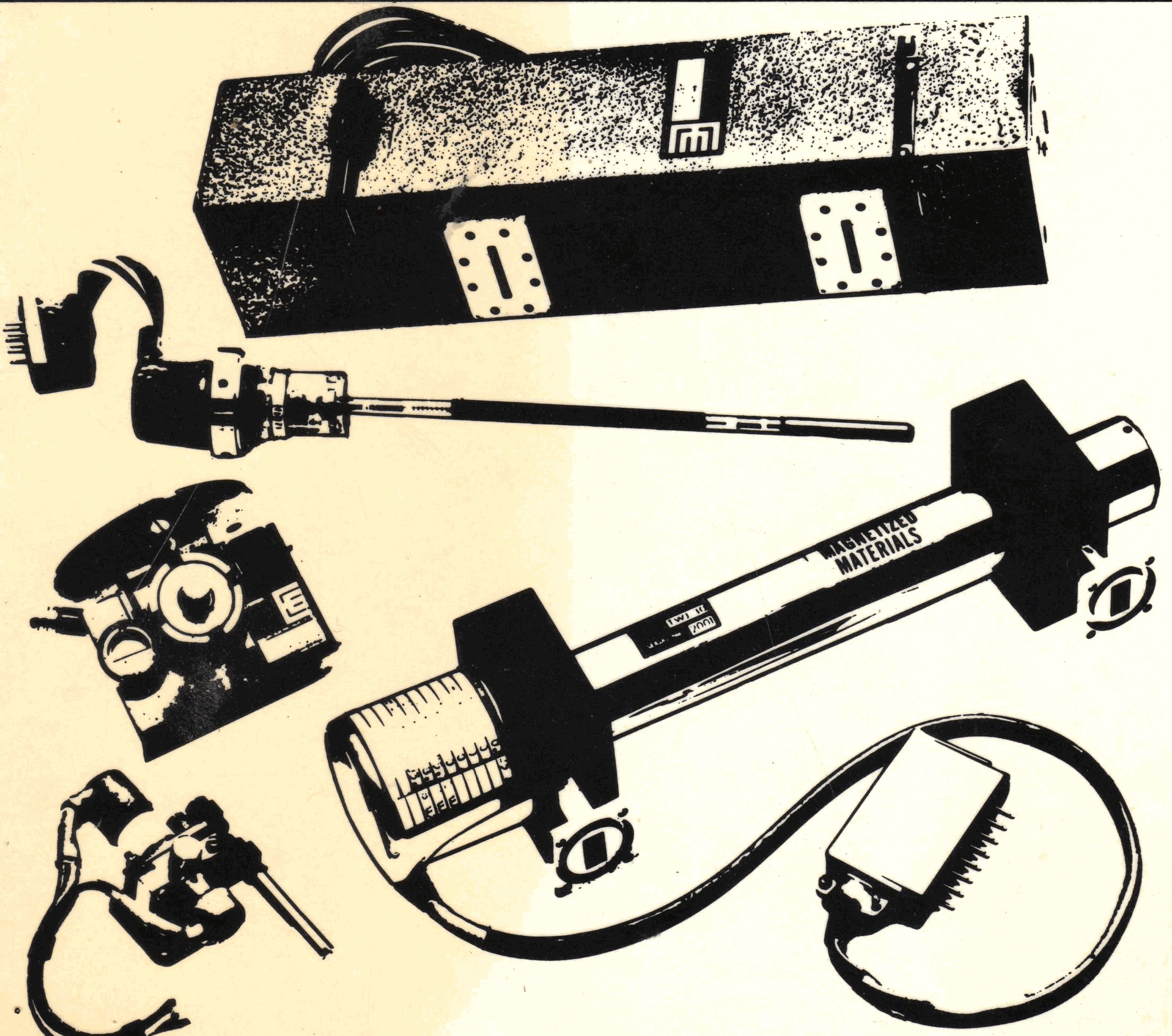
ENGLISH ELECTRIC VALVE COMPANY LIMITED
THE M-O VALVE COMPANY LIMITED

GEC

Oscillator Klystrons
Travelling Wave Tubes
Backward Wave Oscillators

1974
Product Data



Issued by the GEC Electronic Tube Company Limited, a management company which unites the activities of The M-O Valve Company Limited and English Electric Valve Company Limited.

This volume contains data for EEV and M-OV products. Please direct orders for EEV products to Chelmsford and for M-OV products to Hammersmith at the addresses given below. Please do not mix products of both companies on one order.

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QUICK REFERENCE TABLES
AND EQUIVALENTS INDEX

OSCILLATOR KLYSTRONS

TRAVELLING WAVE TUBES

BACKWARD WAVE
OSCILLATORS

OVERSEAS REPRESENTATIVES
AND DISTRIBUTORS

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

- **IGNITRONS**
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  VOLTAGE STABILIZERS
  OTHER PRODUCTS
- **TRIODES**
- **TETRODES AND PENTODE**
- **HYDROGEN THYRATRONS**
  PULSE AMPLIFIER TETRODES
- **MAGNETRONS**
- **AMPLIFIER KLYSTRONS**
- **OSCILLATOR KLYSTRONS**
  TRAVELLING WAVE TUBES
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- **DUPLEXER DEVICES**
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  NOISE TUBES
- **ELECTRO-OPTICAL DEVICES**
  - **Storage Cathode Ray Tubes**
  - **Television Camera Tubes**
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  - **Glow Modulators**
  - **Flash Tubes**
- **VACUUM CAPACITORS**

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

Quick Reference Tables and Equivalents Index

QUICK REFERENCE TABLES

OSCILLATOR KLYSTRONS
TRAVELLING WAVE TUBES
BACKWARD WAVE OSCILLATORS

EEV OSCILLATOR KLYSTRONS

Type	Mechanical tuning range (GHz)	Output power (mW)	Application	Page no.
K300	9.32–9.5	30	Local oscillator	**35**
K302	9.32–9.5	30	Local oscillator	**39**
K311	8.5–9.5	45	Local oscillator	**43**
K324	9.0–10.0	45	Local oscillator	**47**
K335	9.555–9.685	25	Local oscillator	**51**
K337§	9.0–10.0	45	Local oscillator	**55**
K342§	8.5–9.0	70	Local oscillator	**61**
K350**	8.8†	1500	Doppler	**65**
K351§	8.5–9.655	90	Local oscillator	**69**
K357	10.66–10.72	12	Low power doppler	**75**
K359§	8.1–8.75	90	Local oscillator	**79**
K361	10.7–10.725	50	Low power doppler	**85**
K361B	10.675–10.7	50	Low power doppler	**85**

Continued on following page

§ Rugged.

** Two resonator type, fixed tuned.

† Other frequencies available to special order.

EEV OSCILLATOR KLYSTRONS (Continued)

Type	Mechanical tuning range (GHz)	Output power (mW)	Application	Page no.
K366 series	6.125–7.750	1200	Microwave relay	**89**
KY366T series⊕	6.125–7.750	1200	Microwave relay	**93**
K367 series	6.125–7.750	1200	Microwave relay	**101**
KY367T series⊕	6.125–7.750	1200	Microwave relay	**107**
K391§	9.16–9.34	40	Local oscillator	**115**
K391A§	8.8–8.885	90	Local oscillator	**119**
K3007§	9.295–9.395	40	Local oscillator	**123**
K3033	2.65–3.7	100	Local oscillator	**127**
K3035■	34.1–35.6	30	Local oscillator	**131**
K3038■	33.5–36.0	350	Instrumentation	**135**
K3039■	33.5–36.0†	75	Local oscillator	**139**
K3066	10.66–10.72	15	Low power doppler	**143**
K3067	2.95–3.225	40	Local oscillator	**147**
K3069	10.525*	100	Low power doppler	**151**
K3071**	8.8†	1500	Aircraft doppler	**155**

⊕ Vapour cooled

§ Rugged

† Other frequencies available to special order

■ Made to special order only

* Preset to this frequency

** Two resonator type, fixed tuned

EEV OSCILLATOR KLYSTRONS (Continued)

Type	Mechanical tuning range (GHz)	Output power (mW)	Application	**Page no.**
K3071B**	8.77†	1500	Aircraft doppler	**155**
K3073	10.325–10.335	60	Low power doppler	**159**
K3074	10.50–10.55	27	Low power doppler	**163**
K3076§	10.5–10.7	60	Low power doppler	**167**
K3077§	9.35–9.55	50	Low power doppler	**171**
K3078§☆	8.5–9.6	35	Local oscillator	**175**
K3079§	8.05–8.8	90	Paramp pump	**179**
K3080§☆	16.5–17.5	50	Paramp pump	**183**
K3080A§☆	16.5–17.2	65	Paramp pump	**187**
K3081§	9.35–9.55	55	Local oscillator	**191**
K3090**	8.8†	1500	Aircraft doppler	**195**
K3091§	9.35–9.55	50	Local oscillator	**199**
K3094§	9.295–9.395	40	Local oscillator	**203**
K3095§	8.6–9.2	90	Paramp pump	**207**
K3096§	9.0–9.6	90	Paramp pump	**211**

Continued on following page

** Two resonator type, fixed tuned.

† Other frequencies available to special order.

§ Rugged.

☆ Reflector voltage precision tuned within ±5V.

EEV OSCILLATOR KLYSTRONS (Continued)

Type	Mechanical tuning range (GHz)	Output power (mW)	Application	**Page no.**
K3097§	8.74–9.26	50	Local oscillator	**215**
K3098§	8.800–8.885	60	Aircraft doppler	**219**
K3101	12.0–14.5	80	Local oscillator	**223**
K3101M	14.015*	80	Local oscillator	**223**
K3102	14.5–17.0	45	Local oscillator	**227**
K3102M	16.5–17.3	45	Local oscillator	**227**
K3111§☆	8.5–9.6	35	Local oscillator	**231**
K3113§	9.3–9.6	85	Local oscillator	**235**
K3114 series	5.9–8.5	1500	Microwave relay	**239**

§ Rugged

* Preset to this frequency

☆ Reflector voltage precision tuned within ±5V.

M-OV TRAVELLING WAVE TUBES – Low Noise

Type	Frequency range (GHz)	Saturated output power (mW)	Noise factor (db)	Low level gain (db)¶	Focus system	Page no.
TWC18§	4.0–8.0	20	11	40	PPM	**485**
TWC27§■	4.0–8.0	20	11	40	PPM◇	**493**
TWJ20§	12.0–18.0	7	14.5	30	PPM	**509**
TWJ29§■	12.0–18.0	7	14.5	30	PPM◇	**517**
TWJ30§	12.0–18.0	3	13.5	35	PPM	**523**
TWJ33§■	12.0–18.0	3	13.5	35	PPM◇	**531**
TWS17§	2.0–4.1	10	11	39	PPM	**575**
TWS26§■	2.0–4.1	10	11	39	PPM◇	**593**
TWX19§	7.0–12.0	10	11	37	PPM	**623**
TWX28§■	7.0–12.0	10	11	37	PPM◇	**639**

EEV TRAVELLING WAVE TUBES – Low Noise

Type	Frequency range (GHz)	Saturated output power (mW)	Noise factor (db)	Low level gain (db)	Focus system	Page no.
6861	2.7–3.5	1.0	6.5	25	N4004⊕	**247**
N1047M	2.7–3.2	1.5	4.0	24	N4041⊕	**259**

§ Rugged.

¶ Gain at 3db below saturation output power level.

◇ Integral power supply.

■ Made to special order only.

⊕ Solenoid.

EEV TRAVELLING WAVE TUBES – Medium Power

Type	Frequency range (GHz)	Saturated output power (W)	Noise factor (db)	Low level gain (db)¶	Focus system	**Page no.**
N1055△	5.85–7.15	18	27	43	N4085□△ N4094□△	**271**
N1056△	3.7–5.0	17	27	38	N4074□△ N4075□△	**287**
N1070■	5.925–6.425	10	27	35	N4132▲■	**327**
N1071	7.0–8.5	20	24	43	N4134☆★	**339**
N1072†	5.8–7.2	20	23	43	N4135☆★	**357**
N1073†	3.55–5.0	20	23	40	N4136☆★	**373**
N1086†	3.6–4.2	17	24	39	Integral★	**431**

¶ Gain at 3db below saturation output power level.

△ Maintenance type, not recommended for use in new equipment.

□ Conduction cooled periodic permanent magnet. Covers part of frequency range given.

■ Made to special order only.

★ Conduction cooled periodic permanent magnet.

† High efficiency design to minimize power consumption.

☆ Convection cooled version available.

▲ Convection cooled periodic permanent magnet.

M-OV TRAVELLING WAVE TUBES – Medium Power

Type	Frequency range (GHz)	Saturated output power (W)	Noise factor (db)	Low level gain (db)¶	Focus system	Page no.
TWC5	5.925–6.425					
TWC5A	7.4–7.8					
TWC5B	6.9–7.4					
TWC5C	6.425–7.11	10	25	37	PMC5▲	**455**
TWC14	5.925–6.425			36.5		
TWC14A	7.4–7.8			33		
TWC14B	6.9–7.4			33		
TWC14C	6.425–7.11	20	26	36.5	PMC14▲	**467**
TWC35†	5.925–6.425			38		
TWC35A■†	7.4–7.8			35		
TWC35B■†	6.9–7.4			35		
TWC35C■†	6.425–7.11	15	25	38	PPM▲	**499**
TWS6	2.5–4.1	1	21	20	SMS6⊕	**539**
TWS7△	2.7–3.25	3	24	23	SMS7⊕	**547**
TWS10/7642	1.7–2.3	18	28	30	PPM	**555**
TWS12	1.7–2.7	20	30	33	PPM	**563**
TWS24■	1.9–2.33	18	30	35	PPM★	**583**
TWS25■	1.67–1.9	15	30	33	PPM★	**583**
TWS32	1.7–2.7	20	30	33	PPM★	**563**
TWS36	1.7–2.3	20	28	30	PPM★	**599**
TWX8	7.0–11.5	0.5	30	35	PPM▲	**607**
TWX22§	7.0–11.5	1.0	30	35	PPM▲	**631**
TWX34§	7.0–11.5	1.0	30	35	PPM▲	**647**

⊕ Solenoid.

§ Rugged.

EEV TRAVELLING WAVE TUBES – Broadband, Rugged

Type	Frequency range (GHz)	Saturated output power (min) (W)	Gain at saturation (min) (db)	Weight (kg)	Page no.
N1065	9.5–12.4	35	40	2.6	**319**
N1075	8.0–12	100	30	2.7	**389**
N1077	5.0–10	100	30	2.8	**395**
N1078	5.0–10	2.0	36	0.9	**401**
N1079	7.0–11	2.0	36	0.9	**407**
N1080	7.0–11	200	31	3.7	**411**
N1081	9.0–16	100	30	2.5	**415**
N1082	9.0–16	2.0	36	0.9	**421**
N1083	5.0–10	25	43	1.4	**425**

EEV PULSED TRAVELLING WAVE TUBES

Type	Frequency range (GHz)	Peak output power (kW)	Gain (db)	Duty cycle	Solenoid	Page no.
N1061■	X-Band*	900–500	35–25	0.005	N4115	**311**
N1094	4.4–5.8	0.25	40	0.05	Integral★	**441**

■ Made to special order only.

★ Conduction cooled periodic permanent magnet.

* Tubes covering 450MHz bands centred on various frequencies in X-band can be supplied.

M-OV PULSED TRAVELLING WAVE TUBE

Type	Frequency range (GHz)	Peak output power (kW)	Gain (db)	Duty cycle	Solenoid	Page no.
TWX16	8.0–9.3	5.0–20	42–45	0.005	SMX16	**615**

EEV BACKWARD WAVE OSCILLATORS – O Type

Type	Voltage tuning range (GHz)	Typical output power (mW)†	Delay line voltage range (V)	Delay line current max. (mA)	Integral focusing	Page no.
N1010A					Magnet	**681**
N1010S	7.0–11.5	40–130	300–1500	40	Solenoid	**681**
N1034A					Magnet	**693**
N1034S	2.4–4.5	90–400	150–1170	50	Solenoid	**693**

M-OV BACKWARD WAVE OSCILLATORS – M Type

Type	Operating frequency range (GHz)	Typical output power (W)	Tuning (line) voltage range (kV)	Beam current (mA)	Page no.
BWS1	2.5–3.1	400	2.5–4.8	350	**657**
BWS2	3.0–4.0	250	2.2–4.7	350	**665**
BWX5	7.6–10.4	200	2.5–5.1	350	**673**

† Variation of typical output power over the band.

EQUIVALENTS INDEX

OSCILLATOR KLYSTRONS
TRAVELLING WAVE TUBES
BACKWARD WAVE OSCILLATORS

Type to be replaced	EEV/M-OV replacement	Type to be replaced	EEV/M-OV replacement
2K28*	K3033	5960-14-256-8726	K3078
6V202*	K366E	5960-99-000-2164	K302
6V203*	K366G	5960-99-000-2304	K324
6V431*	K366E	5960-99-000-2343	K335
6V432*	K366E	5960-99-000-2381	N1034A
7V204*	K366D	5960-99-000-2393	N1010A
7V205*	K366C	5960-99-000-2494	K351
7V206*	K366B	5960-99-000-4515	K337
7V434*	K366D	5960-99-000-5130	K337
7V435*	K366C	5960-99-000-5730	K337
7V436*	K366B	5960-99-037-2101	K342
8RK17	K3038	5960-99-037-2119	N1034S
8RK19	K3039	5960-99-037-2120	N1010S
8RK22	K3035	5960-99-037-2332	6861
8V207*	K366A	5960-99-037-2422	K350
8V437*	K366A	5960-99-037-3195	K359
59-60/90/011	K3007	5960-99-037-4077	K391A
5960-00-754-9775	K3078	5960-99-037-4166	KY366CD/T
5960-14-220-4521	K3033	5960-99-037-4192	N1047M

* Near equivalent

Type to be replaced	EEV/M-OV replacement
5960-99-037-4672	K3007
5960-99-037-5016	K3101
5960-99-037-5171	K391
5960-99-037-5406	K3102M
5960-99-037-5426*	N1034S
6861	6861
6975	K3078
7642	TWS10/7642
BA9-20	N1010
BA9-20M*	N1010
BWS1	BWS1
BWS2	BWS2
BWX5	BWX5
CO43*	N1010
CO119*	N1034
CV2164	K302
CV2304	K324
CV2343	K335
CV2381	N1034A
CV2393	N1010A
CV2494	K351
CV4515	K337
CV5130	K337

Type to be replaced	EEV/M-OV replacement
CV5362	6861
CV5426	K350
CV5438	TWC5
CV5985	K359
CV6003	K342
CV6023	N1034S
CV6024	N1010S
CV6085	TWS6
CV6117	TWS7
CV6142	K391A
CV6146	KY366C/T
CV6147	KY366D/T
CV6150	KY366CD/T
CV6157	TWS6
CV6179	TWS17
CV6180	TWC18
CV6181	TWX19
CV6182	TWJ20
CV6194	K391
CV8908	N1047M
CV9423	K3007
CV10013	K3101
CV10570	K3102M

* Near equivalent

Type to be replaced	EEV/M-OV replacement	Type to be replaced	EEV/M-OV replacement
CV10611*	N1034S	K3033	K3033
K300	K300	K3035	K3035
K302	K302	K3038	K3038
K311	K311	K3039	K3039
K324	K324	K3066	K3066
K335	K335	K3067	K3067
K336	K350	K3069	K3069
K337	K337	K3071	K3071
K342	K342	K3071B	K3071B
K350	K350	K3073	K3073
K351	K351	K3074	K3074
K357	K357	K3076	K3076
K359	K359	K3077	K3077
K361	K361	K3078	K3078
K361B	K361B	K3079	K3079
K366 Series	K366 Series	K3080	K3080
K367 Series	K367 Series	K3080A	K3080A
K391	K391	K3081	K3081
K391A	K391A	K3090	K3090
K3003	K3081	K3091	K3091
K3007	K3094	K3094	K3094
K3020	K3091	K3095	K3095
K3020A	K3097	K3096	K3096

* Near equivalent

Type to be replaced	EEV/M-OV replacement	Type to be replaced	EEV/M-OV replacement
K3097	K3097	N1055	N1055
K3098	K3098	N1056	N1056
K3101	K3101	N1061	N1061
K3101M	K3101M	N1065	N1065
K3102	K3102	N1070	N1070
K3102M	K3102M	N1071	N1071
K3111	K3111	N1072	N1072
K3113	K3113	N1073	N1073
K3114	K3114	N1074	N1073
KS6-1000D,E,G	K366D,E,G	N1075	N1075
KS7-1000A,B,C	K366A,B,C	N1077	N1077
KS9-40B*	K3091	N1078	N1078
KS9-40D*	K3081	N1079	N1079
KY366T Series	KY366T Series	N1080	N1080
KY367T Series	KY367T Series	N1081	N1081
LB6-10*	N1070	N1082	N1082
LD605*	N1055	N1083	N1083
N1010A	N1010A	N1085	N1072
N1010S	N1010S	N1086	N1086
N1022M	6861	N1094	N1094
N1034A	N1034A	N4004	N4004
N1034S	N1034S	N4041	N4041
N1047M	N1047M	N4075	N4075

* Near equivalent

Type to be replaced	EEV/M-OV replacement	Type to be replaced	EEV/M-OV replacement
N4085	N4085	TV2350	K350
N4094	N4094	TWC5	TWC5
N4115	N4115	TWC5A	TWC5A
N4132	N4132	TWC5B	TWC5B
N4134	N4134	TWC5C	TWC5C
N4135	N4135	TWC14	TWC14
N4136	N4136	TWC14A	TWC14A
PMC5	PMC5	TWC14B	TWC14B
PMC14	PMC14	TWC14C	TWC14C
RK6043	K3065	TWC18	TWC18
SK220 Series	K366 Series	TWC27	TWC27
SK222 Series	K367 Series	TWC35	TWC35
SMS6	SMS6	TWC35A	TWC35A
SMS7	SMS7	TWC35B	TWC35B
SMX16	SMX16	TWC35C	TWC35C
SRU4438	K3080	TWJ20	TWJ20
SZ50*	K351	TWJ29	TWJ29
SZ52A	K3079	TWJ30	TWJ30
SZ52B	K3095	TWJ33	TWJ33
SZ53	K351	TWS6	TWS6
TH2220 Series	K366 Series	TWS7	TWS7
TV220 Series	K366 Series	TWS10/7642	TWS10/7642
TV222 Series	K367 Series	TWS12	TWS12

* Near equivalent

Type to be replaced	EEV/M-OV replacement	Type to be replaced	EEV/M-OV replacement
TWS17	TWS17	VA259 Series	K3114 Series
TWS24	TWS24	VA508	K3071
TWS25	TWS25	VC507M*	K350
TWS26	TWS26	YK1040*	K351
TWS32	TWS32	YK1046*	K391
TWS36	TWS36	YK1071	K367A
TWX8	TWX8	YK1072	K367B
TWX16	TWX16	YK1073	K367C
TWX19	TWX19	YK1074	K367D
TWX22	TWX22	YK1075	K367G
TWX28	TWX28	YK1076	K367E
TWX34	TWX34	YK1082	K3113
VA201B	K351	YK1141	K366A
VA203B/6975	K3078	YK1142	K366B
VA210P	K3073	YK1143	K366C
VA218B	K3069	YK1144	K366D
VA220 Series	K366 Series	YK1145	K366G
VA222 Series	K367 Series	YK1146	K366E

* Near equivalent

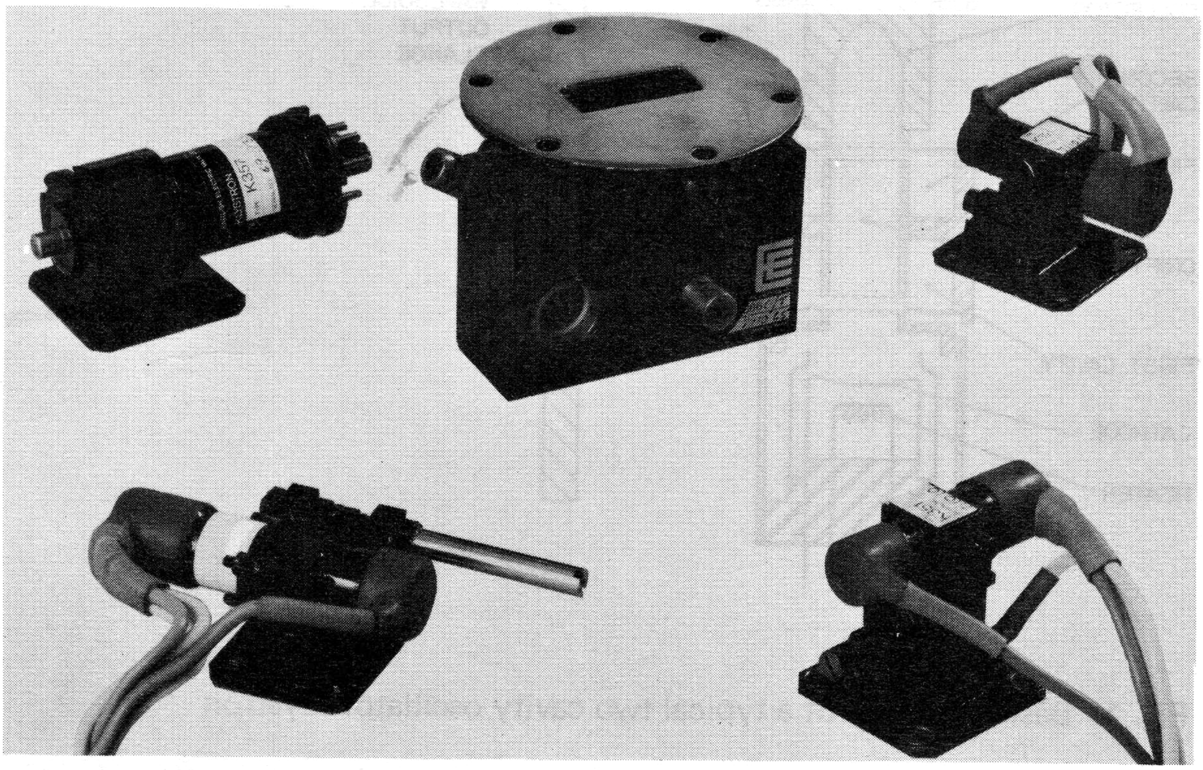
Oscillator Klystrons

PREAMBLE

OSCILLATOR KLYSTRONS

INTRODUCTION

Oscillator klystrons are widely used as low power microwave sources, at frequencies from S-band into the millimetre wave region. Power levels vary from a few milliwatts to several watts, all types can be frequency modulated and most are mechanically tunable. The first practical application was as the local oscillator in radar receivers and now similar tubes are used for test equipment, parametric amplifier pumps and short range c.w. radars such as speed meters. Applications requiring higher power include airborne c.w. radar and microwave communications relay transmitters.



There are two types of oscillator klystron. Reflex klystrons are characterized by simple mechanical tuning over a wide frequency range coupled with convenient and sensitive electronic tuning. Two cavity oscillator klystrons are less easily tuned but more efficient and more powerful.

PRINCIPLES OF OPERATION

The mechanism by which klystrons operate is most easily illustrated by considering the two cavity tube. The reflex klystron can then be regarded as a modification of the two cavity oscillator.

THE TWO CAVITY OSCILLATOR KLYSTRON

The basic structure of a two cavity klystron is shown in Fig. 1. The cathode assembly produces a focused electron beam which is accelerated to the h.t. voltage before entering the first cavity. Both cavities are high Q resonators and must be tuned to the required frequency of oscillation or very close to it.

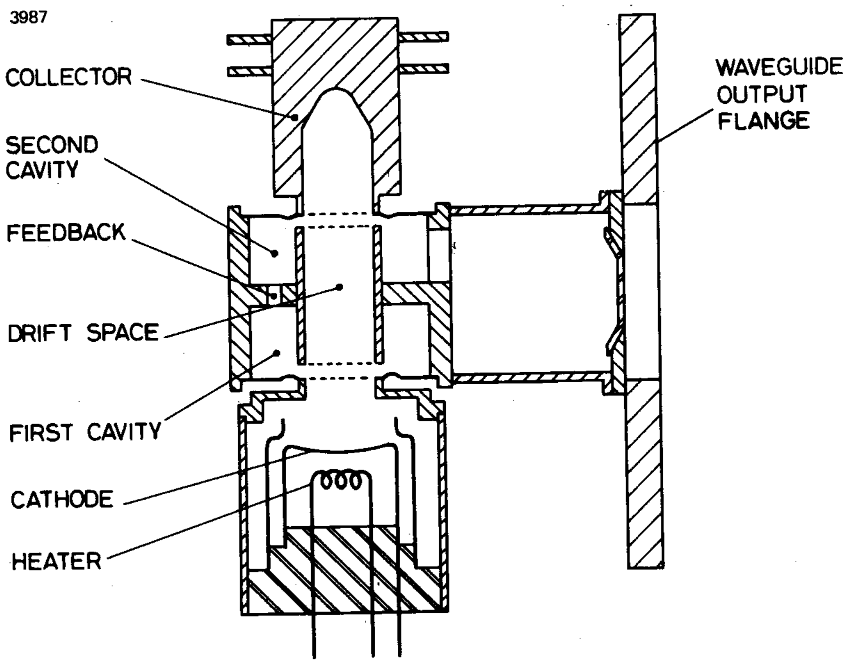


Fig. 1. Basic structure of a typical two cavity oscillator klystron

As the electron beam builds up when the tube is switched on, the r.f. noise component of the beam is coupled into the first cavity, which resonates at the tuned frequency. The resonance produces a very small r.f. voltage across the interaction space and this results in velocity modulation of the beam by slight retardation and acceleration in alternate half-cycles of the resonance.

The velocity modulation is very small, but as the beam travels along the drift space between the cavities it develops a 'bunched' characteristic, as electrons which have been accelerated catch up those ahead which have been retarded (see Fig. 2). By the time the beam arrives at the interaction space of the second cavity it is current modulated at the first cavity resonant frequency; as a result of the bunching process the depth of modulation is very much greater than at the first cavity gap.

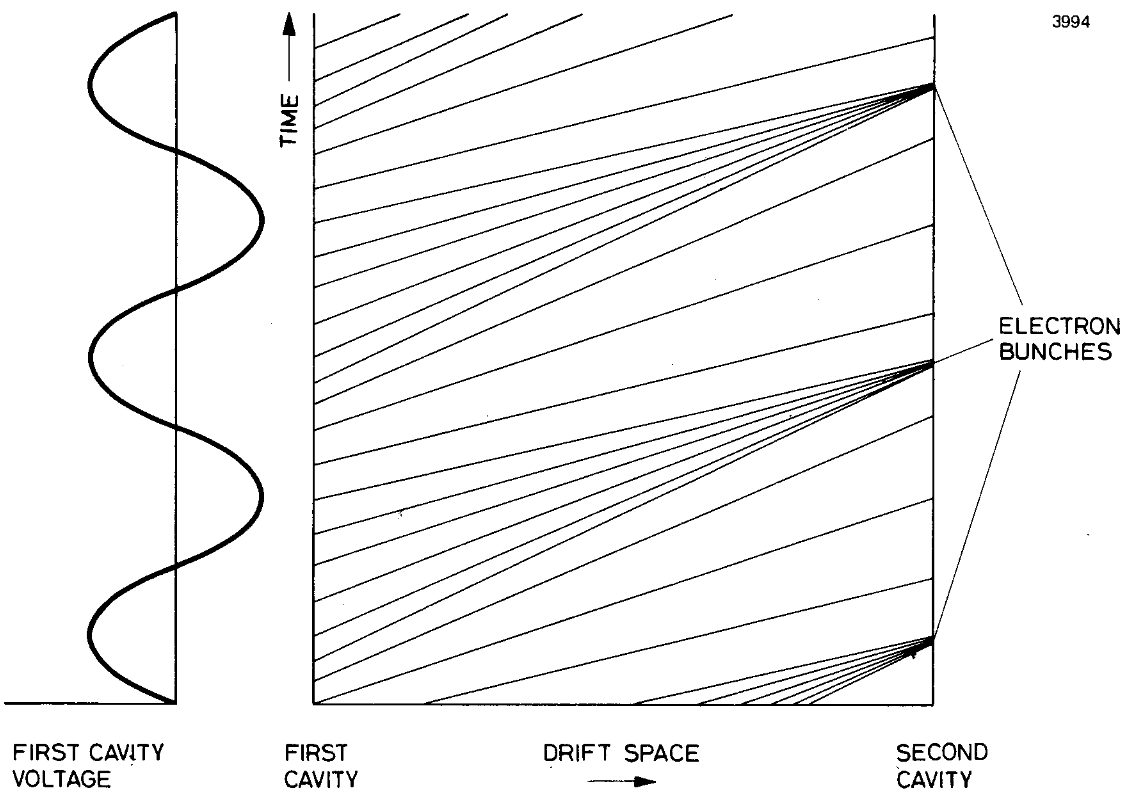


Fig. 2. Applegate diagram for two cavity tube

The modulation on the beam generates oscillation in the second cavity. Part of this power is fed back to the first cavity, the amplitude and phase of the feedback being arranged so that the beam modulation is further increased. The r.f. output is coupled from the second cavity into the external waveguide circuit.

Modes of Oscillation

A number of variable parameters must be correctly matched in order to maintain oscillation. The major factors which control the oscillation of the tube are as follows:

a) the tuning and Q factors of the two cavities
b) the beam voltage
c) the length of the drift space
d) the characteristics of the feedback circuit

The drift space and feedback are fixed by the design of the tube and cavity tuning is normally adjusted during manufacture (two cavity klystrons are not normally regarded as mechanically tunable by the user).

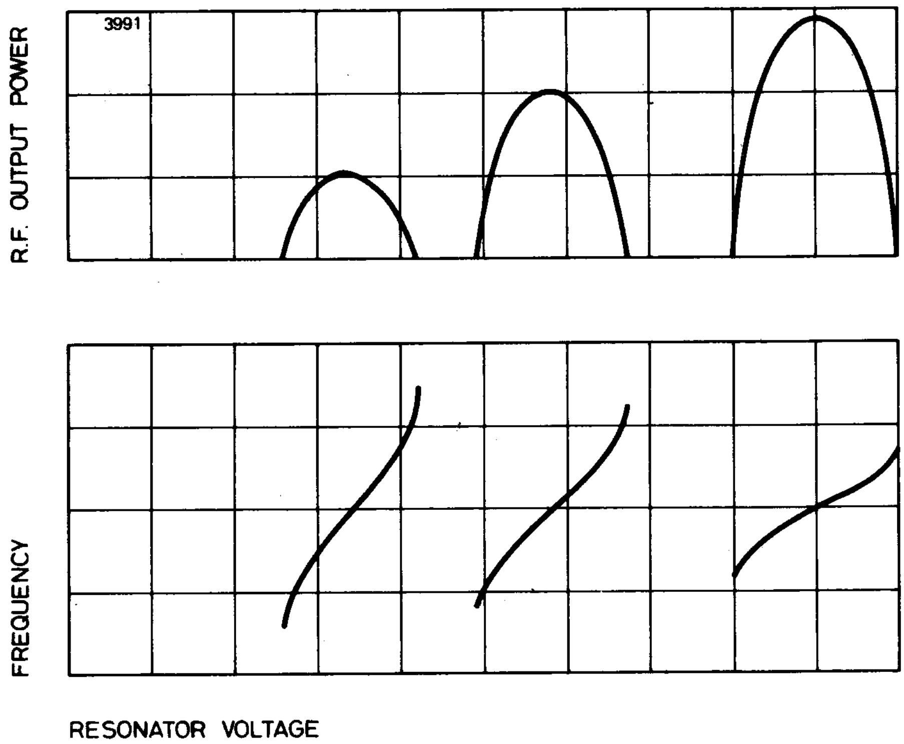


Fig. 3. Variation of power and frequency with beam voltage

The effect of varying the beam voltage is shown in Fig. 3; this shows several ranges of beam voltage, known as modes, for which the tube will oscillate. Maximum power in each mode is obtained at the resonant frequency of the cavities, and raising the power of the beam results in higher r.f. output power. The degree of electronic tuning or modulation which can be obtained by beam voltage variation is greatest in the lower voltage modes, and also depends on the matching of the cavity resonances. Stagger tuning of the cavities provides a wider electronic tuning range at the expense of output power.

THE REFLEX KLYSTRON

In this type of tube an electron beam is again focused through a cavity but the following drift space leads to a reflector electrode, negative with respect to cathode, which returns the beam through the interaction space (see Fig. 4). The beam is velocity modulated on its first transit of the cavity and bunching takes place in the reverse sense to that of the two cavity tube, since the retarded electrons are reflected first and travel a shorter distance (see Fig. 5).

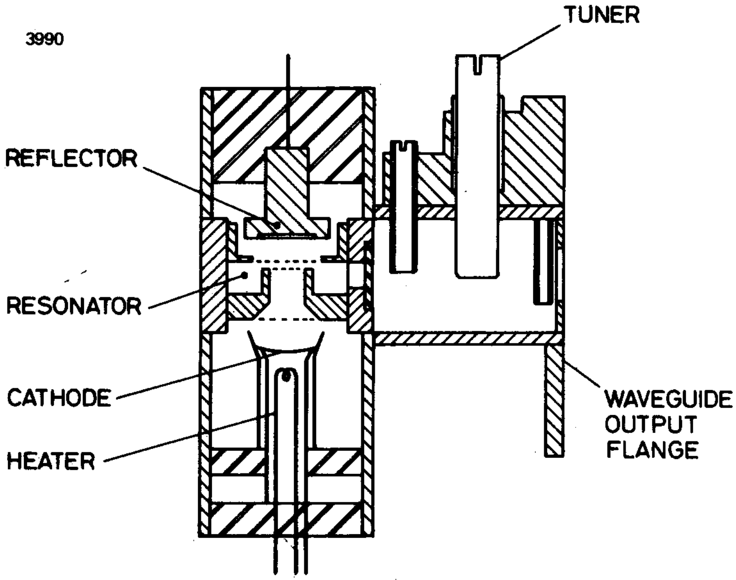


Fig. 4. Electrode structure of a typical reflex klystron

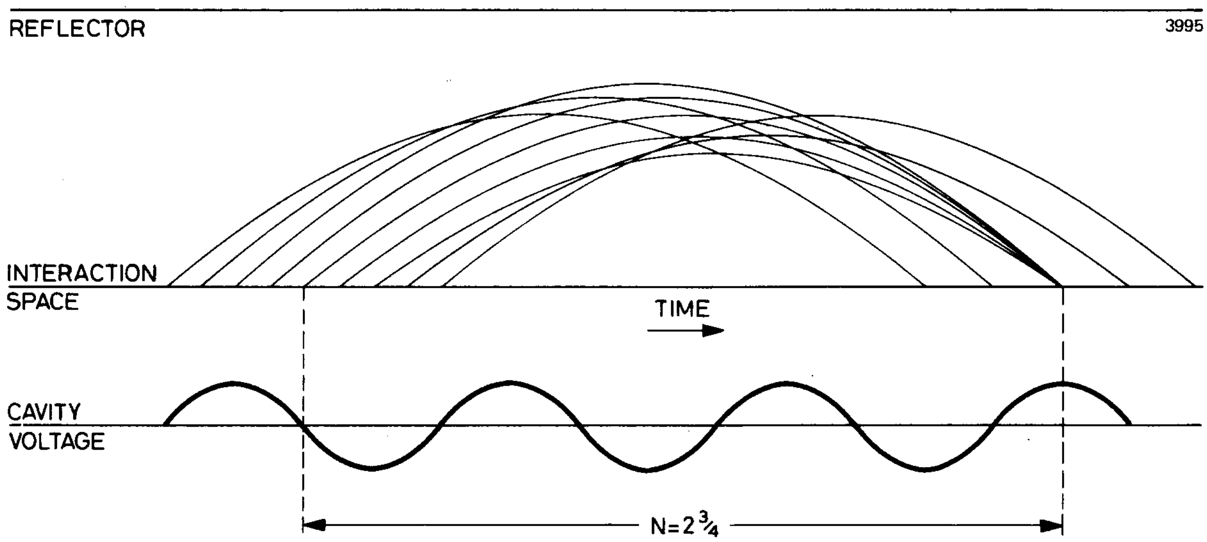


Fig. 5. Beam bunching in the reflex klystron

For maximum power, electron bunches must arrive at the interaction space so as to experience the maximum retarding voltage; this requires a transit time corresponding to n + ¾ cycles of r.f. where n is 0, 1, 2, etc.

The relationship between beam voltage and reflector voltage for the reflex klystron is approximately

$$V_R = \frac{C \cdot f \cdot V_o}{N} - V_o$$

where V_R = reflector voltage
C = a constant for the design of tube
f = frequency of oscillation
V_o = beam voltage
N = n + ¾ for maximum power

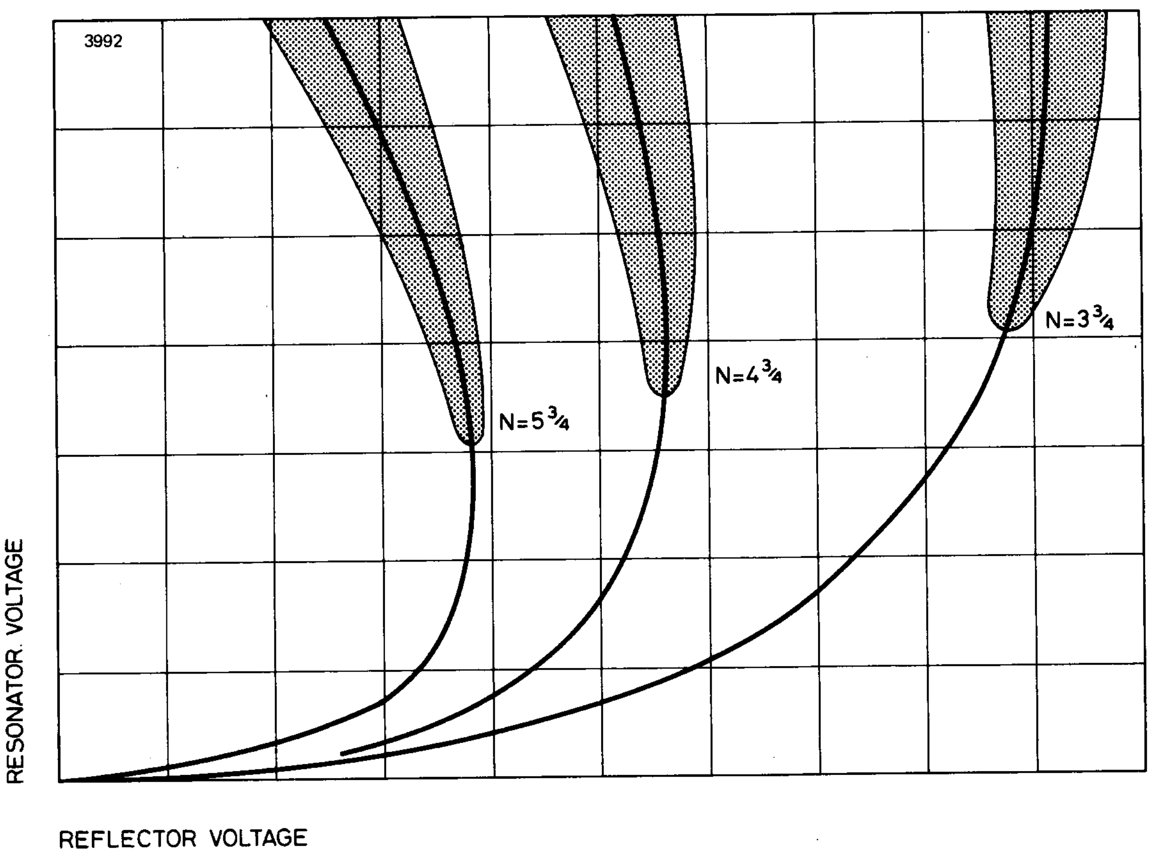


Fig. 6. Reflex klystron modes of oscillation

Fig. 6 shows the mode characteristics of a typical reflex klystron; oscillation occurs only in the shaded regions. In Fig. 7 the higher power and reduced electronic tuning range of the higher reflector voltage modes can be seen.

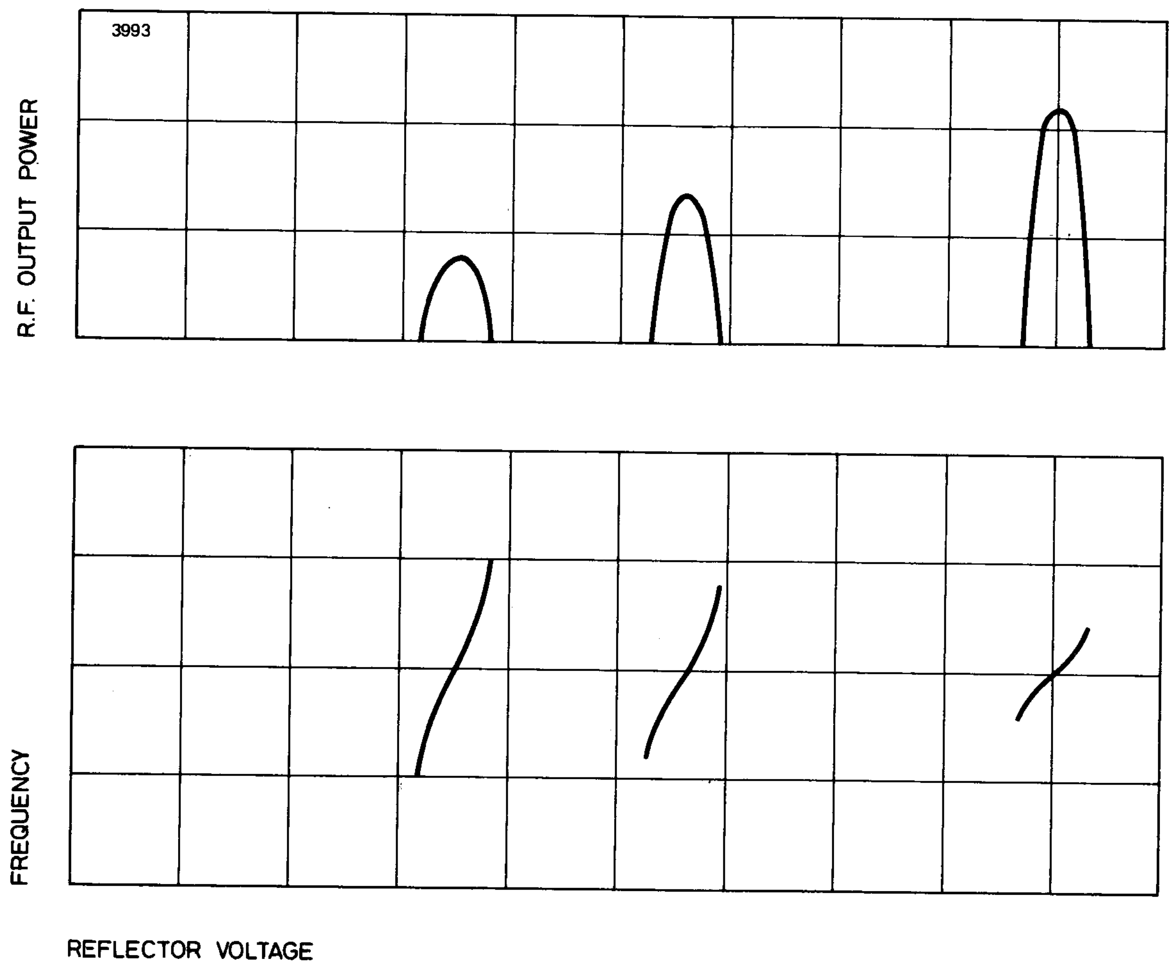


Fig. 7. Variation of power and frequency with reflector voltage

The use of a single resonant cavity simplifies mechanical tuning arrangements and most reflex klystrons can be tuned over relatively large frequency ranges with a single control. Electronic tuning by beam voltage variation is unnecessary, since reflector voltage variation effectively alters the length of the drift space and provides frequency adjustment or modulation. The reflector draws no current so no drive power is required for this type of electronic tuning.

OPERATING NOTES

Ratings and Characteristics

All the ratings given in the data sheets are absolute, non-simultaneous ratings. This means that the equipment designer is responsible for seeing that they are not exceeded, even momentarily, under any conditions of mains fluctuations, surges or component tolerances.

Heater Voltage

Heaters should in general be run as close as possible to the nominal r.m.s. voltage quoted, which is chosen to give the best combination of tube life and performance.

Reflector Voltage

The ratings must not be exceeded, even momentarily, during reflector modulation. The limits quoted under Range of Characteristics include variations over the mechanical tuning range and between individual tubes.

Mechanical Tuning Range

No attempt should be made to tune klystrons to beyond their specified frequency range, where they are not tested for satisfactory operation. Some types which are tuned by sliding plungers or deformation of the vacuum envelope can be damaged by such over-tuning.

Body Temperature

A check should be made during the development of any new equipment that the maximum body temperature will not be exceeded during operation. In most cases the value specified should be regarded as a short-term rating; appreciably lower temperatures during normal operation will give better tube life.

Tuning Rates

The mechanical tuning rates quoted are normally an average value over the specified range. Where reflector modulation sensitivity is given, this is the value at mode optimum and is usually measured as the frequency change produced by a voltage change of 1V. The sensitivity increases towards the limits of the mode.

Mounting

Most oscillator klystrons have waveguide output and are mounted by the waveguide flange. Where vibration tests are specified in the data, these are carried out with the tube mounted normally by the flange to the test fixture.

COOLING

Natural Cooling

Reflex klystrons operating at the lower power levels usually rely on cooling partly by natural convection and partly by conduction through the waveguide. Since the waveguide is normally earthed the klystron operates with the cathode and the heater supply negative to earth. If for any reason the tube is insulated from the waveguide, an air blower may be necessary for a type which would not normally require forced cooling. High altitude operation without pressurizing will reduce the effectiveness of convection or forced-air cooling.

Forced-air Cooling

A number of the higher powered reflex and two cavity klystrons are provided with fins for air cooling. An air supply is required for these types and must be started before the tube is switched on and maintained as long as the klystron is operating. In most cases a separate blower is provided for the tube.

Failure of the cooling air supply can cause rapid overheating of the tube and interlocks should be arranged to switch off all supplies to the klystron in the event of cooling failure.

Vapour Cooling

This cooling method can be applied to the higher power reflex klystrons used for microwave relay transmitters. The main advantage is improved frequency stability and the system is well adapted to unattended operation.

The resonator block of a typical vapour cooled tube incorporates a small boiler containing the coolant fluid. Once the block temperature reaches the boiling point of the coolant, it is effectively limited to this value by evaporation. The coolant vapour is condensed in a separate condenser and the condensate drains back into the boiler.

Using a vapour cooled tube for communications relay service, the frequency stability of the tube is normally adequate without a.f.c. or temperature controlled enclosures.

POWER SUPPLIES

Heater Supply

Most oscillator klystrons operate with the resonator earthed, so that the cathode is some hundreds of volts negative to earth. Some types have one side of the heater connected to cathode and others have a relatively low limit on the heater to cathode voltage, so that the heater supply must also be isolated from earth. Normally an a.c. supply is used; if a tube with a common heater-cathode connection is to have a d.c. heater supply, the positive supply must be connected to the cathode.

The heater voltage, measured at the tube terminals, should be as close as possible to the nominal value. If necessary, the equipment should incorporate means to adjust the voltage, and protection against short-term fluctuations in local mains voltages.

Reflector Supply

Although the reflector current is extremely small in normal operation, a limit is placed on the reflector circuit impedance, normally 0.5MΩ.

No reflex klystron will tolerate positive voltages on the reflector during operation, and it may be necessary to fit a protective diode at the reflector terminal to ensure that this cannot occur.

The reflector voltage may be used for both modulation and fine adjustment of the frequency; stabilization of the reflector supply is necessary for good frequency stability.

Resonator Supply

The resonator voltage is critical for correct operation and some degree of stabilization may be necessary. For two cavity tubes modulation is applied to the resonator voltage.

Tube Protection

Two cavity klystrons require only the normal protection from supply voltage fluctuation necessary for most electronic equipment, with interlocks to the cooling system in most cases.

Reflex types must have additional protection, because of the very low dissipation capability of the reflector. The sequence of voltage application on starting must be controlled, for example by delay switches, so that the reflector voltage is fully established before the beam voltage is applied. When the tube is switched off the reflector voltage must be maintained until the beam voltage has decayed. A failure of the reflector voltage supply during operation will destroy the tube unless an interlock is fitted to the resonator supply, and where forced cooling is necessary this should also be interlocked to all of the tube power supplies.

ENVIRONMENTAL CONDITIONS

Thermal

Many types of oscillator klystron incorporate glass seals and windows, and some older types have internal glass envelopes. Although it is possible for such tubes to be destroyed by severe thermal shock, very few applications present such a hazard and it can be overcome by a combination of thermal protection and tubes developed for the purpose. The continuous operating temperature of a tube is subject to a maximum rating, which may be from 100 to 200°C according to construction. In all cases, improved life and performance are obtained by operating well below the maximum limit.

Pressure

Large variations in atmospheric pressure may produce small frequency changes, and some types intended for airborne service have limits on this effect in their test specifications.

Tubes intended for operation at high altitude have encapsulated leads to prevent voltage breakdown.

Humidity

Some types are subjected to corrosion tests under high humidity or salt-spray conditions; most other klystrons are constructed and finished with similar materials, and can be expected to give satisfactory service under any normal conditions for electronic equipment.

Mechanical

Vibration, shock and continuous acceleration all have measurable effects on the frequency and output power of oscillator klystrons. In some applications these effects are important and tubes are tested accordingly, but mechanical damage is unlikely except in extreme situations. The vibration and shock requirements for typical military applications, including missile types, can usually be met without additional strengthening.

Storage

Tubes should be stored in their original packing if possible; this includes a vapour proof envelope which should not be opened until the tube is required for test or service. If the original packing is not used, the tubes must be protected from excessive moisture, corrosive fumes and dirt, and extreme shock or vibration. The plastic waveguide covers should be left on until tubes are installed.

K300

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron intended for use as a local oscillator.

Frequency range	9320 to 9500	MHz
Typical output power	30	mW
Electronic tuning range	30	MHz
Output	waveguide with dimensions 1.000 x 0.500 inch internal	
Coupler	special, to Admiralty pattern AP54989	
Mechanical tuning	see note 1	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.58	A

Mechanical

Overall dimensions	4.850 x 3.000 x 1.750 inches max 123.2 x 76.20 x 44.45mm max
Net weight	10 ounces (284g) approx
Mounting position	any
Base	5-pin international octal
Top cap	BS448-CT1

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Resonator dissipation	–	20	W
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	35	44	mA
Reflector voltage	–90	–	–150	V
Output power	15	30	–	mW
Mechanical tuning range	9320	–	9500	MHz
Electronic tuning range to –3db points	20	30	–	MHz
Reflector modulation sensitivity	–	0.75	–	MHz/V
Frequency drift (see note 6)	–	3.0	5.0	MHz

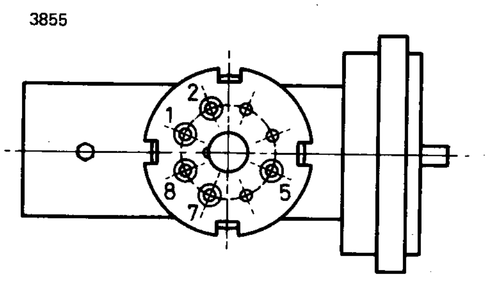
NOTES

1. Mechanical tuning is achieved by means of a reactive stub intruding into the waveguide. This stub may be operated directly by means of the micrometer provided or remotely by means of a shaft engaging a 0.062 inch (1.59mm) diameter pin mounted across the diameter of a 0.250 inch (6.35mm) hole recessed in the micrometer.

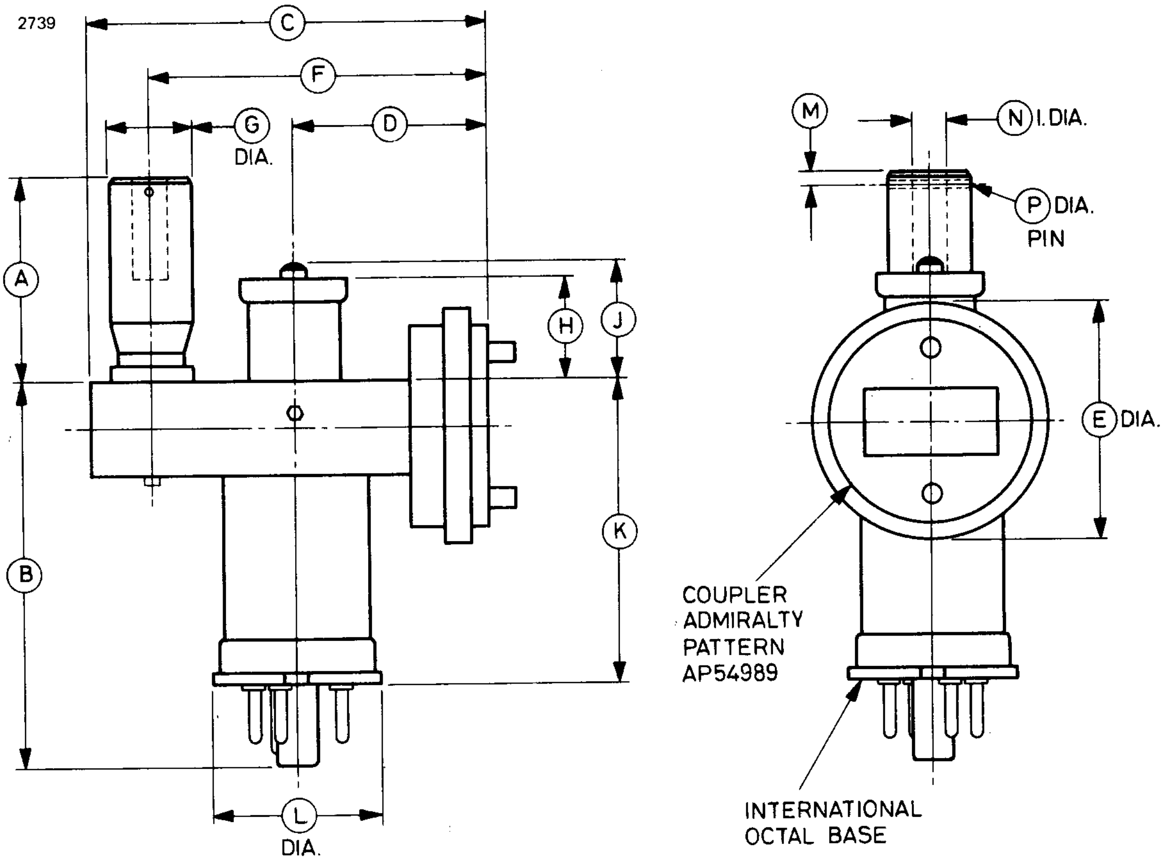
2. The resonator is normally operated at earth potential and in good thermal contact with the main waveguide system. If adequate thermal contact is not obtained, it will be necessary to provide cooling.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Frequency drift is measured between 4 and 15 minutes after switching on all supplies, at 9410 $\pm$ 20MHz.

Base Connections

Pin	Element
1	No connection
2	Heater
3	Omitted
4	Omitted
5	Resonator
6	Omitted
7	Heater, cathode
8	No connection
Top cap	Reflector



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.000 max	50.80 max	H	0.755 ± 0.015	19.18 ± 0.38
B	2.850 max	72.39 max	J	0.875 max	22.23 max
C	3.000 max	76.20 max	K	2.250 ± 0.030	57.15 ± 0.76
D	1.425 ± 0.125	36.20 ± 3.18	L	1.300 max	33.02 max
E	1.750	44.45	M	0.093	2.36
F	2.475 ± 0.025	62.87 ± 0.64	N	0.250	6.35
G	0.625 ± 0.010	15.88 ± 0.25	P	0.062	1.57

Millimetre dimensions have been derived from inches.

K311

OSCILLATOR KLYSTRON

Service Type CV9492

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron for local oscillator service.

Frequency range	8500 to 9500	MHz
Typical output power	45	mW
Electronic tuning range	30	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single shaft	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions	4.390 x 1.940 x 1.906 inches max 111.5 x 49.28 x 48.41mm max
Net weight	10 ounces (280g) approx
Mounting position	any
Base	5-pin octal
Reflector connection (see note 2)	top cap B.S.448-CT1

Cooling (See note 3) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 4)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 5)	–20	–500	V
Body temperature (see note 6)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

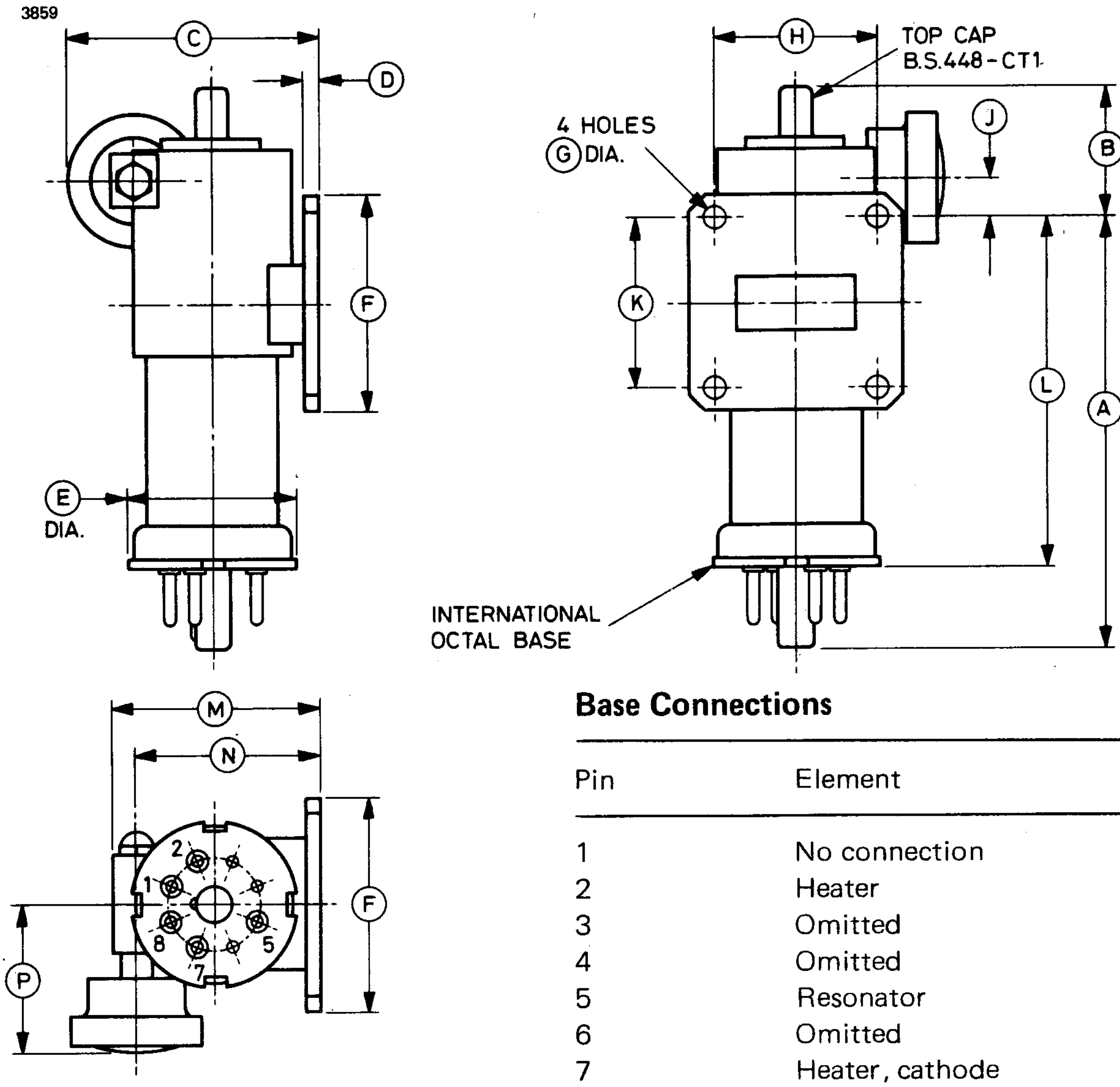
	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	35	44	mA
Reflector voltage	–165	–	–365	V
Output power	30	45	–	mW
Mechanical tuning range . .	8500	–	9500	MHz
Tuning rate	–	7.0	–	MHz/turn
Electronic tuning range to –3db points	20	30	–	MHz
Reflector modulation sensitivity	–	0.75	–	MHz/V
Frequency drift (see note 7) . .	–	3.0	5.0	MHz

NOTES

1. Clockwise rotation of the tuner increases the frequency. The tuner torque is 20oz in (0.14Nm) max. **Warning** No stops are fitted to the tuner and tuning beyond the specified frequency range may damage the klystron.
2. The K311 is available to order with a flexible lead reflector connection.
3. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.

4. All voltages except the heater voltage are with respect to cathode.
5. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
6. For best life, the operating temperature of the klystron body should be kept as low as possible.
7. Measured between 4 and 15 minutes after switching on all supplies, at 9000 ± 20MHz.
8. When supplied as CV9492, the flexible lead reflector connection will be fitted.

OUTLINE (All dimensions without limits are nominal)



Base Connections

Pin	Element
1	No connection
2	Heater
3	Omitted
4	Omitted
5	Resonator
6	Omitted
7	Heater, cathode
8	No connection
Top cap	Reflector

Ref	Inches	Millimetres
A	3.350 max	85.09 max
B	1.000 ± 0.040	25.40 ± 1.02
C	1.906 max	48.41 max
D	0.125	3.18
E	1.300 max	33.02 max
F	1.625 ± 0.005	41.28 ± 0.13
G	0.169 ± 0.003	4.293 ± 0.076

Ref	Inches	Millimetres
H	1.220 ± 0.004	30.99 ± 0.10
J	0.280 ± 0.015	7.11 ± 0.38
K	1.280 ± 0.004	32.51 ± 0.10
L	2.632 ± 0.060	66.85 ± 1.52
M	1.625 max	41.28 max
N	1.394 ± 0.010	35.41 ± 0.25
P	1.125	28.58

Millimetre dimensions have been derived from inches.

K324

OSCILLATOR KLYSTRON

Service Type CV2304

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron for local oscillator service.

Frequency range	9000 to 10 000	MHz
Typical output power	45	mW
Electronic tuning range	30	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single shaft	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions	4.390 x 1.940 x 1.906 inches max 111.5 x 49.28 x 48.41mm max
Net weight	10 ounces (280g) approx
Mounting position	any
Base	5-pin octal
Reflector connection (see note 2)	top cap B.S.448-CT1

Cooling (See note 3) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 4)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 5)	–20	–500	V
Body temperature (see note 6)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

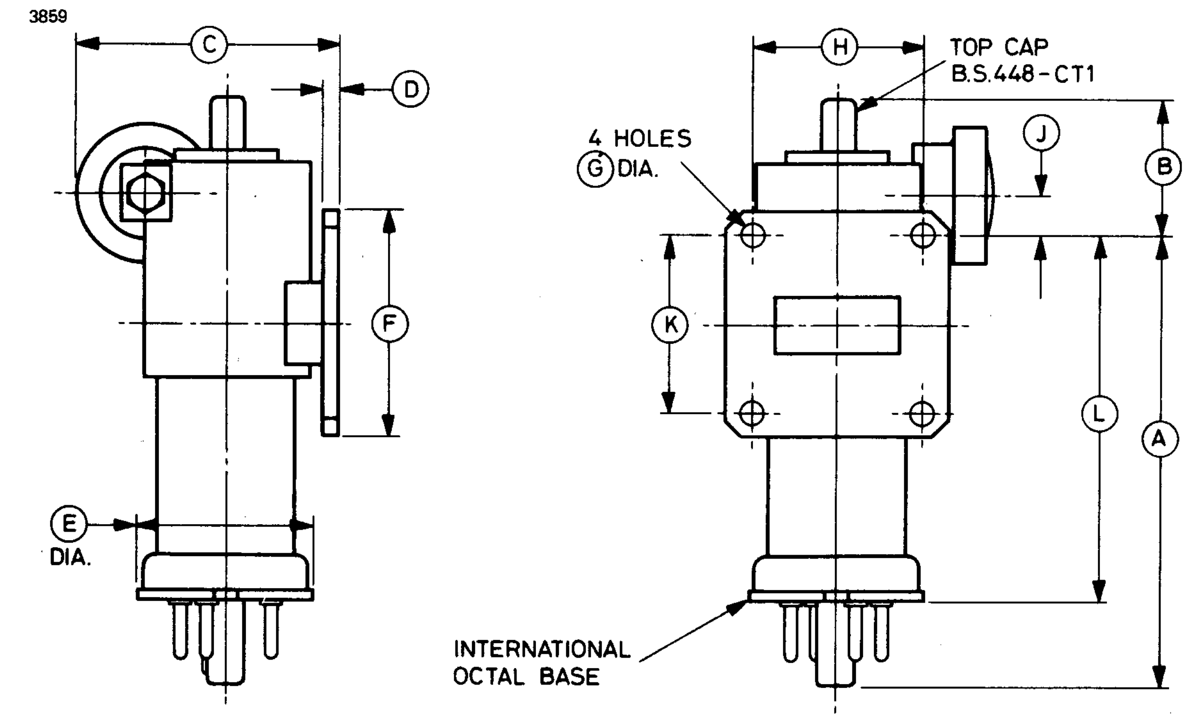
	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	35	44	mA
Reflector voltage	–250	–	–415	V
Output power	30	45	–	mW
Mechanical tuning range	9000	–	10 000	MHz
Tuning rate	–	7.0	–	MHz/turn
Electronic tuning range to –3db points	20	30	–	MHz
Reflector modulation sensitivity	–	0.75	–	MHz/V
Frequency drift (see note 7)	–	3.0	5.0	MHz

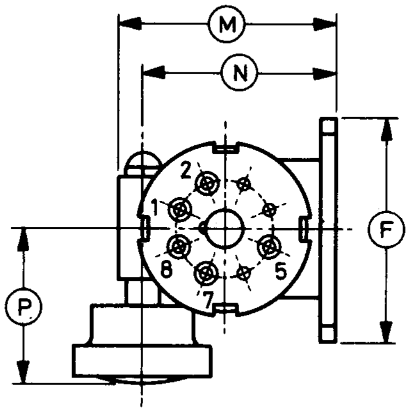
NOTES

1. Clockwise rotation of the tuner increases the frequency. The tuner torque is 20oz in (0.14Nm) max. **Warning** No stops are fitted to the tuner and tuning beyond the specified frequency range may damage the klystron.
2. The K324 is available to order with a flexible lead reflector connection.
3. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.

4. All voltages except the heater voltage are with respect to cathode.
5. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
6. For best life, the operating temperature of the klystron body should be kept as low as possible.
7. Measured between 4 and 15 minutes after switching on all supplies, at 9500 ± 20MHz.

OUTLINE (All dimensions without limits are nominal)





Base Connections

Pin	Element
1	No connection
2	Heater
3	Omitted
4	Omitted
5	Resonator
6	Omitted
7	Heater, cathode
8	No connection
Top cap	Reflector

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.350 max	85.09 max	H	1.220 ± 0.004	30.99 ± 0.10
B	1.000 ± 0.040	25.40 ± 1.02	J	0.280 ± 0.015	7.11 ± 0.38
C	1.906 max	48.41 max	K	1.280 ± 0.004	32.51 ± 0.10
D	0.125	3.18	L	2.632 ± 0.060	66.85 ± 1.52
E	1.300 max	33.02 max	M	1.625 max	41.28 max
F	1.625 ± 0.005	41.28 ± 0.13	N	1.394 ± 0.010	35.41 ± 0.25
G	0.169 ± 0.003	4.293 ± 0.076	P	1.125	28.58

Millimetre dimensions have been derived from inches.

OSCILLATOR KLYSTRON

Service Type CV2343

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron for local oscillator service.

Frequency range	9555 to 9685	MHz
Typical output power	25	mW
Electronic tuning range	30	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions	4.600 x 2.750 x 1.630 inches max 116.8 x 69.85 x 41.40mm max
Net weight	9 ounces (260g) approx
Mounting position	any
Base	5-pin octal
Reflector connection	top cap B.S.448-CT1

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.62	A
Resonator current	20	35	44	mA
Reflector voltage (see note 6)	–110	–	–180	V
Output power	15	25	–	mW
Mechanical tuning range	9555	–	9685	MHz
Tuning rate	–	–	5.0	MHz/div
Electronic tuning range to –3db points	20	30	70	MHz
Reflector modulation sensitivity	–	0.75	–	MHz/V
Frequency drift (see note 7)	–	3.0	5.0	MHz

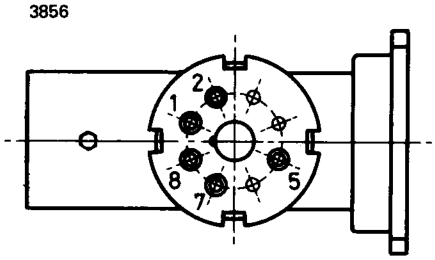
NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 4oz in (0.028Nm) max.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.

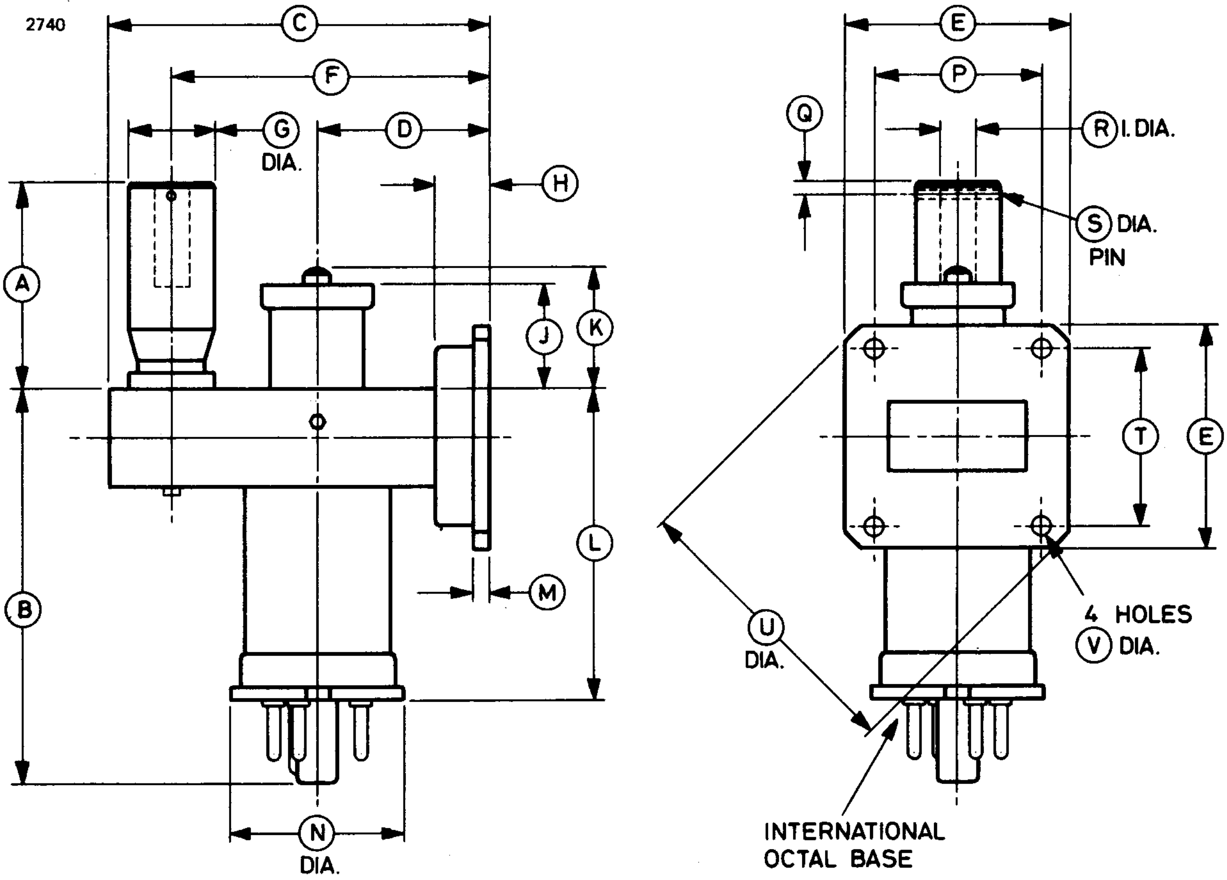
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Each klystron is marked with the reflector voltage and tuner reading which give maximum power at 9620 ± 10MHz.
7. Measured between 4 and 15 minutes after switching on all supplies, at 9620MHz.

Base Connections

Pin	Element
1	No connection
2	Heater
3	Omitted
4	Omitted
5	Resonator
6	Omitted
7	Heater, cathode
8	No connection
Top cap	Reflector



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.750 max	44.45 max	L	2.250 ± 0.030	57.15 ± 0.76
B	2.850 max	72.39 max	M	0.125	3.18
C	2.750 max	69.85 max	N	1.300 max	33.02 max
D	1.250 ± 0.125	31.75 ± 3.18	P	1.220 ± 0.004	30.988 ± 0.102
E	1.625 ± 0.005	41.28 ± 0.13	Q	0.093	2.36
F	2.290 ± 0.015	58.17 ± 0.38	R	0.250	6.35
G	0.625 ± 0.010	15.88 ± 0.25	S	0.062	1.57
H	0.452 max	11.48 max	T	1.280 ± 0.004	32.512 ± 0.102
J	0.755 ± 0.015	19.18 ± 0.38	U	2.125	53.98
K	0.875 max	22.23 max	V	0.147	3.73

Millimetre dimensions have been derived from inches.

K337

OSCILLATOR KLYSTRON

Service Types CV4515, CV5130

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged reflex klystron for local oscillator service.

Frequency range	9000 to 10 000	MHz
Typical output power	45	mW
Electronic tuning range	24	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding lead) .	4.375 x 1.889 x 1.662 inches max 111.1 x 47.98 x 42.21mm max
Net weight	12 ounces (340g) approx
Mounting position	any
Base	solder tags
Reflector connection	flexible lead

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	25	35	40	mA
Reflector voltage	–250	–	–400	V
Output power	30	45	–	mW
Mechanical tuning range	9000	–	10 000	MHz
Mechanical tuning rate:				
mean (see note 6)	6.5	7.0	8.0	MHz/turn
incremental (see note 7)	5.0	–	9.5	MHz/turn
Resetting error (see note 8)	–	1.0	3.0	MHz
Electronic tuning range to –3db points	20	24	–	MHz
Reflector modulation sensitivity:				
at mode optimum	0.5	0.75	1.0	MHz/V
ratio of mode optimum to ±10MHz values	0.33	–	–	
Reflector voltage tracking (see note 9)	–	2.0	3.0	V
Pulling characteristics (see note 10):				
frequency pulling	–	5.0	10	MHz
output power	15	–	–	mW
electronic tuning range	±10	–	–	MHz
Peak frequency modulation with 30g vibration up to 500Hz	–	1.0	2.0	MHz
Effects of constant 50g acceleration:				
frequency deviation	–	1.5	2.0	MHz
power change	–	–	1.0	db

NOTES

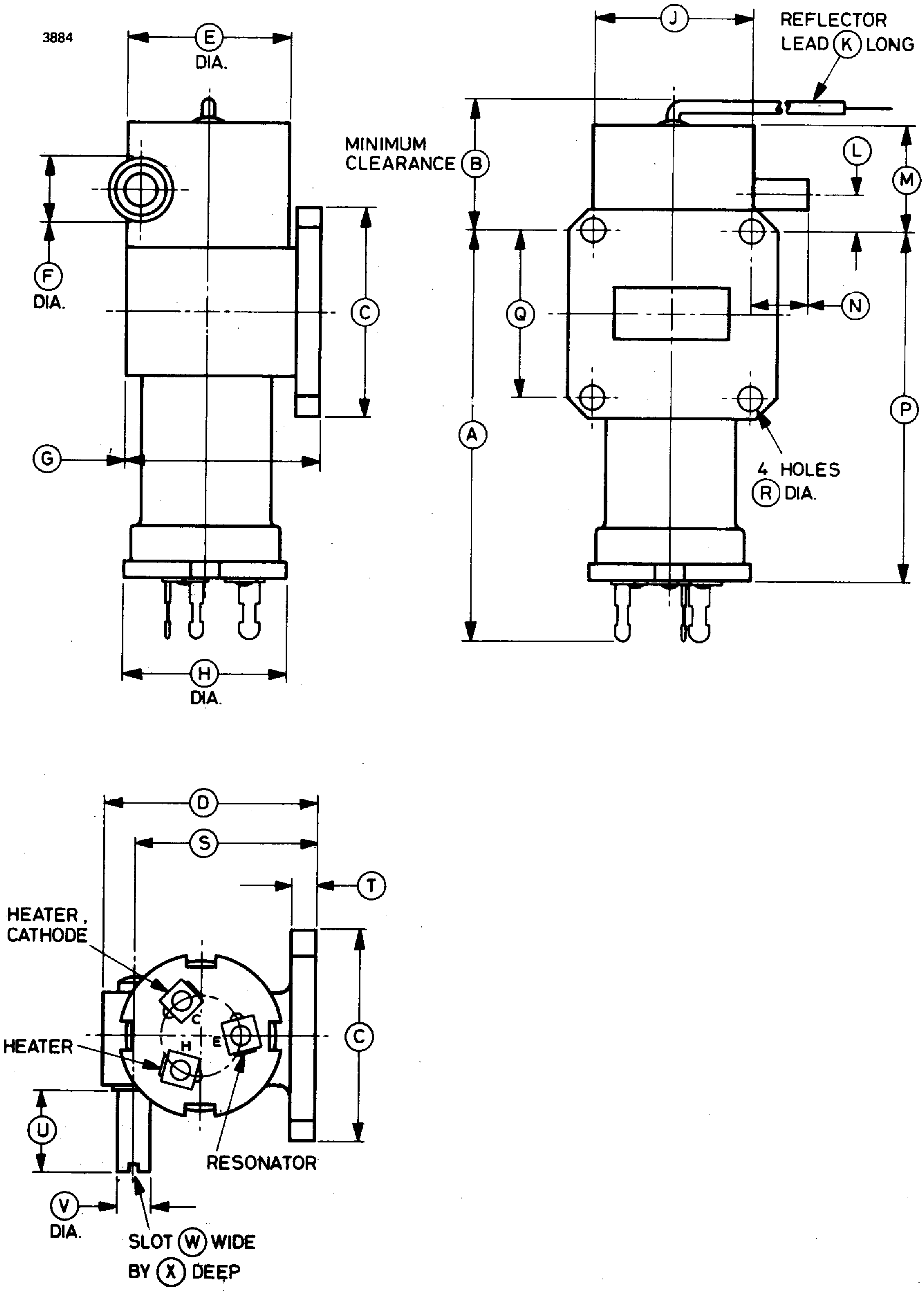
1. Clockwise tuner rotation increases the frequency. The tuner torque is 15oz in (0.1Nm) max. **Warning** No stops are fitted to the tuner and tuning beyond the specified frequency range may damage the klystron.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Average over the range 9000 to 10 000MHz.
7. The limits apply to the maximum and minimum slope of the frequency-tuner turns curve, plotted at 100MHz steps across the frequency range.
8. The frequency difference at the same tuner shaft setting, following an excursion of 100MHz.
9. The deviation from linearity of the graph of reflector voltage for mode optimum against tuner turns, plotted at 100MHz intervals across the frequency range.
10. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.350 max	85.09 max	P	2.682 ± 0.060	68.12 ± 1.52
B	1.025	26.04	Q	1.280 ± 0.004	32.51 ± 0.10
C	1.625 ± 0.005	41.28 ± 0.13	R	0.169 ± 0.003	4.293 ± 0.076
D	1.642 ± 0.020	41.71 ± 0.51	S	1.392 ± 0.015	35.36 ± 0.38
E	1.300 max	33.02 max	T	0.200 ± 0.020	5.08 ± 0.51
F	0.520 max	13.21 max	U	0.406 min	10.31 min
G	1.500 max	38.10 max	V	$0.250^{+0.000}_{-0.005}$	$6.35^{+0.00}_{-0.13}$
H	1.300 max	33.02 max			
J	1.220 ± 0.004	30.99 ± 0.10	W	$0.062^{+0.003}_{-0.000}$	$1.575^{+0.076}_{-0.000}$
K	2.500 min	63.50 min			
L	0.280 ± 0.015	7.11 ± 0.38	X	$0.062^{+0.010}_{-0.000}$	$1.57^{+0.25}_{-0.00}$
M	0.843 ± 0.030	21.41 ± 0.76			
N	0.442 ± 0.020	11.23 ± 0.51			

Millimetre dimensions have been derived from inches.

OUTLINE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K342

OSCILLATOR KLYSTRON

Service Type CV6003

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged reflex klystron for local oscillator service.

Frequency range	8500 to 9000	MHz
Typical output power	45	mW
Electronic tuning range	35	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding lead)	4.375 x 1.889 x 1.662 inches max 111.1 x 47.98 x 42.21mm max
Net weight	12 ounces (340g) approx
Mounting position	any
Base	solder tags
Reflector connection	flexible lead

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.62	A
Resonator current	25	35	40	mA
Reflector voltage	–140	–	–255	V
Output power	30	45	–	mW
Mechanical tuning range	8500	–	9000	MHz
Tuning rate (average)	5.0	7.0	9.5	MHz/turn
Electronic tuning range to –3db points	30	35	–	MHz
Reflector modulation sensitivity:				
at mode optimum	0.5	0.75	1.2	MHz/V
ratio of mode optimum to ±15MHz values	0.3	–	–	
Temperature coefficient of frequency	–	–	–325	kHz/°C
Frequency drift (see note 6)	–	–	6.0	MHz
Pulling characteristics (see note 7):				
frequency pulling	–	3.0	5.0	MHz
output power	20	30	–	mW
Peak frequency modulation with 13g vibration up to 500Hz	–	150	250	kHz
Effects of constant 13g acceleration:				
frequency deviation	–	1.5	2.0	MHz
power change	–	–	10	%

NOTES

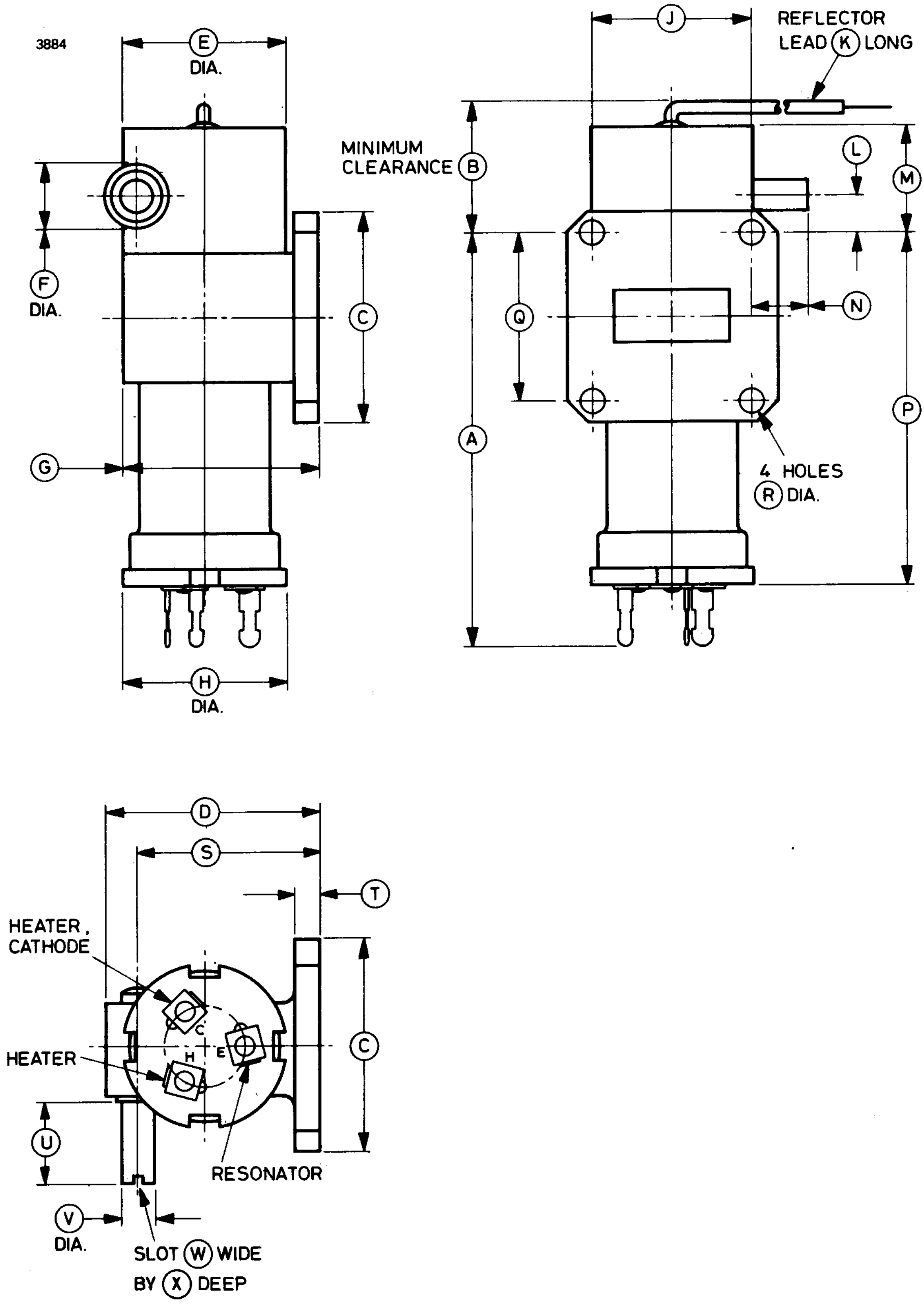
1. Clockwise rotation of the tuner increases the frequency. The tuner torque is 20oz in (0.14Nm) max. **Warning** No stops are fitted to the tuner and tuning beyond the specified frequency range may damage the klystron.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Measured between 4 and 15 minutes after switching on all supplies, at 8750 ± 20MHz.
7. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.350 max	85.09 max	P	2.682 ± 0.060	68.12 ± 1.52
B	1.025	26.04	Q	1.280 ± 0.004	32.51 ± 0.10
C	1.625 ± 0.005	41.28 ± 0.13	R	0.169 ± 0.003	4.293 ± 0.076
D	1.642 ± 0.020	41.71 ± 0.51	S	1.392 ± 0.015	35.36 ± 0.38
E	1.300 max	33.02 max	T	0.200 ± 0.020	5.08 ± 0.51
F	0.520 max	13.21 max	U	0.406 min	10.31 min
G	1.500 max	38.10 max	V	$0.250^{+0.000}_{-0.005}$	$6.35^{+0.00}_{-0.13}$
H	1.300 max	33.02 max			
J	1.220 ± 0.004	30.99 ± 0.10	W	$0.062^{+0.003}_{-0.000}$	$1.575^{+0.076}_{-0.000}$
K	2.500 min	63.50 min			
L	0.280 ± 0.015	7.11 ± 0.38	X	$0.062^{+0.010}_{-0.000}$	$1.57^{+0.25}_{-0.00}$
M	0.843 ± 0.030	21.41 ± 0.76			
N	0.442 ± 0.020	11.23 ± 0.51			

Millimetre dimensions have been derived from inches.

OUTLINE



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SLOT W WIDE
BY X DEEP

K350

OSCILLATOR
KLYSTRON

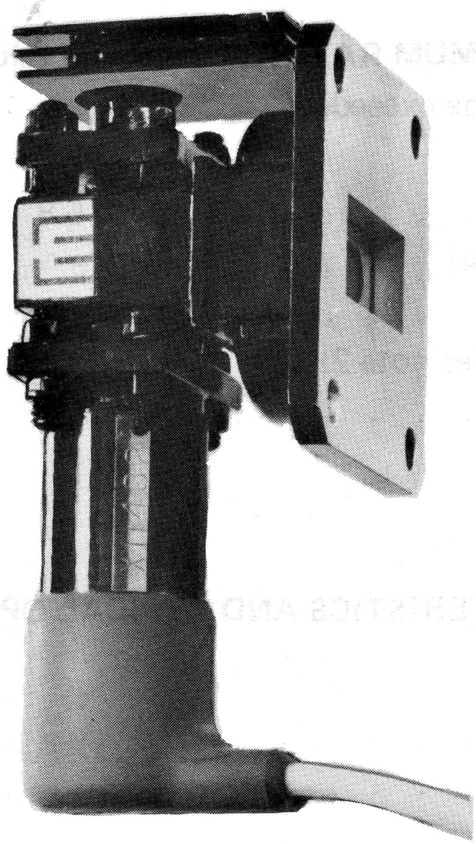
Service Type CV5426

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Forced-air cooled, fixed frequency, two cavity oscillator klystron for airborne doppler. It features low noise modulation and good frequency stability, and can be used at high altitudes without pressurizing.

Frequency (see note 1)	8800 ± 5	MHz
Typical output power	1.5	W
Electronic tuning range	12	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.6	A

Mechanical

Overall dimensions (excluding leads)	3.300 x 1.770 x 1.400 inches max 83.82 x 44.96 x 35.56mm max
Net weight	5 ounces (140g) approx
Mounting position	any
Connections	flexible leads

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

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Beam voltage (see note 4)	–	1100	V
Resonator dissipation	–	130	W
Radiator temperature (see note 2)	–	150	°C
Ambient pressure	25	–	mm Hg

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

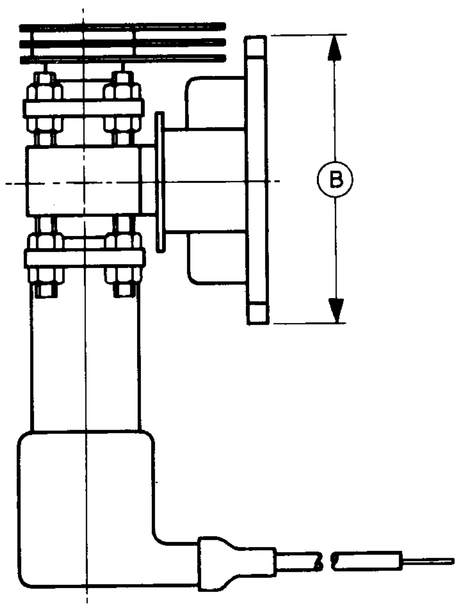
	Min	Typical	Max	
Heater current	1.5	1.6	1.75	A
Frequency	8795	8800	8805	MHz
Beam voltage for mode optimum	680	700	750	V
Beam current	55	70	80	mA
Output power	1.0	1.5	2.5	W
Electronic tuning range to –3db points	10	12	–	MHz
Beam voltage modulation sensitivity	100	200	300	kHz/V
Frequency pulling (see note 5) .	–	2.0	2.5	MHz
Random frequency deviation (peak to peak) (see note 6) .	–	1.0	3.0	kHz
Temperature coefficient of frequency	–	–100	–	kHz/°C

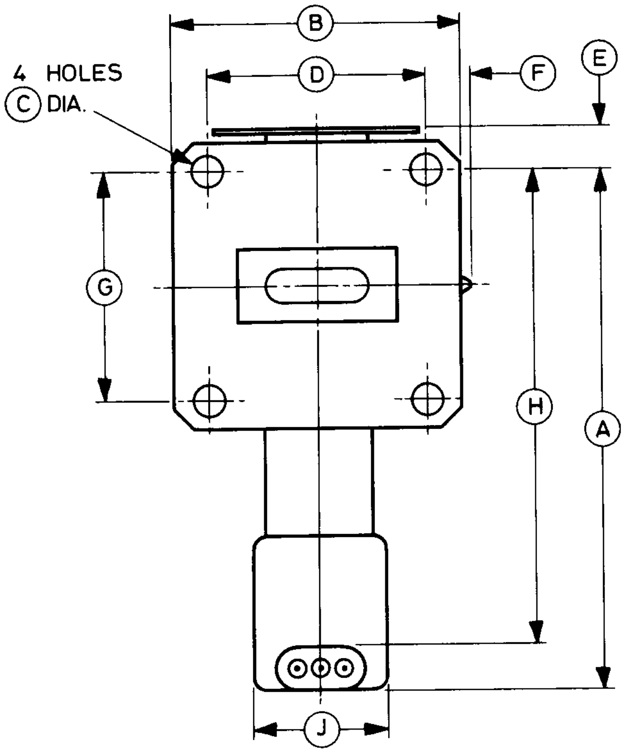
NOTES

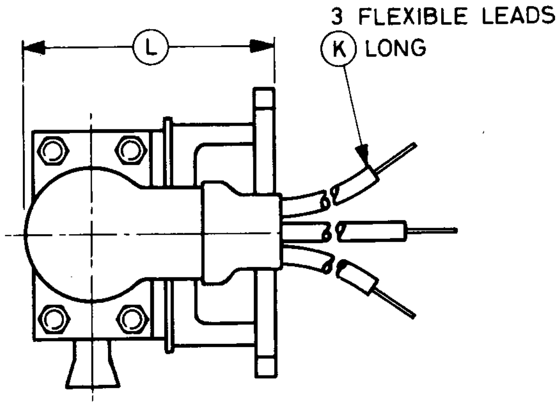
1. Other frequencies can be supplied in the range 8500 to 10 000MHz.
2. Under typical operating conditions, an air flow of 30ft^3/min (0.85m^3/min) directed at the radiator fins is adequate. For best life, the radiator temperature should be kept below 100°C.
3. All voltages except the heater voltage are with respect to cathode.
4. The resonator is normally operated at earth potential.
5. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
6. The random deviations of output frequency from the carrier frequency, produced by random modulating frequencies in the range 150 to 11 000Hz.

OUTLINE

3542A







Lead Connections

Colour	Element
White	Heater, cathode
Yellow	Heater
Green	Cathode

Ref	Inches	Millimetres
A	2.900 max	73.66 max
B	1.625	41.28
C	0.169 ± 0.003	4.293 ± 0.076
D	1.220 ± 0.004	30.988 ± 0.102
E	0.400 max	10.16 max
F	0.345 max	8.76 max

Ref	Inches	Millimetres
G	1.280 ± 0.004	32.512 ± 0.102
H	2.650 max	67.31 max
J	0.750 max	19.05 max
K	8.000 min	203.2 min
L	1.400 max	35.56 max

Millimetre dimensions have been derived from inches.

K351

OSCILLATOR KLYSTRON

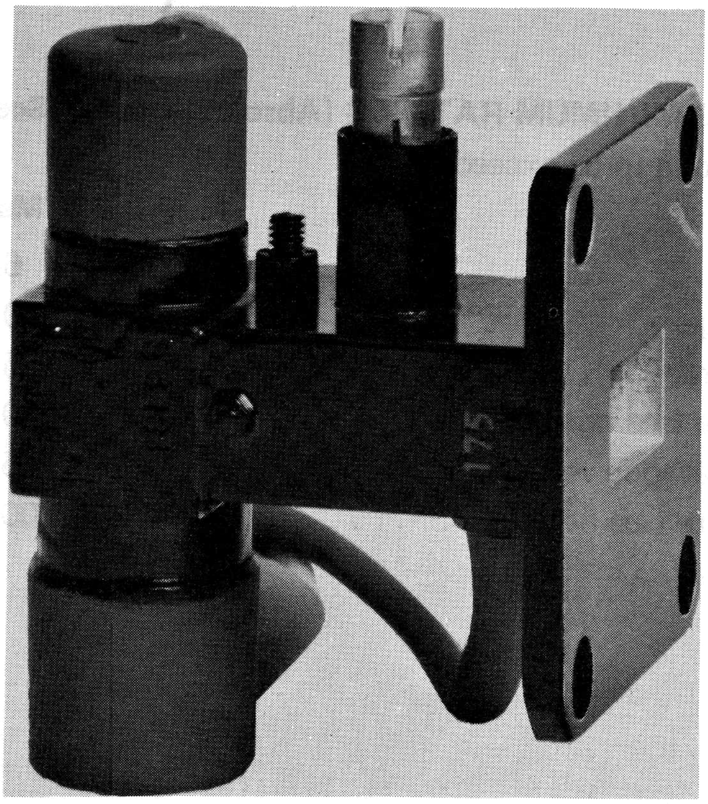
Service Type CV2494

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Extremely rugged, wide band reflex klystron for airborne and similar applications requiring fast warm-up, high frequency stability and low noise under severe environmental conditions.

Frequency range	8500 to 9655	MHz
Typical output power	90	mW
Electronic tuning range	45	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.08	A

Mechanical

Overall dimensions (excluding leads)	2.810 x 1.937 x 1.640 inches max 71.37 x 49.20 x 41.66mm max
Net weight	6 ounces (170g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Resonator current	–	55	mA
Reflector voltage (see note 4)	–20	–500	V
Peak heater to cathode voltage	–	45	V
Body temperature (see note 5)	–	200	°C

PERFORMANCE SPECIFICATION FOR MODE 5¾

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r. (see note 6)	1.1:1	max

Performance at 8500MHz

	Min	Typical	Max	
Heater current	0.7	1.08	1.32	A
Resonator current	30	37	45	mA
Reflector voltage	−80	−105	−135	V
Output power	40	90	–	mW
Electronic tuning range to −3db points	30	55	–	MHz
Reflector modulation coefficient (see note 7)	0.5	2.0	–	MHz/V
Hysteresis	–	5.0	50	%

Performance at 9000MHz

Reflector voltage	–	−135	–	V
Output power	–	110	–	mW
Electronic tuning range to −3db points	–	45	–	MHz
Reflector modulation coefficient (see note 7)	–	3.5	–	MHz/V

Performance at 9655MHz

Reflector voltage	−130	−160	−190	V
Output power	40	80	–	mW
Electronic tuning range to −3db points	30	38	–	MHz
Reflector modulation coefficient (see note 7)	0.5	1.3	–	MHz/V
Hysteresis	–	5.0	50	%

PERFORMANCE SPECIFICATION FOR MODE 6¾

Operating Conditions

Heater voltage	6.3	V
Resonator voltage (see note 8)	250	V
Load v.s.w.r. (see note 6)	1.1:1	max

Performance at 8500MHz

	Min	Typical	Max	
Resonator current	22	28	36	mA
Reflector voltage	–40	–65	–90	V
Output power	12	35	–	mW
Electronic tuning range to –3db points	30	55	–	MHz
Reflector modulation coefficient (see note 7)	1.0	3.0	–	MHz/V
Hysteresis	–	5.0	50	%

Performance at 9000MHz

Reflector voltage	–	–85	–	V
Output power	–	50	–	mW
Electronic tuning range to –3db points	–	45	–	MHz
Reflector modulation coefficient (see note 7)	–	5.5	–	MHz/V

Performance at 9655MHz

Reflector voltage	–90	–105	–125	V
Output power	12	35	–	mW
Electronic tuning range to –3db points	30	38	–	MHz
Reflector modulation coefficient (see note 7)	1.0	1.9	–	MHz/V
Hysteresis	–	5.0	50	%

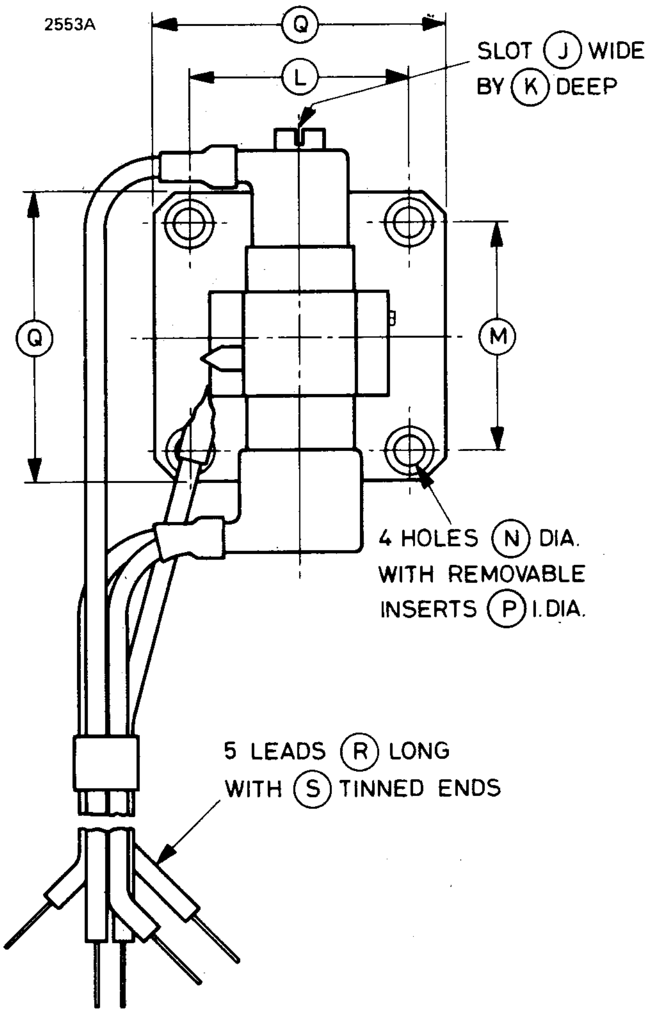
DESIGN APPROVAL TESTS

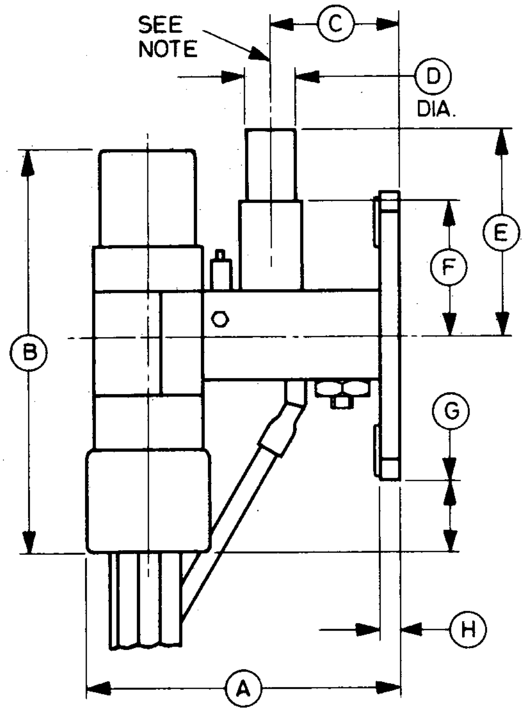
	Typical	Max	
Frequency deviation (peak to peak):			
heater voltage 5.7 to 6.9V . . .	–	1.0	MHz
temperature +25 to +95°C . .	–30	–100 to +50	kHz/°C
vibration 30 to 1000Hz, 10g . . .	–	200	kHz
shock 100g for 6ms	–	1.5	MHz
constant 50g acceleration	–	0.5	MHz
pressure 70 to 760mm	–	1.5	MHz
warm-up 20s to 30 min	–1.5	–3.0	MHz
tuner side thrust 0.25 lb	–	0.5	MHz
tuner resetting	–	1.0	MHz
Power deviation at constant 50g . .	–	1.0	db
Reflector current (peak) (10g at 50Hz for 2 min)	–	10	μA
Residual beam noise (see note 9)	2×10^{-14}	8×10^{-14}	W/MHz/mW
Tuner torque	35	50	oz-in

NOTES

1. The frequency range is covered by approximately 4 turns of the tuner. Clockwise rotation reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ.
5. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink.
6. Spurious modes may arise if the load v.s.w.r. exceeds 1.5:1 over the frequency ranges 7500 to 8500 and 9655 to 10 500MHz.
7. Measured as the frequency deviation produced by a change of 1V in the reflector voltage.
8. Tubes are not tested at this voltage unless specifically requested by the user.
9. Measured by comparison with a standard noise source using a 1MHz bandwidth filter at a frequency 40MHz from the carrier, and expressed in watts per milliwatt of carrier output.

OUTLINE (All dimensions without limits are nominal)





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

Note Tuner misalignment will not exceed 2° over the tuner range.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.937 max	49.20 max	J	0.040	1.02
B	2.500 max	63.50 max	K	0.100	2.54
C	0.720 ± 0.010	18.29 ± 0.25	L	1.220 ± 0.004	30.988 ± 0.102
D	0.281 max	7.14 max	M	1.280 ± 0.004	32.512 ± 0.102
	0.278 min	7.06 min	N	0.219	5.56
E	1.500 max	38.10 max	P	0.185	4.70
F	0.812 max	20.62 max	Q	1.625	41.27
G	0.490 max	12.45 max	R	18.0	457
H	0.117 ± 0.012	2.97 ± 0.30	S	0.375	9.53

Millimetre dimensions have been derived from inches.

K357

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron for doppler speed meters.

Frequency range	10 660 to 10 720	MHz
Typical output power	12	mW
Electronic tuning range	35	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions	3.750 x 1.825 x 1.500 inches max 95.25 x 46.36 x 38.10mm max
Net weight	7 ounces (210g) approx
Mounting position	any
Base	5-pin octal
Reflector connection	top cap B.S.448-CT1

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	350	V
Resonator current	–	40	mA
Reflector voltage (see note 4)	–20	–400	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	250	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

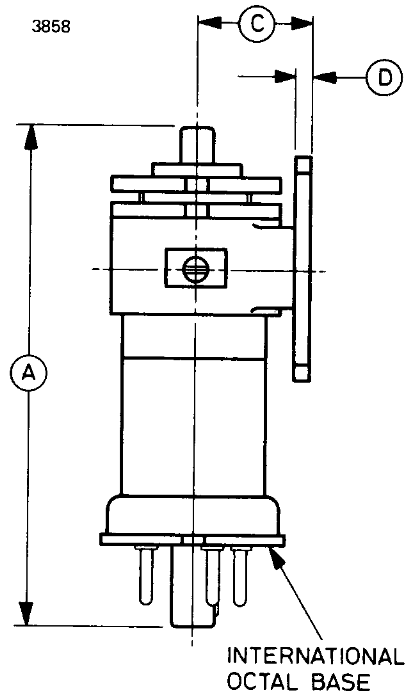
	Min	Typical	Max	
Heater current	0.52	0.58	0.62	A
Resonator current	–	15	20	mA
Reflector voltage (see note 6)	–80	–	–130	V
Output power	10	12	–	mW
Mechanical tuning range	10 660	–	10 720	MHz
Electronic tuning range to –3db points	30	35	–	MHz

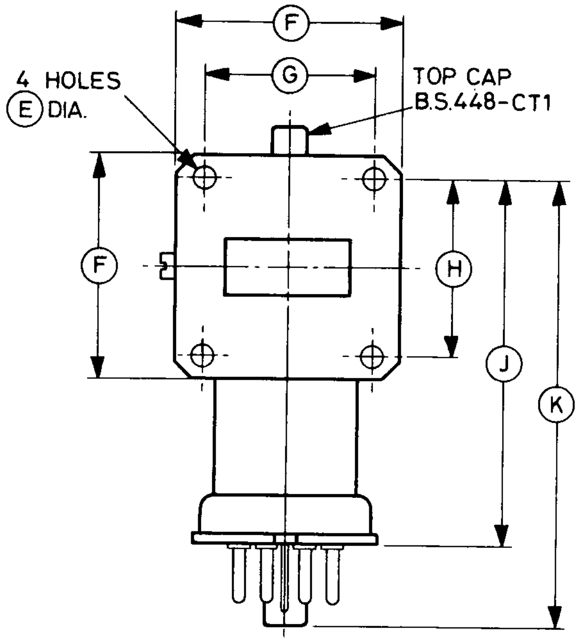
NOTES

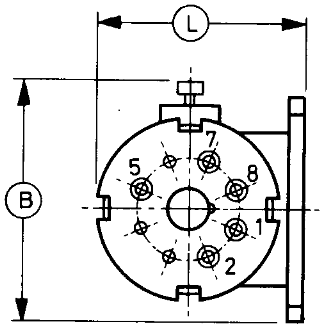
1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Each klystron is marked with the reflector voltage at which it will give maximum power at the midband frequency.

OUTLINE (All dimensions without limits are nominal)

3858







Base Connections

Pin	Element
1	No connection
2	Heater
3	Omitted
4	Omitted
5	Resonator
6	Omitted
7	Cathode, heater
8	No connection
Top cap	Reflector

Ref	Inches	Millimetres
A	3.750 max	95.25 max
B	1.825 max	46.36 max
C	0.830 ± 0.015	21.08 ± 0.38
D	0.125	3.18
E	0.169 ± 0.003	4.293 ± 0.076
F	1.625	41.28

Ref	Inches	Millimetres
G	1.220 ± 0.004	30.99 ± 0.10
H	1.280 ± 0.004	32.51 ± 0.10
J	2.700 max	68.58 max
K	3.300 max	83.82 max
L	1.500 max	38.10 max

Millimetre dimensions have been derived from inches.

K359

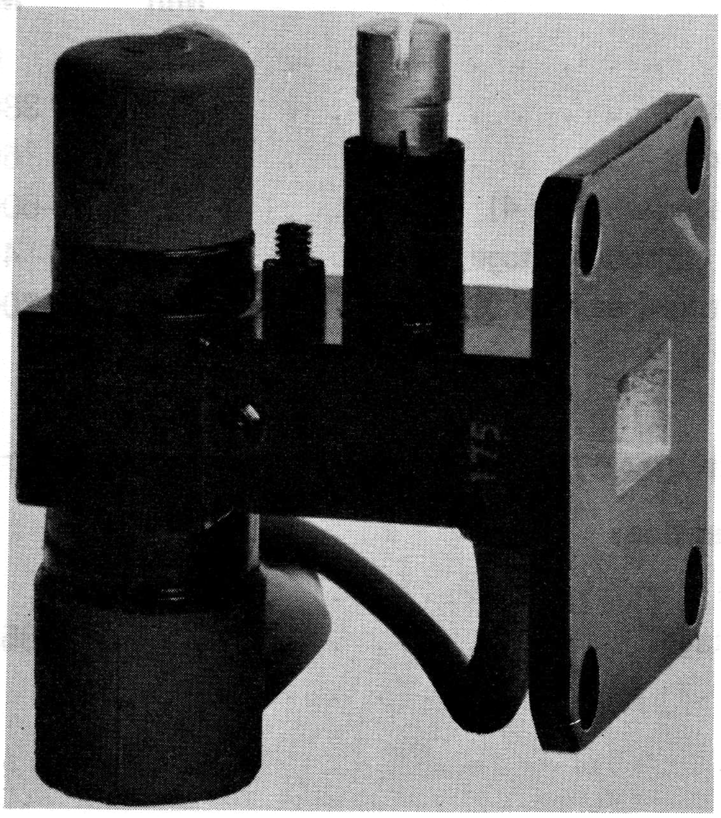
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged, wide band reflex klystron for airborne and similar applications requiring fast warm-up, high frequency stability and low noise under severe environmental conditions. Pressurizing is not required for high altitude operation.

Frequency range	8100 to 8750	MHz
Typical output power	90	mW
Electronic tuning range	55	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.2	A

Mechanical

Overall dimensions (excluding leads)	2.500 x 1.937 x 1.640 inches max 63.50 x 49.20 x 41.66mm max
Net weight	6 ounces (170g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	380	V
Resonator current	–	60	mA
Reflector voltage (see note 4)	–20	–500	V
Peak heater to cathode voltage	–	45	V
Body temperature (see note 5)	–	200	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.4:1	max

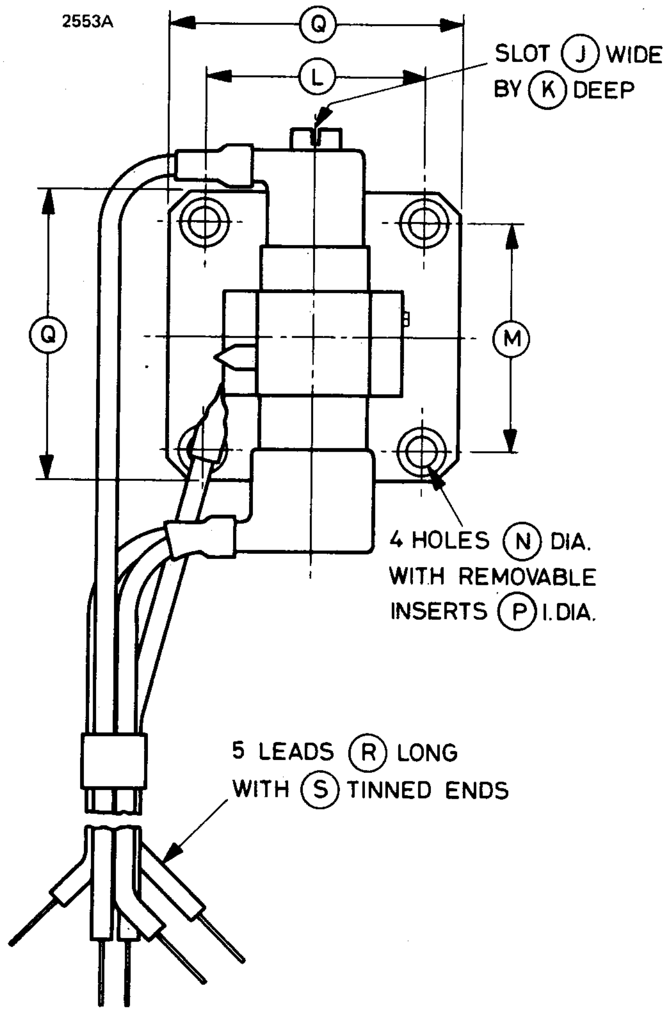
Range of Characteristics

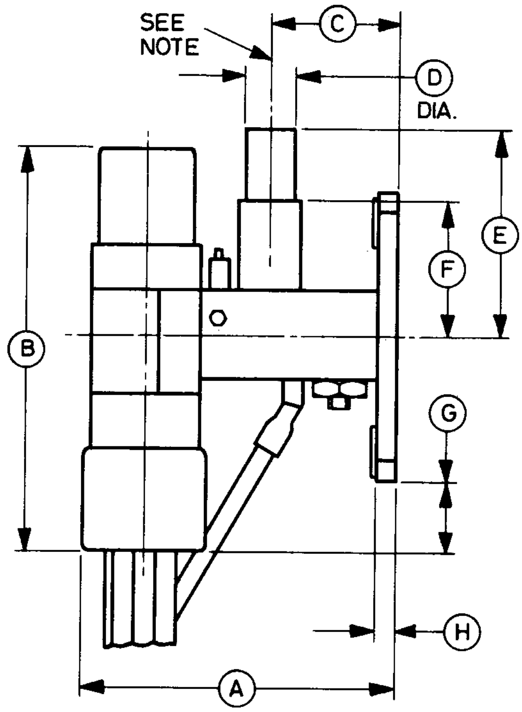
	Min	Typical	Max	
Heater current	1.1	1.2	1.3	A
Resonator current	30	45	55	mA
Reflector voltage . . .	−90	–	−185	V
Output power	40	90	–	mW
Mechanical tuning range .	8100	–	8750	MHz
Tuning rate	–	520	–	MHz/turn
Resetting error (see note 6) .	–	0.5	1.0	MHz
Electronic tuning range to −3db points	30	55	80	MHz
Reflector modulation sensitivity (see notes 7 and 8):				
at mode optimum . . .	1.0	1.3	4.5	MHz/V
at mode optimum ±10MHz	–	2.0	–	MHz/V
Warm-up drift (see notes 8 and 9):				
frequency	–	−1.0	3.0	MHz
output power	–	–	1.0	db
Barometric effect (see note 10)	–	1.5	2.0	MHz
Vibration effects, 20 to 1000Hz at 10g:				
frequency deviation (peak)	–	–	0.1	MHz
output power change (peak)	–	–	10	%
Acceleration effects at 50g:				
frequency deviation . .	–	<0.5	1.0	MHz
output power change . .	–	<1.0	–	db
Peak frequency deviation with 150g shock for 4ms . .	–	1.5	–	MHz
Frequency deviation with tuner sidethrust (see note 11) .	–	<0.2	1.0	MHz
Heater voltage coefficient of frequency (see note 12) .	–	1.0	–	MHz/V
Noise (see notes 8 and 13) .	–	3×10^{-14}	5×10^{-14}	W/MHz/mW

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 25 oz-in (0.18Nm) max.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system. Prolonged operation at low ambient pressures, or insulated from the waveguide, may require additional cooling.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible. Under normal conditions the temperature should not exceed 150°C.
6. The frequency difference at the same tuner shaft setting, following an excursion of half a turn.
7. Measured as the frequency change resulting from a reflector voltage change of 1V.
8. Measured with load v.s.w.r. not greater than 1.2:1.
9. Measured between 20 seconds and 3 minutes 20 seconds after switching on all supplies.
10. The frequency change when the pressure inside and outside the waveguide is increased from 76 to 760mm in not more than 60 seconds.
11. Measured with a side thrust of 1 pound applied to the top of the tuner along two axes perpendicular to each other and the tuner axis.
12. Average over the range of heater voltage 5.7 to 7.0V.
13. Measured in a 1MHz bandwidth, 40MHz from the klystron frequency.

OUTLINE (All dimensions without limits are nominal)





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

Note Tuner misalignment will not exceed 2° over the tuner range.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.937 max	49.20 max	J	0.040	1.02
B	2.500 max	63.50 max	K	0.100	2.54
C	0.720 ± 0.010	18.29 ± 0.25	L	1.220 ± 0.004	30.988 ± 0.102
D	0.281 max	7.14 max	M	1.280 ± 0.004	32.512 ± 0.102
	0.278 min	7.06 min	N	0.219	5.56
E	1.500 max	38.10 max	P	0.185	4.70
F	0.812 max	20.62 max	Q	1.625	41.28
G	0.490 max	12.45 max	R	18.0	457
H	0.117 ± 0.012	2.97 ± 0.30	S	0.375	9.53

Millimetre dimensions have been derived from inches.

K361 K361B

OSCILLATOR KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystrons for doppler speed meters.

Frequency:		
K361	10 700 to 10 725	MHz
K361B	10 675 to 10 700	MHz
Typical output power	27	mW
Electronic tuning range	20	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding leads)	2.625 x 1.875 x 1.500 inches max 66.68 x 47.63 x 38.10mm max
Net weight	7 ounces (200g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

May 1973

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	350	V
Resonator current	–	40	mA
Resonator dissipation	–	12	W
Reflector voltage (see note 4)	–20	–400	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

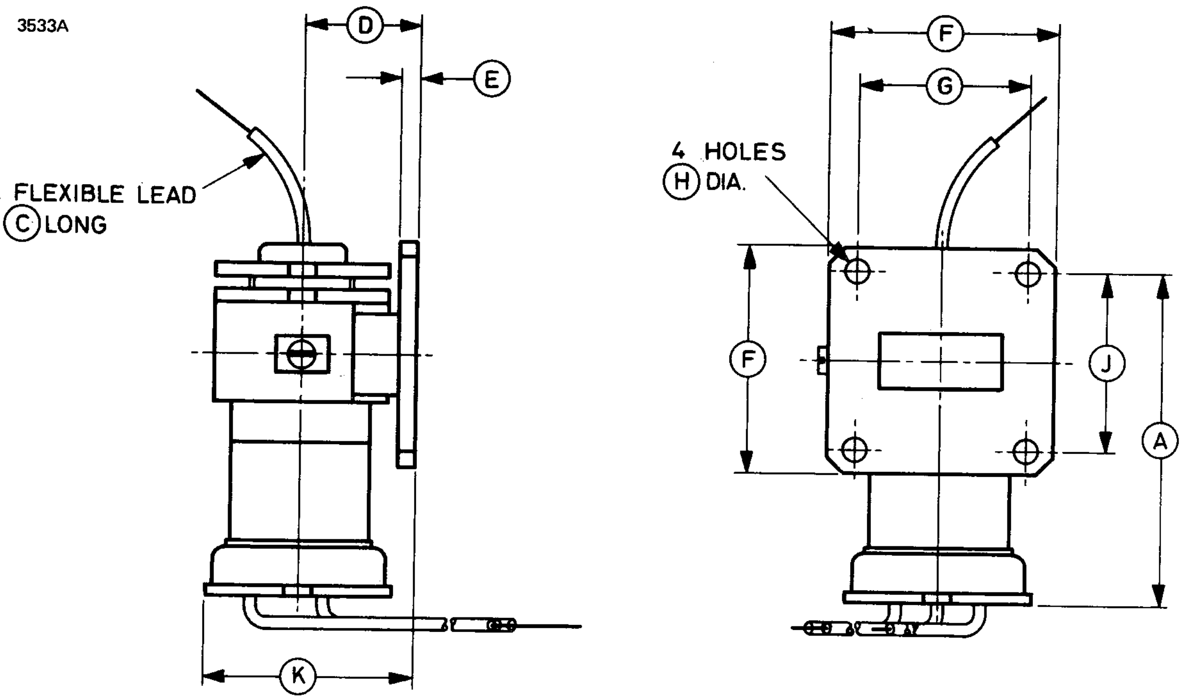
Range of Characteristics

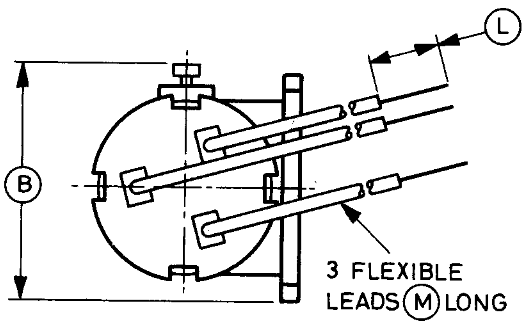
	Min	Typical	Max	
Heater current	0.52	0.58	0.62	A
Resonator current	22	25	35	mA
Reflector voltage (see note 6)	–150	–	–250	V
Output power	20	27	–	mW
Mechanical tuning range:				
K361	10 700	–	10 725	MHz
K361B	10 675	–	10 700	MHz
Electronic tuning range to –3db points	15	20	–	MHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Each klystron is marked with the reflector voltage at which it will give maximum power at the midband frequency.

