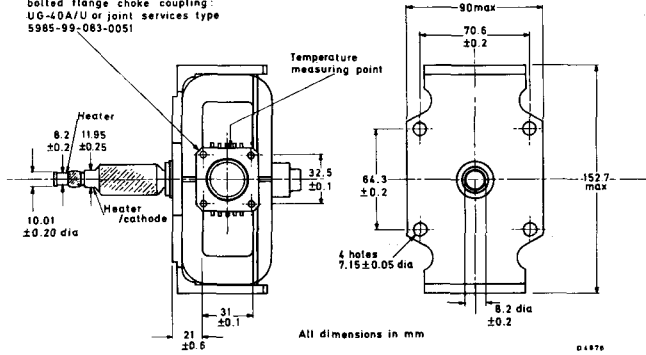
COOLING

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.

OUTLINE DRAWING

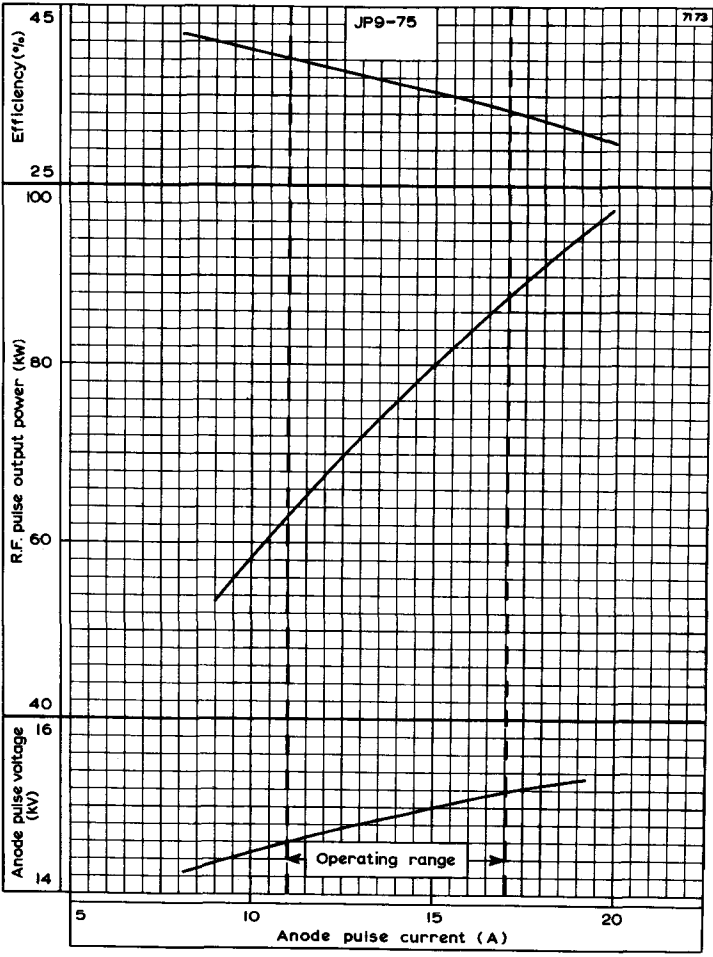


Outlet via WG16(WR90) to take
 bolted flange choke coupling
 UG-40A/U or joint services type
 5985-99-083-0051

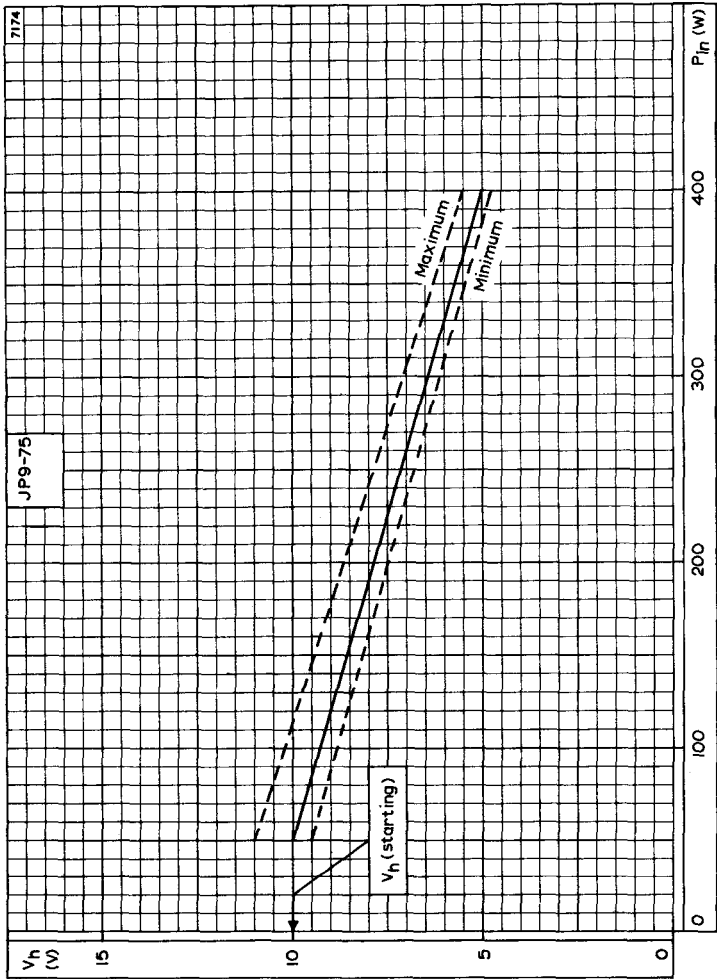


All dimensions in mm

D14976



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 | | to | | |
| Fixed within the band JP9-80 | 9.345 | | 9.405 | Gc/s |
| Fixed within the band JP9-80A | 9.210 | | 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 °C |
| Position of phase of sink from face of mounting plate towards load | 0.26 | to | 0.40 | lg |
| 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 |

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

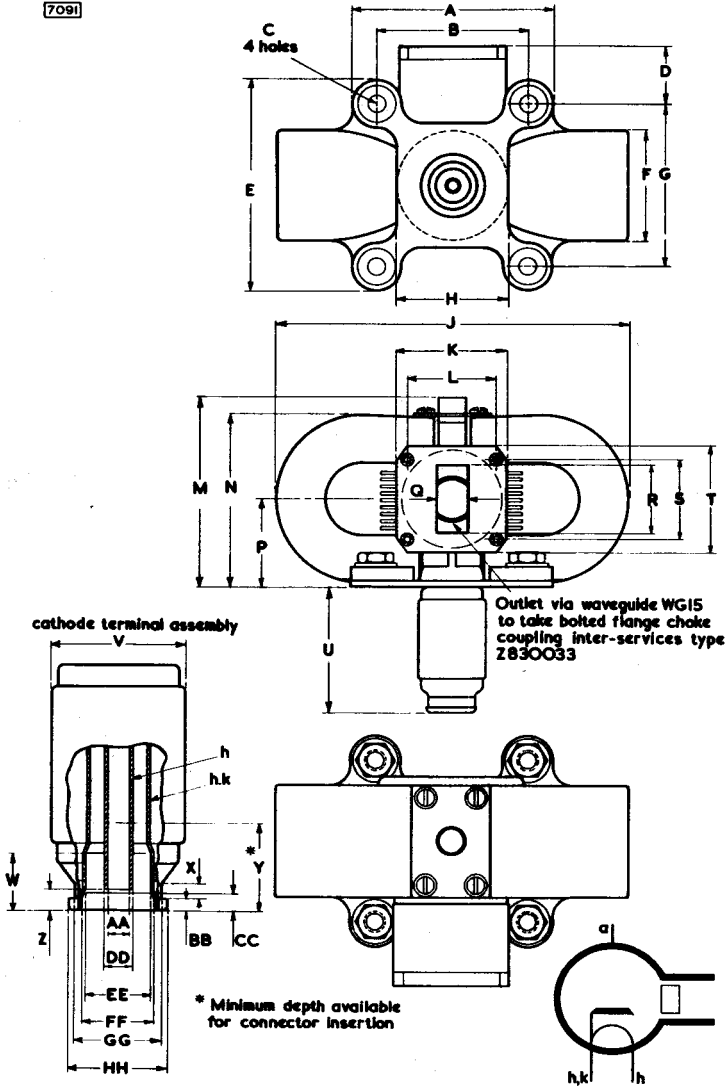
| | Inches | Millimetres | |
|----|-------------------|------------------|-----|
| A | 3.437 | 87.3 | max |
| B | 2.531 \pm 0.010 | 64.29 \pm 0.25 | |
| C | 0.281 \pm 0.005 | 7.14 \pm 0.12 | |
| D | 1.016 \pm 0.024 | 25.8 \pm 0.6 | |
| E | 3.622 | 92 | max |
| F | 1.937 | 49.2 | max |
| G | 2.781 \pm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

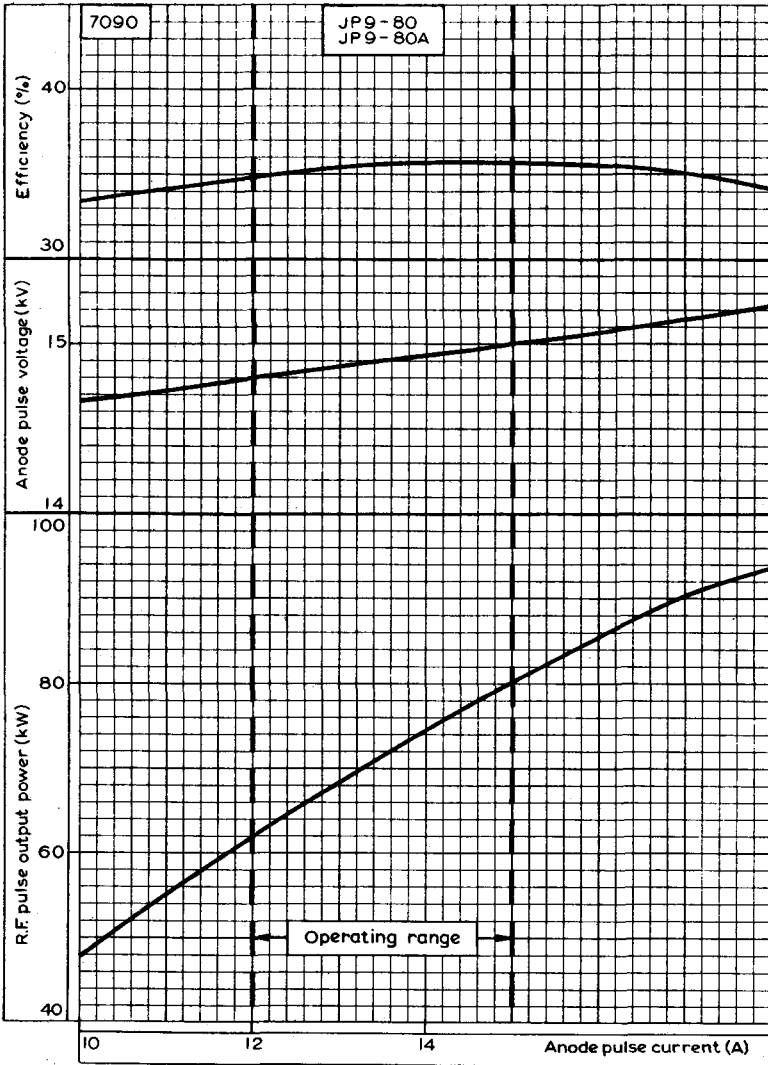


MAGNETRON

JP9-80 JP9-80A

7091



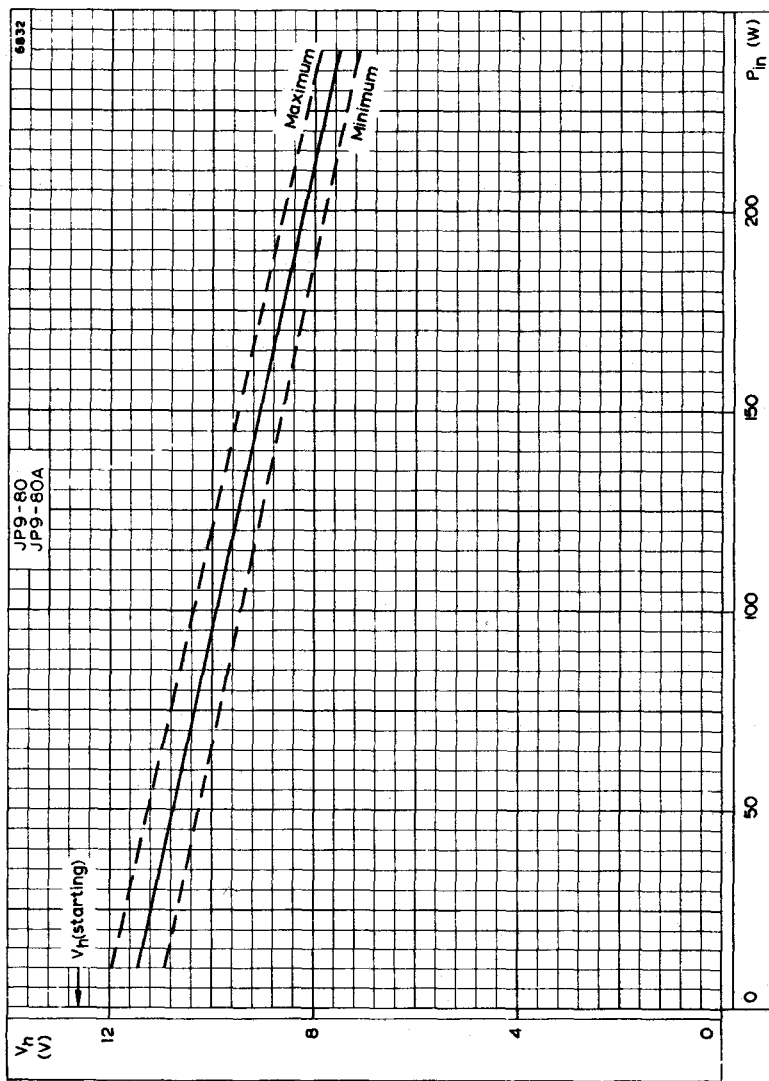


R.F. PULSE OUTPUT POWER, ANODE PULSE VOLTAGE AND EFFICIENCY
PLOTTED AGAINST ANODE PULSE CURRENT



JP9-80 JP9-80A

MAGNETRON



REDUCTION OF HEATER VOLTAGE PLOTTED AGAINST INPUT POWER



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

MOUNTING POSITION

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 | $178 \times 244 \times 290$ | $7 \times 9.6 \times 11.4$ |

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 | $^\circ\text{C}$ |
| Cathode and heater seals max. | 200 | $^\circ\text{C}$ |



MAGNETRON

JP9-180

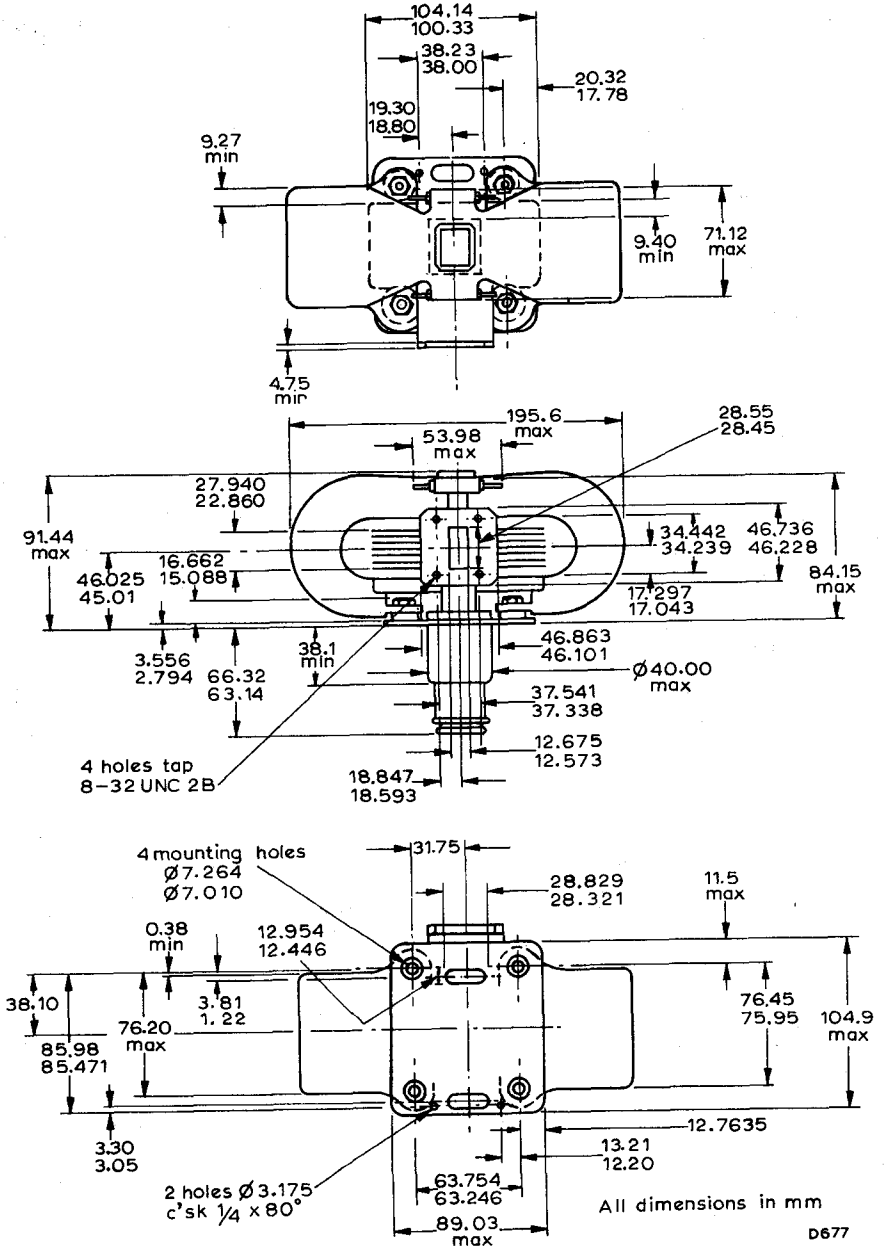
CONVERSION TABLE

(Rounded outwards)

| mm | in | mm | in |
|---------------|---------------|---------------|--------------|
| 0.38 min. | 0.0149 min. | 34.442/34.239 | 1.356/1.348 |
| ∅ 3.175 | ∅ 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. | ∅ 40.00 max. | ∅ 1.575 max. |
| ∅ 7.264/7.010 | ∅ 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 | | |

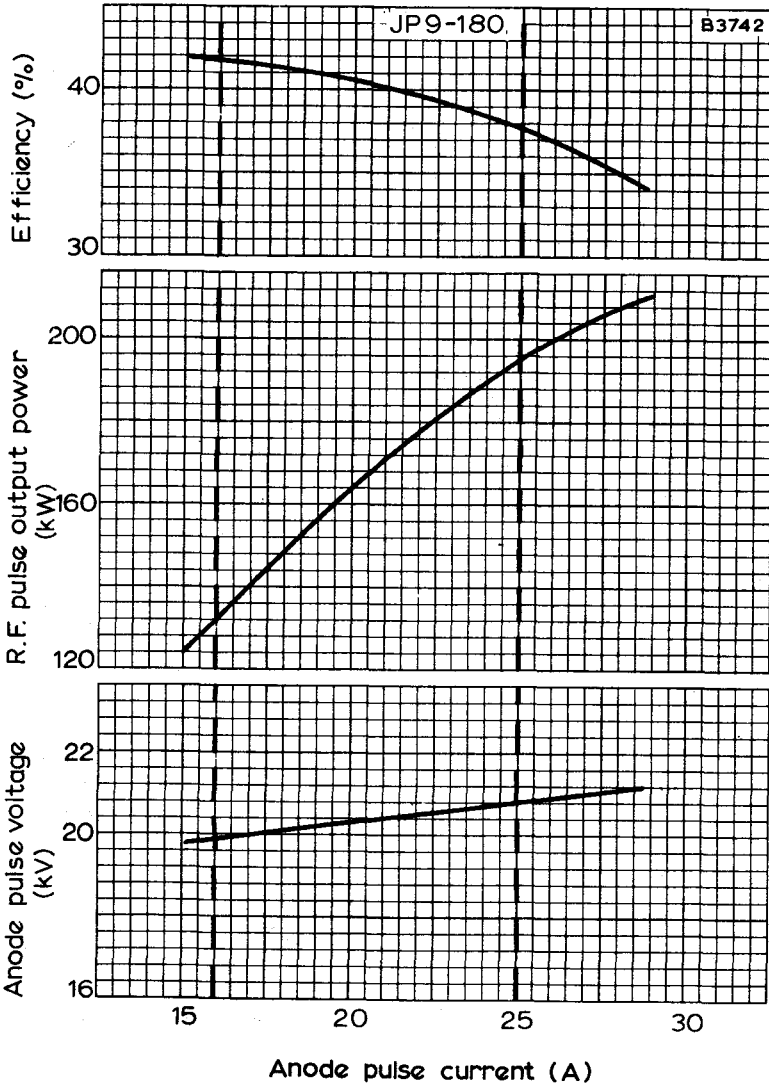


OUTLINE DRAWING OF JP9-180



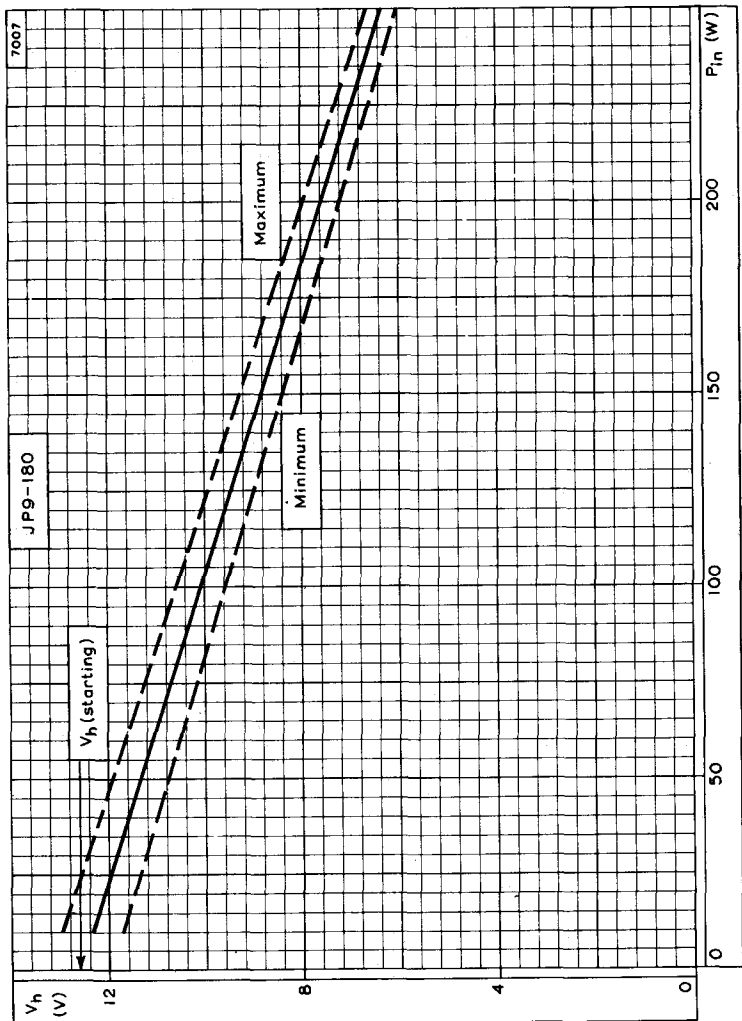
D677





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

| Frequency: | Min. | Max. | |
|--|----------|--------|-------------|
| 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 ($I_{\text{pulse}} = 27.5\text{A}$) | 20 | 23 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 27.5\text{A}$) | 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 | λ g |

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 | μ s |
| 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/ μ s |

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 $\leq 1.2\mu\text{s}$ | 15 | 27.5 | A |
| = $6.0\mu\text{s}$ | 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 | $^{\circ}\text{C}$ |
| Temperature of cathode and heater seals | — | 165 | $^{\circ}\text{C}$ |

MOUNTING POSITION

Any

PRESSURISING

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

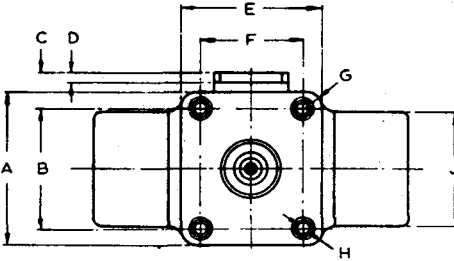
PHYSICAL DATA

| | | | |
|-------------------------------|---|-------------------|----|
| Weight of magnetron | } | 10 | lb |
| | | 4.5 | kg |
| Weight of magnetron in carton | } | 13 | lb |
| | | -6.0 | kg |
| Dimensions of storage carton | { | 7.0 x 9.6 x 11.2 | in |
| | | 178 x 244 x 284.5 | mm |

DIMENSIONS

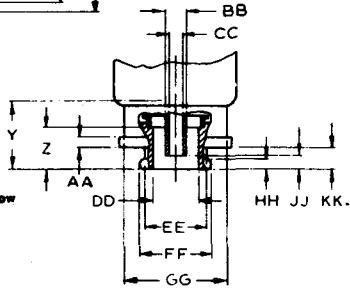
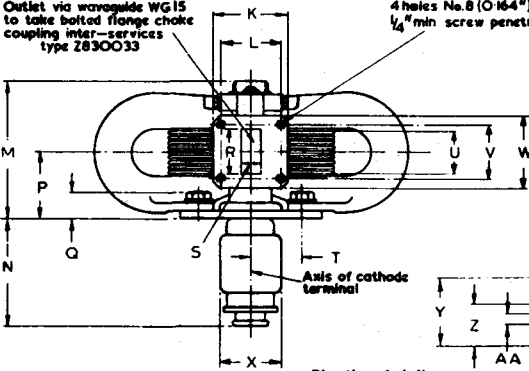
| | Inches | Millimetres | | Inches | Millimetres | |
|---|---------------|--------------|------|--------|---------------|---------------|
| A | 3.874 | 98.4 | max. | W | 1.830 ± 0.01 | 46.48 ± 0.25 |
| B | 3.000 ± 0.01 | 76.20 ± 0.25 | | X | 1.500 | 38.1 |
| C | 0.906 ± 0.02 | 23.0 ± 0.5 | | Y | 0.750 | 19.05 |
| D | 0.250 | 6.35 | | Z | 0.516 | 13.1 |
| E | 3.469 | 88.1 | max. | AA | 0.115 | 3.175 |
| F | 2.500 ± 0.01 | 63.50 ± 0.25 | | BB | 0.250 ± 0.02 | 6.35 ± 0.40 |
| G | 0.512 | 10.3R | | CC | 0.169 ± 0.004 | 4.3 ± 0.1 |
| H | 0.281 | 7.14 | | DD | 0.539 ± 0.004 | 13.7 ± 0.1 |
| J | 2.874 | 73 | max. | | -0.008 | -0.2 |
| K | 1.830 | 46.48 | | EE | 0.750 | 19.05 |
| L | 1.474 ± 0.004 | 37.44 ± 0.10 | | FF | 0.830 ± 0.008 | 21.08 ± 0.20 |
| M | 3.603 | 91.52 | max. | | -0.004 | -0.10 |
| N | 2.680 ± 0.06 | 68.25 ± 1.50 | | GG | 1.252 | 31.8 |
| P | 1.653 ± 0.02 | 41.99 ± 0.50 | | HH | 0.125 ± 0.01 | 3.175 ± 0.250 |
| Q | 0.625 ± 0.03 | 15.88 ± 0.80 | | JJ | 0.125 | 3.175 |
| R | 1.122 | 28.50 | | | 0.187 | 4.75 |
| S | 0.497 | 12.62 | | KK | 0.250 | 6.35 |
| T | 1.250 | 31.75 | | LL | 7.687 | 195.25 |
| U | 1.000 ± 0.04 | 25.4 ± 1.0 | | MM | 4.000 | 101.6 |
| V | 1.352 ± 0.004 | 34.34 ± 0.10 | | NN | 0.500 | 12.7 |



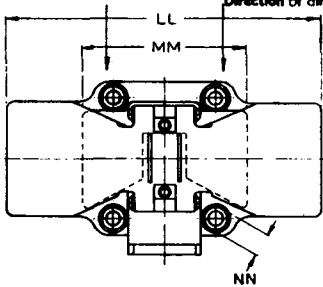


Outlet via waveguide WG15 to take bolted flange choke coupling inter-services type Z830033

4 holes No. 8 (O.164") - 32 UNC 2B
1/4" min screw penetration



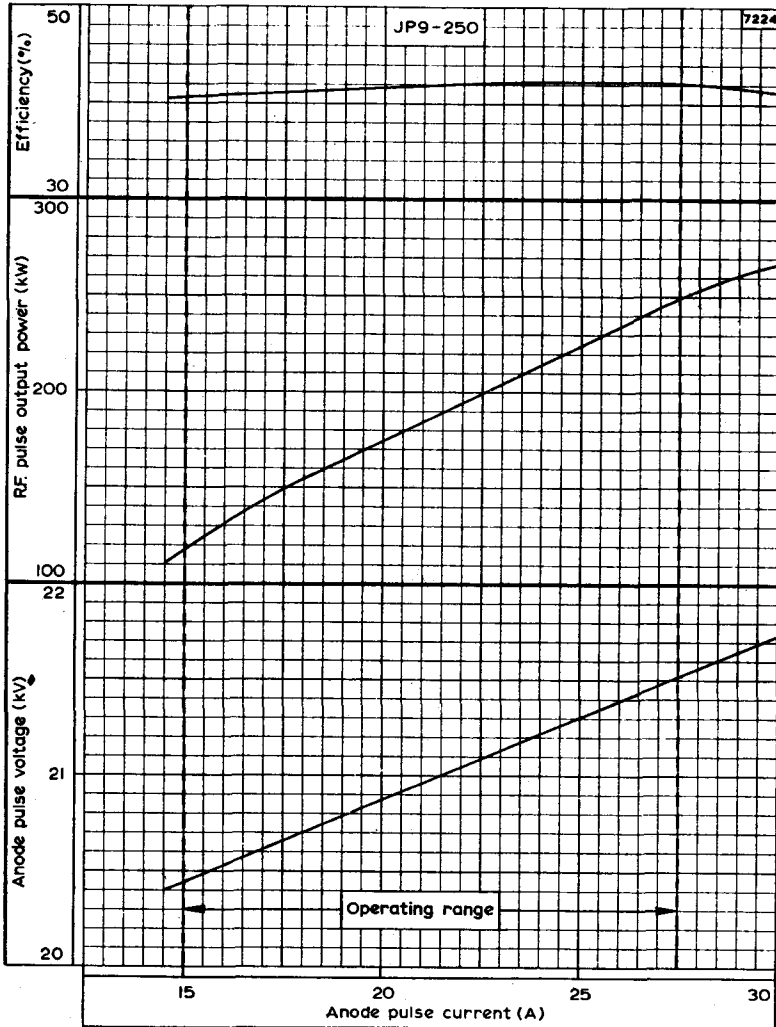
Cathode terminal assembly



7270

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.

JP9-250 Series



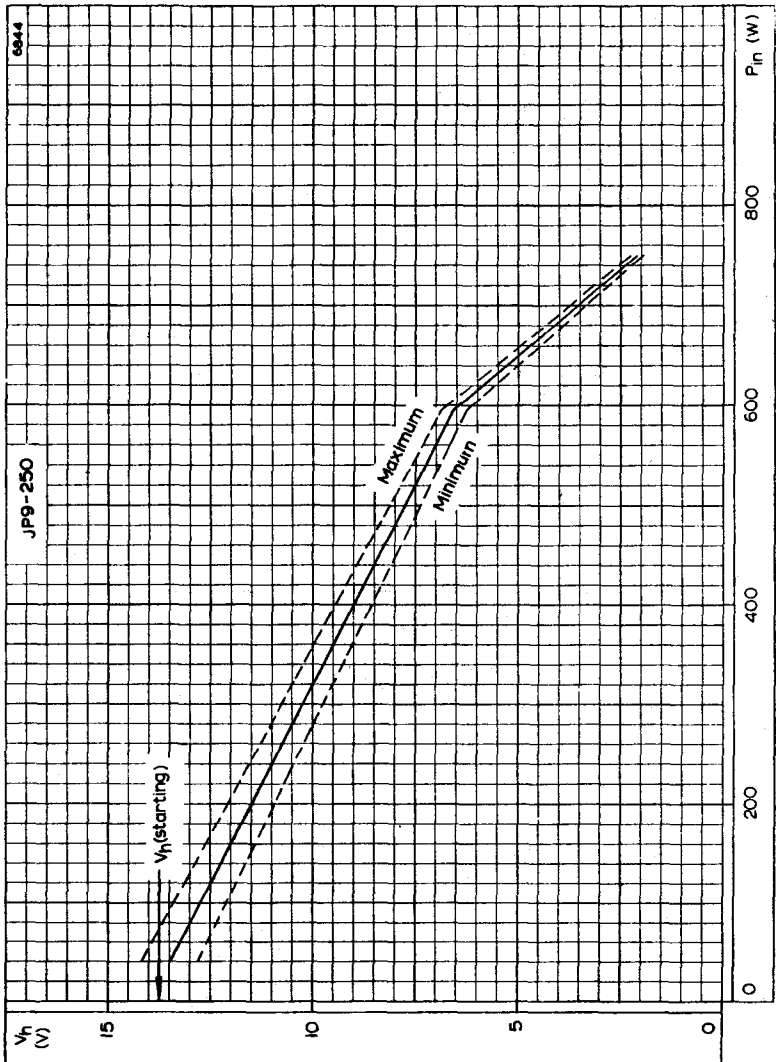
ANODE PULSE VOLTAGE R.F. PULSE OUTPUT POWER AND EFFICIENCY
PLOTTED AGAINST ANODE PULSE CURRENT



JP9-250

Series

MAGNETRON



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER



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 | μ s |
| 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/ μ s |

*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 | μ s |
| Duty cycle | — | 0.0003 | |
| Mean input power | — | 60 | W |
| *Rate of rise of voltage pulse (hard valve modulator) | | | |
| pulse duration > 0.05 μ s | 200 | 300 | kV/ μ s |
| pulse duration = 0.02 μ s (at duty cycle = 1.0×10^{-4}) | — | 600 | kV/ μ s |
| Load mismatch (v.s.w.r.) | — | 1.5 | |
| Temperature of anode block | — | 150 | $^{\circ}$ C |
| Temperature of cathode and heater seals | — | 150 | $^{\circ}$ C |
| Pressurisation of waveguide output system | — | 45 | lb/in ² |
| Pressurisation of input system | 8.7 | 2280 | torr |
| | 450 | — | lb/in ² torr |

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

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 it is necessary to obtain the mean input power from the measured mean input current $\times 12,500$. 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 | λ g |
| 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

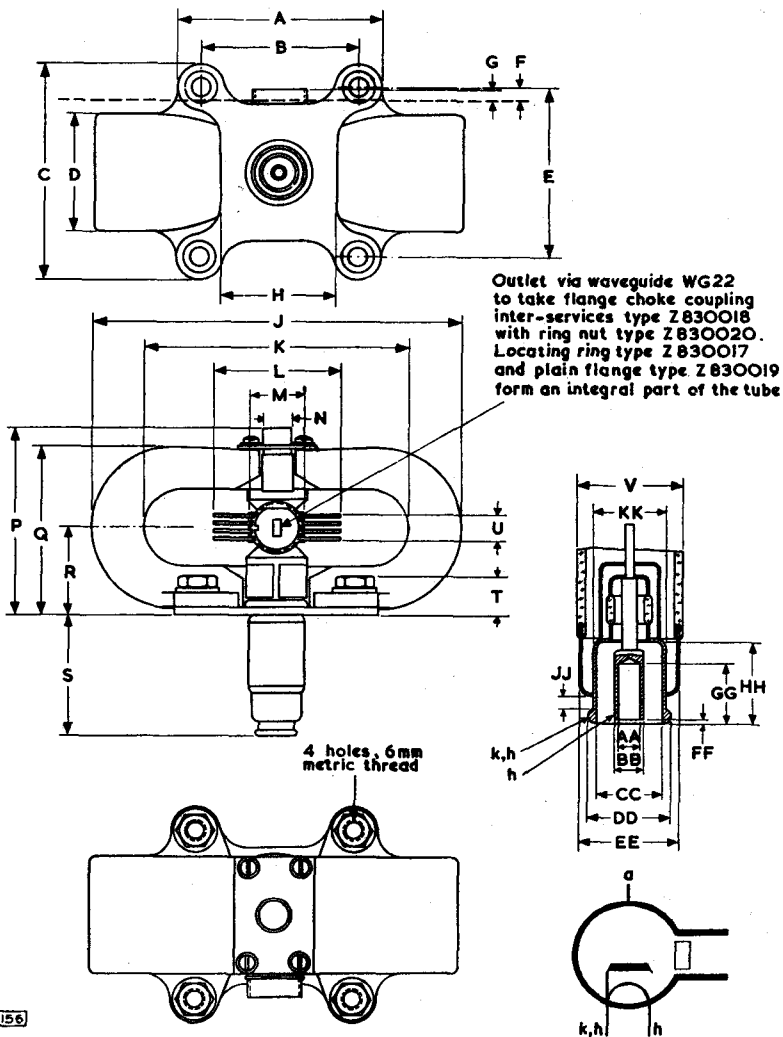
| | | | |
|-------------------------------|---|-------------------|------|
| Weight of magnetron | } | 4lb | 3oz |
| | | 1.9 | kg |
| Weight of magnetron in carton | } | 12lb | 13oz |
| | | 5.8 | kg |
| Dimensions of storage carton | } | 7.0 × 9.6 × 11.2 | in |
| | | 178 × 244 × 284.5 | mm |

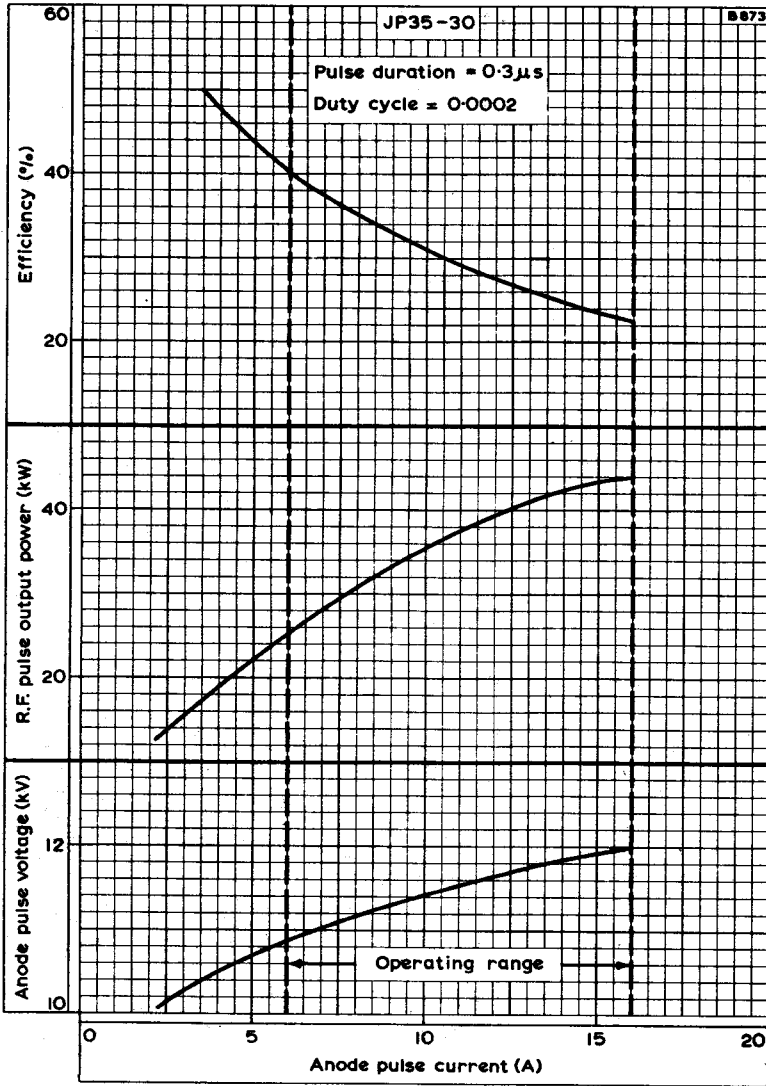
DIMENSIONS

| | <i>Inches</i> | <i>Millimetres</i> | |
|----|-------------------|--------------------|------|
| 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 | |

JP35-30

MAGNETRON



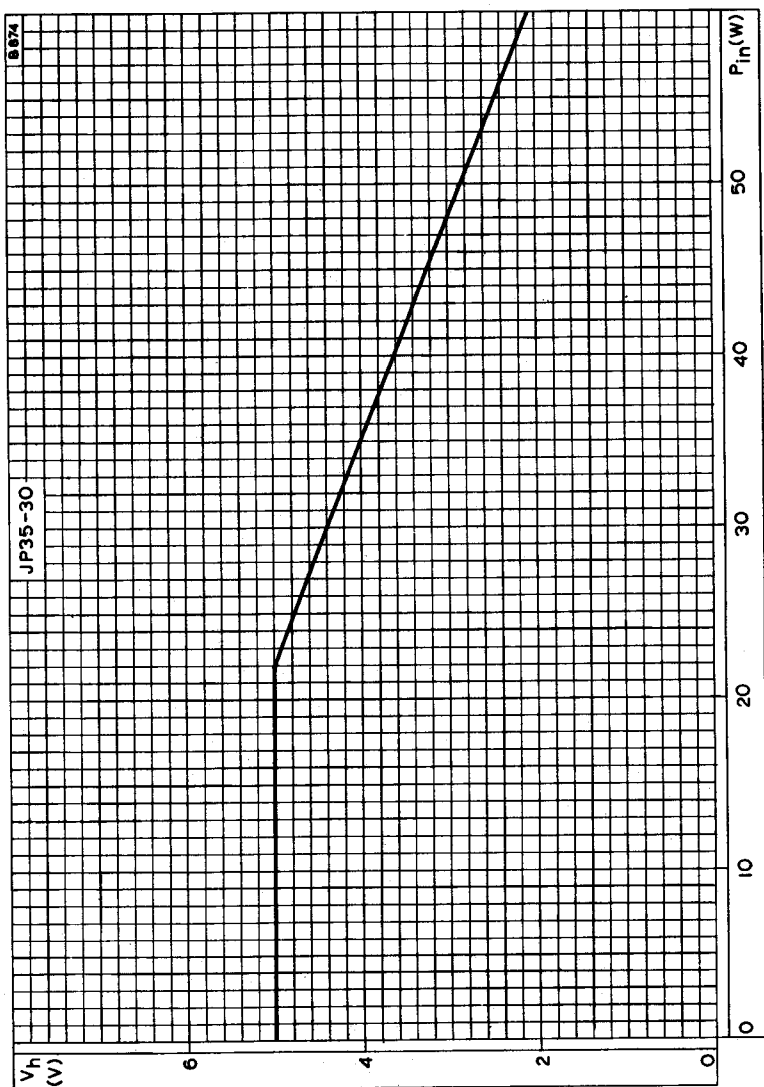


ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE PULSE CURRENT



JP35-30

MAGNETRON



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



TUNABLE MAGNETRON

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

JPG9-01

JPT9-01

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

| Frequency | Min. | Max. | |
|---|------|--------|-------------|
| 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 1k Ω 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

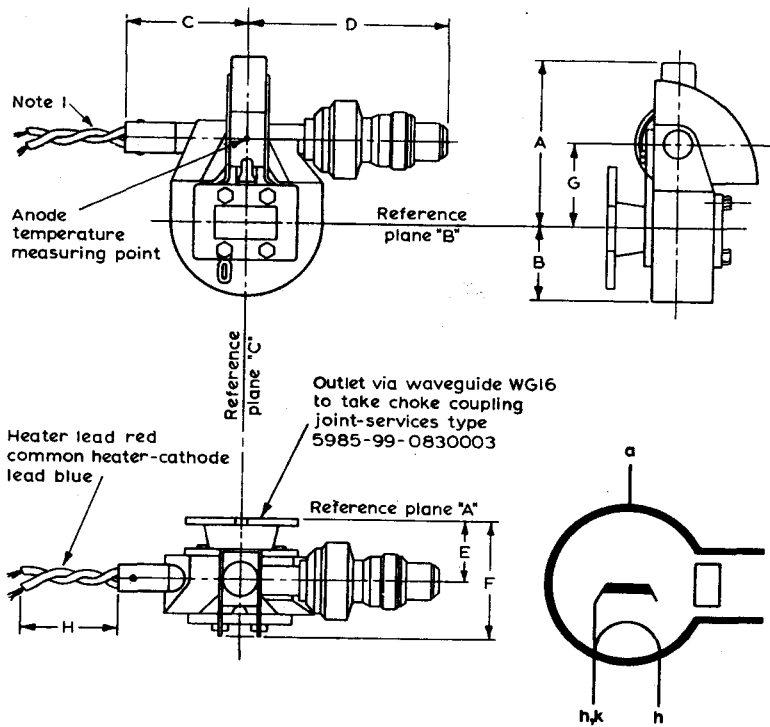
| | | |
|-------------------------------|--------------------------------------|----------|
| Weight of magnetron | { 1 lb 8 oz 680 | g |
| Weight of magnetron in carton | { 2 lb 8 oz 1.13 | kg |
| Dimensions of storage carton | { 5.0 × 7.0 × 7.5 127 × 178 × 190 | in mm |

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



9472

ANODE CONNECTION TERMINATED AT THE BASE PLATE



JPG9-01 JPT9-01

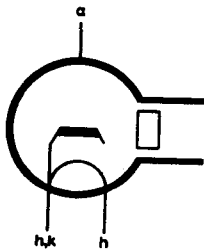
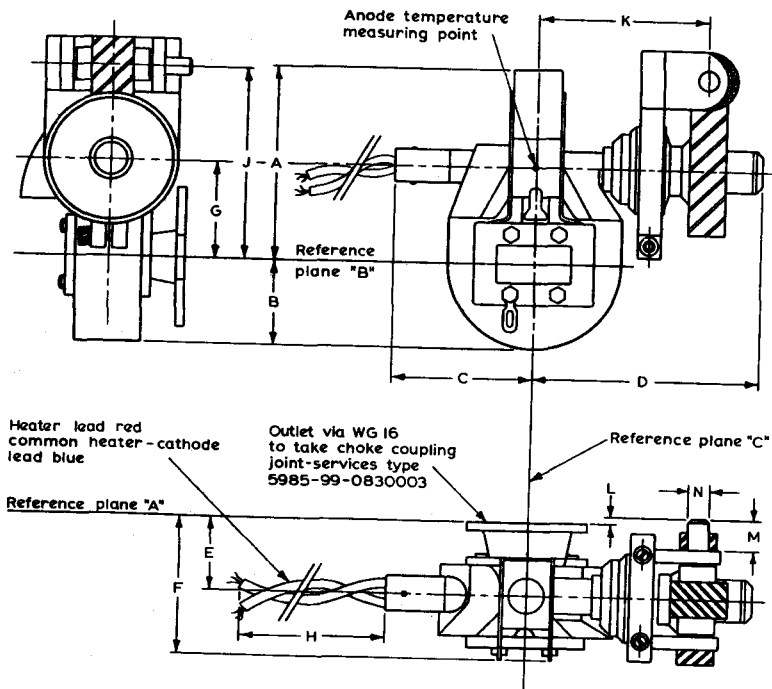
TUNABLE MAGNETRON

DIMENSIONS OF JPG9-01

| | <i>Inches</i> | <i>Millimetres</i> |
|---|-------------------|--------------------|
| 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



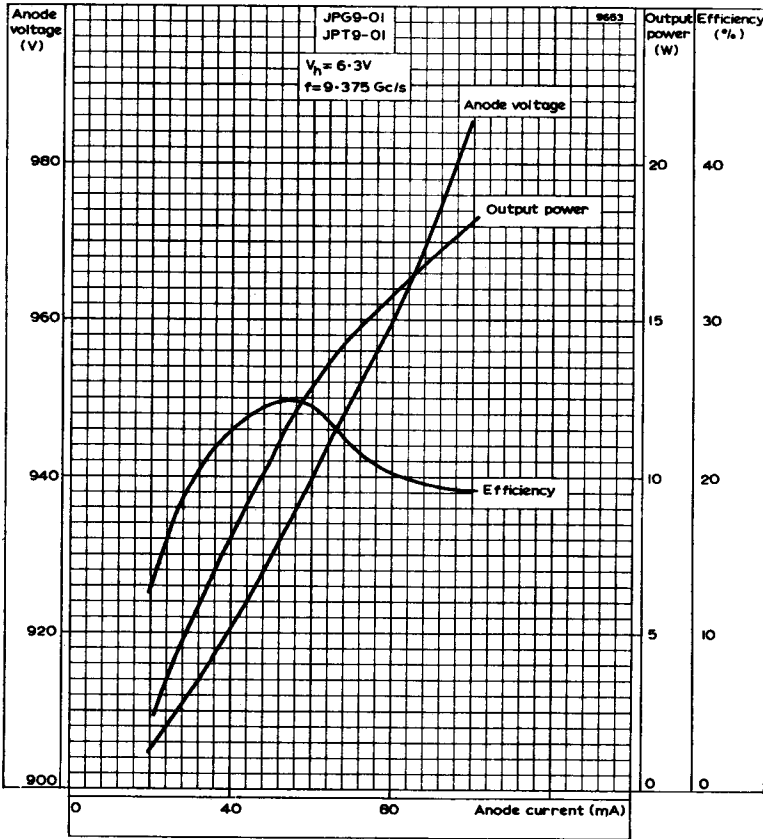
9434

ANODE CONNECTION TERMINATED AT THE BASE PLATE



TUNABLE MAGNETRON

JPG9-01
JPT9-01

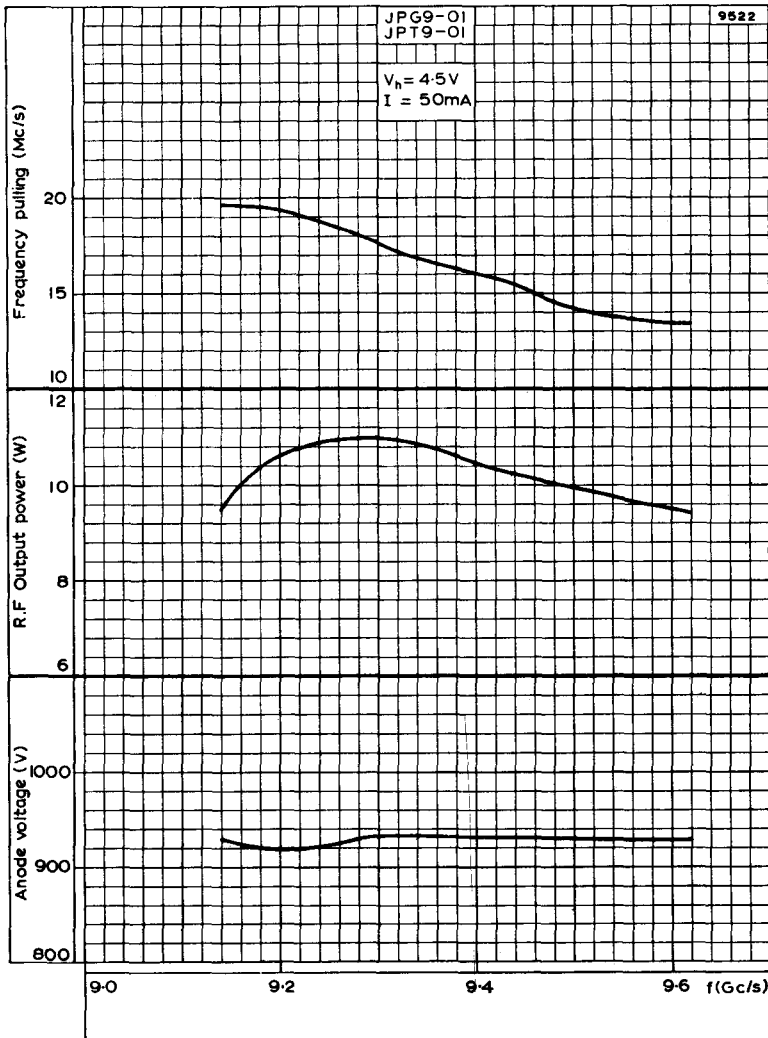


ANODE VOLTAGE, OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE CURRENT



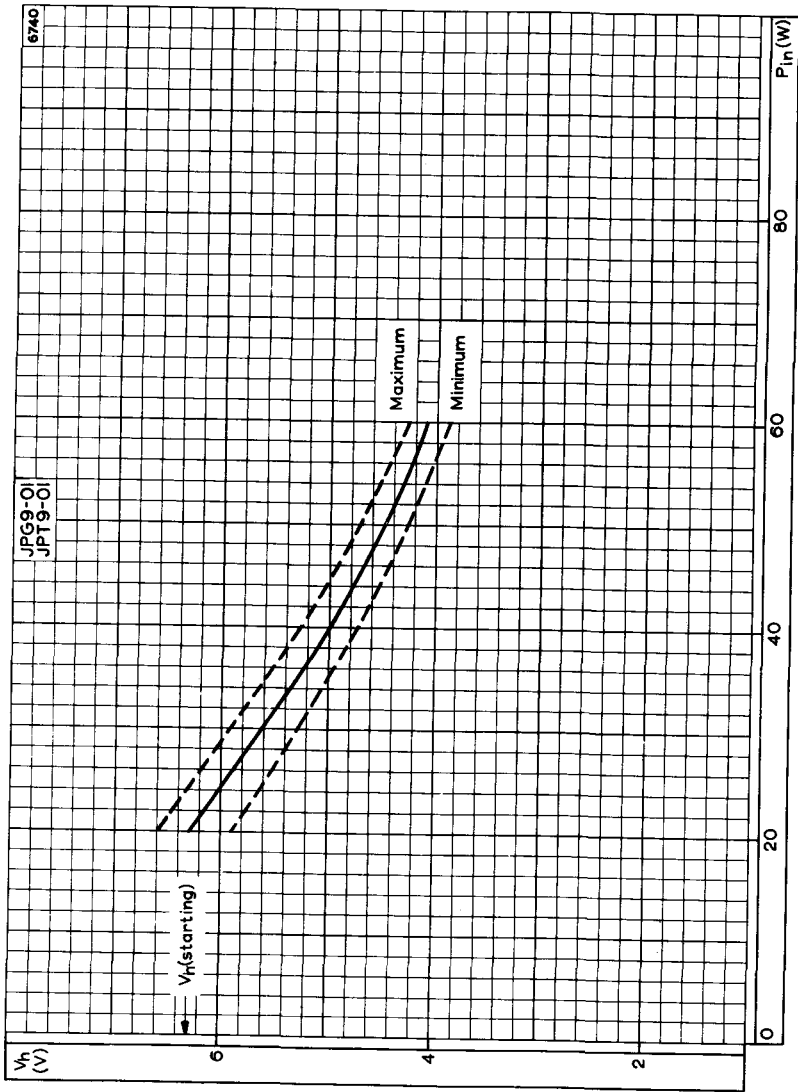
JPG9-01 JPT9-01

TUNABLE MAGNETRON



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





HEATER VOLTAGE PLOTTED AGAINST INPUT POWER



TUNABLE MAGNETRON

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

JPG9-02

JPT9-02

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 ($I_{\text{pulse}} = 120\text{mA}$) | 0.95 | 1.15 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 120\text{mA}$) | 18 | — | W |
| Frequency pulling factor (v.s.w.r. = 1.5) | — | 20 | Mc/s |
| Frequency pushing factor ($I_{\text{pulse}} = 140\text{mA}$) | — | 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

| | <i>Min.</i> | <i>Max.</i> | |
|-------------------------------|-------------|-------------|-------|
| 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

| | <i>Min.</i> | <i>Max.</i> | |
|---|-------------|-------------|-------|
| 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

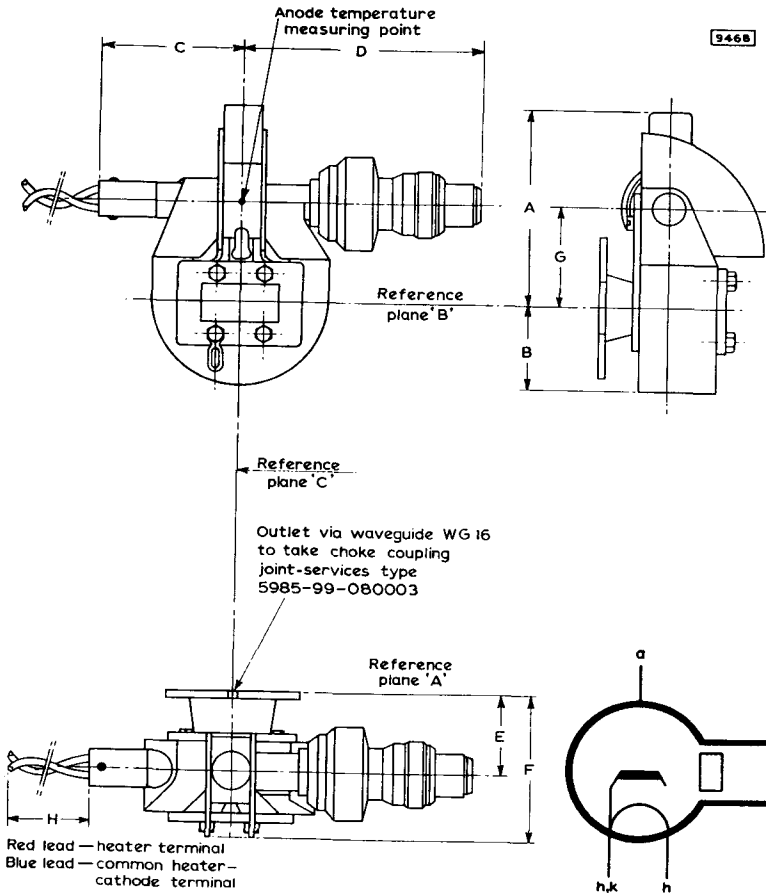
| | | |
|-------------------------------|--------------------------------------|----------|
| Weight of magnetron | { 1 lb 8 oz 680 | g |
| Weight of magnetron in carton | { 2 lb 8 oz 1.13 | kg |
| Dimensions of storage carton | { 5.0 × 7.0 × 7.5 127 × 178 × 190 | in mm |

DIMENSIONS OF JPT9-02

| | <i>Inches</i> | <i>Millimetres</i> | |
|---|---------------|--------------------|------|
| 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



JPG9-02 JPT9-02

TUNABLE MAGNETRON

DIMENSIONS OF JPG9-02

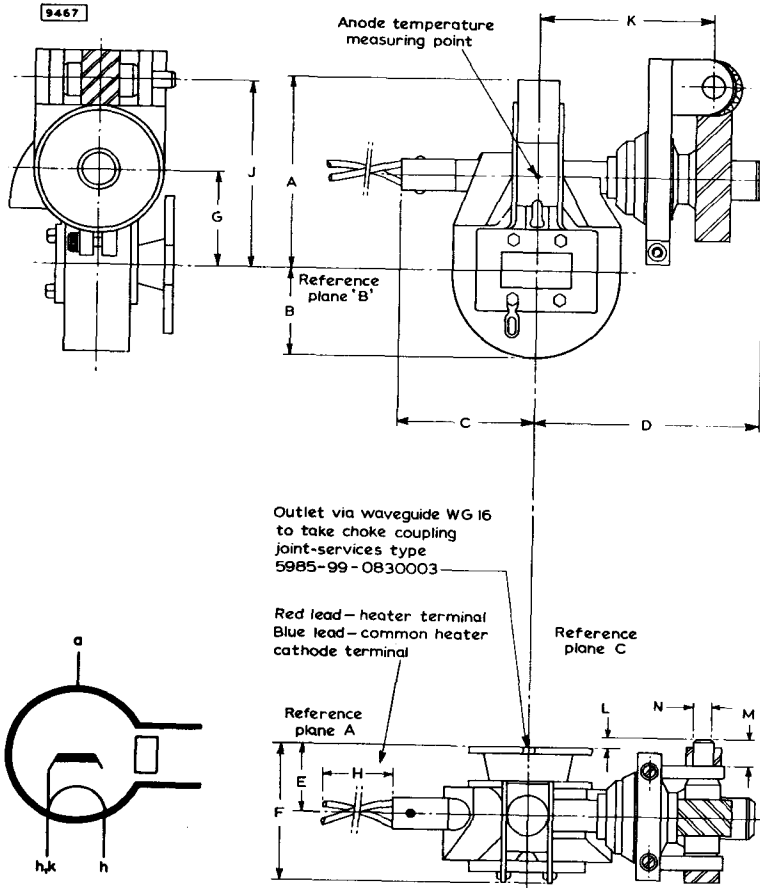
| | <i>Inches</i> | <i>Millimetres</i> | |
|---|-------------------|--------------------|------|
| A | 2.56 | 65 | max. |
| B | 1.26 | 32 | max. |
| C | 1.97 | 50 | max. |
| D | 2.39 | 86 | max. |
| E | 0.965 ± 0.040 | 24.5 ± 1.0 | |
| F | 2.24 | 57 | max. |
| G | 1.223 ± 0.075 | 31 ± 2 | |
| H | 5.12 ± 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 | |



TUNABLE MAGNETRON

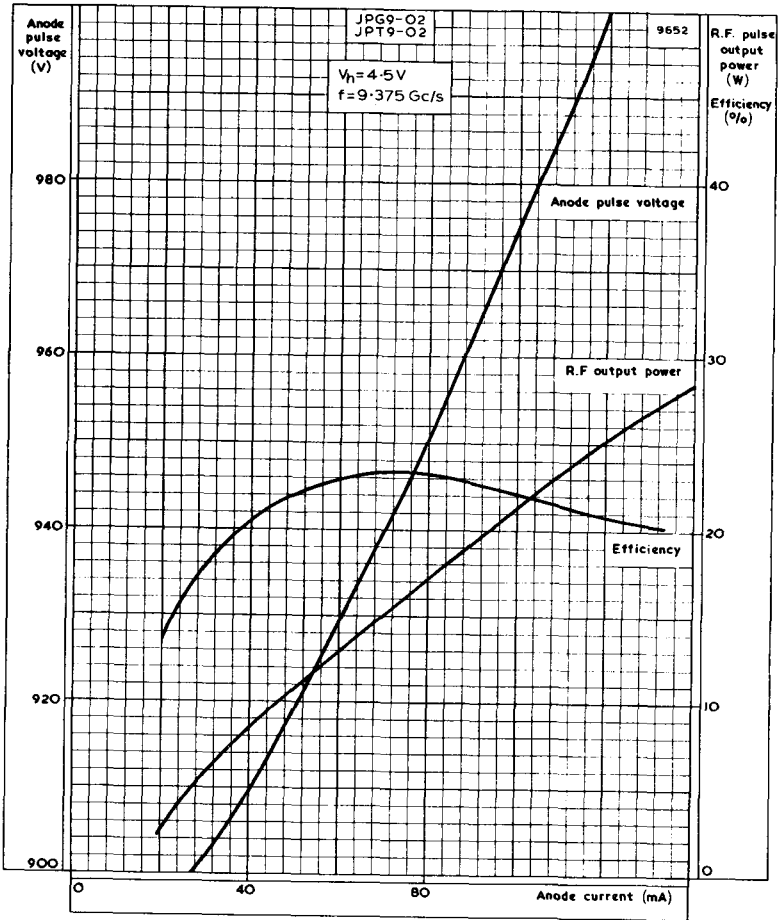
JPG9-02 JPT9-02

OUTLINE DRAWING OF JPG9-02



ANODE CONNECTION TERMINATED AT THE BASE PLATE



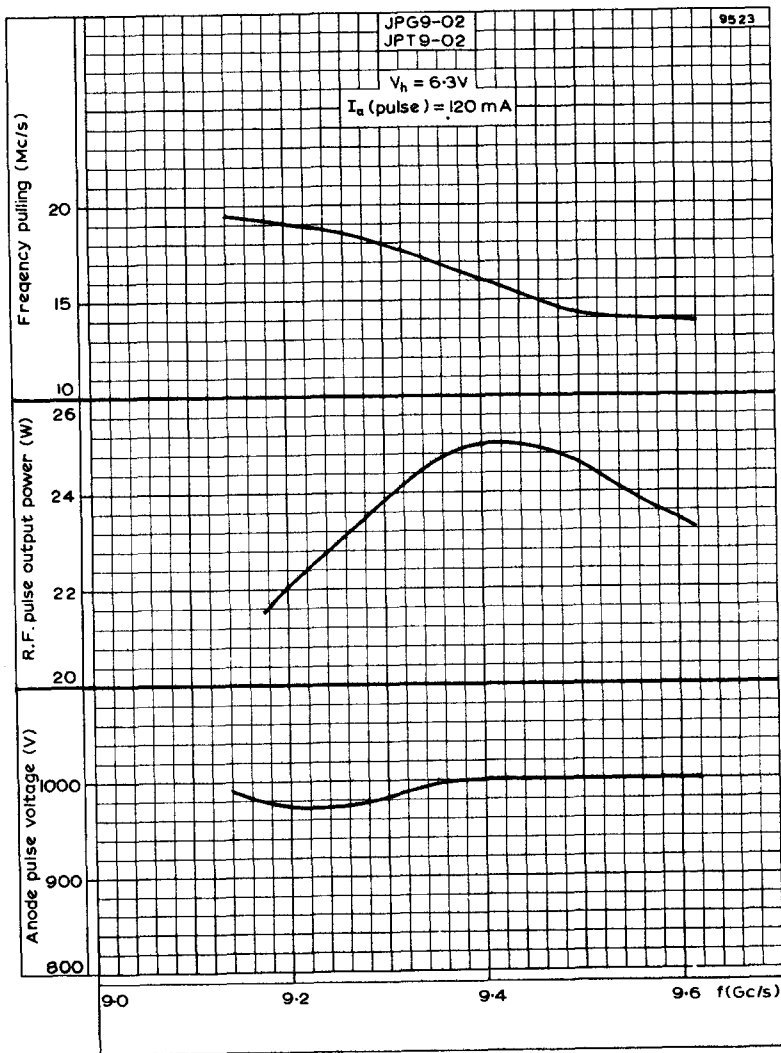


ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY PLOTTED AGAINST ANODE CURRENT



JPG9-02 JPT9-02

TUNABLE MAGNETRON



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



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 | μ s |
| 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/ μ s |
| 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°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 ($I_{\text{pulse}} = 100\text{mA}$) | 0.9 | - | 1.1 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 100\text{mA}$) | 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 ($I_{\text{pulse}} = 100\text{mA}$) | - | 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 | $^{\circ}\text{C}$ |

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

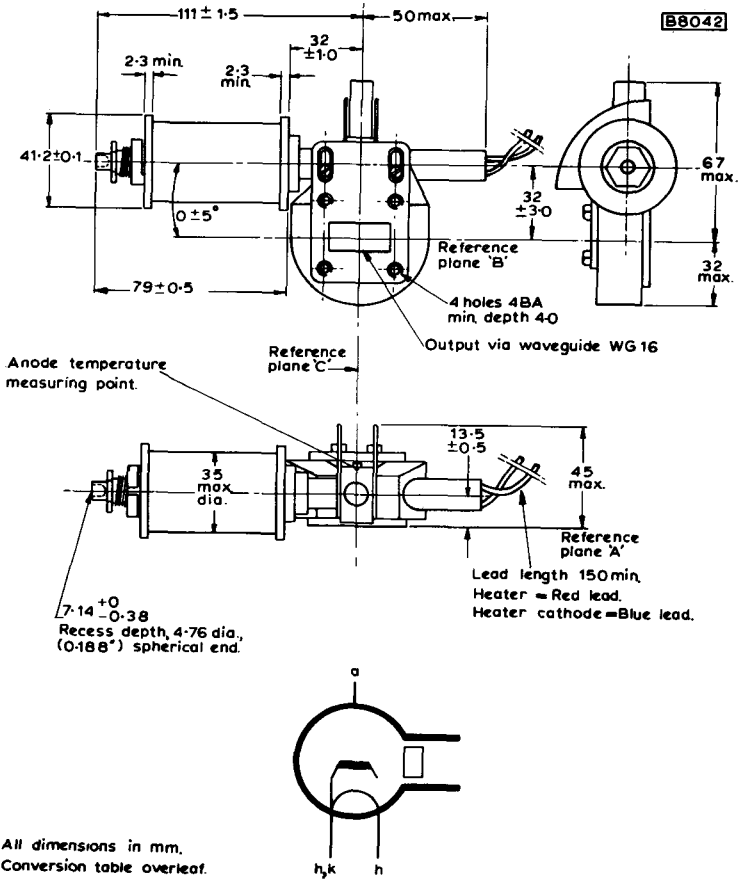
Any

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



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

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

JPT9-60

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 ($I_{\text{pulse}} = 14\text{A}$) | 13 | 15.5 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 14\text{A}$) | 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 |

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

| | <i>Min.</i> | <i>Max.</i> | |
|---|-------------|--------------|----------------------------|
| Pulse current | — | 15.5 | A |
| Pulse voltage | — | 16.0 | kV |
| Pulse duration | — | 3.6 | μ s |
| Duty cycle | — | 0.0012 | |
| Mean input power | — | 230 | W |
| Voltage pulse rise time | | | |
| $0.1\mu\text{s} \leq t_p \leq 1.0\mu\text{s}$ | — | 0.08 | μ s |
| $t_p = 3.6\mu\text{s}$ | — | 0.12 | μ s |
| Load mismatch (v.s.w.r.) | — | 1.5 | |
| Temperature of anode block | -60 | 150 | $^{\circ}$ C |
| Pressurisation of waveguide output system | — | { 43 2200 | lb/in ² torr |
| Pressurisation of input system | { 11 550 | — | lb/in ² torr |

MOUNTING POSITION

Any

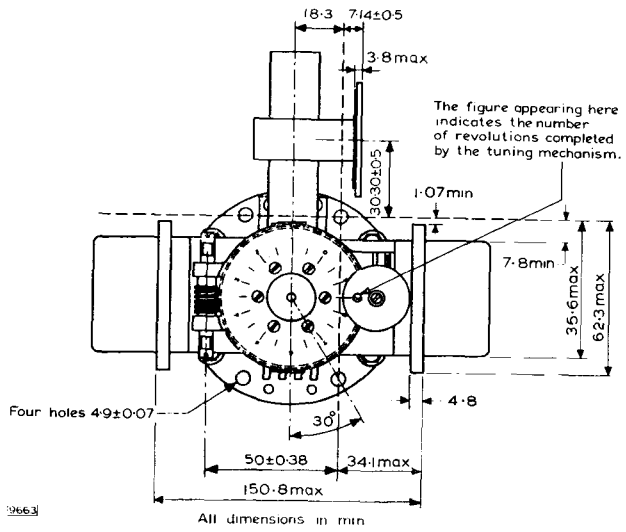
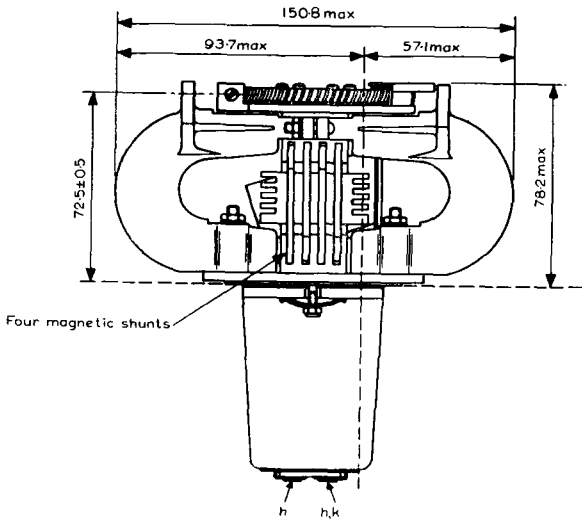
MECHANICAL CHARACTERISTICS

| | <i>Min.</i> | <i>Max.</i> | |
|---|-------------|-------------|-------|
| 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 2.2 | lb kg |
| Weight of magnetron in carton | { 13.9 6.3 | lb kg |
| Dimensions of storage carton | { 12.5 × 13 × 13 318 × 330 × 330 | in mm |



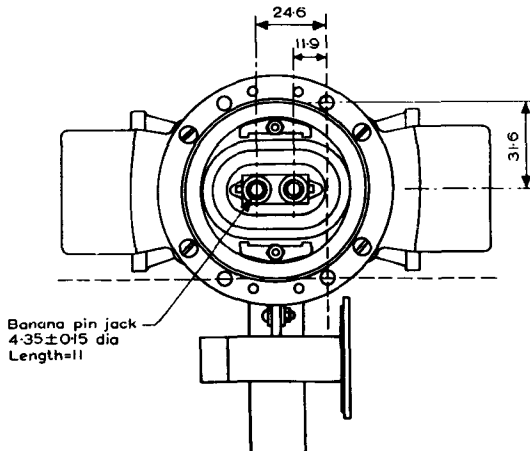
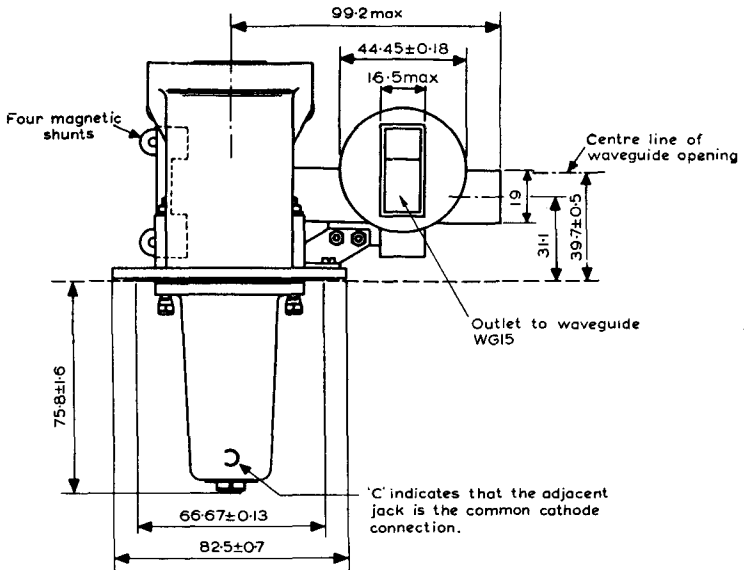


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JPT9-60

MAGNETRON

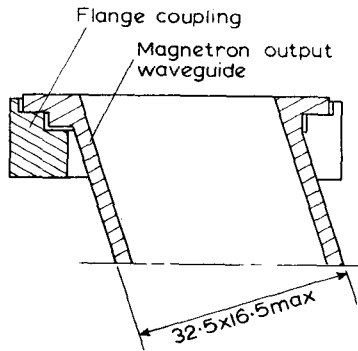
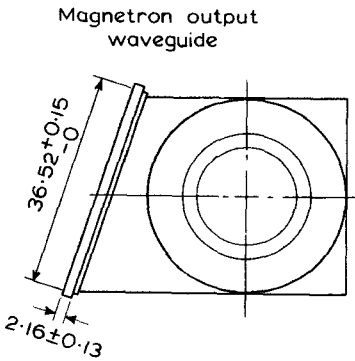
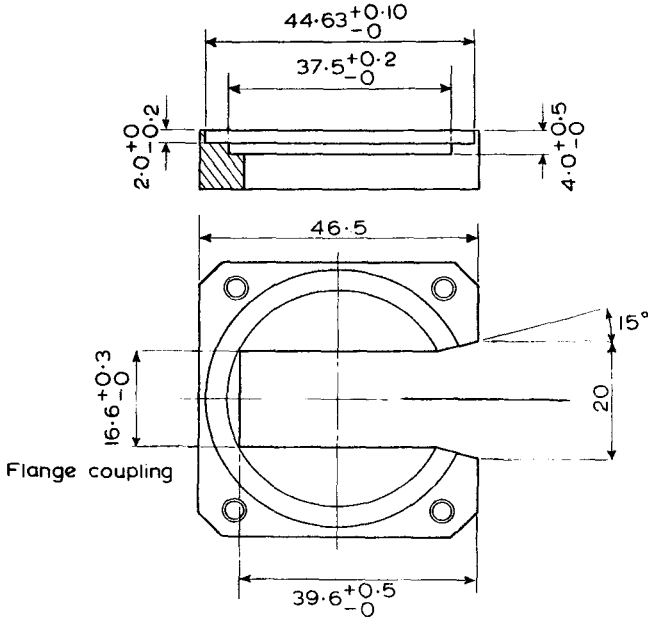


9664

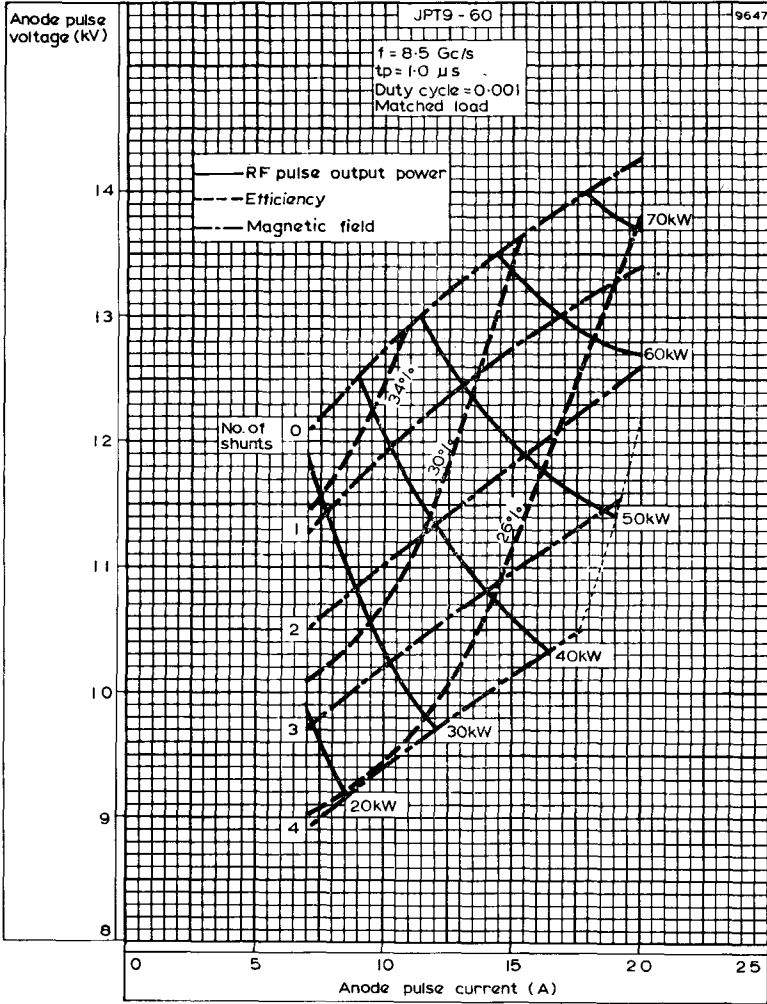
All dimensions in mm



9508

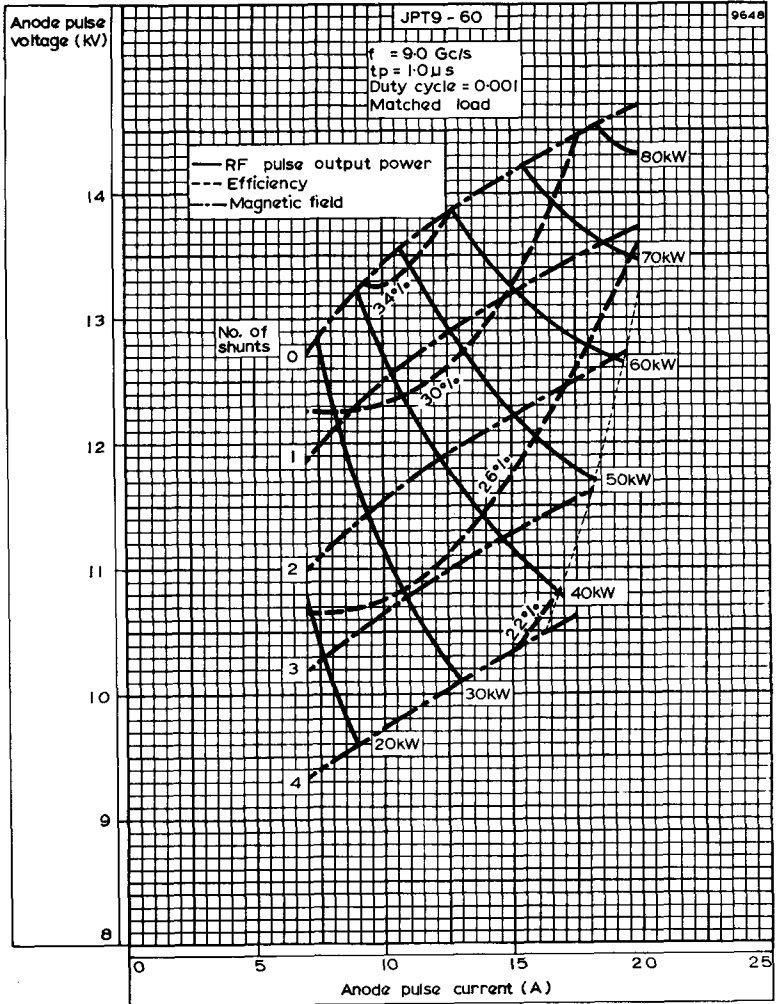


All dimensions in mm



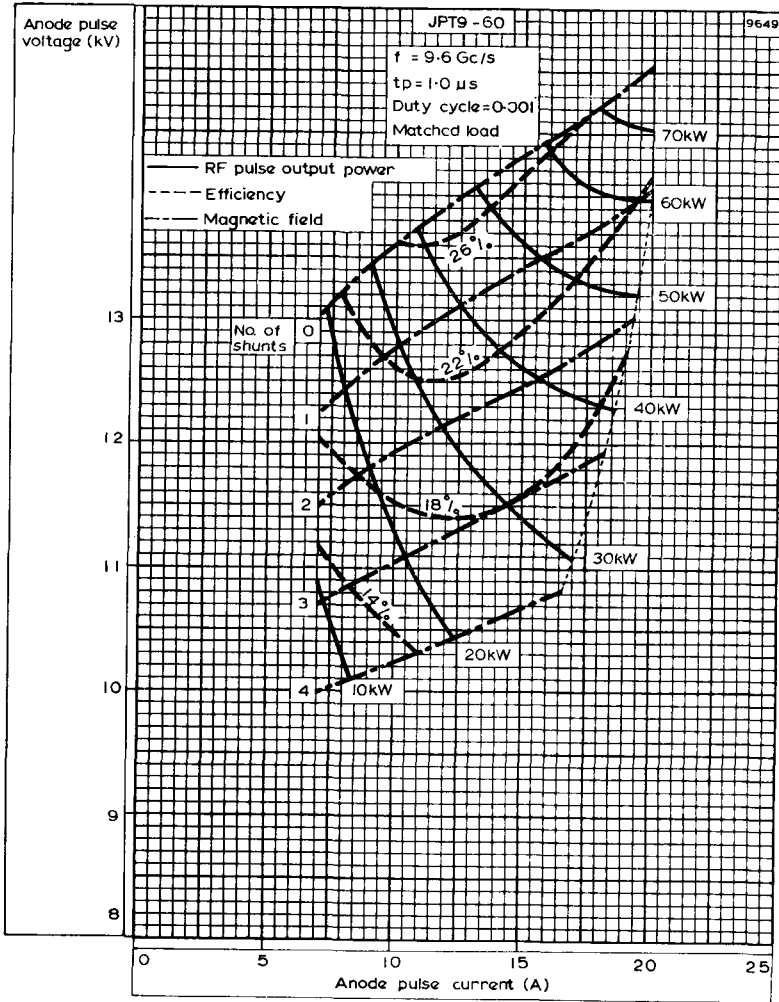
PERFORMANCE CHART ($f = 8.5\text{Gc/s}$)





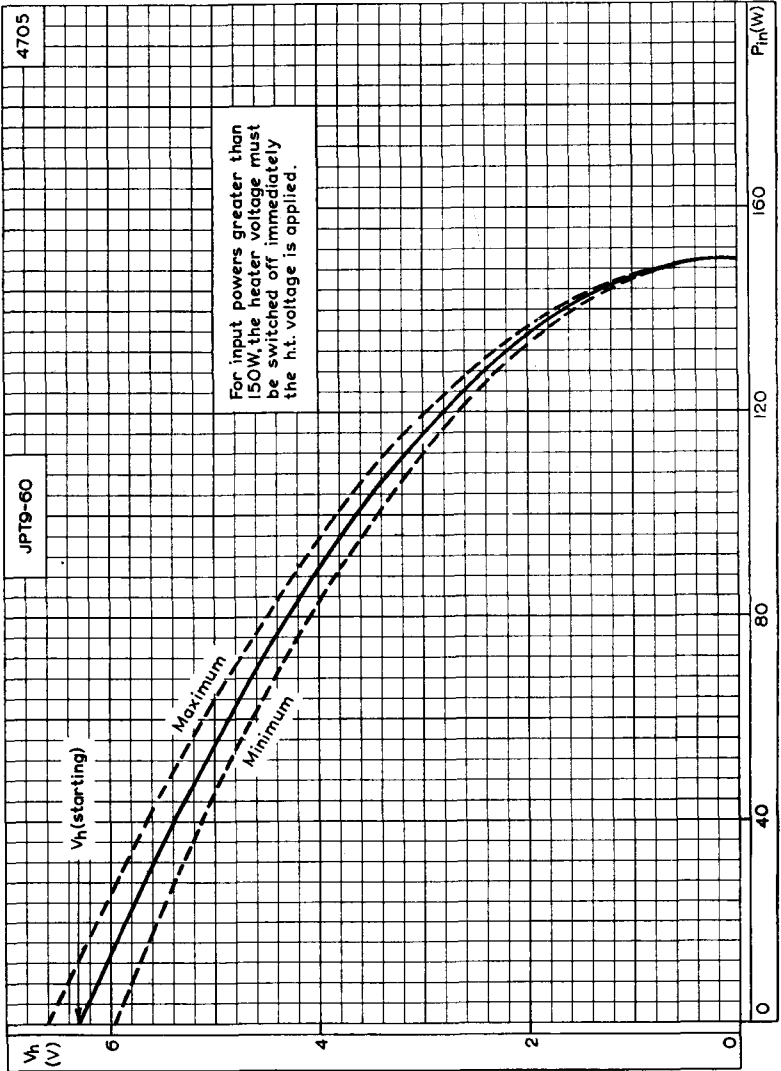
PERFORMANCE CHART ($f = 9.0\text{Gc/s}$)





PERFORMANCE CHART ($f = 9.6\text{Gc/s}$)





HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER



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 | μ s |
| 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/ μ s |
| 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 ($I_{\text{pulse}} = 27.5\text{A}$) | 20 | 23 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 27.5\text{A}$) | 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 ($t_p \leq 1.5\mu\text{s}$) | 70 | 225 | kV/ μs |
| ($t_p > 1.5\mu\text{s}$) | 70 | 200 | kV/ μs |
| Load mismatch (v. s. w. r.) | - | 1.5 | |

CATHODE

Indirectly heated

| | | |
|----------------------|------------------|----------|
| V_h | $13.75 \pm 10\%$ | 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°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 | °C |
| Cathode and heater seals | max. | 165 | °C |

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

OPERATING NOTES

Input pressurization min. 0.82kg/cm² (11.6lb/in²) absolute.

