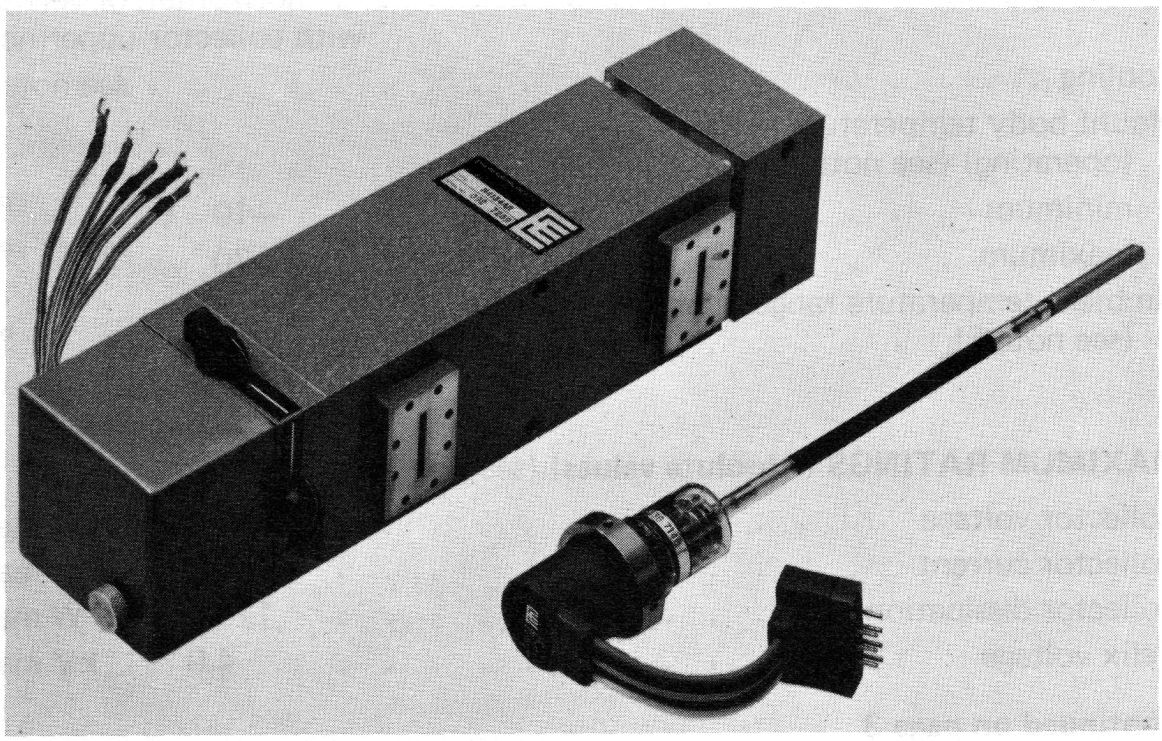
N1071

7.0–8.5GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Power amplifier travelling wave tube for wideband communication systems requiring low AM/PM conversion, low noise factor and high gain. The tube is operated in a conduction cooled periodic permanent magnet focusing mount with waveguide r.f. connections. Tubes are fully interchangeable in the mount and tube replacement is a simple operation.

Frequency range	7.0 to 8.5	GHz
Saturation output power (see note 1)	16	W
Working output power (see note 1)	5 to 10	W
Nominal gain	43	db
Noise factor	24	db
AM/PM conversion (at 10W output)	1.0	degree/db



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage (see note 2)	6.3	V
Heater current	0.8	A
Heater starting current (peak)	5.0	A max
Cathode pre-heating time	see note 3	

Mechanical

Tube base	moulded cap and flying leads fitted with plug type BA7P
Mounting position	horizontal, or vertical with collector uppermost

Focusing Mounts (see note 4)

Three frequency variants of the conduction cooled mount are available:

frequency range 7.1 to 7.75GHz	N4134/1
frequency range 7.75 to 8.4GHz	N4134/2
frequency range 7.1 to 8.4GHz	N4134/3

R.F. connections on mount	waveguide, 1.122 x 0.412 inch internal, with RETMA flange CMR112	
Net weight	15 pounds (6.8kg) approx	
Mounting position	horizontal, or vertical with collector uppermost	
Cooling	see note 4	
Mount body temperature range (operating) (see note 4):		
minimum	−10	°C
maximum	+70	°C
Ambient temperature range (storage) (see note 5)	−50 to +85	°C

MAXIMUM RATINGS (Absolute values) (see note 6)

Collector voltage	4.0	kV max
Collector current	50	mA max
Collector dissipation	120	W max
Helix voltage	4.0	kV max

Continued on page 3

MAXIMUM RATINGS (Absolute values) — continued

Helix current:	
continuous	2.0 mA max
for 1 second max	4.0 mA max
Anode voltage	4.0 kV max
Anode current	0.5 mA max
Heater voltage	6.6 V max
Collector temperature	200 °C max
Mount temperature range (operating), excluding conduction block or heat sink (see note 4)	−10 to +70°C max
Mount temperature range (storage) (see note 5)	−50 to +85°C max
Temperature of collector conduction block (see note 4)	105 °C max
Temperature difference over length of mount (excluding collector conduction block)	10 °C max