OUTLINE (All dimensions without limits are nominal)





Lead Connections

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

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.450 max	62.23 max	G	1.220 ± 0.004	30.99 ± 0.10
B	1.875 max	47.63 max	H	0.169 ± 0.003	4.293 ± 0.076
C	12.000 min	304.8 min	J	1.280 ± 0.004	32.51 ± 0.10
D	0.830 ± 0.015	21.08 ± 0.38	K	1.500 max	38.10 max
E	0.125	3.18	L	0.500 ± 0.250	12.70 ± 6.35
F	1.625	41.28	M	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K366 Series

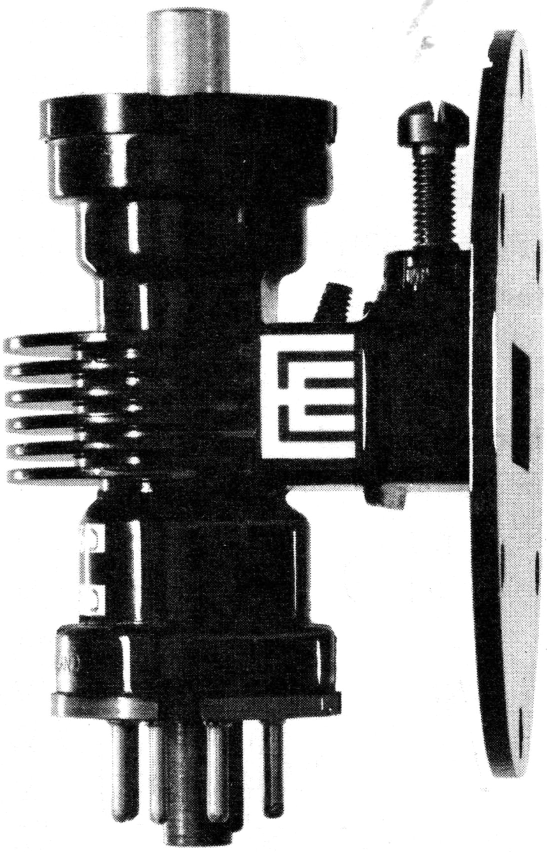
REFLEX KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Forced-air cooled reflex klystron oscillators for microwave relay service.

Frequency range (see General Data)	6125 to 7900	MHz
Typical output power	1.2	W
Electronic tuning range	30	MHz
Output	no. 14 waveguide (1.372 x 0.622 inch internal)	
Coupler	UG-344/U (154 I.E.C.-UAR70)	
Mechanical tuning	single screw	



A conduction cooled variant of the K366 Series is available as the K367 Series. They are electrically identical but the K367 has a second flange for coupling to a heat sink and is designed to operate without a blower.

GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.8	A
Mechanical tuning range (see note 1):		
K366A	7425 to 7750	MHz
K366B	7125 to 7425	MHz
K366C	6875 to 7125	MHz
K366D	6575 to 6875	MHz
K366E	6125 to 6425	MHz
K366G	6425 to 6575	MHz
K366J	7700 to 7900	MHz

Mechanical

Overall dimensions	3.750 x 3.190 x 2.375 inches max 95.25 x 81.03 x 60.33mm max
Net weight	9 ounces (260g) approx
Mounting position	any
Top cap	B.S.448-CT2
Base	6-pin wafer octal

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

Under normal operating conditions, an airflow of 30ft^3/min (0.85m^3/min) directed at the cooling fins will give adequate cooling.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage (see notes 2 and 3)	–	775	V
Resonator current	–	80	mA
Reflector voltage (see notes 2 and 4)	−50	−1000	V
Reflector circuit impedance	–	0.5	MΩ
Peak heater to cathode voltage	–	±45	V
Body temperature	–	150	°C

PERFORMANCE SPECIFICATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	750	V
Load v.s.w.r.	1.1:1	max

Performance

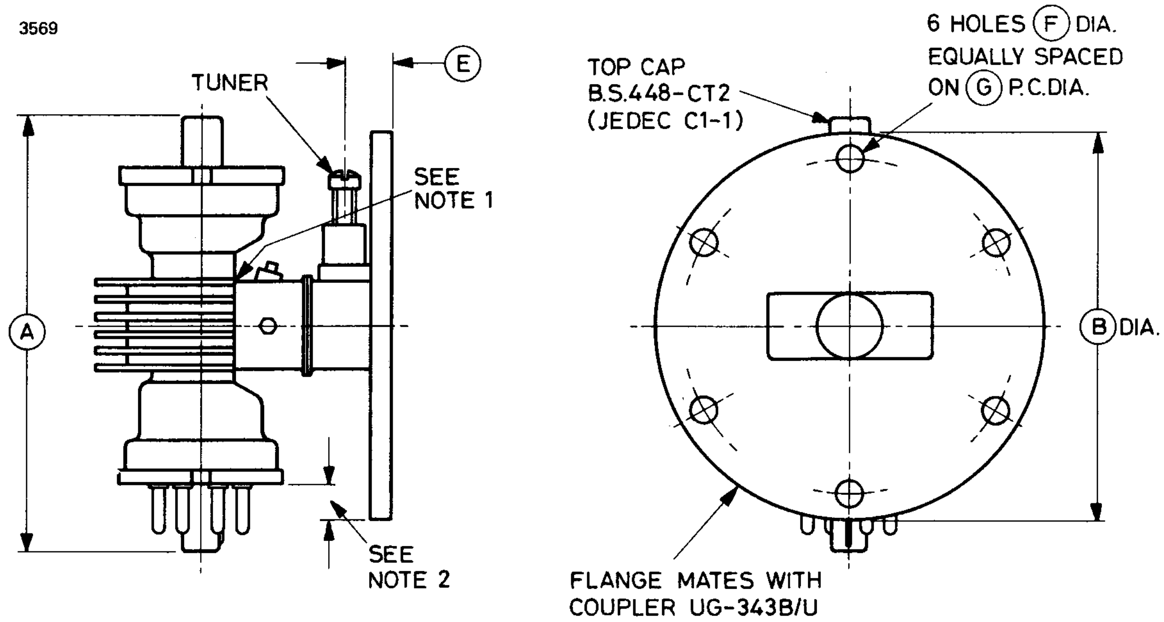
	Min	Typical	Max	
Heater current	0.7	0.86	0.9	A
Resonator current	55	75	80	mA
Reflector voltage (see note 5)	–250	–350	–400	V
Output power	0.7	1.2	–	W
Electronic tuning range to –3db:				
K366A,J	25	30	–	MHz
K366B,C,D,E,G	28	40	–	MHz
Reflector modulation sensitivity	225	400	525	kHz/V
Mechanical tuning rate	60	100	–	MHz/turn
Temperature coefficient of frequency	–	–	±100	kHz/°C

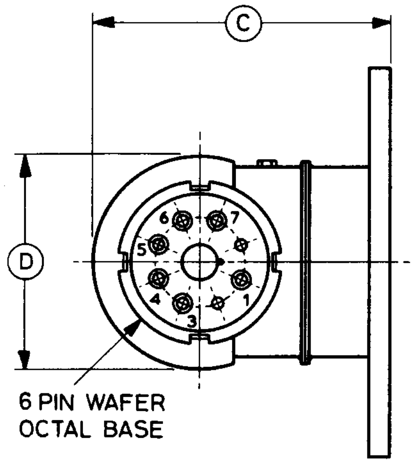
NOTES

1. Tubes are despatched with tuners set to the centre frequency of the range. Clockwise rotation of the tuner screw reduces the frequency.
2. The correct sequence of application of voltages is as follows:
   a) heater voltage and cooling-air blowers
   b) reflector voltage
   c) resonator voltage.
   Voltage transients at switch-on must be avoided.
3. The resonator voltage must not be applied until the reflector voltage is fully established. The tube is normally operated with the resonator earthed and the cathode negative.
4. Any reflector modulation must not cause these limits to be exceeded. Operation with the reflector positive or disconnected, even momentarily, is likely to damage the tube.
5. For maximum power. The limits include variations over the tuning range and between tubes.

OUTLINE

3569





Notes

1. Maximum temperature measured at this point 150°C.
2. The base will not extend below the flange.

Ref	Inches	Millimetres
A	3.750 max	95.25 max
B	3.190 max	81.03 max
C	2.375 max	60.33 max
D	1.750 max	44.45 max
E	0.375 ± 0.015	9.53 ± 0.38
F	0.220	5.59
G	2.750 ± 0.010	69.85 ± 0.25

Millimetre dimensions have been derived from inches.

Base Connections

Pin	Element
1	Resonator
2	Omitted
3	No connection
4	Cathode
5	Heater
6	Heater
7	No connection
8	Omitted
Top cap	Reflector

KY366T Series

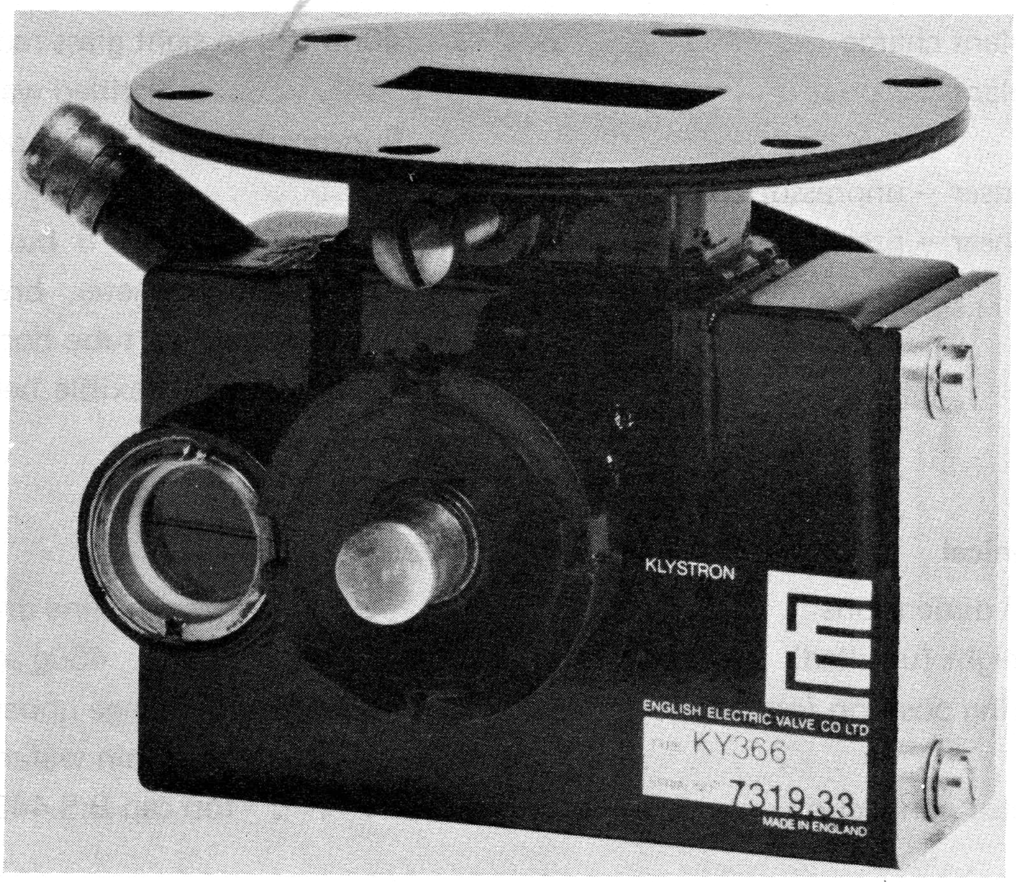
VAPOUR COOLED OSCILLATOR KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Vapour cooled reflex klystrons for communications relay service. Vapour cooling gives a very low temperature coefficient of frequency, eliminating the need for a.f.c. and temperature stabilization.

Frequency range (see General Data)	6125 to 7900	MHz
Typical output power	1.2	W
Electronic tuning range	35	MHz
Output	to no. 14 waveguide (1.372 x 0.622 inch internal)	
Coupler	UG-343A/U (Z830037)	
Mechanical tuning (see note 1)	single screw	



July 1973

GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.85	A
Mechanical tuning range:		
KY366A/T	7425 to 7750	MHz
KY366B/T	7125 to 7425	MHz
KY366C/T	6875 to 7125	MHz
KY366CD/T	6640 to 6940	MHz
KY366D/T	6575 to 6875	MHz
KY366E/T	6125 to 6425	MHz
KY366G/T	6425 to 6575	MHz
KY366J/T	7700 to 7900	MHz

Cooling

Boiler:	
coolant charge	40ml (fill to sight glass red line)
coolant	distilled water or fluorocarbon liquid (see note 2)
Condenser – unpressurized	see page 8
Condenser – pressurized	as shown on page 8 but with 0.010 inch diameter breather hole increased to tube bore and closed off with flexible bellows.

Mechanical

Overall dimensions	see outline drawing
Net weight (unfilled)	480g approx
Mounting position (see page 8)	waveguide flange uppermost
Base	6-pin wafer octal
Reflector connection	top cap B.S.448-CT2

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating to be exceeded.

	Min	Max	
Heater voltage (see note 3)	5.7	6.9	V
Resonator voltage (see note 3)	–	775	V
Resonator current	–	80	mA
Reflector voltage (see notes 3, 4 and 5)	–150	–1000	V
Heater to cathode voltage	–	±45	V
Boiler coolant charge	20	–	ml

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	750	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.7	0.85	0.9	A
Resonator current	55	72	80	mA
Reflector voltage	–250	–320	–400	V
Output power:				
KY366 A and J	0.7	1.2	2.0	W
KY366 B to G	0.9	1.4	2.0	W
Mechanical tuning rate (see note 1)	60	100	120	MHz/turn
Electronic tuning range to –3db points:				
KY366 A and J	25	38	55	MHz
KY366 B to G	28	42	65	MHz
Reflector modulation sensitivity	225	400	525	kHz/V
Variation of frequency with ambient temperature:				
in free air	–	10	–	kHz/°C
with thermal insulation	–	2.4	–	kHz/°C
Peak frequency modulation due to vapour cooling	–	10	–	kHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 32oz in (0.23Nm) max.
2. Distilled water may be used as the coolant, but where low ambient temperatures are encountered, or the klystron body is to be operated at other than earth potential, a fluorocarbon liquid must be used. Suitable fluorocarbon liquids are:—

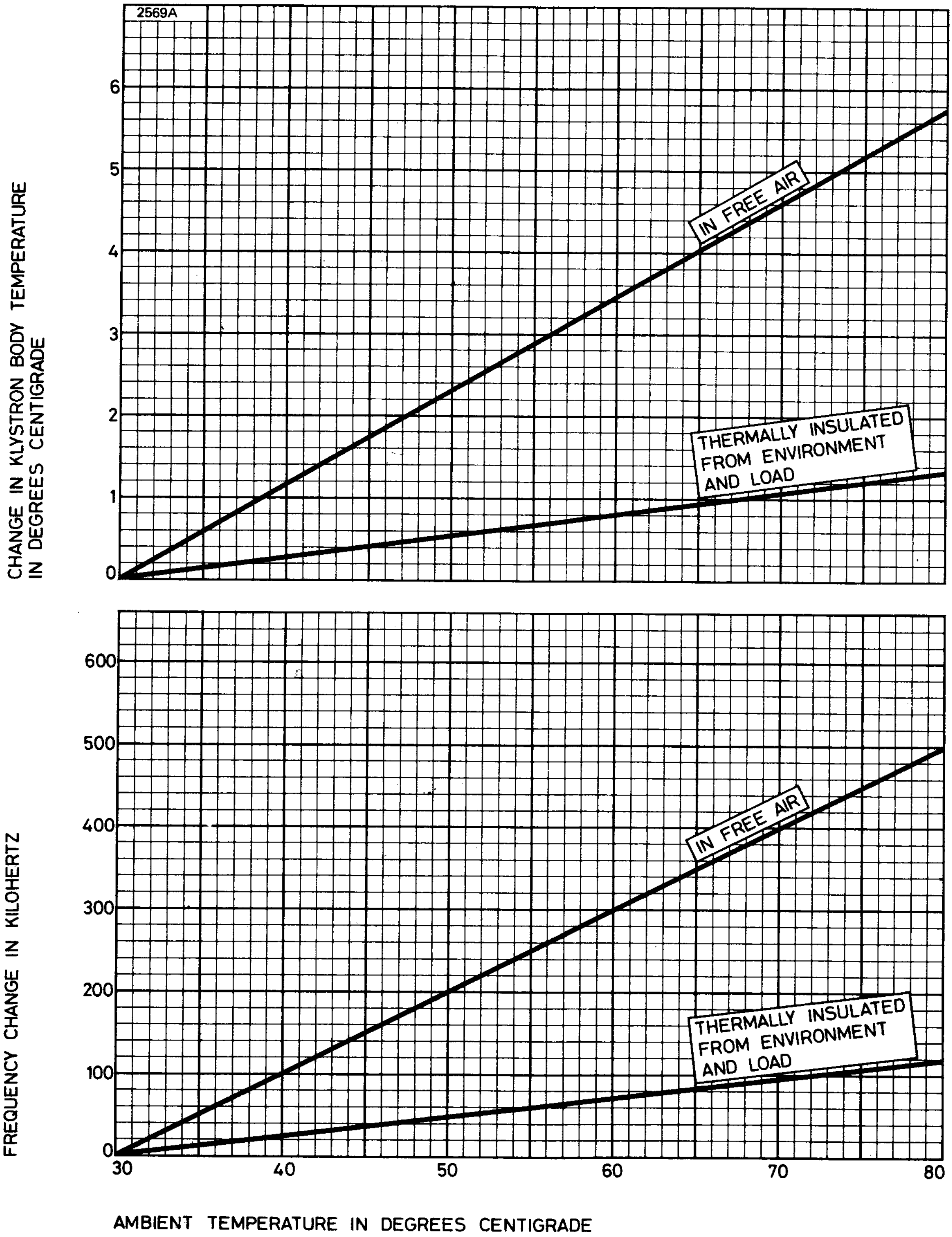
   'Flutec' PP3 (Imperial Smelting Corporation)
   FC75 (3M Company)

3. The resonator voltage must not be applied until the reflector voltage is fully established. The recommended sequence of application of voltages is:

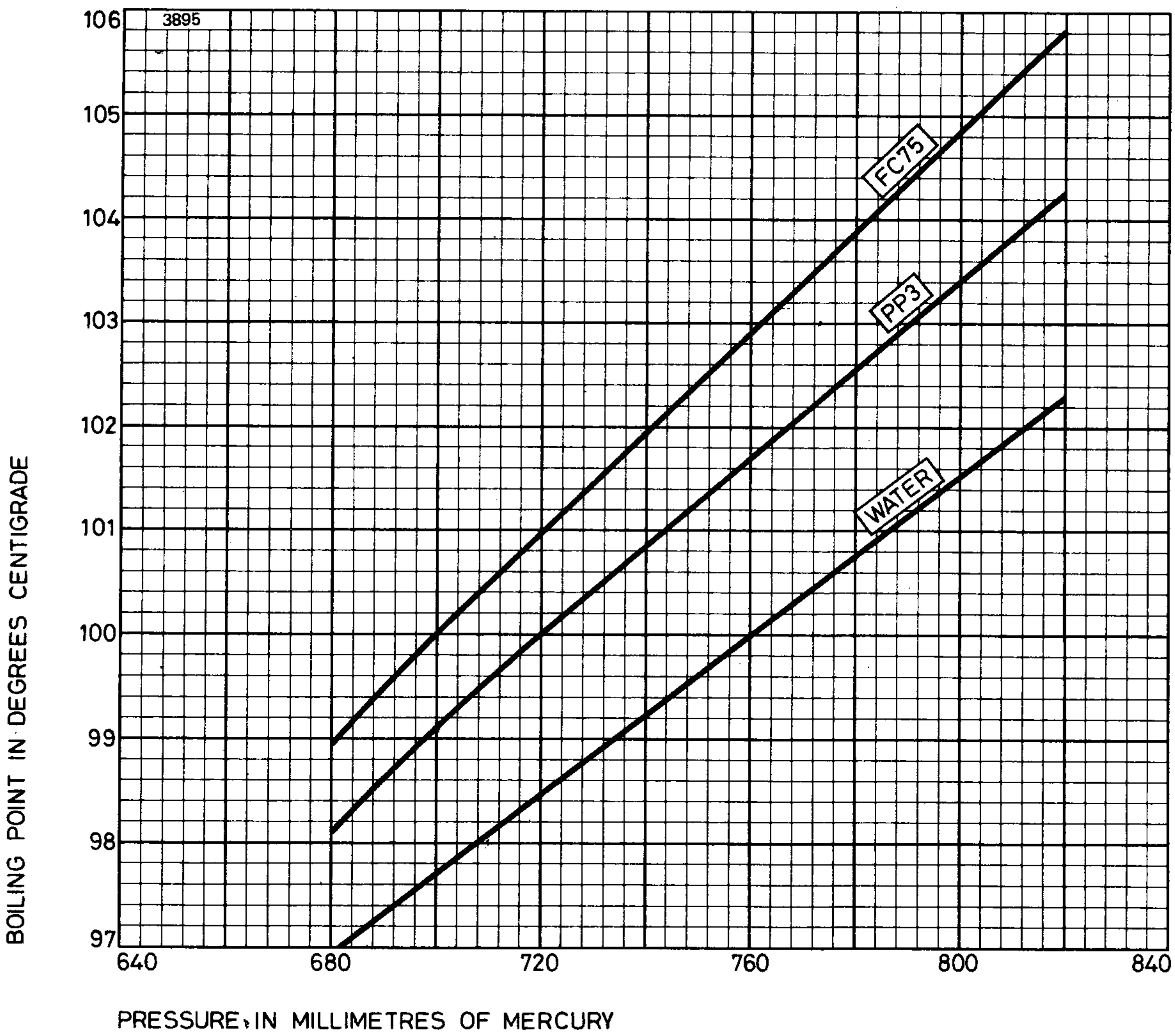
   a) Heater voltage
   b) Reflector voltage
   c) Resonator voltage.

   Voltage transients at switch-on must be avoided.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. Any reflector modulation must not cause these limits to be exceeded.

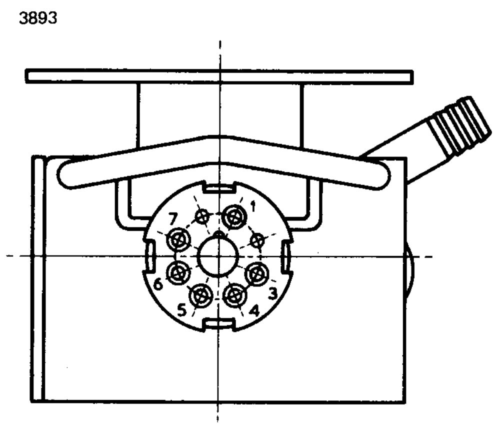
TYPICAL TEMPERATURE CHARACTERISTICS



BOILING POINT VARIATION OF COOLANTS

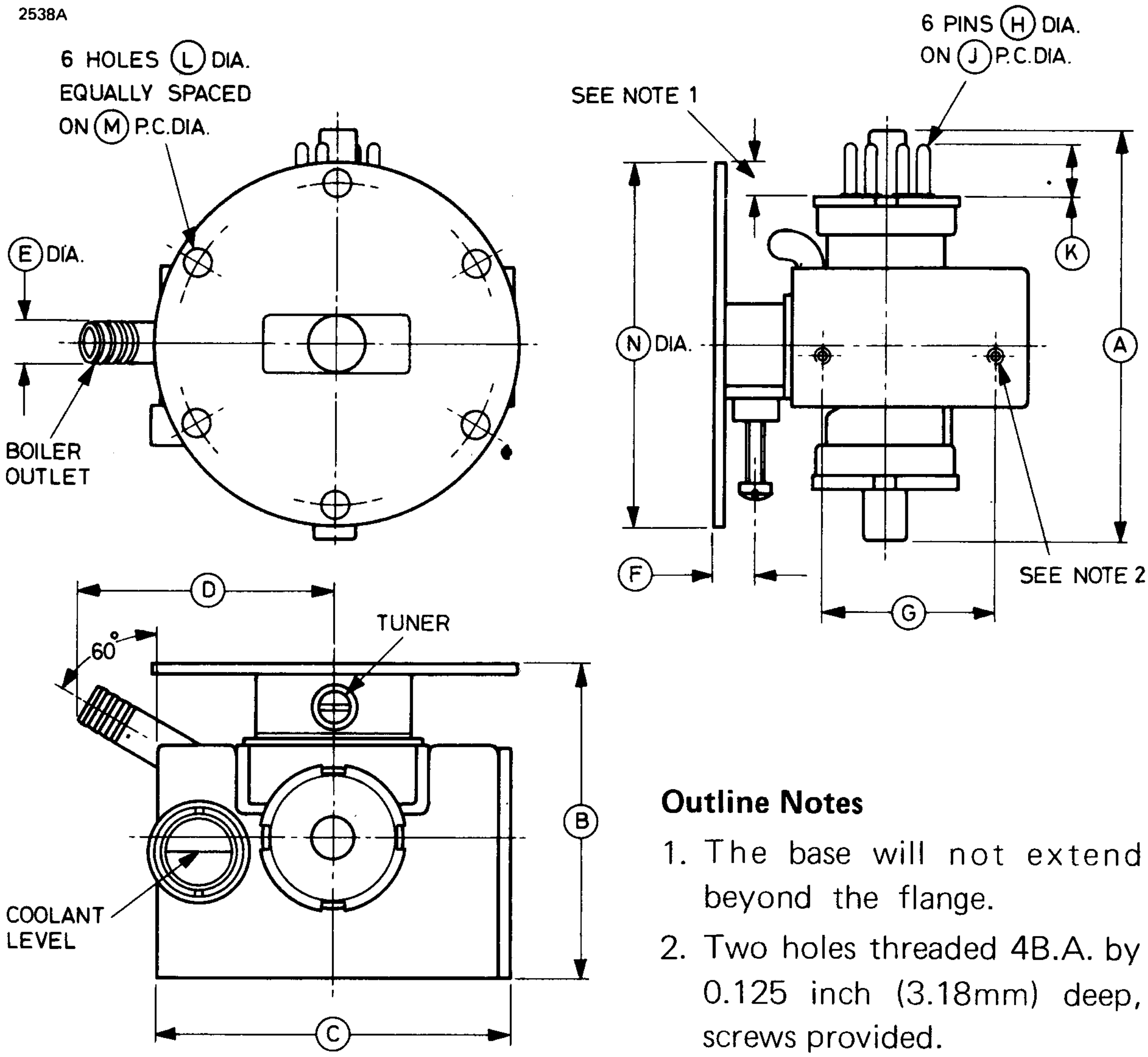


Base Connections



Pin	Element
1	Resonator
2	Omitted
3	No connection
4	Cathode
5	Heater
6	Heater
7	No connection
8	Omitted
Top cap	Reflector

OUTLINE (All dimensions without limits are nominal)



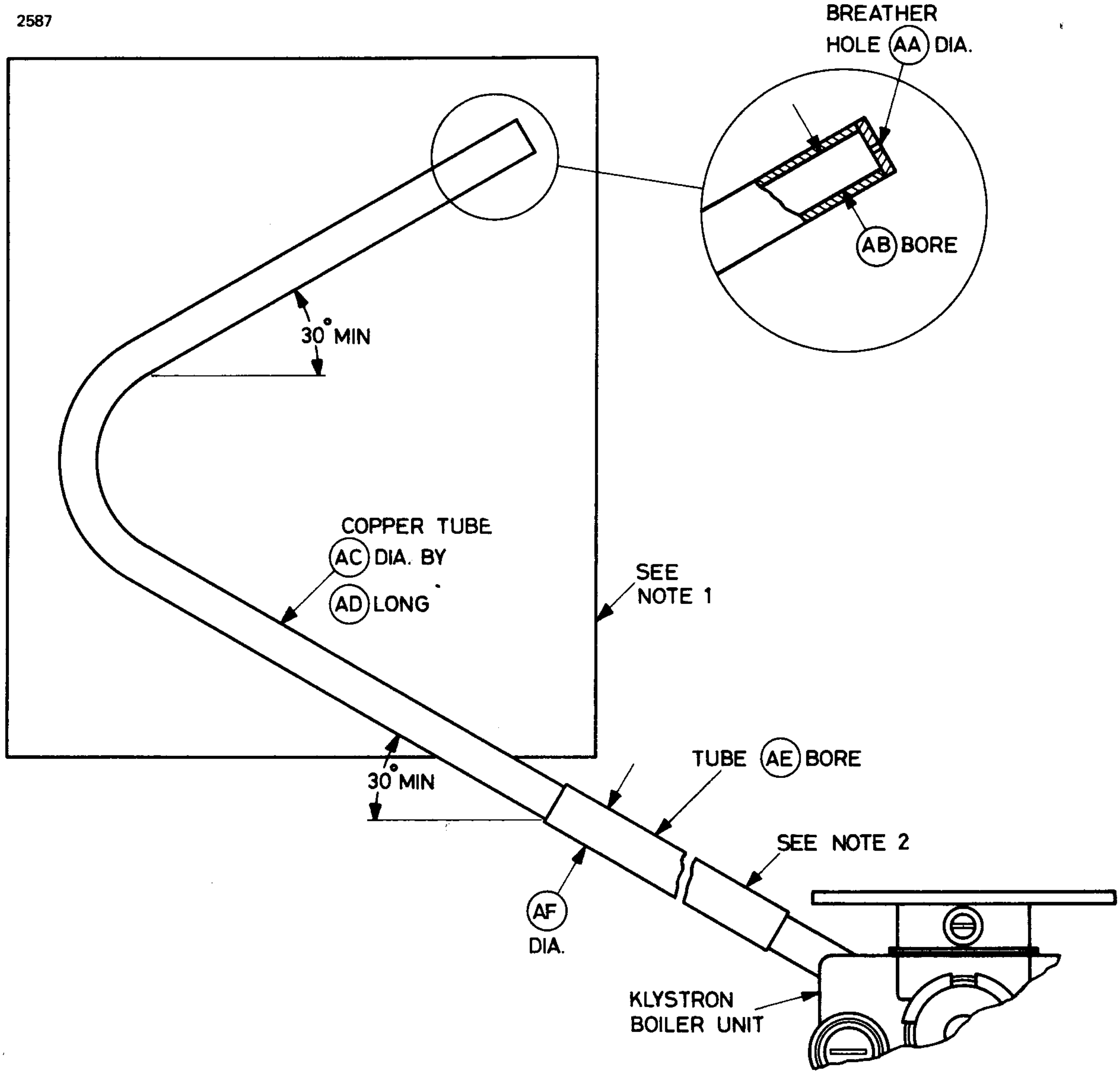
Outline Notes

1. The base will not extend beyond the flange.
2. Two holes threaded 4B.A. by 0.125 inch (3.18mm) deep, screws provided.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.750 max	95.25 max	H	0.093 ± 0.003	2.362 ± 0.076
B	2.700 max	68.58 max	J	0.687	17.45
C	3.050 max	77.47 max	K	0.500 ± 0.010	12.70 ± 0.25
D	2.187	55.55	L	0.220	5.59
E	0.375	9.53	M	2.750 ± 0.010	69.85 ± 0.25
F	0.375 ± 0.015	9.53 ± 0.38	N	3.190 max	81.03 max
G	1.468	37.29			

Millimetre dimensions have been derived from inches.

CONDENSER UNIT



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	0.010	0.25	AD	18.0	457.2
AB	0.250 min	6.35 min	AE*	0.315	8.0
AC	0.375	9.53	AF*	0.433	11.0

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

Notes

1. The copper tube is soldered to a brass condenser plate 0.125 inch (3.18mm) thick and $90in^2$ ($580.6cm^2$) area approx.
2. 'Hallprene' Viton tube, obtainable from Hall and Hall Ltd., Oldfield Works, Hampton, Middlesex.

K367 Series

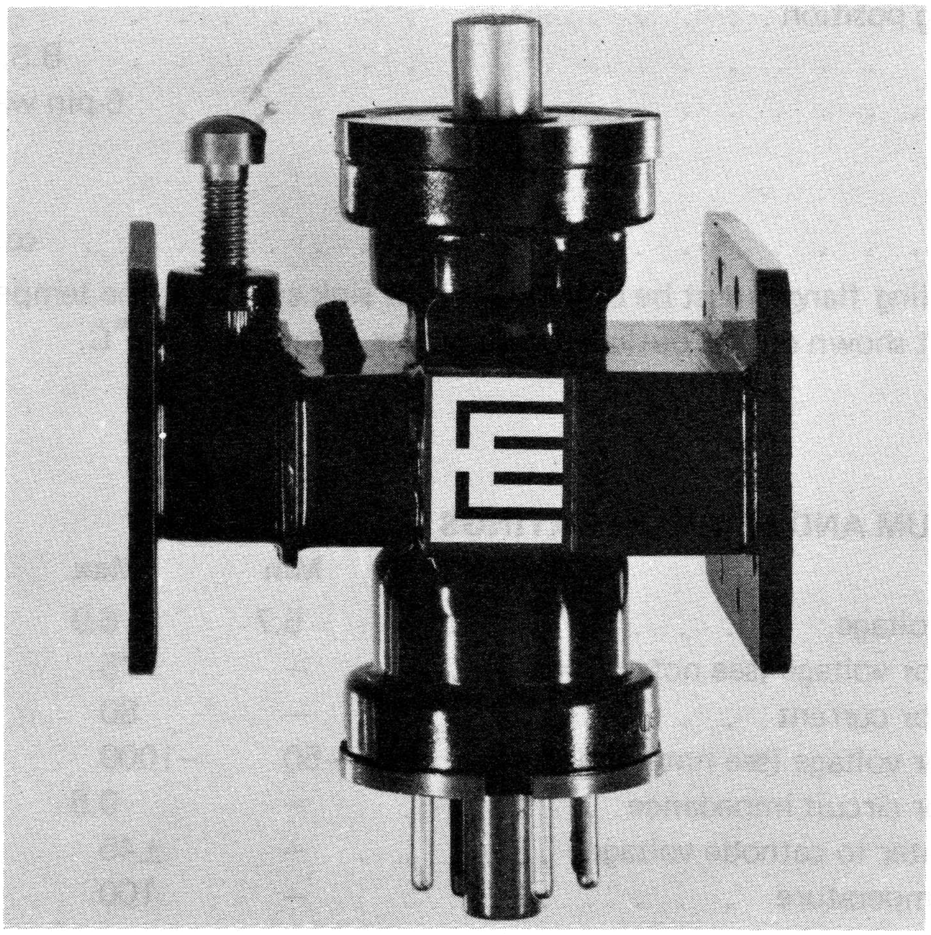
REFLEX KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Conduction cooled reflex klystron oscillators for microwave relay service.

Frequency range (see General Data)	6125 to 7900	MHz
Typical output power	1.2	W
Electronic tuning range	30	MHz
Output	no. 14 waveguide (1.372 x 0.622 inch internal)	
Coupler	CMR-137	
Mechanical tuning	single screw	



March 1972

GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.8	A
Mechanical tuning range (see note 1):		
K367A	7425 to 7750	MHz
K367B	7125 to 7425	MHz
K367C	6875 to 7125	MHz
K367D	6575 to 6875	MHz
K367E	6125 to 6425	MHz
K367G	6425 to 6575	MHz
K367J	7700 to 7900	MHz

Mechanical

Overall dimensions	3.750 x 2.482 x 2.295 inches max 95.25 x 63.04 x 58.29mm max
Net weight	12 ounces (340g) approx
Mounting position	any
Top cap	B.S.448-CT2
Base	6-pin wafer octal

Cooling . . . . conduction

The cooling flange must be bolted to a heat sink such that the temperature at the point shown on the outline drawing does not exceed 100°C.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage (see notes 2 and 3)	–	775	V
Resonator current	–	80	mA
Reflector voltage (see notes 2 and 4)	–50	–1000	V
Reflector circuit impedance	–	0.5	MΩ
Peak heater to cathode voltage	–	±45	V
Body temperature	–	100	°C

PERFORMANCE SPECIFICATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	750	V
Load v.s.w.r.	1.1:1	max

Performance

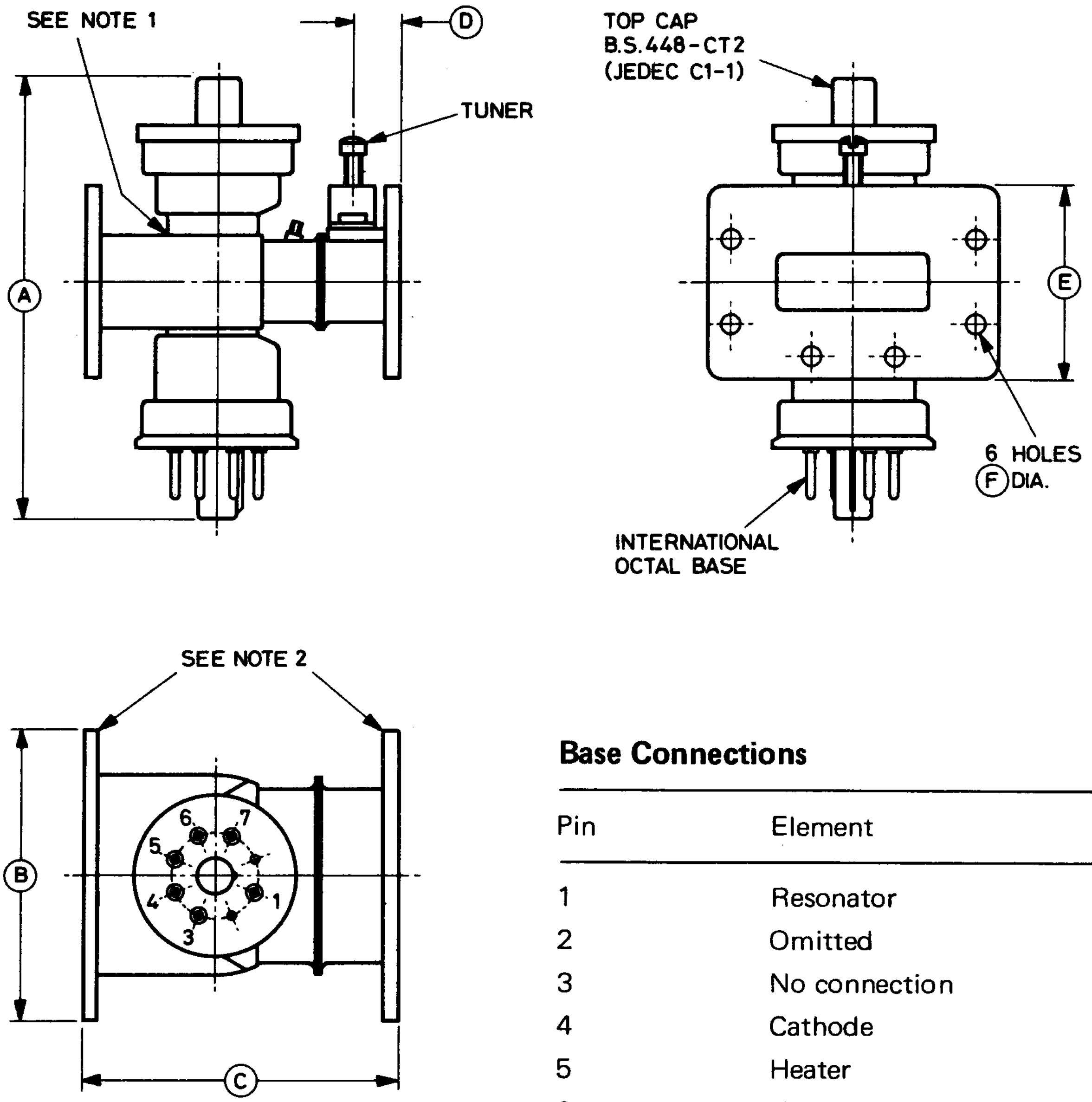
	Min	Typical	Max	
Heater current	0.7	0.86	0.9	A
Resonator current	55	75	80	mA
Reflector voltage (see note 5)	–250	–350	–400	V
Output power	0.7	1.2	–	W
Electronic tuning range to –3db:				
K367A,J	25	30	–	MHz
K367B,C,D,E,G	28	40	–	MHz
Reflector modulation sensitivity	225	400	525	kHz/V
Mechanical tuning rate	60	100	–	MHz/turn
Temperature coefficient of frequency	–	–	±100	kHz/°C

NOTES

1. Tubes are despatched with tuners set to the centre frequency of the range. Clockwise rotation of the tuner screw reduces the frequency.
2. The correct sequence of application of voltages is as follows:
   a) heater voltage
   b) reflector voltage
   c) resonator voltage.
   Voltage transients at switch-on must be avoided.
3. The resonator voltage must not be applied until the reflector voltage is fully established. The tube is normally operated with the resonator earthed and the cathode negative.
4. Any reflector modulation must not cause these limits to be exceeded. Operation with the reflector positive or disconnected, even momentarily, is likely to damage the tube.
5. For maximum power. The limits include variations over the tuning range and between tubes.

OUTLINE

3614



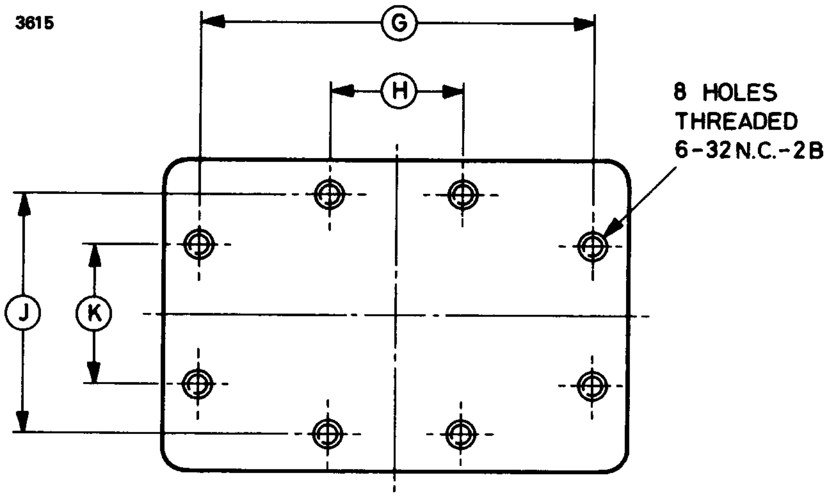
Base Connections

Pin	Element
1	Resonator
2	Omitted
3	No connection
4	Cathode
5	Heater
6	Heater
7	No connection
8	Omitted
Top cap	Reflector

Outline Notes

1. Body temperature measured at this point.
2. Both flanges mate with CMR-137.

Detail of Conduction Cooling Flange



Outline Dimensions

Ref	Inches	Millimetres
A	3.750 max	95.25 max
B	2.295 max	58.29 max
C	2.467 ± 0.015	62.66 ± 0.38
D	0.375 ± 0.015	9.53 ± 0.38
E	1.545 max	39.24 max
F	0.147	3.73
G	1.930 ± 0.004	49.022 ± 0.102
H	0.644 ± 0.004	16.358 ± 0.102
J	1.180 ± 0.004	29.972 ± 0.102
K	0.686 ± 0.004	17.424 ± 0.102

Millimetre dimensions have been derived from inches.

KY367T Series

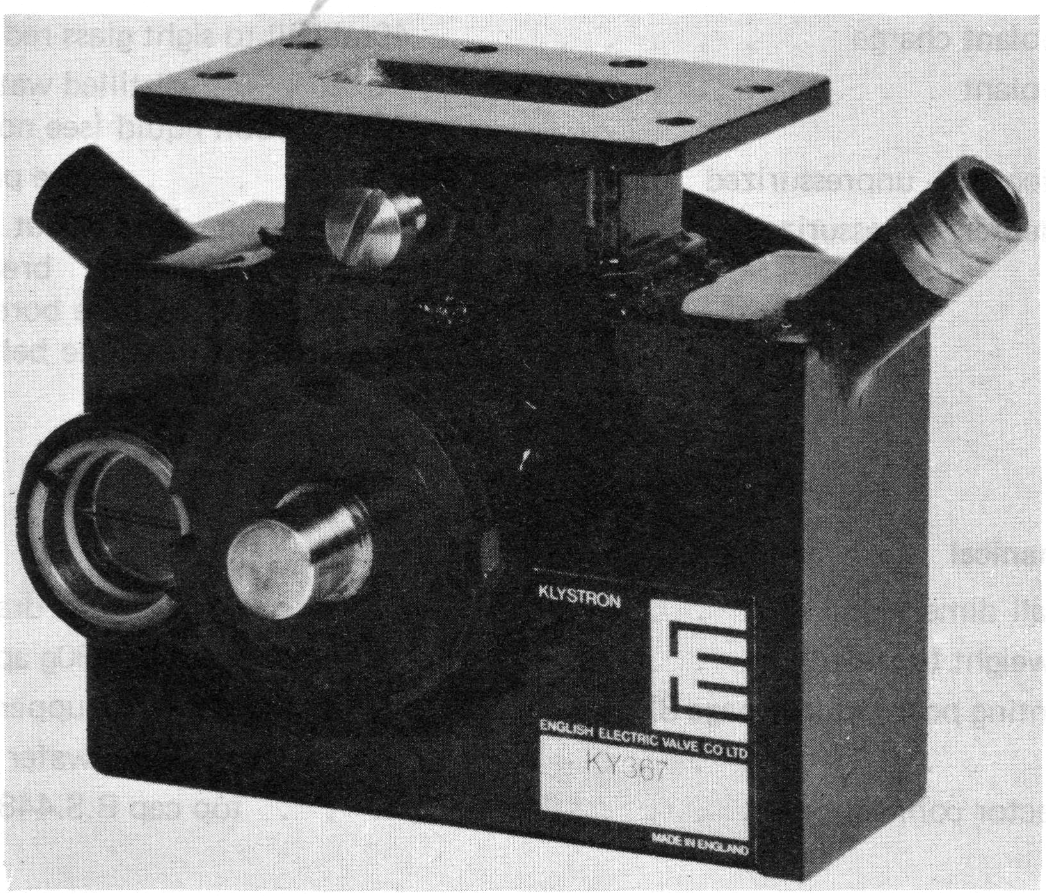
VAPOUR COOLED OSCILLATOR KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Vapour cooled reflex klystrons for communications relay service. Vapour cooling gives a very low temperature coefficient of frequency, eliminating the need for a.f.c. and temperature stabilization.

Frequency range (see General Data)	6125 to 7900	MHz
Typical output power	1.2	W
Electronic tuning range	35	MHz
Output	to no. 14 waveguide (1.372 x 0.622 inch internal)	
Coupler	CRM-137	
Mechanical tuning (see note 1)	single screw	



GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.85	A
Mechanical tuning range:		
KY367A/T	7425 to 7750	MHz
KY367B/T	7125 to 7425	MHz
KY367C/T	6875 to 7125	MHz
KY367D/T	6575 to 6875	MHz
KY367E/T	6125 to 6425	MHz
KY367G/T	6425 to 6575	MHz
KY367J/T	7700 to 7900	MHz

Cooling

Boiler:	
coolant charge	40ml (fill to sight glass red line)
coolant	distilled water or fluorocarbon liquid (see note 2)
Condenser — unpressurized	see page 8
Condenser — pressurized	as shown on page 8 but with 0.010 inch diameter breather hole increased to tube bore and closed off with flexible bellows.

Mechanical

Overall dimensions	see outline drawing
Net weight (unfilled)	480g approx
Mounting position (see page 8)	waveguide flange uppermost
Base	6-pin wafer octal
Reflector connection	top cap B.S.448-CT2

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating to be exceeded.

	Min	Max	
Heater voltage (see note 3)	5.7	6.9	V
Resonator voltage (see note 3)	–	775	V
Resonator current	–	80	mA
Reflector voltage (see notes 3, 4 and 5)	–150	–1000	V
Heater to cathode voltage	–	±45	V
Boiler coolant charge	20	–	ml

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	750	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.7	0.85	0.9	A
Resonator current	55	72	80	mA
Reflector voltage	–250	–320	–400	V
Output power:				
KY367A and J	0.7	1.2	2.0	W
KY367 B to G	0.9	1.4	2.0	W
Mechanical tuning rate (see note 1)	60	100	120	MHz/turn
Electronic tuning range to –3db points:				
KY367 A and J	25	38	55	MHz
KY367 B to G	28	42	65	MHz
Reflector modulation sensitivity	225	400	525	kHz/V
Variation of frequency with ambient temperature:				
in free air	–	10	–	kHz/°C
with thermal insulation	–	2.4	–	kHz/°C
Peak frequency modulation due to vapour cooling	–	10	–	kHz

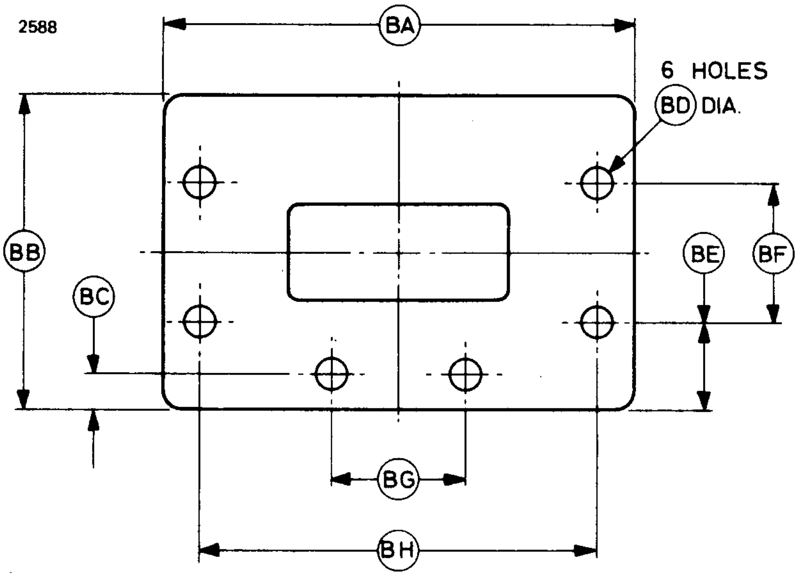
NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 32oz in (0.23Nm) max.
2. Distilled water may be used as the coolant, but where low ambient temperatures are encountered, or the klystron body is to be operated at other than earth potential, a fluorocarbon liquid must be used. Suitable fluorocarbon liquids are:—

   'Flutec' PP3 (Imperial Smelting Corporation)
   FC75 (3M Company)
3. The resonator voltage must not be applied until the reflector voltage is fully established. The recommended sequence of application of voltages is: heater voltage — reflector voltage — resonator voltage. Voltage transients at switch-on must be avoided.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. Any reflector modulation must not cause these limits to be exceeded.

OUTPUT FLANGE (All dimensions without limits are nominal)

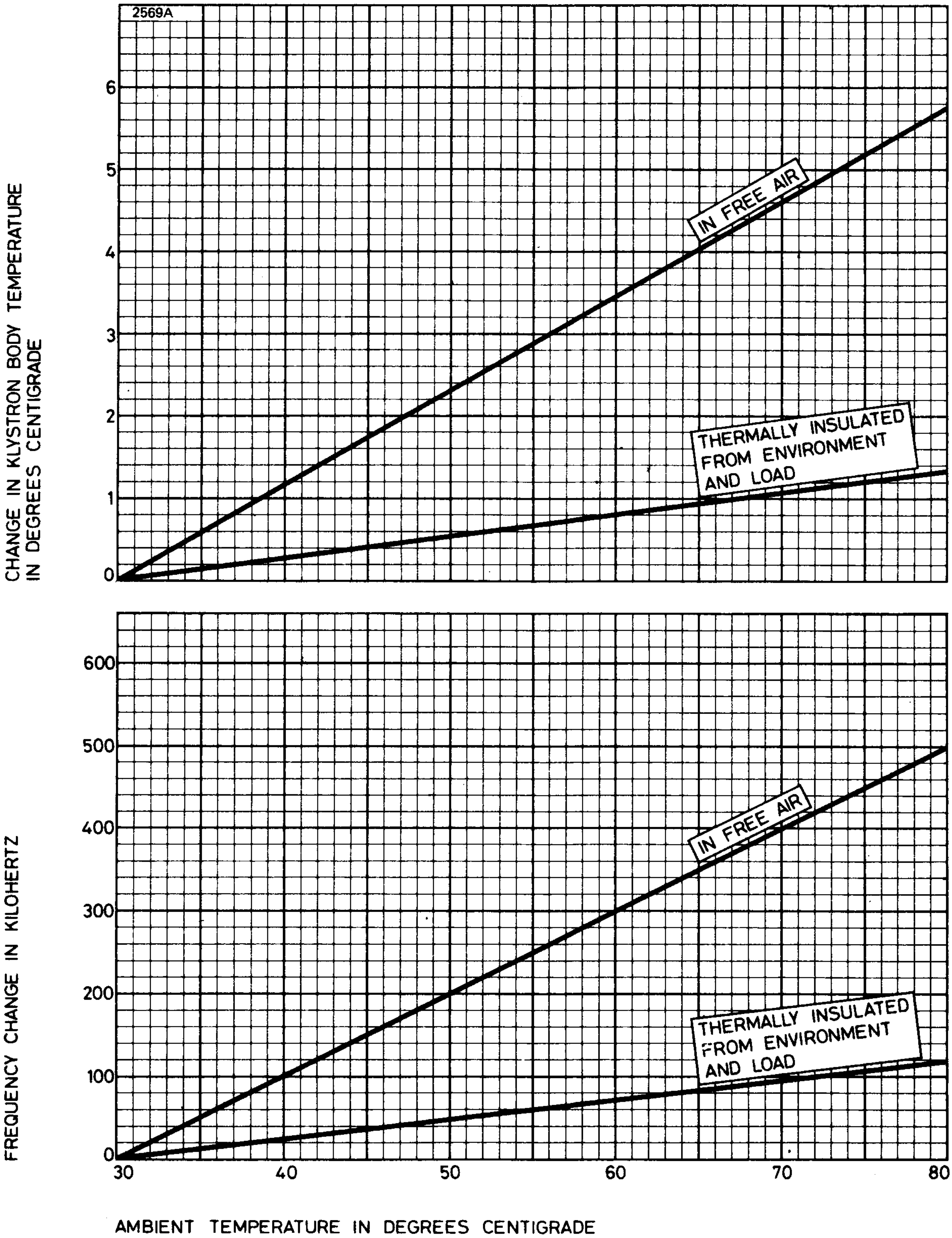
2588



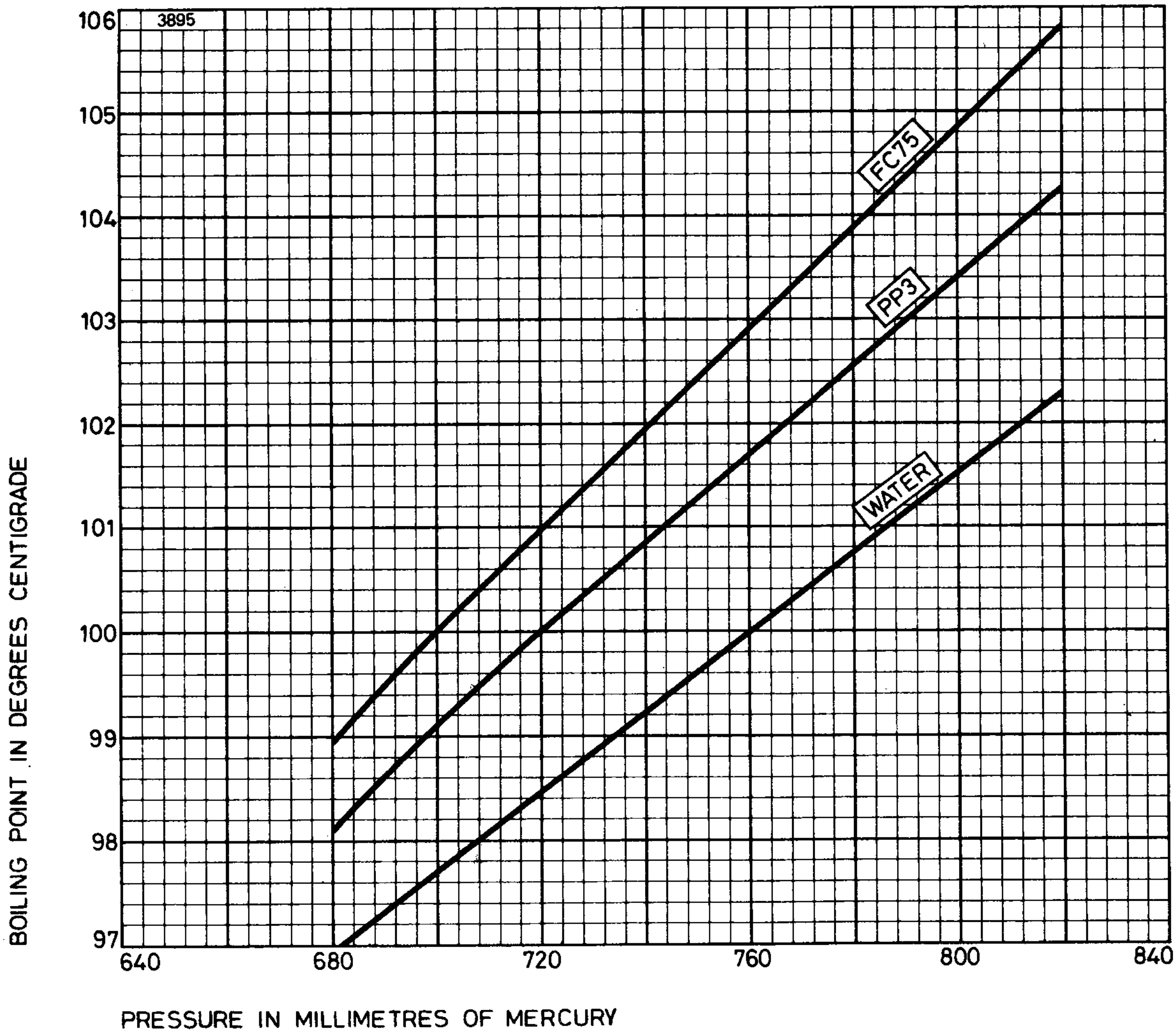
Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.295 max	58.29 max	BE	0.422	10.72
BB	1.545 max	39.24 max	BF	0.686 ± 0.004	17.424 ± 0.102
BC	0.176	4.47	BG	0.644 ± 0.004	16.358 ± 0.102
BD	0.147	3.73	BH	1.930 ± 0.004	49.022 ± 0.102

Millimetre dimensions have been derived from inches.

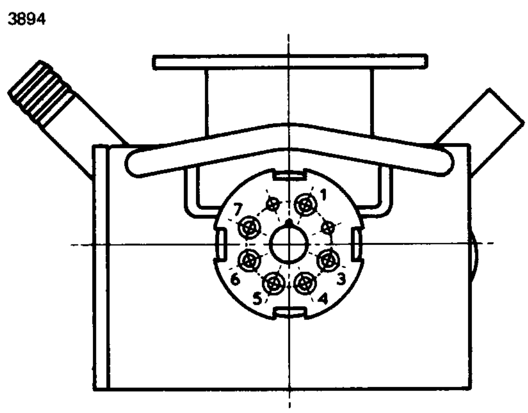
TYPICAL TEMPERATURE CHARACTERISTICS



BOILING POINT VARIATION OF COOLANTS

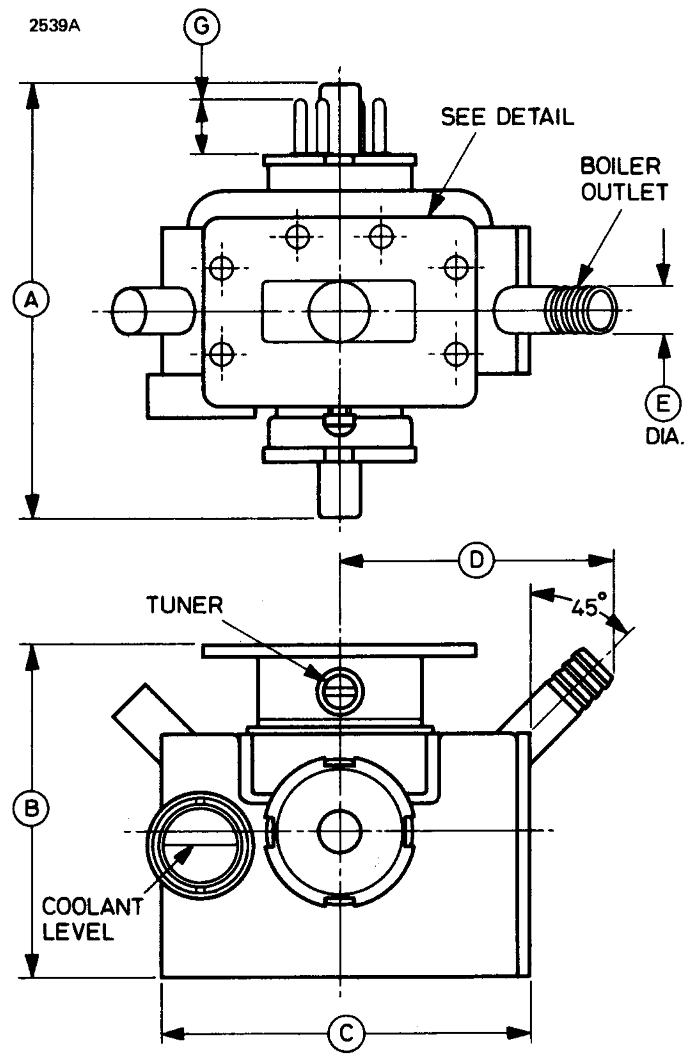


Base Connections



Pin	Element
1	Resonator
2	Omitted
3	No connection
4	Cathode
5	Heater
6	Heater
7	No connection
8	Omitted
Top cap	Reflector

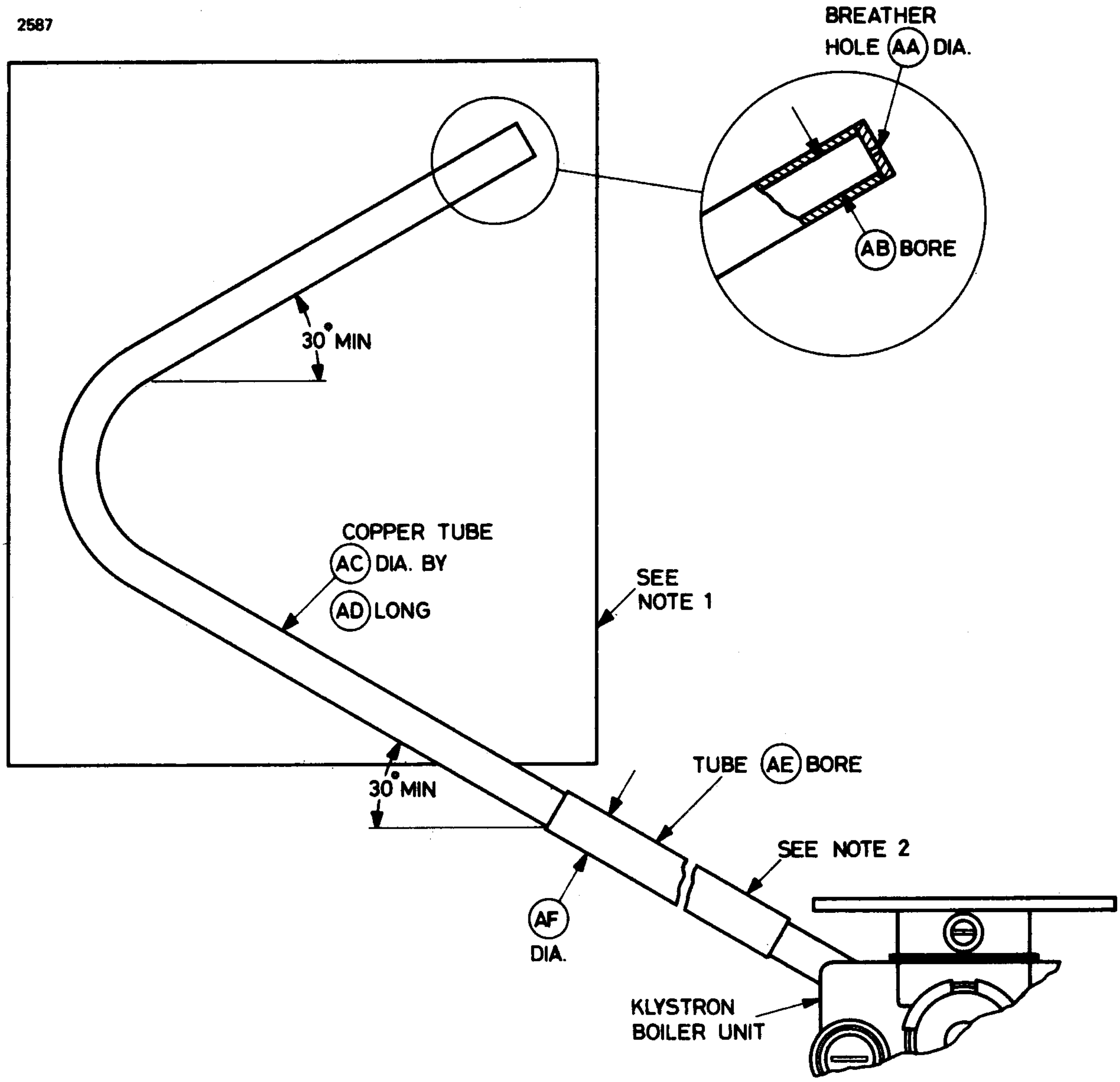
OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.750 max	95.25 max	F	0.375 ± 0.015	9.53 ± 0.38
B	2.700 max	68.58 max	G	0.500 ± 0.010	12.70 ± 0.25
C	3.050 max	77.47 max	H	0.093 ± 0.003	2.362 ± 0.076
D	2.000	50.80	J	0.687	17.45
E	0.375	9.53			

Millimetre dimensions have been derived from inches.

CONDENSER UNIT



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	0.010	0.25	AD	18.0	457.2
AB	0.250 min	6.35 min	AE*	0.315	8.0
AC	0.375	9.53	AF*	0.433	11.0

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

Notes

1. The copper tube is soldered to a brass condenser plate 0.125 inch (3.18mm) thick and 90in^2 (580.6cm^2) area approx.
2. 'Hallprene' Viton tube, obtainable from Hall and Hall Ltd., Oldfield Works, Hampton, Middlesex.

K391

OSCILLATOR KLYSTRON

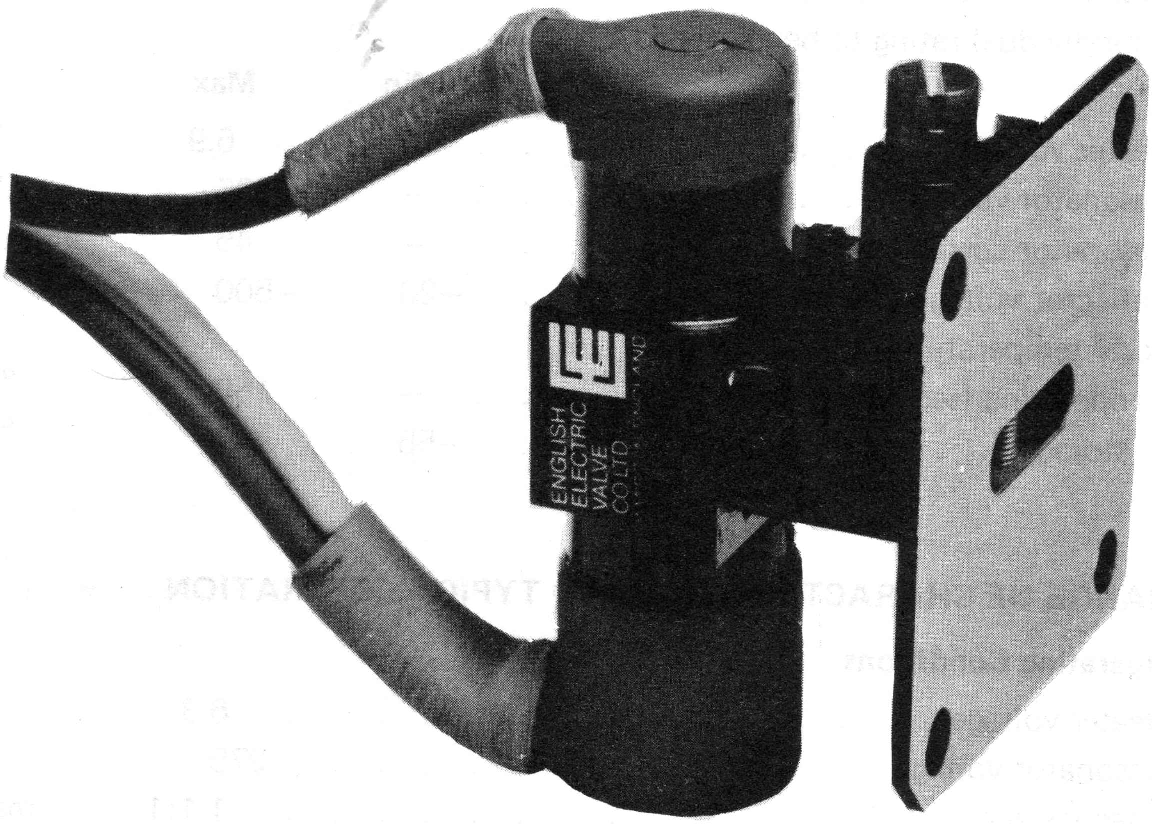
Service Type CV6194

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged, low voltage reflex klystron for airborne service.

Frequency range	9160 to 9340	MHz
Typical output power	40	mW
Electronic tuning range	30	MHz
Output		to no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-39/U (154 I.E.C.-UBR100)
Mechanical tuning (see note 1)		single screw



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding leads)	2.260 x 1.637 x 1.400 inches max 57.40 x 41.58 x 35.56mm max
Net weight	4.5 ounces (130g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	325	V
Resonator current	–	45	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature:			
operating (see note 5)	–	150	°C
storage	–55	+45	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	275	V
Load v.s.w.r.	1.1:1	max

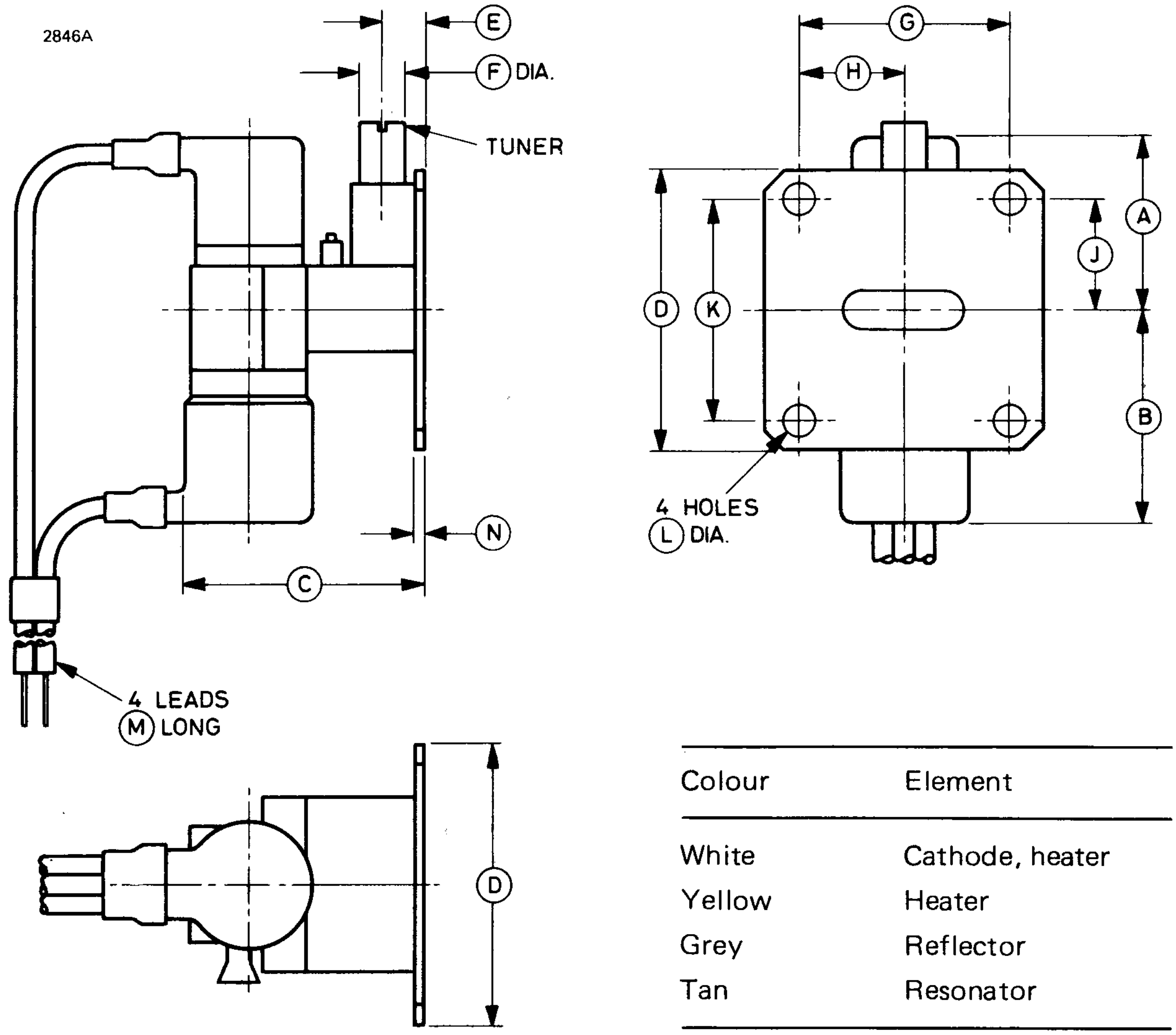
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	33	40	mA
Reflector voltage	−75	–	−100	V
Output power	25	40	60	mW
Mechanical tuning range . . .	9160	–	9340	MHz
Tuning rate	150	180	250	MHz/turn
Electronic tuning range to −3db points	25	30	–	MHz
Reflector modulation sensitivity .	0.5	–	1.5	MHz/V
Pulling characteristics (see note 6):				
frequency pulling	–	4.0	6.0	MHz
output power	10	–	–	mW
Temperature coefficient of frequency	−50	−130	−200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz) .	–	100	200	kHz
Warm-up drift (see note 7) . . .	–	–	1.0	db

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 35oz-in (0.25Nm) max.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
7. The change in output power, measured between 40 seconds and 3 minutes after switching on all supplies.

OUTLINE



Colour	Element
White	Cathode, heater
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.000 max	25.40 max	H	0.610 ± 0.004	15.494 ± 0.102
B	1.260 max	32.00 max	J	0.640 ± 0.004	16.256 ± 0.102
C	1.400 max	35.56 max	K	1.280 ± 0.004	32.512 ± 0.102
D	1.625 ± 0.012	41.28 ± 0.30	L	0.170	4.32
E	0.322 ± 0.010	8.18 ± 0.25	M	8.000 min	203.2 min
F	0.250 ± 0.002	6.350 ± 0.051	N	0.062 ± 0.010	1.57 ± 0.25
G	1.220 ± 0.004	30.988 ± 0.102			

Millimetre dimensions have been derived from inches.

K391A

OSCILLATOR KLYSTRON

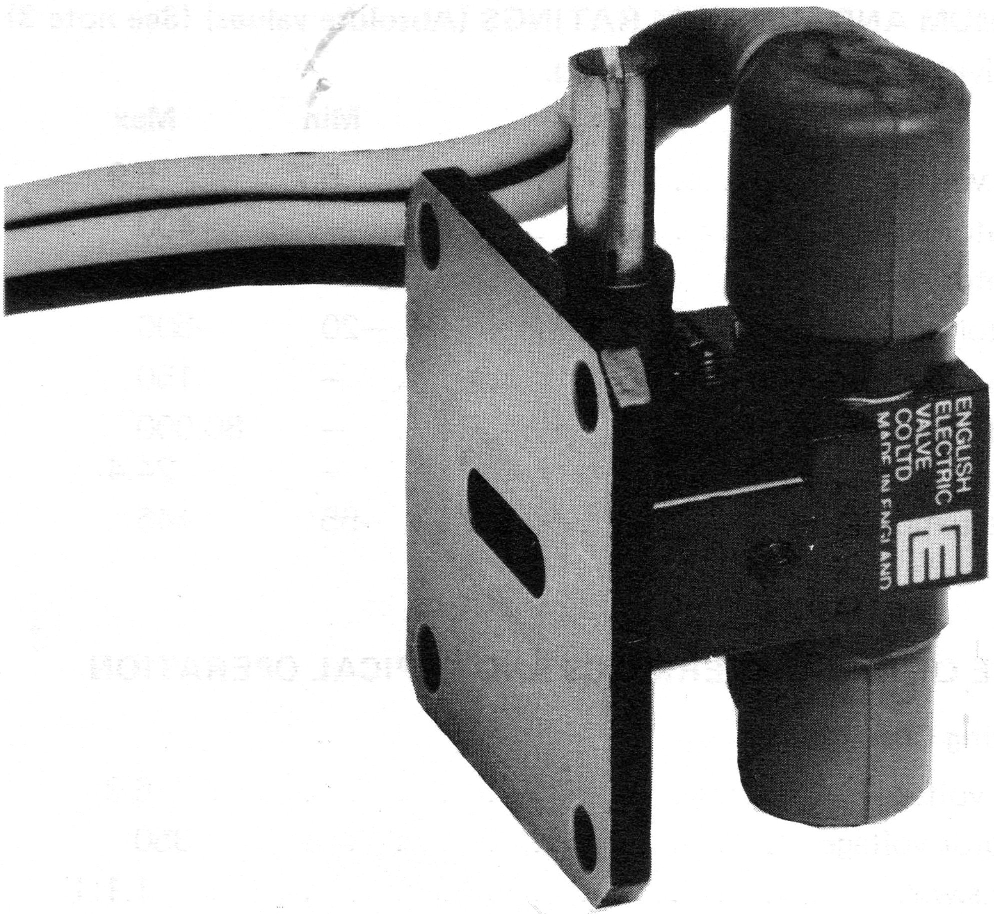
Service Type CV6142

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged reflex klystron for airborne radar and similar applications.

Frequency range	8800 to 8885	MHz
Typical output power	60	mW
Electronic tuning range	40	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding leads)	2.400 x 1.637 x 1.400 inches max 60.96 x 41.60 x 35.56mm max
Net weight	5 ounces (140g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C
Altitude (operating)	–	80 000	ft
	–	24.4	km
Storage temperature	–55	+45	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

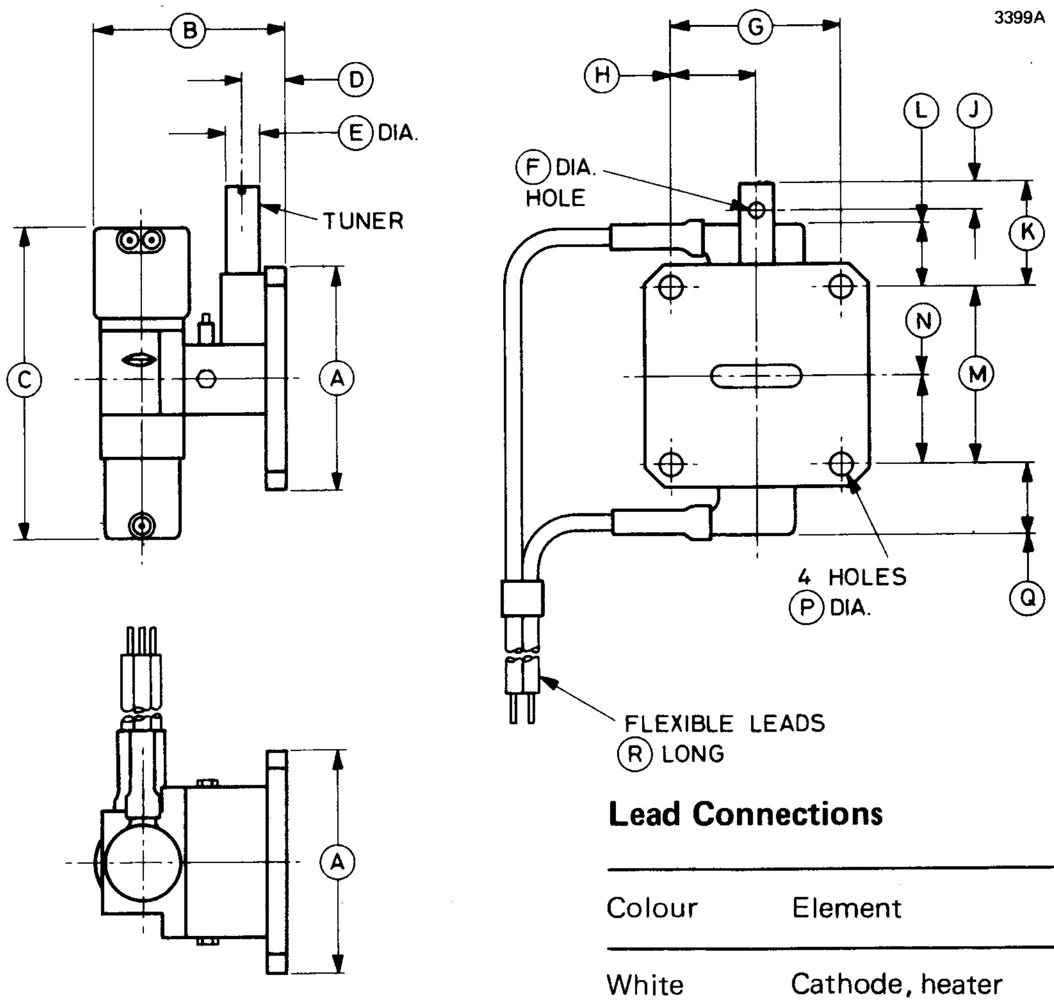
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	30	38	mA
Reflector voltage	–140	–	–200	V
Output power	40	60	–	mW
Mechanical tuning range . .	8800	–	8885	MHz
Tuning rate	–	250	–	MHz/turn
Electronic tuning range to –3db points	30	40	–	MHz
Reflector modulation sensitivity	0.5	1.0	1.5	MHz/V
Temperature coefficient of frequency	–50	–100	–200	kHz/°C
Peak frequency modulation with 10g vibration (25 to 1000Hz)	–	60	100	kHz
Barometric effect (see note 6) .	–	1.5	–	MHz
Warm-up drift (see note 7):				
frequency	–	–	10	MHz
output power	–	–	1.0	db

NOTES

1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. The frequency change when the ambient pressure is increased from 76 to 760mm Hg.
7. Measured between 1 minute and 2 minutes after switching on all supplies.

OUTLINE (All dimensions without limits are nominal)



Lead Connections

Colour	Element
White	Cathode, heater
Yellow	Heater
Grey	Reflector

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38	J	0.200 ± 0.005	5.08 ± 0.13
B	1.400 max	35.56 max	K	0.760 max	19.30 max
C	2.400 max	60.96 max	L	0.658 max	16.71 max
D	0.312 ± 0.010	7.92 ± 0.25	M	1.280 ± 0.004	32.512 ± 0.102
E	0.250	6.35	N	0.640 ± 0.004	16.256 ± 0.102
F	0.110	2.79	P	0.170	4.32
G	1.220 ± 0.004	30.988 ± 0.102	Q	0.458 max	11.63 max
H	0.610 ± 0.004	15.494 ± 0.102	R	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K3007

OSCILLATOR KLYSTRON

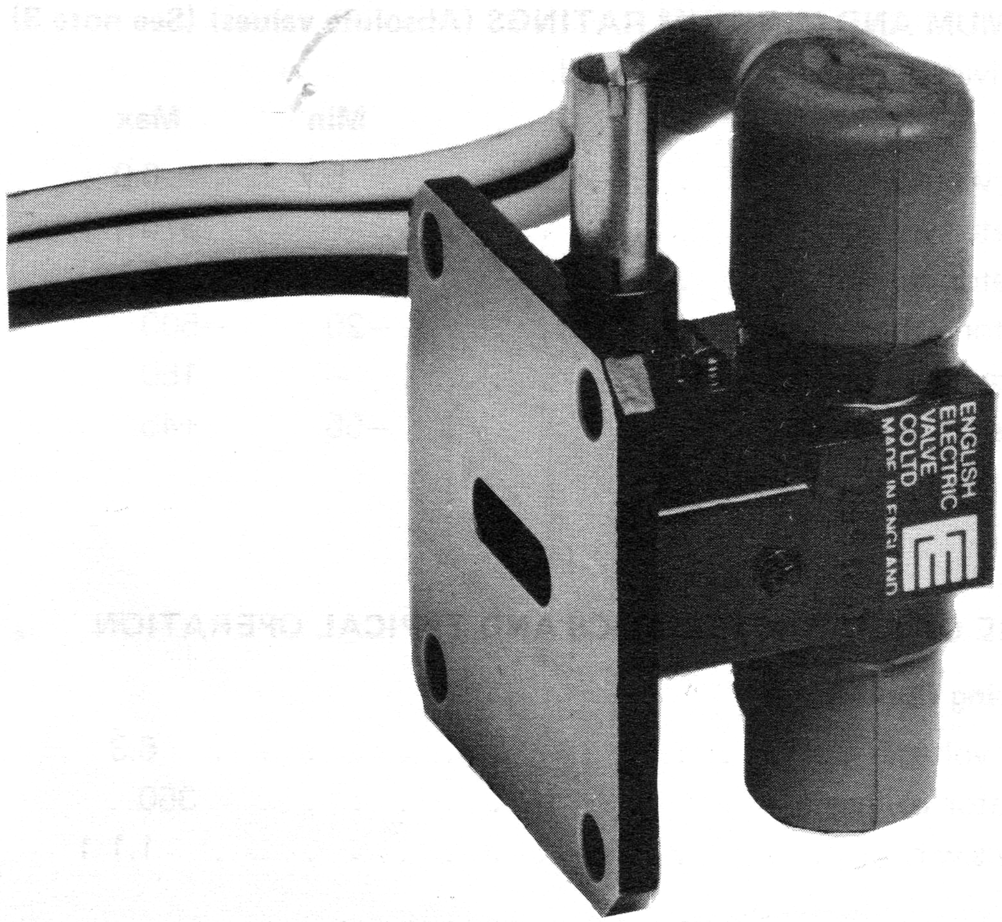
Service Type CV9423

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged reflex klystron for airborne radar.

Frequency range	9295 to 9395	MHz
Typical output power	40	mW
Electronic tuning range	35	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding leads)	2.382 x 1.637 x 1.400 inches max 60.50 x 41.58 x 35.56mm max
Net weight	5.5 ounces (160g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	375	V
Resonator current	–	45	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C
Storage temperature	–55	+45	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

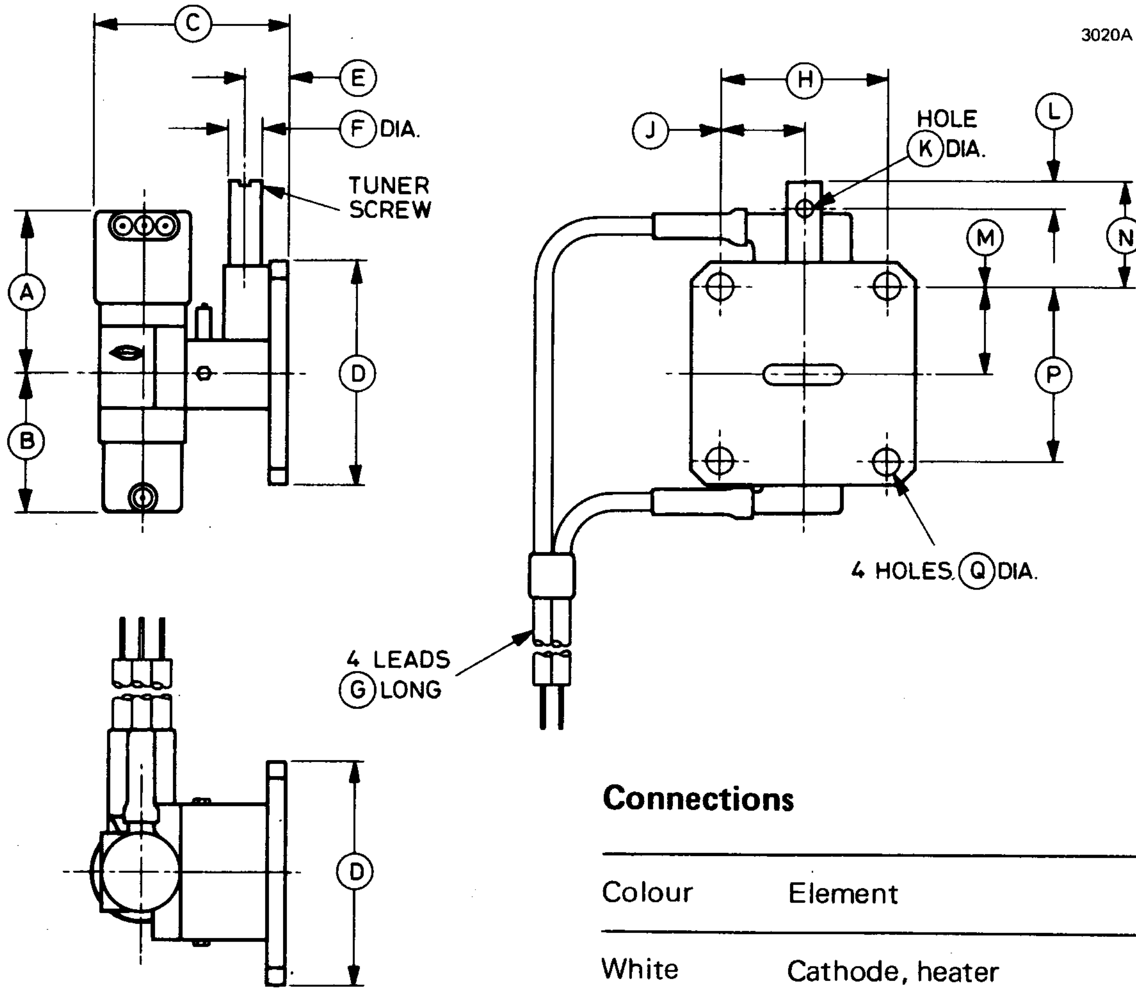
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	25	33	40	mA
Reflector voltage	–170	–	–220	V
Output power	25	40	50	mW
Mechanical tuning range . .	9295	–	9395	MHz
Tuning rate	150	200	250	MHz/turn
Electronic tuning range to –3db points	25	35	–	MHz
Reflector modulation sensitivity	0.5	0.7	2.0	MHz/V
Temperature coefficient of frequency	–50	–130	–200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz)	–	50	100	kHz
Warm-up drift (see note 6):				
frequency	–	–	–6.0	MHz
output power	–	–	1.0	db
Pulling effect (see note 7):				
frequency	–	4.0	–	MHz
output power	10	–	–	mW
Barometric effect (see note 8) .	–	–1.0	–	MHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 35oz in (0.25Nm) max.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Measured between 40 seconds and 3 minutes 40 seconds after switching on all supplies.
7. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
8. The frequency change when the ambient pressure is increased from 76 to 760mm Hg.

OUTLINE (All dimensions without limits are nominal)



Connections

Colour	Element
White	Cathode, heater
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref	Inches	Millimetres
A	1.300 max	33.02 max
B	1.000 max	25.40 max
C	1.400 max	35.56 max
D	1.625 ± 0.015	41.28 ± 0.38
E	0.312 ± 0.010	7.92 ± 0.25
F	0.250	6.35
G	12.000 min	304.8 min
H	1.220 ± 0.004	30.988 ± 0.102

Ref	Inches	Millimetres
J	0.610 ± 0.004	15.494 ± 0.102
K	0.110	2.79
L	0.200	5.08
M	0.640 ± 0.004	16.256 ± 0.102
N	0.760 max	19.30 max
P	1.280 ± 0.004	32.512 ± 0.102
Q	0.170	4.32

Millimetre dimensions have been derived from inches.

K3033

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Reflex klystron for use with separate external cavity over the frequency range 2650 to 3700MHz, for local oscillator or signal generator applications. Special cavities and selected reflector modes extend the frequency range from 1800 to 4000MHz.

Frequency range (depending on cavity)	1800 to 4000	MHz
Typical output power	100	mW
Electronic tuning range	30	MHz

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3 ± 5%	V
Heater current	0.65	A

Mechanical

Overall length	4.150 inches (105.4mm) max
Overall diameter	1.378 inches (35.0mm) max
Envelope	glass
Mounting position	any
Base	4 pin octal
Cooling	see note 1

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	6.0	6.6	V
Resonator voltage	–	330	V
Resonator current	–	45	mA
Reflector voltage	–25	–500	V
Peak heater to cathode voltage	–	50	V
Cavity temperature (see note 1)	–	150	°C
Altitude	–	10 000	ft
	–	3.05	km
V.S.W.R.	–	1.2:1	

TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage (see note 2)	300	V

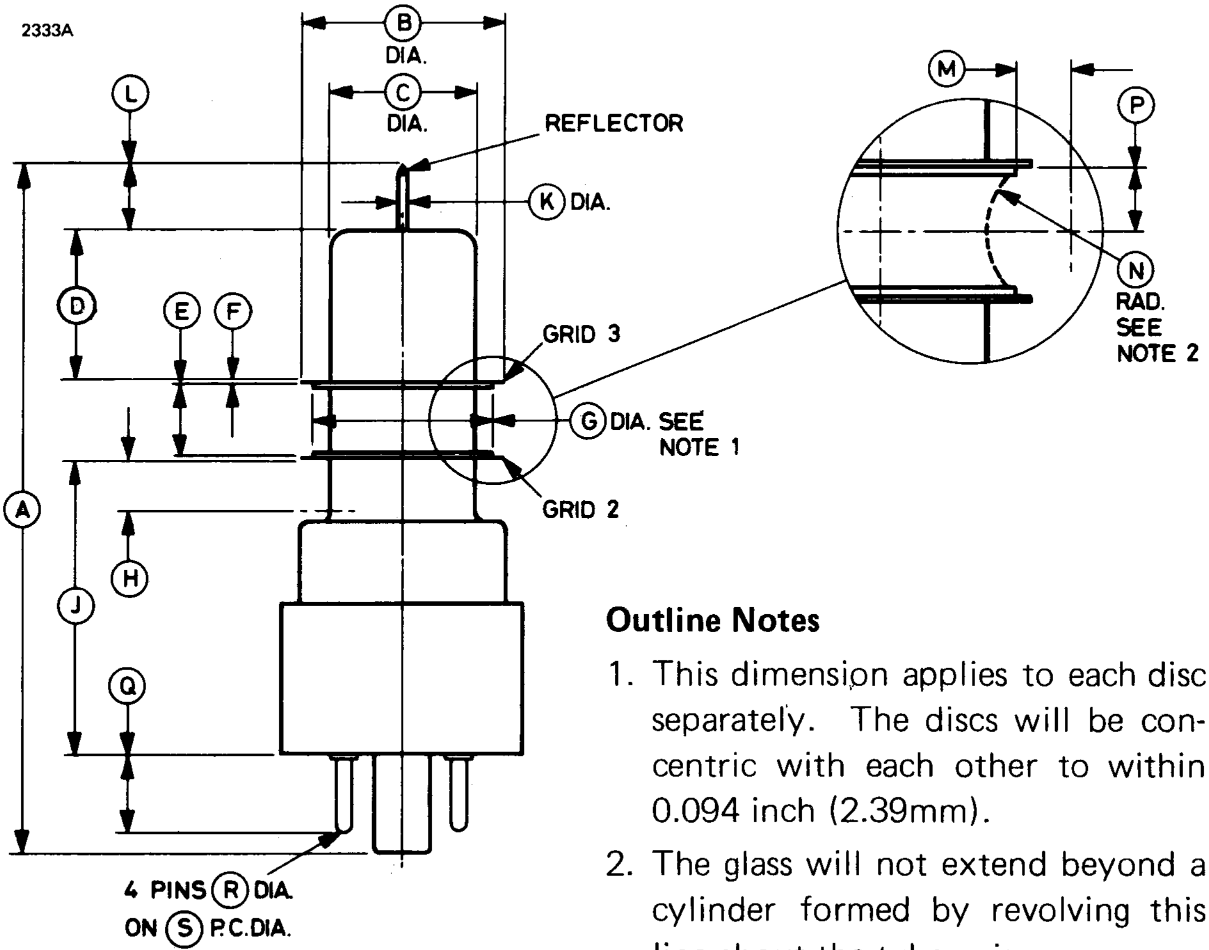
Typical Performance

	Min	Typical	Max	
Heater current	0.55	0.65	0.75	A
Frequency	–	3500	–	MHz
Beam current	–	35	45	mA
Reflector voltage (2¾ mode)	–150	–	–250	V
Output power	80	100	–	mW
Electronic tuning range to –3db points	20	30	–	MHz

NOTES

1. The grid ring cavity contacts may require cooling by forced-air.
2. Both resonator discs grid 2 and grid 3 are at this voltage. English Electric Valve Company Ltd. should be consulted if grid 1 is to be used for modulation purposes or is at resonator potential.

OUTLINE



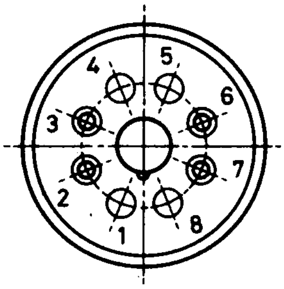
Outline Notes

1. This dimension applies to each disc separately. The discs will be concentric with each other to within 0.094 inch (2.39mm).
2. The glass will not extend beyond a cylinder formed by revolving this line about the tube axis.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.150 max	105.4 max	J	1.656 ± 0.125	42.06 ± 3.18
B	1.125 ± 0.010	28.58 ± 0.25	K	0.062 max	1.57 max
C	0.812 ± 0.031	20.62 ± 0.79		0.055 min	1.40 min
D	0.844 ± 0.047	21.44 ± 1.19	L	0.313 min	7.95 min
E	0.405 ± 0.003	10.287 ± 0.076	M	0.188 max	4.78 max
F	0.010	0.25	N	0.250 min	6.35 min
G	1.005 max	25.53 max	P	0.204 max	5.18 max
H	0.250 min	6.35 min		0.201 min	5.11 min

Millimetre dimensions have been derived from inches.

Base Connections



Pin	Element
1	No pin
2	Heater
3	Cathode
4	No pin
5	No pin
6	Grid 1
7	Heater
8	No pin

K3035

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

The K3035 is a rugged reflex klystron operating in the Q(Ka)-band. The cavity block design gives excellent thermal stability, and rigorous processing ensures long life and low noise characteristics.

Frequency range	34.1 to 35.6	GHz
Typical output power	30	mW
Electronic tuning range	60	MHz
Output	to no. 22 waveguide (0.280 x 0.140 inch internal)	
Coupler	NATO S.N. 5985-99-083-0018	
Mechanical tuning	differential screw thread	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.6	A
Heater starting current, peak value, not to be exceeded	5.0	A max
Cathode heating time (minimum)	2	min

Mechanical

Overall dimensions (excluding leads)	4.094 x 3.500 x 2.010 inches max 104.0 x 88.9 x 51.05mm max
Net weight	10 ounces (280g) approx
Mounting position	any
Connections	Ether 7-pin plug type BA7H

Cooling (See note 1) . . . . convection or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 2)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.9	6.7	V
Resonator voltage	–	2.1	kV
Resonator current	–	17.5	mA
Resonator dissipation	–	35	W
Reflector voltage (see note 3)	–150	–500	V
Grid voltage (see note 3)	–10	–100	V
Body temperature	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	2.0	kV
Load v.s.w.r.	1.1:1	max

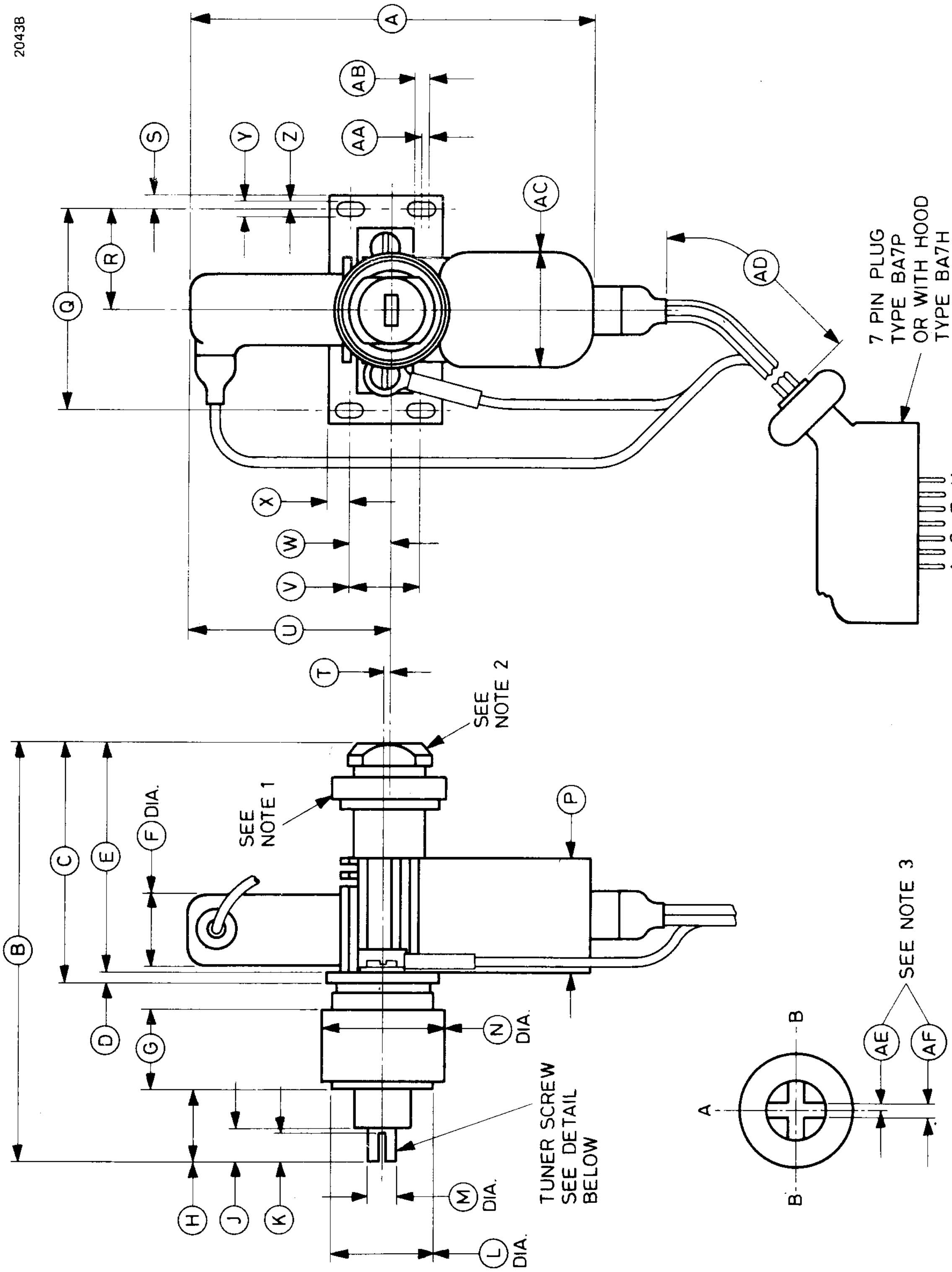
Range of Characteristics

	Min	Typical	Max	
Heater current	1.4	1.6	1.8	A
Resonator current	–	15	17.5	mA
Reflector voltage (see note 4)	–90	–	–500	V
Grid voltage (see note 5)	–10	–50	–100	V
Output power	30	75	–	mW
Mechanical tuning range (see note 6)	34.1	–	35.6	GHz
Electronic tuning range to –3db points	–	65	–	MHz
Reflector modulation sensitivity	–	0.8	–	MHz/V

NOTES

1. It may be necessary to provide forced-air cooling to ensure that the maximum body temperature is not exceeded.
2. All voltages except the heater voltage are with respect to cathode.
3. The reflector and grid voltages must never become equal to or more positive than the cathode; protective diodes should be fitted if necessary to prevent this. The reflector connection must be made at all times during operation.
4. Adjusted for maximum output power.
5. Set to within ±2V of the marked value.
6. Serious mechanical damage may result if the klystron is tuned beyond the range specified in the test sheet supplied with each tube.

OUTLINE



Outline Notes

1. Ring nut to NATO S.N. 5985-99-083-0020.
2. Flange to suit NATO S.N. 5985-99-083-0018.
3. Symmetrical tolerance 0.002 inch wide datum A and B (BS308).

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.500 max	88.90 max	R	0.875	22.23
B	4.094 max	104.0 max	S	0.120 ± 0.010	3.05 ± 0.25
	3.625 min	92.08 min	T	0.050 ± 0.015	1.27 ± 0.38
C	2.094	53.19	U	1.750 max	44.45 max
D	0.100	2.54	V	0.625	15.88
E	2.000	50.80	W	0.360 ± 0.020	9.14 ± 0.51
F	0.750 max	19.05 max	X	0.188	4.78
G	0.688 max	17.46 max	Y	0.140 ± 0.015	3.56 ± 0.38
H	0.625	15.88	Z	0.062	1.57
J	0.281	7.14	AA	0.062	1.57
K	0.250	6.35	AB	0.125	3.18
L	0.875 ± 0.010	22.23 ± 0.25	AC	1.000 max	25.40 max
M	0.248 ± 0.001	6.299 ± 0.025	AD	9.000 ± 0.500	228.6 ± 12.7
N	1.078 max	27.38 max	AE	0.0312	0.793
P	1.000 max	25.40 max	AF	0.063 max	1.60 max
Q	1.750	44.45		0.062 min	1.57 min

Millimetre dimensions have been derived from inches.

Lead Connections

Pin	Colour	Element
A	Black	Earth
B	Yellow	Heater
C	White	Heater, Cathode
D	Blue	Grid
E	Green	Reflector
F	–	No Connection
H	–	No Connection

K3038

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

The K3038 is a rugged reflex klystron operating in the Q (Ka)-band. The cavity block design gives excellent thermal stability, and rigorous processing ensures long life and low noise characteristics.

Centre frequency (see note 1) . . .	in the range 31 to 37	GHz
Mechanical tuning range	2.5	GHz min
Typical output power	350	mW
Typical electronic tuning range	50	MHz
Output	to no. 22 waveguide	
Coupler	UG-599/U or NATO S.N. 5985-99-083-0018	
Mechanical tuning	differential screw thread and optional locknut	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.6	A

Mechanical

Overall dimensions	see outline drawing
Net weight	10 ounces (0.3kg) approx
Mounting position	any
Connections	flexible leads

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

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.9	6.7	V
Resonator voltage	2.3	2.7	kV
Resonator current	–	30	mA
Resonator dissipation	–	70	W
Reflector voltage (see note 4)	–500	–900	V
Grid voltage (see note 4)	–10	–100	V
Reflector-cathode circuit impedance	–	0.5	MΩ
Body temperature (see note 2)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	2.5	kV
Load v.s.w.r.	1.1:1	max

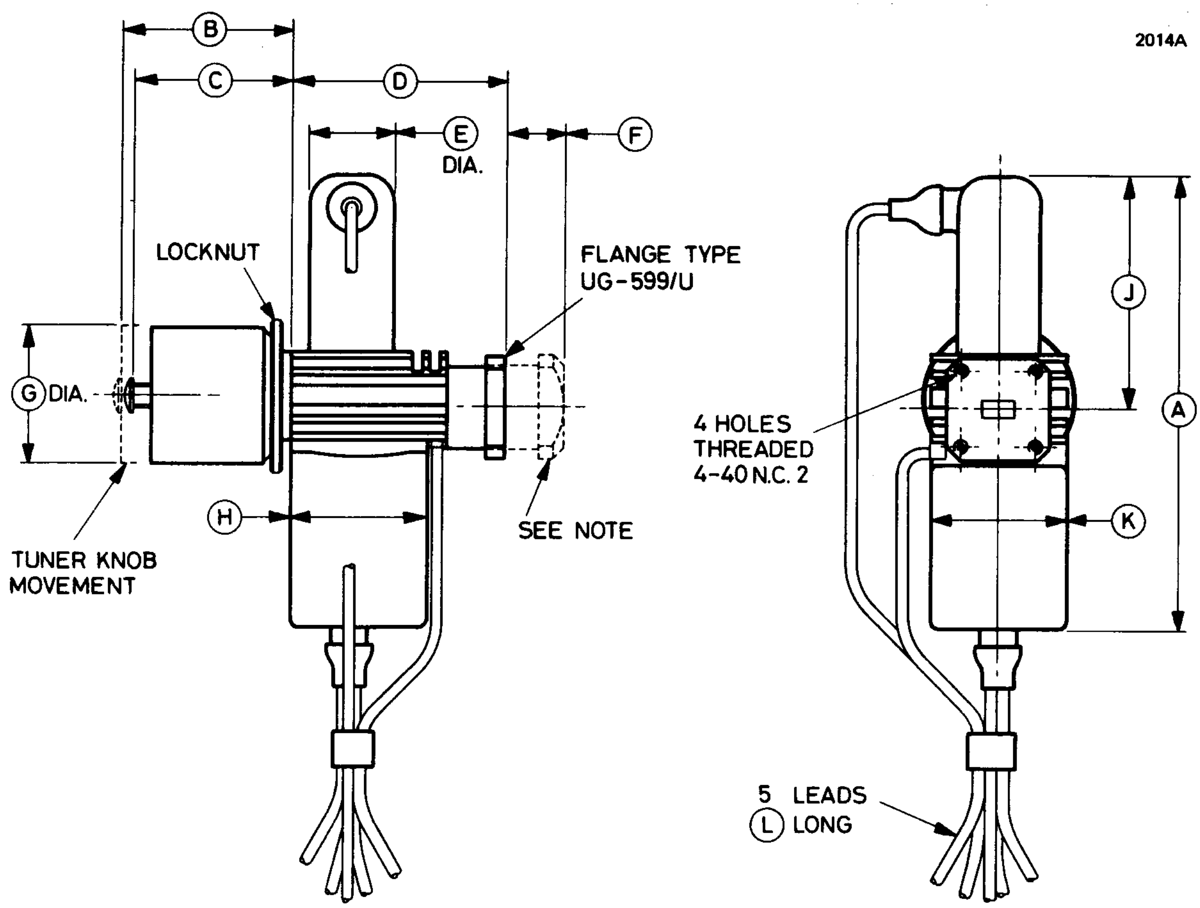
Range of Characteristics

	Min	Typical	Max	
Heater current	1.4	1.6	1.7	A
Resonator current	–	27	30	mA
Grid voltage (see note 5)	–	–53	–	V
Grid current	–	–	25	μA
Reflector voltage (see note 6)	–500	–	–900	V
Output power	250	450	–	mW
Mechanical tuning range (see note 7)	2.5	3.3	–	GHz
Electronic tuning range to –3db points	–	50	–	MHz
Reflector modulation sensitivity	–	0.8	–	MHz/V

NOTES

1. Tubes can be supplied to a specified centre frequency within this range, the normal tolerance being $\pm$200MHz. Tubes to closer tolerances can be supplied.
2. Forced-air cooling must be provided to ensure that the maximum body temperature rating of 150°C is not exceeded.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector and grid voltages must never become equal to or more positive than the cathode; if there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection is made at all times during operation.
5. The grid voltage is set to within $\pm$2V of the marked value in the range −10 to −100V.
6. The reflector voltage is adjusted for maximum output power. The limits given include the variations over the mechanical tuning range and also variations from tube to tube.
7. Serious mechanical damage may result if the klystron is tuned beyond the range specified in the test sheet supplied with each tube.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	3.500 max	88.90 max
B	1.219	30.96
C	1.141	28.98
D	1.563	39.70
E	0.625	15.88
F	0.438	11.13
G	1.000	25.40
H	1.000	25.40
J	1.688	42.88
K	1.000	25.40
L	9.000 min	228.6 min

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Green	Reflector
Black	Earth
Blue	Grid
Yellow	Heater
White	Heater, cathode

Note To suit flange NATO S.N. 5985-99-083-0018. When this flange is used, dimension D is increased by dimension F as shown.

K3039

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

The K3039 is a rugged reflex klystron operating in the Q (Ka)-band. The cavity block design gives excellent thermal stability, and rigorous processing ensures long life and low noise characteristics.

Centre frequency (see note 1) . . .	in the range 31 to 37	GHz
Mechanical tuning range	2.5	GHz min
Typical output power	75	mW
Typical electronic tuning range	50	MHz
Output	to no. 22 waveguide	
Coupler	UG-599/U or NATO S.N. 5985-99-083-0018	
Mechanical tuning	differential screw thread and optional locknut	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.6	A

Mechanical

Overall dimensions	see outline drawing
Net weight	10 ounces (0.3kg) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . convection or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.9	6.7	V
Resonator voltage	1.8	2.2	kV
Resonator current	–	20	mA
Reflector voltage (see note 4)	–150	–500	V
Grid voltage (see note 4)	–10	–100	V
Reflector-cathode circuit impedance	–	0.5	MΩ
Body temperature (see note 2)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	2.0	kV
Load v.s.w.r.	1.1:1	max

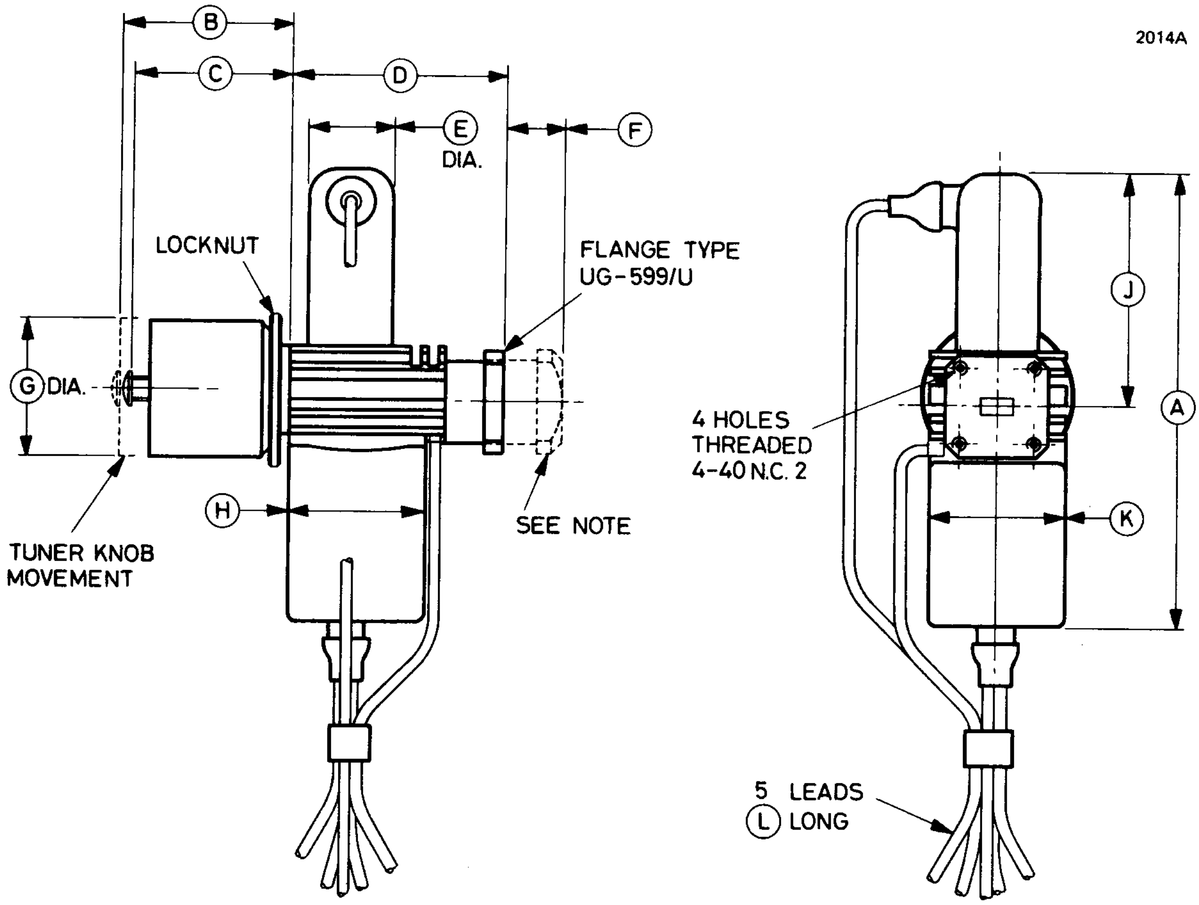
Range of Characteristics

	Min	Typical	Max	
Heater current	1.4	1.6	1.7	A
Resonator current	–	19	20	mA
Grid voltage (see note 5)	–	–53	–	V
Grid current	–	–	25	μA
Reflector voltage (see note 6)	–150	–	–500	V
Output power	30	75	–	mW
Mechanical tuning range (see note 7)	2.5	3.3	–	GHz
Electronic tuning range to –3db points	–	50	–	MHz
Reflector modulation sensitivity	–	0.8	–	MHz/V

NOTES

1. Tubes can be supplied to a specified centre frequency within this range, the normal tolerance being ±200MHz. Tubes to closer tolerances can be supplied.
2. It may be necessary to provide cooling to ensure that the maximum body temperature rating of 150°C is not exceeded.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector and grid voltages must never become equal to or more positive than the cathode; if there is any chance of this happening, a protective diode must be fitted. It is imperative that the reflector connection is made at all times during operation.
5. The grid voltage is set to within ±2V of the marked value in the range −10 to −100V.
6. The reflector voltage is adjusted for maximum output power. The limits given include the variations over the mechanical tuning range and also variations from tube to tube.
7. Serious mechanical damage may result if the klystron is tuned beyond the range specified in the test sheet supplied with each tube.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	3.500 max	88.90 max
B	1.219	30.96
C	1.141	28.98
D	1.563	39.70
E	0.625	15.88
F	0.438	11.13
G	1.000	25.40
H	1.000	25.40
J	1.688	42.88
K	1.000	25.40
L	9.000 min	228.6 min

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Green	Reflector
Black	Earth
Blue	Grid
Yellow	Heater
White	Heater, cathode

Note To suit flange NATO S.N. 5985-99-083-0018. When this flange is used, dimension D is increased by dimension F as shown.

K3066

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron for doppler speed meters.

Frequency range	10 660 to 10 720	MHz
Typical output power	15	mW
Electronic tuning range	45	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions	3.750 x 1.825 x 1.500 inches max 95.25 x 46.36 x 38.10mm max
Net weight	7 ounces (200g) approx
Mounting position	any
Base	5-pin octal
Reflector connection	top cap B.S.448-CT1

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	350	V
Resonator current	–	40	mA
Reflector voltage (see note 4)	–20	–400	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

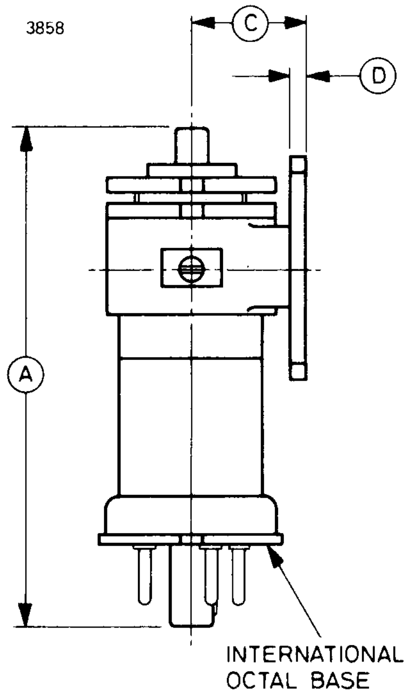
	Min	Typical	Max	
Heater current	0.52	0.58	0.62	A
Resonator current	–	22	27	mA
Reflector voltage	–65	–	–130	V
Output power	12	15	–	mW
Mechanical tuning range	10 660	–	10 720	MHz
Electronic tuning range to –3db points	30	45	–	MHz

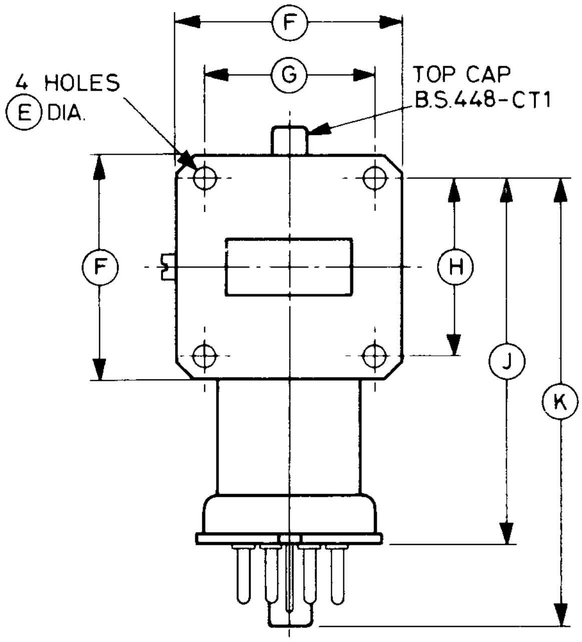
NOTES

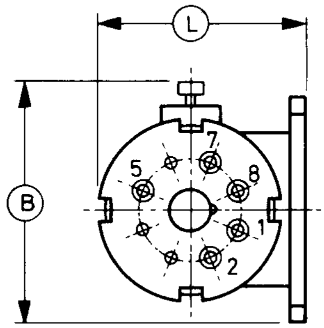
1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Each klystron is marked with the reflector voltage at which it will give maximum power at the midband frequency.

OUTLINE (All dimensions without limits are nominal)

3858







Base Connections

Pin	Element
1	No connection
2	Heater
3	Omitted
4	Omitted
5	Resonator
6	Omitted
7	Cathode, heater
8	No connection
Top cap	Reflector

Ref	Inches	Millimetres
A	3.750 max	95.25 max
B	1.825 max	46.36 max
C	0.830 $\pm$ 0.015	21.08 $\pm$ 0.38
D	0.125	3.18
E	0.169 $\pm$ 0.003	4.293 $\pm$ 0.076
F	1.625	41.28

Ref	Inches	Millimetres
G	1.220 $\pm$ 0.004	30.99 $\pm$ 0.10
H	1.280 $\pm$ 0.004	32.51 $\pm$ 0.10
J	2.700 max	68.58 max
K	3.300 max	83.82 max
L	1.500 max	38.10 max

Millimetre dimensions have been derived from inches.