Output pressurization max. 3.2kg/cm² (45lb/in²) 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/cm² (14.2lb/in²) absolute.

TUNING MECHANISM

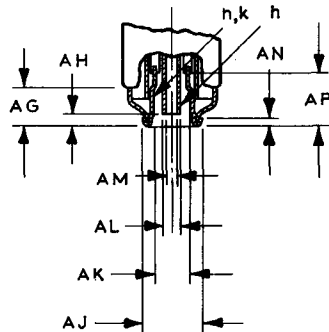
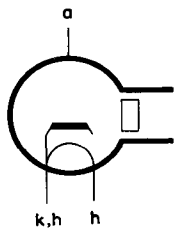
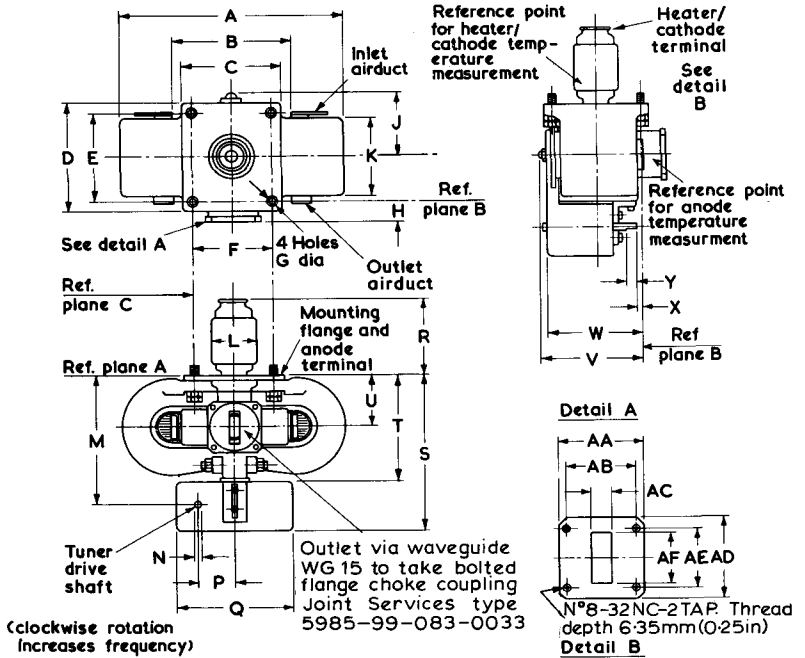
The frequency of the magnetron decreases with clockwise rotation of the tuner drive shaft, as viewed directly towards the waveguide flange. (See page D4.)

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

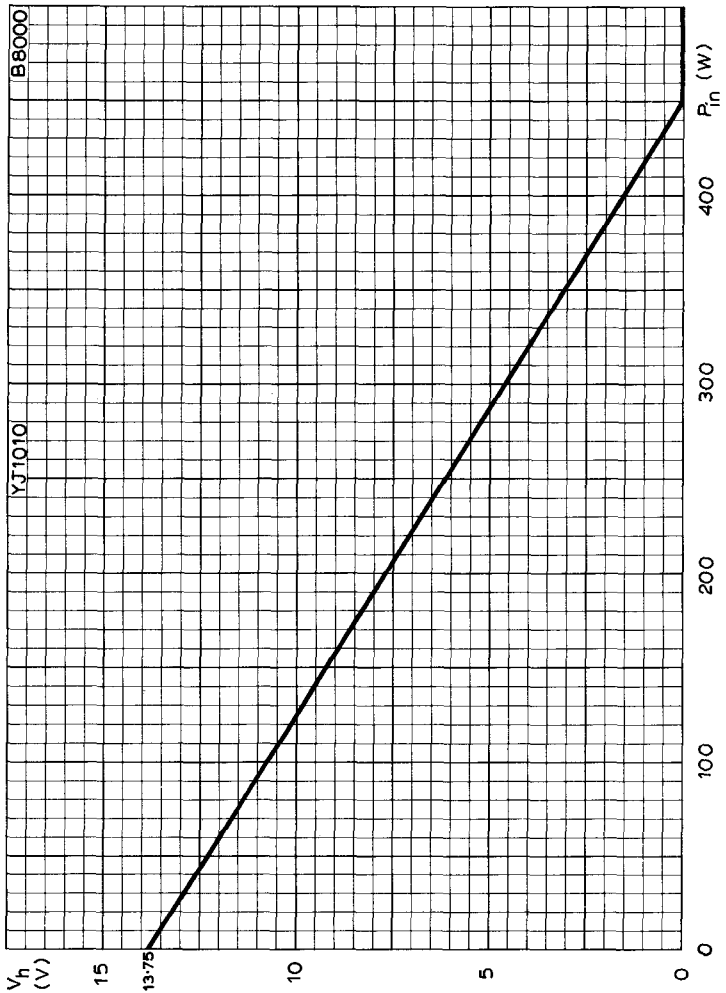


DIMENSIONS

| | 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



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 | μ s |
| 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/ μ s |
| 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 ($I_{\text{pulse}} = 12.5\text{A}$) | 11.5 | 13.5 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 12.5\text{A}$) | 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 $< 0.1\mu\text{s}$ | 200 | 400 | kV/ μs |
| Rate of rise of voltage pulse $\geq 0.1\mu\text{s}$ | - | 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

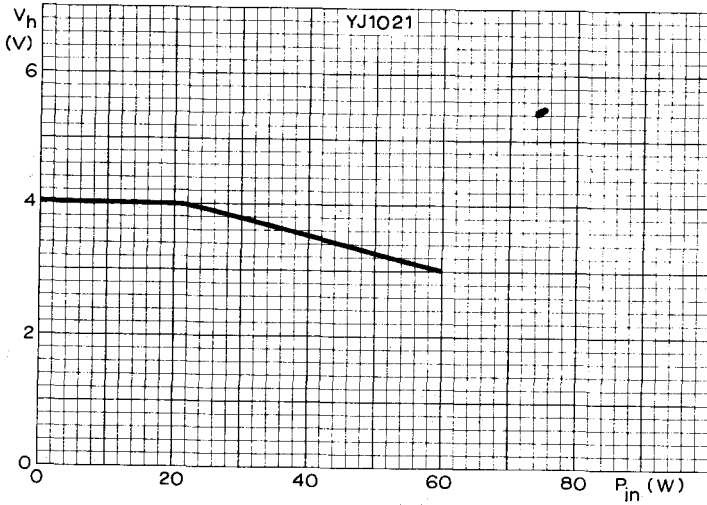
| | | |
|---|-----|--------------------|
| Anode block max. (between 2nd and 3rd fins) | 150 | $^{\circ}\text{C}$ |
| Cathode and heater seals max. | 150 | $^{\circ}\text{C}$ |

ACCESSORY

Cathode connector

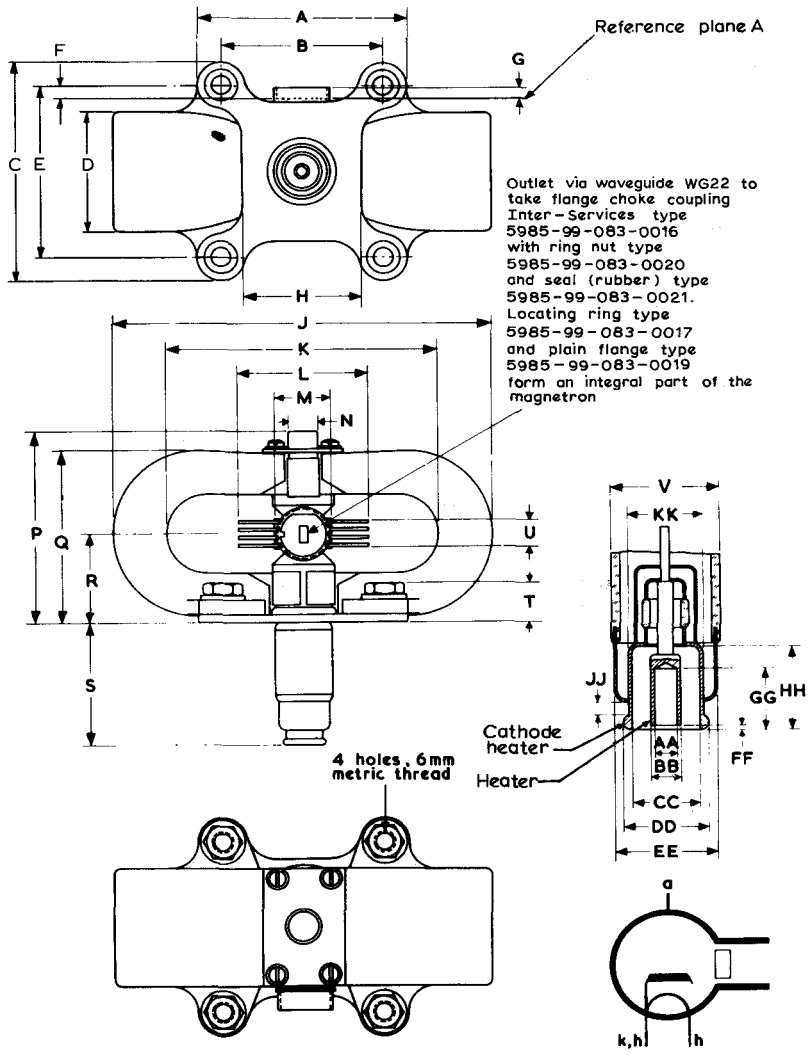
55356





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





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.



QUICK REFERENCE DATA

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

| | | |
|----------------------------------|--------------------------|-----|
| Frequency (Mechanically tunable) | 5.65 | GHz |
| Power output (pulsed) | 160 | 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 | GHz |
| Pulse voltage (I pulse = 0.8A) | 1.00 | 1.35 | kV |
| R. F. pulse power output (I pulse = 0.8A) | 70 | - | W |
| Frequency pulling (v. s. w. r. = 1.5) | - | 12 | MHz |
| Frequency temperature coefficient | - | -0.1 | MHz per °C |
| Frequency modulation under vibration of 12g (50-2000Hz) | - | 2.0 | MHz |
| Input capacitance | - | 6.0 | pF |
| Frequency pushing | - | 15 | MHz 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 | MHz |

CATHODE

Indirectly heated

| | | |
|----|-----|---|
| Vh | 5.0 | V |
| Ih | 0.5 | A |

Heating time. At ambient temperatures above 0°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 | °C |

MOUNTING POSITION

Any

PHYSICAL DATA

| | |
|-------------------------------------|-----------------|
| | kg |
| Weight of magnetron | 0.2 |
| Weight of magnetron in carton | 4.1 |
| | mm |
| <i>Dimensions of storage carton</i> | 318 × 292 × 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.

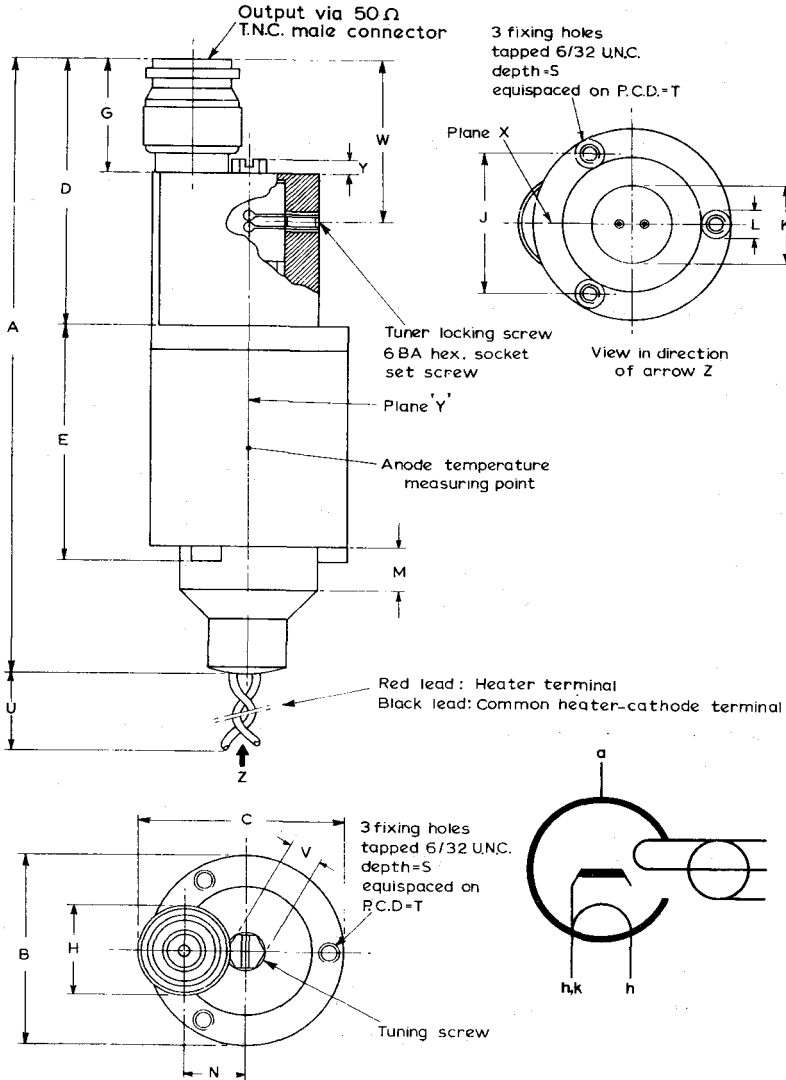
OUTPUT CONNECTION

Output via 50Ω T.N.C. Male Connector

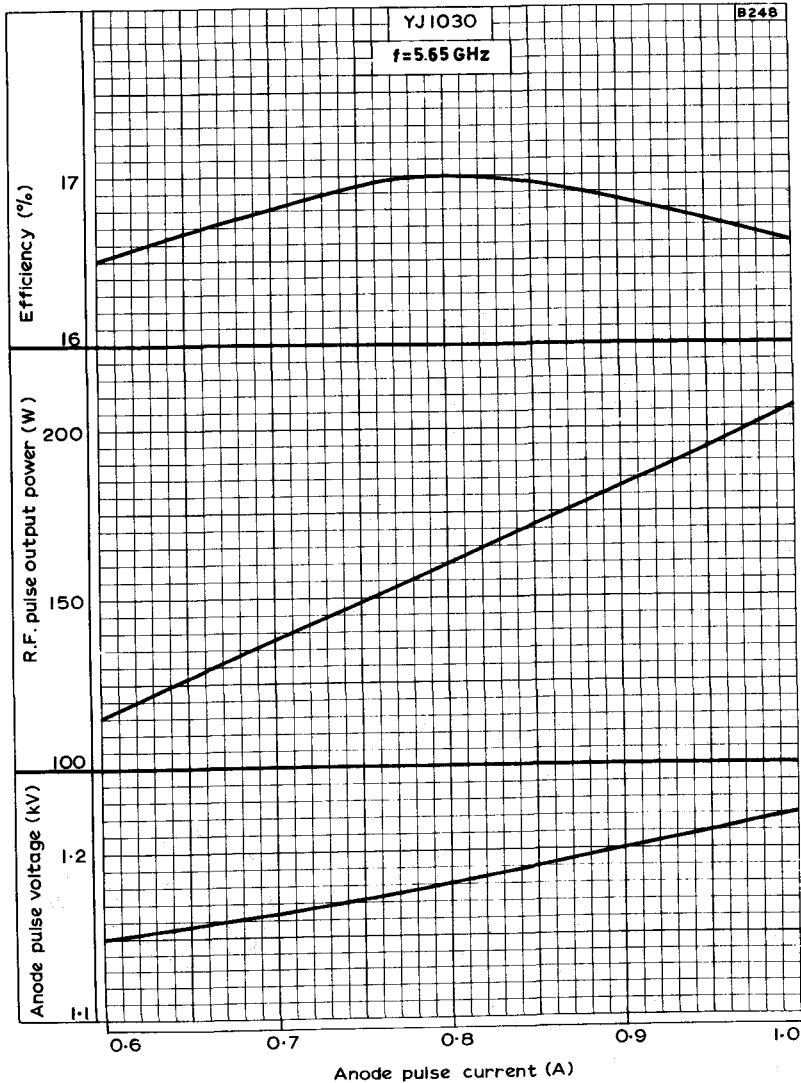
DIMENSIONS

Millimetres

| | |
|---|-------------------|
| A | 101.75 ± 1.75 |
| B | 32.25 ± 0.25 |
| C | 34.25 ± 0.25 |
| D | 44.25 ± 0.75 |
| E | 39.25 ± 0.75 |
| G | 18.0 ± 0.2 |
| H | 16.25 max. |
| J | 22.25 ± 0.25 |
| K | 12.75 ± 0.25 |
| L | 4.5 ± 0.1 |
| M | 7.5 ± 0.5 |
| N | 10.00 ± 0.25 |
| S | 4.25 ± 0.25 |
| T | 27.0 |
| U | 203 min. |
| V | 4.875 ± 0.025 |
| W | 26.0 ± 0.4 |
| Y | 1.95 ± 0.55 |



9957



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

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 | μ s |
| Pulse repetition rate | 400 | pulse/s |
| Rate of rise of voltage pulse | 70 | kV/ μ s |

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 | μ s |
| v.s.w.r. at output connection | 1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 80 | kV/ μ s |

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 | μ s |
| Rate of rise of voltage pulse (see note 3) | - | 80 | kV/ μ s |
| Anode temperature | - | 120 | $^{\circ}$ C |
| v.s.w.r. at output connection | - | 1.3:1 | |



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) | 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°C the cathode must be heated for at least 90 seconds before the application of h.t. For ambient temperatures between 0 and -55°C the cathode heating time is 120 seconds minimum.
2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is $\pm 10\%$.
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.

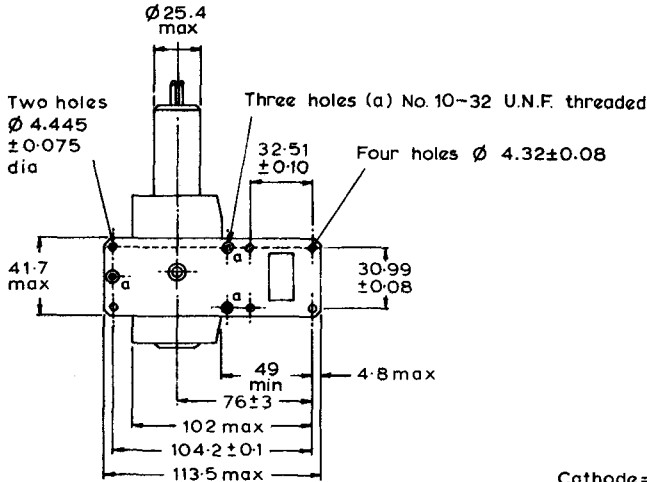
CONVERSION TABLE
(Rounded outwards)

| mm | in | mm | in |
|-----------------|-------------------|-------------|---------------|
| 3.18 ± 0.25 | 0.125 ± 0.010 | 49 min. | 1.92 min. |
| ∅ 4.32 ± 0.08 | ∅ 0.1701 ± 0.0032 | 55.6 max. | 2.19 max. |
| ∅ 4.445 ± 0.075 | ∅ 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. |
| ∅ 25.4 max. | ∅ 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

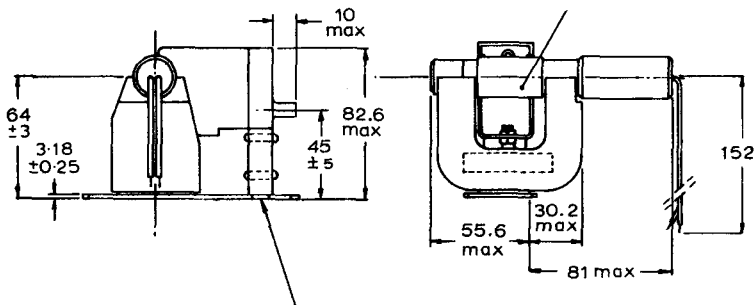
D655



Cathode = Yellow lead

Heater = Green lead

Anode temperature
 measuring point



Outlet via WG16(R100;WR90) to take
 bolted flange choke coupling Joint
 Services type 5985-99-083-0051

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 | μ s |
| 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/ μ s |
| 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 ($I_{\text{pulse}} = 7.5\text{A}$) | 7.0 | | 7.7 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 7.5\text{A}$) | 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:-

| | | | | |
|--|------|----|------|-----|
| R.F. pulse power output ($I_{\text{pulse}} = 7.5\text{A}$) | | | 16 | kW |
| | Min. | | Max. | |
| Frequency fixed within the band | 9.21 | to | 9.27 | GHz |
| Pulse voltage ($I_{\text{pulse}} = 7.5\text{A}$) | 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 60000ft 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

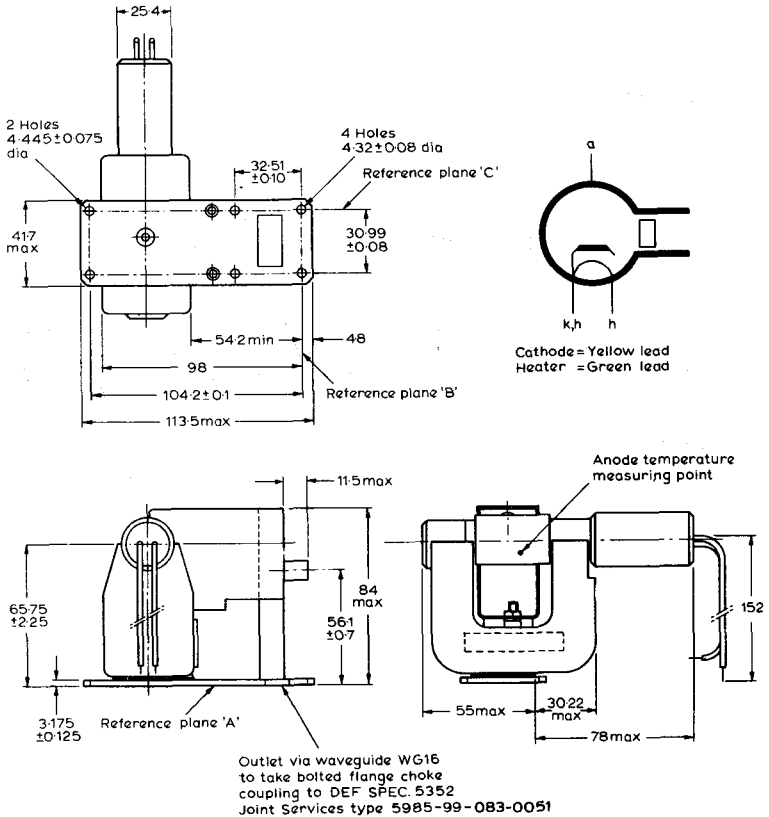
In normal circumstances natural cooling is adequate, but where the ambient temperature is abnormally high, or convection cooling is restricted, artificial cooling may be necessary to keep the block temperature below the permitted maximum.

Temperature

| | | |
|------------------|-----|----|
| Anode block max. | 120 | °C |
|------------------|-----|----|



OUTLINE DRAWING OF YJ1050



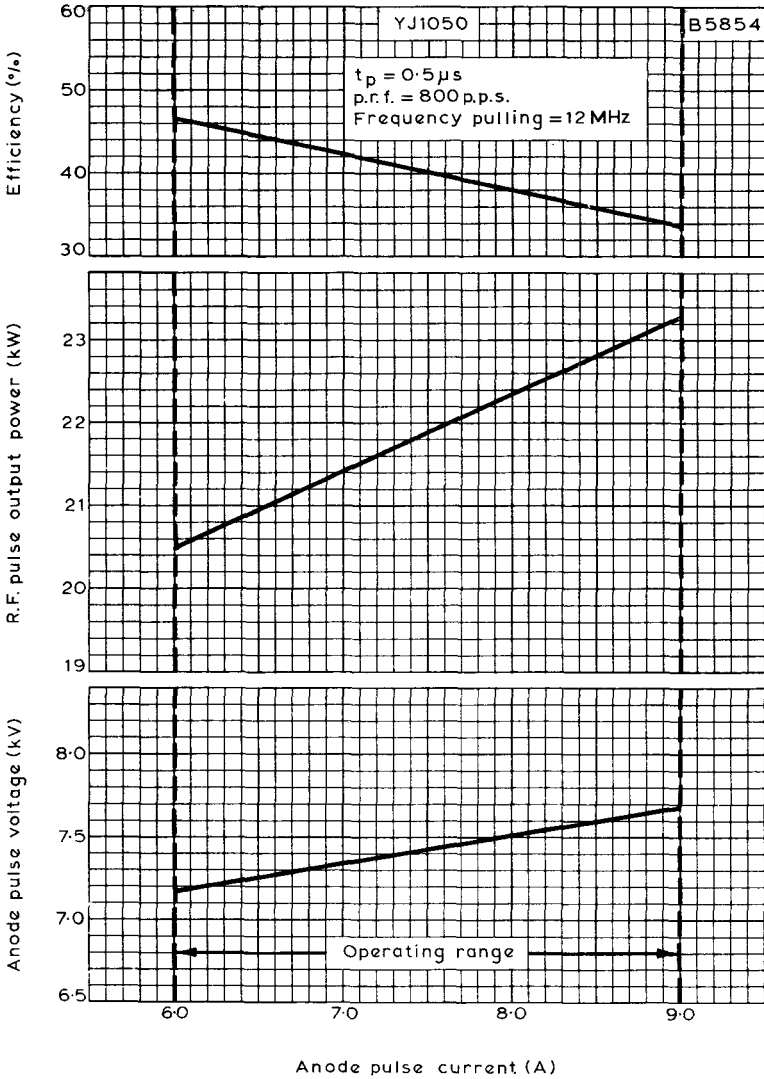
All dimensions in mm

B5851

DIMENSIONS

| Millimetres | Inches | Millimetres | Inches | |
|--------------|---------------|---------------|---------------|------|
| 152 | 5.98 | 41.7 | 1.641 | max. |
| 113.5 | 4.468 | 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 | 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 | 4.32 ± 0.08 | 0.170 ± 0.003 | dia. |
| 54.2 | 2.134 | 3.175 ± 0.125 | 0.125 ± 0.005 | |





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



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 °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°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 | $\text{kV}/\mu\text{s}$ |
| Load mismatch (v. s. w. r.) | - | 1.5 | |
| Temperature of anode block | - | 120 | $^{\circ}\text{C}$ |

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.



MAGNETRON

YJ1060



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



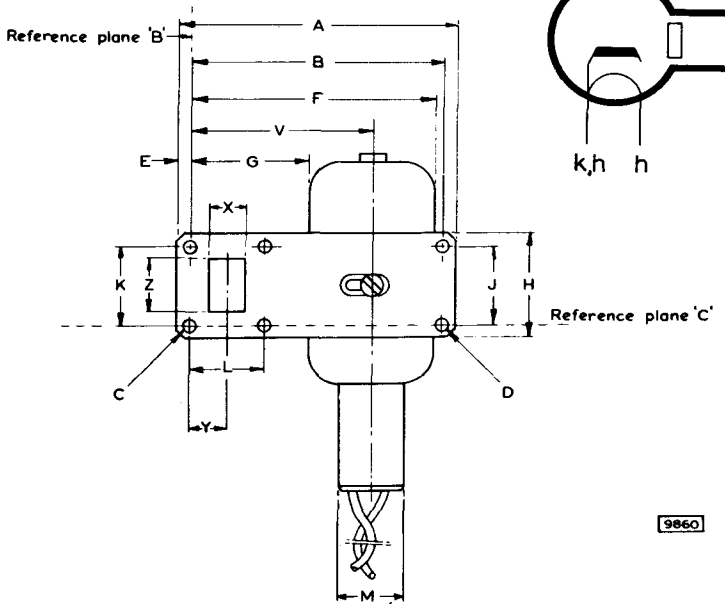
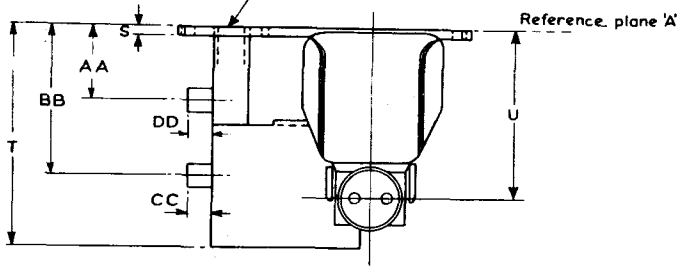
DIMENSIONS

| | 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



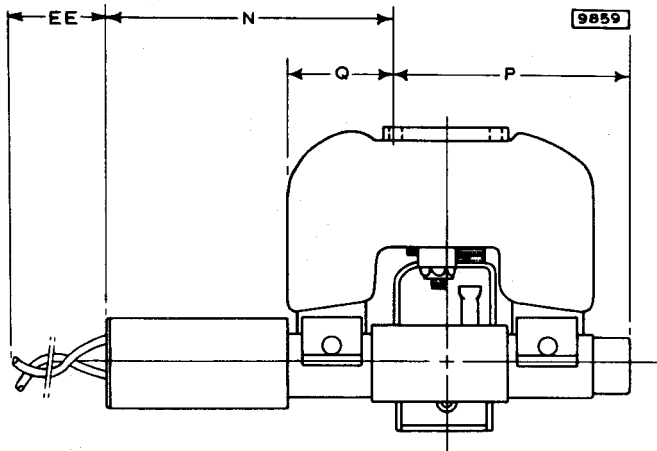
OUTLET VIA WAVEGUIDE WG16
TO TAKE BOLTED FLANGE CHOKE
COUPLING JOINT-SERVICES TYPE 5985-99-0830051



9860

ANODE CONNECTION TERMINATED AT THE BASE PLATE





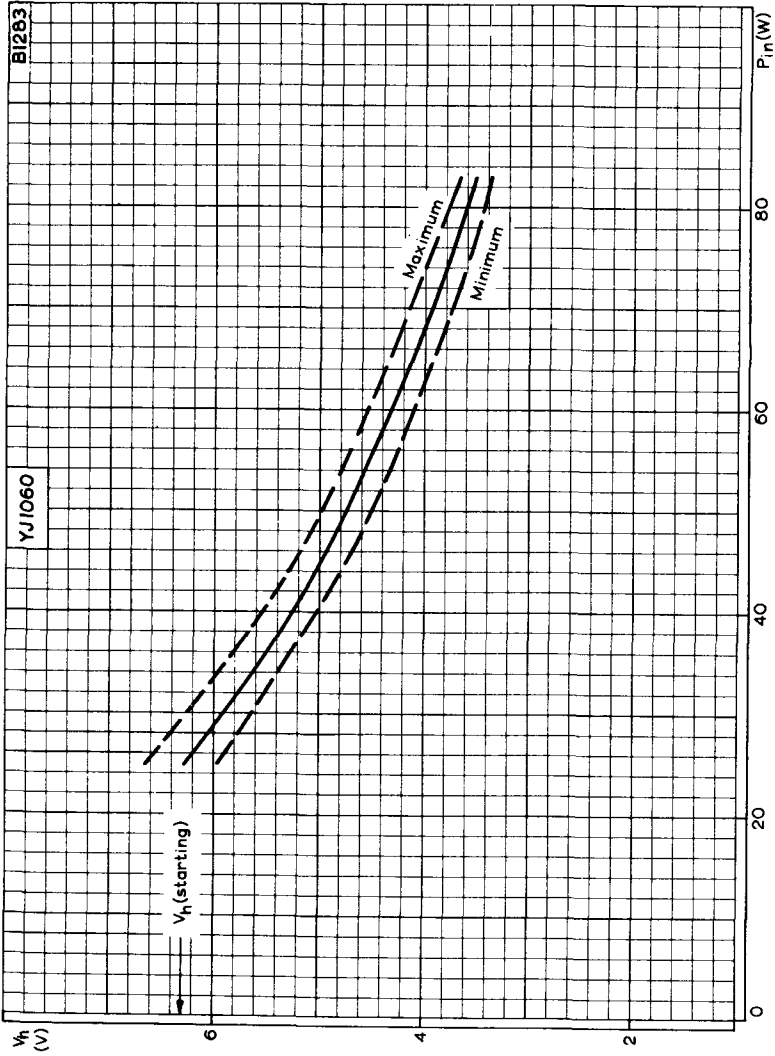
COMMON HEATER/CATHODE LEAD IDENTIFIED BY A SLEEVE

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 ($I_{\text{pulse}} = 6.0A$) | 5.5 | 5.9 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 6.0A$) | 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

| | | | |
|------------------------------------|--------|--------|-------------|
| R.F. pulse power output | 10.5 | 10.5 | kW |
| Duty factor | 0.0001 | 0.0005 | |
| Pulse duration | 0.1 | 0.5 | μ s |
| 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 | 34.2 | 34.2 | kW ← |
| Rate of rise of voltage pulse | 110 | 100 | kV/ μ s |
| Mean input current | 0.65* | 3.0 | mA |
| Mean input power | 3.7 | 17.1 | 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 6.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | Min. | Max. | |
|-------------------------------|------|-------|-------------|
| Pulse current | 4.5 | 7.0 | A |
| Pulse duration | - | 1.0 | μ s |
| Duty factor | - | 0.002 | |
| Mean input power | - | 85 | W |
| Rate of rise of voltage pulse | - | 120 | kV/ μ s |
| Load mismatch (v.s.w.r.) | - | 1.5 | |
| Temperature of anode block | - | 120 | °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 ($I_{\text{pulse}} = 6.0\text{A}$) | 7.0 | kW |
| | Min. | Max. |
| Frequency fixed within the band | 9.38 to 9.44 | Gc/s |
| Pulse voltage ($I_{\text{pulse}} = 6.0\text{A}$) | 5.5 to 6.0 | kV |

MOUNTING POSITION Any

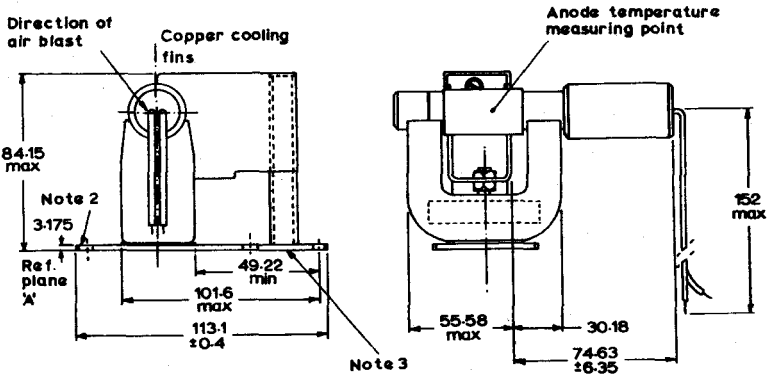
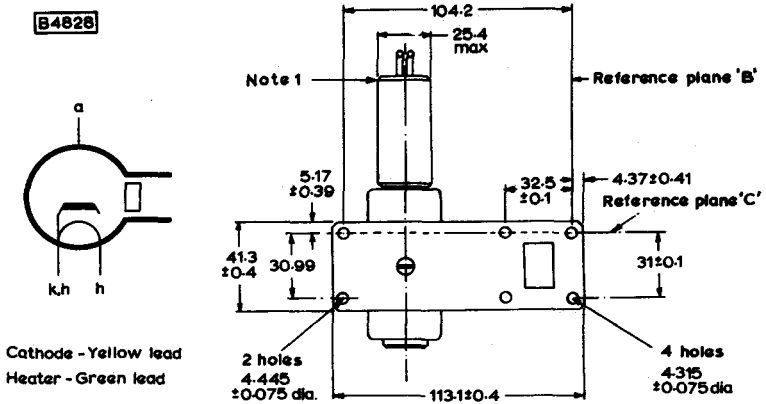
PHYSICAL DATA

| | |
|-------------------------------|--------------|
| | kg |
| Weight of magnetron | 1.4 |
| Weight of magnetron in carton | 2.5 |
| | cm |
| Dimensions of storage carton | 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.

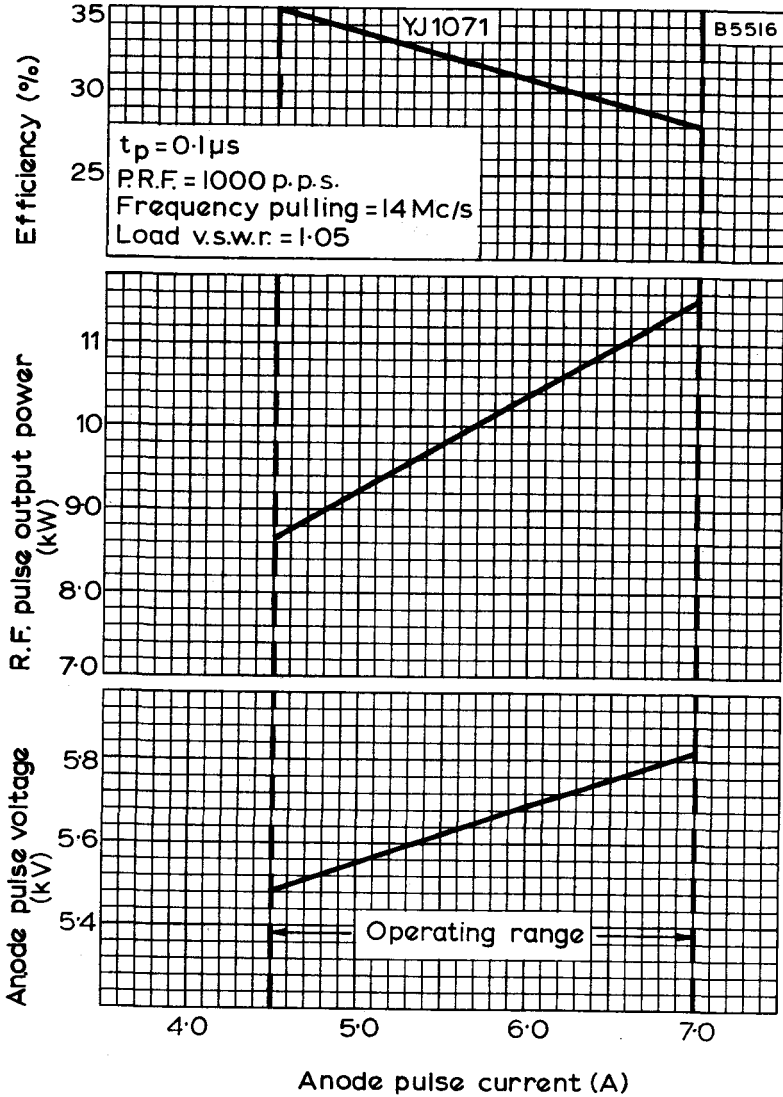
B4828



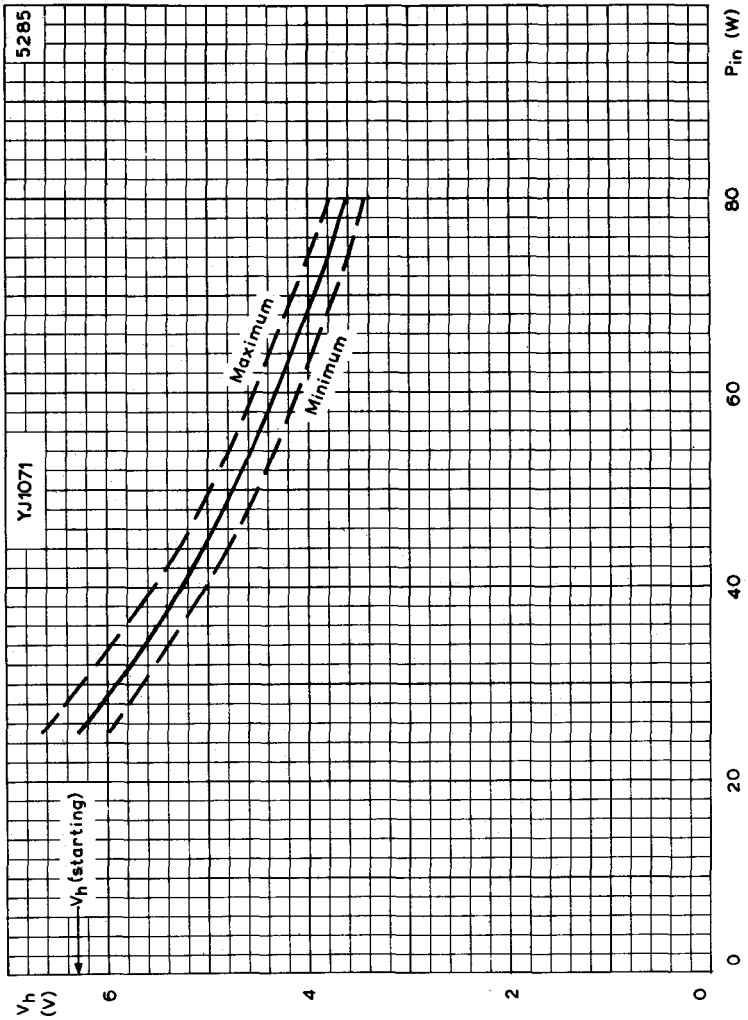
All dimensions in mm

NOTES

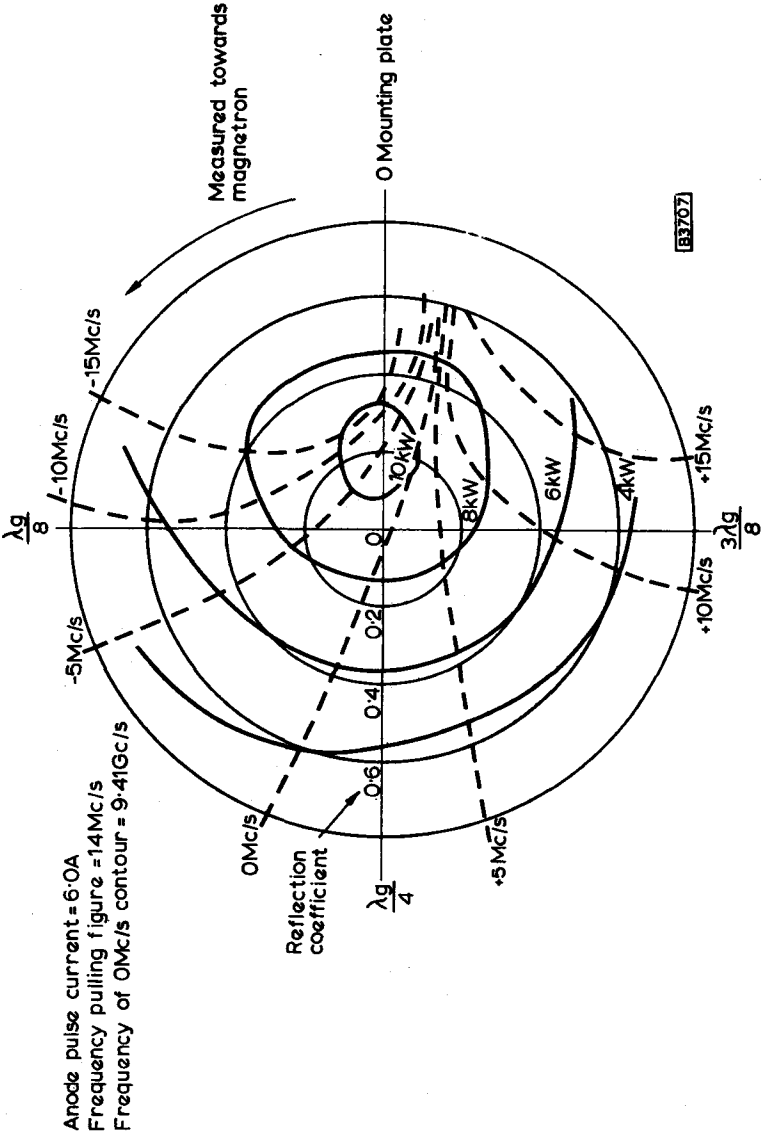
1. The protector sleeve shall be within 5° of a normal to reference plane C.
2. A cylinder 0.33in (8.38mm) diameter centred in the holes shown shall clear the side of the magnet.
3. The outlet via the waveguide WG16 is to take a bolted flange choke coupling, Joint Services type 5985-99-0830051.



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



HEATER VOLTAGE PLOTTED AGAINST INPUT POWER



RIEKE DIAGRAM

Mullard

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 ($I_{\text{pulse}} = 0.9\text{A}$) | | 1.025 | 1.350 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 0.9\text{A}$) | | 30 | - | W |
| Frequency pulling (v. s. w. r. = 1.5:1) | | - | 3.0 | MHz |
| Frequency temperature coefficient over the range $T_{\text{anode}} = 60$ 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 ($I_{\text{pulse}} = 0.9\text{A}$) | | - | 25 | kHz/mA |

TYPICAL OPERATION at $f = 9.25\text{GHz}$ (YJ1090) and $f = 8.75\text{GHz}$ (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°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 | μ s |
| Duty factor | - | 0.004 | |
| Mean input power | - | 6.0 | W |
| Rate of rise of voltage pulse | - | 10 | kV/ μ s |
| 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 ($I_{\text{pulse}} = 0.9A$) | | 20 | W |
| | Min. | Max. | |
| Over the frequency band | YJ1090 | 9.0 to 9.5 | GHz |
| | YJ1091 | 8.5 to 9.0 | GHz |
| Pulse voltage ($I_{\text{pulse}} = 0.9A$) | | 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

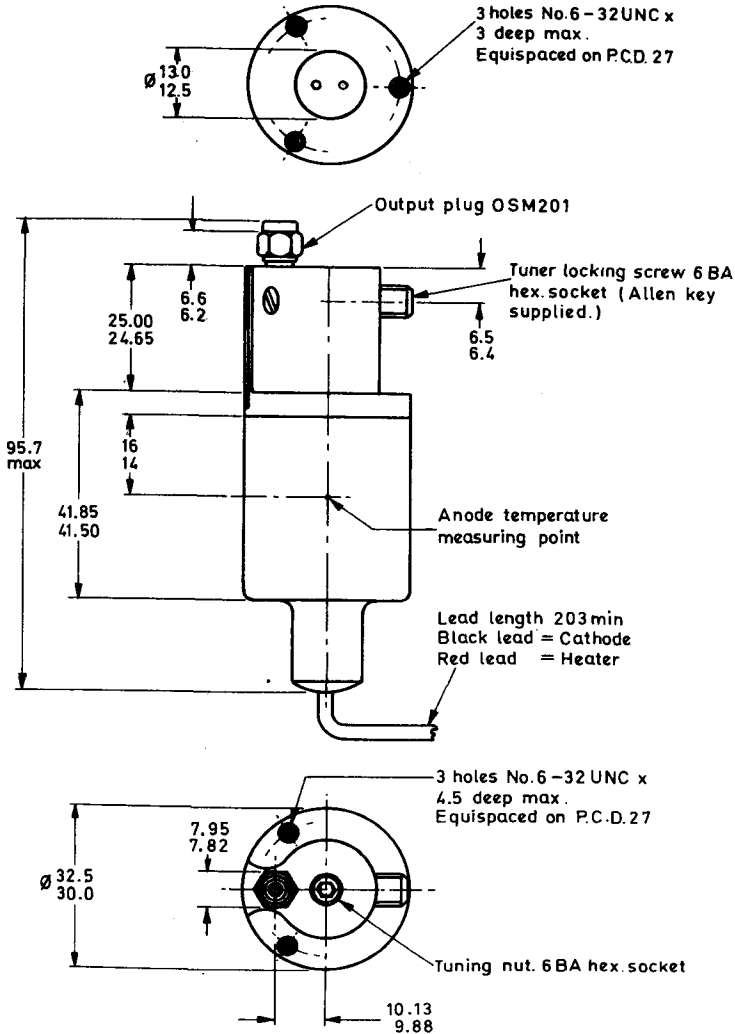
Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted.

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 |



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 ($I_{\text{pulse}} = 0.9\text{A}$) | | 1.025 | 1.350 | kV |
| R.F. pulse power output ($I_{\text{pulse}} = 0.9\text{A}$) | | 150 | - | W |
| Frequency pulling (v. s. w. r. = 1.5:1) | | - | 15 | MHz |
| Frequency temperature coefficient over the range $T_{\text{anode}} = 60$ 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 ($I_{\text{pulse}} = 0.9\text{A}$) | | - | 25 | kHz/mA |

TYPICAL OPERATION at $f = 9.25\text{GHz}$ (YJ1100) and $f = 8.75\text{GHz}$ (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°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 | °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 ($I_{\text{pulse}} = 0.9A$) | 120 | W |
| Pulse voltage ($I_{\text{pulse}} = 0.9A$) | 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

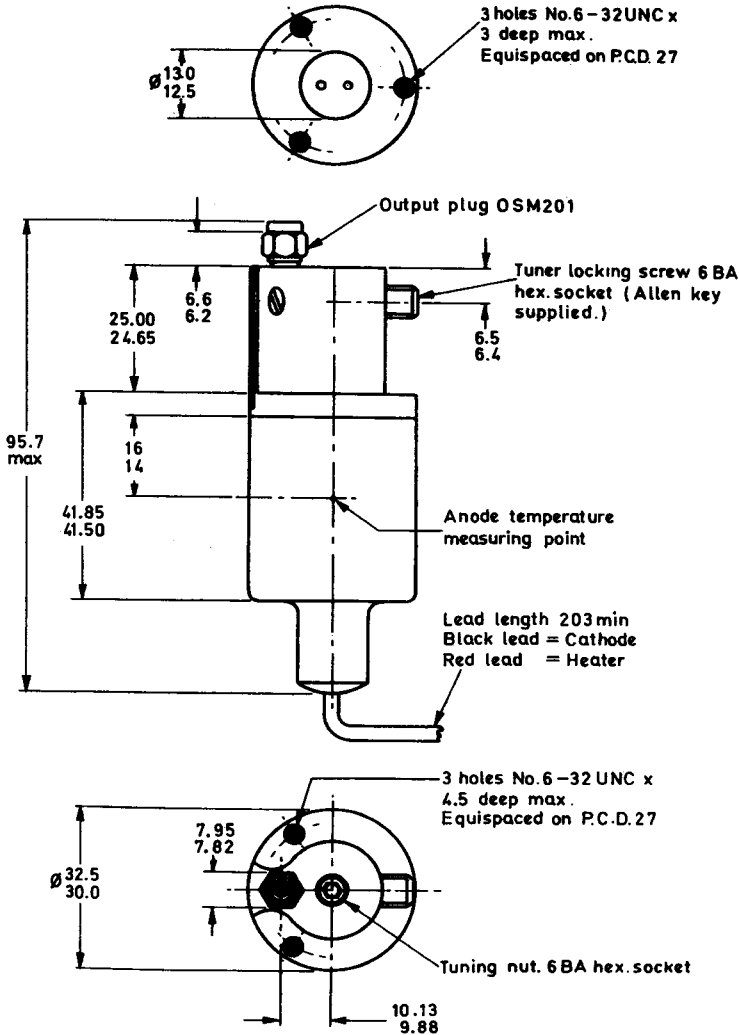
Adjustment of the tuning mechanism beyond the stated frequency limits must not be attempted.

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 |
| 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 |
| Pulse voltage ($I_{\text{pulse}} = 7.5A$) | 7.0 | | 8.2 kV |
| R.F. pulse power output ($I_{\text{pulse}} = 7.5A$) | 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 | 0.00005 | ← |
| Pulse duration | 0.5 | 0.1 | 0.05 | μs |
| Pulse repetition frequency | 1000 | 1000 | 1000 | p.p.s. |
| Heater voltage (running) | 6.0 | 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 |
| $I_{h(\text{surge})}$ max. | 5.0 | A |

Heating time. At ambient temperatures above 0°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 8.

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 | $^{\circ}C$ |

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 ($I_{pulse} = 7.5A$) | 14 | kW |
| | Min. | Max. |
| Frequency YJ1110 | 9.345 to 9.405 | Gc/s |
| Pulse voltage ($I_{pulse} = 7.5A$) | 7.0 to 8.4 | kV |

MOUNTING POSITION

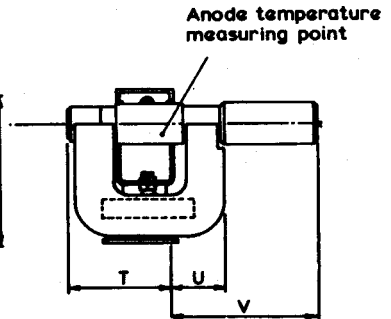
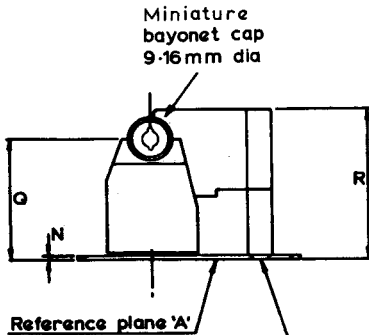
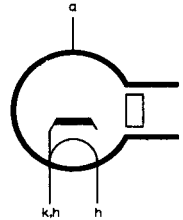
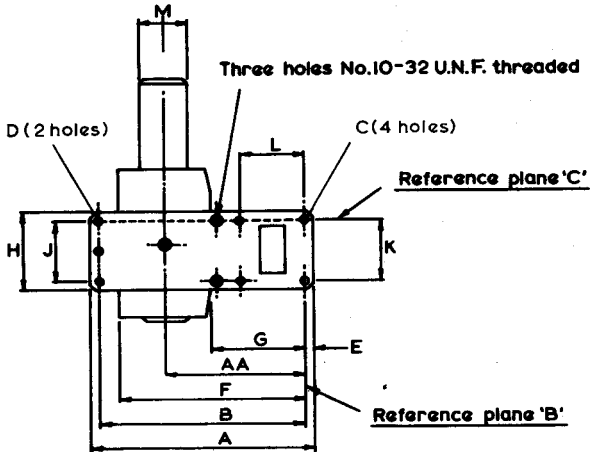
Any

PHYSICAL DATA

| | |
|-------------------------------|--------------------|
| | kg |
| Weight of magnetron | 1.5 |
| Weight of magnetron in carton | 2.9 |
| | cm |
| Dimensions of storage carton | 19.7 x 20.4 x 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.

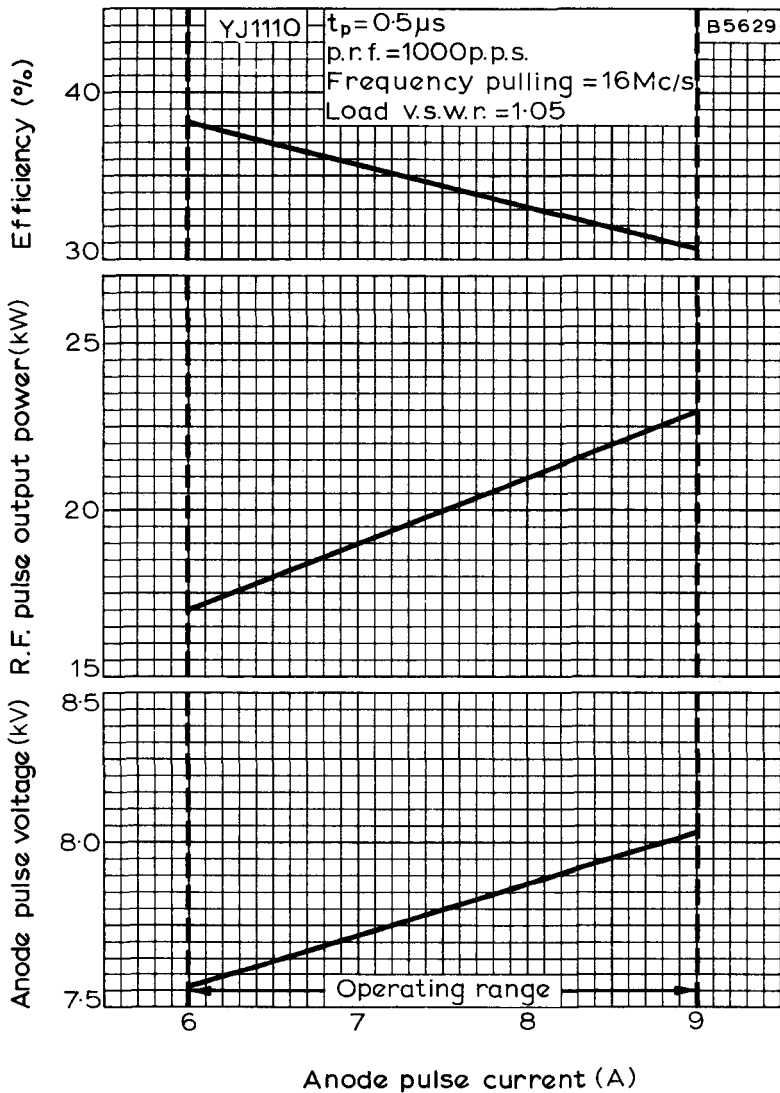


Outlet via WG16(R100-WR90) to take bolted flange choke coupling Joint Services type 5985-99-0830051.

DIMENSIONS

| | Millimetres | |
|----|--------------|-----------|
| A | 113.5 | max. |
| B | 104.2 ± 0.10 | |
| C | 4.32 ± 0.08 | dia. |
| D | 4.45 ± 0.08 | dia. |
| E | 4.80 | max. |
| F | 102 | max. |
| G | 47.00 | min. |
| H | 41.70 | max. |
| J | 30.99 ± 0.08 | |
| K | 30.99 ± 0.08 | |
| L | 32.51 ± 0.10 | |
| M | 25.40 | max. dia. |
| N | 3.18 ± 0.25 | |
| Q | 65 ± 3.0 | |
| R | 84.00 | max. |
| T | 55.00 | max. |
| U | 28.00 | max. |
| V | 78.00 | max. |
| AA | 76 ± 3.0 | |

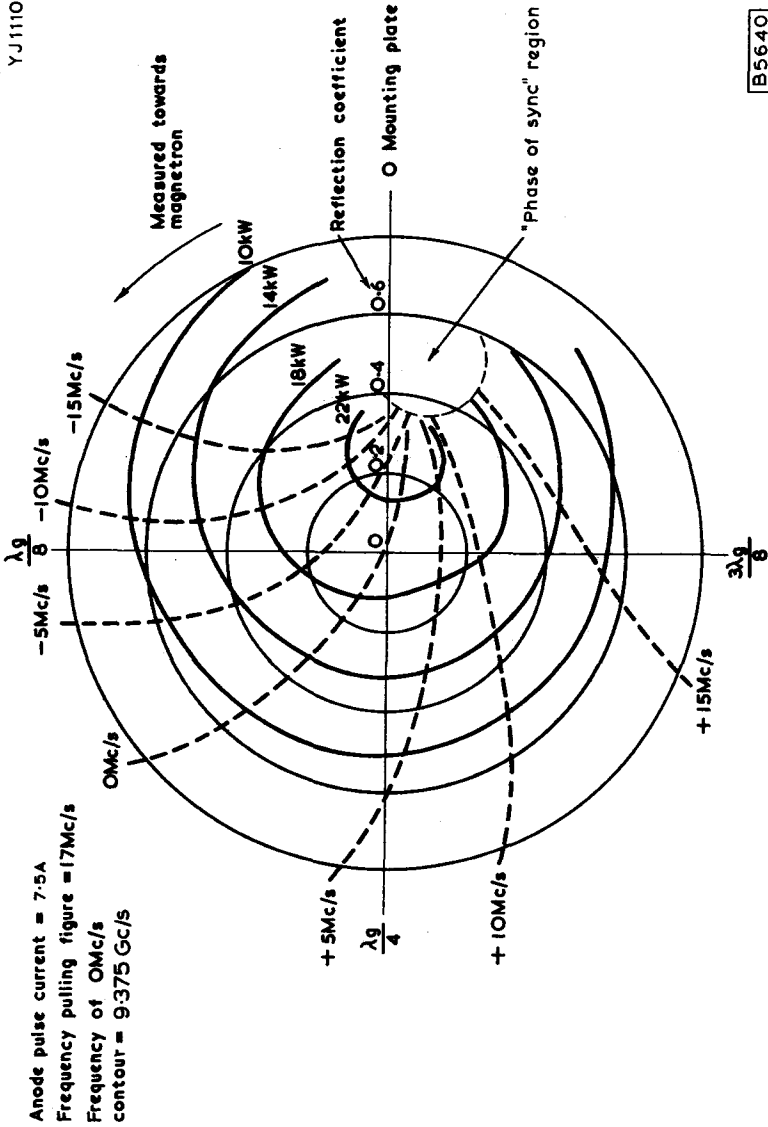




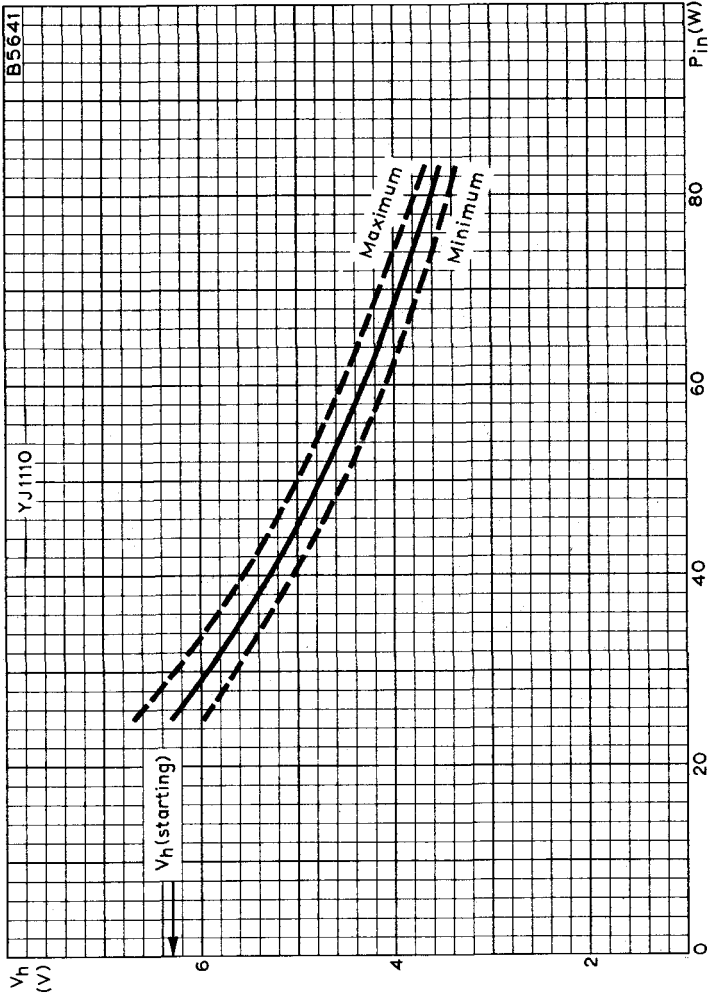
ANODE PULSE VOLTAGE, R.F. PULSE OUTPUT POWER AND EFFICIENCY
 PLOTTED AGAINST ANODE PULSE CURRENT

YJ1110

B5640



RIEKE DIAGRAM



HEATER VOLTAGE PLOTTED AGAINST MEAN INPUT POWER

QUICK REFERENCE DATA

X-band, fixed frequency, pulsed magnetron.

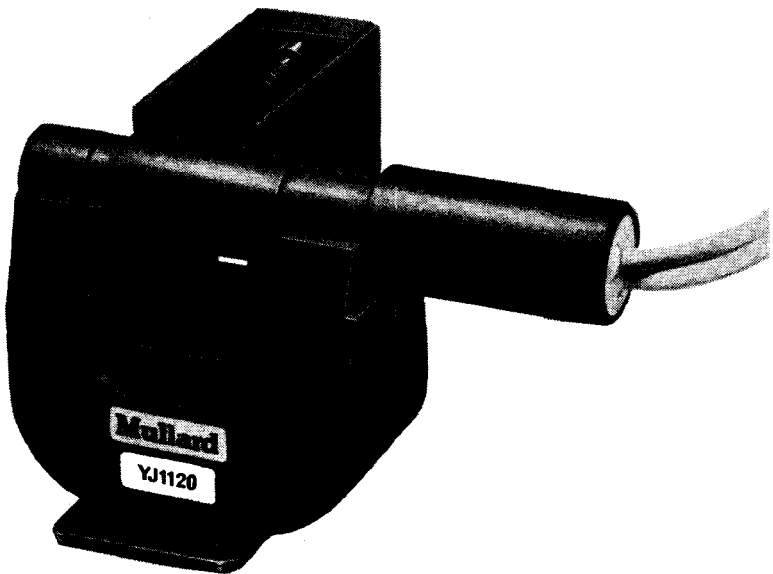
Frequency (fixed within the band) 9.380 to 9.440 GHz

Power output (peak) 25 kW

Output connection Waveguide 16 flange

Construction Packaged

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



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) | 4.0 | mA |
| Duty factor | 0.0005 | |
| Pulse duration (t_p) (see note 3) | 0.5 | μ s |
| v.s.w.r. at output coupler | 1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | 120 | kV/ μ s |

Limits and characteristics

| | Min. | Max. | |
|---|-------|-------------------|-------|
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power output (mean) | 10 | - | W |
| Frequency (see note 5) | 9.380 | 9.440 | 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) | - | 18 | MHz |
| Stability (see note 8) | - | 0.25 | % |
| Frequency pushing (see note 9) | - | 1.5 | MHz/A |
| Cold impedance (see note 10) | | | |
| Heater current (see note 11) | | | |
| Frequency temperature coefficient (see note 12) | | | |
| Input capacitance (see note 13) | | | |

TYPICAL OPERATION

| Operating conditions | Condition 1 | Condition 2 | |
|-------------------------------|-------------|-------------|-------------|
| Heater voltage | 6.3 | 6.3 | V |
| Anode current (peak) | 8.0 | 8.0 | A |
| Pulse duration (t_p) | 0.05 | 1.0 | μ s |
| Pulse repetition rate | 2000 | 500 | pulse/s |
| Rate of rise of voltage pulse | 110 | 110 | kV/ μ s |
| Typical performance | | | |
| Anode voltage (peak) | 8.3 | 8.3 | kV |
| Power output (peak) | 25 | 25 | kW |
| Power output (mean) | 2.5 | 12.5 | W |

CATHODE

Indirectly heated

| | | |
|-------------------------------------|------|---|
| Heater voltage (see note 1) | 6.3 | V |
| Heater current | 0.55 | A |
| Heating time (minimum) (see note 2) | 120 | s |

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 16) | 5.9 | 6.7 | V |
| Heater current (surge) | - | 5.0 | A |
| Anode current (peak) | 6.0 | 10 | A |
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power input (peak) | - | 75 | kW |
| Power input (mean) | - | 85 | W |
| Duty factor | - | 0.0015 | |
| Pulse duration (t_p) (see note 3) | 0.05 | 2.0 | μ s |
| Rate of rise of voltage pulse (see note 4) | - | 120 | kV/ μ s |
| Anode temperature (see note 14) | - | 120 | $^{\circ}$ 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 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 operated under the specified test conditions.

| | Min. | Max. | |
|-----------------------------|-------|-------------------|-----|
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power output (mean) | 8.0 | - | W |
| Frequency | 9.380 | 9.440 | GHz |
| R.F. bandwidth at 1/4 power | - | $\frac{3.0}{t_p}$ | MHz |
| Stability | - | 1.0 | % ← |

MOUNTING POSITION AND STORAGE

| | |
|----------------------------------|-------------|
| Mounting position | Any |
| Mounting and storage precautions | see note 15 |

OUTPUT COUPLER

The output connection of the magnetron should be connected directly to a waveguide choke flange type UG-40B/U (5985-99-083-0051).

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.

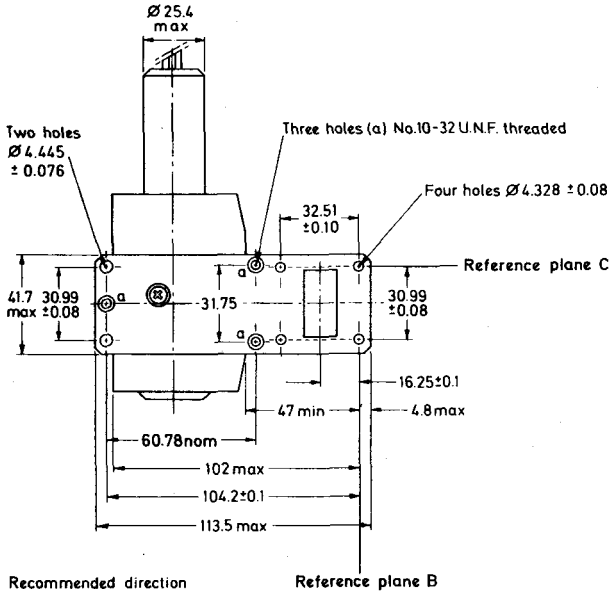
NOTES

1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced if the mean input power is greater than 40W.
2. For ambient temperatures above 0°C. For ambient temperatures between 0°C and -55°C the cathode heating time is 180 seconds.
3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is $\pm 10\%$.
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. 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 6 to 10A peak.
7. Measured at an anode current of 8A peak under matched conditions. A mismatch of 1.5:1 is then varied through all phases.
8. Measured with 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 9.380 to 9.440GHz. 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 of operation.
9. Design test only. Measured over the anode current range of 6 to 10A peak.
10. 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 16.5 to 22.5mm.
11. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.43 to 0.6A.
12. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.25\text{MHz}/^\circ\text{C}$.
13. Design test only. The maximum input capacitance is 9pF.
14. Measured at the point indicated on the outline drawing.
15. 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.

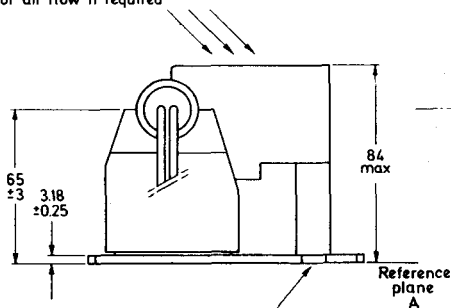
When storing, magnetrons should be kept as far apart as possible, at least 150mm (6 in). During shipment adequate separation between magnetrons is provided by the dimensions of the inner packs of the storage cartons and it is recommended that magnetrons not in use be kept in these packs.

16. The magnetron is normally 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.

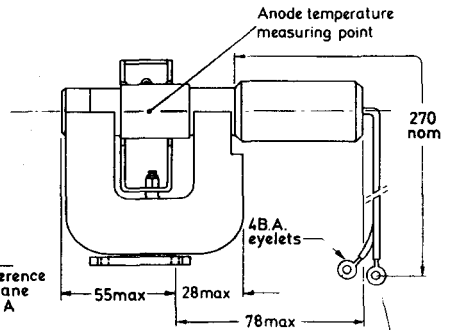
OUTLINE DRAWING OF YJ1120



Recommended direction of air flow if required



Outlet via WG16 to take bolted flange choke coupling Joint Services type 5985-99-083-0051



Lead connections
Heater /cathode - yellow lead
Heater - green lead

All dimensions in mm

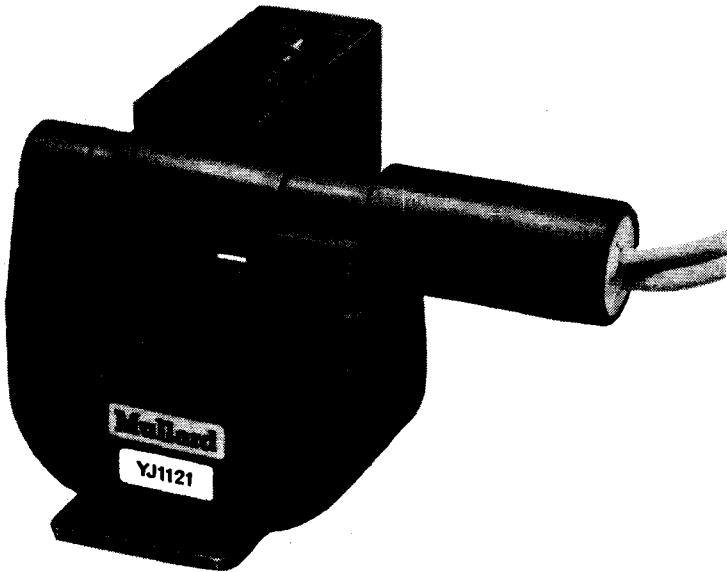
D4121

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 |
| Output connection | Waveguide 16 flange | |
| Construction | Packaged | |

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



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) | 4.5 | mA |
| Duty factor | 0.0005 | |
| Pulse duration (t_p) (see note 3) | 0.5 | μ s |
| v. s. w. r. at output coupler | 1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | 120 | kV/ μ s |

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 6) | - | $\frac{2.5}{t_p}$ | MHz |
| Minor lobe level (see note 6) | 6.0 | - | dB |
| Frequency pulling (see note 7) | - | 18 | MHz |
| Stability (see note 8) | - | 0.25 | % |
| Frequency pushing (see note 9) | - | 1.5 | MHz/A |
| Cold impedance (see note 10) | | | |
| Heater current (see note 11) | | | |
| Frequency temperature coefficient (see note 12) | | | |
| Input capacitance (see note 13) | | | |

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 | μ s |
| Pulse repetition rate | 2400 | 800 | pulse/s |
| Rate of rise of voltage pulse | 110 | 110 | kV/ μ s |
| 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 (see note 1) | 6.3 | V |
| Heater current | 0.55 | A |
| Heating time (minimum) (see note 2) | 120 | s |

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 16) | 5.9 | 6.7 | V |
| Heater current (surge) | - | 5.0 | A |
| Anode current (peak) | 6.0 | 10 | A |
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power input (peak) | - | 85 | kW ← |
| Power input (mean) | - | 85 | W |
| Duty factor | - | 0.0015 | |
| Pulse duration (t_p) (see note 3) | 0.05 | 2.0 | μ s |
| Rate of rise of voltage pulse (see note 4) | - | 120 | kV/ μ s |
| Anode temperature (see note 14) | - | 120 | $^{\circ}$ 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 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 operated under the specified test conditions.

| | Min. | Max. | |
|------------------------------|-------|-------------------|-----|
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power output (mean) | 9.0 | - | W |
| Frequency | 9.415 | 9.475 | GHz |
| R. F. bandwidth at 1/4 power | - | $\frac{3.0}{r_p}$ | MHz |
| Stability | - | 1.0 | % ← |

MOUNTING POSITION AND STORAGE

| | |
|----------------------------------|-------------|
| Mounting position | Any |
| Mounting and storage precautions | see note 15 |

OUTPUT COUPLER

The output connection of the magnetron should be connected directly to a waveguide choke flange type UG-40B/U (5985-99-083-0051).

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.