TYPICAL OPERATION (at 7.75GHz) (see note 7)

	5W Output	10W Output	
Operational Conditions (see note 6)			
Collector voltage	1.8	2.0	kV
Collector current	40	45	mA
Helix voltage	3.33	3.38	kV
Anode voltage	2.5	2.7	kV
Typical Performance			
Helix current	0.2	0.2	mA
Anode current	zero	zero	
Gain at 5.0W output	43	—	db
Gain at 10W output	—	44	db
Saturation output power (see note 8)	13	16	W
Maximum saturation output power (see note 9)	18	22	W
Noise factor	24	24	db
Cold insertion loss	60	60	db
Input v.s.w.r. over the band (see note 10)	1.3:1	1.3:1	max
Output v.s.w.r. over the band (see note 10)	1.4:1	1.4:1	max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(For 5W Output Power Operation) (see note 1)

Recommended Applied Conditions (see note 6)

Frequency range	7.0 to 8.5	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage	1.8	kV
Collector current	40	mA
Output power	5.0	W
Load v.s.w.r.	less than 1.5:1	

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.70	1.0	A
Helix voltage	3.2	3.7	kV
Helix current:			
switching on, zero r.f. drive	—	2.0	mA
focused, with r.f. drive	—	1.5	mA
Anode voltage	2.3	3.0	kV
Anode current	—	0.5	mA
Input power	—	0.5	mW
Saturation output power (see note 8)	11	—	W
Noise factor (see note 11)	—	25	db
Gain flatness (see note 12)	—	0.01	db/MHz
AM/PM conversion (see note 13)	—	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	—	db
Input v.s.w.r. (hot) (see note 10)	—	1.5:1	
Output v.s.w.r. (hot) (see note 10)	—	1.5:1	
Cold insertion loss	55	—	db

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 10W Output Power Operation) (see note 1)

Recommended Applied Conditions (see note 6)

Frequency range	7.0 to 8.5	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage	2.0	kV
Collector current	45	mA
Output power	10	W
Load v.s.w.r.	less than 1.5:1	

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.70	1.0	A
Helix voltage	3.2	3.7	kV
Helix current:			
switching on, zero r.f. drive	—	2.0	mA
focused, with r.f. drive	—	1.5	mA
Anode voltage	2.5	3.2	kV
Anode current	—	0.5	mA
Input power	—	0.8	mW
Saturation output power (see note 8)	14	—	W
Noise factor (see note 11)	—	25	db
Gain flatness (see note 12)	—	0.01	db/MHz
AM/PM conversion (see note 13)	—	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	—	db
Input v.s.w.r. (hot) (see note 10)	—	1.5:1	
Output v.s.w.r. (hot) (see note 10)	—	1.5:1	
Cold insertion loss	55	—	db

NOTES

1. The tube is intended for operation at 5 to 10 watts output power under the conditions specified. Reference should be made to English Electric Valve Company Ltd. if operation under conditions other than those specified herein is required.

2. The heater voltage must be maintained within ±5% of the nominal value.

3. The cathode pre-heating time for a tube on initial installation is 2½ minutes minimum; this time may be reduced to 1½ minutes minimum for subsequent switching on.

4. Conduction cooled mounts can be mounted horizontally or vertically with the collector uppermost, being designed for use where direct convection cooling of the collector block is difficult. The collector conduction block must be cooled by means of a further heat sink, e.g. a finned panel, which is not supplied but is normally incorporated in the structure of the equipment. The heat sink should be designed so that the body of the mount is no more than 10°C above the ambient temperature of its surroundings (this implies a maximum ambient temperature of 60°C).

5. Exposure to temperatures lower than −50°C will cause an irreversible change to the permanent magnets in the mount and a complete failure of the mount.

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

7. For other frequencies within the operating range of the tube and mount the helix voltage will need adjustment if maximum gain is to be obtained.

8. With the helix voltage fixed and only the input power adjusted for maximum output.

9. With both the helix voltage and input power adjusted for maximum output. The tube must not be operated continuously under these conditions.

10. The matching adjustments on the mount are preset during manufacture. With any tube operated in either mount N4134/1 or mount N4134/2, the v.s.w.r. will remain below the quoted value over the specified frequency range of the mount. With any tube operated in mount N4134/3, the v.s.w.r. limit is relaxed to 1.7:1.

11. The noise factor is measured under full operating conditions, using a suitable FM receiver, demodulator and baseband selective amplifier. The limit applies for any 4.0kHz bandwidth in the demodulated frequency band from 10kHz to 10MHz.

12. Over the recommended frequency range.

13. The value given for AM/PM conversion is that obtained under the specified conditions. Lower values may be achieved with other settings of helix voltage and input power.

OPERATING NOTES FOR N1071 IN P.P.M. MOUNT N4134

The operating principles of a periodic permanent magnet array focusing an electron beam in a travelling wave tube are complex and complete transmission of the beam can only be achieved over a limited range of electrode potentials. Consequently there are certain requirements that must be complied with when designing the power supply and installing a tube.