K3067

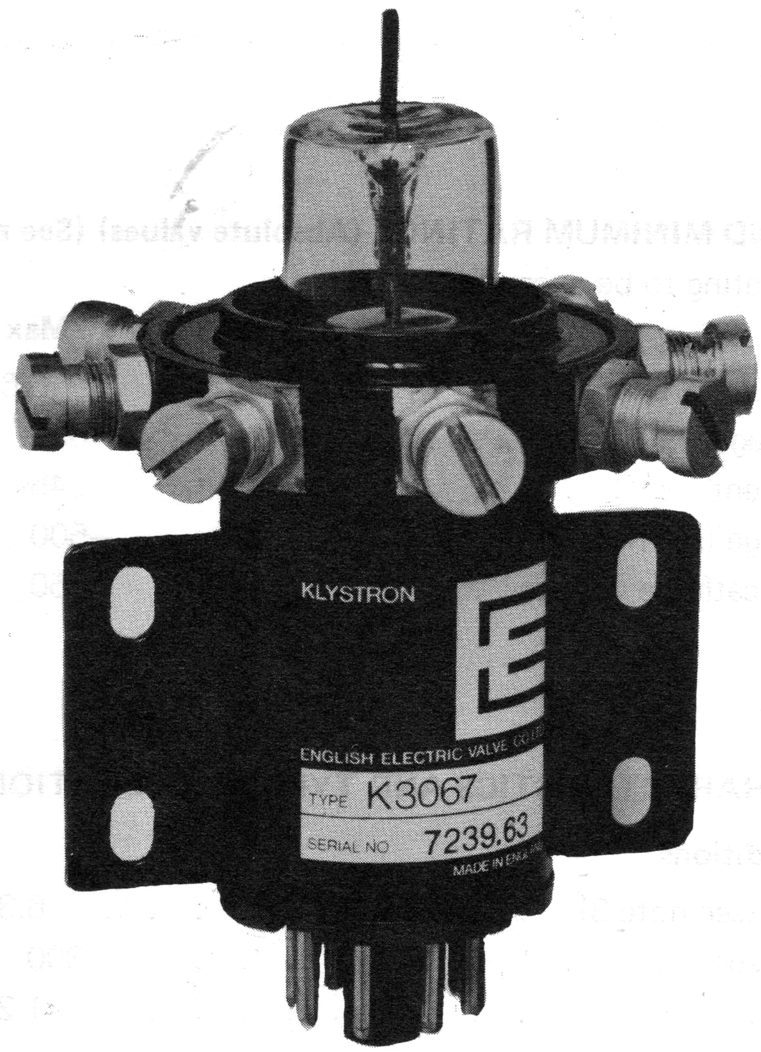
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron for local oscillator service.

Frequency range	2950 to 3225	MHz
Typical output power	60	mW
Electronic tuning range	20	MHz
Output		special coaxial
Mechanical tuning		seven screws



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.65	A

Mechanical

Overall dimensions	4.500 x 3.250 x 3.250 inches max 114.3 x 82.55 x 82.55mm max
Net weight	6½ ounces (185g) approx
Mounting position	any
Base	octal

Cooling . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 1)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	6.0	6.6	V
Resonator voltage	–	330	V
Resonator current	–	45	mA
Reflector voltage (see note 2)	–25	–500	V
Peak heater to cathode voltage	–	50	V

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage (see note 3)	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.2:1	max

Range of Characteristics

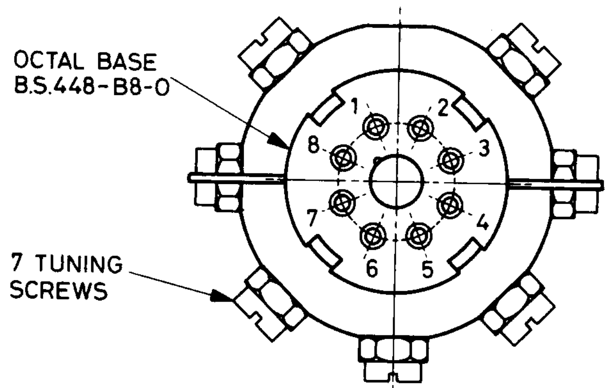
	Min	Typical	Max	
Heater current	0.55	0.65	0.75	A
Resonator current	–	30	40	mA
Reflector voltage	–35	–	–110	V
Output power	35	60	–	mW
Mechanical tuning range	2950	–	3225	MHz
Electronic tuning range to –3db points	15	20	–	MHz

NOTES

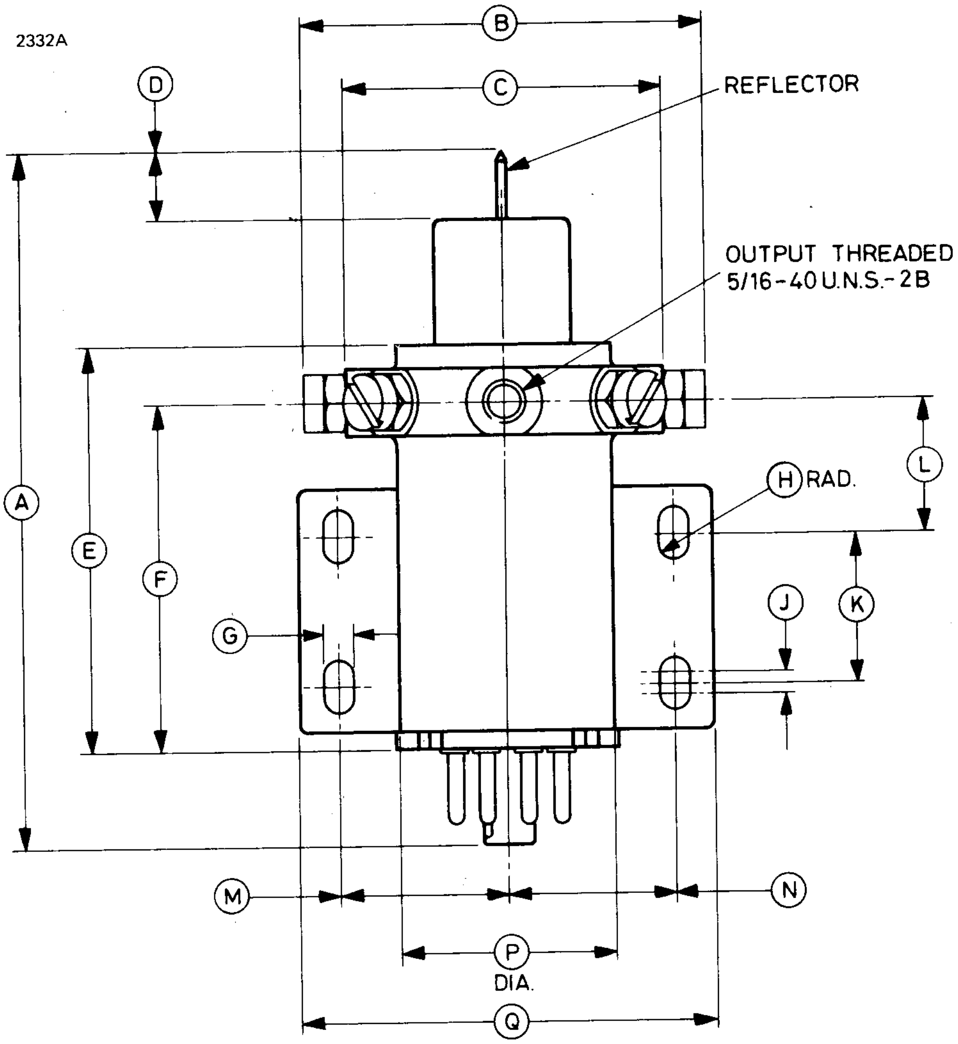
1. All voltages except the heater voltage are with respect to cathode.
2. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
3. For maximum life, allow a minimum of 30 seconds warm-up.

Base Connections

Pin	Element
1	Resonator
2	Heater
3	Cathode
4	No connection
5	No connection
6	No connection
7	Heater
8	No connection



OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.500 max	114.3 max	H	0.084 ± 0.010	2.13 ± 0.25
B	3.250 max	82.55 max	J	0.125 ± 0.005	3.18 ± 0.13
C	1.840 ± 0.020	46.74 ± 0.51	K	0.875 ± 0.015	22.23 ± 0.38
D	0.317 min	8.05 min	L	0.780 ± 0.025	19.81 ± 0.64
E	2.450 max	63.50 max	M	0.968 ± 0.010	24.59 ± 0.25
F	2.020 ± 0.080	51.31 ± 2.03	N	0.968 ± 0.010	24.59 ± 0.25
G	$0.165^{+0.005}_{-0.000}$	$4.19^{+0.13}_{-0.00}$	P	1.325 max	33.66 max
			Q	2.500 max	63.50 max

Millimetre dimensions have been derived from inches.

K3069

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage fixed frequency reflex klystron designed for use in doppler speed measuring systems, e.g. police and railway traffic control.

Frequency	10.525 ± 0.012	GHz
Typical output power	100	mW
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	$6.3 \pm 5\%$	V
Heater current	0.45	A

Mechanical

Overall dimensions	3.000 x 1.250 x 1.640 inches max 76.20 x 31.75 x 41.66mm max
Net weight	3½ ounces (100g) approx
Mounting position	any
Base	peewee wafer (A3-108)
Reflector connection	top cap B.S.448-CT1

Cooling (See note 1) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 2)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Reflector voltage (see note 3)	–20	–500	V
Body temperature (see note 4)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Frequency	10.525	GHz
Load v.s.w.r.	1.1:1	max

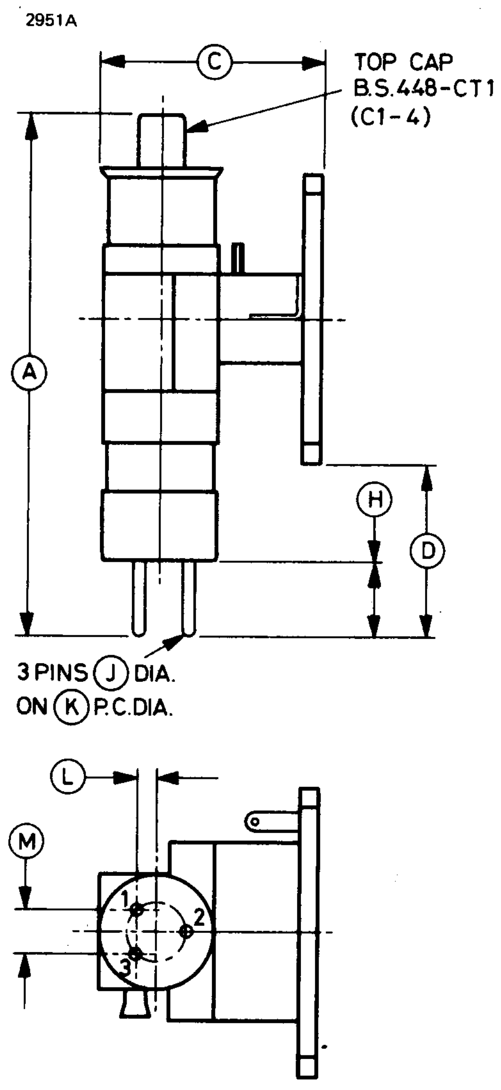
Range of Characteristics

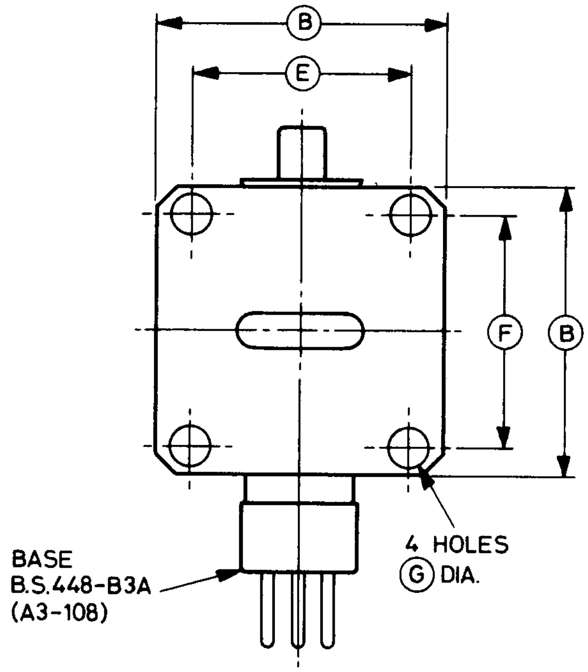
	Min	Typical	Max	
Heater current	–	0.45	0.50	A
Resonator current	–	33	37	mA
Reflector voltage	–150	–190	–250	V
Output power	55	100	–	mW
Peak frequency modulation with 10g vibration (30 to 3000Hz)	–	50	200	kHz

NOTES

1. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
2. All voltages except the heater voltage are with respect to the cathode.
3. The reflector circuit impedance must not exceed 0.5MΩ.
4. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink.

OUTLINE (All dimensions without limits are nominal)





Pin	Element
1*	Heater
2*	Cathode
3	Heater
Top cap	Reflector

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.000 max	76.20 max	G	0.220 ± 0.003	5.588 ± 0.076
B	1.625 ± 0.015	41.28 ± 0.38	H	0.447 max	11.35 max
C	1.250 max	31.75 max	J	0.093 ± 0.003	2.362 ± 0.076
D	1.125 max	28.58 max	K	0.344	8.74
E	1.220 ± 0.004	30.988 ± 0.102	L	0.122	3.10
F	1.280 ± 0.004	32.512 ± 0.102	M	0.243	6.17

Millimetre dimensions have been derived from inches.

K3071 K3071B

OSCILLATOR KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Forced-air cooled, fixed frequency, two cavity oscillator klystrons designed for airborne doppler and beacon radar applications. The sturdy construction gives good frequency stability, low noise and low microphonics. The connections are silicone rubber moulded for unpressurized high altitude operation.

Frequency:		
K3071	8800 ± 5	MHz
K3071B	8770 ± 5	MHz
Typical output power	1.5	W
Electronic tuning range	15	MHz
Output	no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	

Variants of this type can be supplied for operation at any frequency in the range 8000 to 9500MHz, and up to 5W c.w. output.

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.8	A

Mechanical

Overall dimensions (excluding leads)	2.750 x 1.875 x 1.350 inches max 69.85 x 47.63 x 34.29mm max
Net weight	8 ounces (230g) approx
Mounting position	any
Connections	flexible leads

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 1)

No individual rating is to be exceeded

	Min	Max	
Heater voltage (see note 2)	5.7	6.9	V
Beam voltage (see note 3)	–	900	V
Beam current	–	75	mA
Radiator temperature	–	200	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Load v.s.w.r.	1.1:1	

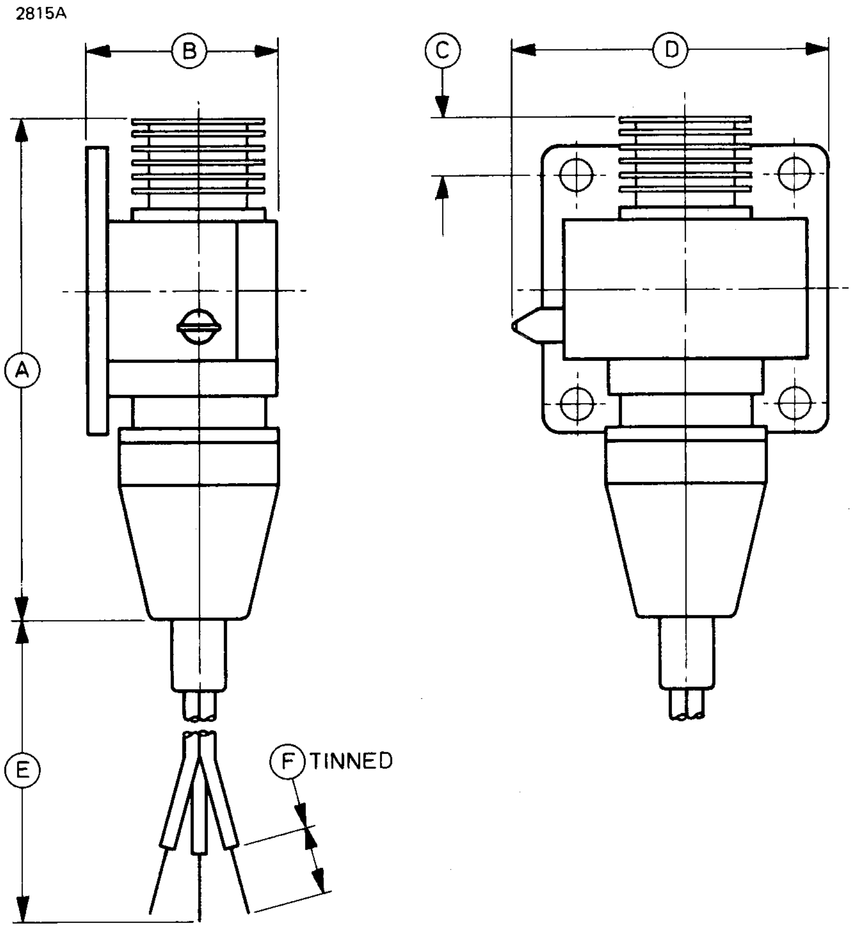
Range of Characteristics

	Min	Typical	Max	
Heater current	0.7	0.8	1.1	A
Frequency:				
K3071	8795	8800	8805	MHz
K3071B	8765	8770	8775	MHz
Beam voltage	710	740	770	V
Beam current	40	50	70	mA
Output power	1.25	1.5	3.0	W
Electronic tuning range to –3db points	10	15	–	MHz
Modulation voltage (see note 4)	1.7	2.5	3.4	$V_{r.m.s.}$
Beam voltage modulation sensitivity	100	130	200	kHz/V
Temperature coefficient of frequency	–	+40	±150	kHz/°C
Heater voltage coefficient of frequency	–	0.5	2.0	kHz/V
Random frequency deviation (peak to peak) (see note 5)	–	0.5	3.0	kHz
Radiator temperature (see note 6)	–	70	150	°C

NOTES

1. All voltages except the heater voltage are with respect to cathode.
2. When a d.c. heater supply is used the positive terminal of the heater supply must be connected to the common heater-cathode connection (white lead).
3. The beam and heater voltages may be applied simultaneously; the klystron is normally operated with the resonator body at earth potential.
4. The r.m.s. beam voltage modulation required to produce 0.96MHz peak to peak modulation on the output carrier.
5. This represents the random deviations of the output frequency from the carrier, produced by random modulating frequencies in the range 150 to 11 000Hz.
6. For maximum life the radiator temperature should be kept below 100°C. A suitable blower is Vactric type VBM1½, delivering 30ft^3/min approx. If the air cooling fails, the klystron must be switched off.

OUTLINE



Ref	Inches	Millimetres
A	2.750 max	69.85 max
B	1.350 max	34.29 max
C	0.400 max	10.16 max
D	1.875 max	47.63 max
E	18.000 $\pm$ 1.000	457.2 $\pm$ 25.4
F	0.375 $\pm$ 0.125	9.53 $\pm$ 3.18

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Yellow	Heater
White*	Heater
Green*	Cathode

* Internally connected.

K3073

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage reflex klystron designed for applications requiring low vibration f.m. and good frequency stability characteristics, e.g. distance measuring equipment.

Frequency range (see note 1)	10.325 to 10.335	GHz
Typical output power	60	mW
Electronic tuning range	40	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3 $\pm$ 5%	V
Heater current	0.41	A

Mechanical

Overall dimensions (excluding leads)	2.480 x 1.400 x 1.640 inches max 63.00 x 35.56 x 41.66mm max
Net weight	6 ounces (170g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	400	V
Resonator current	–	50	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C
Storage temperature	–55	+100	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

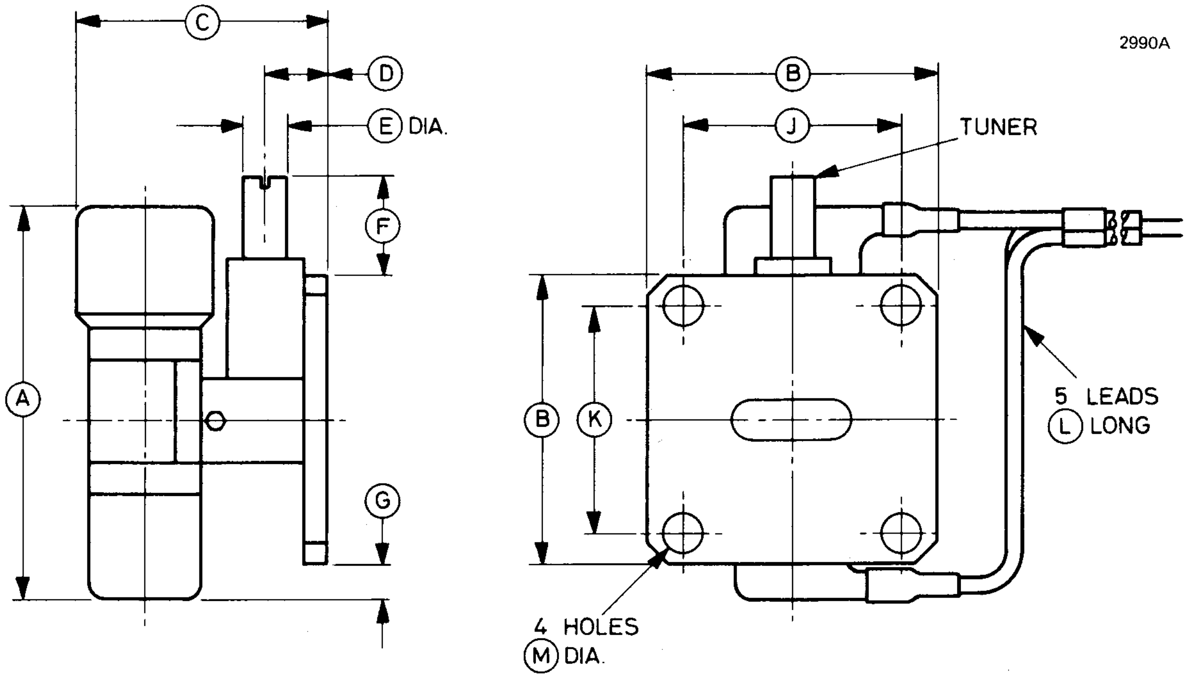
Range of Characteristics

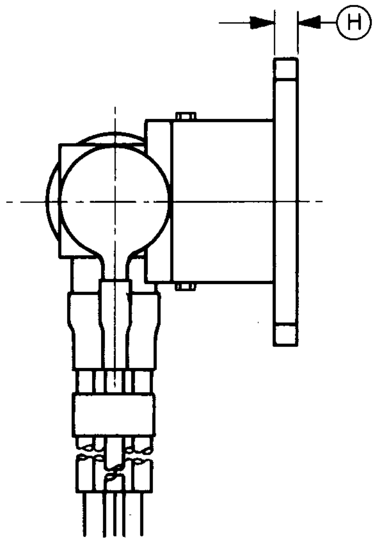
	Min	Typical	Max	
Heater current	0.30	0.41	0.50	A
Resonator current	20	30	35	mA
Reflector voltage	–80	–110	–140	V
Output power	40	60	–	mW
Mechanical tuning range	10.325	–	10.335	GHz
Electronic tuning range to –3db points	30	40	–	MHz
Reflector modulation sensitivity (see note 6)	1.5	2.5	4.0	MHz/V
Temperature coefficient of frequency (see note 7)	–	–	+0	kHz/°C
			–80	kHz/°C
Peak frequency modulation with 10g vibration (75 to 6000Hz)	–	25	100	kHz
Warm-up drift (see note 8)	–	1.5	2	MHz

NOTES

1. Other frequency ranges can be supplied.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink, preferably below 100°C.
6. These limits apply for a maximum change in frequency of ±2.5MHz.
7. Over an ambient temperature range from −55 to +80°C.
8. Measured between 2 minutes and 60 minutes after switching on all supplies, with the ambient temperature maintained constant.

OUTLINE





Lead	Element
Green*	Cathode
White*	Heater
Yellow	Heater
Brown	Resonator
Grey	Reflector

* Internally connected.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.200 max	55.88 max	G	0.187 max	4.75 max
B	1.625 ± 0.015	41.28 ± 0.38	H	0.125	3.18
C	1.400 max	35.56 max	J	1.220 ± 0.004	30.99 ± 0.10
D	0.347 ± 0.020	8.81 ± 0.51	K	1.280 ± 0.004	32.51 ± 0.10
E	0.2475 ± 0.0025	6.287 ± 0.064	L	6.000 min	152.4 min
F	0.550 ± 0.100	13.97 ± 2.54	M	0.220 ± 0.003	5.588 ± 0.076

Millimetre dimensions have been derived from inches.

K3074

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

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

Frequency range	10.50 to 10.55	GHz
Typical output power	27	mW
Electronic tuning range	20	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions (excluding leads)	2.625 x 1.875 x 1.500 inches max 66.68 x 47.63 x 38.1mm max
Net weight	7 ounces (200g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	350	V
Resonator current	–	40	mA
Resonator dissipation	–	12	W
Reflector voltage (see note 4)	–20	–400	V
Body temperature (see note 5)	–	140	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

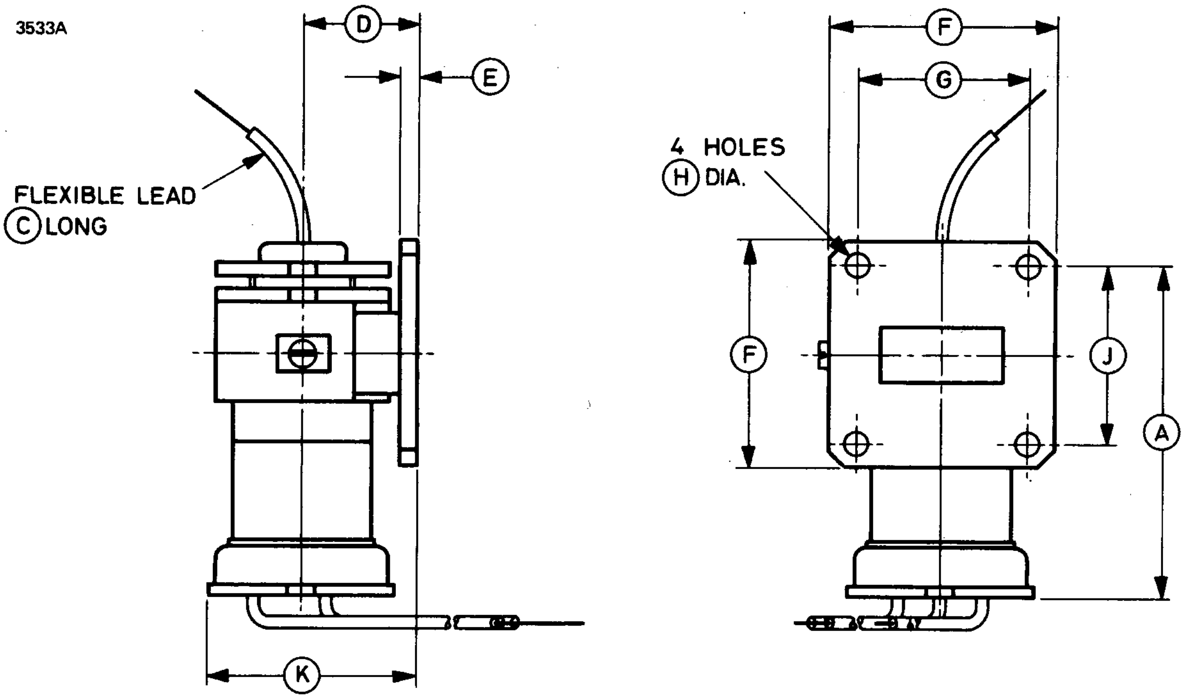
	Min	Typical	Max	
Heater current	0.52	0.58	0.62	A
Resonator current	22	25	35	mA
Reflector voltage (see note 6)	–150	–200	–250	V
Output power	20	27	–	mW
Mechanical tuning range	10.50	–	10.55	GHz
Electronic tuning range to –3db points	15	20	–	MHz

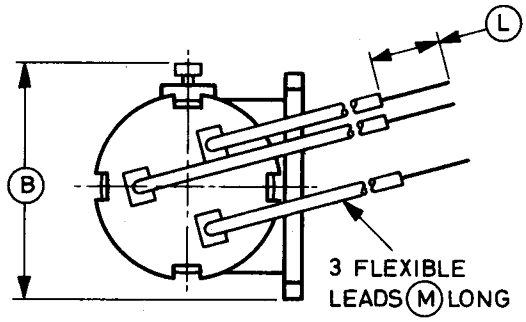
NOTES

1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.
6. Each klystron is marked with the reflector voltage at which it will give maximum power at the midband frequency.

OUTLINE (All dimensions without limits are nominal)

3533A





Lead Connections

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

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.450 max	62.23 max	G	1.220 ± 0.004	30.99 ± 0.10
B	1.875 max	47.63 max	H	0.169 ± 0.003	4.293 ± 0.076
C	12.000 min	304.8 min	J	1.280 ± 0.004	32.51 ± 0.10
D	0.830 ± 0.015	21.08 ± 0.38	K	1.500 max	38.10 max
E	0.125	3.18	L	0.500 ± 0.250	12.70 ± 6.35
F	1.625	41.28	M	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K3076

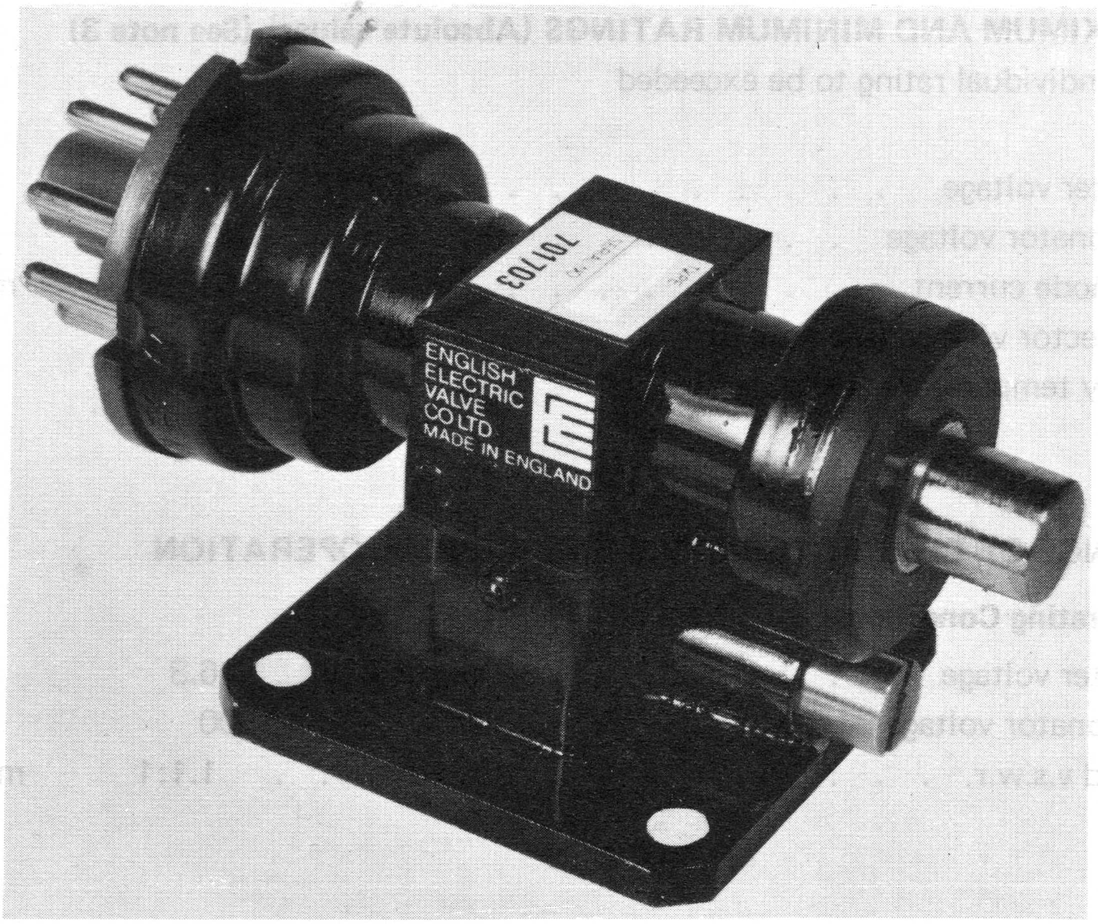
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage rugged reflex klystron with low vibration f.m. characteristics, for use in Doppler speed measuring systems, e.g. police and railway traffic control.

Frequency range (see note 1)	10.5 to 10.7	GHz
Typical output power	60	mW
Electronic tuning range	30	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.45	A

Mechanical

Overall dimensions	3.380 x 1.750 x 1.640 inches max 85.85 x 44.45 x 41.66mm max
Net weight	5 ounces (140g) approx
Mounting position	any
Base	international octal
Reflector connection	top cap B.S.448-CT2

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	6.0	6.6	V
Resonator voltage	–	350	V
Cathode current	–	50	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.4	0.45	0.5	A
Resonator current	–	30	37	mA
Reflector voltage	–90	–115	–140	V
Output power	40	60	–	mW
Mechanical tuning range . . .	10.50	–	10.70	GHz
Electronic tuning range to –3db points	20	30	–	MHz
Vibration (75 to 6000Hz at 2g) (see note 6)	–	0.5	1.0	mV

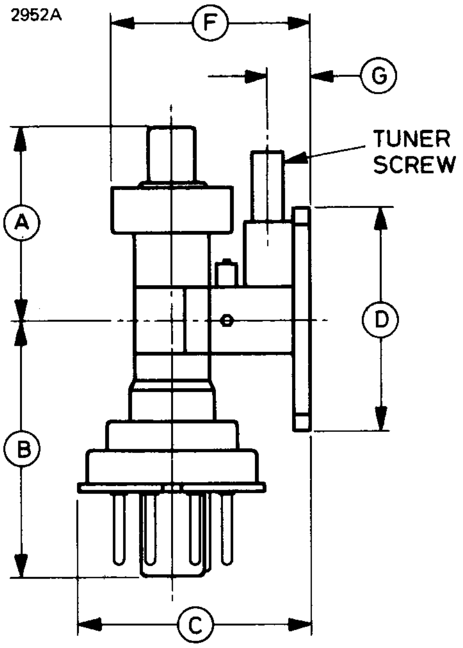
NOTES

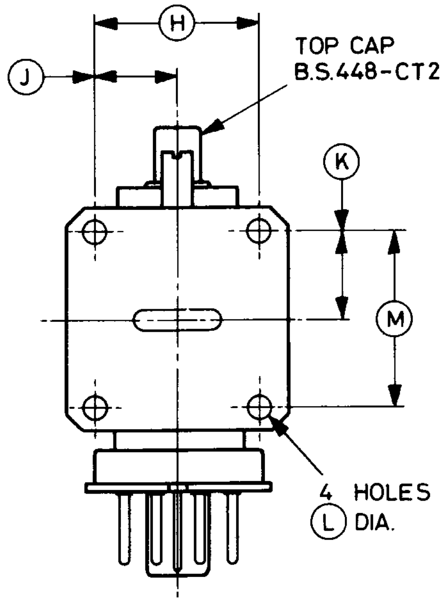
1. Tubes can be supplied preset to any frequency within the specified range.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ.
5. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink.
6. With the klystron operating normally, and with 1.0mW of the output power fed to a matched mixer diode, the output voltage from the mixer diode as measured across a 600Ω resistive load will not exceed the stated limit. The conversion loss of the mixer diode shall not exceed 5.5db.

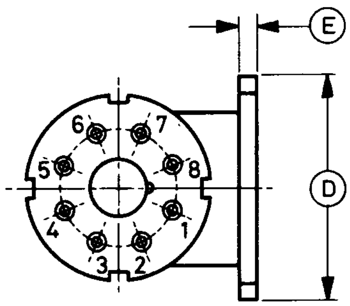
   If required, the vibration performance may be measured in terms of peak frequency modulation, in which case the limit will be 100kHz maximum for 10g vibration over the range 75 to 6000Hz.

OUTLINE

2952A







Pin	Element
1	Resonator
2	Heater
3	No connection
4	No connection
5	No connection
6	No connection
7	Heater
8	Cathode
Top cap	Reflector

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.450 max	36.83 max	G	0.312 ± 0.010	7.92 ± 0.25
B	1.930 max	49.02 max	H	1.220 ± 0.004	30.988 ± 0.102
C	1.750 max	44.45 max	J	0.610 ± 0.004	15.494 ± 0.102
D	1.625 ± 0.015	41.28 ± 0.38	K	0.640 ± 0.004	16.256 ± 0.102
E	0.135 ± 0.010	3.43 ± 0.25	L	0.170	4.32
F	1.600 max	40.64 max	M	1.280 ± 0.004	32.512 ± 0.102

Millimetre dimensions have been derived from inches.

K3077

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage rugged reflex klystron with low vibration f.m. characteristics, for use in speed doppler, local oscillator and marine radar applications.

Frequency range (see note 1)	9350 to 9550	MHz
Typical output power	50	mW
Electronic tuning range	45	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3 ± 5%	V
Heater current	0.57	A

Mechanical

Overall dimensions	3.380 x 1.750 x 1.640 inches max 85.85 x 44.45 x 41.66mm max
Net weight	5 ounces (140g) approx
Mounting position	any
Base	international octal
Reflector connection	top cap B.S.448-CT2

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	6.0	6.6	V
Resonator voltage	–	350	V
Cathode current	–	30	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

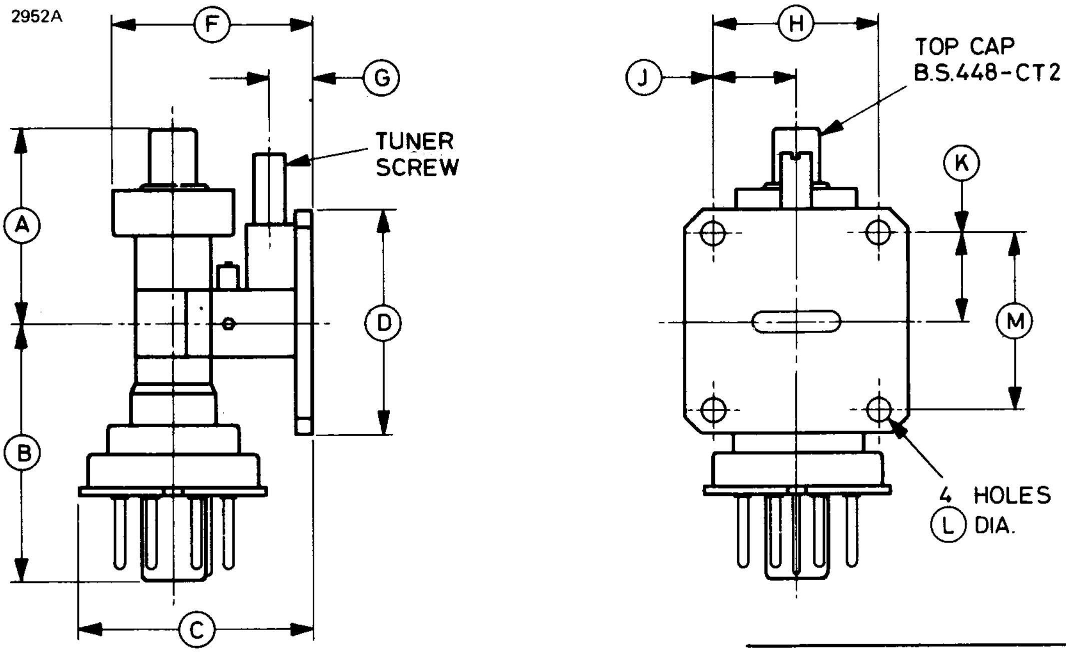
	Min	Typical	Max	
Heater current	0.52	0.57	0.61	A
Resonator current	15	22	25	mA
Reflector voltage	−65	−90	−115	V
Output power	30	50	70	mW
Mechanical tuning range . .	9350	–	9550	MHz
Electronic tuning range to −3db points	30	45	–	MHz
Temperature coefficient of frequency	−50	−100	−200	kHz/°C
Vibration (75 to 6000Hz at 2g) (see note 6)	–	0.4	1.0	mV

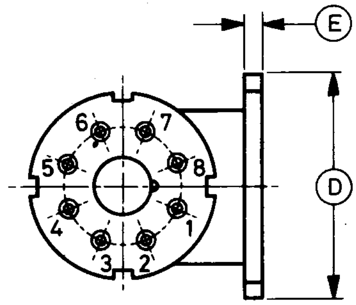
NOTES

1. Tubes can be supplied preset to any frequency within the specified range.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ.
5. For best life, the operating temperature of the klystron body must be kept as low as possible by providing an adequate heat sink.
6. With the klystron operating normally, and with 1.0mW of the output power fed to a matched mixer diode, the output voltage from the mixer diode as measured across a 600Ω resistive load will not exceed the stated limit. The conversion loss of the mixer diode shall not exceed 5.5db.

   If required, the vibration performance may be measured in terms of peak frequency modulation, in which case the limit will be 100kHz maximum for 10g vibration over the range 75 to 6000Hz.

OUTLINE





Pin	Element
1	Resonator
2	Heater
3	No connection
4	No connection
5	No connection
6	No connection
7	Heater
8	Cathode
Top cap	Reflector

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.450 max	36.83 max	G	0.312 ± 0.010	7.92 ± 0.25
B	1.930 max	49.02 max	H	1.220 ± 0.004	30.988 ± 0.102
C	1.750 max	44.45 max	J	0.610 ± 0.004	15.494 ± 0.102
D	1.625 ± 0.015	41.28 ± 0.38	K	0.640 ± 0.004	16.256 ± 0.102
E	0.135 ± 0.010	3.43 ± 0.25	L	0.170	4.32
F	1.600 max	40.64 max	M	1.280 ± 0.004	32.512 ± 0.102

Millimetre dimensions have been derived from inches.

K3078

OSCILLATOR KLYSTRON

American Equivalent 6975

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage rugged reflex klystron suitable for use under severe environmental conditions.

Frequency range	8.5 to 9.6	GHz
Typical output power	35	mW
Electronic tuning range	37	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.45	A

Mechanical

Overall dimensions	see outline drawing
Net weight	3 ounces (85g) approx
Mounting position	any
Base	peewee wafer (A3-108)
Reflector connection	top cap B.S.448-CT1 (JEDEC C1-4)

Cooling (See note 1) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 2)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Reflector voltage (see note 3)	–20	–500	V
Body temperature (see note 4)	–	200	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
A) At 8.5GHz				
Resonator current	–	29	45	mA
Reflector voltage	–85	–95	–105	V
Output power	20	30	–	mW
Electronic tuning range to –3db points	30	35	–	MHz
B) At 9.0GHz				
Resonator current	–	29	–	mA
Reflector voltage	–	–120	–	V
Output power	–	45	–	mW
Electronic tuning range to –3db points	–	38	–	MHz

Continued on page 3

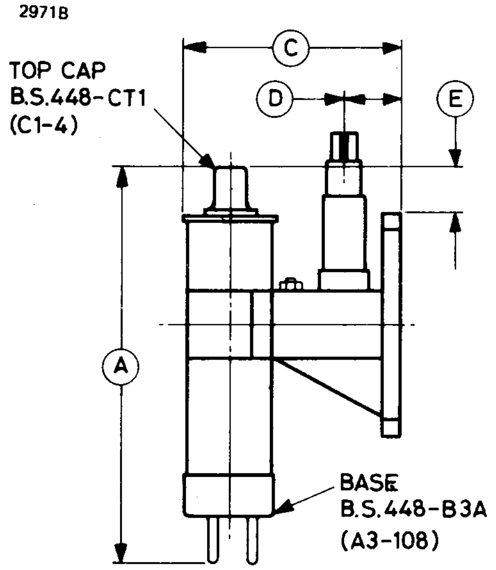
Range of Characteristics (continued)

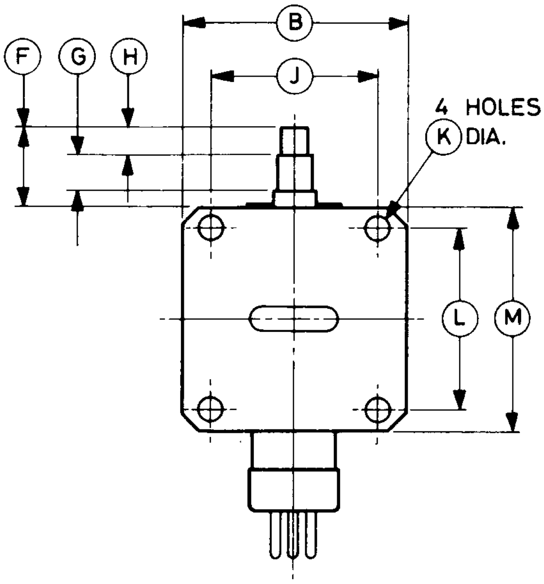
	Min	Typical	Max	
C) At 9.6GHz				
Heater current	0.40	0.45	0.50	A
Resonator current	–	29	45	mA
Reflector voltage	−140	−145	−150	V
Output power	20	40	–	mW
Electronic tuning range to −3db points	30	40	–	MHz
Modulation coefficient:				
reflector voltage	1.0	1.1	2.0	MHz/V
beam voltage	–	50	150	kHz/V
heater voltage	–	0	4.0	MHz/V
temperature	0	−70	−200	kHz/°C
Peak frequency modulation with 10g vibration (50 to 1000Hz) .	–	125	500	kHz
Shock (100g) (Δf peak to peak) .	–	1.0	2.0	MHz
Residual beam modulation (Δf peak to peak)	–	40	100	kHz

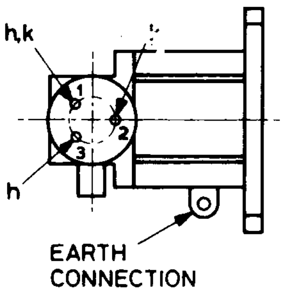
NOTES

1. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
2. All voltages except the heater voltage are with respect to cathode.
3. The reflector circuit impedance must not exceed 0.5MΩ.
4. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink. Under normal conditions the temperature should not exceed 150°C.

OUTLINE



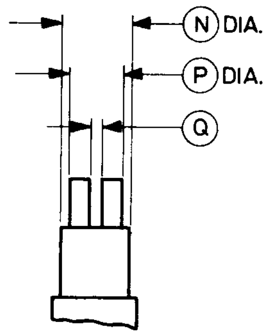




Pin	Element
1*	Heater
2*	Cathode
3	Heater
Cap	Reflector

* Internally connected

Tuner Detail



Ref	Inches	Millimetres
A	3.000 max	76.20 max
B	1.625 ± 0.010	41.28 ± 0.25
C	1.650 max	41.91 max
D	0.400 ± 0.025	10.16 ± 0.64
E	0.450 max	11.43 max
F	0.675 max	17.15 max
G	0.250 ± 0.025	6.35 ± 0.64
H	0.180 ± 0.020	4.57 ± 0.51
J	1.220 ± 0.004	30.988 ± 0.102

Ref	Inches	Millimetres
K	$0.218^{+0.005}_{-0.004}$	$5.537^{+0.127}_{-0.102}$
L	1.280 ± 0.004	32.512 ± 0.102
M	1.625 ± 0.010	41.28 ± 0.25
N	$0.247^{+0.003}_{-0.002}$	$6.274^{+0.076}_{-0.051}$
P	0.187 ± 0.010	4.75 ± 0.25
Q	0.040 ± 0.010	1.02 ± 0.25

Millimetre dimensions have been derived from inches.

K3079

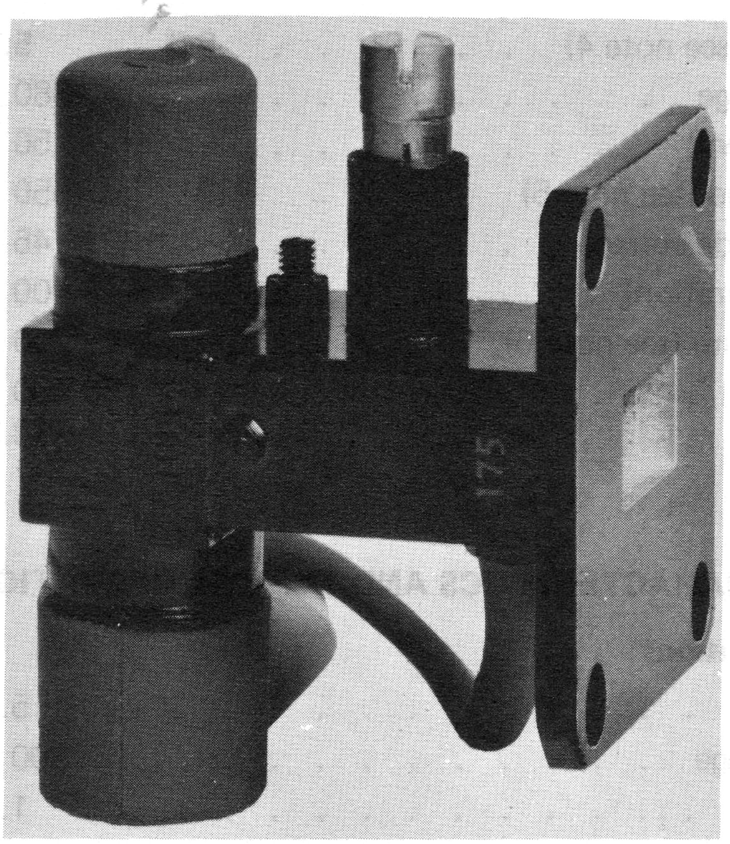
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage rugged reflex klystron with wide frequency range, excellent frequency stability and low noise characteristics, for use in paramp and airborne radar applications.

Frequency range	8050 to 8800	MHz
Typical output power	90	mW
Electronic tuning range	35	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



July 1973

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	5.2	V
Heater current	1.04	A

Mechanical

Overall dimensions (excluding leads)	2.810 x 1.940 x 1.640 inches max 71.37 x 49.28 x 41.66mm max
Net weight	6 ounces (170g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage (see note 4)	5.0	5.7	V
Resonator voltage	–	380	V
Resonator current	–	50	mA
Reflector voltage (see note 5)	–20	–550	V
Heater to cathode voltage	–	45	V
Shock (short duration)	–	100	g
Body temperature (see note 6)	–	200	°C
Altitude	–	60 000	ft
	–	18.3	km

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	5.2	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

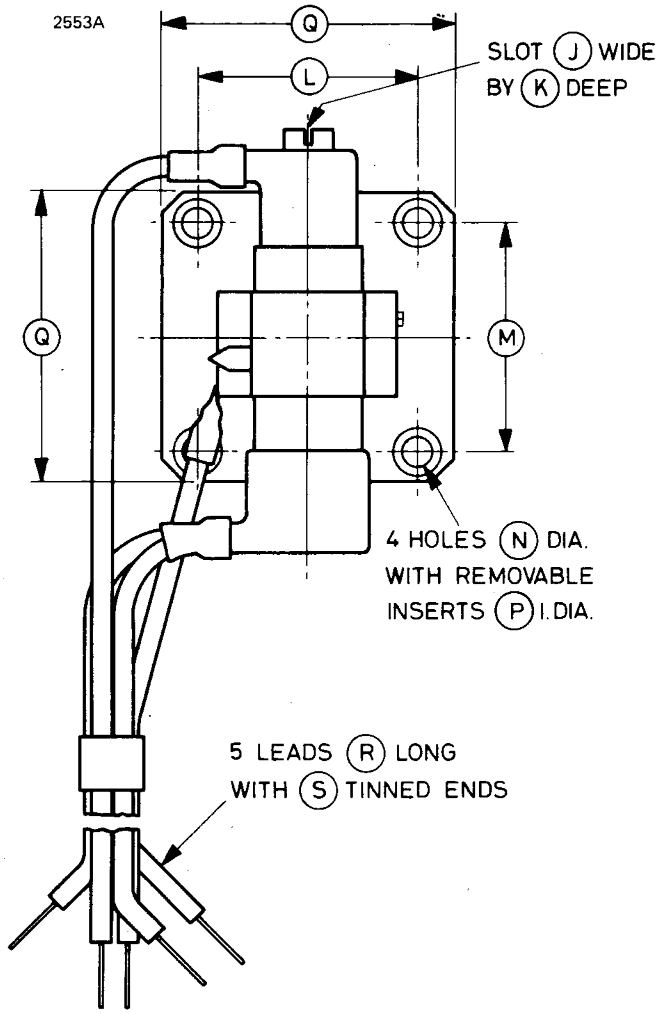
Range of Characteristics

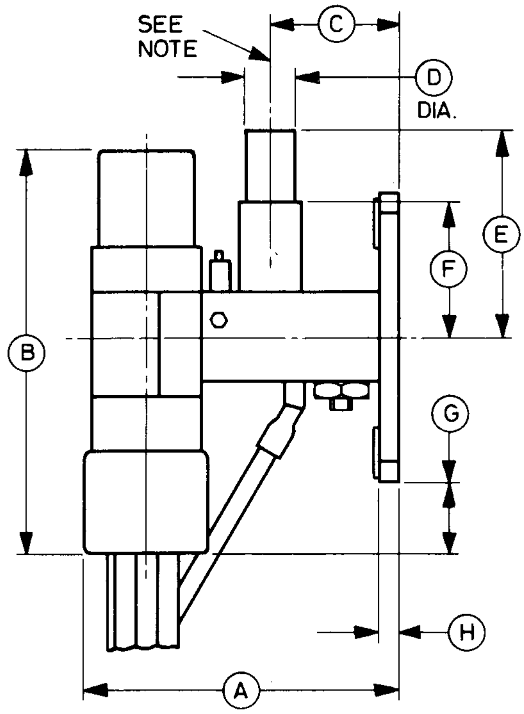
	Min	Typical	Max	
Heater current	0.9	1.04	1.2	A
Resonator current	–	32	50	mA
Reflector voltage . . .	–90	–150	–195	V
Output power	25	90	–	mW
Mechanical tuning range .	8050	–	8800	MHz
Resetting error	–	0.5	1.0	MHz
Electronic tuning range to –3db points	20	35	–	MHz
Temperature coefficient of frequency	–	50	100	kHz/°C
Peak frequency modulation with 10g vibration (20 to 1000Hz)	–	60	200	kHz
Frequency deviation:				
100g shock	–	0.2	1.0	MHz
tuner sidethrust	–	0.2	0.5	MHz
Noise (see note 7)	–	3.5×10^{-14}	8×10^{-14}	W/MHz/mW

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 20 to 50oz-in (0.14 to 0.35Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. For maximum life, the heater voltage should be in the range 5.0 to 5.4V.
5. The reflector circuit impedance must not exceed 0.5MΩ.
6. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink.
7. Noise is measured in a 1MHz channel, 40MHz away from the carrier frequency, by comparison with the output of a standard gas discharge tube. The noise power is expressed in watts per MHz of i.f. bandwidth per milliwatt of r.f. output power.

OUTLINE (All dimensions without limits are nominal)





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

Note Tuner misalignment will not exceed 2° over the tuner range.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.937 max	49.20 max	J	0.040	1.02
B	2.500 max	63.50 max	K	0.100	2.54
C	0.720 ± 0.010	18.29 ± 0.25	L	1.220 ± 0.004	30.988 ± 0.102
D	0.281 max 0.278 min	7.14 max 7.06 min	M	1.280 ± 0.004	32.512 ± 0.102
			N	0.219	5.56
E	1.500 max	38.10 max	P	0.185	4.70
F	0.812 max	20.62 max	Q	1.625	41.28
G	0.490 max	12.45 max	R	18.0	457
H	0.117 ± 0.012	2.97 ± 0.30	S	0.375	9.53

Millimetre dimensions have been derived from inches.

K3080

OSCILLATOR KLYSTRON

ABRIDGED DATA

Integral cavity, long life reflex klystron able to operate under severe environmental conditions.

Frequency range	16.5 to 17.5	GHz
Typical output power	65	mW
Output	no. 18 waveguide (0.622 x 0.311 inch internal)	
Coupler	UG-419/U	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.55	A

Mechanical

Overall dimensions (excluding flexible leads)	2.240 x 2.000 x 1.320 inches max 56.9 x 50.8 x 33.5mm max
Net weight	4 ounces (110g) approx
Mounting position	any
Connections	moulded base with flying leads

Cooling (See note 2) . . . . conduction/natural

March 1972

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

	Min	Max	
Heater voltage (see note 4)	5.7	7.0	V
Resonator voltage	–	350	V
Resonator current	–	35	mA
Reflector voltage (see note 5)	–20	–500	V
Ambient temperature (operating)	–55	+120	°C
Body temperature (see note 2)	–	+175	°C
Altitude (operating)	–	100 000	ft
	–	30.5	km

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	330	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

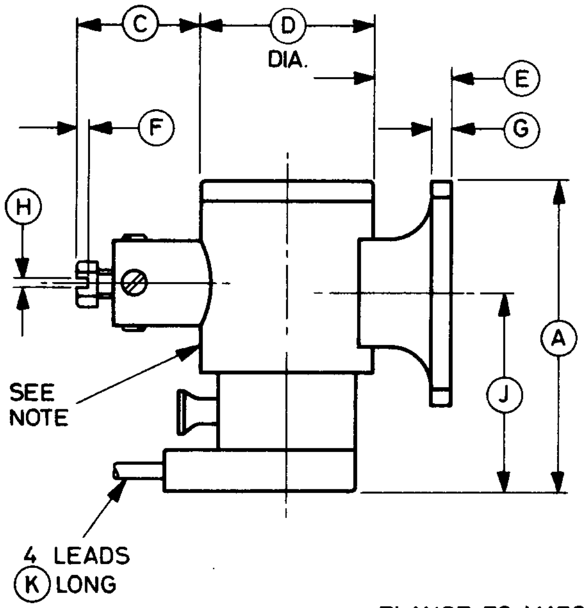
	Min	Typical	Max	
Heater current	0.5	0.55	0.6	A
Resonator current	14	20	32	mA
Reflector voltage:				
over tuning range	–95	–	–140	V
at 16.5GHz	–95	–	–105	V
Output power	30	65	–	mW
Mechanical tuning range	16.5	–	17.5	GHz
Electronic tuning range to 3db	50	70	–	MHz
Reflector modulation sensitivity	1.3	–	3.5	MHz/V

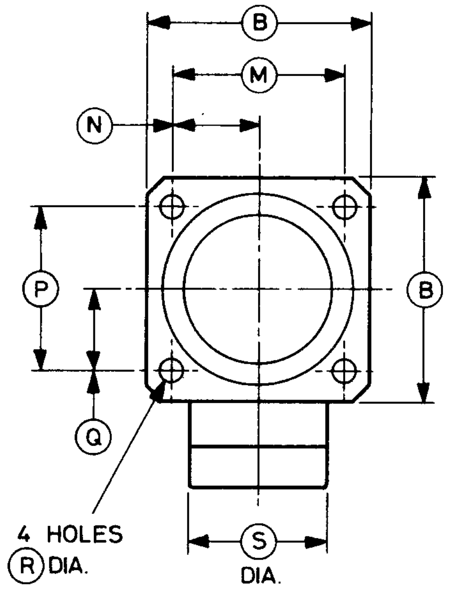
NOTES

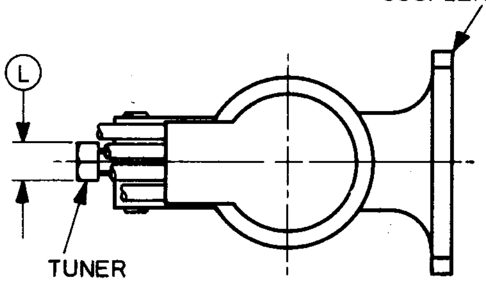
1. Clockwise rotation of the tuner increases the frequency.
2. At high ambient temperatures, or if the tube is thermally insulated from the waveguide, forced-air cooling may be necessary.
3. All voltages except the heater voltage are with respect to cathode.
4. If a d.c. heater supply is used, the positive terminal must be connected to the common heater-cathode connection (yellow lead).
5. The reflector must never become positive with respect to cathode.

OUTLINE (All dimensions without limits are nominal)

3793







Lead Connections

Colour	Element
Black	Resonator
Brown	Heater
Orange	Reflector
Yellow	Heater, cathode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.000 max	50.80 max	K	18.000	457.2
B	1.312	33.32	L	0.250	6.35
C	0.900 max	22.86 max	M	0.994 ± 0.005	25.25 ± 0.13
D	0.990 max	25.15 max	N	0.497 ± 0.005	12.62 ± 0.13
E	0.350 max	8.89 max	P	0.956 ± 0.005	24.28 ± 0.13
F	0.080 ± 0.010	2.03 ± 0.25	Q	0.478 ± 0.005	12.14 ± 0.13
G	0.130 ± 0.010	3.30 ± 0.25	R	0.144 ± 0.005	3.66 ± 0.13
H	0.050 ± 0.010	1.27 ± 0.25	S	0.800 max	20.32 max
J	1.200 max	30.48 max			

Millimetre dimensions have been derived from inches.

Note Body temperature measured at this point.

K3080A

OSCILLATOR KLYSTRON

ABRIDGED DATA

Integral cavity, long life reflex klystron able to operate under severe environmental conditions.

Frequency range	16.5 to 17.2	GHz
Typical output power	65	mW
Output	no. 18 waveguide (0.622 x 0.311 inch internal)	
Coupler	UG-419/U	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.55	A

Mechanical

Overall dimensions (excluding flexible leads)	2.240 x 2.000 x 1.320 inches max 56.9 x 50.8 x 33.5mm max
Net weight	4 ounces (110g) approx
Mounting position	any
Connections	moulded base with flying leads

Cooling (See note 2) . . . . conduction/natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

	Min	Max	
Heater voltage (see note 4)	5.7	7.0	V
Resonator voltage	–	350	V
Resonator current	–	30	mA
Reflector voltage (see note 5)	–20	–500	V
Ambient temperature (operating)	–55	+120	°C
Body temperature (see note 2)	–	+175	°C
Altitude (operating)	–	100 000	ft
	–	30.5	km

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

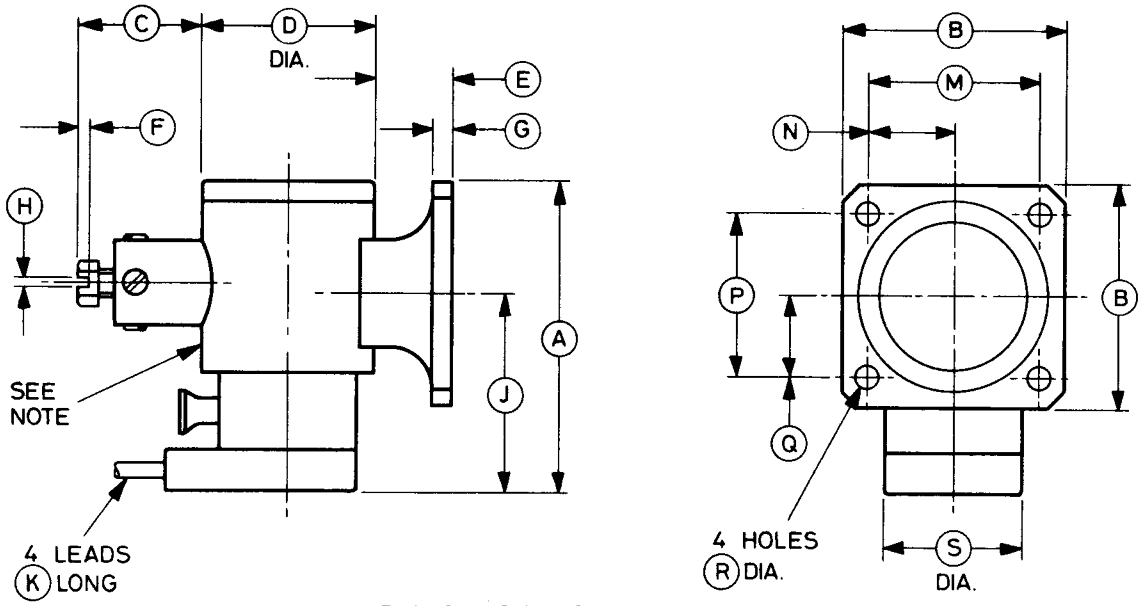
	Min	Typical	Max	
Heater current	0.5	0.55	0.6	A
Resonator current	14	20	30	mA
Reflector voltage:				
over tuning range	–95	–	–140	V
at 16.5GHz	–95	–	–105	V
Output power	50	65	–	mW
Mechanical tuning range	16.5	–	17.2	GHz
Electronic tuning range to 3db	50	70	–	MHz
Reflector modulation sensitivity	1.3	–	3.5	MHz/V

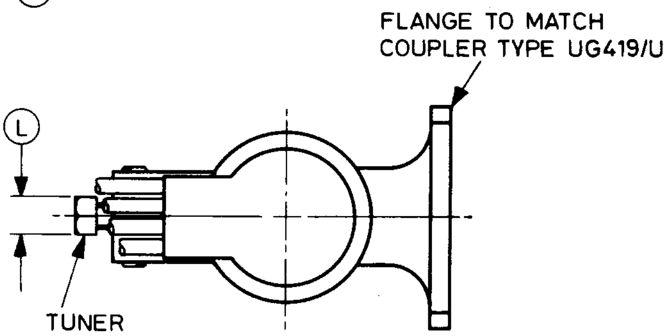
NOTES

1. Clockwise rotation of the tuner increases the frequency.
2. At high ambient temperatures, or if the tube is thermally insulated from the waveguide, forced-air cooling may be necessary.
3. All voltages except the heater voltage are with respect to cathode.
4. If a d.c. heater supply is used, the positive terminal must be connected to the common heater-cathode connection (yellow lead).
5. The reflector must never become positive with respect to cathode.

OUTLINE (All dimensions without limits are nominal)

3793





Lead Connections

Colour	Element
Black	Resonator
Brown	Heater
Orange	Reflector
Yellow	Heater, cathode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.000 max	50.80 max	K	18.000	457.2
B	1.312	33.32	L	0.250	6.35
C	0.900 max	22.86 max	M	0.994 ± 0.005	25.25 ± 0.13
D	0.990 max	25.15 max	N	0.497 ± 0.005	12.62 ± 0.13
E	0.350 max	8.89 max	P	0.956 ± 0.005	24.28 ± 0.13
F	0.080 ± 0.010	2.03 ± 0.25	Q	0.478 ± 0.005	12.14 ± 0.13
G	0.130 ± 0.010	3.30 ± 0.25	R	0.144 ± 0.005	3.66 ± 0.13
H	0.050 ± 0.010	1.27 ± 0.25	S	0.800 max	20.32 max
J	1.200 max	30.48 max			

Millimetre dimensions have been derived from inches.

Note Body temperature measured at this point.

K3081

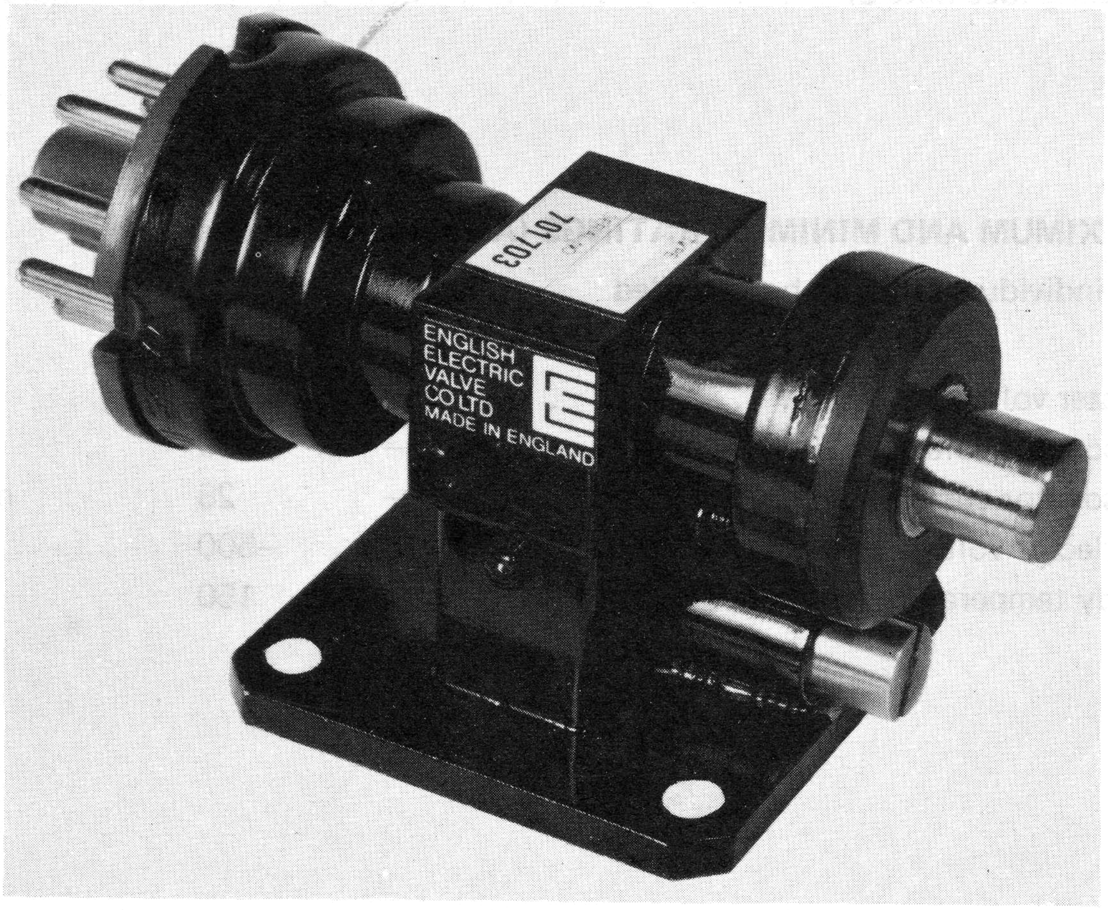
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Long life, rugged reflex klystron for marine applications.

Frequency range	9350 to 9550	MHz
Typical output power	55	mW
Electronic tuning range	40	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.57	A

Mechanical

Overall dimensions	3.380 x 1.750 x 1.640 inches max 85.85 x 44.45 x 41.66mm max
Net weight	5½ ounces (160g) approx
Mounting position	any
Base	international octal
Reflector connection	top cap B.S.448-CT2

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Resonator current	–	28	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 2)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

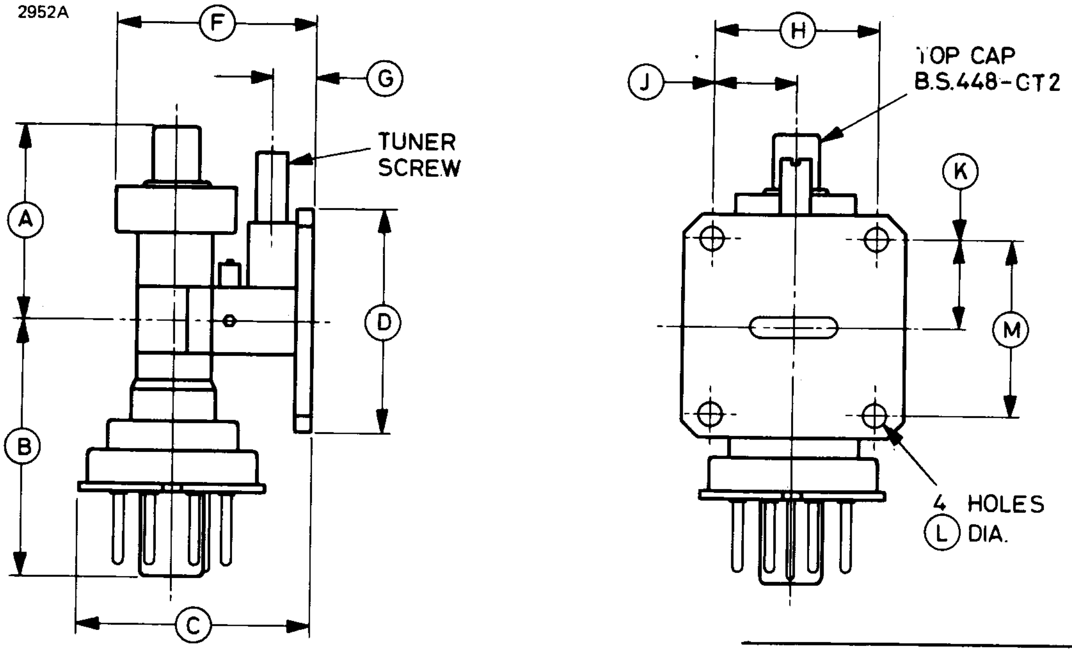
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.57	0.61	A
Resonator current	15	22	25	mA
Reflector voltage	–65	–90	–115	V
Output power	30	55	–	mW
Mechanical tuning range	9350	–	9550	MHz
Electronic tuning range to –3db points	30	40	–	MHz
Temperature coefficient of frequency	–50	–150	–200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz)	–	50	100	kHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 15 to 35oz-in (0.1 to 0.25Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system. Maximum life is attained by operating at temperatures below the specified limit.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ.

OUTLINE



Pin	Element
1	Resonator
2	Heater
3	No connection
4	No connection
5	No connection
6	No connection
7	Heater
8	Cathode
Top cap	Reflector

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.450 max	36.83 max	G	0.312 ± 0.010	7.92 ± 0.25
B	1.930 max	49.02 max	H	1.220 ± 0.004	30.988 ± 0.102
C	1.750 max	44.45 max	J	0.610 ± 0.004	15.494 ± 0.102
D	1.625 ± 0.015	41.28 ± 0.38	K	0.640 ± 0.004	16.256 ± 0.102
E	0.135 ± 0.010	3.43 ± 0.25	L	0.170	4.32
F	1.600 max	40.64 max	M	1.280 ± 0.004	32.512 ± 0.102

Millimetre dimensions have been derived from inches.

K3090

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Forced-air cooled, fixed frequency, two cavity oscillator klystron designed for airborne doppler and beacon radar applications. The sturdy construction gives good frequency stability, low noise and low microphonics. The connections are silicone rubber moulded for unpressurized high altitude operation.

Frequency	8800 ± 5	MHz
Typical output power	1.5	W
Electronic tuning range	15	MHz
Output	no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	

Variants of this type can be supplied for operation at any frequency in the range 8000 to 9500MHz, and up to 5W c.w. output.

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.8	A

Mechanical

Overall dimensions (excluding leads)	2.750 x 1.875 x 1.350 inches max 69.85 x 47.63 x 34.29mm max
Net weight	8 ounces (230g) approx
Mounting position	any
Connections	flexible leads

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 1)

No individual rating is to be exceeded

	Min	Max	
Heater voltage (see note 2)	5.7	6.9	V
Beam voltage (see note 3)	–	900	V
Beam current	–	75	mA
Radiator temperature	–	200	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Load v.s.w.r.	1.1:1	

Range of Characteristics

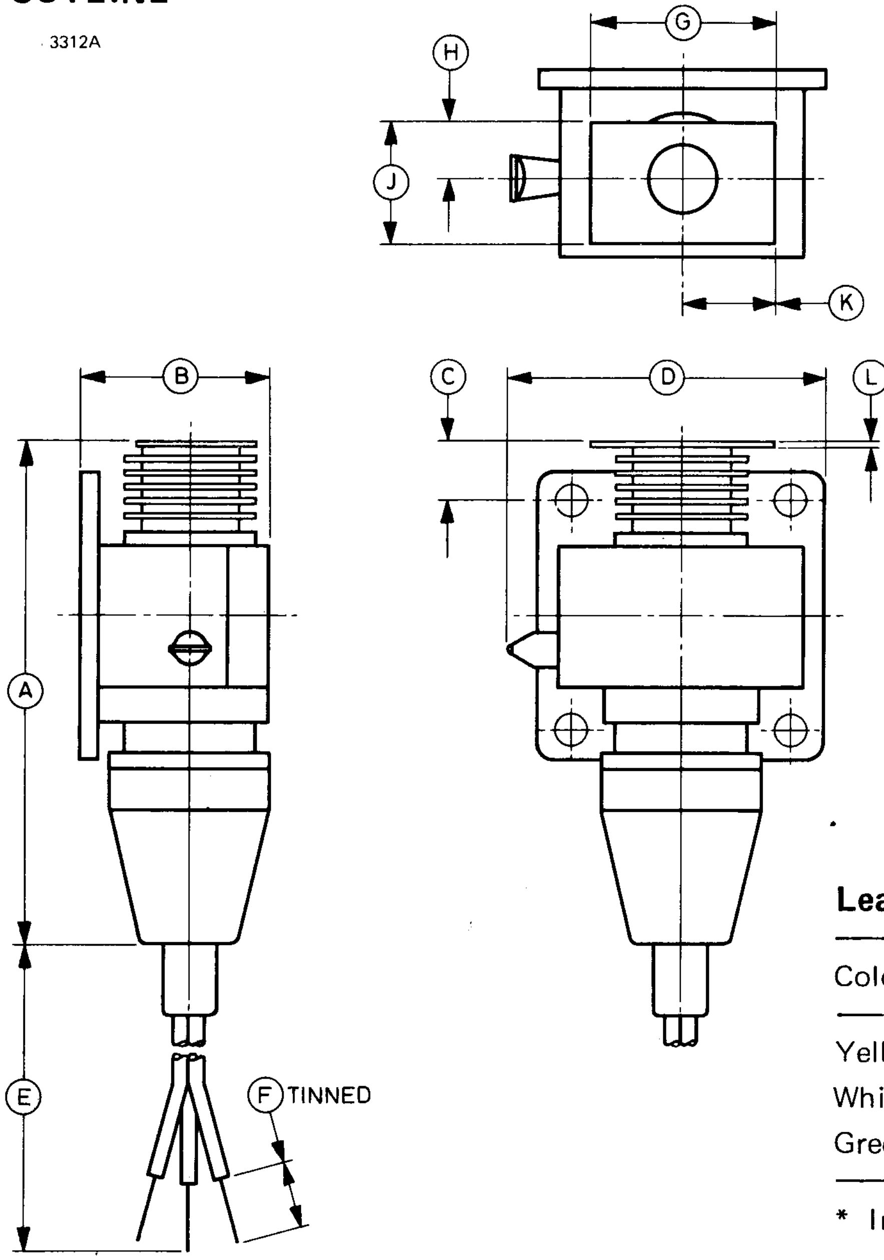
	Min	Typical	Max	
Heater current	0.7	0.8	1.1	A
Frequency	8795	8800	8805	MHz
Beam voltage	710	730	750	V
Beam current	40	50	70	mA
Output power	1.25	1.5	3.0	W
Electronic tuning range to –3db points	10	15	–	MHz
Modulation voltage (see note 4)	1.7	2.5	3.4	$V_{r.m.s.}$
Beam voltage modulation sensitivity	100	130	200	kHz/V
Temperature coefficient of frequency	–	+40	±150	kHz/°C
Heater voltage coefficient of frequency	–	0.5	2.0	kHz/V
Random frequency deviation (peak to peak) (see note 5)	–	0.5	3.0	kHz
Radiator temperature (see note 6)	–	70	150	°C

NOTES

1. All voltages except the heater voltage are with respect to cathode.
2. When a d.c. heater supply is used the positive terminal of the heater supply must be connected to the common heater-cathode connection (white lead).
3. The beam and heater voltages may be applied simultaneously; the klystron is normally operated with the resonator body at earth potential.
4. The r.m.s. beam voltage modulation required to produce 0.96MHz peak to peak modulation on the output carrier.
5. This represents the random deviations of the output frequency from the carrier, produced by random modulating frequencies in the range 150 to 11 000Hz.
6. For maximum life the radiator temperature should be kept below 100°C. A suitable blower is Vactric type VBM1½, delivering 30ft^3/min approx. If the air cooling fails, the klystron must be switched off.

OUTLINE

3312A



Lead Connections

Colour	Element
Yellow	Heater
White*	Heater
Green*	Cathode

* Internally connected.

Ref	Inches	Millimetres
A	2.750 max	69.85 max
B	1.350 max	34.29 max
C	0.400 max	10.16 max
D	1.875 max	47.63 max
E	18.000 ± 1.000	457.2 ± 25.4
F	0.375 ± 0.125	9.53 ± 3.18

Ref	Inches	Millimetres
G	1.031 ± 0.010	26.19 ± 0.25
H	0.312 ± 0.005	7.92 ± 0.13
J	0.687 ± 0.010	17.45 ± 0.25
K	0.515 ± 0.005	13.08 ± 0.13
L	0.030	0.76

Millimetre dimensions have been derived from inches.

K3091

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Long life, rugged reflex klystron for marine applications.

Frequency range	9350 to 9550	MHz
Typical output power	50	mW
Electronic tuning range	40	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.57	A

Mechanical

Overall dimensions	2.420 x 1.640 x 1.400 inches max 61.47 x 41.66 x 35.56mm max
Net weight	5½ ounces (160g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Resonator current	–	28	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 2)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

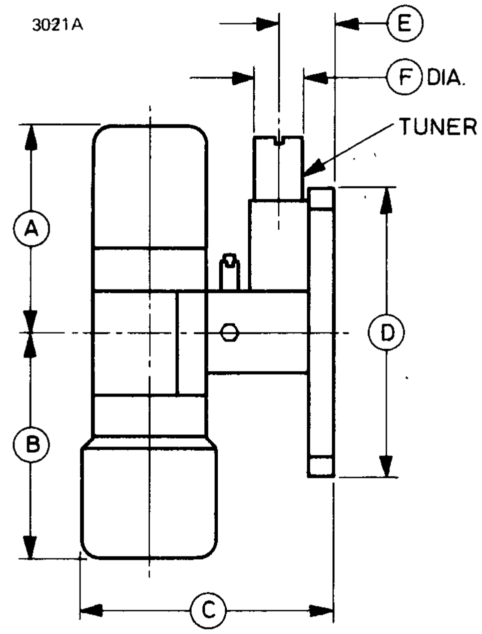
	Min	Typical	Max	
Heater current	0.52	0.57	0.61	A
Resonator current	15	20	25	mA
Reflector voltage	–60	–85	–120	V
Output power	30	50	70	mW
Mechanical tuning range	9350	–	9550	MHz
Tuning rate	150	160	170	MHz/turn
Electronic tuning range to –3db points	30	40	–	MHz
Temperature coefficient of frequency	–50	–150	–200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz)	–	50	100	kHz

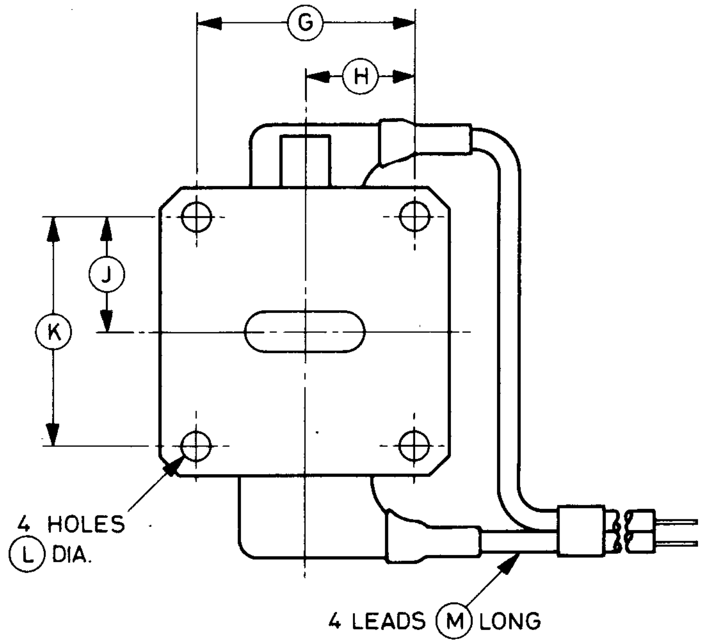
NOTES

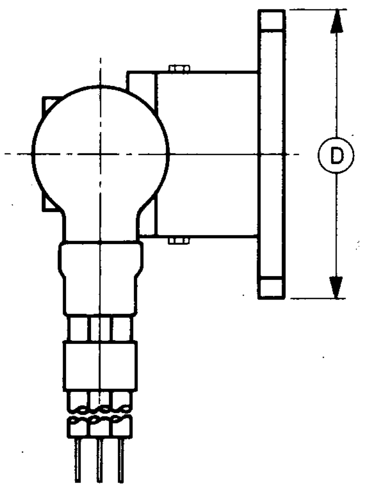
1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 15 to 35oz-in (0.1 to 0.25Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system. Maximum life is attained by operating at temperatures below the specified limit.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ.

OUTLINE

3021A







Lead Connections

Colour	Element
White	Heater, cathode
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref	Inches	Millimetres
A	1.160 max	29.46 max
B	1.260 max	32.00 max
C	1.400 max	35.56 max
D	1.625 ± 0.015	41.28 ± 0.38
E	0.312 ± 0.010	7.93 ± 0.25
F	0.281 $^{+0.000}_{-0.003}$	7.137 $^{+0.000}_{-0.076}$

Ref	Inches	Millimetres
G	1.220 ± 0.004	30.988 ± 0.102
H	0.610 ± 0.004	15.494 ± 0.102
J	0.640 ± 0.004	16.256 ± 0.102
K	1.280 ± 0.004	32.512 ± 0.102
L	0.150 $^{+0.000}_{-0.003}$	3.810 $^{+0.000}_{-0.076}$
M	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K3094

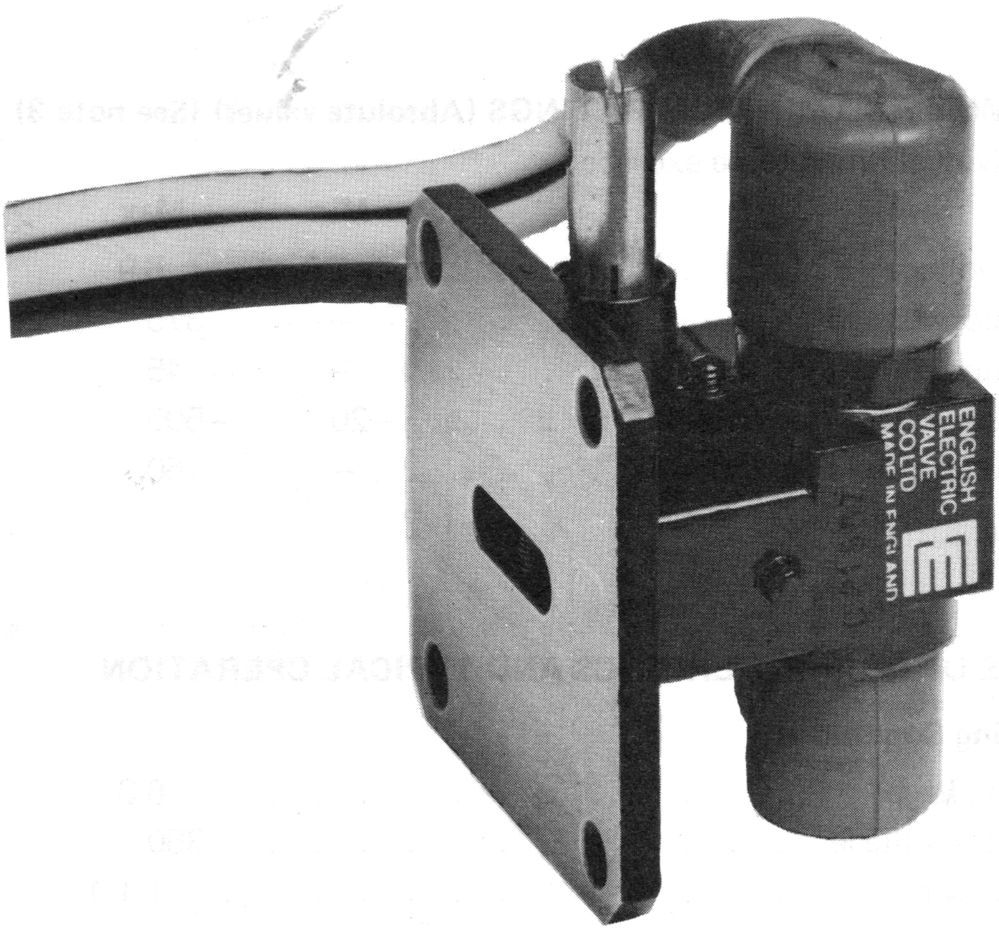
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Long life, rugged reflex klystron suitable for airborne applications.

Frequency range	9295 to 9395	MHz
Typical output power	40	mW
Electronic tuning range	35	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.58	A

Mechanical

Overall dimensions (excluding leads)	2.404 x 1.400 x 1.640 inches max 61.06 x 35.56 x 41.66mm max
Net weight	5½ ounces (160g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	375	V
Resonator current	–	45	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

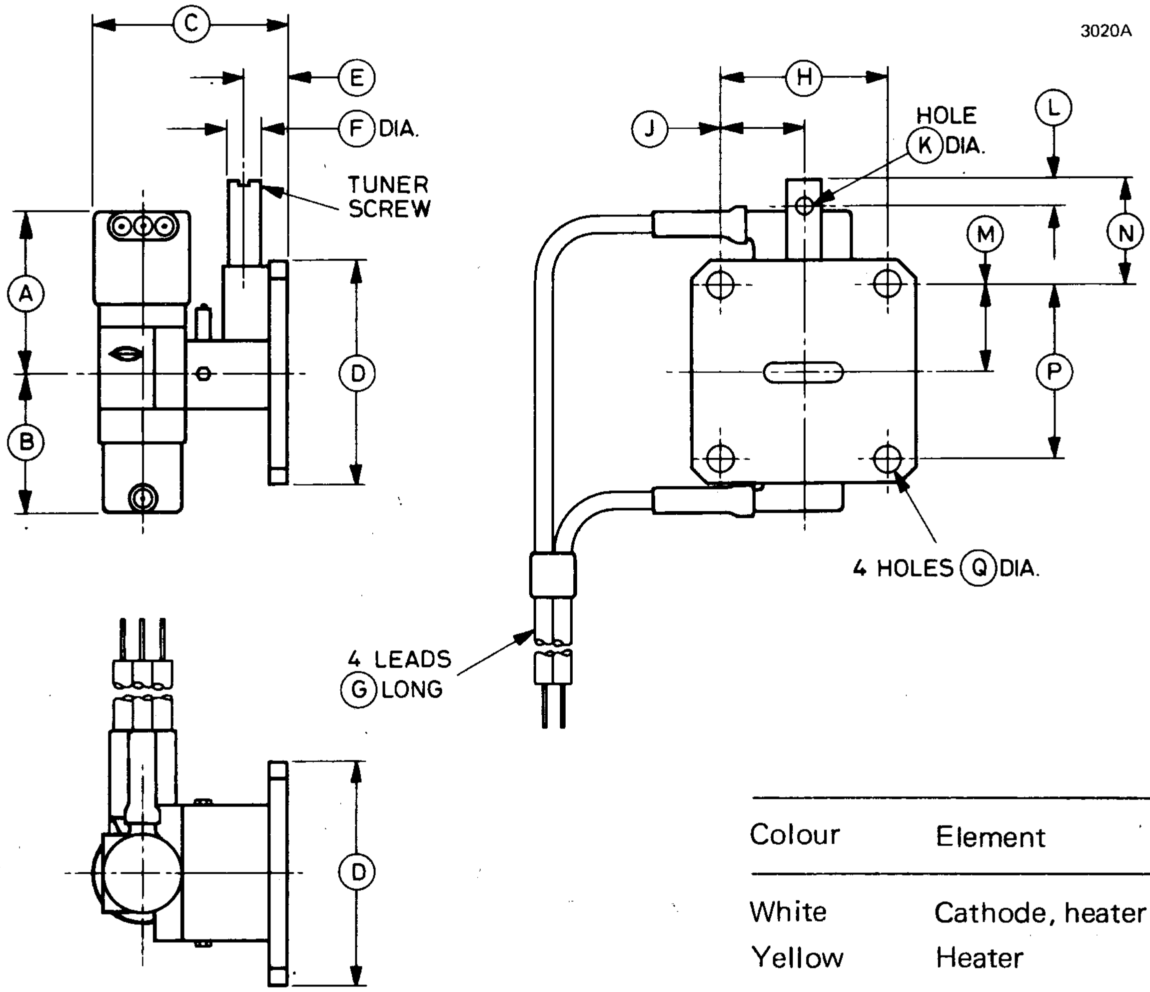
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	25	35	40	mA
Reflector voltage (see note 6) .	−170	−190	−220	V
Output power	25	40	50	mW
Mechanical tuning range . . .	9295	–	9395	MHz
Tuning rate	150	180	250	MHz/turn
Electronic tuning range to −3db points	25	35	–	MHz
Reflector modulation sensitivity .	0.5	1.2	2.0	MHz/V
Temperature coefficient of frequency	−50	−150	−200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz) .	–	50	100	kHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 15 to 35oz-in (0.1 to 0.25Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ.
5. For best life, the operating temperature of the klystron body should be kept as low as possible. Under normal operating conditions the temperature should not exceed 150°C.
6. No mode or part of a mode other than the required mode will exist in the reflector voltage range −150 to −250V as the klystron is tuned over the mechanical tuning range.

OUTLINE (All dimensions without limits are nominal)



Colour	Element
White	Cathode, heater
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.300 max	33.02 max	J	0.610 ± 0.004	15.494 ± 0.102
B	1.000 max	25.40 max	K	0.110	2.79
C	1.400 max	35.56 max	L	0.200	5.08
D	1.625 ± 0.015	41.28 ± 0.38	M	0.640 ± 0.004	16.256 ± 0.102
E	0.312 ± 0.010	7.92 ± 0.25	N	0.760 max	19.30 max
F	0.250	6.35	P	1.280 ± 0.004	32.512 ± 0.102
G	12.000 min	304.8 min	Q	0.170	4.32
H	1.220 ± 0.004	30.988 ± 0.102			

Millimetre dimensions have been derived from inches.

K3095

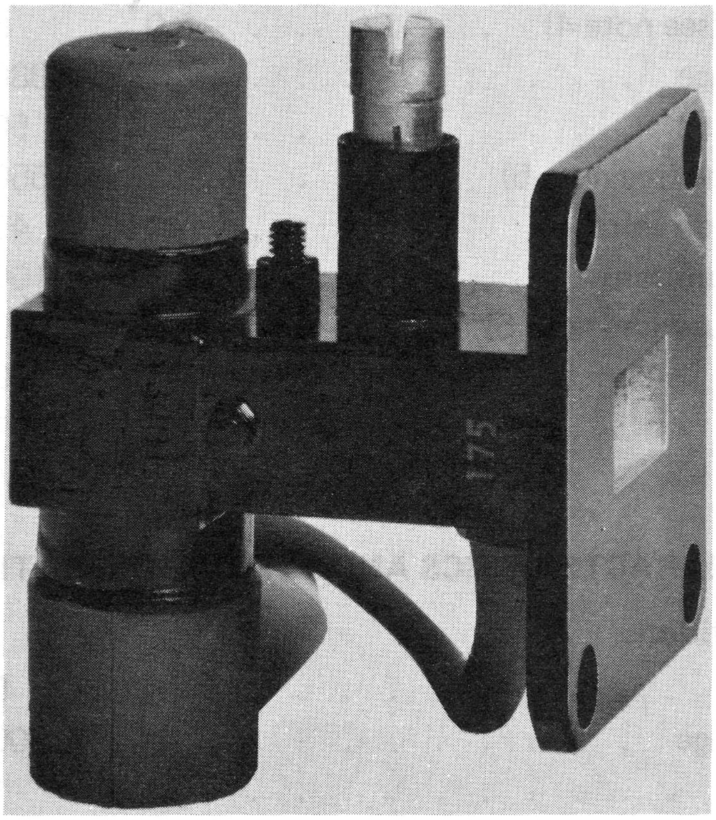
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage rugged reflex klystron with wide frequency range, excellent frequency stability and low noise characteristics, for use in paramp and airborne radar applications.

Frequency range	8600 to 9200	MHz
Typical output power	90	mW
Electronic tuning range	35	MHz
Output		to no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-39/U (154 I.E.C.-UBR100)
Mechanical tuning (see note 1)		single screw



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	5.2	V
Heater current	1.04	A

Mechanical

Overall dimensions (excluding leads)	2.810 x 1.940 x 1.640 inches max 71.37 x 49.28 x 41.66mm max
Net weight	6 ounces (170g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage (see note 4)	5.0	5.7	V
Resonator voltage	–	380	V
Resonator current	–	50	mA
Reflector voltage (see note 5)	–20	–550	V
Heater to cathode voltage	–	45	V
Shock (short duration)	–	100	g
Body temperature (see note 6)	–	200	°C
Altitude	–	60 000	ft
	–	18.3	km

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	5.2	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

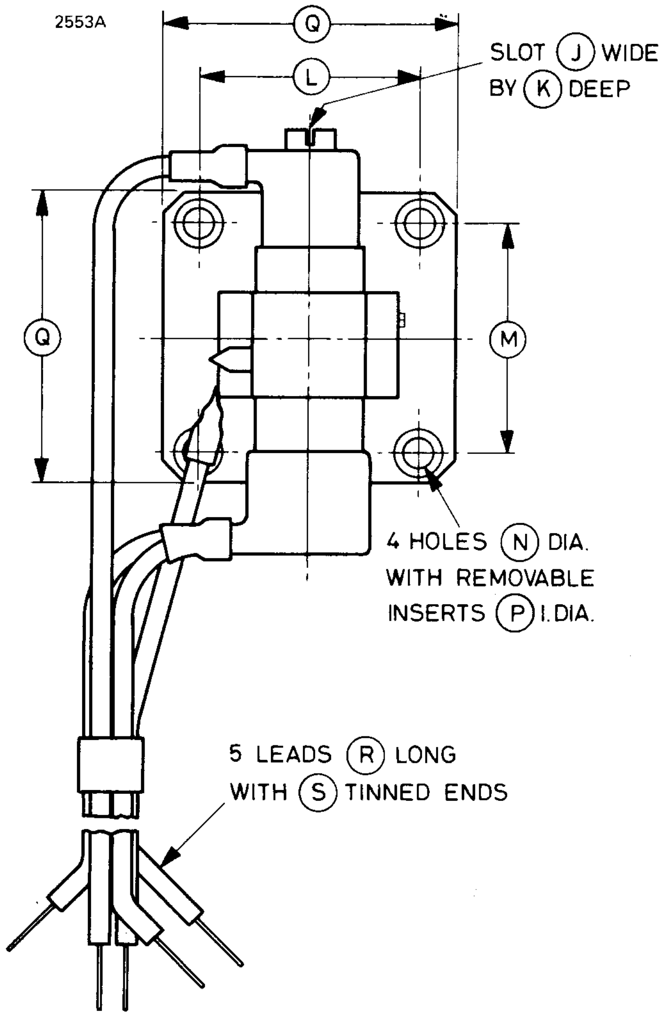
Range of Characteristics

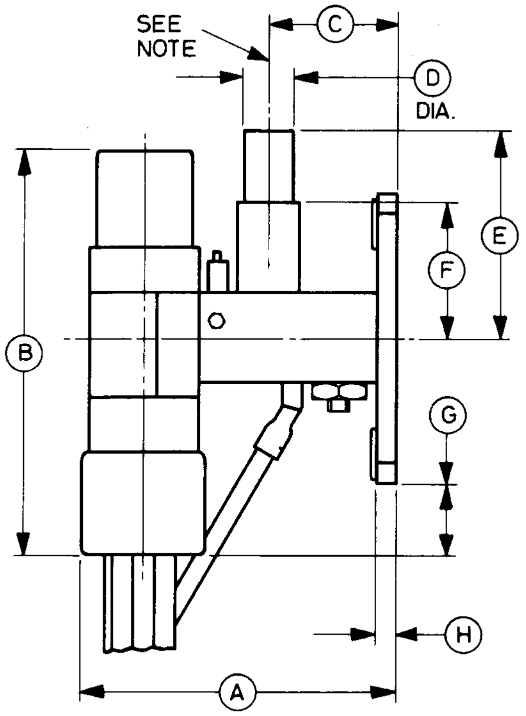
	Min	Typical	Max	
Heater current	0.9	1.04	1.2	A
Resonator current	–	32	50	mA
Reflector voltage . . .	–80	–150	–190	V
Output power	30	90	–	mW
Mechanical tuning range .	8600	–	9200	MHz
Resetting error	–	0.5	1.0	MHz
Electronic tuning range to –3db points	20	35	–	MHz
Temperature coefficient of frequency	–	50	100	kHz/°C
Peak frequency modulation with 10g vibration (20 to 1000Hz)	–	60	200	kHz
Frequency deviation:				
100g shock	–	0.2	1.0	MHz
tuner sidethrust	–	0.2	0.5	MHz
Noise (see note 7)	–	3.5×10^{-14}	8×10^{-14}	W/MHz/mW

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 20 to 50oz-in (0.14 to 0.35Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. For maximum life, the heater voltage should be in the range 5.0 to 5.4V.
5. The reflector circuit impedance must not exceed 0.5MΩ.
6. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink.
7. Noise is measured in a 1MHz channel, 40MHz away from the carrier frequency, by comparison with the output of a standard gas discharge tube. The noise power is expressed in watts per MHz of i.f. bandwidth per milliwatt of r.f. output power.

OUTLINE (All dimensions without limits are nominal)





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

Note Tuner misalignment will not exceed 2° over the tuner range.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.937 max	49.20 max	J	0.040	1.02
B	2.500 max	63.50 max	K	0.100	2.54
C	0.720 ± 0.010	18.29 ± 0.25	L	1.220 ± 0.004	30.988 ± 0.102
D	0.281 max 0.278 min	7.14 max 7.06 min	M	1.280 ± 0.004	32.512 ± 0.102
			N	0.219	5.56
E	1.500 max	38.10 max	P	0.185	4.70
F	0.812 max	20.62 max	Q	1.625	41.28
G	0.490 max	12.45 max	R	18.0	457
H	0.117 ± 0.012	2.97 ± 0.30	S	0.375	9.53

Millimetre dimensions have been derived from inches.

K3096

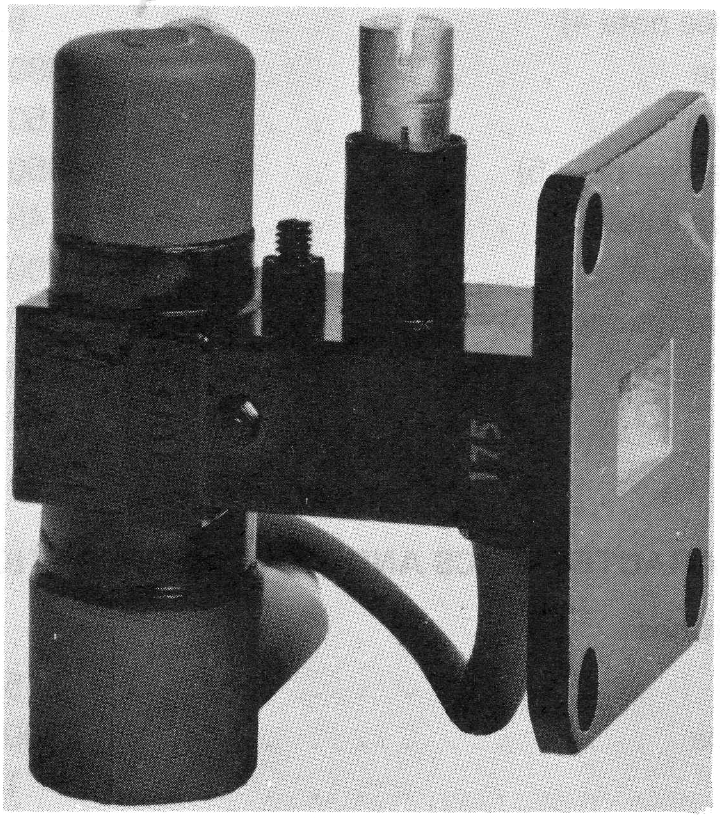
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Low voltage rugged reflex klystron with wide frequency range, excellent frequency stability and low noise characteristics, for use in paramp and airborne radar applications.

Frequency range	9000 to 9600	MHz
Typical output power	90	mW
Electronic tuning range	35	MHz
Output		to no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-39/U (154 I.E.C.-UBR100)
Mechanical tuning (see note 1)		single screw



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	5.2	V
Heater current	1.04	A

Mechanical

Overall dimensions (excluding leads)	2.810 x 1.940 x 1.640 inches max 71.37 x 49.28 x 41.66mm max
Net weight	6 ounces (170g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage (see note 4)	5.0	5.7	V
Resonator voltage	–	380	V
Resonator current	–	50	mA
Reflector voltage (see note 5)	–20	–550	V
Heater to cathode voltage	–	45	V
Shock (short duration)	–	100	g
Body temperature (see note 6)	–	200	°C
Altitude	–	60 000	ft
	–	18.3	km

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	5.2	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

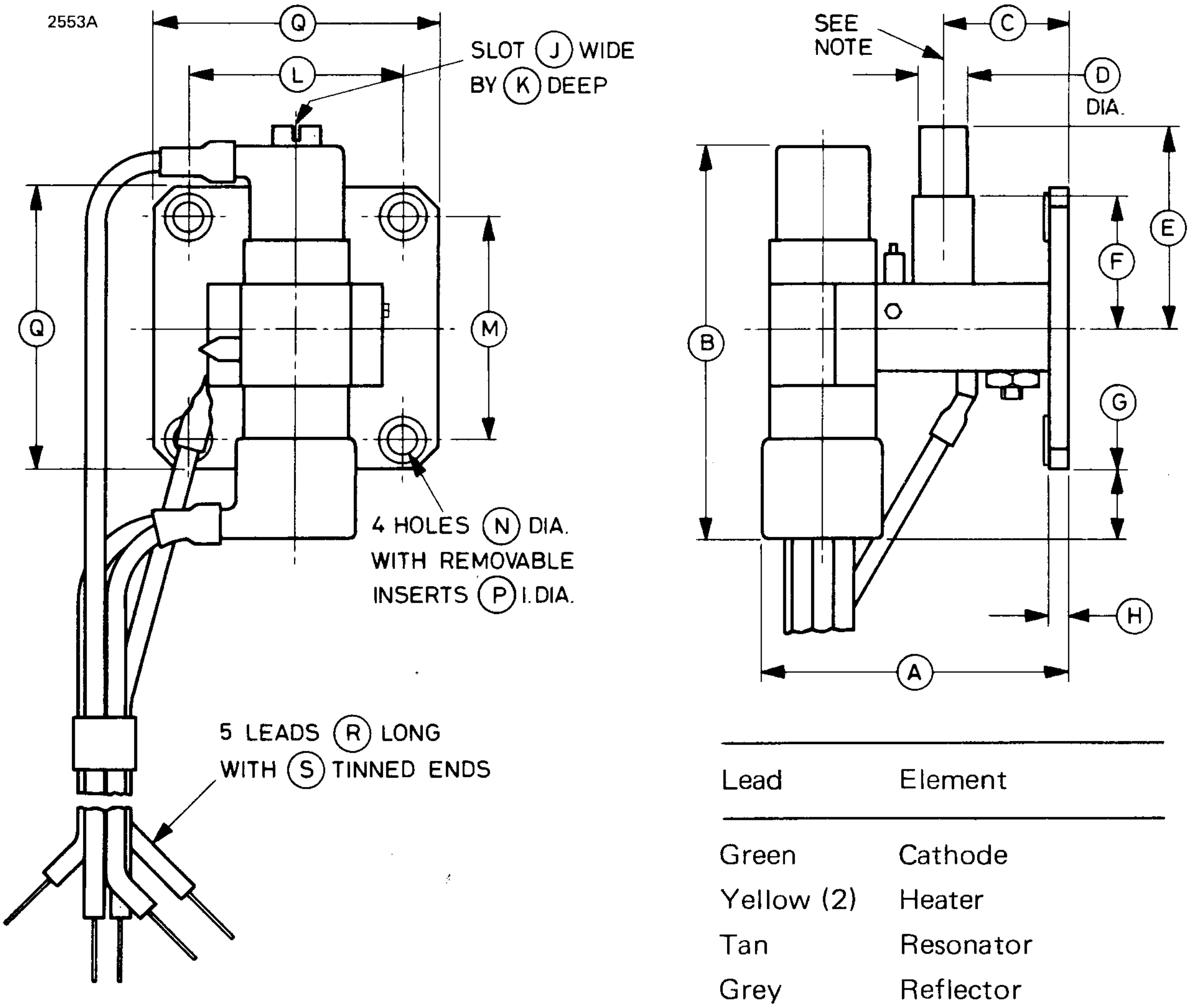
Range of Characteristics

	Min	Typical	Max	
Heater current	0.9	1.04	1.2	A
Resonator current	–	32	50	mA
Reflector voltage	–80	–150	–190	V
Output power	30	90	–	mW
Mechanical tuning range	9000	–	9600	MHz
Resetting error	–	0.5	1.0	MHz
Electronic tuning range to –3db points	20	35	–	MHz
Temperature coefficient of frequency	–	50	100	kHz/°C
Peak frequency modulation with 10g vibration (20 to 1000Hz)	–	60	200	kHz
Frequency deviation:				
100g shock	–	0.2	1.0	MHz
tuner sidethrust	–	0.2	0.5	MHz
Noise (see note 7)	–	3.5×10^{-14}	8×10^{-14}	W/MHz/mW

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 20 to 50oz-in (0.14 to 0.35Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. For maximum life, the heater voltage should be in the range 5.0 to 5.4V.
5. The reflector circuit impedance must not exceed 0.5MΩ.
6. For best life, the operating temperature of the klystron body should be kept as low as possible by providing an adequate heat sink.
7. Noise is measured in a 1MHz channel, 40MHz away from the carrier frequency, by comparison with the output of a standard gas discharge tube. The noise power is expressed in watts per MHz of i.f. bandwidth per milliwatt of r.f. output power.

OUTLINE (All dimensions without limits are nominal)



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

Note Tuner misalignment will not exceed 2° over the tuner range.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.937 max	49.20 max	J	0.040	1.02
B	2.500 max	63.50 max	K	0.100	2.54
C	0.720 ± 0.010	18.29 ± 0.25	L	1.220 ± 0.004	30.988 ± 0.102
D	0.281 max	7.14 max	M	1.280 ± 0.004	32.512 ± 0.102
	0.278 min	7.06 min	N	0.219	5.56
E	1.500 max	38.10 max	P	0.185	4.70
F	0.812 max	20.62 max	Q	1.625	41.28
G	0.490 max	12.45 max	R	18.0	457
H	0.117 ± 0.012	2.97 ± 0.30	S	0.375	9.53

Millimetre dimensions have been derived from inches.

K3097

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Long life, rugged reflex klystron for marine applications.

Frequency range	8740 to 9260	MHz
Typical output power	50	mW
Electronic tuning range	40	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.57	A

Mechanical

Overall dimensions (excluding leads)	2.420 x 1.400 x 1.640 inches max 61.47 x 35.56 x 41.66mm max
Net weight	5½ ounces (160g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Resonator current	–	28	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

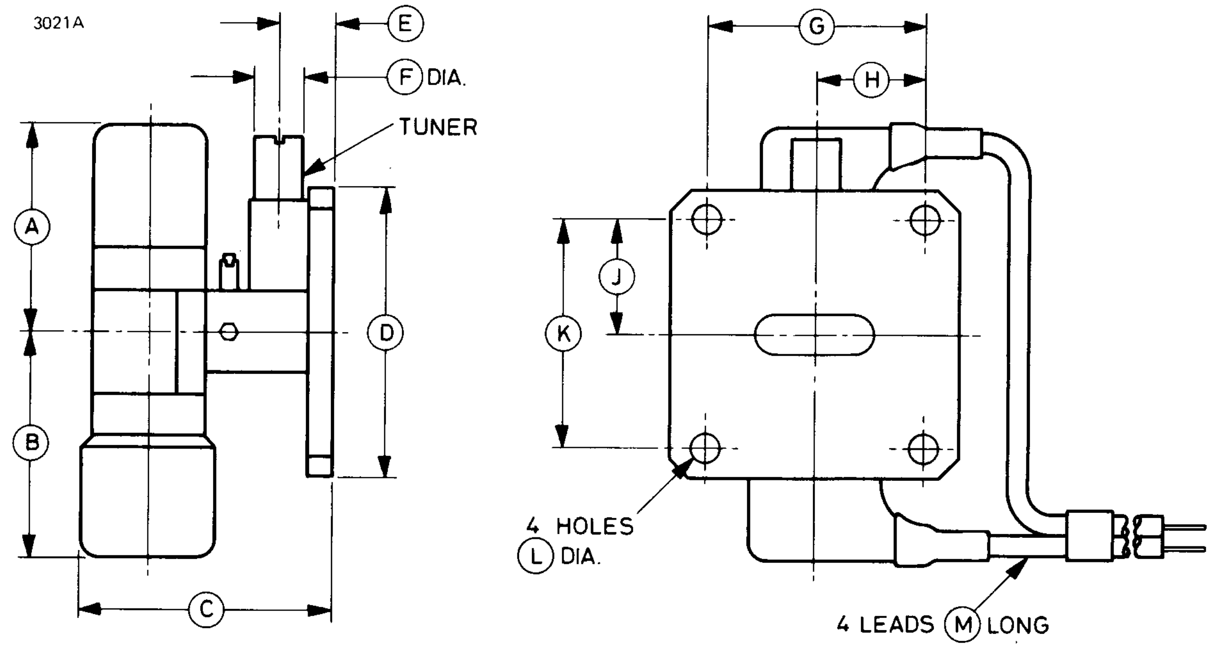
Range of Characteristics

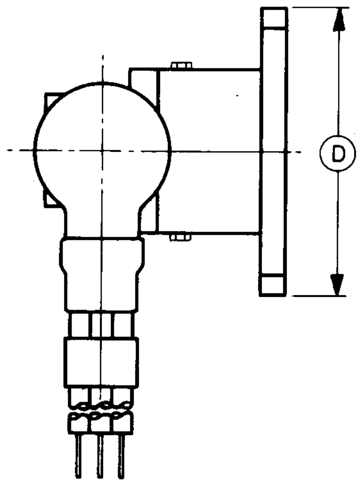
	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	15	20	25	mA
Reflector voltage	–60	–85	–120	V
Output power	30	50	70	mW
Mechanical tuning range	8740	–	9260	MHz
Tuning rate	150	160	170	MHz/turn
Electronic tuning range to –3db points	30	40	–	MHz
Temperature coefficient of frequency	–50	–150	–200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz)	–	50	100	kHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency. The tuner torque is 15 to 35oz-in (0.11 to 0.25Nm).
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible.

OUTLINE





Lead Connections

Colour	Element
White	Heater, cathode
Yellow	Heater
Grey	Reflector
Tan	Resonator

Ref	Inches	Millimetres
A	1.160 max	29.46 max
B	1.260 max	32.00 max
C	1.400 max	35.56 max
D	1.625 ± 0.015	41.28 ± 0.38
E	0.312 ± 0.010	7.93 ± 0.25
F	$0.281\ ^{+0.000}_{-0.003}$	$7.137\ ^{+0.000}_{-0.076}$
G	1.220 ± 0.004	30.988 ± 0.102
H	0.610 ± 0.004	15.494 ± 0.102
J	0.640 ± 0.004	16.256 ± 0.102
K	1.280 ± 0.004	32.512 ± 0.102
L	$0.150\ ^{+0.000}_{-0.003}$	$3.810\ ^{+0.000}_{-0.076}$
M	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K3098

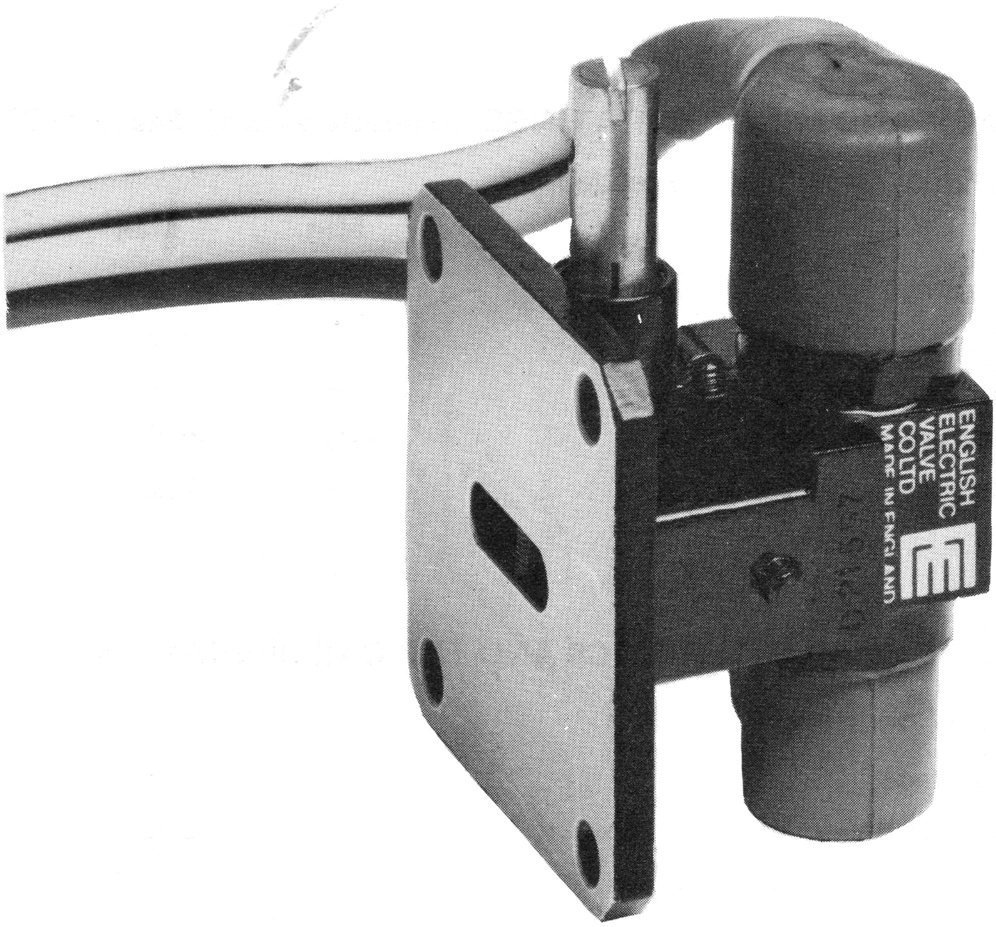
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Long life, rugged reflex klystron suitable for airborne applications.

Frequency range	8800 to 8885	MHz
Typical output power	60	mW
Electronic tuning range	40	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



August 1973

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.58	A

Mechanical

Overall dimensions (excluding leads)	2.400 x 1.640 x 1.400 inches max 60.96 x 41.66 x 35.56mm max
Net weight	5½ ounces (160g) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	375	V
Resonator current	–	45	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 2)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

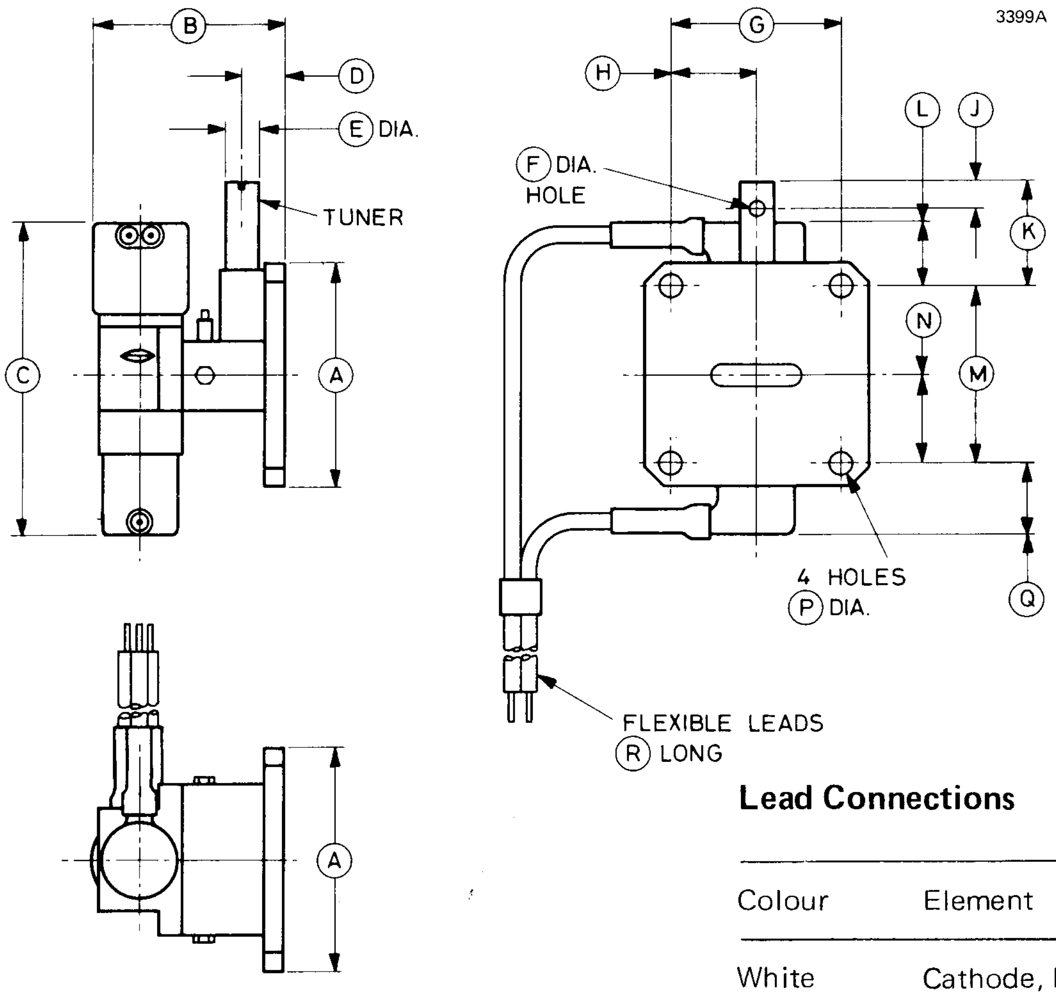
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	30	40	mA
Reflector voltage	–140	–	–220	V
Output power	30	60	–	mW
Mechanical tuning range . . .	8800	–	8885	MHz
Electronic tuning range to –3db points	30	40	–	MHz
Reflector modulation sensitivity . .	0.5	1.0	1.5	MHz/V
Temperature coefficient of frequency	–50	–150	–200	kHz/°C
Peak frequency modulation with 10g vibration (30 to 1000Hz) .	–	50	100	kHz

NOTES

1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system. Maximum life is attained by operating at temperatures below the specified limit.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.

OUTLINE (All dimensions without limits are nominal)



Lead Connections

Colour	Element
White	Cathode, heater
Yellow	Heater
Grey	Reflector

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38	J	0.200 ± 0.005	5.08 ± 0.13
B	1.400 max	35.56 max	K	0.760 max	19.30 max
C	2.400 max	60.96 max	L	0.658 max	16.71 max
D	0.312 ± 0.010	7.92 ± 0.25	M	1.280 ± 0.004	32.512 ± 0.102
E	0.250	6.35	N	0.640 ± 0.004	16.256 ± 0.102
F	0.110	2.79	P	0.170	4.32
G	1.220 ± 0.004	30.988 ± 0.102	Q	0.458 max	11.63 max
H	0.610 ± 0.004	15.494 ± 0.102	R	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K3101
K3101M

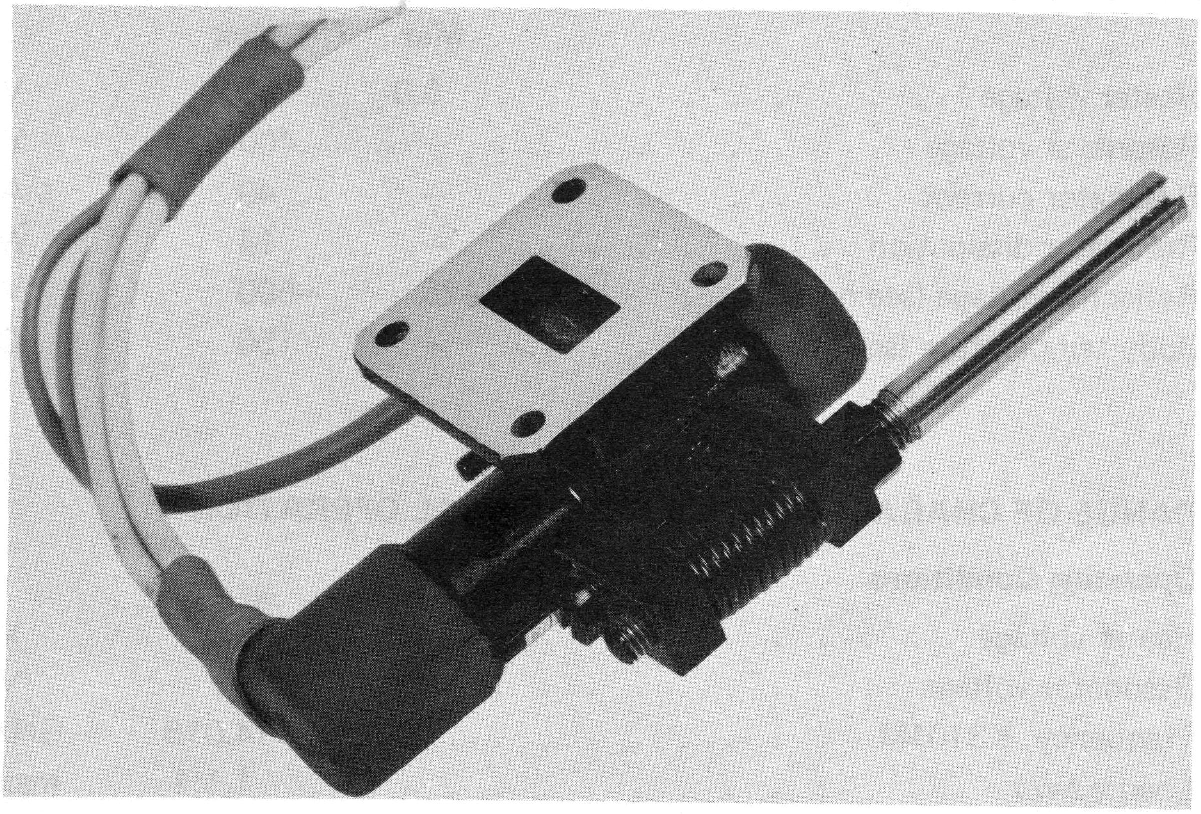
OSCILLATOR KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Wide-band low voltage reflex klystrons for local oscillator applications. The K3101M is similar to K3101 but is supplied preset to 14.015GHz.