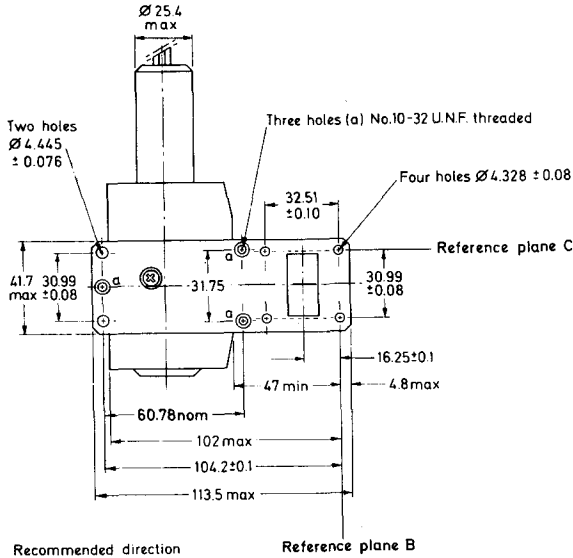
NOTES



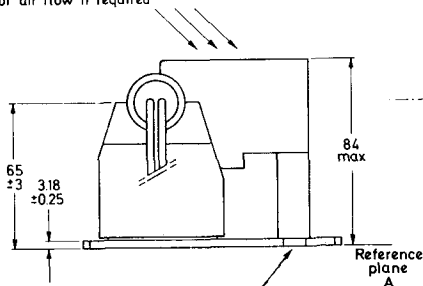
1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced if the mean input power is greater than 40W.
2. For ambient temperatures above 0°C. For ambient temperatures between 0°C and -55°C the cathode heating time is 180 seconds.
3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is $\pm 10\%$.
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. 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 6 to 10A peak.
7. Measured at an anode current of 9A peak under matched conditions. A mismatch of 1.5:1 is then varied through all phases.
8. Measured with 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 9.415 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 of operation.
9. Design test only. Measured over the anode current range of 6 to 10A peak.
10. 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 16.5 to 22.5mm.
11. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.43 to 0.6A.
12. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.25\text{MHz}/^\circ\text{C}$.
13. Design test only. The maximum input capacitance is 9pF.
14. Measured at the point indicated on the outline drawing.
15. 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 packs of the storage cartons and it is recommended that magnetrons not in use be kept in these packs.
16. The magnetron is normally 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.

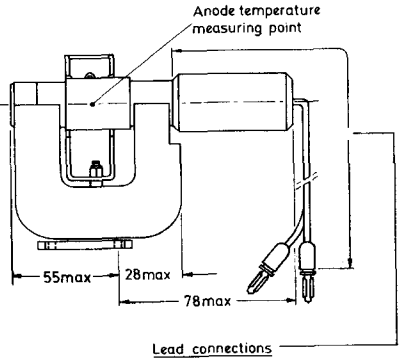
OUTLINE DRAWING OF YJ1121



Recommended direction of air flow if required



Outlet via WG16 to take bolted flange choke coupling Joint Services type 5985-99-083-0051



Belling Lee t378/A3 black plug Heater /cathode - yellow lead 140 mm
 Belling Lee L378/A4 red plug - Heater - green lead 165 mm

All dimensions in mm

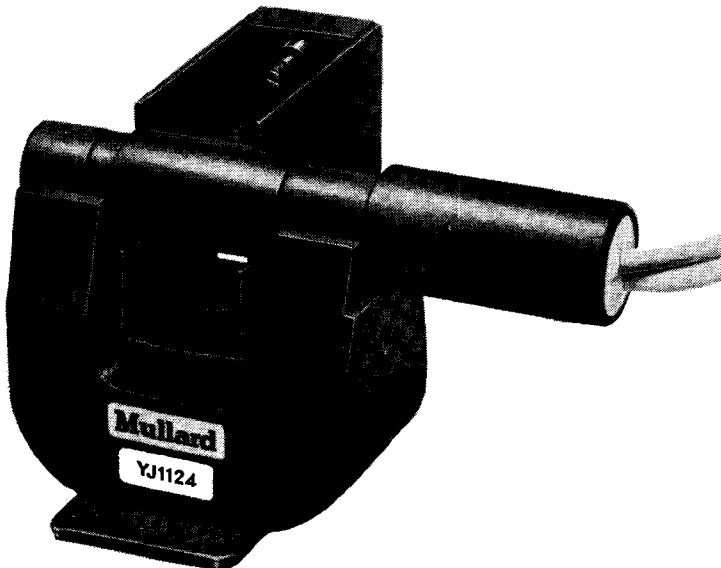
04122

QUICK REFERENCE DATA

X-band, fixed frequency, pulsed magnetrons

| | | | |
|-----------------------------------|--------|---------------------|-----|
| Frequency (fixed within the band) | YJ1123 | 9.415 to 9.460 | GHz |
| | YJ1124 | 9.620 to 9.680 | GHz |
| Power output (peak) | | 26 | kW |
| Output connection | | Waveguide 16 flange | |
| Construction | | Packaged | |

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



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) | 4.5 | mA |
| Duty factor | 0.0005 | |
| Pulse duration (t_p) (see note 3) | 0.5 | μ s |
| v. s. w. r. at output coupler | 1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | 120 | kV/ μ s |

Limits and characteristics

| | Min. | Max. | |
|---|-------|-------------------|-------|
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power output (mean) | 11 | - | W |
| Frequency (see note 5) YJ1123 | 9.415 | 9.460 | GHz |
| YJ1124 | 9.620 | 9.680 | 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) | - | 18 | MHz |
| Stability (see note 8) | - | 0.25 | % |
| Frequency pushing (see note 9) | - | 1.5 | MHz/A |
| Cold impedance (see note 10) | | | |
| Heater current (see note 11) | | | |
| Frequency temperature coefficient (see note 12) | | | |
| Input capacitance (see note 13) | | | |

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 | μ s |
| Pulse repetition rate | 2400 | 800 | pulse/s |
| Rate of rise of voltage pulse | 110 | 110 | kV/ μ s |

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 (see note 1) | 6.3 | V |
| Heater current | 0.55 | A |
| Heating time (minimum) (see note 2) | 120 | s |

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 16) | 5.9 | 6.7 | V |
| Heater current (surge) | - | 5.0 | A |
| Anode current (peak) | 6.0 | 10 | A |
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power input (peak) | - | 85 | kW |
| Power input (mean) | - | 85 | W |
| Duty factor | - | 0.0015 | |
| Pulse duration (t_p) (see note 3) | 0.05 | 2.0 | μ s |
| Rate of rise of voltage pulse (see note 4) | - | 120 | kV/ μ s |
| Anode temperature (see note 14) | - | 120 | $^{\circ}$ 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 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 operated under the specified test conditions.

| | Min. | Max. | |
|------------------------------|------------------|----------------------|------------------------------|
| Anode voltage (peak) | 7.5 | 8.5 | kV |
| Power output (mean) | 8.0 | - | W |
| Frequency | YJ1123 YJ1124 | 9.415 9.620 | 9.460 9.680 GHz GHz |
| R. F. bandwidth at 1/4 power | - | $\frac{3.0}{\tau_p}$ | MHz |
| Stability | - | 0.5 | % |

MOUNTING POSITION AND STORAGE

| | |
|----------------------------------|-------------|
| Mounting position | Any |
| Mounting and storage precautions | see note 15 |

OUTPUT COUPLER

The output connection of the magnetron should be connected directly to a waveguide choke flange type UG-40B/U (5985-99-083-0051).

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

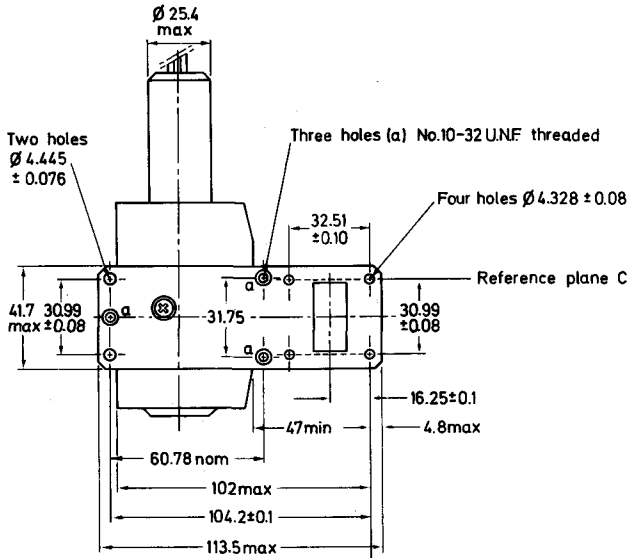
The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

NOTES

1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced if the mean input power is greater than 40W.
2. For ambient temperatures above 0°C. For ambient temperatures between 0°C and -55°C the cathode heating time is 180 seconds.
3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is $\pm 10\%$.
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. 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 6 to 10A peak.
7. Measured at an anode current of 9A peak under matched conditions. A mismatch of 1.5:1 is then varied through all phases.
8. Measured with 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 within the specified frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of ten minutes of operation.
9. Measured over the anode current range of 6 to 10A peak.
10. 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 16.5 to 22.5mm.
11. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.43 to 0.6A.
12. Design test only. The maximum frequency change with anode temperature change (after warming) is $-0.25\text{MHz}/^\circ\text{C}$.
13. Design test only. The maximum input capacitance is 9pF.
14. Measured at the point indicated on the outline drawing.
15. 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.

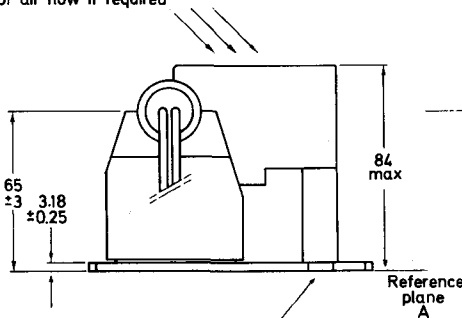
When storing, magnetrons should be kept as far apart as possible, at least 150mm (6 in). During shipment adequate separation between magnetrons is provided by the dimensions of the inner packs of the storage cartons and it is recommended that magnetrons not in use be kept in these packs.
16. The magnetron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

OUTLINE DRAWING

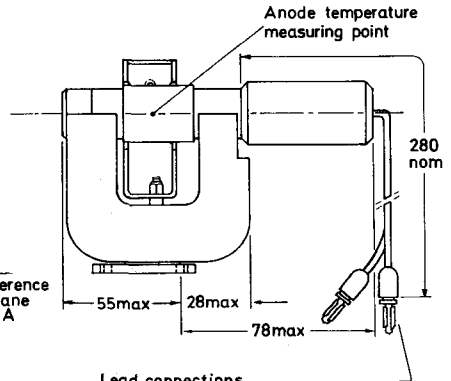


Recommended direction of air flow if required

Reference plane B



Outlet via WG16 to take bolted flange choke coupling joint Services type 5985-99-083-0051



Lead connections

- Heater / cathode - yellow lead - black plug
- Heater - green lead - red plug
- Black plug - Belling Lee L378A/3
- Red plug - Belling Lee L378A/4

All dimensions in mm

D4123

Mullard

QUICK REFERENCE DATA

Pulsed magnetron tunable by means of an integral servo-motor over 450MHz sweep in 500 μ s.

| | | |
|--------------|------------|-----|
| 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 \pm 250MHz range)

| | | | |
|--|--------|-------|-------------|
| R. F. pulse power output | 205 | 205 | kW |
| Duty factor | 0.0007 | 0.001 | |
| Pulse duration | 0.2 | 1.0 | μ s |
| 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/ μ s |
| 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 \pm 10% | V |
| I_h | 3.15 \pm 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 $^{\circ}$ 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:

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

CHARACTERISTICS

| | Min. | Max. | |
|--|------|------|-----------|
| Frequency | 8.7 | 9.5 | GHz |
| *Frequency sweep | 400 | - | MHz |
| Pulse voltage ($I_{\text{pulse}} = 27.5\text{A}$) | 21 | 24 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 27.5\text{A}$) | 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 pre-determined 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 $1.0\mu\text{s}$ | - | 200 | kV/ μs |
| Long pulse operation - up to $2.0\mu\text{s}$ | - | 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 |
| Weight of magnetron | 6.8 |

COOLING

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

Temperature

| | | |
|------------------|-----|----|
| Anode block max. | 120 | °C |
|------------------|-----|----|

OUTPUT CONNECTION

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

OPERATING NOTES

Tunable version with optional fixed frequency lock, YJ1181.

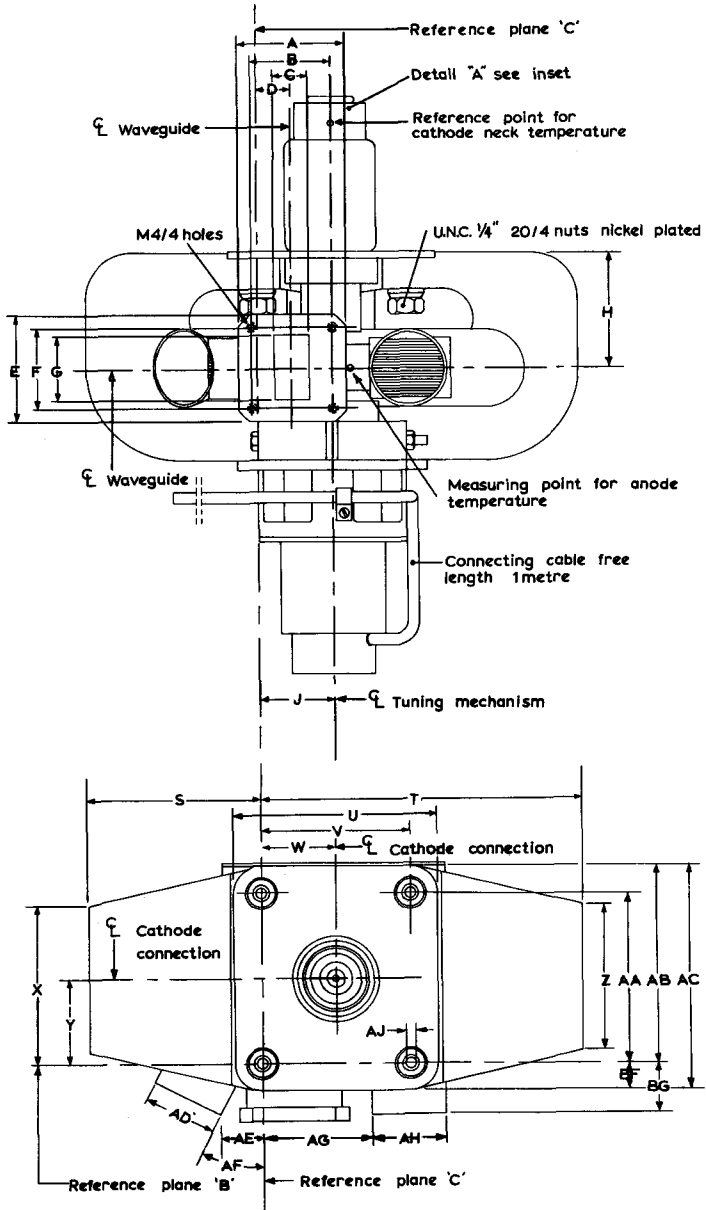
The lock consists of a small mechanical device mounted with the electrical connections to the two-phase, 400Hz drive motor.

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.

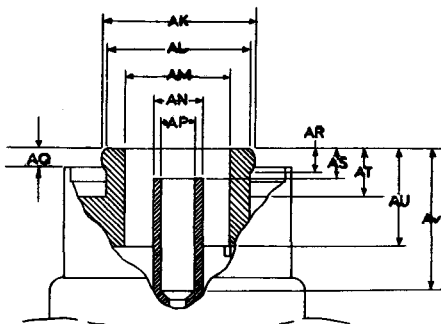
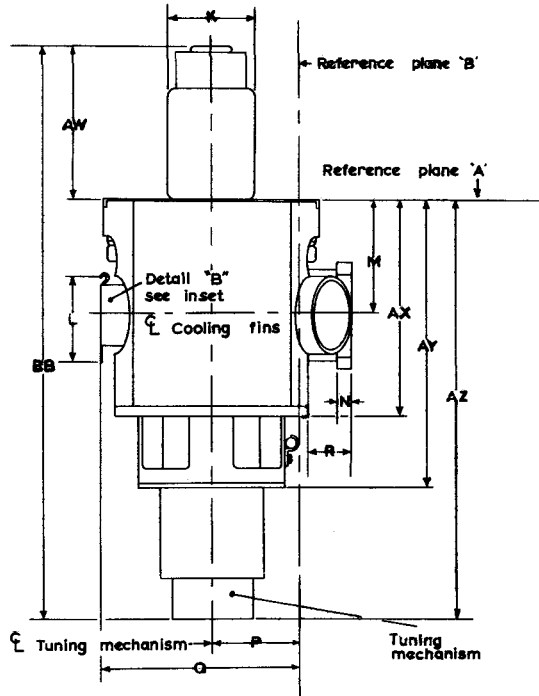
OUTLINE AND DIMENSIONS OF YJ1180 AND YJ1181



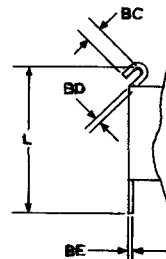
DIMENSIONS OF YJ1180 AND YJ1181

| | Millimetres |
|----|-----------------|
| A | 46.5 |
| B | 37.4 ± 0.1 |
| C | 12.6 |
| D | 14.75 ± 1.2 |
| E | 46.5 |
| F | 34.3 ± 0.1 |
| G | 28.5 |
| H | 47.1 ± 1.2 |
| J | 31.75 ± 2.0 |
| S | 75 max. |
| T | 138.5 max. |
| U | 88.1 max. |
| V | 63.5 ± 0.25 |
| W | 31.75 ± 1.2 |
| X | 75 max. |
| Y | 38.1 ± 1.2 |
| Z | 73 max. |
| AA | 76.2 ± 0.25 |
| AB | 86.9 max. |
| AC | 98.4 max. |
| AD | 32 dia. |
| AE | 18.5 |
| AF | 27° |
| AG | 47.5 |
| AH | 32 dia. |
| AJ | 7.15 dia. |
| BF | 10.7 max. |
| BG | 22.5 |

OUTLINE AND DIMENSIONS OF YJ1180 AND YJ1181



DETAIL "A"

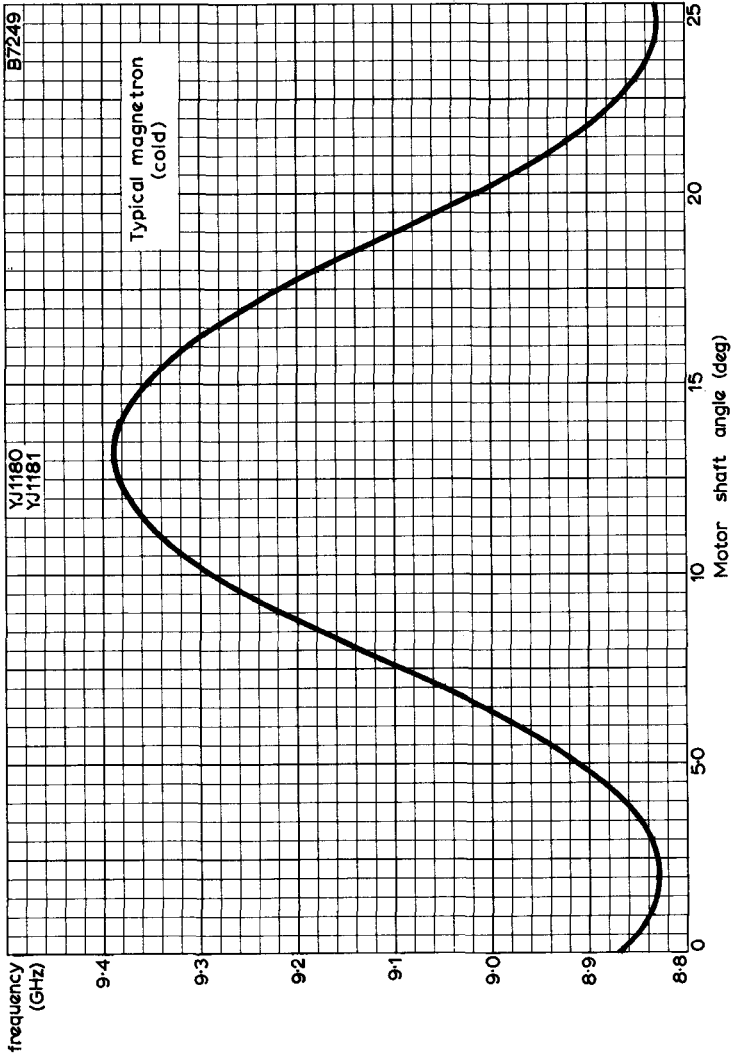


DETAIL "B"

B7248

DIMENSIONS OF YJ1180 AND YJ1181

| | Millimetres |
|----|----------------|
| K | 38.1 dia. |
| L | 38 |
| M | 47.1±3.0 |
| N | 6.5 |
| P | 38.1±2.0 |
| Q | 85.5±3.0 |
| R | 23±0.8 |
| AK | 21.1±0.15 dia. |
| AL | 19 dia. |
| AM | 13.7±0.15 dia. |
| AN | 6.35±0.4 dia. |
| AP | 4.3±0.12 dia. |
| AQ | 0 min. |
| AR | 3.2±0.25 |
| AS | 3.95±0.8 |
| AT | 6.35 |
| AU | 13.1 min. |
| AV | 19 min. |
| AW | 67.5±2.4 |
| AX | 96 max. |
| AY | 127 max. |
| AZ | 185 max. |
| BB | 255 max. |
| BC | 4.0 |
| BD | 1.6 |
| BE | 1.0 |



PASSIVE RESONANCE FREQUENCY AS A FUNCTION OF
THE MOTOR SHAFT ANGLE

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 | μ s |
| 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/ μ s |
| 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 \pm 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 ($I_{\text{pulse}} = 12\text{A}$) | 11 | 12.5 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 12\text{A}$) | 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:-

R. F. pulse power output ($I_{\text{pulse}} = 12\text{A}$) 35 kW

| | Min. | Max. | |
|---|-------|-------|-----|
| Frequency fixed within the band | 9.345 | 9.405 | GHz |
| Pulse voltage ($I_{\text{pulse}} = 12\text{A}$) | 11 | 13.5 | kV |

MOUNTING POSITION

Any

COOLING

Temperatures

| | | |
|-------------------------------|-----|--------------------|
| Anode block max. | 120 | $^{\circ}\text{C}$ |
| Cathode and heater seals max. | 150 | $^{\circ}\text{C}$ |

PRESSURISING

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

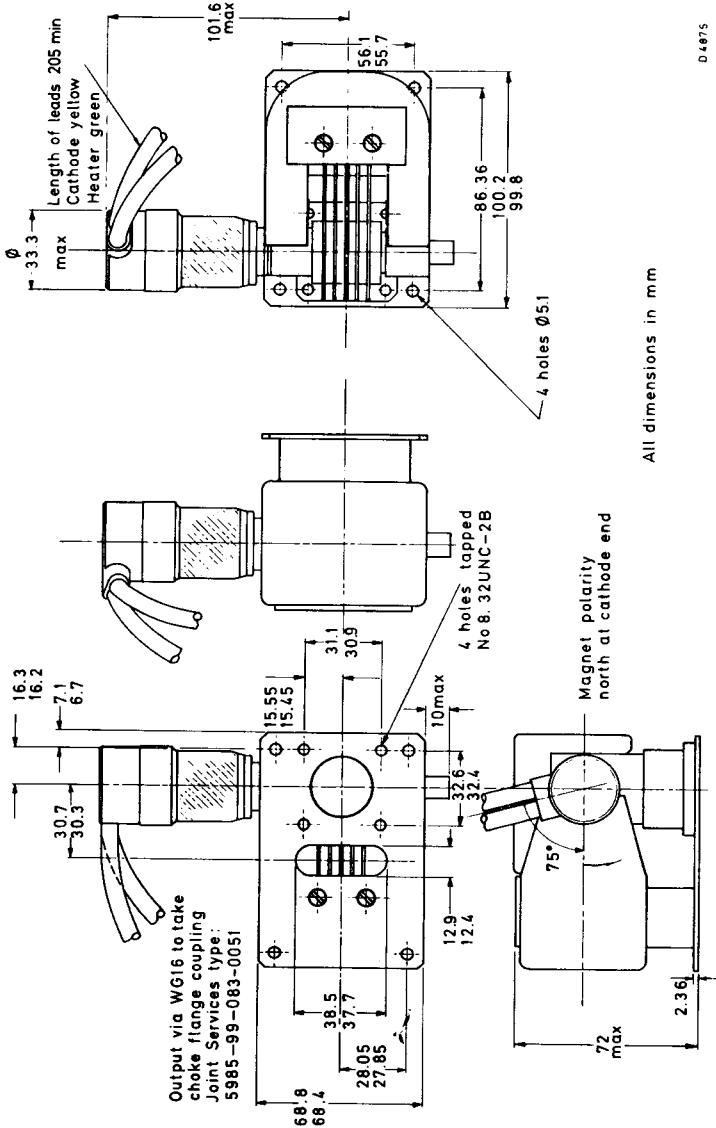
PHYSICAL DATA

| | | |
|---------------------|-----|----|
| Weight of magnetron | 1.9 | kg |
|---------------------|-----|----|

MAGNETRON

YJ1200 YJ1201

OUTLINE DRAWING OF YJ1200

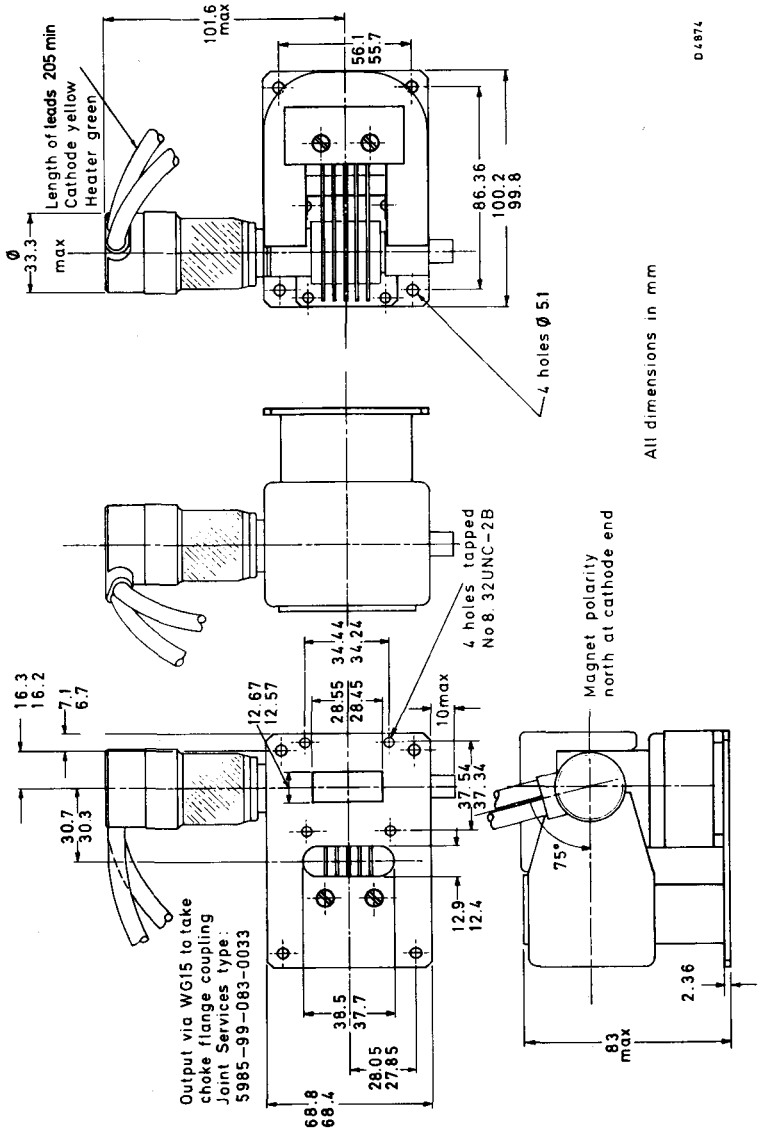


D.4875

All dimensions in mm



OUTLINE DRAWING YJ1201



D 4874

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 | μ s |
| 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/ μ s |
| 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 |
| $I_{h(\text{surge})}$ 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 ($I_{\text{pulse}} = 17.5\text{A}$) | 14 | 16 | kV |
| R. F. Pulse power output ($I_{\text{pulse}} = 17.5\text{A}$) | 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:-

| | | | |
|--|-------|-------|-----|
| R. F. Pulse power output ($I_{\text{pulse}} = 17.5\text{A}$) | | 75 | kW |
| | Min. | Max. | |
| Frequency fixed within the band | 9.315 | 9.375 | GHz |
| Pulse voltage ($I_{\text{pulse}} = 17.5\text{A}$) | 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 $\pm 0.5\text{mm}$ or 1.5g whichever is the smaller in the frequency range 5 to 150Hz in any plane and the total frequency deviation shall not exceed 100kHz.

ACCELERATION

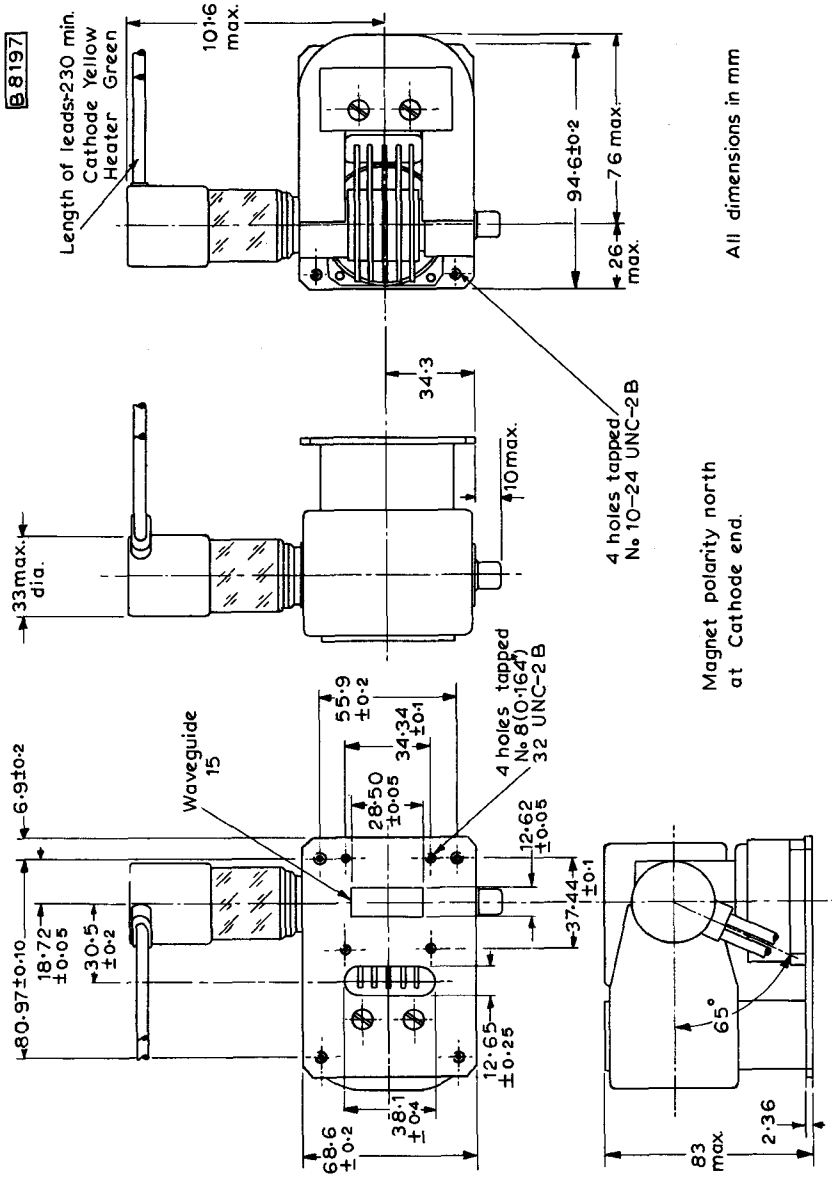
The magnetron will function normally when subjected to an acceleration of 5.5g in any plane. No part of the valve will break loose when subjected to an acceleration of 10g in any plane.

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



TENTATIVE DATA

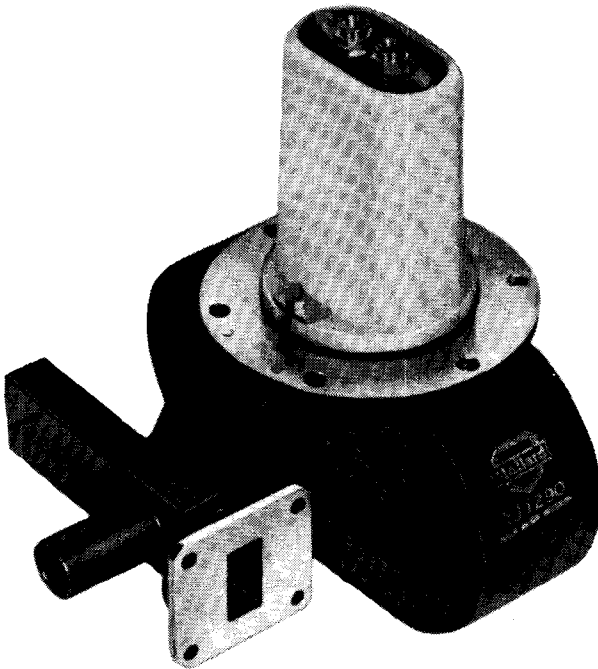
QUICK REFERENCE DATA

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 | μ s |
| Pulse repetition rate | 1250 | pulse/s |
| Rate of rise of voltage pulse | 145 | kV/ μ s |

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 | μ s |
| v. s. w. r. at output connection | † 1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | ‡ 150 | kV/ μ s |

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 | μ s |
| Rate of rise of voltage pulse (see note 4) | 100 | 150 | kV/ μ s |
| Anode temperature (see note 8) | - | 120 | $^{\circ}$ 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 $0.43\text{m}^3/\text{min}$ ($15\text{ft}^3/\text{min}$) at $T_{\text{amb}} = 55^{\circ}\text{C}$ 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

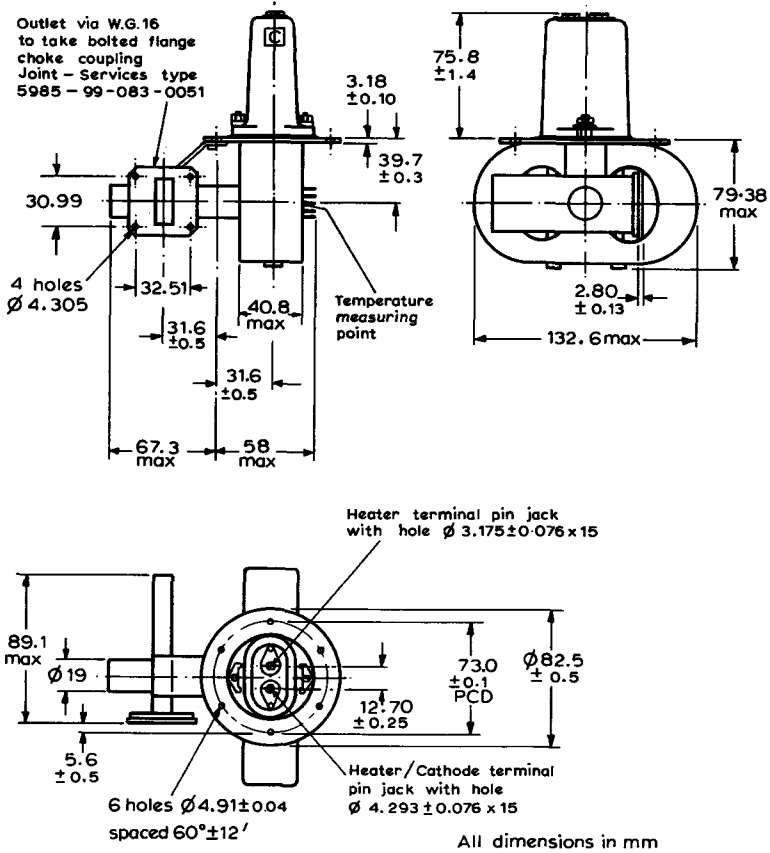
The magnetron is vibration tested to ensure that it will withstand normal conditions of service.

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°C the cathode must be heated for at least 2 minutes before the application of H.T. For ambient temperatures between -15°C and -55°C the cathode heating time is 3 minutes minimum.
3. The tolerance of pulse current duration (t_p) measured at 50% amplitude is $\pm 10\%$.
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



Millimetre to inch conversion table overleaf



Millimetre to inch conversion table (rounded outwards).

| Millimetres | Inches |
|----------------------|-------------------------|
| 2.80 ± 0.13 | 0.110 ± 0.005 |
| ∅ 3.175 ± 0.076 × 15 | ∅ 0.125 ± 0.003 × 0.591 |
| 3.18 ± 0.10 | 0.1252 ± 0.0040 |
| ∅ 4.293 ± 0.076 × 15 | ∅ 0.169 ± 0.003 × 0.591 |
| ∅ 4.305 | ∅ 0.1695 |
| ∅ 4.91 ± 0.04 | ∅ 0.1932 ± 0.0015 |
| 5.6 ± 0.5 | 0.220 ± 0.020 |
| 12.70 ± 0.25 | 0.500 ± 0.010 |
| ∅ 19 | ∅ 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 |

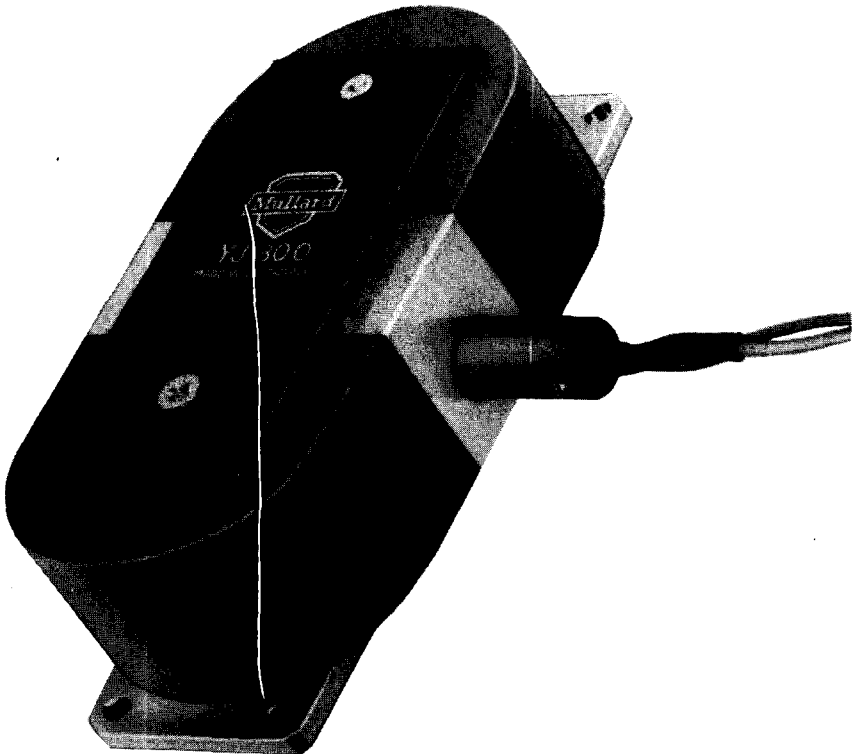


QUICK REFERENCE DATA

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



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 | μ s |
| Pulse repetition rate | 2000 | 1000 | pulse/s |
| Rate of rise of voltage pulse | 60 | 60 | kV/ μ s |

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 | μ s |
| v.s.w.r. at output coupler | 1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 75 | kV/ μ s |

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 | μ s |
| Rate of rise of anode voltage (see note 3) | - | 75 | kV/ μ s |
| Anode temperature | - | 120 | $^{\circ}$ 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°C. For ambient temperatures between 0°C and -55°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 $-0.25\text{MHz}/^{\circ}\text{C}$.
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.

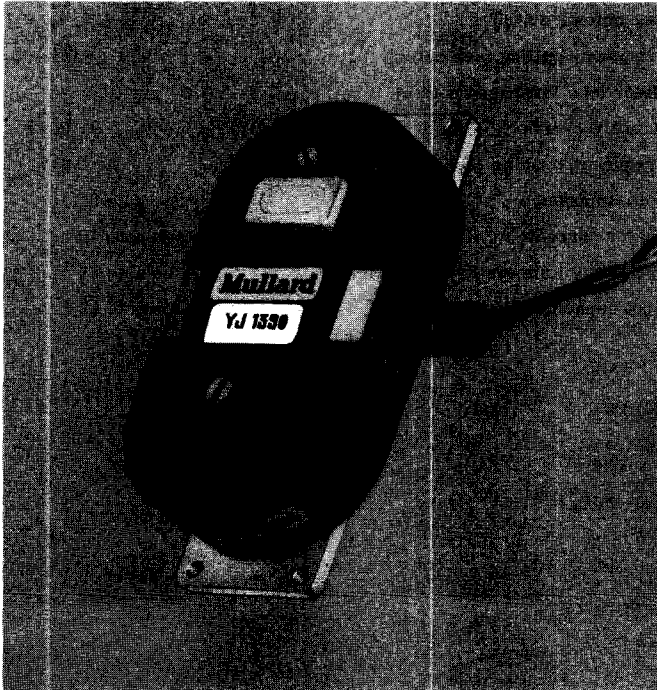
TENTATIVE DATA

QUICK REFERENCE DATA

X-Band, fixed frequency, pulsed magnetron.

| | | |
|-----------------------------------|----------------|---------------------|
| Frequency (fixed within the band) | 9.380 to 9.440 | GHz |
| Power output (peak) | 1.4 | kW |
| Construction | | Packaged |
| Output connection | | Waveguide 16 flange |

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



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) | 2.25 | mA |
| Duty factor | 0.001 | |
| Pulse duration (t_p) (see note 2) | 0.5 | μ s |
| v. s. w. r. at output connection (max.) | 1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 70 | kV/ μ s |

Limits and characteristics

| | Min. | Max. | |
|---|-------------|-------------------|-------|
| Anode voltage (peak) | 1.8 | 2.2 | kV |
| Power output (mean) | 1.2 | - | W |
| Frequency (see note 4) | 9.380 | 9.440 | GHz |
| R. F. Bandwidth at 1/4 power (see notes 2 and 5) | - | $\frac{2.5}{t_p}$ | MHz |
| Frequency pulling (see note 6) | - | 18 | MHz |
| Minor lobe level (see note 5) | 6.0 | - | dB |
| Stability (see note 7) | - | 0.25 | % |
| Frequency pushing (see note 8) | - | 2.5 | MHz/A |
| Cold impedance | see note 9 | | |
| Heater current | see note 10 | | |
| Frequency temperature coefficient | see note 11 | | |
| Input capacitance | see note 12 | | |

TYPICAL OPERATION

| | Condition 1 | Condition 2 | |
|-------------------------------|-------------|-------------|-------------|
| Operating conditions | | | |
| Heater voltage | 6.3 | 6.3 | V |
| Anode current (peak) | 2.25 | 2.25 | A |
| Pulse duration (t_p) | 0.1 | 0.5 | μ s |
| Pulse repetition rate | 1500 | 1500 | pulse/s |
| Rate of rise of voltage pulse | 60 | 60 | kV/ μ s |
| Typical performance | | | |
| Anode voltage (peak) | 2.0 | 2.0 | kV |
| Power output (peak) | 1.4 | 1.4 | kW |
| Power output (mean) | 0.21 | 1.05 | W |

CATHODE

Indirectly heated

| | | |
|----------------------------------|-----|---|
| Heater voltage | 6.3 | V |
| Heater current | 0.4 | A |
| Heating time (min.) (see note 1) | 30 | s |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

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

| | Min. | Max. | |
|--|------|--------|--------------|
| Heater voltage (see note 13) | 5.7 | 6.9 | V |
| Anode voltage (peak) | - | 2.2 | kV |
| Anode current (peak) | 1.9 | 2.5 | A |
| Power input (peak) | - | 5.5 | kW |
| Pulse power input (mean) | - | 8.25 | W |
| Duty factor | - | 0.0015 | |
| Pulse duration (t_p) (see note 2) | 0.05 | 1.0 | μ s |
| Rate of rise of voltage pulse (see note 3) | - | 70 | kV/ μ s |
| Anode temperature | - | 120 | $^{\circ}$ 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) | 1.8 | 2.2 | kV |
| Power output (mean) | 1.0 | - | kW |
| Frequency | 9.380 | 9.440 | 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 14 |

OUTPUT COUPLER

The output connection of the magnetron should be directly connected to a waveguide choke flange type UG-40B/U (5985-99-083-0051).

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 -15°C the cathode must be heated for at least 30 seconds before the application of h.t. For ambient temperatures between -15 and -35°C the cathode heating time is 45 seconds minimum.
2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is $\pm 10\%$.
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 1.9 to 2.5A peak.
6. Measured at an anode current of 2.25A peak under matched conditions. A mismatch of 1.5:1 is then varied through all phases.
7. 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 9.380 to 9.440GHz. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.
8. Design test only. Measured over the anode current range of 1.9 to 2.5A peak.
9. 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 3.0 to 9.0mm.
10. Measured with a heater voltage of 6.3V and no anode input power, the heater current limits are 0.3 to 0.5A.
11. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/degC.
12. Design test only. The maximum input capacitance is 9pF.
13. The magnetron is normally tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 3kHz 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.
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 (2in), from the magnet.

When storing, magnetrons should be kept as far apart as possible, at least 150mm (6in). During shipment adequate separation between magnetrons 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.

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 ($I_{\text{pulse}} = 4.5\text{A}$) | 5.3 | 5.7 | kV |
| R. F. pulse power output ($I_{\text{pulse}} = 4.5\text{A}$) | 7.0 | - | kW |
| Frequency pulling (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 | 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

| | | |
|----------------|-----|----|
| 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 within 3 seconds of applying h.t. in accordance with the formula:

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

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 | °C |

MOUNTING POSITION

Any



MAGNETRON

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

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 | - |

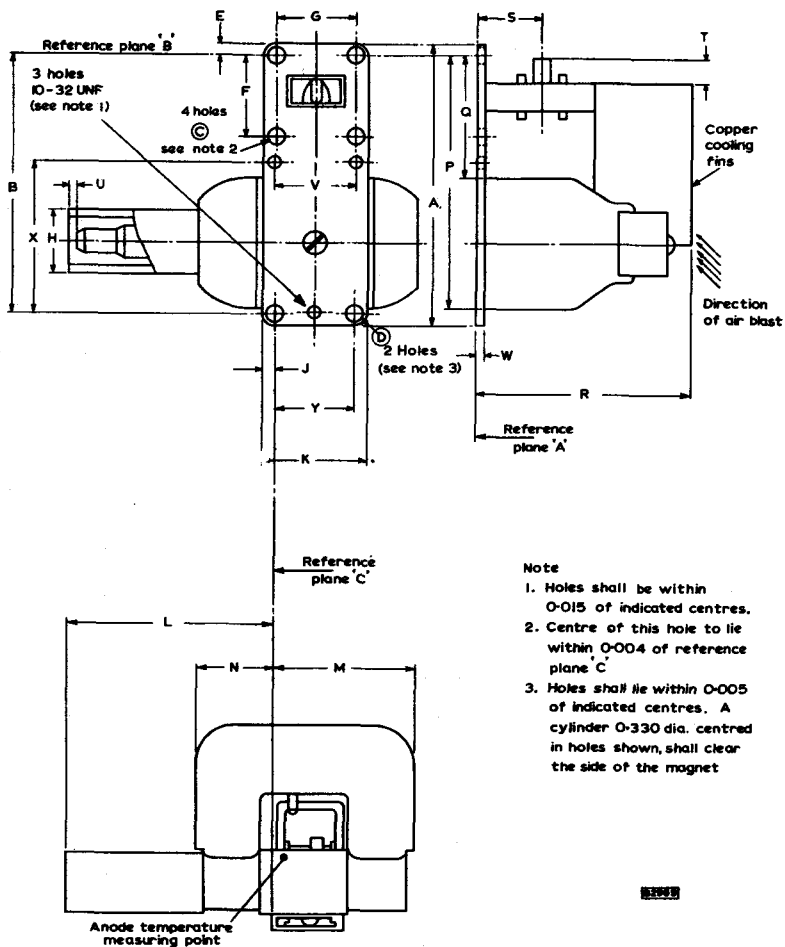
Millimetre dimensions derived from original inch dimensions.



MAGNETRON

2J42

(MIL-E-1/667E)

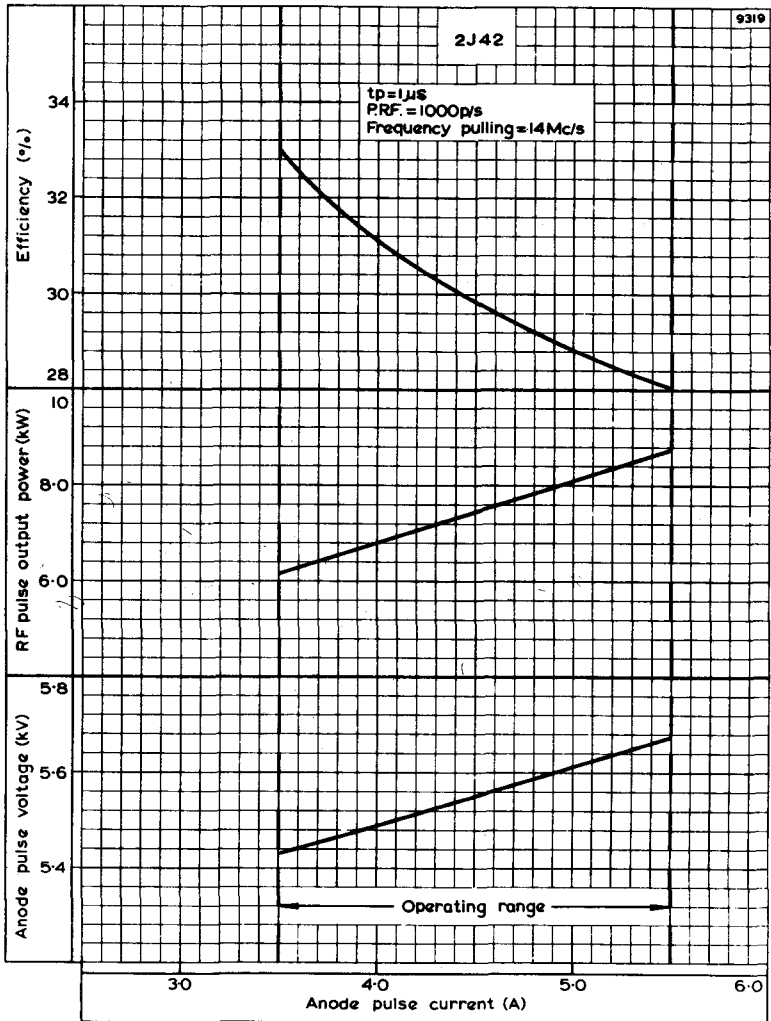


Note

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

13442





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

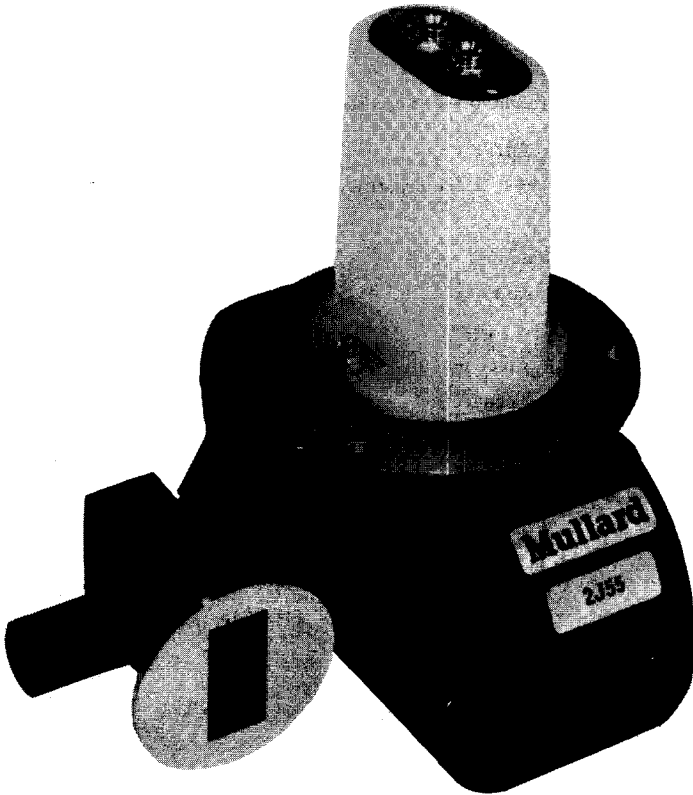


QUICK REFERENCE DATA

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 | μ s |
| Pulse repetition rate | 1000 | 400 | pulse/s |
| Rate of rise of voltage pulse | 150 | 150 | kV/ μ s |

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 | μ s |
| v.s.w.r. at output connection | <1.05:1 | |
| Rate of rise of voltage pulse (see note 4) | 150 | kV/ μ s |

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 | μ s |
| Rate of rise of voltage pulse (see note 4) | - | 160 | kV/ μ s |
| Anode temperature (see note 13) | - | 120 | $^{\circ}$ 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 |
| Weight of magnetron | 1.81 |
| Weight of magnetron in storage carton | 1.92 |
| | mm |
| Dimensions of storage carton | 204 × 241 × 266.7 |

NOTES

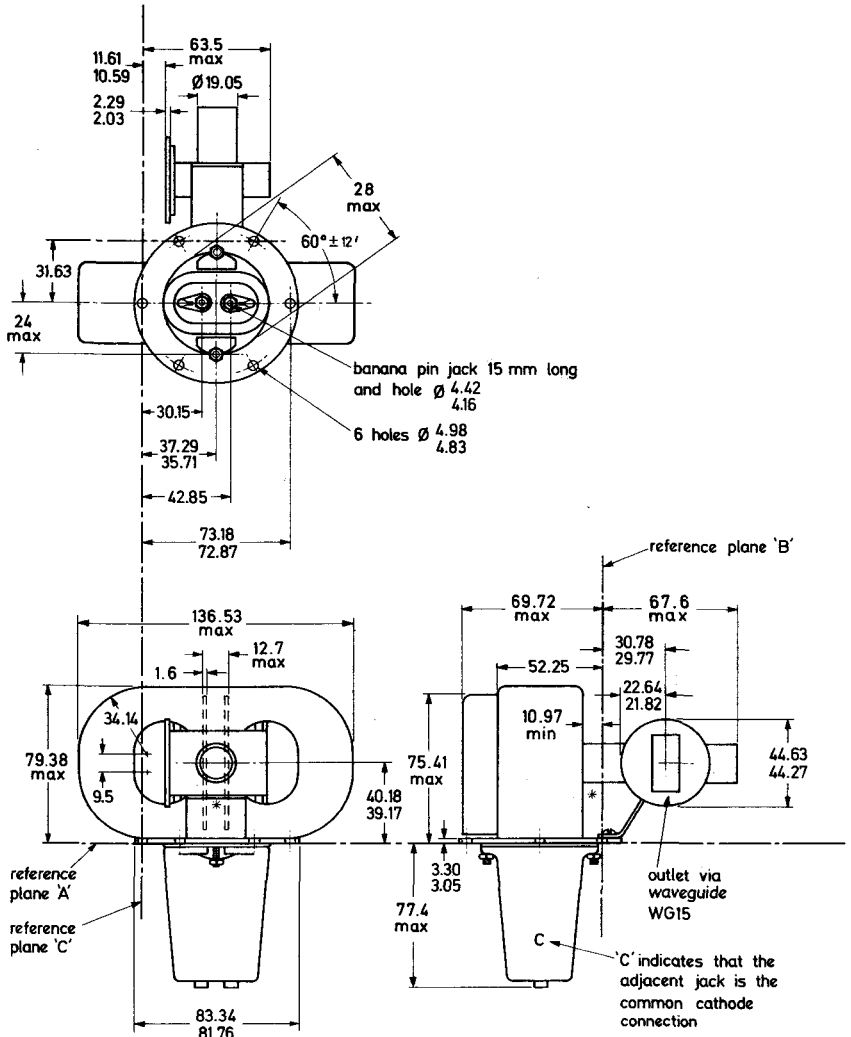
1. With no anode input power. Immediately after the application of anode power the heater voltage must be reduced in accordance with the heater derating chart on page 8.
2. For ambient temperatures above 0°C. For ambient temperatures between 0°C and -55°C the cathode heating time is 180 seconds.
3. The 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°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 $-0.25\text{MHz}/^{\circ}\text{C}$.
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.

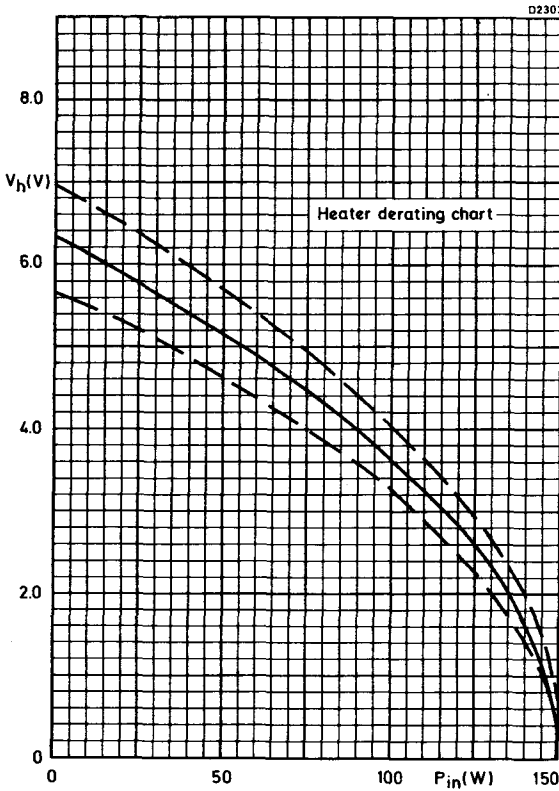
OUTLINE DRAWING OF 2J55



* Temperature measuring point

All dimensions in mm

D 4 877



HEATER VOLTAGE PLOTTED AGAINST MEAN ANODE
INPUT POWER

TENTATIVE DATA

QUICK REFERENCE DATA

C-Band, fixed frequency, pulsed magnetron

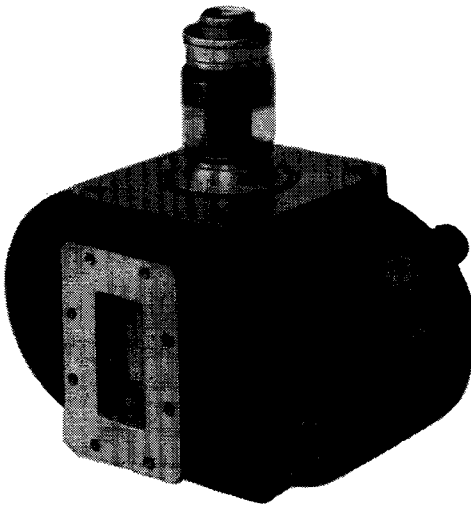
Frequency (fixed within the band) 5.38 to 5.42 GHz

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 | μ s |
| Pulse repetition rate | 400 | pulse/s |
| Rate of rise of voltage pulse | 100 | kV/ μ s |
| 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 | μ s |
| v.s.w.r. at output connection | 1.05:1 | |
| Rate of rise of voltage pulse (see note 3) | 120 | kV/ μ s |



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 | μ s |
| Rate of rise of voltage pulse (see note 3) | - | 120 | kV/ μ s |
| Anode temperature | - | 150 | $^{\circ}$ C |
| Cathode and heater seals temperature | - | 165 | $^{\circ}$ 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 x 38mm (3 in x 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 x 347 x 310 | 15 x 13.7 x 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 |

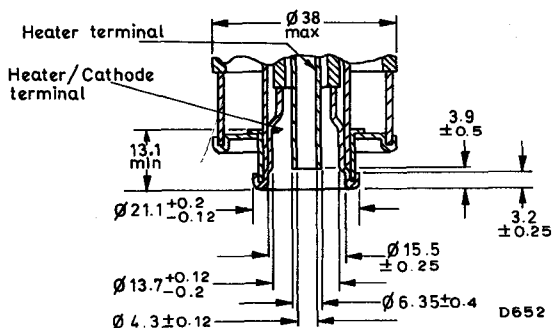
2. The tolerance of current pulse duration (t_p) measured at 50% amplitude is $\pm 10\%$.
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.
4. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over an anode current range of 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 100 μs interval is 5 μs .
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.



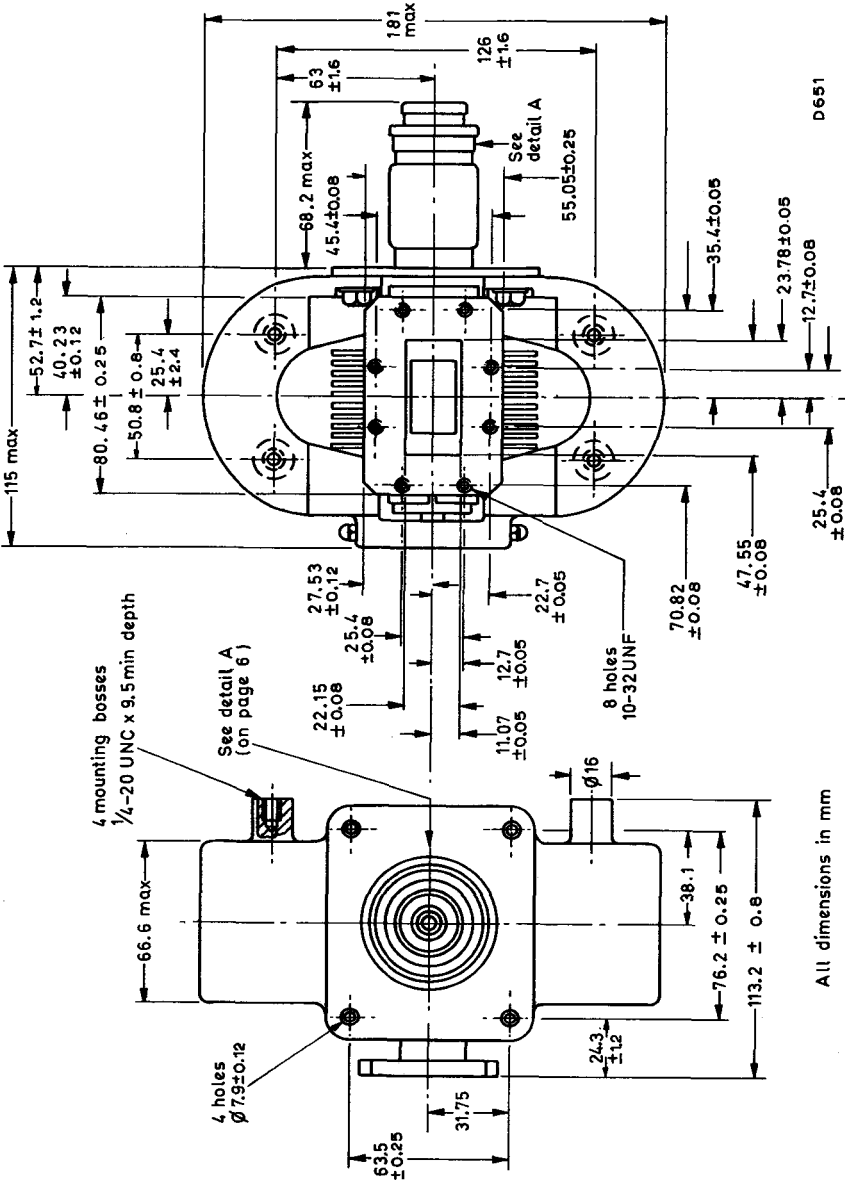
CONVERSION TABLE
(Rounded outwards)

| 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 |
| ∅ 4.3 ± 0.12 | ∅ 0.169 ± 0.005 | ∅ 38 max. | ∅ 1.50 max. |
| ∅ 6.35 ± 0.4 | ∅ 0.25 ± 0.016 | 38.1 | 1.50 |
| ∅ 7.9 ± 0.12 | ∅ 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 |
| ∅ 13.7 ^{+0.12} _{-0.2} | ∅ 0.540 ^{+0.005} _{-0.008} | 55.05 ± 0.25 | 2.167 ± 0.010 |
| ∅ 15.5 ± 0.25 | ∅ 0.610 ± 0.010 | 63 ± 1.6 | 2.480 ± 0.063 |
| ∅ 16 | ∅ 0.63 | 63.5 ± 0.25 | 2.5 ± 0.01 |
| | | 66.6 max. | 2.63 max. |
| ∅ 21.1 ^{+0.2} _{-0.12} | ∅ 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



OUTLINE DRAWING OF 6521



D 6521

All dimensions in mm



HEATING MAGNETRONS

C 

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 $\pm 2.5\%$ 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 does 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 influence 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 $10\text{mW}/\text{cm}^2$. The power output of industrial magnetrons is such that, with improperly sealed 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 $I_a = 750\text{mA d.c.}$, v.s.w.r. < 1.05) | 4.4 | 4.8 | kV |
| Operating voltage range (d.c.), within the range (at $I_a = 800\text{mA d.c.}$, 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 $\pm 0.1\lambda$ | | |
| 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 $\pm 0.1\lambda$ | | | |
| 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 $\pm 0.03\lambda$ 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 $\pm 0.03\lambda$ | | | |
| 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 | °C |
| Cathode radiator | 180 | °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°C during operation. This requires a minimum air flow of 0.22m³/min (8.0ft³/min). If after blowing is provided the minimum air flow may be reduced to 0.06m³/min (2.0ft³/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°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 $T_{in} = 25^{\circ}\text{C}$, the minimum air flow is 1.7m³/min (60ft³/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°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

50 Ω coaxial transmission line with 16mm inner conductor and 39mm outer conductor.

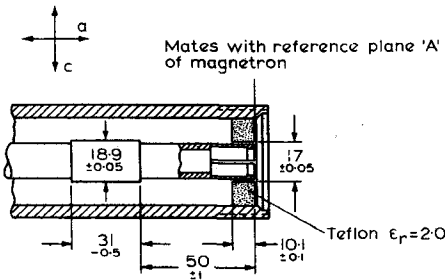
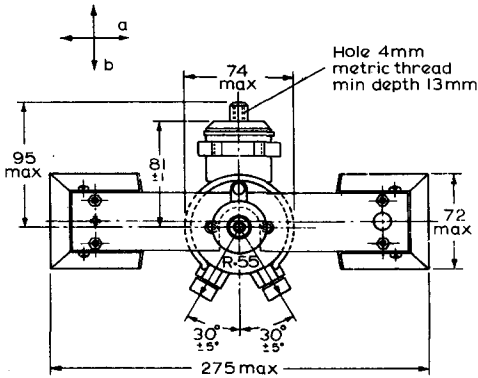
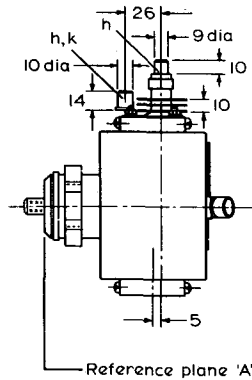
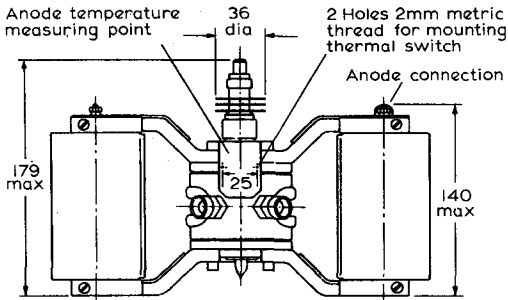
PHYSICAL DATA

| | YJ1160 | YJ1162 | |
|-------------------------|--------|--------|----|
| Net weight of magnetron | 5.1 | 7.9 | kg |
| | 11.2 | 17.4 | lb |

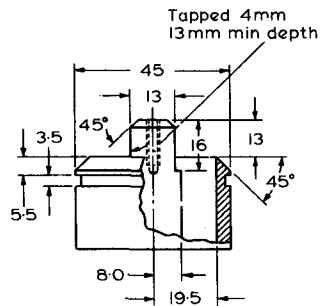
ACCESSORIES

| | |
|-------------------------------|-------|
| Cap nut | 55312 |
| Split spring ring | 55313 |
| Heater terminal cooling clip | 40634 |
| Cathode terminal cooling clip | 40649 |

OUTLINE DRAWING OF YJ1160



Fixed reflection element



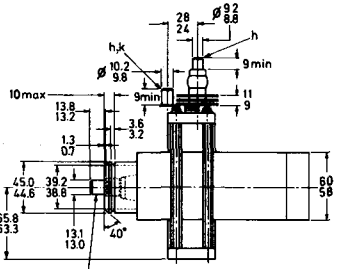
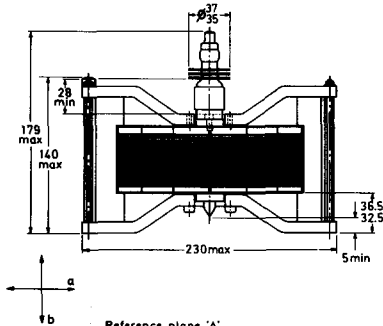
Output terminal

All dimensions in mm

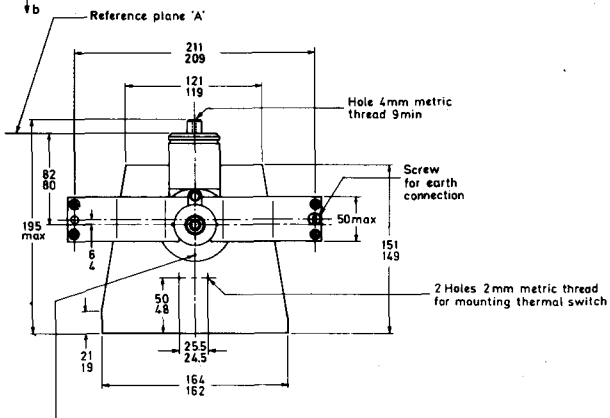
85059

OUTLINE DRAWING OF YJ1162

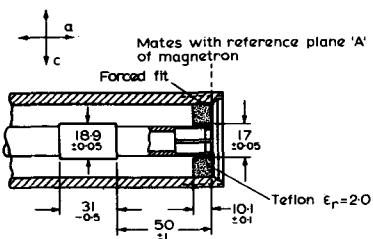
D2389



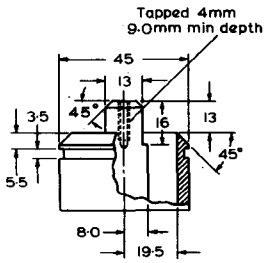
Eccentricity of inner conductor with respect to outer 0.4 max



Reference plane for temperature measurements



Fixed reflection element

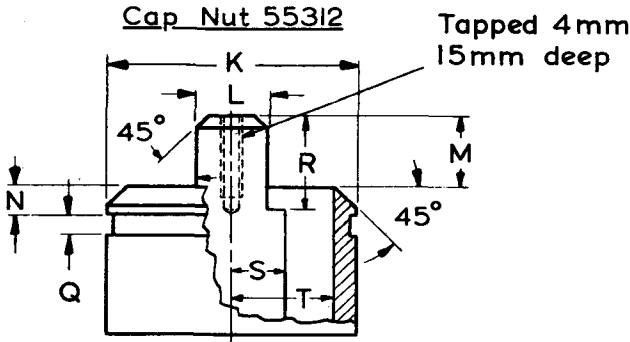
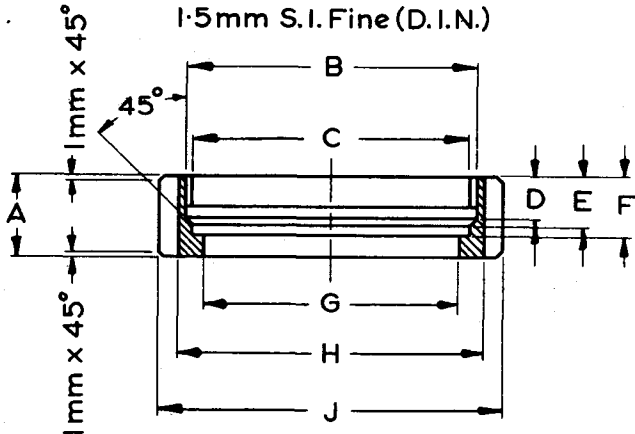


Output terminal

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 | | | |

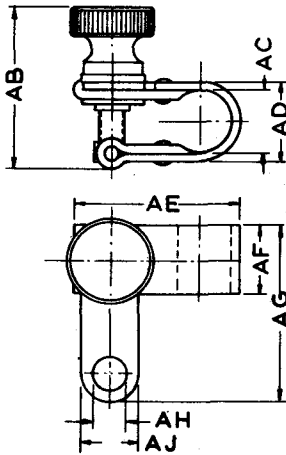


Output Terminal

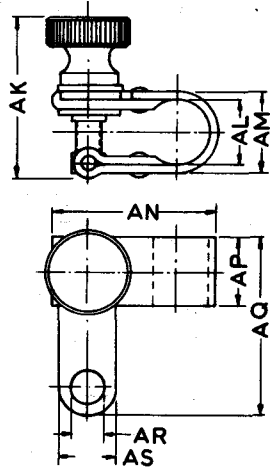
9379

OUTLINE AND DIMENSIONS OF COOLING CLIPS

| | <i>Inches</i> | <i>Millimetres</i> | | <i>Inches</i> | <i>Millimetres</i> |
|----|---------------|--------------------|----|---------------|--------------------|
| AB | 1.06 | 27 | AK | 1.02 | 26 |
| AC | 0.41 | 10.5 | AL | 0.35 | 9 |
| AD | 0.51 | 13 | AM | 0.47 | 12 |
| AE | 1.10 | 28 | AN | 1.10 | 28 |
| AF | 0.47 | 12 | AP | 0.47 | 12 |
| AG | 1.18 | 30 | AQ | 1.18 | 30 |
| AH | 0.26 | 6.5 | AR | 0.26 | 6.5 |
| AJ | 0.47 | 12 | AS | 0.47 | 12 |

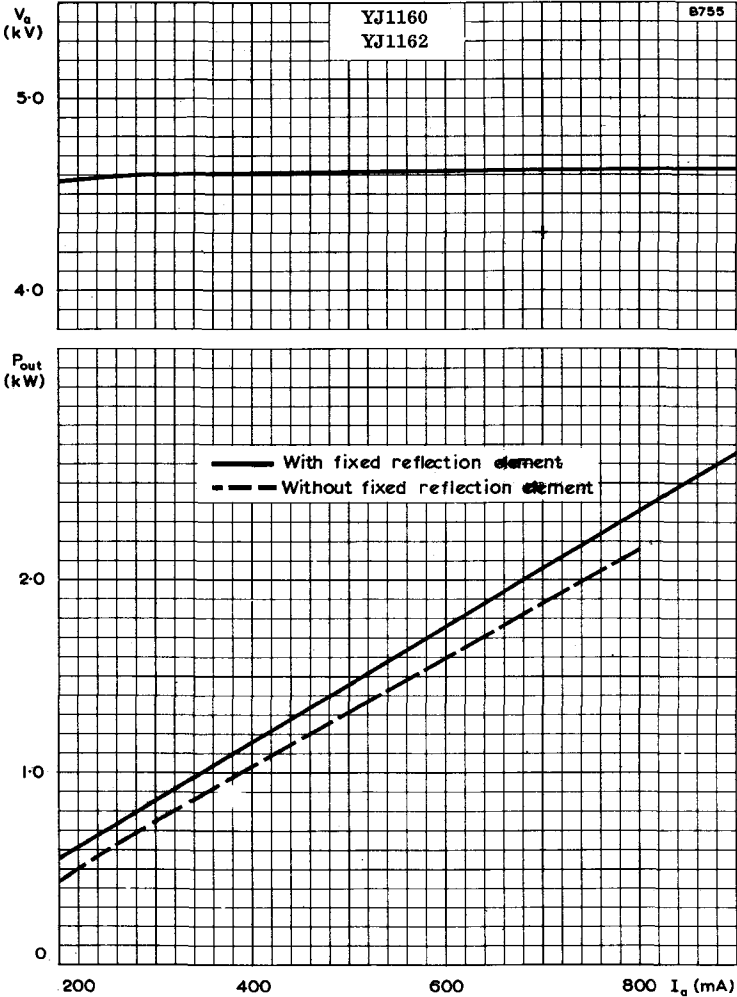


Cathode terminal
cooling clip 40649

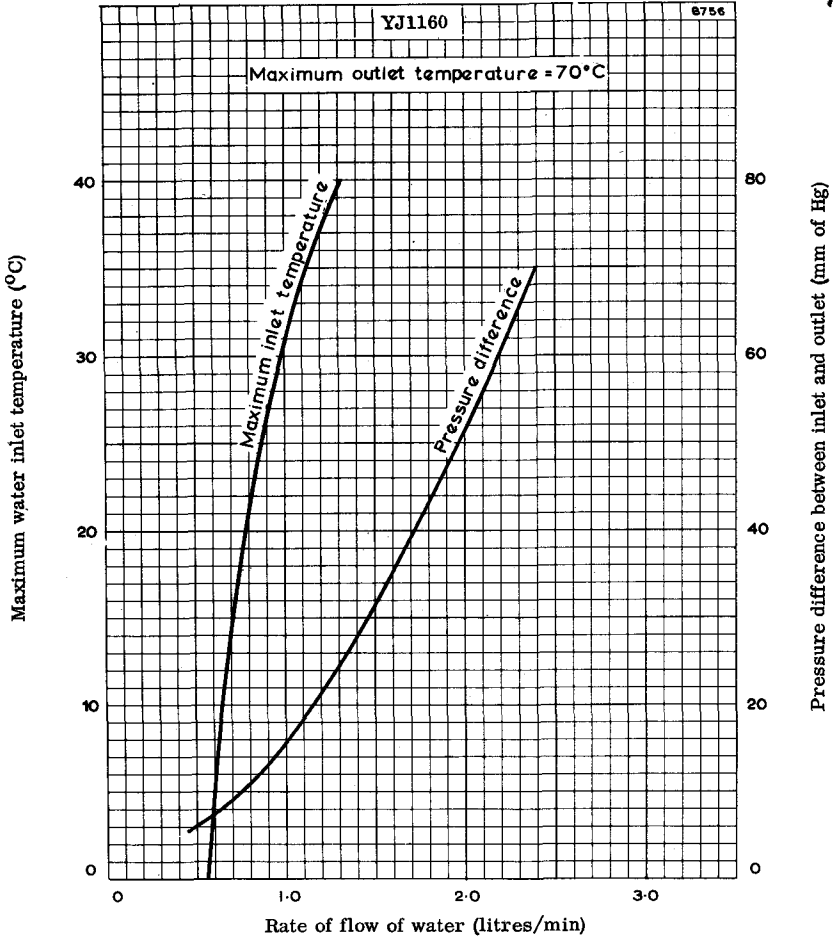


heater terminal
cooling clip 40634

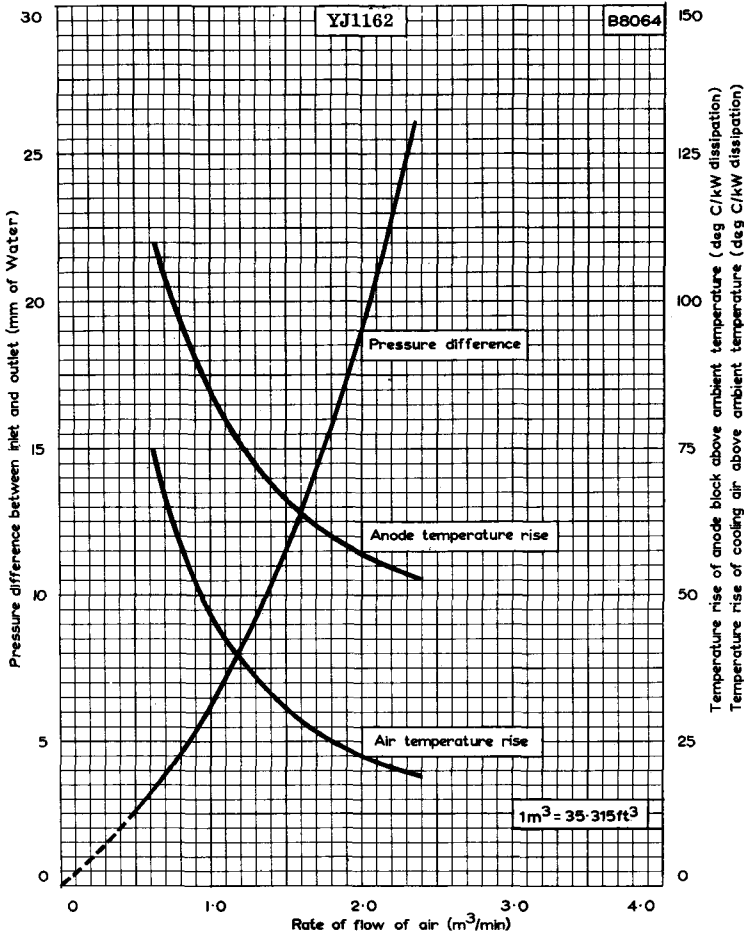
9177



OUTPUT POWER AND ANODE VOLTAGE PLOTTED AGAINST MEAN ANODE CURRENT

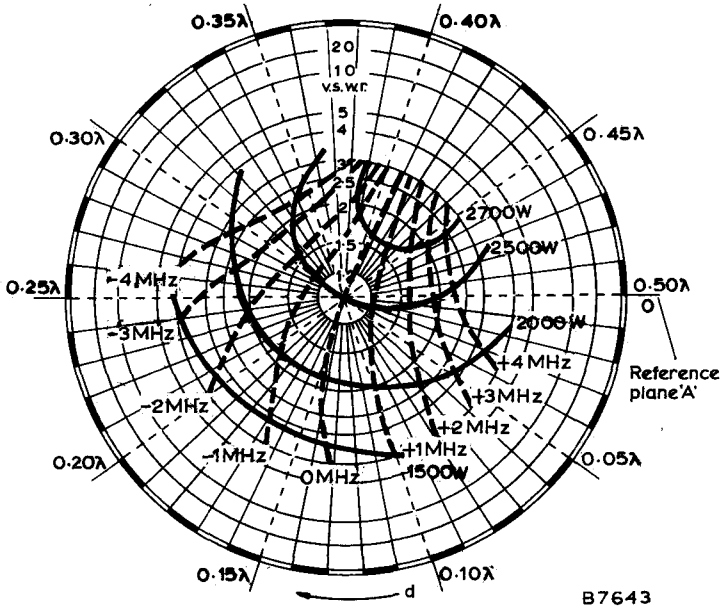


COOLING CURVES FOR YJ1160



COOLING CURVES FOR YJ1162

RIEKE DIAGRAM (WITH REFLECTION ELEMENT)

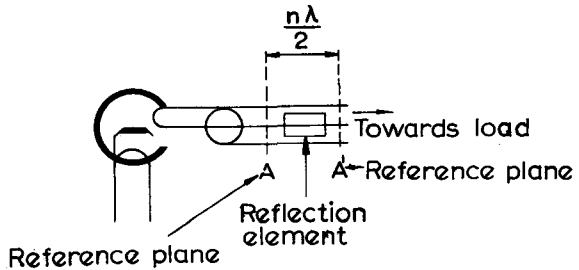


Measured with a.c. supply. $I_a = 850\text{mA}$

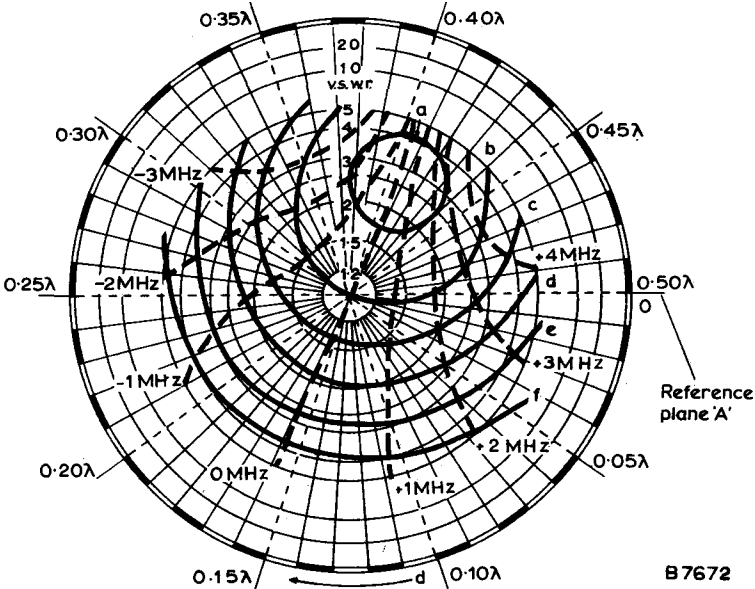
————— = Output power

- - - - - = Frequency pulling

d = Distance of standing wave from reference plane 'A' towards load.