A. Power Supply

(1) The travelling wave tube heater voltage must be applied at least 2½ minutes before any h.t. voltages are applied.

(2) During switch-on, the anode voltage must be delayed so that it does not reach its full value until all other electrodes have reached their final voltages.

(3) During switch off, the anode voltage should be reduced before all other voltages or excessive currents may be drawn.

(4) The anode and helix voltages should be stabilized to ±2%.

(5) A protective device must be included in the helix circuit to cut off the h.t. supply if the helix current exceeds 2mA. This device may be over-ridden during installation as long as the helix current does not exceed 4mA for a maximum period of 1 second.

(6) As the anode voltage rises through the range 200 to 1500V, the helix current is normally above 1mA and the peak value may be in excess of 2mA. Accordingly the anode voltage should rise sufficiently quickly through this range to ensure that the protective device in the helix circuit is not operated.

B. Initial Installation of Travelling Wave Tube

(1) Before inserting the travelling wave tube the focusing screws on the mount must be set to a central position pointing to the white line.

(2) Pull down the sprung retaining finger and insert the travelling wave tube in the mount taking care to avoid radial force. Slightly increase the pressure to overcome the extra resistance as the collector enters the conduction block, and ensure that the keyway on the travelling wave tube mates correctly with the spigot on the mount, and the tube is pushed right in. Release the retaining finger so that it presses against the moulded base of the travelling wave tube.

(3) Engage the 7-pin plug on the end of the travelling wave tube leads with the supply socket.

(4) Close the cover.

C. Initial Switching On

(1) Switch on the travelling wave tube heater and allow a minimum of 2½ minutes cathode preheating time.

(2) Apply h.t. voltages, delaying anode voltage until all other voltages have reached their full operating values.

(3) Set helix voltage to 3500 volts and anode voltage to 2500 volts, with zero r.f. input.

(4) Successively adjust the focusing screws until the helix current is reduced

to a minimum. Adjust anode voltage to obtain a collector current of 40 or 45mA as required.

(5) Finally with r.f. drive applied some slight readjustment of the focusing screws may be required to achieve minimum helix current.

D. Subsequent Switching On

Once the travelling wave tube has been set up and focused as described above it may be subsequently switched on again from cold, without further adjustment as follows:

(1) Allow 1½ minutes minimum cathode preheating time.

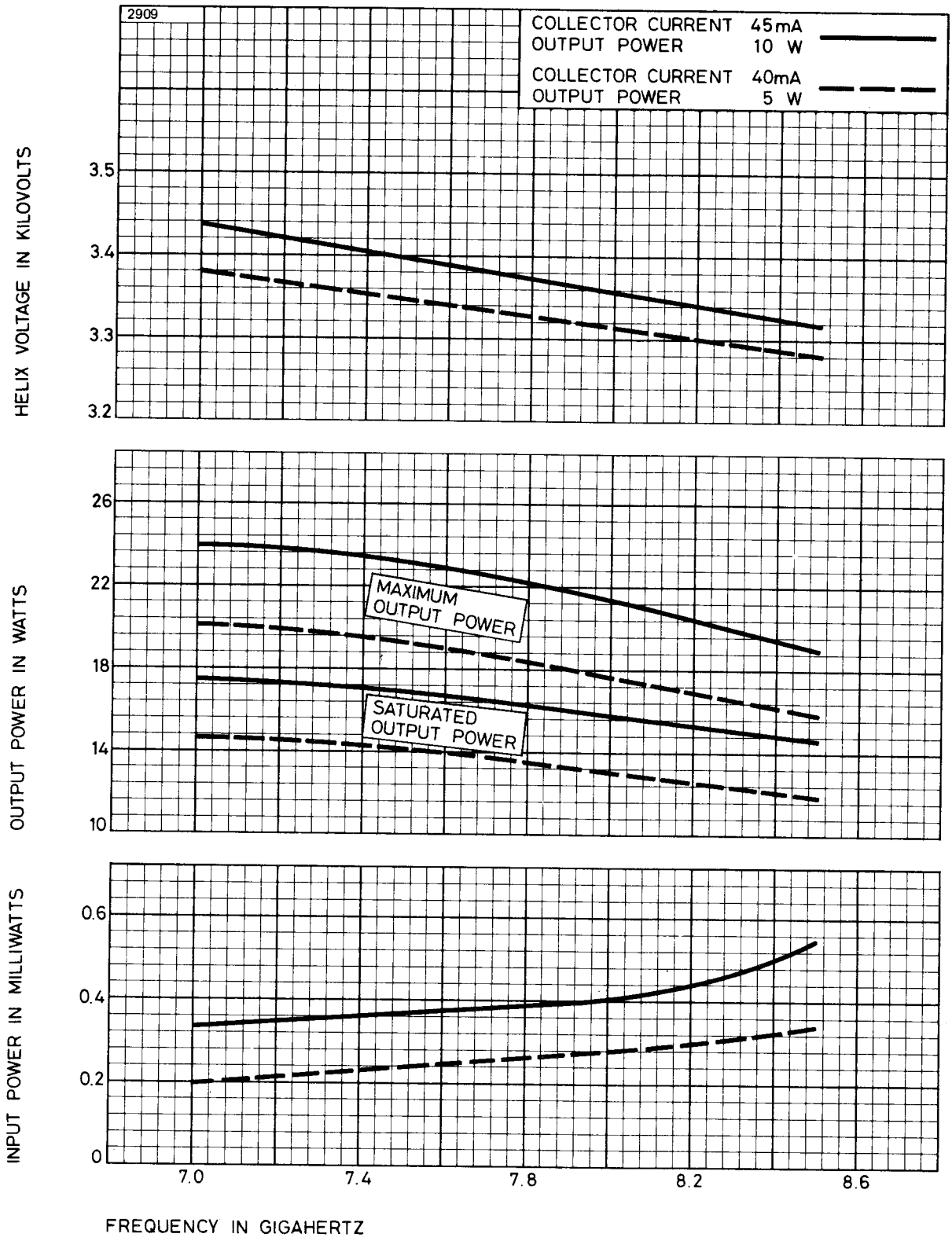
(2) Switch on h.t. voltages, delaying anode voltage until all other voltages have reached their full operating values.