Frequency range, K3101	12.0 to 14.5		GHz
	Mode A	**Mode B**	
Typical output power	40	80	mW
Electronic tuning range	80	50	MHz
Output			to no. 18 waveguide (0.622 x 0.311 inch internal)
Coupler			UG-419/U (154 I.E.C.-UBR140)
Mechanical tuning, K3101 (see note 1)			single screw



GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 2)	6.3 ± 5%	V
Heater current	0.6	A

Mechanical

Overall dimensions	see outline drawing
Net weight	4 ounces (113g) approx
Mounting position	any
Connections	flexible leads

Cooling (see note 3) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (see note 4)

No individual rating to be exceeded

	Min	Max	
Heater voltage	6.0	6.6	V
Resonator voltage	–	400	V
Resonator current	–	40	mA
Resonator dissipation	–	14	W
Reflector voltage (see note 5)	–25	–500	V
Body temperature (see note 3)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Frequency, K3101M	14.015	GHz
Load v.s.w.r.	1.1:1	max

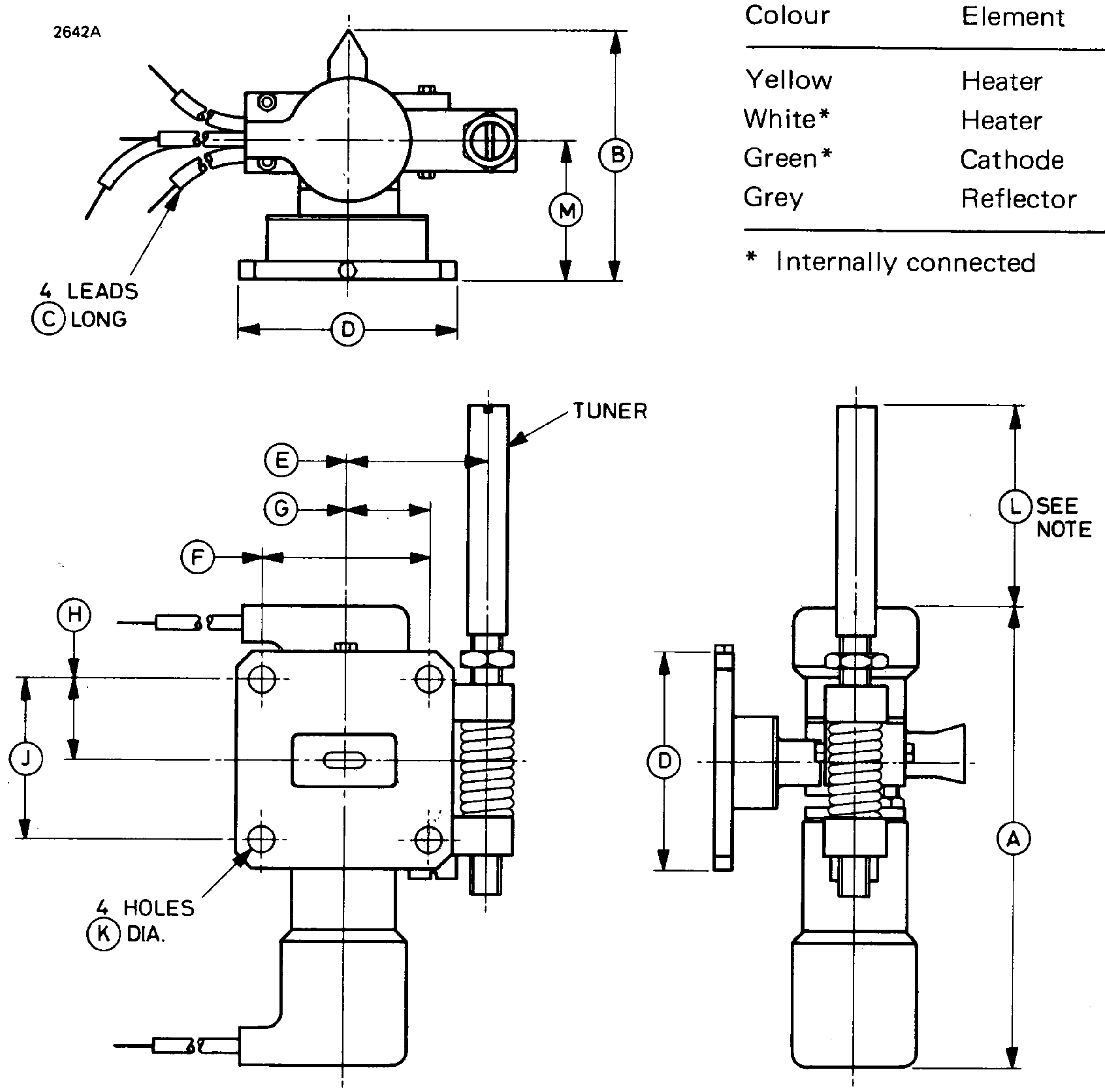
Range of Characteristics

	Min	Typical K3101	Typical K3101M	Max	
Heater current	0.52	0.60	0.60	0.65	A
Resonator current . . .	25	30	30	40	mA
Frequency	–	13.25	14.015	–	GHz
MODE A:					
reflector voltage . .	–50	–130	–160	–250	V
output power . . .	15	40	40	–	mW
electronic tuning range to –3db points . . .	40	80	80	–	MHz
MODE B:					
reflector voltage . .	–100	–230	–270	–350	V
output power . . .	40	80	80	–	mW
electronic tuning range to –3db points . . .	20	50	50	–	MHz

NOTES

1. For maximum tuner life, adjust only when necessary and on no account exceed the stated frequency limits. Clockwise rotation of the tuner reduces the frequency.
2. For maximum life allow a minimum warm-up time of 30 seconds.
3. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
4. All voltages except the heater voltage are with respect to cathode.
5. The reflector circuit impedance must not exceed 0.5MΩ.

OUTLINE (All dimensions without limits are nominal)



Colour	Element
Yellow	Heater
White*	Heater
Green*	Cathode
Grey	Reflector

* Internally connected

Note The value given applies when set to mid-band frequency.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.000 max	76.20 max	G	0.497 ± 0.002	12.624 ± 0.051
B	1.625 max	41.28 max	H	0.478 ± 0.002	12.141 ± 0.051
C	9.000 min	228.6 min	J	0.956 ± 0.004	24.282 ± 0.102
D	1.312 ± 0.004	33.325 ± 0.102	K	0.147	3.73
E	0.844 ± 0.031	21.44 ± 0.79	L	1.200	30.48
F	0.994 ± 0.004	25.248 ± 0.102	M	0.840 ± 0.020	21.34 ± 0.51

Millimetre dimensions have been derived from inches.

K3102
K3102M

OSCILLATOR KLYSTRONS

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Wide-band low voltage reflex klystrons for local oscillator applications. The tubes are identical apart from their frequency ranges.

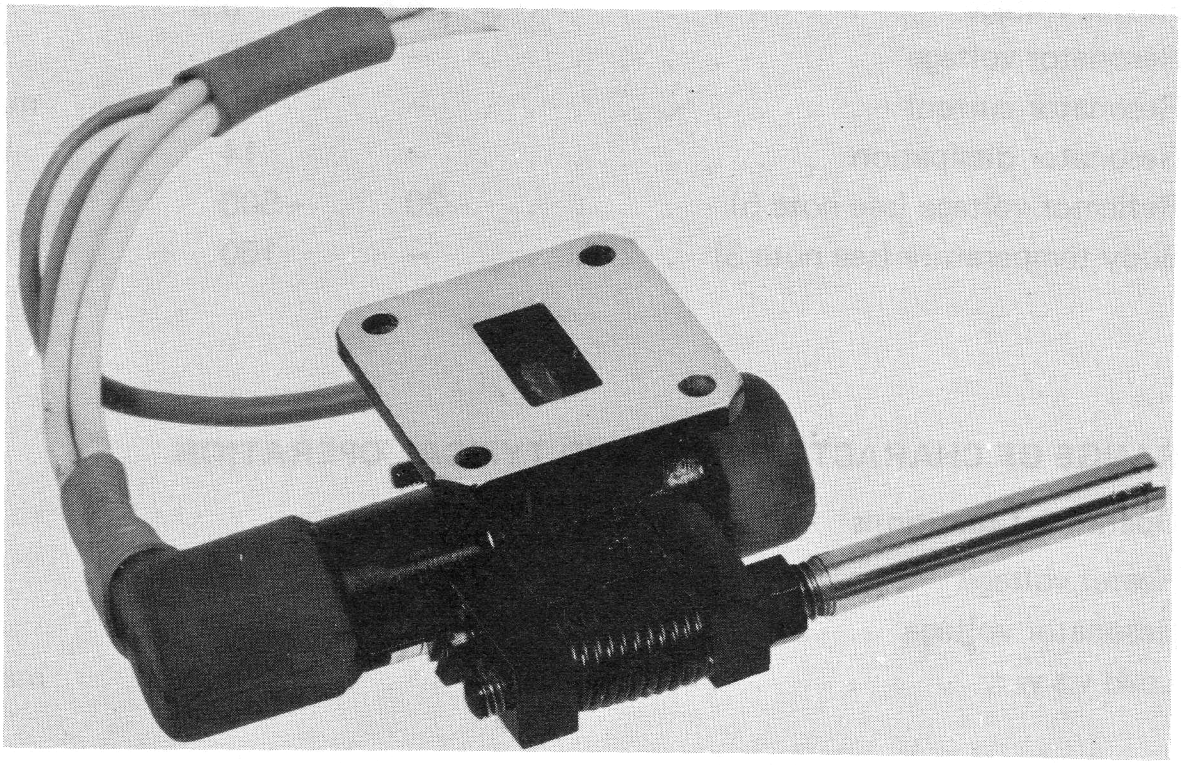
Frequency range:

K3102	14.5 to 17.0		GHz
K3102M	16.5 to 17.3		GHz
	Mode A	**Mode B**	
Typical output power	35	45	mW
Electronic tuning range	120	75	MHz

Output . . . . to no. 18 waveguide (0.622 x 0.311 inch internal)

Coupler UG-419/U (154 I.E.C.-UBR140)

Mechanical tuning (see note 1) . . . . single screw



GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 2)	6.3	V
Heater current	0.6	A

Mechanical

Overall dimensions	see outline drawing
Net weight	4 ounces (113g) approx
Mounting position	any
Connections	flexible leads

Cooling (see note 3) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (see note 4)

No individual rating to be exceeded

	Min	Max	
Heater voltage	5.8	6.8	V
Resonator voltage	–	400	V
Resonator current	–	40	mA
Resonator dissipation	–	14	W
Reflector voltage (see note 5)	–20	–500	V
Body temperature (see note 3)	–	150	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	350	V
Load v.s.w.r.	1.1:1	max

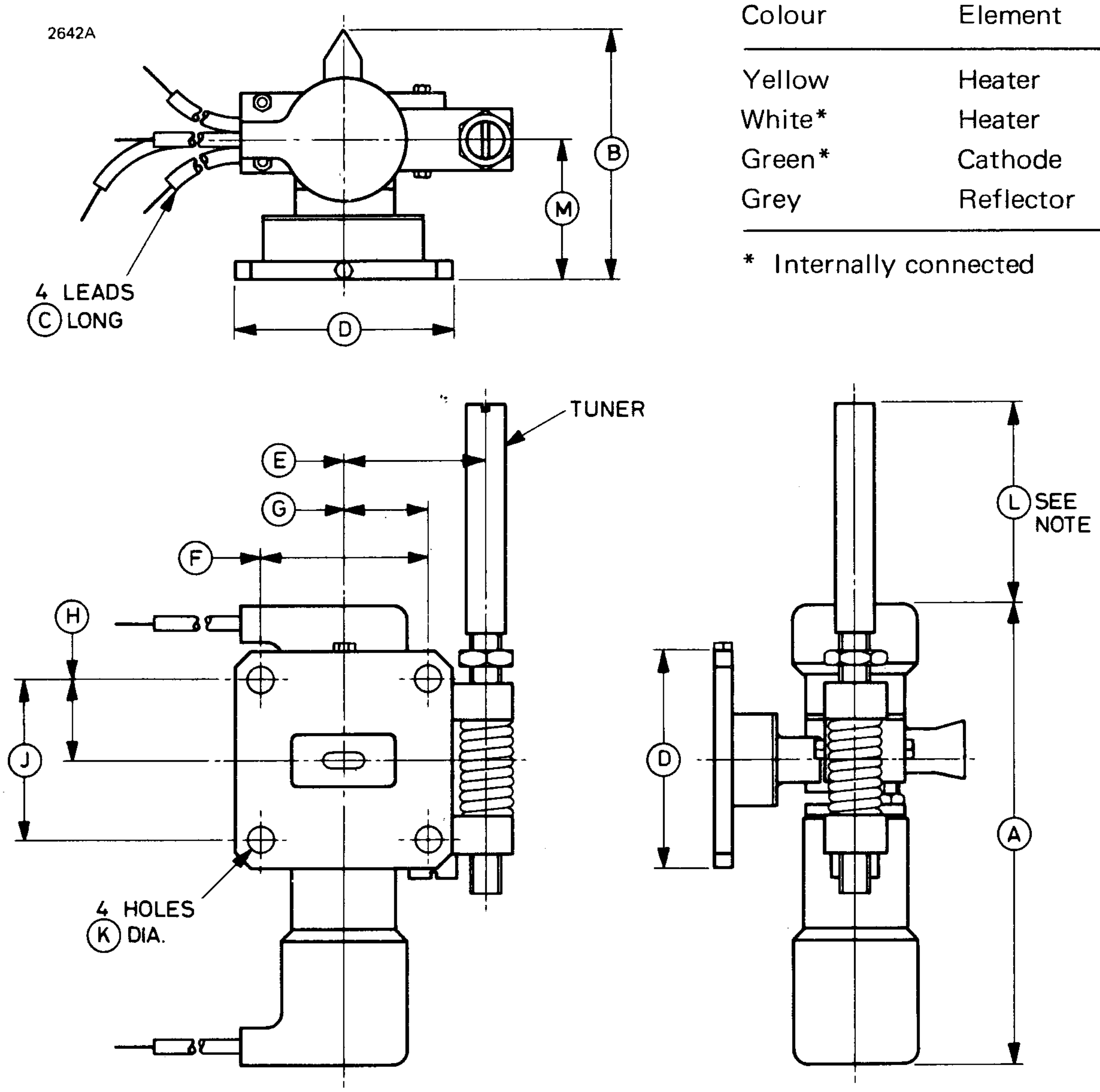
Range of Characteristics

	Min	Typical	Max	
Heater current	0.52	0.60	0.65	A
Resonator current	25	30	40	mA
Mechanical tuning range:				
K3102	14.5	–	17.0	GHz
K3102M	16.5	–	17.3	GHz
MODE A:				
reflector voltage	–50	–120	–250	V
output power	15	35	–	mW
electronic tuning range to –3db points	50	120	–	MHz
MODE B:				
reflector voltage	–100	–180	–350	V
output power	20	45	–	mW
electronic tuning range to –3db points	25	75	–	MHz

NOTES

1. For maximum tuner life, adjust only when necessary and on no account exceed the stated frequency limits. Clockwise rotation of the tuner reduces the frequency.
2. For maximum life allow a minimum warm-up time of 30 seconds.
3. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
4. All voltages except the heater voltage are with respect to cathode.
5. The reflector circuit impedance must not exceed 0.5MΩ.

OUTLINE (All dimensions without limits are nominal)



Colour	Element
Yellow	Heater
White*	Heater
Green*	Cathode
Grey	Reflector

* Internally connected

Note The value given applies when set to mid-band frequency.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.000 max	76.20 max	G	0.497 ± 0.002	12.624 ± 0.051
B	1.625 max	41.28 max	H	0.478 ± 0.002	12.141 ± 0.051
C	9.000 min	228.6 min	J	0.956 ± 0.004	24.282 ± 0.102
D	1.312 ± 0.004	33.325 ± 0.102	K	0.147	3.73
E	0.844 ± 0.031	21.44 ± 0.79	L	1.200	30.48
F	0.994 ± 0.004	25.248 ± 0.102	M	0.840 ± 0.020	21.34 ± 0.51

Millimetre dimensions have been derived from inches.

K3111

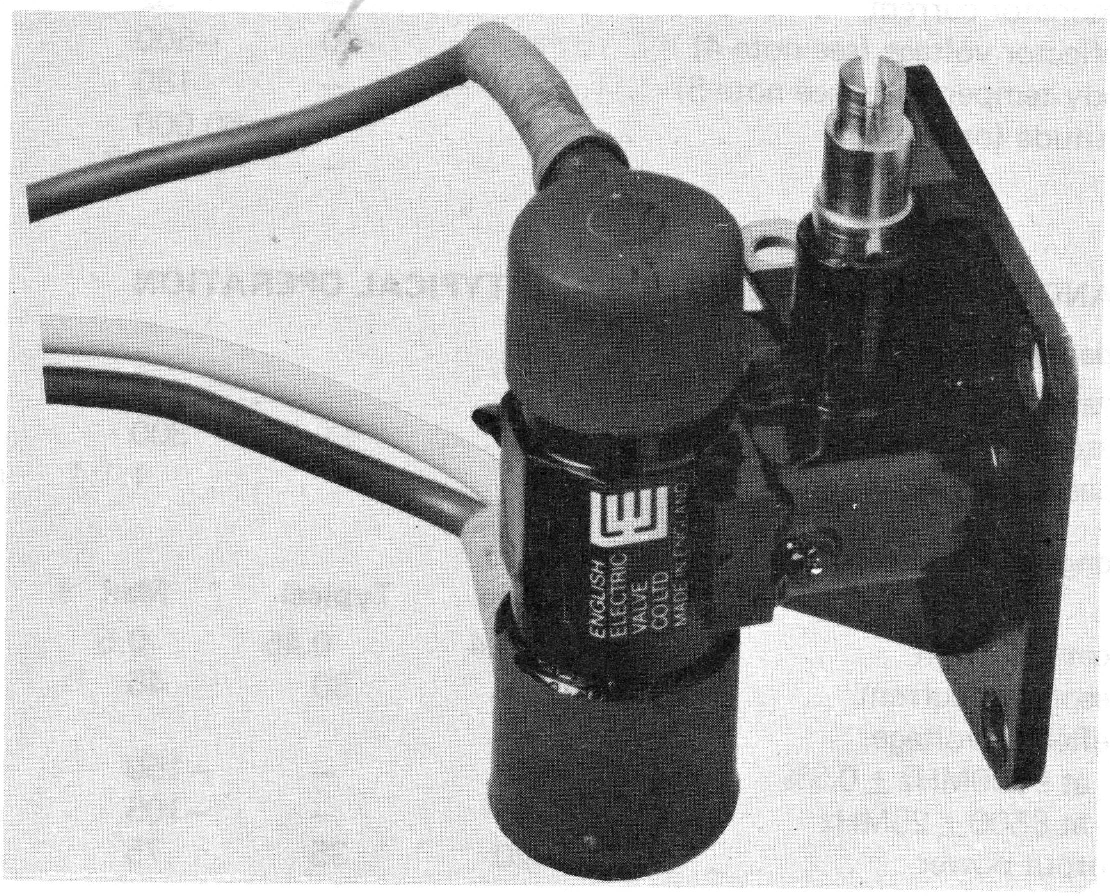
OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Rugged reflex klystron for airborne radar and similar applications.

Frequency range	8500 to 9600	MHz
Typical output power	35	mW
Electronic tuning range	37	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning (see note 1)	single screw	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.45	A

Mechanical

Overall dimensions (excluding leads)	3.075 x 1.635 x 1.500 inches max 78.11 x 41.53 x 38.10mm max
Net weight	120g (4.2 ounces) approx
Mounting position	any
Connections	flexible leads

Cooling (See note 2) . . . . natural

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage	–	350	V
Resonator current	–	52	mA
Reflector voltage (see note 4)	–20	–500	V
Body temperature (see note 5)	–	180	°C
Altitude (operating)	–	60 000	ft
	–	18.3	km

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	300	V
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Typical	Max	
Heater current	0.4	0.45	0.5	A
Resonator current	–	30	45	mA
Reflector voltage:				
at 9600MHz ± 0.3%	–140	–	–150	V
at 8500 ± 25MHz	–85	–	–105	V
Output power	20	35	75	mW

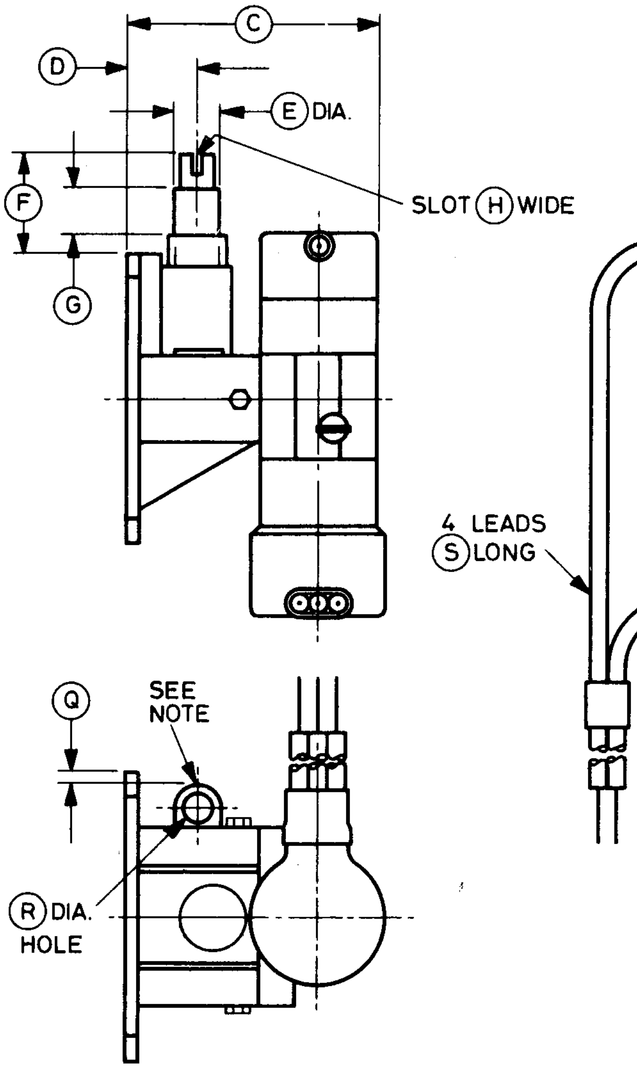
Range of Characteristics (Continued)

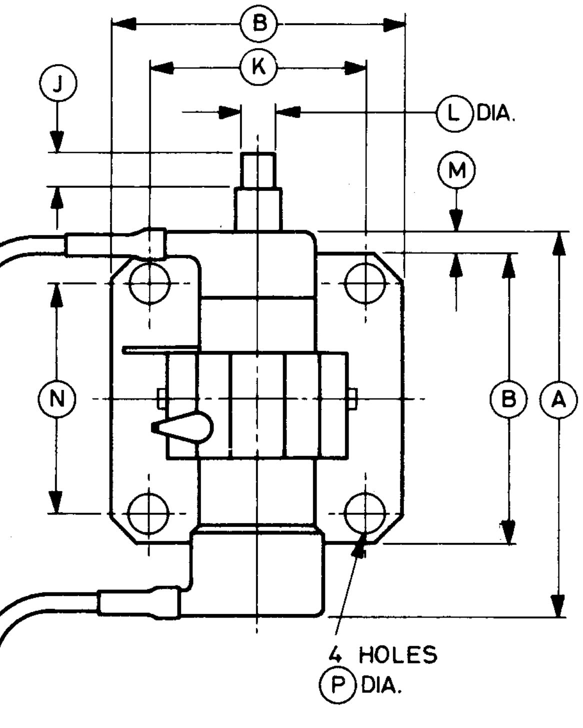
	Min	Typical	Max	
Mechanical tuning range . . .	8500	–	9600	MHz
Electronic tuning range to –3db points	30	37	–	MHz
Temperature coefficient of frequency	0	–50	–200	kHz/°C
Vibration tests (see note 6):				
peak frequency modulation at 10g (see note 7)	–	–	300	kHz
peak frequency modulation (random vibration) (see note 8) .	–	–	300	kHz
peak reflector current at 10g (see note 9)	–	–	5.0	μA

NOTES

1. Clockwise rotation of the tuner reduces the frequency.
2. The resonator is normally operated at earth potential and in good thermal contact with the waveguide system.
3. All voltages except the heater voltage are with respect to cathode.
4. The reflector circuit impedance must not exceed 0.5MΩ. The reflector must never become positive with respect to cathode.
5. For best life, the operating temperature of the klystron body should be kept as low as possible. Under normal conditions the temperature should not exceed 150°C.
6. Each test is performed with vibration along each of the three perpendicular axes of the tube, with reflector voltage adjusted for maximum output. Vibration tests are performed on a sampling basis.
7. Vibration frequency swept at 1 octave per minute in both directions over the range 50 to 2000Hz.
8. Power density 0.06g^2/Hz, for one hour in each plane. Peak frequency modulation measured over at least 5 minutes in each plane. See MIL-STD-202D, method 214-2, test condition C.
9. Vibration frequency 50Hz, 2 minutes in each plane. Reflector current measured across 10kΩ, with frequency response better than –3db, d.c. to 100Hz.
10. A 6 day humidity test to I.E.C. 68-2-4, test D, severity IV, is carried out on a sampling basis.

OUTLINE





Colour	Element
White	Heater, cathode
Yellow	Heater
Grey	Reflector
Brown	Resonator

Note Envelope temperature measured at this point.

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.400 max	60.96 max	K	1.220 ± 0.004	30.99 ± 0.10
B	1.625 ± 0.010	41.28 ± 0.25	L	0.187 ± 0.010	4.75 ± 0.25
C	1.500 max	38.10 max	M	0.300 max	7.62 max
D	0.400 ± 0.025	10.16 ± 0.64	N	1.280 ± 0.004	32.51 ± 0.10
E	0.2475 ± 0.0025	6.287 ± 0.064	P	0.2185 ± 0.0045	5.550 ± 0.114
F	0.675 max	17.15 max	Q	0.075 ± 0.025	1.91 ± 0.64
G	0.250 ± 0.025	6.35 ± 0.64	R	0.1425 ± 0.0075	3.620 ± 0.191
H	0.040 ± 0.010	1.02 ± 0.25	S	12.000 min	304.8 min
J	0.180 ± 0.020	4.57 ± 0.51			

Millimetre dimensions have been derived from inches.

K3113

OSCILLATOR KLYSTRON

The data should be read in conjunction with the Oscillator Klystron Preamble.

ABRIDGED DATA

Extremely rugged reflex klystron for airborne and similar applications requiring fast warm-up, high frequency stability and low noise under severe environmental conditions.

Frequency range	9300 to 9600	MHz
Typical output power	85	mW
Electronic tuning range	35	MHz
Output	to no. 16 waveguide (0.900 x 0.400 inch internal)	
Coupler	UG-39/U (154 I.E.C.-UBR100)	
Mechanical tuning	single screw	

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.1	A

Mechanical

Overall dimensions (excluding leads)	2.400 x 1.640 x 1.400 inches max 60.96 x 41.66 x 35.56mm max
Net weight	5 ounces (142g) approx
Mounting position	any
Connections	flexible leads

Cooling . . . . . natural

August 1973

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

	Min	Max	
Heater voltage	6.0	6.6	V
Resonator voltage	–	350	V
Resonator current	–	55	mA
Reflector voltage	–20	–500	V
Peak heater to cathode voltage	–	45	V
Body temperature	–	200	°C
Storage temperature	–55	+100	°C

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

Heater voltage	6.3	V
Resonator voltage	320	V
Load v.s.w.r.	1.1:1	max

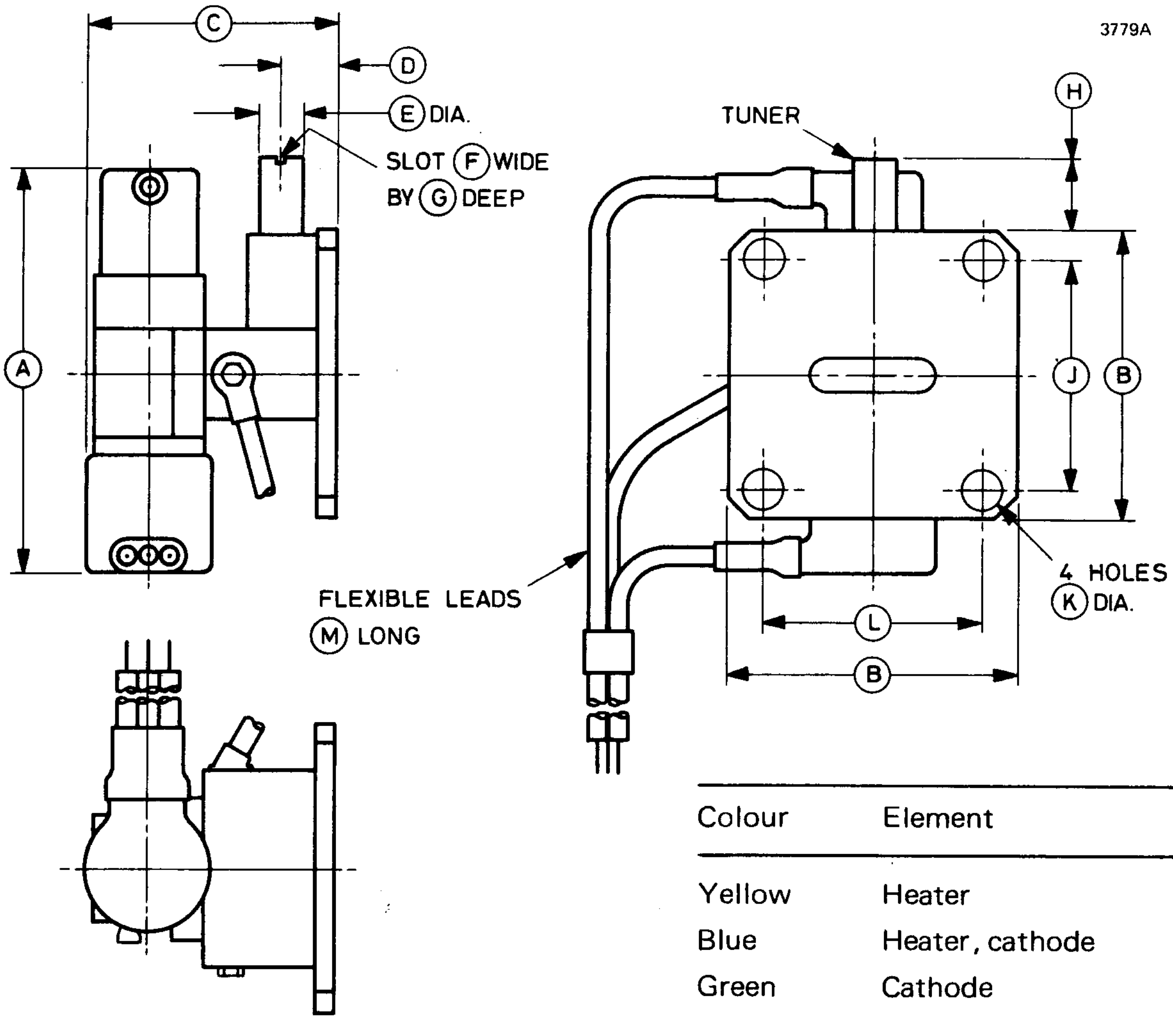
Range of Characteristics

	Min	Typical	Max	
Heater current	1.0	1.1	1.32	A
Resonator current	–	35	40	mA
Reflector voltage	–125	–	–164	V
Output power	45	85	140	mW
Mechanical tuning range	9300	–	9600	MHz
Tuning rate	180	200	240	MHz/turn
Electronic tuning range to –3db points	30	35	–	MHz

DESIGN APPROVAL TESTS

	Typical	Max	
Frequency deviation (peak to peak):			
temperature +25 to +95°C	–30	–100 to +100	kHz/°C
vibration 30 to 1000Hz, 10g	–	200	kHz
shock 150g for 4ms	–	2.0	MHz

OUTLINE (All dimensions without limits are nominal)



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

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.400 max	60.96 max	G	0.031	0.79
B	1.625 ± 0.015	41.28 ± 0.38	H	0.475 max	12.07 max
C	1.400 max	35.56 max	J	1.280 ± 0.004	32.512 ± 0.102
D	0.312 ± 0.010	7.92 ± 0.25	K	$0.218 {}^{+0.005}_{-0.004}$	$5.537 {}^{+0.127}_{-0.102}$
E	$0.247 {}^{+0.003}_{-0.002}$	$6.274 {}^{+0.076}_{-0.051}$	L	1.220 ± 0.004	30.988 ± 0.102
F	0.040 ± 0.010	1.02 ± 0.25	M	12.000 min	304.8 min

Millimetre dimensions have been derived from inches.

K3114 Series

REFLEX KLYSTRONS

ABRIDGED DATA

A series of tunable reflex klystrons for reliable telecommunication service as transmitters or local oscillators. Each tube, when used with the appropriate MA3114 cavity (or suitable equivalent: e.g. VA1259), delivers an output of at least 1 watt for transmitter use, and at least 20 milliwatts as a local oscillator. The MA3114 cavity is detachable, and normally it is only necessary to replace the tube at end of life. These long life tubes have excellent frequency stability with changes in ambient temperature when conduction cooled, but further improvement may be obtained when a vapour cooling system is used.

Frequency range (covered by 5 tubes)	5.9 to 8.5	GHz
Typical output power:		
transmitter	1.5	W
local oscillator	80	mW
R.F. output	external cavity mates with UG-344/U flange	

GENERAL DATA

Electrical

Cathode	indirectly heated oxide coated	
Heater voltage	6.3	V
Heater current	0.75	A
Output power, minimum:		
K3114A, B, C, E, F (transmitter service)	1	W
K3114A,B (local oscillator service)	25	mW
K3114C, E, F (local oscillator service)	20	mW
Mechanical tuning range:		
K3114A	5.9 to 6.5	GHz
K3114B	6.5 to 7.125	GHz
K3114C	7.1 to 7.8	GHz
K3114E	7.7 to 8.4	GHz
K3114F	7.75 to 8.50	GHz

Mechanical

Overall dimensions	see outline drawings
Weight:	
tube only	14 ounces (0.4kg) approx
tube and cavity	1.4 pounds (0.63kg) approx
Mounting position	any
Reflector cap	B.S.448-CT2
Base	6 pin wafer octal

MAXIMUM AND MINIMUM RATINGS

(Absolute values. See notes 1 and 2)

	Min	Max	
Heater voltage	5.7	6.9	V
Resonator voltage (transmitter)	–	800	V
Reflector voltage:			
transmitter	–150	–1000	V
local oscillator	–50	–1000	V
Peak heater to cathode voltage	–	±45	V
Total impedance in reflector-cathode circuit	–	0.1	MΩ
Surface temperature	–	150	°C

TYPICAL OPERATION (see note 3)

Transmitter service (K3114B)

Frequency	6.5	7.125	GHz
Resonator voltage	750	750	V
Resonator current	78	77	mA
Reflector voltage	–305	–430	V
Output power	1.5	1.7	W
Electronic tuning range (3db points)	55	55	MHz
Reflector modulation sensitivity	350	400	kHz/V
Beam voltage modulation coefficient	150	150	kHz/V
Heater frequency modulation (peak to peak)	10	10	kHz

Local oscillator service (K3114B)

Resonator voltage	300	300	V
Resonator current	20	19	mA
Reflector voltage	–130	–180	V
Output power	75	80	mW
Electronic tuning range (3db points)	30	30	MHz
Reflector modulation sensitivity	900	800	kHz/V

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions — Transmitter Service

Heater voltage	6.3	V
Resonator voltage	750	V
Reflector voltage		Adjust
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Max	
Heater current	0.6	0.9	A
Resonator current	–	80	mA
Reflector voltage	–275	–475	V
Electronic tuning range	30	–	MHz
Reflector modulation sensitivity	250	–	kHz/V
Beam voltage modulation coefficient	–	250	kHz/V
Heater frequency modulation (peak to peak)	–	100	kHz

Test Conditions — Local Oscillator Service

Heater voltage	6.3	V
Resonator voltage	300	V
Reflector voltage		Adjust
Load v.s.w.r.	1.1:1	max

Range of Characteristics

	Min	Max	
Heater current	0.6	0.9	A
Resonator current	–	25	mA
Reflector voltage	–70	–225	V
Electronic tuning range	20	–	MHz
Reflector modulation sensitivity	750	–	kHz/V

NOTES

1. All voltages except heater voltages are with respect to the cathode.
2. It is essential that the tube is not operated outside these ratings under any conditions. The ratings given are limiting values, and cannot necessarily be used simultaneously.
3. Although the values shown are for the K3114B, they are representative of every K3114 with the exceptions noted under 'General Data'.

OPERATING INSTRUCTIONS

1. These instructions are intended as a guide to circuit designers and tube users, for installing and operating the reflex klystron type K3114. If the information given below is used, long and reliable performance of the tube will result.

2. a) Never apply the resonator voltage before the reflector voltage, even for a short period.

   b) Do not operate the tube at any time without a negative voltage on the reflector.

3. a) Voltage surges at switching on must be limited to be within the maximum ratings.

   The recommended sequence of application of voltages is:

   i) Heater voltage
   ii) Reflector voltage
   iii) Resonator voltage

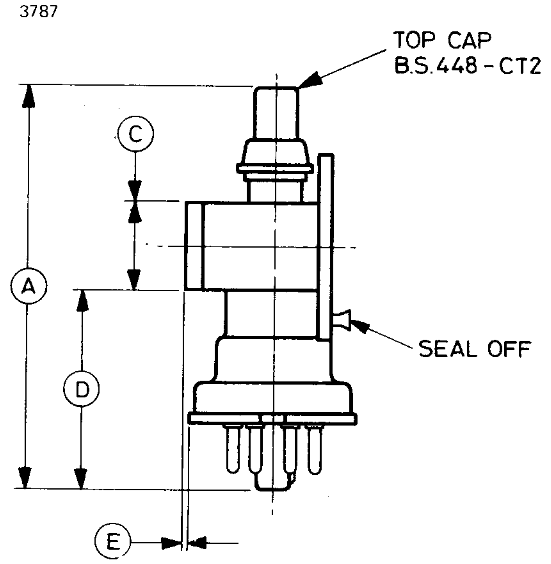
   b) The reflector must never be allowed to become positive with respect to the cathode. Neither must it be allowed to become disconnected from the power supply while the resonator voltage is applied.

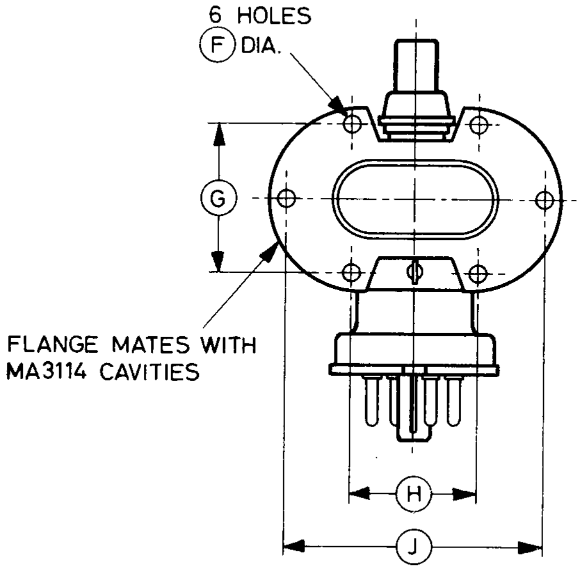
   If the reflector is modulated, the modulating voltage must be limited such that it never drives the reflector positive with respect to the cathode. If such a positive condition is possible a protective circuit should be fitted so that the reflector is never allowed to be less than −150Vd.c. with respect to the cathode in the transmitting condition and never less than −50Vd.c. in the local oscillator condition. The maximum total impedance in the reflector circuit should not exceed 0.1MΩ.

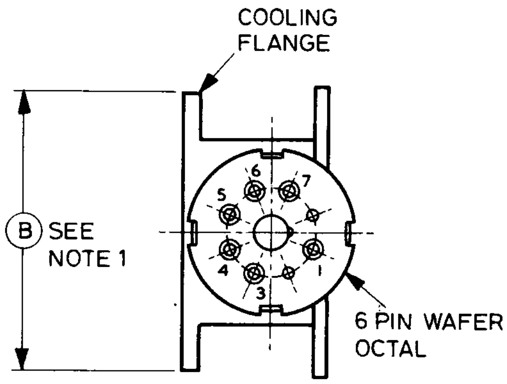
4. The maximum allowable tube surface temperature is 150°C. The tube should be conduction cooled through either the cavity output flange or the cooling flange. It must be clamped, metal-to-metal, to a heat sink. The mating surface of the heat sink should be flat to within 0.002 inch over the contact area. If the tube is operated electrically isolated from ground, electrical isolation may be placed between the heat sink and ground, but not between the tube and the heat sink.

5. If a d.c. heater supply is used, care must be taken to ensure that the positive side of the d.c. supply is connected to the cathode lead. Tube life will be reduced greatly if the d.c. heater polarity is reversed.

OUTLINE (See page 6 for outline notes)







Pin	Element
1	Shell
2	No pin
3	No connection
4	Cathode
5	Heater
6	Heater
7	No connection
8	No pin
Cap	Reflector

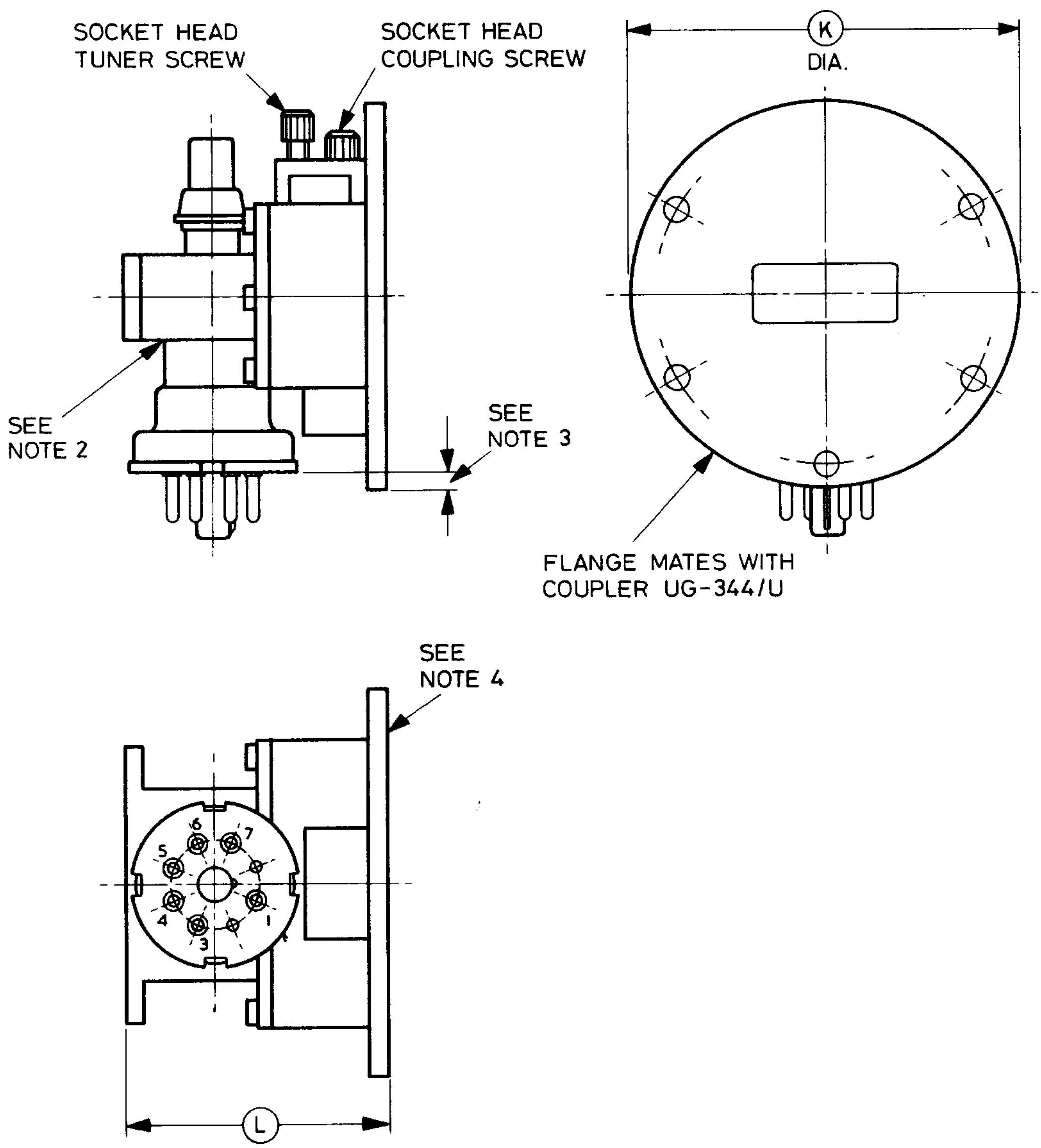
Ref	Inches	Millimetres
A	3.500 max	88.90 max
B	2.290 ± 0.050	58.17 ± 1.27
C	0.695 +0.020 −0.035	17.65 +0.51 −0.89
D	1.600 ± 0.150	40.64 ± 3.81
E	0.200 max 0.000 min	5.08 max 0.00 min

Ref	Inches	Millimetres
F	0.142	3.60
G	1.205 ± 0.002	30.607 ± 0.051
H	0.995 ± 0.002	25.273 ± 0.051
J	2.068 ± 0.002	52.527 ± 0.051
K	3.190 max	81.03 max
L	2.100 ± 0.100	53.34 ± 2.54

Millimetre dimensions have been derived from inches except dimension F.

K3114 WITH MA3114 EXTERNAL CAVITY

3788



Outline Notes

1. Flange face will be flat within 0.005 inch (0.13mm).
2. Maximum temperature measured at this point 150°C.
3. The base wafer will not extend below the flange.
4. The flange face is flat to within 0.002 inch (0.05mm).

Travelling Wave Tubes

6861

LOW NOISE
TRAVELLING WAVE TUBE

Service Type CV5362

ABRIDGED DATA

Low noise travelling wave tube for use in the input stage of radar and other microwave receivers, and in i.f. amplifier service. The tube is contained in a metal canister and is fitted with coaxial input and output connectors. A separate focusing solenoid is required.

Frequency range	2.7 to 3.5	GHz
Saturation output power	1.0	mW
Noise factor	6.5	db
Low level gain	25	db
Recommended solenoid		N4004

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	5.0	V
Heater current	0.5	A
Heater starting current (peak)	4.0	A max
Cathode heating time (minimum)	1.0	min

Mechanical

Overall length	19.375 inches (492.1mm) max
Overall diameter	1.380 inches (35.1mm) max
Net weight	1.75 pounds (800g) approx
R.F. connections	50Ω coaxial plug connectors type 'N' U.S. military no. UG-1185/U
Base	international octal
Collector connection	4mm socket
Mounting position	any
Cooling	natural

April 1973

MAXIMUM AND MINIMUM RATINGS (Absolute values) (see note 1)

No individual rating to be exceeded

	Min	Max	
Collector voltage	–	500	V
Collector current	–	500	μA
Helix voltage	–	500	V
Helix current (see note 2)	–	5.0	μA
Grid 4 voltage	–	500	V
Grid 4 dissipation	–	0.1	W
Grid 3 voltage	–	300	V
Grid 3 dissipation	–	0.1	W
Grid 2 voltage	–	75	V
Grid 2 dissipation	–	0.1	W
Grid 1 voltage	–	20	V
Grid 1 dissipation	–	0.1	W
Heater voltage	–	5.25	V
Magnetic field (see note 3)	40	–	mT
	400	–	gauss
Peak input power	–	100	W
Mean input power	–	0.4	W
Canister temperature (at hottest point)	–	175	°C

TYPICAL OPERATION (at 3.1GHz)

Operational Conditions (see note 1)

Collector voltage (see note 4)	400	V
Collector current	150	μA
Helix voltage (see notes 5 and 6)	375	V
Grid 4 voltage (see note 6)	200	V
Grid 3 voltage (see note 6)	40	V
Grid 2 voltage (see note 7)	20	V approx
Grid 1 voltage	0	V
Magnetic field (see notes 8 and 9)	52.5	mT
	525	gauss

Typical Performance

Helix current (see note 6)	0.5	μA
Grid 4 current	less than 1.0	μA
Grid 3 current	less than 1.0	μA
Grid 2 current	less than 1.0	μA
Grid 1 current	less than 1.0	μA
Cold insertion loss	80	db
Gain	25	db
Noise factor (see note 6)	6.5	db
Output power (saturated)	1.0	mW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(Over the frequency range 2.7 to 3.5GHz)

Recommended Applied Conditions (see note 1)

Heater voltage (see note 10)	5.0	V
Collector voltage (see note 4)	400	V
Collector current	150	μA
Helix voltage (see notes 5 and 6)	350 to 390	V
Grid 4 voltage (see note 6)	160 to 275	V
Grid 3 voltage (see note 6)	20 to 50	V
Grid 2 voltage (see note 7)	0 to 30	V
Grid 1 voltage	0	V
Magnetic field (see notes 8 and 9)	52.5	mT
	525	gauss

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	–	0.85	A
Helix current	–	5.0	μA
Grid 4 current	–	10	μA
Grid 3 current	–	10	μA
Grid 2 current	–	10	μA
Grid 1 current	–	10	μA
Gain	20	–	db
Noise factor	–	7.0	db
Output power (saturated)	0.25	–	mW
Tube input v.s.w.r. (see note 11)	–	1.7:1	
Tube output v.s.w.r. (see note 11)	–	2.0:1	

NOTES

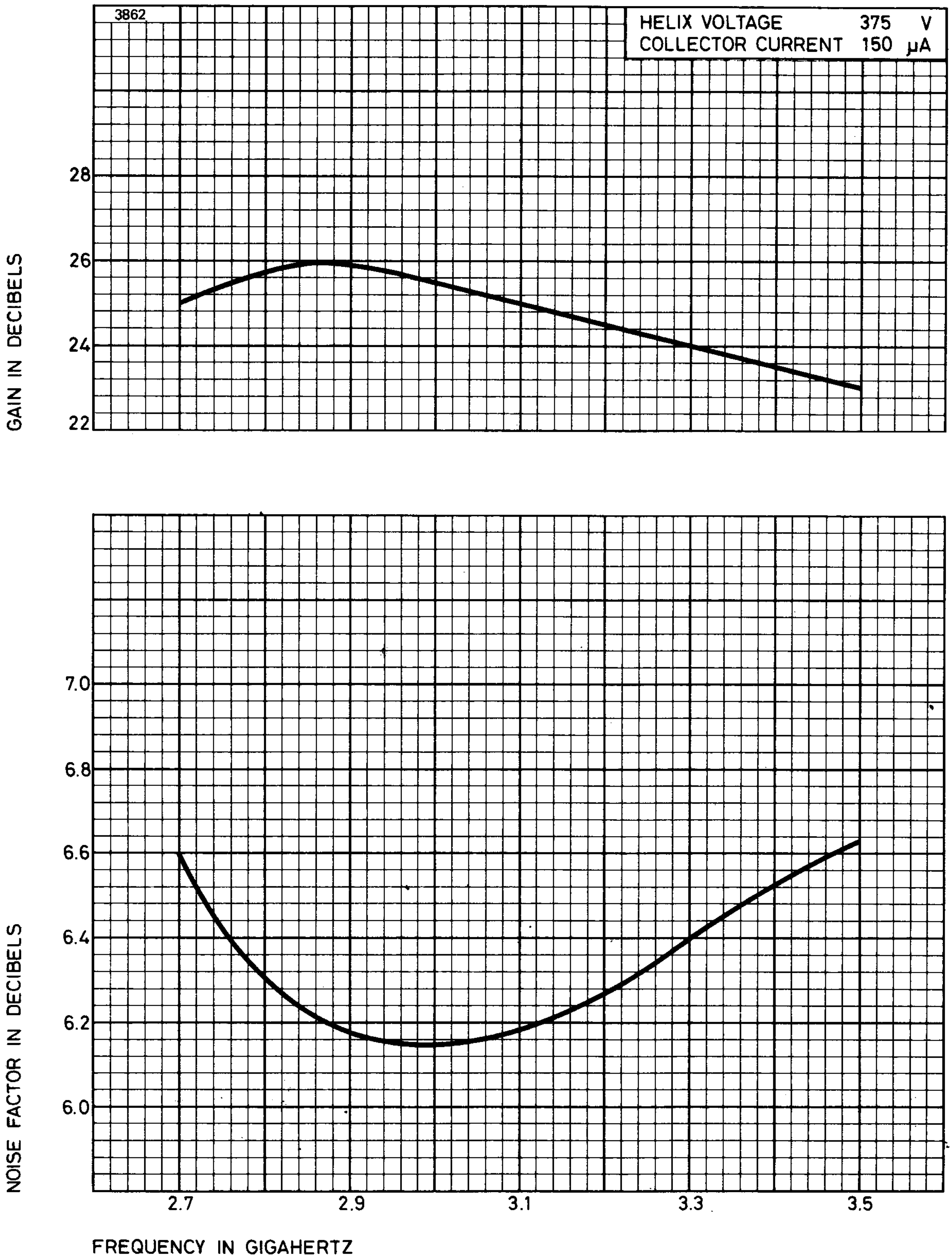
1. All voltages apart from the heater voltage are with respect to the cathode. It may sometimes be convenient to earth the collector and maintain the cathode at a negative potential.
2. During alignment in the magnetic focusing field this maximum value of helix current may be exceeded for short periods, but must never exceed 25μA.
3. This minimum value of magnetic field strength will focus the electron beam but the optimum noise figure will not be obtained.
4. It is necessary to maintain the collector positive with respect to the helix. Fluctuations in collector voltage should be less than $\pm$10%.
5. The helix voltage should be set to the optimum value for the frequency of operation and stabilized to within $\pm$5%.
6. In order to operate the tube at the lowest noise factor it is necessary to adjust the electrode voltages as follows. First align the travelling wave tube in the focusing solenoid for minimum helix current. Then with the tube connected in its circuit, apply a signal or noise input and adjust the helix voltage to give maximum output. This value of helix voltage simultaneously produces optimum gain and minimum noise factor. Next, with no input signal, vary grid 3 and grid 4 voltages alternately until the receiver output reaches a minimum. The voltages reached in this way are those which will operate the 6861 at the lowest noise factor for the particular frequency to which the equipment is tuned. For wide band operation these adjustments should be carried out at the centre frequency. If the focusing field changes, it will be necessary to repeat the above adjustments. Grid 3 and grid 4 voltages should be stabilized to within $\pm$5%.
7. Grid 2 voltage is adjusted to give 150μA collector current and should be stabilized to within $\pm$5%.
8. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.
9. The measurements are made with the magnetic field adjusted to 52.5mT (525 gauss) $\pm$5%. Provision must be made for aligning the

tube in the solenoid. An adjustment of ±0.100 inch (±2.54mm) about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the EEV lightweight solenoid type N4004 is recommended.

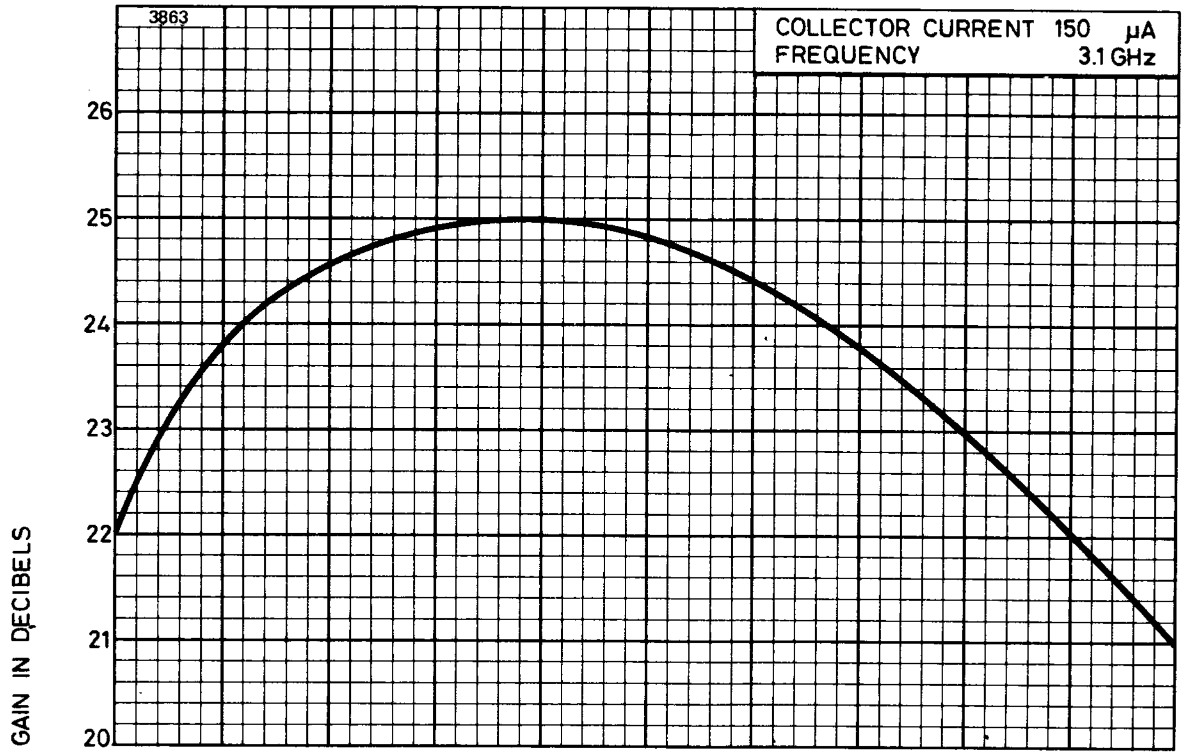
10. Tolerance ±5%.

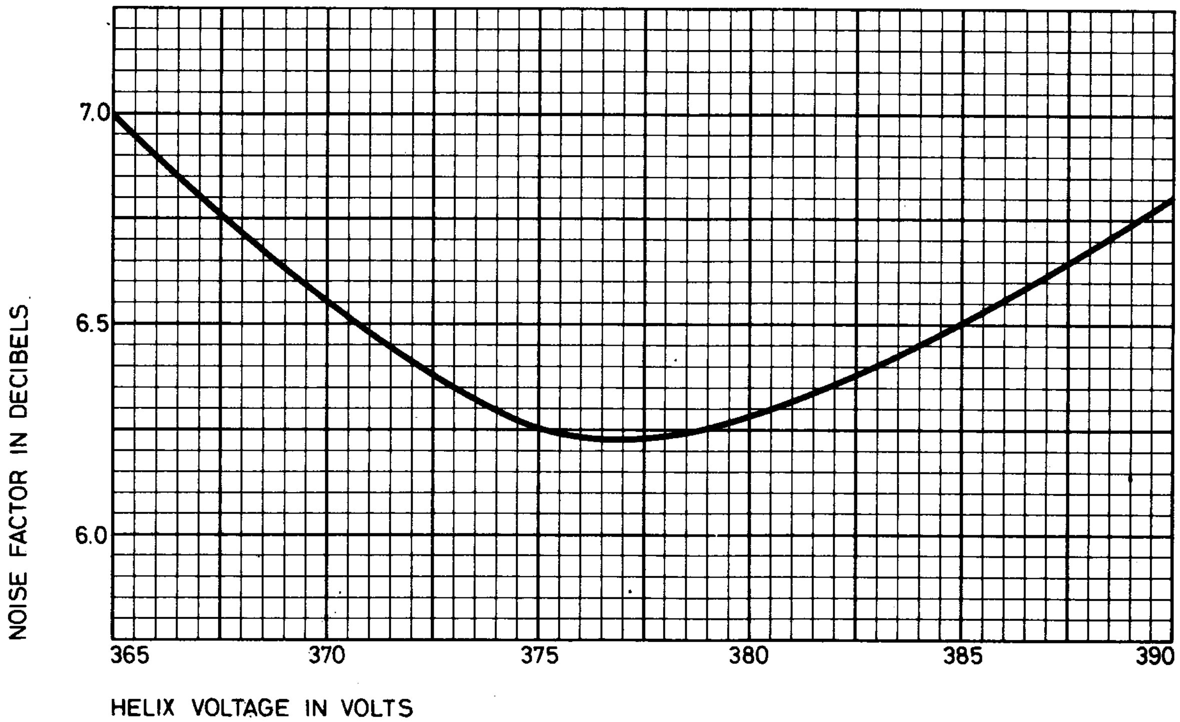
11. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

TYPICAL PERFORMANCE CHARACTERISTICS

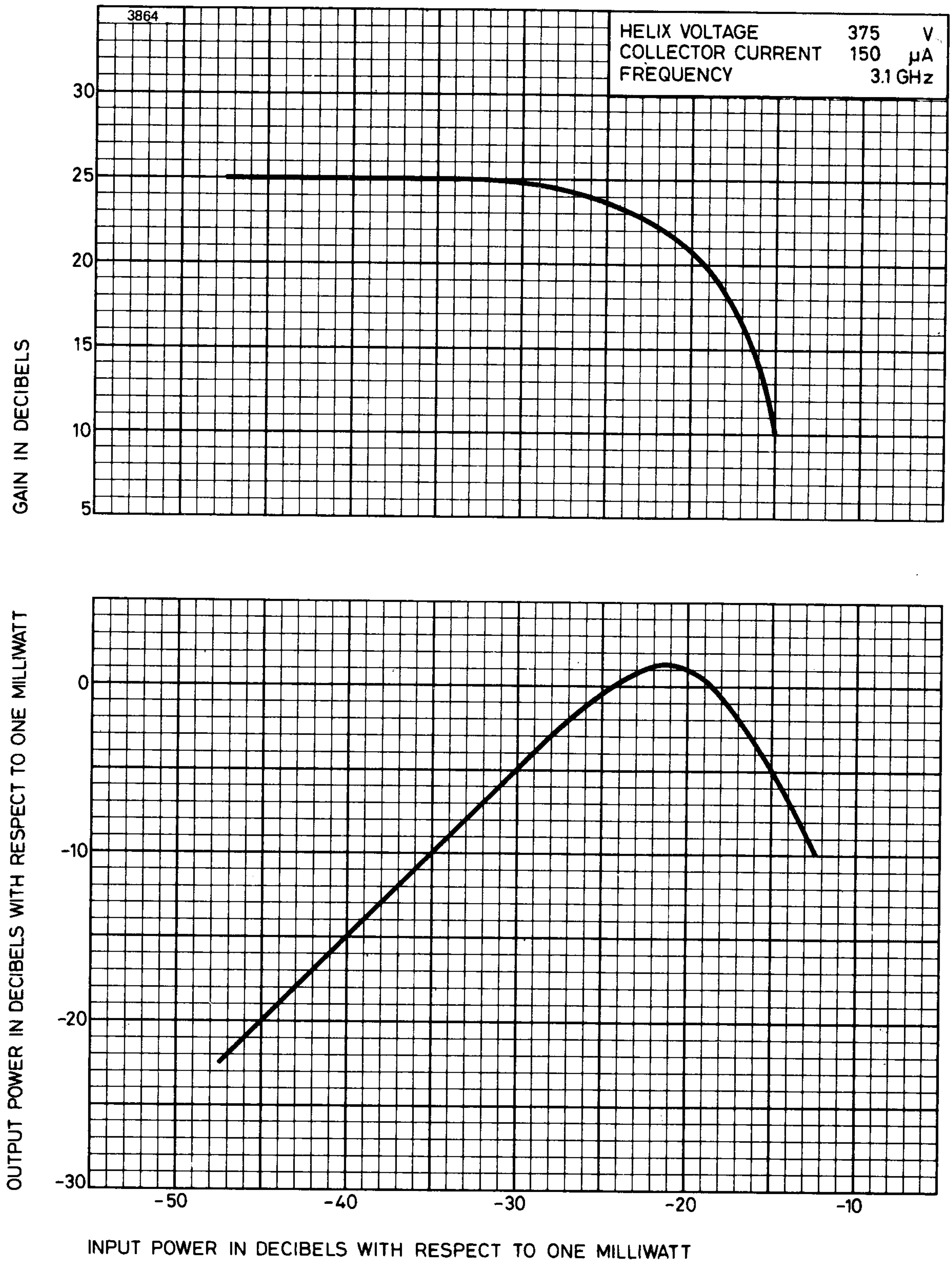


TYPICAL PERFORMANCE CHARACTERISTICS

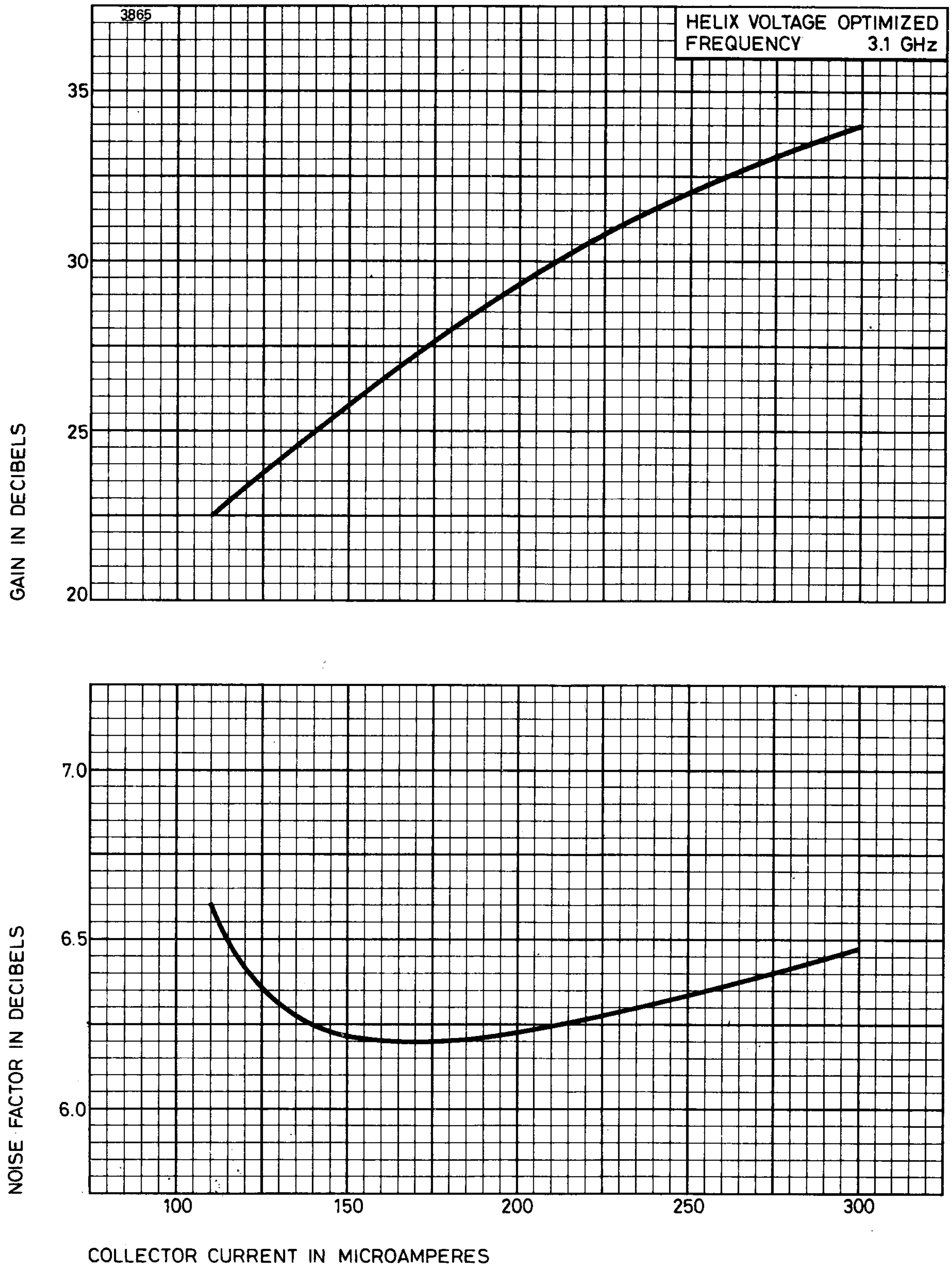




TYPICAL PERFORMANCE CHARACTERISTICS

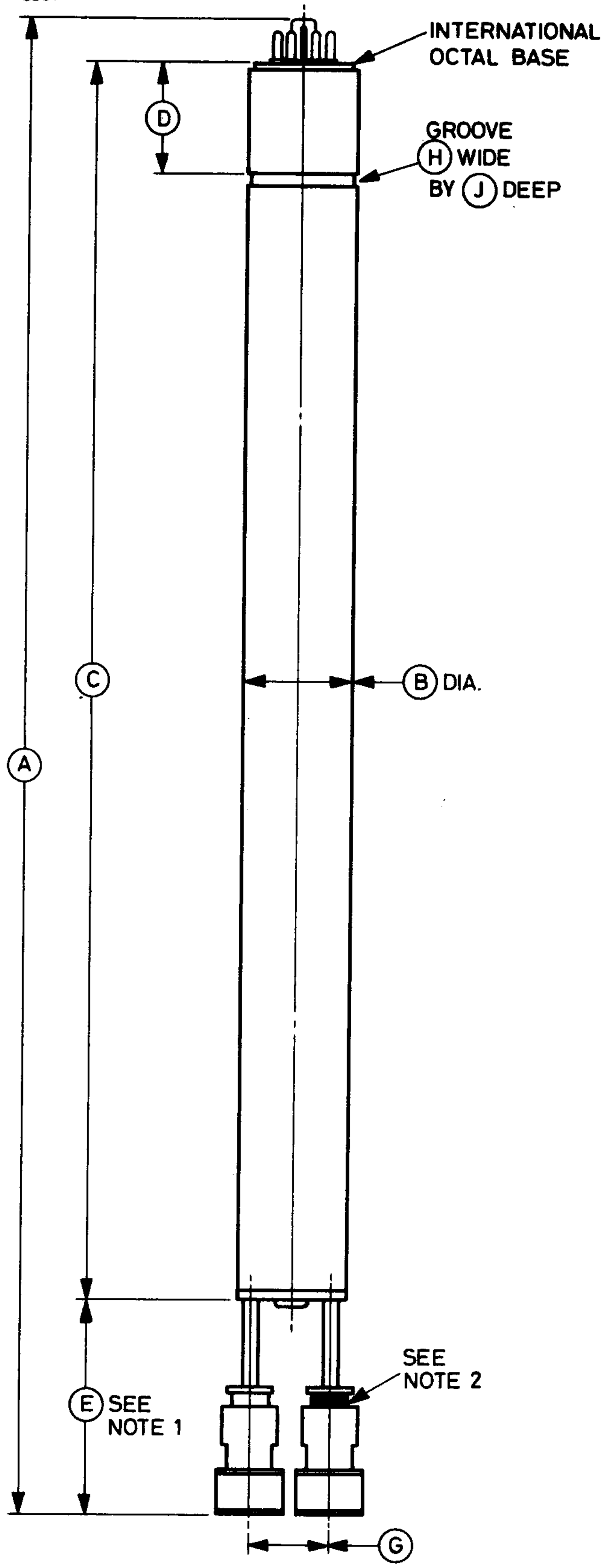


TYPICAL PERFORMANCE CHARACTERISTICS

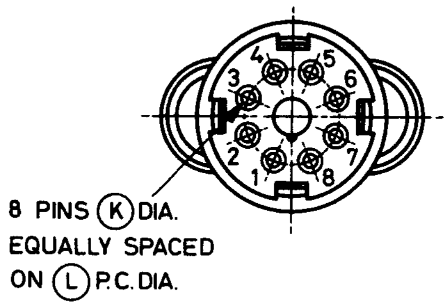


OUTLINE

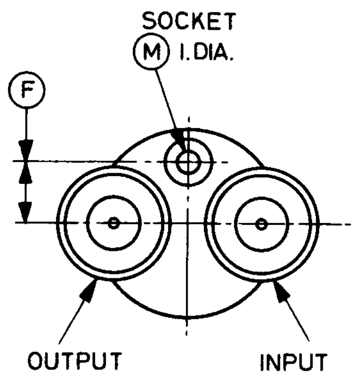
3861



Enlarged View on Base



Enlarged View on Connectors



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	19.375 max	492.1 max	G	1.000 ± 0.125	25.40 ± 3.18
B	1.380 max	35.05 max	H	0.145	3.68
C	15.843 ± 0.032	402.4 ± 0.81	J	0.042	1.07
D	1.428 ± 0.015	36.27 ± 0.38	K	0.093 ± 0.003	2.362 ± 0.076
E	2.750 ± 0.250	69.85 ± 6.35	L	0.687	17.45
F	0.400 ± 0.005	10.16 ± 0.13	M	0.158	4.00

Millimetre dimensions have been derived from inches except dimension M.

Connections

Pin	Element
1	Grid 1
2	No connection
3	Helix
4	Grid 4
5	Grid 3
6	Grid 2
7	Heater
8	Heater, cathode
Socket	Collector

Outline Notes

1. The two connectors will not necessarily be at the same level but both will be within the maximum dimension.
2. Coaxial plug connectors 50Ω type N. The input connector is indicated by a black band.

N1047M

LOW NOISE
TRAVELLING WAVE TUBE

Service Type CV8908

ABRIDGED DATA

Low noise travelling wave tube for use in the input stage of radar and other microwave receivers, and in i.f. amplifier service. The tube is contained in a metal canister and is fitted with coaxial input and output connectors. A separate focusing solenoid is required.

Frequency range	2.7 to 3.2	GHz
Saturation output power	1.5	mW
Noise factor	4.0	db
Low level gain	24	db
Recommended solenoid		N4041

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	5.0	V
Heater current	0.3	A
Heater starting current (peak)	4.0	A max
Cathode heating time (minimum) (see note 1)	2.0	min

Mechanical

Overall length	18.000 inches (457.2mm) max
Canister diameter	1.400 inches (35.56mm) max
Net weight	1.75 pounds (800g) approx
R.F. connections	50Ω coaxial plug connectors type 'N' U.S. military no. UG-1185/U
Base	international octal
Collector connection (earthed)	tag and screw to hole tapped 4BA
Mounting position	any

MAXIMUM AND MINIMUM RATINGS (Absolute values) (see note 2)

No individual rating to be exceeded

	Min	Max	
Collector voltage	400	1100	V
Collector current	–	200	μA
Helix voltage	–	500	V
Helix current (see note 3)	–	5.0	μA
Grid 4 voltage	–	500	V
Grid 3 voltage	–	150	V
Grid 1 and 2 voltage	–	20	V
Heater voltage	4.75	5.25	V
Magnetic field (see note 4)	60	–	mT
	600	–	gauss
Peak r.f. input power	–	75	W
Mean r.f. input power	–	0.3	W
Canister temperature (at hottest point)	–	150	°C

TYPICAL OPERATION (at 2.9GHz)

Operational Conditions (see note 2)

Heater voltage	5.0	V
Collector voltage (see note 5)	800	V
Collector current	130	μA
Helix voltage (see notes 6 and 7)	375	V
Grid 4 voltage (see note 7)	230	V
Grid 3 voltage (see note 7)	25	V
Grid 1 and 2 voltage (see note 8)	8.5	V
Magnetic field (see notes 9 and 10)	140	mT
	1400	gauss

Continued on page 3

Typical Performance

Helix current (see note 7)	0.5	μA
Grid 4 current	less than 1	μA
Grid 3 current	less than 1	μA
Grid 1 and 2 current	50	μA
Cold insertion loss	70	db
Gain	24	db
Noise factor (see note 7)	4.0	db
Output power (saturated)	1.5	mW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(Over the frequency range 2.7 to 3.2GHz)

Recommended Applied Conditions (see note 2)

Heater voltage (see note 11)	5.0	V
Collector voltage (see note 5)	800	V
Collector current (see note 8)	100 to 200	μA
Helix voltage (see notes 6 and 7)	350 to 400	V
Grid 4 voltage (see note 7)	150 to 400	V
Grid 3 voltage (see note 7)	0 to 50	V
Grid 1 and 2 voltage (see note 8)	0 to 20	V
Magnetic field (see notes 9 and 10)	140 ± 7	mT
	1400 ± 70	gauss

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.2	0.5	A
Helix current	—	5	μA
Grid 4 current	—	10	μA
Grid 3 current	—	10	μA
Grid 1 and 2 current	—	100	μA
Gain	21	27	db
Noise factor	—	4.5	db
Output power (saturated)	1.0	—	mW
Tube input v.s.w.r. (see note 12)	—	1.7:1	
Tube output v.s.w.r. (see note 12)	—	2.0:1	

NOTES

1. The time between the application of full heater voltage and the application of h.t. voltages. In the event of a power supply failure of less than 10 seconds duration, all voltages may be re-applied simultaneously.
2. All voltages apart from the heater voltage are with respect to the cathode. It may sometimes be convenient to earth the collector and maintain the cathode at a negative potential.
3. During alignment in the magnetic focusing field this maximum value of helix current may be exceeded for short periods, but must never exceed $25\mu A$.
4. This minimum value of magnetic field strength will focus the electron beam but the optimum noise figure will not be obtained.
5. It is necessary to maintain the collector positive with respect to the helix. Fluctuations in collector voltage should be less than $\pm 10\%$.
6. The helix voltage should be set to the optimum value for the frequency of operation and stabilized to within $\pm 1\%$.
7. In order to operate the tube at the lowest noise factor it is necessary to adjust the electrode voltages as follows. After a cathode pre-heating time of at least 2 minutes, switch on the h.t. voltage with grid 1 and 2 voltage at zero and the other voltages at the values specified under Typical Operation on page 2. Slowly increase the grid 1 and 2 voltage, adjusting the centring of the tube in the magnetic field to obtain minimum helix current, until the specified collector current is reached. With a signal or noise input applied to the tube, adjust the helix voltage to give maximum output. This value of helix voltage simultaneously produces optimum gain and minimum noise factor. Next, with no input signal, vary grid 3 and grid 4 voltages alternately until the receiver output reaches a minimum. The voltages reached in this way are those which will operate the N1047M at the lowest noise factor for the particular frequency to which the equipment is tuned. For wide band operation these adjustments should be carried out at the centre frequency. If the focusing field changes, it will be necessary to repeat the adjustment above. Grid 3 and grid 4 voltages should be stabilized to within $\pm 5\%$.

8. Grid 1 and 2 voltage is adjusted to give the correct collector current and should be stabilized to within ±5%.

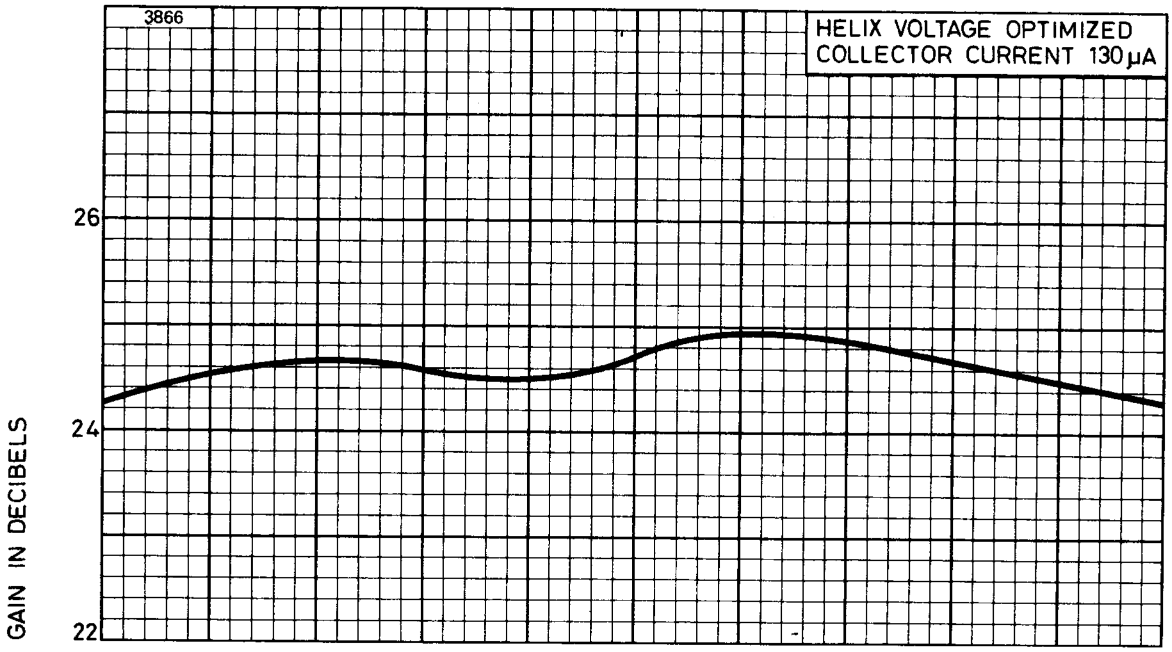
9. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.

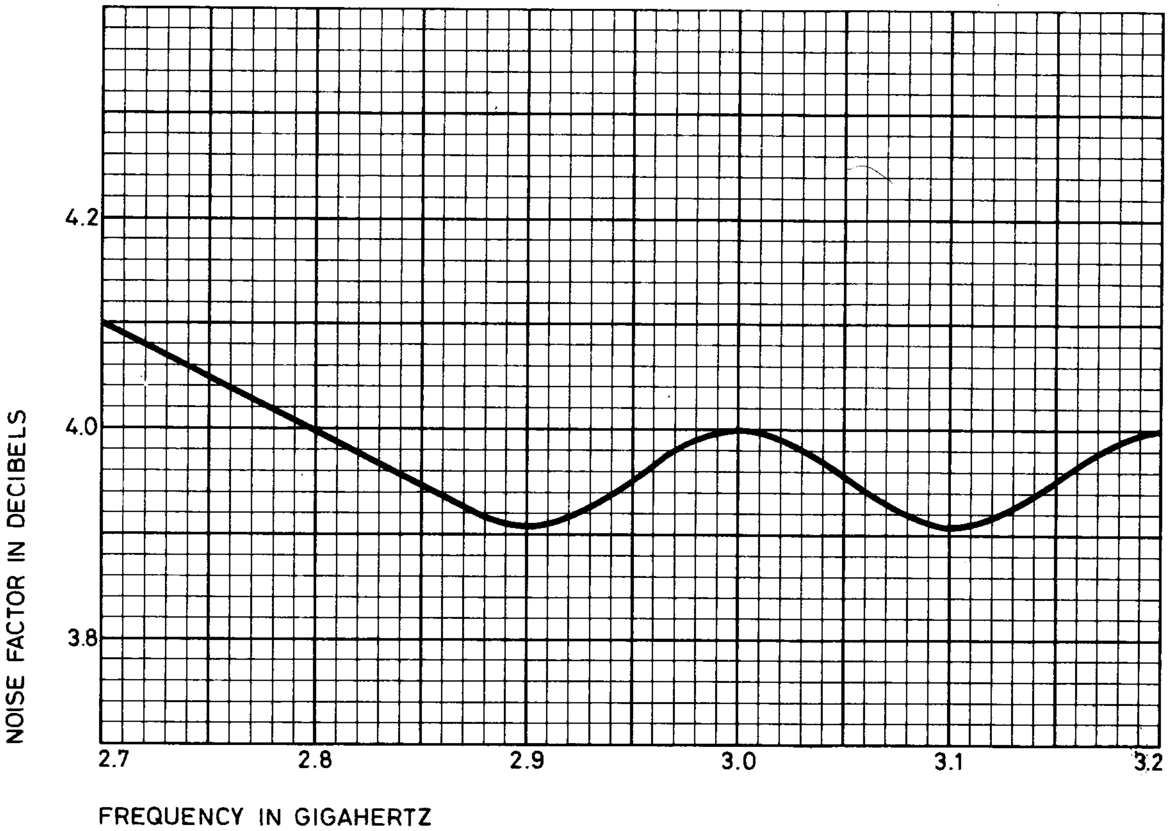
10. Provision must be made for aligning the tube in the solenoid. An adjustment of ±0.100 inch (±2.54mm) about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the EEV lightweight solenoid type N4041 is recommended.

11. Tolerance ±5%.

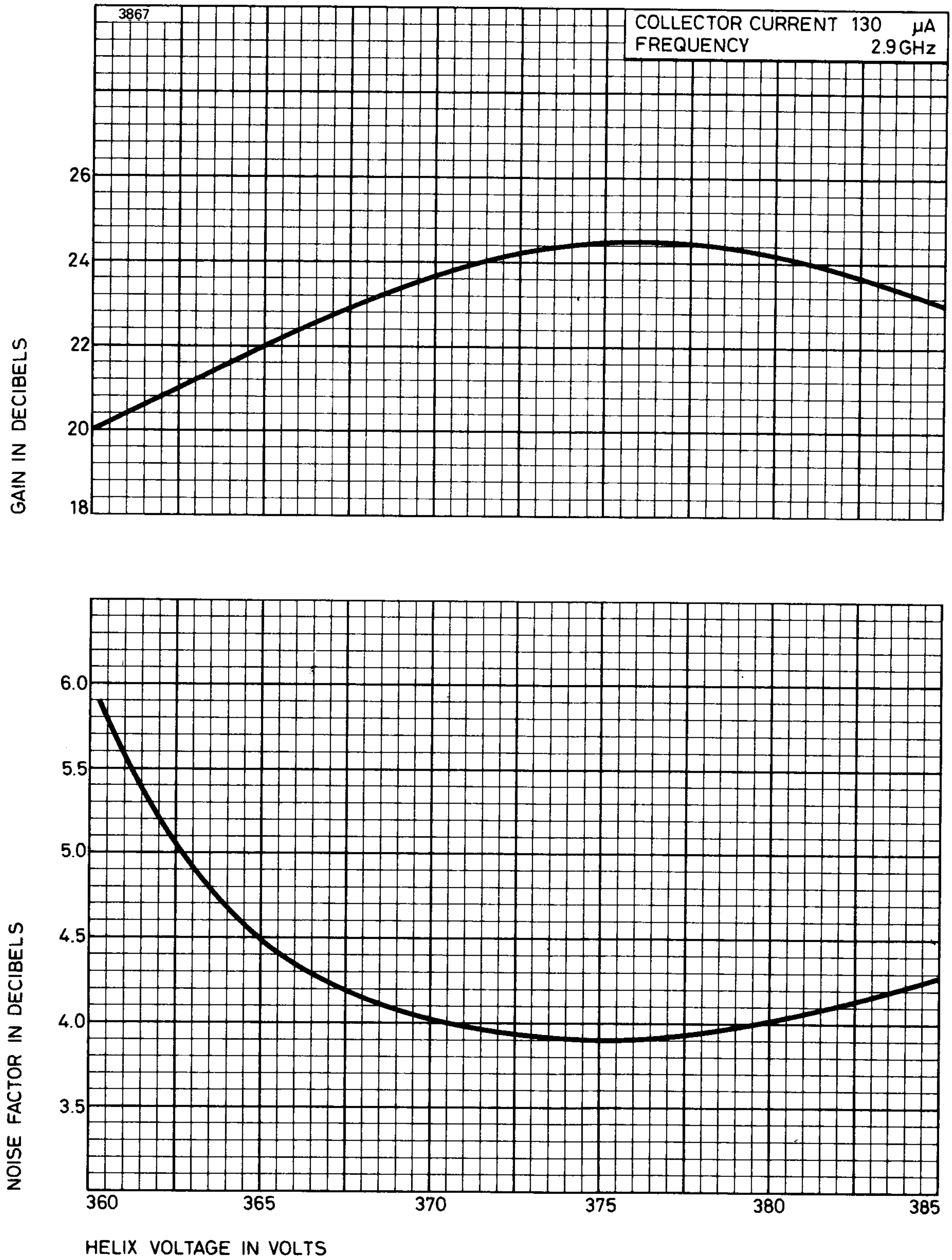
12. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

TYPICAL PERFORMANCE CHARACTERISTICS

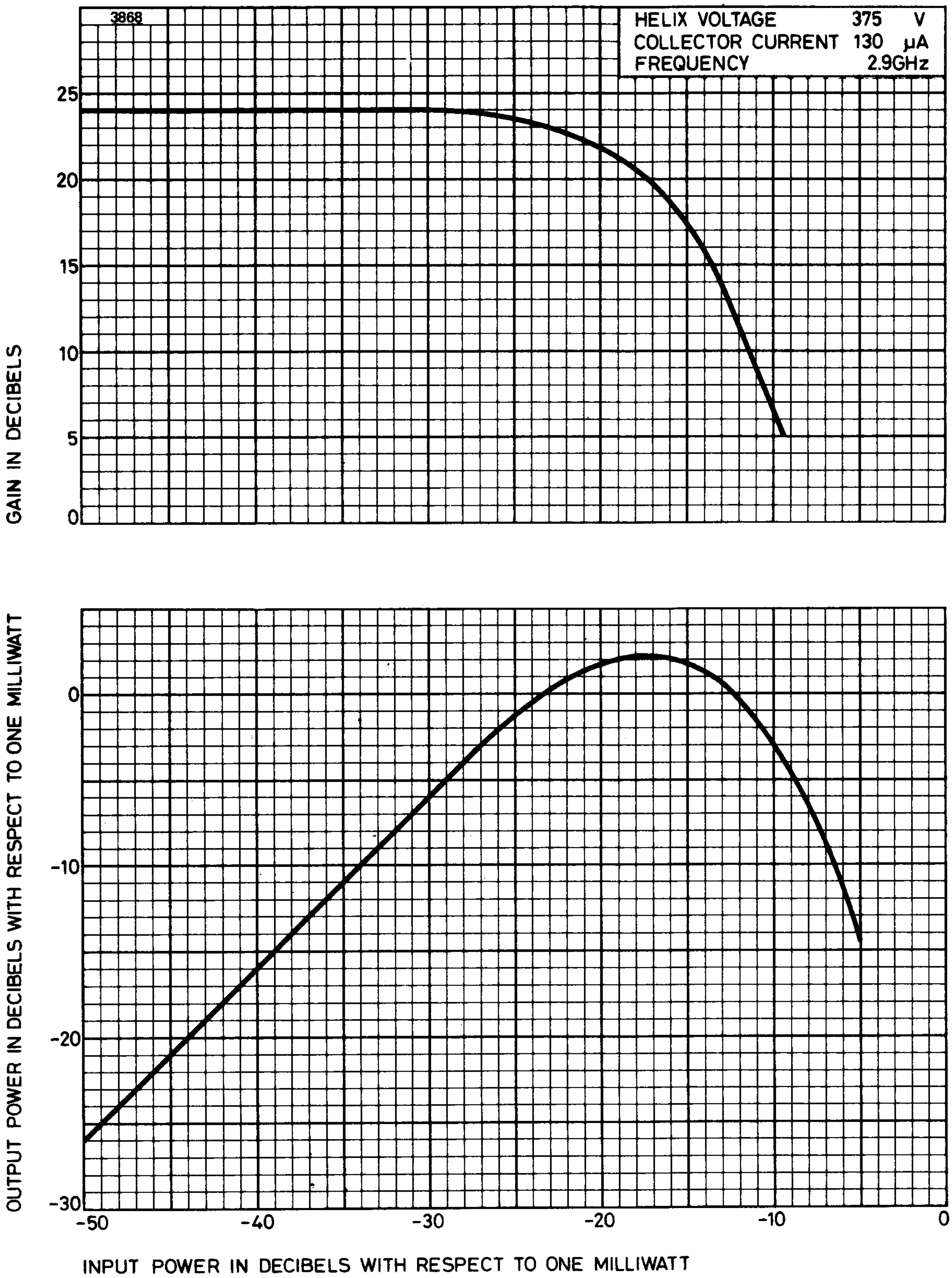




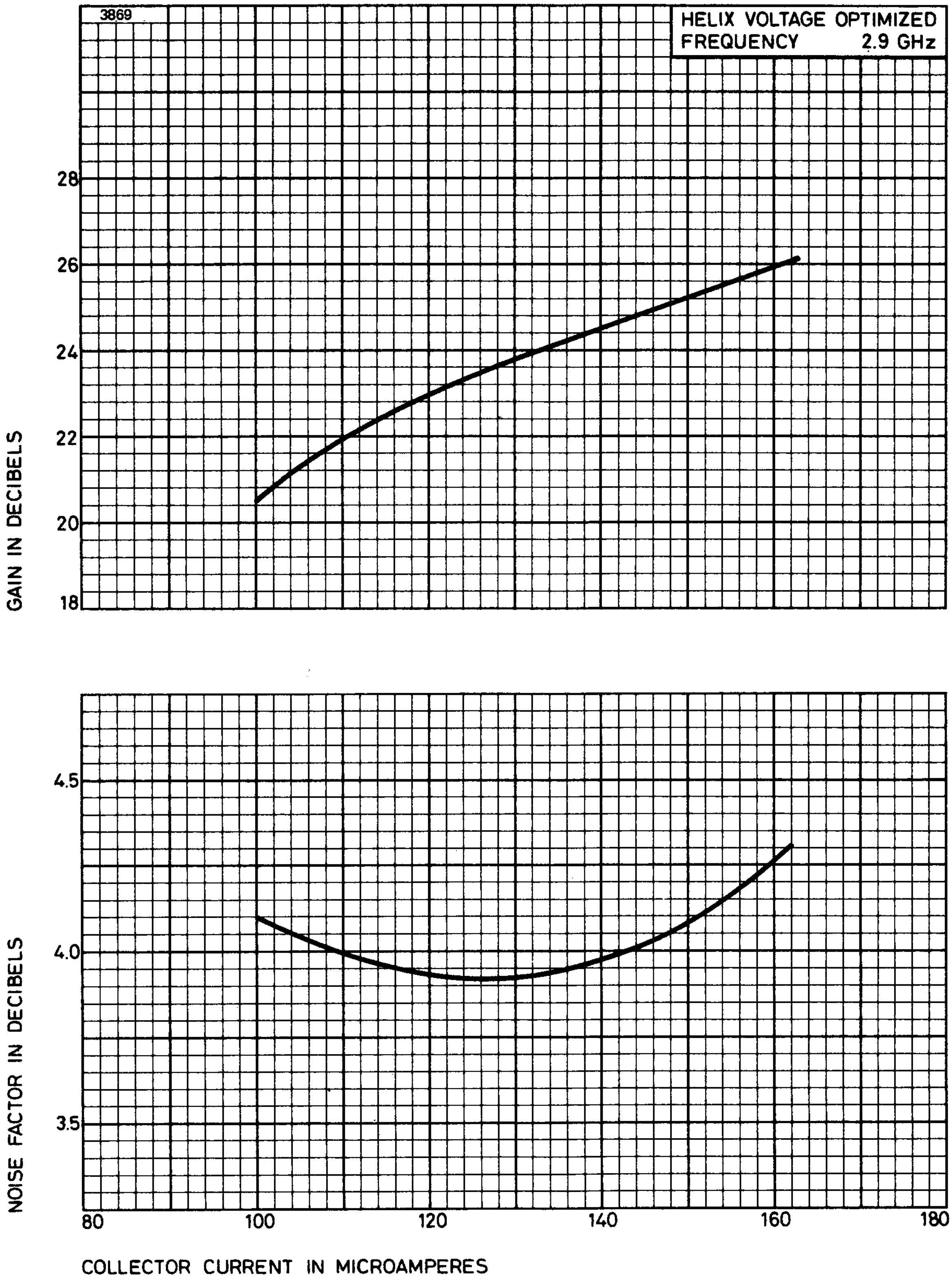
TYPICAL PERFORMANCE CHARACTERISTICS



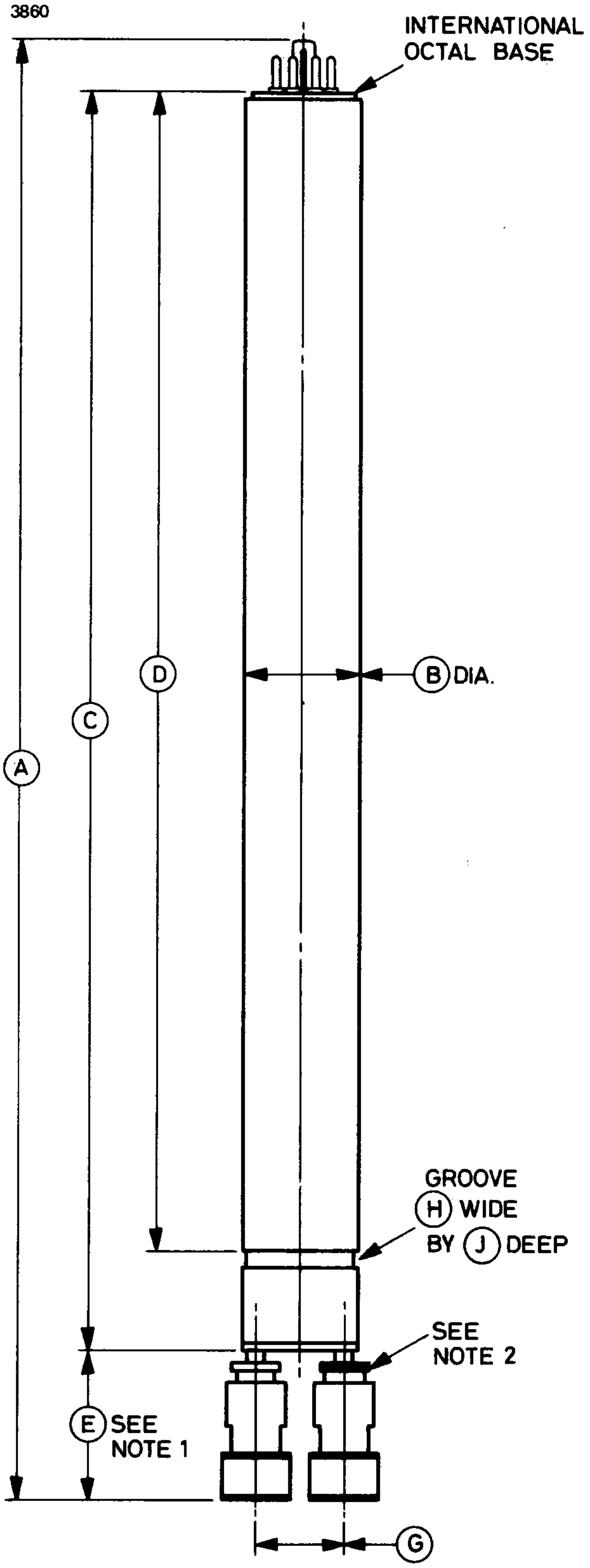
TYPICAL PERFORMANCE CHARACTERISTICS



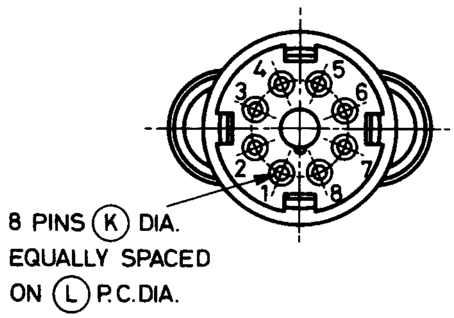
TYPICAL PERFORMANCE CHARACTERISTICS



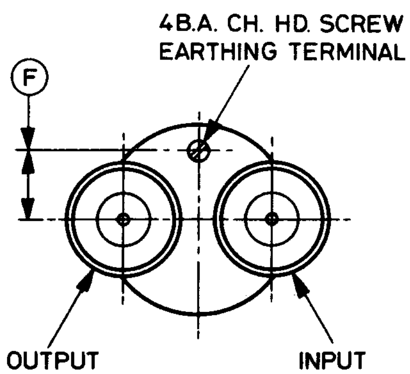
OUTLINE



Enlarged View on Base



Enlarged View on Connectors



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	18.000 max	457.2 max	G	1.062 ± 0.020	26.97 ± 0.51
B	1.400 max	35.56 max	H	0.156	3.96
C	15.325 ± 0.050	389.3 ± 1.3	J	0.015	0.38
D	14.090 ± 0.050	357.9 ± 1.3	K	0.093 ± 0.003	2.362 ± 0.076
E	1.800 max	45.72 max	L	0.687	17.45
F	0.500	12.70			

Millimetre dimensions have been derived from inches

Connections

Pin	Element
1	Grid 1 and 2
2	No connection
3	Helix
4	Grid 4
5	Grid 3
6	No connection
7	Heater
8	Heater, cathode
4B.A. Screw	Collector

Outline Notes

1. The two connectors will not necessarily be at the same level but both will be within the maximum dimension.
2. Coaxial plug connectors 50Ω type N. The input connector is indicated by a black band.

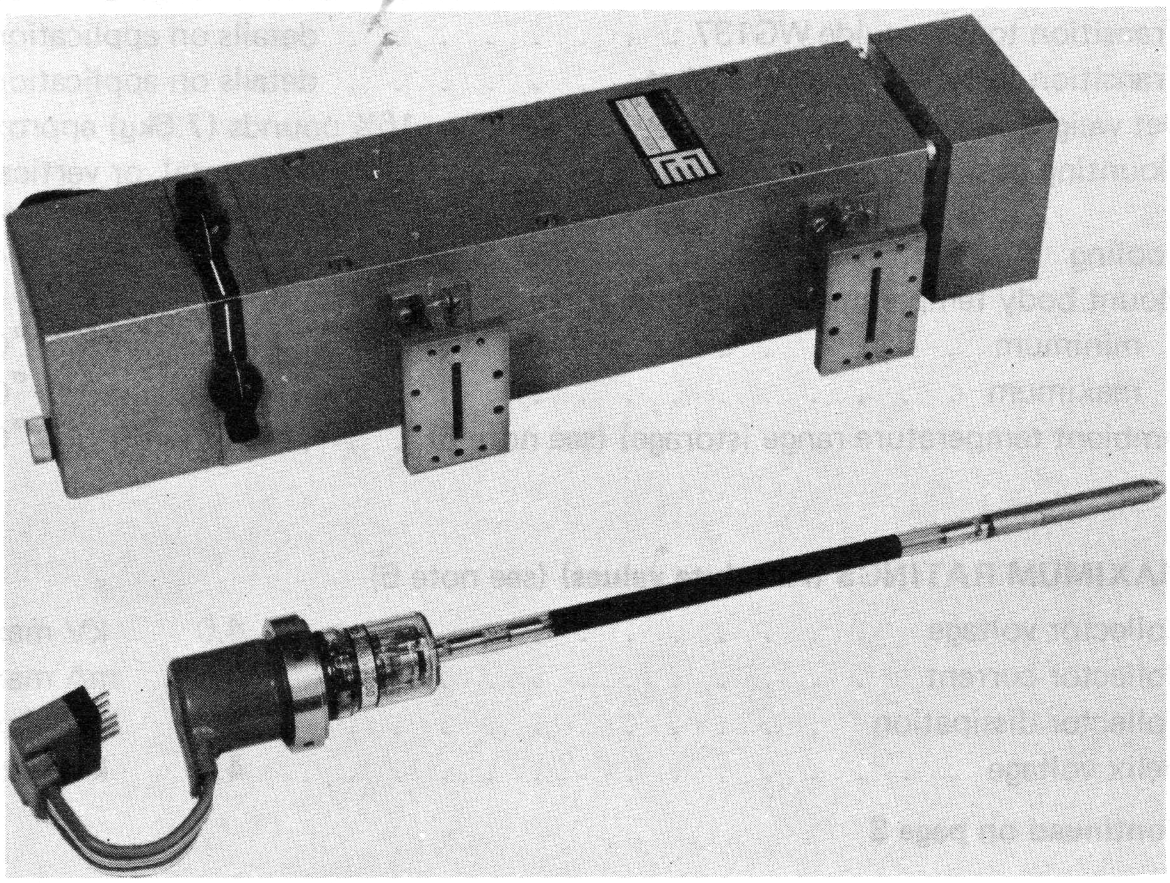
N1055

5.85–7.15GHz 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 relatively simple operation.

Frequency range	5.85 to 7.15	GHz
Saturation output power (nominal, see note 1)	18	W
Working output power (see note 1)	5 to 10	W
Nominal gain at 10W output	43	db
Noise factor	27	db
AM/PM conversion (at 10W output)	1.0	degree/db



June 1973

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 Mount (see note 4)

Two frequency variants of the conduction cooled mount are available:

frequency range 5.85 to 6.45GHz		N4085
frequency range 6.45 to 7.15GHz		N4094
R.F. connections on mount	waveguide, 1.372 x 0.125 inch internal, with modified RETMA flange CMR137	
Transition to waveguide WG137	details on application	
Transition to type N coaxial socket	details on application	
Net weight	16½ pounds (7.6kg) 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
Grid 2 voltage	4.0	kV max
Grid 2 current	0.5	mA max
Grid 1 voltage (negative value, never positive)	150	V max
Heater voltage	6.6	V max
Collector temperature	275	°C max
Mount temperature range (operating), excluding conduction block or heat sink (see note 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 6.5GHz)

	5W Output	10W Output	
Operational Conditions (see note 6)			
Collector voltage	1.8	2.0	kV
Collector current (see note 7)	40	45	mA
Helix voltage (see note 8)	3.37	3.40	kV
Grid 2 voltage (see note 7)	3.55	3.75	kV
Grid 1 voltage (see note 7)	–45	–45	V
Typical Performance			
Helix current	0.2	0.3	mA
Grid 2 current	0.1	0.1	mA
Grid 1 current	zero	zero	
Gain at 5.0W output	42	–	db
Gain at 10W output	–	43	db
Saturation output power (see note 9)	14	18	W
Maximum saturation output power (see note 10)	20	22	W
Noise factor	27	27	db
Cold insertion loss	60	60	db
Input v.s.w.r. over the band (see note 11)	1.5:1	1.5:1	max
Output v.s.w.r. over the band (see note 11)	1.5:1	1.5:1	max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 5W Output Power Operation) (see note 1)

Recommended Applied Conditions (see note 6)

Frequency range	5.85 to 7.15	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage	1.8	kV
Collector current (see note 7)	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	0.75	1.0	A
Helix voltage	3.2	3.7	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	1.5	mA
Grid 2 voltage (see note 7)	3.5	3.7	kV
Grid 2 current	–	0.5	mA
Grid 1 voltage (negative value) (see note 7)	0	80	V
Input power	–	0.5	mW
Saturation output power (see note 9)	10	–	W
Noise factor (see note 12)	–	28	db
Gain flatness (see note 13)	–	0.01	db/MHz
AM/PM conversion (see note 14)	–	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 11)	–	1.5:1	
Output v.s.w.r. (hot) (see note 11)	–	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	5.85 to 7.15	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage	2.0	kV
Collector current (see note 7)	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	0.75	1.0	A
Helix voltage	3.2	3.7	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	1.5	mA
Grid 2 voltage (see note 7)	3.7	3.9	kV
Grid 2 current	–	0.5	mA
Grid 1 voltage (negative value) (see note 7)	0	80	V
Input power	–	1.0	mW
Saturation output power (see note 9)	14	–	W
Noise factor (see note 12)	–	28	db
Gain flatness (see note 13)	–	0.01	db/MHz
AM/PM conversion (see note 14)	–	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 11)	–	1.5:1	
Output v.s.w.r. (hot) (see note 11)	–	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 heating time for a tube on initial installation is 2½ minutes minimum; this time may be reduced to one minute minimum for subsequent switching on.
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. The collector current is set to the recommended value by adjustment of the potentials applied to grid 1 and grid 2, in such a way as to ensure minimum helix current.
8. 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.
9. With the helix voltage fixed and only the input power adjusted for maximum output.
10. With both the helix voltage and input power adjusted for maximum output. The tube must not be operated continuously under these conditions.
11. The matching adjustments on the mount are preset during manufacture. With any tube operated in the mount under the recommended applied conditions, the v.s.w.r. will remain below the quoted value over the specified frequency range of the mount.
12. 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.
13. Over the recommended frequency range.
14. 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 N1055 IN P.P.M. MOUNTS N4085 AND N4094

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

A. Power Supply

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

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

(3) During switch-off, the grid 2 voltage should be reduced before all other voltages or excessive currents may be drawn.

(4) The grid 1, grid 2 and helix voltages should be stabilized to $\pm 2\%$.

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

B. Initial Installation of Travelling Wave Tube

(1) Before inserting the travelling wave tube the focusing screws on the mount must be set to a central position 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 grid 2 voltage until all other voltages have reached their full operating values.

(3) Set helix voltage to 3500 volts, grid 2 to 3700 volts and grid 1 to −50 volts, with zero r.f. input.

(4) Adjust the focusing screws until the helix current is reduced to a minimum.

(5) Adjust grid 1 and grid 2 voltages in turn to achieve the required collector current, with minimum helix current.

(6) Finally with r.f. drive applied, repeat steps (4) and (5) to achieve minimum helix current.

Note Reduction of the negative voltage on grid 1 increases the cathode current. If this does not produce a corresponding increase in collector current, the tube is operating with too low a negative voltage on grid 1, causing interception of current by grid 2. This situation must be avoided, as it will damage the tube.

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 one minute minimum cathode preheating time.

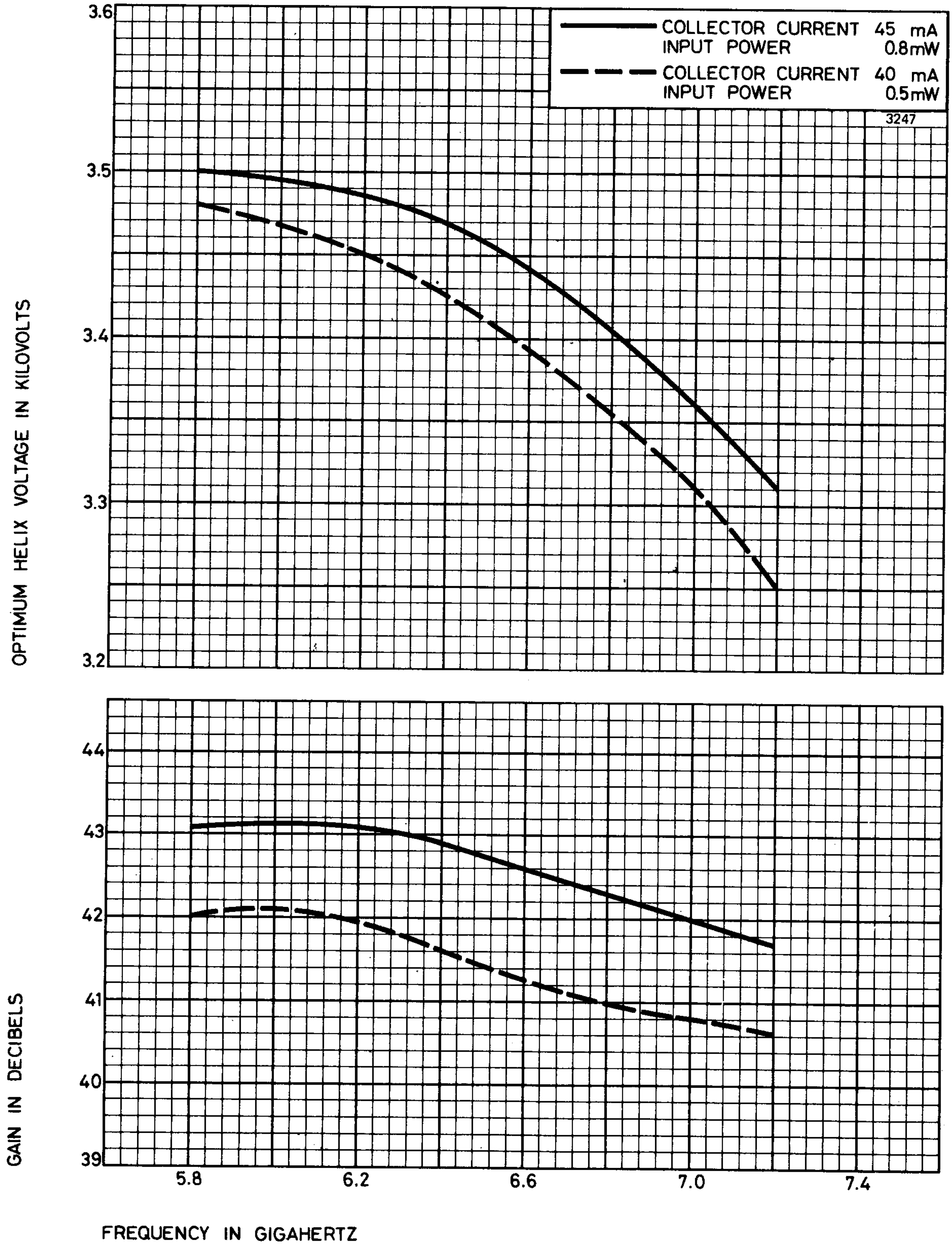
(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

E. Supply Interruption

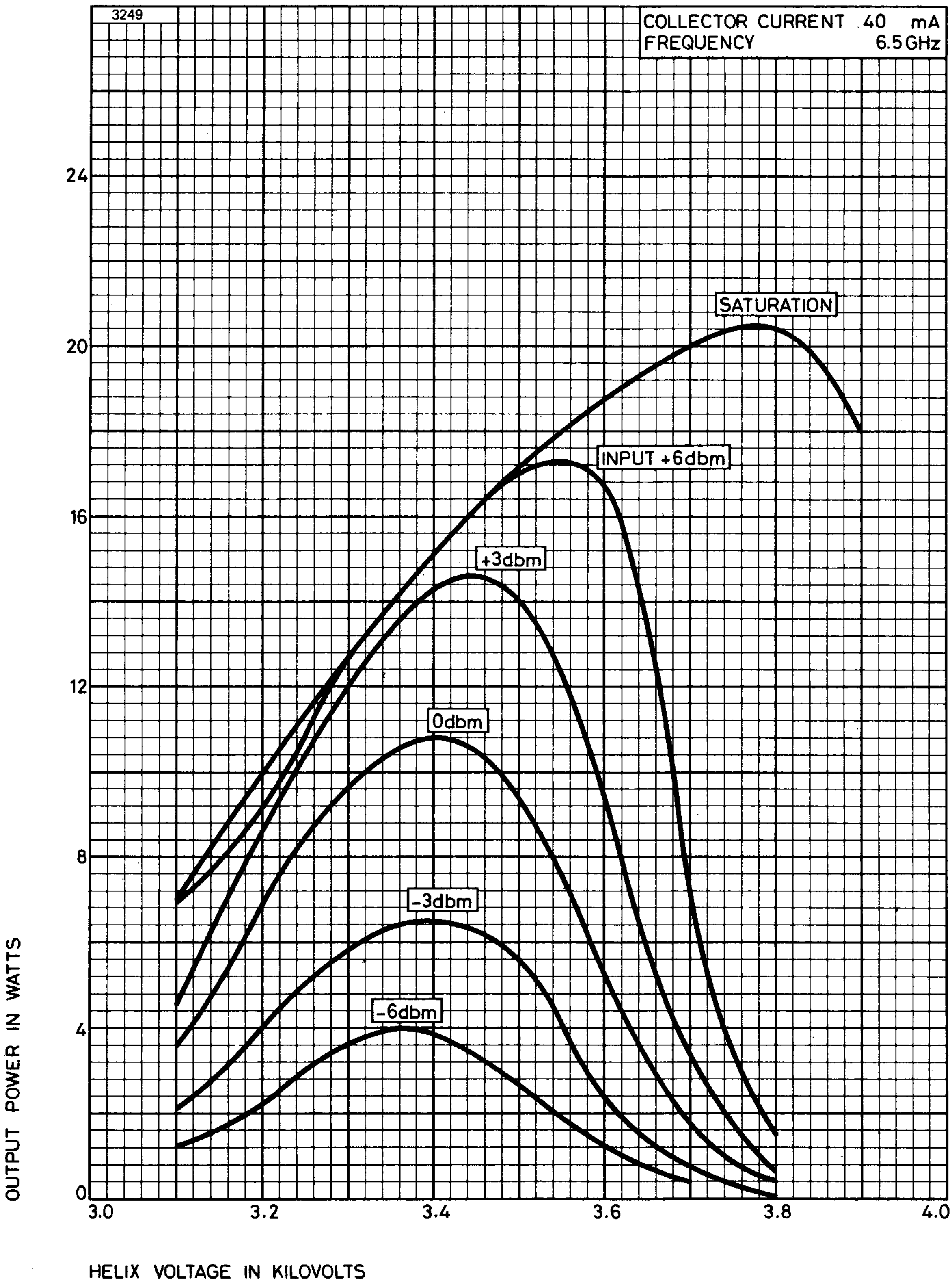
(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting grid 2 voltage which must be delayed as in C(2) above.

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

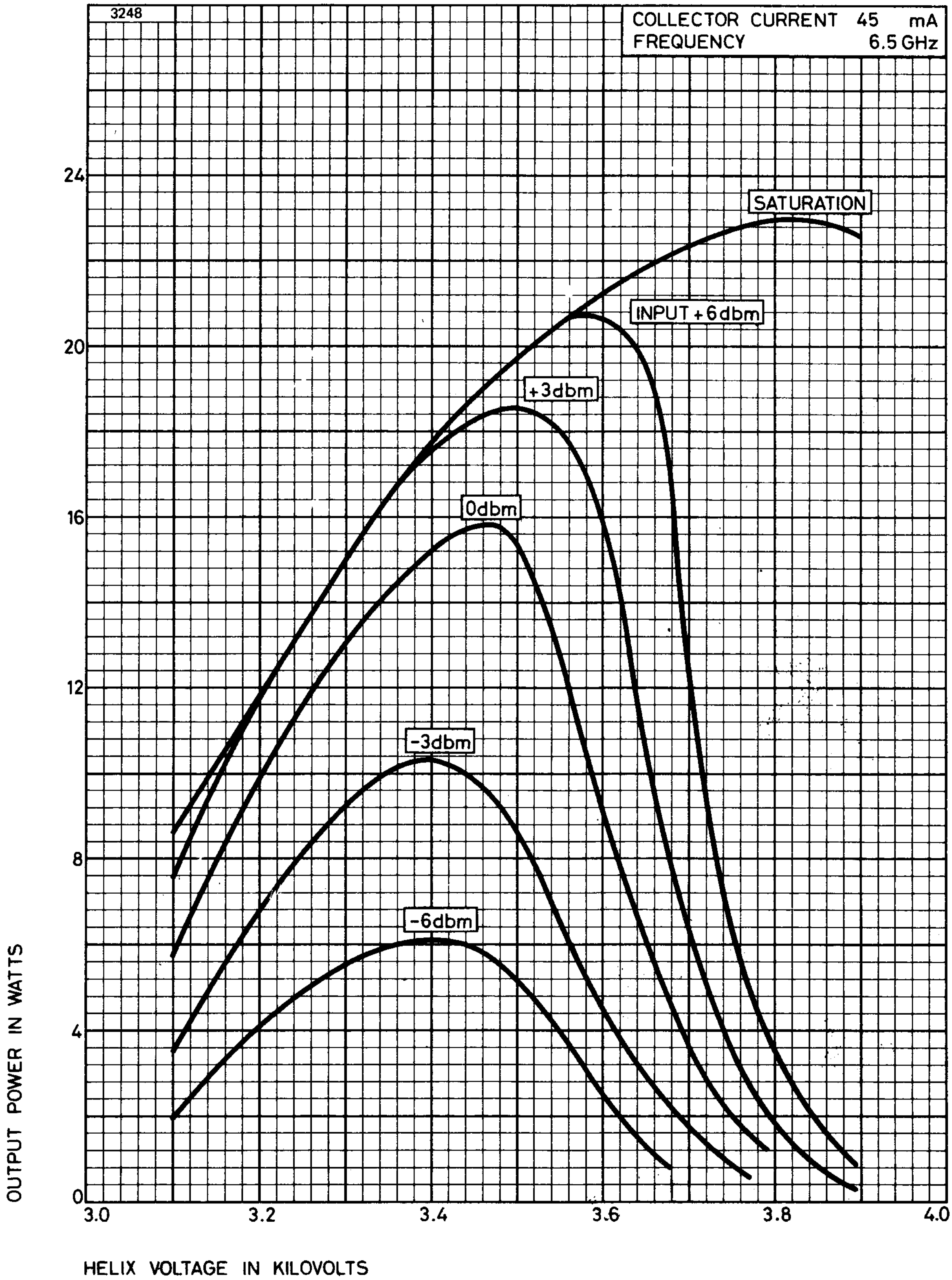
TYPICAL PERFORMANCE CHARACTERISTICS



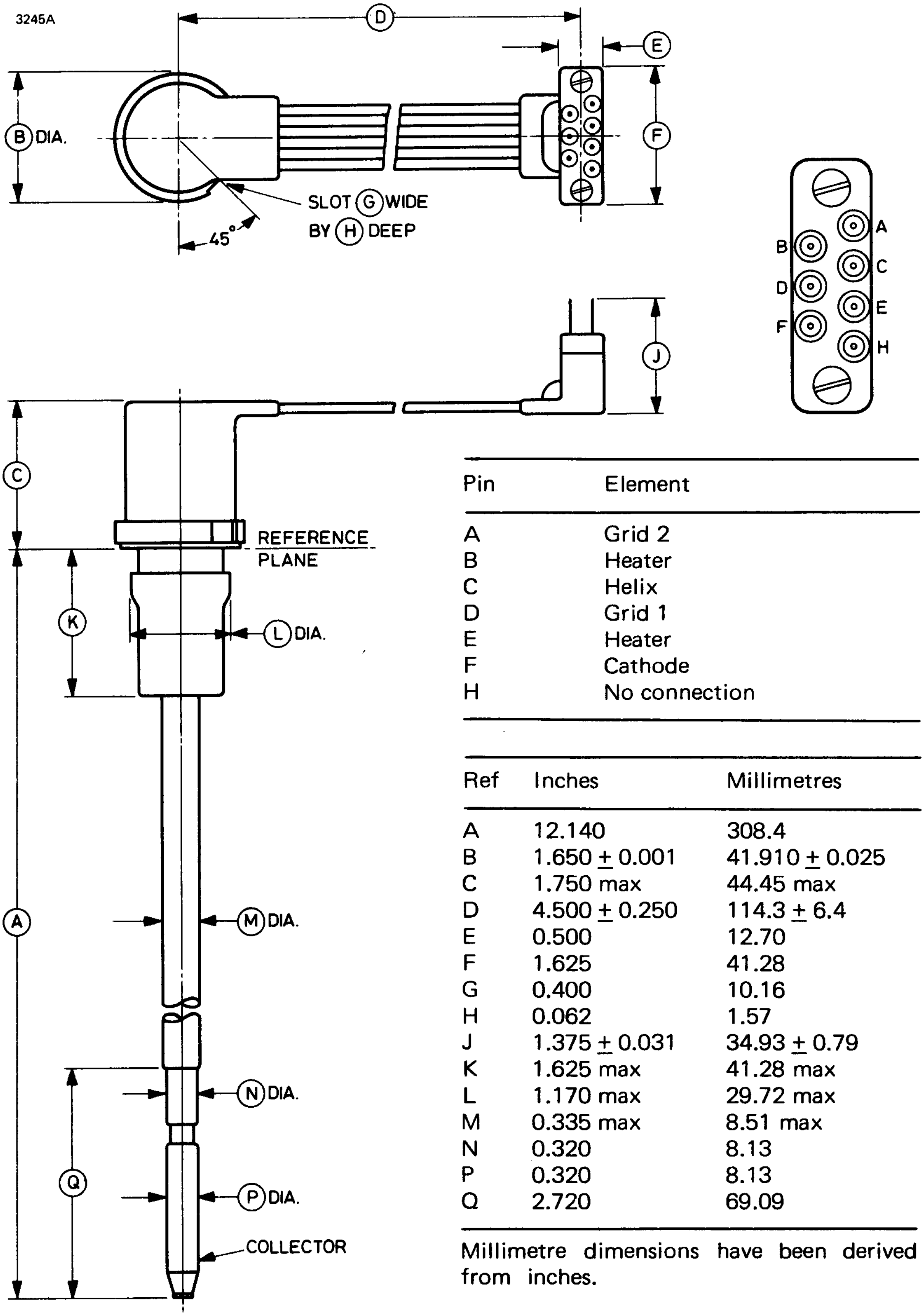
TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



N1055 OUTLINE (All dimensions without limits are nominal)

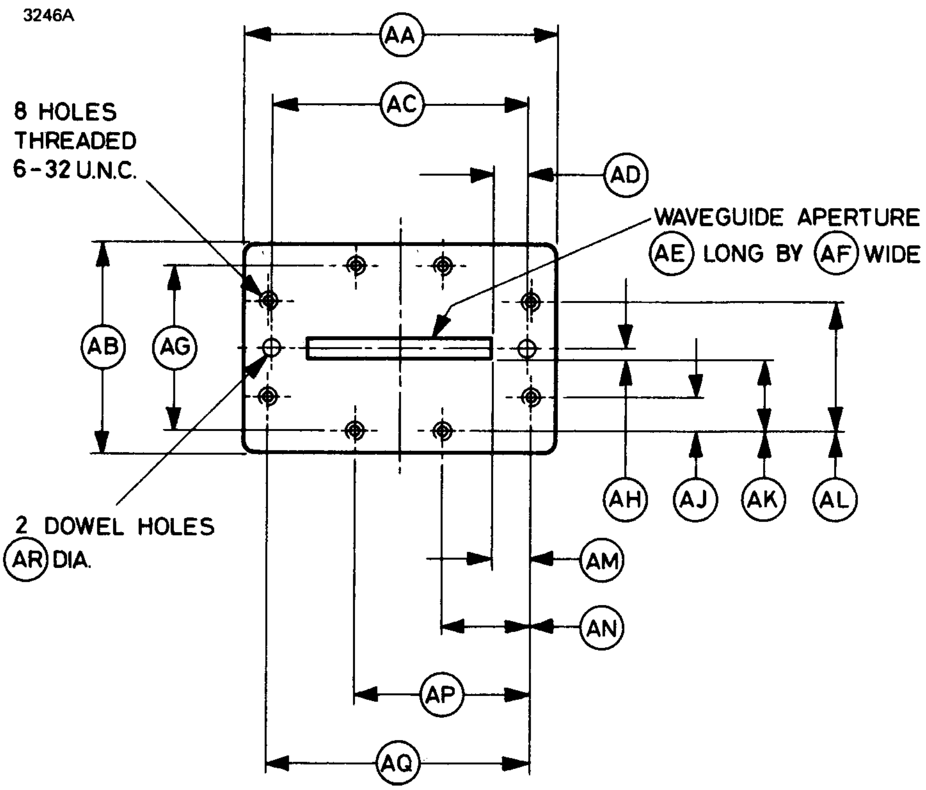


Pin	Element
A	Grid 2
B	Heater
C	Helix
D	Grid 1
E	Heater
F	Cathode
H	No connection

Ref	Inches	Millimetres
A	12.140	308.4
B	1.650 ± 0.001	41.910 ± 0.025
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	1.625 max	41.28 max
L	1.170 max	29.72 max
M	0.335 max	8.51 max
N	0.320	8.13
P	0.320	8.13
Q	2.720	69.09

Millimetre dimensions have been derived from inches.