RIEKE DIAGRAM (WITHOUT REFLECTION ELEMENT)



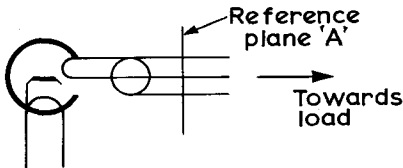
Measured with a.c. supply. $I_a = 750\text{mA}$

$i_{a(pk)} = 2.0\text{A}$

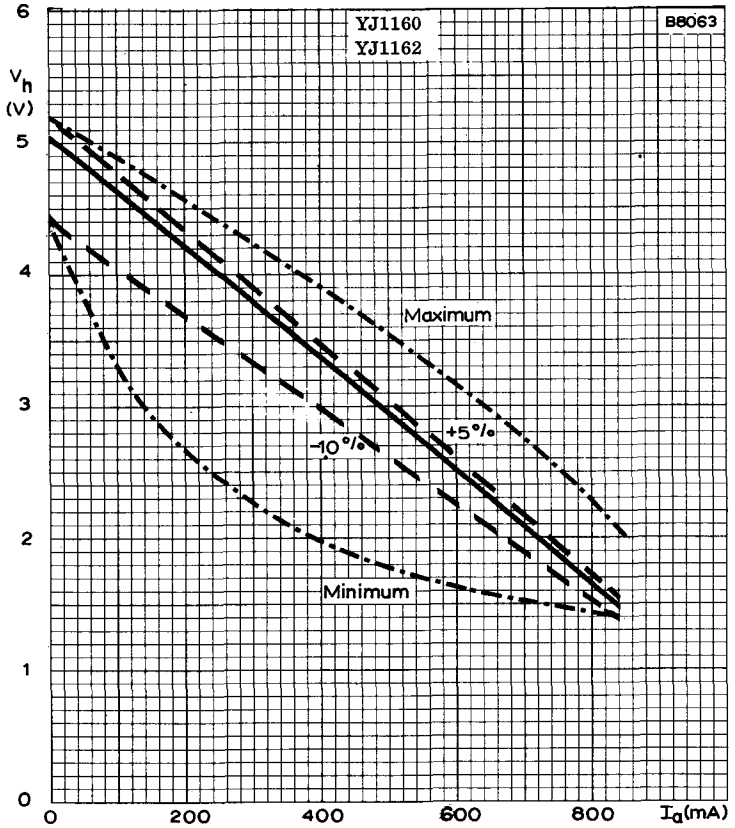
— = Output power

- - - = 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

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 ± 10% | V | |
| I_f (at $V_f = 5.5V$ 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 | λ_{guide} |
| 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 $0.1 \text{ m}^3/\text{min}$ is required at room temperature (typical 18°C).

Maximum temperatures

| | | |
|---|-----|------------------|
| Anode block (see page 9 for reference point) | 90 | $^\circ\text{C}$ |
| Cooling water outlet temperature | 70 | $^\circ\text{C}$ |
| Filament and filament/cathode terminals and any other point | 200 | $^\circ\text{C}$ |

At standby with filament voltage = 5.5V water and forced-air cooling is required to prevent overheating.

A thermostwitch 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°C .

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 , $r_f(\text{cold})$, 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

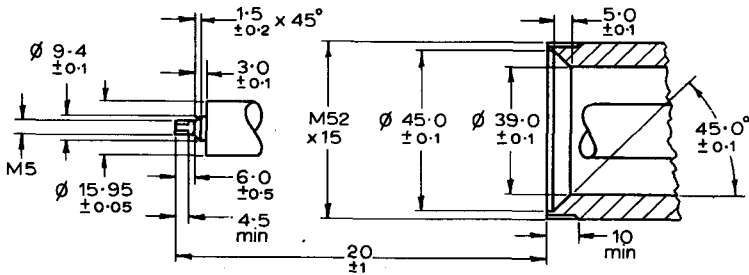
Optimum output power and life will be obtained when the magnetron is loaded with an impedance giving a v.s.w.r. of approximately 1.5 in the phase of sink region. This phase condition is reached when the position of the voltage standing wave minimum is at a distance of about $0.39\lambda_{\text{guide}}$ 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 0.1m³/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)

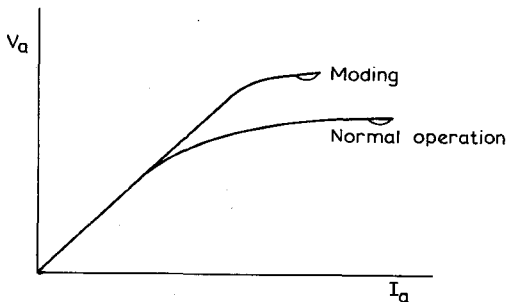
Operational checks

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.

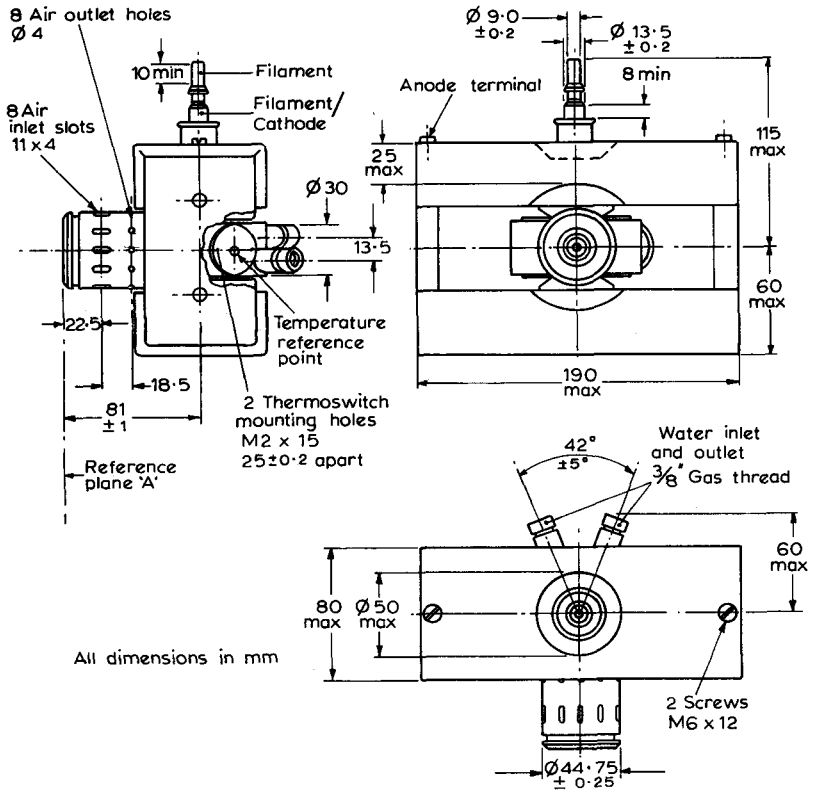
Operating conditions including v.s.w.r. must be checked at once and the magnetron replaced if under the correct conditions moding still occurs. The mean anode current may be measured directly across the sampling resistor.



X-Y Display of magnetron characteristic

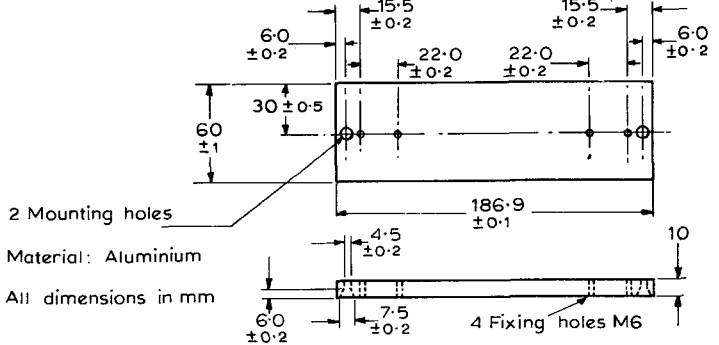


OUTLINE DRAWING



All dimensions in mm

MOUNTING PLATE 55327



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 | ∅ |
| 10 | 0.393 | min |
| 13.5 | 0.532 | |
| 13.5 ± 0.2 | 0.5315 ± 0.0079 | ∅ |
| 18.5 | 0.728 | |
| 22.5 | 0.886 | |
| 25 | 0.99 | max |
| 25 ± 0.2 | 0.9842 ± 0.0079 | |
| 30 | 1.18 | ∅ |
| 44.75 ± 0.25 | 1.762 ± 0.010 | ∅ |
| 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 |

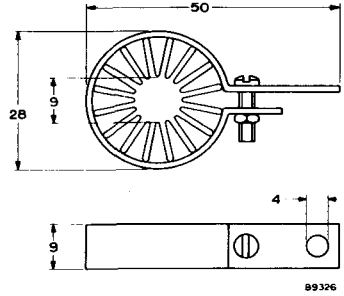
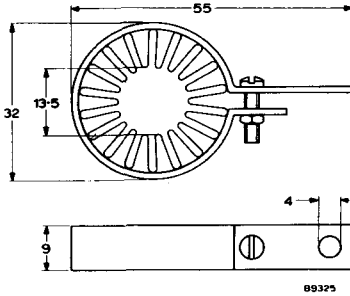
Mounting plate 55327

| | | |
|-------------|-----------------|---|
| 4.5 ± 0.2 | 0.1772 ± 0.0079 | ∅ |
| 6.0 ± 0.2 | 0.2362 ± 0.0079 | |
| 7.5 ± 0.2 | 0.2953 ± 0.0079 | ∅ |
| 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

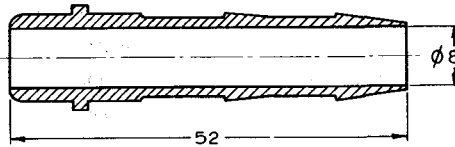
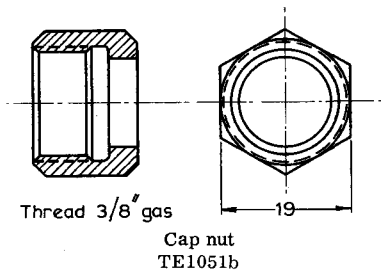


Filament/cathode connector
55324

| Millimetres | Inches |
|-------------|-----------|
| 4 dia | 0.16 dia |
| 9 | 0.35 |
| 13.5 dia | 0.532 dia |
| 32 dia | 1.26 dia |
| 55 | 2.17 |

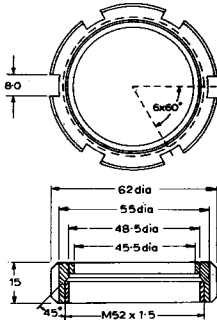
Filament connector
55323

| Millimetres | Inches |
|-------------|----------|
| 4 dia | 0.16 dia |
| 9 | 0.35 |
| 9 dia | 0.35 dia |
| 28 dia | 1.10 dia |
| 50 | 1.97 |



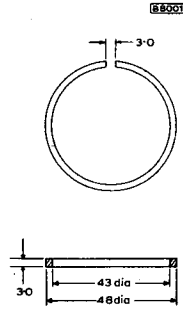
Connection for 9mm hose
TE1051c

| Millimetres | Inches |
|-------------|----------|
| 8 dia | 0.31 dia |
| 19 | 0.75 |
| 52 | 2.05 |



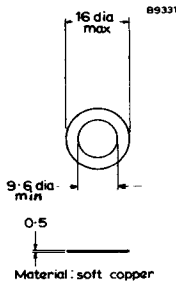
Cap nut
55312

| 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

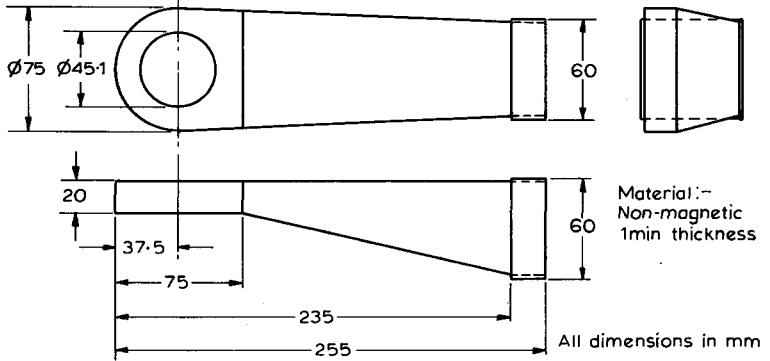
| Millimetres | Inches |
|-------------|----------|
| 3.0 | 0.118 |
| 43 dia | 1.69 dia |
| 48 dia | 1.89 dia |



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

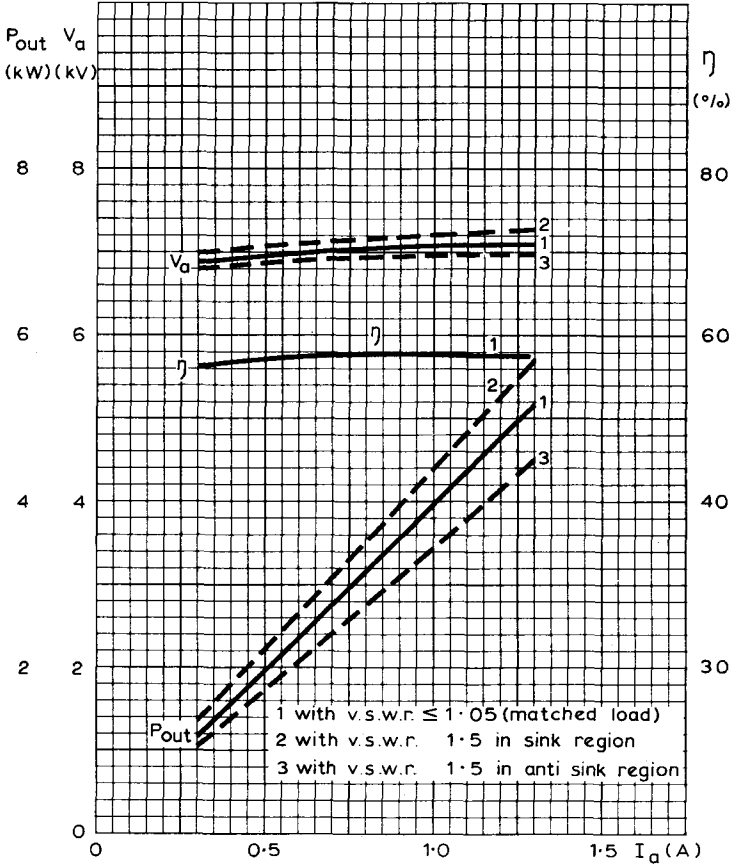


Pressure loss at $0.1 \text{ m}^3/\text{min}$:

About 60mm water with air outlet only via outlet holes.

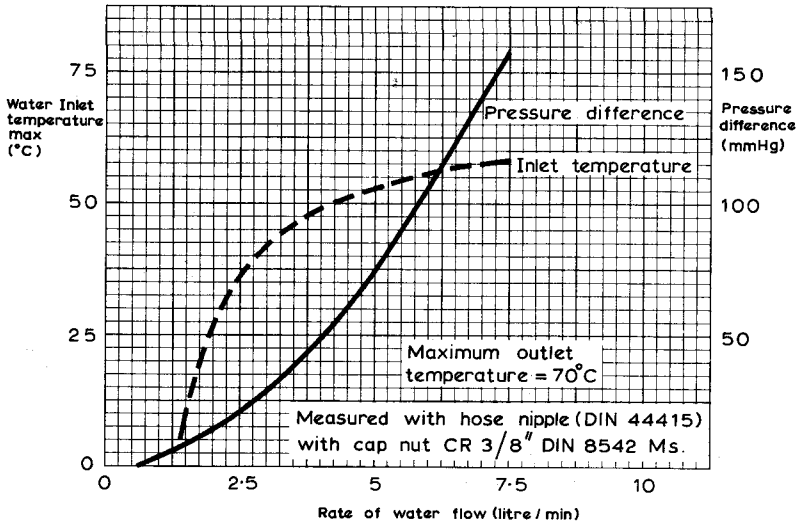
About 30mm water if air can also escape towards the load through the waveguide or coaxial line.

| 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 |

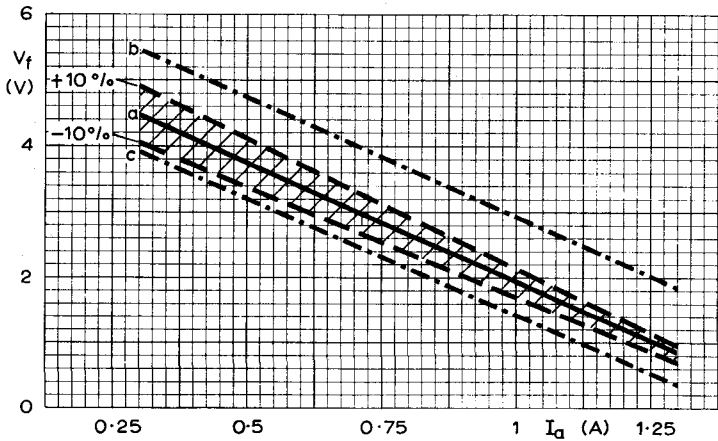


OUTPUT POWER, ANODE VOLTAGE AND EFFICIENCY
PLOTTED AGAINST ANODE CURRENT





COOLING CHARACTERISTICS



HEATER DERATING CHART

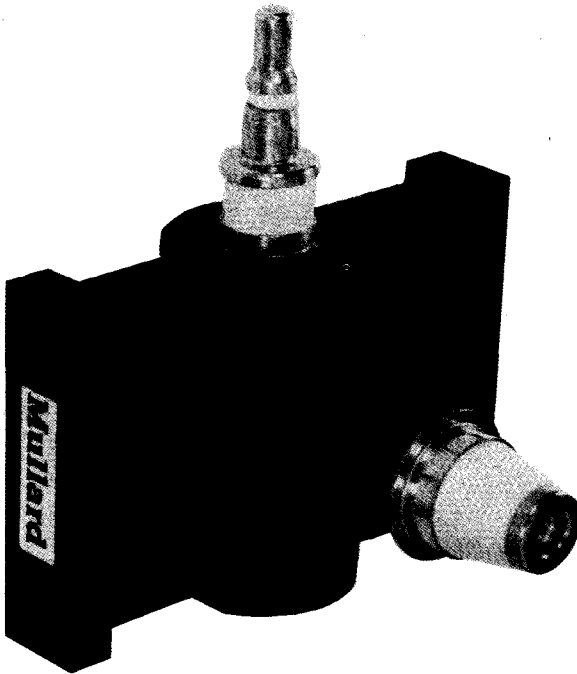


QUICK REFERENCE DATA

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



Mullard

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 | °C |
| Temperature at any other point on the tube | - | 200 | °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 | °C |
| Quantity | 1.2 | m ³ /min |
| Pressure drop | 10 | mm (water gauge) |

PHYSICAL DATA

| | | |
|---------------------------------------|-----------------------|--------------------------|
| Weight of magnetron | kg 2.3 | lb 5.1 |
| Weight of magnetron in storage carton | 3.45 | 7.6 |
| Dimensions of storage carton | mm 310 × 310 × 310 | in 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, $\pm 10\%$ 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 which ever 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

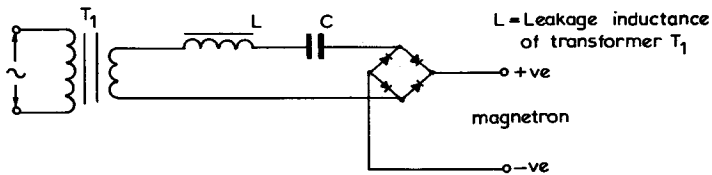
General

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 circuit 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.

DESIGN AND OPERATING INFORMATION (contd.)

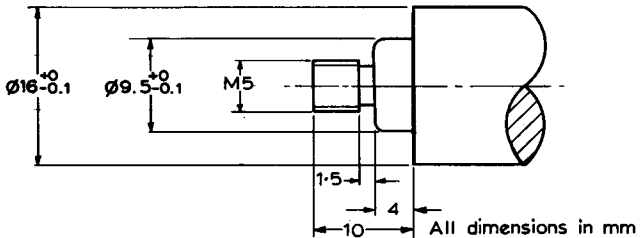
Load impedance measured with measuring probe

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 | $\varnothing 16 \begin{smallmatrix} +0 \\ -0.1 \end{smallmatrix}$ | $\varnothing 0.63 \begin{smallmatrix} +0 \\ -0.0078 \end{smallmatrix}$ |
| $\varnothing 9.5 \begin{smallmatrix} +0 \\ -0.1 \end{smallmatrix}$ | $\varnothing 0.374 \begin{smallmatrix} +0 \\ -0.0078 \end{smallmatrix}$ | | |

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.

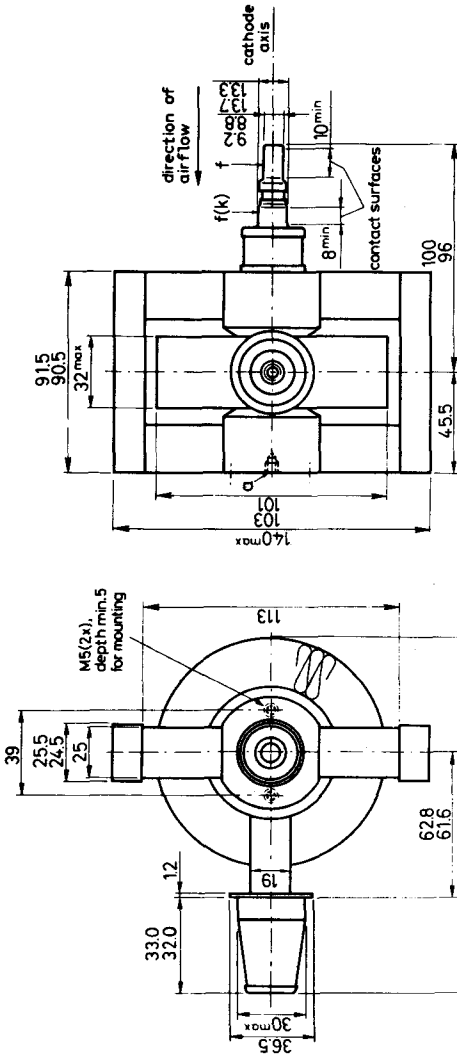
The user should be aware of the strong magnetic fields around the magnetron. When handling the tube, non-magnetic tools must be used and care should be taken to avoid damage to watches and other precision instruments.

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

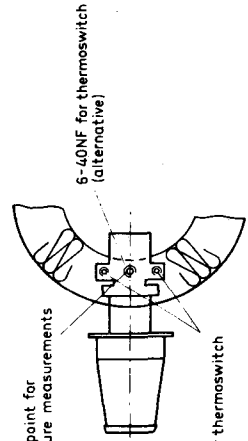
In order to achieve good r.f. contact between the magnetron output and the external r.f. circuit it is essential to fit r.f. gasket type 55341. The output coupling of the magnetron should not be used as the only means of mounting. The magnetron should be mounted and secured by the mounting holes provided (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 ensure adequate separation between magnets.

OUTLINE DRAWING OF YJ1280



side view

top view



part of bottom view

All dimensions in mm

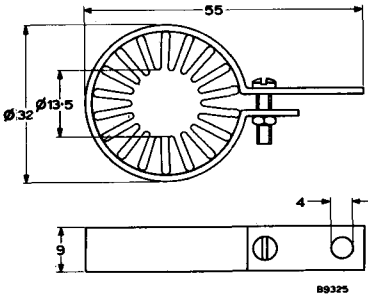
CONVERSION TABLE (Rounded outwards)

| 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. |



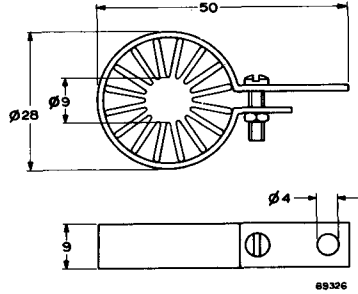
ACCESSORIES

Inch dimensions given in conversion tables below are derived from original millimetre dimensions



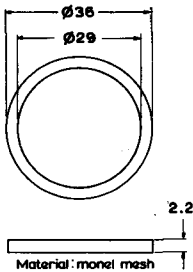
Filament/cathode connector
55324

| Millimetres | Inches |
|-------------|--------|
| Ø 4 | Ø 0.16 |
| 9 | 0.35 |
| Ø 13.5 | Ø 0.53 |
| Ø 32 | Ø 1.26 |
| 55 | 2.16 |



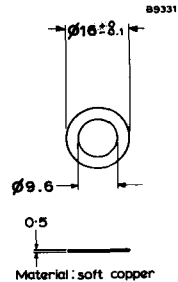
Filament connector
55323

| Millimetres | Inches |
|-------------|--------|
| Ø 4 | Ø 0.16 |
| 9 | 0.35 |
| Ø 9 | Ø 0.35 |
| Ø 28 | Ø 1.10 |
| 50 | 1.97 |



R. F. gasket
55341

| Millimetres | Inches |
|-------------|--------|
| 2.2 | 0.87 |
| Ø 29 | Ø 1.14 |
| Ø 36 | Ø 1.42 |

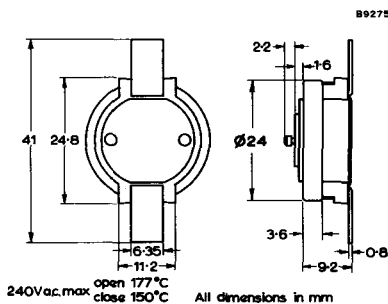
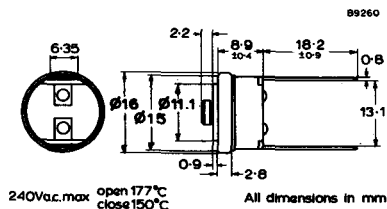


Washer
55328

| 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

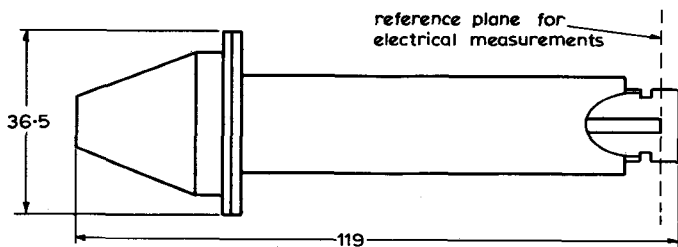


Thermoswitch 4.5A max
S-32997

Thermoswitch 25A max
S-330923

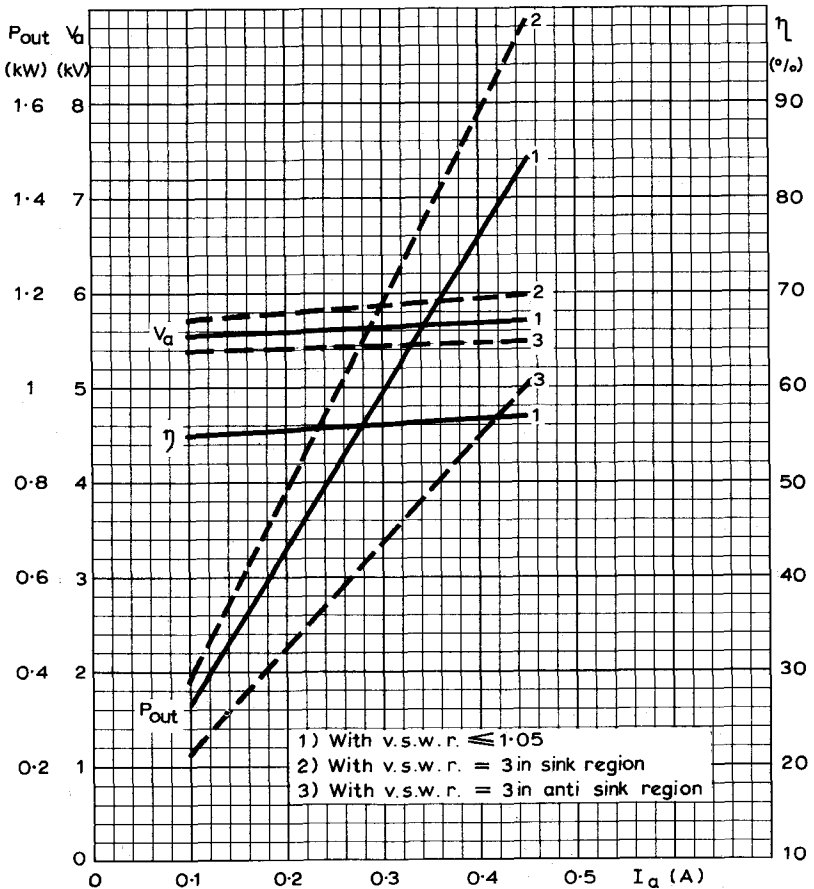
| Millimetres | Inches |
|-------------|---------------|
| 0.8 | 0.031 |
| 0.9 | 0.035 |
| 2.2 | 0.086 |
| 2.8 | 0.110 |
| 6.35 | 0.25 |
| 8.9 ± 0.4 | 0.350 ± 0.015 |
| ∅ 11.1 | ∅ 0.437 |
| 13.1 | 0.515 |
| ∅ 15 | ∅ 0.59 |
| ∅ 16 | ∅ 0.63 |
| 18.2 ± 0.9 | 0.716 ± 0.035 |

| 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 |
| ∅ 24 | ∅ 0.94 |
| 24.8 | 0.976 |
| 41 | 1.61 |



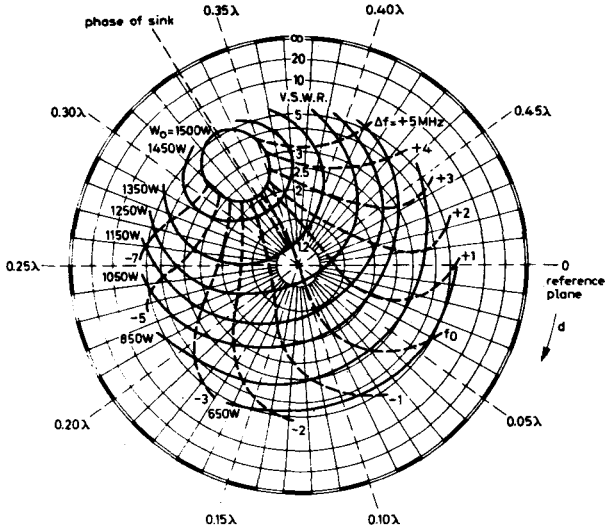
Measuring probe
55336

| Millimetres | Inches |
|-------------|--------|
| 36.5 | 1.43 |
| 119 | 4.68 |



OUTPUT POWER, ANODE VOLTAGE AND EFFICIENCY
PLOTTED AGAINST ANODE CURRENT

LOAD DIAGRAM



Mean anode current $I_a = 380\text{mA}$

Frequency $f_o = 2.45\text{GHz}$

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 $I_a = 200\text{mA d.c.}$, 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 $Z > 250\Omega$)

| | | |
|-----------------------------|-----|----|
| *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 $Z > 500\Omega$)

| | | |
|-----------------------------|-----|----|
| *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 | °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 | °C |

†Excluding fixed reflection element

CATHODE

Indirectly heated

| | A.C. or rectified A.C. | D.C. | |
|------------------------------------|---------------------------|------|------|
| Anode supply | | | |
| **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

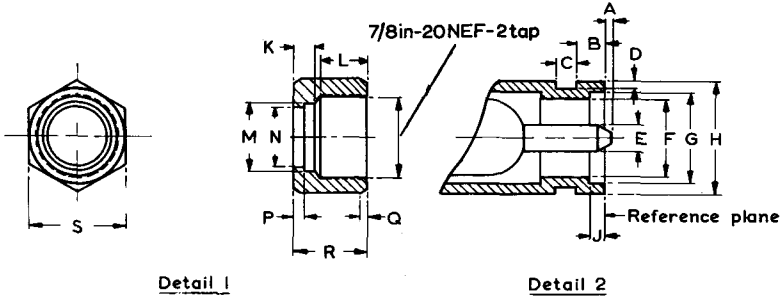
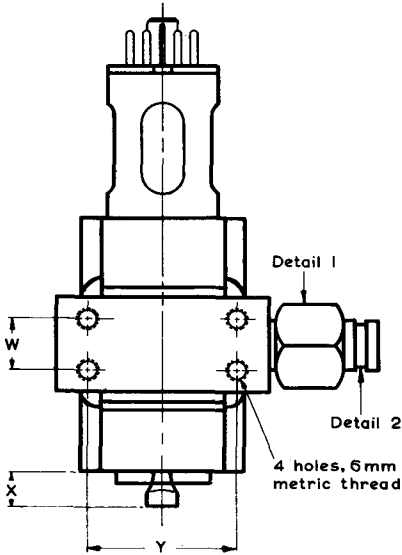
| | kg | lb |
|-------------------------------|-----|-----|
| Weight of magnetron | 2.4 | 5.3 |
| Weight of magnetron in carton | 3.5 | 7.7 |

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



Note:

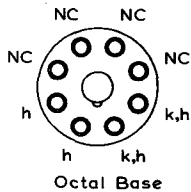
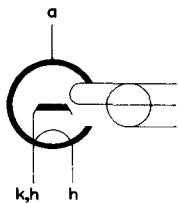
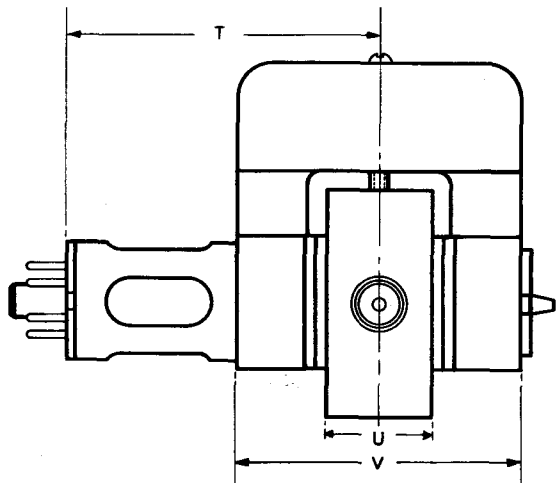
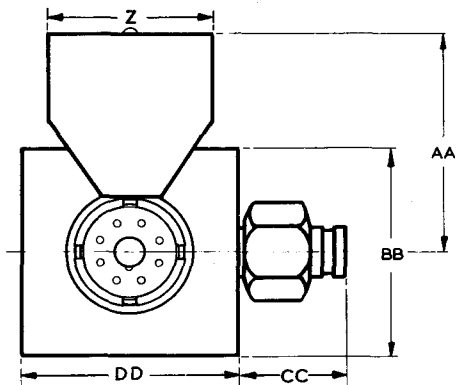
The inner conductor (E above) will always lie within a circle of diameter 5.5mm.

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.

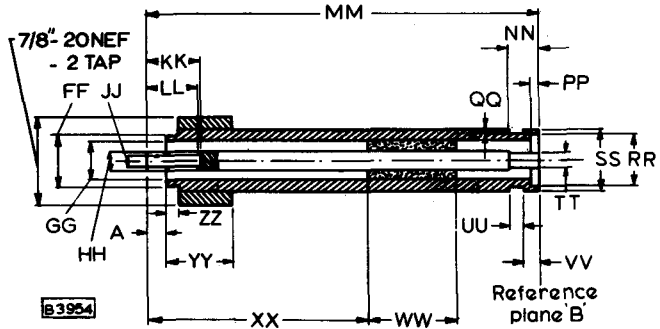




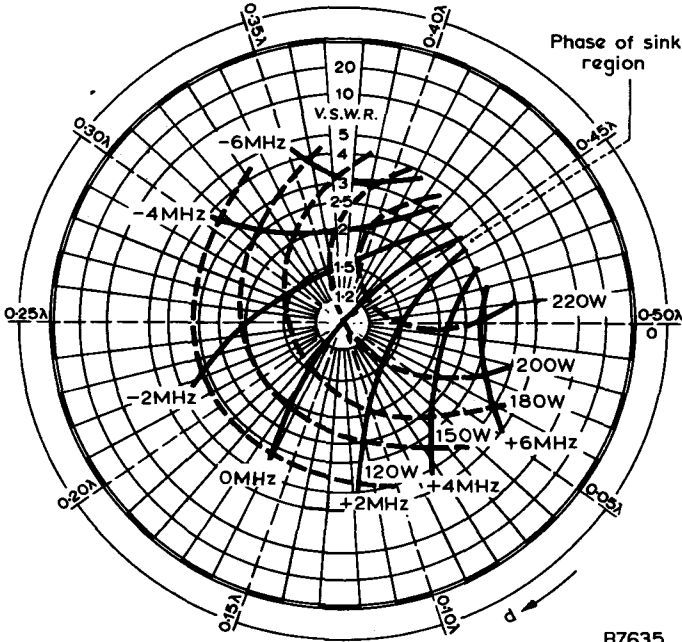
The anode is terminated in NC the base plate.

6147

FIXED REFLECTION ELEMENT
TEFLON $\epsilon_r = 2.0$ DRIVING FIT



RIEKE DIAGRAM

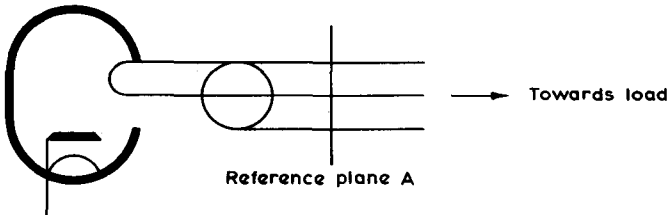


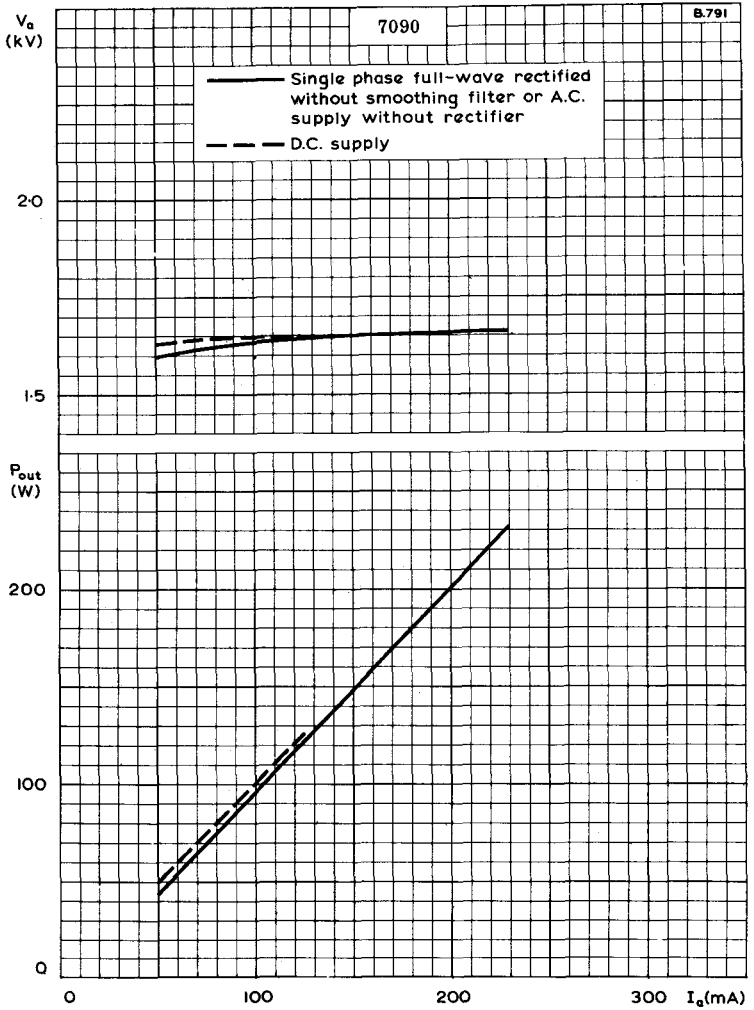
Measured with a.c. supply $I_a = 0.2A$

--- = Output power

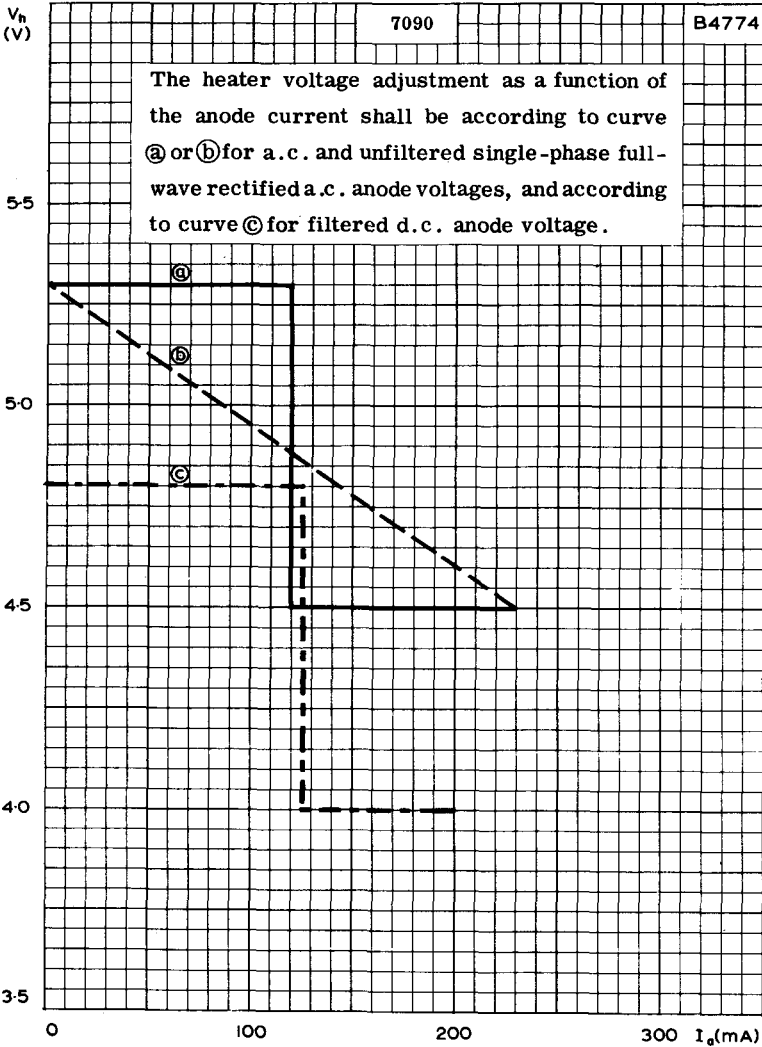
— = Frequency pulling

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



1. HEATER

The heater voltage unless otherwise specified in individual data sheets must be set within $\pm 7\%$ of the nominal value and temporary fluctuations must be within $\pm 10\%$. 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.

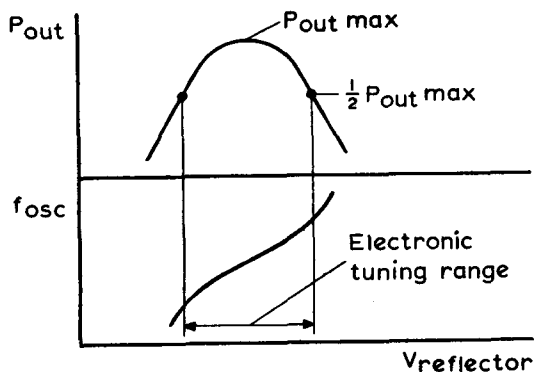
6. TUNING

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.



7664

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

KS7-85

Frequency: 7Gc/s. band. Mechanical tuning.
 Power output: 50mW minimum.
 Construction: All metal, coaxial output probe.
 Application: Local oscillator, signal generator.

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 |
| $V_{\text{resonator}}$ | 300 | V |
| $I_{\text{resonator}}$ | 24 | mA |
| $V_{\text{reflector}}$ | -140 | V |
| $I_{\text{reflector}}$ | 1.0 | μA |
| Electronic tuning range between half power points | 38 | Mc/s |
| P_{out} | 100 | mW |

COOLING

Natural

ABSOLUTE RATINGS

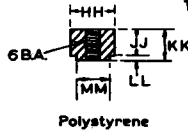
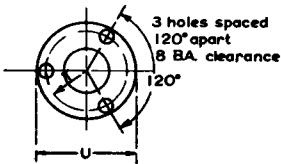
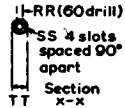
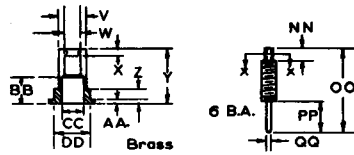
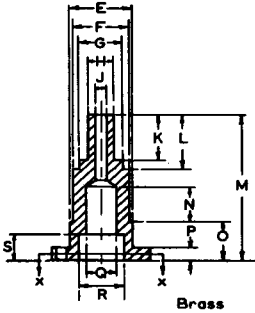
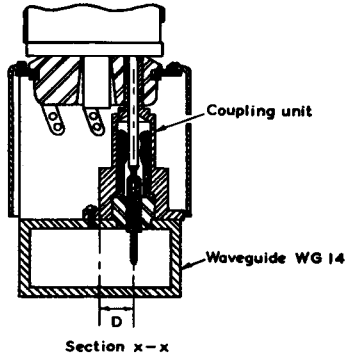
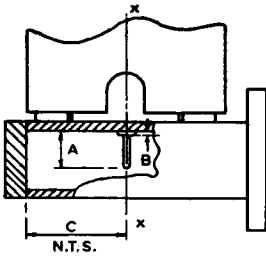
| | | |
|--------------------------------|--------------|----|
| $V_{\text{resonator max.}}$ | 350 | V |
| $I_{\text{resonator max.}}$ | 37 | mA |
| $V_{\text{reflector max.}}$ | -1.0 to -400 | V |
| $V_{h-k \text{ max.}}$ | -150 | V |
| $T_{\text{amb (shell) max.}}$ | 110 | °C |
| $T_{\text{coaxial line max.}}$ | 90 | °C |

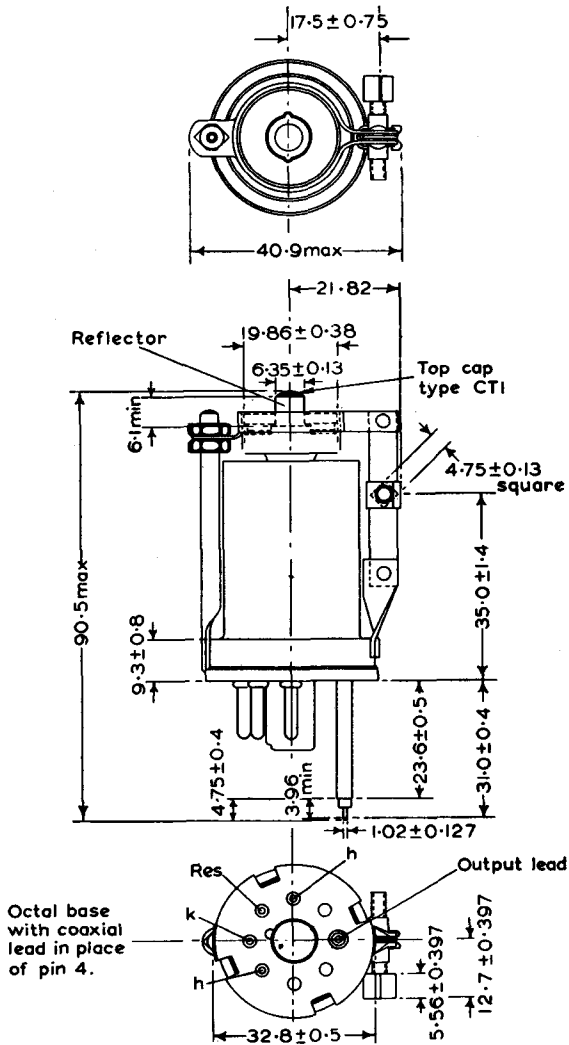
OPERATING NOTE

The prescribed tuning range is covered by five turns of the mechanical tuning screw. ←

| | <i>Inches</i> | <i>Millimetres</i> |
|----|---------------|--------------------|
| 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 |

6306





6331

All dimensions in mm

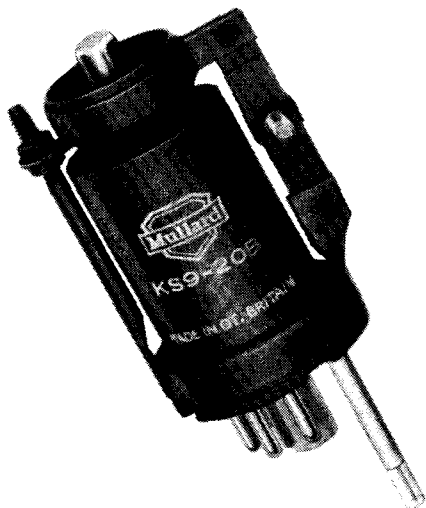
QUICK REFERENCE DATA

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 | | Min. | Max. | |
|--|-----------|------|------|-------|----------|
| | (GHz) | | | | |
| 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 |
| Cathode to heater voltage | 0 | 50 | 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

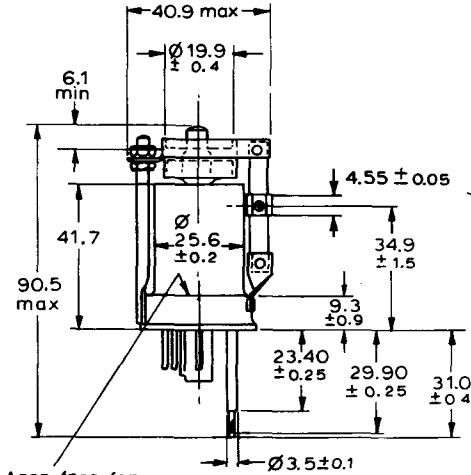
| | |
|------------------------------|--------------|
| | g |
| Weight of klystron | 65 |
| Weight of klystron in carton | 130 |
| | mm |
| Dimensions of storage carton | 95 × 51 × 51 |

NOTES

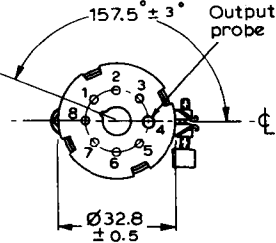
1. With the klystron operated in a standard waveguide launching section as shown on page 6.
2. Operation in mode A at a frequency of 9.370GHz.
3. Reflector voltage adjusted for the maximum power point of the mode.
4. There shall be no discontinuities at the maximum power points nor shall the power fall 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

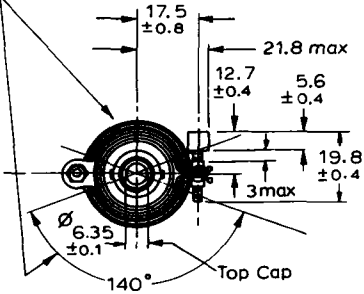
D4955



View of underside of I.O. base (BS448)



Area free for mounting



Base connections

- 1 Shell/resonator
 - 2 Heater
 - 3 N.P.
 - 4 Output probe
 - 5 N.P.
 - 6 N.P.
 - 7 Heater
 - 8 Cathode
- Top cap = Reflector

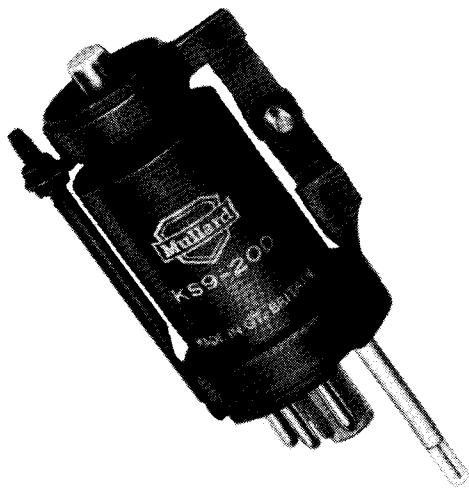
All dimensions in mm

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 |
| Cathode to heater voltage | 0 | 50 | 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 page 2.

| | Min. | Max. | |
|--------------|------|------|----|
| Power output | 10 | - | mW |

MOUNTING POSITION

Any

COOLING

Natural

PHYSICAL DATA

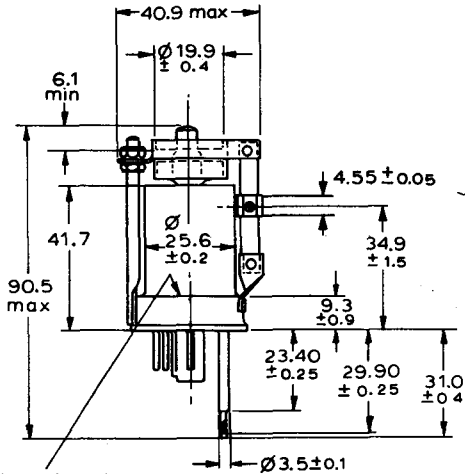
| | |
|--------------------------------------|--------------|
| Weight of klystron | g |
| | 65 |
| Weight of klystron in storage carton | 130 |
| | mm |
| Dimensions of storage carton | 95 × 51 × 51 |

NOTES

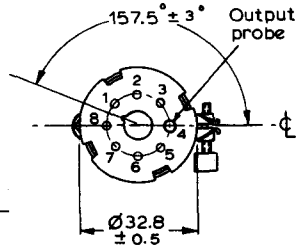
1. With the klystron operated in a standard waveguide launching section as shown on page 5.
2. Reflector voltage adjusted for the maximum power point of the mode.
3. There shall be no discontinuities at the maximum power points nor shall the power fall below that specified as a mismatch represented by 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

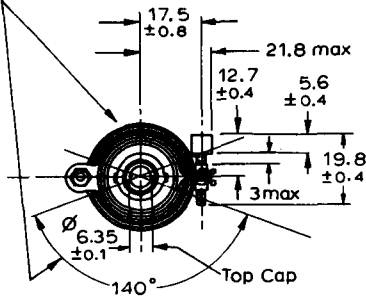
D4955



View of underside of I.O. base (BS448)



Area free for mounting



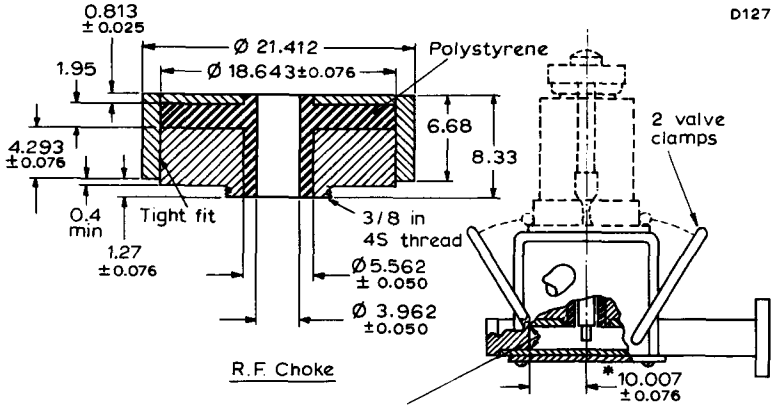
Base connections

- 1 Shell/resonator
 - 2 Heater
 - 3 N.P.
 - 4 Output probe
 - 5 N.P.
 - 6 N.P.
 - 7 Heater
 - 8 Cathode
- Top cap = Reflector

All dimensions in mm

MOUNTING

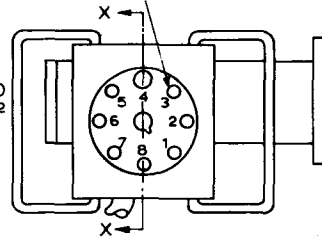
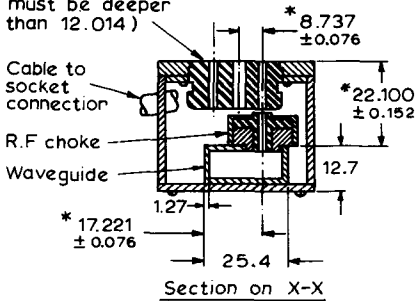
D127



Modified international octal socket (Individual pin sockets must be deeper than 12.014)

Inner edges of plug shall be brazed to waveguide

Modified octal, remove pin sockets 3, 4, 5 & 6



All dimensions in mm

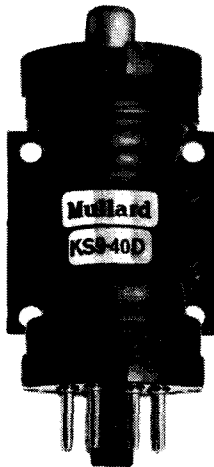
Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.

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 |
| Cathode to heater voltage | 0 | 50 | V ← |
| Body temperature (see note 7) | - | 150 | °C |
| v. s. w. r. | - | 1.5:1 | |
| Impedance of reflector/cathode circuit | - | 100 | 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.

| | | |
|---------------------|----|----|
| Power output (min.) | 20 | mW |
|---------------------|----|----|

MOUNTING POSITION

Any

COOLING

Natural

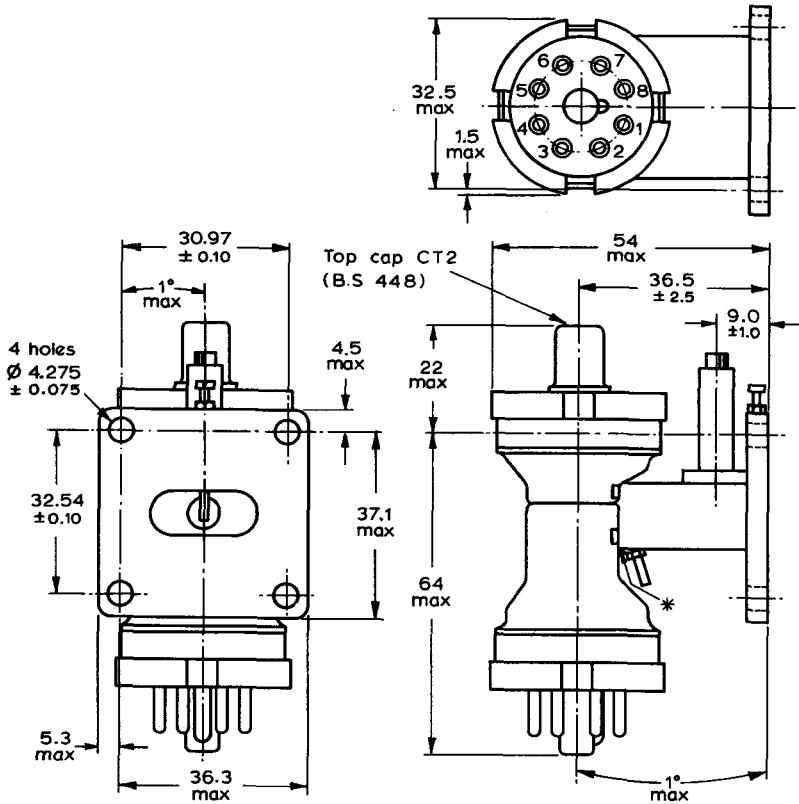
PHYSICAL DATA

| | |
|--------------------------------------|-------------|
| | g |
| Weight of klystron | 130 |
| Weight of klystron in storage carton | 150 |
| | mm |
| Dimensions of storage carton | 140×114×123 |

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.

OUTLINE DRAWING OF KS9-40 AND KS9-40D



All dimensions in mm

* Temperature measuring point

D 424

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

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

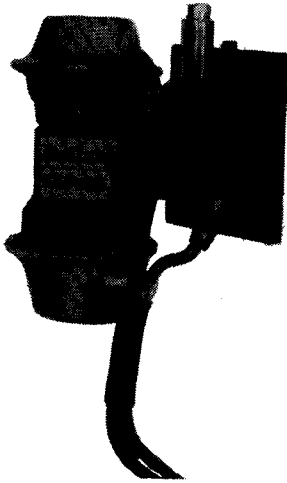
Construction KS9-40B Metal body with flying leads

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 |
| Cathode to heater voltage | 0 | 50 | V ← |
| Body temperature (see note 7) | - | 150 | °C |
| v. s. w. r. | - | 1.5:1 | |
| Impedance of reflector/cathode circuit | - | 100 | 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.

| | | |
|---------------------|----|----|
| Power output (min.) | 20 | mW |
|---------------------|----|----|

MOUNTING POSITION

Any

COOLING

Natural

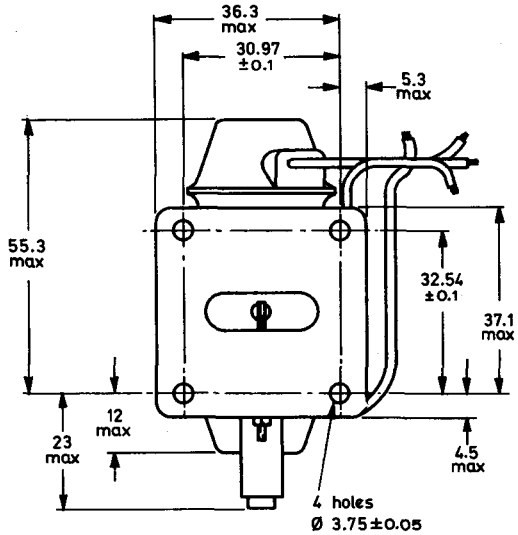
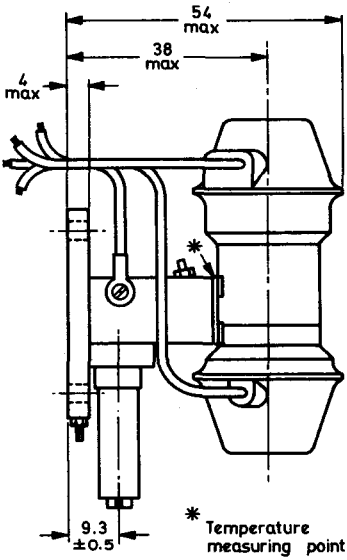
PHYSICAL DATA

| | |
|--------------------------------------|-------------|
| | g |
| Weight of klystron | 130 |
| Weight of klystron in storage carton | 150 |
| | mm |
| Dimensions of storage carton | 140×114×123 |

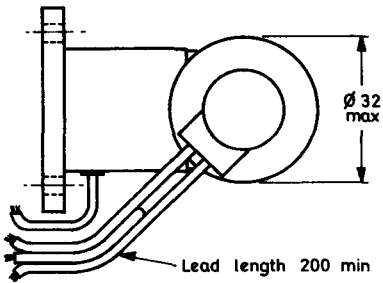
NOTES

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.

OUTLINE DRAWING OF KS9-40B



Outlet via waveguide RG-52 / U (W.G.16)
to take bolted plain flange similar to
UG-39 / U

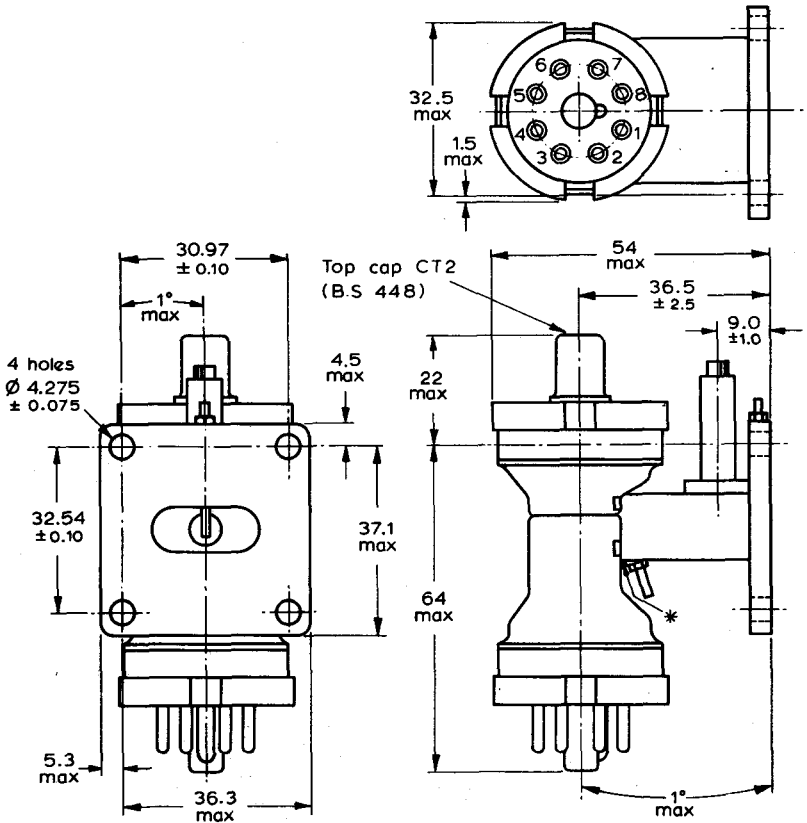


| Lead colour code | |
|------------------|------------------|
| White | Heater / cathode |
| Yellow | Heater |
| Grey | Reflector |
| Brown | Resonator |

All dimensions in mm

D654

OUTLINE DRAWING OF KS9-40G



All dimensions in mm

* Temperature measuring point

D 424

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

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)} = 11kW)

| | | |
|----------|-----|---|
| Cavity 1 | 2.0 | W |
| Cavity 2 | 50 | W |
| Cavity 3 | 80 | W |

YK1001 YK1002

POWER KLYSTRON

ABSOLUTE MAXIMUM RATINGS

| | | |
|---|------|----|
| Peak collector voltage ($I_{\text{beam}} = 0\text{A}$) | 21 | kV |
| Collector voltage max. | 18.5 | kV |
| Peak drift tube No. 5 voltage ($I_{\text{beam}} = 0\text{A}$) | 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 ($V_{\text{coll}} < V_{\text{cavity 5}}$) | 150 | mA |
| normal collector operation ($V_{\text{coll}} = V_{\text{cavity 5}}$) | 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 | m Ω |
| 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 $1\text{m}^3/\text{min}$ ($35.3\text{ft}^3/\text{min}$) directed at cavities Nos. 1, 2 and 3 and $2\text{m}^3/\text{min}$ ($70.6\text{ft}^3/\text{min}$) 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 $2\text{m}^3/\text{min}$ ($70.6\text{ft}^3/\text{min}$) at a pressure of 90mm H₂O.

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 |
| | | 265 | lb |
| | | 120 | kg |

Weight of accessories

ACCESSORIES

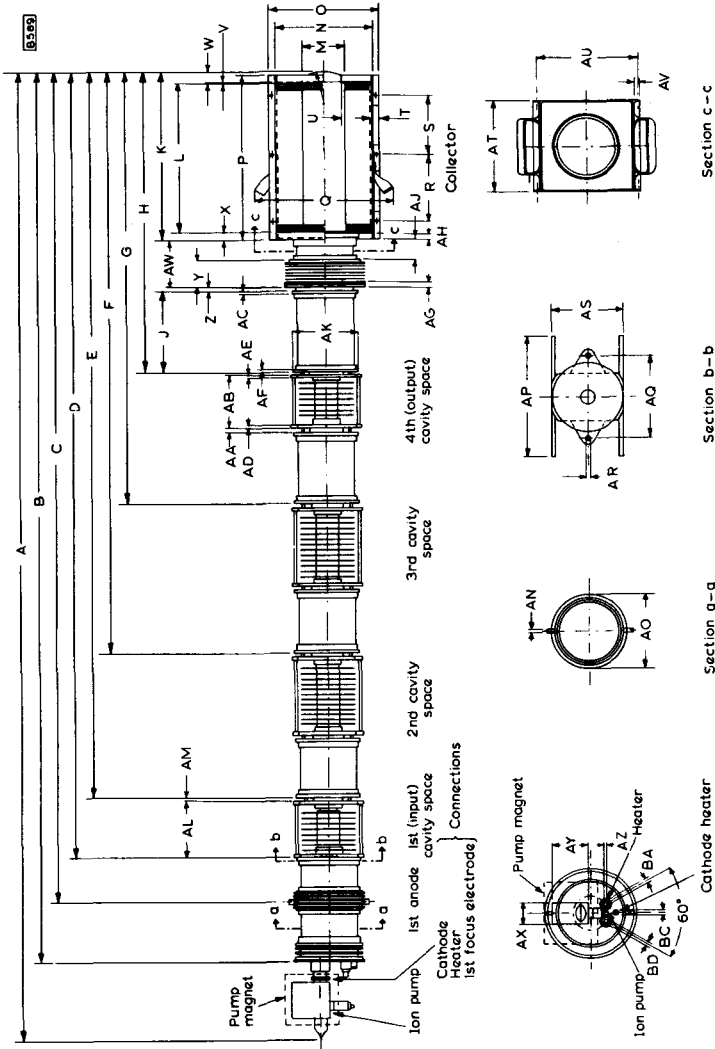
| | |
|------------------------------|--------|
| Heater connector | 40649 |
| Cathode connector | 40649 |
| Focusing electrode connector | 40634 |
| First anode connector | 40634 |
| Collector connector | 40634 |
| Ion pump connector | 55351 |
| Ion pump magnet | TE1053 |
| 5 focusing magnets | TE1065 |
| 4 resonant cavities | TE1066 |



YK1001 YK1002

POWER KLYSTRON

OUTLINE DRAWING OF YK1001



DIMENSIONS OF YK1001

The inch dimensions are derived from the original millimetre dimensions.

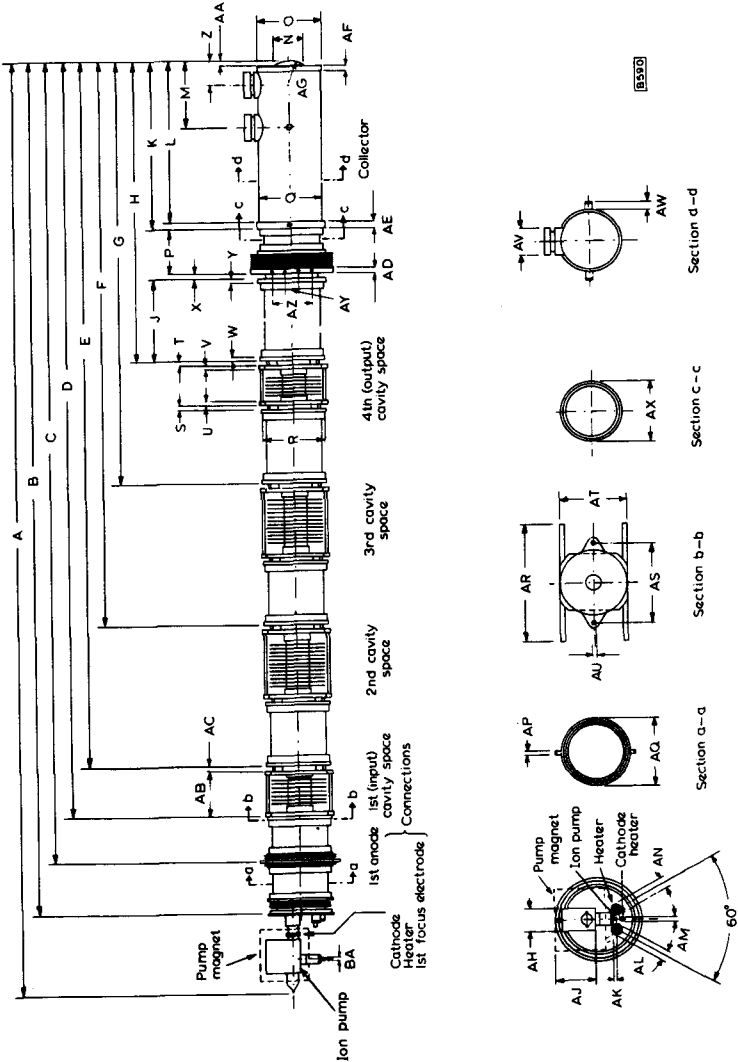
| | Millimetres | Inches | | Millimetres | Inches | | Millimetres | Inches |
|---|-------------|-------------|----|-------------|---------------|----|-------------|--------|
| A | 1642 | 64.6 | T | 12 | 0.47 | AL | 80 | 3.15 |
| B | 1499 | 59 | U | 60 | 2.36 | AM | 7.0 | 0.28 |
| C | 1393 | 54.8 | V | 1.5 | 0.06 | AN | 9.0 | 0.35 |
| 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 | 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 | 4.606 + 0.004 | BC | 10.5 | 0.59 |
| S | 114 | 4.5 | | -0.2 | -0.008 | BD | 9.0 | 0.35 |



YK1001 YK1002

POWER KLYSTRON

OUTLINE DRAWING OF YK1002



DIMENSIONS OF YK1002

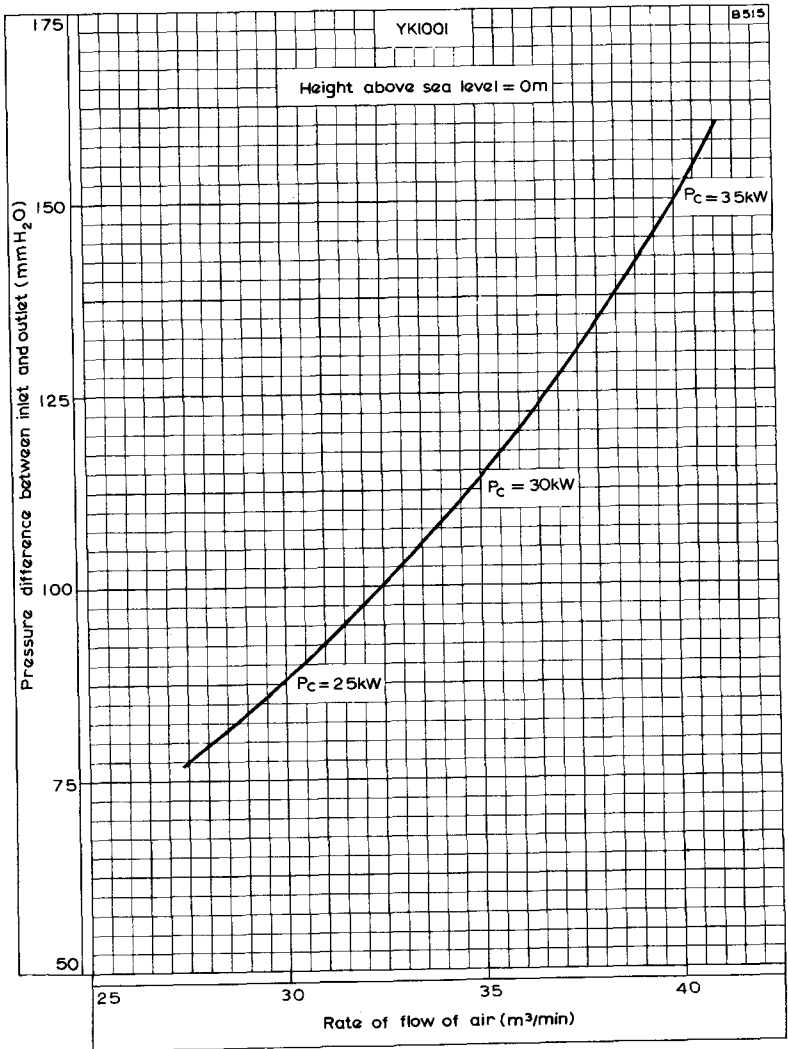
The inch dimensions are derived from the original millimetre dimensions.

| | Millimetres | Inches | | Millimetres | Inches | | Millimetres | Inches |
|---|-------------|-----------|----|-------------|-------------|----|-------------|--------|
| A | 1642 | 64.6 | R | 117+0.1 | 4.606+0.004 | AH | 38 | 1.5 |
| B | 1499 | 59 | S | 7.0 | 0.28 | AJ | 75 | 2.95 |
| C | 1393 | 54.8 | T | 7.0±0.5 | 0.28±0.02 | AK | 6.0 | 0.24 |
| D | 1306 | 51.4 | U | 8.0 | 0.315 | AL | 9.0 | 0.35 |
| E | 1219 | 48 | V | 8.0 | 0.315 | AM | 10.5 | 0.59 |
| F | 963 | 37.9 | W | 6.3±0.2 | 0.248±0.008 | AN | 10.5 | 0.59 |
| G | 707 | 27.8 | X | 7.0±0.5 | 0.28±0.02 | AP | 9.0 | 0.35 |
| H | 496 | 19.53 | Y | 6.3±0.2 | 0.248±0.008 | AQ | 130 | 5.12 |
| J | 117±0.5 | 4.60±0.02 | Z | 40 | 1.58 | AR | 200 | 7.9 |
| K | 295 | 11.6 | AA | 10 | 0.39 | AS | 150 | 5.9 |
| L | 285 | 11.2 | AB | 80 | 3.15 | AT | 120 | 4.72 |
| M | 122 | 4.8 | AC | 7.0 | 0.28 | AU | 8.5 | 0.33 |
| N | 60 | 2.36 | AD | 8.0 | 0.315 | AV | 38.1 | 1.5 |
| O | 117.5 | 4.6 | AE | 10 | 0.39 | AW | 15 | 0.6 |
| P | 77.5 | 3.05 | AF | 5.0 | 0.2 | AX | 117 | 4.6 |
| Q | 115 | 4.53 | AG | 55 | 2.17 | AY | 20 | 0.79 |
| | | | | | | AZ | 60 | 2.36 |



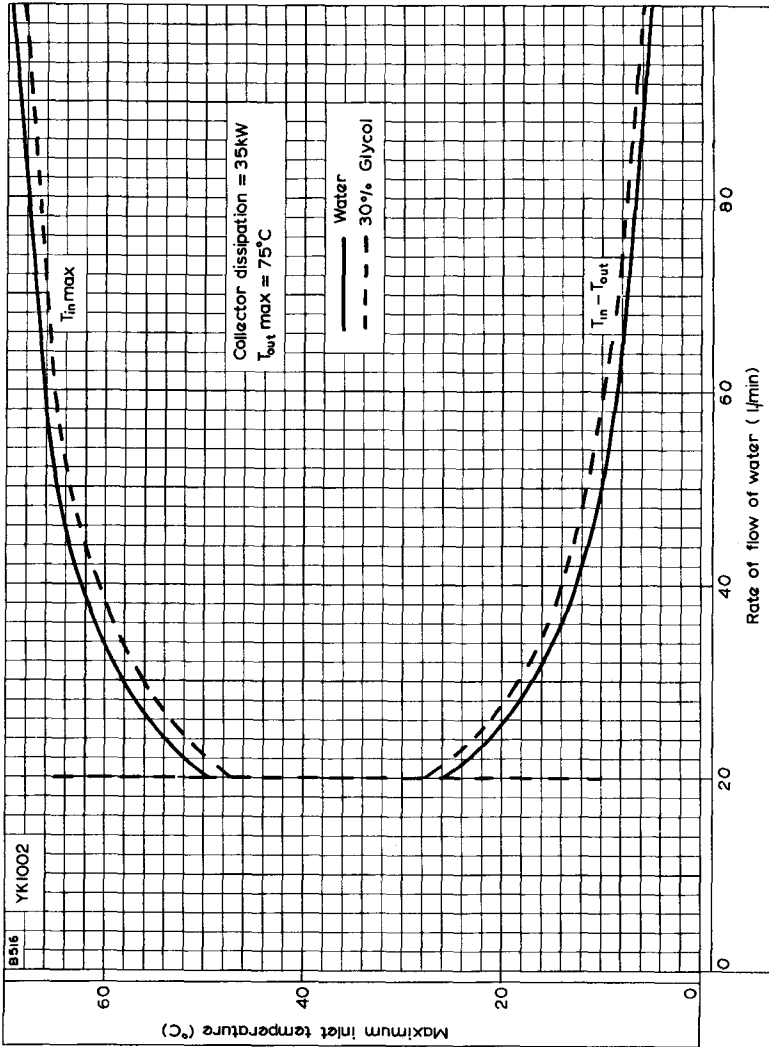
YK1001 YK1002

POWER KLYSTRON



COOLING CURVE FOR YK1001



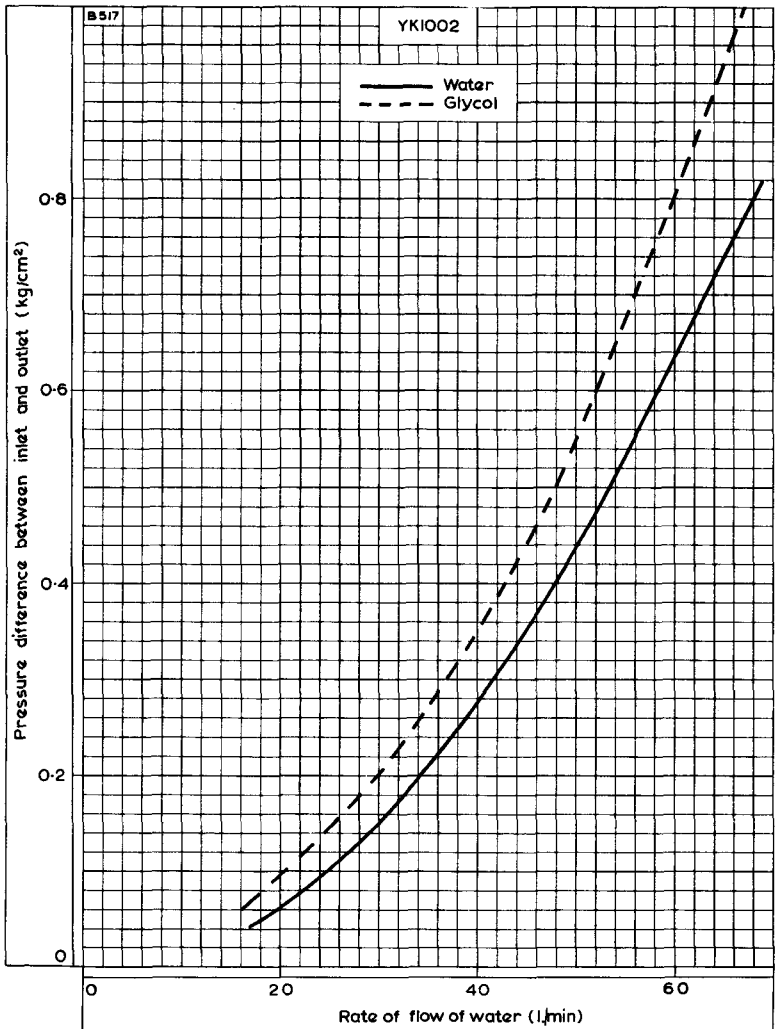


COOLING CURVE FOR YK1002



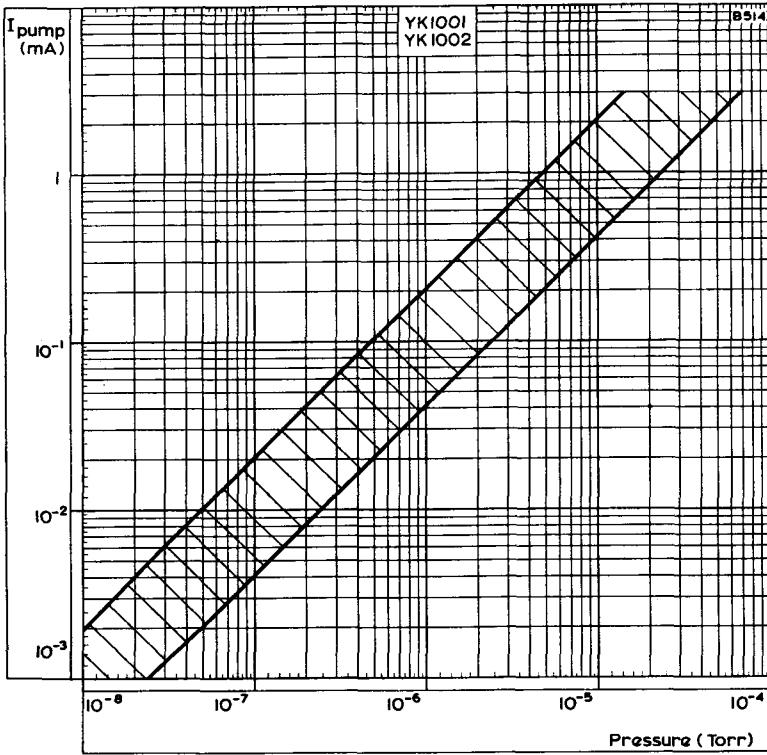
YK1001 YK1002

POWER KLYSTRON



COOLING CURVE FOR YK1002





ION PUMP CHARACTERISTICS



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 | k Ω |
| Min. accelerator voltage source resistance | 10 | k Ω |
| 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 $\pm 3\%$ will not damage the tube, but should not exceed $\pm 1\%$ 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 50 Ω 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 occurred.