E. Supply Interruption

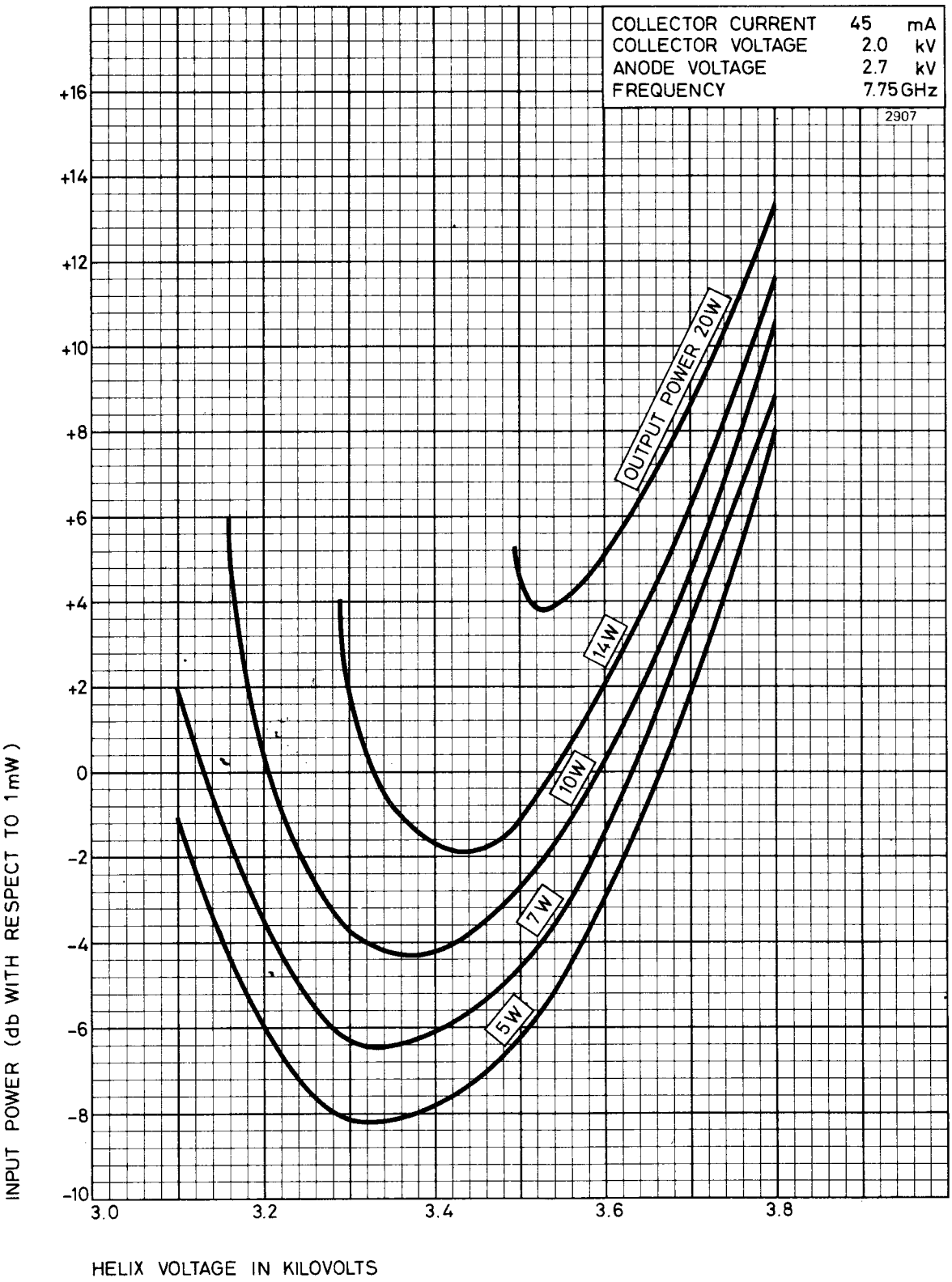
(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting anode voltage which must be delayed as in C(2) above.