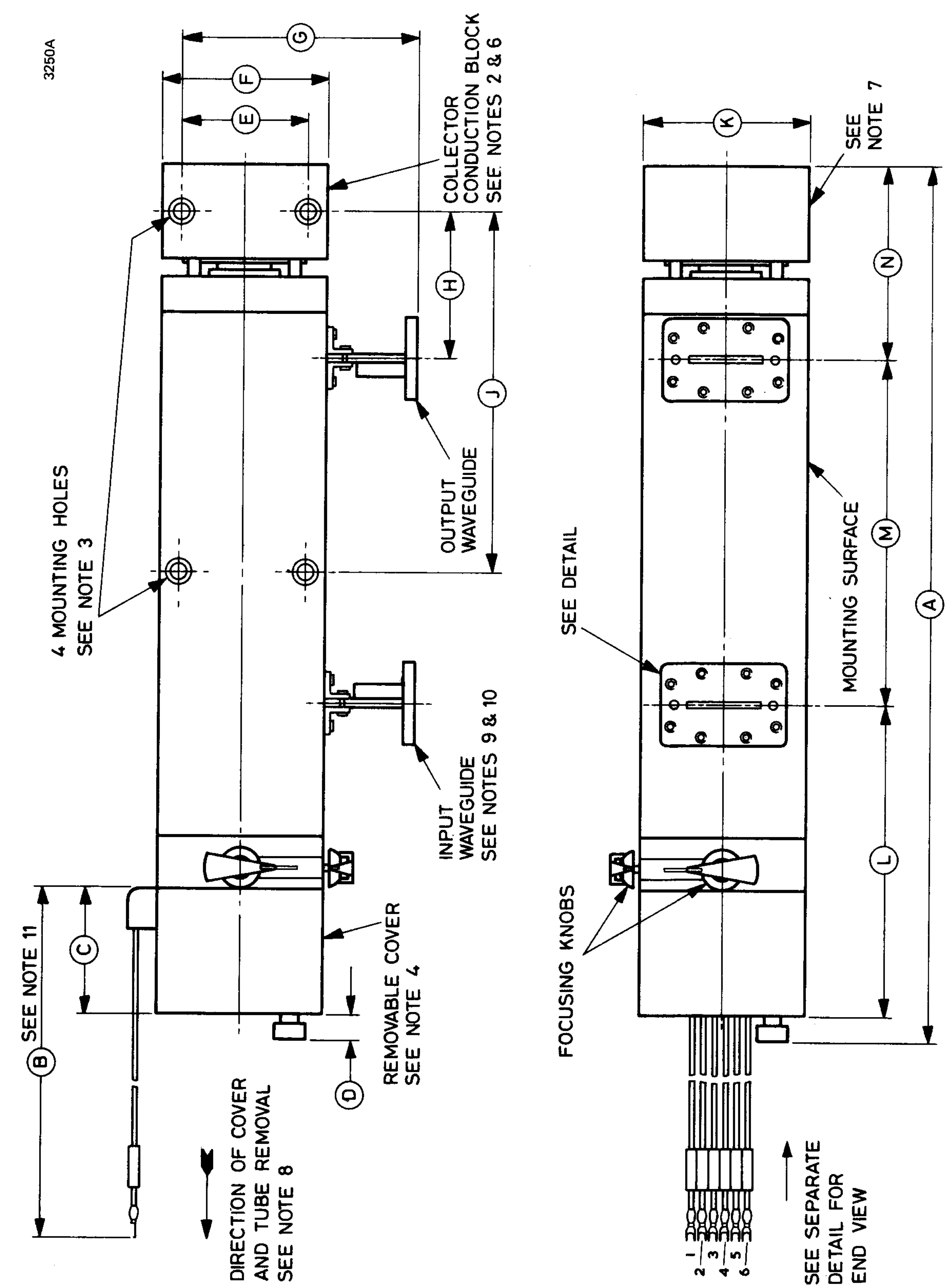
WAVEGUIDE FLANGE (All dimensions without limits are nominal)



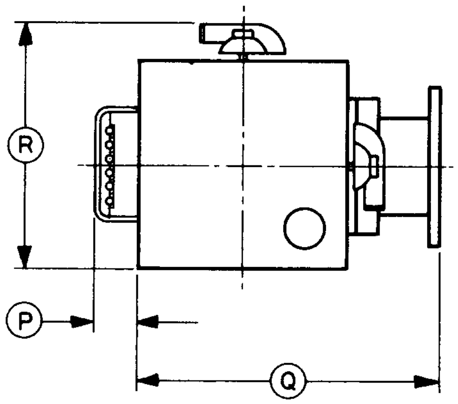
Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	2.281	57.94	AK	0.5275 ± 0.002	13.399 ± 0.051
AB	1.531	38.89	AL	0.933 ± 0.004	23.698 ± 0.102
AC	1.875 ± 0.002	47.625 ± 0.051	AM	0.279 ± 0.002	7.087 ± 0.051
AD	0.2515 ± 0.002	6.388 ± 0.051	AN	0.643 ± 0.004	16.332 ± 0.102
AE	1.372 ± 0.004	34.849 ± 0.102	AP	1.287 ± 0.004	32.690 ± 0.102
AF	0.125 ± 0.004	3.175 ± 0.102	AQ	1.930 ± 0.004	49.022 ± 0.102
AG	1.180 ± 0.004	29.972 ± 0.102	AR	0.129 max	3.277 max
AH	0.0625 ± 0.001	1.588 ± 0.025		0.128 min	3.251 min
AJ	0.247 ± 0.004	6.274 ± 0.102			

Millimetre dimensions have been derived from inches.

N4085 AND N4094 OUTLINE (See Outline Note 1 on page 16)



N4085 AND N4094 OUTLINE



Ref	Inches	Millimetres
A	15.750 max	400 max
B	12.000 nom	304.8 nom
C	2.250 ± 0.015	57.15 ± 0.38
D	0.375 max	9.53 max
E	2.450 ± 0.010	62.23 ± 0.25
F	2.968 ± 0.032	75.39 ± 0.81
G	4.056 ± 0.020	103.0 ± 0.5
H	2.625 ± 0.015	66.68 ± 0.38
J	6.500 ± 0.015	165.10 ± 0.38
K	2.968 ± 0.032	75.39 ± 0.81
L	5.600 max	142.2 max
M	6.245 ± 0.020	158.6 ± 0.5
N	3.500 max	88.90 max
P	0.750 max	19.05 max
Q	4.375 max	111.1 max
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	Green	Grid 1
5	Blue	Grid 2
6	Orange	Helix

OUTLINE NOTES FOR N4085 AND N4094

1. Certain alternative orientations of end cover and focusing screws, and positions of mounting holes, are possible by arrangement.
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.
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 can be fitted on both the input and output waveguides if required.
6. For efficient operation the collector conduction block must be bolted to a heat sink having a thermal impedance of 0.5°C/watt.
7. This surface of the mount is flat to within 0.003 inch (0.076mm). The mating surface must be equally flat and must be smeared with silicone grease before bolting down the mount, to ensure good thermal contact.
8. The overall length of the mount together with an adequate allowance for tube withdrawal is 28 inches (711mm).
9. The waveguide flange is based on RETMA flange CMR137. The fixing holes may be threaded or clearance to suit customers' requirements.
10. Transitions to full size no. 14 waveguide are available.
11. The mount has six screened leads fitted with spade terminals to suit 4BA or 6–32 screws. Alternative lead lengths and terminations can be supplied to suit customers' requirements.

N1056

3.6–5.0GHz 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 relatively simple operation.

Frequency range	3.6 to 5.0	GHz
Saturation output power (nominal)	17	W
Working output power	10	W
Nominal gain	38	db
Noise factor	27	db
AM/PM conversion (at 10W output)	1.0	degree/db

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage (see note 1)	6.3	V
Heater current	0.8	A
Heater starting current (peak)	5.0	A max
Cathode pre-heating time	see note 2	

Mechanical

Tube dimensions	see page 17
Tube base	moulded cap and flexible leads fitted with plug type BA7P
Mounting position	horizontal, or vertical with collector ·ppermost

Focusing Mount (see note 3)

Two mounts are available covering American F.C.C. bands:

frequency range 3.7 to 4.2GHz	N4074
frequency range 4.4 to 5.0GHz	N4075

R.F. connections on mount:

N4074	no. 11A waveguide (WR229) with RETMA flange CMR229
N4075	no. 12 waveguide (WR187) with RETMA flange CMR187

Net weight	17¾ pounds (8.5kg) approx	
Mounting position	horizontal, or vertical with collector uppermost	
Cooling	see note 3	
Ambient temperature range (operating):		
minimum	−10	°C
maximum	see note 3	
Ambient temperature range (storage) (see note 4)	−50 to +85	°C

MAXIMUM RATINGS (Absolute values) (see note 5)

Collector voltage	3.5	kV max
Collector current	50	mA max
Collector dissipation	100	W max
Helix voltage	3.5	kV max
Helix current:		
continuous	2.0	mA max
for 1 second max	4.0	mA max
Grid 2 voltage	3.5	kV max
Grid 2 current	0.5	mA max
Grid 1 voltage (negative value, never positive)	150	V max
Heater voltage	6.6	V max
Temperature of hottest part of mount (excluding conduction block or heat sink) (see note 3)	85	°C max
Temperature of collector conduction block (see note 3)	105	°C max
Temperature difference over length of mount (excluding collector conduction block)	10	°C max

TYPICAL OPERATION (at 4.0GHz) (see note 6)

Operational Conditions (see note 5)

	5W Output	10W Output	
Collector voltage	2.0	2.0	kV
Collector current (see note 7)	40	45	mA
Helix voltage	3.0	3.0	kV
Grid 2 voltage	3.2	3.25	kV
Grid 1 voltage (see note 7)	–75	–60	V

Typical Performance

	5W Output	10W Output	
Helix current	0.5	0.5	mA
Grid 2 current	0.1	0.1	mA
Grid 1 current	zero	zero	
Gain at 5.0W output	37	–	db
Gain at 10W output	–	38	db
Saturation output power (see note 8)	13	17	W
Maximum saturation output power (see note 9)	19	20	W
Noise factor	27	27	db
Cold insertion loss	55	55	db min
Input v.s.w.r. over the band (see note 10)	1.5:1	1.5:1	max
Output v.s.w.r. over the band (see note 10)	1.5:1	1.5:1	max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
(For 5.0W Output Power Operation)

Recommended Applied Conditions (see note 5)

Frequency range	3.6 to 5.0	GHz
Heater voltage (see note 1)	6.3	V
Collector voltage	2.0	kV
Collector current (see note 7)	40	mA
Grid 2 voltage	3.2	kV
Input power	1.0	mW
Output power	5.0	W
Load v.s.w.r.	less than 1.5:1	

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.75	1.0	A
Helix voltage	2.75	3.15	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	2.0	mA
Grid 2 current	–	0.5	mA
Grid 1 voltage (negative value) (see note 7)	0	100	V
Maximum saturation output power (see note 9)	14	–	W
Noise factor (see note 11)	–	27	db
Gain flatness (see note 12)	–	0.01	db/MHz
AM/PM conversion (see note 13)	–	2.0	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 10)	–	1.5:1	
Output v.s.w.r. (hot) (see note 10)	–	1.5:1	

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

Recommended Applied Conditions (see note 5)

Frequency range	3.6 to 5.0	GHz
Heater voltage (see note 1)	6.3	V
Collector voltage	2.0	kV
Collector current (see note 7)	45	mA
Grid 2 voltage	3.25	kV
Input power	2.0	mW
Output power	10	W
Load v.s.w.r.	less than 1.5:1	

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.75	1.0	A
Helix voltage	2.75	3.15	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	2.0	mA

Continued on page 5

Range of Characteristics (continued)

	Min	Max	
Grid 2 current	–	0.5	mA
Grid 1 voltage (negative value) (see note 7) .	0	100	V
Maximum saturated output power (see note 9)	18	–	W
Noise factor (see note 11)	–	27	db
Gain flatness (see note 12)	–	0.01	db/MHz
AM/PM conversion (see note 13)	–	2.0	degrees/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	

NOTES

1. The heater voltage must be maintained within ±5% of the nominal value.
2. The cathode pre-heating time for a tube on initial installation is 2½ minutes minimum; this time may be reduced to one minute minimum for subsequent switching on.
3. Conduction cooled mounts can be mounted horizontally or vertically with the collector uppermost, being designed for use where direct convection cooling of the collector block is difficult. The collector conduction block must be cooled by means of a further heat sink, e.g. a finned panel, which is not supplied but is normally incorporated in the structure of the equipment. It is important that the secondary heat sink is designed in such a way that the temperature of the mount remains below its maximum rating at the maximum ambient temperature of the equipment. The body of the mount will usually be between 5°C and 20°C above ambient, depending on the design of heat sink.
4. 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.

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

6. 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.

7. The collector current is set to the recommended value by adjustment of the potential applied to grid 1.

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 the mount under the recommended applied conditions, the v.s.w.r. will remain below the quoted value over the specified frequency range of the mount.

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 of the tube.

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 N1056 IN P.P.M. MOUNTS N4074 AND N4075

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

A. Power Supply

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

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

(3) During switch-off, the grid 2 voltage should be reduced before all other voltages or excessive currents may be drawn.

(4) The grid 1, grid 2 and helix voltages should be stabilized to $\pm 2\%$.

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

B. Initial Installation of Travelling Wave Tube

(1) Before inserting the travelling wave tube the focusing screws on the mount must be set to a central position 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 grid 2 voltage until all other voltages have reached their full operating values.

(3) Set helix voltage to 3000 volts, grid 2 to 3200 volts and grid 1 to −75 volts, with zero r.f. input.

(4) Adjust the focusing screws until the helix current is reduced to a minimum.

(5) Adjust grid 1 and grid 2 voltages in turn to achieve the required collector current, with minimum helix current.

(6) Finally with r.f. drive applied, repeat steps (4) and (5) to achieve minimum helix current.

Note Reduction of the negative voltage on grid 1 increases the cathode current. If this does not produce a corresponding increase in collector current, the tube is operating with too low a negative voltage on grid 1, causing interception of current by grid 2. This situation must be avoided, as it will damage the tube.

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 one minute minimum cathode pre-heating time.

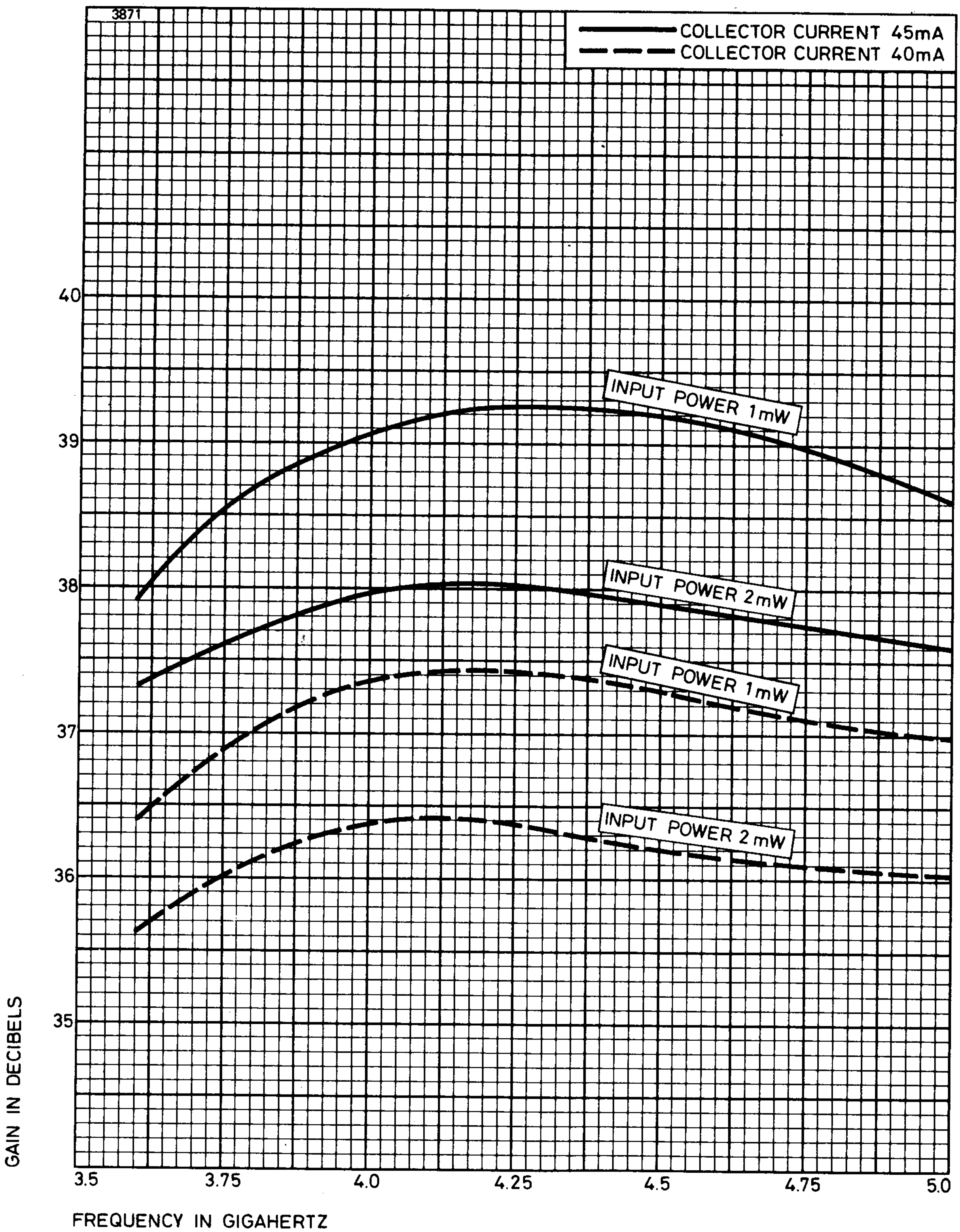
(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

E. Supply Interruption

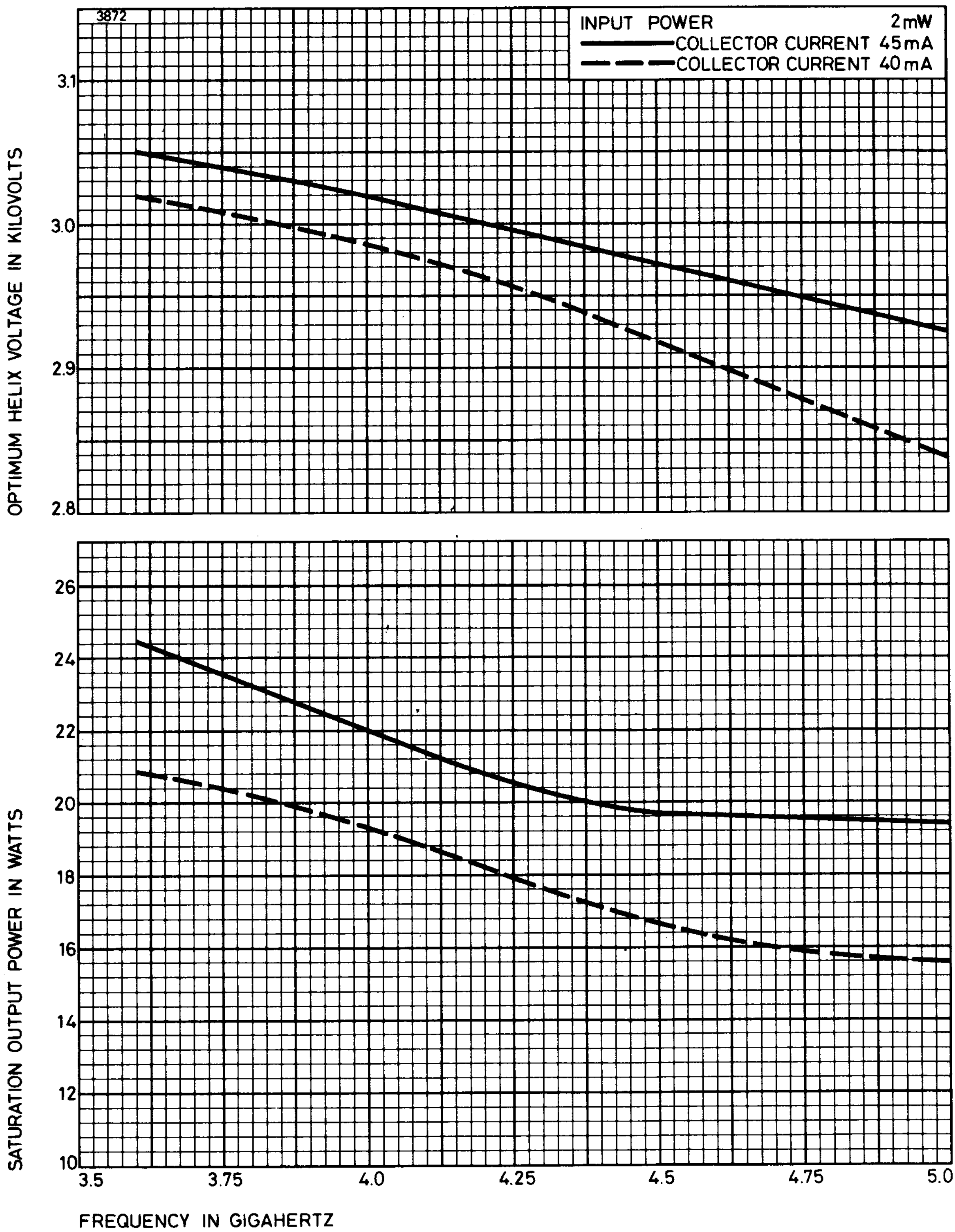
(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting grid 2 voltage which must be delayed as in C(2) above.

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

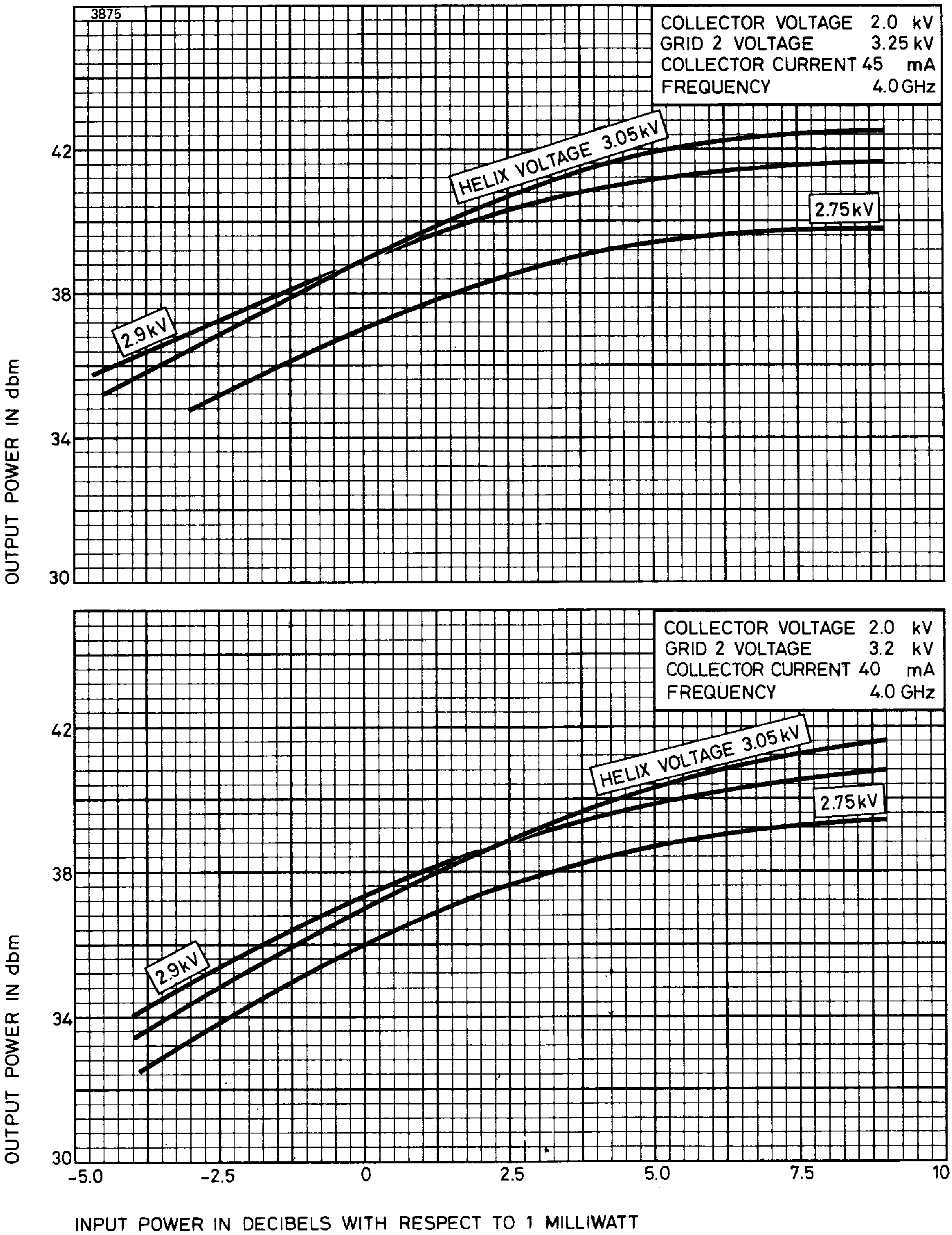
TYPICAL PERFORMANCE CHARACTERISTICS



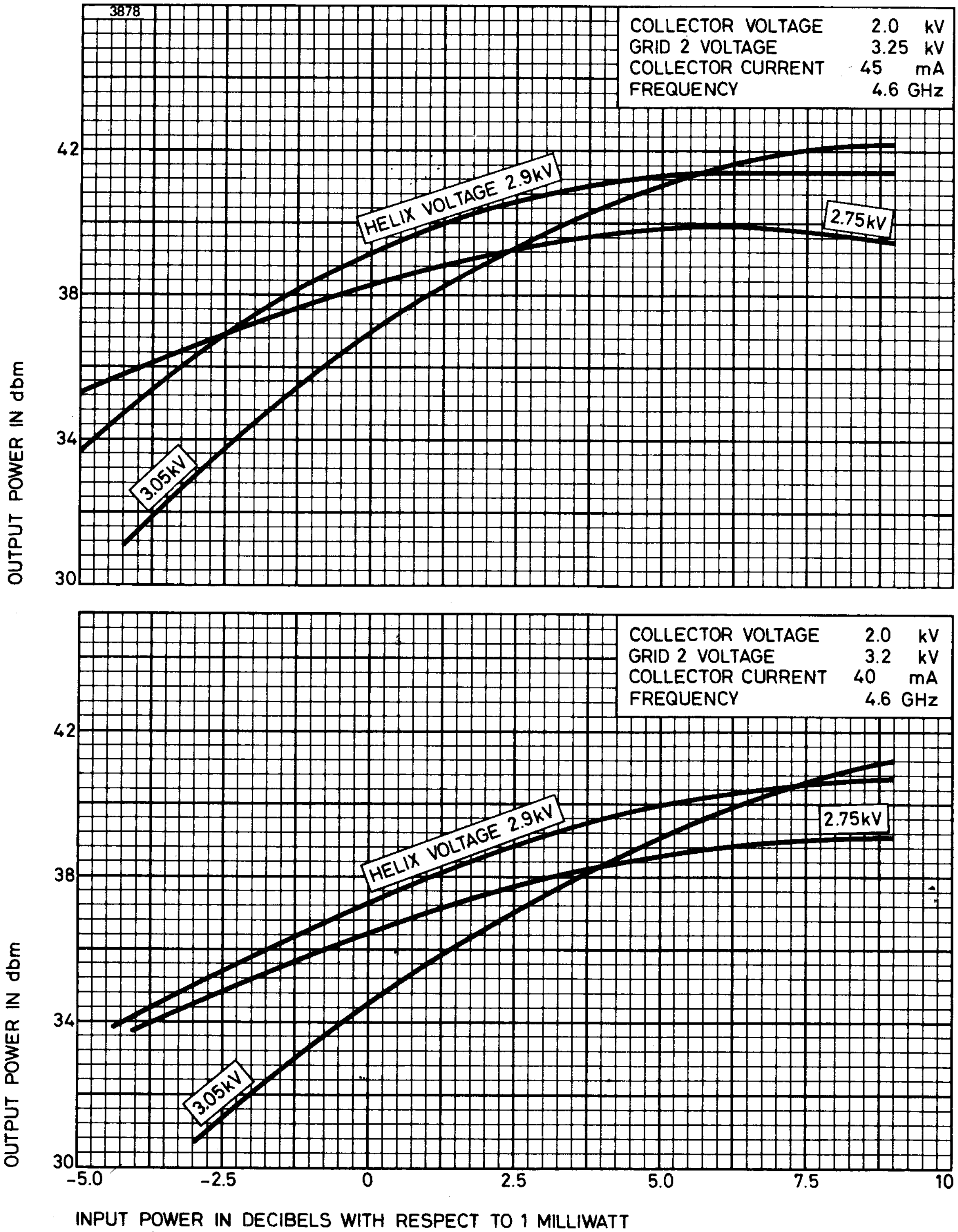
TYPICAL PERFORMANCE CHARACTERISTICS



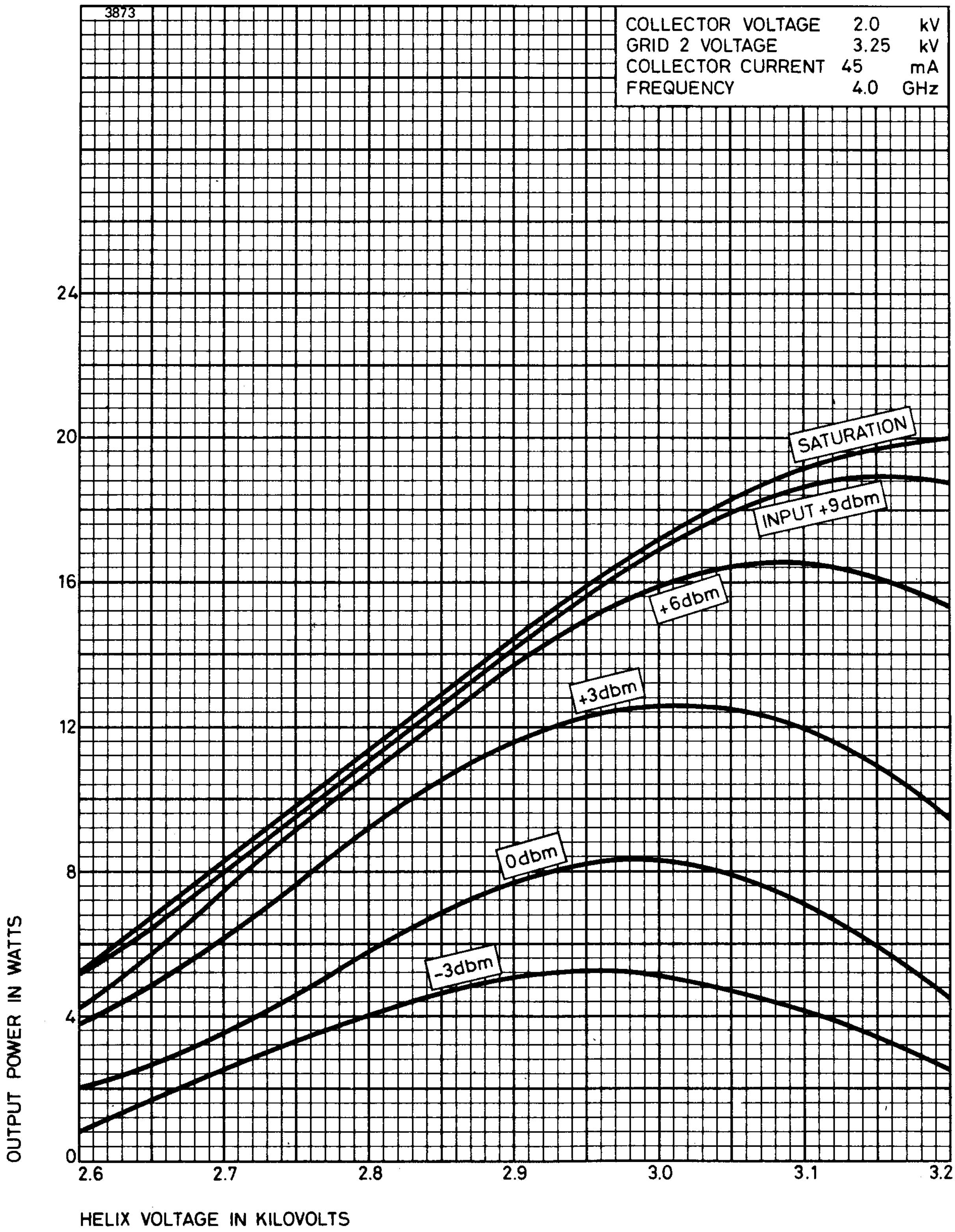
TYPICAL PERFORMANCE CHARACTERISTICS



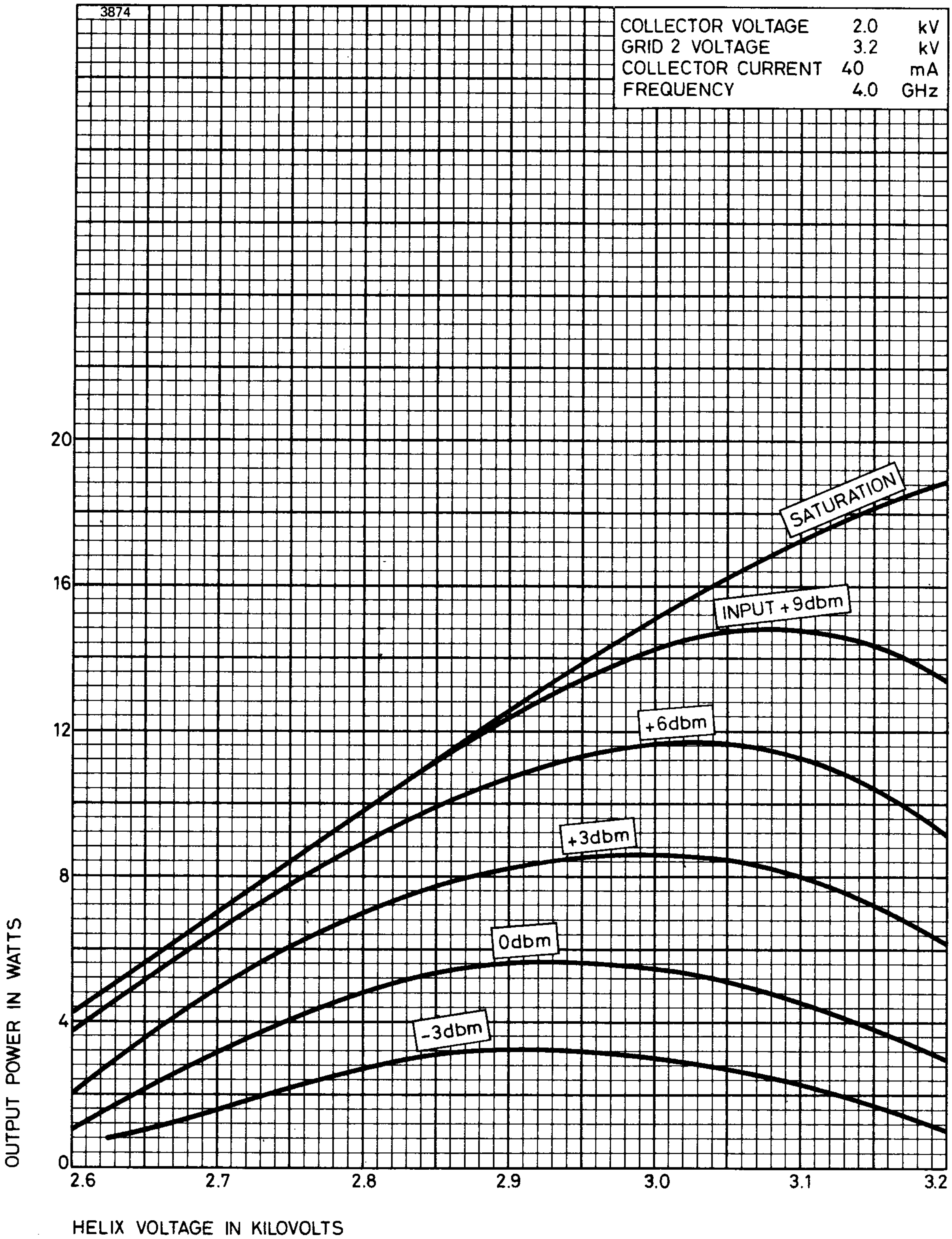
TYPICAL PERFORMANCE CHARACTERISTICS



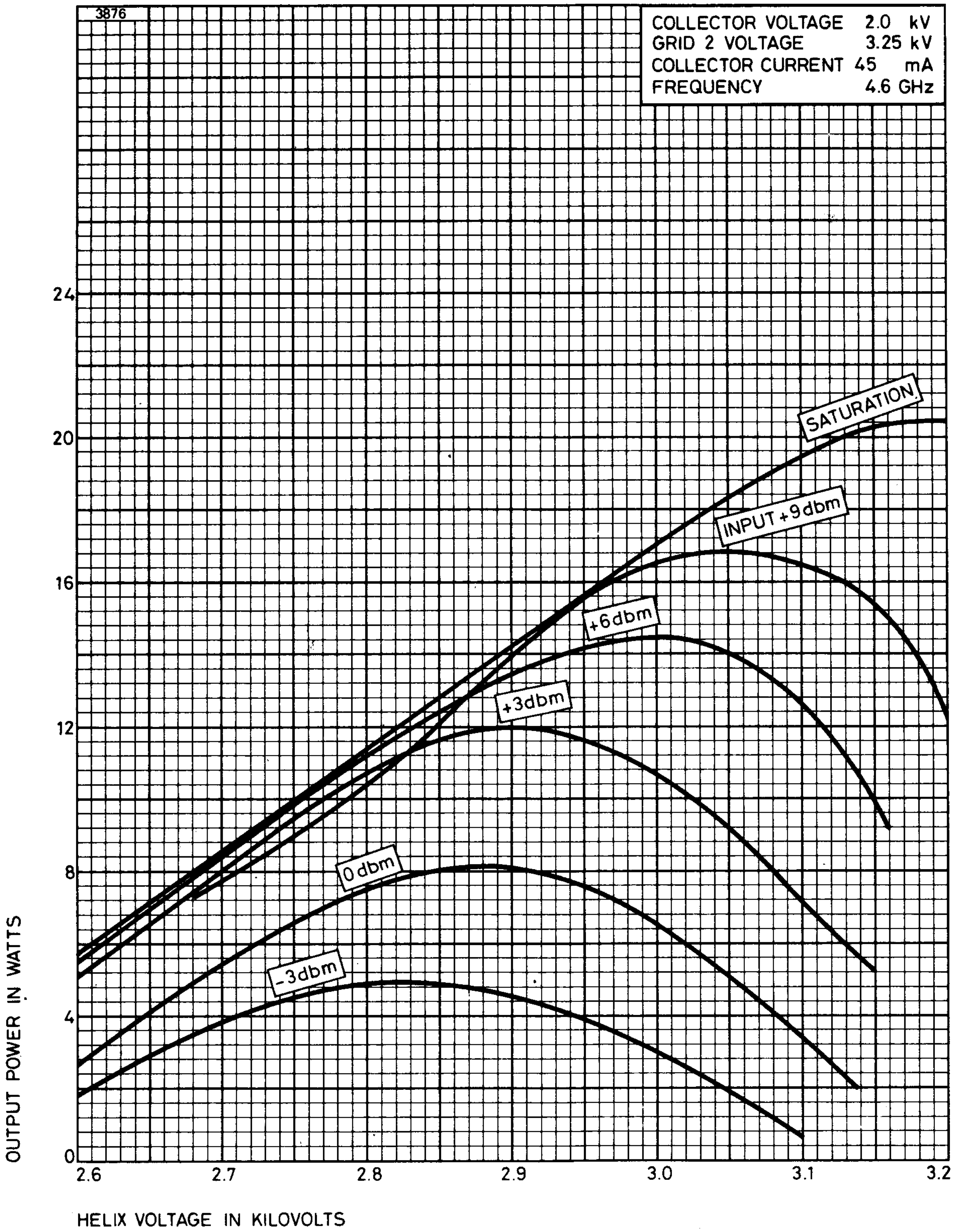
TYPICAL PERFORMANCE CHARACTERISTICS



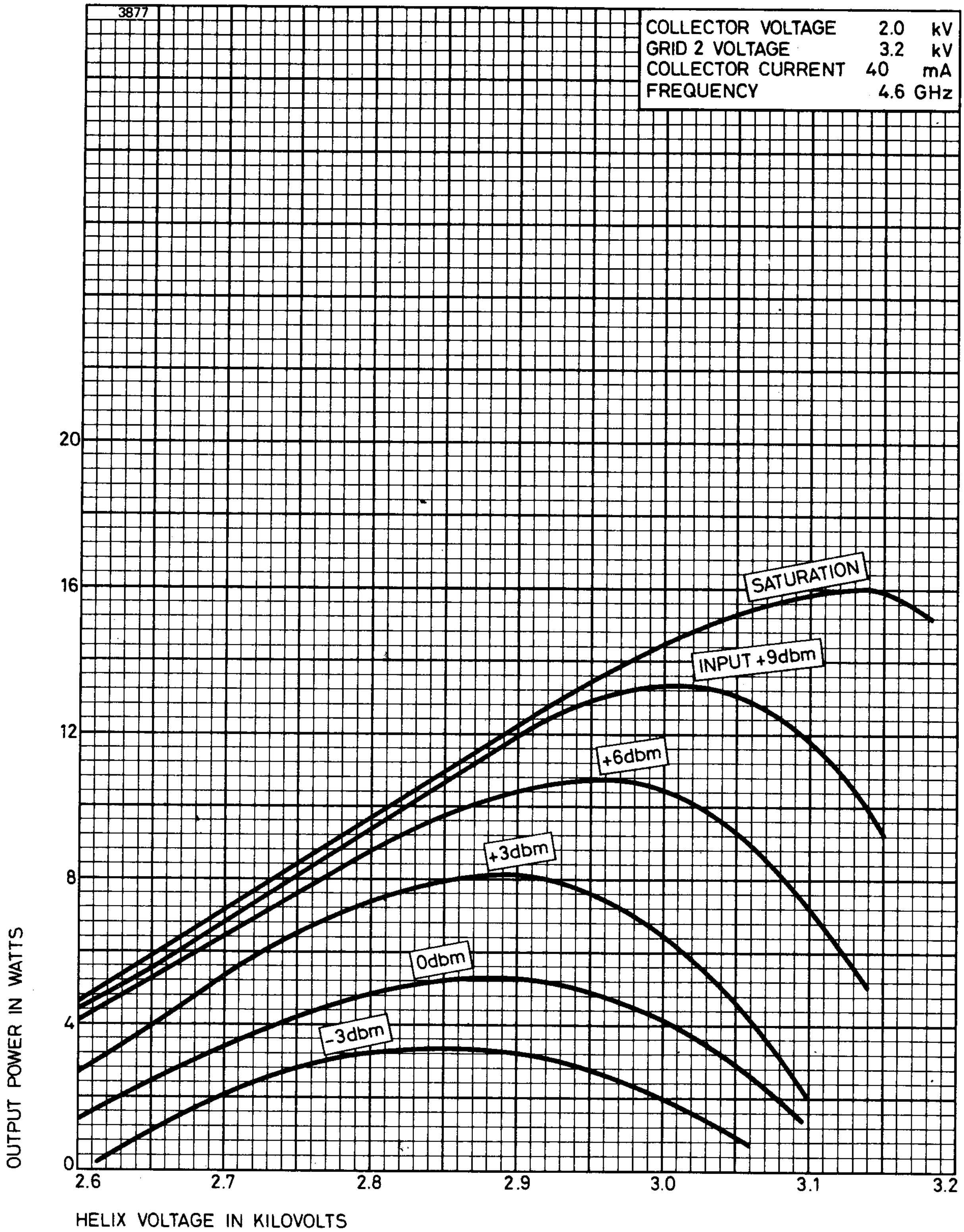
TYPICAL PERFORMANCE CHARACTERISTICS



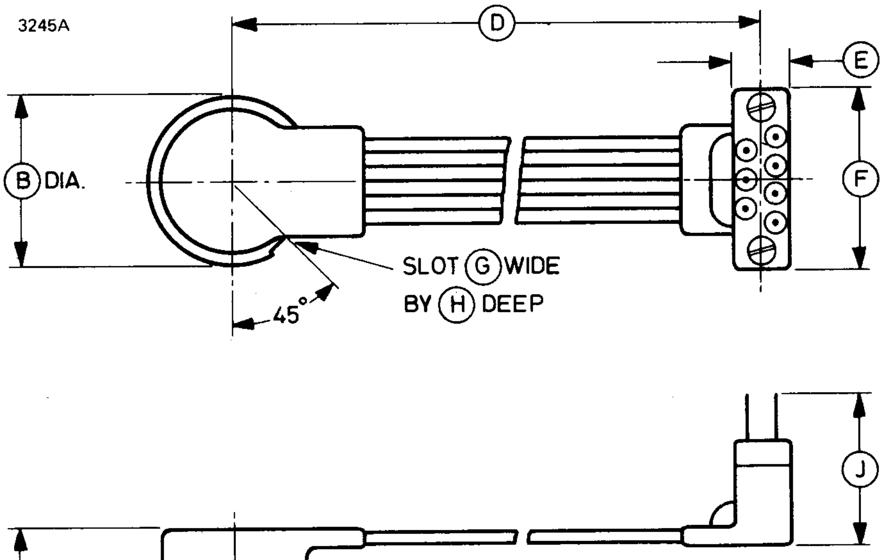
TYPICAL PERFORMANCE CHARACTERISTICS



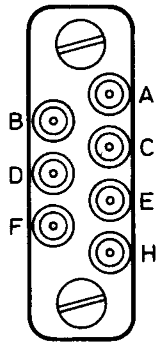
TYPICAL PERFORMANCE CHARACTERISTICS

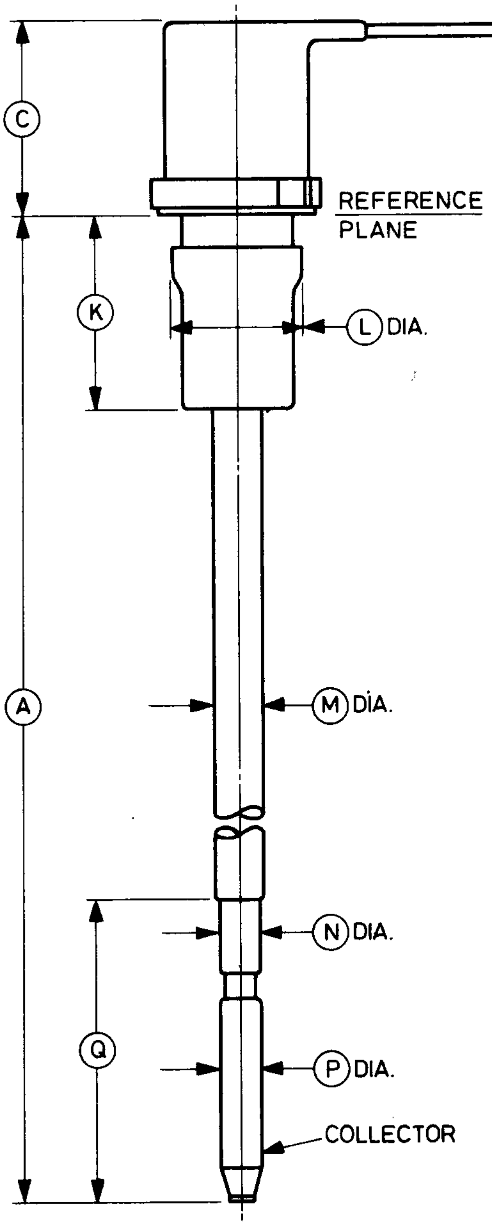


N1056 OUTLINE (All dimensions without limits are nominal)



Detail of Plug Type BA7P



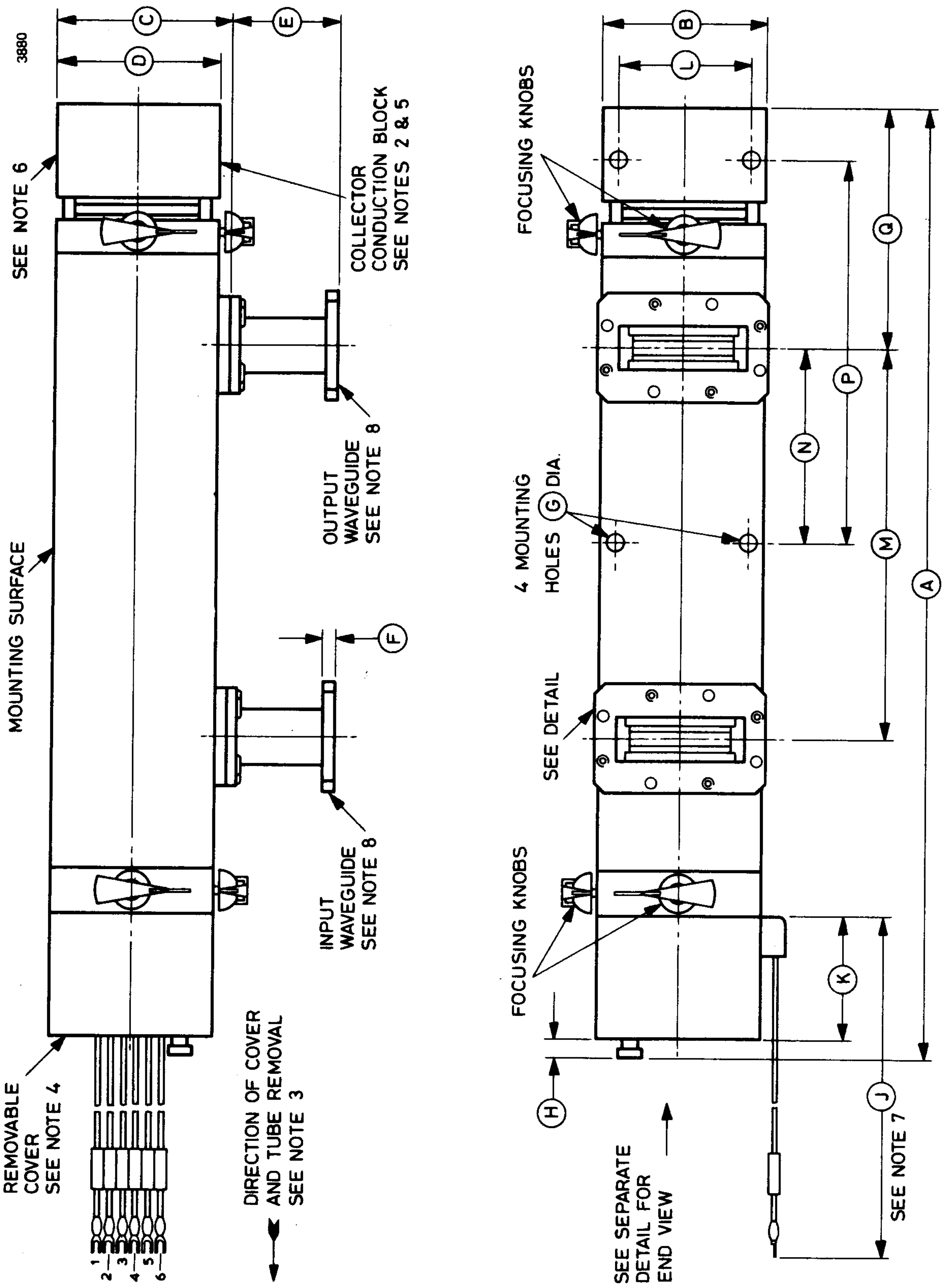


Pin	Element
A	Grid 2
B	Heater
C	Helix
D	Grid 1
E	Heater
F	Cathode
H	No connection

Ref	Inches	Millimetres
A	13.916 ± 0.062	353.5 ± 1.6
B	1.650 ± 0.001	41.910 ± 0.025
C	1.750 max	44.45 max
D	6.500 ± 0.250	165.1 ± 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	1.312 max	33.32 max
L	1.170 max	29.72 max
M	0.440 max	11.18 max
N	0.392 ± 0.003	9.957 ± 0.076
P	0.392 ± 0.003	9.957 ± 0.076
Q	3.180 ± 0.037	80.77 ± 0.94

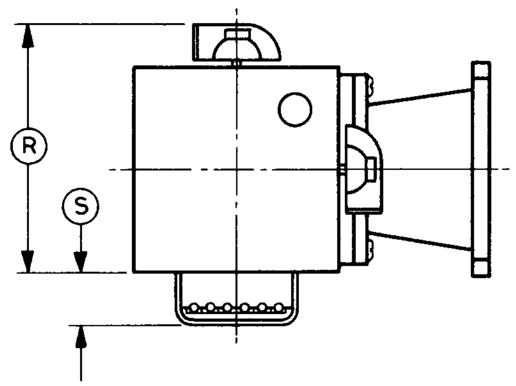
Millimetre dimensions have been derived from inches.

N4074 MOUNT OUTLINE (See Outline Note 1 on page 23)



End View of N4074 Mount

3881



Lead Connections

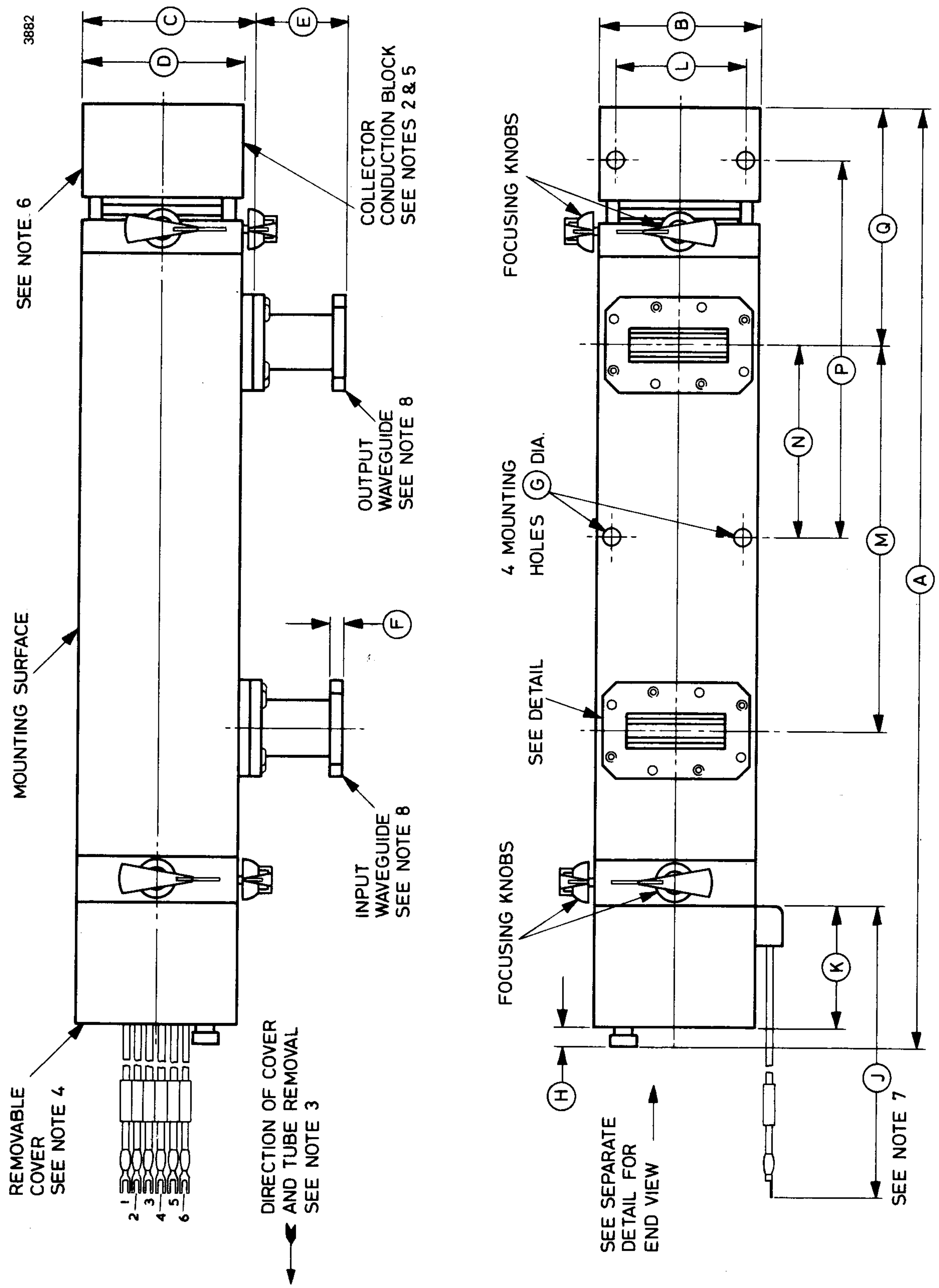
Lead	Colour	Element	Lead	Colour	Element
1	Yellow	Cathode	4	Green	Grid 1
2	Brown	Heater	5	Blue	Grid 2
3	Brown	Heater	6	Orange	Helix

Outline Dimensions (All dimensions without limits are nominal)

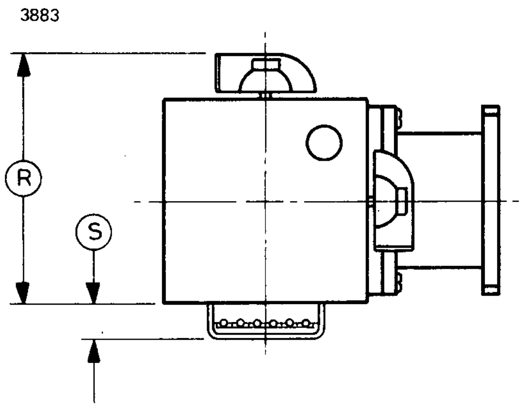
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	17.382 max	441.5 max	J	12.000	304.8
B	2.968 ± 0.032	75.39 ± 0.81	K	2.270 max	57.66 max
C	3.200 ± 0.062	81.28 ± 1.57	L	2.450 ± 0.010	62.23 ± 0.25
D	2.968 ± 0.032	75.39 ± 0.81	M	7.150 ± 0.020	181.6 ± 0.5
E	1.970 ± 0.010	50.04 ± 0.25	N	3.563 ± 0.015	90.50 ± 0.38
F	$0.250^{+0.000}_{-0.032}$	$6.35^{+0.00}_{-0.81}$	P	7.000 ± 0.010	177.80 ± 0.25
			Q	4.400 max	111.8 max
G	0.290	7.37	R	3.750 max	95.25 max
H	0.312	7.92	S	0.750 max	19.05 max

Millimetre dimensions have been derived from inches.

N4075 MOUNT OUTLINE (See Outline Note 1 on page 23)



End View of N4075 Mount



Lead Connections

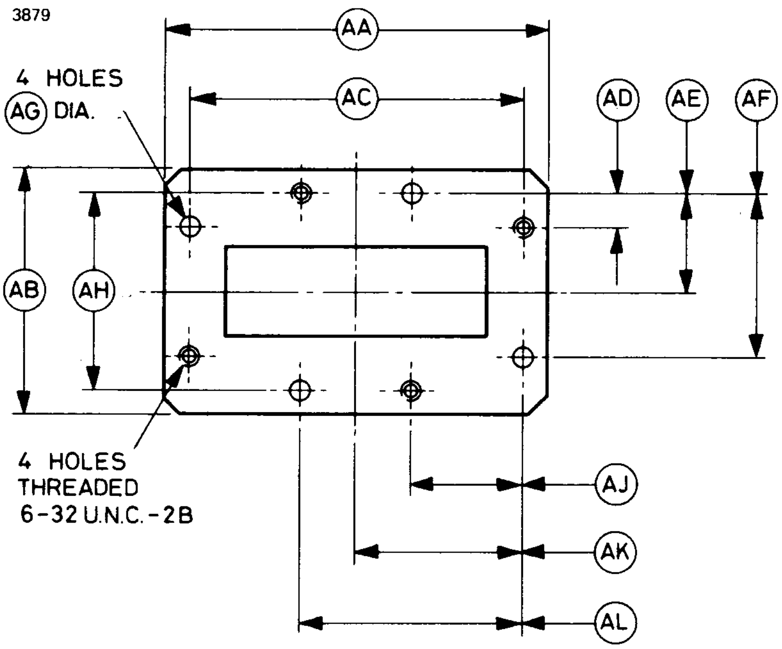
Lead	Colour	Element	Lead	Colour	Element
1	Yellow	Cathode	4	Green	Grid 1
2	Brown	Heater	5	Blue	Grid 2
3	Brown	Heater	6	Orange	Helix

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	17.382 max	441.5 max	J	12.000	304.8
B	2.968 ± 0.032	75.39 ± 0.81	K	2.270 max	57.66 max
C	3.200 ± 0.062	81.28 ± 1.57	L	2.450 ± 0.010	62.23 ± 0.25
D	2.968 ± 0.032	75.39 ± 0.81	M	7.150 ± 0.020	181.6 ± 0.5
E	1.700 ± 0.010	43.18 ± 0.25	N	3.563 ± 0.015	90.50 ± 0.38
F	$0.250^{+0.000}_{-0.032}$	$6.35^{+0.00}_{-0.81}$	P	7.000 ± 0.010	177.80 ± 0.25
			Q	4.400 max	111.8 max
G	0.290	7.37	R	3.750 max	95.25 max
H	0.312	7.92	S	0.500	12.70

Millimetre dimensions have been derived from inches.

WAVEGUIDE FLANGE DETAILS



Dimensions for N4074 Flange (RETMA Type CMR229)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	3.156 ± 0.016	80.16 ± 0.41	AG	0.147 ± 0.005	3.73 ± 0.13
AB	2.000 ± 0.016	50.80 ± 0.41	AH	1.688 ± 0.004	42.875 ± 0.102
AC	2.844 ± 0.004	72.238 ± 0.102	AJ	0.922 ± 0.004	23.419 ± 0.102
AD	0.438 ± 0.004	11.125 ± 0.102	AK	1.422 ± 0.004	36.119 ± 0.102
AE	0.844 ± 0.004	21.438 ± 0.102	AL	1.922 ± 0.004	48.819 ± 0.102
AF	1.250 ± 0.004	31.750 ± 0.102			

Dimensions for N4075 Flange (RETMA Type CMR187)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	2.781 ± 0.005	70.64 ± 0.13	AG	0.147 ± 0.005	3.73 ± 0.13
AB	1.781 ± 0.005	45.24 ± 0.13	AH	1.430 ± 0.005	36.32 ± 0.13
AC	2.430 ± 0.005	61.72 ± 0.13	AJ	0.810 ± 0.005	20.57 ± 0.13
AD	0.247 ± 0.005	6.27 ± 0.13	AK	1.215 ± 0.005	30.86 ± 0.13
AE	0.715 ± 0.005	18.16 ± 0.13	AL	1.620 ± 0.005	41.15 ± 0.13
AF	1.183 ± 0.005	30.05 ± 0.13			

Millimetre dimensions have been derived from inches.

Outline Notes for N4074 and N4075 Mounts

1. Certain alternative orientations of end cover and focusing screws, and positions of mounting holes, are possible by arrangement.
2. The collector connection is to the body of the mount which must always be properly earthed during operation.
3. The overall length of the mount together with an adequate allowance for tube withdrawal is 35 inches (889mm).
4. An end clearance of 2¼ inches (57mm) must be allowed to permit the removal of the cover for tube insertion or withdrawal. The travelling wave tube leads plug into a socket inside the cover. An alternative cover, measuring 3 x 4¼ x 2¼ inches (76.2 x 108 x 57.2mm) and incorporating a mains interlock, can be supplied.
5. For efficient operation the collector conduction block must be bolted to a heat sink having a thermal impedance of 0.5°C/watt.
6. This surface of the mount is flat to within 0.003 inch (0.076mm). The mating surface must be equally flat and must be smeared with silicone grease before bolting down the mount, to ensure good thermal contact.
7. The mount has six screened leads fitted with spade terminals to suit 4BA or 6–32 screws. Alternative lead lengths and terminations can be supplied to suit customers' requirements.
8. The waveguide input and output ports of N4074 are designed for connection to full size number 11A waveguide (WR229), and those of N4075 for connection to full size number 12 waveguide (WR187), via the transition sections fitted. At least 1.0 inch of plain waveguide must be allowed before any bend, twist etc., or the match may be affected.

   The mount can be supplied without the waveguide transitions, in which case the waveguide aperture is 1.872 x 0.250 inches (47.55 x 6.35mm) and the flange is CMR187 with all holes threaded.

N1061

X-BAND PULSED TRAVELLING WAVE TUBE

DESCRIPTION

The N1061 is a high power, magnetically focused, broadband pulsed travelling wave amplifier. It is intended primarily for radar applications and is capable of output powers up to 1.0MW over an instantaneous bandwidth in excess of 450MHz at X-band. The gain of the tube at saturation is between 25 and 35db and the rated duty cycle is 0.005.

The tube is of the 'severed' type, the connections to the slow wave structure at the sever being taken to waveguide loads external to the vacuum envelope. This overcomes the disadvantages of internal loads at high mean power levels.

The tube is of rugged metal-ceramic construction and is liquid cooled. R.F. connections to the tube are made via no. 15 waveguide (WR112, RG-51/U). Pressurization of the output waveguide system is required.

Focusing of the tube is by means of a separate liquid cooled solenoid type N4115. The tube is self-locating in the solenoid, no focusing adjustments being required. An energizing power of some 4kW is needed to provide the required axial field of 200mT (2000 gauss).

The tube is designed for vertical mounting with the cathode end down, the gun assembly being mounted in an oil-filled pulse transformer.

Variants of the tube covering 450MHz bands centred on various frequencies in X-band can be supplied.

GENERAL DATA

Travelling Wave Amplifier N1061

Electrical

Cathode	indirectly heated	
Heater voltage	3.3	V
Heater current	54	A

Mechanical

Overall length	30 inches (76.2cm) nom
Overall diameter	10 inches (25.4cm) nom
Net weight	75 pounds (34kg) approx

Cooling	water
Collector water flow	10 imp.gal/min (45.4 l./min)
Collector pressure drop	20 lb/in^2 (1.4kg/cm^2)
Body water flow	1 imp.gal/min (4.54 l./min)
Body pressure drop	15 lb/in^2 (1.05kg/cm^2)

Typical Performance

Beam voltage (peak)	100	kV
Beam current (peak)	31	A
Pulse duration	8.0	μs
R.F. duty cycle	0.005	
Instantaneous bandwidth	450	MHz
Output power (peak)	900	kW
Gain	33	db
Efficiency	29	%

Solenoid N4115

Electrical

Solenoid voltage	80	V
Solenoid current	55	A
Bucking coil voltage	9.0	V
Bucking coil current	13	A

Mechanical

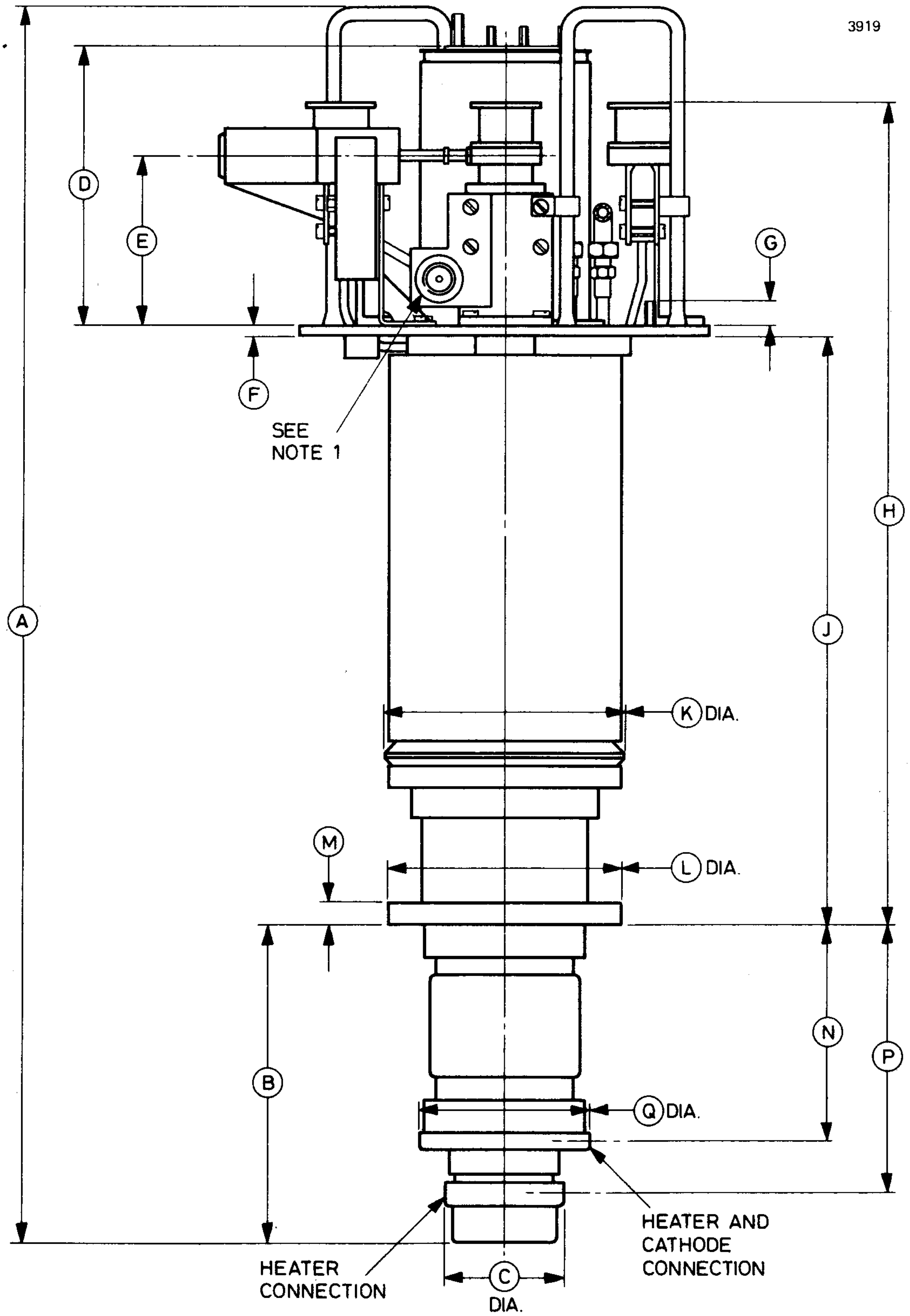
Overall dimensions	18 x 15 x 13 inches approx 46 x 38 x 33cm approx
Net weight	320 pounds (145kg) approx

Cooling	water
Water flow rate	3 imp.gal/min (13.6 l./min)
Pressure drop	35 lb/in^2 (2.45kg/cm^2)

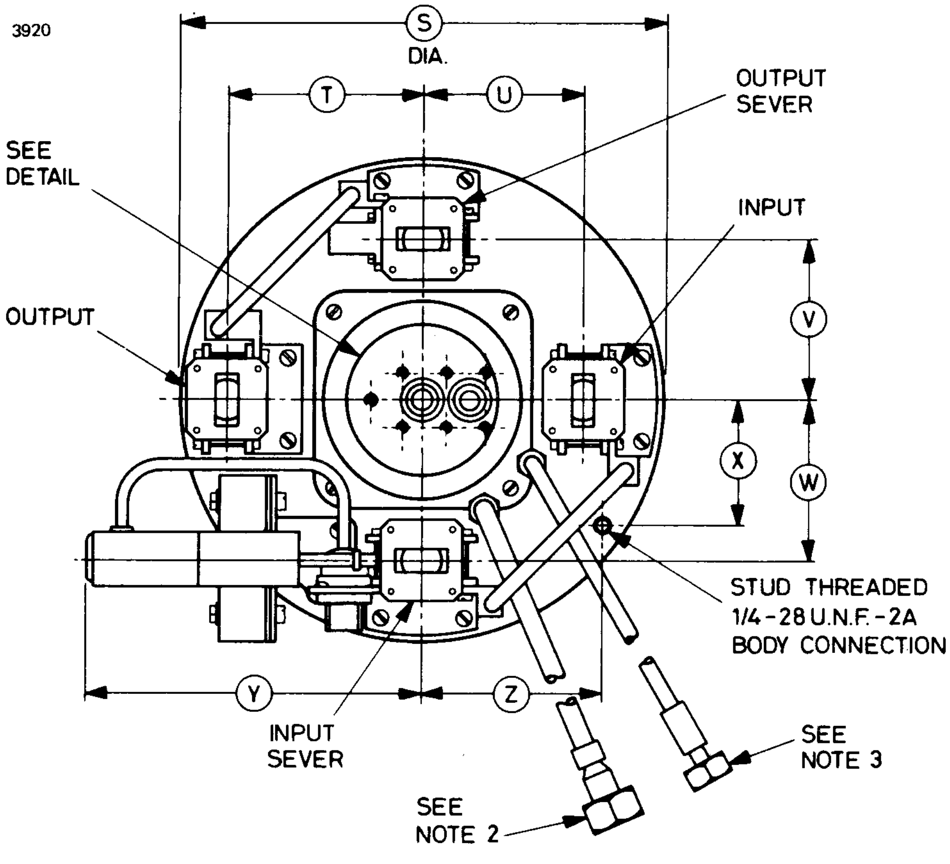
X-RAY WARNING

X-rays are emitted by the N1061. These rays can constitute a health hazard unless the device is adequately shielded for X-ray radiation.

N1061 OUTLINE (See page 6 for dimensions)



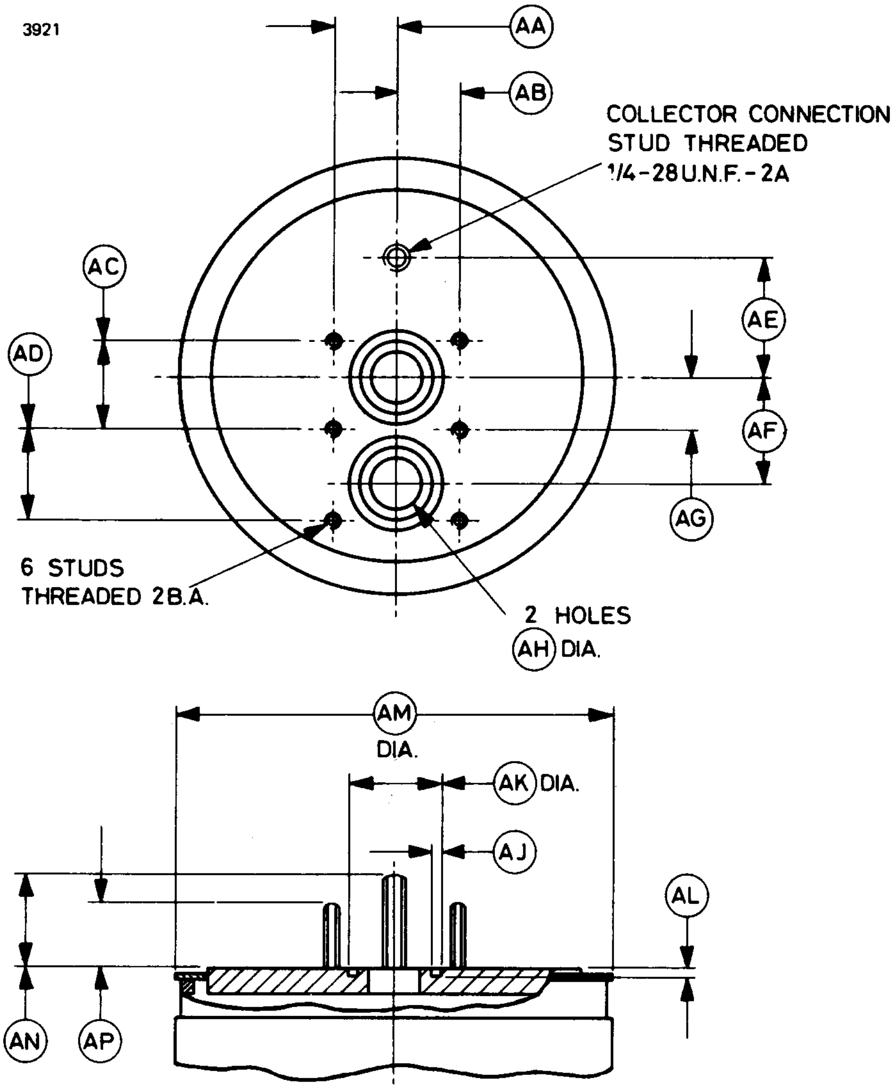
N1061 OUTLINE



N1061 Outline Notes

1. Appendage pump connections P.E.T.201 socket.
2. Body cooling water connection, $^3/_8$ B.S.P.
3. Body cooling water connection, $^1/_4$ B.S.P.

Enlarged Detail of Collector End



Note Collector water seals use O-ring type OS14 (B.S.1806).

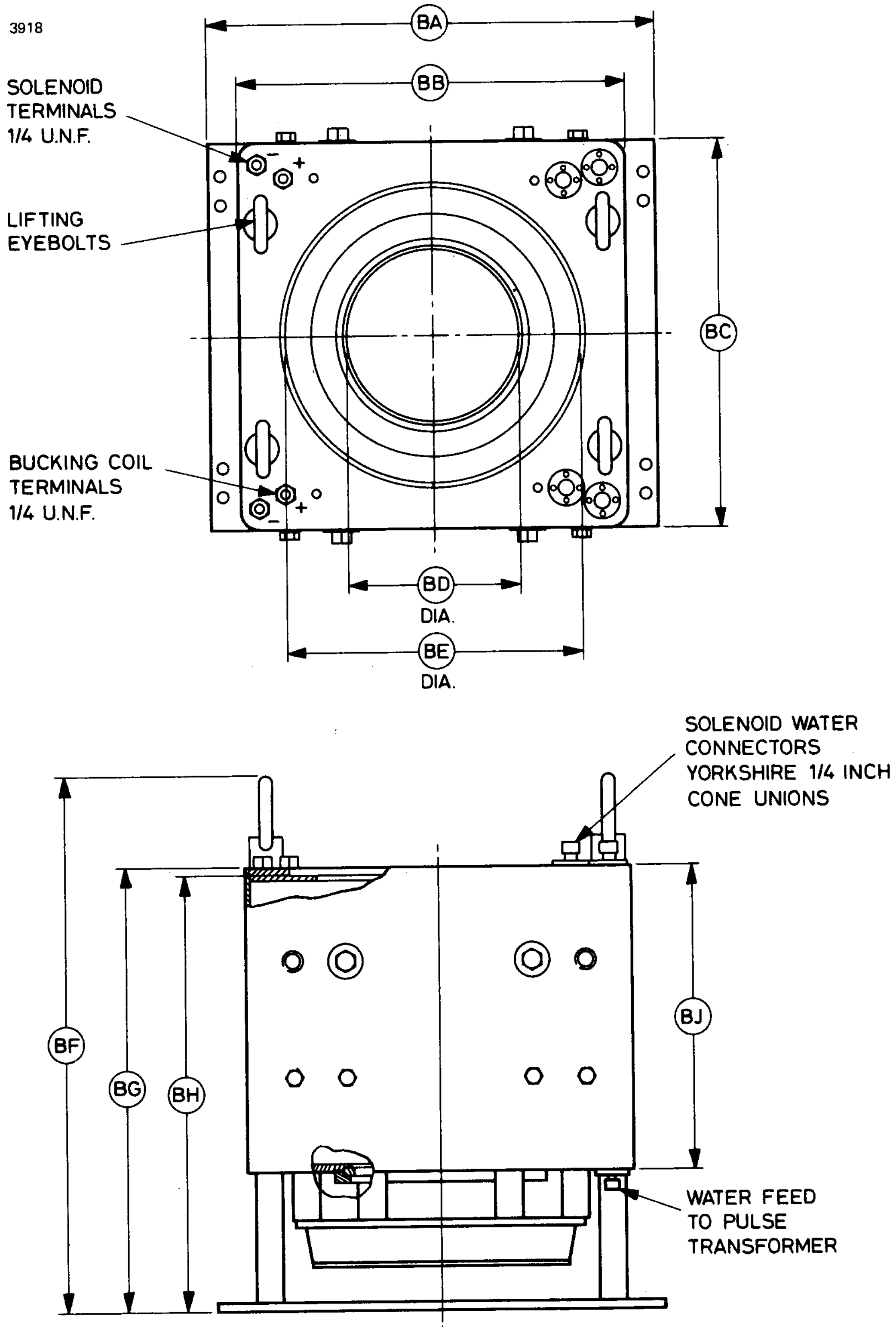
N1061 Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	30.000 ± 0.060	762.0 ± 1.5
B	7.667 ± 0.030	194.7 ± 0.8
C	3.000 ± 0.015	76.20 ± 0.38
D	6.875 ± 0.125	174.6 ± 3.2
E	4.125 ± 0.060	104.8 ± 1.5
F	0.312	7.92
G	0.625	15.88
H	20.000 ± 0.010	508.00 ± 0.25
J	14.262 ± 0.030	362.3 ± 0.8
K	$5.828\,^{+0.000}_{-0.003}$	$148.031\,^{+0.000}_{-0.076}$
L	5.750 ± 0.020	146.1 ± 0.51
M	0.600	15.24
N	5.075 ± 0.015	128.9 ± 0.4
P	6.415 ± 0.015	162.9 ± 0.4
Q	4.187 ± 0.015	106.3 ± 0.38
S	$10.005\,^{+0.000}_{-0.003}$	$254.127\,^{+0.000}_{-0.076}$
T	4.000 ± 0.005	101.6 ± 0.13
U	3.355 ± 0.005	85.22 ± 0.13
V	3.355 ± 0.005	85.22 ± 0.13

Ref	Inches	Millimetres
W	3.355 ± 0.005	85.22 ± 0.13
X	2.625 ± 0.125	66.68 ± 3.18
Y	7.375	187.3
Z	3.750 ± 0.125	95.25 ± 3.18
AA	0.625	15.88
AB	0.625	15.88
AC	0.875	22.23
AD	0.875	22.23
AE	1.187	30.15
AF	1.000	25.40
AG	0.500	12.70
AH	0.500	12.70
AJ	$0.141\,^{+0.010}_{-0.000}$	$3.58\,^{+0.25}_{-0.00}$
AK	$0.927\,^{+0.020}_{-0.000}$	$23.55\,^{+0.51}_{-0.00}$
AL	$0.081\,^{+0.010}_{-0.000}$	$2.06\,^{+0.25}_{-0.00}$
AM	4.250 max	108.0 max
AN	0.875	22.23
AP	0.625	15.88

Millimetre dimensions have been derived from inches.

N4115 SOLENOID OUTLINE



N4115 Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
BA	15.180	385.6
BB	13.250	336.6
BC	13.180	334.8
BD	$5.830^{+0.003}_{-0.000}$	$148.082^{+0.076}_{-0.000}$
BE	$10.010^{+0.005}_{-0.000}$	$254.254^{+0.127}_{-0.000}$
BF	17.750 max	450.9 max
BG	14.835	376.8
BH	14.548	369.5
BJ	10.560	268.2

Millimetre dimensions have been derived from inches.

N1065

10.5–12.4GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	10.5 to 12.4	GHz
Minimum c.w. output power (saturation)	35	W
Maximum drive for 35W saturation output	9.0	mW
Operating temperature range	−30 to +85	°C

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage (see note 1)	6.3	V
Heater current	0.95	A
Cathode pre-heating time (minimum)	2.0	min

GENERAL (continued)

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 2)	colour coded flexible leads
R.F. connections	coaxial, type OSM224 female
Mounting position (see note 3)	any
Net weight	5¾ pounds (2.6kg) approx

Cooling	conduction cooled	
Heat sink temperature (see note 4)	90	°C max

Environmental

Vibration	10g from 16 to 2000Hz
Shock	12g for 11ms
Altitude	sea level to 20 000ft (6km)
Operating temperature range	–30 to +85°C
Acceleration	18g

MAXIMUM RATINGS (Absolute values)

Heater voltage	6.5	V max
Heater current	1.25	A max
Helix to cathode voltage (see note 5)	5.3	kV max
Helix current (see note 6)	10	mA max
Helix to collector voltage	3.2	kV max
Collector current	85	mA max
Collector dissipation	200	W max
Helix to anode voltage	1500	V max
Anode current	1.5	mA max
R.F. return power (see note 7)	9.0	W max
Base plate temperature	120	°C max
Input v.s.w.r. (hot)	2:1	max

TYPICAL OPERATION

Frequency	10.5	12.4	GHz
Collector to cathode voltage	2.0	2.0	kV
Collector current	64	64	mA
Helix to cathode voltage	4.83	4.83	kV
Helix current	2.5	2.5	mA
Helix to anode voltage	600	600	V
Anode current	0.1	0.1	mA
Saturation output power	38	38	W
Drive power	1.0	7.0	mW
Noise output	–63	–63	dbW/10MHz
Total input power	145	145	W
Efficiency	26	26	%
AM/PM conversion at saturation	4.0	4.0	degree/db
Phase sensitivity (helix voltage)	0.9	0.9	degree/V

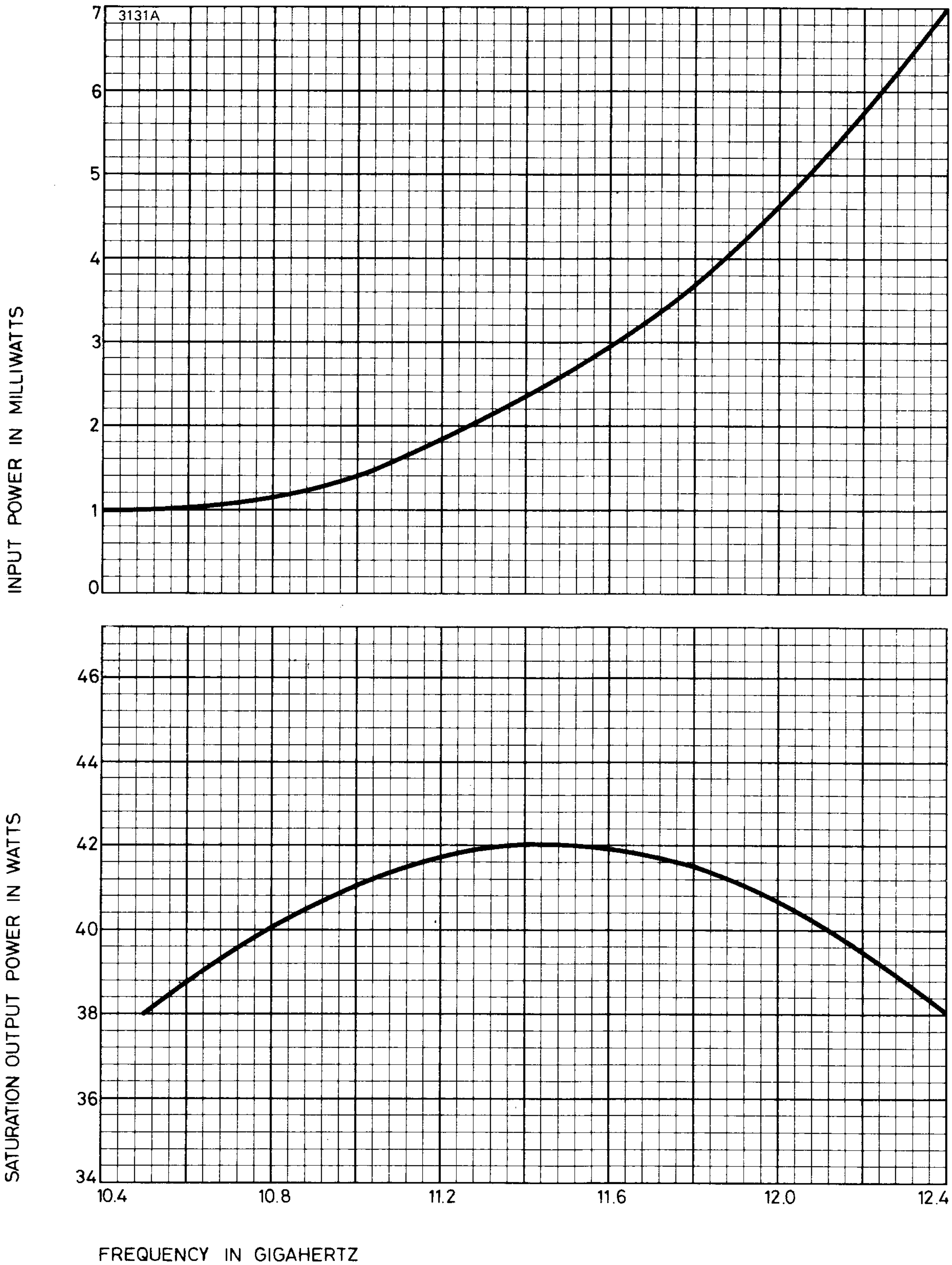
RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

	Min	Max	
Frequency	10.5	12.4	GHz
Collector to cathode voltage	1.9	2.2	kV
Collector current	–	75	mA
Helix to cathode voltage	4.65	5.0	kV
Helix current	–	10	mA
Helix to anode voltage	0	1400	V
Anode current	–	1.5	mA
Saturation output power	35	50	W
Drive power for saturation	–	12	mW
Noise output	–	–54	dbW/10MHz
Total input power	–	180	W

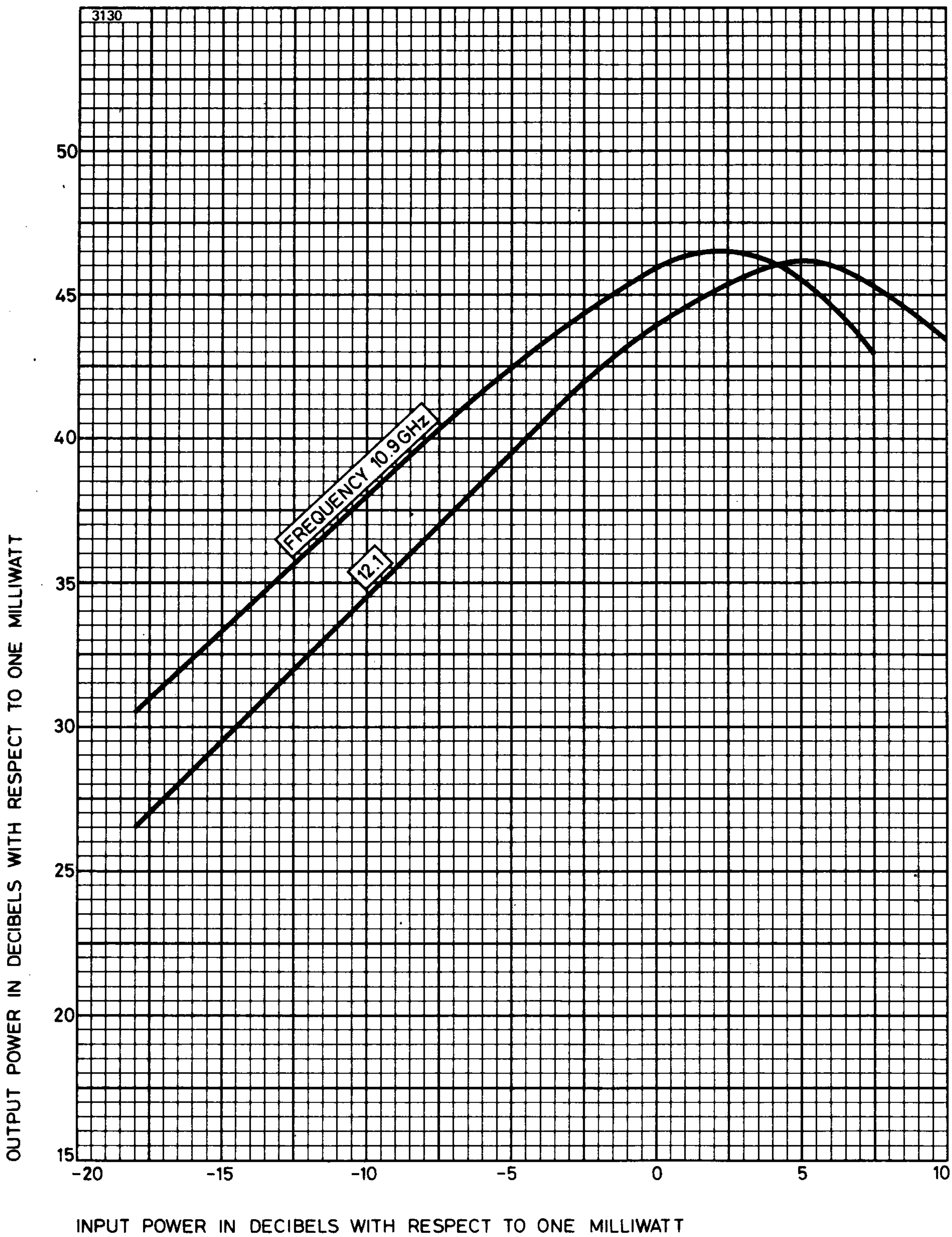
NOTES

1. The heater voltage is set to the value marked on the tube capsule and lies in the range 6.0 to 6.5V.
2. The lead lengths will be in accordance with customers' requirements.
3. The tube should be shielded from strong stray magnetic fields.
4. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
5. The helix is operated at earth potential.
6. A helix over-current trip should be fitted.
7. It is advisable to fit a reverse power trip, set to operate if the return power exceeds 10W.

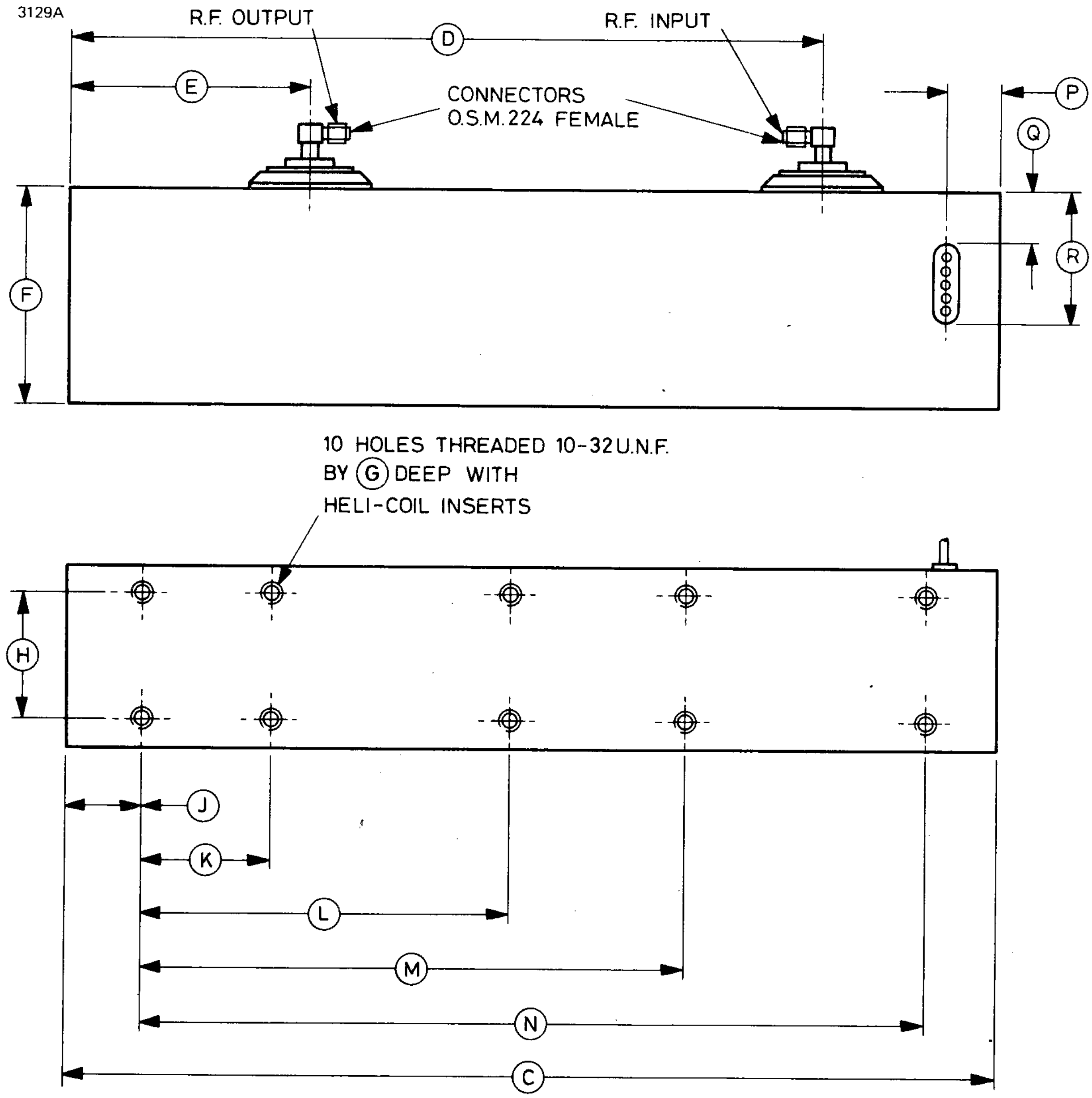
TYPICAL PERFORMANCE CHARACTERISTICS



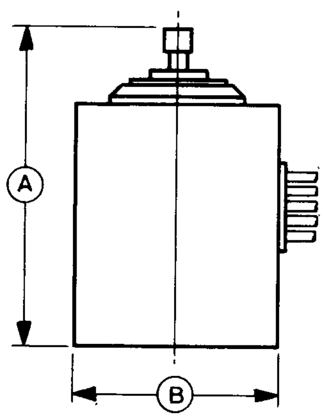
TYPICAL PERFORMANCE CHARACTERISTICS



OUTLINE



View on End of Tube



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.250 max	82.55 max
B	2.125 max	53.98 max
C	10.750 max	273.1 max
D	8.665 ± 0.145	220.1 ± 3.68
E	2.750	69.85
F	2.490 max	63.25 max
G	0.380	9.65
H	1.500 ± 0.010	38.10 ± 0.25
J	0.875	22.23
K	1.500 ± 0.010	38.10 ± 0.25
L	4.250 ± 0.010	108.0 ± 0.25
M	6.250 ± 0.010	158.8 ± 0.25
N	9.000 ± 0.010	228.6 ± 0.25
P	0.625 ± 0.040	15.88 ± 1.02
Q	0.600 ± 0.040	15.24 ± 1.02
R	1.500 ± 0.040	38.10 ± 1.02

Millimetre dimensions have been derived from inches.

Lead Connections

Lead	Element
Yellow	Heater, cathode
Brown	Heater
Green	Anode
Orange	Helix
Red	Collector

N1070

6GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

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

Frequency range	5.925 to 6.425	GHz
Saturation output power (nominal)	10	W
Working output power (see note 1)	5.0	W
Nominal gain	35	db
Noise factor	27	db

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage (see note 2)	6.3	V
Heater current	0.85	A
Heater starting current (peak)	5.0	A max
Cathode pre-heating time	see note 3	

Mechanical

Tube base	moulded cap and flexible leads fitted with plug type BA7P

Focusing Mount	**N4132T**
R.F. connections on mount	waveguide, 1.372 x 0.622 inch internal, with flange CPR137
Net weight	16½ pounds (7.6kg) approx
Mounting position	see note 4

Continued on page 2

Focusing Mount (continued)

Cooling	see note 4	
Mount body temperature range (operating):		
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	2.4	kV max
Collector current	40	mA max
Collector dissipation	65	W max
Helix voltage	3.0	kV max
Helix current:		
continuous	2.0	mA max
for 1 second max	4.0	mA max
Grid 2 voltage	3.5	kV max
Grid 2 current	0.5	mA max
Grid 1 voltage (negative value, never positive)	50	V max
Heater voltage	6.6	V max
Collector temperature	275	°C max
Mount temperature range (operating), excluding heat sink	–10 to +70	°C max
Mount temperature range (storage) (see note 5)	–50 to +85	°C max
Temperature difference over length of mount (excluding collector heat sink)	10	°C max

TYPICAL OPERATION (at 6.2GHz) (see note 7)

Operational Conditions (see note 6)

Collector voltage	1.5	kV
Collector current (see note 8)	30	mA
Input power	2.0	mW
Grid 2 voltage (see note 8)	2.05	kV
Grid 1 voltage (see note 8)	0	V
Output power (see notes 1 and 9)	5.0	W

Typical Performance

Helix current	0.3	mA
Grid 2 current	0.1	mA
Grid 1 current	0	mA
Helix voltage	2.52	kV
Noise factor	27	db
Cold insertion loss	60	db
Input v.s.w.r. (see note 10)	1.15:1	max
Output v.s.w.r. (see note 10)	1.3:1	max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN (See note 1)

Recommended Applied Conditions (see note 6)

Frequency range	5.925 to 6.425	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage	1.5	kV
Collector current (see note 8)	30	mA
Input power	2.0	mW
Load v.s.w.r.	less than 1.5:1	

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.75	1.0	A
Helix voltage	2.3	3.0	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	1.5	mA
Grid 2 voltage (see note 8)	1.9	2.5	kV
Grid 2 current	–	0.5	mA
Grid 1 voltage (negative value) (see note 8)	0	50	V
Output power	5.0	–	W
Noise factor (see note 11)	–	30	db
Gain flatness (see note 12)	–	0.01	db/MHz
Input v.s.w.r. (hot) (see note 10)	–	1.15:1	
Output v.s.w.r. (hot) (see note 10)	–	1.3:1	
Cold insertion loss	55	–	db

NOTES

1. The tube is intended for operation at 5 watts nominal 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 $\pm 5\%$ of the nominal value.
3. The cathode pre-heating time for a tube on initial installation is 3 minutes minimum; this time may be reduced to one minute minimum for subsequent switching on.
4. The mount should be operated with its major axis horizontal and there must be adequate clearance around the radiator for air to flow freely past it. Forced-air cooling is required for any other mounting position.
5. Exposure to temperatures lower than $-50^{\circ}C$ 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.
8. The helix current is minimized by adjustment of grid 1 voltage and the collector current set to the desired value by adjustment of grid 2 voltage.
9. The power output is set to 5 watts by reducing the helix voltage from the point of maximum output. This reduction is typically 200 to 250 volts.
10. The specified match is obtained over any ± 25MHz band throughout the frequency range by adjustment of the narrow band matching screws located on the waveguides.
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.

OPERATING NOTES FOR N1070 in P.P.M. MOUNT N4132T

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 3 minutes before any h.t. voltages are applied.

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

(3) During switch off, the grid 2 voltage should be reduced before all other voltages or excessive currents may be drawn.

(4) The grid 1, grid 2 and helix voltages should be stabilized to $\pm 2\%$.

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

B. Initial Installation of Travelling Wave Tube

(1) Before inserting the travelling wave tube the focusing screws on the mount must be set to a central position 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 heat sink, ensuring that the keyway on the travelling wave tube mates correctly with the spigot on the mount, and push the tube 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 3 minutes cathode pre-heating time.

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

(3) Set helix voltage to 2520 volts and grid 1 voltage to zero volts, with zero r.f. input. Set grid 2 voltage to 2050 volts for operation with 30mA collector current.

(4) Successively adjust the focusing screws until the helix current is reduced to a minimum. Adjust grid 1 voltage to minimize helix current and grid 2 voltage to obtain a collector current of 30mA.

(5) Finally with r.f. drive applied some slight readjustment of the focusing screws, grid 1 voltage and grid 2 voltage may be required to achieve minimum helix current at the required collector 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 to the focusing screws or grid 1 voltage, as follows:

(1) Allow one minute minimum cathode pre-heating time.

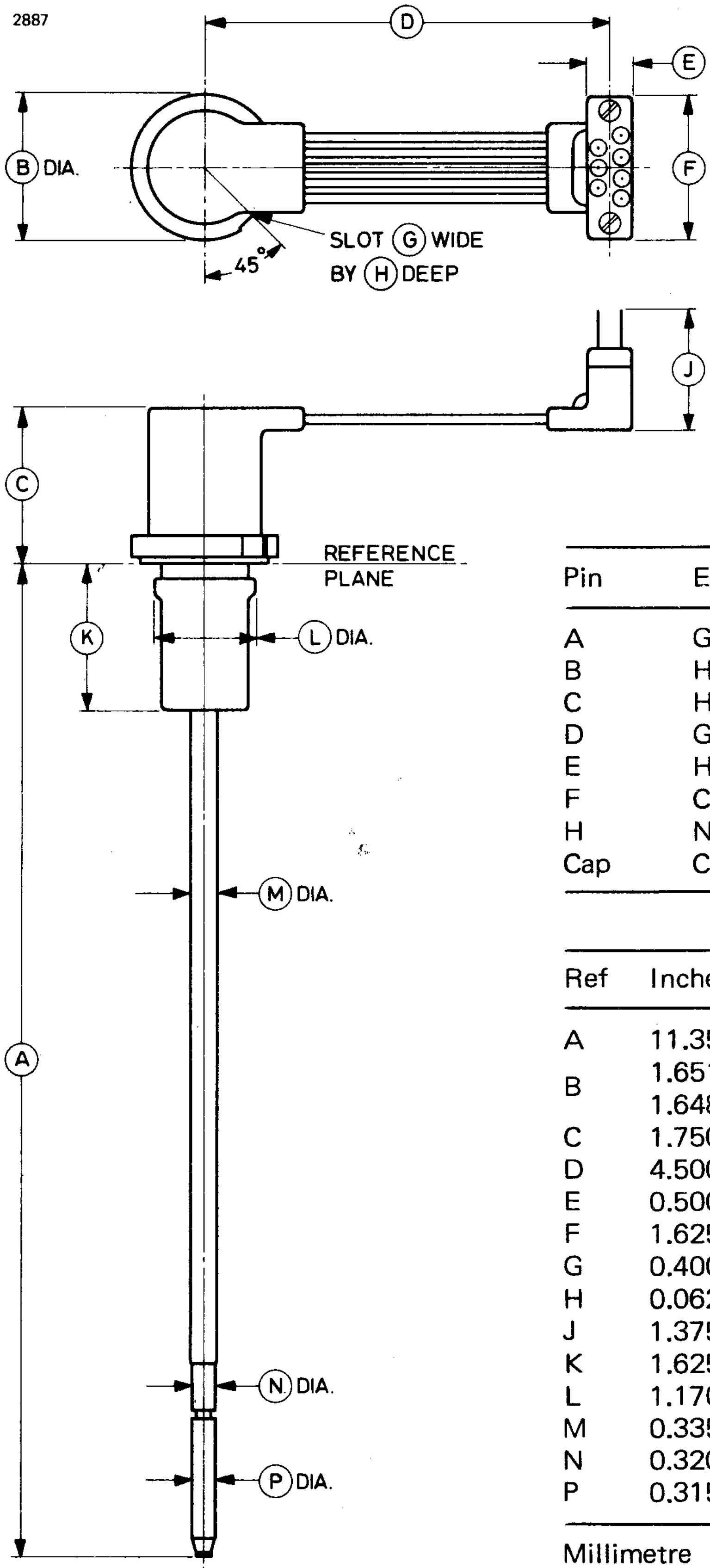
(2) Switch on h.t. voltages, delaying grid 2 voltage until all other voltages have reached their full operating values.

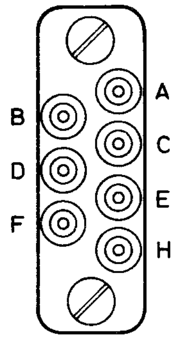
E. Supply Interruption

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

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

N1070 OUTLINE (All dimensions without limits are nominal)





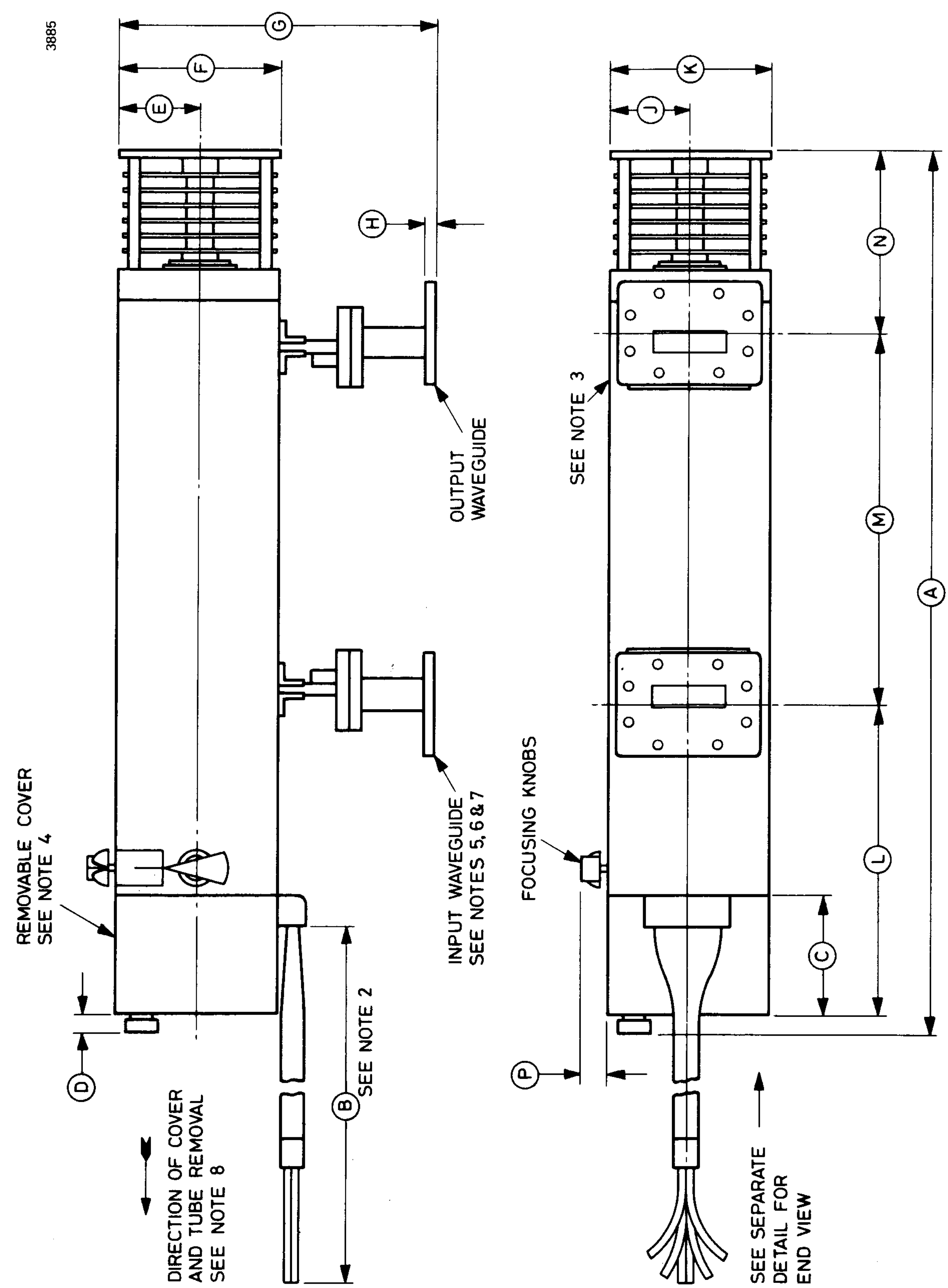
DETAIL OF PLUG
TYPE BA7P

Pin	Element
A	Grid 2
B	Heater
C	Helix
D	Grid 1
E	Heater
F	Cathode
H	No connection
Cap	Collector

Ref	Inches	Millimetres
A	11.350 ± 0.062	288.3 ± 1.6
B	1.651 max	41.94 max
	1.648 min	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	1.625 max	41.28 max
L	1.170 max	29.72 max
M	0.335 max	8.51 max
N	0.320	8.13
P	0.315	8.00

Millimetre dimensions have been derived from inches.

N4132T MOUNT OUTLINE (See Outline Note 1 on page 11)



N4132T MOUNT OUTLINE

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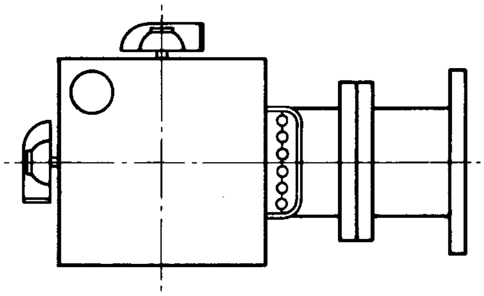


Outline Dimensions

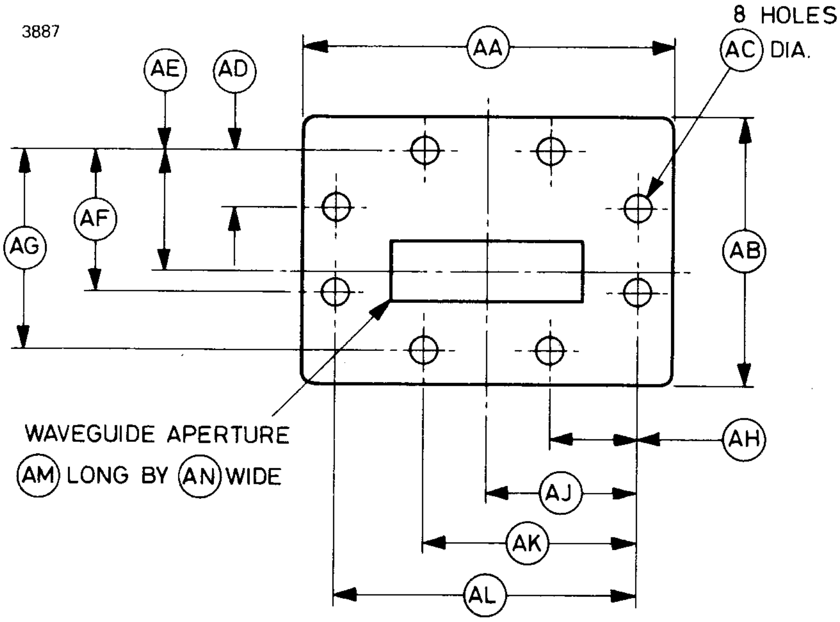
Ref	Inches	Millimetres
A	16.307 max	414.2 max
B	18.000 ± 0.500	457.2 ± 12.7
C	2.270 max	57.66 max
D	0.312 max	7.92 max
E	1.484 ± 0.015	37.69 ± 0.38
F	2.968 ± 0.032	75.39 ± 0.81
G	5.875	149.2
H	$0.250\,^{+0.000}_{-0.032}$	$6.35\,^{+0.00}_{-0.81}$
J	1.484 ± 0.015	37.69 ± 0.38
K	2.968 ± 0.032	75.39 ± 0.81
L	5.750 max	146.1 max
M	6.840 ± 0.015	173.7 ± 0.38
N	3.390 max	86.11 max
P	0.750 max	19.05 max

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Yellow	Cathode
Brown	Heater
Brown	Heater
Green	Grid 1
Blue	Grid 2
Orange	Helix

WAVEGUIDE FLANGE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	2.687 ± 0.015	68.25 ± 0.38	AH	0.656	16.66
AB	1.937 ± 0.015	49.20 ± 0.38	AJ	1.094	27.79
AC	0.198 ± 0.002	5.029 ± 0.051	AK	1.532	38.91
AD	0.406	10.31	AL	2.188	55.58
AE	0.872	22.15	AM	1.372	34.85
AF	1.032	26.21	AN	0.414	10.52
AG	1.438	36.53			

Millimetre dimensions have been derived from inches.

OUTLINE NOTES FOR N4132T

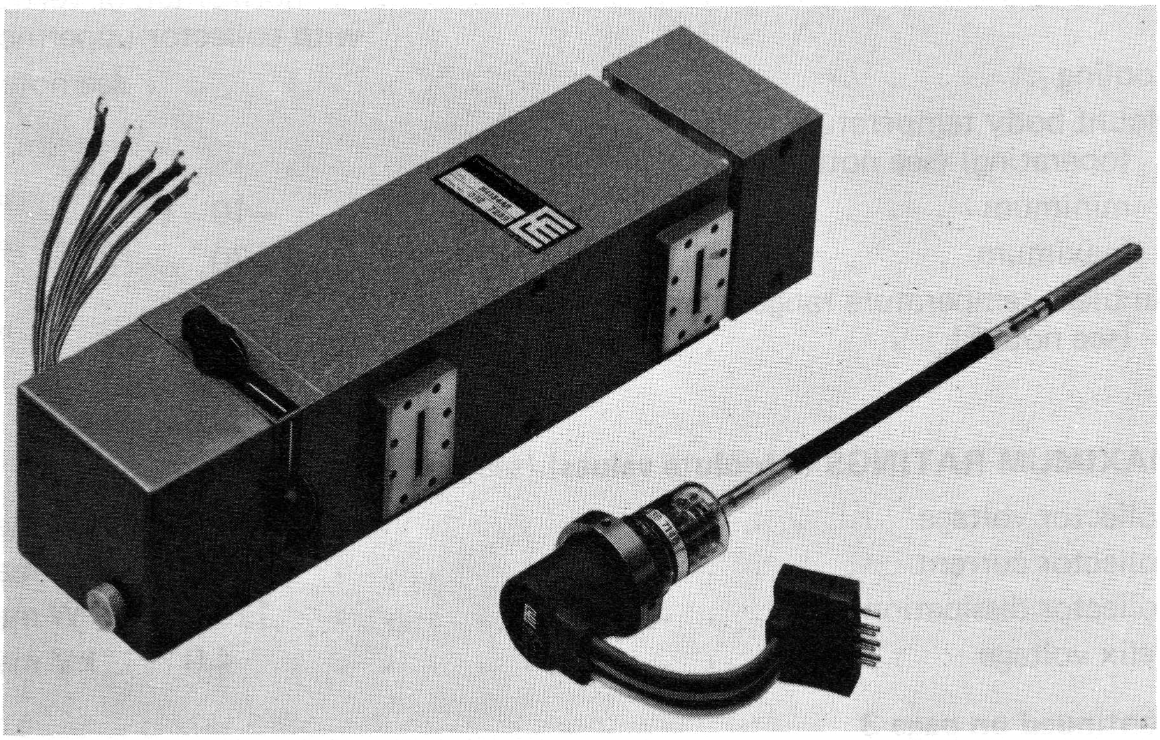
1. Certain alternative orientations of end cover and focusing screws are possible by arrangement.
2. The mount has six screened leads fitted with spade terminals to suit 4BA or 6–32 screws. Alternative lead lengths and terminations can be supplied to suit customers' requirements.
3. The collector connection is to the body of the mount which must always be properly earthed during operation.
4. An end clearance of 2¼ inches (57mm) must be allowed to permit the removal of the cover for tube insertion or withdrawal. The travelling wave tube leads plug into a socket inside the cover. An alternative cover, measuring 3 x 4¼ x 2¼ inches (76.2 x 108 x 57.2mm) and incorporating a mains interlock, can be supplied.
5. Matching screws are fitted on both the input and output waveguides.
6. The waveguide flange is based on RETMA flange CPR137 (see page 10).
7. The mount as shown includes transitions for connection to no. 14 waveguide; it can be supplied without the transitions.
8. The overall length of the mount together with an adequate allowance for tube withdrawal is 29 inches (737mm).

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 overridden 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.

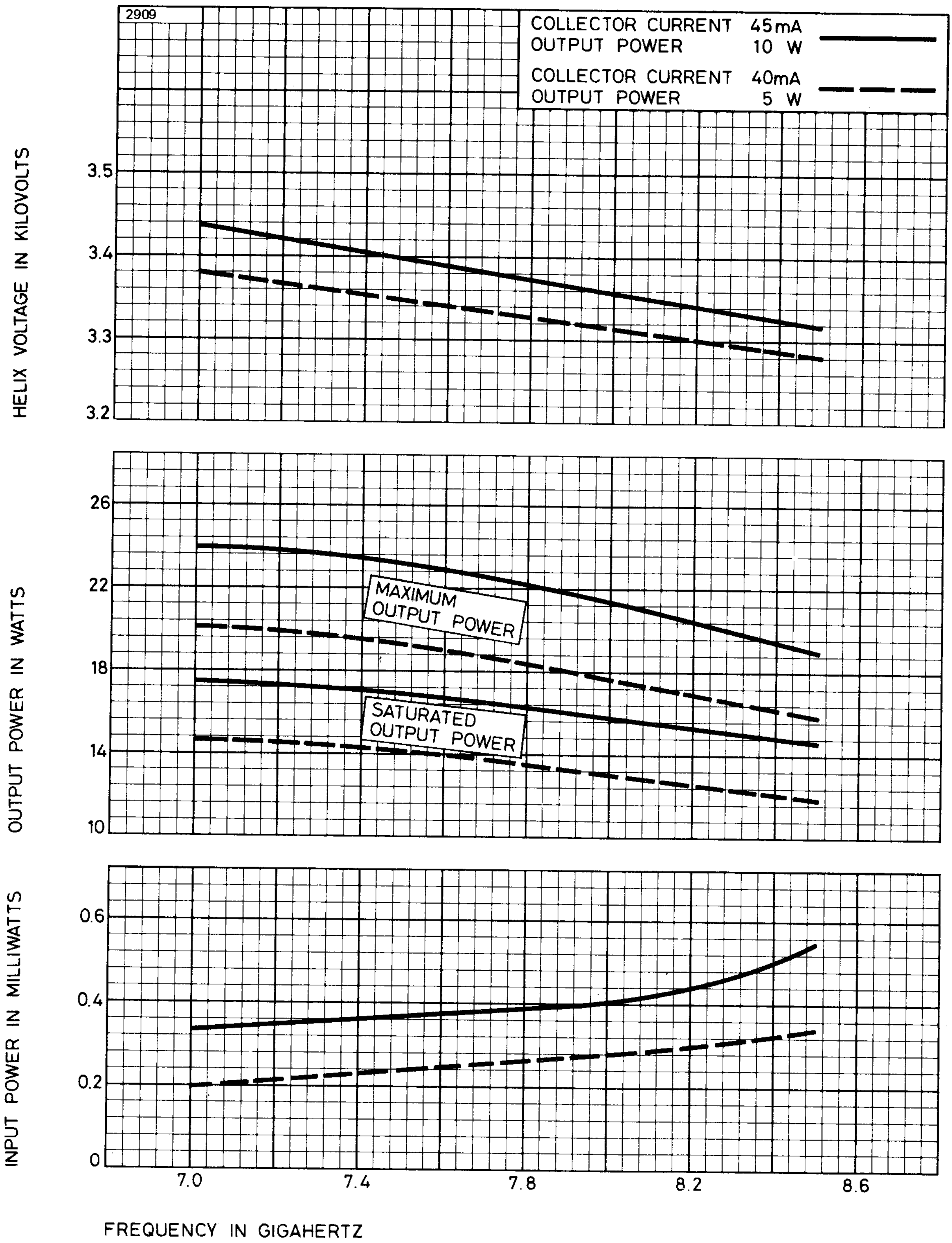
(2) Switch on h.t. voltages, delaying anode voltage until all other voltages have reached their full operating values.