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 | m Ω |
| t_{h-k} min. | 180 | s |

*Maximum heater voltage fluctuation $\pm 3\%$ 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 | k Ω |
| 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.

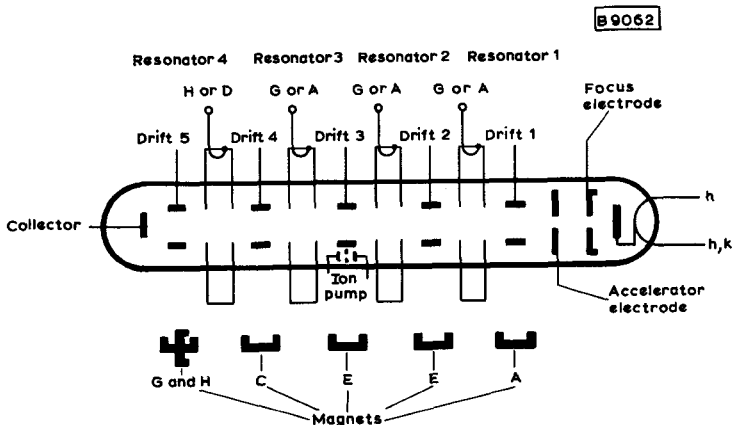
PHYSICAL DATA

| | | |
|---------------------------------|-----|----|
| Weight of klystron (approx.) | 60 | kg |
| Weight of accessories (approx.) | 130 | kg |



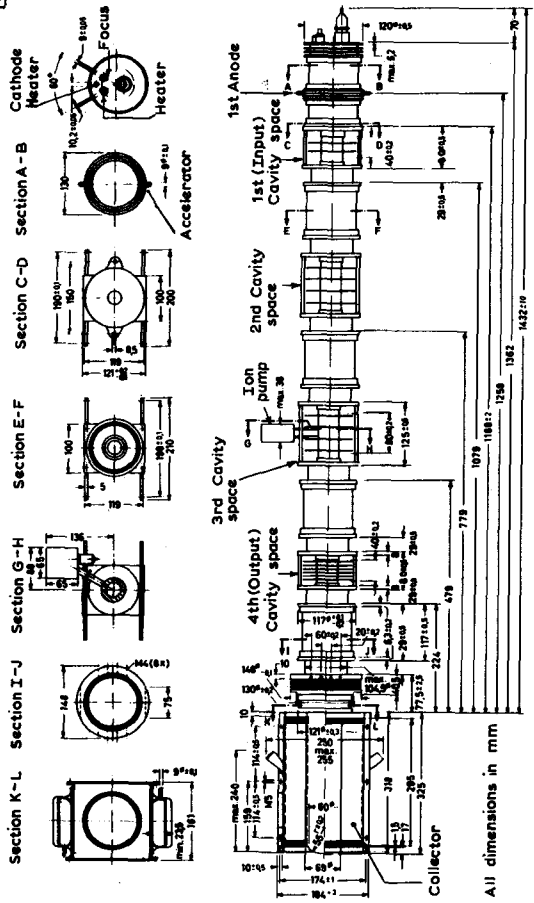
ACCESSORIES

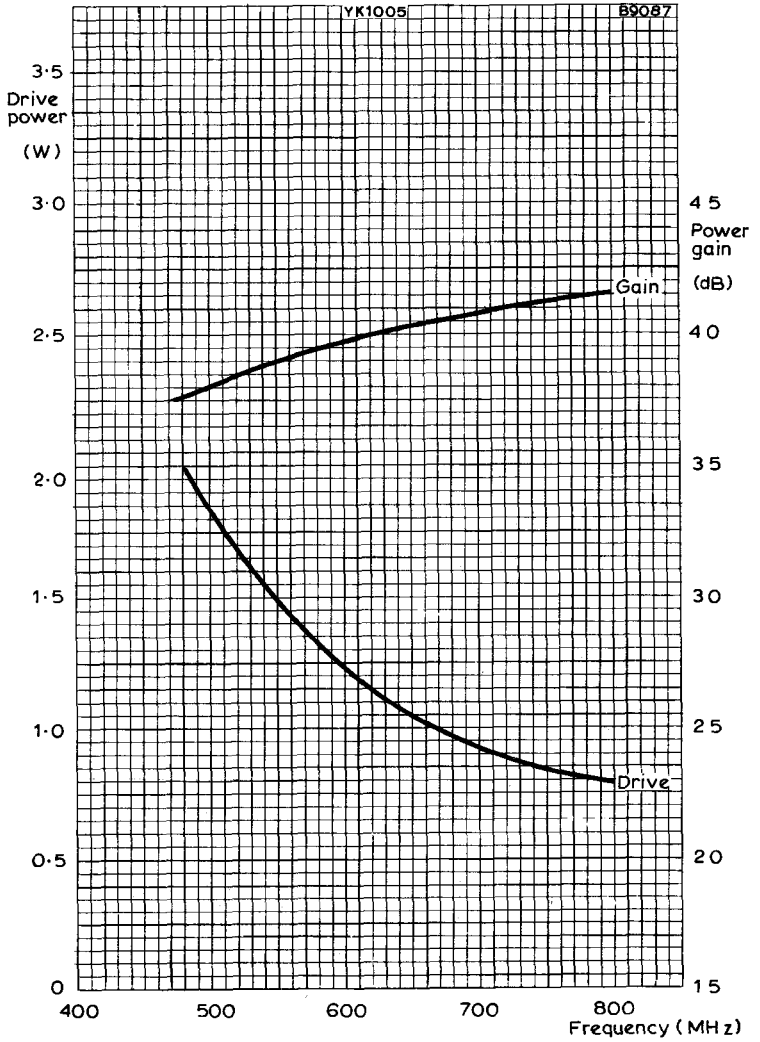
| | | |
|---------------------------------------|----------------------------|----------------|
| Heater connector | 40649 | |
| Heater/cathode connector | 40649 | |
| Focusing electrode connector | 40634 | |
| Accelerating electrode connector | 40634 | |
| Collector connector | 40634 | |
| Ion pump 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

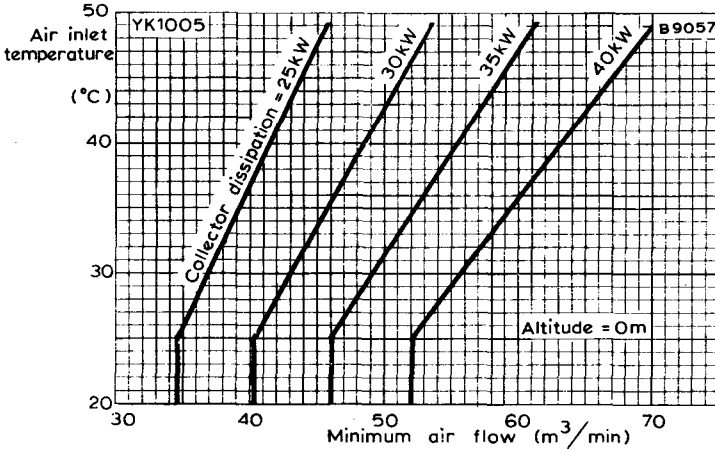
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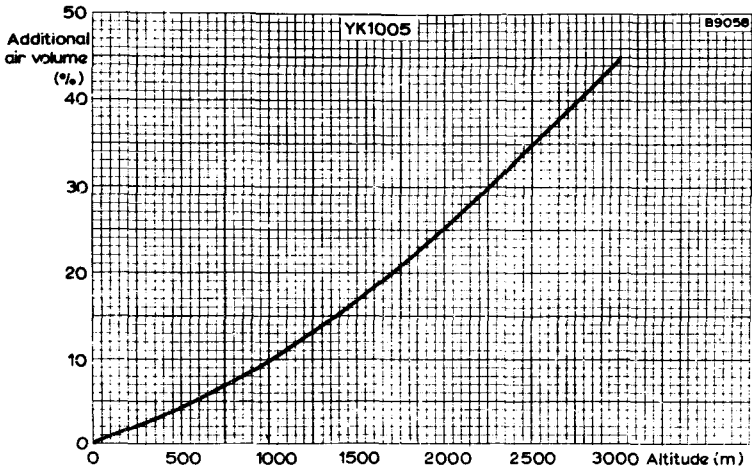


DRIVE POWER AND POWER GAIN PLOTTED AGAINST OPERATING FREQUENCY



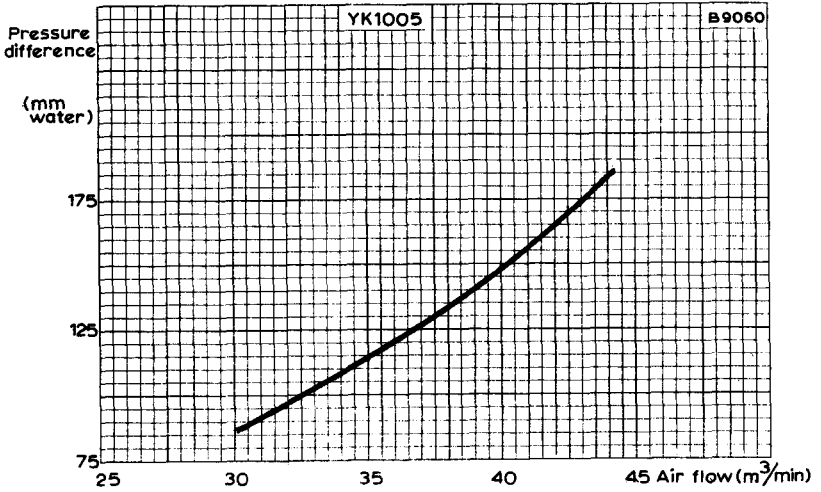


AIR INLET TEMPERATURE PLOTTED AGAINST MINIMUM AIR FLOW WITH COLLECTOR DISSIPATION AS PARAMETER

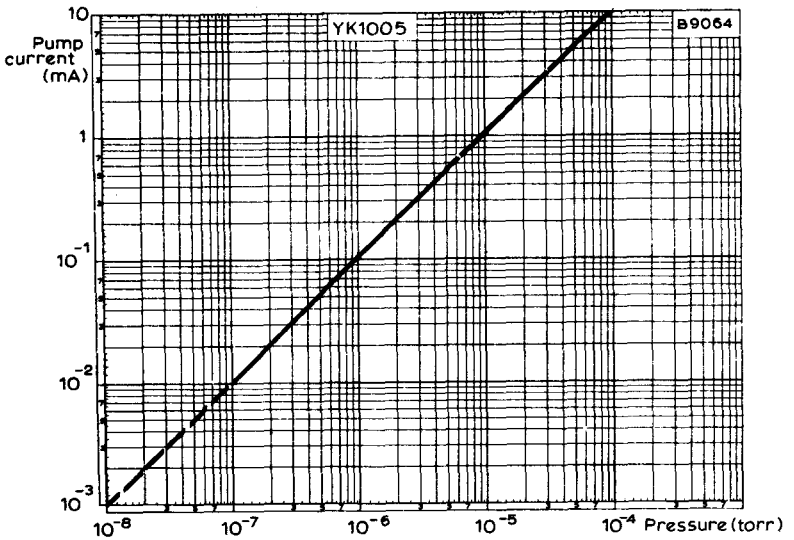


ADDITIONAL AIR VOLUME REQUIRED FOR INCREASED ALTITUDE





AIR FLOW CHARACTERISTICS



PUMP CURRENT AS A FUNCTION OF PRESSURE



QUICK REFERENCE DATA

X-band, lightweight reflex klystron, with integral tuning cavity for local oscillator applications.

Frequency range 9.16 to 9.34 GHz

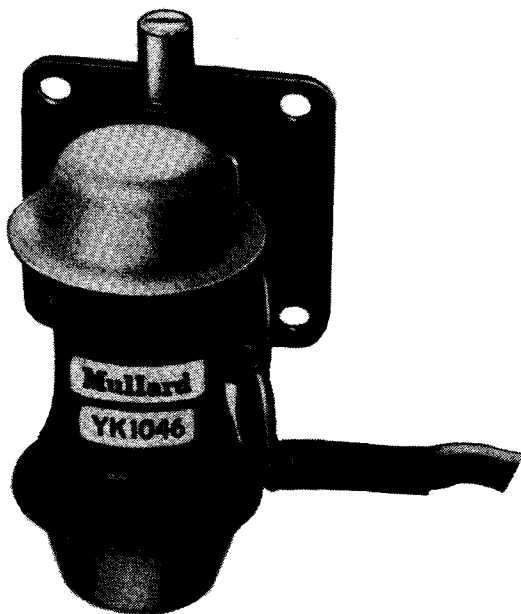
Power output 35 mW

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 | °C |
| Storage temperature | -55 | +75 | °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

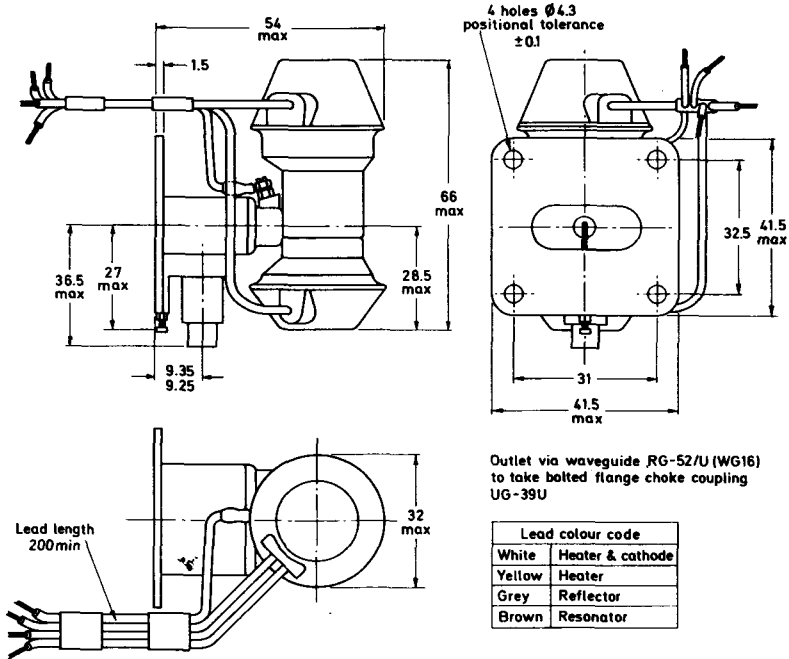
PHYSICAL DATA

| | | |
|------------------------------|-----------------|----|
| | g | |
| Weight of klystron | 92 | |
| 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.

OUTLINE DRAWING



All dimensions in mm

D.1958

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

| | 10.5 | 11.5 | 12.2 | Gc/s |
|--|------|------|------|------------|
| 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 $+40^\circ C$) | - | - | 0.25 | Mc/s per deg C |

| | Min. | Typ. | Max. | |
|---|------|------|------|------|
| *Frequency change with atmospheric pressure change equivalent to operation 0 to 66 000ft 0 to 98 000ft | | 1.0 | 3.0 | Mc/s |
| | | 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 |

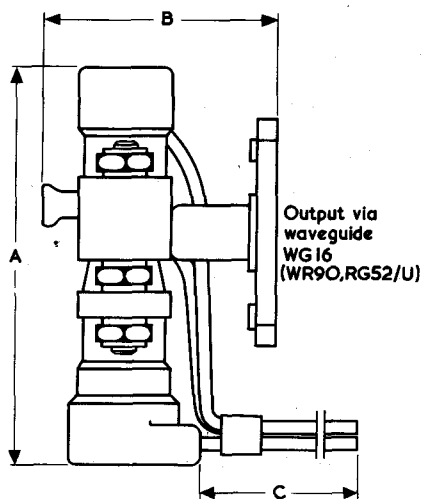
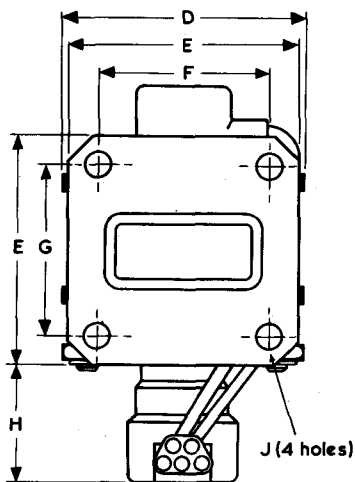
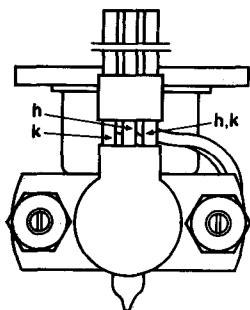
YK1091 Pin connections

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



83340

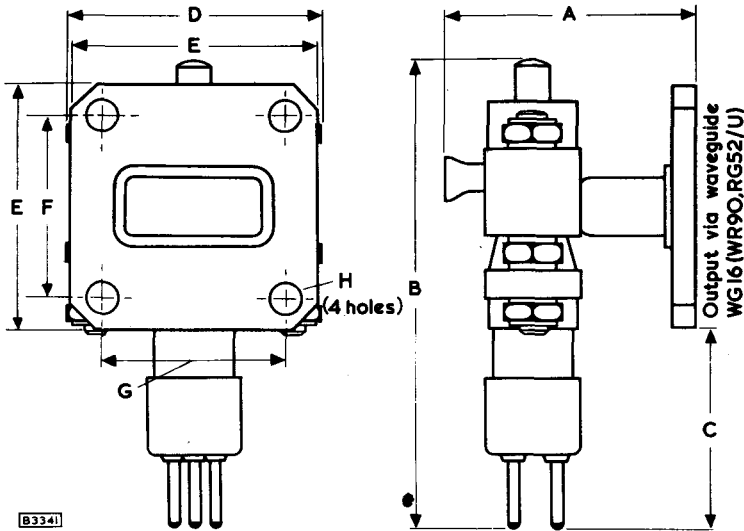
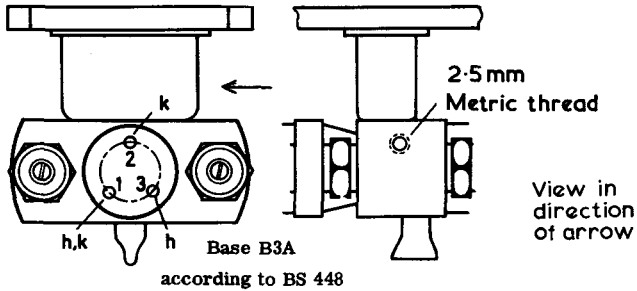
DIMENSIONS

| | 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

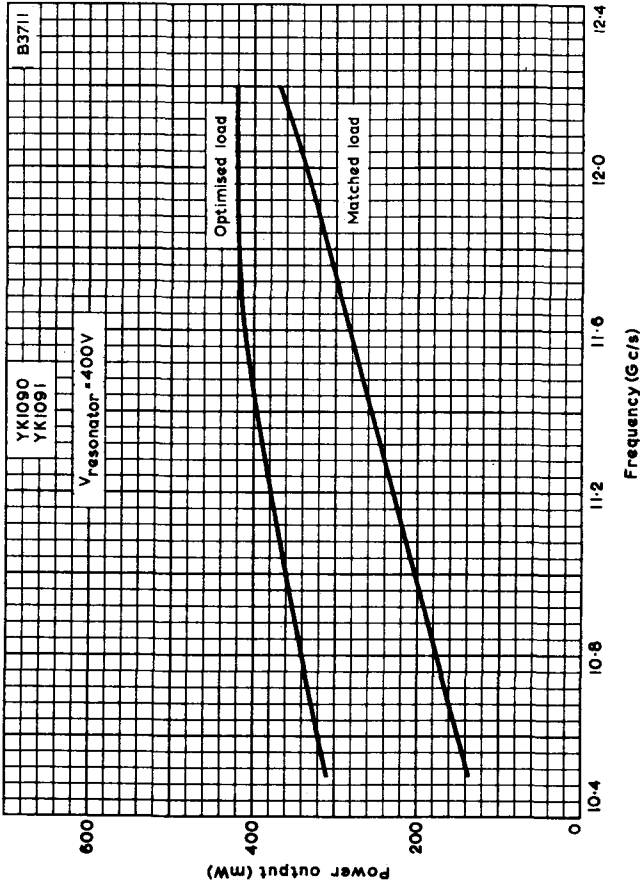


DIMENSIONS

| | 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 | |

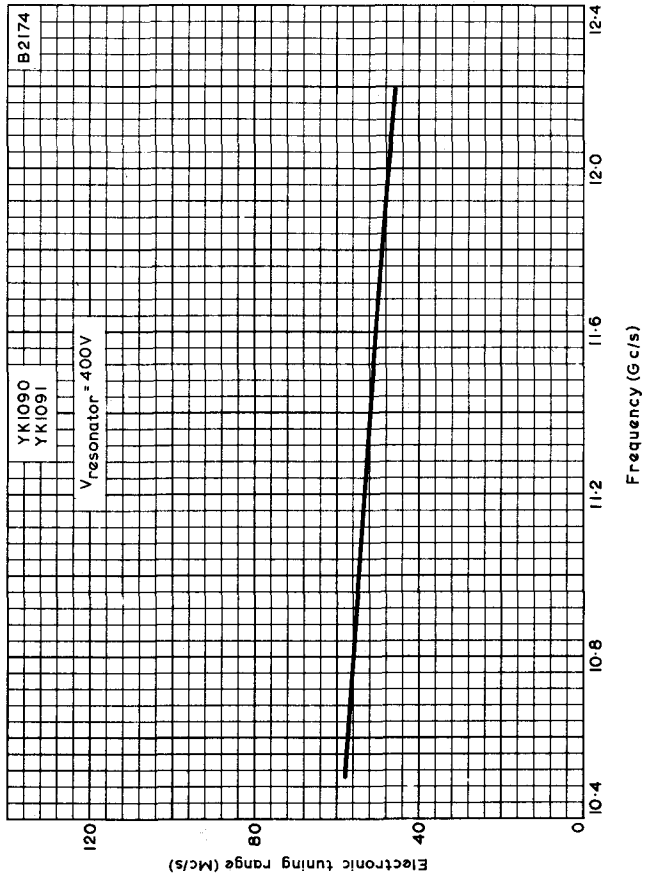
Inch dimensions derived from original millimetre dimensions.





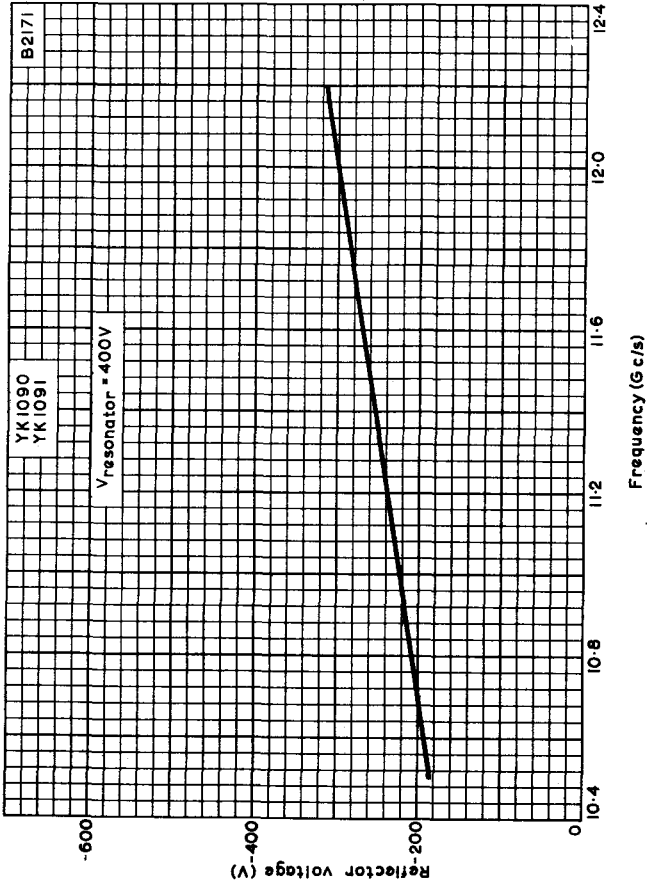
TYPICAL POWER OUTPUT FOR OPTIMISED AND MATCHED LOAD PLOTTED AGAINST FREQUENCY, $V_{resonator} = 400V$





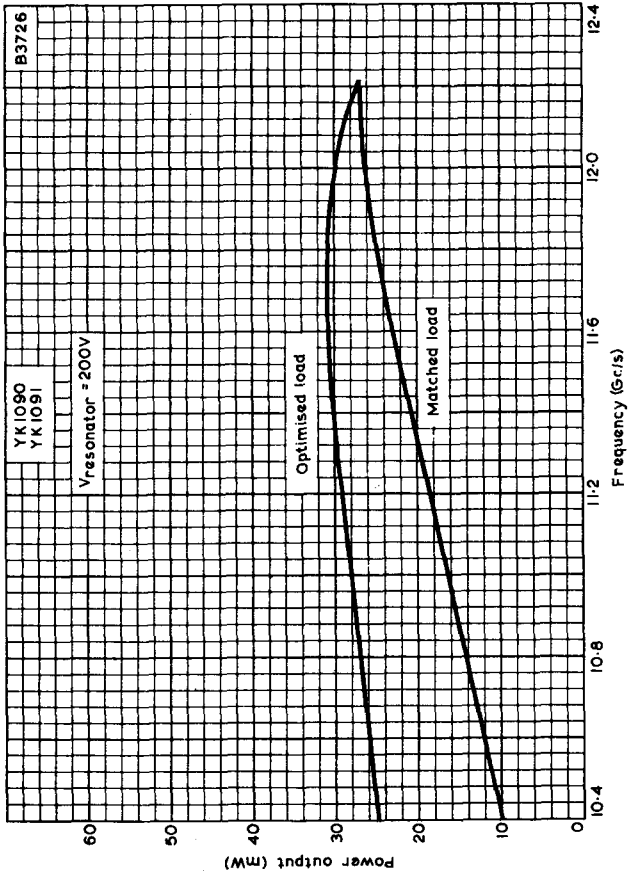
TYPICAL ELECTRONIC TUNING RANGE PLOTTED AGAINST FREQUENCY.
 Vresonator = 400V.





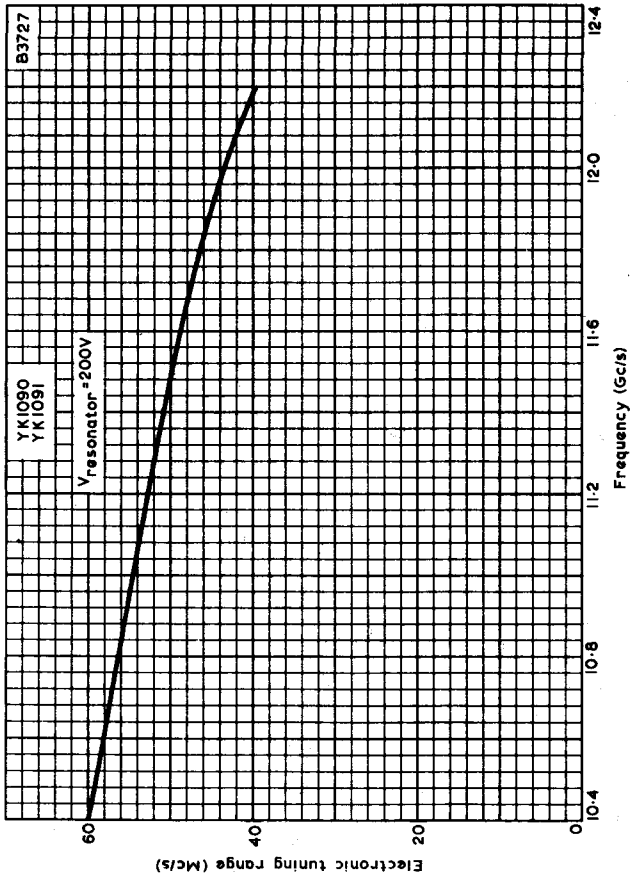
TYPICAL REFLECTOR VOLTAGE PLOTTED AGAINST FREQUENCY.
Vresonator = 400V.





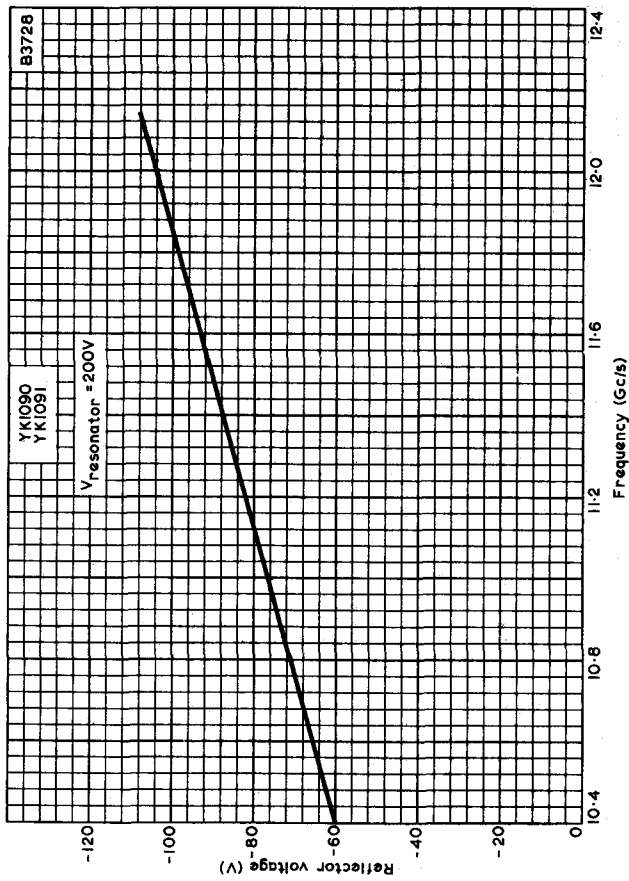
TYPICAL POWER OUTPUT FOR OPTIMISED AND MATCHED LOAD
 PLOTTED AGAINST FREQUENCY. $V_{\text{resonator}} = 200\text{V}$





TYPICAL ELECTRONIC TUNING RANGE PLOTTED AGAINST
FREQUENCY. $V_{\text{resonator}} = 200\text{V}$





TYPICAL REFLECTOR VOLTAGE PLOTTED AGAINST FREQUENCY.
 $V_{\text{resonator}} = 200\text{V}$



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 | Min. | Max. | |
|--|-----------|------|----------------|-----|
| | (GHz) | | | |
| 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 |
| Cathode to heater voltage | 0 | 50 | 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 above.

| | | |
|---------------------|----|----|
| Power output (min.) | 10 | mW |
|---------------------|----|----|

MOUNTING POSITION

Any

COOLING

Natural

PHYSICAL DATA

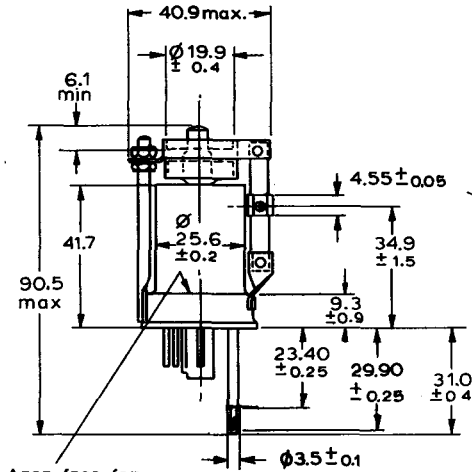
| | |
|--------------------------------------|--------------|
| | g |
| Weight of klystron | 65 |
| Weight of klystron in storage carton | 130 |
| | mm |
| Dimensions of storage carton | 95 × 51 × 51 |

NOTES

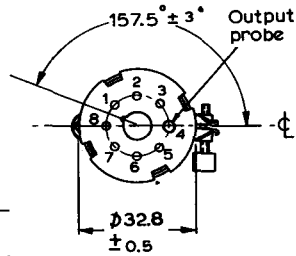
1. With the klystron operated in a standard waveguide launching section as shown on page 6.
2. Reflector voltage adjusted for the maximum power point of the mode. If it is required to operate the klystron over the entire width of either mode at the extreme frequency limits, it is recommended that the 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

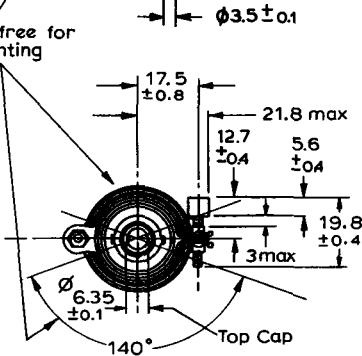
D4955



View of underside of I.Q. base (BS448)



Area free for mounting



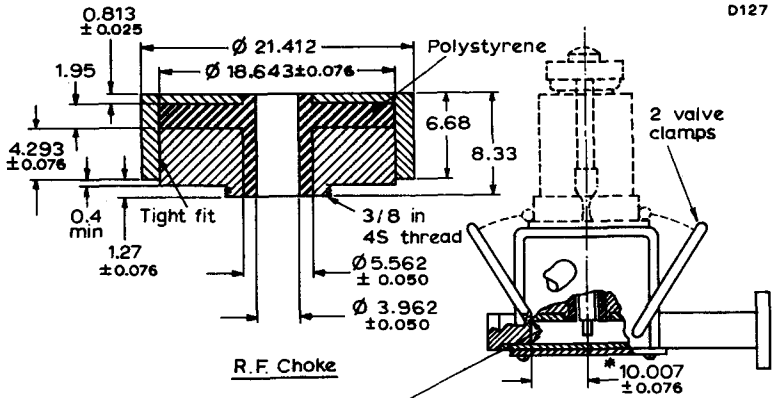
Base connections

- 1 Shell/resonator
 - 2 Heater
 - 3 N.P.
 - 4 Output probe
 - 5 N.P.
 - 6 N.P.
 - 7 Heater
 - 8 Cathode
- Top cap = Reflector

All dimensions in mm

MOUNTING

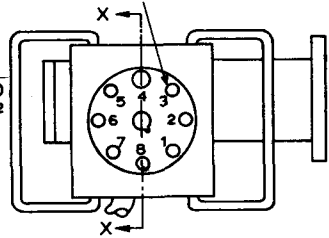
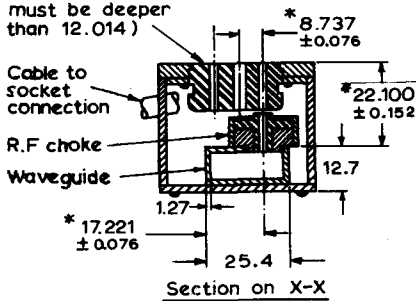
D127



Modified international octal socket (Individual pin sockets must be deeper than 12.014)

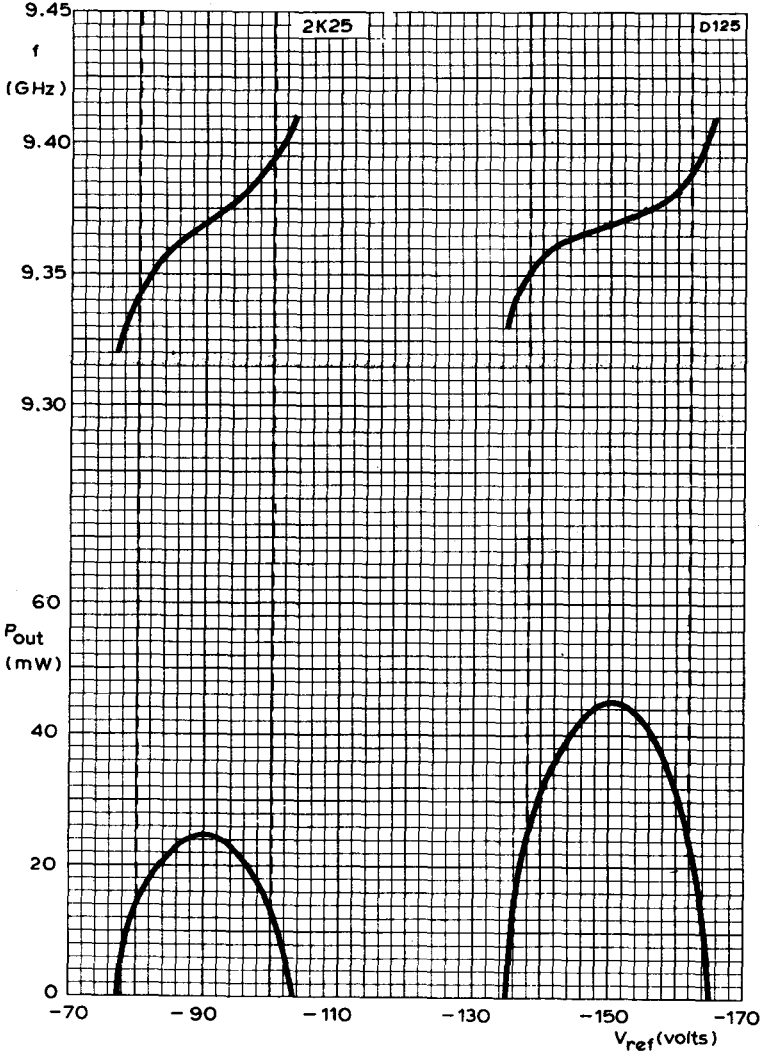
Inner edges of plug shall be brazed to waveguide

Modified octal, remove pin sockets 3, 4, 5 & 6



All dimensions in mm

Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.



TYPICAL CURVES OF POWER AND FREQUENCY AGAINST REFLECTOR VOLTAGE

QUICK REFERENCE DATA

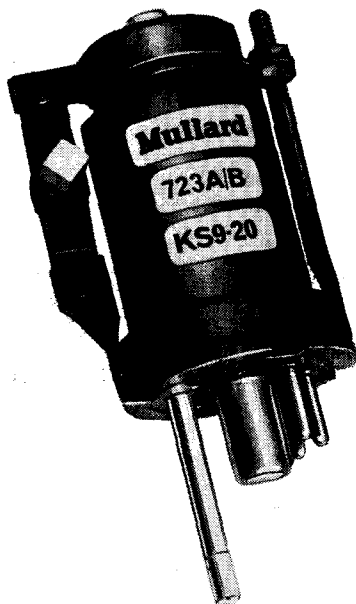
X-Band, reflex klystron, with integral tuning cavity for local oscillator applications.

| | | |
|-------------------|--|-----|
| 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) | Limits | | |
|---------------------------------|--------------------|--------|------|----|
| | | 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. | | |
| 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 |
| Cathode to heater voltage | 0 | 50 | 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 above.

| | | |
|---------------------|----|----|
| Power output (min.) | 10 | mW |
|---------------------|----|----|

MOUNTING POSITION

Any

COOLING

Natural

PHYSICAL DATA

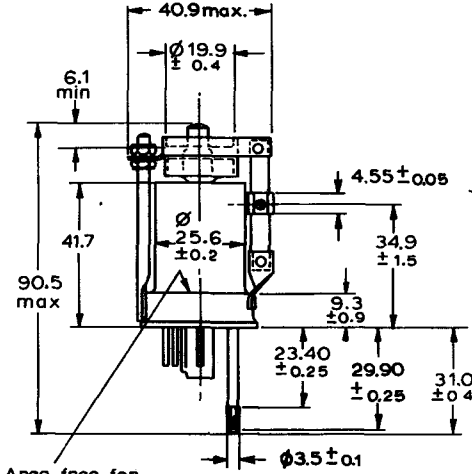
| | |
|--------------------------------------|--------------|
| | g |
| Weight of klystron | 65 |
| Weight of klystron in storage carton | 130 |
| | mm |
| Dimensions of storage carton | 95 × 51 × 51 |

NOTES

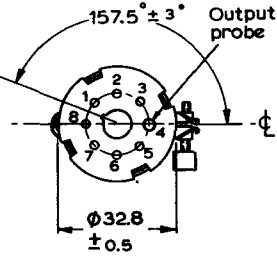
1. With the klystron operated in a standard waveguide launching section as shown on page 6.
2. Reflector voltage adjusted for the maximum power point of the mode. If it is required to operate the klystron over the entire width of either mode at the extreme frequency limits, it is recommended that the 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

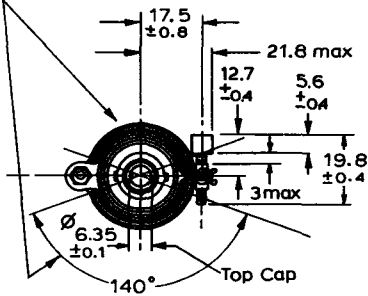
D4955



View of underside of I.O. base (BS448)



Area free for mounting



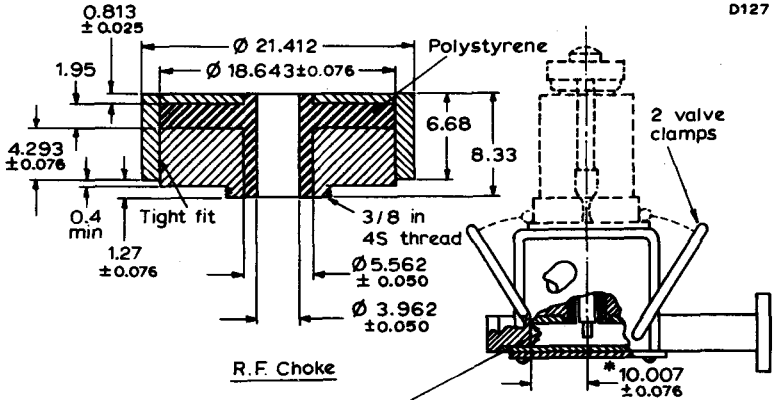
Base connections

- 1 Shell/resonator
 - 2 Heater
 - 3 N.P
 - 4 Output probe
 - 5 N.P
 - 6 N.P
 - 7 Heater
 - 8 Cathode
- Top cap = Reflector

All dimensions in mm

MOUNTING

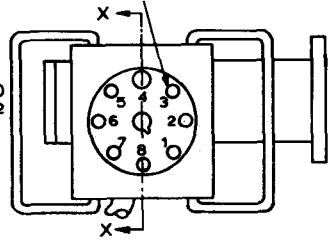
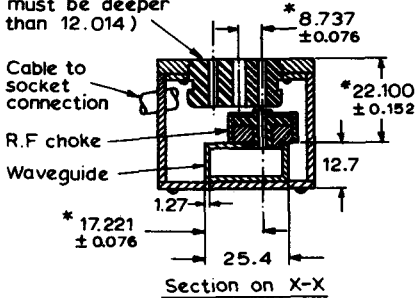
D127



Modified international octal socket (Individual pin sockets must be deeper than 12.014)

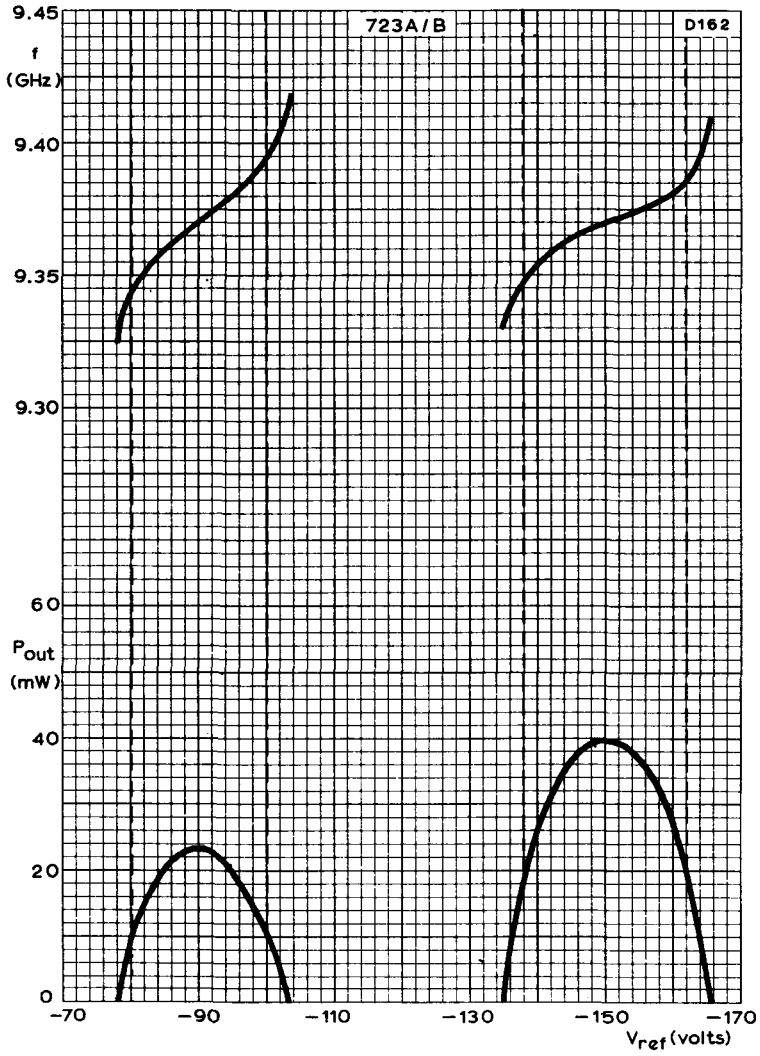
Inner edges of plug shall be brazed to waveguide

Modified octal, remove pin sockets 3, 4, 5 & 6



All dimensions in mm

Dimensions indicated by * determine the broad band characteristics of the coupler and should be held to tolerances shown.



TYPICAL CURVES OF POWER AND FREQUENCY
AGAINST REFLECTOR VOLTAGE

TRAVELLING WAVE TUBES



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 pre-setting 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

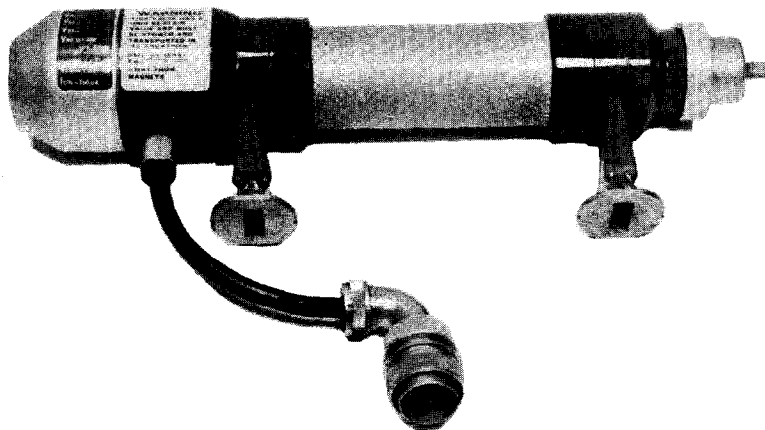
QUICK REFERENCE DATA

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 | μ W |
| Noise factor | 22 | dB |
| Input match | 2.0 | |
| Output match | 2.0 | |
| Grid 1 current | 1.0 | μ A |
| Grid 2 current | 1.0 | μ A |
| Grid 3 current | 1.0 | μ A |
| Helix current | 15 | μ A |
| Collector current | 550 | μ A |

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 |

RADAR TRAVELLING-WAVE TUBE

LA9-3B

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 | μ A |
| 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 | μ A |
| Grid 2 current | - | 10 | μ A |
| Grid 3 current | - | 10 | μ A |
| Helix current | - | 50 | μ A |
| 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 | μ A |
| Collector voltage | - | 1.7 | kV |
| Collector current | - | 600 | μ A |

Mullard

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 | μ A |
| Grid 2 voltage | 0 | 200 | V |
| Grid 2 current | - | 10 | μ A |
| Grid 3 voltage | 0 | 250 | V |
| Grid 3 current | - | 10 | μ A |
| Helix voltage | 1.15 | 1.45 | kV |
| Helix current | - | 60 | μ A |
| Collector voltage (see note 5) | | | |
| Collector current | - | 550 | μ A |

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 | $^{\circ}$ C |

RADAR TRAVELLING-WAVE TUBE

LA9-3B

PHYSICAL DATA

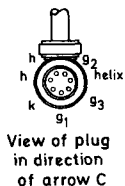
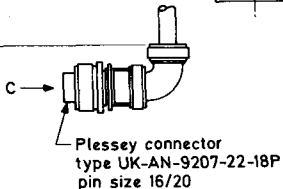
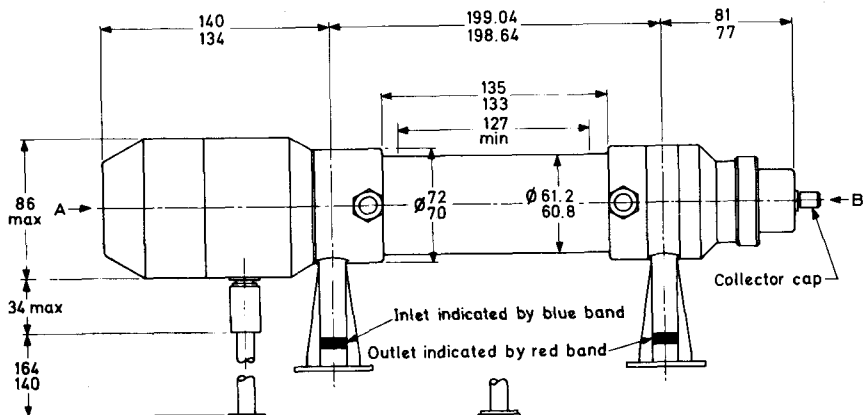
Packaged tube

| | 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 |

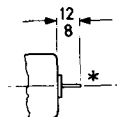
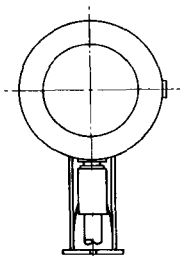
NOTES

1. The absolute variation of heater voltage should be less than $\pm 5\%$. 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

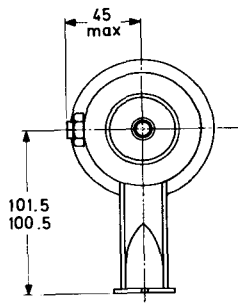


Inlet and outlet via waveguide
WG16 to take choke flange
coupling Joint-Service
No. 5985-99-083-0003



View of collector socket-
pin with protector removed

* This collector socket-pin is
silver-plated and is intended
for a soldered connection



All dimensions in mm

D2295

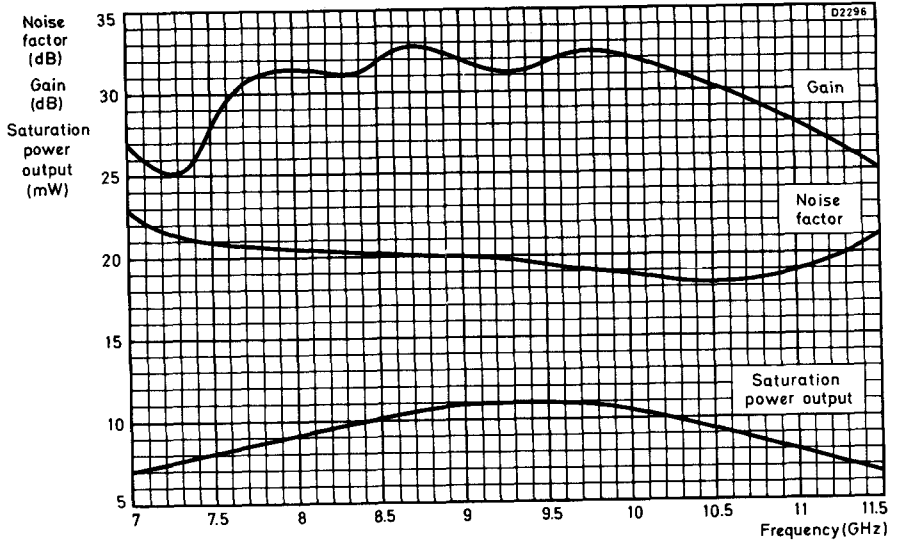
RADAR TRAVELLING-WAVE TUBE

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

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



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 | μ s |
| 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 |

RADAR TRAVELLING-WAVE TUBE

LB3-250B

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 | μ s |
| Duty cycle | 0.005 | |

Mullard

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 | $^{\circ}\text{C}$ |

AMBIENT TEMPERATURE RANGE

| | Min. | Max. | |
|---------------------------------|------|------|--------------------|
| Operation to full specification | -10 | +65 | $^{\circ}\text{C}$ |

RADAR TRAVELLING-WAVE TUBE

LB3-250B

PHYSICAL DATA

| | kg | lb |
|-------------------|-----|-----|
| Weight of capsule | 2.3 | 5.0 |
| Weight of mount | 21 | 46 |

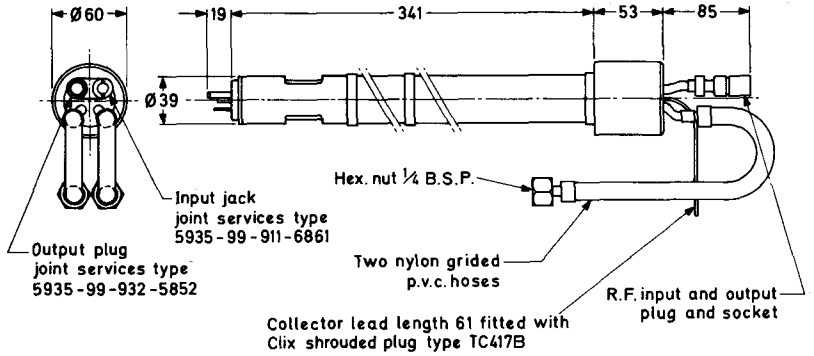
R. F. CONNECTIONS

Coaxial plugs: type C

NOTES

1. The absolute variation of heater voltage should be less than $\pm 5\%$. 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



All dimensions in mm

D2297

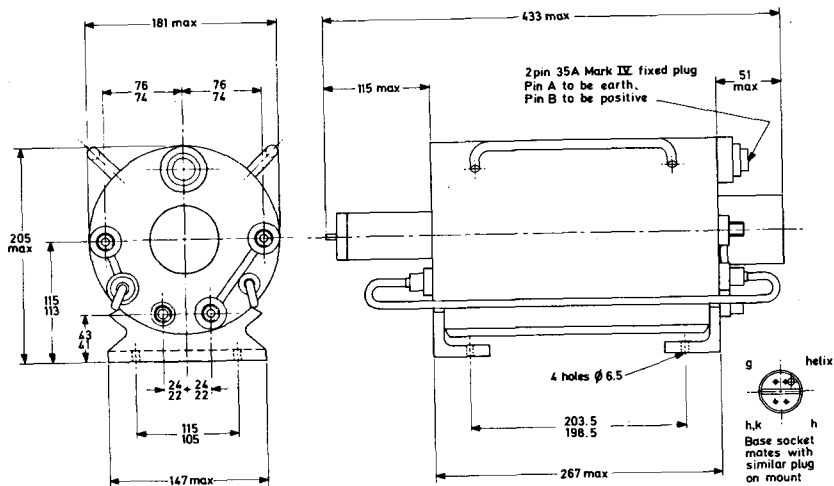
CONVERSION TABLE
(Rounded outwards)

| LB3-250B | | LB3-250B MOUNT (S3L1) | |
|----------|-------|-----------------------|-------------|
| mm | in | 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. |

RADAR TRAVELLING-WAVE TUBE

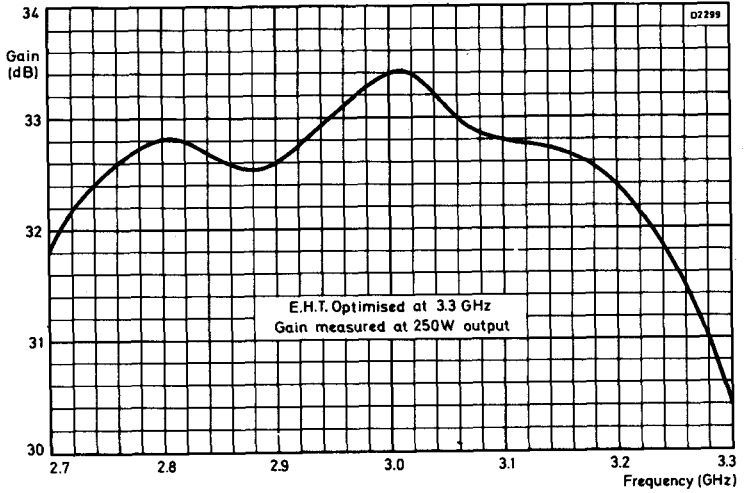
LB3-250B

OUTLINE DRAWING OF LB3-250B MOUNT (S3L1)

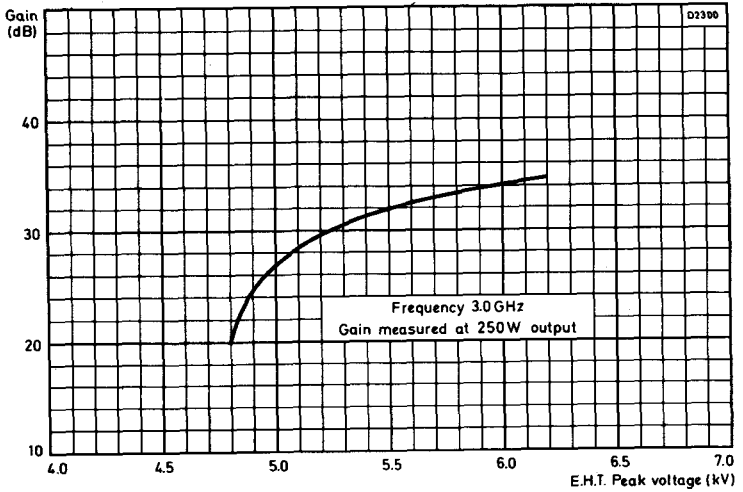


All dimensions in mm

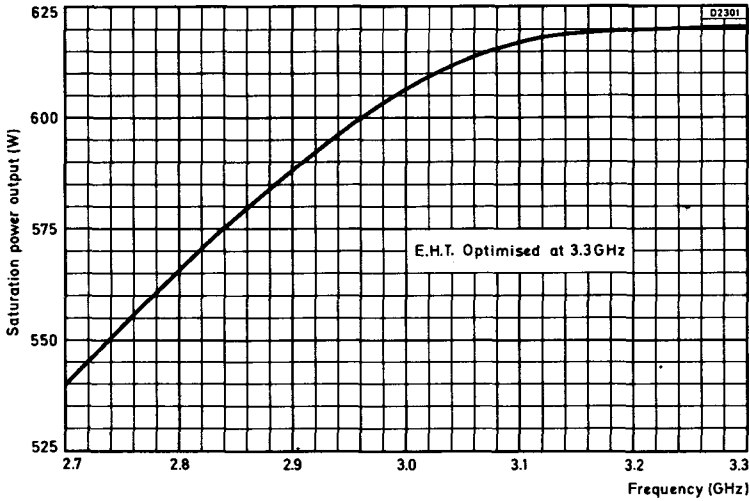
0258



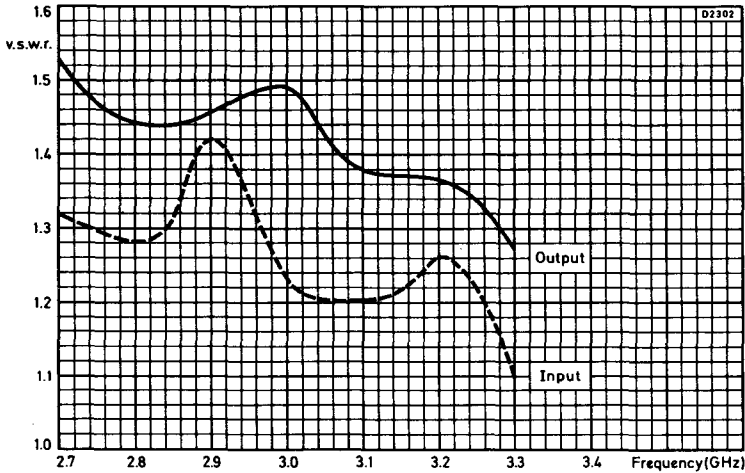
TYPICAL GAIN PLOTTED AGAINST FREQUENCY



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

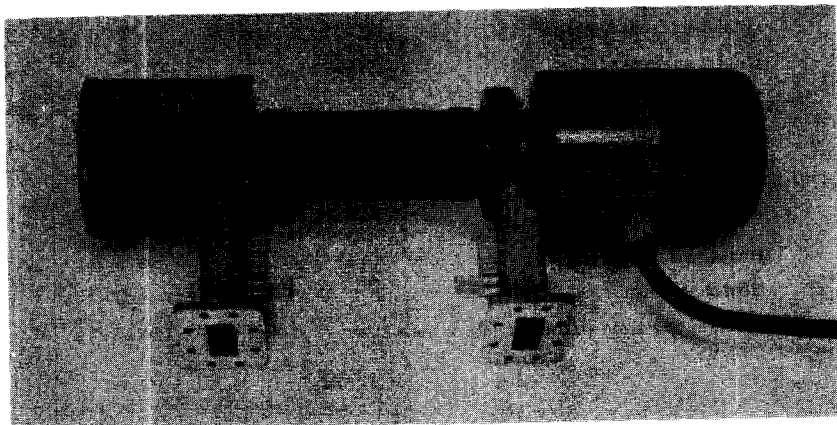
LB6-10

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



Mullard

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 | μ A |
| Grid 2 current | 10 | μ A |
| 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 |

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-10

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 | μ A |
| Grid 2 current | - | 250 | μ A |
| 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

Mullard

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 | μ A |
| Grid 2 voltage (see note 13 and 14) | 1.6 | 2.3 | kV |
| Grid 2 current | -250 | +250 | μ A |
| 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

LB6-10

COOLING

Tube installed in convection-cooled mount type P6LA.

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

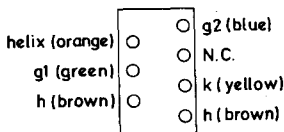
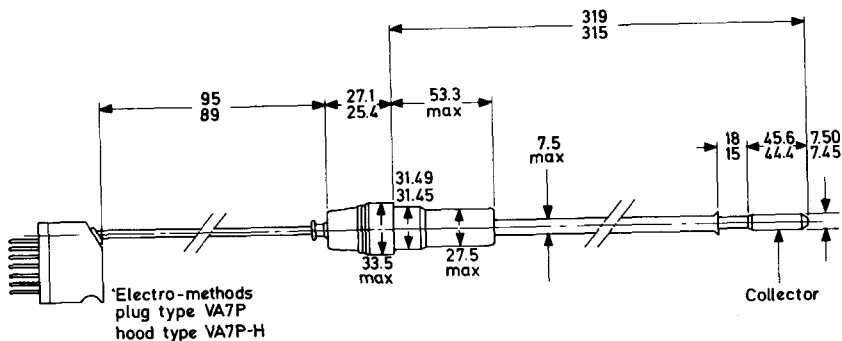
| | kg | lb |
|----------------------------------|-----------------|--------------------|
| Weight | 5.0 | 11 |
| Weight in inner storage pack | 5.3 | 11.7 |
| Weight in transit carton | 25.4 | 55.9 |
| | mm | in |
| Dimensions of inner storage pack | 255 × 140 × 495 | 10 × 5.5 × 19.5 |
| Dimensions 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 $\pm 3\%$. 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 $\pm 25\text{MHz}$ 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 $\pm 2\%$ 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.



Connections viewed
looking at plug

D2274

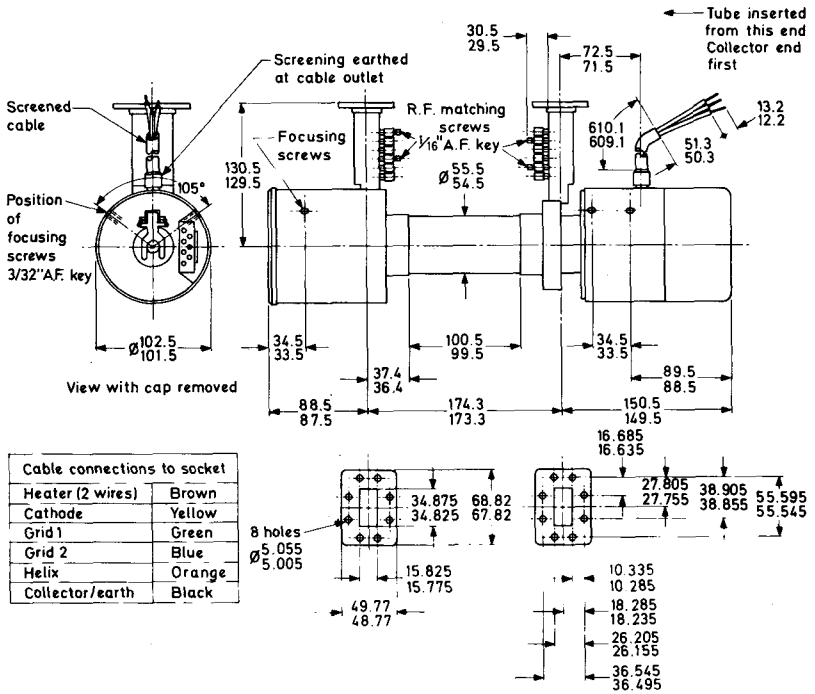
All dimensions in mm

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 19.6Nm (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.



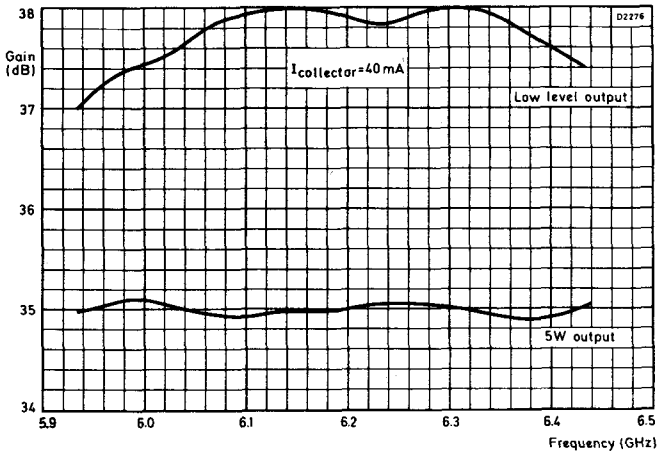
| Cable connections to socket | |
|-----------------------------|--------|
| Heater (2 wires) | Brown |
| Cathode | Yellow |
| Grid 1 | Green |
| Grid 2 | Blue |
| Helix | Orange |
| Collector/earth | Black |

All dimensions in mm

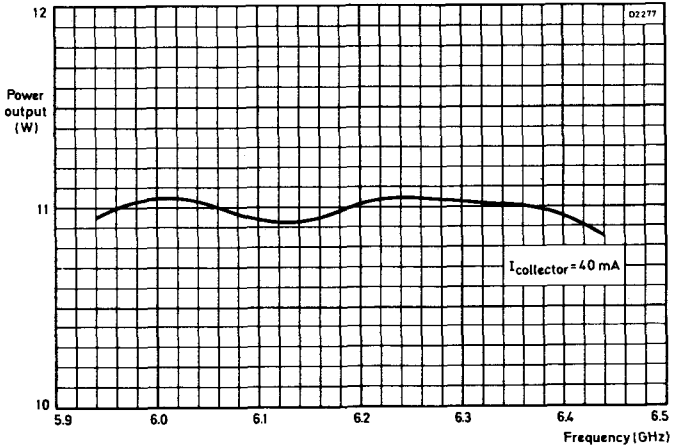
02275

CONVERSION TABLE (Rounded outwards)

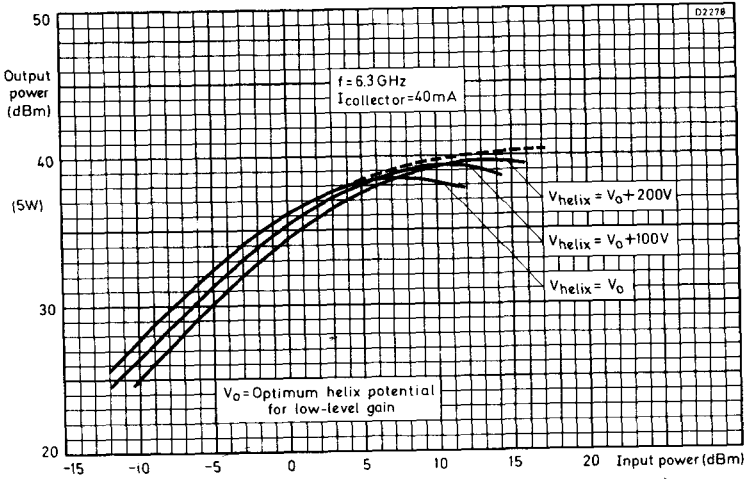
| mm | in |
|---------------|------------------|
| ∅ 5.055/5.005 | ∅0.19901/0.19694 |
| 10.335/10.285 | 0.40689/0.40492 |
| 13.2/12.2 | 0.519/0.480 |
| 15.825/15.775 | 0.62303/0.62106 |
| 16.685/16.635 | 0.65689/0.65492 |
| 18.285/18.235 | 0.71988/0.71791 |
| 26.205/26.155 | 1.03169/1.02972 |
| 27.805/27.755 | 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 |
| ∅ 55.5/54.5 | ∅2.185/2.145 |
| 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 |
| ∅102.5/101.5 | ∅4.035/3.996 |
| 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 |



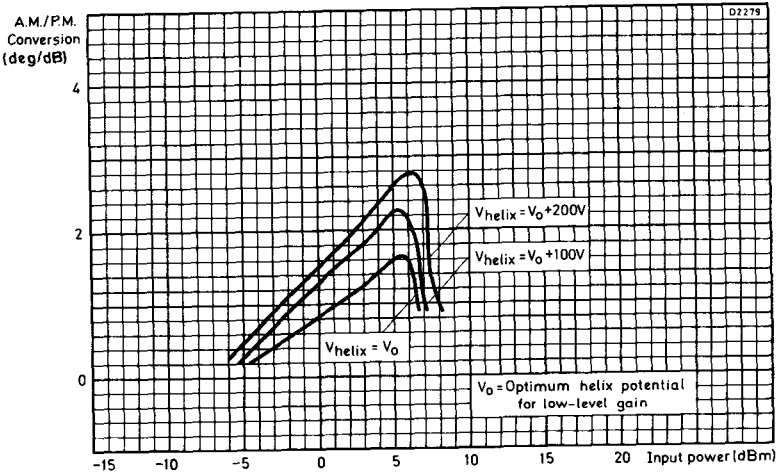
TYPICAL GAIN PLOTTED AGAINST FREQUENCY



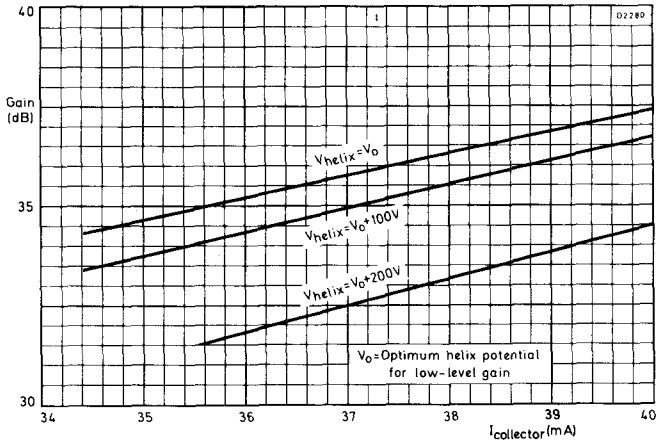
TYPICAL SATURATION POWER OUTPUT PLOTTED AGAINST FREQUENCY



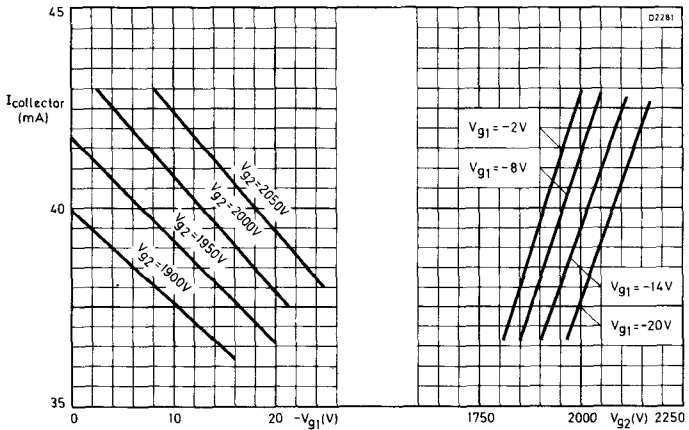
TYPICAL OUTPUT POWER PLOTTED AGAINST INPUT POWER FOR VARIOUS HELIX POTENTIALS



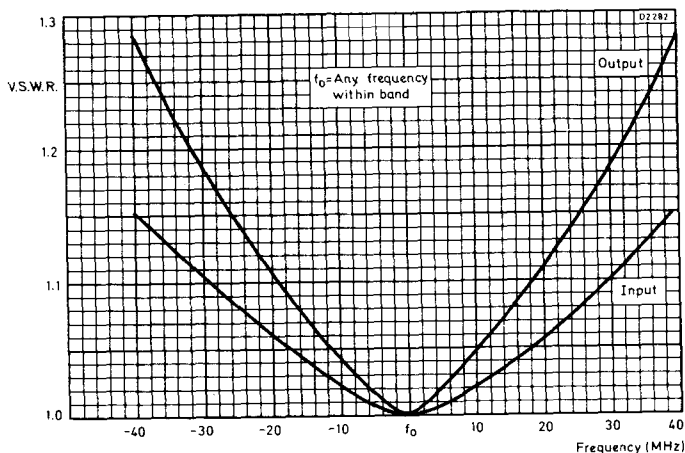
TYPICAL A.M./P.M. CONVERSION FIGURES PLOTTED AGAINST INPUT POWER FOR VARIOUS HELIX POTENTIALS



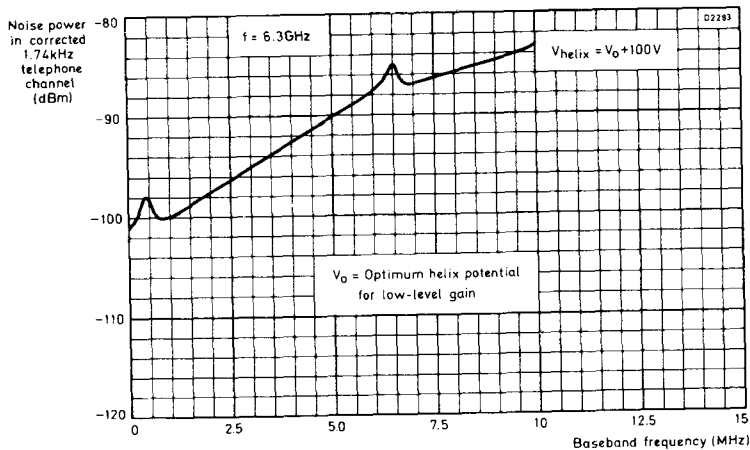
TYPICAL LOW LEVEL GAIN PLOTTED AGAINST COLLECTOR CURRENT FOR VARIOUS HELIX POTENTIALS



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

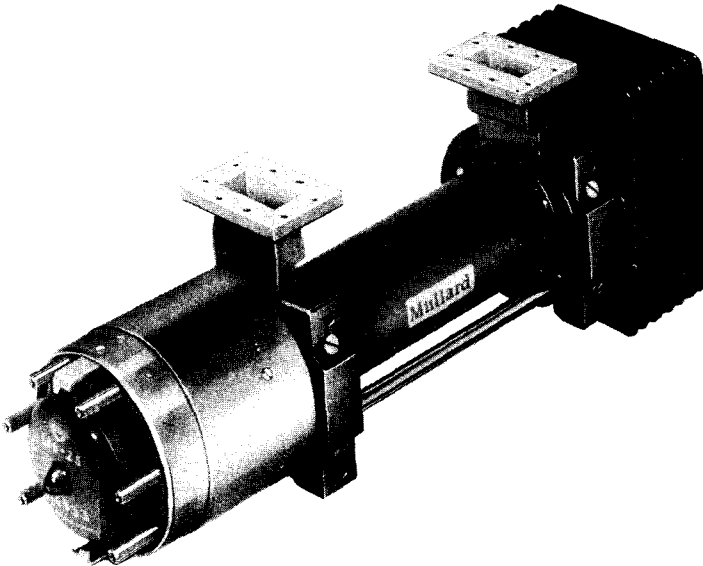
LB6-25

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

Mullard

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 | μ A |
| Grid 2 current | 5.0 | μ A |
| 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 |

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-25

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 | μ A |
| Grid 2 current | - | 250 | μ A |
| 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 | μ A |
| Grid 2 voltage (see notes 13 and 14) | 1.9 | 2.7 | kV |
| Grid 2 current | -250 | +250 | μ A |
| 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.