(2) For interruptions in excess of ten seconds all voltages must be re-applied in accordance with paragraph D above.

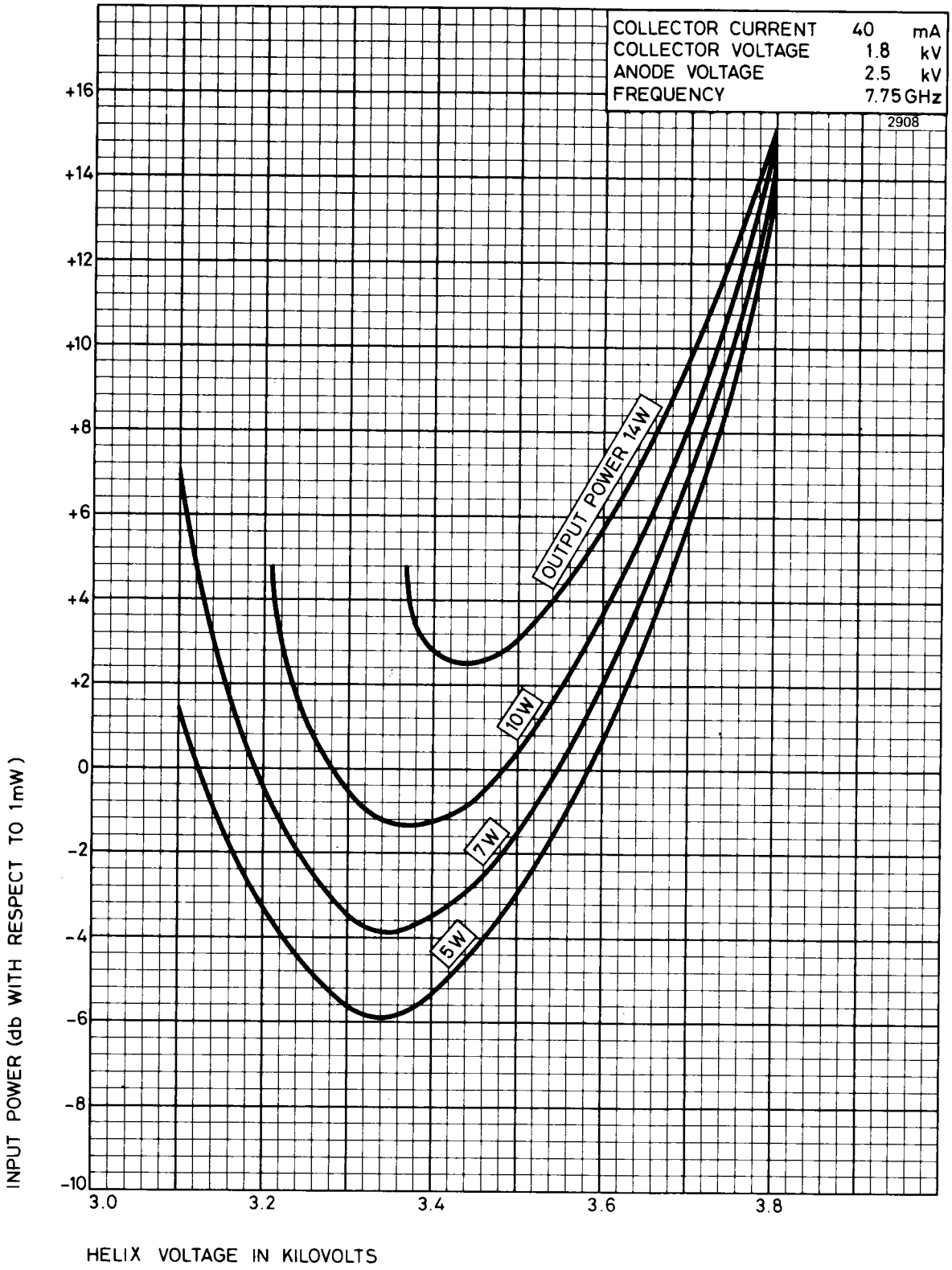
TYPICAL PERFORMANCE CHARACTERISTICS