E. Supply Interruption

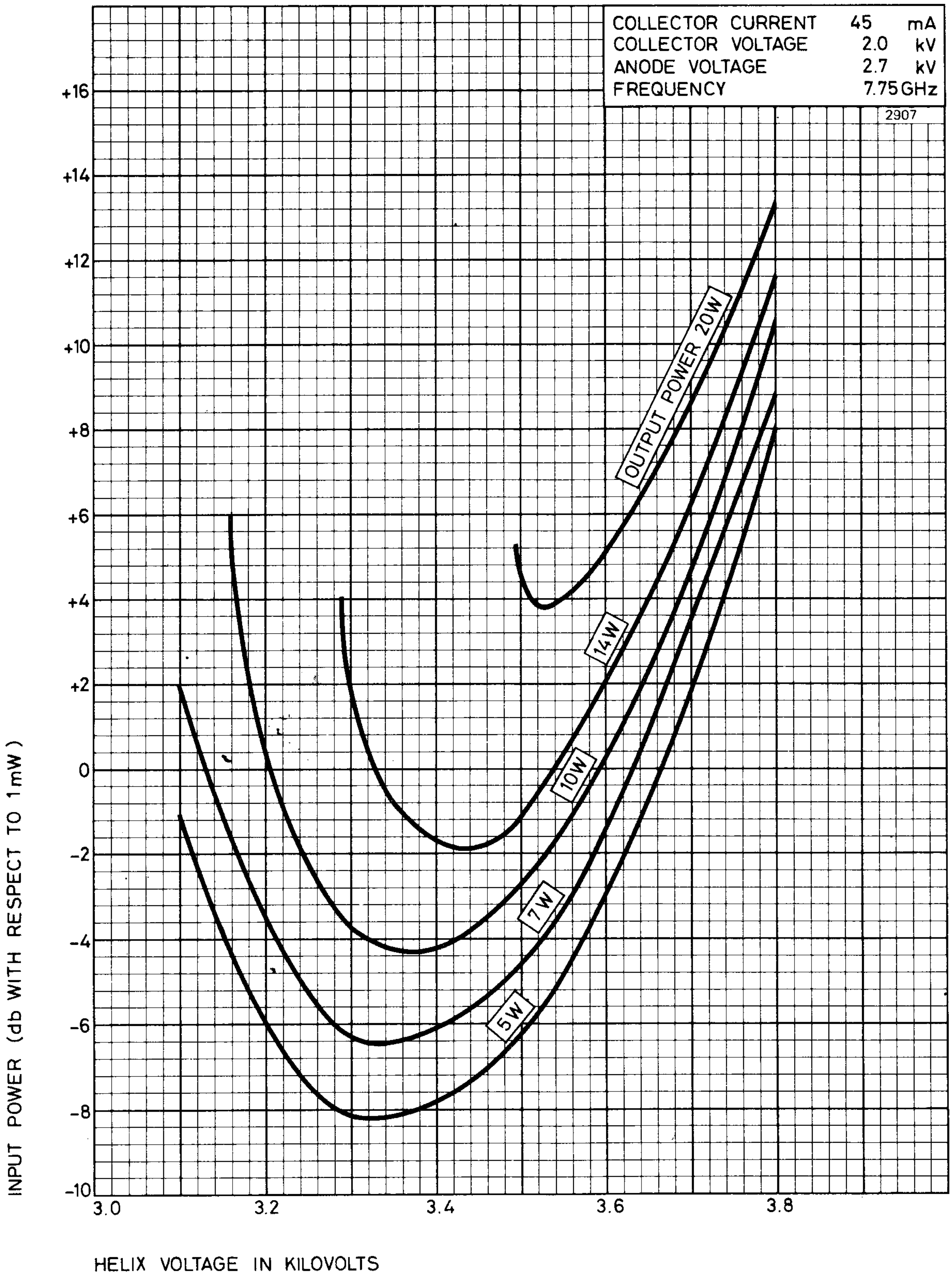
(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting anode voltage which must be delayed as in C(2) above.

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

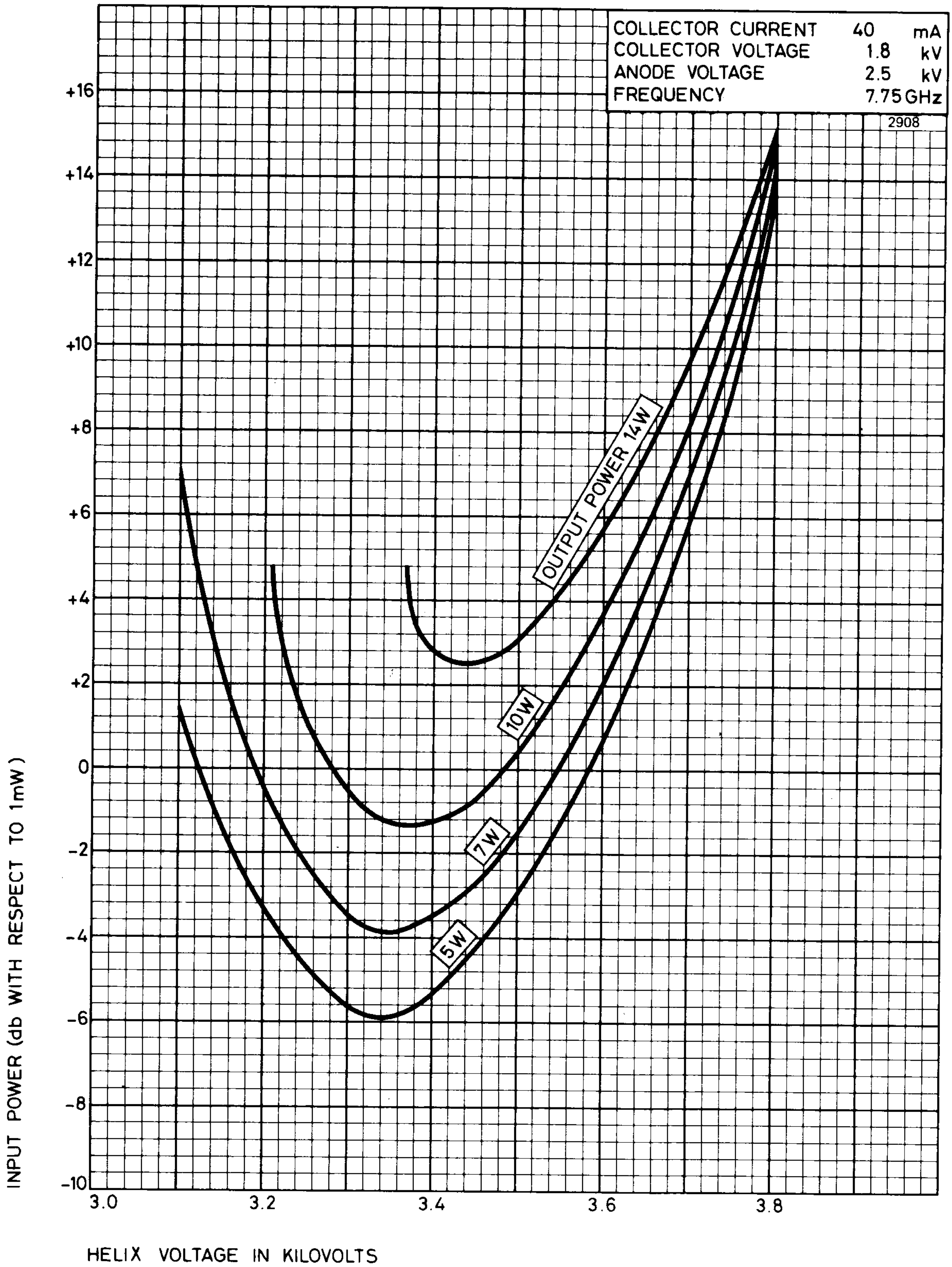
TYPICAL PERFORMANCE CHARACTERISTICS



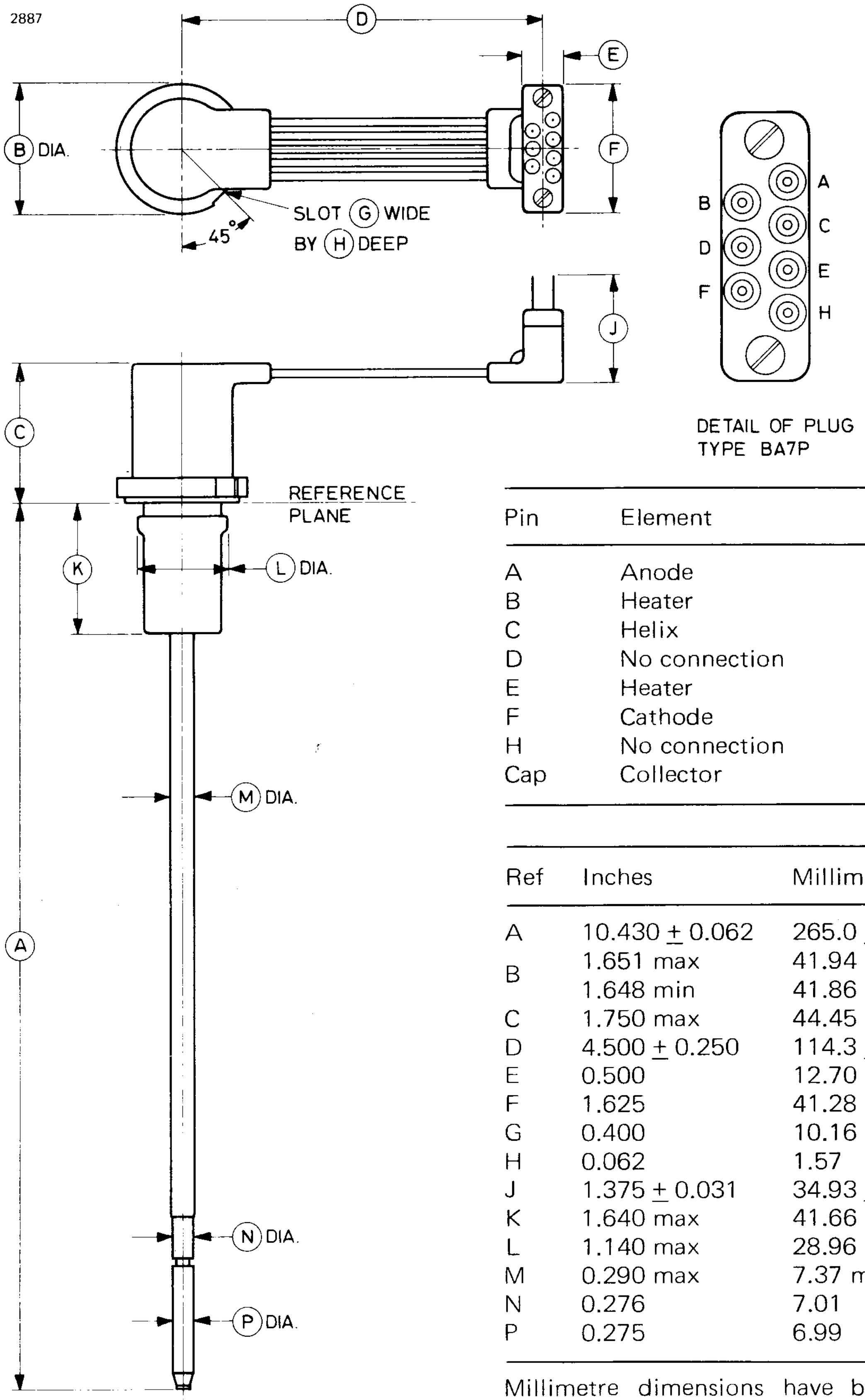
TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



N1071 OUTLINE (All dimensions without limits are nominal)

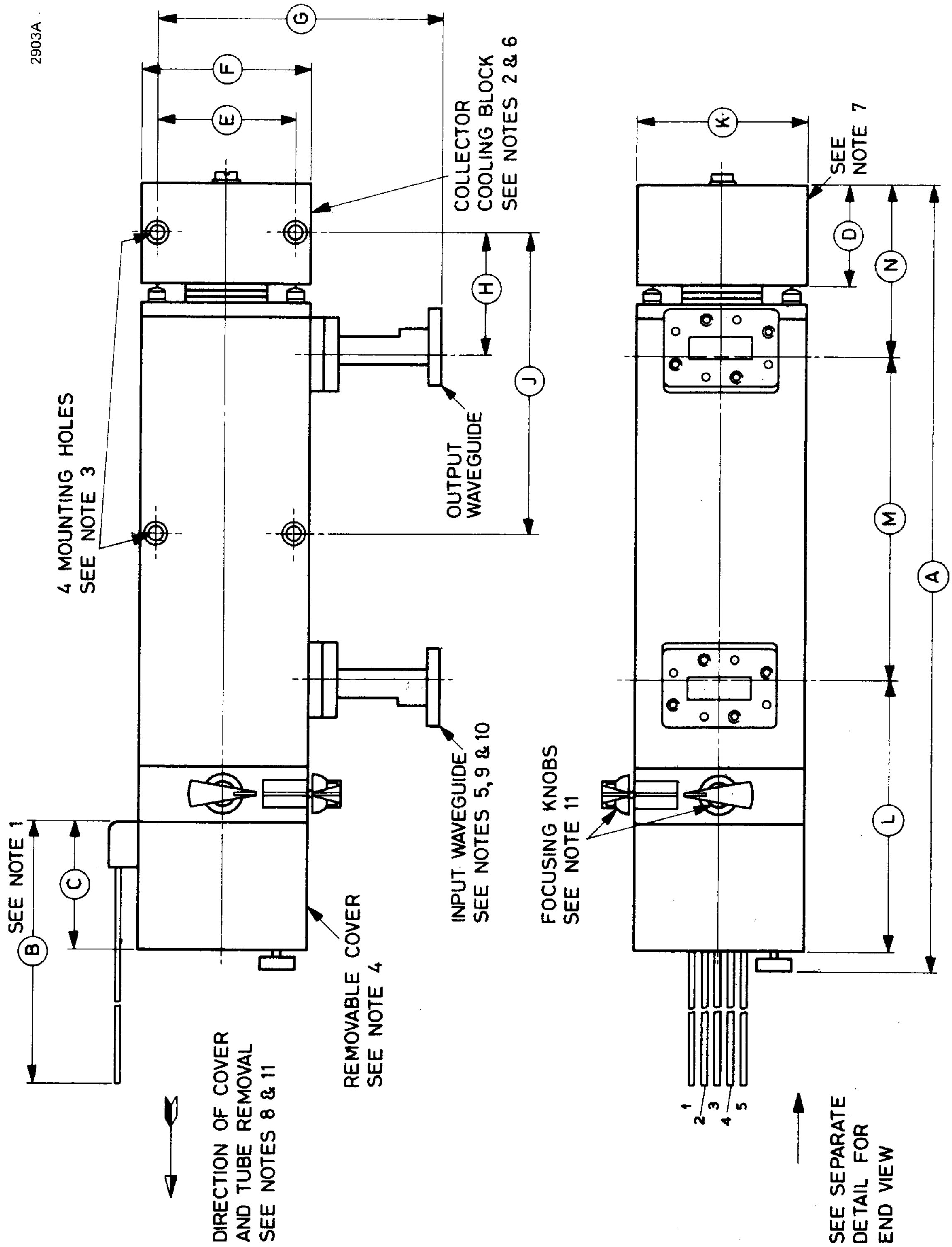


Pin	Element
A	Anode
B	Heater
C	Helix
D	No connection
E	Heater
F	Cathode
H	No connection
Cap	Collector

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)

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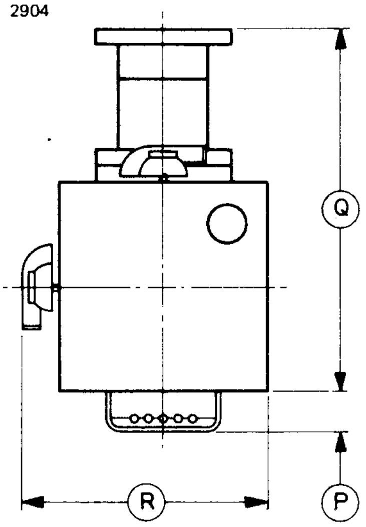


Ref	Inches	Millimetres
A	14.733 max	374.2 max
B	69.500	1765
C	2.270 max	57.66 max
D	1.750 ± 0.015	44.45 ± 0.38
E	2.450 ± 0.010	62.23 ± 0.25
F	2.968 ± 0.032	75.39 ± 0.81
G	4.540 ± 0.030	115.3 ± 0.8
H	2.150 ± 0.015	54.61 ± 0.38
J	5.250 ± 0.010	133.4 ± 0.3
K	2.968 ± 0.032	75.39 ± 0.81
L	5.000 max	127.0 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.

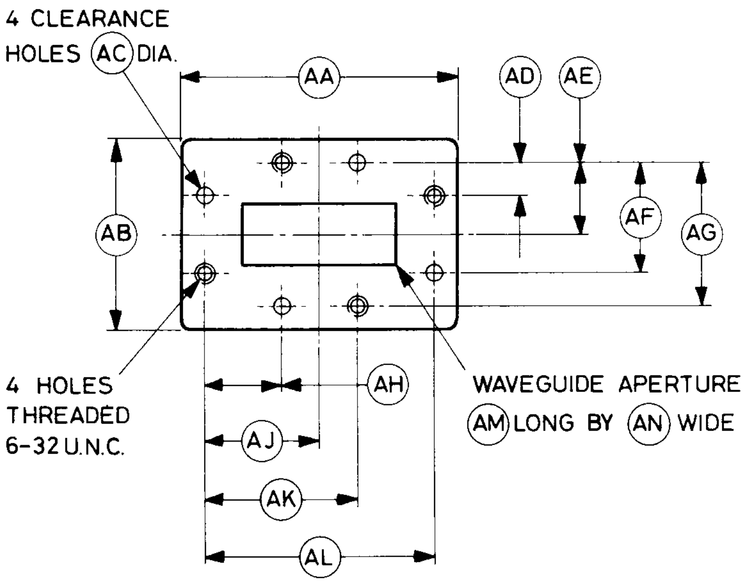
Lead	Colour	Element
1	Yellow	Cathode
2	Brown	Heater
3	Brown	Heater
4	Blue	Anode
5	Orange	Helix

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

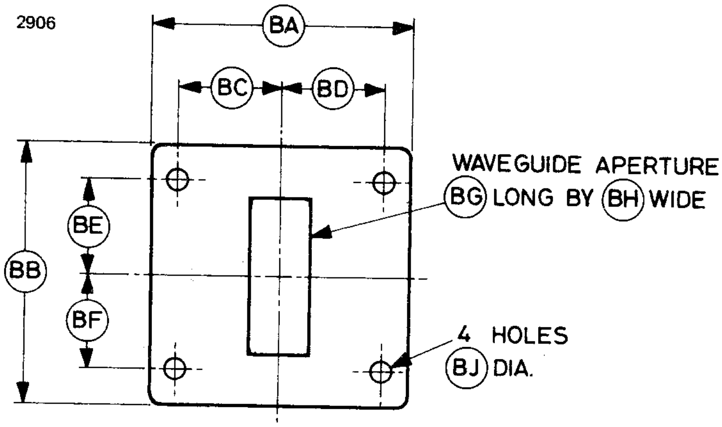


Ref	Inches	Millimetres
AA	2.016	51.21
AB	1.375	34.93
AC	0.147 + 0.003 − 0.001	3.734 + 0.076 − 0.025
AD	0.237	6.020
AE	0.517	13.13
AF	0.797	20.24
AG	1.034	26.26
AH	0.553	14.05
AJ	0.830	21.08
AK	1.107	28.12
AL	1.660	42.16
AM	1.122	28.50
AN	0.412	10.46

Millimetre dimensions have been derived from inches.

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

2906



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.

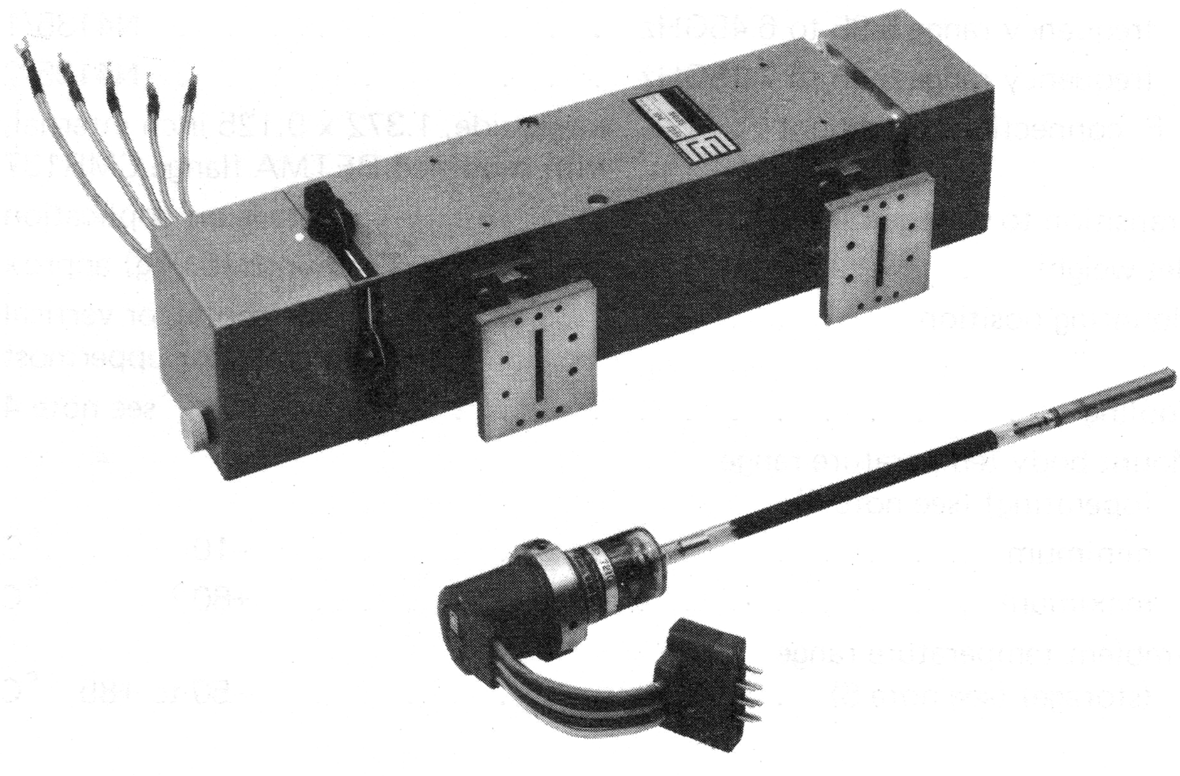
N1072

5.8–7.2GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Long life travelling wave tube for wideband communication systems. Operated at 10W output in the common carrier frequency band, the tube typically requires less than 70W total primary power to satisfy the gain, noise and AM/PM conversion requirements of typical 1800 channel multiplex systems. The tube is operated in a periodic permanent magnet mount cooled either by natural convection or by conduction through an attached heat sink. Replacement of the tube within the mount is an operation of the utmost simplicity.

Frequency range	5.8 to 7.2	GHz
Saturation output power (nominal, see note 1)	19	W
Working output power (see note 1)	5 to 10	W
Nominal gain (at 10W output)	44	db
Noise factor	23	db
AM/PM conversion (at 10W output)	1.0	degree/db



November 1973

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 Mount (see note 4)

Two frequency variants of the mount are available:

frequency range 5.85 to 6.45GHz	N4135/1
frequency range 6.45 to 7.15GHz	N4135/2
R.F. connections on mount	waveguide, 1.372 x 0.125 inch internal, with modified RETMA flange CMR137
Transition to waveguide WR137	details on application
Net weight	13 pounds (5.9kg) 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	+80	°C

Ambient temperature range (storage) (see note 5)	−50 to +85	°C

MAXIMUM RATINGS (Absolute values) (see note 6)

Collector voltage	2.7	kV max
Collector current	50	mA max
Collector dissipation	120	W max
Helix voltage	4.0	kV max
Helix current:		
continuous	2.0	mA max
for 1 second max	4.0	mA max
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 +80	°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

TYPICAL OPERATION (at 6.5GHz)

	5W Output	10W Output	
Operational Conditions (see note 6)			
Collector voltage (see note 7)	1.5	1.7	kV
Collector current	40	45	mA
Helix voltage (see note 8)	3.35	3.40	kV
Anode voltage	2.5	2.7	kV
Typical Performance			
Helix current	0.15	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 9)	16	19	W
Maximum saturation output power (see note 10)	20	24	W
Noise factor	23	23	db
Cold insertion loss	80	80	db
Input v.s.w.r. over the band (see note 11)	1.25:1	1.25:1	max
Output v.s.w.r. over the band (see note 11)	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	5.8 to 7.2	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage (see note 7)	1.5	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 (see note 8)	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	–	0.2	mA
Input power	–	0.5	mW
Saturation output power	11	–	W
Noise factor (see note 12)	–	24	db
Gain flatness (see note 13)	–	0.01	db/MHz
AM/PM conversion (see note 14)	–	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 11)	–	1.5:1	
Output v.s.w.r. (hot) (see note 11)	–	1.5:1	
Cold insertion loss	65	–	db

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

Recommended Applied Conditions (see note 6)

Frequency range	5.8 to 7.2	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage (see note 7)	1.7	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 (see note 8)	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	–	0.2	mA
Input power	–	1.0	mW
Saturation output power (see note 9) . . .	14	–	W
Noise factor (see note 12)	–	24	db
Gain flatness (see note 13)	–	0.01	db/MHz
AM/PM conversion (see note 14)	–	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 11)	–	1.5:1	
Output v.s.w.r. (hot) (see note 11)	–	1.5:1	
Cold insertion loss	65	–	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 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 conduc-

tion 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 20°C above the ambient temperature of its surroundings (this implies a maximum ambient temperature of 60°C). A convection cooled version is available.

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. Operation at lower values of collector voltage (1.3kV at 5W, 1.5kV at 10W) is possible under certain special conditions. EEV should be consulted if this use is required.

8. The helix voltage is adjusted for maximum gain to a value which depends upon frequency.

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

10. With both the helix voltage and input power adjusted for maximum output. The tube must not be operated continuously under these conditions. The collector voltage may need to be set above the minimum value to limit the helix current.

11. The matching adjustments on the mount are preset during manufacture. With any tube operated either in mount N4135/1 or mount N4135/2, the v.s.w.r. will remain below the quoted value over the specified frequency range of the mount.

12. 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.

13. Over the recommended frequency range.

14. 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 N1072 IN P.P.M. MOUNT N4135

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 will not have risen appreciably 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 $\pm 2\%$. Voltage ripple limits will be determined by the application.

(5) Limits for collector voltage stabilization and ripple will depend upon the operating value, higher values permitting wider limits.

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

B. Initial Installation of Travelling Wave Tube

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

(2) Pull down the sprung retaining finger and insert the travelling wave tube in the mount taking care to avoid radial force. Slightly increase the pressure to overcome the extra resistance as the collector enters the heat sink, 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 and anode voltages to typical operating values.

(4) Adjust the focusing screws until the helix current is reduced to a minimum. Adjust anode voltage to obtain collector current as required.

(5) Adjust r.f. input power and helix voltage to obtain required output power, re-adjusting focusing screws if necessary.

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.

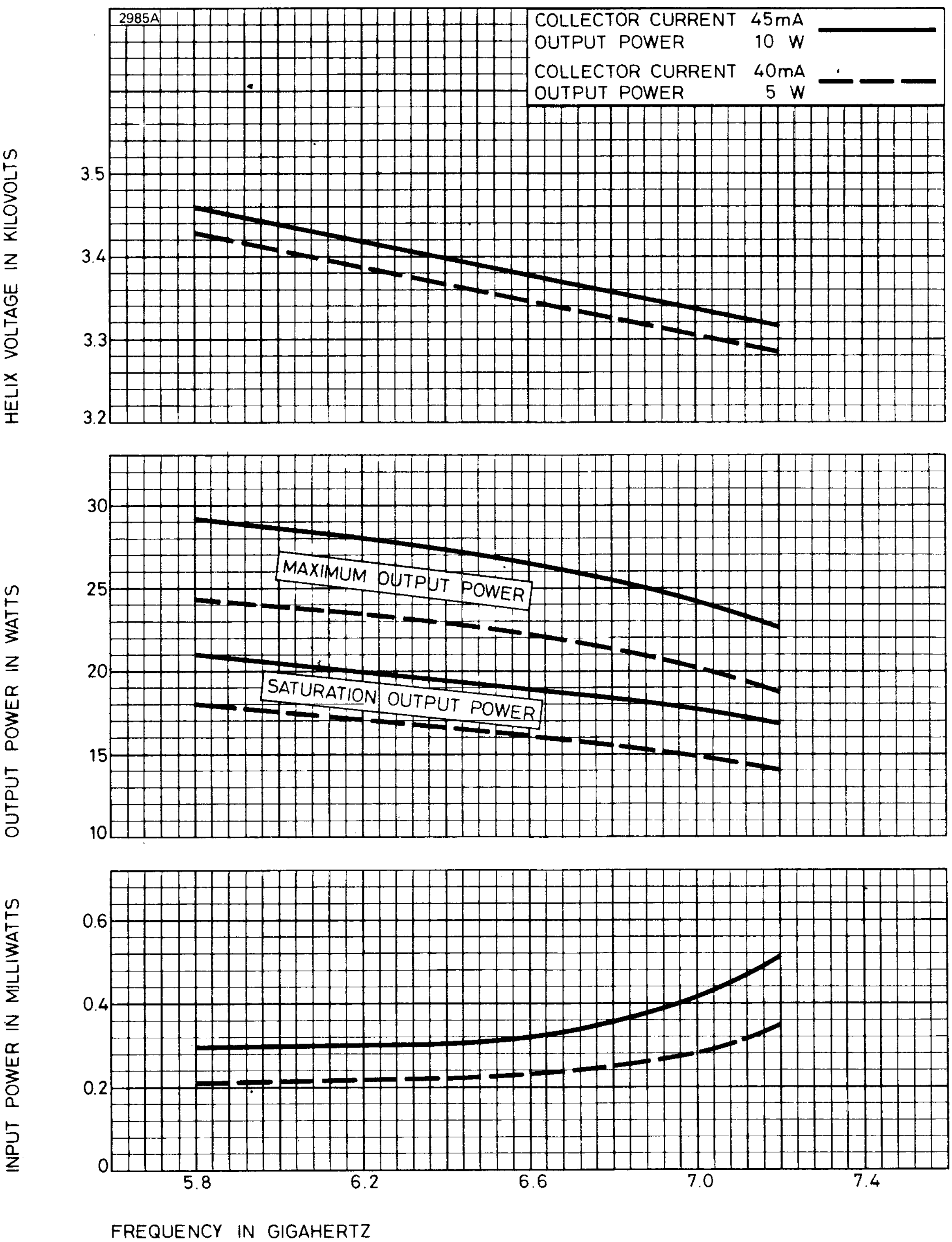
(2) Switch on h.t. voltages, delaying anode voltage until all other voltages have reached their full operating values.

E. Supply Interruption

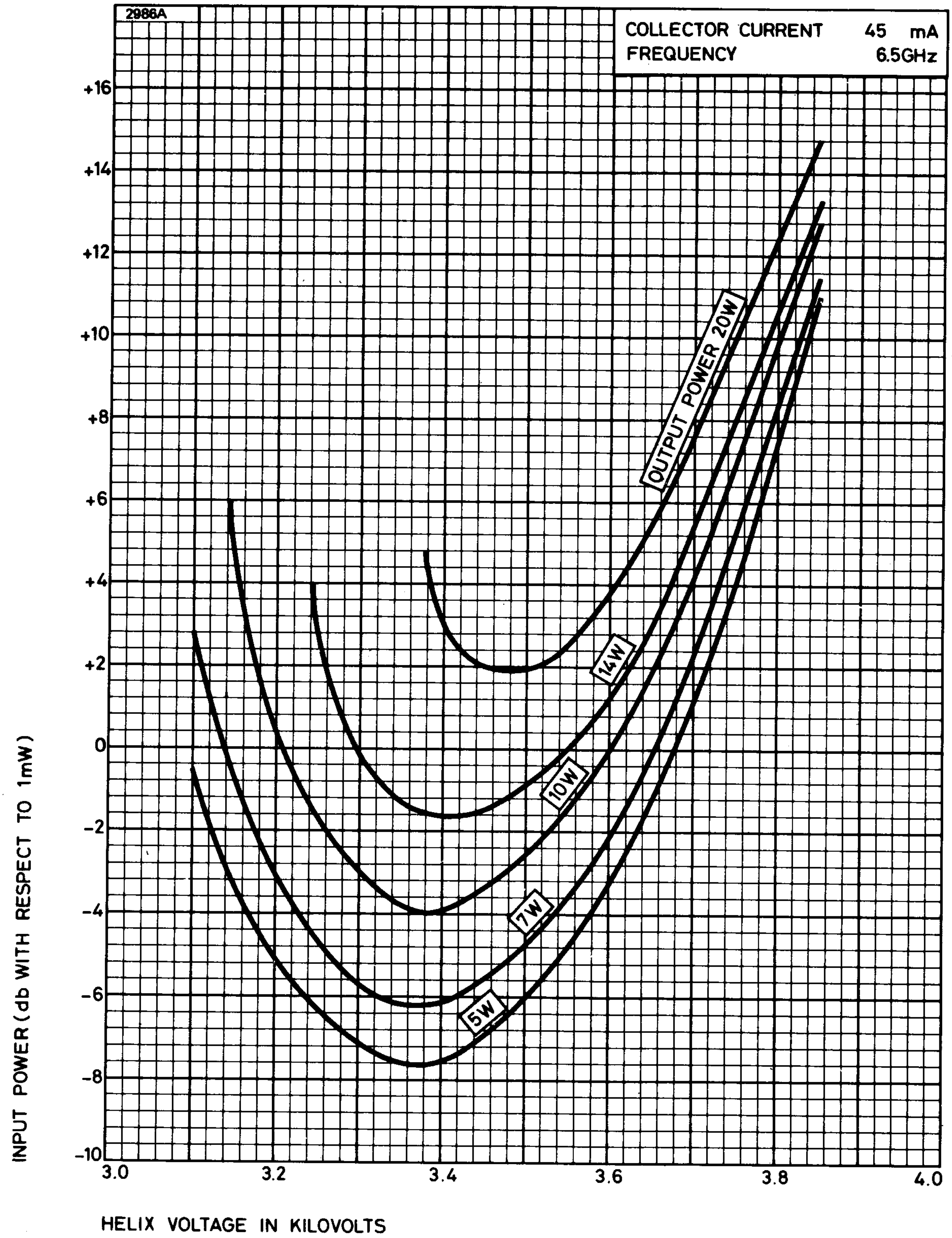
(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting anode voltage which must be delayed as in C(2) above.

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

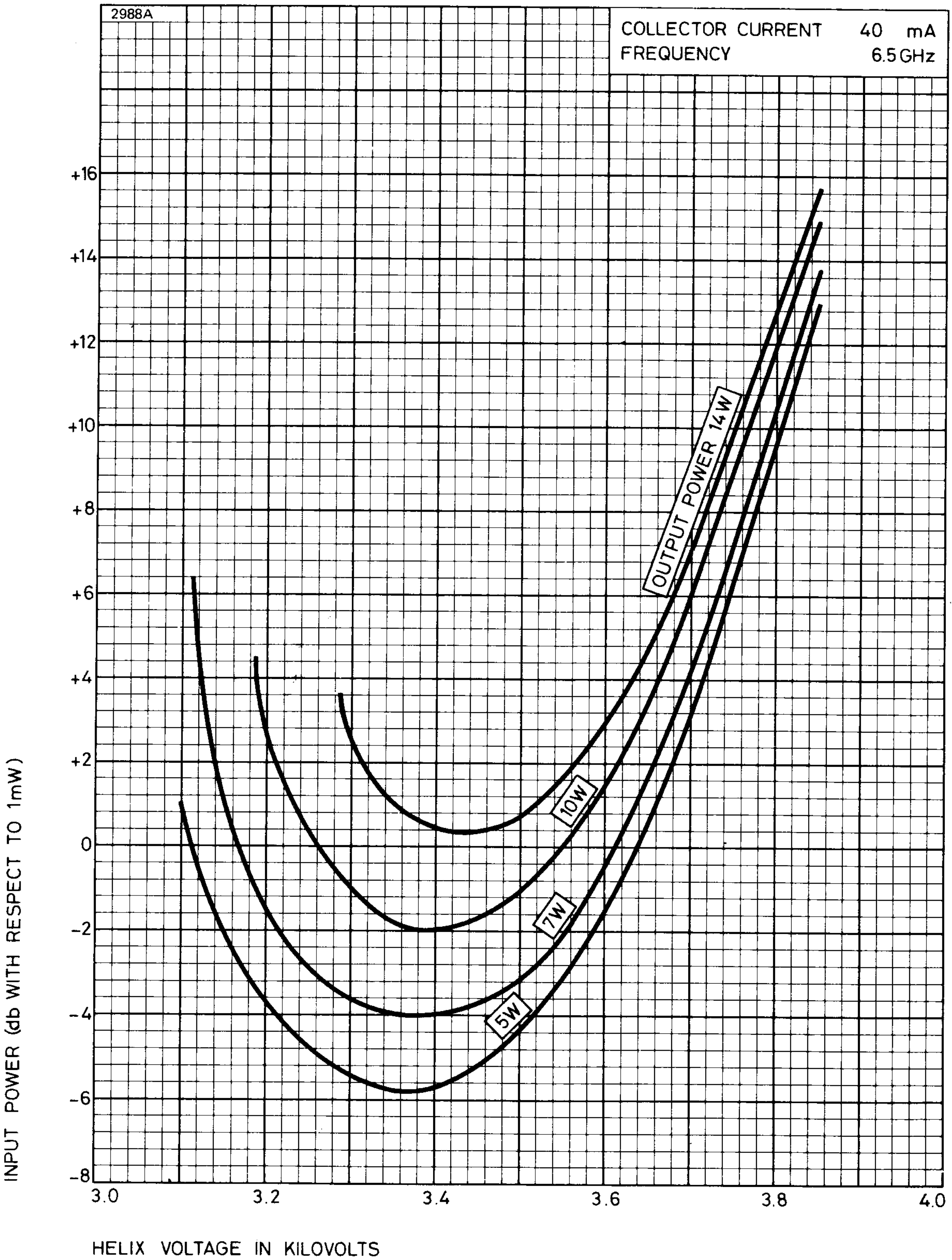
TYPICAL PERFORMANCE CHARACTERISTICS



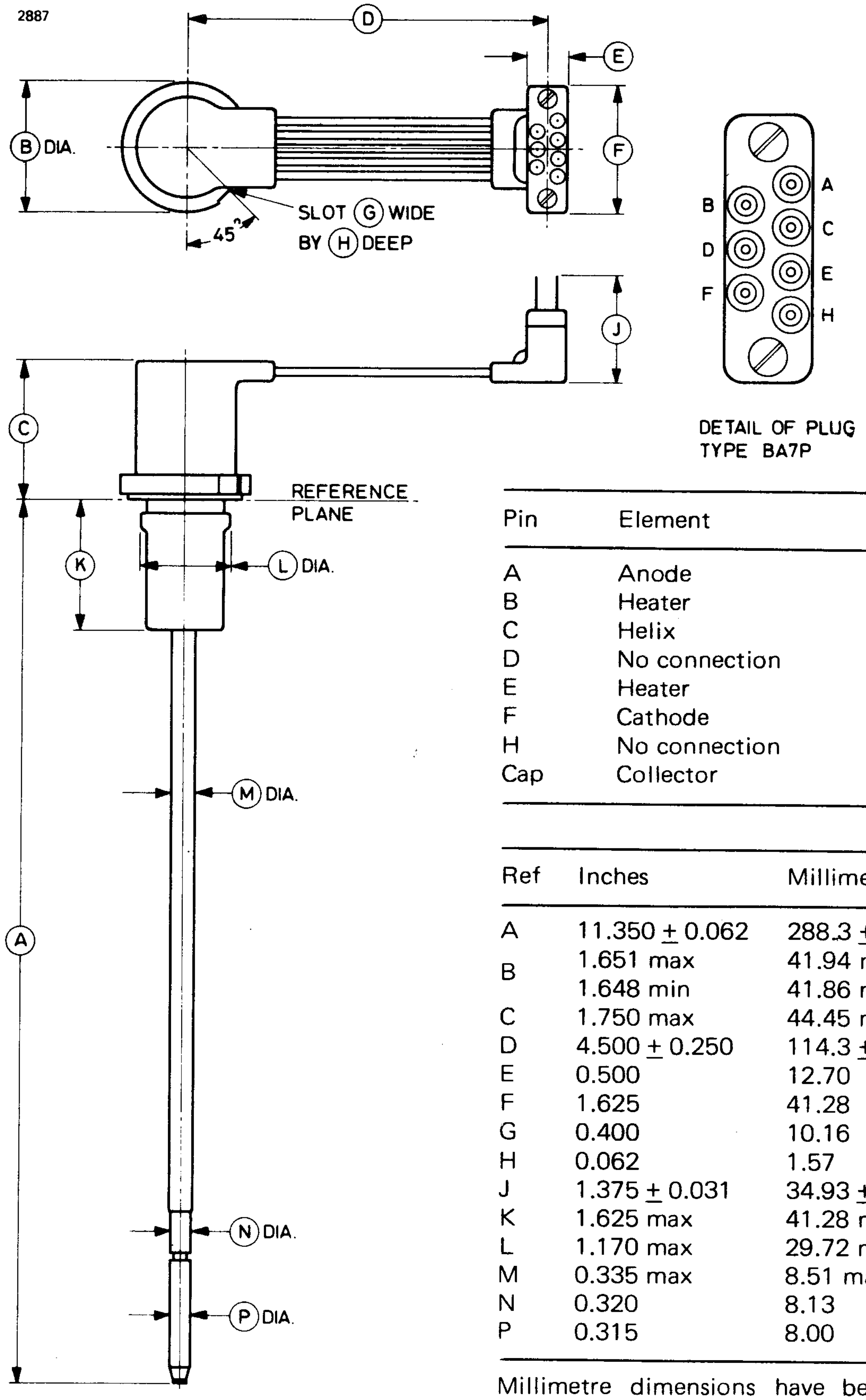
TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



N1072 OUTLINE (All dimensions without limits are nominal)

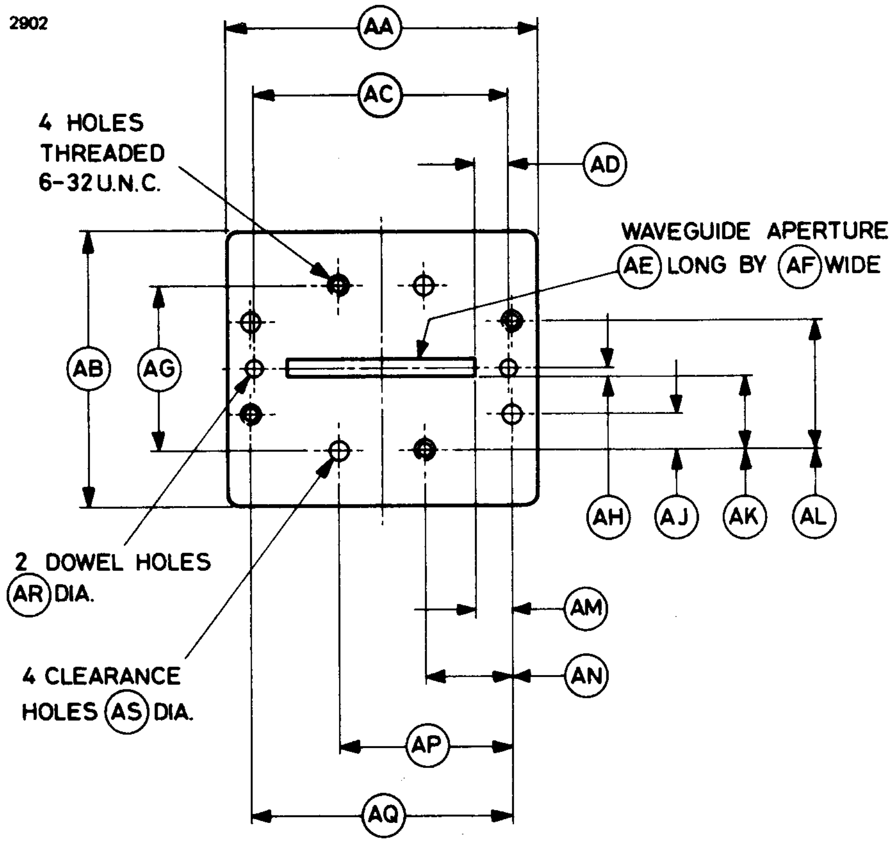


Pin	Element
A	Anode
B	Heater
C	Helix
D	No connection
E	Heater
F	Cathode
H	No connection
Cap	Collector

Ref	Inches	Millimetres
A	11.350 ± 0.062	288.3 ± 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	1.625 max	41.28 max
L	1.170 max	29.72 max
M	0.335 max	8.51 max
N	0.320	8.13
P	0.315	8.00

Millimetre dimensions have been derived from inches.

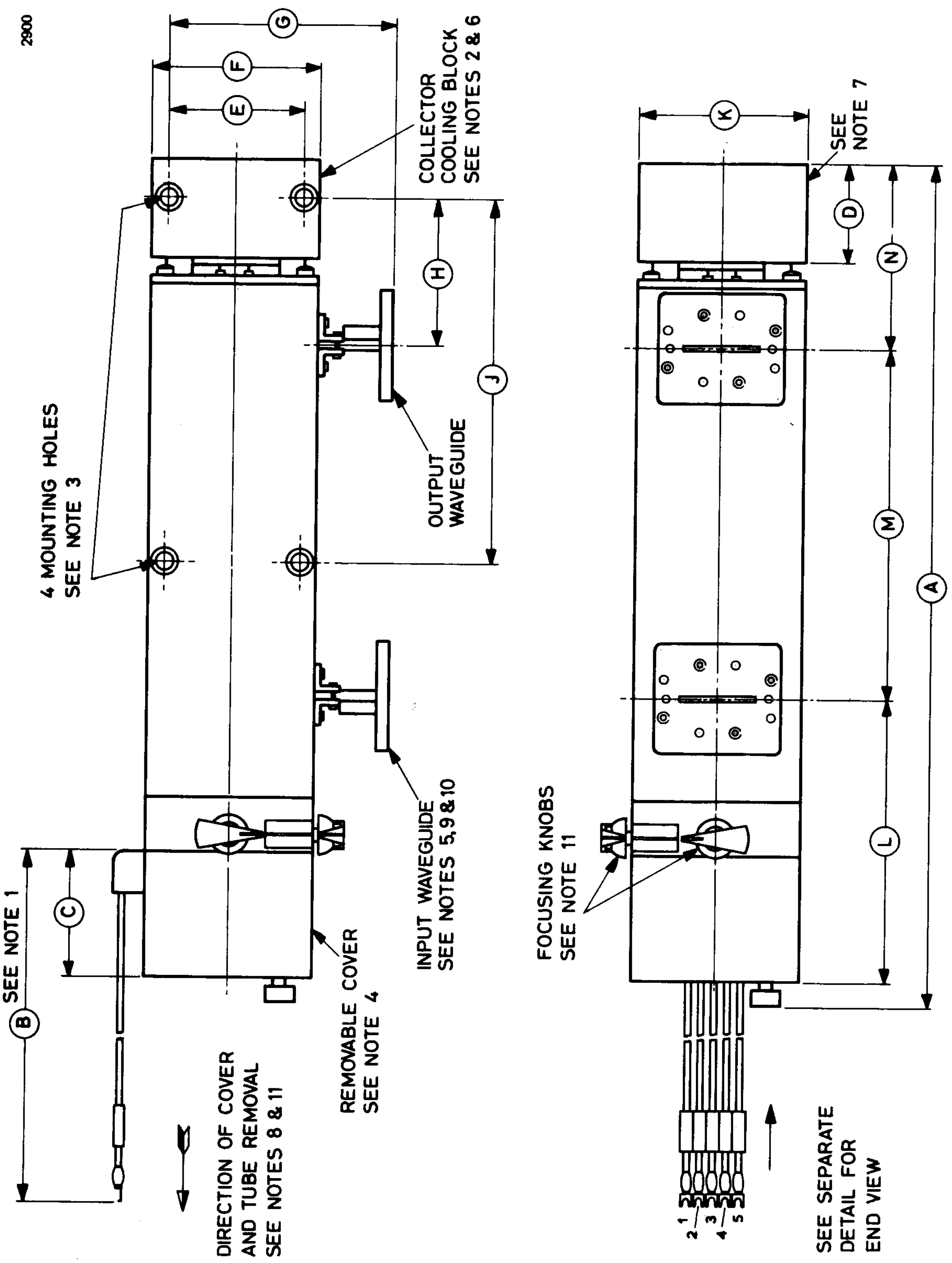
N4135 Waveguide Flange (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	2.281	57.94	AK	0.527 ± 0.002	13.386 ± 0.051
AB	2.000	50.80	AL	0.932 ± 0.004	23.673 ± 0.102
AC	1.875 ± 0.002	47.625 ± 0.051	AM	0.279 ± 0.002	7.087 ± 0.051
AD	0.2515 ± 0.002	6.388 ± 0.051	AN	0.643 ± 0.004	16.332 ± 0.102
AE	1.372 ± 0.004	34.849 ± 0.102	AP	1.287 ± 0.004	32.690 ± 0.102
AF	0.125 ± 0.004	3.175 ± 0.102	AQ	1.930 ± 0.004	49.022 ± 0.102
AG	1.179 ± 0.004	29.947 ± 0.102	AR	0.129 max	3.277 max
AH	0.0625 ± 0.001	1.588 ± 0.025		0.128 min	3.251 min
AJ	0.247 ± 0.004	6.274 ± 0.102	AS	0.144 ± 0.002	3.658 ± 0.051

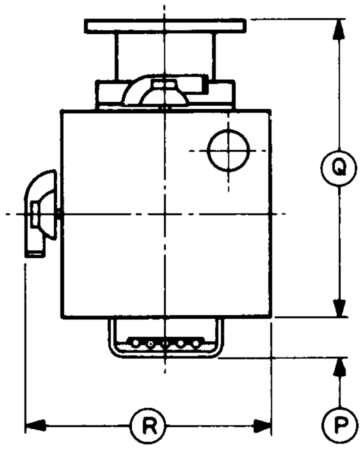
Millimetre dimensions have been derived from inches.

N4135 OUTLINE (See page 16 for Outline Notes)



N4135 OUTLINE

2901



Ref	Inches	Millimetres
A	15.185 max	385.7 max
B	12.000 nom	304.8 nom
C	2.250 ± 0.015	57.15 ± 0.38
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	4.056 ± 0.020	103.0 ± 0.5
H	2.625 ± 0.015	66.68 ± 0.38
J	6.500 ± 0.010	165.1 ± 0.4
K	2.968 ± 0.032	75.39 ± 0.81
L	5.050 max	128.3 max
M	6.245 ± 0.015	158.6 ± 0.4
N	3.500 max	88.90 max
P	0.500 max	12.70 max
Q	4.346 max	110.4 max
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

N4135 Outline Notes

1. The mount has five screened leads fitted with spade terminals to suit 4BA or 6–32 screws. 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. Alternative forms of cover can be supplied. A microswitch for interlocking with the power supply unit can be provided.

5. Matching screws on both the input and output waveguides can be fitted if required on the type shown. The mount can also be supplied with alternative waveguides approximately 1 inch (25mm) shorter; matching screws cannot be fitted to this version.

6. 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. The attached heat sink should have a thermal impedance of 0.5°C/watt.

7. A convection cooled version for horizontal mounting is available within the same overall length.

8. The overall length of the mount together with an adequate allowance for tube withdrawal is 28.250 inches (717.6mm).

9. The waveguide flange is based on RETMA flange CMR137. The fixing holes may be tapped or clearance to suit customers' requirements. Alternative dowel holes may be provided.

10. Transitions to full size No. 14 waveguide are available.

11. Certain alternative orientations of end cover and focusing screws, and position of mounting holes, are possible by arrangement.

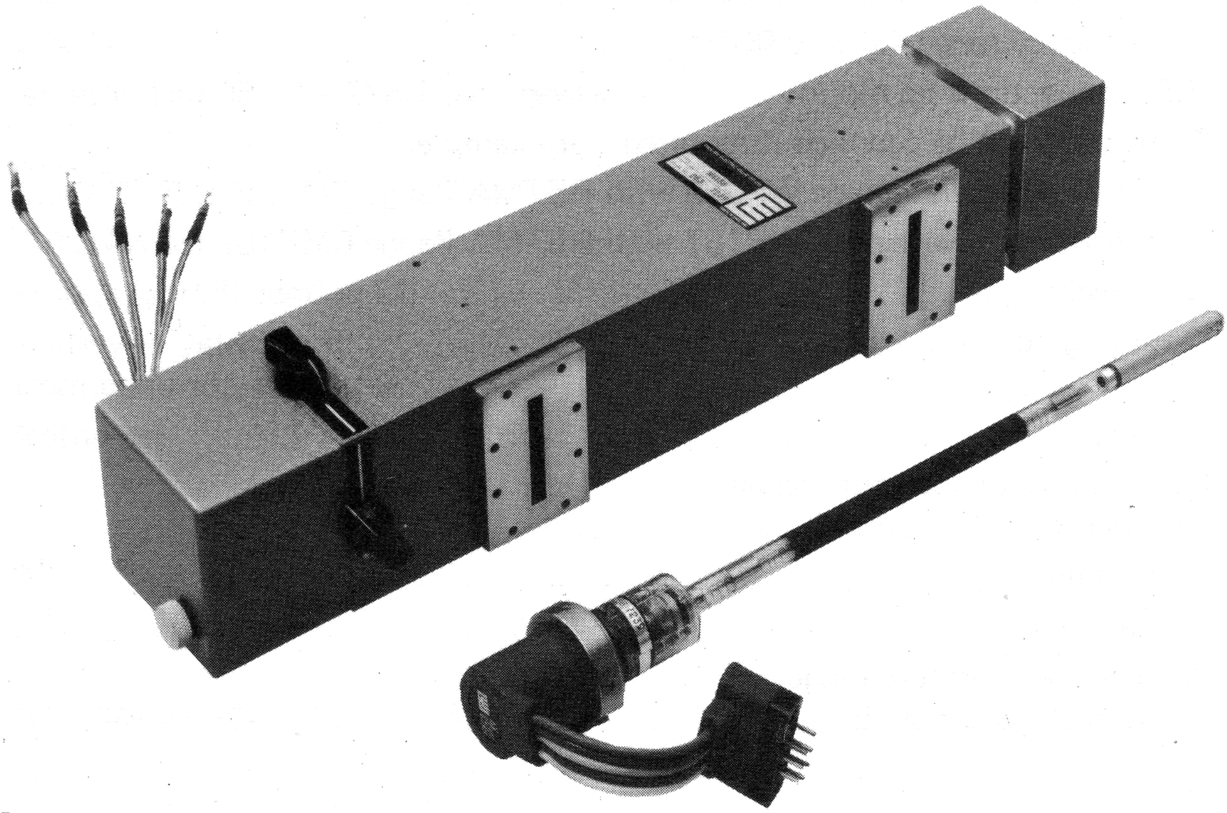
N1073

3.55–5.0GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Long life travelling wave tube for wideband communication systems. Operated at 10W output in the common carrier frequency band, the tube typically requires less than 70W total primary power to satisfy the gain, noise and AM/PM conversion requirements of typical 1800 channel multiplex systems. The tube is operated in a periodic permanent magnet mount cooled either by natural convection or by conduction through an attached heat sink. Replacement of the tube within the mount is an operation of the utmost simplicity.

Frequency range	3.55 to 5.0	GHz
Saturation output power (nominal, see note 1)	16	W
Working output power (see note 1)	5 to 10	W
Nominal gain (at 10W output)	41	db
Noise factor	23	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 Mount (see note 4)

Two frequency variants of the mount are available:

frequency range 3.55 to 4.2GHZ	N4136/1
frequency range 4.4 to 5.0GHz	N4136/2

R.F. connections on mount . . . waveguide, 1.872 x 0.250 inch internal

Transitions can be supplied if required, for example:

transition to waveguide WR229 with RETMA flange CMR229 for N4136/1

transition to waveguide WR187 with RETMA flange CMR187 for N4136/2

Net weight	13 pounds (5.9kg) 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	+80	°C
Ambient temperature range (storage) (see note 5)	–50 to +85	°C

MAXIMUM RATINGS (Absolute values) (see note 6)

Collector voltage	2.5	kV max
Collector current	50	mA max
Collector dissipation	120	W max
Helix voltage	4.0	kV max
Helix current:		
continuous	2.0	mA max
for 1 second max	4.0	mA max
Anode voltage	3.0	kV max
Anode current	0.25	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 +80	°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

TYPICAL OPERATION (at 4.3GHz)

	5W Output	10W Output	
Operational Conditions (see note 6)			
Collector voltage (see note 7)	1.5	1.7	kV
Collector current	40	45	mA
Helix voltage (see note 8)	2.92	2.97	kV
Anode voltage	2.1	2.3	kV
Typical Performance			
Helix current	0.1	0.15	mA
Anode current	zero	zero	
Gain at 5.0W output	40	—	db
Gain at 10W output	—	41	db
Saturation output power (see note 9)	14	16	W
Maximum saturation output power (see note 10)	20	25	W
Noise factor	23	23	db
Cold insertion loss	80	80	db
Input v.s.w.r. over the band (see note 11)	1.3:1	1.3:1	max
Output v.s.w.r. over the band (see note 11)	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	3.55 to 5.0	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage (see note 7)	1.5	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	0.65	0.85	A
Helix voltage (see note 8)	2.75	3.15	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	1.5	mA
Anode voltage	2.0	2.5	kV
Anode current	–	0.2	mA
Input power	–	1.25	mW
Saturation output power (see note 9)	11	–	W
Noise factor (see note 12)	–	24	db
Gain flatness (see note 13)	–	0.01	db/MHz
AM/PM conversion (see note 14)	–	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 11)	–	1.5:1	
Output v.s.w.r. (hot) (see note 11)	–	1.5:1	
Cold insertion loss	65	–	db

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

Recommended Applied Conditions (see note 6)

Frequency range	3.55 to 5.0	GHz
Heater voltage (see note 2)	6.3	V
Collector voltage (see note 7)	1.7	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	0.65	0.85	A
Helix voltage (see note 8)	2.75	3.15	kV
Helix current:			
switching on, zero r.f. drive	–	2.0	mA
focused, with r.f. drive	–	1.5	mA
Anode voltage	2.2	2.7	kV
Anode current	–	0.2	mA
Input power	–	2.0	mW
Saturation output power (see note 9) . . .	14	–	W
Noise factor (see note 12)	–	24	db
Gain flatness (see note 13)	–	0.01	db/MHz
AM/PM conversion (see note 14)	–	2.5	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot) (see note 11)	–	1.5:1	
Output v.s.w.r. (hot) (see note 11)	–	1.5:1	
Cold insertion loss	65	–	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 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 conduc-

tion 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 20°C above the ambient temperature of its surroundings (this implies a maximum ambient temperature of 60°C). A convection cooled version is available.

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. Operation at lower values of collector voltage (1.3kV at 5W, 1.5kV at 10W) is possible under certain special conditions. EEV should be consulted if this use is required.

8. The helix voltage is adjusted for maximum gain to a value which depends upon frequency.

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

10. With both the helix voltage and input power adjusted for maximum output. The tube must not be operated continuously under these conditions. The collector voltage may need to be set above the minimum value to limit the helix current.

11. The matching adjustments on the mount are preset during manufacture. With any tube operated either in mount N4136/1 or mount N4136/2, the v.s.w.r. will remain below the quoted value over the specified frequency range of the mount.

12. 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.

13. Over the recommended frequency range.

14. 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 N1073 in P.P.M. MOUNT N4136

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 will not have risen appreciably 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%. Voltage ripple limits will be determined by the application.

(5) Limits for collector voltage stabilization and ripple will depend upon the operating value, higher values permitting wider limits.

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

(7) Anode voltages in the range 200 to 1500V produce helix currents generally between 1mA and 3mA. Accordingly the anode voltage should rise through this range sufficiently quickly 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 heat sink, 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 and anode voltages to typical operating values.

(4) Adjust the focusing screws until the helix current is reduced to a minimum. Adjust anode voltage to obtain collector current as required.

(5) Adjust r.f. input power and helix voltage to obtain required output power, re-adjusting focusing screws if necessary.

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.

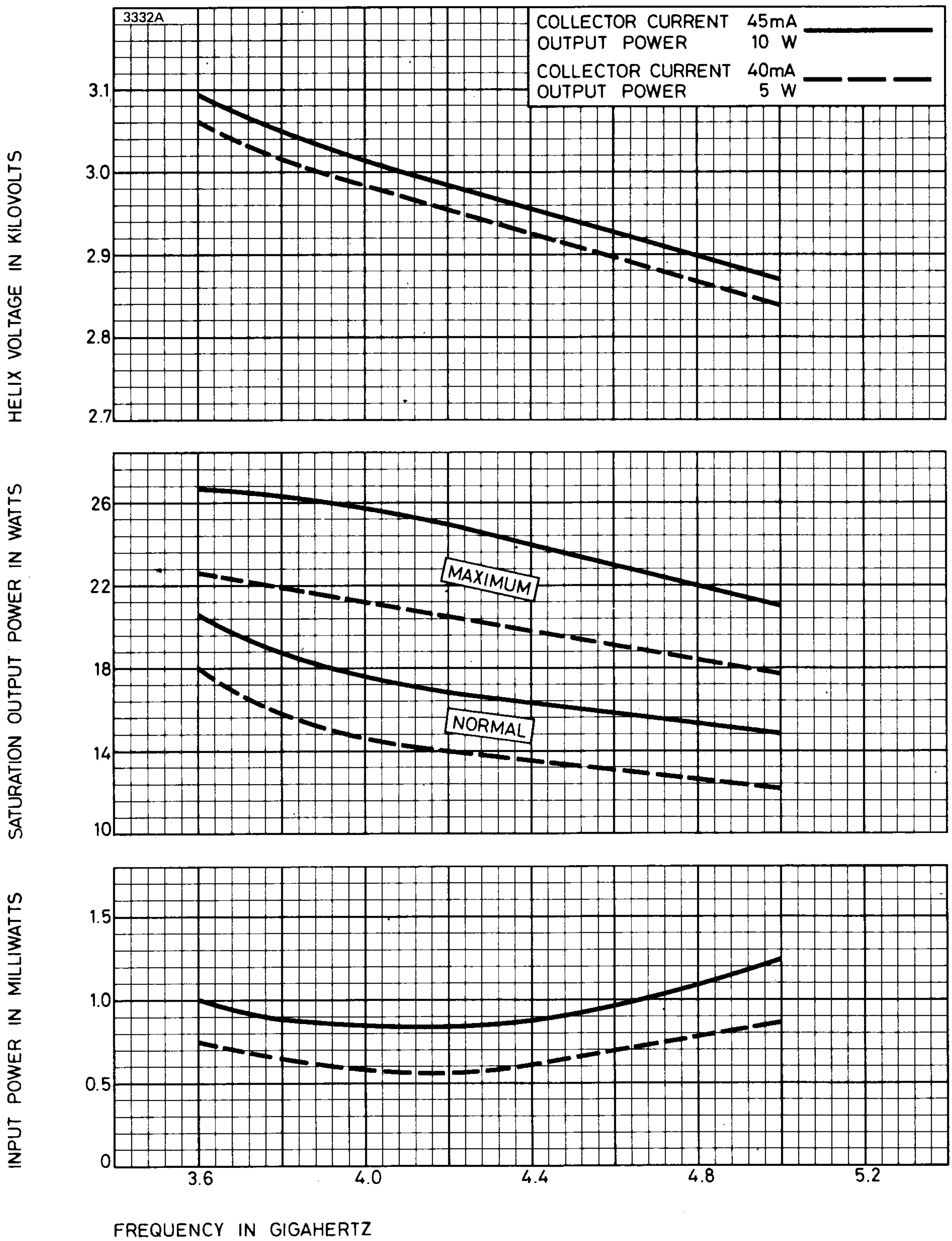
(2) Switch on h.t. voltages, delaying anode voltage until all other voltages have reached their full operating values.

E. Supply Interruption

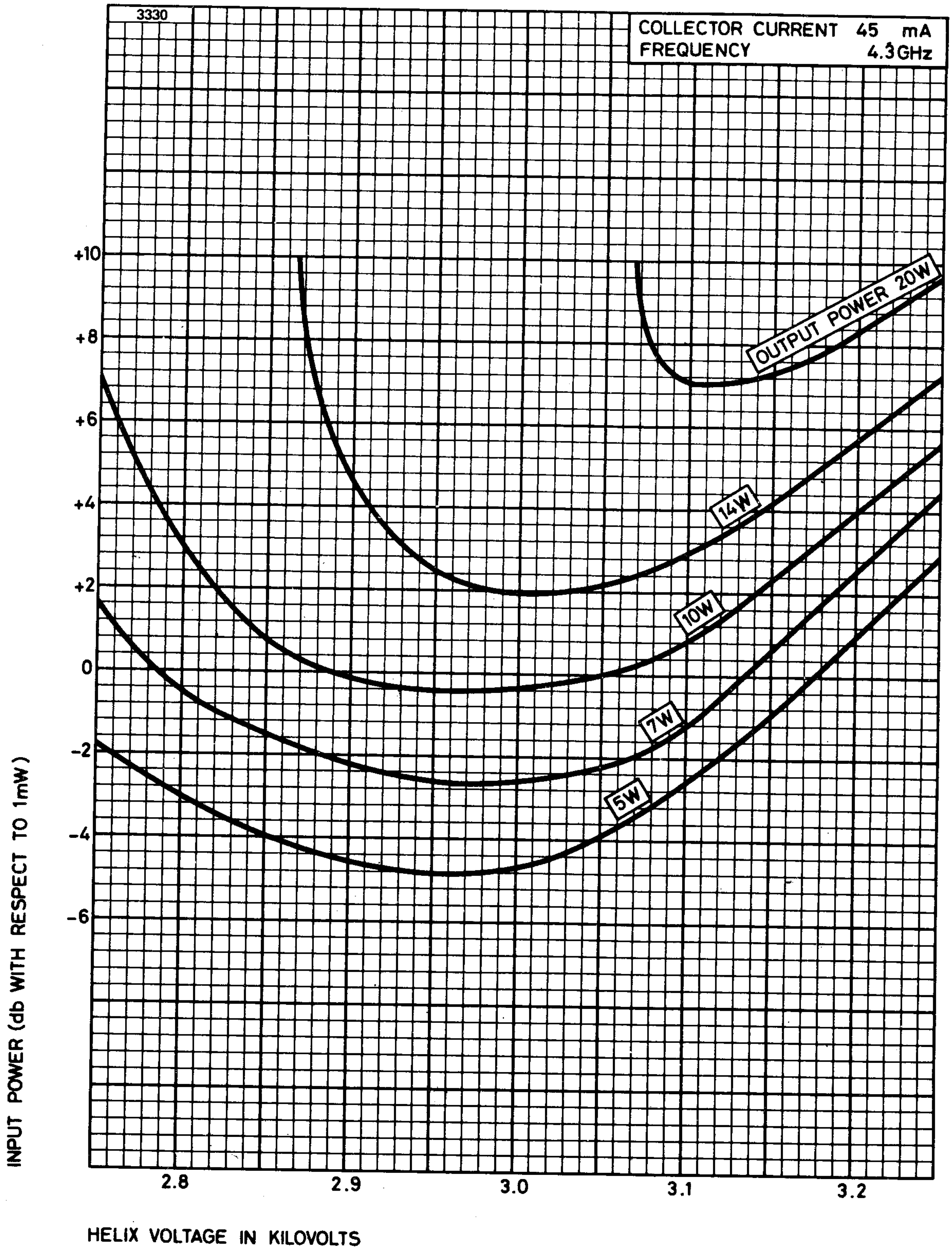
(1) In the event of a supply failure not exceeding ten seconds, h.t. voltages may be re-applied immediately excepting anode voltage which must be delayed as in C(2) above.

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

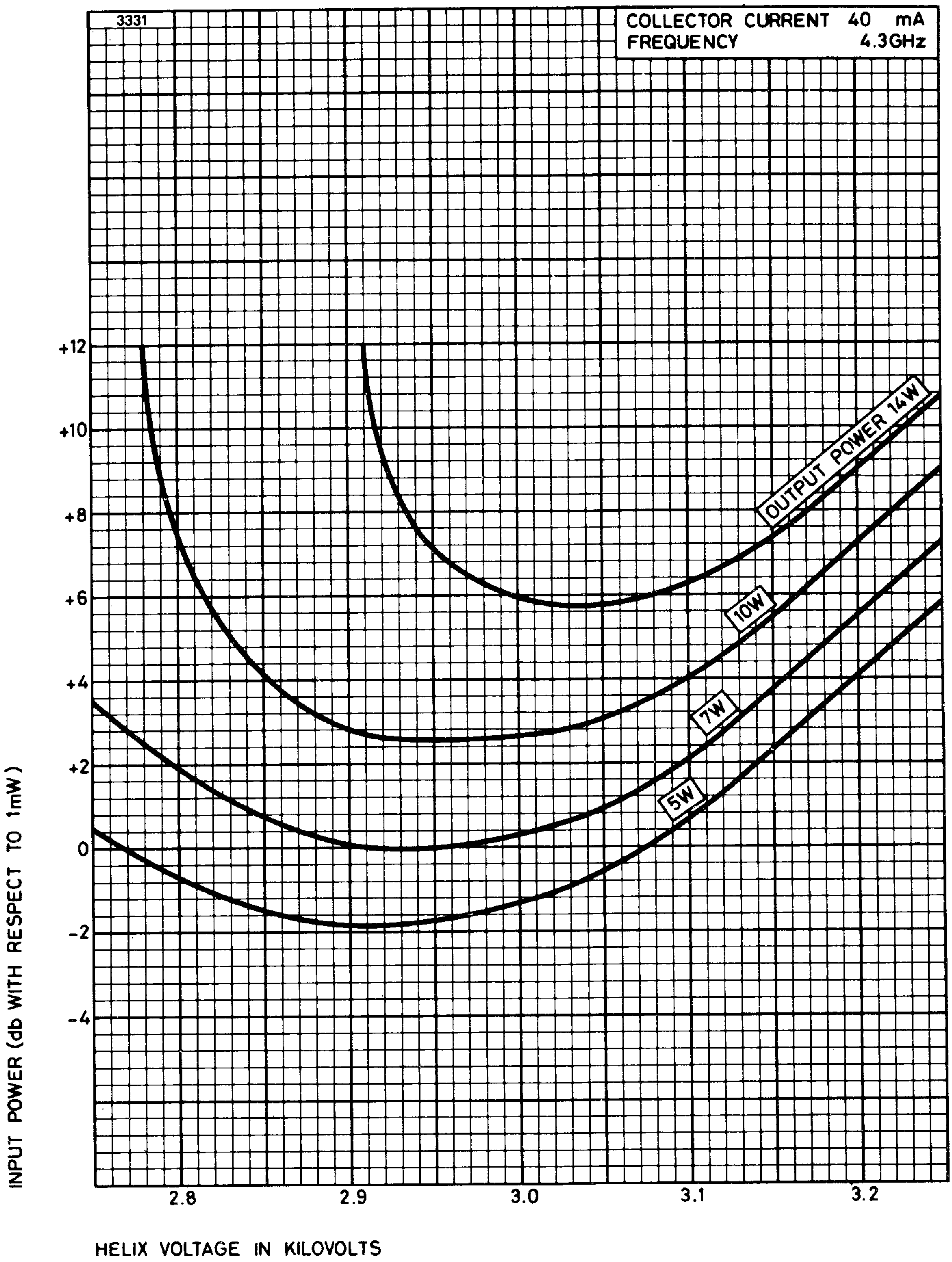
TYPICAL PERFORMANCE CHARACTERISTICS



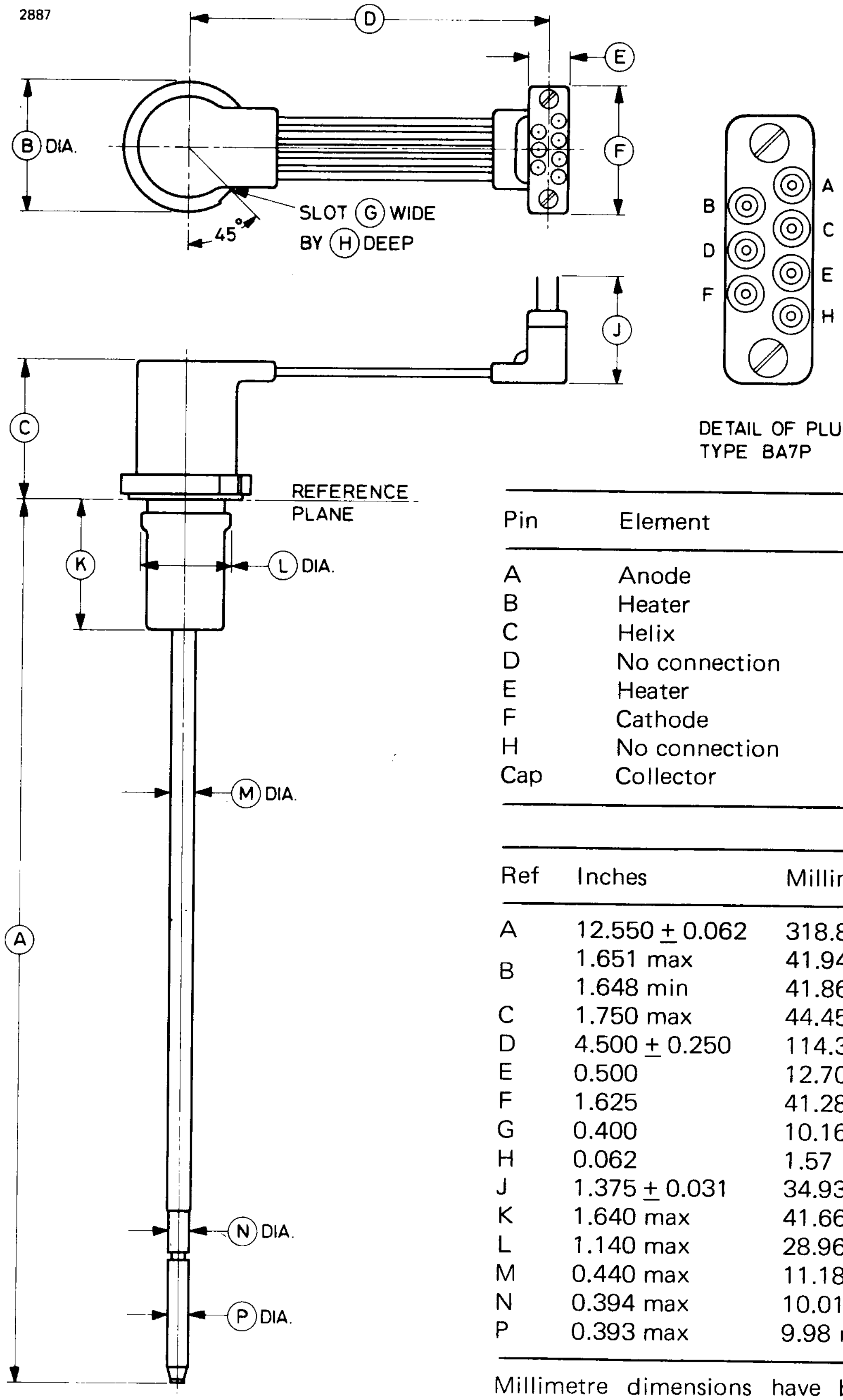
TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



N1073 OUTLINE (All dimensions without limits are nominal)



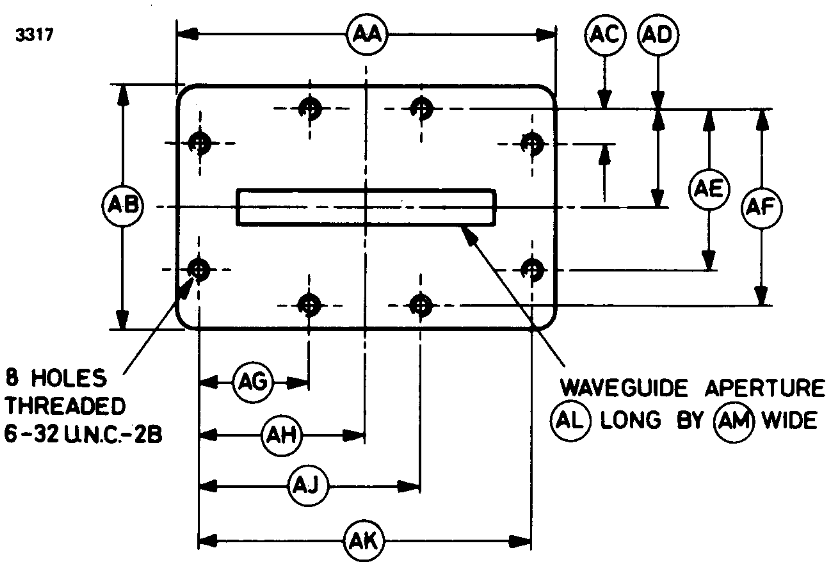
DETAIL OF PLUG
TYPE BA7P

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

Ref	Inches	Millimetres
A	12.550 ± 0.062	318.8 ± 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	0.440 max	11.18 max
N	0.394 max	10.01 max
P	0.393 max	9.98 max

Millimetre dimensions have been derived from inches.

N4136 Waveguide Flange (All dimensions without limits are nominal)

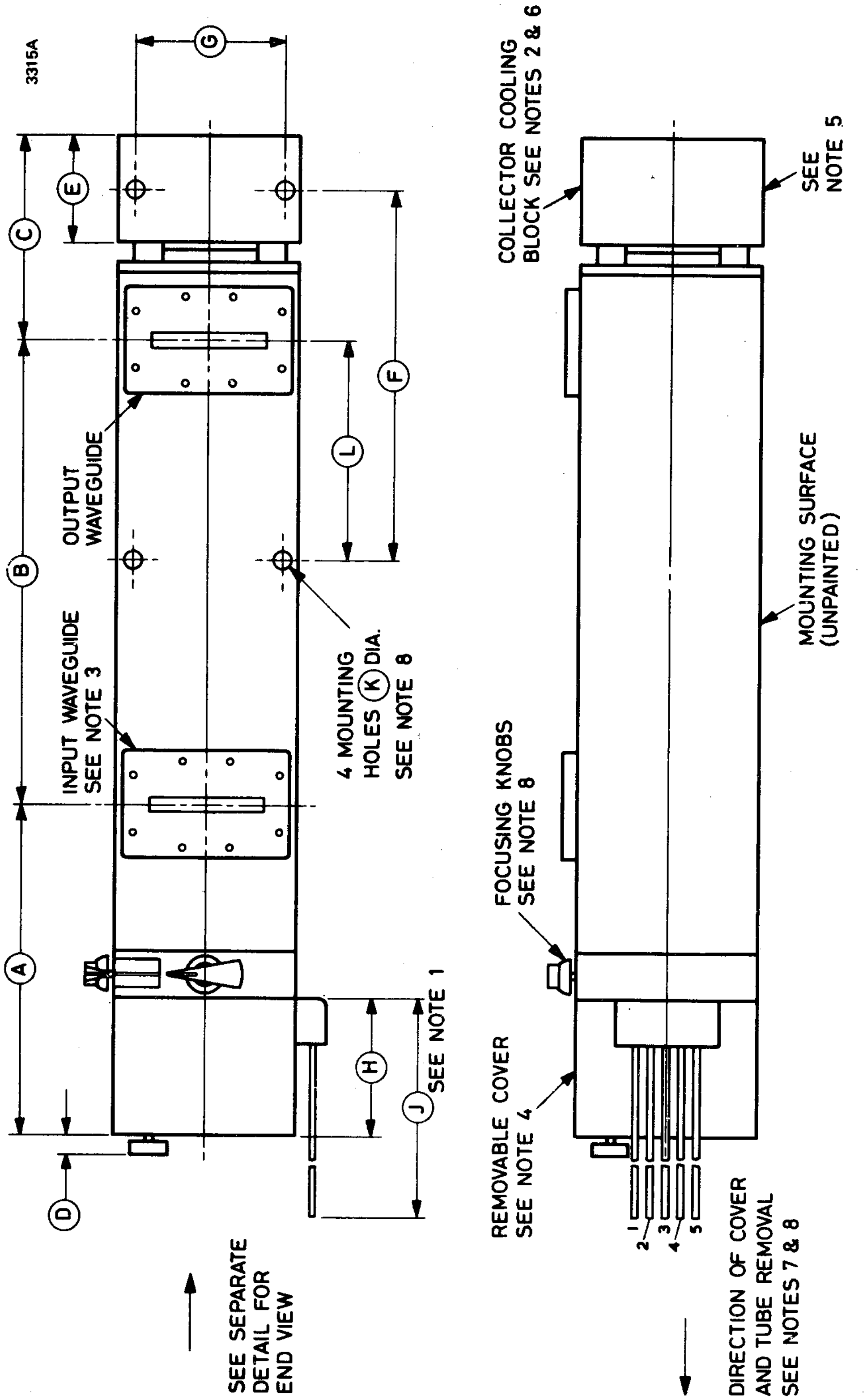


Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	2.781 ± 0.016	70.64 ± 0.41	AG	0.810 ± 0.005	20.57 ± 0.13
AB	1.781 ± 0.016	45.24 ± 0.41	AH	1.215 ± 0.005	30.86 ± 0.13
AC	0.247 ± 0.005	6.27 ± 0.13	AJ	1.620 ± 0.005	41.15 ± 0.13
AD	0.715 ± 0.005	18.16 ± 0.13	AK	2.430 ± 0.005	61.72 ± 0.13
AE	1.183 ± 0.005	30.05 ± 0.13	AL	1.872 ± 0.005	47.55 ± 0.13
AF	1.430 ± 0.005	36.32 ± 0.13	AM	0.250 ± 0.005	6.35 ± 0.13

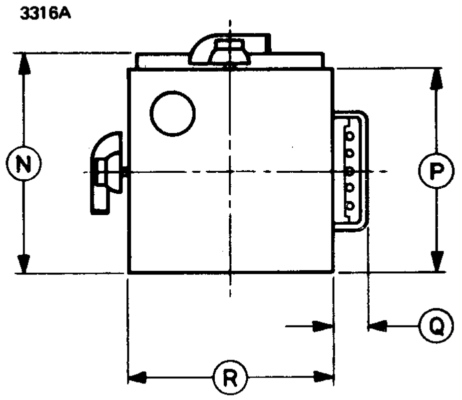
Millimetre dimensions have been derived from inches.

N4136 CONDUCTION COOLED MOUNT

See outline note 6 for convection cooled mount.



N4136 OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	5.375 max	136.5 max
B	7.150 ± 0.020	181.6 ± 0.5
C	3.500 max	88.90 max
D	0.313 max	7.95 max
E	1.750 ± 0.010	44.45 ± 0.25
F	6.000 ± 0.010	152.40 ± 0.25
G	2.450 ± 0.010	62.23 ± 0.25
H	2.270 max	57.66 max
J	12.000	304.8
K	0.290	7.37
L	3.563 ± 0.015	90.50 ± 0.38
N	3.200 ± 0.062	81.28 ± 1.57
P	2.968 ± 0.032	75.39 ± 0.81
Q	0.500 max	12.70 max
R	2.968 ± 0.032	75.39 ± 0.81

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

N4136 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. The waveguide flange is based on RETMA flange CMR187 (see page 13).
4. An end clearance of 2¼ inches (57mm) must be allowed to permit the removal of the cover for tube insertion or withdrawal. The travelling wave tube leads plug into a socket inside the cover. Alternative forms of cover can be supplied. A microswitch for interlocking with the power supply unit can be provided.
5. 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. The attached heat sink should have a thermal impedance of 0.5°C/watt.
6. A convection cooled version for horizontal mounting is available within the same overall length.
7. The overall length of the mount together with an adequate allowance for tube withdrawal is 28 inches (711.2mm).
8. Certain alternative orientations of end cover and focusing screws, and position of mounting holes, are possible by arrangement.

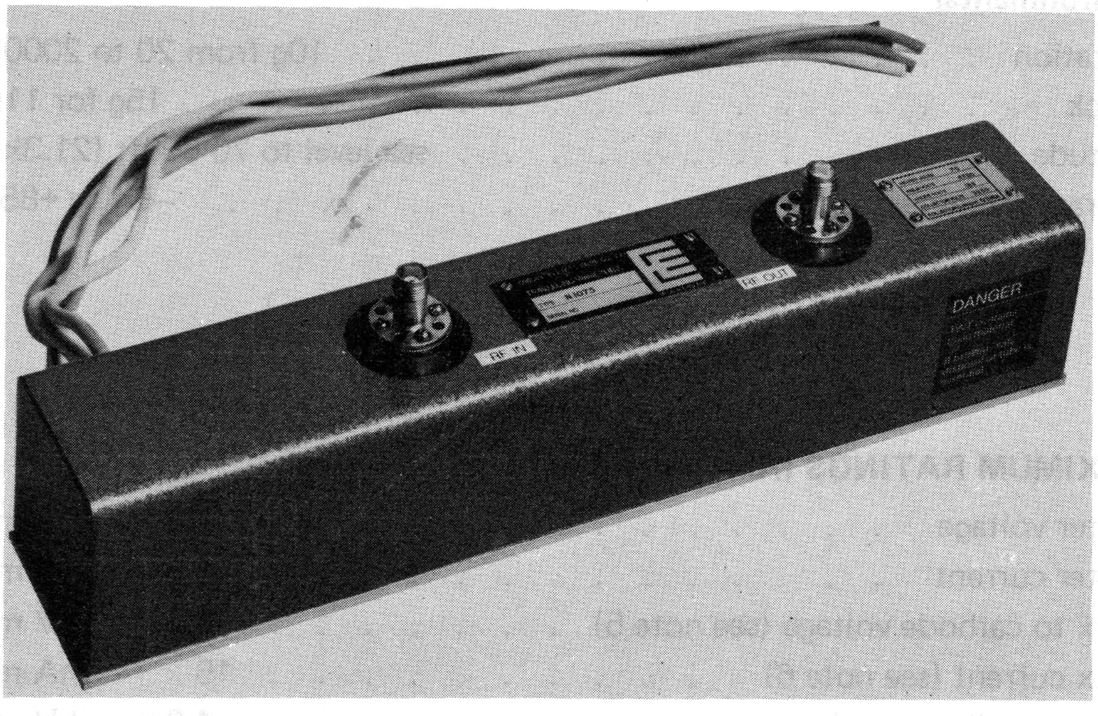
N1075

8.0–12GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	8.0 to 12	GHz
Minimum c.w. output power (saturation)	100	W
Minimum gain (at 100W output)	30	db
Operating temperature range	–54 to +85	°C



GENERAL

Electrical

Cathode	indirectly heated, impregnated	
Heater current	3.0	A
Heater voltage (see note 1)	6.0 to 7.5	V
Cathode pre-heating time (minimum)	3.0	min

GENERAL (continued)

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 2)	colour coded flexible leads
R.F. connections	coaxial, T.N.C. female
Mounting position (see note 3)	any
Net weight	6 pounds (2.7kg) approx

Cooling		conduction cooled
Heat sink temperature (see note 4)	90	°C max

Environmental

Vibration	10g from 20 to 2000Hz
Shock	15g for 11ms
Altitude	sea level to 70 000ft (21.3km)
Operating temperature range	–54 to +85°C

MAXIMUM RATINGS (Absolute values)

Heater voltage	8.0	V max
Heater current	3.5	A max
Helix to cathode voltage (see note 5)	6.5	kV max
Helix current (see note 6)	15	mA max
Helix to collector voltage	4.0	kV max
Collector current	250	mA max
Collector dissipation	750	W max
Helix to anode voltage	–500	V max
Anode current	1.5	mA max
R.F. return power (see note 7)	20	W max
Base plate temperature	100	°C max

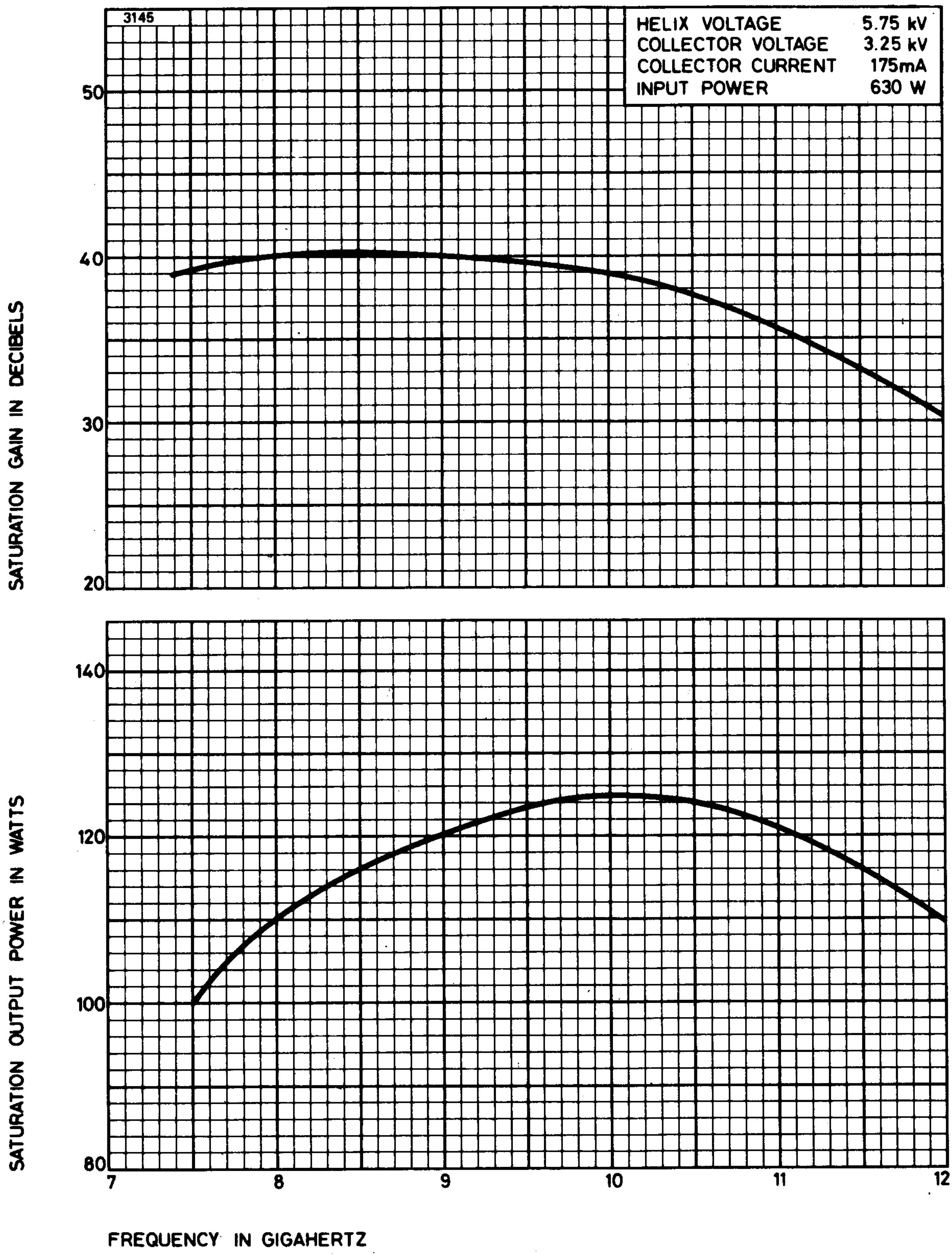
TYPICAL OPERATION

Frequency	10	GHz
Collector to cathode voltage	3.25	kV
Collector current	175	mA
Helix to cathode voltage	5.75	kV
Helix current	7.0	mA
Helix to anode voltage	−125	V
Anode current	0.1	mA
Saturation output power	125	W
Gain at saturation	35	db
Noise output (with no drive)	−65	dbW/MHz
Total input power	630	W
Efficiency	20	%

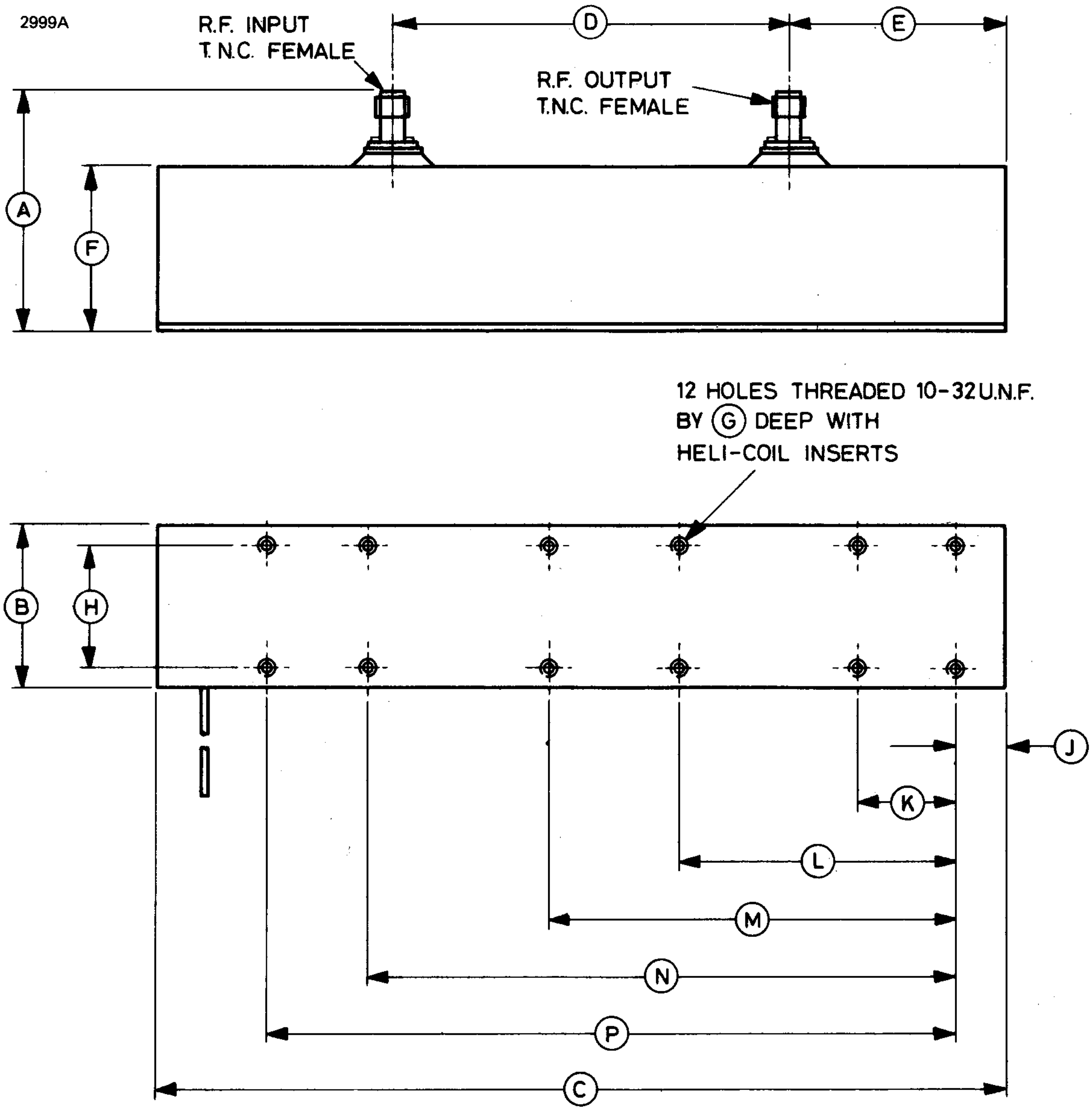
NOTES

1. The heater voltage is set to the value marked on the tube capsule and lies in the range 6.0 to 7.5V.
2. The lead lengths will be in accordance with customers' requirements.
3. The tube should be shielded from strong stray magnetic fields.
4. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
5. The helix is operated at earth potential.
6. It is advisable to use a helix over-current trip.
7. It is advisable to fit a reverse power trip, set to operate if the return power exceeds 20W.

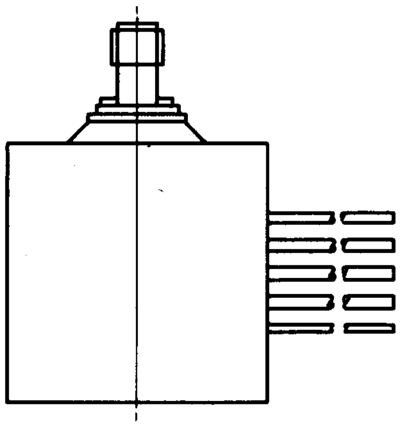
TYPICAL PERFORMANCE CHARACTERISTICS



OUTLINE



Enlarged View on Output End



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.688 max	93.68 max
B	2.500 max	63.50 max
C	13.000 max	330.2 max
D	6.000 max	152.4 max
E	3.313	84.15
F	2.563	65.10
G	0.380	9.65
H	1.875	47.63
J	0.750	19.05
K	1.500	38.10
L	4.250	108.0
M	6.250	158.8
N	9.000	228.6
P	10.500	266.7

Millimetre dimensions have been derived from inches.

Lead Connections

Lead	Element
Yellow	Heater, cathode
White	Heater
Green	Anode
Orange	Helix
Red	Collector

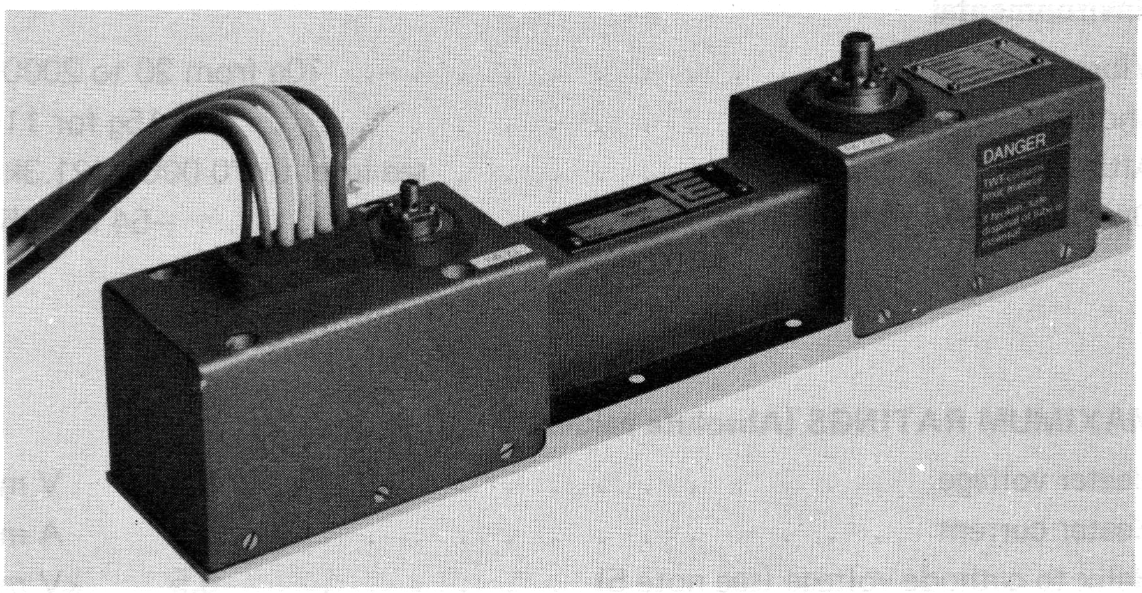
N1077

5.0–10GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	5.0 to 10	GHz
Minimum c.w. output power (saturation)	100	W
Minimum gain (at 100W output)	30	db
Operating temperature range	−54 to +85	°C



GENERAL

Electrical

Cathode	indirectly heated, impregnated	
Heater current	3.0	A
Heater voltage (see note 1)	6.0 to 7.5	V
Cathode pre-heating time (minimum)	3.0	min

GENERAL (continued)

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 2)	colour coded flexible leads
R.F. connections:	
input	coaxial, S.M.A. female
output	coaxial, T.N.C. female
Mounting position (see note 3)	any
Net weight	7½ pounds (3.4kg) approx

Cooling	conduction cooled	
Heat sink temperature (see note 4)	90	°C max

Environmental

Vibration	10g from 20 to 2000Hz
Shock	15g for 11ms
Altitude	sea level to 70 000ft (21.3km)
Operating temperature range	−54 to +85°C

MAXIMUM RATINGS (Absolute values)

Heater voltage	8.0	V max
Heater current	3.5	A max
Helix to cathode voltage (see note 5)	6.5	kV max
Helix current (see note 6)	15	mA max
Helix to collector voltage	4.0	kV max
Collector current	250	mA max
Collector dissipation	1000	W max
Helix to anode voltage	−500	V max
Anode current	1.5	mA max
R.F. return power (see note 7)	20	W max
Base plate temperature	100	°C max

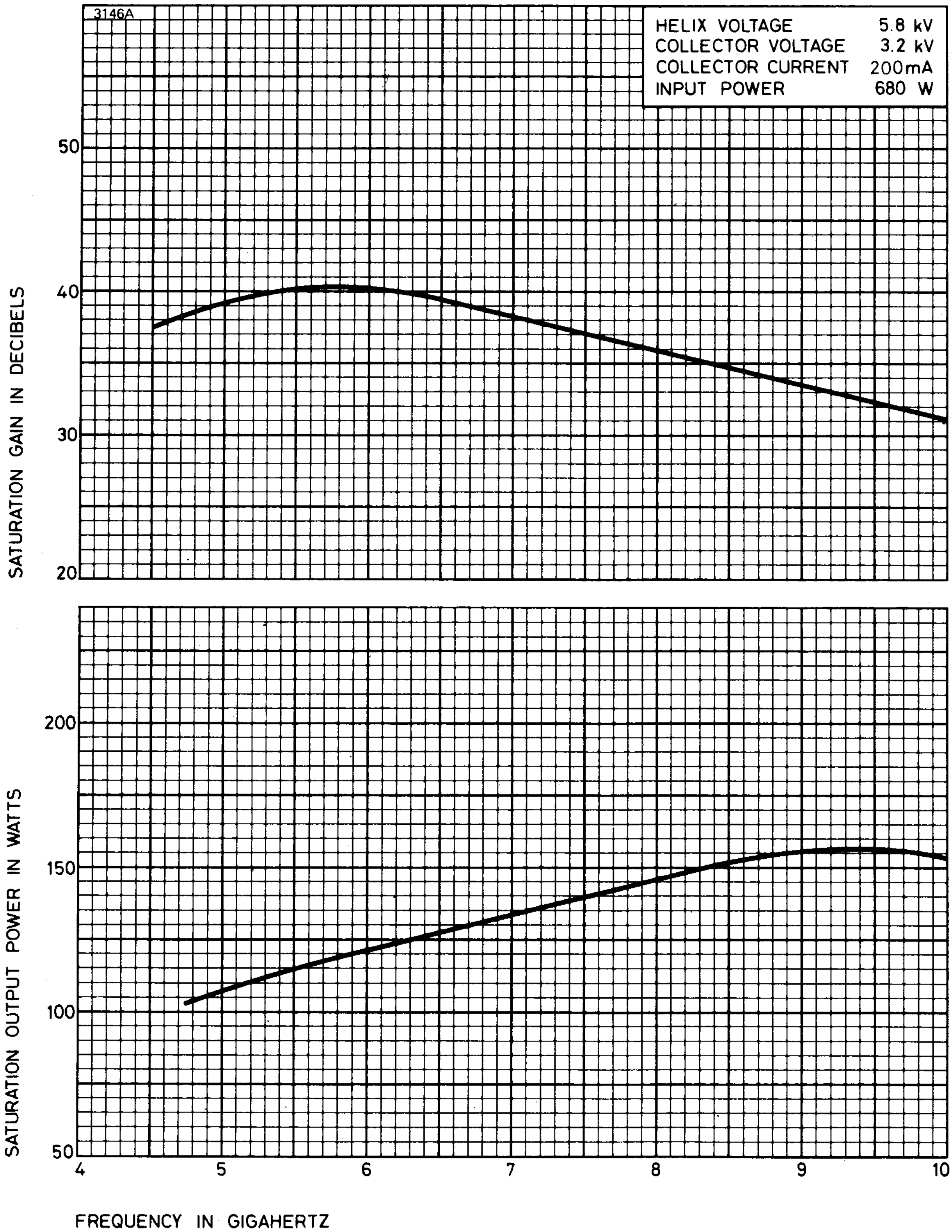
TYPICAL OPERATION

Frequency	7.5	GHz
Collector to cathode voltage	3.2	kV
Collector current	200	mA
Helix to cathode voltage	5.8	kV
Helix current	5.0	mA
Helix to anode voltage	–600	V
Anode current	0.1	mA
Saturation output power	140	W
Gain at saturation	35	db
Noise output (with no drive)	–65	dbW/MHz
Total input power	680	W
Efficiency	20	%

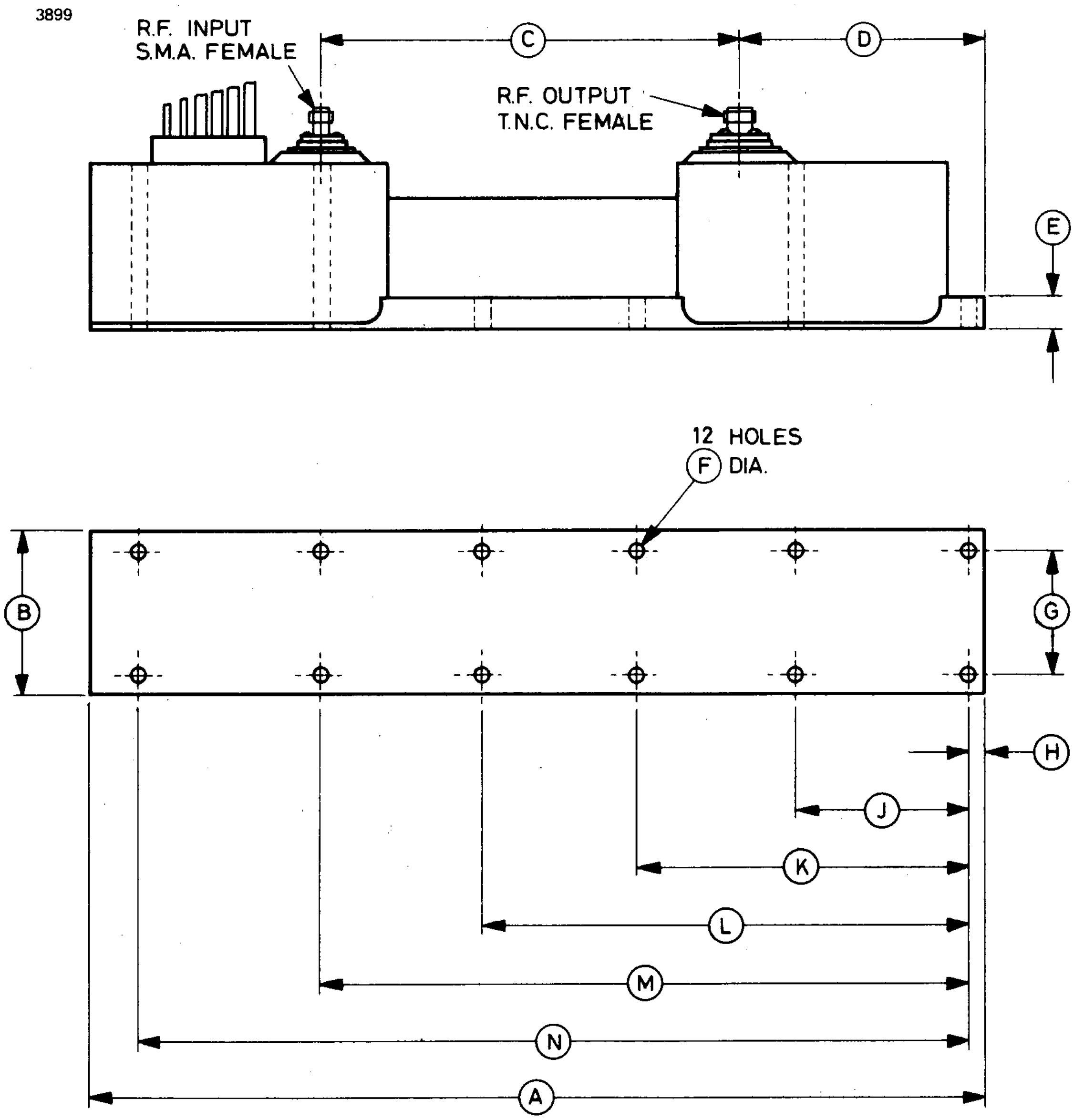
NOTES

1. The heater voltage is set to the value marked on the tube capsule and lies in the range 6.0 to 7.5V.
2. The lead lengths will be in accordance with customers' requirements.
3. The tube should be shielded from strong stray magnetic fields.
4. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
5. The helix is operated at earth potential.
6. It is advisable to use a helix over-current trip.
7. It is advisable to fit a reverse power trip, set to operate if the return power exceeds 20W.

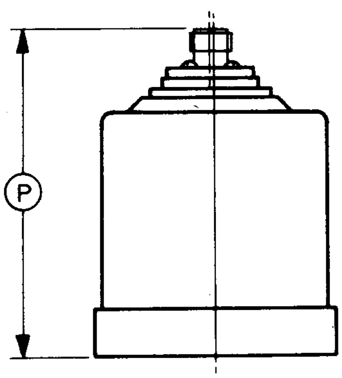
TYPICAL PERFORMANCE CHARACTERISTICS



OUTLINE



Enlarged View on Output End



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	13.500 max	342.9 max
B	2.500 max	63.50 max
C	6.750 max	171.5 max
D	3.800 max	96.52 max
E	0.500 max	12.70 max
F	0.196	4.98
G	1.875 ± 0.010	47.63 ± 0.25
H	0.250 ± 0.010	6.35 ± 0.25
J	2.600 ± 0.010	66.04 ± 0.25
K	5.000 ± 0.010	127.0 ± 0.3
L	7.345 ± 0.005	186.6 ± 0.1
M	9.750 ± 0.010	247.7 ± 0.3
N	12.500 ± 0.010	317.5 ± 0.3
P	3.500 max	88.90 max

Millimetre dimensions have been derived from inches.

Lead Connections

Lead	Element
Yellow	Heater, cathode
White	Heater
Green	Anode
Orange	Helix
Red	Collector

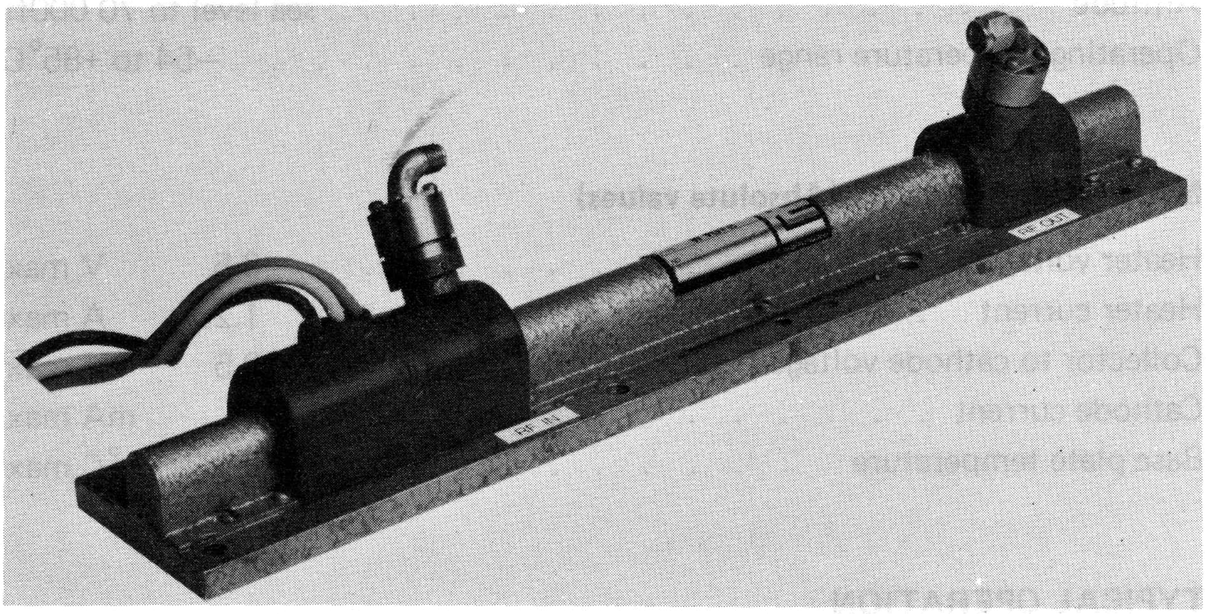
N1078

5.0–10GHz DRIVER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	5.0 to 10	GHz
Minimum c.w. output power (saturation)	2.0	W
Minimum small signal gain	36	db
Operating temperature range	–54 to +85	°C



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.9	A
Cathode pre-heating time (minimum)	2.0	min

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 1)	colour coded flexible leads
R.F. connections:	
input	coaxial, S.M.A. male
output	coaxial, S.M.A. female
Mounting position (see note 2)	any
Net weight	2 pounds (0.9kg) approx

Cooling . . . . conduction cooled

Heat sink temperature (see note 3)	90	°C max

Environmental

Vibration	10g from 20 to 2000Hz
Shock	15g for 11ms
Altitude	sea level to 70 000ft
Operating temperature range	−54 to +85°C

MAXIMUM RATINGS (Absolute values)

Heater voltage	6.5	V max
Heater current	1.25	A max
Collector to cathode voltage (see note 4)	2.5	kV max
Cathode current	30	mA max
Base plate temperature	100	°C max

TYPICAL OPERATION

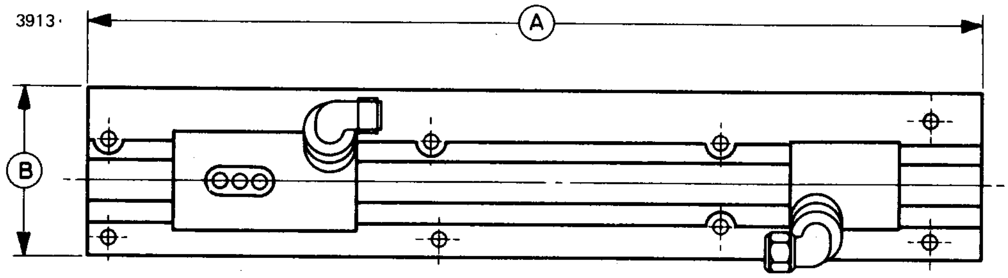
Frequency	7.5	GHz
Cathode current	25	mA
Collector to cathode voltage	2.0	kV
Output power (saturation)	4.0	W
Small signal gain	45	db
Phase sensitivity (helix voltage)	3.0	degree/V

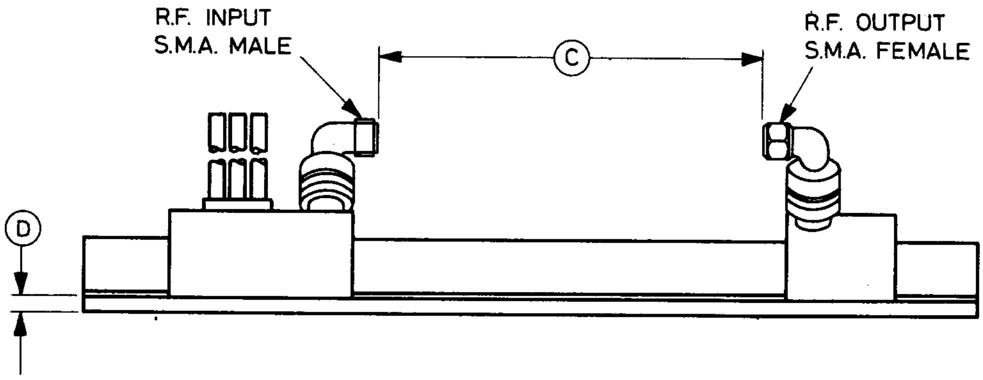
NOTES

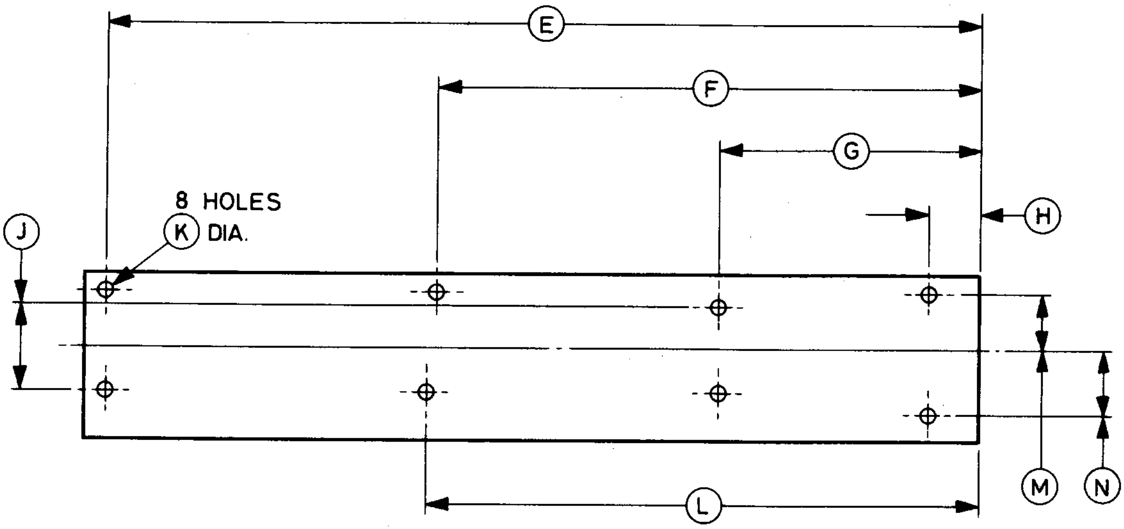
1. The lead lengths will be in accordance with customers' requirements.
2. The tube should be shielded from strong stray magnetic fields.
3. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
4. The anode and collector are strapped internally and connected to earth.
5. For helix modulation the tube can be fitted with a d.c. block and monitor tee on the r.f. input. The helix can then be isolated from earth and a maximum voltage of 200V can be used to modulate the helix. Further details on application.

OUTLINE

3913

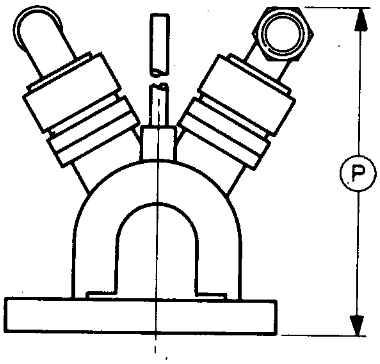






Enlarged View on Input End

3912



Lead Connections

Colour	Element
Yellow	Heater, cathode
Brown	Heater
Green	Anode, collector, helix and earth

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	11.000 max	279.4 max
B	2.020 max	51.31 max
C	5.000 max	127.0 max
D	0.250	6.35
E	10.500 ± 0.005	266.7 ± 0.1
F	6.500 ± 0.005	165.1 ± 0.1
G	3.125 ± 0.005	79.38 ± 0.13
H	0.625 ± 0.005	15.88 ± 0.13
J	1.005 ± 0.010	25.53 ± 0.25
K	0.196	4.98
L	6.625 ± 0.005	168.3 ± 0.1
M	0.625 ± 0.005	15.88 ± 0.13
N	0.880 ± 0.010	22.35 ± 0.25
P	3.000 max	76.20 max

Millimetre dimensions have been derived from inches.

N1079

7.0–11GHz DRIVER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	7.0 to 11	GHz
Minimum c.w. output power (saturation)	2.0	W
Minimum small signal gain	36	db
Operating temperature range	−54 to +85	°C

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.9	A
Cathode pre-heating time (minimum)	2.0	min

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 1)	colour coded flexible leads
R.F. connections	coaxial, S.M.A. female
Mounting position (see note 2)	any
Net weight	2 pounds (0.9kg) approx

Cooling	conduction cooled	
Heat sink temperature (see note 3)	90	°C max

Environmental

Vibration	10g from 20 to 2000Hz
Shock	15g for 11ms
Altitude	sea level to 70 000ft
Operating temperature range	−54 to +85°C

MAXIMUM RATINGS (Absolute values)

Heater voltage	6.5	V max
Heater current	1.25	A max
Collector to cathode voltage (see note 4)	2.5	kV max
Cathode current	30	mA max
Base plate temperature	100	°C max

TYPICAL OPERATION

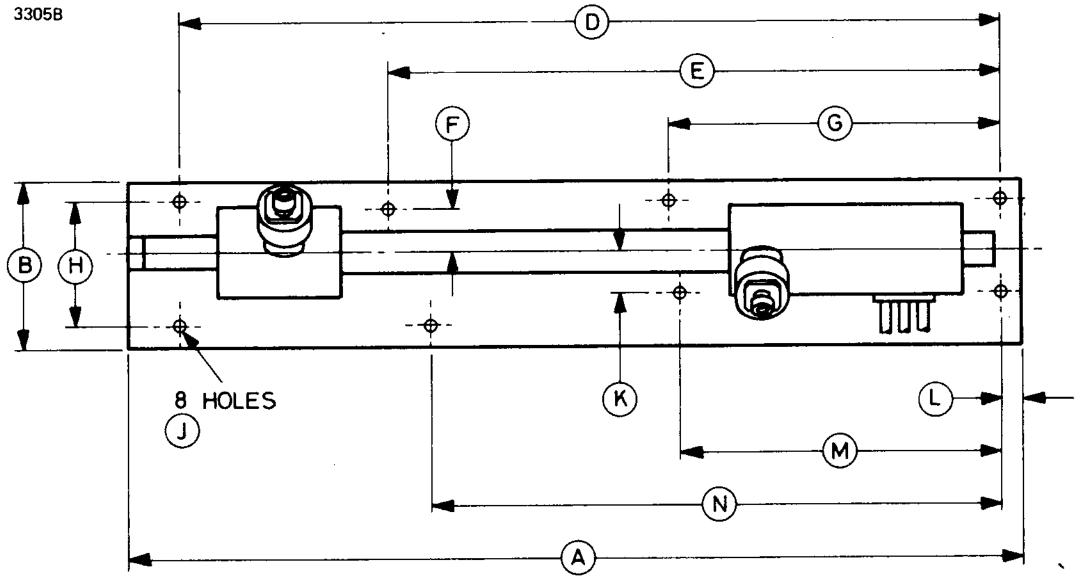
Frequency	9.0	GHz
Cathode current	25	mA
Collector to cathode voltage	2.0	kV
Output power (saturation)	4.0	W
Small signal gain	45	db
Phase sensitivity (helix voltage)	3.0	degree/V

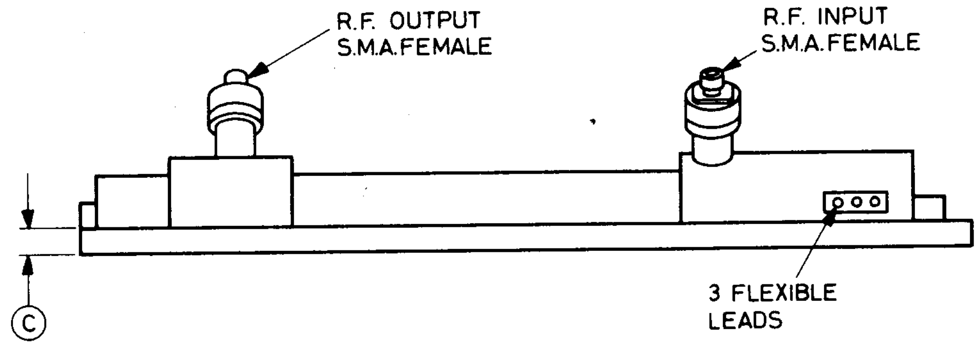
NOTES

1. The lead lengths will be in accordance with customers' requirements.
2. The tube should be shielded from strong stray magnetic fields.
3. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
4. The anode and collector are strapped internally and connected to earth.
5. For helix modulation the tube can be fitted with a d.c. block and monitor tee on the r.f. input. The helix can then be isolated from earth and a maximum voltage of 200V can be used to modulate the helix. Further details on application.