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-25

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

| | kg | lb | |
|--|-----------------|--------------------|--|
| Tube | | | |
| 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 | |

Mullard

NOTES

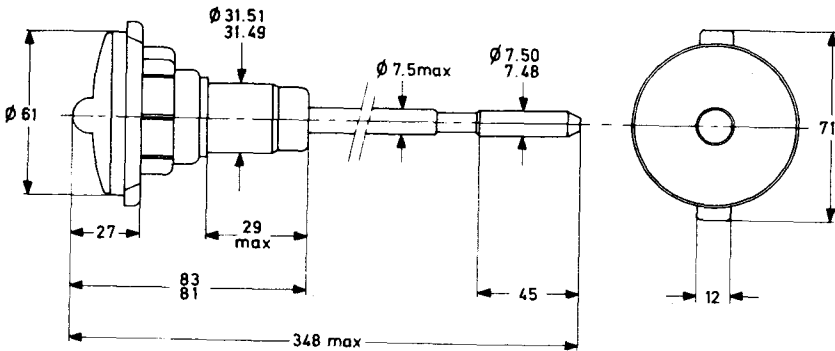
1. The absolute variation of the heater voltage must be less than $\pm 2\%$. When operated on d.c. the heater must be negative with respect to the cathode.
2. The pre-heating time for a new tube must be at least 5 minutes.
3. Grid 2 voltage should be adjusted to give the specified collector current while 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 $\pm 2\%$ 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.

COMMUNICATIONS TRAVELLING-WAVE TUBE

LB6-25

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.



D2288

All dimensions in mm

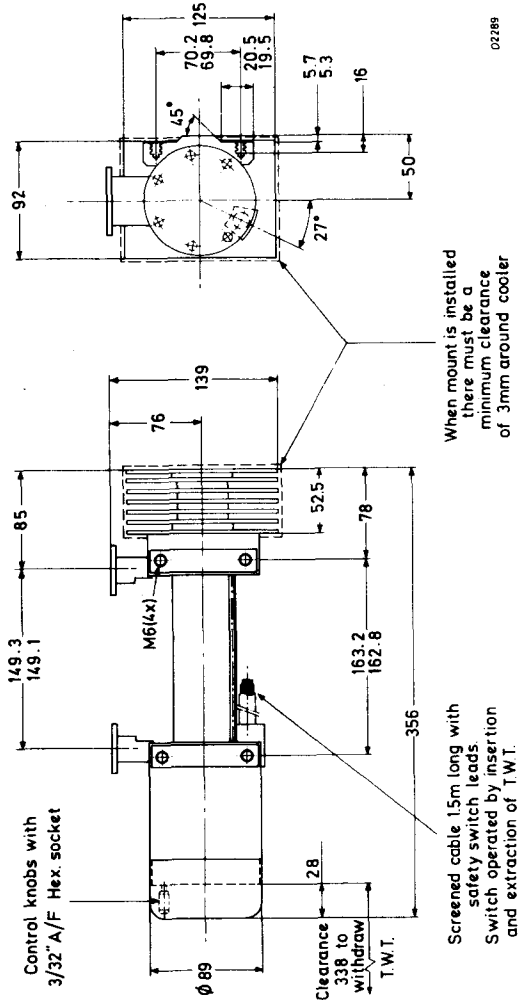
CONVERSION TABLE (Rounded outwards)

| 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. |

Mullard

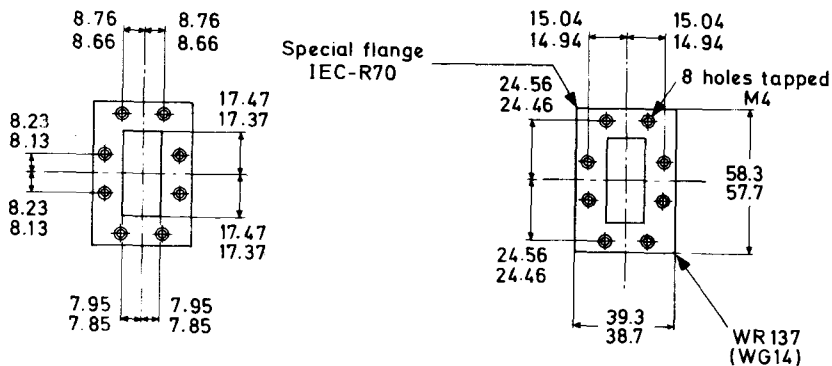
OUTLINE DRAWING OF P6L11 MOUNT

Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6Nm (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.



02288

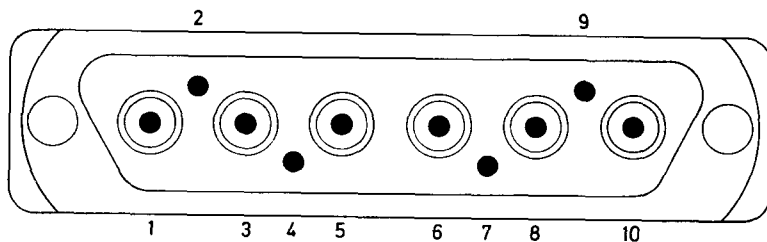
All dimensions in mm



All dimensions in mm

D2389

AMPHENOL PLUG 17-801



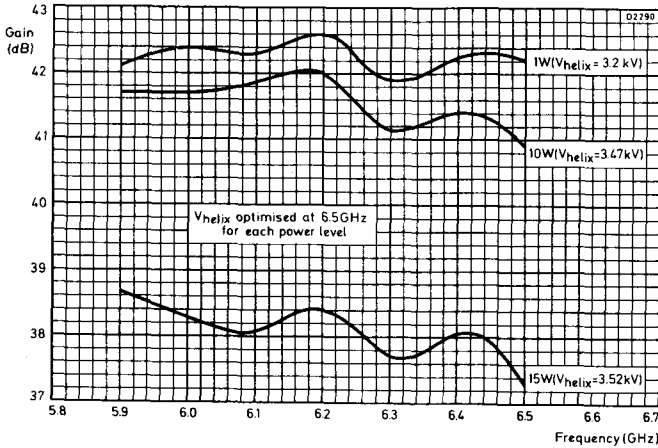
D2390

Plug connections to mount

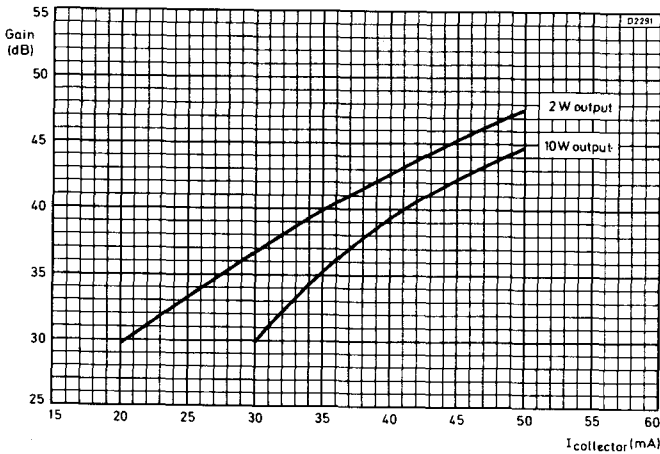
1. Helix
2. Collector (earth)
3. Grid 2
4. -
5. Grid 1
6. Cathode
7. Safety circuit
8. Heater
9. Safety circuit
10. Heater

CONVERSION TABLE
(Rounded outwards)

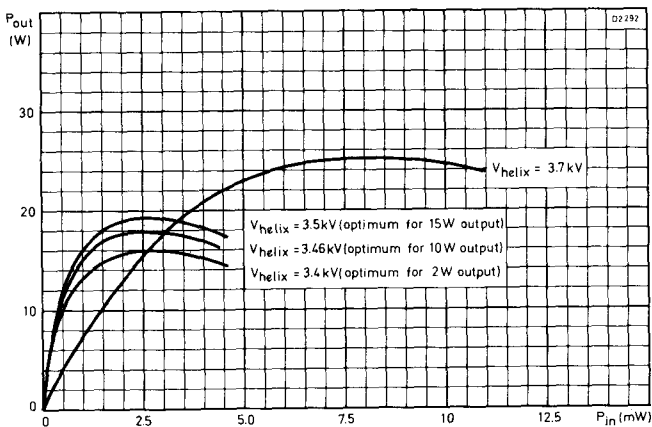
| mm | in |
|-------------|---------------|
| 5.7/5.3 | 0.2244/0.2087 |
| 7.95/7.85 | 0.3130/0.3091 |
| 8.23/8.13 | 0.3240/0.3201 |
| 8.76/8.66 | 0.3449/0.3409 |
| 15.04/14.94 | 0.5921/0.5882 |
| 16 | 0.63 |
| 20.5/19.5 | 0.807/0.768 |
| 24.56/24.46 | 0.9669/0.9630 |
| 28 | 1.10 |
| 39.3/38.7 | 1.5472/1.5236 |
| 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 |



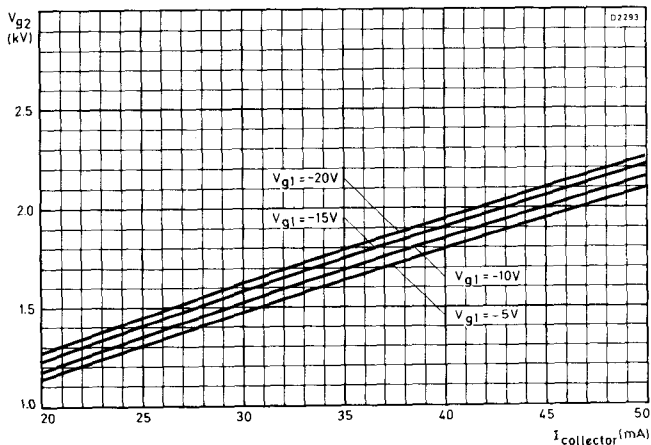
TYPICAL GAIN PLOTTED AGAINST FREQUENCY AT VARIOUS POWER LEVELS



TYPICAL GAIN PLOTTED AGAINST COLLECTOR CURRENT AT 6.2GHz



TYPICAL OUTPUT POWER PLOTTED AGAINST INPUT POWER AT VARIOUS HELIX VOLTAGES AT 6.2GHz



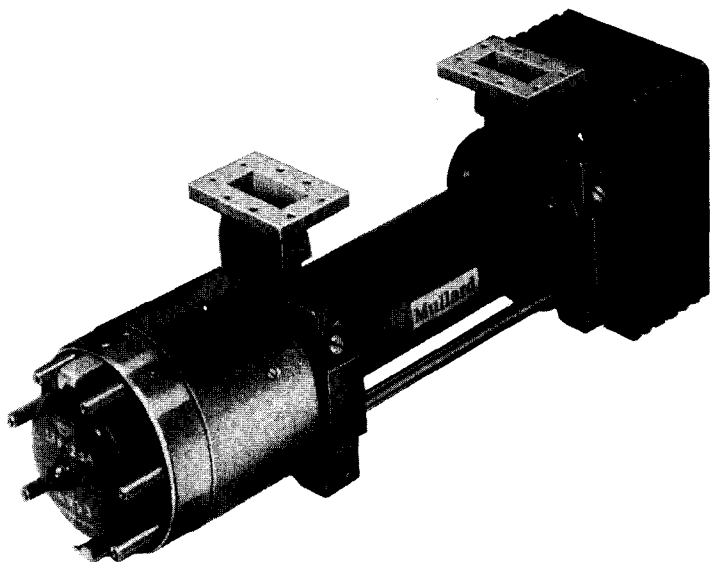
TYPICAL GRID 2 VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT

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 | μ A |
| Grid 2 current | 5.0 | μ A |
| 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 | μ A |
| Grid 2 current | - | 250 | μ A |
| 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 | μ A |
| Grid 2 voltage (see notes 13 and 14) | 1.9 | 2.7 | kV |
| Grid 2 current | -250 | +250 | μ A |
| 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

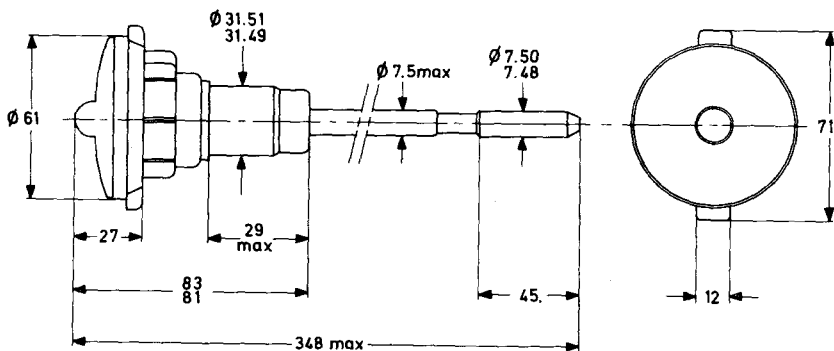
| | kg | lb |
|--|-----------------|--------------------|
| Weight | 4.9 | 10.7 |
| Weight in inner storage pack | 5.2 | 11.4 |
| Weight in transit carton (2 inner packs per carton) | 25.3 | 55.6 |
| | mm | in |
| Dimensions of inner storage pack | 255 × 140 × 495 | 10 × 5.5 × 19.5 |
| Dimensions of transit carton | 520 × 410 × 640 | 20.5 × 16.3 × 25.3 |

NOTES

1. The absolute variation of the heater voltage must be less than $\pm 2\%$. 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 $\pm 2\%$ 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.



D2268

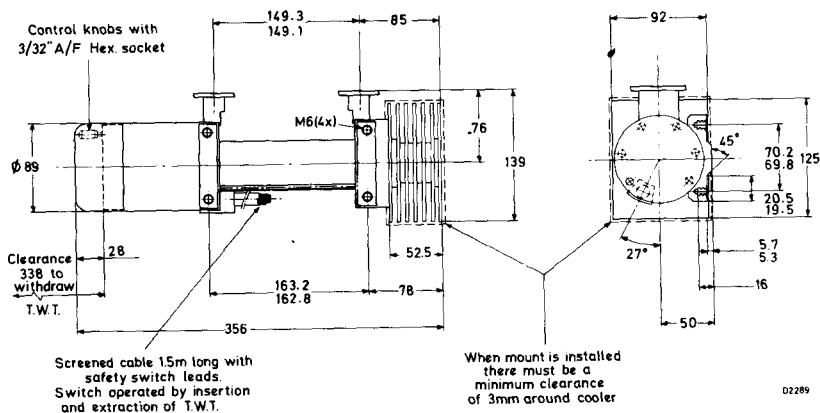
All dimensions in mm

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. |

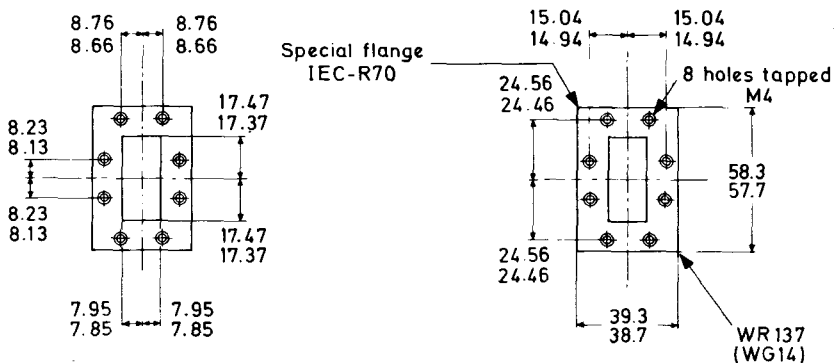
OUTLINE DRAWING OF P6L11A MOUNT

Note that the installation should be designed so that maximum misalignment moment at r.f. connectors is 19.6Nm (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

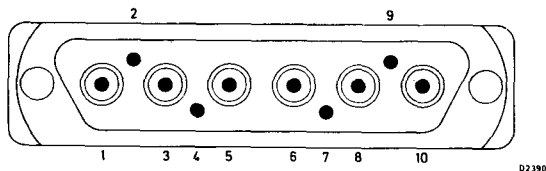
02289



All dimensions in mm

D2389

AMPHENOL PLUG NO. 17-801



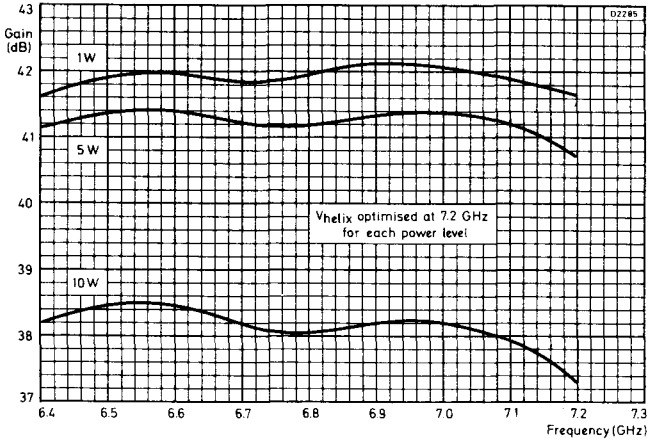
D2390

Plug connections to mount

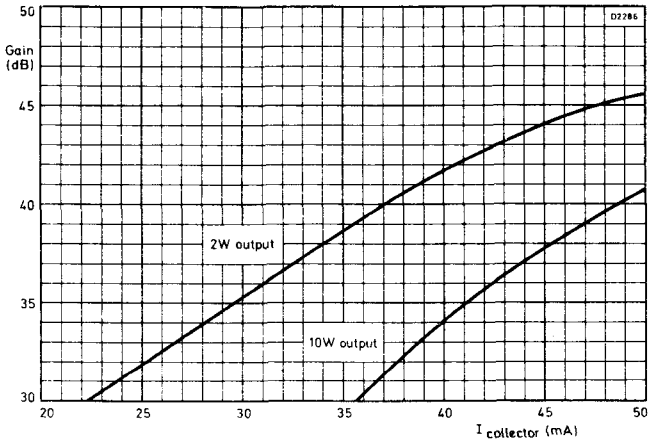
1. Helix
2. Collector (earth)
3. Grid 2
4. -
5. Grid 1
6. Cathode
7. Safety circuit
8. Heater
9. Safety circuit
10. Heater

CONVERSION TABLE
(Rounded outwards)

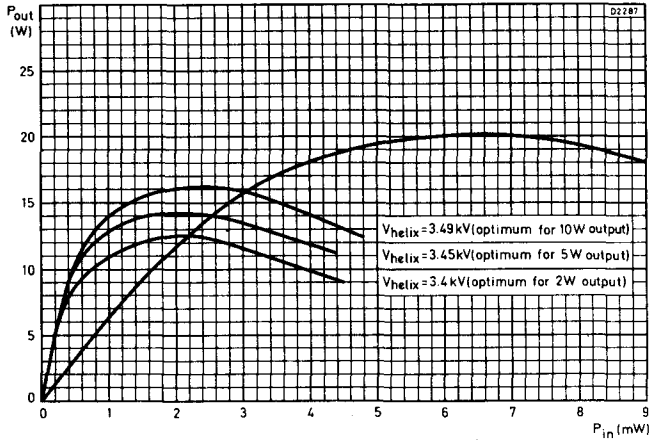
| mm | in |
|-------------|---------------|
| 5.7/5.3 | 0.2244/0.2087 |
| 7.95/7.85 | 0.3130/0.3091 |
| 8.23/8.13 | 0.3240/0.3201 |
| 8.76/8.66 | 0.3449/0.3409 |
| 15.04/14.94 | 0.5921/0.5882 |
| 16 | 0.63 |
| 20.5/19.5 | 0.807/0.768 |
| 24.56/24.46 | 0.9669/0.9630 |
| 28 | 1.10 |
| 39.3/38.7 | 1.5472/1.5236 |
| 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 |
| ∅ 89 | ∅ 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 |



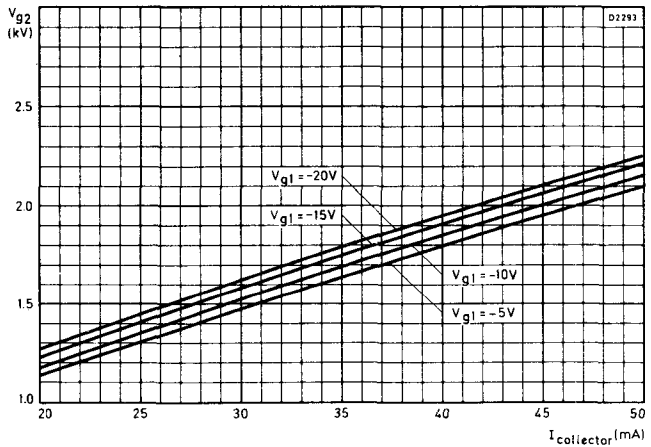
TYPICAL GAIN PLOTTED AGAINST FREQUENCY AT VARIOUS POWER LEVELS



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

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 |

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 | μ A |
| Grid 2 current | - | 250 | μ A |
| 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 | μ A |
| Grid 2 voltage (see notes 13 and 14) | 1.7 | 2.3 | kV |
| Grid 2 current | -250 | +250 | μ A |
| 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 | °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

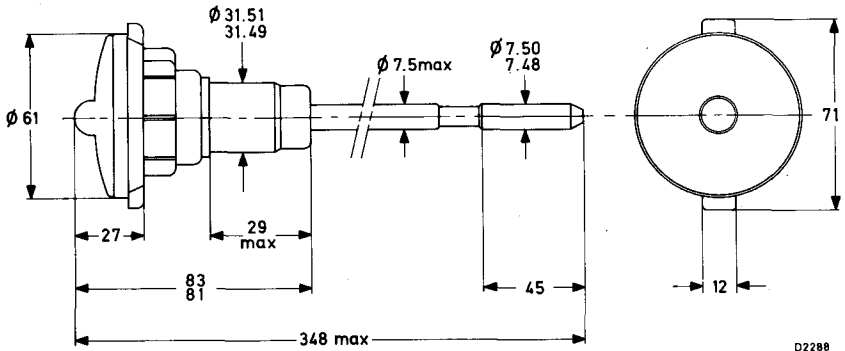
| Tube | kg | lb |
|--|-----------------|--------------------|
| Weight | 0.15 | 0.33 |
| Weight in inner storage pack (2 tubes per inner pack) | 0.55 | 1.2 |
| Weight in transit carton | 4.5 | 9.9 |
| | mm | in |
| Dimensions of inner storage pack | 150 × 115 × 505 | 6 × 4.5 × 20 |
| Dimensions of transit 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 $\pm 2\%$. 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 $\pm 2\%$ 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 $-60^{\circ}C$ 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.



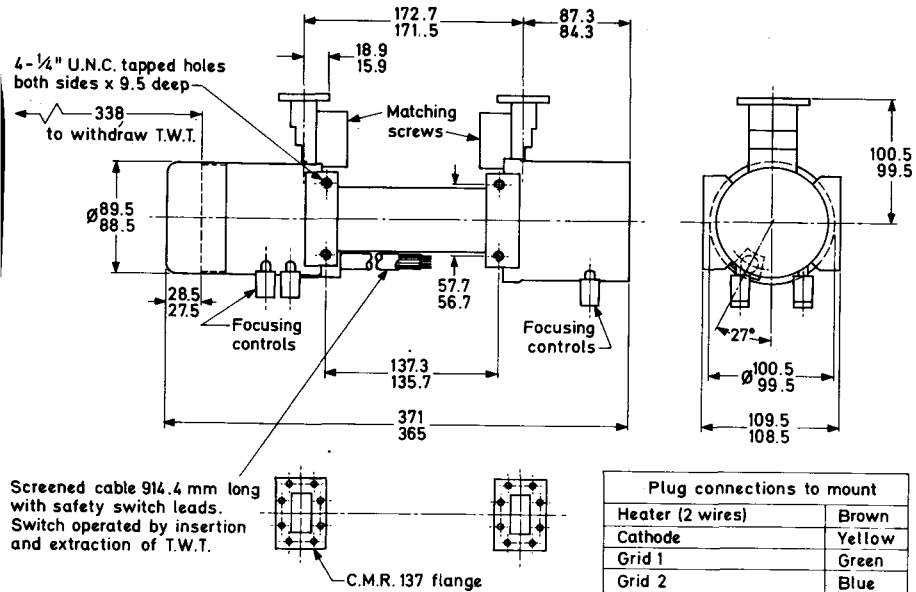
All dimensions in mm

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.



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 |
| ∅ 89.5/88.5 | ∅ 3.5236/3.4842 |
| 100.5/99.5 | 3.9567/3.9173 |
| ∅ 100.5/99.5 | ∅ 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 |



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 | $6.3 \pm 2\%$ | 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 ($T_{amb} = 65^{\circ}C$) 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 | $^{\circ}C$ |
| mount type 55332 | 150 | $^{\circ}C$ |

*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

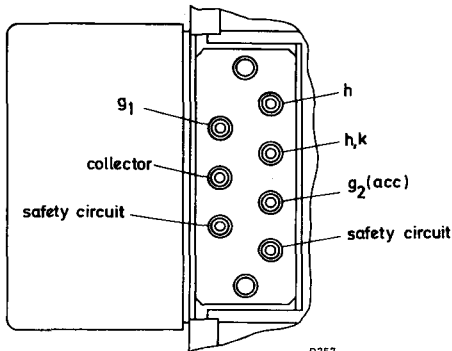
| | |
|--|-----------|
| PPM mount for convection cooling | 55329 |
| PPM mount for conduction cooling | 55332 |
| Waveguide taper to waveguide IEC-R40 (WG11A.WR229) with flange IEC-UER40) | 2 × 55330 |
| Waveguide taper to waveguide IEC-F40 with flange IEC-UGF40 | 2 × 55333 |
| Clamp for fastening of 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



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°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.

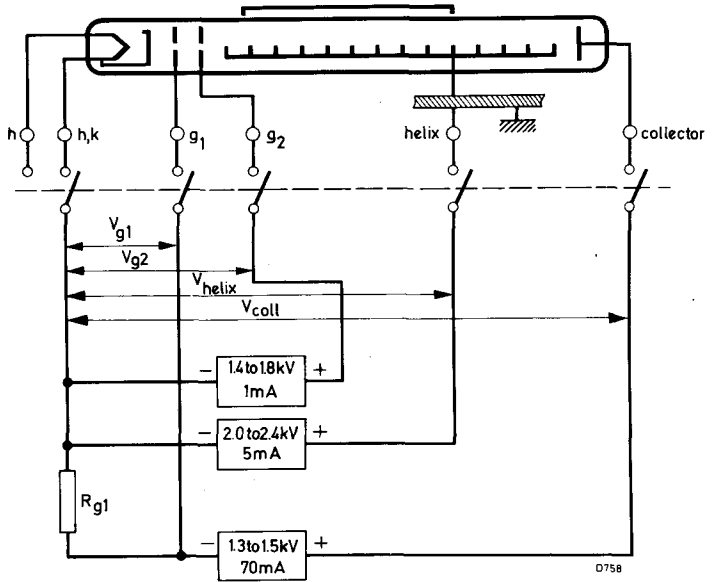
6. Power supply

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.

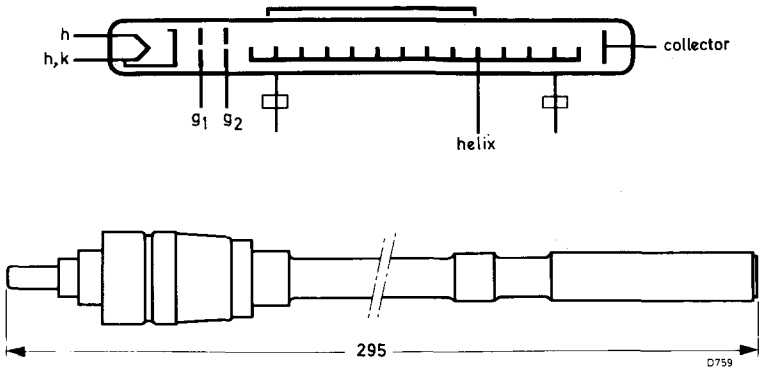


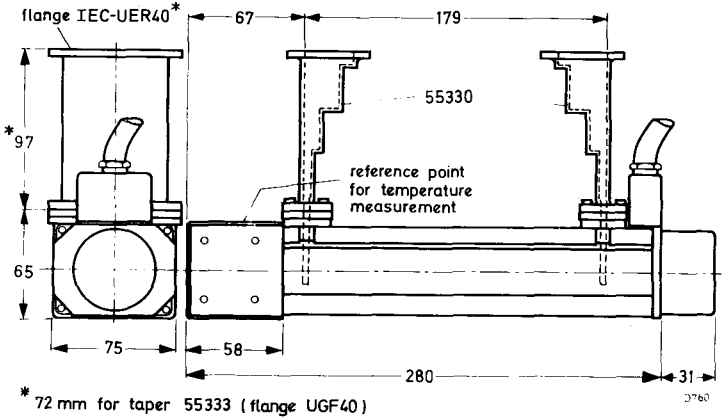
CIRCUIT DIAGRAM OF POWER SUPPLY FOR 10 AND 15W OPERATION



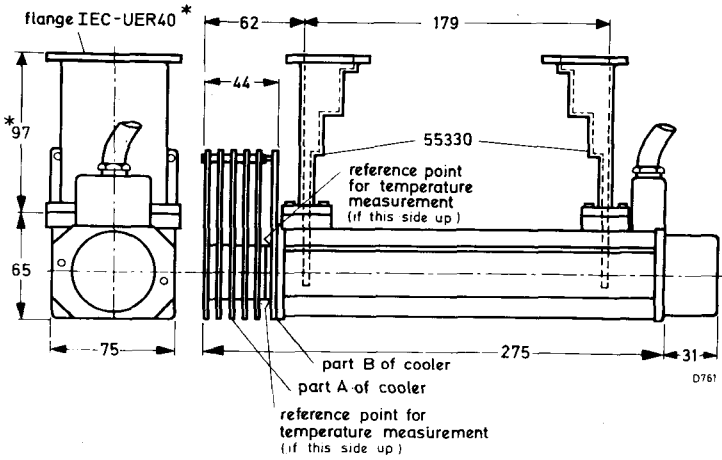
* For 5W operation a minimum of 1.1kV is required.

OUTLINE DRAWING OF YH1090



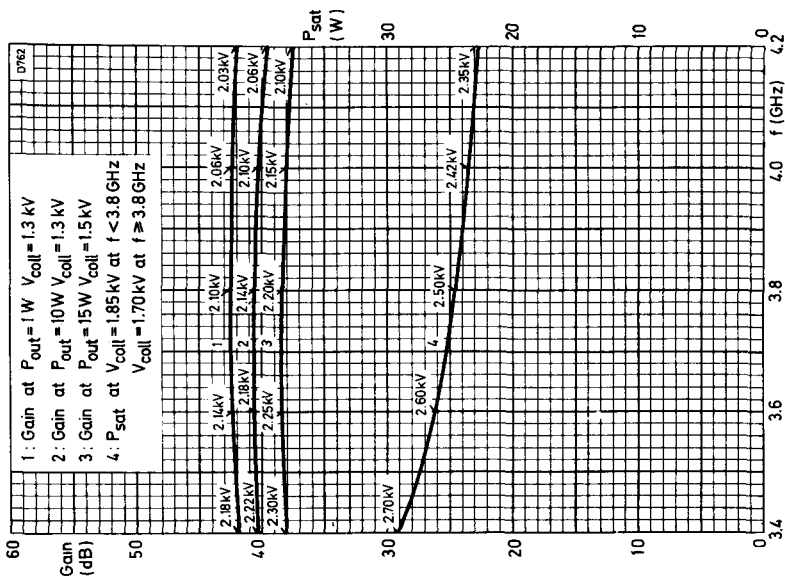


Mount 55332 with conduction cooling and waveguide tapers 55330

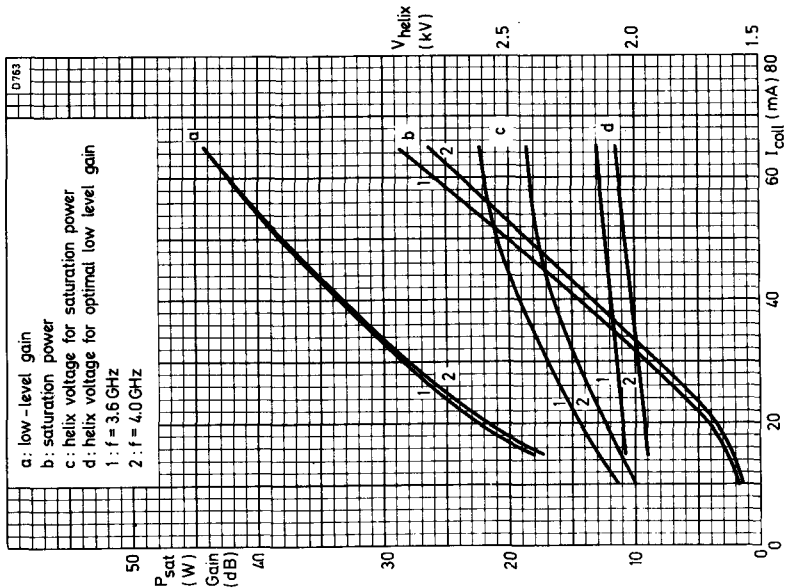


Mount 55329 with convection cooling and waveguide tapers 55330



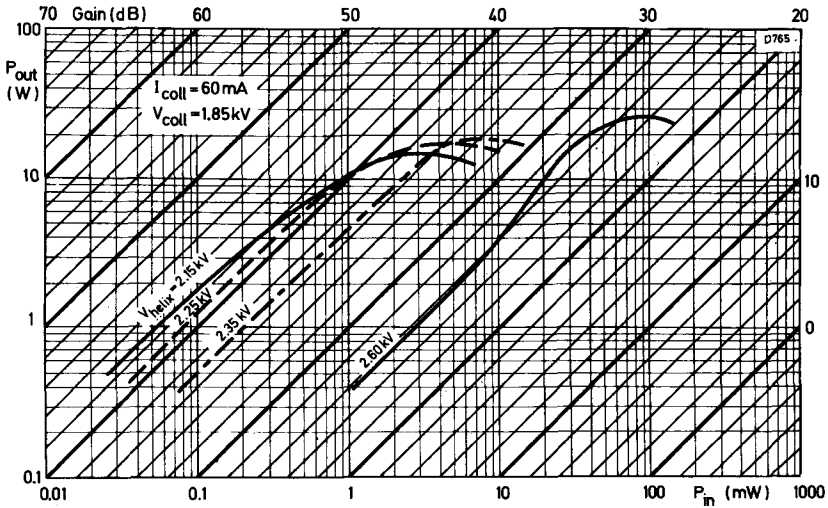


GAIN AND SATURATED OUTPUT POWER PLOTTED AGAINST FREQUENCY FOR VARIOUS OPERATING CONDITIONS

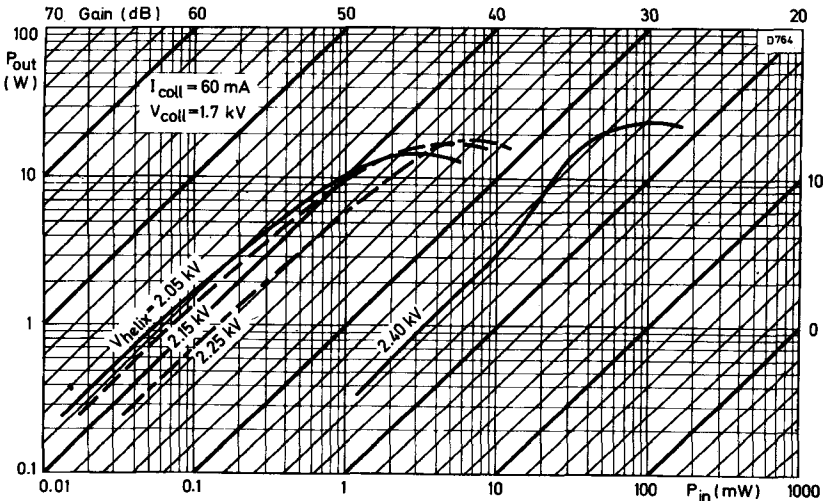


GAIN, SATURATED OUTPUT POWER AND HELIX VOLTAGE PLOTTED AGAINST COLLECTOR CURRENT AT TWO SPECIFIC FREQUENCIES



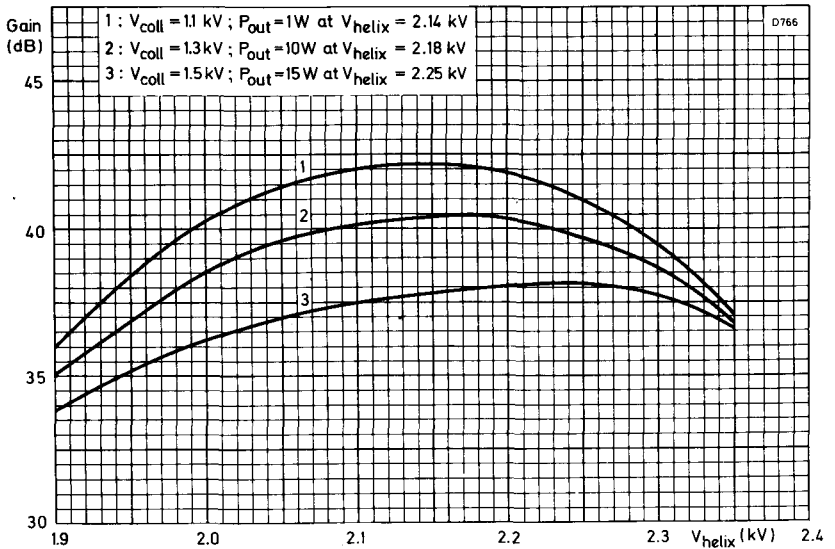


OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 3.6GHz

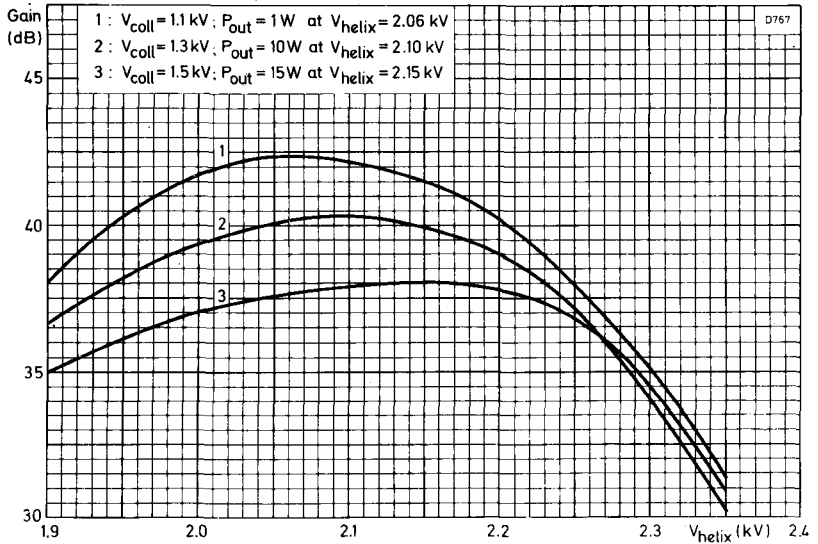


OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 4GHz



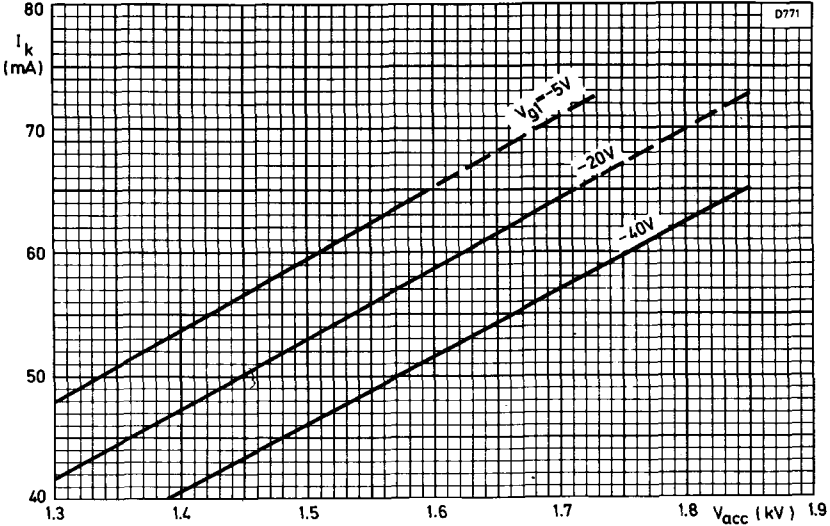


GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 3.6GHz

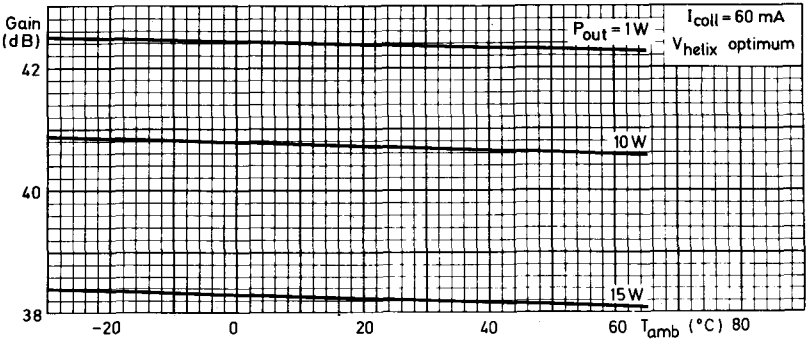
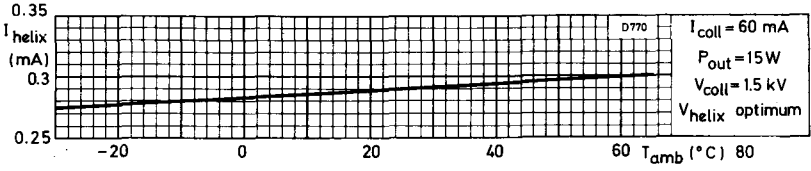


GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 4GHz



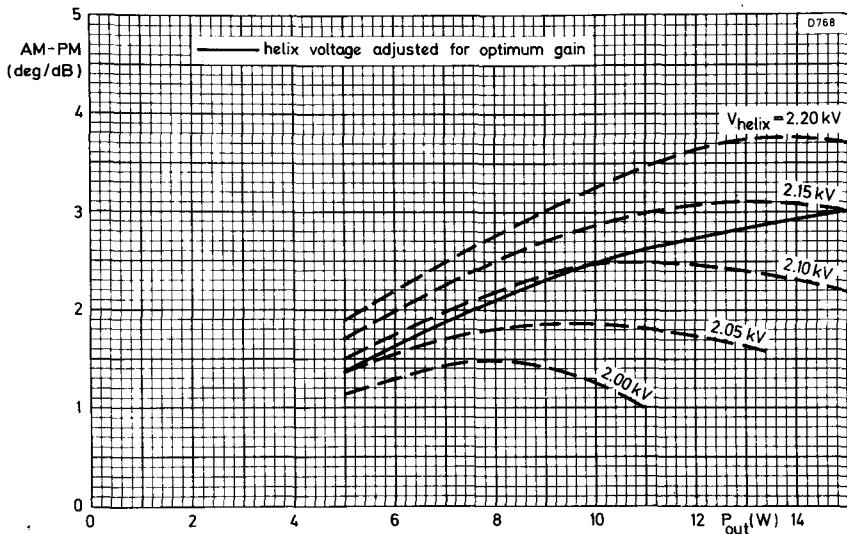


CATHODE CURRENT PLOTTED AGAINST ACCELERATOR VOLTAGE WITH GRID VOLTAGE AS PARAMETER

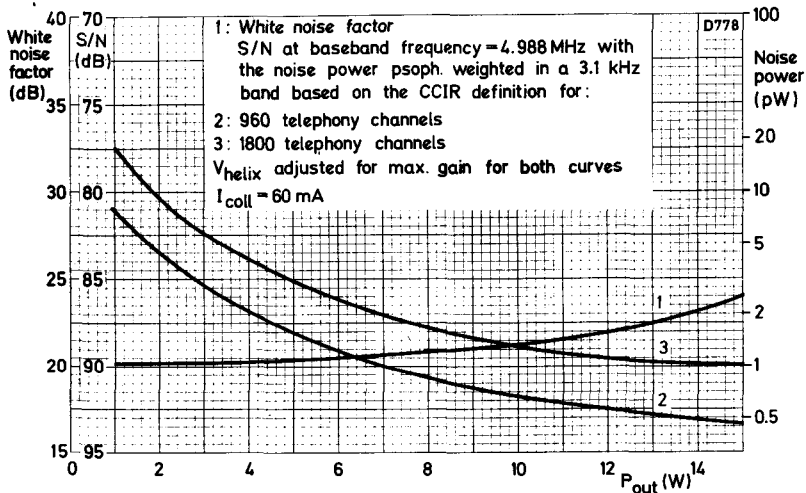


HELIX CURRENT AND GAIN PLOTTED AGAINST AMBIENT TEMPERATURE WITH OUTPUT POWER AS PARAMETER. FREQUENCY = 4GHz



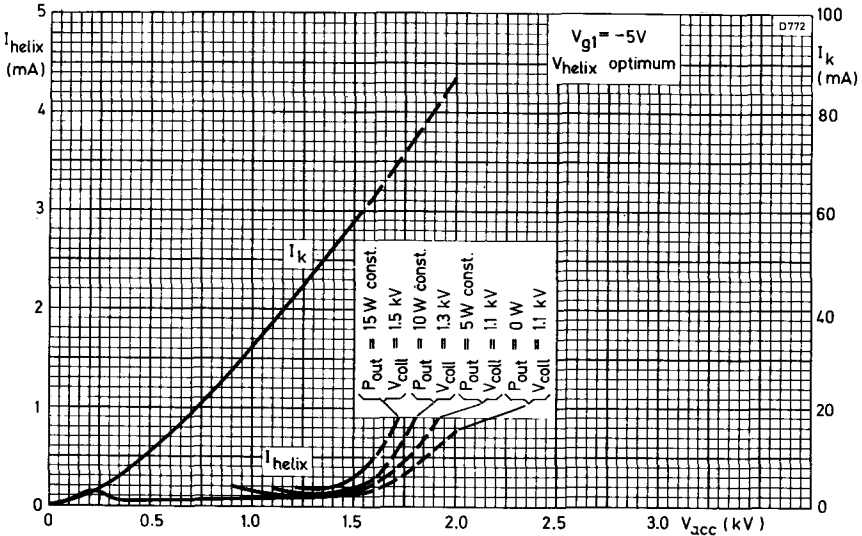


AM TO PM CONVERSION PLOTTED AGAINST POWER OUTPUT WITH HELIX VOLTAGE AS PARAMETER. FREQUENCY=4GHz

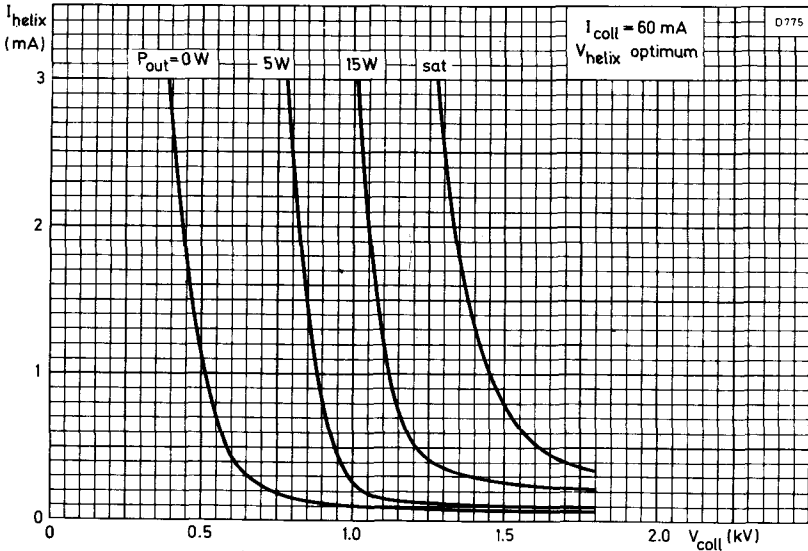


SIGNAL TO NOISE RATIO AND WHITE NOISE FACTOR PLOTTED AGAINST POWER OUTPUT AT 4GHz



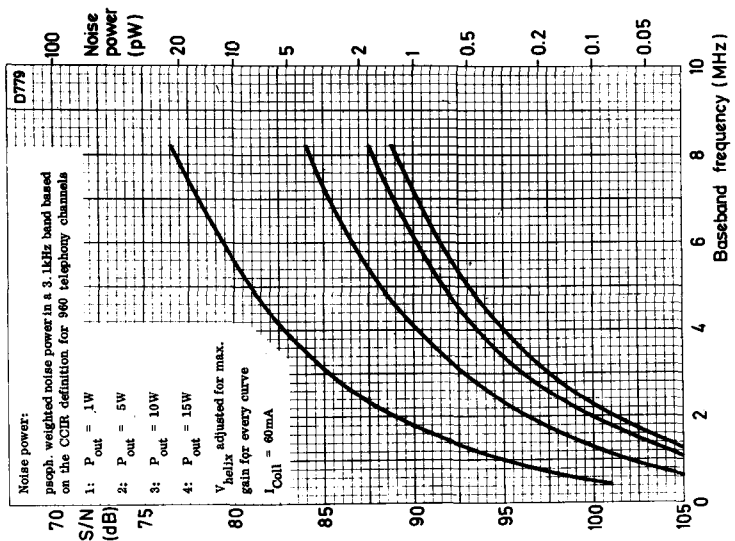
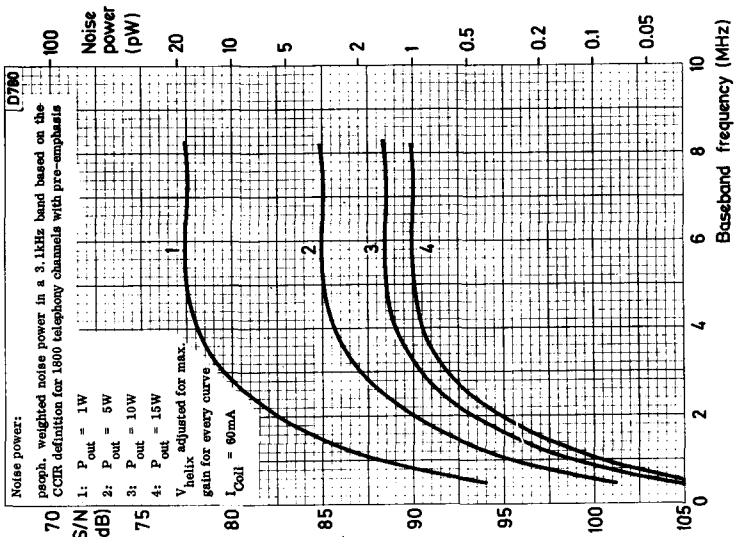


CATHODE AND HELIX CURRENTS PLOTTED AGAINST ACCELERATOR VOLTAGE. FREQUENCY=4GHz



HELIX CURRENT PLOTTED AGAINST COLLECTOR VOLTAGE WITH POWER OUTPUT AS PARAMETER. FREQUENCY=4GHz





INTERBAND NOISE CHARACTERISTICS at 4GHz



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 |



TRAVELLING-WAVE TUBE

YH1170

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|-------|--------------------|
| Collector to helix voltage max. | 2.5 | kV |
| Collector dissipation ($T_{amb} = 65^{\circ}\text{C}$) 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 | $^{\circ}\text{C}$ |

*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 |

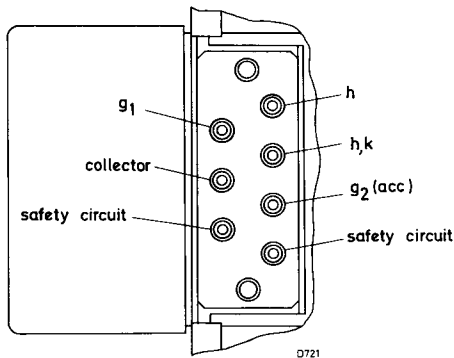


CONNECTIONS

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°C, the cooler temperature at the reference point (see page 7) is well below the limit, provided an aluminium heatsink of 300×300×6mm 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.

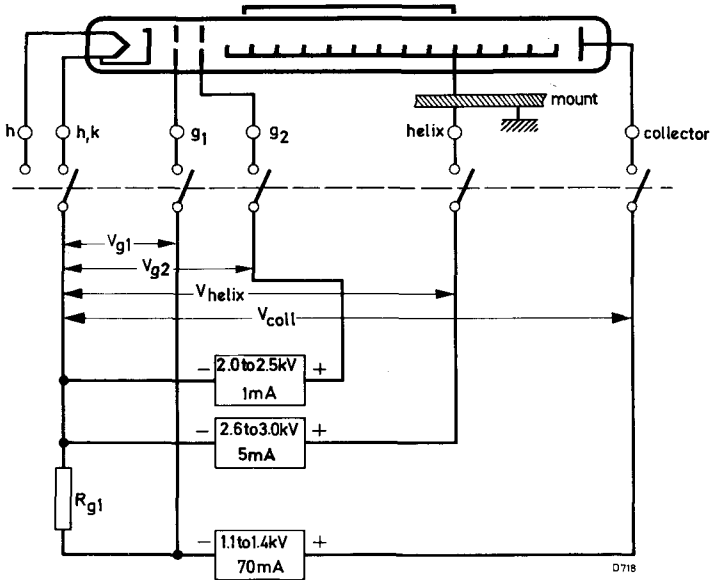


OPERATING NOTES (contd.)

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.

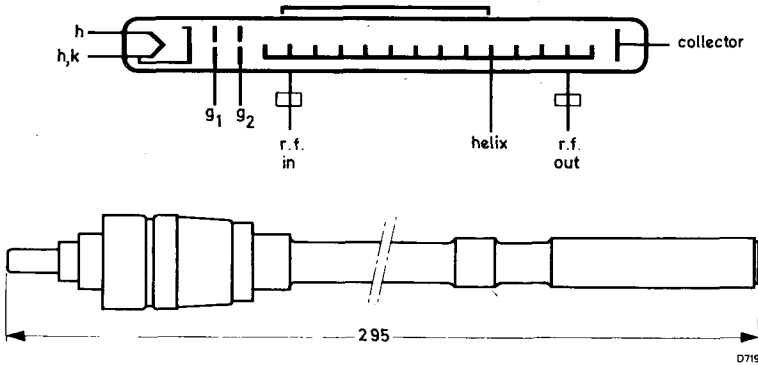
7. Power supply

The design of the power supply for 5, 10 and 15W operation is shown below.

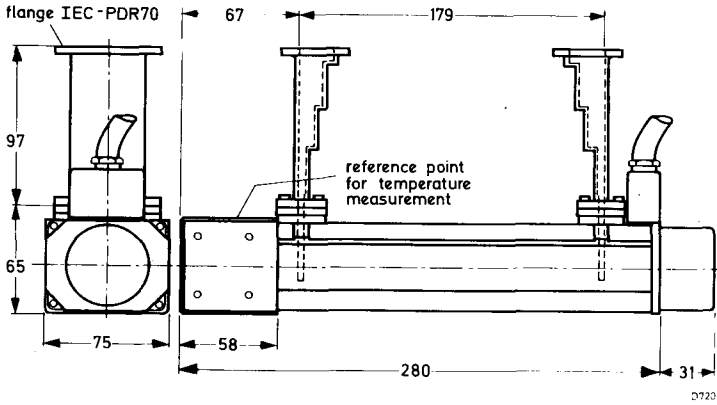


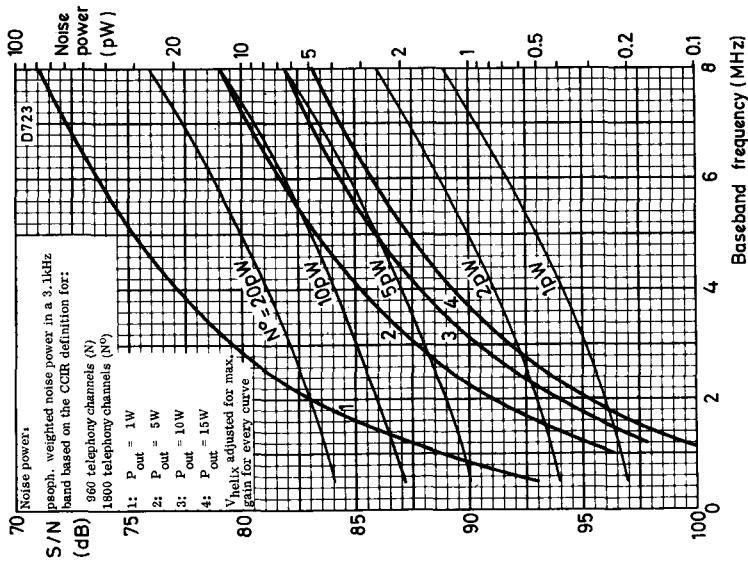
The design of the power supply should be such that V_{g2} (accelerator) can be varied between 2 and 2.5kV, V_{helix} between 2.6 and 3kV and V_{g1} is -5V at a collector current of 55mA. The collector voltage must be 1.1, 1.3, or 1.5kV at a collector current of 55mA for a desired output of 5, 10 or 15W 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

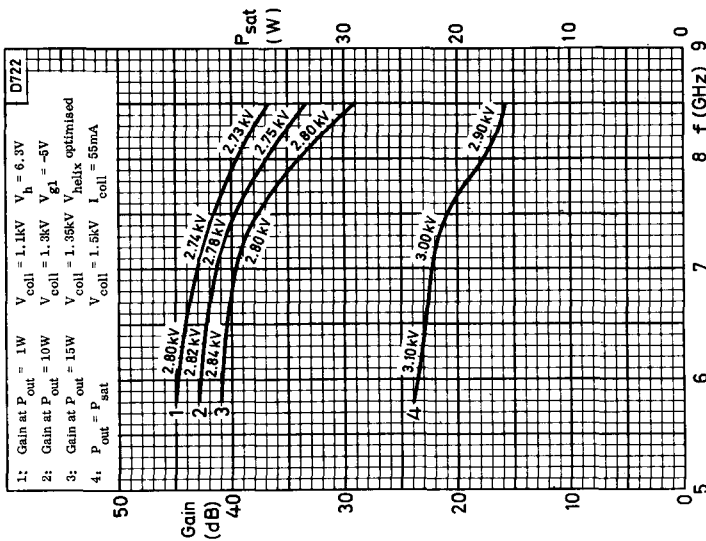


Mount with conduction (heatsink) cooling and waveguide tapers.



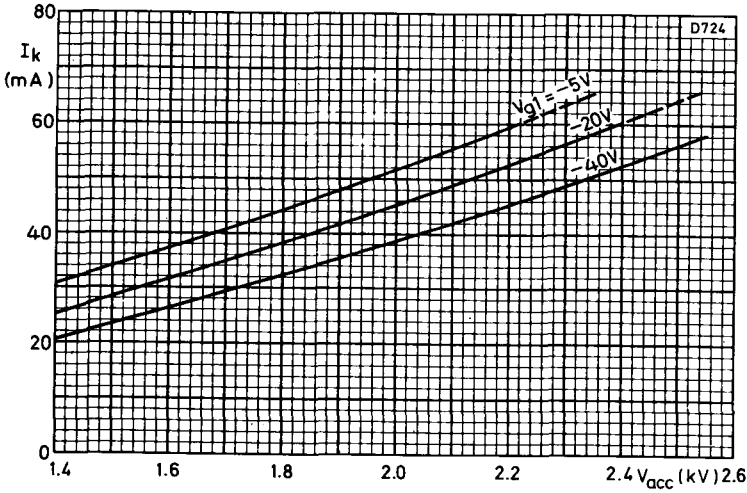


INTERBAND NOISE CHARACTERISTICS

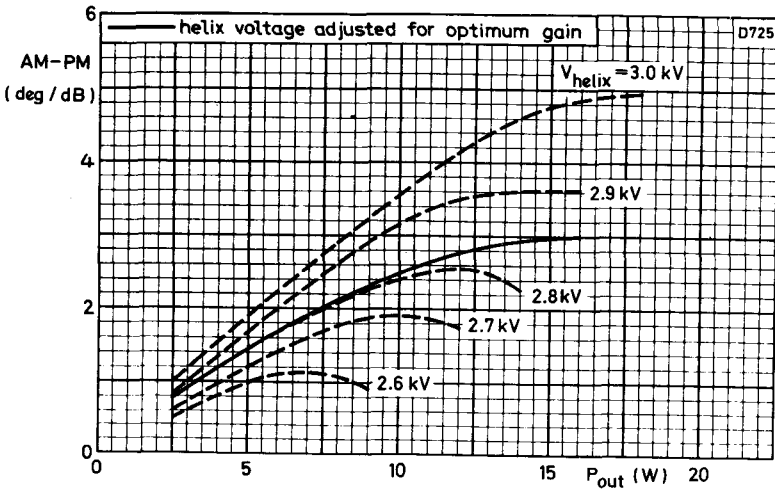


GAIN AND SATURATED OUTPUT POWER PLOTTED AGAINST FREQUENCY FOR VARIOUS OPERATING CONDITIONS



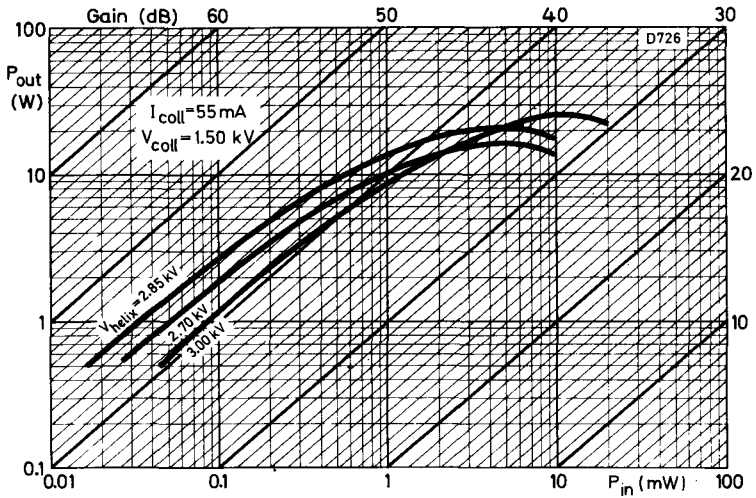


CATHODE CURRENT PLOTTED AGAINST ACCELERATOR VOLTAGE WITH GRID VOLTAGE AS PARAMETER

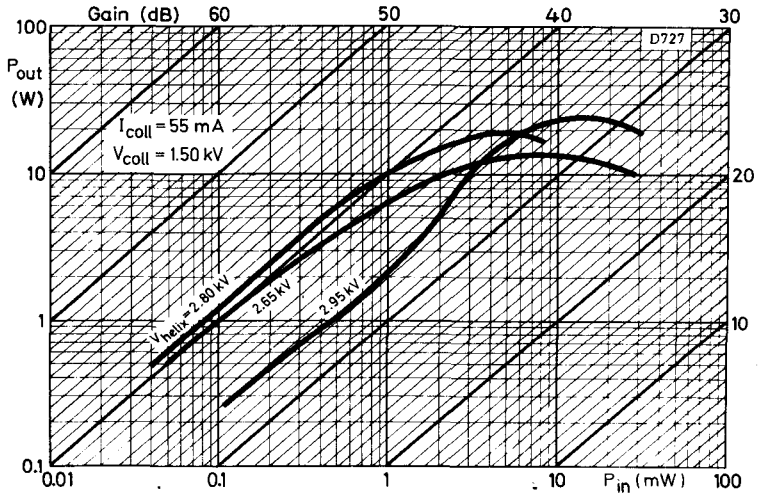


AM TO PM CONVERSION PLOTTED AGAINST POWER OUTPUT WITH HELIX VOLTAGE AS PARAMETER. FREQUENCY = 6GHz



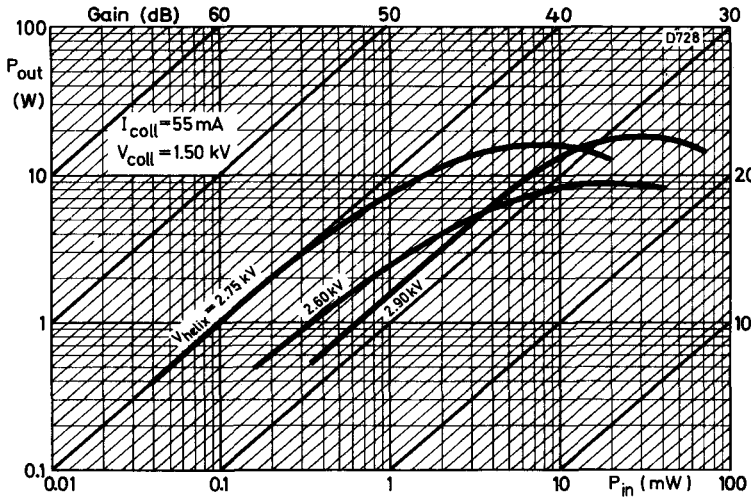


OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 6GHz

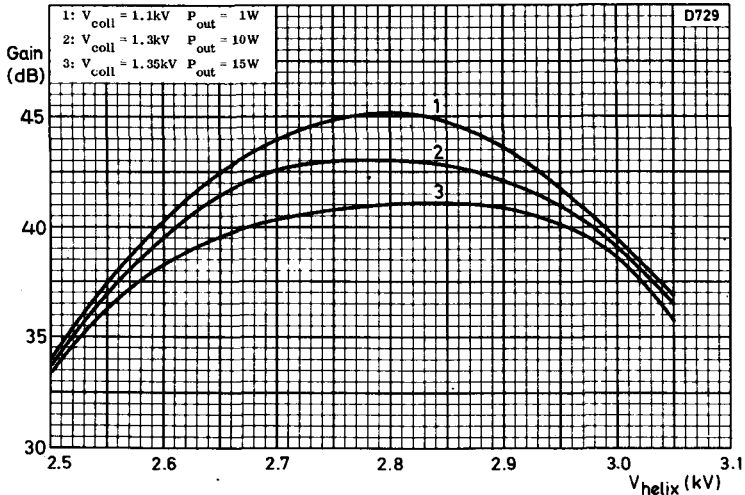


OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 7.2GHz



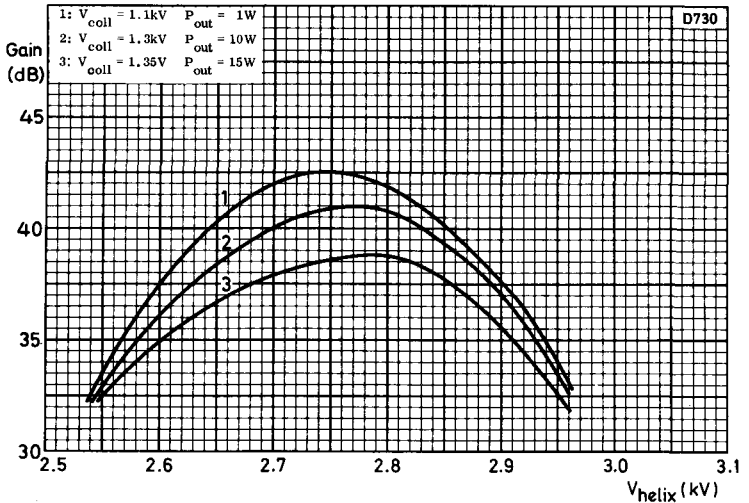


OUTPUT POWER PLOTTED AGAINST INPUT POWER AT 8GHz

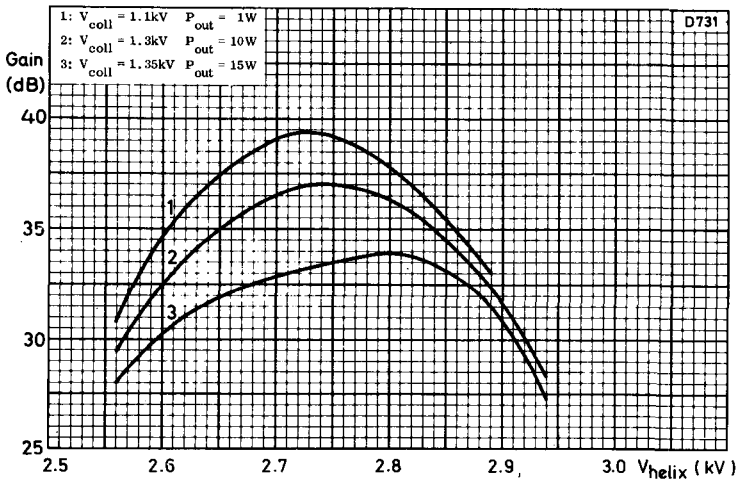


GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS COLLECTOR VOLTAGES AND OUTPUT POWERS AT 6GHz



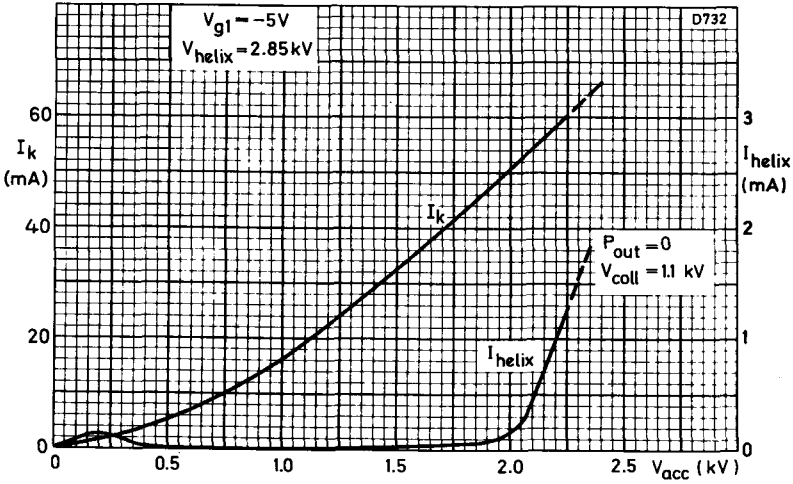


GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 7.2GHz

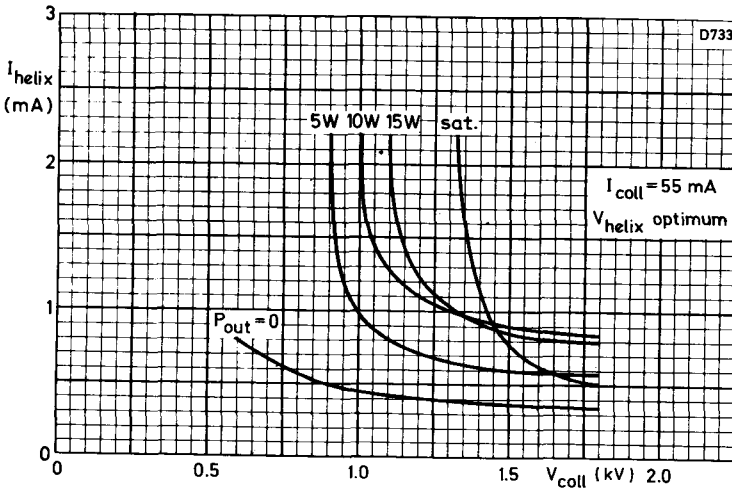


GAIN PLOTTED AGAINST HELIX VOLTAGE FOR VARIOUS OUTPUT POWERS AND COLLECTOR VOLTAGES AT 8GHz



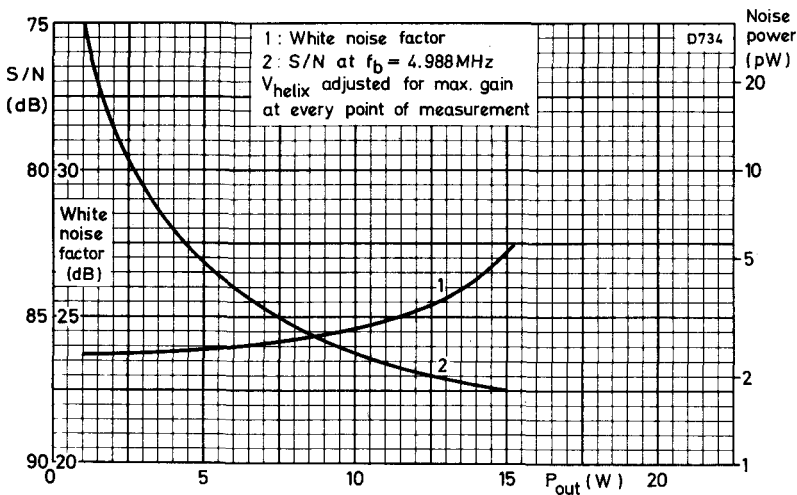


CATHODE AND HELIX CURRENTS PLOTTED AGAINST ACCELERATOR VOLTAGE



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



TENTATIVE DATA

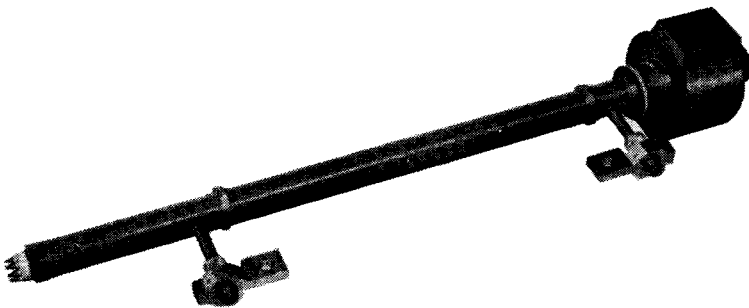
QUICK REFERENCE DATA

High power linear amplifier for television transposer service with common vision and sound transmission in the U. H. F. bands IV and V (470-860MHz).

| | | |
|---|----------------------|-----|
| Frequency range | 470 to 860 | MHz |
| *Output power, peak sync (CCIR system G) | 220 | W |
| *Gain (approx.) | 30 | dB |
| *Intermodulation product (ref. peak sync) | -54 | dB |
| Construction | Unpackaged | |
| tube | metal-ceramic | |
| mount | permanent magnet | |
| Input and output connector | 50 Ω , type N | |

*With phase compensation unit type 55382

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



TYPICAL OPERATION

Vision and sound combined (CCIR system G) using phase compensation unit type 55382.

Operating conditions (electrode potentials measured with respect to cathode)

| | | | | |
|--|------|------|------|-----|
| Frequency of vision carrier | 550 | 615 | 780 | MHz |
| Helix voltage | 3.65 | 3.5 | 3.3 | kV |
| Collector voltage | 3.65 | 3.5 | 3.3 | kV |
| Grid 1 voltage | -100 | -100 | -100 | V |
| Grid 2 voltage (approx.) (see note 1) | 560 | 610 | 680 | V |
| Cathode current | 850 | 850 | 850 | mA |
| Helix current | 10 | 10 | 10 | mA |

Typical performance

| | | | | |
|--|------------|------------|------------|-----|
| Output power, peak sync | 220 | 220 | 220 | W |
| Output power, sound | 44 | 44 | 44 | W |
| Gain (see note 2) | 30 | 31 | 32 | dB |
| Intermodulation product (ref. peak sync) (see note 3) | -54 | -54 | -54 | dB |
| Low frequency linearity (see note 4) | ≥ 95 | ≥ 95 | ≥ 95 | % |
| Differential gain (see note 4) | ≥ 95 | ≥ 95 | ≥ 95 | % |
| Differential phase of colour subcarrier | ≤ 3.0 | ≤ 3.0 | ≤ 3.0 | deg |

CATHODE

Indirectly heated dispenser cathode

| | | |
|---|---------------|---|
| Heater voltage (a. c. or d. c.) | $6.5 \pm 2\%$ | V |
| Heater current ($V_h = 6.5V$) (approx.) | 3.2 | A |
| Pre-heating time (minimum) | 300 | s |

The heater starting current should never exceed a peak value of 8A with an a. c. supply, or 6A when a d. c. supply is used. When operated from d. c. the cathode must be connected to the positive side of the heater supply.

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 | - | 1.0 | kV |
| Grid 2 current | - | 3.0 | mA |
| Helix voltage | - | 4.2 | kV |
| Helix current | - | 20 | mA |
| Collector to helix voltage | - | 500 | V |
| Collector dissipation | - | 4.0 | kW |
| Power reflected from load | - | 20 | W |
| Cathode current | - | 1.0 | A |
| Altitude | - | 3.0 | km |

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

Forced-air

Minimum airflow (at sea level and for inlet temperatures up to 45°C)

3.5 m³/min
50 mm of water

for other altitudes

see page 7

Temperature

Reference point on mount cooler
max. (see outline drawing)

200 °C

AMBIENT TEMPERATURE

| | Min. | Max. | |
|---------------------------------|------|------|----|
| Operation to full specification | -20 | +50 | °C |
| Storage for tube and mount | -40 | - | °C |

PHYSICAL DATA

Tube

| | | |
|------------------|-----|-----|
| | kg | lb |
| Weight (approx.) | 3.5 | 7.7 |

Mount

| | | |
|------------------|----|-----|
| Weight (approx.) | 53 | 117 |
|------------------|----|-----|

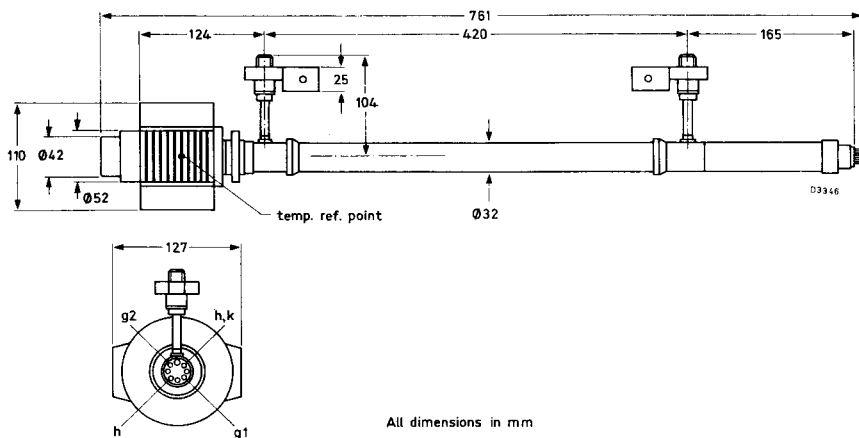
ACCESSORIES

| | |
|--|-------|
| Permanent magnet mount | 55380 |
| Base connector with 5 core cable (2m long) | 55381 |
| Phase compensation unit for 19 in. rack | 55382 |

NOTES

1. To be adjusted for indicated cathode current.
2. Including a loss of approximately 3dB in the phase compensation unit.
3. The intermodulation products of the input test signals are -70dB with respect to peak sync. The signals are set at $f_V = -8\text{dB}$, $f_S = -7\text{dB}$ and $f_{SB} = -17\text{dB}$ with respect to peak sync level. Vision/sound ratio 5: 1.
4. Measured with vision signal as well as with combined vision-sound signals.