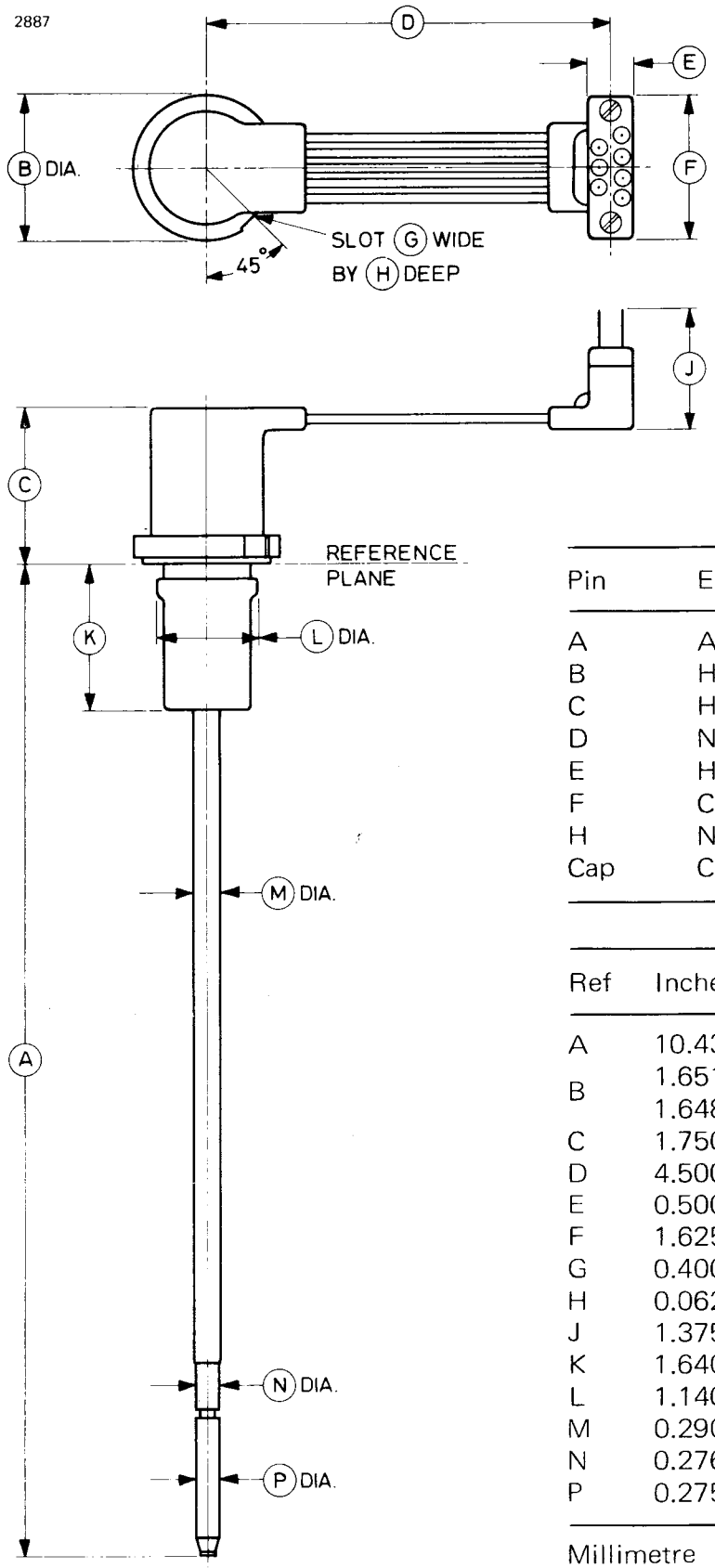
TYPICAL PERFORMANCE CHARACTERISTICS

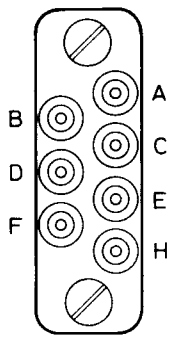


TYPICAL PERFORMANCE CHARACTERISTICS



N1071 OUTLINE (All dimensions without limits are nominal)