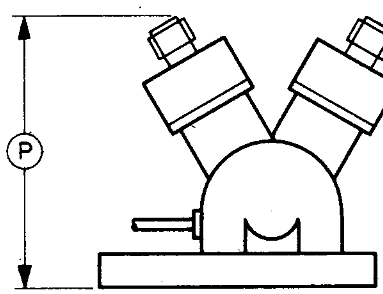
OUTLINE (All dimensions without limits are nominal)

3305B





Enlarged View on Input End of Tube



Outline Dimensions

Ref	Inches	Millimetres
A	11.000 max	279.4 max
B	2.000	50.80
C	0.250	6.35
D	9.875	250.8
E	7.375	187.3
F	0.500	12.70
G	4.000	101.6
H	1.500	38.10
J	0.196	4.98
K	0.500	12.70
L	0.250	6.35
M	3.875	98.43
N	6.875	174.6
P	2.375	56.33

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Yellow	Heater, cathode
Brown	Heater
Green	Anode, collector, helix and earth

N1080

7.0–11GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	7.0 to 11	GHz
Minimum c.w. output power (saturation)	200	W
Minimum gain (at 200W output)	31	db
Operating temperature range	–54 to +85	°C

GENERAL

Electrical

Cathode	indirectly heated, impregnated	
Heater current	3.0	A
Heater voltage (see note 1)	6.0 to 7.5	V
Cathode pre-heating time (minimum)	3.0	min

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 2)	colour coded flexible leads
R.F. connections:	
input	coaxial, S.M.A. female
output	coaxial, T.N.C. female
Mounting position (see note 3)	any
Net weight	8½ pounds (3.9kg) approx

Cooling

Cooling	conduction cooled	
Heat sink temperature (see note 4)	90	°C max

Environmental

Vibration	10g from 20 to 2000Hz
Shock	15g for 11ms
Altitude	sea level to 70 000ft
Operating temperature range	–54 to +85°C

MAXIMUM RATINGS (Absolute values)

Heater voltage	8.0	V max
Heater current	3.5	A max
Helix to cathode voltage (see note 5)	8.5	kV max
Helix current (see note 6)	20	mA max
Helix to collector voltage	4.5	kV max
Collector current	300	mA max
Collector dissipation	1500	W max
Helix to anode voltage	–1000	V max
Anode current	1.5	mA max
R.F. return power (see note 7)	35	W max
Base plate temperature	100	°C max

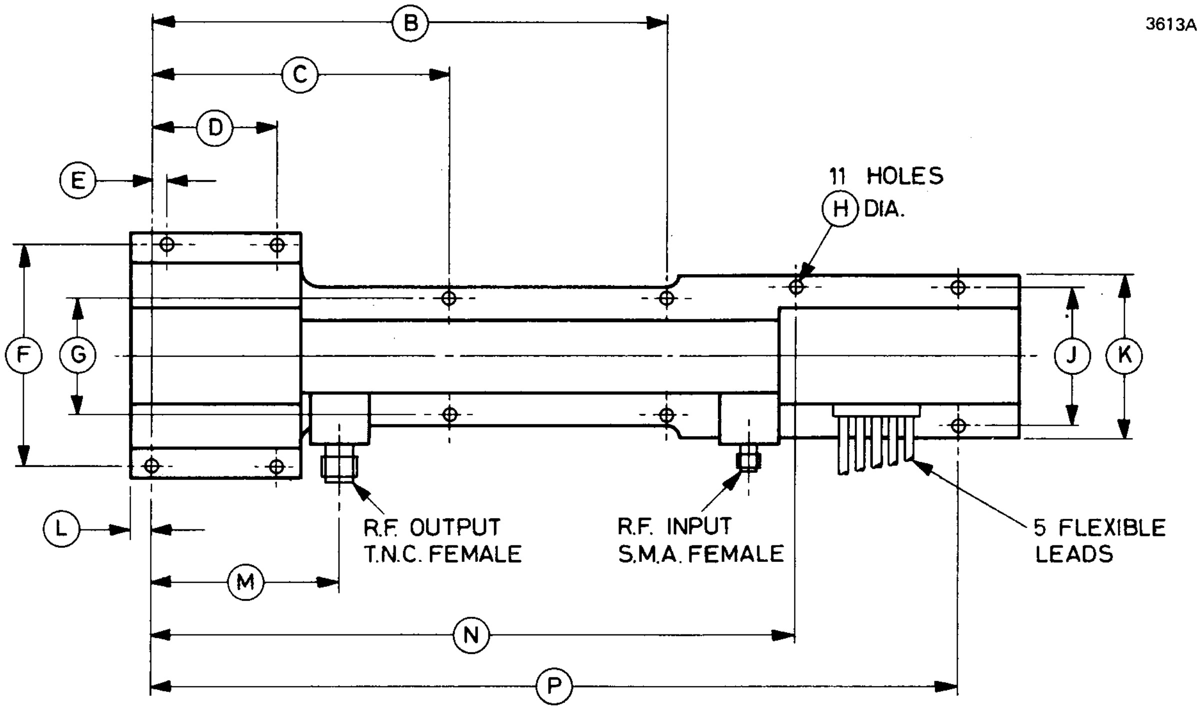
TYPICAL OPERATION

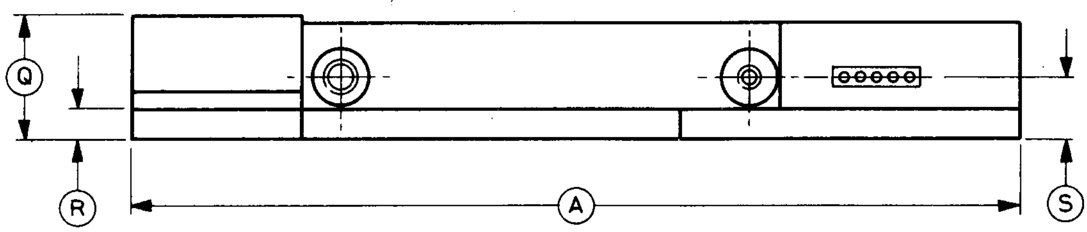
Frequency	9.0	GHz
Collector to cathode voltage	4.0	kV
Collector current	280	mA
Helix to cathode voltage	8.0	kV
Helix current	9.0	mA
Helix to anode voltage	–300	V
Anode current	0.3	mA
Output power (saturation)	240	W
Gain at saturation	35	db
Total noise output (with no drive)	15	mW max

NOTES

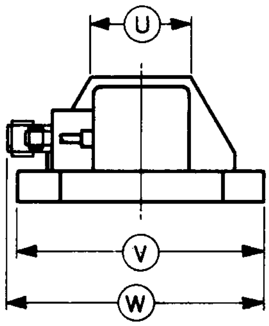
1. The heater voltage is set to the value marked on the tube capsule and lies in the range 6.0 to 7.5V.
2. The lead lengths will be in accordance with customers' requirements.
3. The tube should be shielded from strong stray magnetic fields.
4. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
5. The helix is operated at earth potential.
6. It is advisable to use a helix over-current trip.
7. It is advisable to fit a reverse power trip, set to operate if the return power exceeds 35W.

OUTLINE





View on Input End of Tube



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	14.200 max	360.7 max
B	8.250 ± 0.010	209.55 ± 0.25
C	4.750 ± 0.010	120.65 ± 0.25
D	2.000 ± 0.010	50.80 ± 0.25
E	0.255	6.48
F	3.575 ± 0.005	90.81 ± 0.13
G	1.875 ± 0.005	47.63 ± 0.13
H	0.209	5.31
J	2.250 ± 0.005	57.15 ± 0.13
K	2.625	66.68
L	0.375	9.53
M	3.000 ± 0.050	76.20 ± 1.27
N	10.500 ± 0.010	266.70 ± 0.25
P	12.875 ± 0.010	327.03 ± 0.25
Q	2.000 max	50.80 max
R	0.500	12.70
S	1.125 max	28.58 max
U	1.750	44.45
V	3.960	100.6
W	4.125 max	104.8 max

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
White	Heater
Yellow	Heater, cathode
Green	Anode
Orange	Helix
Red	Collector

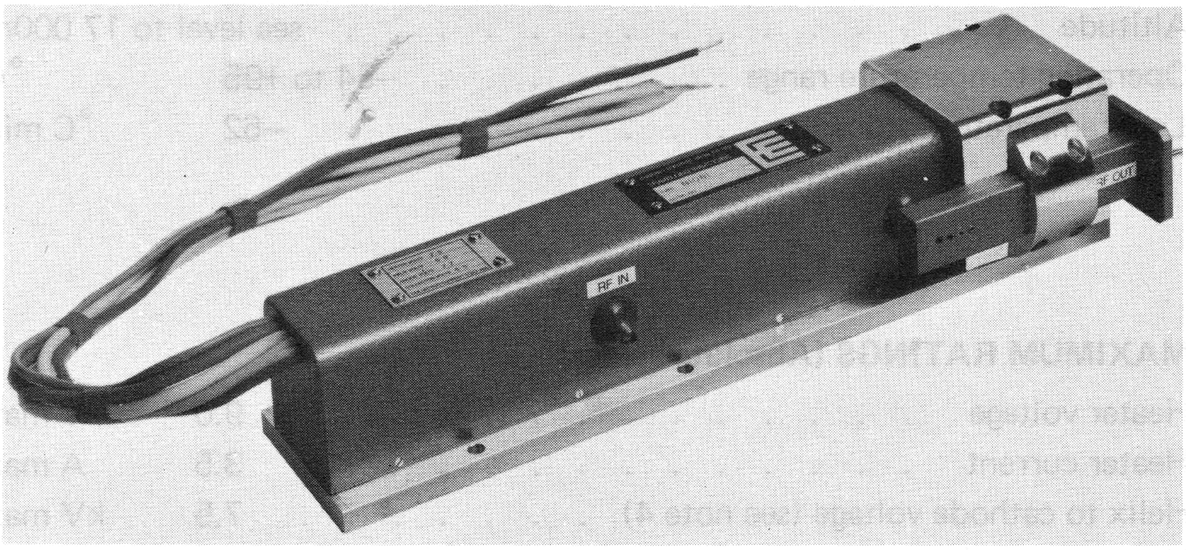
N1081

9.0–16GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. input connection and waveguide output.

Frequency range	9.0 to 16	GHz
Minimum c.w. output power (saturation)	100	W
Minimum gain (at 100W output)	30	db
Operating temperature range	−54 to +95	°C



GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	8.0	V
Heater current	3.0	A
Cathode pre-heating time (minimum)	3.0	min

Mechanical

Overall dimensions (excluding r.f. connectors)	30 x 6.5 x 6.5cm max
D.C. connections (see note 1)	colour coded flexible leads
R.F. connections:	
output	waveguide, flange NFR 24
input	coaxial, S.M.A. female
Mounting position (see note 2)	any
Net weight	6 pounds (2.8kg) max

Cooling	conduction cooled	
Heat sink temperature	95	°C max

Environmental (Generally to B.S.3G 100)

Vibration	see note 3	
Shock	see note 3	
Altitude	sea level to 17 000m	
Operating temperature range	–54 to +95	°C
Low temperature storage	–62	°C min

MAXIMUM RATINGS (Absolute values)

Heater voltage	9.0	V max
Heater current	3.5	A max
Helix to cathode voltage (see note 4)	7.5	kV max
Helix current (see note 5)	10	mA max
Helix to collector voltage	5.0	kV max
Collector current	200	mA max
Collector dissipation	850	W max
Helix to anode voltage	7.5	kV max
Anode current	1.5	mA max
R.F. return power (see note 6)	20	W max
Base plate temperature (see note 7)	100	°C max

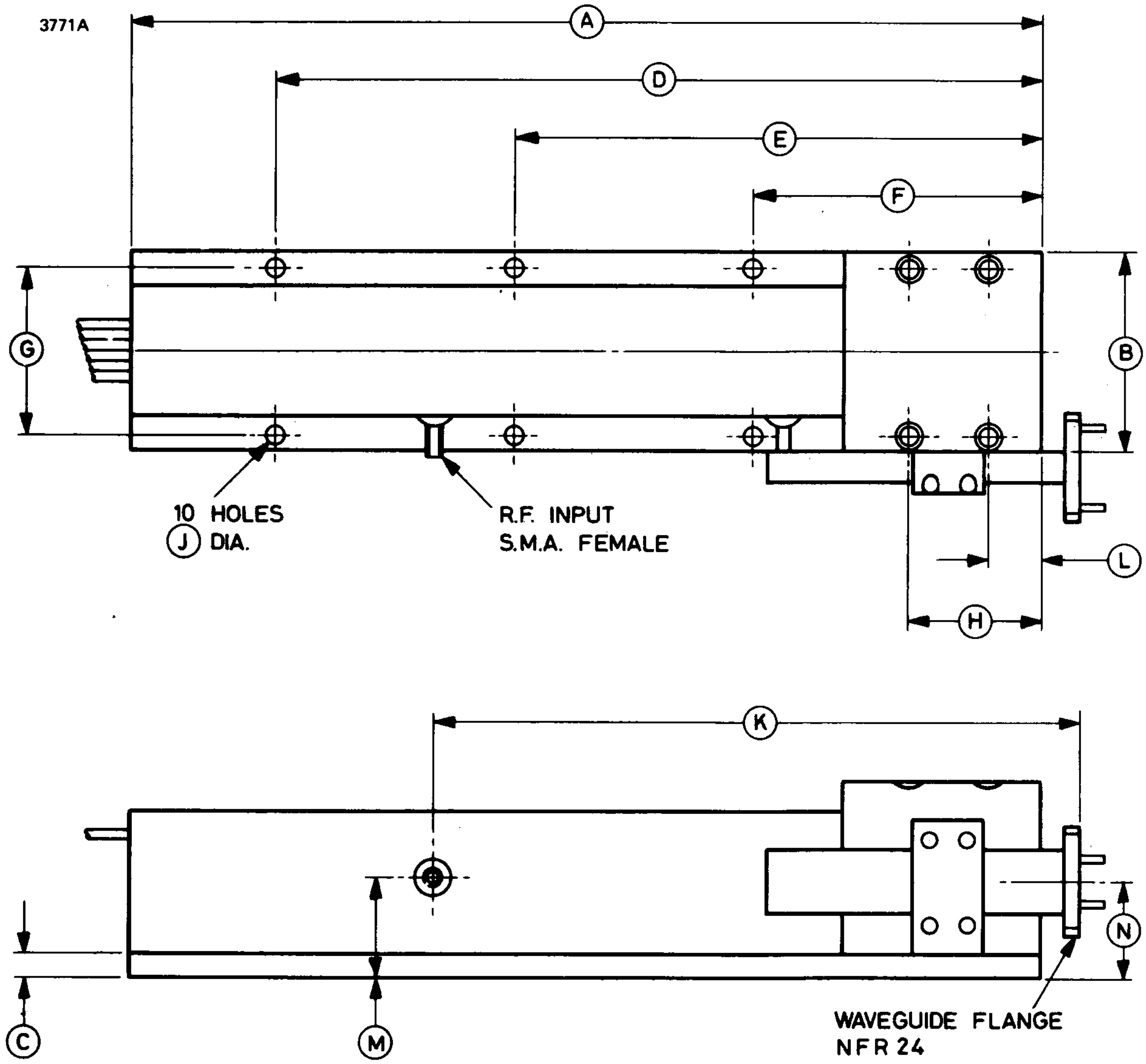
TYPICAL OPERATION (9.0 to 16GHz)

Collector to cathode voltage	4.2	kV
Collector current	180	mA
Helix to cathode voltage	7.1	kV
Helix current	5.0	mA
Helix to anode voltage (see note 8)	–400	V
Anode current	0.1	mA
Output power (minimum)	100	W
Gain at 100W (minimum)	30	db
Gain variation (maximum) (see note 9)	3.0	db
Noise factor (maximum)	30	db
Efficiency (minimum)	12	%
Input v.s.w.r. (maximum)	3:1	
Output v.s.w.r. (maximum)	3:1	

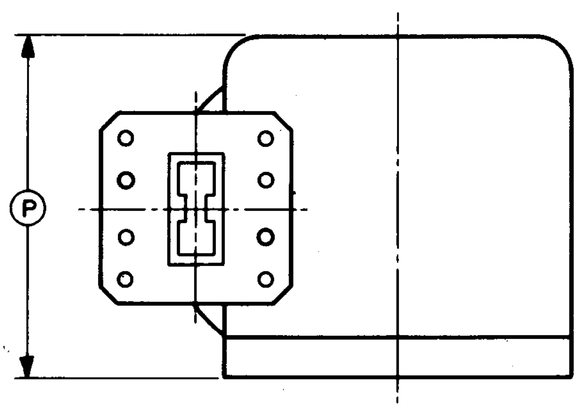
NOTES

1. The lead lengths will be in accordance with customers' requirements.
2. The tube should be shielded from strong stray magnetic fields.
3. B.S.3G 100 for highly manoeuverable supersonic military aircraft.
4. The helix is operated at earth potential.
5. A helix over-current trip should be fitted. During switching on and off sequences, the peak helix current should not exceed 20mA and the voltages should be established in less than 50ms.
6. It is advisable to fit a reverse power trip set to operate if the return power exceeds 25W.
7. Provision is made for a thermal interlock to be fitted at the collector end of the tube.
8. The anode voltage can be used to decrease the gain of the tube by more than 20db.
9. Using an approved gain equalizer.

OUTLINE (All dimensions without limits are nominal)



Enlarged View on Output End of Tube



Outline Dimensions (All dimensions are nominal)

Ref	Inches	Millimetres
A	11.562	293.7
B	2.500	63.50
C	0.300	7.62
D	9.650	245.1
E	6.650	168.9
F	3.650	92.71
G	2.100	53.34
H	1.651	41.94
J	0.210	5.33
K	8.150	207.0
L	0.651	16.54
M	1.283	32.59
N	1.217	30.91
P	2.475	62.87

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
White	Heater
White	Heater
Yellow	Cathode
Green	Anode (Grid)
Orange	Helix
Red	Collector

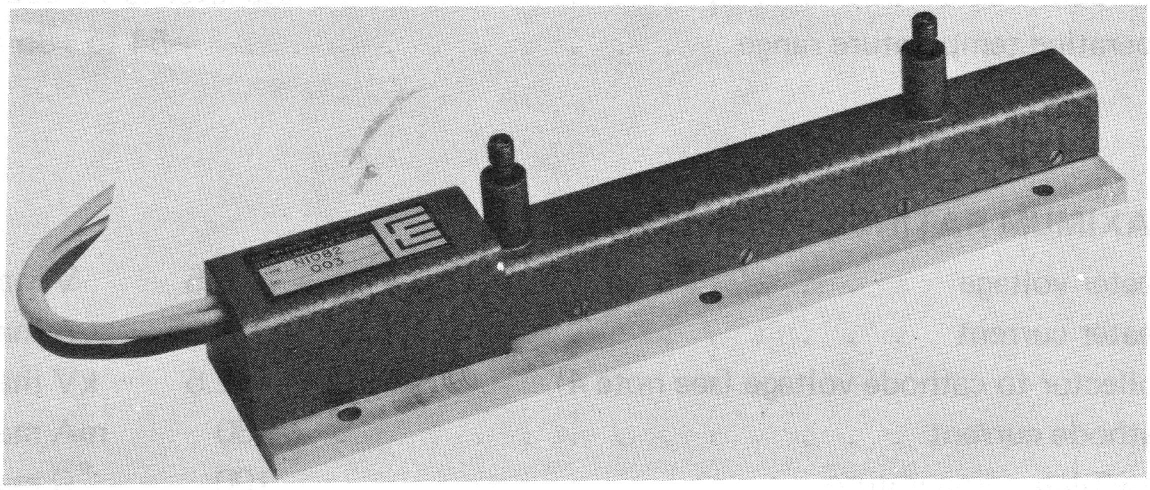
N1082

8–16GHz DRIVER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	8.0 to 16	GHz
Minimum c.w. output power (saturation)	1.0	W
Minimum small signal gain	36	db
Operating temperature range	–54 to +85	°C



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	0.9	A
Cathode pre-heating time (minimum)	2.0	min

Continued on page 2

GENERAL (continued)

Mechanical

Overall dimensions	see outline drawing
D.C. connections (see note 1)	colour coded flexible leads
R.F. connections	coaxial, SMA female
Mounting position (see note 2)	any
Net weight	1.5 pounds (0.7kg) approx

Cooling	conduction cooled	
Heat sink temperature (see note 3)	90	°C max

Environmental

Vibration	10g from 20 to 2000Hz
Shock	15g for 11ms
Altitude	sea level to 70 000ft
Operating temperature range	–54 to +85°C

MAXIMUM RATINGS (Absolute values)

Heater voltage	6.5	V max
Heater current	1.25	A max
Collector to cathode voltage (see note 4)	2.5	kV max
Cathode current	30	mA max
Base plate temperature	100	°C max

TYPICAL OPERATION

Frequency	12	GHz
Cathode current	20	mA
Collector to cathode voltage	2.0	kV
Saturation output power	2.0	W
Small signal gain	45	db
Phase sensitivity (helix voltage)	3.0	degree/V

NOTES

1. The lead lengths will be in accordance with customers' requirements.
2. The tube should be shielded from strong stray magnetic fields.
3. The temperature of the heat sink in the region of the collector is permitted to rise to a maximum of 95°C.
4. The anode and collector are strapped internally and connected to earth.
5. For helix modulation the tube can be fitted with a d.c. block and monitor tee on the r.f. input. The helix can then be isolated from earth and a maximum voltage of 200V can be used to modulate the helix. Further details on application.

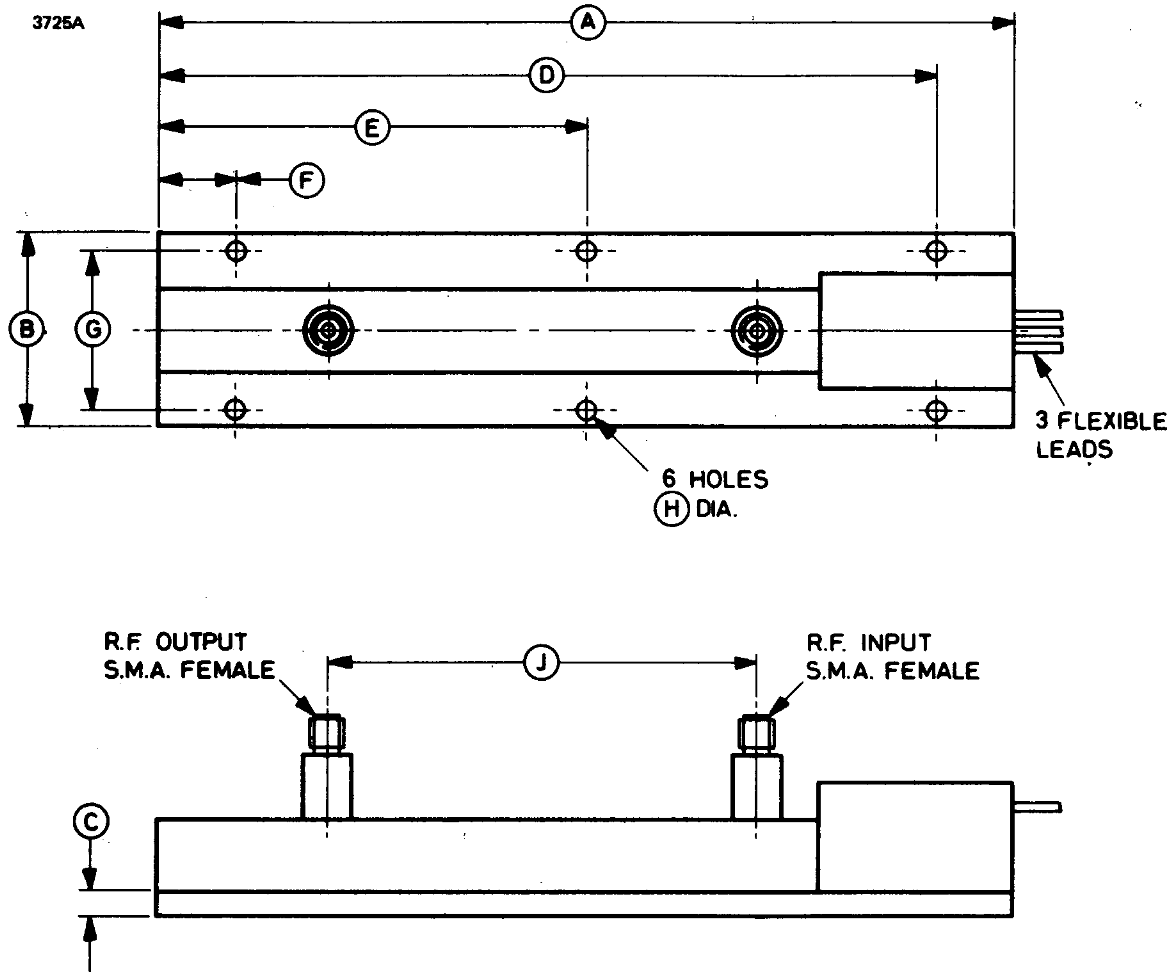
Outline Dimensions (All dimensions are nominal)

Ref	Inches	Millimetres
A	8.800	223.5
B	2.000	50.80
C	0.250	6.35
D	8.000	203.2
E	4.400	111.8
F	0.800	20.32
G	1.625	41.28
H	0.197	5.00
J	4.406	111.9
K	2.065	52.45

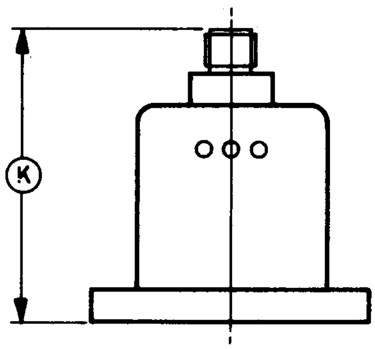
Millimetre dimensions have been derived from inches.

OUTLINE

3725A



Enlarged View on Input End



Lead Connections

Colour	Element
Yellow	Heater, cathode
Brown	Heater
Green	Anode, collector, helix and earth

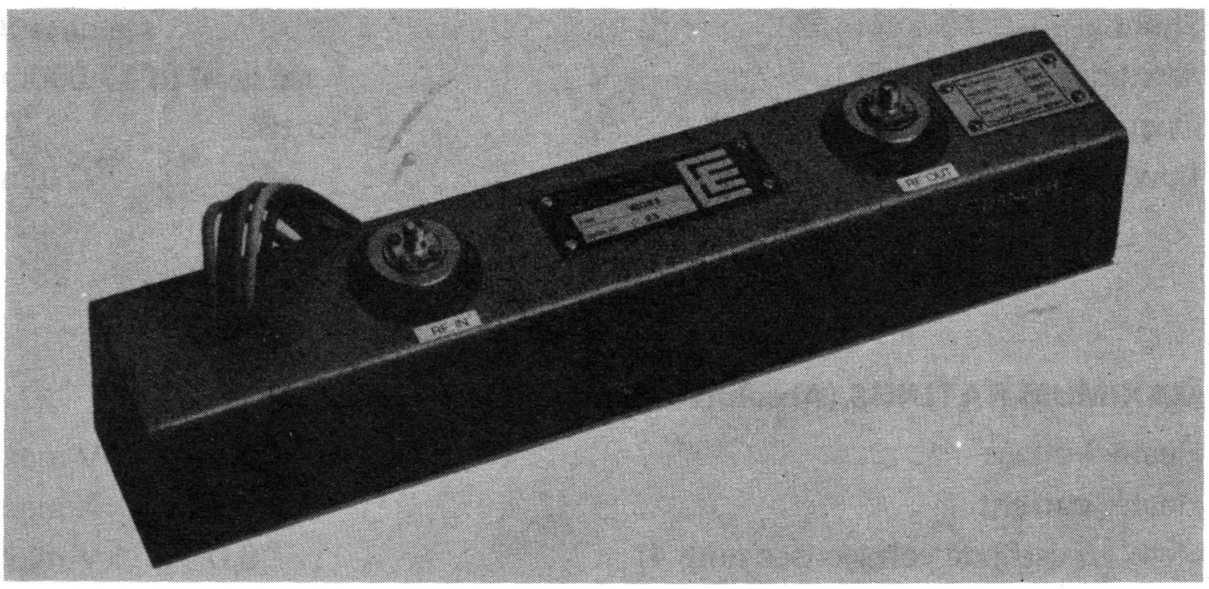
N1083

4.8—9.6GHz POWER TRAVELLING WAVE TUBE

ABRIDGED DATA

Broadband power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. The tube is ruggedly designed and packaged in a conduction cooled capsule with coaxial r.f. connections.

Frequency range	4.8 to 9.6	GHz
Minimum c.w. output power (saturation)	25	W
Minimum gain (at 25W output)	43	db
Operating temperature range	–54 to +95	°C



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	1.0	A
Cathode pre-heating time (minimum)	2.0	min

Mechanical

Overall dimensions (excluding coaxial connectors)	31 x 5.5 x 5.5cm max
D.C. connections (see note 1)	colour coded flexible leads
R.F. connections:	
output	coaxial, S.M.A. female
input	coaxial, S.M.A. female
Mounting position (see note 2)	any
Net weight	3¾ pounds (1.7kg) max

Cooling	conduction cooled	
Heat sink temperature	95	°C max

Environmental (Generally to B.S.3G 100)

Vibration	see note 3	
Shock	see note 3	
Altitude	sea level to 17 000m	
Operating temperature range	−54 to +95	°C
Low temperature storage	−62	°C min

MAXIMUM RATINGS (Absolute values)

Heater voltage	6.5	V max
Heater current	1.25	A max
Helix to cathode voltage (see note 4)	5.0	kV max
Helix current (see note 5)	10	mA max
Helix to collector voltage	4.0	kV max
Collector current	100	mA max
Collector dissipation	250	W max
Helix to anode voltage	−5.0	kV max
Anode current	1.5	mA max
R.F. return power (see note 6)	9.0	W max
Base plate temperature (see note 7)	100	°C max

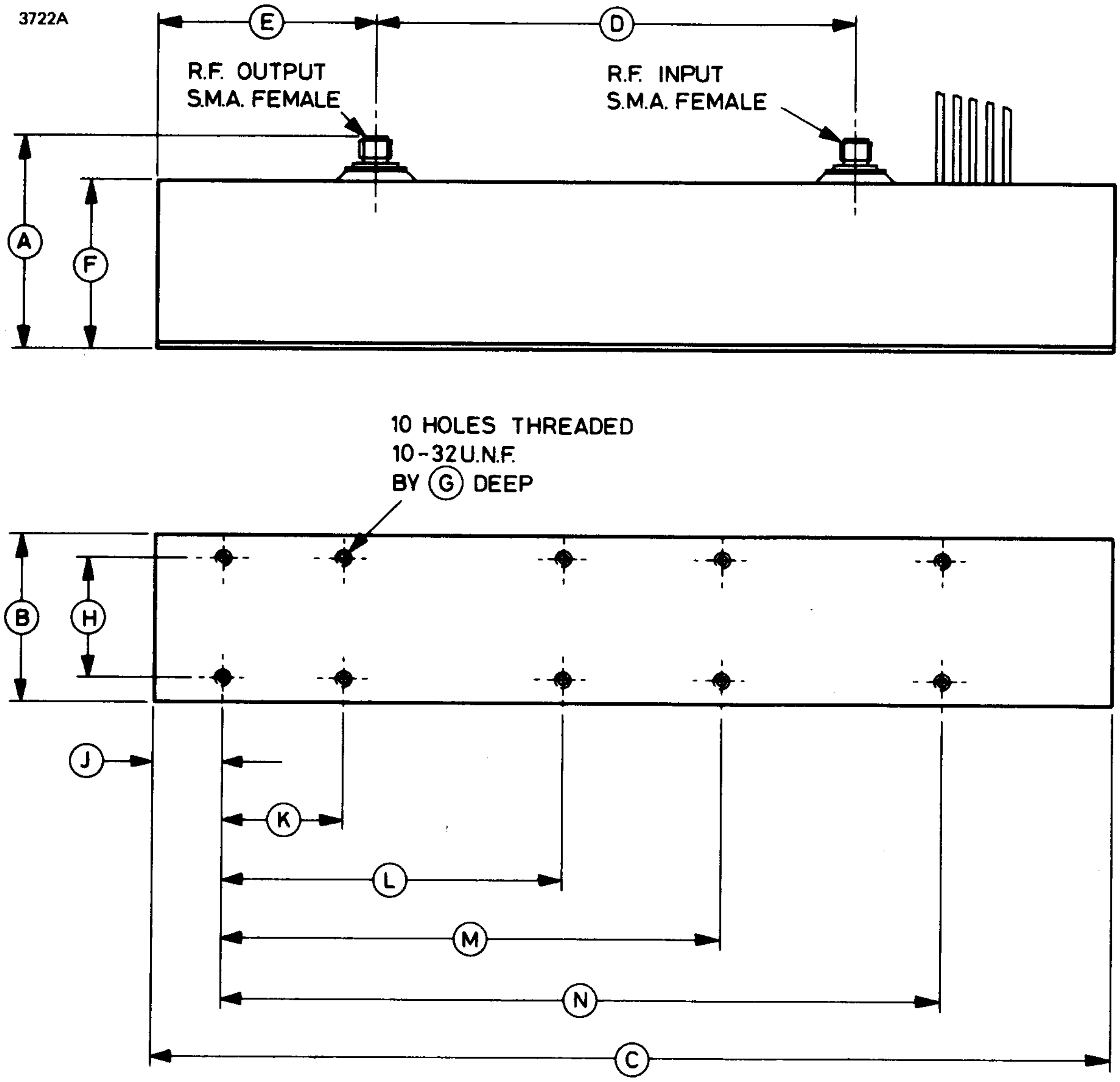
TYPICAL OPERATION (4.8 to 9.6GHz)

Collector to cathode voltage	2.0	kV
Collector current	88	mA
Helix to cathode voltage	3.3	kV
Helix current	4.0	mA
Helix to anode voltage (see note 8)	–400	V
Anode current	0.1	mA
Output power (minimum)	25	W
Gain at 25W (minimum)	43	db
Gain variation (maximum) (see note 9)	3.0	db
Noise factor (maximum)	30	db
Efficiency (minimum)	12	%
Phase sensitivity of helix voltage (minimum)	1.0	degree/V
Input v.s.w.r. (maximum)	3:1	
Output v.s.w.r. (maximum)	3:1	

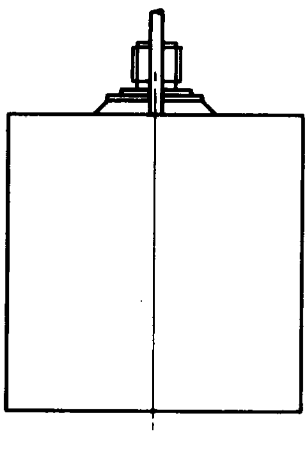
NOTES

1. The lead lengths will be in accordance with customers' requirements.
2. The tube should be shielded from strong stray magnetic fields.
3. B.S.3G 100 for highly manoeuverable supersonic military aircraft.
4. The helix is operated at or near earth potential.
5. A helix over-current trip should be fitted. During switching on and off sequences, the peak helix current should not exceed 20mA and the voltages should be established in less than 50ms.
6. It is advisable to fit a reverse power trip set to operate if the return power exceeds 9.0W.
7. Provision is made for a thermal interlock to be fitted at the collector end of the tube.
8. The anode voltage can be used to decrease the gain of the tube by more than 20db.
9. Using an approved gain equalizer.

OUTLINE



Enlarged View on End of Tube



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	2.650 max	67.31 max
B	2.125 max	53.98 max
C	12.000 max	304.8 max
D	6.000 max	152.4 max
E	2.750	69.85
F	2.125	53.98
G	0.375	9.53
H	1.500	38.10
J	0.875	22.23
K	1.500	38.10
L	4.250	108.0
M	6.250	158.8
N	9.000	228.6

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Yellow	Heater, cathode
Brown	Heater
Green	Anode
Orange	Helix
Red	Collector

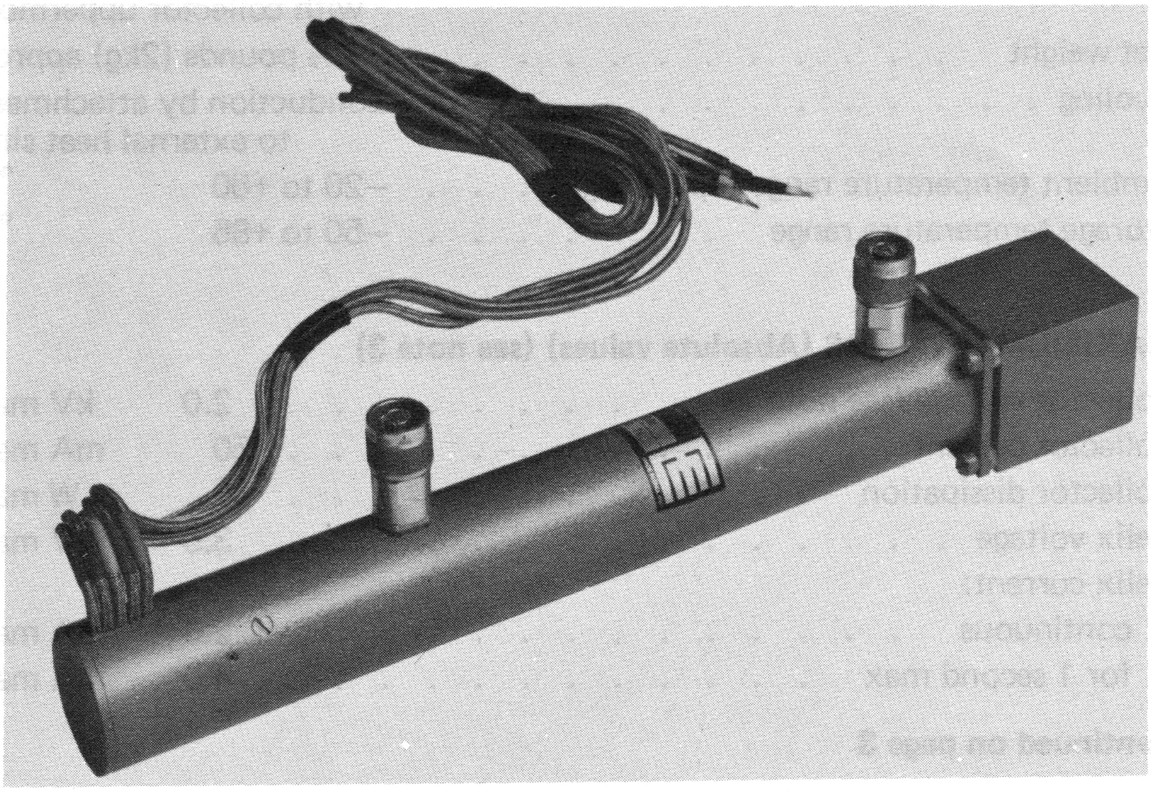
3.6–4.2GHz POWER TRAVELLING WAVE TUBE

DESCRIPTION

High efficiency travelling wave tube for operation at 11W output in wideband communications systems. The tube is packaged in a conduction cooled periodic permanent magnet focusing mount with coaxial r.f. input and output connectors.

The total power requirement of the tube is 60W while the gain, noise factor and AM/PM conversion are compatible with 1800 channel multiplex system requirements.

Mounting is by means of the collector cooling block, thereby allowing easy replacement. At the end of tube life, the complete package may be returned to English Electric Valve Company for replacement of the travelling wave tube vacuum envelope section.



ABRIDGED DATA

Frequency range	3.6 to 4.2	GHz
Saturation output power	17	W
Working output power	11	W
Nominal gain	39	db
Noise factor	24	db
AM/PM conversion	2.25	degree/db

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage (see note 1)	6.3	V
Heater current	0.8	A
Heater starting current (peak)	5.0	A max
Cathode pre-heating time	90	s min

Mechanical

Tube connections (see note 2)	5 screened flexible leads
R.F. connections	N type coaxial plug
Alternative r.f. connections	details on application
Mounting position	horizontal, or vertical with collector uppermost
Net weight	4½ pounds (2kg) approx
Cooling	conduction by attachment to external heat sink
Ambient temperature range (operating)	–20 to +60 °C
Storage temperature range	–50 to +85 °C

MAXIMUM RATINGS (Absolute values) (see note 3)

Collector voltage (see note 2)	2.0	kV max
Collector current	50	mA max
Collector dissipation	80	W max
Helix voltage	3.5	kV max
Helix current:		
continuous	2.0	mA max
for 1 second max	4.0	mA max

Continued on page 3

MAXIMUM RATINGS (Absolute values) – continued

Anode voltage	3.0	kV max
Anode current	0.25	mA max
Heater voltage (see note 1)	6.6	V max
Operating temperature range:		
body (excluding collector cooling block)	–20 to +85	°C max
collector cooling block (see note 4)	105	°C max
Storage temperature range	–50 to +85	°C max

TYPICAL OPERATION (at 3.9GHz)

Operational Conditions (see note 3)

Collector voltage (see note 5)	1.30	kV
Helix voltage (see note 6)	3.03	kV
Anode voltage	2.20	kV
R.F. input power	1.5	mW

Typical Performance

Collector current	40	mA
Helix current	0.25	mA
Anode current	0.02	mA
Output power	11	W
Saturation output power (see note 7)	17	W
Maximum saturation output power (see note 8)	23	W
Noise factor (see note 9)	24	db
AM/PM conversion (see note 10)	2.25	degree/db
Cold insertion loss	80	db
Input v.s.w.r. over the band	1.50:1	max
Output v.s.w.r. over the band	1.75:1	max

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Recommended Applied Conditions (see note 3)

Frequency range	3.6 to 4.2	GHz
Heater voltage (see note 1)	6.3	V
Collector voltage (see note 5)	1.3	kV
Collector current	40	mA
Output power (see note 11)	11	W
Load v.s.w.r.	less than 1.5:1	

Range of Characteristics (with recommended applied conditions)

	Min	Max	
Heater current	0.65	0.85	A
Helix voltage (see note 6)	2.85	3.15	kV
Helix current:			
at start of life	–	0.5	mA
at end of life	–	1.5	mA
Anode voltage	2.0	2.5	kV
Anode current	–	0.2	mA
Input power	–	3.0	mW
Saturation output power (see note 7)	14	–	W
Noise factor (see note 9)	–	25	db
Gain flatness	–	0.01	db/MHz
AM/PM conversion (see note 10)	–	2.75	degree/db
Harmonic content (below output power level of fundamental)	20	–	db
Input v.s.w.r. (hot)	–	2.0:1	
Output v.s.w.r. (hot)	–	2.0:1	
Cold insertion loss	65	–	db

NOTES

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

2. The collector connection is via the body of the mount which must always be properly earthed during operation.

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

4. The collector cooling block must be attached to an external heat sink, such as a finned panel, within the equipment in which the tube is operated. The heat sink should be designed to avoid the return of heat to the body of the tube.

5. This is the minimum recommended value for continuous operation at 11W output. The helix and anode currents increase rapidly as the collector voltage is reduced from this value.

6. The helix voltage is adjusted for maximum gain to a value which depends upon frequency.
7. With the helix voltage fixed and only the input power adjusted for maximum output.
8. With both the helix voltage and input power adjusted for maximum output. The tube must not be operated continuously under these conditions. The collector voltage must be increased from the minimum value to limit the helix current.
9. 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.
10. 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.
11. The tube is not intended for continuous operation at output power levels above 12 watts.

OPERATING NOTES FOR N1086

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 1½ minutes before any h.t. voltages are applied.

(2) During switch-on, the anode voltage must be delayed so that it will not have risen appreciably 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 $\pm 2\%$. Voltage ripple limits will be determined by the application.

(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.

B. Switching On

(1) Switch on the travelling wave tube heater and allow a minimum of 1½ minutes cathode pre-heating time.

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

(3) Set the helix and anode voltages to the typical operating values.

(4) Adjust the anode voltage to obtain a collector current of 40mA.

C. Setting R.F. Power

(1) Apply an r.f. input power of between 1 and 3mW approximately.

(2) Adjust the helix voltage to obtain maximum output power.

(3) Adjust the r.f. input power to give 11W output, re-adjusting the helix voltage as necessary to maintain maximum gain.

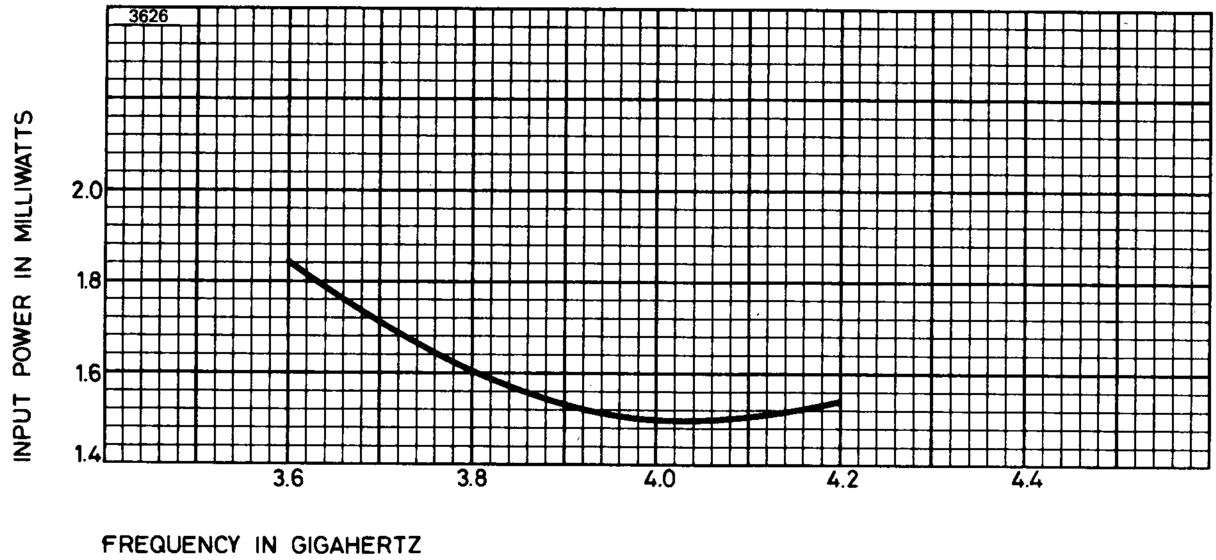
(4) Alternatively, if the r.f. input power is fixed at a value between 1¼ and 2mW, adjust the collector current by means of the anode voltage to obtain 11W output, with the helix voltage set for maximum gain.

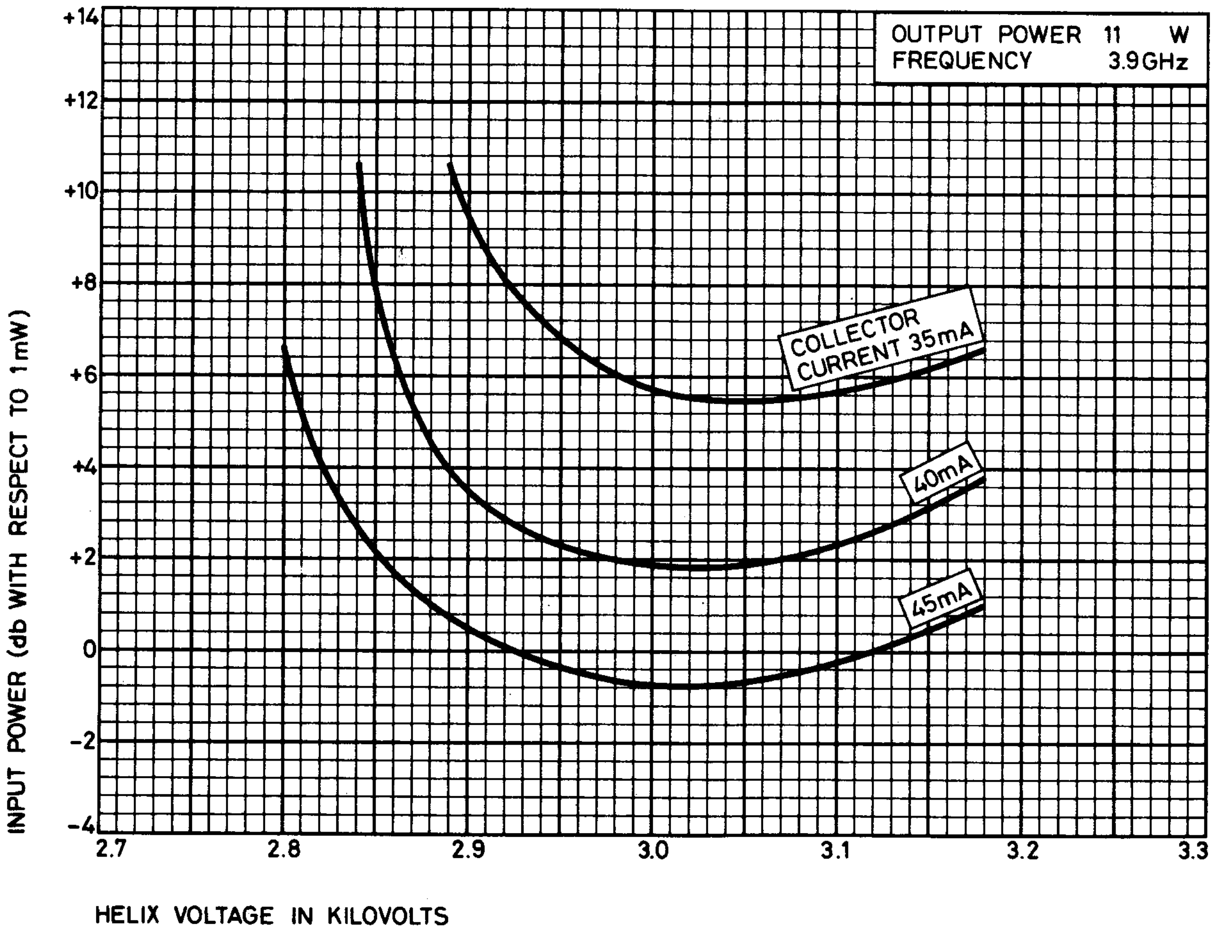
D. Supply Interruption

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

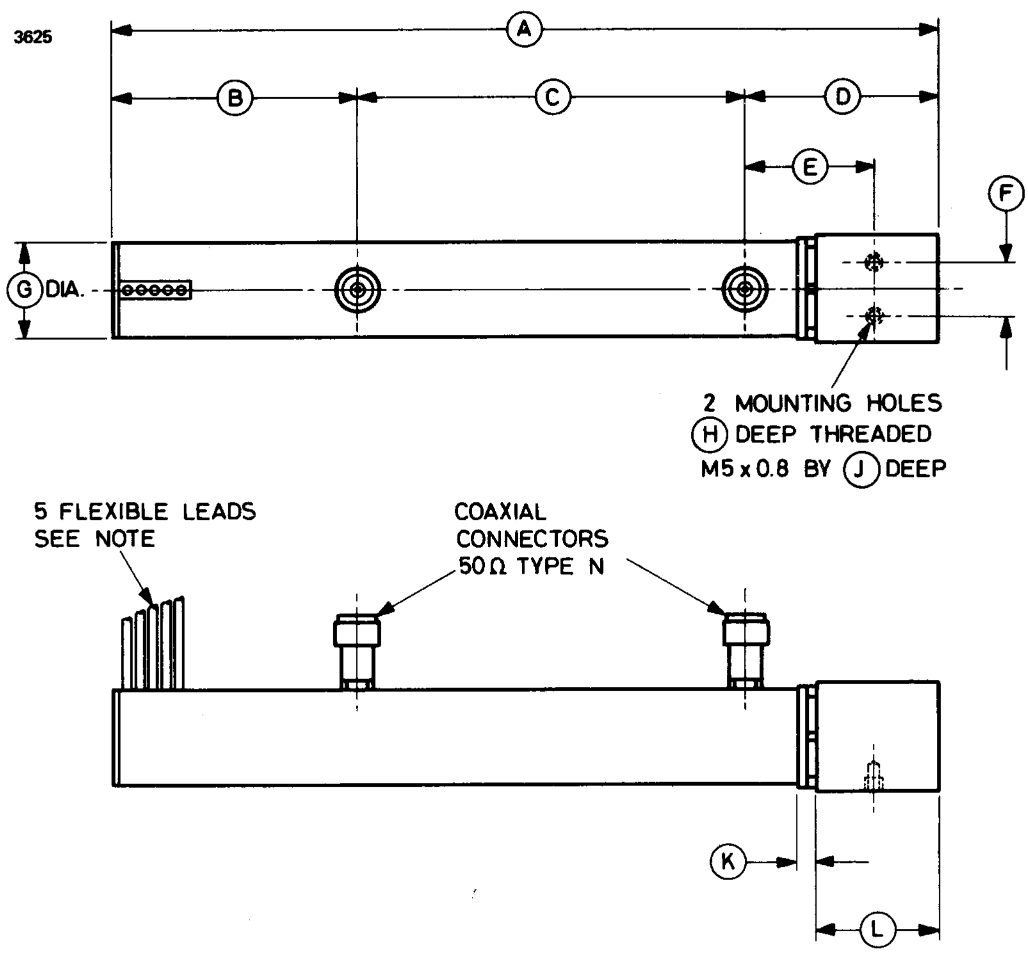
(2) For interruptions in excess of ten seconds all voltages must be re-applied in accordance with paragraph B above.

TYPICAL PERFORMANCE CHARACTERISTICS

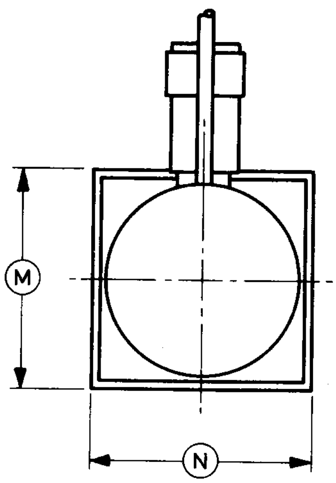




OUTLINE (All dimensions without limits are nominal)



Enlarged View on Input End of Tube



Outline Dimensions

Ref	Inches	Millimetres
A	15.000 max	381.0 max
B	4.500 max	114.3 max
C	7.000 ± 0.030	177.8 ± 0.8
D	3.750 max	95.25 max
E	2.355 ± 0.030	59.82 ± 0.76
F	0.984 ± 0.010	24.99 ± 0.25
G	1.760 max	44.70 max
H	0.500	12.70
J	0.250	6.35
K	0.281 ± 0.010	7.14 ± 0.25
L	2.250 ± 0.010	57.15 ± 0.25
M	1.975 ± 0.010	50.17 ± 0.25
N	1.975 ± 0.010	50.17 ± 0.25

Millimetre dimensions have been derived from inches.

Lead Connections

Colour	Element
Brown	Heater
Brown	Heater
Yellow	Cathode
Blue	Anode
Orange	Helix

Outline Note

Five individually screened leads, nominal length 60 inches (1524mm), with bared ends.

N1094

TRAVELLING WAVE TUBE

ABRIDGED DATA

Pulsed power amplifier travelling wave tube, helix type, integral with periodic permanent magnet focus mount. It has a high μ gridded electron gun capable of operating at a 5% duty cycle. The tube is ruggedly designed and packaged in a conduction cooled capsule suitable for ground or airborne applications.

Frequency range	4.4 to 5.8	GHz
Minimum peak output power (saturated)	250	W
Minimum gain at 250W output	40	db
Operating temperature range	−54 to +90	°C

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	6.3	V
Heater current	1.4	A
Cathode pre-heating time (minimum)	2.5	min

Mechanical

Overall dimensions	see Outline
D.C. connections	colour coded flying leads
R.F. connections	coaxial SMA female
Mounting position	any
Net weight	2.5 pounds (1.1kg) max

Environmental

Ambient temperature range	−54 to +90	°C
Heat sink temperature	100	°C max
Altitude	50 000ft (15km)	max
Vibration 20 to 2000Hz	10	g max
Shock (11ms)	20	g max

TYPICAL OPERATION (All voltages with respect to cathode)

Frequency	4.4 to 5.8	GHz
Collector voltage	3.3	kV
Collector current (peak)	350	mA
Helix voltage (see note)	5.6	kV
Helix current (peak)	40	mA
Grid bias voltage	−100	V
Peak positive grid voltage	+70	V
Grid current (peak)	40	mA
R.F. drive power	20	mW
Output power (peak)	260	W
Duty cycle	0.05	

Note The tube is normally operated with the helix earthed.

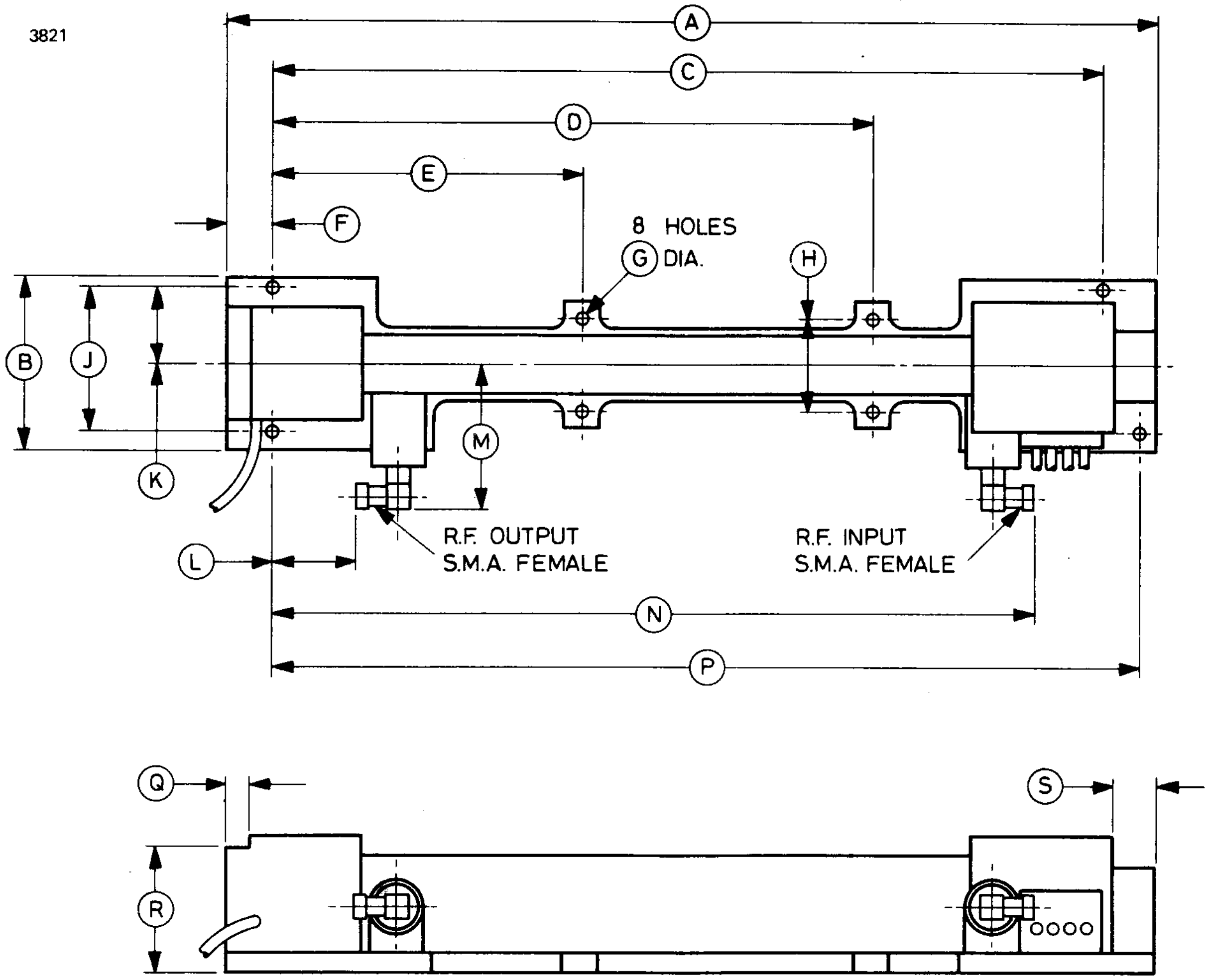
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.250 max	285.8 max	L	0.850	21.59
B	2.100 max	53.34 max	M	1.750 max	44.45 max
C	10.062 ± 0.010	255.6 ± 0.3	N	9.150	232.4
D	7.250 ± 0.010	184.2 ± 0.3	P	10.500 ± 0.010	266.7 ± 0.3
E	3.470 ± 0.010	88.14 ± 0.25	Q	0.312 min	7.92 min
F	0.562	14.27	R	1.500	38.10
G	0.150	3.81	S	0.312 min	7.92 min
H	1.125 ± 0.010	28.58 ± 0.25	T	1.312 max	33.32 max
J	1.733 ± 0.010	44.02 ± 0.25	U	1.656	42.06
K	0.921 ± 0.010	23.39 ± 0.25			

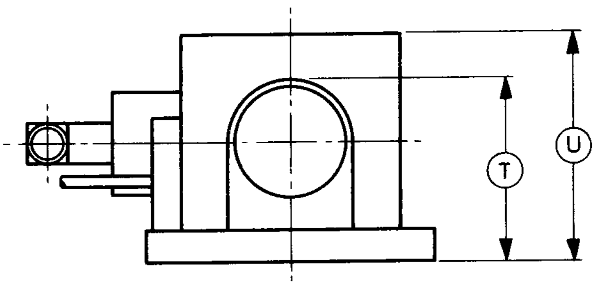
Millimetre dimensions have been derived from inches.

OUTLINE

3821



Enlarged View on Input End



Lead Connections

Colour	Element
Brown	Heater
Yellow	Heater, cathode
Green	Grid
Orange	Helix, earth
Red	Collector

Note Length of flexible leads to suit customer requirements.

N4004

TRAVELLING WAVE TUBE SOLENOID

DESCRIPTION

The N4004 is a lightweight solenoid for use with the 3.1GHz low noise travelling wave tube 6861.

GENERAL DATA

Field strength	6.0mT/A (60 gauss/A) approx	
Resistance:		
at 20°C core temperature	1.4	Ω approx
at 120°C core temperature	1.9	Ω approx
Maximum mean winding temperature	150	°C
Maximum ambient temperature with typical mounting	40	°C
Overall dimensions	17.000 x 6.030 x 6.000 inches max 431.8 x 153.2 x 152.4mm max	
Net weight	26 pounds (12kg) approx	
Cooling (see note 1)	natural air circulation and conduction through mounting blocks	

TYPICAL OPERATING CONDITIONS (For 52.5mT, 525 gauss, field)

D.C. current	9.0	A
D.C. voltage (approx)	17.5	V
Operating temperature inside centre tube (for 20°C ambient temperature)	120	°C

SOLENOID CONNECTIONS

1. Unscrew the clamping ring and remove the octal base holder assembly.
2. Solder leads to the appropriate pin tabs according to the tube base connections (see the tube data sheet) and re-assemble the base holder and large aluminium ring.
3. Thread the leads through the clamping ring and screw the clamping ring home. Adjust the base assembly to be approximately central.
4. Connect the tube leads to a suitable power supply.

INSTALLING A TRAVELLING WAVE TUBE

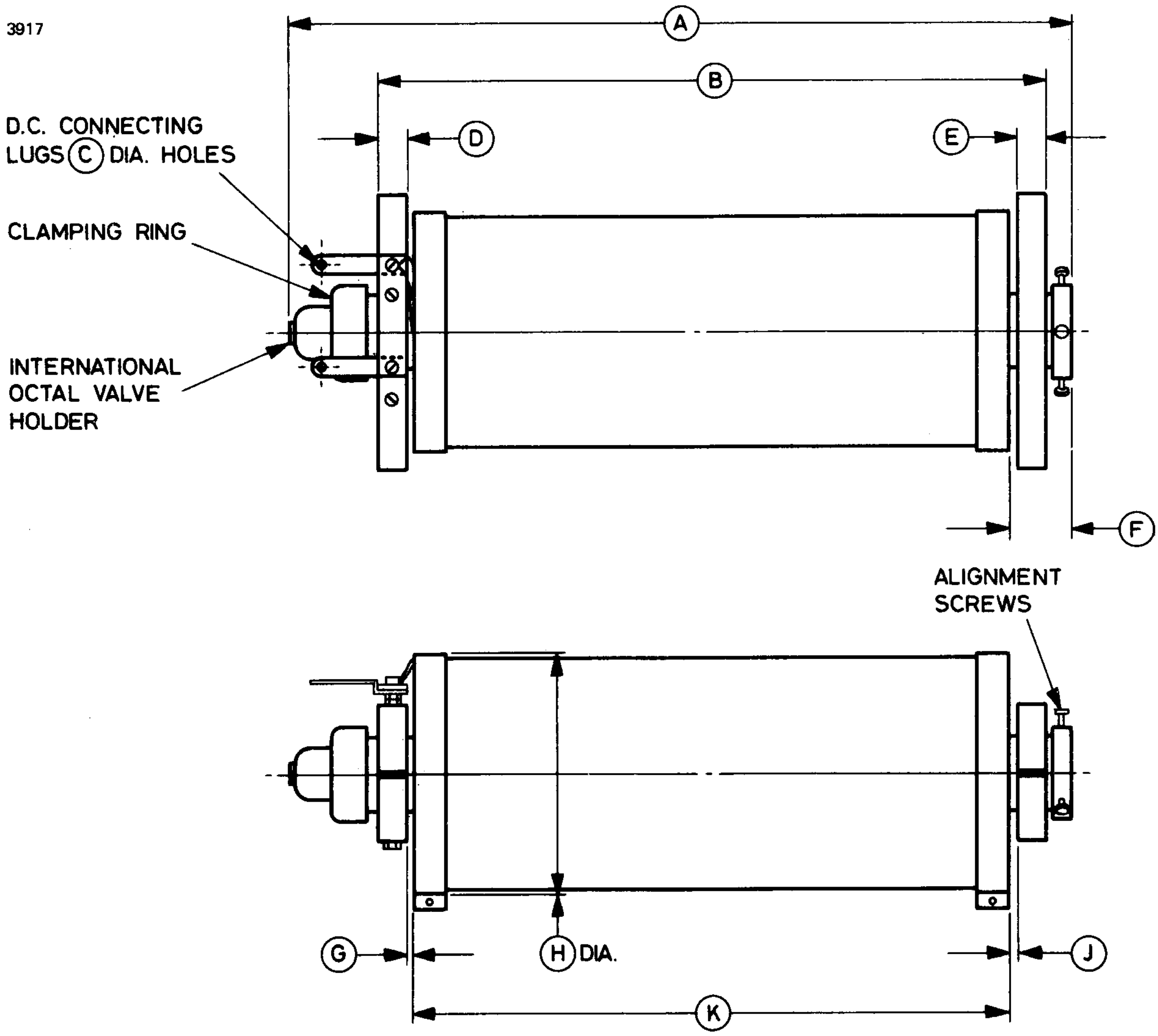
1. Unscrew the three alignment screws sufficiently to allow the travelling wave tube to be inserted, base end first, into the solenoid. Rotate the tube until the key of the base fits into the socket and push home. Apply pressure to the collector cap rather than to the r.f. connectors. Adjust the alignment screws so that the tube is approximately central. Connect the collector lead.
2. Switch on the tube heater, and adjust the solenoid current to a value about 10% greater than that shown on page 1.
3. After 2 minutes switch on the h.t. with grid 2 voltage control set at minimum, and the other voltages at their specified values.
4. Slowly increase grid 2 voltage and note whether the helix current is excessive. If so, adjust the alignment screws to reduce the helix current and increase grid 2 voltage to give the rated collector current.
5. If it is found that the alignment screws cannot give sufficient movement of the travelling wave tube for optimum focus, i.e., low helix current, slacken the clamping ring and readjust the centring of the base. Screw the clamping ring tight, and repeat steps 4 and 5 until satisfactory focusing conditions are reached. Having performed these adjustments, it is not usually necessary to repeat the adjustment of the base when the tube is replaced.
6. After a time the solenoid will warm up, and it will be necessary to readjust the current through it. Adjust this current to the value required to give the specified field.

NOTES

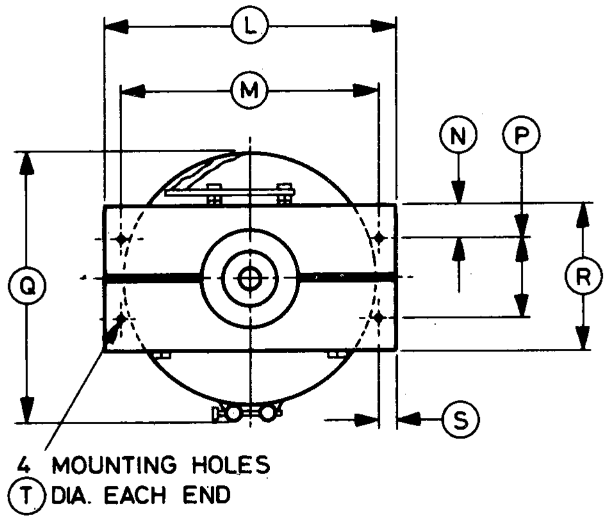
1. A considerable reduction in operating temperature may be achieved by mounting the solenoid, by means of the mounting blocks, directly on to a chassis or panel which then acts as a heat sink. Care should be taken that the material of the chassis or panel does not disturb the magnetic field.

OUTLINE

3917



End View



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	16.750 ± 0.250	425.5 ± 6.4
B	14.125 ± 0.125	358.8 ± 3.2
C	0.250	6.35
D	0.625	15.88
E	0.625	15.88
F	1.312	33.32
G	0.125 min	3.18 min
H	5.250 max	133.4 max
J	0.125 min	3.18 min
K	12.750 ± 0.125	323.9 ± 3.2
L	6.000 ± 0.030	152.4 ± 0.8
M	5.250 ± 0.010	133.4 ± 0.3
N	0.750	19.05
P	1.500 ± 0.030	38.10 ± 0.76
Q	6.000 max	152.4 max
R	3.000 ± 0.030	76.20 ± 0.76
S	0.375	9.53
T	0.196	4.98

Millimetre dimensions have been derived from inches.

N4041

TRAVELLING WAVE TUBE MOUNT

DESCRIPTION

The N4041 is a wire wound magnetic focusing mount designed for use with the low noise travelling wave tube type N1047M. The solenoid in the mount operates at 10.5A d.c. at approximately 95V and provides a uniform field of 140mT (1400 gauss). Forced-air cooling of the solenoid winding and the travelling wave tube is provided by an integral fan unit.

The tube is inserted into the mount at the end remote from the fan unit and plugs into an international octal socket within the mount. Power supplies are connected to the tube, the solenoid and the fan unit via four multi-pin plugs situated on the terminal box on the top of the mount. An interlock circuit prevents supplies being connected to the solenoid or the tube until all four plugs are inserted. R.F. connections are made direct to the coaxial plugs of the travelling wave tube.

The mount is provided with an internal protection switch which may be incorporated in a simple relay circuit. If for any reason the solenoid temperature should exceed the safe limit, the switch opens and the relay circuit should be arranged so that it isolates both tube and solenoid from the supplies until the relay is set.

GENERAL DATA

Field strength	13mT/A (130 gauss/A) approx
Solenoid resistance:	
at 20°C core temperature	7.5 Ω approx
at operating temperature	9.0 Ω approx
Overall dimensions	16.875 x 8.250 x 11.750 inches max
	428.6 x 209.6 x 298.5mm max
Overall length of tube and mount assembly	19.750 inches (502mm) max
Net weight	76 pounds (35kg) approx
Cooling	by integral fan unit
Mounting position	any
Fan unit supply	200/250V single phase a.c., 50 or 60Hz, 100W

MAXIMUM RATINGS (Absolute values)

Input power to solenoid when in thermal equilibrium	1200	W max
Surge current when switched on cold	15	A max
Continuous operating current when in thermal equilibrium	11	A max
Voltage between solenoid winding and earthed cover	150	V max
Voltage between thermal cut-out and earth	250	V max
Thermal cut-out contacts:		
a.c. voltage	250	V max
a.c. current	3.0	A max
d.c. voltage	50	V max
d.c. current	0.5	A max
Ambient and air inlet temperature	40	°C max

TYPICAL OPERATING CONDITIONS

Solenoid current, d.c.	10.5	A
Solenoid voltage, d.c. (10.5A solenoid current, in thermal equilibrium, and ambient temperature 20°C)	95	V
Field strength	140	mT
	1400	gauss
Running temperature, inside of centre tube (for 20°C ambient temperature)	50	°C

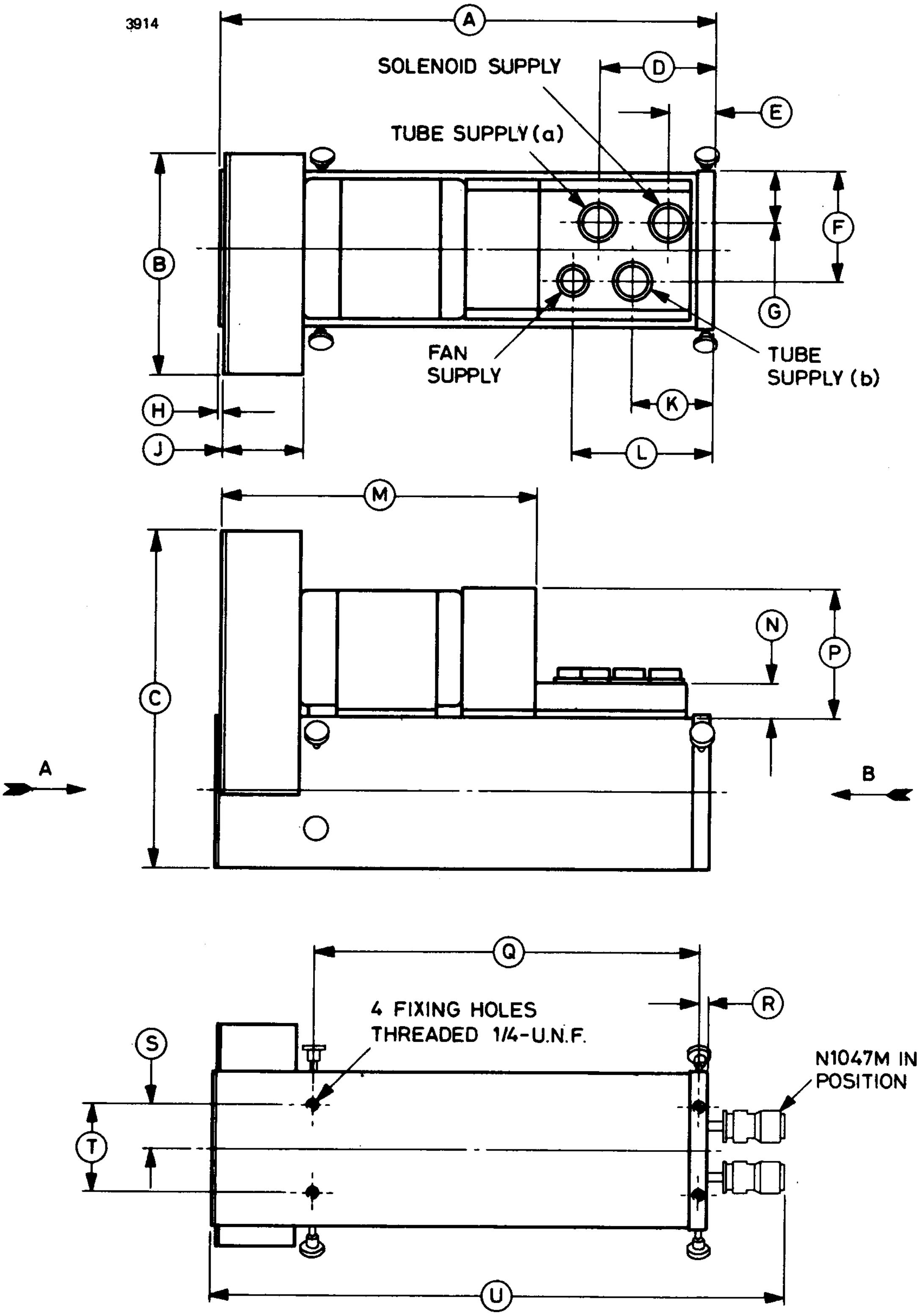
FOCUSING MOUNT AND TUBE CONNECTIONS

Supplies are connected to the tube, solenoid and fan by means of Plessey plugs and sockets (the plugs only are supplied with the solenoid). Each of the four plugs on the top of the mount casing is different so that the sockets are not interchangeable. The connections are shown on page 6.

TRAVELLING WAVE TUBE INSTALLATION

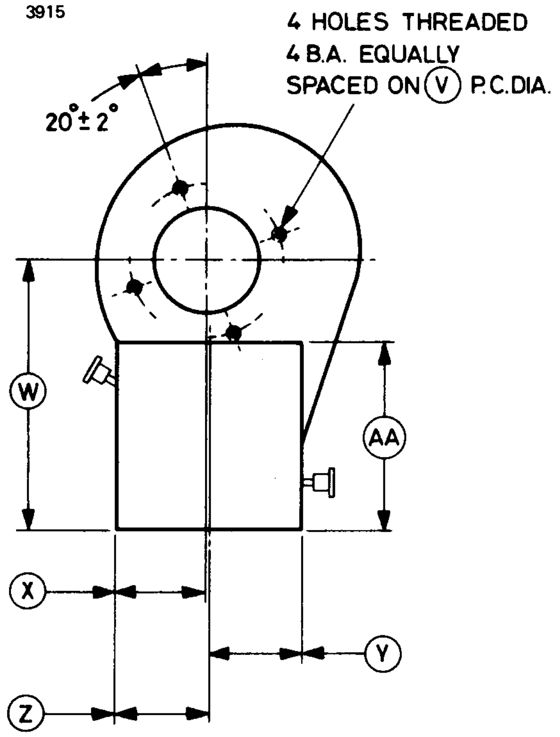
1. Unscrew the four alignment screws sufficiently to allow the travelling wave tube to be inserted. Insert the tube and rotate it until the key of the base fits into the socket, then push home, applying pressure to the collector cap rather than to the r.f. connectors. Screw down the alignment screws just sufficiently to touch the tube and unlock the spring loaded alignment plungers. Adjust the alignment screws so that the tube is approximately central. Connect the collector lead.
2. Switch on the tube heater and the solenoid fan. Adjust the solenoid voltage to the value shown on the solenoid casing. The solenoid current will be higher than 10.5A until the solenoid reaches the correct operating temperature.
3. After at least two minutes switch on the h.t. voltage with grid 1 and 2 voltage set at zero, and the other voltages at the values specified on the tube data sheet.
4. Slowly increase the grid 1 and 2 voltage, adjusting the alignment screws to reduce the helix current (if any) to a minimum. Continue increasing the grid 1 and 2 voltage until the specified collector current is reached. The grid 1 and 2 voltage should now be checked by means of a high resistance voltmeter. The helix current should be below 0.5μA.
5. Adjust the helix, grid 3 and grid 4 voltages for minimum noise factor and optimum gain as specified in the N1047M data sheet.
6. A further fine adjustment of the alignment screws may later be necessary to reduce the noise output of the travelling wave tube to a minimum.

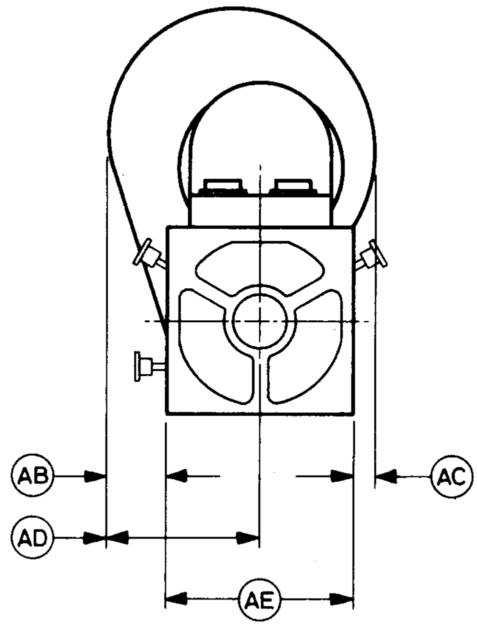
OUTLINE (See page 6 for Plug Connections)



OUTLINE DETAILS

View in Direction A **View in Direction B**





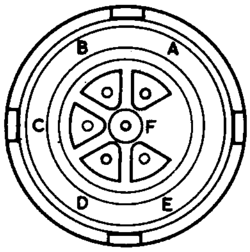
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	16.875 max	428.6 max	R	0.250	6.35
B	8.250 max	209.6 max	S	1.500	38.10
C	11.750 max	298.5 max	T	3.000	76.20
D	3.937 max	100.0 max	U	19.750 max	501.7 max
E	1.562 max	39.67 max	V	4.375	111.1
F	3.687 ± 0.032	93.65 ± 0.81	W	7.700 ± 0.062	195.6 ± 1.6
G	1.687 ± 0.032	42.85 ± 0.81	X	2.625 ± 0.062	66.68 ± 1.57
H	0.125	3.18	Y	2.687	68.25
J	2.875	73.03	Z	2.687	68.25
K	2.750 max	69.85 max	AA	5.312 max	134.9 max
L	4.750 max	120.7 max	AB	1.750 max	44.45 max
M	10.875	276.2	AC	0.813	20.65
N	1.250 max	31.75 max	AD	4.500 max	114.3 max
P	5.156 max	131.0 max	AE	5.375 max	136.5 max
Q	13.062 ± 0.032	331.8 ± 0.8			

Millimetre dimensions have been derived from inches.

PLUG CONNECTIONS

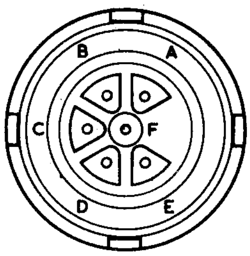
Tube Supply (a)



Plessey Plug CZ63958

Pin	Element
A	Helix
B	Grid 4
C	Grid 3
D	Interlock
E	Heater
F	Heater, cathode

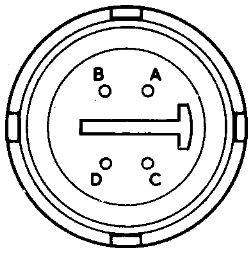
Tube Supply (b)



Plessey Plug CZ63958/1

Pin	Element
A	No connection
B	Cathode
C	Grids 1 and 2
D	Interlock
E	Earth
F	No connection

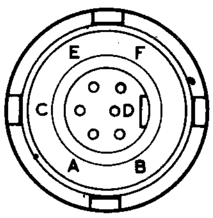
Solenoid Supply



Plessey Plug CZ63956

Pin	Element
A	Solenoid+
B	Solenoid–
C	Interlock
D	Interlock

Fan Supply



Plessey Plug CZ63955

Pin	Element
A	Fan+
B	Fan–
C	Fan (earth)
D	Thermal switch
E	Thermal switch
F	No connection

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

Travelling wave tubes giving low f.m. noise and AM/PM conversion designed for operation in 1800 channel radio communications systems. The tube is readily replaceable in a periodic permanent magnet focusing mount which also contains the R.F. couplings.

Cooling is by natural convection and R.F. terminations are in waveguide (1.372in. x 0.125in. internal) with optional transitions to WG14 (WR137).

*Frequency range	5.8–7.8	GHz
Operating power level	5	W
Nominal gain (at 5W output)	36	dB
Noise factor	<28	dB
AM/PM conversion (at 5W output)	<2.5	°/dB

*The tube is normally manufactured in 4 frequency ranges.

TWC5	5.925–6.425	GHz
TWC5A	7.400–7.800	GHz
TWC5B	6.900–7.400	GHz
TWC5C	6.425–7.110	GHz

TYPICAL OPERATION AND PERFORMANCE CHARACTERISTICS

	TWC5	TWC5A	
Frequency	5.925–6.425	7.400–7.800	GHz
Output power	5	5	W
I_{coll}	25–35	30–40	mA
V_{coll}	1.8	1.8	kV
V_{hel}	3.2	3.1	kV
V_{g1}	−10	−10	V
V_{g2}	2.0	2.2	kV
I_{hel}	0.2	0.2	mA
I_{g2}	0	0	mA
Gain (at 5W output)	36.0	36.0	dB
Noise factor (at 5W output)	<28	<28	dB
AM/PM conversion (at 5W output)	<2.0	<2.0	°/dB
Gain flatness (at 5W output)			
Over any 30MHz band	<±0.15	<±0.15	dB
Over any 3MHz band	<±0.02	<±0.02	dB
Input VSWR (hot)	<1.3:1	<1.3:1	
Output VSWR (hot)	<1.5:1	<1.5:1	

MECHANICAL DATA

Dimensions See Outline drawing Mount Reference PMC5
Weight (including mount) 4.75kg (10.75lb)

MAXIMUM RATINGS (Absolute and non-simultaneous)

V_{coll} (see Notes 1, 2, 3)	3.5	kV
V_{hel} (see Notes 1, 3)	4.0	kV
$+V_{g1}$ (see Notes 1, 3)	0	V
$-V_{g1}$ (see Notes 1, 3)	100	V
V_{g2} (see Notes 1, 3)	3.5	kV
V_{heater} (see Note 3)	4.5	V
I_{coll}	50	mA
I_{hel} (see Note 4)	2.5	mA
I_{g1}	1.0	mA
I_{g2}	1.0	mA
I_{heater} (surge)	10	A
Heater warm-up time	>3	min
Interruption time in heater power (with other supplies on)(see Note 5)	<8	s
P_{coll}	80	W
P_{out}	20	W
P_{in}	1	W
$T_{ambient}$ (operating)	0 – +55	°C
$T_{storage}$ (Mount)	–30 – +70	°C
$T_{storage}$ (Tube)	–60 – +70	°C
Altitude (operating)	<15,000	ft

NOTES

1. Voltages are quoted relative to cathode.
2. The collector is connected to the capsule body which is normally earthed.
3. It is essential to apply electrode voltages in the order specified in the setting up procedure.
4. This value may be momentarily exceeded, e.g. on switching on and off and may rise to 4.0mA. A protective excess current device should be provided to trip the h.t. supplies if the continuous helix current exceeds 2.5mA.
5. Interruption of the heater supply for up to 8 seconds will not cause the trips to operate.

CONNECTIONS

Power Supplies

a) Use Electro-Methods socket type BA7S (obtainable from Pye Connectors Ltd., Hitchin Street, Biggleswade, Bedfordshire, U.K.) to mate with corresponding plug fitted to tube.

Pin A	Grid 2
B	Heater (internally connected to cathode)
C	Helix
D	Grid 1
E	Heater
F	Cathode
*H	Safety Earth
Mount Body	Connected to collector when tube is installed

*When the end cap of the mount is removed, the connections to the power supply connecting plug are exposed. To eliminate the danger of electric shock a lead from pin H on the connecting plug is connected to the inside face of this cap by means of a flying socket. When the cap is removed, the connection between the cap and the body is broken. It is recommended that a suitable protection device be included in the external power supply circuit so that if the connection between pin H and the mount body is broken by removal of the cap, the high voltage supplies to the tube are removed.

R.F. Connectors

Waveguide:- 0.125in. (3.175mm) x 1.375in. (34.925mm) internal dimensions. Waveguide flanges:- See outline drawing. Other flanges can be fitted to customer requirements. Tapers to WG14 (WR137) can be incorporated or supplied separately.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN (For 5W Output Power Operation)

Recommended Applied Conditions

The following conditions apply to all frequency variants.

Frequency range	See page 1	
Heater voltage (see Note 5).	4.0 ± 5%	V
Collector voltage (see Notes 1, 2)	1.8	kV
Output power (see Note 6).	5	W
Load V.S.W.R.	<1.5:1	

RANGE OF CHARACTERISTICS (with recommended applied conditions)

	Min	Max	
Heater current (see Note 5)	3.25	4.25	A
Collector current	0	40	mA
Helix voltage (see Note 1)	3.0	3.5	kV
Helix current (see Note 4)	0	2	mA
Grid 1 voltage (see Note 1)	–50	0	V
Grid 1 current	–	0.5	mA
Grid 2 voltage (operational) (see Note 1)	0	2.7	kV
Grid 2 current	0	0.5	mA
Saturation output power (see Note 6) .	10	–	W
Gain (at 5W output) (see Note 7) . . .	36	40	dB
Noise factor (see Notes 8, 9)	–	28	dB
AM/PM conversion	–	2.5	°/dB
Gain flatness over any 30MHz band (see Note 9)	–	±0.15	dB
Gain flatness over any 3MHz band (see Note 9)	–	±0.02	dB
Input V.S.W.R. (hot).	–	1.5:1	
Output V.S.W.R. (hot)	–	2.0:1	
Cold insertion loss	55	–	dB
Power efficiency at 5W output (see Note 10)	7	–	%

NOTES

6. The tube is designed for continuous operation at 5 watts of output power. Prolonged operation at higher power levels may reduce the operating life.
7. The tube is normally adjusted to give 36dB gain at 5 watts output. Higher gain is possible by increasing the collector current to a maximum of 40mA but this may cause some degradation in the operational life.
8. Measured as the mean noise figure over any band of 3kHz within any 30MHz band.
9. Over the recommended frequency range.
10. Efficiency = $\dfrac{P_{out}}{P_{collector} + P_{helix} + P_{heater}}$

OPERATING NOTES

Power Supply

a) The travelling wave tube heater voltage must be applied at least 3 minutes before any h.t. voltages are applied.
b) During switch-on the Grid 2 voltage must not be applied until all other electrodes have reached their final voltages.
c) During switch-off the Grid 2 voltage should be reduced to zero before all other voltages or excessive currents may be drawn.
d) The Grid 2, helix and collector voltages should typically be stabilized to ±2%. The ripple content, stability, and regulation of the supply are determined by the tolerable gain and phase modulation levels. Further details available on request.
e) A protective device must be included in the helix circuit to cut off the h.t. supply if the helix current continuously exceeds 2.5mA. As the Grid 2 voltage rises through the range 0 to 1kV the helix current is normally above 1mA and the peak value may be as high as 5mA. Accordingly the Grid 2 voltage should rise sufficiently quickly through this range to ensure that the protective device in the helix circuit is not operated. Alternatively the protective device may be overridden during installation as long as the helix current does not exceed 5mA for a maximum period of 1 second.

Initial Installation of Travelling Wave Tube

The mount should be mounted horizontally with a free airflow over the collector cooler. Other mounting positions are permissible but forced air cooling will be required and must be sufficient to ensure that the maximum temperature of the collector cooler measured at the outside of the fins does not exceed 200°C under the worst conditions of ambient temperature. About 0.6m^3/min. (20ft^3/min.) delivered through a nozzle directed at right angles to the tube axis into the cooling fins is typical. The capsule must be securely earthed by means of both of the earthing tags provided.

The mount contains a periodic magnet focusing system, with facilities for adjusting the position of the tube for best focusing. There are six focusing screws. Two of these are thumbscrews and are positioned on the cylindrical section on which the end cap is a push fit. Next to this is a rectangular section carrying two more focusing screws. The collector cooler end plate carries at its centre the collector clamping nut and on its edge the remaining two focusing screws. The clamping nut and focusing screws are operated by the same size Allen key. The r.f. connections are made by waveguide of internal dimensions 3.175 x 34.925mm (0.125 x 1.375in.).

Fitting the Tube into the Mount

After slackening the collector clamping nut, the tube may be slipped into the mount. During the last inch of movement the 7-pin plug should be entered into its slot, and both it and the tube pushed home simultaneously. Some resistance will be felt at this stage as the tube engages its supporting structure, but only light axial pressure is sufficient to ensure that the tube goes fully home; poor focusing and impedance matching may indicate that the tube is not fully home in the mount. The application of radial forces to the tube should be avoided. The base of the tube carries an indicating line, appropriate to the frequency band required (see below), and the tube should be rotated until this line points towards the centre of the 7-pin plug. The tube is now locked in place by tightening the collector clamping nut, but excessive force should be avoided.

The coloured indicating line on the base of the tube should be correctly orientated in the mount for optimum performance over any given frequency range. The following designations apply for the frequency bands stated. Other variants are available upon request.

TWC5	5925–6425MHz	coded yellow
TWC5A	7400–7800MHz	coded red
TWC5B	6900–7400MHz	coded blue

INITIAL SETTING UP PROCEDURE

a) Adjust heater volts to 4.0V and leave to warm up for 3 minutes.
b) Apply 1.8kV to the collector, set V_{g1} to the value given on the information sheet supplied with the tube, and similarly apply V_{helix} at the indicated value.
c) Gradually increase V_{g2} until the collector current reaches the indicated value. During the operation the helix interception current should be minimized by readjusting V_{g1} and adjusting the mechanical focusing controls on the mount. In some cases it may be necessary to temporarily apply −15 Volts to Grid 1 until the peak of helix current has been passed.
d) Apply an R.F. signal of approximately −10dBm to the input of the tube and optimise the helix voltage for maximum output power.
e) Readjust V_{g1} and the mechanical focusing controls for minimum helix current.
f) Increase the R.F. drive level to obtain 5 watts of output power and repeat step (e).

Note that the collector current indicated with the tube is that which gives a gain of 36dB at 5 watts output. Higher gain is possible by increasing the collector current up to a maximum of 40mA but this may cause some degradation in the operational life.

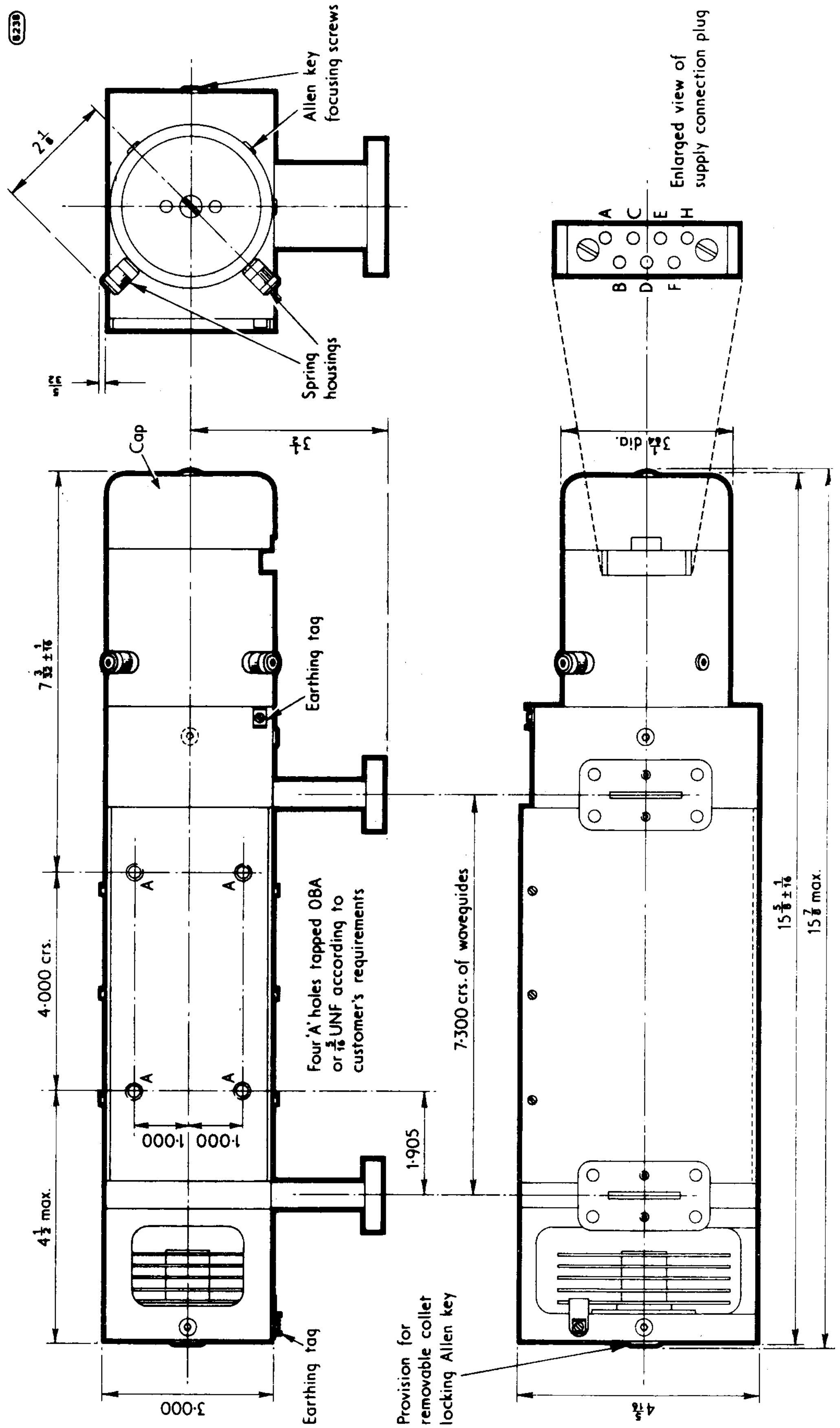
Subsequent Switching On

Once the tube has been adjusted as described above the electrode potentials may subsequently be applied together as long as the heater supply has not been disconnected for over 8 seconds and the rise of $V_{grid\ 2}$ is slightly delayed behind the rise of V_{col} and V_{hel}. When a tube has been stored for over 1 year it is advisable to operate it without R.F. drive for about 15 minutes and then, after a further 45 minutes with R.F. drive, to repeat the optimisation of voltages and of the mechanical focus condition.

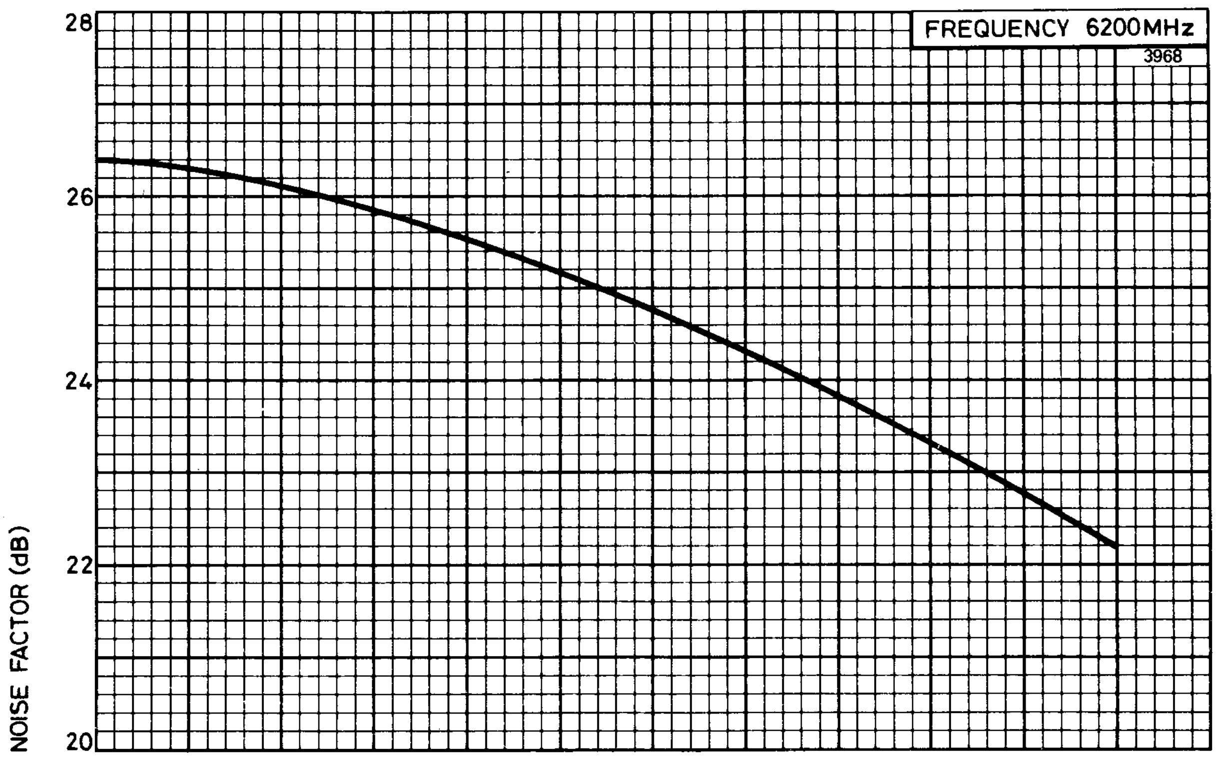
Removing the Tube from the Mount

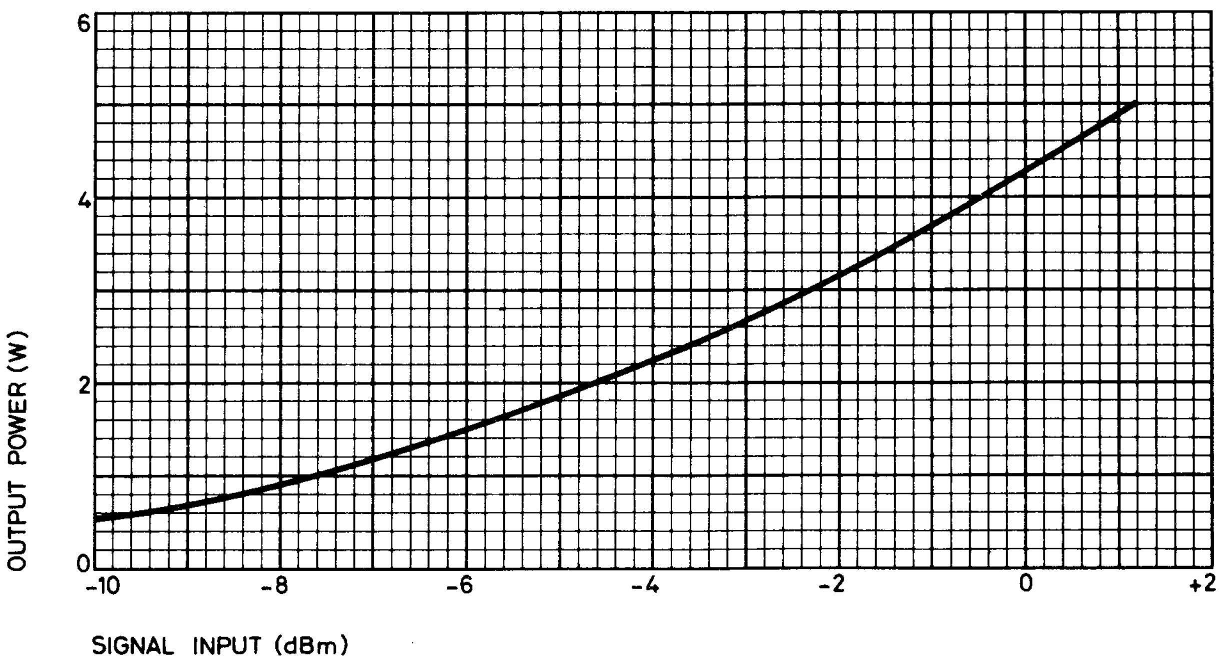
After slackening the collector clamping nut, the tube and its plug should be gently withdrawn. Should the collector clamp fail to release fully it should do so on applying light axial pressure on the tube base and rotating it slightly, but the application of radial forces to the tube should be avoided.

OUTLINE OF TWC5 WITH MOUNT REFERENCE PMC5

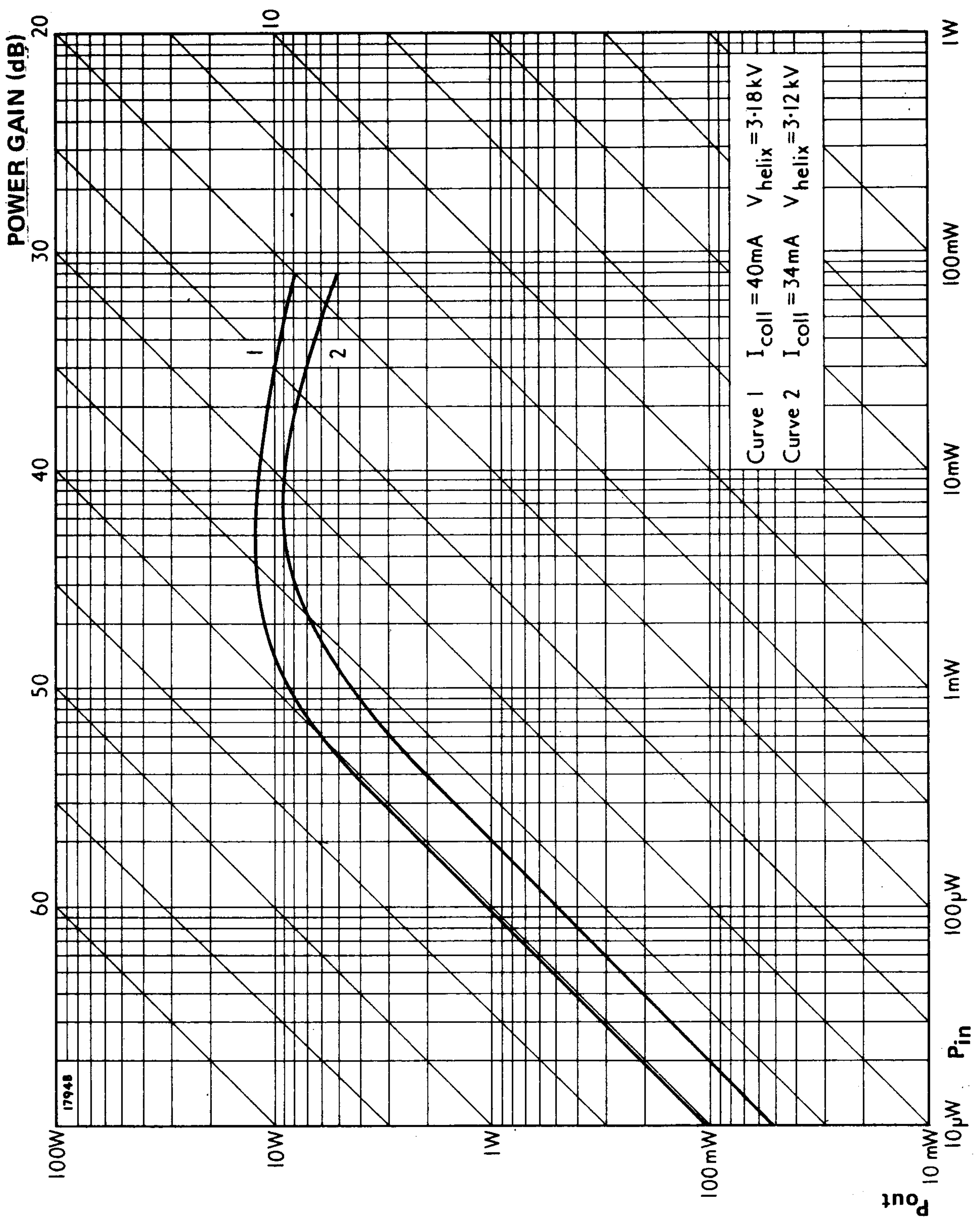


NOISE LEVEL IN THE PRESENCE OF A CARRIER UNDER OPTIMUM CONDITIONS FOR 5W COMMUNICATION SERVICE

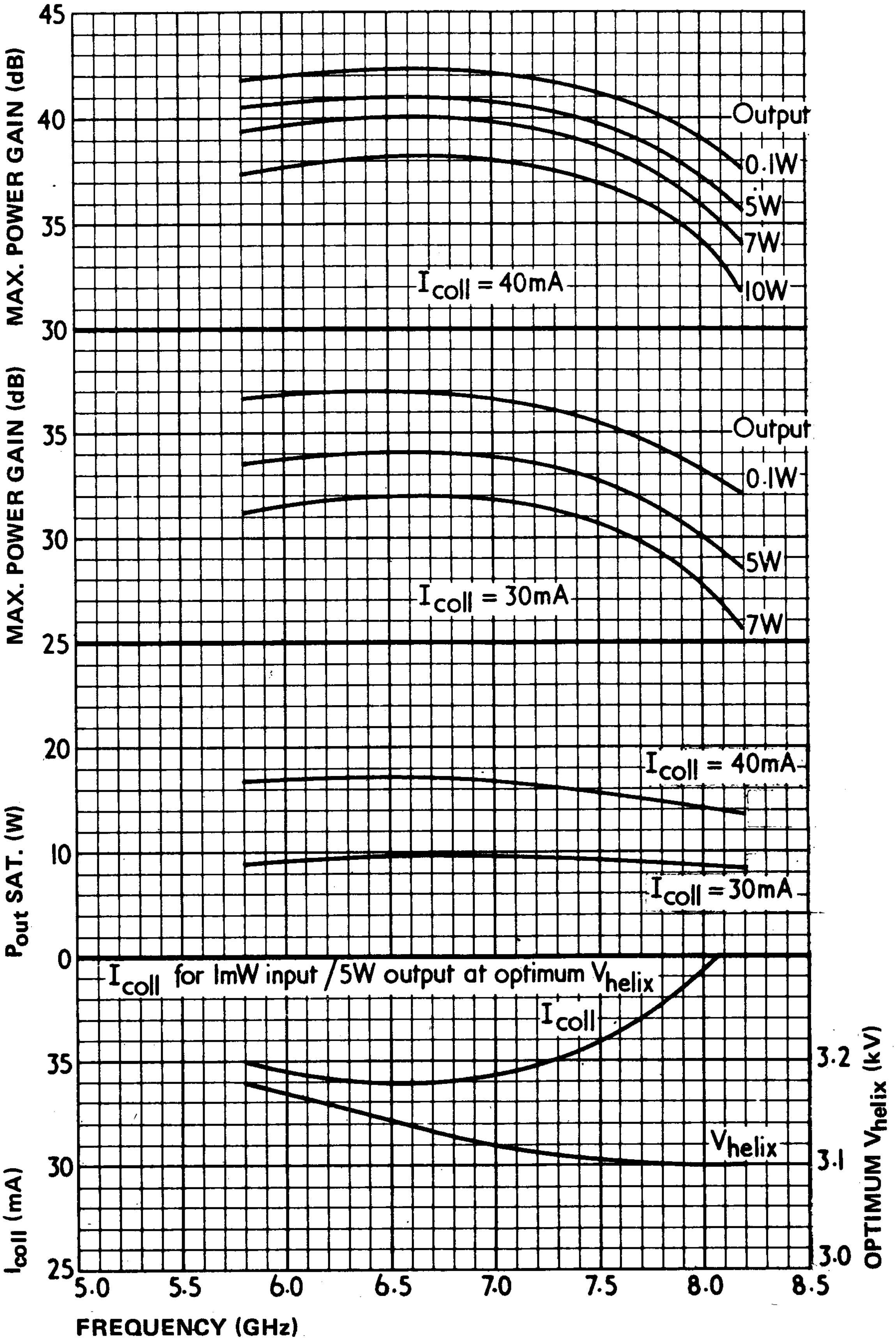




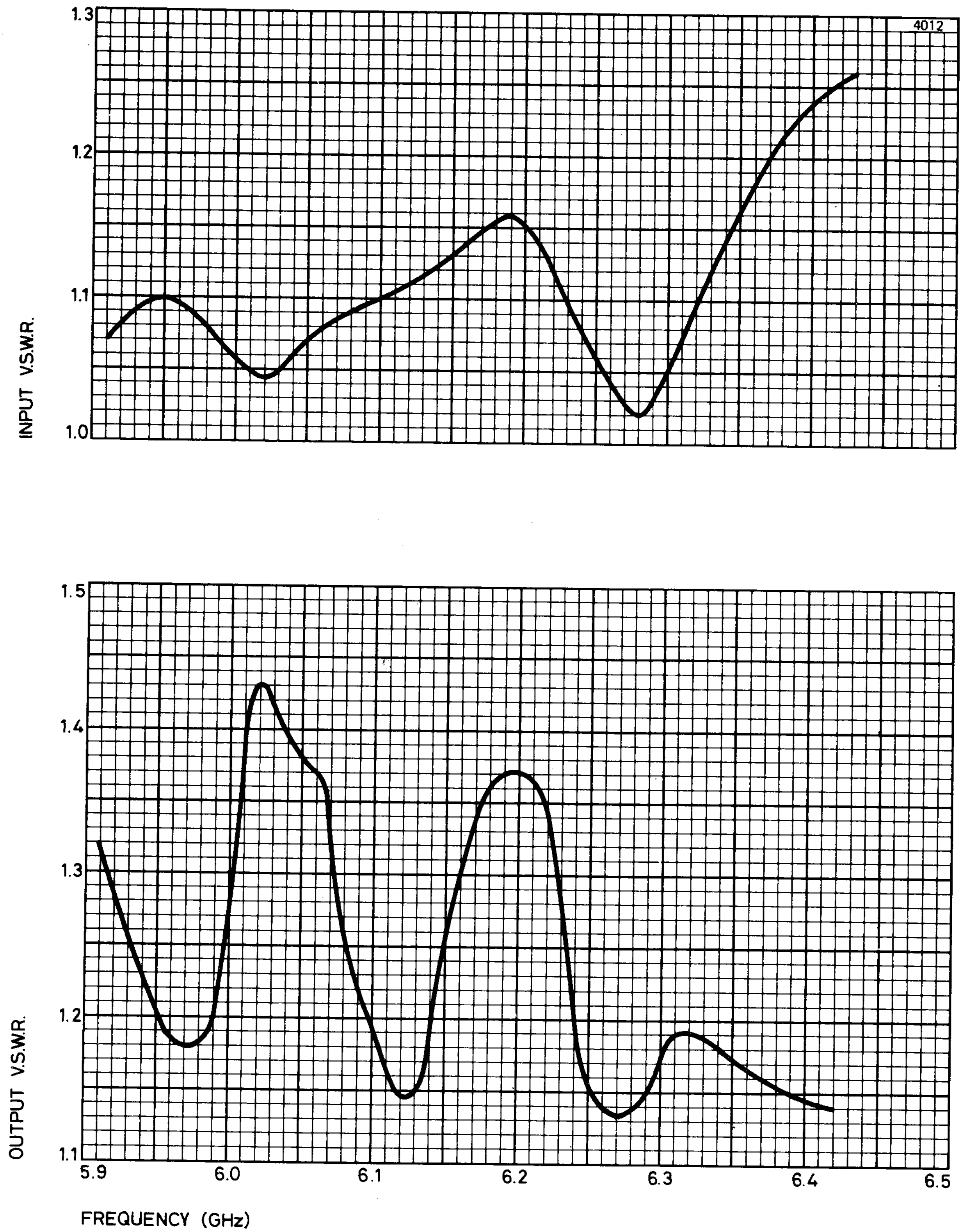
INPUT/OUTPUT CHARACTERISTICS WITH FIXED HELIX VOLTAGE



FREQUENCY PERFORMANCE CURVES



TYPICAL TWC5 MATCHING CURVES (MEASURED HOT)



THE M-O VALVE
COMPANY LIMITED

TWC14

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

Travelling wave tubes giving low f.m. noise and AM/PM conversion designed for operation in 1800 channel radio communications systems. The tube is readily replaceable in a periodic permanent magnet focusing mount which also contains the R.F. couplings.

Cooling is by natural convection and R.F. terminations are in waveguide (1.732in. x 0.125in. internal) with optional transitions to WG14 (WR137).

*Frequency range	5.8–7.8	GHz
Operating power level	10	W
Nominal gain (at 10W output)	38	dB
Noise factor	<28	dB
AM/PM conversion (at 10W output)	<2.5	°/dB

*The tube is normally manufactured in 4 frequency ranges.

TWC14	5.925–6.425	GHz
TWC14A	7.400–7.800	GHz
TWC14B	6.900–7.400	GHz
TWC14C	6.425–7.110	GHz

TYPICAL OPERATION AND PERFORMANCE CHARACTERISTICS

	TWC14	TWC14C	
Frequency	5.925–6.425	6.425–7.110	GHz
Output power	10	10	W
I_{coll}	43	44	mA
V_{coll}	1.8	1.8	kV
V_{hel}	3.2	3.1	kV
V_{g1}	−25	−25	V
V_{g2}	2.1	2.1	kV
I_{hel}	0.2	0.2	mA
I_{g2}	0	0	mA
Gain (at 10W output)	36.5	36.5	dB
Noise factor (at 10W output)	<28	<28	dB
AM/PM conversion (at 10W output)	<2.0	<2.0	°/dB
Gain flatness (at 10W output)			
Over any 30MHz band	<±0.15	<±0.15	dB
Over any 3MHz band	<±0.02	<±0.02	dB
Input VSWR (hot)	<1.3:1	<1.3:1	
Output VSWR (hot)	<1.5:1	<1.5:1	

MECHANICAL DATA

Dimensions See Outline drawing Mount Reference PMC14
Weight (including mount) 4.75kg (10.75lb.)

MAXIMUM RATINGS (Absolute and non-simultaneous)

V_{coll} (see Notes 1, 2, 3)	3.5	kV
V_{hel} (see Notes 1, 3)	4.0	kV
V_{g1} (see Notes 1, 3)	−100 – 0	V
V_{g2} (see Notes 1, 3)	3.6	kV
V_{heater} (see Note 3)	7.0	V
I_{coll}	50	mA
I_{hel} (see Note 4)	2.5	mA
I_{g1}	1.0	mA
I_{g2}	1.0	mA
I_{heater} (surge)	2.0	A
Heater warm-up time	>3	min
Interruption time in heater power (with other supplies on) (see Note 5)	<8	s
P_{coll}	90	W
P_{out}	25	W
P_{in}	1	W
$T_{ambient}$ (operating)	0 – +55	°C
$T_{storage}$ (Mount)	−30 – +70	°C
$T_{storage}$ (Tube)	−60 – +70	°C
Altitude (operating)	<15,000	ft

NOTES

1. Voltages are quoted relative to cathode.
2. The collector is connected to the capsule body which is normally earthed.
3. It is essential to apply electrode voltages in the order specified in the setting up procedure.
4. This value may be momentarily exceeded, e.g. on switching on and off and may rise to 5.0mA. A protective excess current device should be provided to trip the h.t. supplies if the continuous helix current exceeds 2.5mA.
5. Interruption of the heater supply for up to 8 seconds will not cause the trips to operate.

CONNECTIONS

Power Supplies

a) Use Electro-Methods socket type BA7S (obtainable from Pye Connectors Ltd., Hitchin Street, Biggleswade, Bedfordshire, U.K.) to mate with corresponding plug fitted to tube.

Pin A	Grid 2
B	Heater (internally connected to cathode)
C	Helix
D	Grid 1
E	Heater
F	Cathode
*H	Safety Earth
Mount Body	Connected to collector when tube is installed

*When the end cap of the mount is removed, the connections to the power supply connecting plug are exposed. To eliminate the danger of electric shock a lead from pin H on the connecting plug is connected to the inside face of this cap by means of a flying socket. When the cap is removed, the connection between the cap and the body is broken. It is recommended that a suitable protection device be included in the external power supply circuit so that if the connection between pin H and the mount body is broken by removal of the cap, the high voltage supplies to the tube are removed.

R.F. Connectors

Waveguide:- 0.125in. (3.175mm) x 1.375in. (34.925mm) internal dimensions. Waveguide flanges:- See outline drawing. Other flanges can be fitted to customer requirements. Tapers to WG14 (WR137) can be incorporated or supplied separately.

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

Recommended Applied Conditions

The following conditions apply to all frequency variants except that the gain of the TWC14A and TWC14B is lower. See note 7 below.

Frequency range	See page 1	
Heater voltage (see Note 5)	6.3 ± 3%	V
Collector voltage (see Notes 1, 2)	1.8	kV
Output power (see Note 6)	10	W
Load V.S.W.R.	<1.5:1	

RANGE OF CHARACTERISTICS (with recommended applied conditions)

	Min	Max	
Heater current (see Note 5)	0.7	1.3	A
Collector current	25	45	mA
Helix voltage (see Note 1)	3.0	3.6	kV
Helix current (see Note 4)	0	2	mA
Grid 1 voltage (see Note 1).	–50	0	V
Grid 1 current	–	0.5	mA
Grid 2 voltage (operational)(see Note 1) .	0	2.7	kV
Grid 2 current	0	0.5	mA
Saturation output power (see Note 6) .	15	–	W
Gain (at 10W output)(see Note 7) . .	36.5	41	dB
Noise factor (see Notes 8, 9)	–	28	dB
AM/PM Conversion	–	2.5	°/dB
Gain flatness over any 30MHz band (see Note 9)	–	±0.15	dB
Gain flatness over any 3MHz band (see Note 9)	–	±0.02	dB
Input V.S.W.R. (hot)	–	1.5:1	
Output V.S.W.R. (hot)	–	2.0:1	
Cold insertion loss	55	–	dB
Power efficiency at 10W output (see Note 10)	11.5	–	%

NOTES

6. The tube is designed for continuous operation at 10 watts of output power. Prolonged operation at higher power levels may reduce the operating life.
7. The minimum gain of the TWC14A and TWC14B is 33dB.
8. Measured as the mean noise figure over any band of 3kHz within any 30MHz band
9. Over the recommended frequency range.
10. Efficiency = $\dfrac{P_{out}}{P_{collector} + P_{helix} + P_{heater}}$

OPERATING NOTES

Power Supply

a) The travelling wave tube heater voltage must be applied at least 3 minutes before any h.t. voltages are applied.
b) During switch-on the Grid 2 voltage must not be applied until all other electrodes have reached their final voltages.
c) During switch-off the Grid 2 voltage should be reduced to zero before all other voltages or excessive currents may be drawn.
d) The Grid 2, helix and collector voltages should typically be stabilized to ±2%. The ripple content, stability, and regulation of the supply are determined by the tolerable gain and phase modulation levels. A 2% change from synchronous helix voltage causes a gain drop of approx. 0.5dB.
A 1% change from synchronous helix voltage causes a phase change of approximately 30°. Further details available on request.
e) A protective device must be included in the helix circuit to cut off the h.t. supply if the helix current continuously exceeds 2.5mA. As the Grid 2 voltage rises through the range 0 to 1kV the helix current is normally above 1mA and the peak value may be as high as 5mA. Accordingly the Grid 2 voltage should rise sufficiently quickly through this range to ensure that the protective device in the helix circuit is not operated. Alternatively the protective device may be overridden during installation as long as the helix current does not exceed 5mA for a maximum period of 1 second.

Initial Installation of Travelling Wave Tube

The mount should be mounted horizontally with a free airflow over the collector cooler. Other mounting positions are permissible but forced air cooling will be required and must be sufficient to ensure that the maximum temperature of the collector cooler measured at the outside of the fins does not exceed 200°C under the worst conditions of ambient temperature. About $0.6m^3$/min. ($20ft^3$/min.) delivered through a nozzle directed at right angles to the tube axis into the cooling fins is typical. The capsule must be securely earthed by means of both of the earthing tags provided.

The mount contains a periodic magnetic focusing system, with facilities for adjusting the position of the tube for best focusing. There are six focusing screws. Two of these are thumbscrews and are positioned on the cylindrical section on which the end cap is a push fit. Next to this is a rectangular section carrying two more focusing screws. The collector cooler end plate carries at its centre the collector clamping nut and on its edge the remaining two focusing screws. The clamping nut and focusing screws are operated by the same size Allen key. The r.f. connections are made by waveguide of internal dimensions 3.175 x 34.925mm (0.125 x 1.375in.).