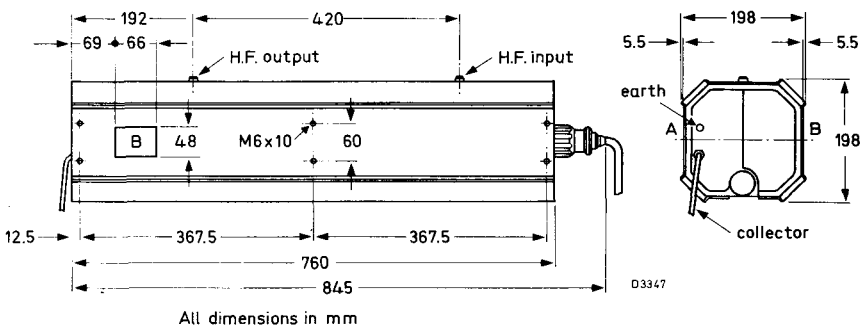
OUTLINE DRAWING OF YH1210



CONVERSION TABLE

| mm | in | mm | in |
|------|-------|-----|-------|
| 25 | 0.98 | 124 | 4.88 |
| Ø 32 | Ø1.26 | 127 | 5.00 |
| Ø 42 | Ø1.65 | 165 | 6.50 |
| Ø 52 | Ø2.05 | 420 | 16.54 |
| 104 | 4.09 | 761 | 29.96 |
| 110 | 4.33 | | |

OUTLINE DRAWING OF MOUNT



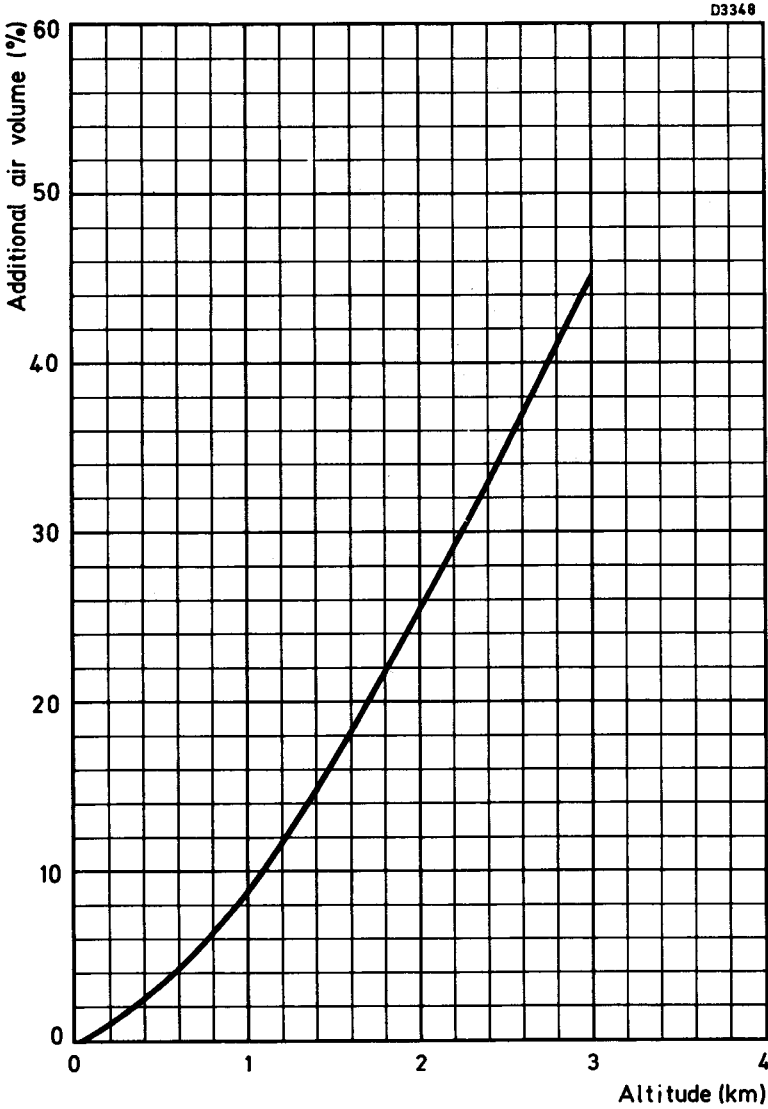
| Plug connections to mount | |
|---------------------------|--------------|
| Heater | Brown |
| Heater/Cathode | Brown/Yellow |
| Cathode | Yellow |
| Grid 1 | Green |
| Grid 2 | Blue |
| Earth via mount | Black |

The helix is internally connected to the tube body, which in turn is connected to the mount. The mount is earthed.

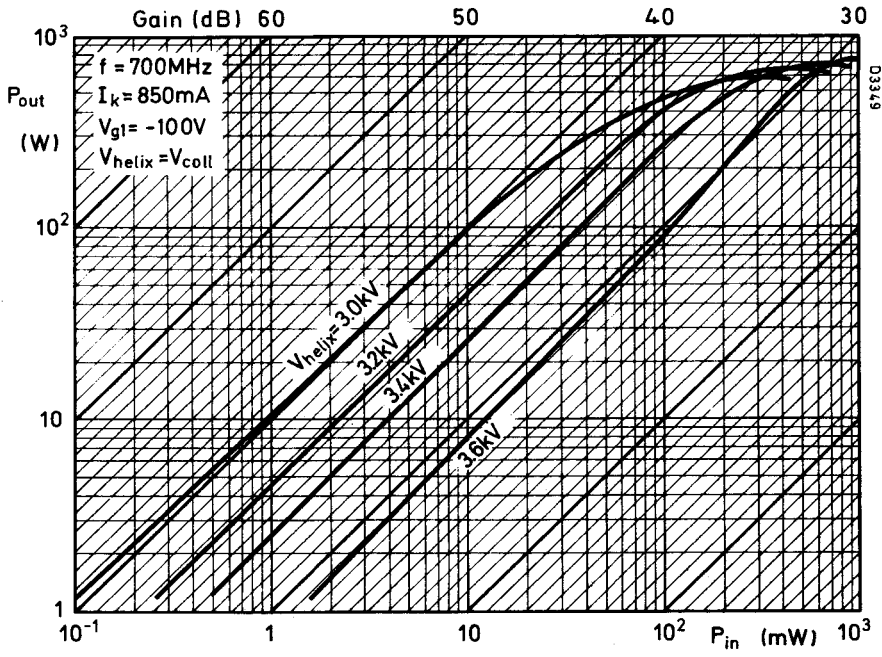
The collector is electrically isolated from the tube body and is connected to its power supply via the flying lead.

CONVERSION TABLE

| mm | in | mm | in |
|------|-------|-------|-------|
| 5.5 | 0.217 | 192 | 7.56 |
| 12.5 | 0.492 | 198 | 7.80 |
| 48 | 1.89 | 367.5 | 14.47 |
| 60 | 2.36 | 420 | 16.53 |
| 66 | 2.60 | 760 | 29.92 |
| 69 | 2.72 | 845 | 33.27 |



ADDITIONAL AIR VOLUME PLOTTED
AGAINST ALTITUDE



OUTPUT POWER PLOTTED AGAINST INPUT POWER

MICROWAVE COMPONENTS



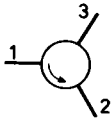
CIRCULATORS

GENERAL EXPLANATORY NOTES

INTRODUCTION

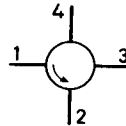
A circulator is a passive non-reciprocal device with three or more ports. It contains a core of ferrite material in which energy introduced into one port is transferred to an adjacent port, the other ports being isolated.

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.



3 port circulator
Fig.1

symbols



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

7249201

GENERAL EXPLANATORY NOTES

CIRCULATORS

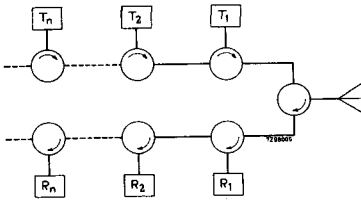


Fig. 4
Duplexing of a number of transmitters and receivers

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.

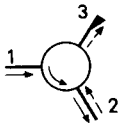


fig. 5

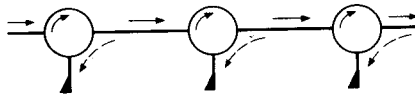


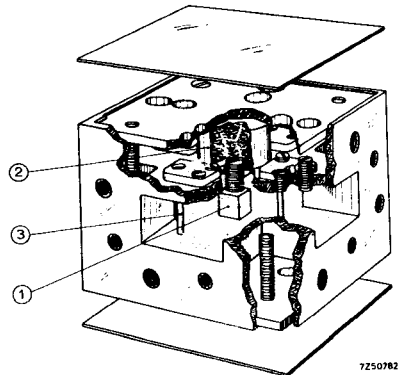
fig. 6

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

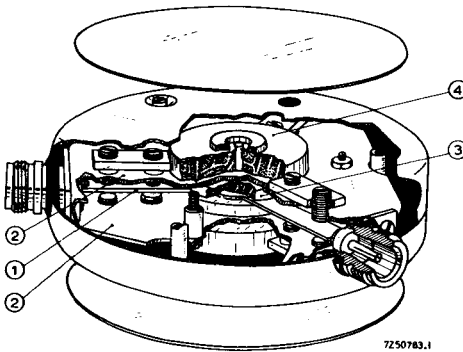


In this type three or four waveguides intersect each other at 120° or 90° angles. In Fig.7 a 4-port waveguide circulator of the junction type is shown. Exactly in the centre of the intersection a piece of ferrite (1) is located between two magnets (2).

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-arrangement¹⁾. 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.



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 biased by a magnetic field. The non-reciprocal behaviour of this type of isolator is produced by gyromagnetic effects which occur between the high frequency magnetic field and the electrons in the ferrite.

APPLICATION

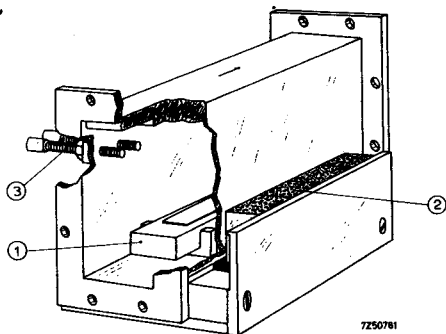
The main application of an isolator is to improve the behaviour of klystrons, magnetrons or travelling wave tubes by isolating the source from the load. The main factor is that an antenna or amplifier can not be ideally matched to the preceding function over the required frequency range so that energy 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°C to $+125^{\circ}\text{C}$.

TEST SPECIFICATION

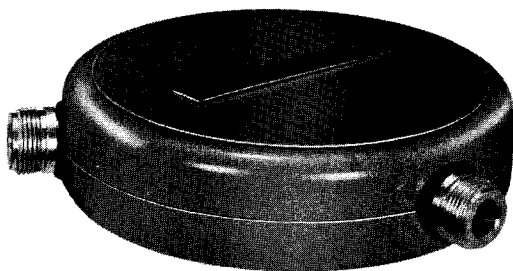
The isolators can withstand the following tests:

- 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.





ELECTRICAL DATA

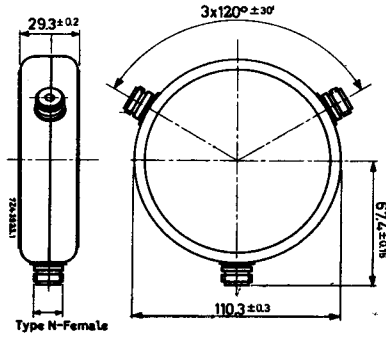
| | |
|-------------------------------|---------------|
| Frequency range | 1.9-2.3 GHz |
| Isolation α_{1-3} | > 20 dB |
| Insertion loss α_{1-2} | < 0.75 dB |
| V.S.W.R. | < 1.15 |
| Nominal power (c.w.) | 50 W |
| Temperature range | -10 to +80 °C |

For other temperature ranges please inquire

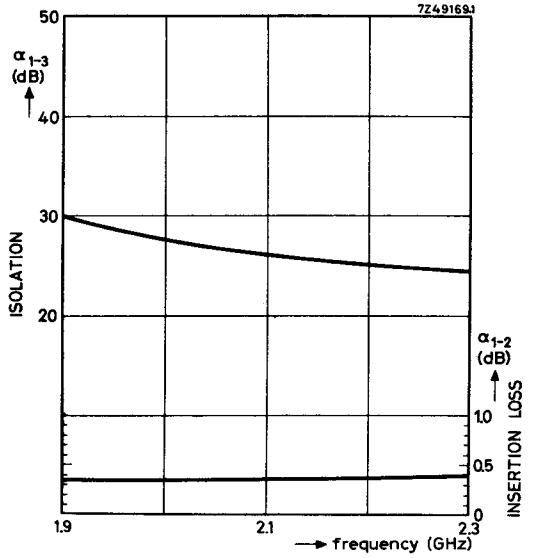
MECHANICAL DATA

| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 600 g |

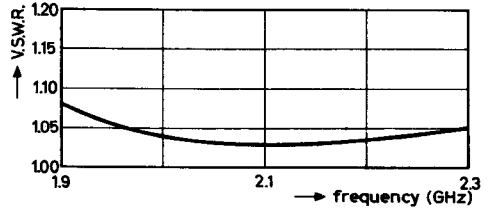
CL5001



Dimensions in mm

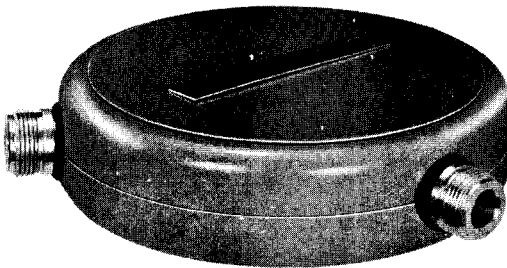


Typical performance as a function of frequency at a working temperature of 20°C .



CIRCULATOR

CL5005



ELECTRICAL DATA

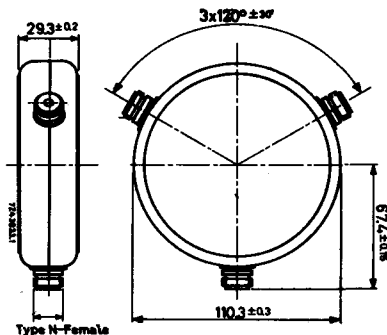
| | |
|-------------------------------|---------------|
| Frequency range | 2.2-3.0 GHz |
| Isolation α_{1-3} | > 20 dB |
| Insertion loss α_{1-2} | < 0.6 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 50 W |
| Temperature range | -10 to +80 °C |

For other temperature ranges please inquire

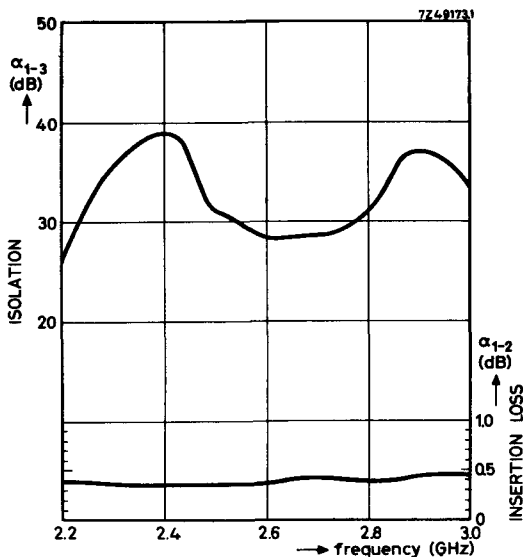
MECHANICAL DATA

| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 600 g |

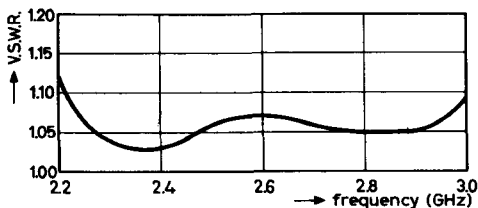
CL5005

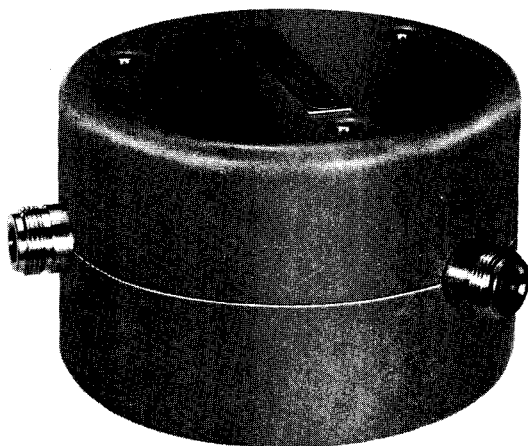


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20°C .





ELECTRICAL DATA

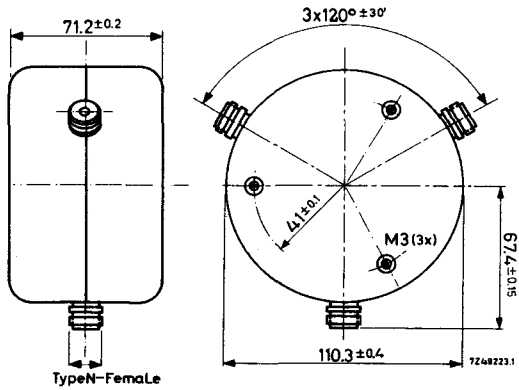
| | |
|------------------------------|---------------|
| Frequency range | 0.47-0.60 GHz |
| Isolation α_1 -3 | > 20 dB |
| Insertion loss α_1 -2 | < 0.6 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 100 W |
| Temperature range | -10 to +80 °C |

For other temperature ranges please inquire

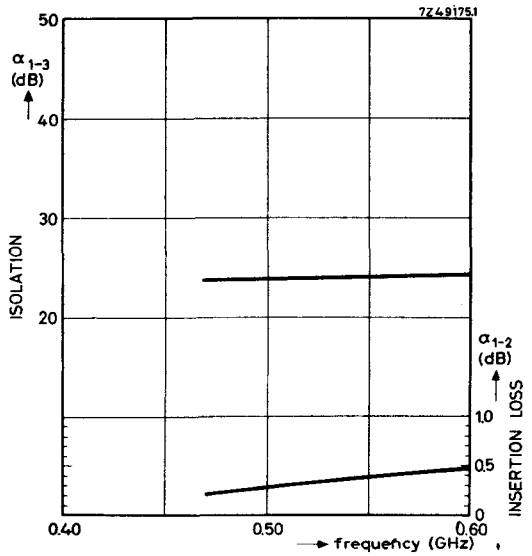
MECHANICAL DATA

| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 2080 g |

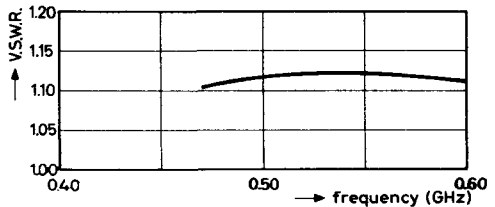
CL5007

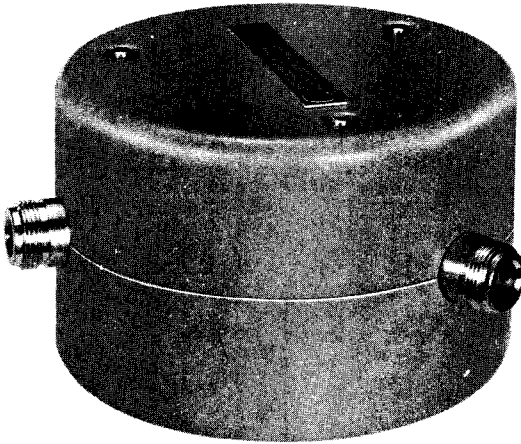


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20°C .





ELECTRICAL DATA

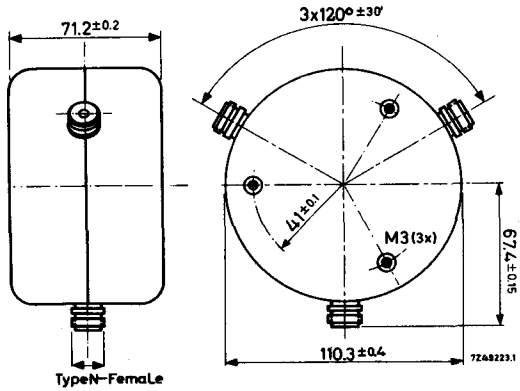
| | |
|------------------------------|---------------|
| Frequency range | 0.59-0.72 GHz |
| Isolation α_1 -3 | > 20 dB |
| Insertion loss α_1 -2 | < 0.6 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 100 W |
| Temperature range | -10 to +80 °C |

For other temperature ranges please inquire

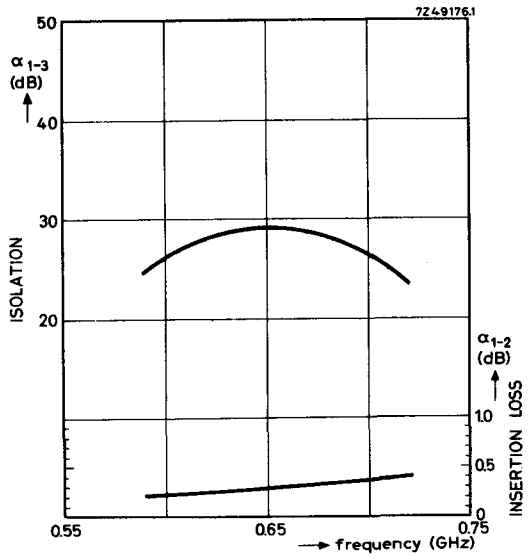
MECHANICAL DATA

| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 2080 g |

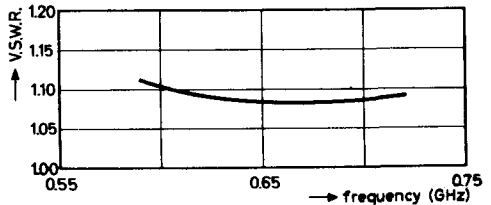
CL5008

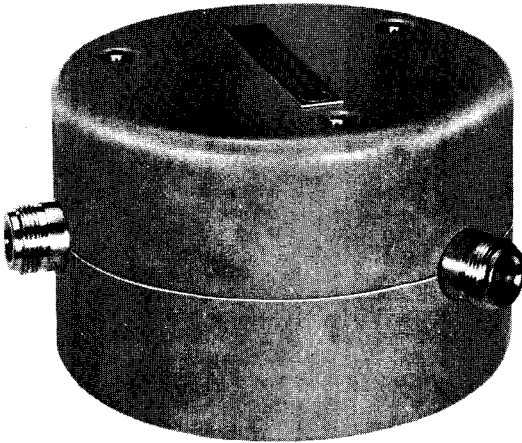


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20°C .





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 |

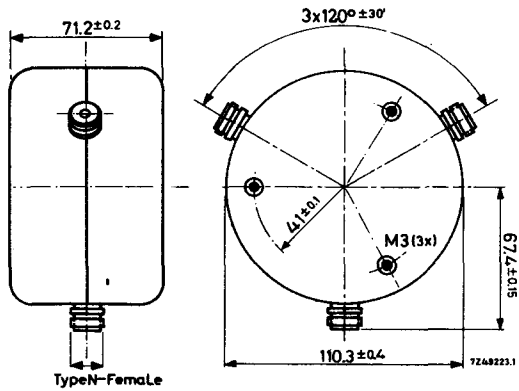
For other temperature ranges please inquire

MECHANICAL DATA

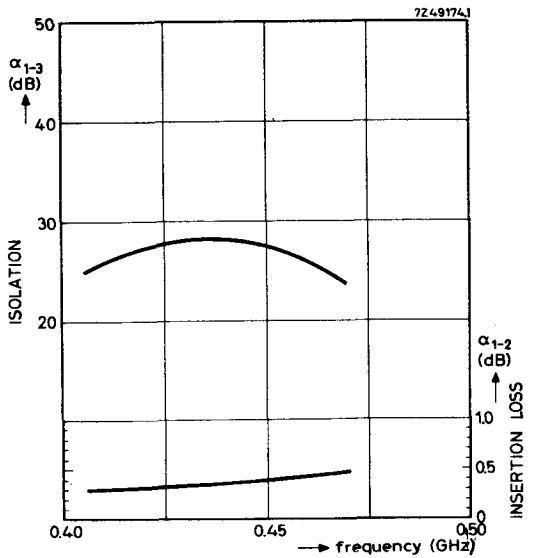
| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 2080 g |



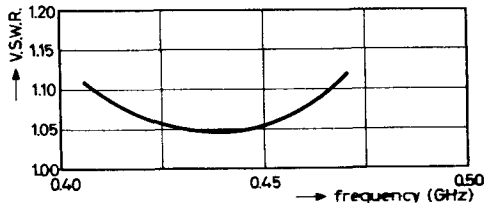
CL5009

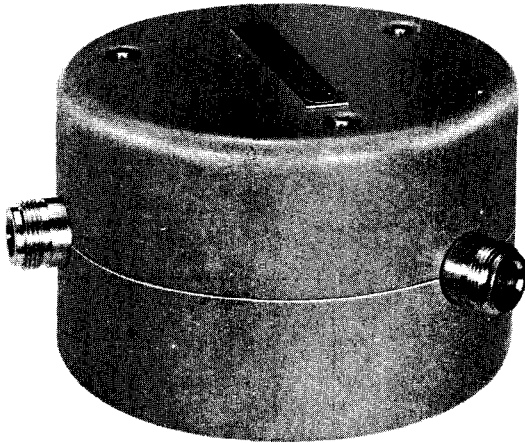


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 °C |

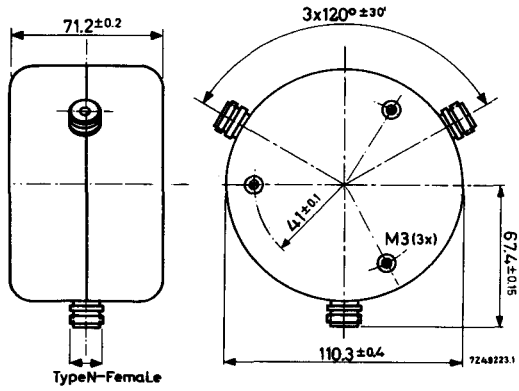
For other temperature ranges please inquire

MECHANICAL DATA

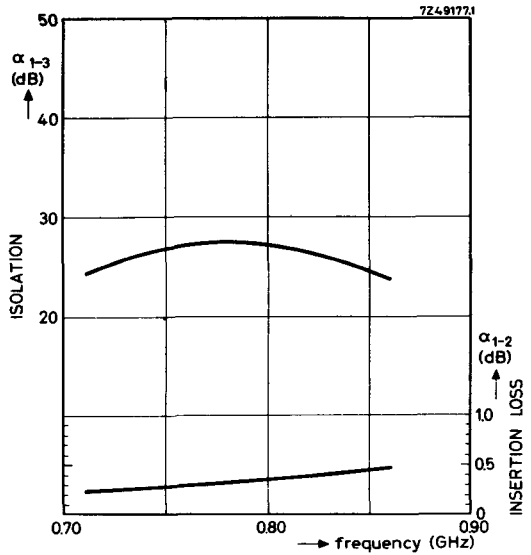
| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 2080 g |



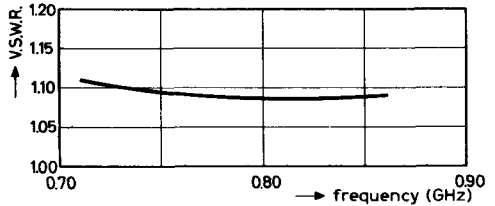
CL5010

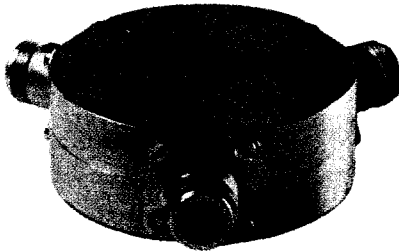


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20°C .





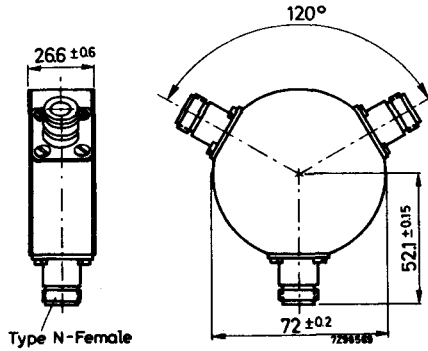
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 °C |
| | For other temperature ranges please inquire |

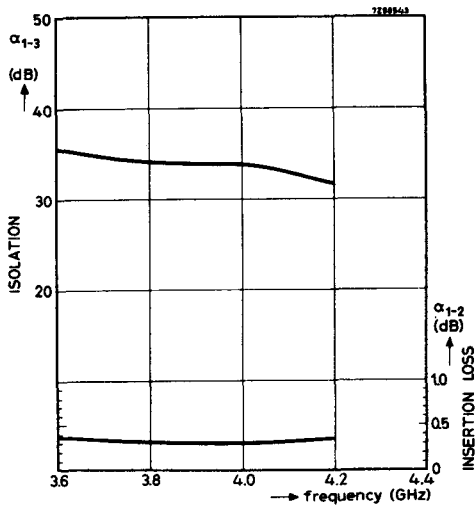
MECHANICAL DATA

| | |
|--------------|---|
| Construction | coaxial 3 port |
| Material | brass |
| Terminations | type N-female |
| Finish | silverplated, top and bottom cover black |
| Weight | 550 g |

CL5012

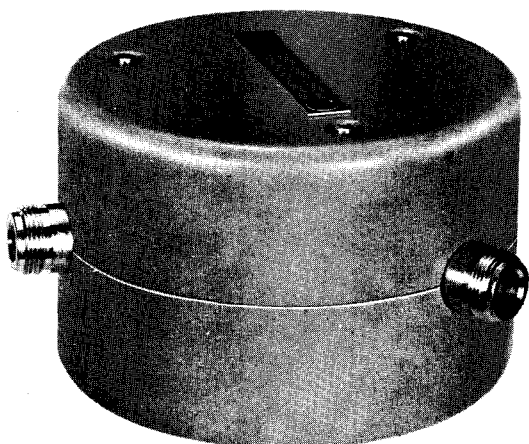


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C





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 °C |

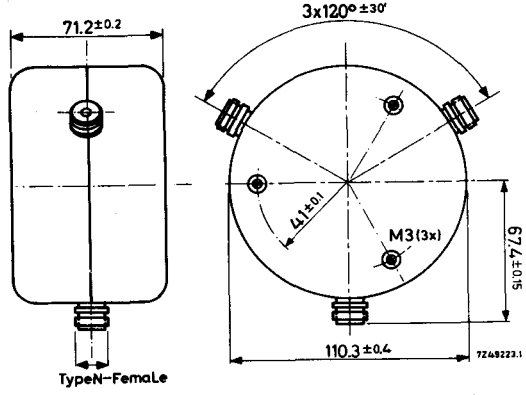
For other temperature ranges please inquire

MECHANICAL DATA

| | |
|--------------|---|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, body outside enamelled grey |
| Weight | 2080 g |

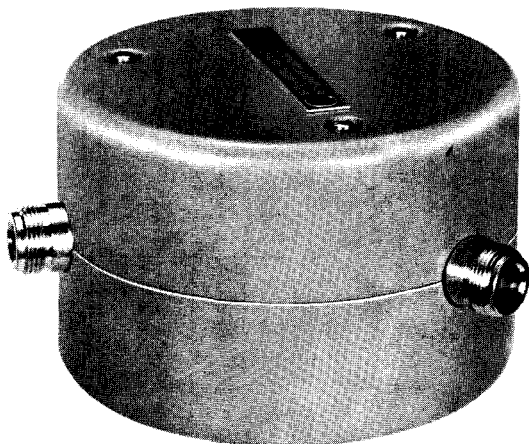


CL5014



Dimensions in mm





ELECTRICAL DATA

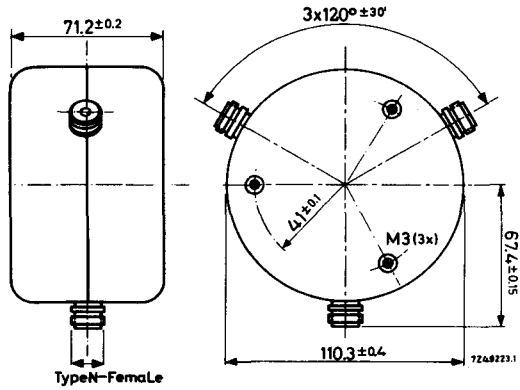
| | |
|-------------------------------|-----------------|
| Frequency range | 0.608-0.783 GHz |
| Isolation α_{1-3} | > 20 dB |
| Insertion loss α_{1-2} | < 0.75 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 100 W |
| Temperature range | -10 to +80 °C |

For other temperature ranges please inquire

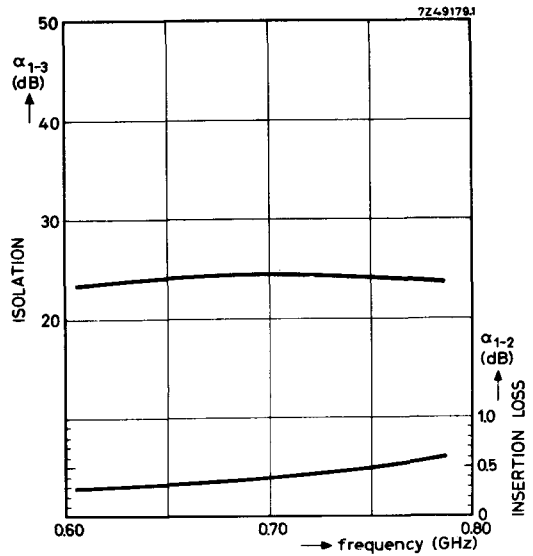
MECHANICAL DATA

| | |
|--------------|-----------------------------|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated |
| | body outside enamelled grey |
| Weight | 2080 g |

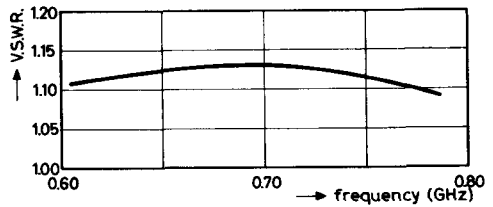
CL5015

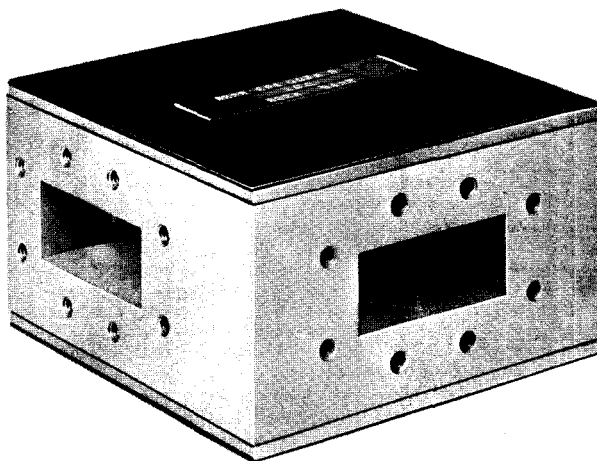


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20°C .





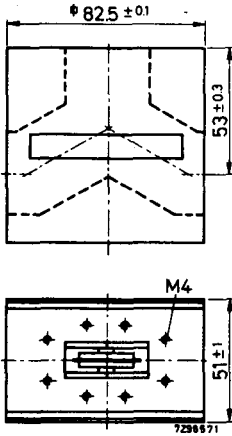
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 |

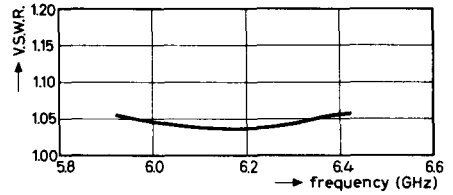
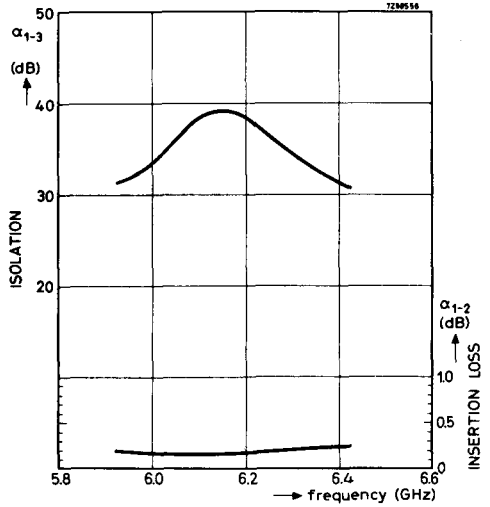
MECHANICAL DATA

| | |
|--------------|--------------------------|
| Construction | waveguide 3 port |
| Material | aluminium |
| Flange type | UER70 (I.E.C.) |
| Finish | alodine, covers black |
| Weight | 950 g |

CL5020



Dimensions in mm

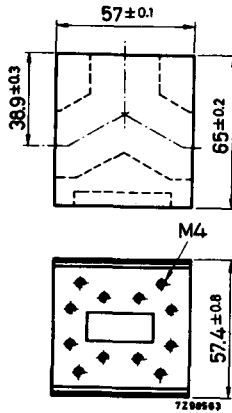


Typical performance as a function of frequency at a working temperature of 20 °C.



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 |

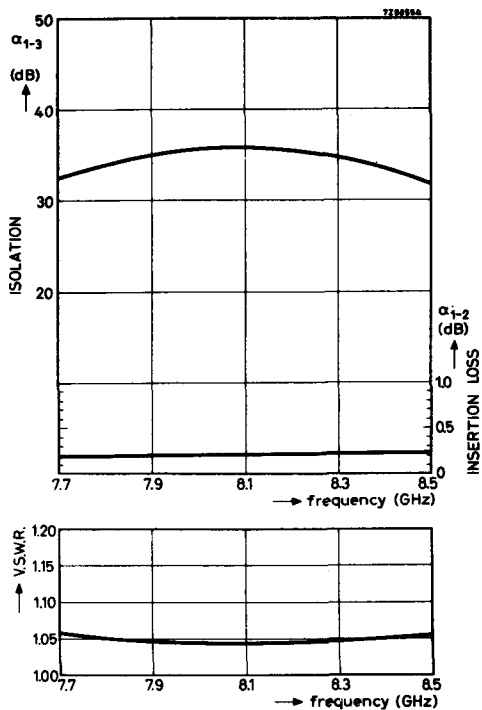
For other temperature ranges please inquire

MECHANICAL DATA

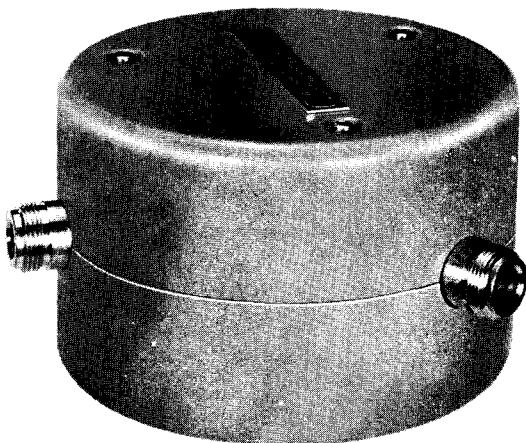
| | |
|--------------|--|
| Construction | waveguide 3 port |
| Material | brass |
| Flange type | UER84/UBR84 (I.E.C.) |
| Finish | goldplated upon silverplated outside enamelled grey |



CL5021



Typical performance as a function of frequency at a working temperature of 20 °C.



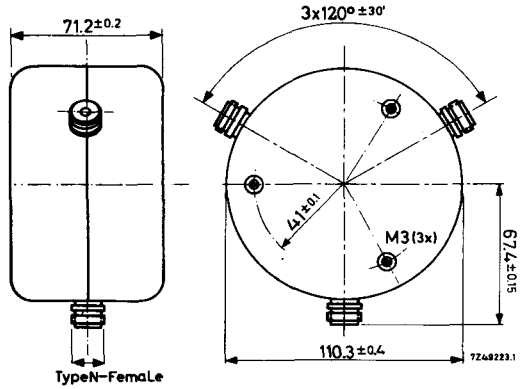
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 °C |
| | For other temperature ranges please inquire |

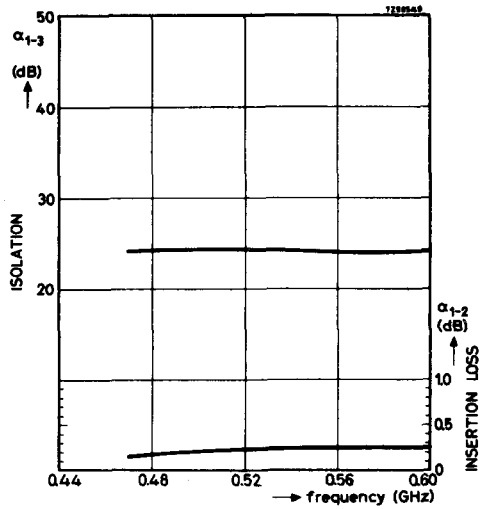
MECHANICAL DATA

| | |
|--------------|--|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, outside enamelled grey |
| Weight | 2080 g |

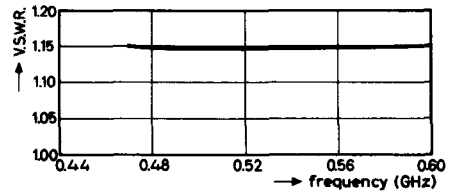
CL5027

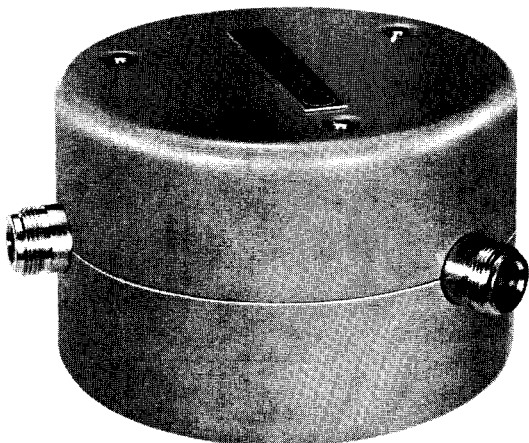


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

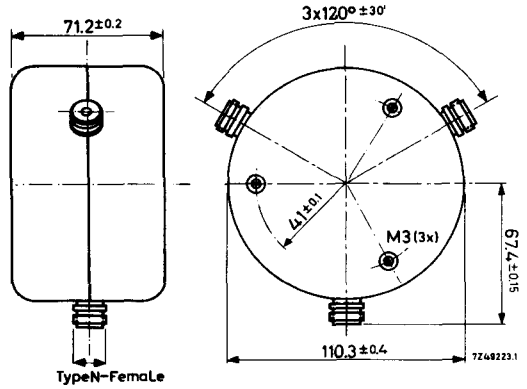
| | |
|-------------------------------|---|
| Frequency range | 0.59-0.72 GHz |
| Isolation α_{1-3} | > 22 dB |
| Insertion loss α_{1-2} | < 0.35 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 500 W |
| Temperature range | -10 to +70 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

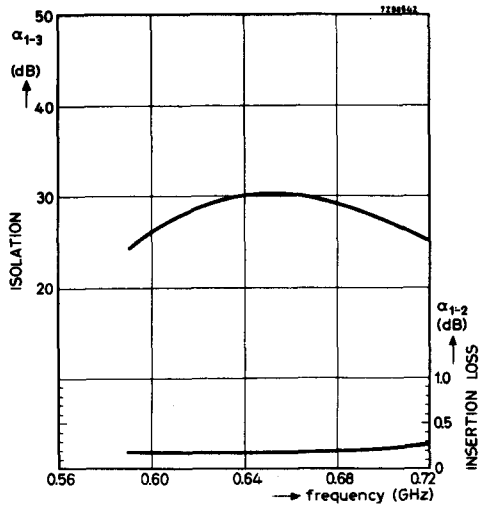
| | |
|--------------|--|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, outside enamelled grey |
| Weight | 2080 g |



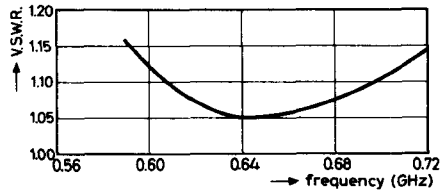
CL5028

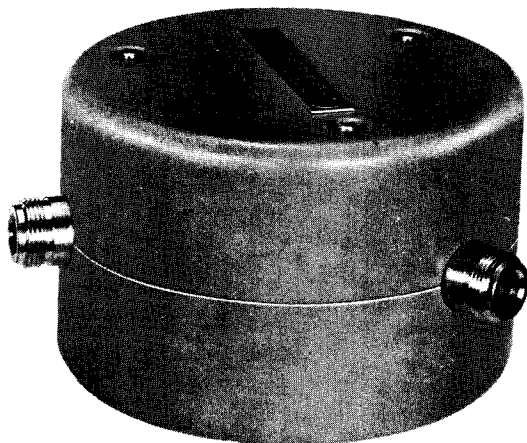


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

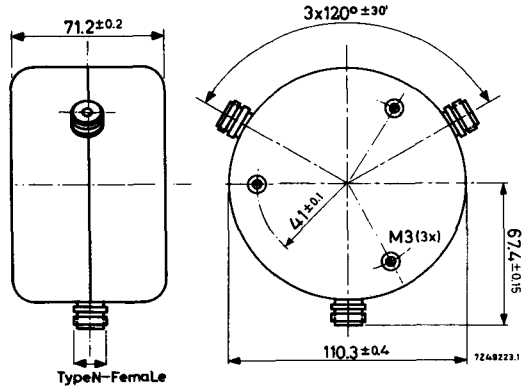
| | |
|-------------------------------|---------------|
| Frequency range | 0.71-0.86 GHz |
| Isolation α_{1-3} | > 22 dB |
| Insertion loss α_{1-2} | < 0.35 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 500 W |
| Temperature range | -10 to +70 °C |

For other temperature ranges please inquire

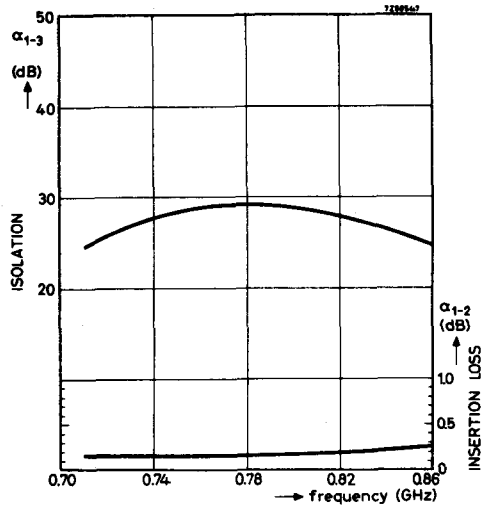
MECHANICAL DATA

| | |
|--------------|--|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | connectors silverplated, outside enamelled grey |
| Weight | 2080 g |

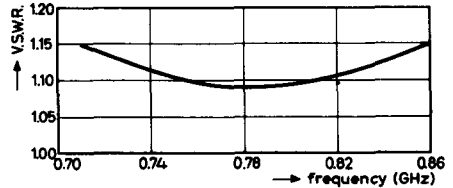
CL5029

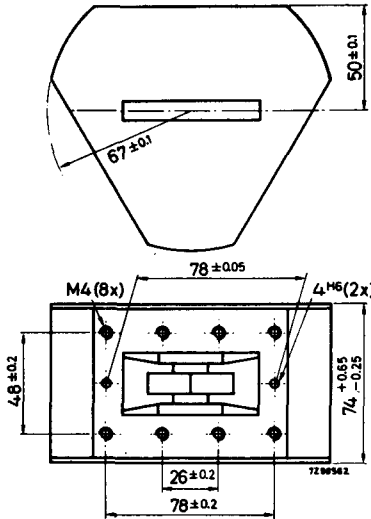


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





Dimensions in mm

ELECTRICAL DATA

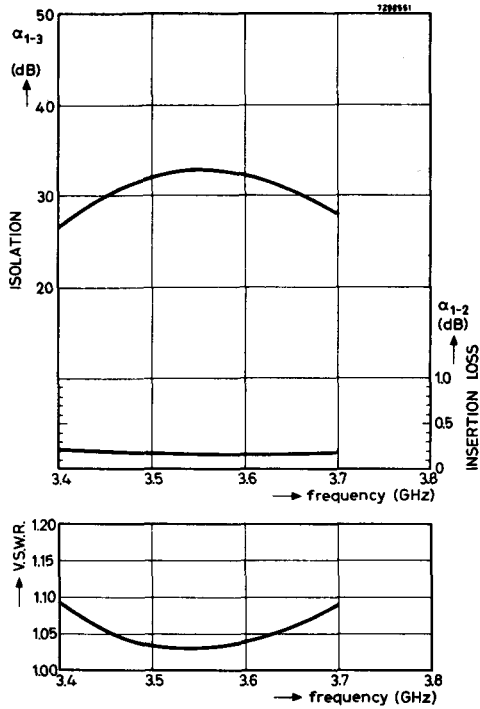
| | |
|-------------------------------|---|
| Frequency range | 3.4-3.7 GHz |
| Isolation α_{1-3} | > 25 dB |
| Insertion loss α_{1-2} | < 0.3 dB |
| V.S.W.R. | < 1.1 |
| Nominal power (c.w.) | 50 W |
| Temperature range | +5 to +45 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

| | |
|--------------|-----------------------------------|
| Construction | waveguide 3 port |
| Material | aluminium |
| Flange type | C.C.T.U. No.6 *) |
| Finish | alodine outside enamelled grey |

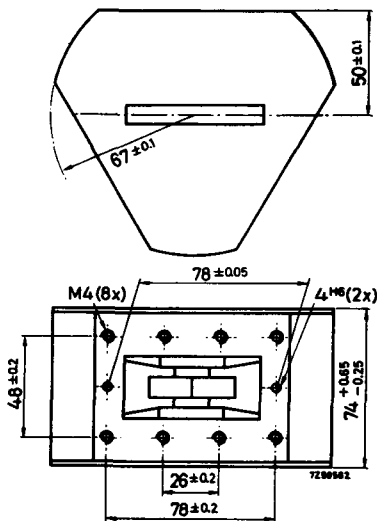
*) UER40 available on request

CL5031



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

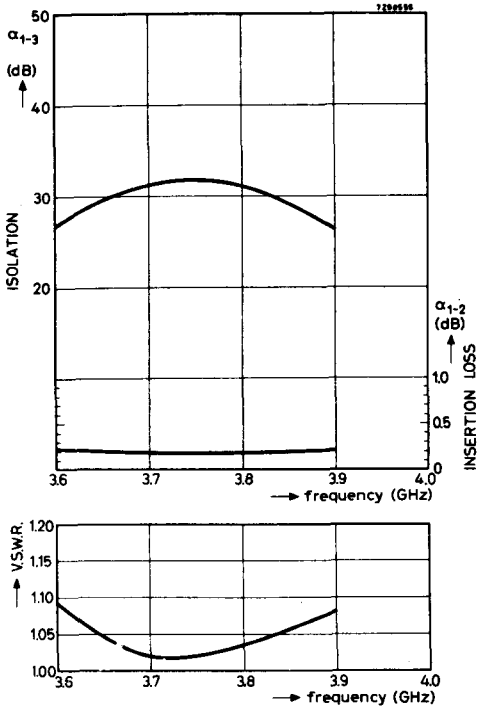
MECHANICAL DATA

| | |
|--------------|------------------------------------|
| Construction | waveguide 3 port |
| Material | aluminium |
| Flange type | C.C.T.U. No.6 *) |
| Finish | alodine, outside enamelled grey |

*) UER40 available on request

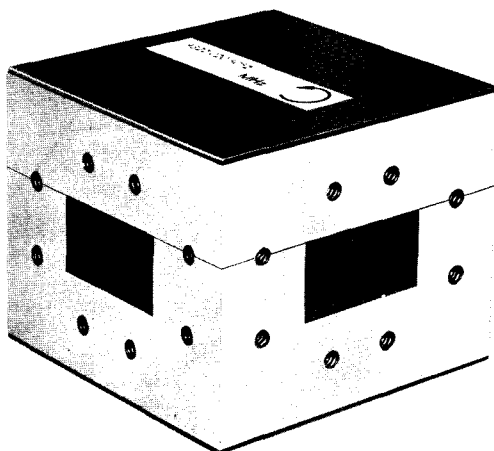


CL504I



Typical performance as a function of frequency at a working temperature of 20 °C.





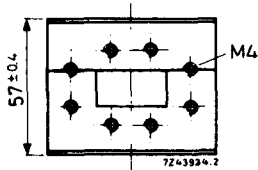
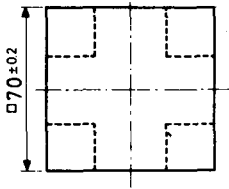
ELECTRICAL DATA

| | |
|-----------------------------|---|
| 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 |

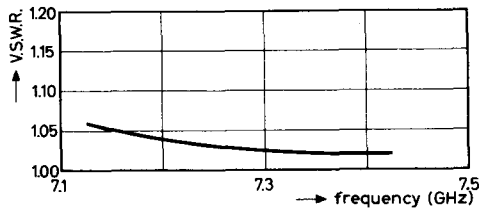
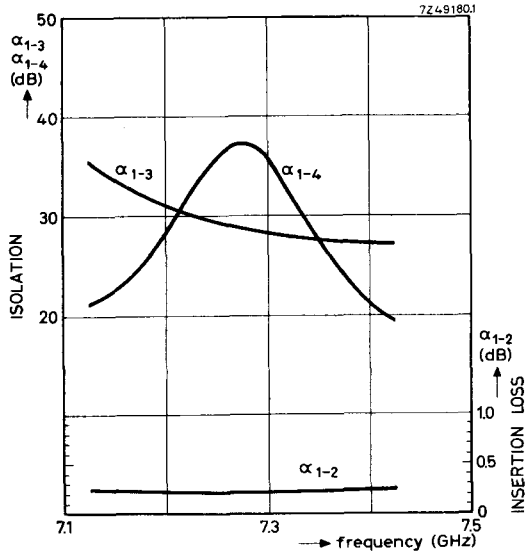
MECHANICAL DATA

| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |

CL5050

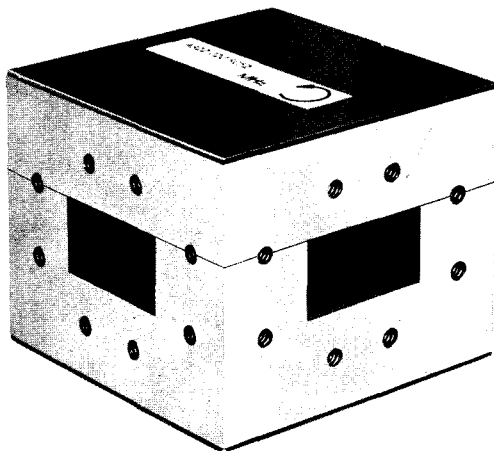


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

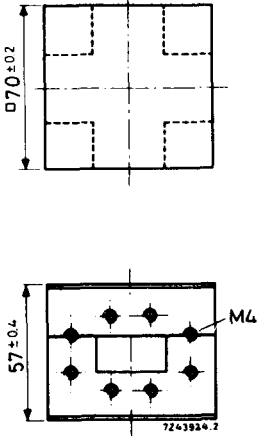
| | |
|-----------------------------|-----------------|
| Frequency range | 6.825-7.125 GHz |
| Isolation α_1-3 | > 25 dB |
| α_1-4 | > 18 dB |
| Insertion loss α_1-2 | < 0.4 |
| V.S.W.R. | < 1.08 |
| Nominal power (c.w.) | 100 W |
| Temperature range | +10 to +60 °C |

For other temperature ranges please inquire

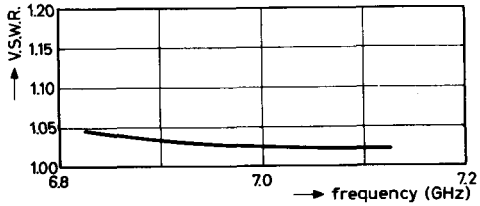
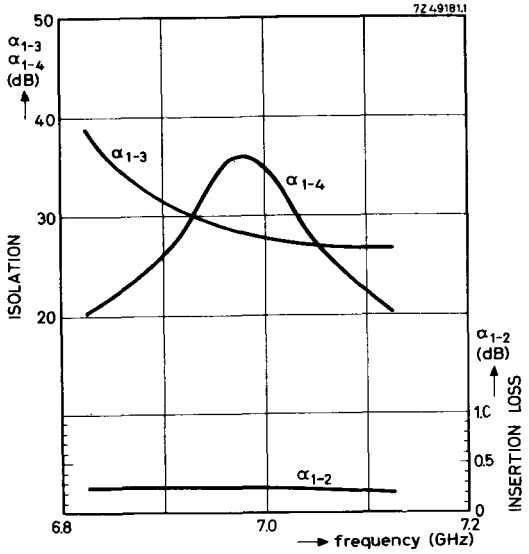
MECHANICAL DATA

| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |

CL5051



Dimensions in mm.

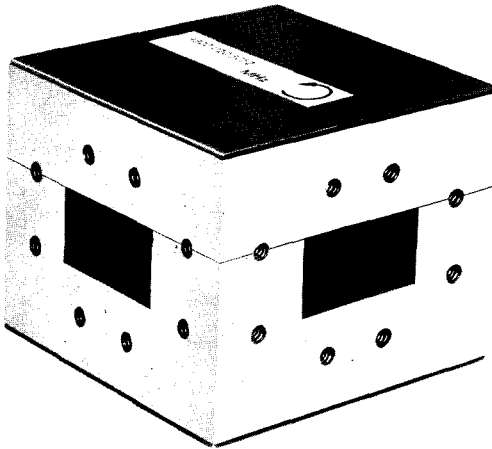


Typical performance as a function of frequency at a working temperature of 20 °C.



CIRCULATOR

CL5052



ELECTRICAL DATA

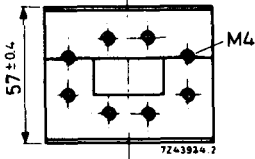
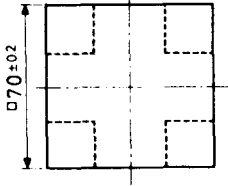
| | |
|-------------------------------|-----------------|
| Frequency range | 6.125-6.425 GHz |
| Isolation α_{1-3} | > 30 dB |
| α_{1-4} | > 18 dB |
| Insertion loss α_{1-2} | < 0.4 dB |
| V.S.W.R. | < 1.1 |
| Nominal power (c.w.) | 100 W |
| Temperature range | +10 to +60 °C |

For other temperature ranges please inquire

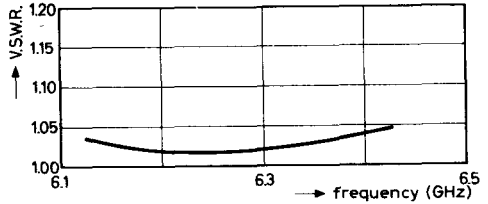
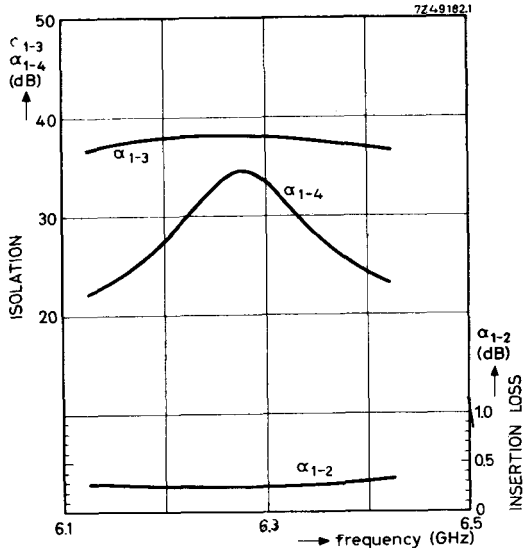
MECHANICAL DATA

| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |

CL5052

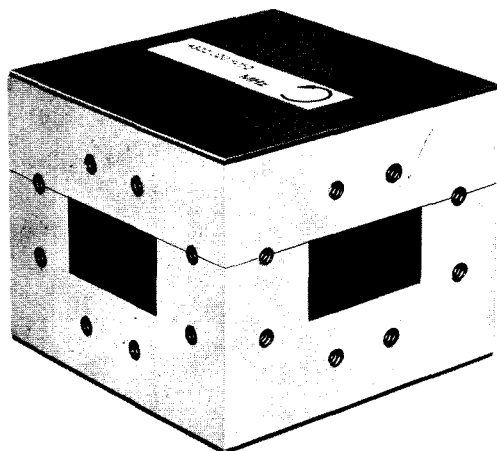


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





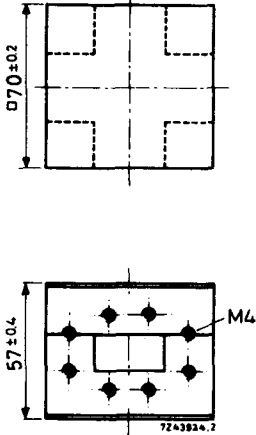
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 |

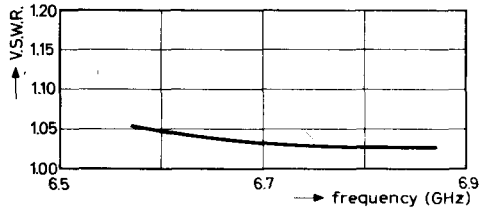
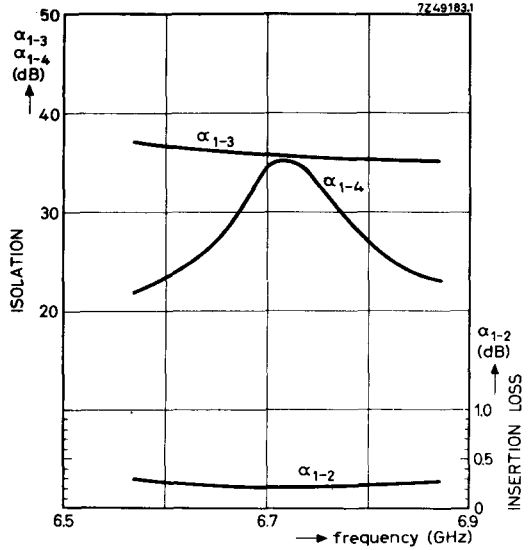
MECHANICAL DATA

| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |

CL5053

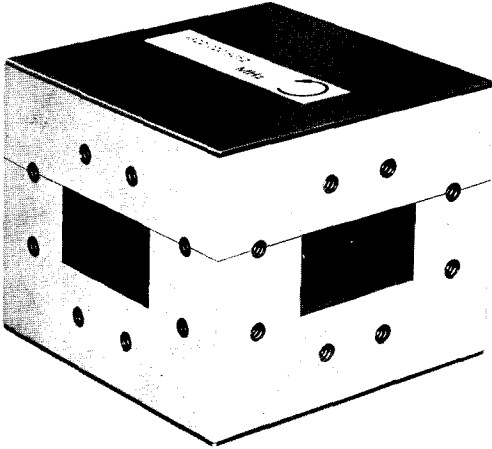


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

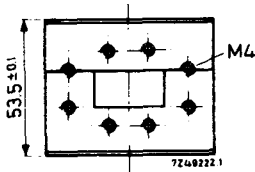
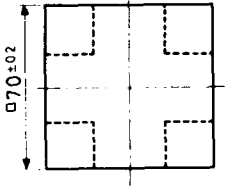
| | |
|-------------------------------|---|
| Frequency range | 7.425-7.725 GHz |
| Isolation α_{1-3} | > 30 dB |
| α_{1-4} | > 20 dB |
| Insertion loss α_{1-2} | < 0.4 dB |
| V.S.W.R. | < 1.1 |
| Nominal power (c.w.) | 100 W |
| Temperature range | +10 to +60 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

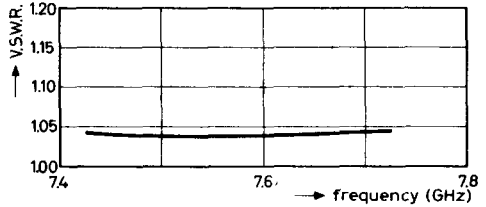
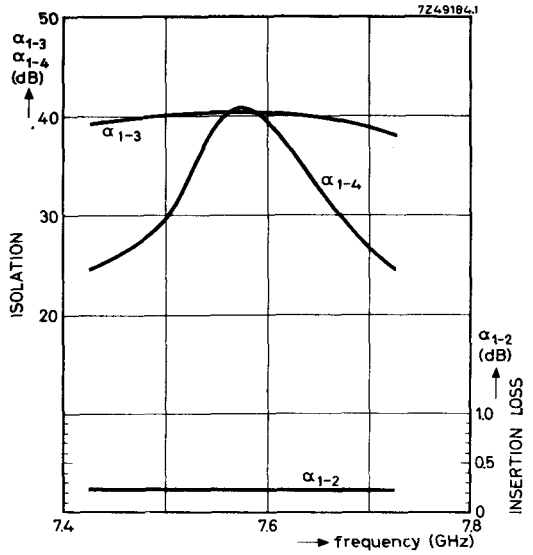
| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |



CL5054

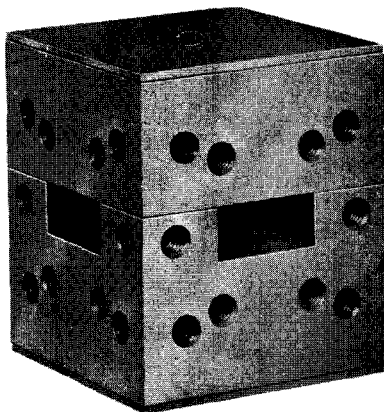


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





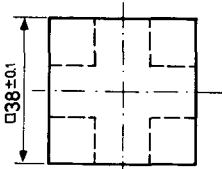
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 |

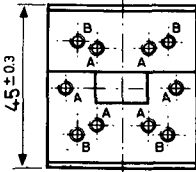
MECHANICAL DATA

| | |
|--------------|--|
| 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

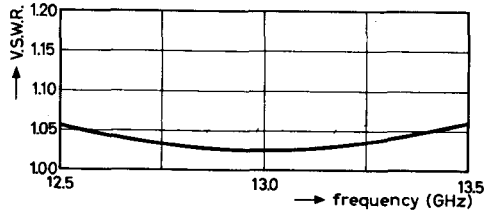
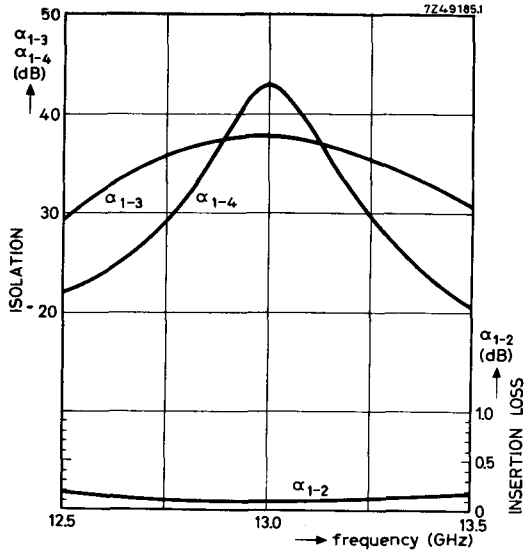


A for IEC flange UER 140
B for IEC flange UBR 140



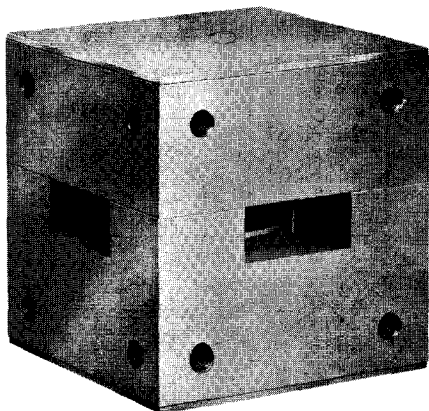
7249225

Dimensions in mm.



Typical performance as a function of frequency
at a working temperature of 20 °C.





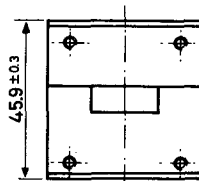
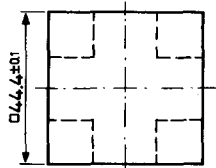
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 |

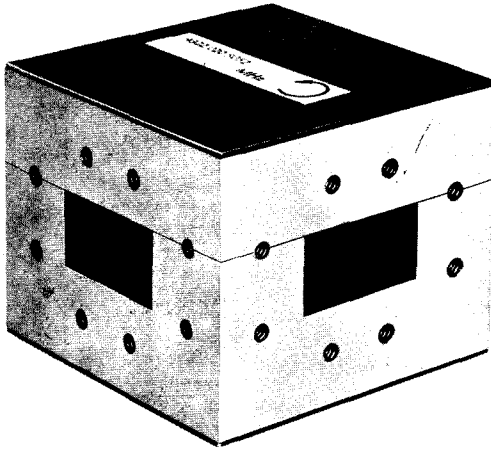
CL5056



7Z49221

Dimensions in mm.





ELECTRICAL DATA

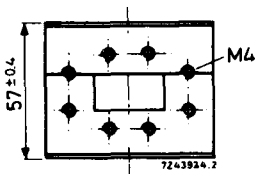
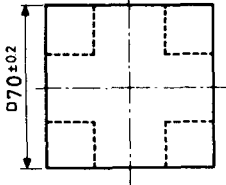
| | |
|-------------------------------|---|
| Frequency range | 5.925 - 6.175 GHz |
| Isolation α_{1-3} | > 30 dB |
| α_{1-4} | > 20 dB |
| Insertion loss α_{1-2} | < 0.4 dB |
| V.S.W.R. | < 1.1 |
| Nominal power (c.w.) | 100 W |
| Temperature range | +10 to +60 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

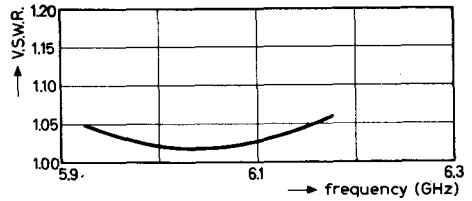
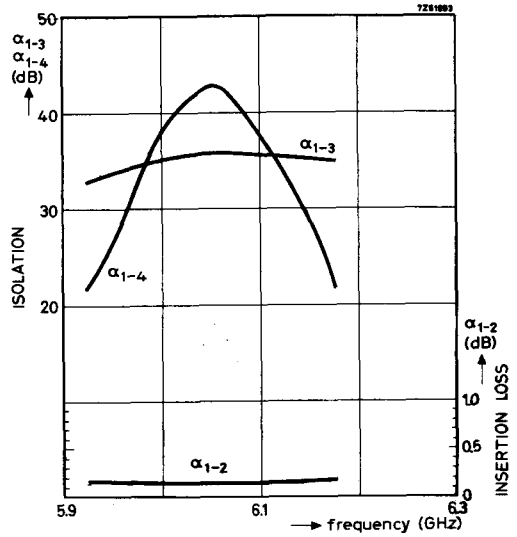
| | |
|--------------|--|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated outside enamelled grey |
| Weight | 920 g |



CL5057

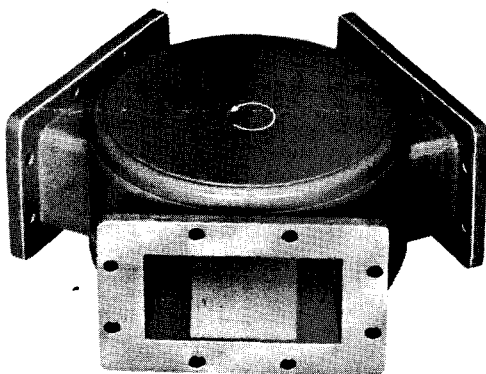


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

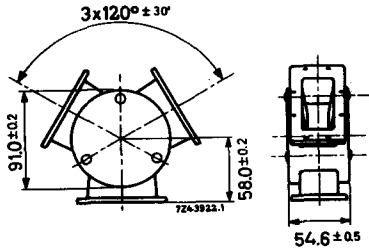
For other temperature ranges please inquire

MECHANICAL DATA

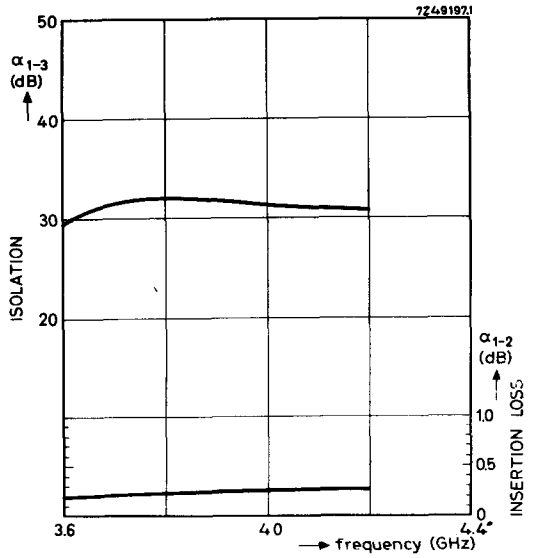
| | |
|--------------|---|
| Construction | waveguide 3 port |
| Material | aluminium |
| Flange type | UER 40 (I.E.C.) |
| Finish | iridium flashed, covers enamelled grey |



CL5075

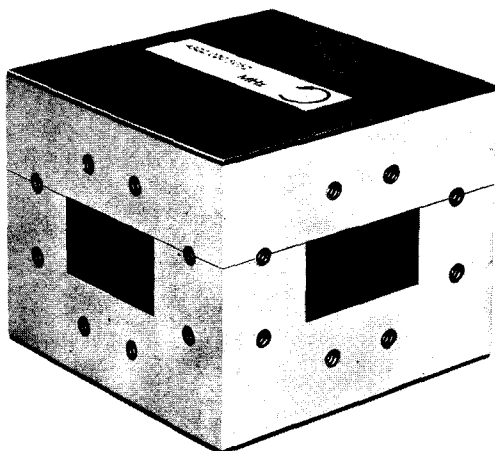


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





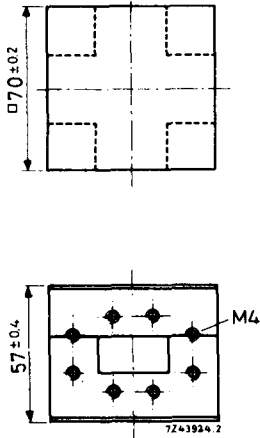
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 °C |
| | For other temperature ranges please inquire |

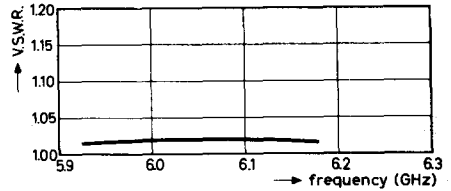
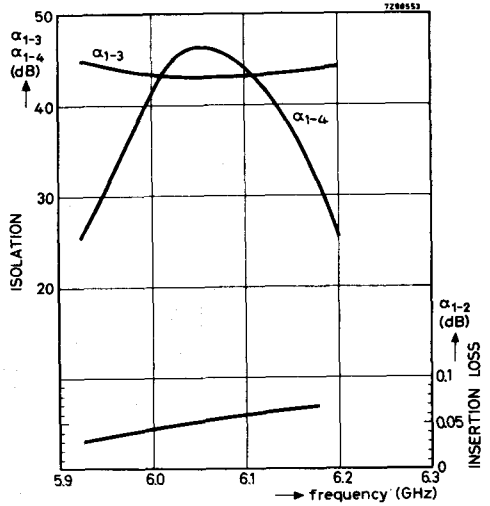
MECHANICAL DATA

| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |

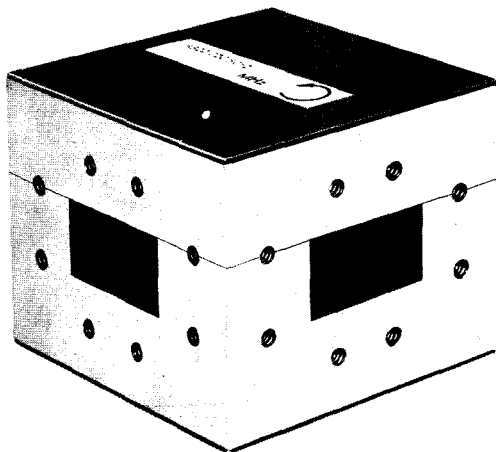
CL5081



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.



ELECTRICAL DATA

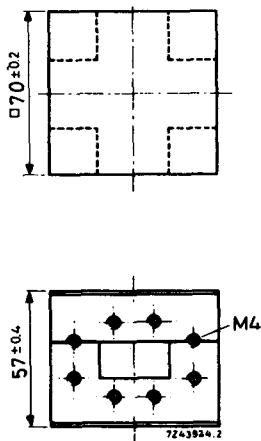
| | |
|-------------------------------|---|
| Frequency range | 6.125-6.425 GHz |
| Isolation α_{1-3} | > 30 dB |
| α_{1-4} | > 20 dB |
| Insertion loss α_{1-2} | < 0.1 dB |
| V.S.W.R. | < 1.06 |
| Nominal power (c.w.) | 150 W |
| Temperature range | +10 to +60 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

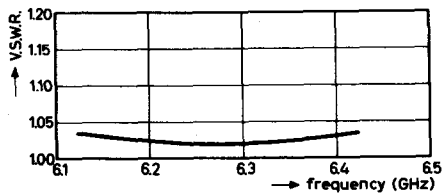
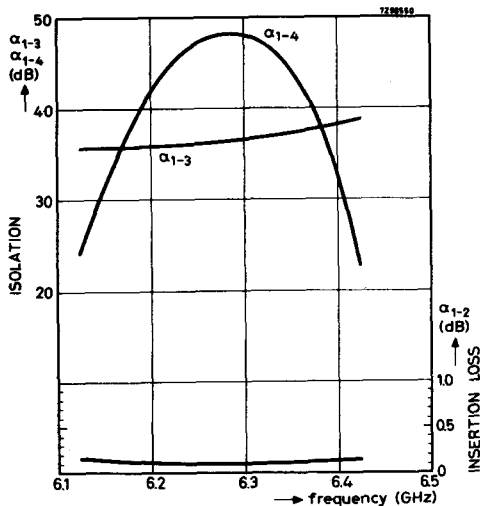
| | |
|--------------|---|
| Construction | waveguide 4 port |
| Material | brass |
| Flange type | UER 70 (I.E.C.) |
| Finish | goldplated upon silverplated, covers black |
| Weight | 920 g |



CL5091

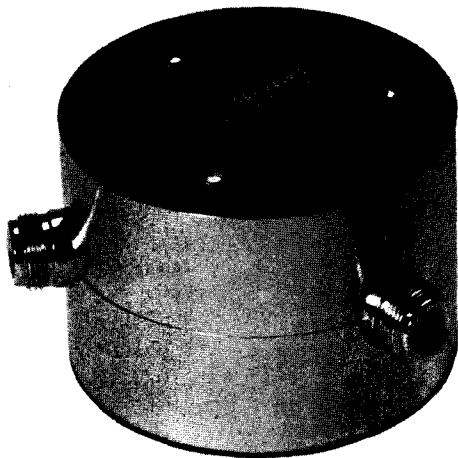


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





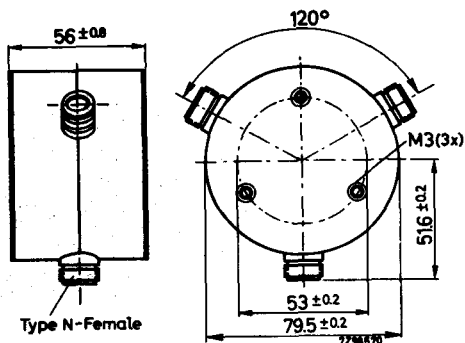
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 °C |
| | For other temperature ranges please inquire |

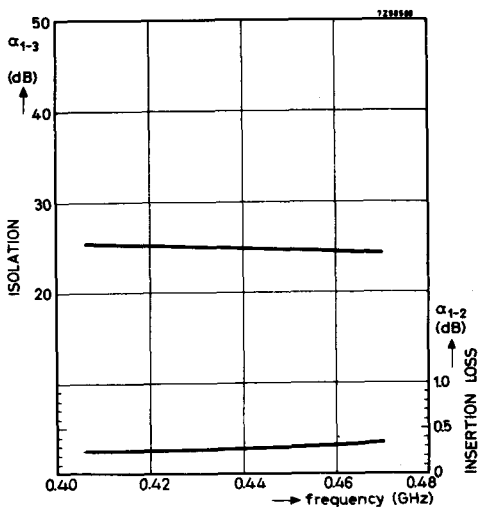
MECHANICAL DATA

| | |
|--------------|--------------------------------------|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | silverplated |
| Weight | top and bottom cover black 1200 g |

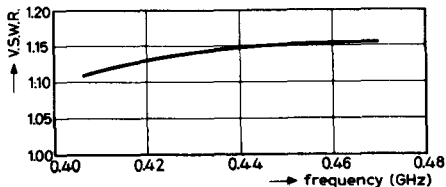
CL5151



Dimensions in mm

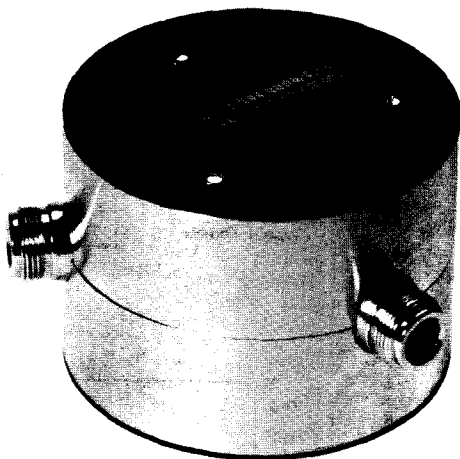


Typical performance as a function of frequency at a working temperature of 20°C .