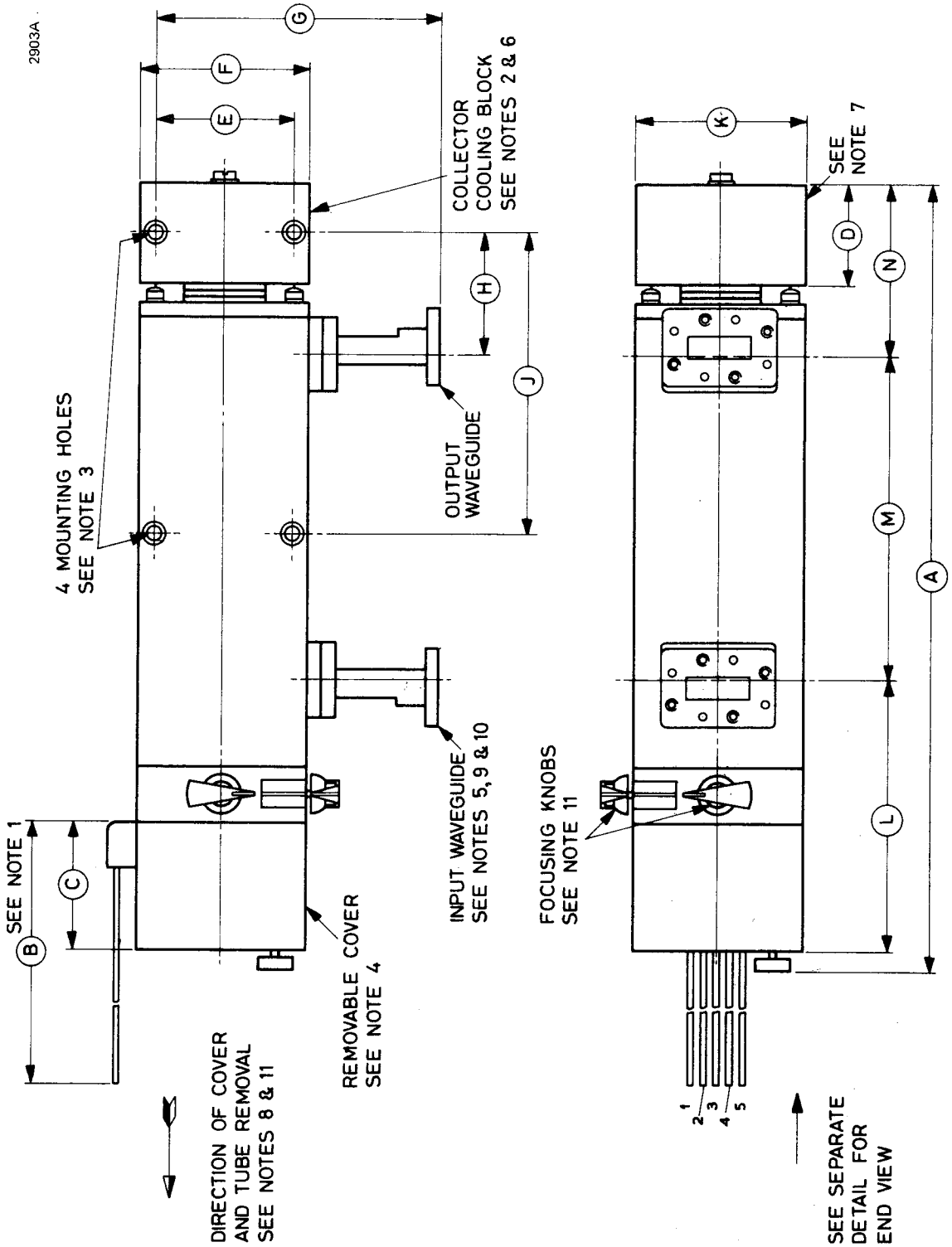
DETAIL OF PLUG
TYPE BA7P

Pin	Element
A	Anode
B	Heater
C	Helix
D	No connection
E	Heater
F	Cathode
H	No connection
Cap	Collector

Ref	Inches	Millimetres
A	10.430 ± 0.062	265.0 ± 1.6
B	1.651 max 1.648 min	41.94 max 41.86 min
C	1.750 max	44.45 max
D	4.500 ± 0.250	114.3 ± 6.4
E	0.500	12.70
F	1.625	41.28
G	0.400	10.16
H	0.062	1.57
J	1.375 ± 0.031	34.93 ± 0.79
K	1.640 max	41.66 max
L	1.140 max	28.96 max
M	0.290 max	7.37 max
N	0.276	7.01
P	0.275	6.99

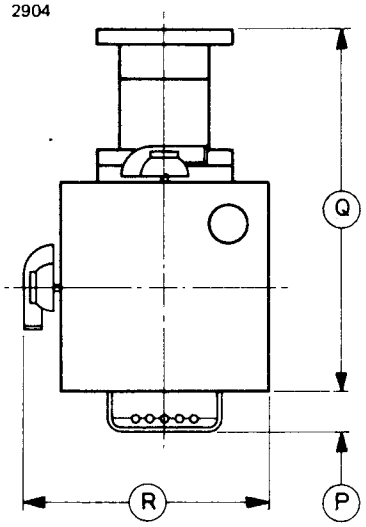
Millimetre dimensions have been derived from inches.

N4134 OUTLINE (See page 16 for Outline Notes)



N4134 OUTLINE (All dimensions without limits are nominal)

2904



Ref	Inches	Millimetres
A	14.733 max	374.2 max
B	69.500	1765
C	2.270 max	57.66 max
D	1.750 ± 0.015	44.45 ± 0.38
E	2.450 ± 0.010	62.23 ± 0.25
F	2.968 ± 0.032	75.39 ± 0.81
G	4.540 ± 0.030	115.3 ± 0.8
H	2.150 ± 0.015	54.61 ± 0.38
J	5.250 ± 0.010	133.4 ± 0.3
K	2.968 ± 0.032	75.39 ± 0.81
L	5.000 max	127.0 max
M	5.680 ± 0.020	144.3 ± 0.5
N	3.500 max	88.90 max
P	0.500 max	12.70 max
Q	4.800 ± 0.030	121.9 ± 0.8
R	3.750 max	95.25 max

Millimetre dimensions have been derived from inches.

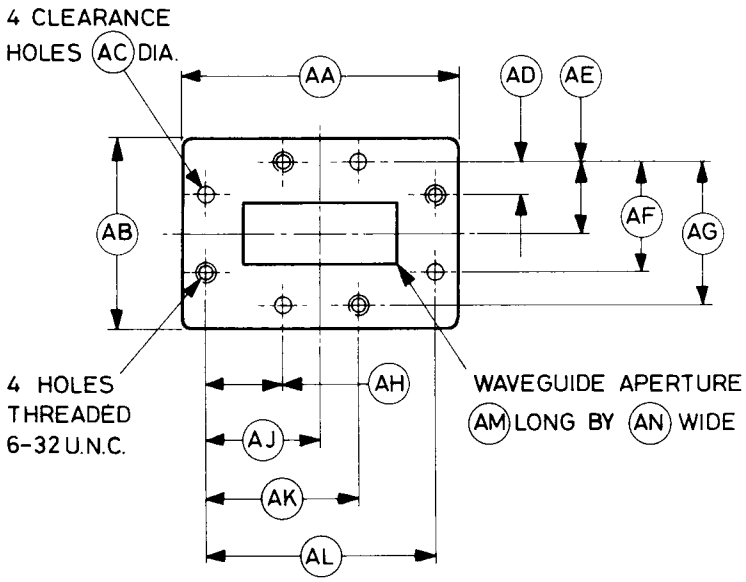
Lead	Colour	Element
1	Yellow	Cathode
2	Brown	Heater
3	Brown	Heater
4	Blue	Anode
5	Orange	Helix

N4134 Outline Notes

1. Alternative lead lengths and terminations can be supplied to suit customers' requirements.
2. The collector connection is to the body of the mount which must always be properly earthed during operation.
3. Clearance holes $^{9}/_{32}$ inch (7.14mm) diameter, counterbored $^{13}/_{32}$ inch (10.32mm) diameter and $^{7}/_{16}$ inch (11.11mm) deep, to suit $^{1}/_{4}$ inch (6.35mm) diameter socket head cap screws. Alternative sizes may be supplied.
4. An end clearance of $2^{1}/_{4}$ inches (57mm) must be allowed to permit the removal of the cover for tube insertion or withdrawal. The travelling wave tube leads plug into a socket inside the cover. An alternative cover, measuring 3 x $4^{1}/_{4}$ x $2^{1}/_{4}$ inches (76.2 x 108 x 57.2mm) and incorporating a mains interlock, can be supplied.
5. Matching screws on both the input and output waveguides can be fitted if required.
6. For efficient operation the collector cooling block must be bolted to a heat sink having a thermal impedance of 0.5°C/watt.
7. All four faces of the collector cooling block are flat to within 0.003 inch (0.076mm) over the length indicated. The mating surface of the attached heat sink must be equally flat and must be smeared with a suitable grease before bolting down the mount, to ensure good thermal contact.
8. The overall length of the mount together with an adequate allowance for tube withdrawal is 27 inches (686mm).
9. The waveguide flange is based on RETMA flange CMR112 (see page 17). A square flange type UG-51/U is also available (see page 18).
10. The mount as shown includes transitions for connection to no. 15 waveguide; it can be supplied without the transitions.
11. Certain alternative orientations of end cover and focusing screws, and position of mounting holes, are possible by arrangement.

N4134 Waveguide Flange (All dimensions without limits are nominal)

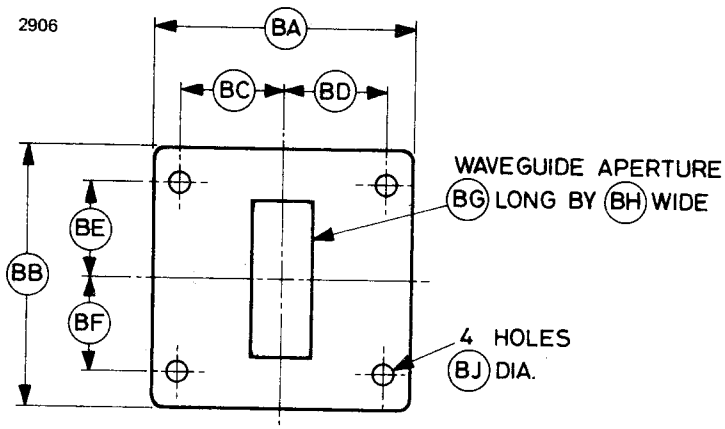
2905



Ref	Inches	Millimetres
AA	2.016	51.21
AB	1.375	34.93
AC	$0.147^{+0.003}_{-0.001}$	$3.734^{+0.076}_{-0.025}$
AD	0.237	6.020
AE	0.517	13.13
AF	0.797	20.24
AG	1.034	26.26
AH	0.553	14.05
AJ	0.830	21.08
AK	1.107	28.12
AL	1.660	42.16
AM	1.122	28.50
AN	0.412	10.46

Millimetre dimensions have been derived from inches.

N4134 Alternative Waveguide Flange
(All dimensions without limits are nominal)



Ref	Inches	Millimetres
BA	1.875	47.63
BB	1.875	47.63
BC	0.737	18.72
BD	0.737	18.72
BE	0.676	17.17
BF	0.676	17.17
BG	1.122	28.50
BH	0.412	10.46
BJ	0.170	4.32

Millimetre dimensions have been derived from inches.