CIRCULATOR

CL5171



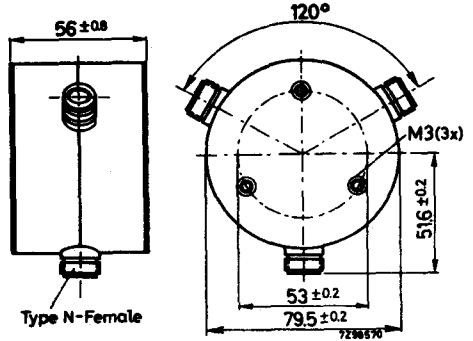
ELECTRICAL DATA

| | |
|-------------------------------|---|
| Frequency range | 0.59-0.72 GHz |
| Isolation α_{1-3} | > 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 |

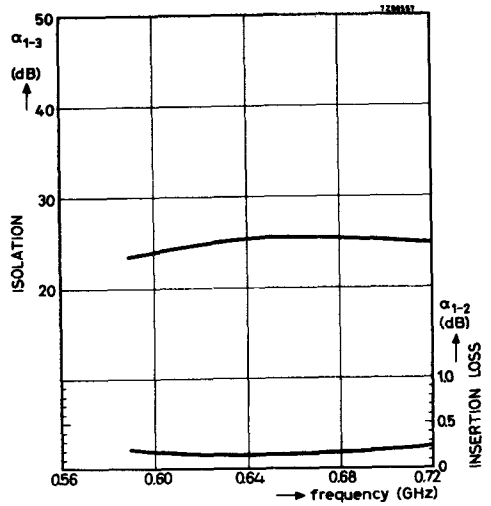
MECHANICAL DATA

| | |
|--------------|----------------------------|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | silverplated |
| | top and bottom cover black |
| Weight | 1200 g |

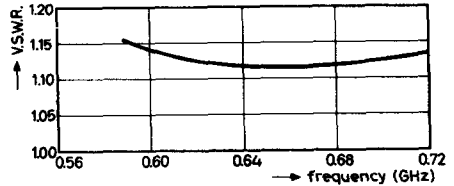
CL5171

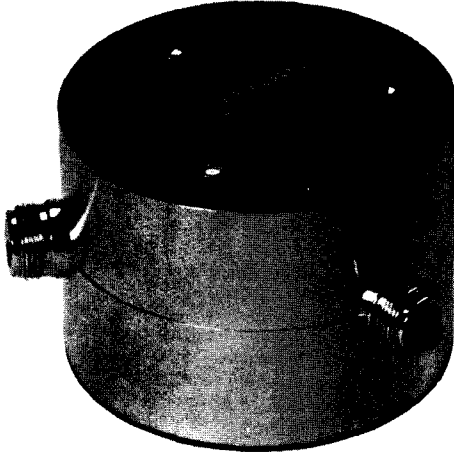


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20°C .





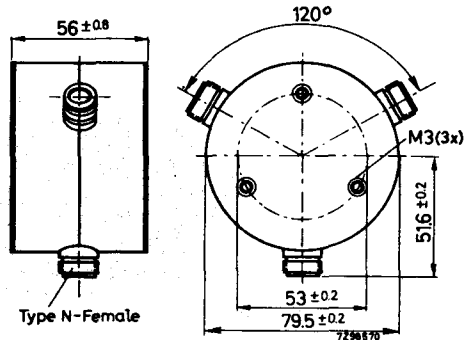
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 |

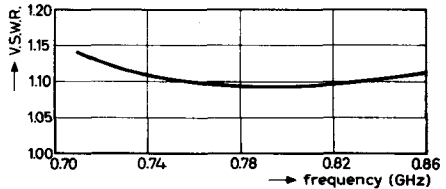
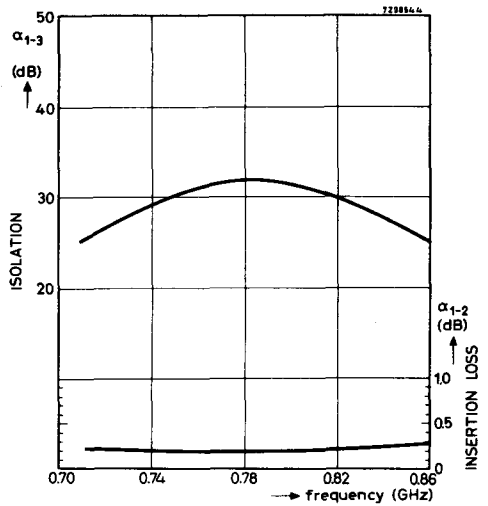
MECHANICAL DATA

| | |
|--------------|----------------------------|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | silverplated |
| | top and bottom cover black |
| Weight | 1200 g |

CL5181

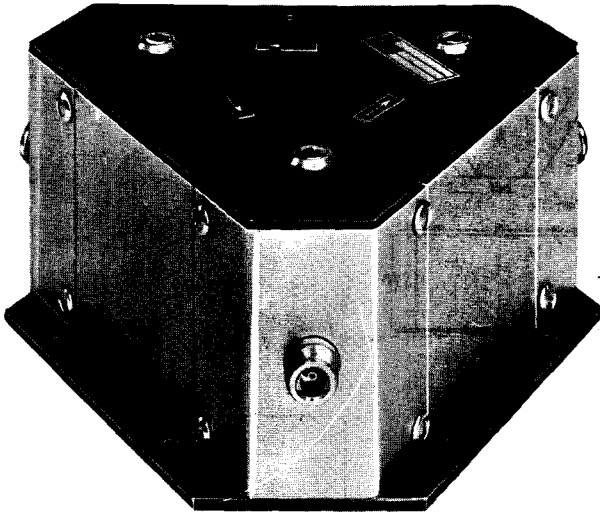


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





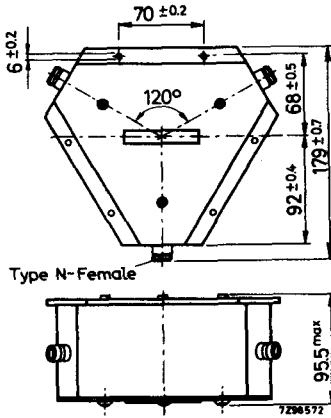
ELECTRICAL DATA

| | |
|-------------------------------|---|
| 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 |

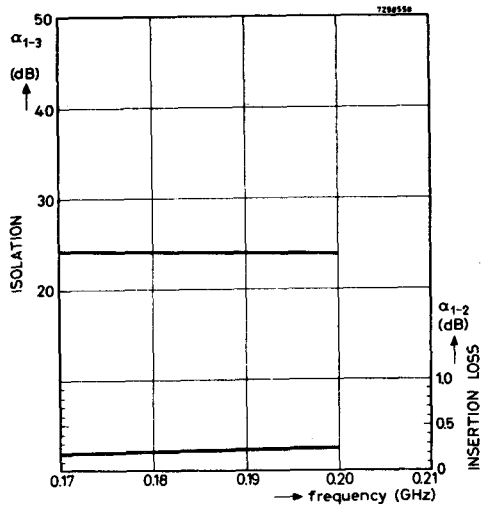
MECHANICAL DATA

| | |
|--------------|--|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | body nickelplated connectors silverplated |
| Weight | top and bottom cover black 6400 g |

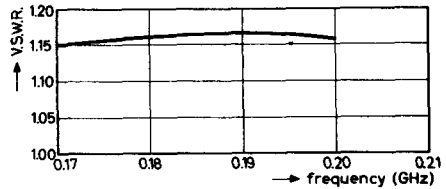
CL5191

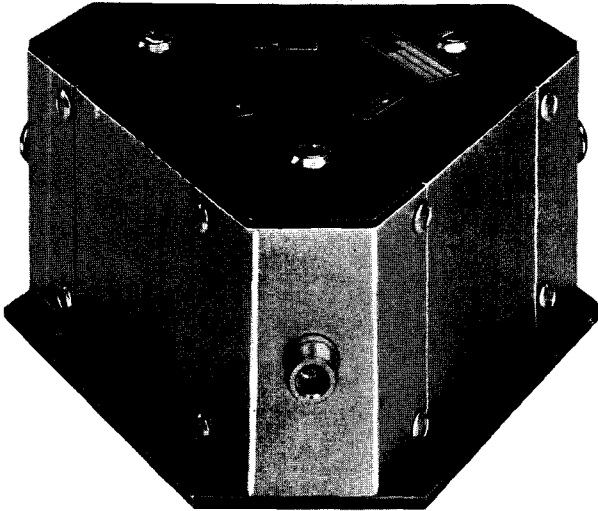


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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

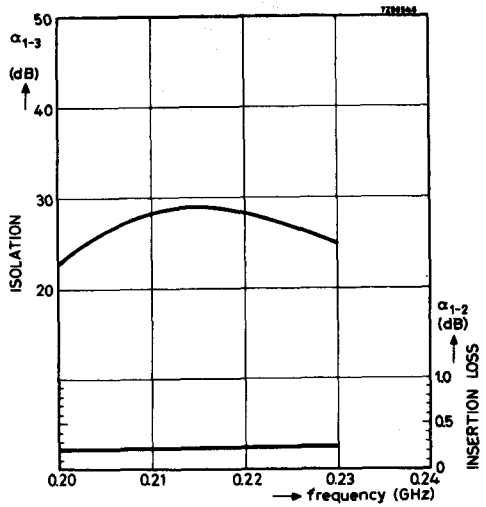
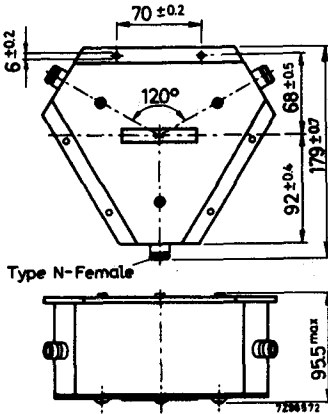
MECHANICAL DATA

| | |
|--------------|--|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | body nickelplated connectors silverplated |
| Weight | top and bottom cover black 6400 g |

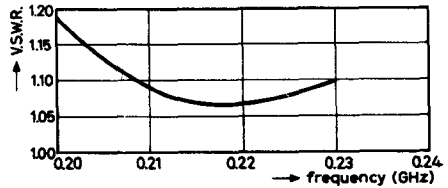


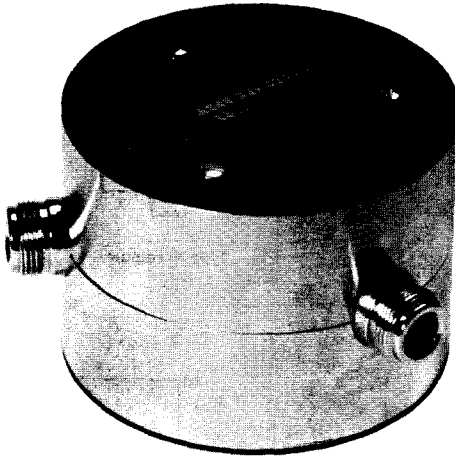
CL5201

Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

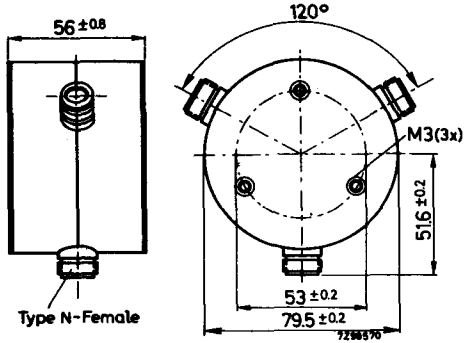
| | |
|-------------------------------|---|
| Frequency range | 0.47-0.59 GHz |
| Isolation α_{1-3} | > 22 dB |
| Insertion loss α_{1-2} | < 0.35 dB |
| V.S.W.R. | < 1.2 |
| Nominal power (c.w.) | 100 W |
| Temperature range | +10 to +70 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

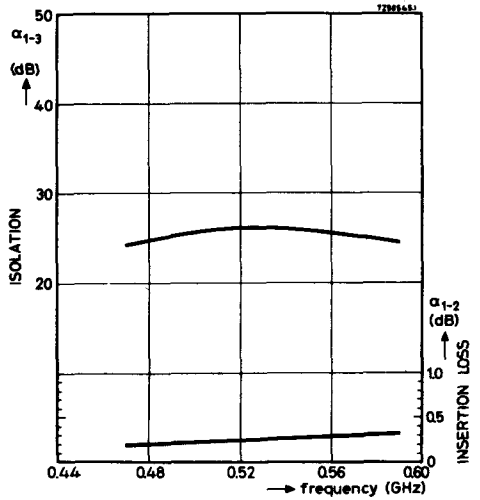
| | |
|--------------|----------------------------|
| Construction | coaxial 3 port |
| Terminations | type N-female |
| Finish | silverplated |
| | top and bottom cover black |
| Weight | 1200 g |



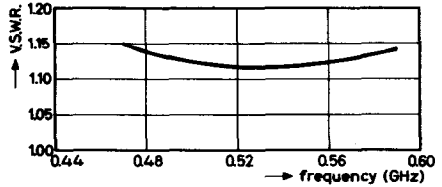
CL5251

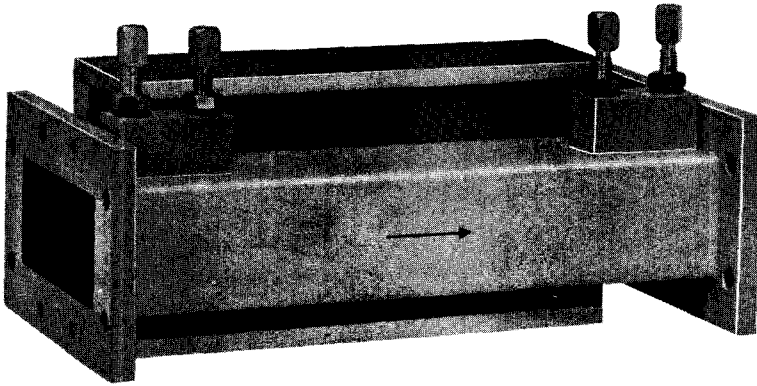


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

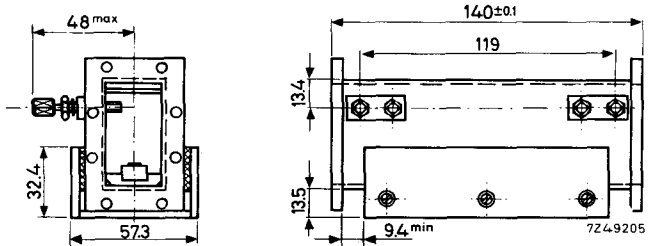
| | |
|----------------------|---------------|
| Frequency range | 3.8 - 4.2 GHz |
| Isolation | > 30 dB |
| Insertion loss | < 0.8 dB |
| V.S.W.R. | < 1.05 |
| Nominal power (c.w.) | 10 W |
| Temperature range | +10 to +40 °C |

For other temperature ranges please inquire

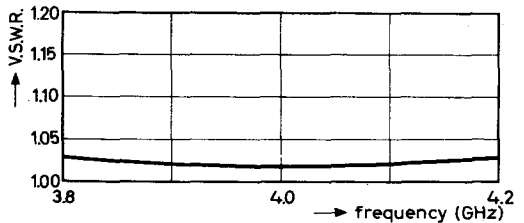
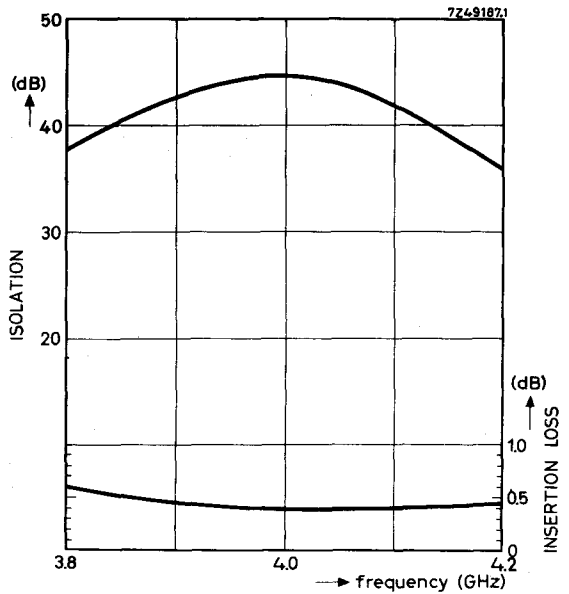
MECHANICAL DATA

| | |
|---------------------------------|---|
| 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 nickel standard mat |
| of magnet system | |
| Weight | 1700 g |

CL6201

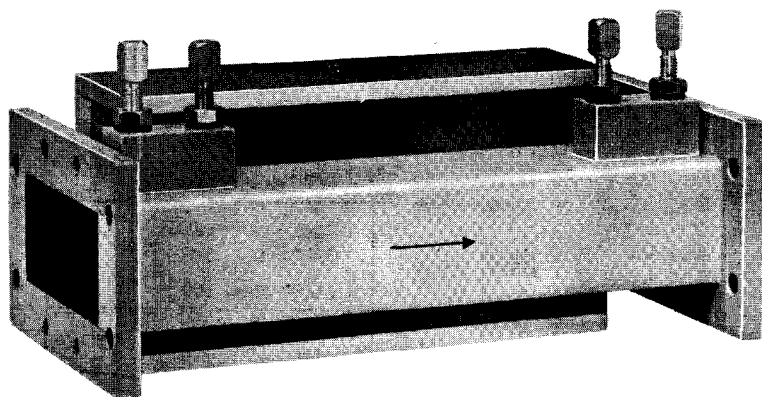


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

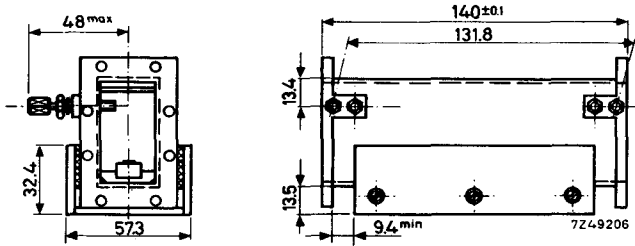
For other temperature ranges please inquire

MECHANICAL DATA

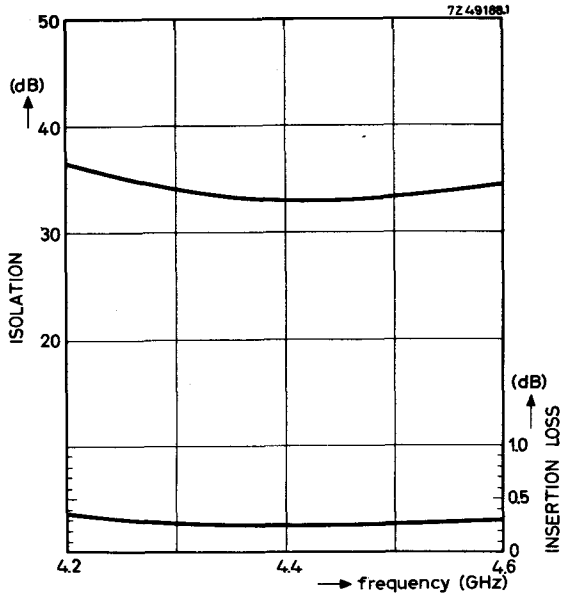
| | |
|---------------------------------|--|
| Material | brass |
| Waveguide type | R 48 (I.E.C.) |
| Flange type | UER 48 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey |
| of magnet system | nickel standard mat |
| Weight | 1680 g |



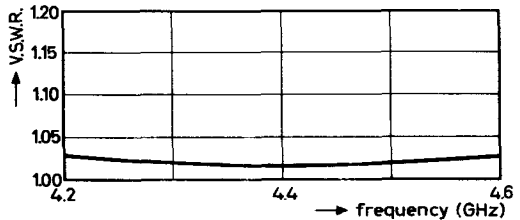
CL6202

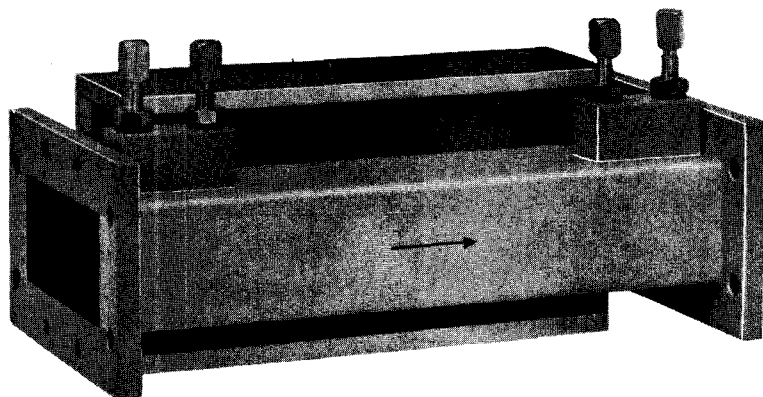


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

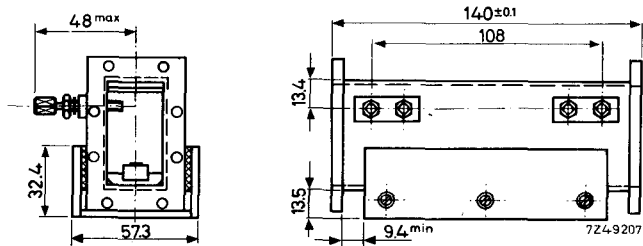
For other temperature ranges please inquire

MECHANICAL DATA

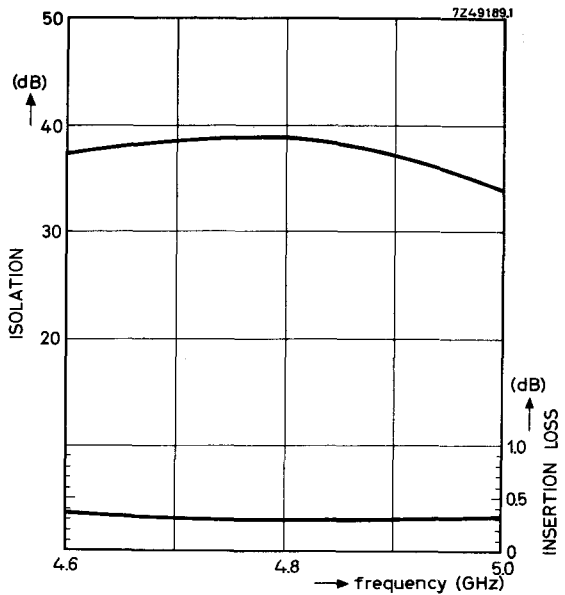
| | |
|---------------------------------|---|
| Material | brass |
| Waveguide type | R 48 (I.E.C.) |
| Flange type | UER 48 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey nickel standard mat |
| of magnet system | |
| Weight | 1680 g |



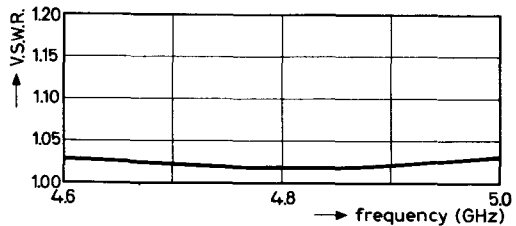
CL6203

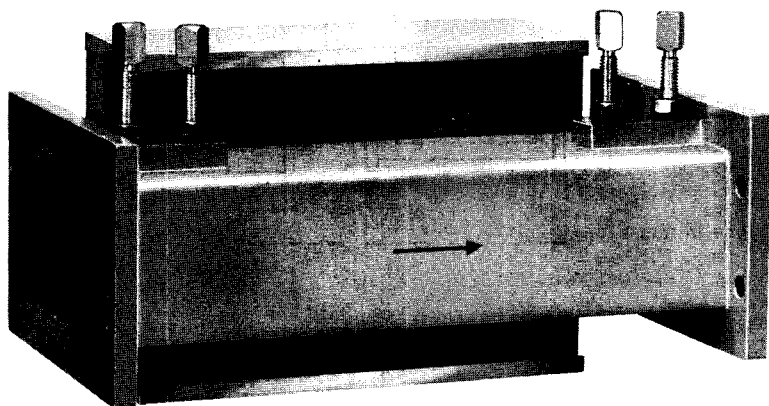


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





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

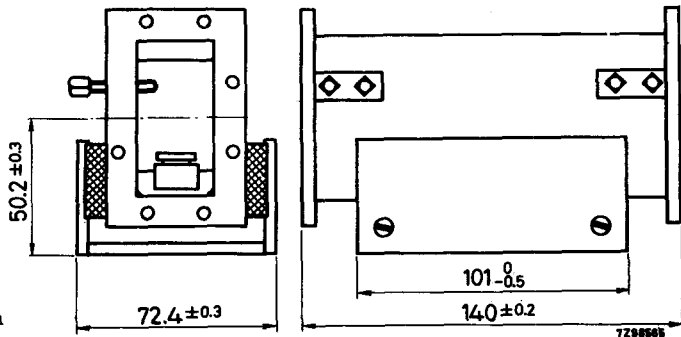
MECHANICAL DATA

| | |
|---------------------------------|--|
| 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 |
| | nickel standard mat |

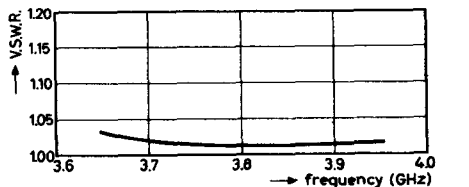
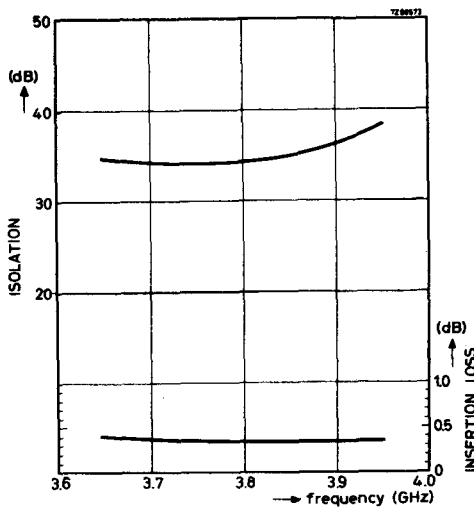
of magnet system



CL6204

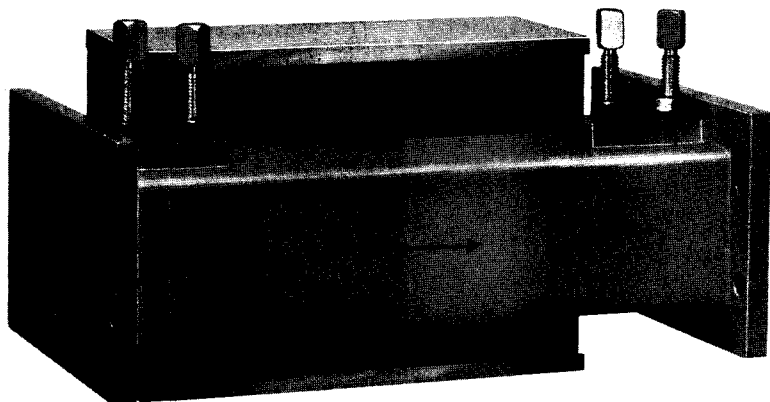


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 °C |
| | For other temperature ranges please inquire |

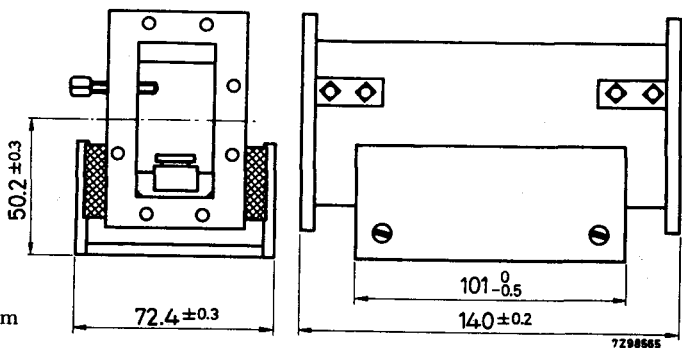


MECHANICAL DATA

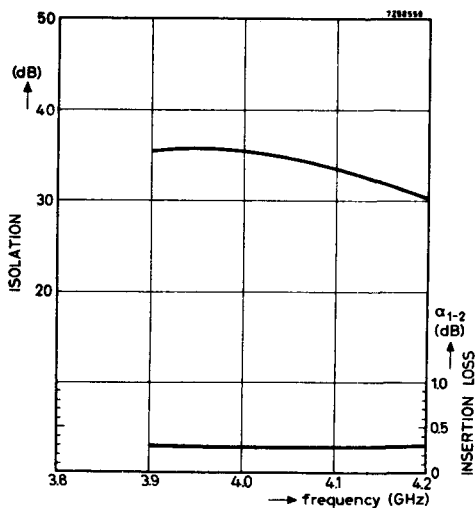
| | |
|---------------------------------|--|
| Material | brass |
| Waveguide type | R40 (I.E.C.) |
| Flange type | UER40 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated |
| | outside enamelled grey |
| | nickel standard mat |
| of magnet system | |



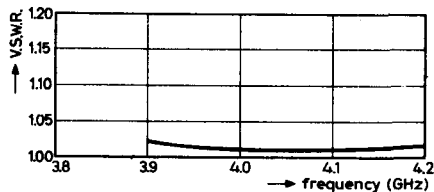
CL6205

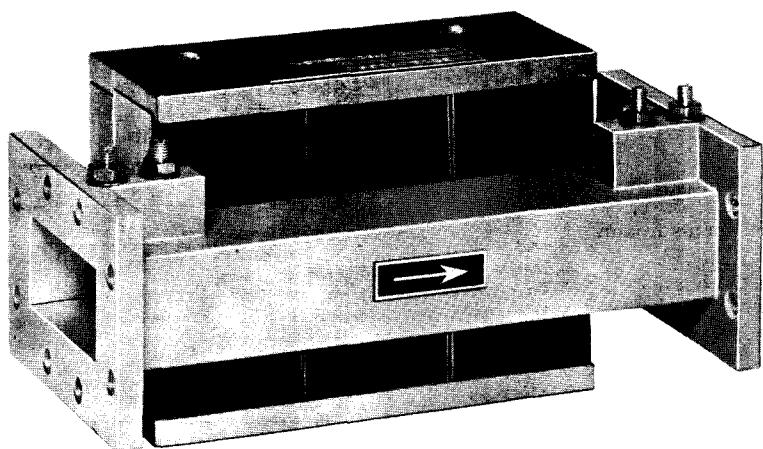


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





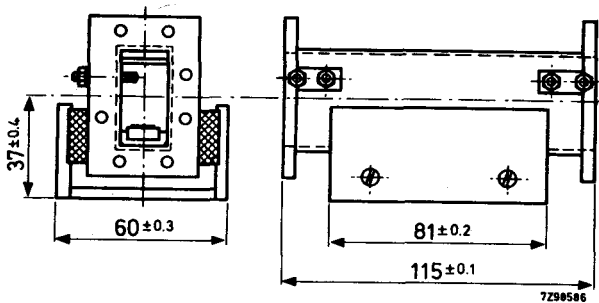
ELECTRICAL DATA

| | |
|----------------------|---|
| 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 |

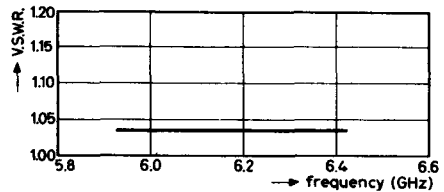
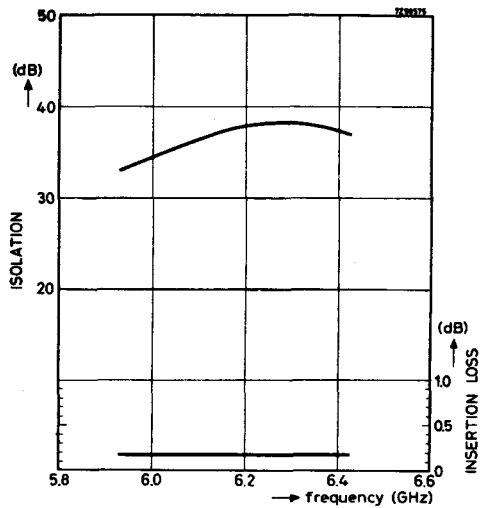
MECHANICAL DATA

| | |
|---------------------------------|--|
| 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 |

CL6206

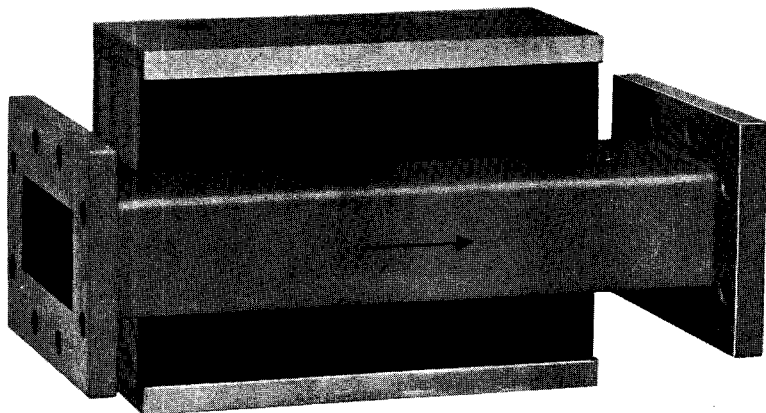


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

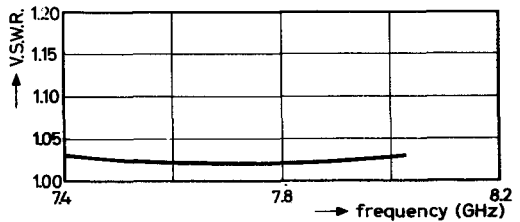
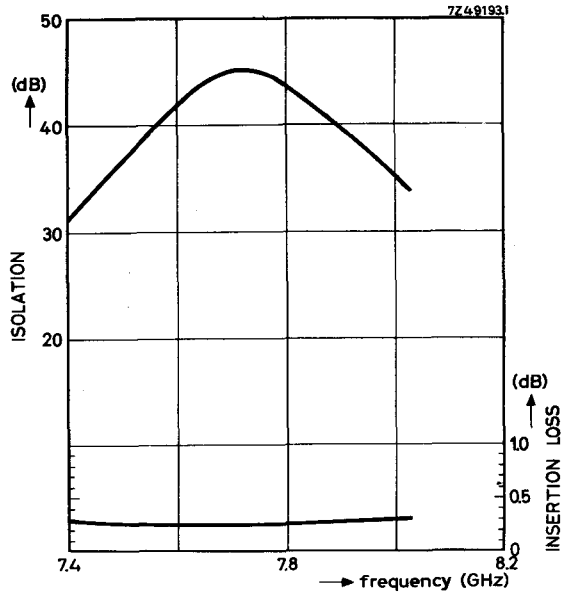
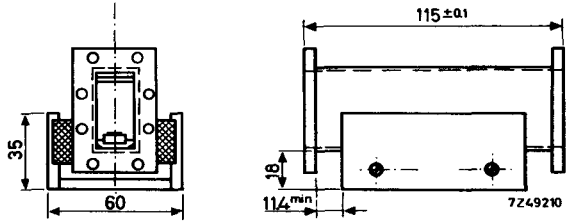
MECHANICAL DATA

| | |
|---------------------------------|---|
| 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 |



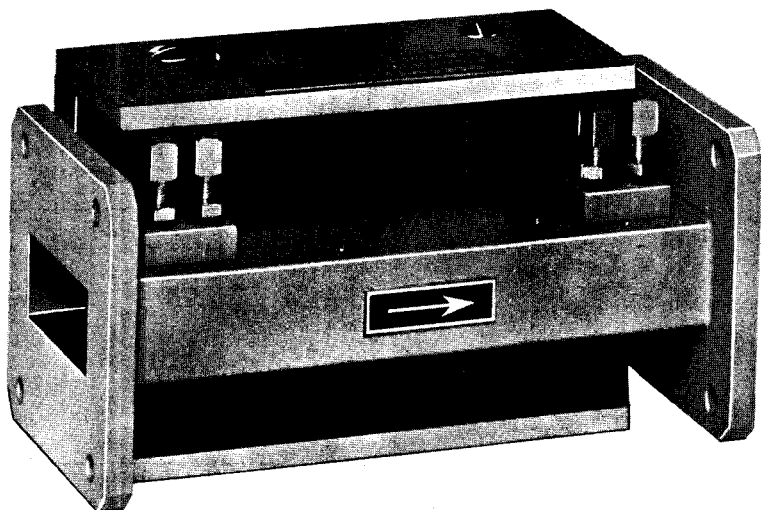
CL6210

Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

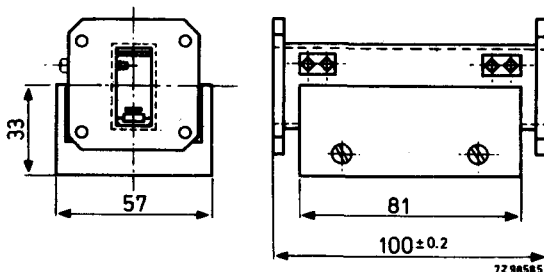
For other temperature ranges please inquire

MECHANICAL DATA

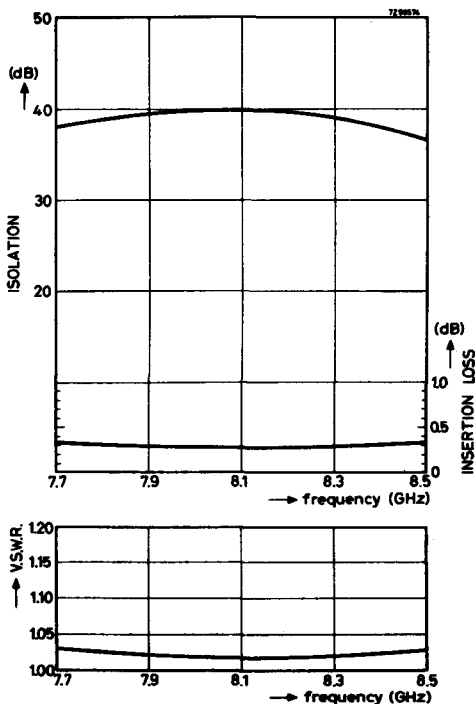
| | |
|---------------------------------|--|
| Material | brass |
| Waveguide type | R84 (I.E.C.). |
| Flange type | UBR84 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey |
| of magnet system | nickel standard mat |
| Weight | 1260 g |



CL6214

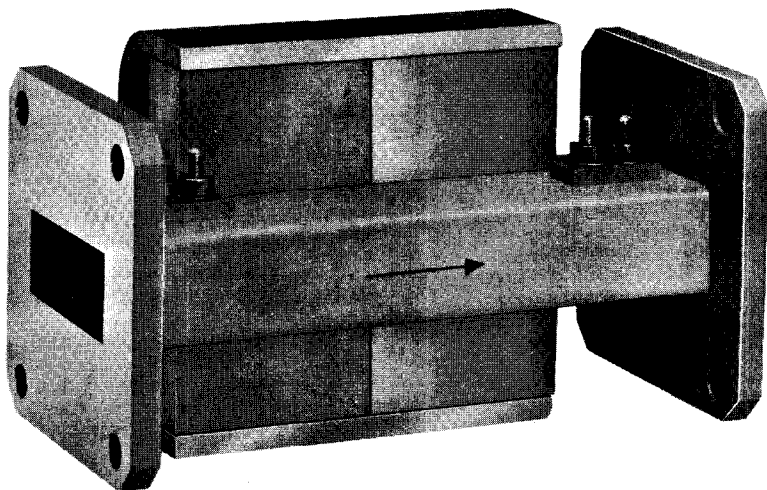


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

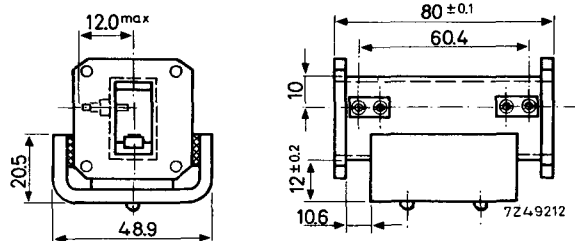
For other temperature ranges please inquire

MECHANICAL DATA

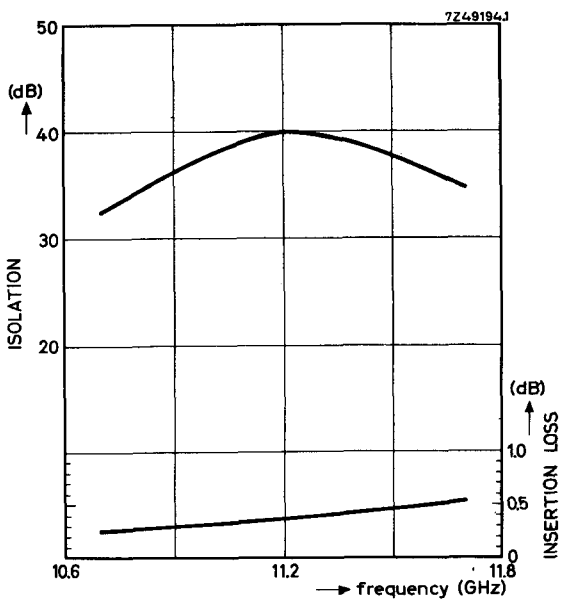
| | |
|---------------------------------|--|
| Material | brass |
| Waveguide type | R 100 (I.E.C.) |
| Flange type | UBR 100 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey |
| of magnet system | nickel standard mat |
| Weight | 430 g |



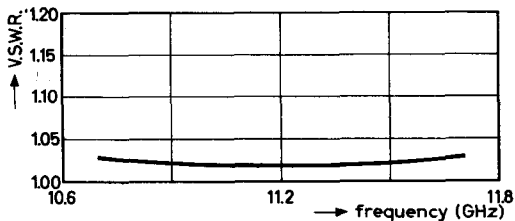
CL6215

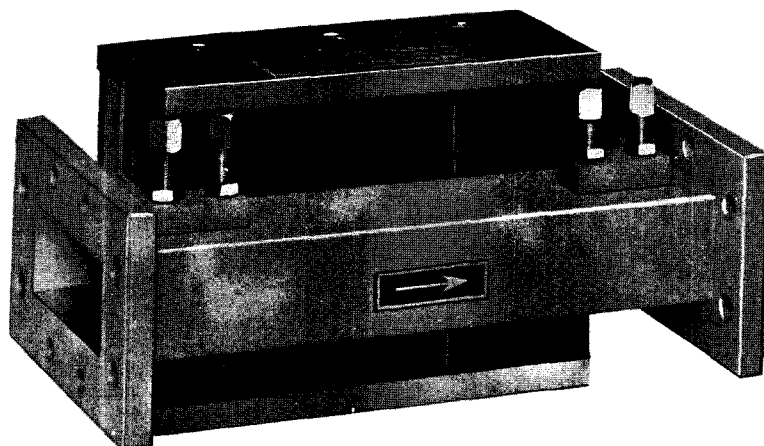


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

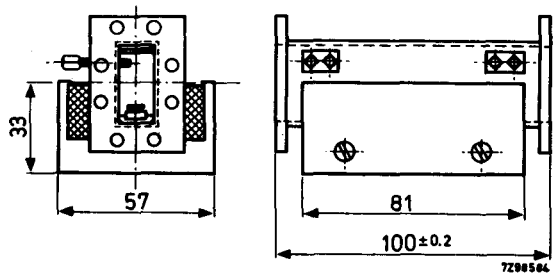
| | |
|----------------------|---|
| Frequency range | 7.7-8.5 GHz |
| Isolation | > 30 dB |
| Insertion loss | < 0.5 dB |
| V.S.W.R. | < 1.05 |
| Nominal power (c.w.) | 10 W |
| Temperature range | +10 to +70 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

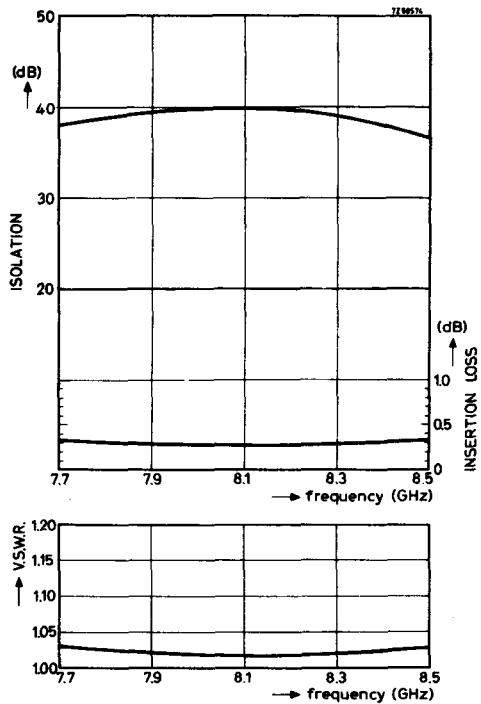
| | |
|---------------------------------|--|
| Material | brass |
| Waveguide type | R84 (I.E.C.) |
| Flange type | UER84 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey |
| of magnet system | nickel standard mat |
| Weight | 1260 g |



CL6216

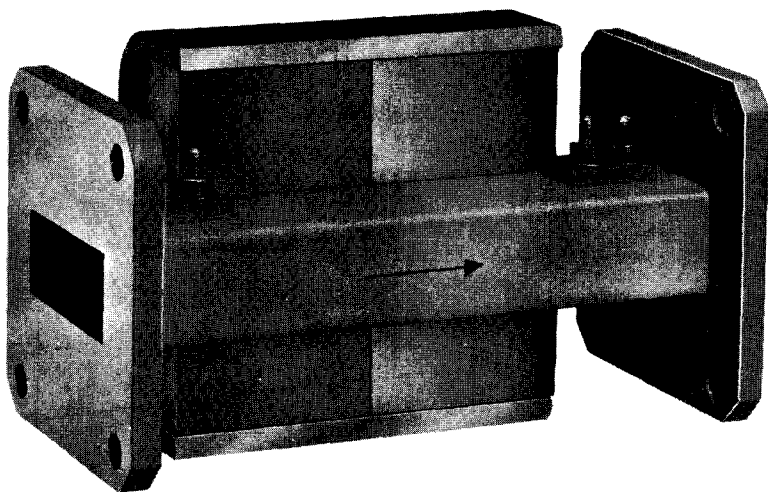


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

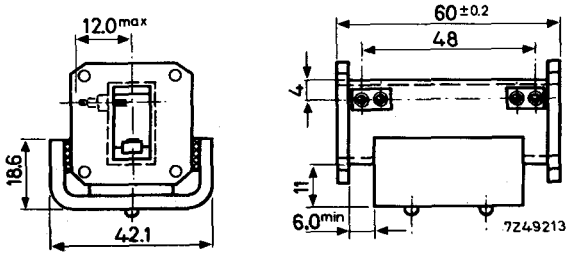
For other temperature ranges please inquire

MECHANICAL DATA

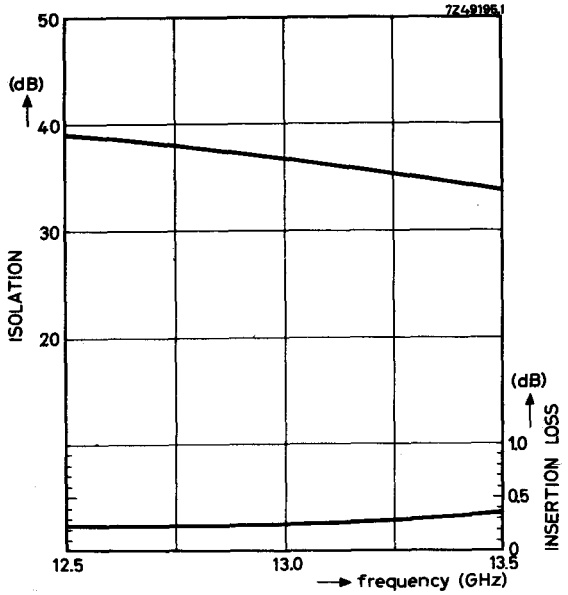
| | |
|---------------------------------|---|
| Material | brass |
| Waveguide type | R 140 (I.E.C.) |
| Flange type | UBR 140 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey nickel standard mat |
| of magnet system | |
| Weight | 220 g |



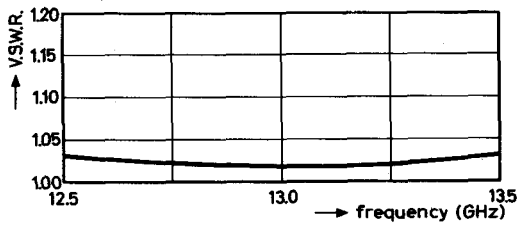
CL6217

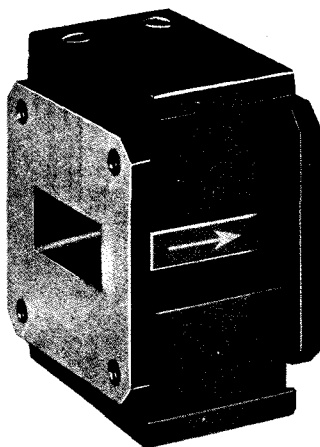


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

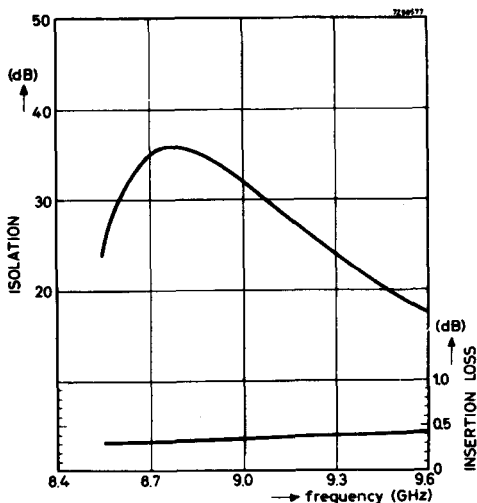
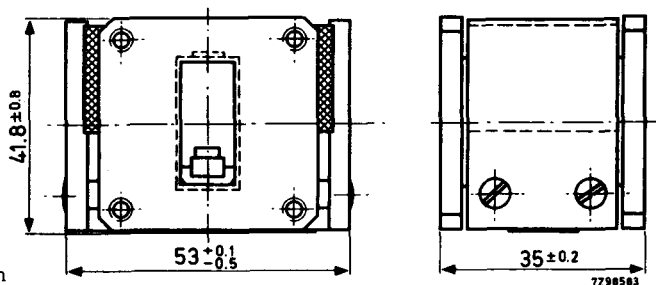
| | |
|----------------------|---------------|
| Frequency range | 8.5-9.6 GHz |
| Isolation | > 15 dB |
| Insertion loss | < 0.6 dB |
| V.S.W.R. | < 1.15 |
| Nominal power (c.w.) | 1 W |
| Temperature range | +10 to +70 °C |

For other temperature ranges please inquire

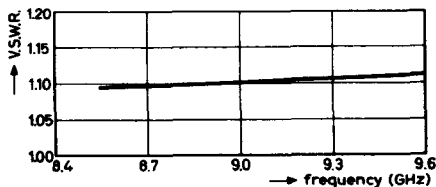
MECHANICAL DATA

| | |
|---------------------------------|---|
| 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 |
| | nickel standard mat |
| of magnet system | |
| Weight | 400 g |

CL6221

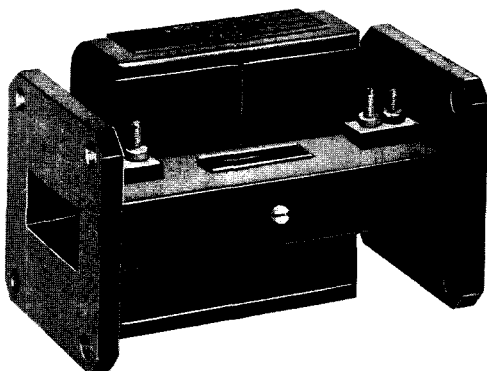


Typical performance as a function of frequency at a working temperature of 20 °C.



ISOLATOR

CL6222



ELECTRICAL DATA

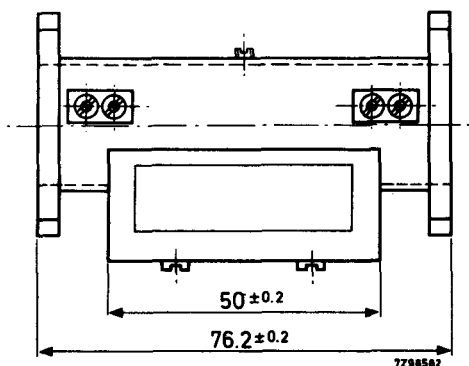
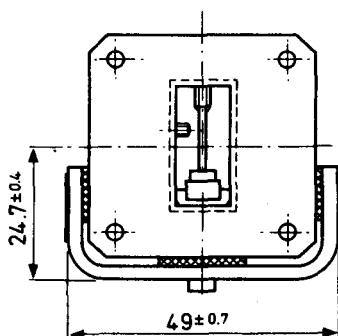
| | |
|----------------------|---|
| Frequency range | 8.5-9.6 GHz |
| Isolation | > 30 dB |
| Insertion loss | < 0.5 dB |
| V.S.W.R. | < 1.05 |
| Nominal power (c.w.) | 10 W |
| Temperature range | -10 to +70 °C |
| | For other temperature ranges please inquire |

MECHANICAL DATA

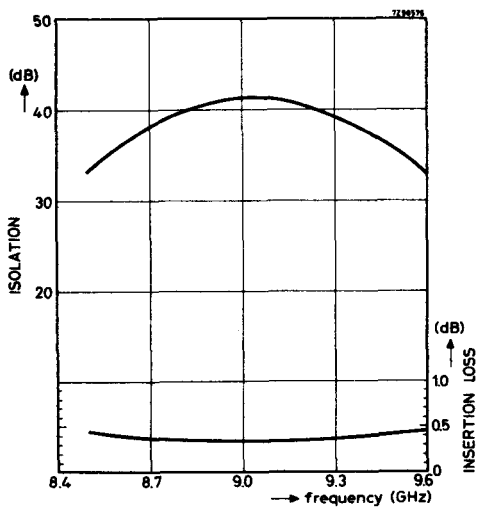
| | |
|---------------------------------|---|
| Material | brass |
| Waveguide type | R100 (I.E.C.) |
| Flange type | UBR100 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | nickelplated |
| | outside enamelled black |
| | nickel standard mat |
| of magnet system | |
| Weight | 420 g |



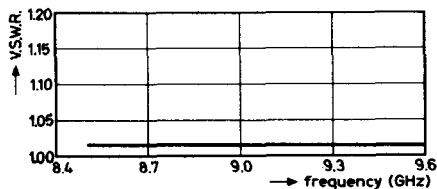
CL6222

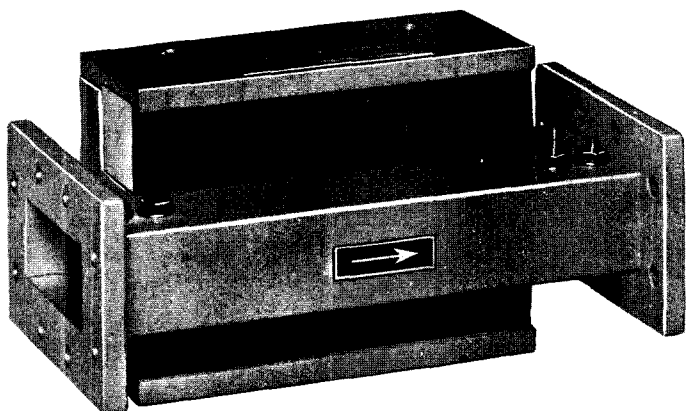


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

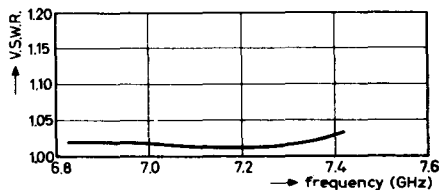
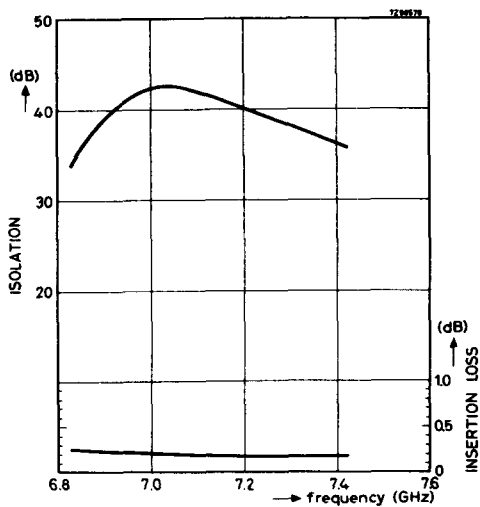
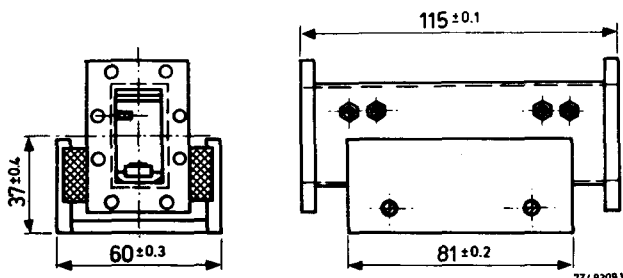
MECHANICAL DATA

| | |
|---------------------------------|--|
| 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 |



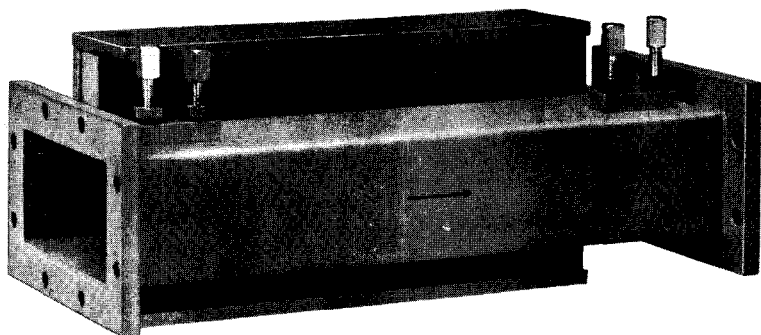
CL6231

Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

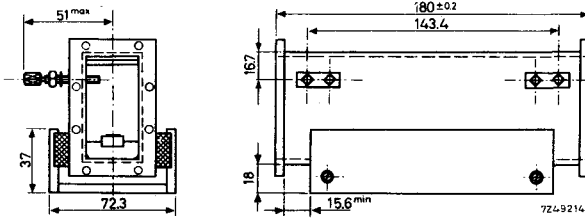
| | |
|----------------------|---------------|
| Frequency range | 3.8 - 4.2 GHz |
| Isolation | > 30 dB |
| Insertion loss | < 0.5 dB |
| V.S.W.R. | < 1.05 |
| Nominal power (c.w.) | 10 W |
| Temperature range | +10 to +80 °C |

For other temperature ranges please inquire

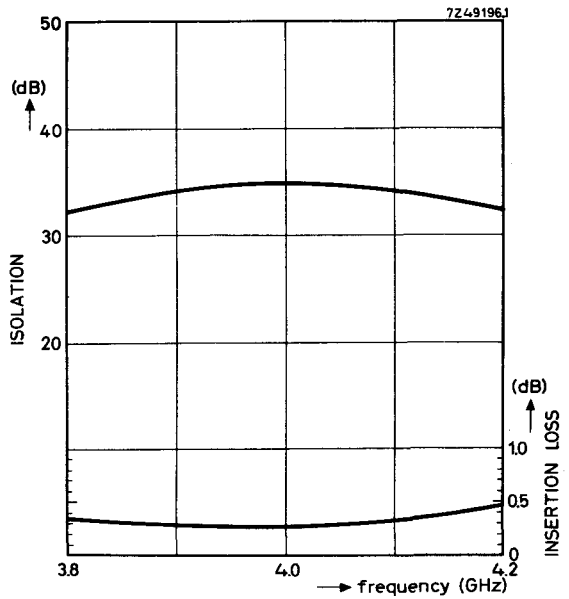
MECHANICAL DATA

| | |
|---------------------------------|--|
| 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 |

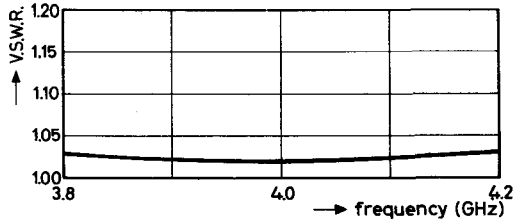
CL6240

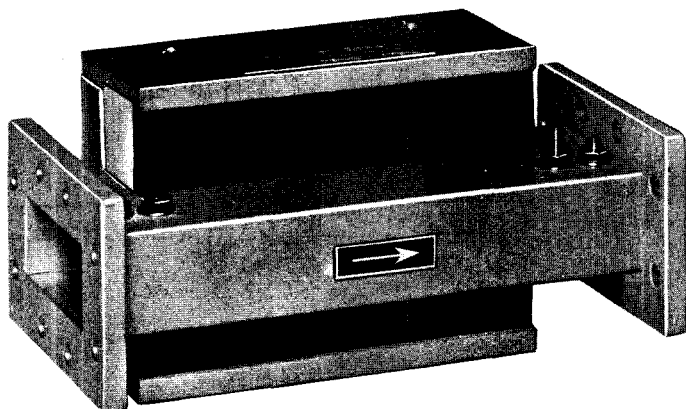


Dimensions in mm.



Typical performance as a function of frequency at a working temperature of 20 °C.





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 |

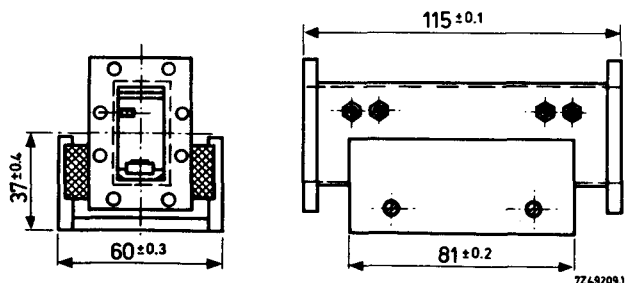
For other temperature ranges please inquire

MECHANICAL DATA

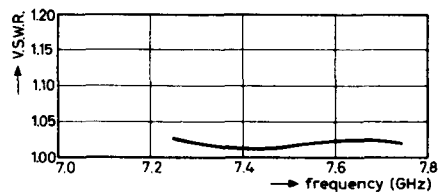
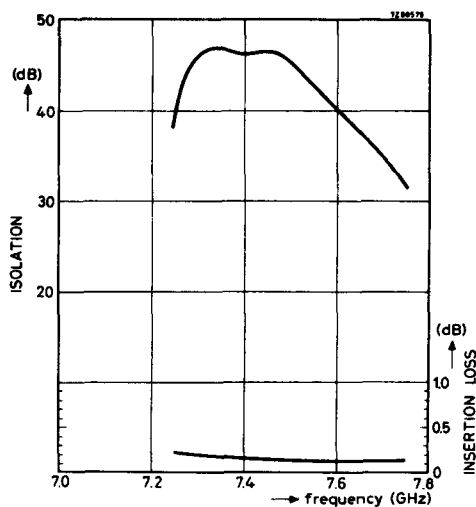
| | |
|---------------------------------|---|
| Material | brass |
| Waveguide type | R70 (I.E.C.) |
| Flange type | UER70 (I.E.C.); other flanges to order |
| Finish of waveguide and flanges | goldplated upon silverplated outside enamelled grey nickel standard mat |
| Weight of magnet system | 1450 g |

CL6241

Dimensions in mm

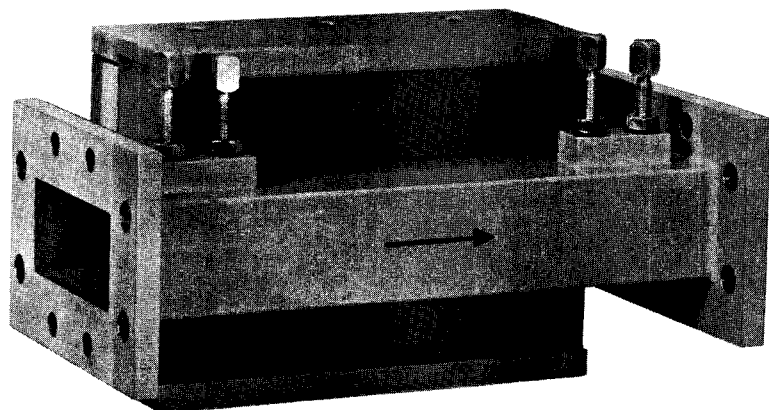


7Z49209.1



Typical performance as a function of frequency at a working temperature of 20 °C.





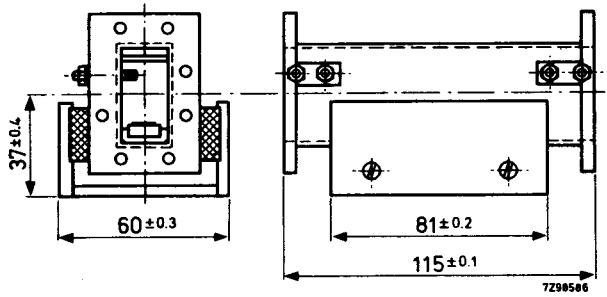
ELECTRICAL DATA

| | |
|----------------------|---|
| 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 |

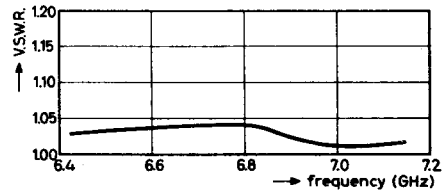
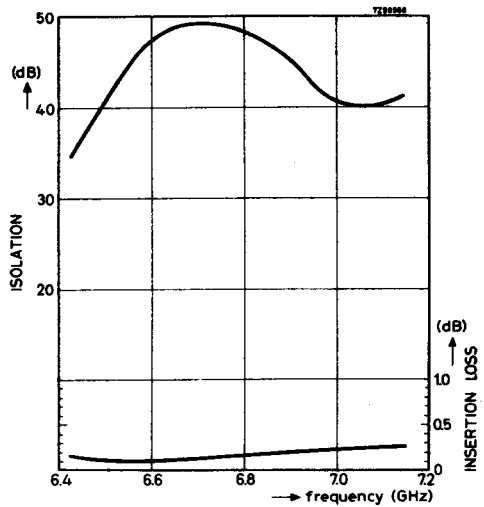
MECHANICAL DATA

| | |
|---------------------------------|--|
| 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

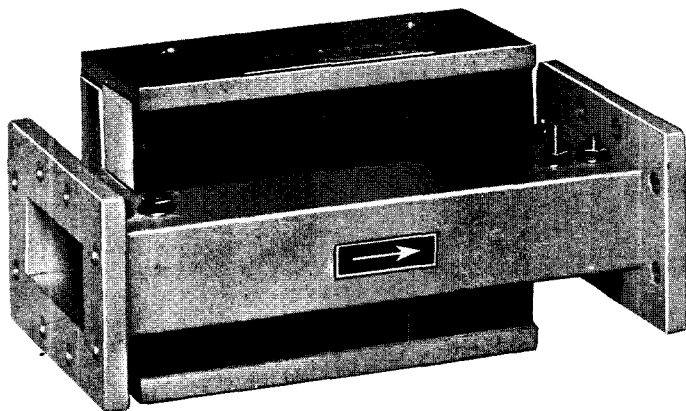


Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.





ELECTRICAL DATA

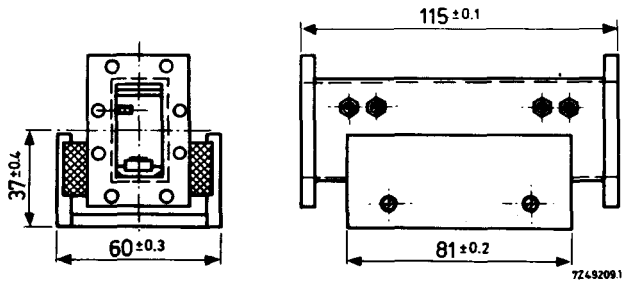
| | |
|----------------------|-----------------|
| Frequency range | 7.125-7.750 GHz |
| Isolation | > 30 dB |
| Insertion loss | < 0.3 dB |
| V.S.W.R. | < 1.05 |
| Nominal power (c.w.) | 20 W |
| Temperature range | -10 to +70 °C |

For other temperature ranges please inquire

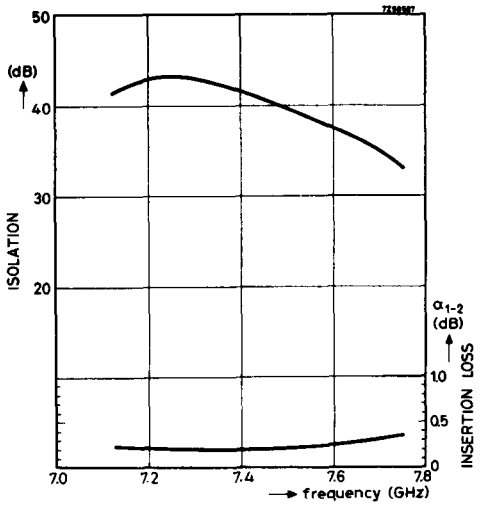
MECHANICAL DATA

| | |
|---------------------------------|--|
| 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 |
| | nickel standard mat |
| of magnet system | |
| Weight | 1450 g |

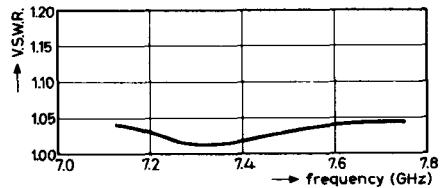
CL6291



Dimensions in mm



Typical performance as a function of frequency at a working temperature of 20 °C.



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 |
|--------------------|------|----|

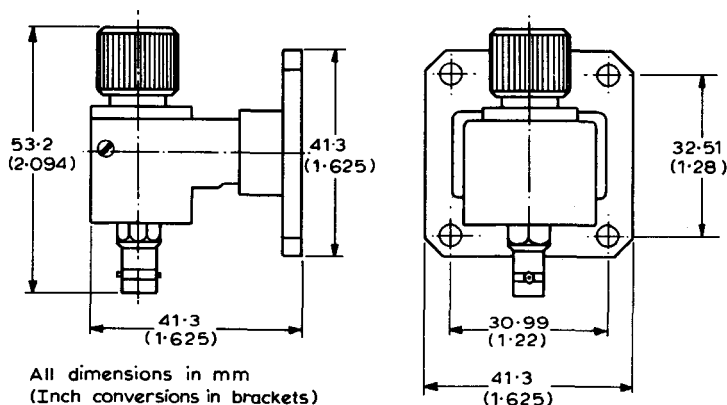
| | |
|-----------------|-----------|
| v.s.w.r. (typ.) | > 2.5 : 1 |
|-----------------|-----------|

| | |
|---------|-------------------------------|
| Flanges | American plain square: UG39/U |
|---------|-------------------------------|

Joint-Services specification: 5985-99-083-0052

| | |
|-----------------|----------------------------------|
| External finish | Nickel plated with rhodium flash |
|-----------------|----------------------------------|

OUTLINE DRAWING



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 ($T_{amb} = 20^{\circ}C$)

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

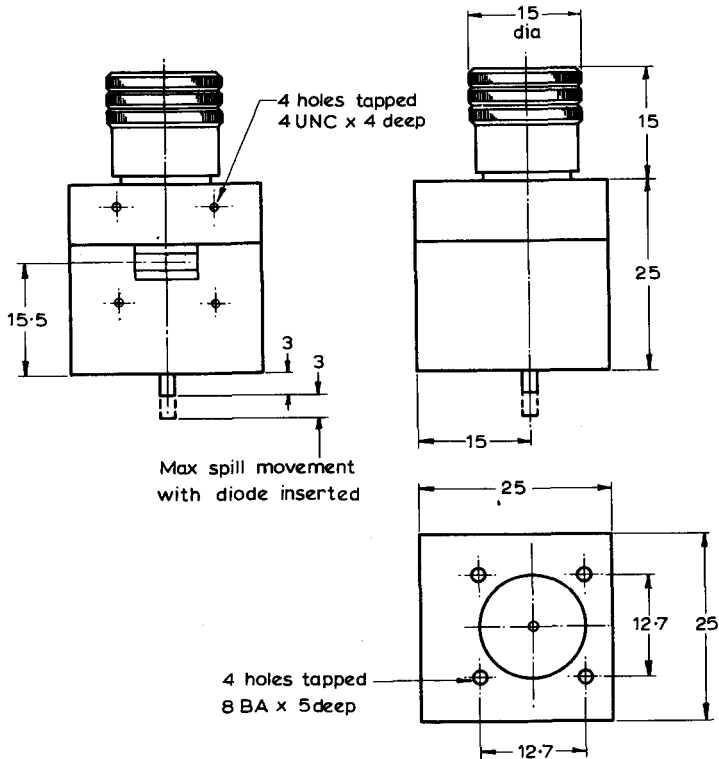
135

g

Finish

Gold plate, including the i.f. solder spill.

OUTLINE DRAWING OF CL7310



All dimensions in mm



X-BAND COAXIAL BALANCED MIXERS

CL7330
CL7331
CL7332

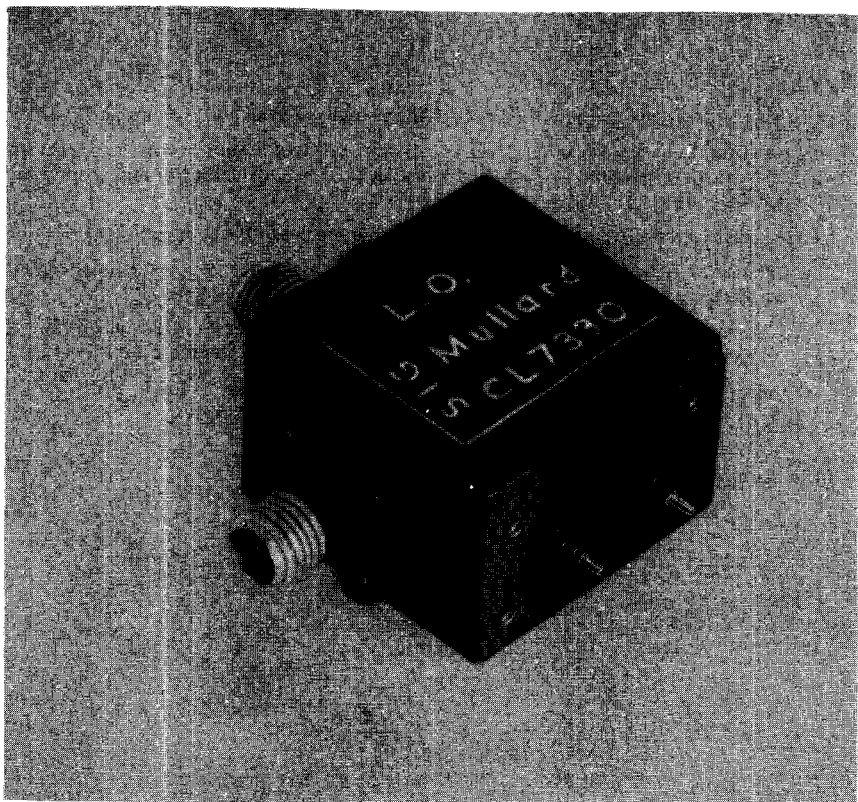
QUICK REFERENCE DATA

Miniature, thin film microstrip balanced mixers using bonded non-replaceable Schottky barrier diodes. The mixers are suitable for radar and communications receivers particularly where size and weight are critical.

Frequency range

| | | |
|-----------------------|--------------|-----|
| CL7330 | 9 to 10 | GHz |
| CL7331 | 10.7 to 11.7 | GHz |
| CL7332 | 11.7 to 12.7 | GHz |
| Noise figure, typical | 7.0 | dB |
| Input connectors | O.S.M.204 | |

Unless otherwise stated, data is applicable to all types



Mullard

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$) (see note 1)

Centre frequency

| | | | | |
|-------------------------------------|-----------|-------|-------|----------|
| CL7330 | | 9.5 | | GHz |
| CL7331 | | 11.2 | | GHz |
| CL7332 | | 12.2 | | GHz |
| | Min. | Typ. | Max. | |
| Bandwidth | ± 500 | - | - | MHz |
| Isolation (see note 2) | 15 | 20 | - | dB |
| v. s. w. r. (see notes 2 and 3) | - | 2.0:1 | 3.0:1 | |
| Noise figure (see notes 2 and 4) | - | 7.0 | 7.5 | dB |
| Out of balance (see note 5) | - | 0.5 | 1.5 | dB |
| I. F. impedance (see note 2) | - | 135 | - | Ω |
| Output capacitance | - | 4.0 | - | pF |
| Local oscillator power (see note 2) | - | 2.0 | 2.5 | mW |
| Input impedance (nominal) | | 50 | | Ω |

NOTES

1. Characteristics apply to the whole 1GHz frequency range of each mixer.
2. The local oscillator power level is adjusted to give 1.5mA rectified current on the most efficient diode, that is, i.f. output terminal indicating the higher current of the two.
3. Characteristics applicable to both signal and local oscillator inputs.
4. The noise figure is the overall value including a 1.5dB i.f. amplifier noise figure at 45MHz.
5. The power level is adjusted to give 1.5mA rectified current from the most efficient diode. If this level is P_1 , the power is increased to P_2 to give 1.5mA rectified current from the other diode. Out of balance is defined as $10 \log_{10} \frac{P_1}{P_2}$ dB.

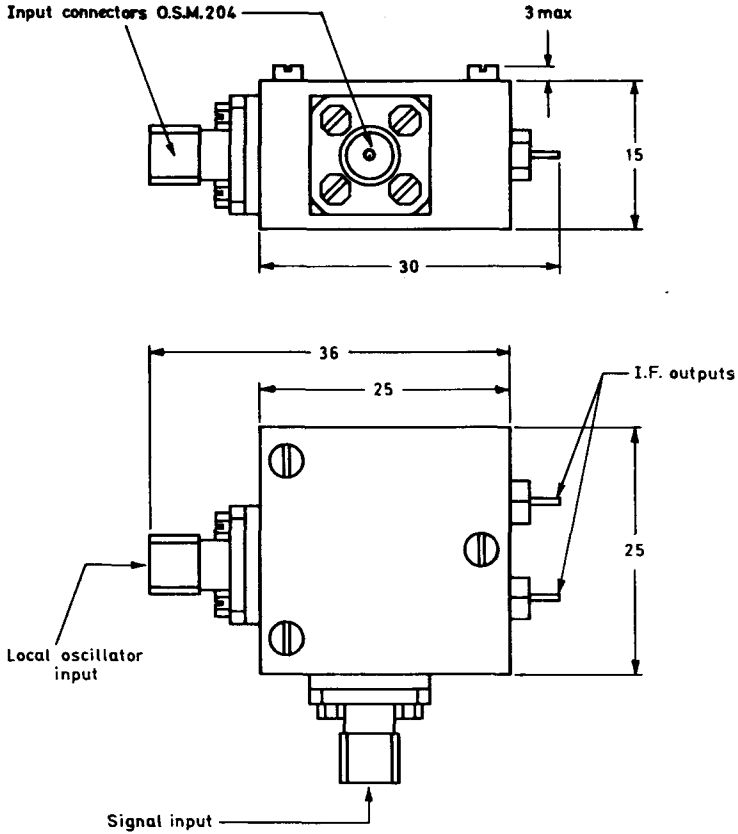
WEIGHT

32 g

X-BAND COAXIAL BALANCED MIXERS

CL7330
CL7331
CL7332

OUTLINE DRAWING OF CL7330, CL7331 AND CL7332



All dimensions in mm

D2528

Mullard

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| CL5007 | F | CL6216 | F |
| CL5008 | F | CL6217 | F |
| CL5009 | F | CL6221 | F |
| CL5010 | F | CL6222 | F |
| CL5012 | F | CL6231 | F |
| CL5014 | F | CL6240 | F |
| CL5015 | F | CL6241 | F |
| CL5020 | F | CL6251 | F |
| CL5021 | F | CL6291 | F |
| CL5027 | F | CL7309 | F |
| CL5028 | F | CL7310 | F |
| CL5029 | F | CL7330 | F |
| CL5031 | F | CL7331 | F |
| CL5041 | F | CL7332 | F |
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| CL5052 | F | JP2-2-5A | see YJ1162 |
| CL5053 | F | JP2-2-5W | see YJ1160 |
| CL5054 | F | JP8-02B | B |
| CL5055 | F | JP9-2-5 | B |
| CL5056 | F | JP9-2-5B | B |
| CL5057 | F | JP9-2-5C | B |
| CL5075 | F | JP9-2-5D | B |
| CL5081 | F | JP9-2-5E | B |
| CL5091 | F | JP9-2-5F | B |
| CL5151 | F | JP9-2-5H | B |
| CL5171 | F | JP9-2-5L | B |
| CL5181 | F | JP9-2-5M | B |
| CL5191 | F | JP9-5M | B |
| CL5201 | F | JP9-7 | B |
| CL5251 | F | JP9-7A | B |
| CL6201 | F | JP9-7B | B |
| CL6202 | F | JP9-7D | B |
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| CL6204 | F | JP9-15B | B |
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| CL6206 | F | JP9-50A | B |
| CL6210 | F | JP9-75 | B |

| Type No. | Section | Type No. | Section |
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| JP9-80 | B | YJ1121 | B |
| JP9-80A | B | YJ1123 | B |
| JP9-180 | B | YJ1124 | B |
| JP9-250 series | B | YJ1160 | C |
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| JPT9-01K | B | YJ1191 | C |
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| KS9-40B | D | YK1002 | D |
| KS9-40D | D | YK1005 | D |
| KS9-40G | D | YK1046 | D |
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