Fitting the Tube into the Mount

1. Ensure that the collector clamping screw is released.
2. Insert the tube into the mount, as the collector engages into the cooler and the gun end into its support, a slight resistance will be felt. Line up the key on the base of the tube with the key-way in the mount and push the tube in with a light but firm axial pressure so that the key and key-way engage.
3. Lock collector clamping screw avoiding excessive force while maintaining light axial pressure on the base of the tube.
4. Insert 7 pin plug into slot.
5. Connect flying socket to pin inside the cap.
6. Put on cap.

Note:- Avoid radial pressure on the tube when in the mount.

INITIAL SETTING UP PROCEDURE

a) Adjust heater volts to 6.3V and leave to warm up for 3 minutes.
b) Apply 1.8kV to the collector, set V_{g1} to the value given on the information sheet supplied with the tube, and similarly apply V_{helix} at the indicated value.
c) Gradually increase V_{g2} until the collector current reaches the indicated value. During the operation the helix interception current should be minimized by readjusting V_{g1} and adjusting the mechanical focusing controls on the mount.
d) Apply an R.F. signal of approximately −10dBm to the input of the tube and optimise the helix voltage for maximum output power.
e) Readjust V_{g1} and the mechanical focusing controls for minimum helix current.
f) Increase the R.F. drive level to obtain 10 watts of output power and repeat step (e).
Note that the collector current indicated with the tube is that which gives a gain of 36.5dB (TWC14 and TWC14C) and 33dB (TWC14A and TWC14B) at 10 watts output. Higher gain is possible by increasing the collector current up to a maximum of 45mA but this may cause some degradation in the operational life.

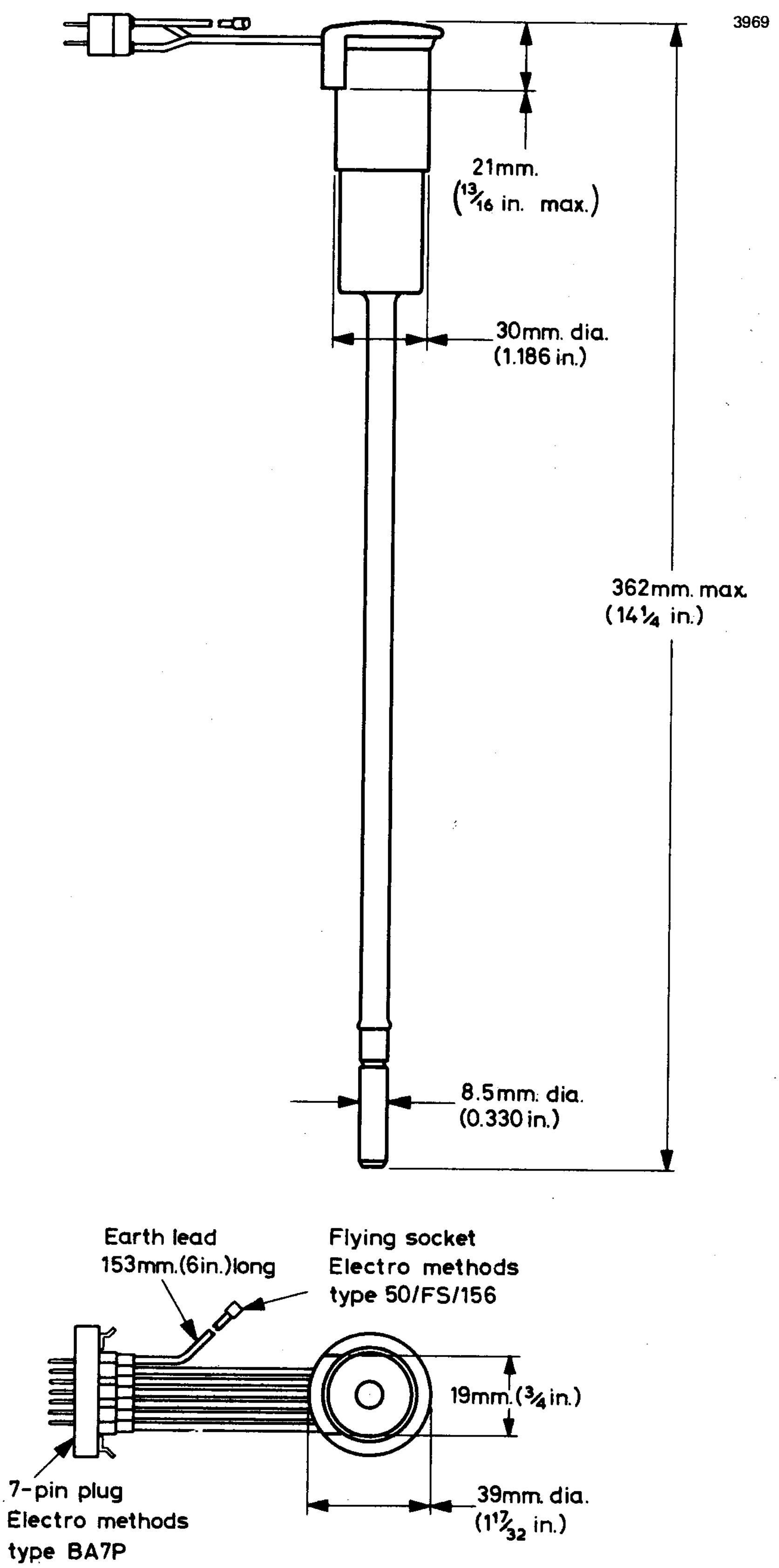
Subsequent Switching On

Once the tube has been adjusted as described above the electrode potentials may subsequently be applied together as long as the heater supply has not been disconnected for over 8 seconds and the rise of $V_{grid\ 2}$ is slightly delayed behind the rise of V_{col} and V_{hel}. When a tube has been stored for over 1 year it is advisable to operate it without R.F. drive for about 15 minutes and then, after a further 45 minutes with R.F. drive, to repeat the optimisation of voltages and of the mechanical focus condition.

Removing the Tube from the Mount

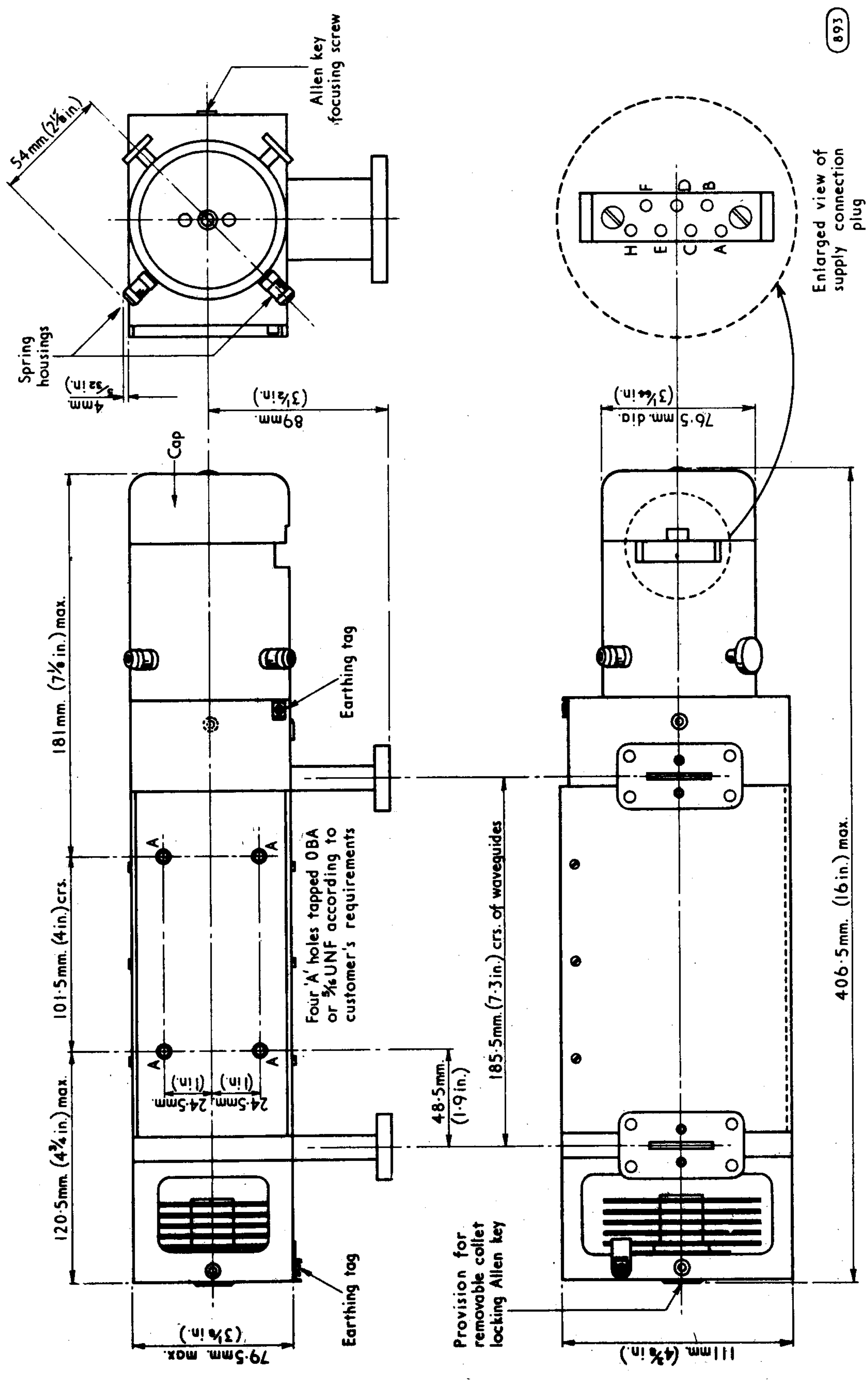
After slackening the collector clamping nut, the tube and its plug should be gently withdrawn. Should the collector clamp fail to release fully it should do so on applying light axial pressure on the tube base and rotating it slightly, but the application of radial forces to the tube should be avoided.

OUTLINE

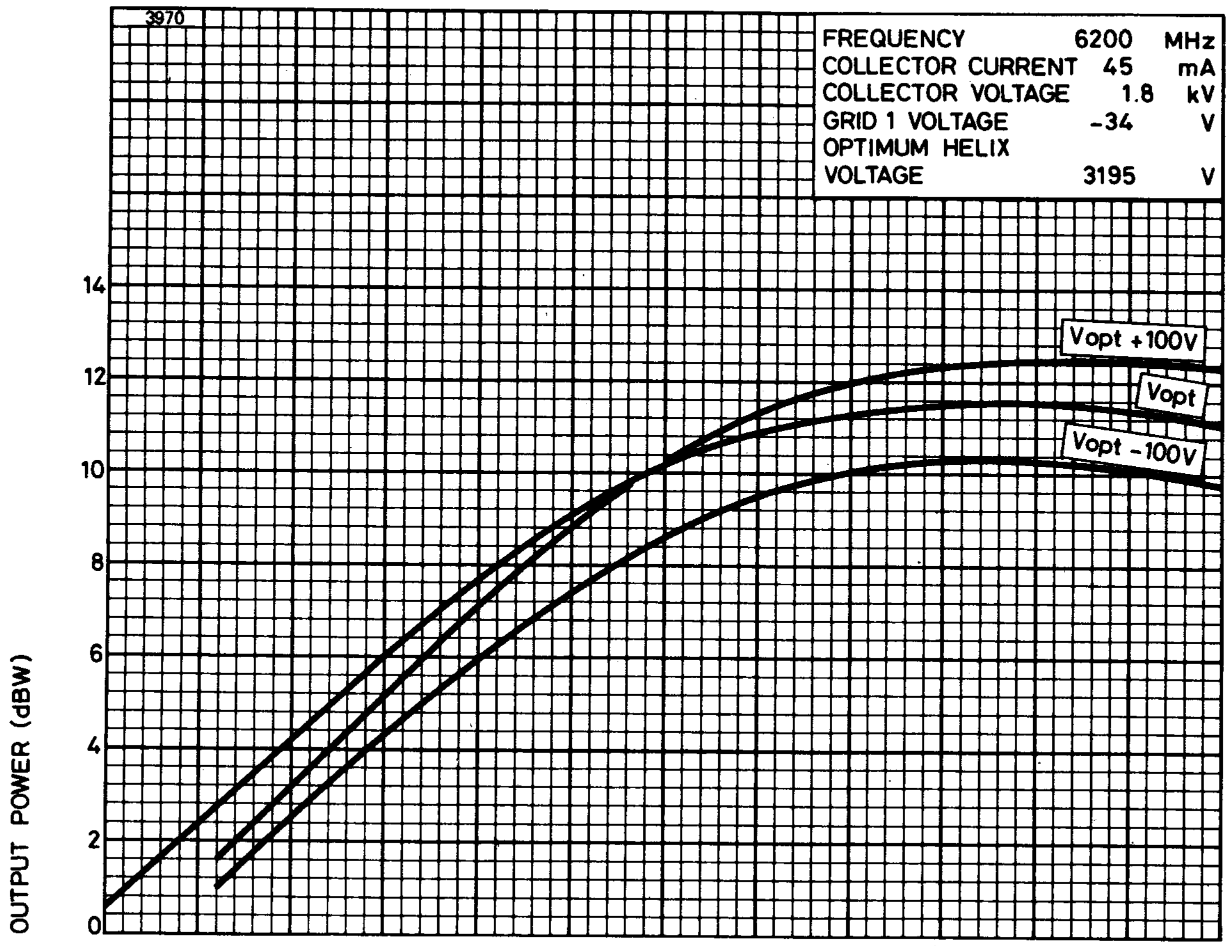


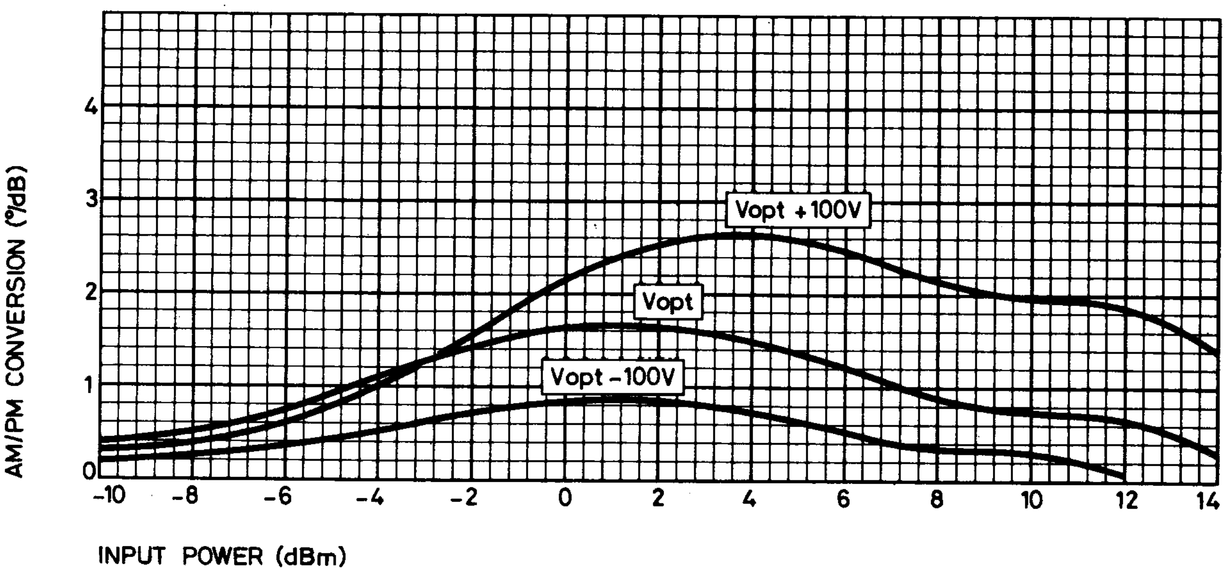
3969
21mm.
(13/16 in. max.)
30mm. dia.
(1.186 in.)
362mm. max.
(14¼ in.)
8.5mm. dia.
(0.330 in.)
Earth lead
153mm.(6in.)long
Flying socket
Electro methods
type 50/FS/156
19mm.(¾ in.)
7-pin plug
Electro methods
type BA7P
39mm. dia.
(1 17/32 in.)

OUTLINE OF TWC14 IN CONVECTION COOLED MOUNT (PMC14/1)

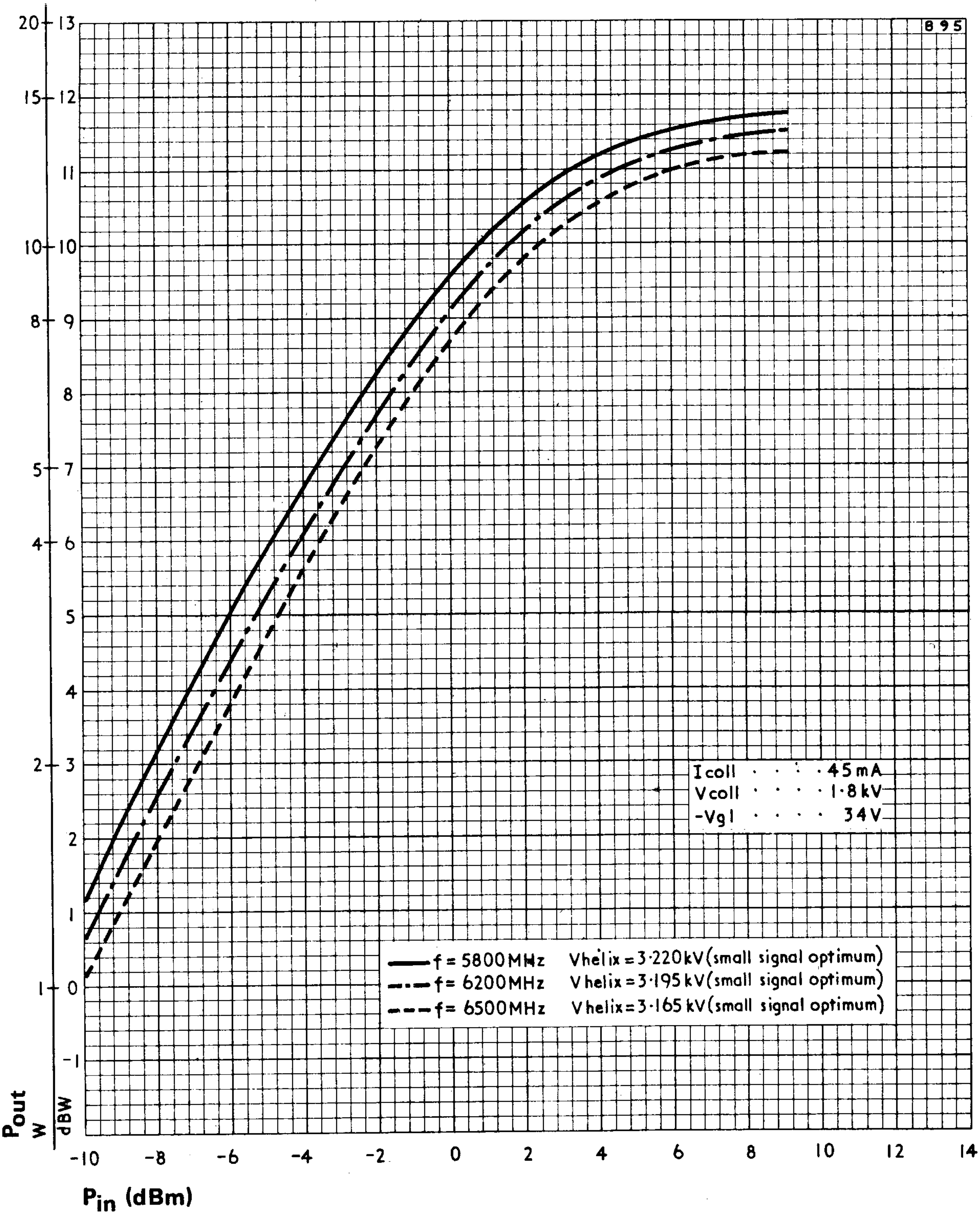


POWER OUTPUT – POWER INPUT WITH FREQUENCY AS PARAMETER

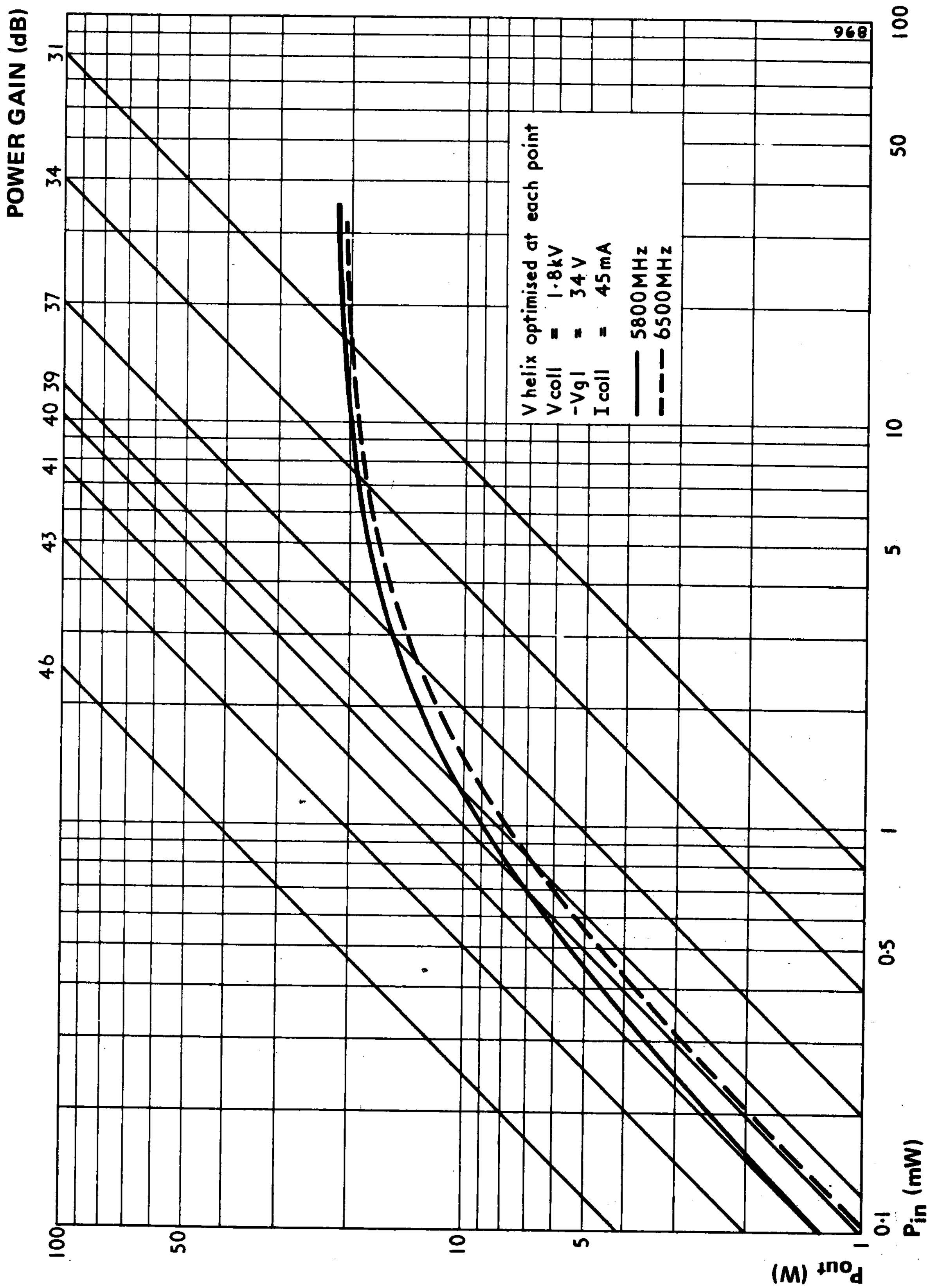




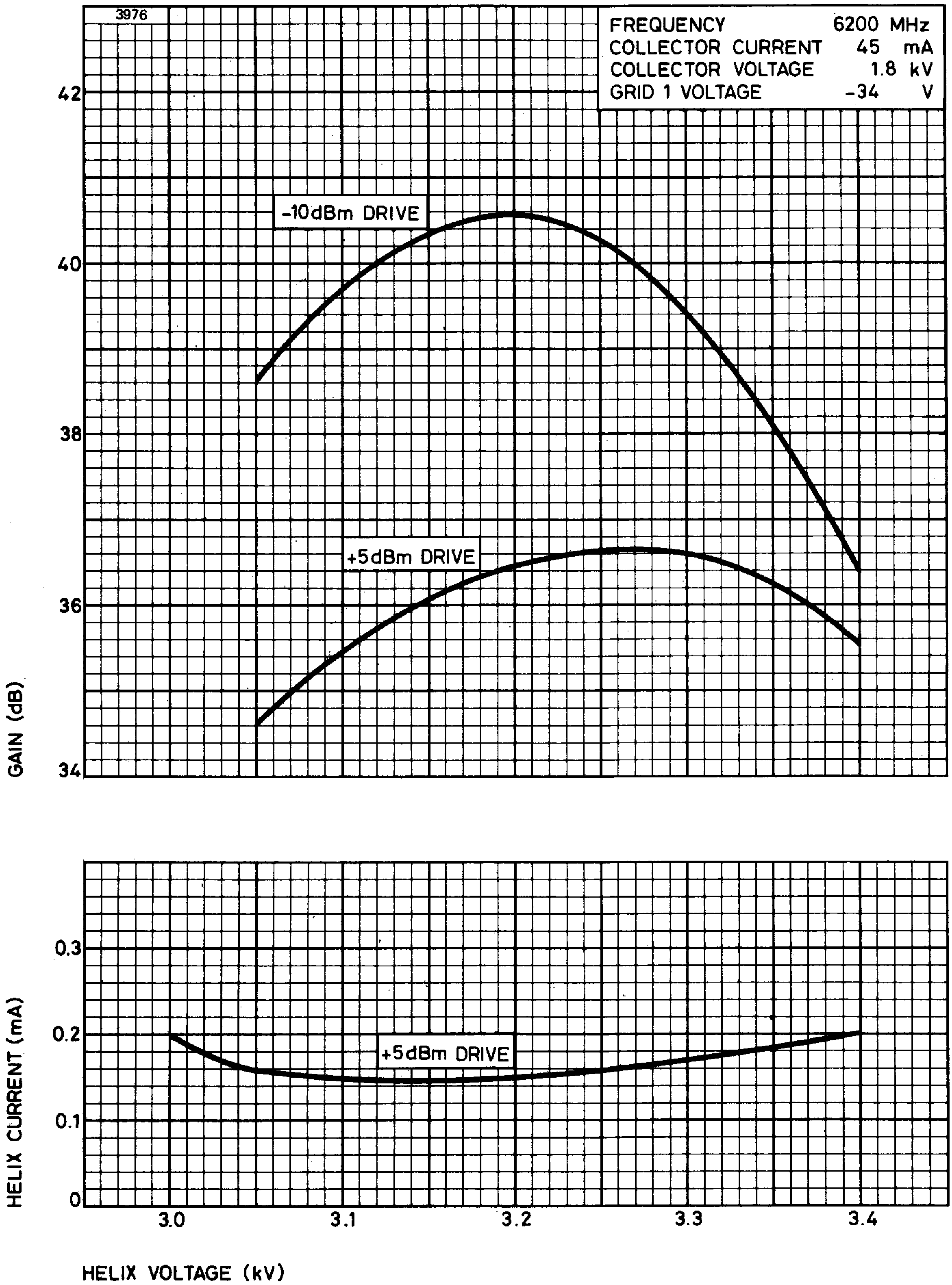
POWER OUTPUT AND AM/PM CONVERSION – POWER INPUT WITH OPTIMISED HELIX VOLTAGE AS PARAMETER



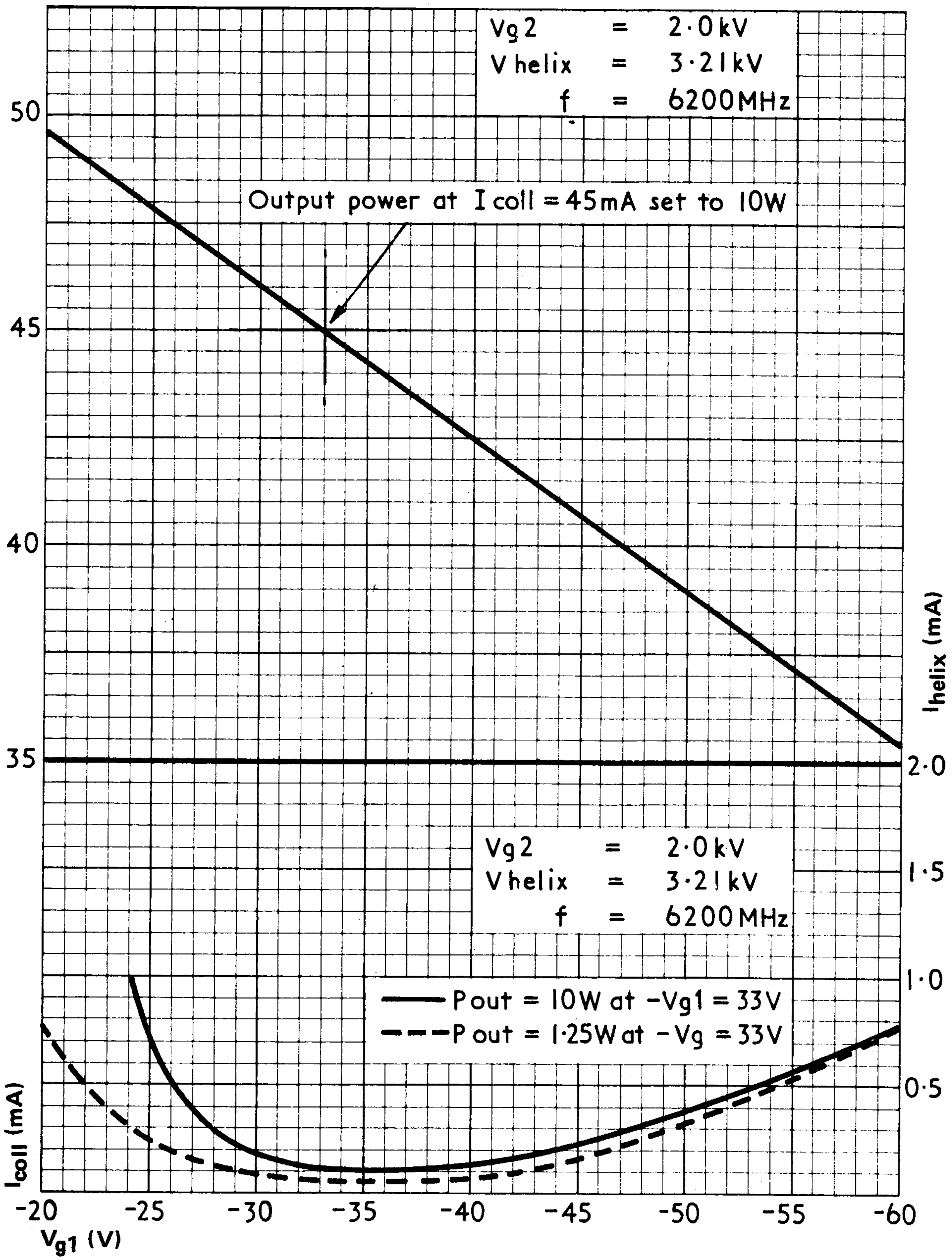
SYNCHRONOUS POWER OUTPUT – POWER INPUT



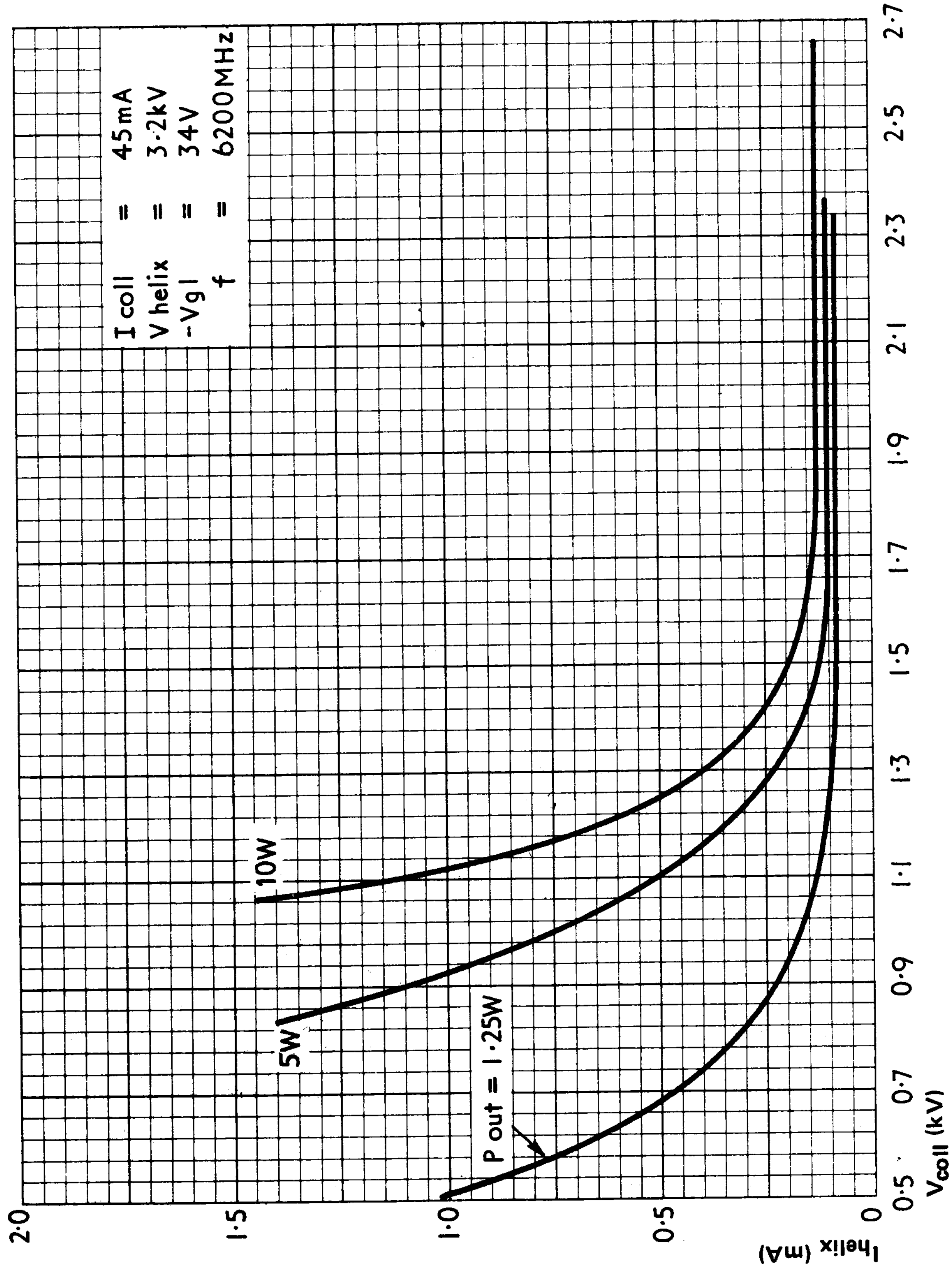
GAIN AND HELIX CURRENT – HELIX VOLTAGE WITH DRIVE AS PARAMETER



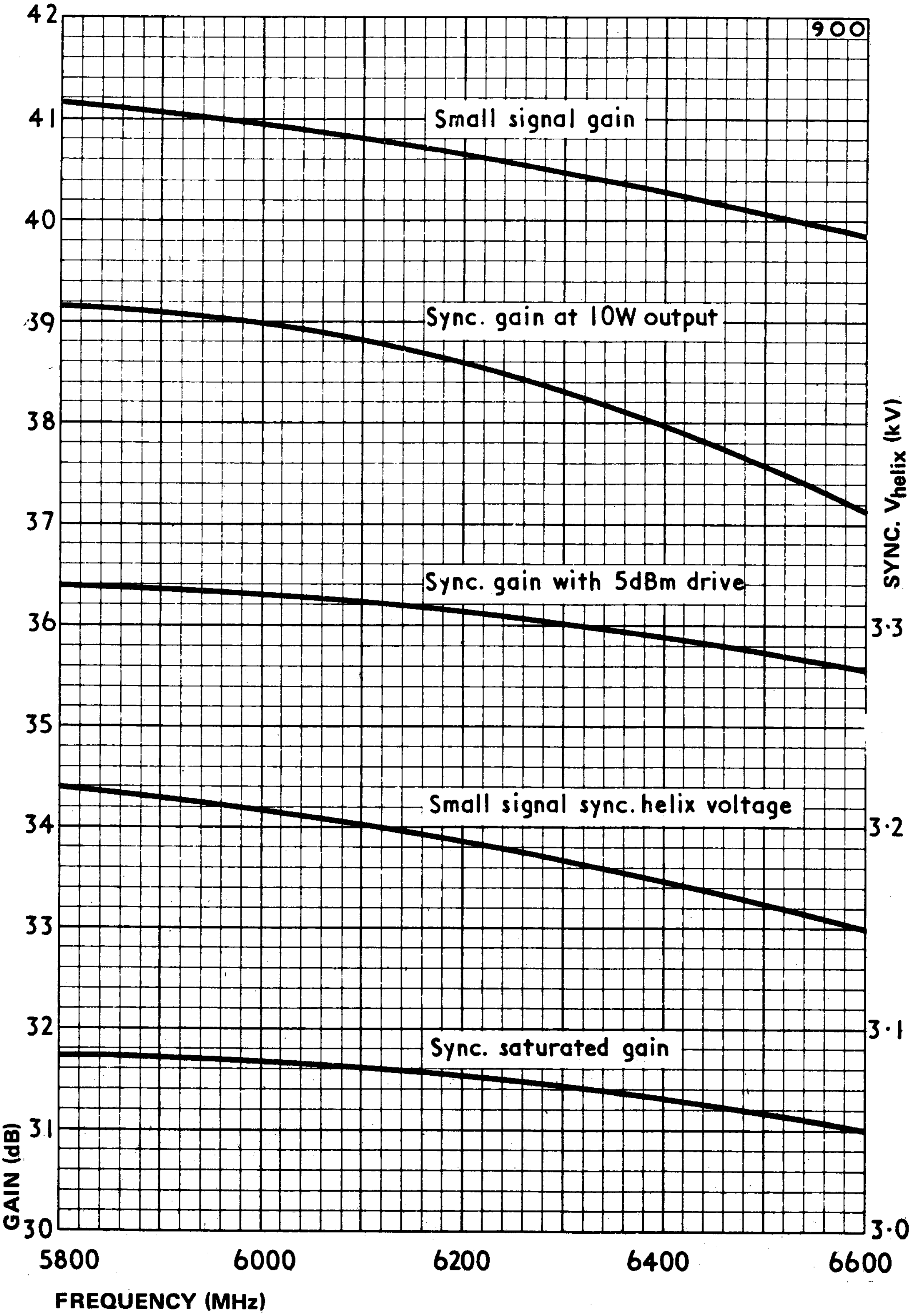
COLLECTOR AND HELIX CURRENT – GRID 1 VOLTAGE WITH OUTPUT POWER AS PARAMETER



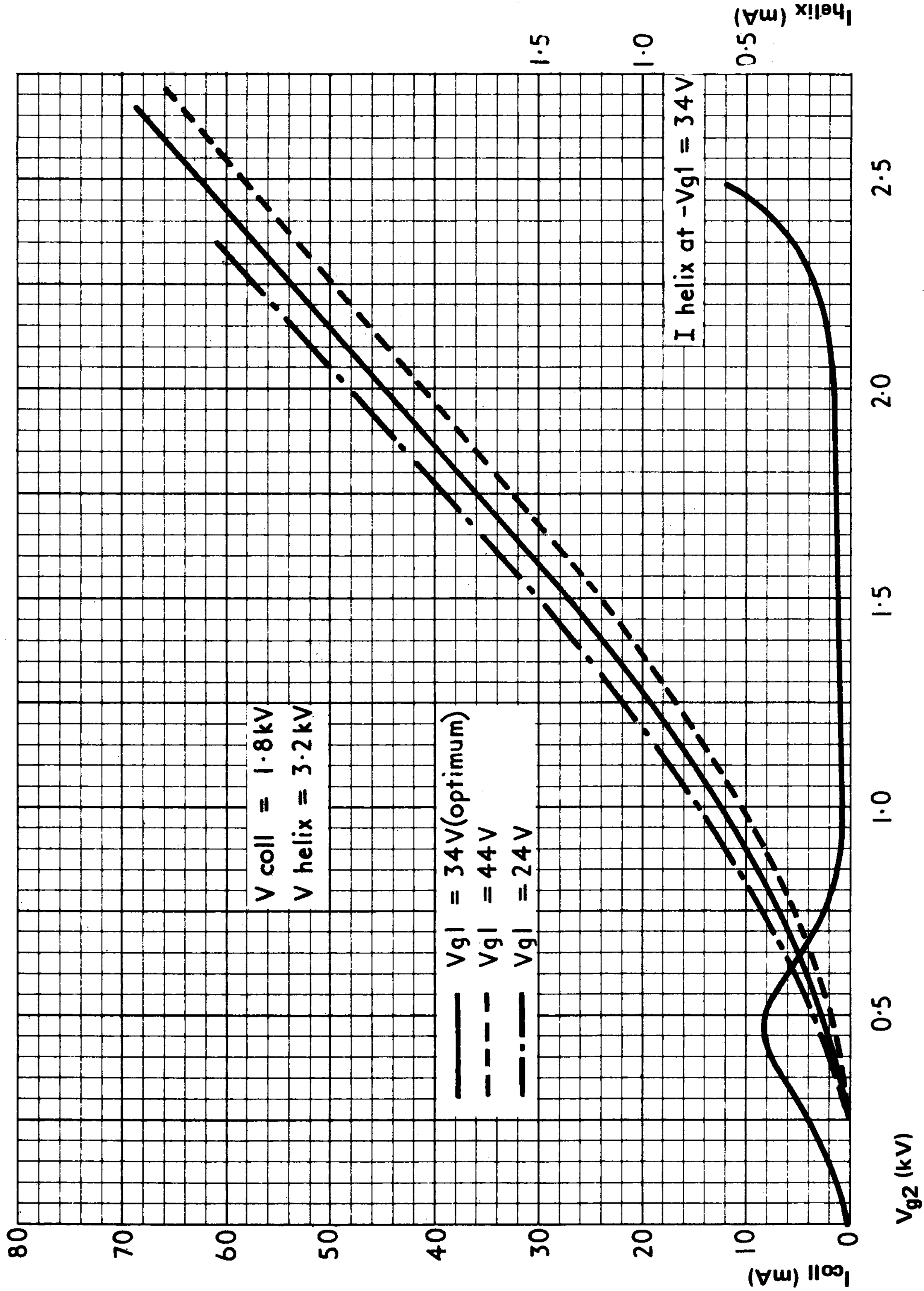
HELIX CURRENT – COLLECTOR VOLTAGE WITH OUTPUT POWER AS PARAMETER



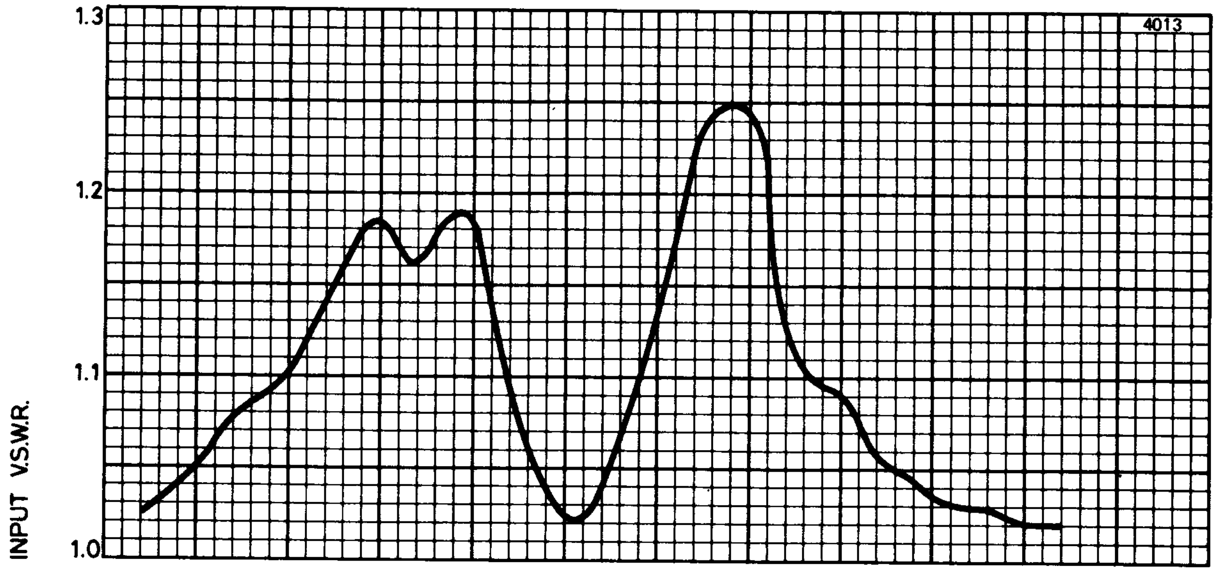
GAIN AND SYNCHRONOUS HELIX VOLTAGE – FREQUENCY

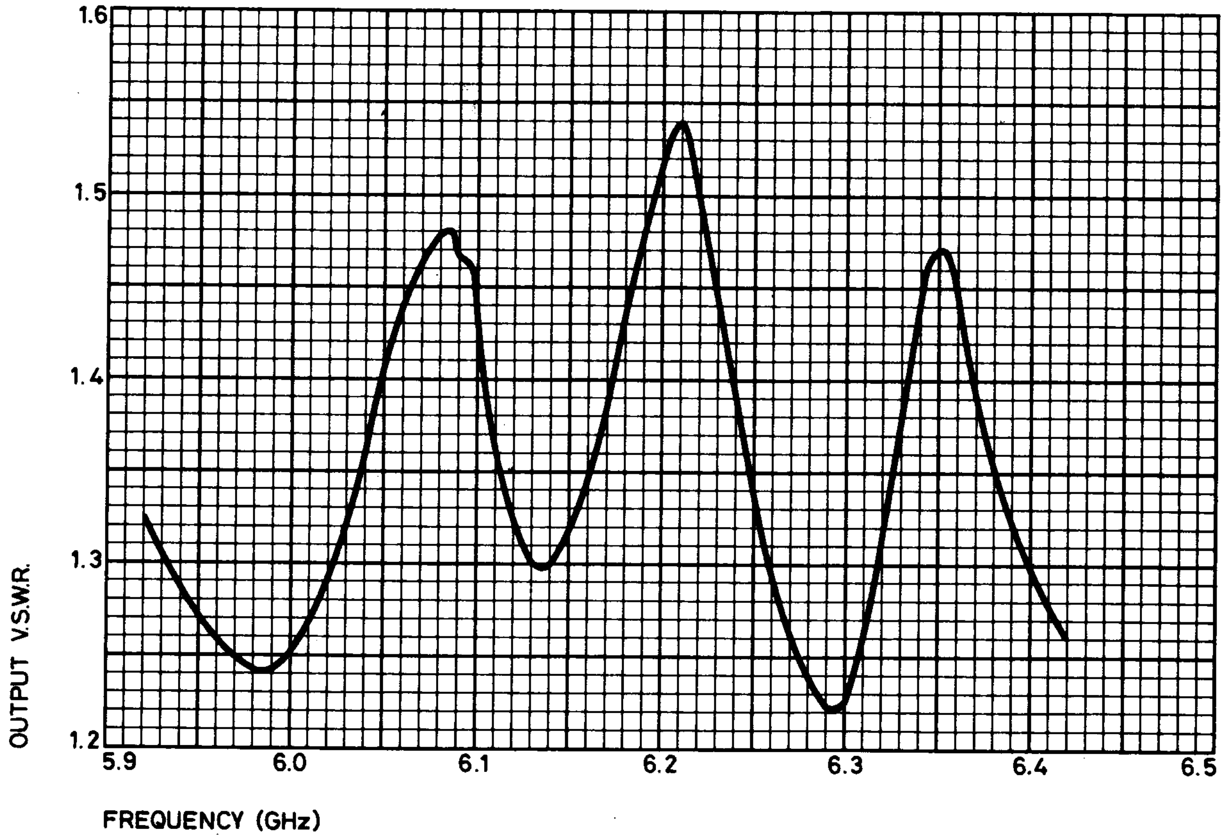


COLLECTOR AND HELIX CURRENT – GRID 2 VOLTAGE WITH GRID 1 VOLTAGE AS PARAMETER



TYPICAL TWC14 MATCHING CURVES (MEASURED HOT)





TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise amplifier giving a gain of 35 to 42dB and a noise factor better than 11dB over a frequency range of 4.0 to 8.0GHz.

DESCRIPTION

A rugged low noise amplifier designed for use in severe environments. The noise factor typically varies by less than 0.75dB over the frequency range and the gain is constant to within 4dB. The dynamic range is 34dB at full bandwidth operation increasing to 70dB when operated over a bandwidth of 1MHz. The use of Alnico magnets of low magnetic temperature coefficient in a periodic permanent magnet focussing assembly ensures light weight and stability of performance over a wide operational temperature range. Complete magnetic shielding enables tubes to be mounted side by side and eliminates interference with adjacent equipment. The low power dissipation, less than 3 watts including the cathode heater supply, allows the tube to be mounted in any position without the necessity for forced air cooling.
R.F. connections are by means of 50Ω type N connectors but alternative connectors e.g. SMA coaxial can be supplied to special order. Power connection is by an Electromethods type BA15P plug or by flying leads; the tube is fully insulated so that cathode, helix, or collector may be grounded.
The amplifier is normally adjusted for optimum broadband performance but it is possible for the performance to be upgraded in restricted bandwidths. Similarly, performance outside the conventional octave bandwidth can be provided.
Considerable variation in the mechanical format is possible to special order.

HEATER

V_h	6.3	V
I_h (approx)	0.25	A
I_h (surge)(max)	1.5	A

RATINGS (Absolute)

	Min	Max	
V_{coll}	V_{helix}	1200	V
V_{helix}	550	950	V
V_{g5}	–	650	V
V_{g4}	–	400	V
V_{g3}	–	200	V
V_{g2}	–	100	V
$-V_{g1}$	250	0	V
I_{helix}	–	1.0	mA
I_g (on any grid)	–	50	μA
t_{hk}	2	–	min

TYPICAL OPERATION

Frequency range (see Note 3)	4.0–8.0	GHz
V_{coll} (see Note 1)	V_{helix} + 200	V
V_{helix} (see Note 1)	650–850	V
$-V_{g1}$ (see Note 1)	50–0	V
V_{g2} (see Notes 1, 2, 3)	0–50	V
V_{g3} (see Note 1)	0–120	V
V_{g4} (see Note 1)	0–200	V
V_{g5} (see Note 1)	100–500	V
I_{helix}	0–100	μA
I_{coll} (see Notes 2, 3)	400–1000	μA
Max noise factor (see Note 3)	11	dB
Min small signal gain (see Note 3)	35	dB
Max small signal gain (see Note 3)	42	dB
Max gain variation (4.0–8.0GHz)(see Note 3)	4	dB
Min power output (saturated)(see Note 3)	7	dBm
Max v.s.w.r. (input)(see Note 3)	2.5:1	
Max v.s.w.r. (output)(see Note 3)	2.5:1	
Minimum isolation	55	dB

NOTES

1. All voltages with respect to cathode. Collector, helix or cathode may be earthed.
2. Adjust V_{g2} to give the collector current specified for the tube.
3. A significant improvement in r.f. performance is possible over narrow bandwidths (500–1000MHz). Details of performance are available on request.

POWER REQUIREMENTS

The requirements in terms of voltage installation accuracy, voltage stability, and ripple level are dependant upon the performance requirements of the application but the following conditions define a power supply capable of minimising performance drift and spurious modulation levels. Where RF performance requirements are less severe, some degredation of the power supply is permissible. Further information will be supplied on request.

Electrode	Voltage Range Min		Voltage Range Max		Current Range Min	Current Range Max
Heater	6.24	Volts	6.36	Volts	0.19A	0.26A
Grid 1. . . .	−50	Volts	0	Volts	−10μA	20μA
Grid 2	0	Volts	50	Volts	−10μA	20μA
Grid 3	0	Volts	120	Volts	−10μA	20μA
Grid 4	0	Volts	200	Volts	−10μA	20μA
Grid 5 . . .	100	Volts	500	Volts	−10μA	20μA
Helix	650	Volts	850	Volts	−10μA	100μA
Collector. . .	V_{hel}	Volts	V_{hel} + 200		300μA	1500μA

Electrode	Installation Accuracy ±%	Stability ±%	Ripple Volts p−p
Heater	1.0	1.0	—
Grid 1	1.0	1.0	0.020
Grid 2	—	1.0	0.020
Grid 3	1.0	1.0	0.020
Grid 4	1.0	1.0	0.050
Grid 5	1.0	1.0	0.050
Helix	0.25	0.25	0.050
Collector . . .	1.0	5.0	10.0

NOTES

1. Stability includes power supply variations from all causes including temperature.
2. The tube may be operated with any one of the following elements at capsule (ground) potential:
   Cathode
   Helix
   Collector
3. The tube operating voltages and currents are listed on an affixed label.

INSTALLATION AND ALIGNMENT

1. Connect power supply and r.f. lines to the tube.
2. Apply rated heater voltage for a period of two minutes. The full rated heater voltage may be applied instantaneously.
3. Set grid 2 to zero volts and all other voltages as shown on tube label.
4. Increase the grid 2 voltage until the collector current reaches the value shown on the tube label. Grid 2 voltage should then agree approximately with that shown on the label. Collector current should be set to an accuracy of 1%.

After initial installation and setting of voltages, subsequent switching procedure may be as follows:-

a) As 2 above.
b) All other voltages may then be immediately applied at preset values providing that the grid 2 voltage is not achieved before the helix voltage.

AMPLIFIER CONNECTIONS (Use socket to mate with Electromethods Plug type BA15P)

Pin A:	NC	Pin J:	Grid 2
B:	NC	K:	Grid 5
C:	Grid 1	L:	Cathode
D:	Helix	M:	Heater
E:	Collector	N:	Heater/Cathode
F:	Grid 4	P:	Capsule earth
H:	Grid 3	R:	NC
		S:	NC

POWER SUPPLY

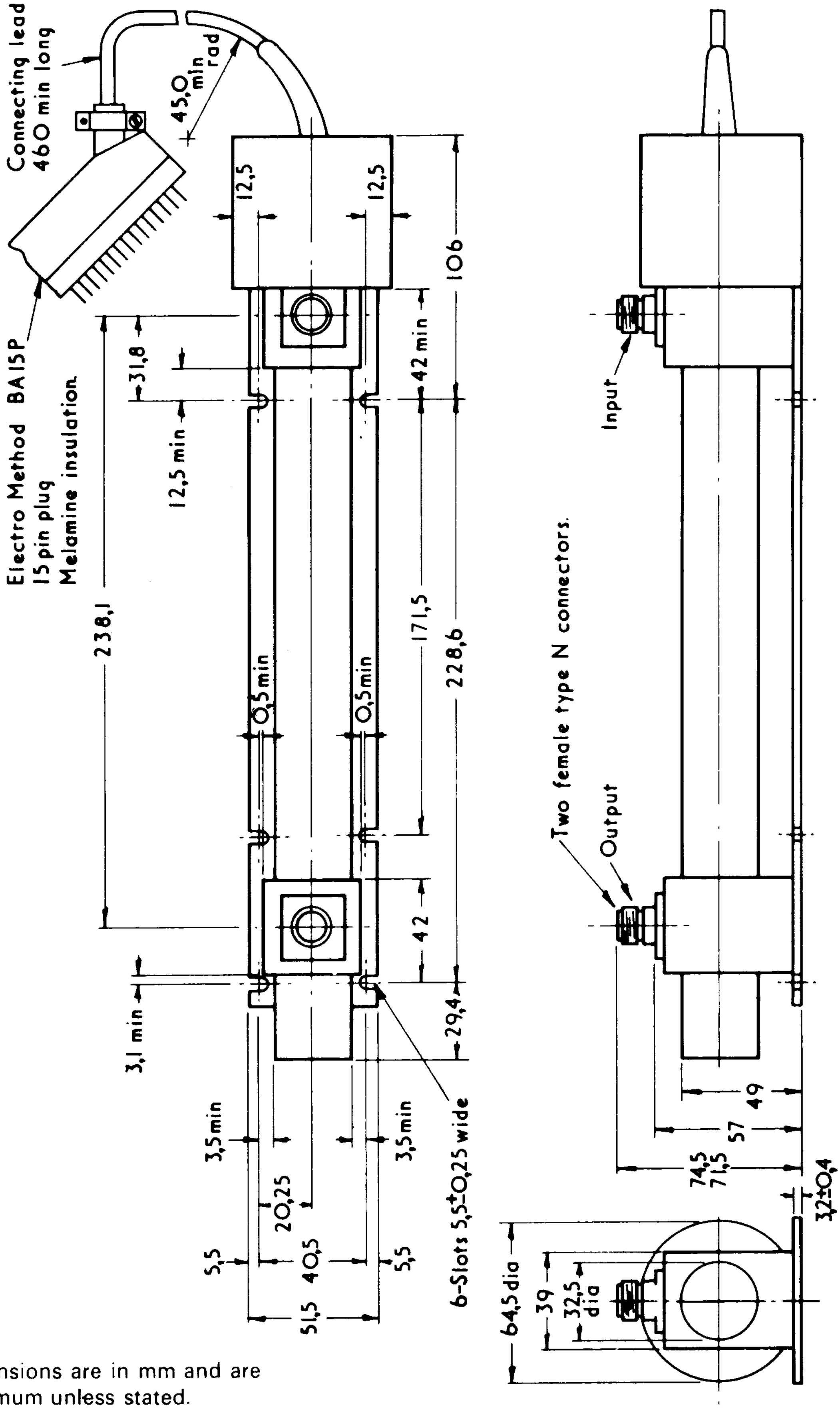
The tube can be supplied complete with a power supply in which case it has the type No. TWC27.

MECHANICAL

Dimensions See outline drawing
Weight 2.1kG (4.6lbs.)

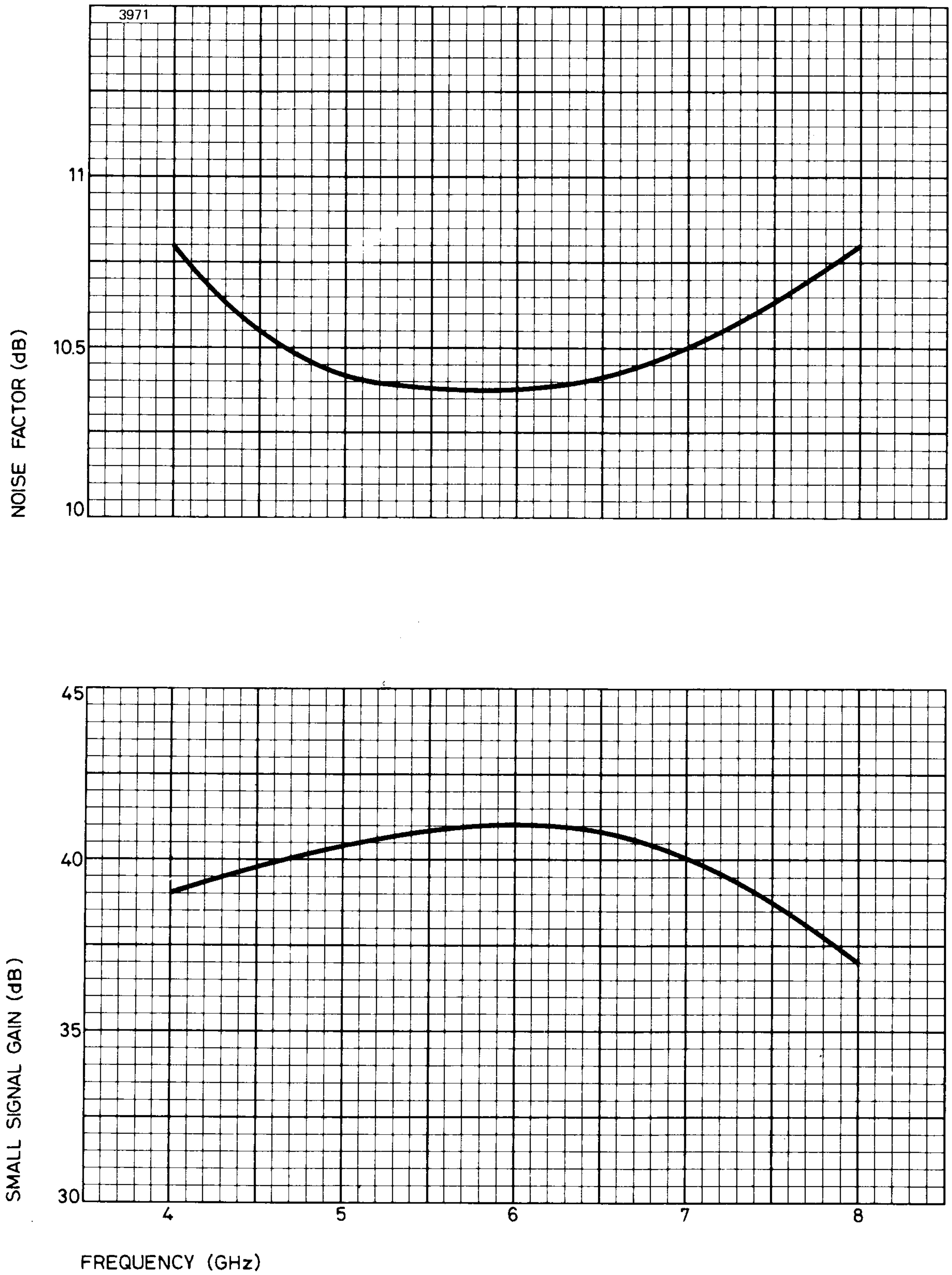
Note:- Variation in the mechanical configuration is possible. Further details will be supplied on request.

OUTLINE

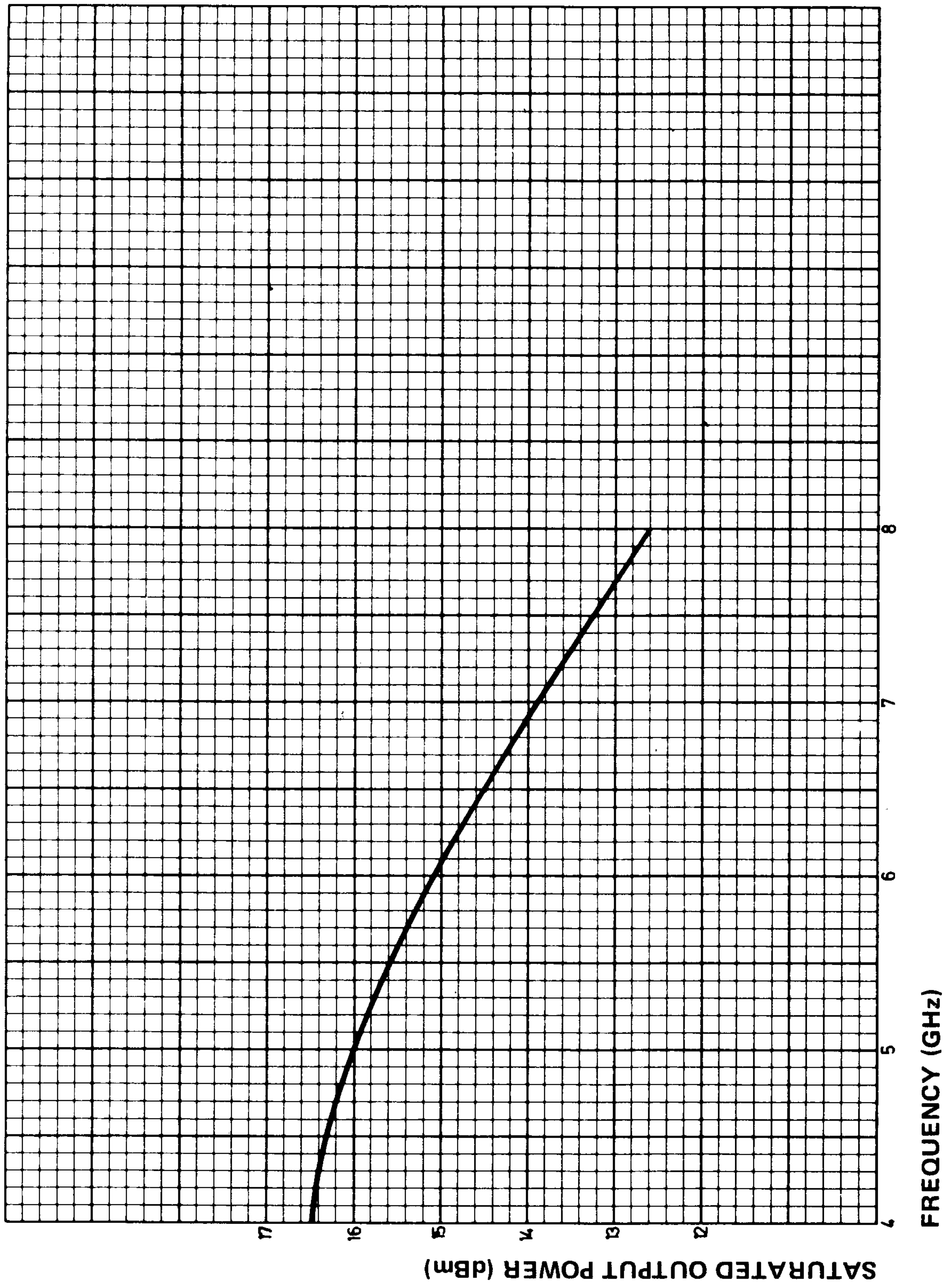


Dimensions are in mm and are maximum unless stated.

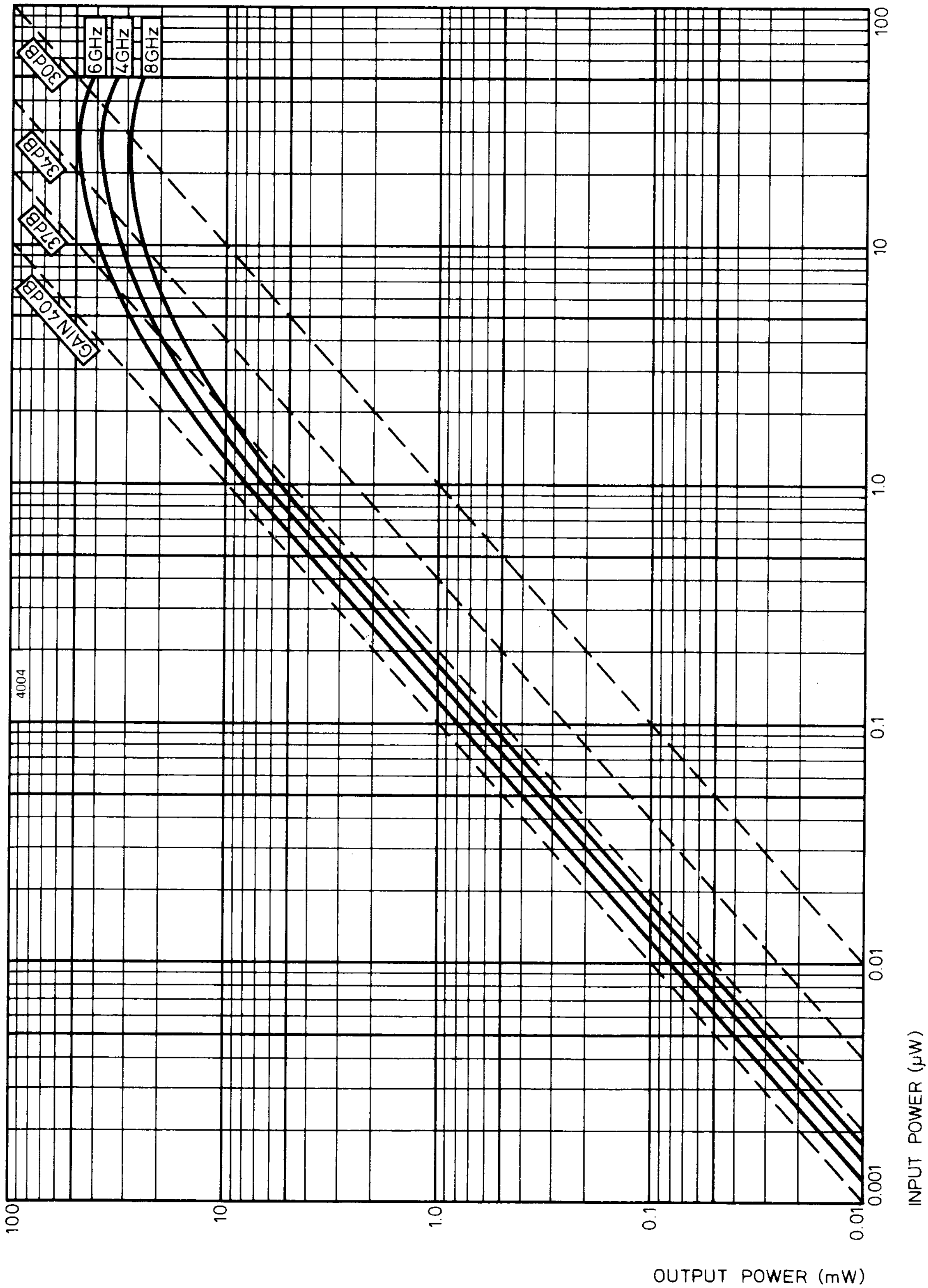
NOISE FACTOR AND GAIN – FREQUENCY



SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



G.E.C.

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise travelling wave amplifier with integral power supply giving a gain of 35 to 42dB over the frequency range 4.0 to 8.0GHz and a noise factor better than 11dB.

DESCRIPTION

Simplicity of installation and low cost replacement combined with excellent broadband performance has been achieved by combining a rugged travelling wave tube amplifier package with a stabilised power supply. Modular construction has been adopted, allowing considerable flexibility and space saving and, since the tube and power supply are separable, replacement costs are minimised. A built in correction circuit compensates for changes in performance with life so no adjustment is required in operation. The power input requirement is 115V or 240V a.c. at 50/60Hz or 28V d.c. at 1A.

The amplifier is normally adjusted at the factory for optimum broadband performance but it is possible for this to be upgraded at discrete frequencies on request. R.F. connections are made by means of type N 5ohm coaxial connectors. Under broadband conditions the noise factor is typically better than the stated maximum. The dynamic range is 34dB for bandwidth operation, increasing to 70dB for operation over 1MHz. The maximum gain variation over the frequency range is typically 4dB and the noise factor varies by less than 0.75dB.

Complete magnetic shielding allows tubes to be operated side by side and eliminates interference with companion equipment.

POWER SUPPLIES

The units can be supplied to operate from alternative inputs:-

1. 115V or 240V ± 10%
   Single phase
   50/60Hz

or

2. 28V d.c.
   at 1A.

Connections

Plug type: Bendix PTO 6E-8-4S (SR) Supplied
Pin A. Neutral
B. Line
C. Earth (connected to case)
D. No connection.

Controls

Power on/off switch with associated indicator light.
Remote switching facility can be provided to order.

TYPICAL OPERATION

Frequency range	4.0 to 8.0	GHz
Maximum noise factor	11	dB
Minimum small signal gain	35	dB
Maximum small signal gain	42	dB
Maximum gain variation over frequency range	5	dB
Minimum saturated power output	7	dBm
Maximum input VSWR (hot)	2.5:1	–
Maximum output VSWR (hot)	2.5:1	–
Minimum Isolation	55	dB

Note

A significant improvement in r.f. performance is available over narrow bandwidths (500 to 1000MHz). Details are available on request.

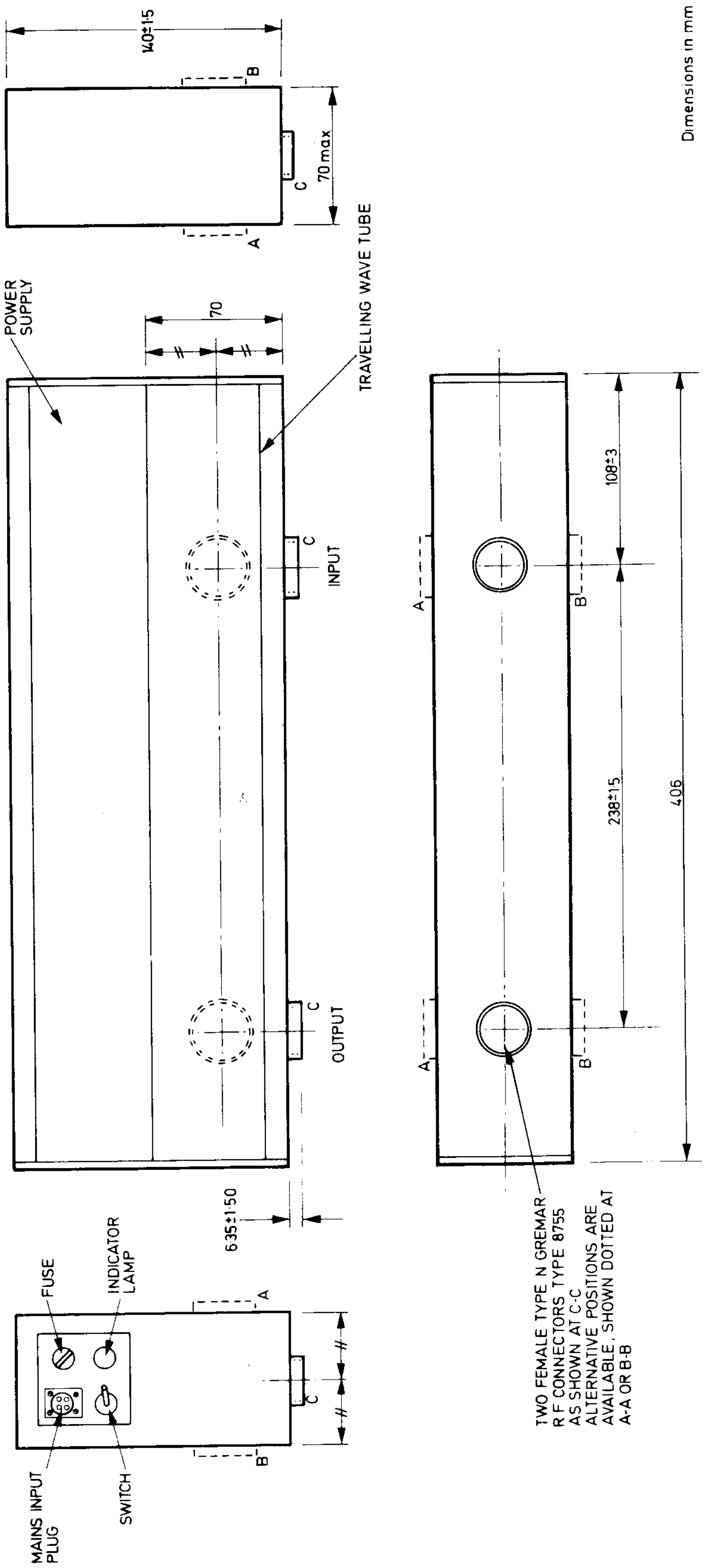
INSTALLATION

Apply mains input to the 4 pin bayonet connector on the front panel using the socket provided.
Connect r.f. input and output using type N connectors. The r.f. input level should not be allowed to exceed 250mW c.w.
Switch on. The red indicator light will glow. After a 90 second automatic delay the amplifier will be operational.

Warning

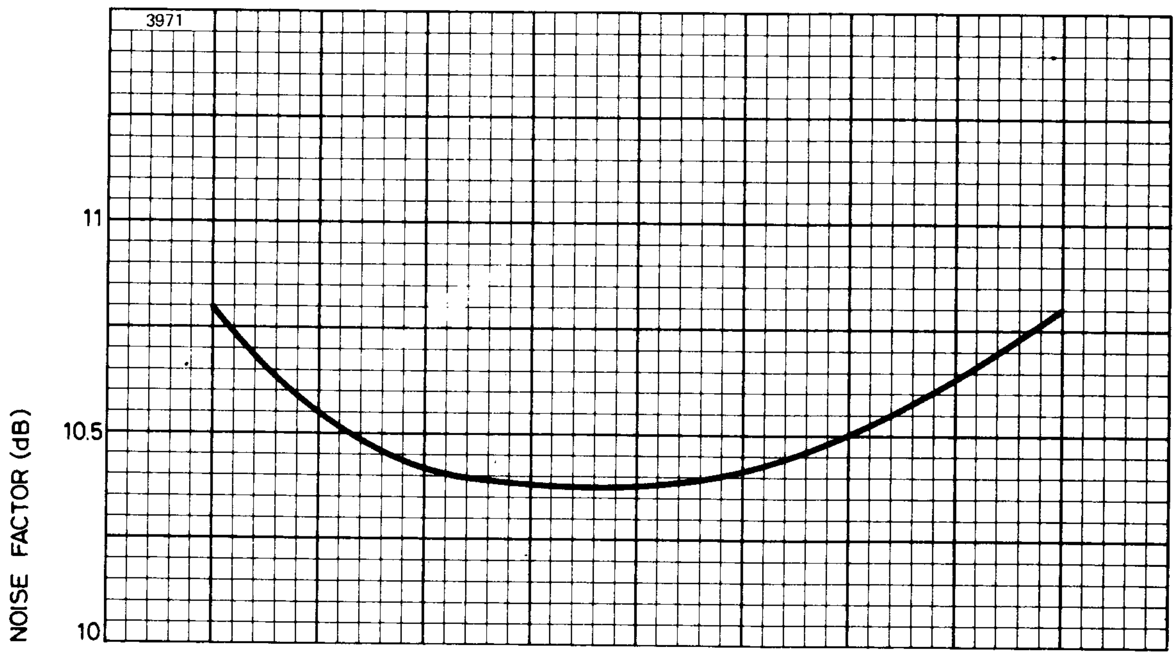
On no account should internal adjustments be made to the power supplies. Alignment requires precision measuring facilities and broadband performance will be lost if power supply controls are adjusted indiscriminately. Damage to the power supply or the tube may be caused by random adjustment.

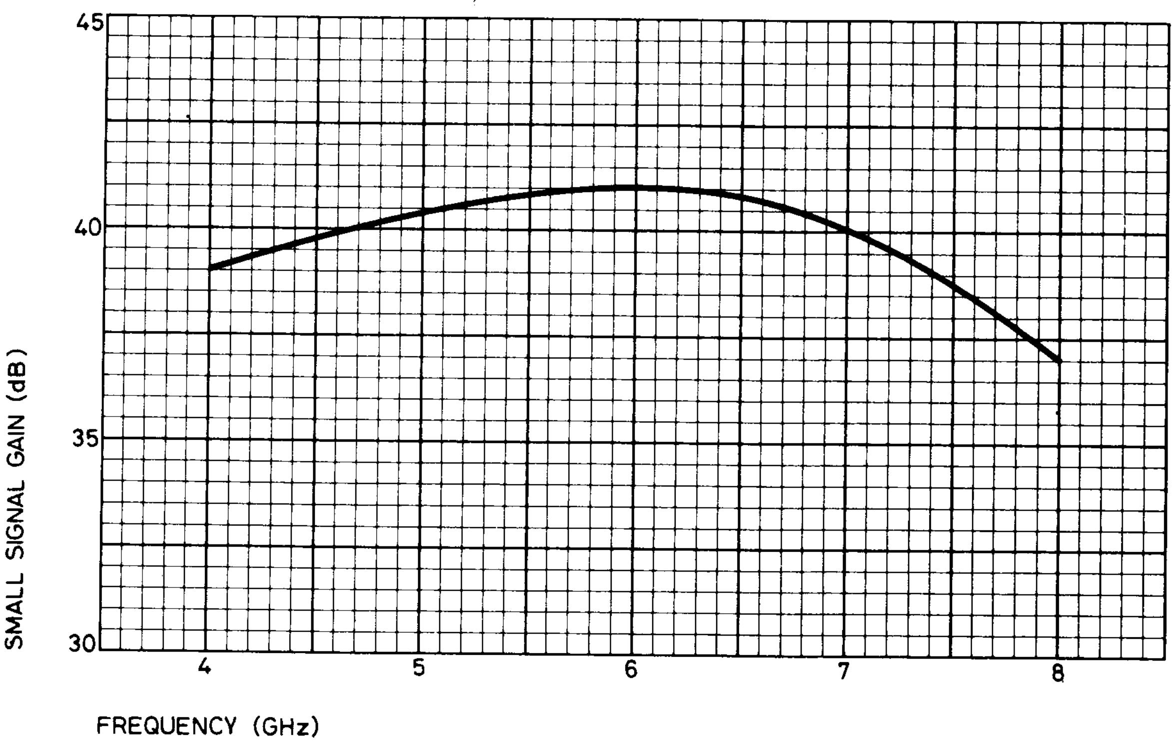
OUTLINE DRAWING OF INTEGRAL POWER SUPPLY AND T.W.T. PACKAGE



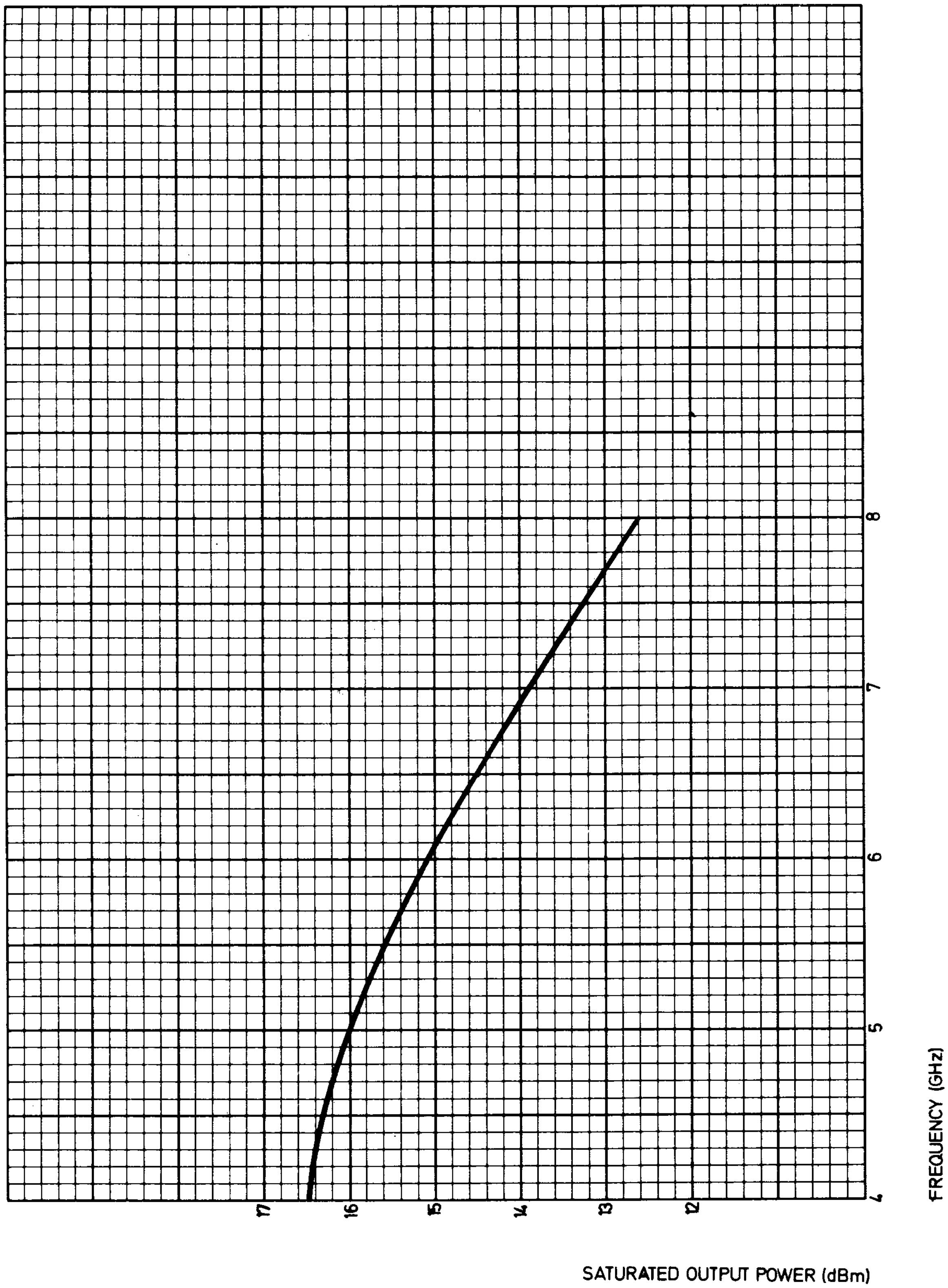
OUTLINE DRAWING OF INTEGRAL POWER SUPPLY AND TWT PACKAGE

NOISE FACTOR AND GAIN – FREQUENCY

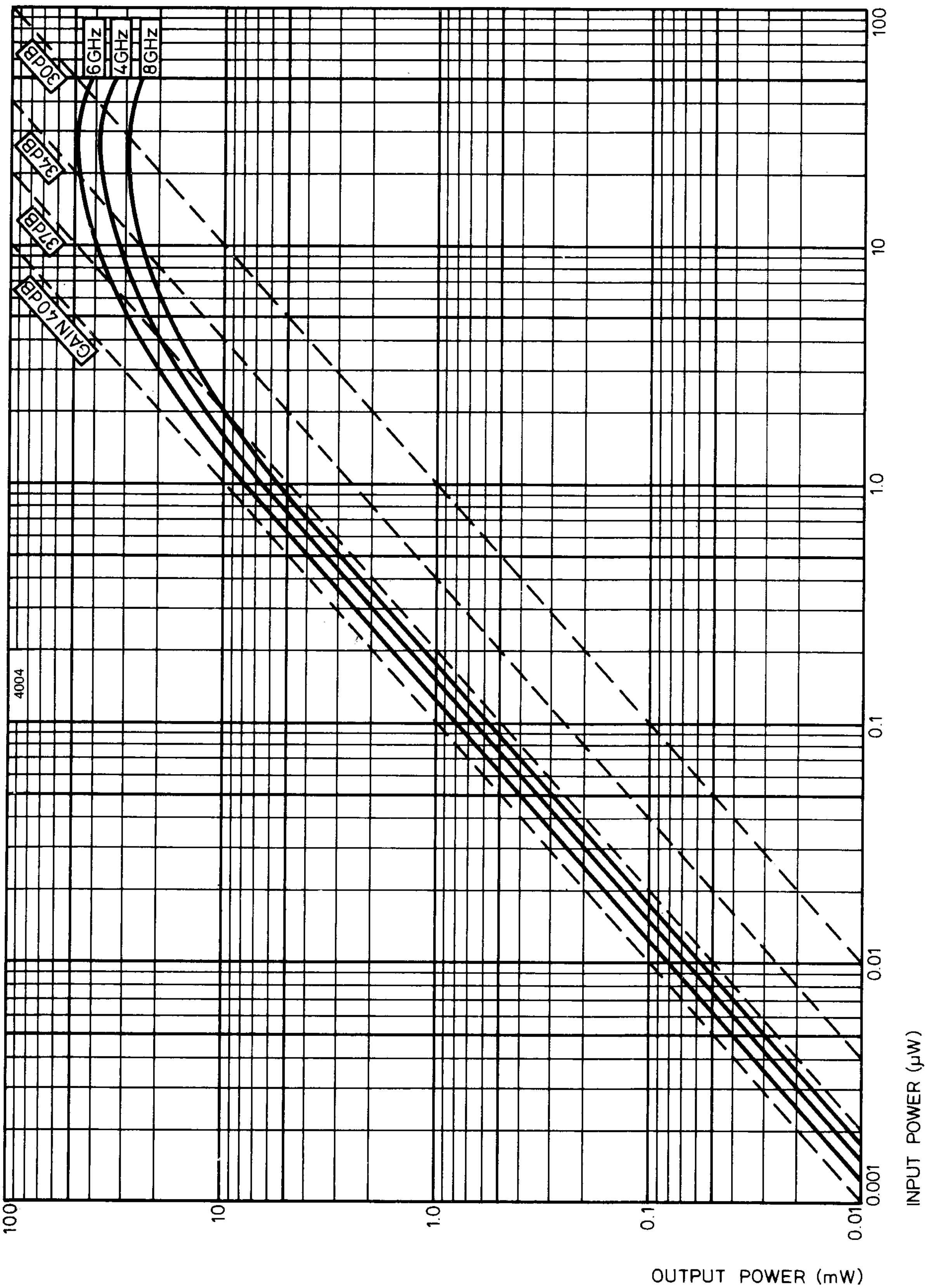




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



THE M-O VALVE
COMPANY LIMITED

TWC35 SERIES

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A fully packaged C-Band travelling wave tube amplifier designed especially for high efficiency and long life in high capacity multi-channel radio communications systems within the frequency range 5.8—7.8GHz.

The gain at 10 watts output is 40dB and AM/PM conversion, noise figure, gain ripple, and V.S.W.R. are all maintained at levels which allow the equipment designer adequate margins in meeting the requirements of typical 1800 channel multiplex systems.

The total power consumption is less than 50 watts at the operating power level of 10 watts while the completely packaged design provides a compact amplifier weighing less than 5½ lbs. which allows flexibility in equipment mounting, simplicity of installation and maintenance free service. A new electron gun with a very low cathode current density ensures reliability and stability of performance over operating periods of several years.

Cooling is by natural convection and RF terminations are in waveguide (1.372 in. x 0.125 in. internal) with optional transitions to WG14 (WR137).

Frequency range*	5.8 to 7.8	GHz
Operating power level	10	W
Nominal gain (at 10W output)	40	dB
Noise factor	<26	dB
AM/PM conversion (at 10W output)	1.0	°/dB

*The tube is available in 4 frequency ranges.

TWC35	5.925—6.425	GHz
TWC35A	7.400—7.800	GHz
TWC35B	6.900—7.400	GHz
TWC35C	6.425—7.110	GHz

TYPICAL OPERATION AND PERFORMANCE CHARACTERISTICS

Frequency	5.925–6.425	GHz
Output power	10	W
I_{coll}	31.0	mA
V_{coll}	1.3	kV
V_{hel}	3.5	kV
V_{g2}	0.85	kV
I_{hel}	0.2	mA
I_{g2}	0	mA
Gain (at 10W output)	39	dB
Noise factor (at 10W output)	<26	dB
AM/PM conversion (at 10W output)	<1.5	°/dB
Gain flatness (at 10W output)		
Over any 30MHz band	<±0.15	dB
Over any 3MHz band	<±0.02	dB
Input VSWR (hot)	<1.3:1	Ratio
Output VSWR (hot)	<1.4:1	Ratio

MECHANICAL DATA

Dimensions See outline drawing
Weight 5½ lb. (2.5kg)

MAXIMUM RATINGS (Absolute and non-simultaneous)

			Notes
V_{coll}	1.5	kV	1,2
V_{hel}	4.0	kV	1
V_{g2}	2.0	kV	1
V_{heater}	7.0	V	3
I_{coll}	37	mA	
I_{hel}	3.0	mA	4
I_{g2}	1.0	mA	
I_{heater} (surge)	2.0	A	
Heater warm-up time	>3	minutes	
Interruption time in heater power (with other supplies on)	<8	seconds	5

MAXIMUM RATINGS (contd)

P_{coll}	50	W
P_{out}	15	W
P_{in}	1	W
$T_{ambient}$ (operating)	0 to +55	°C
$T_{storage}$	−50 to +70	°C
Altitude (operating)	<15,000	ft

NOTES

1. Voltages are quoted relative to cathode.
2. The collector is connected to the capsule body which is normally earthed.
3. The heater supply must be insulated from the cathode by at least 20V.
4. This value may be momentarily exceeded, e.g. on switching on and off and may rise to 5.0mA. A protective excess current device should be provided to trip the h.t. supplies if the continuous helix current exceeds 2.5mA.
5. Interruption of the heater supply for up to 8 seconds will not cause the trips to operate.

CONNECTIONS

Power Supplies

a) Use Electro-Methods socket type BA15.S (obtainable from Ether Ltd., Hitchin Street, Biggleswade, Bedfordshire, U.K.) to mate with corresponding plug fitted to tube.

Pin A	Heater +
B	Heater −
C	Cathode
D	Not used
E	Not used
F	Strapped to pin B, in tube.
H	Safety Earth (Package Body)
J	Collector (Package Body)
K	Not used
L	Grid 2
M	Helix
N and P	Strapped in tube. May be used for power supply interlock.
R and S	Strapped in tube. May be used for power supply interlock.

b) Alternative flying lead connections supplied to special order.

Brown/yellow	Heater +
Brown	Heater –
Yellow	Cathode
Black	Collector (connected to package body)
Black	Package body
Blue	Grid 2
Orange	Helix

R.F. Connectors

Waveguide:- 0.125 in. (3.175mm) x 1.375 in. (34.925mm) internal dimensions.
Waveguide flanges:- See outline drawing. Other flanges can be fitted to customer requirements. Tapers to WG14 (WR137) can be incorporated or supplied separately.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN (For 10W Output Power operation)

Recommended Applied Conditions (TWC35)

			Notes
Frequency range	5.925–6.425	GHz	
Heater voltage	6.3V ± 3%	V	3,5
Collector voltage	1.3	kV	1,2
Output power	10	W	6
Load V.S.W.R.	<1.5:1	Ratio	

RANGE OF CHARACTERISTICS (with recommended applied conditions)

	Min	Max		Notes
Heater current	0.5	0.7	A	5
Collector current	25	35	mA	
Helix voltage	3.2	3.7	kV	1
Helix current	0	2	mA	4
Grid 2 voltage (operational)	0.6	1.0	kV	1
Grid 2 current	0	0.5	mA	

	Min	Max		Notes
Input power (for 10W output). . .	0.631	1.585	mW	
Saturation output power . . .	14	–	W	6
Noise factor.	–	26	dB	7,8
AM/PM conversion	–	2.5	°/dB	
Gain flatness over any 30MHz band .	–	±0.15	dB	8
Gain flatness over any 3MHz band .	–	±0.02	dB	8
Input V.S.W.R. (hot).	–	1.5:1	Ratio	
Output V.S.W.R. (hot)	–	2.0:1	Ratio	
Cold insertion loss	55	–	dB	
Power efficiency at 10W output .	20	–	%	9

NOTES

6. The tube is designed for continuous operation at 10 watts of output power. Prolonged operation at higher power levels may reduce the operating life.
7. Measured as the mean noise figure over any band of 3kHz within any 30MHz band.
8. Over the recommended frequency range.
9. Efficiency = $\dfrac{P_{out}}{P_{collector} + P_{helix} + P_{heater}}$

OPERATING NOTES

Power Supply

a) The travelling wave tube heater voltage must be applied at least 3 minutes before any h.t. voltages are applied
b) During switch-on the Grid 2 voltage must not be applied until all other electrodes have reached their final voltages.
c) During switch-off the Grid 2 voltage should be reduced to zero before all other voltages or excessive currents may be drawn.
d) The Grid 2, helix and collector voltages should be stabilized to ±2%.
e) A protective device must be included in the helix circuit to cut off the h.t. supply if the helix current continuously exceeds 2.5mA. As the Grid 2 voltage rises through the range 100 to 600V the helix current is normally above 1mA and the peak value may be as high as 5mA. Accordingly the Grid 2 voltage should rise sufficiently quickly through this range to ensure that the protective device in the helix circuit is not operated. Alternatively the protective device may be overridden during installation as long as the helix current does not exceed 5mA for a maximum period of 1 second.

Initial Installation of Travelling Wave Tube

a) Installation involves making the R.F. input and output connections to the waveguides and making the electrical power connection. A detachable cover is provided over the cooling system for protection during handling and mechanical interlocking is incorporated to prevent inadvertant operation when the cover is attached. The cover must be fitted during all non-operational storage periods.
b) The tube should be mounted with the axis horizontal, with the waveguide flanges facing vertically upwards or downwards, and with free air circulation over the collector cooler. Tubes of modified design permitting other methods of horizontal mounting or incorporating conduction cooling are available to special order. Vertical mounting is only permissible in the case of convection cooled variants if forced air cooling is provided. In this case the cooler should be uppermost.
c) The amplifier should be separated from non-magnetised magnetic materials by a minimum of 1 inch. Amplifiers are capable of operating satisfactorily when placed side by side with their axes parallel and a centre line spacing of 6 inches and are not affected by stray magnetic fields of one on the other.

SETTING UP PROCEDURE

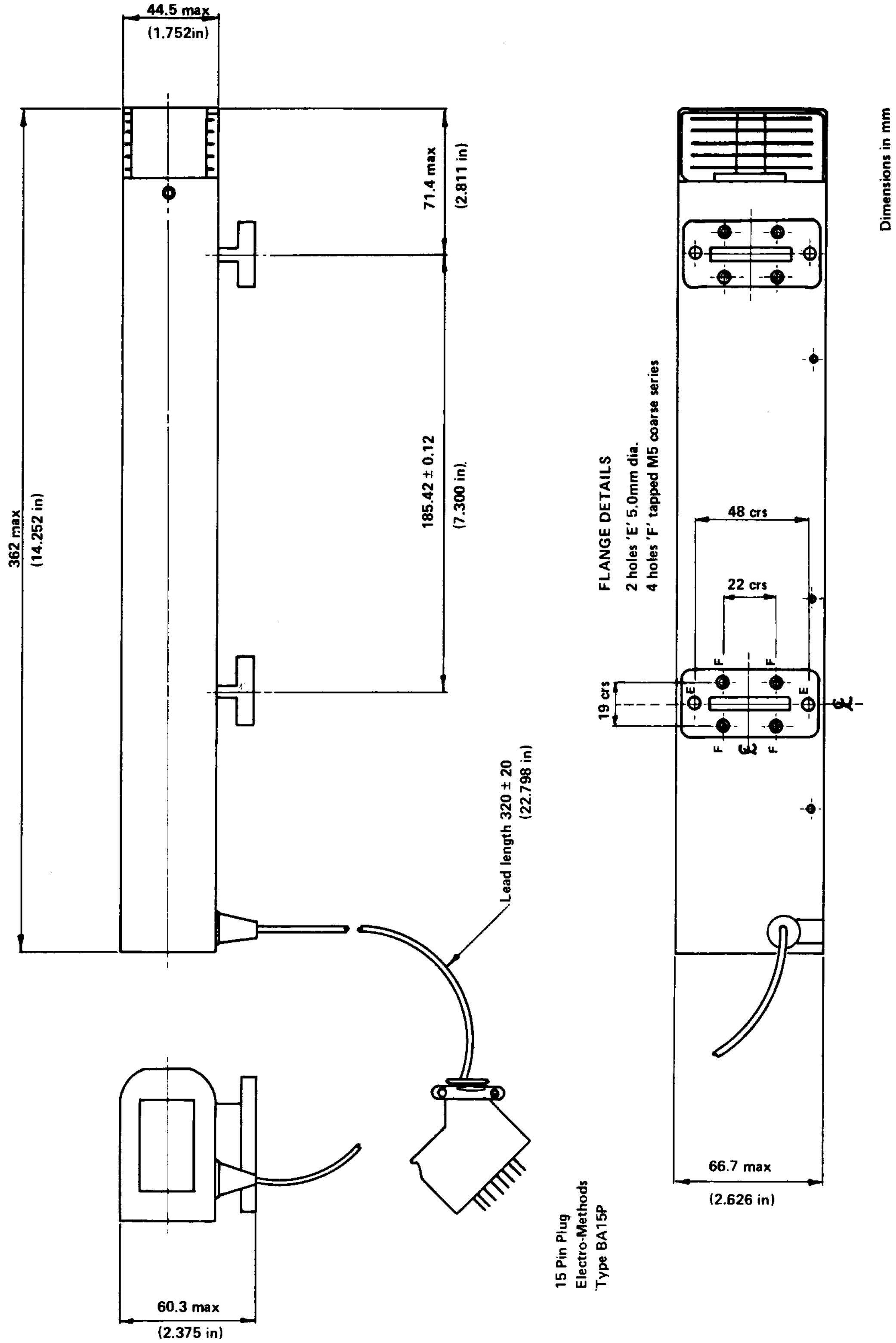
a) Adjust the heater voltage to 6.3 volts and leave to warm up for 3 minutes.
b) Apply V_{col} between 1.25kV and 1.3kV and V_{hel} at approximately the indicated value.
c) Gradually increase $V_{grid\ 2}$ until the collector current reaches the indicated value.
d) Apply an R.F. signal of approximately 0.6mW and adjust V_{hel} for maximum output power. Increase the drive level gradually, optimising the V_{hel} for each setting until the output power is 10 watts.
e) To achieve best AM/PM conversion reduce V_{hel} by 75V ± 25V and increase the collector current by means of $V_{grid\ 2}$ to restore the power output of 10 watts.

Subsequent Switching On

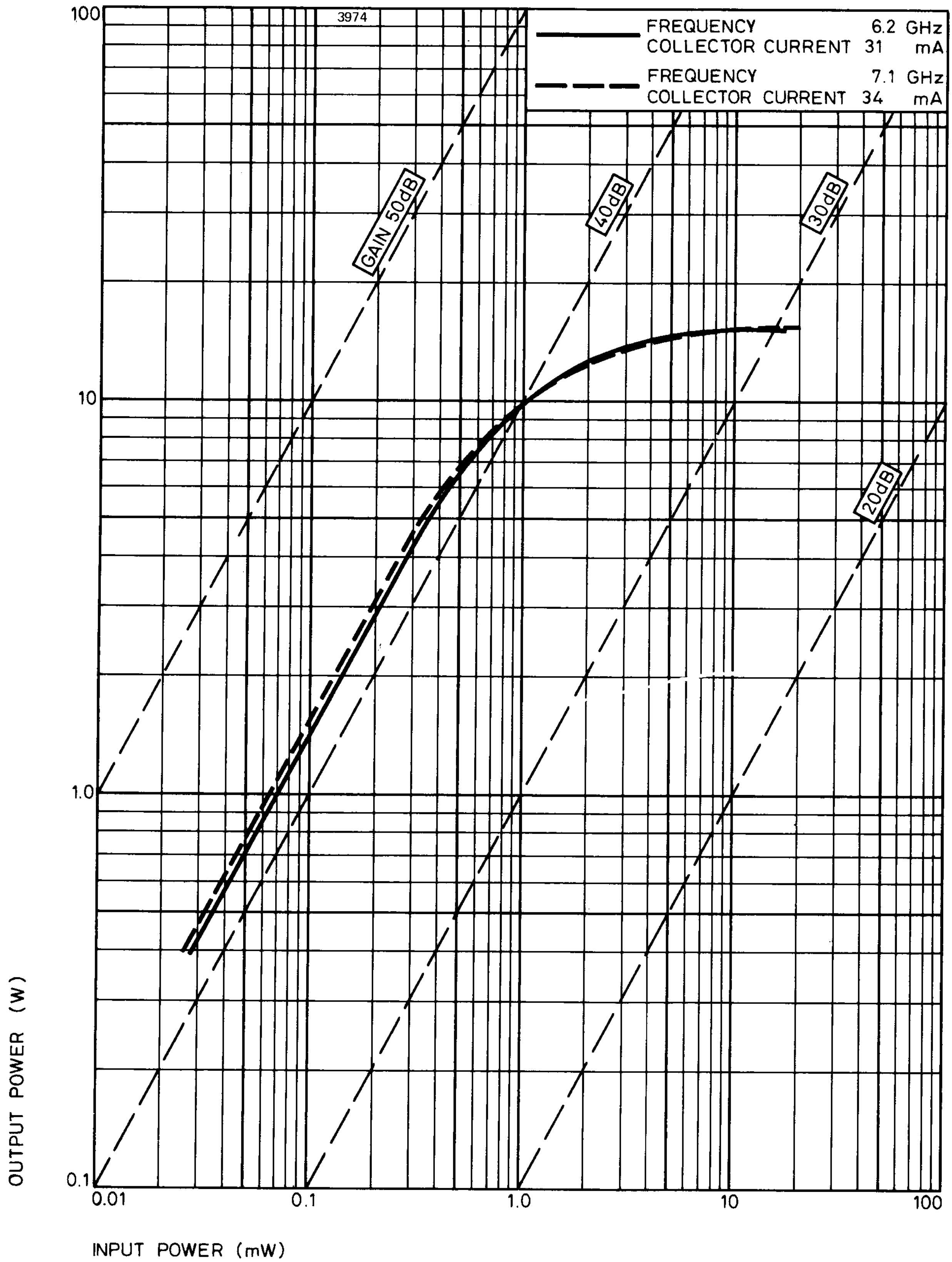
After the setting up procedure described above, the electrode potentials may subsequently be applied together as long as the heater supply has not been disconnected for over 8 seconds and the rise of $V_{grid\ 2}$ is slightly delayed behind the rise of V_{col} and V_{hel}.

OUTLINE

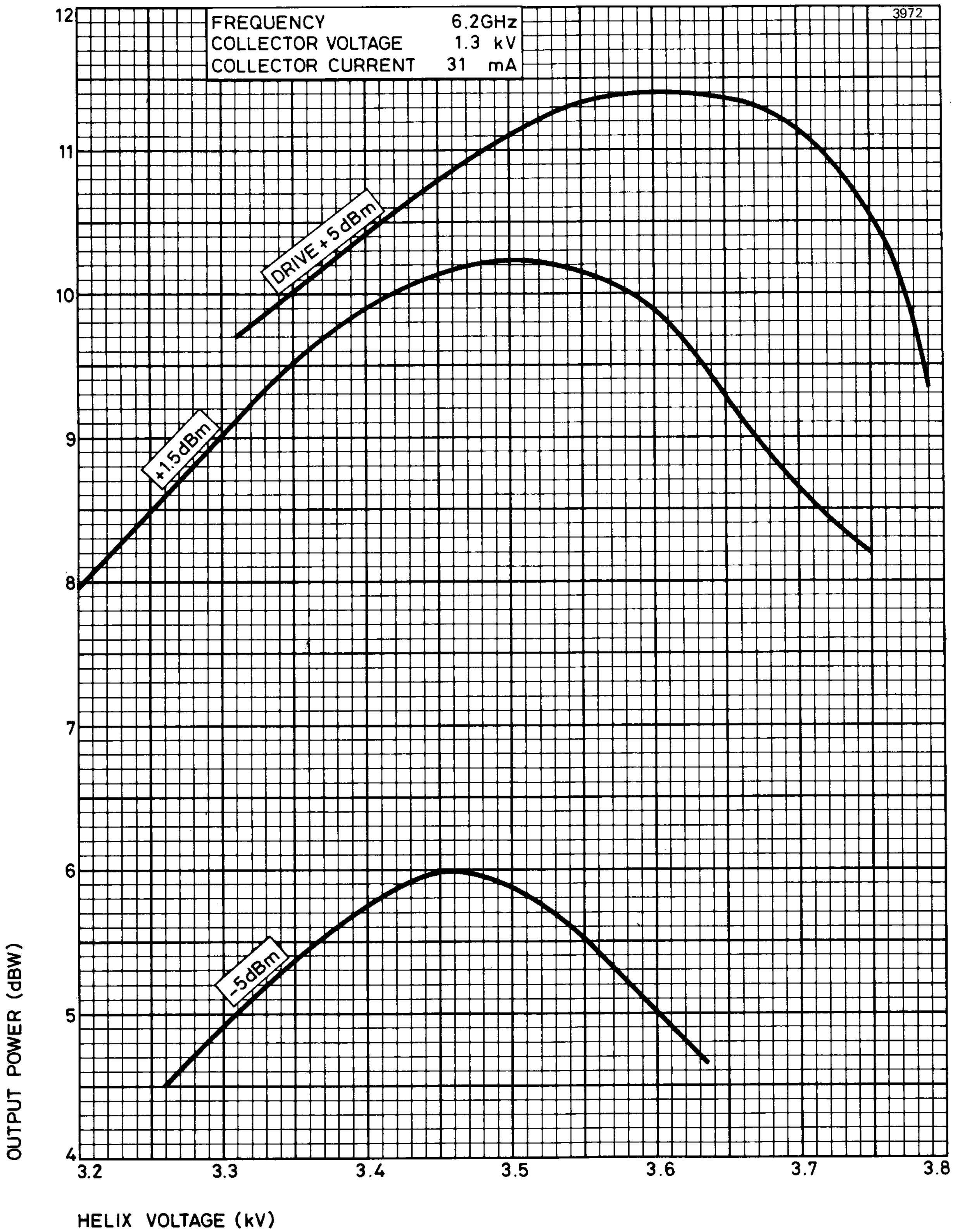
1074



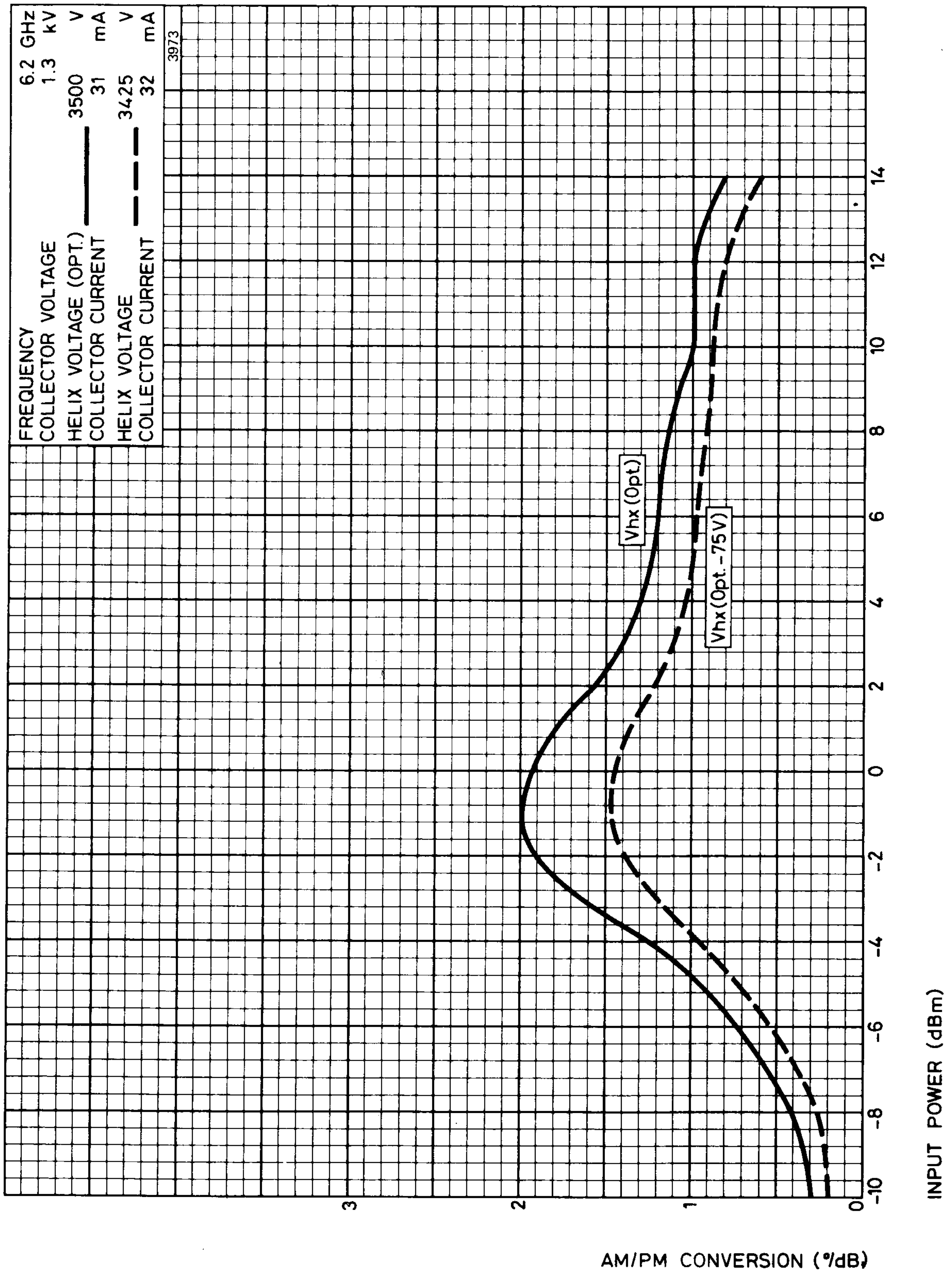
SYNCHRONOUS POWER OUTPUT – POWER INPUT



POWER OUTPUT – HELIX VOLTAGE



AM/PM CONVERSION – POWER INPUT



TWJ20

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise amplifier giving a gain of 25 to 35dB and a noise factor better than 15dB over a frequency range of 12.0 to 18.0GHz.

DESCRIPTION

A rugged low noise amplifier designed for use in severe environments. The noise factor typically varies by less than 0.75dB over the frequency range and the gain is constant to within 7dB. The dynamic range is 35dB at full bandwidth operation increasing to 72dB when operated over a bandwidth of 1MHz. The use of Alnico magnets of low magnetic temperature coefficient in a periodic permanent magnet focussing assembly ensures light weight and stability of performance over a wide operational temperature range. Complete magnetic shielding enables tubes to be mounted side by side and eliminates interference with adjacent equipment. The low power dissipation, less than 3 watts including the cathode heater supply, allows the tube to be mounted in any position without the necessity for forced air cooling.
R.F. connections are by means of waveguide WG18. Power connection is by an Electromethods type BA15P plug or by flying leads; the tube is fully insulated so that cathode, helix, or collector may be grounded.
The amplifier is normally adjusted for optimum broadband performance but it is possible for the performance to be upgraded in restricted bandwidths. Similarly, performance outside the conventional octave bandwidth can be provided.
Considerable variation in the mechanical format is possible to special order.

HEATER

V_h	6.3	V
I_h (approx)	0.25	A
I_h (surge)(max)	1.5	A

RATINGS (Absolute)

	Min	Max	
V_{coll}	V_{helix}	1650	V
V_{helix}	1100	1400	V
V_{g4}	–	800	V
V_{g3}	–	600	V
V_{g2}	–	500	V
$-V_{g1}$	250	0	V
I_{helix}	–	1.0	mA
I_g (on any grid)	–	50	μA
t_{hk}	2	–	min

TYPICAL OPERATION

Frequency range (see Note 3)	12.0–18.0	GHz
V_{coll} (see Note 1)	V_{helix} + 200	V
V_{helix} (see Note 1)	1100–1300	V
$-V_{g1}$ (see Note 1)	50–0	V
V_{g2} (see Notes 1, 2, 3)	0–200	V
V_{g3} (see Note 1)	0–300	V
V_{g4} (see Note 1)	100–400	V
I_{helix}	0–200	μA
I_{coll} (see Notes 2, 3)	400–1200	μA
Max noise factor (see Note 3)	15	dB
Min small signal gain (see Note 3)	25	dB
Max small signal gain (see Note 3)	35	dB
Max. gain variation (12.0–18.0GHz) (see Note 3)	7	dB
Min power output (saturated)(see Note 3)	7	dBm
Max v.s.w.r. (input)(see Note 3)	2.5:1	
Max v.s.w.r. (output)(see Note 3)	2.5:1	
Minimum isolation	55	dB

NOTES

1. All voltages with respect to cathode. Collector, helix or cathode may be earthed.
2. Adjust V_{g2} to give the collector current specified for the tube.
3. A significant improvement in r.f. performance is possible over narrow bandwidths (500–1000MHz). Details of performance are available on request.

POWER REQUIREMENTS

The requirements in terms of voltage installation accuracy, voltage stability, and ripple level are dependant upon the performance requirements of the application but the following conditions define a power supply capable of minimising performance drift and spurious modulation levels. Where RF performance requirements are less severe, some degredation of the power supply is permissible. Further information will be supplied on request.

Electrode	Voltage Range Min	Voltage Range Max	Current Range Min	Current Range Max
Heater	6.24 Volts	6.36 Volts	0.19A	0.26A
Grid 1	−50 Volts	0 Volts	−10μA	20μA
Grid 2	0 Volts	150 Volts	−10μA	20μA
Grid 3	0 Volts	300 Volts	−10μA	20μA
Grid 4	75 Volts	500 Volts	−10μA	20μA
Helix	1100 Volts	1300 Volts	−10μA	200μA
Collector	V_{hel} Volts	V_{hel} + 200	300μA	1500μA

Electrode	Installation Accuracy ±%	Stability ±%	Ripple Volts p−p
Heater	1.0	1.0	−
Grid 1	1.0	1.0	0.020
Grid 2	−	1.0	0.020
Grid 3	1.0	1.0	0.020
Grid 4	1.0	1.0	0.050
Helix	0.25	0.25	0.050
Collector	1.0	5.0	10.0

NOTES

1. Stability includes power supply variations from all causes including temperature.
2. The tube may be operated with any one of the following elements at capsule (ground) potential:
   Cathode
   Helix
   Collector
3. The tube operating voltages and currents are listed on an affixed label.

INSTALLATION AND ALIGNMENT

1. Connect power supply and r.f. lines to the tube.
2. Apply rated heater voltage for a period of two minutes. The full rated heater voltage may be applied instantaneously.
3. Set grid 2 to zero volts and all other voltages as shown on tube label.
4. Increase the grid 2 voltage until the collector current reaches the value shown on the tube label. Grid 2 voltage should then agree approximately with that shown on the label. Collector current should be set to an accuracy of 1%.

After initial installation and setting of voltages, subsequent switching procedure may be as follows:-

a) As 2 above.
b) All other voltages may then be immediately applied at preset values providing that the grid 2 voltage is not achieved before the helix voltage.

AMPLIFIER CONNECTIONS (Use socket to mate with Electromethods Plug type BA15P)

Pin A:	NC	Pin J:	Grid 2
B:	NC	K:	NC
C:	Grid 1	L:	Cathode
D:	Helix	M:	Heater
E:	Collector	N:	Heater/Cathode
F:	Grid 4	P:	Capsule earth
H:	Grid 3	R:	NC
		S:	NC

POWER SUPPLY

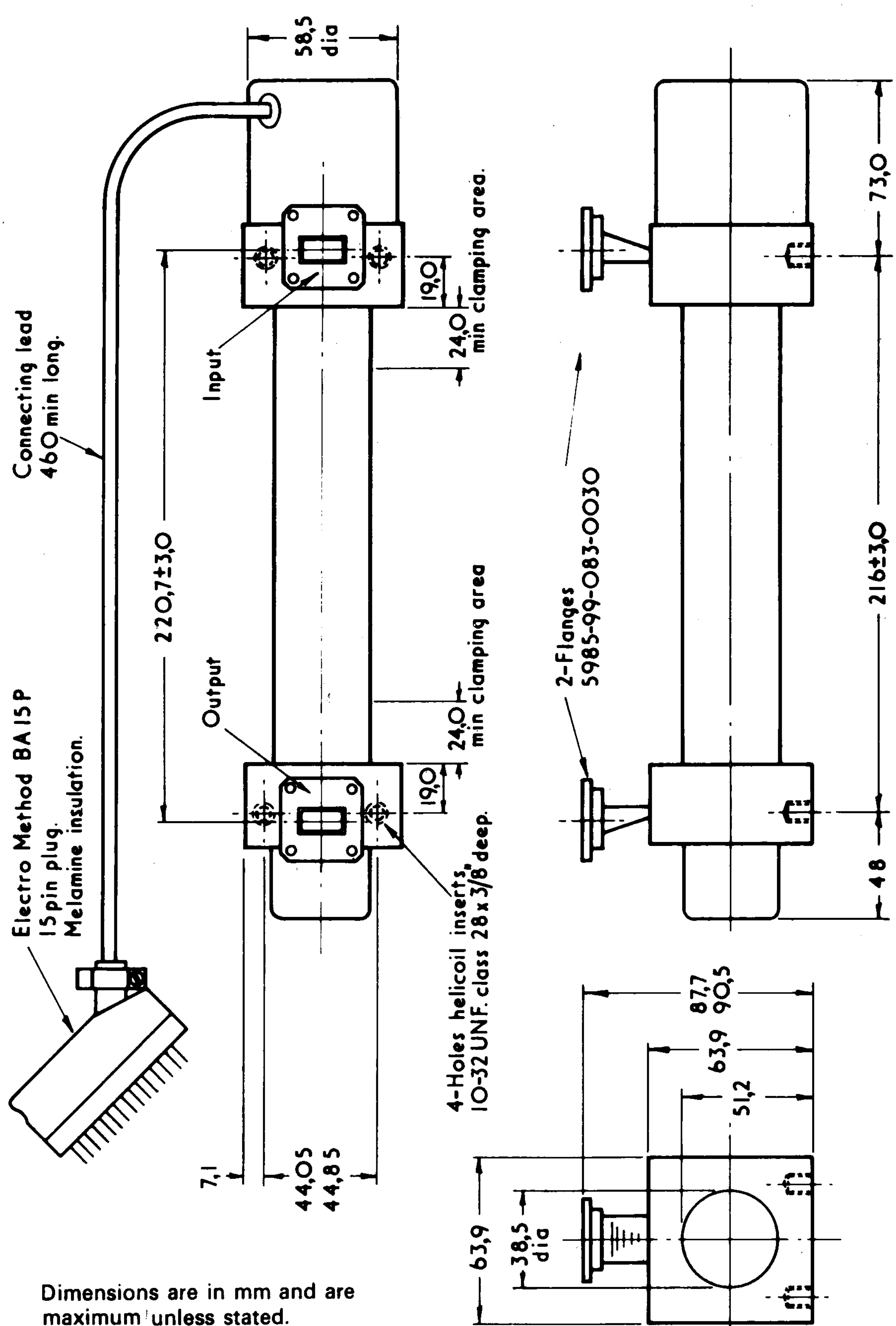
The tube can be supplied complete with a power supply in which case it has the type No. TWJ29.

MECHANICAL

Dimensions See outline drawing
Weight 2.4kg (5.25lb.)

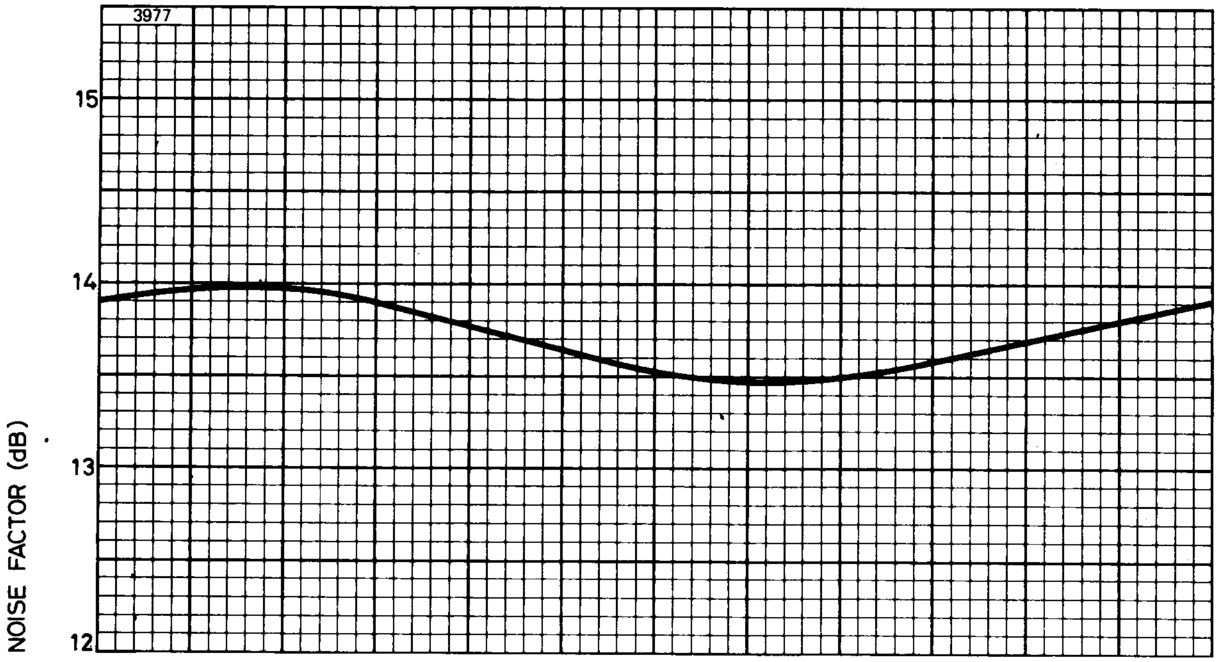
Note:- Variation in the mechanical configuration is possible. Further details will be supplied on request.

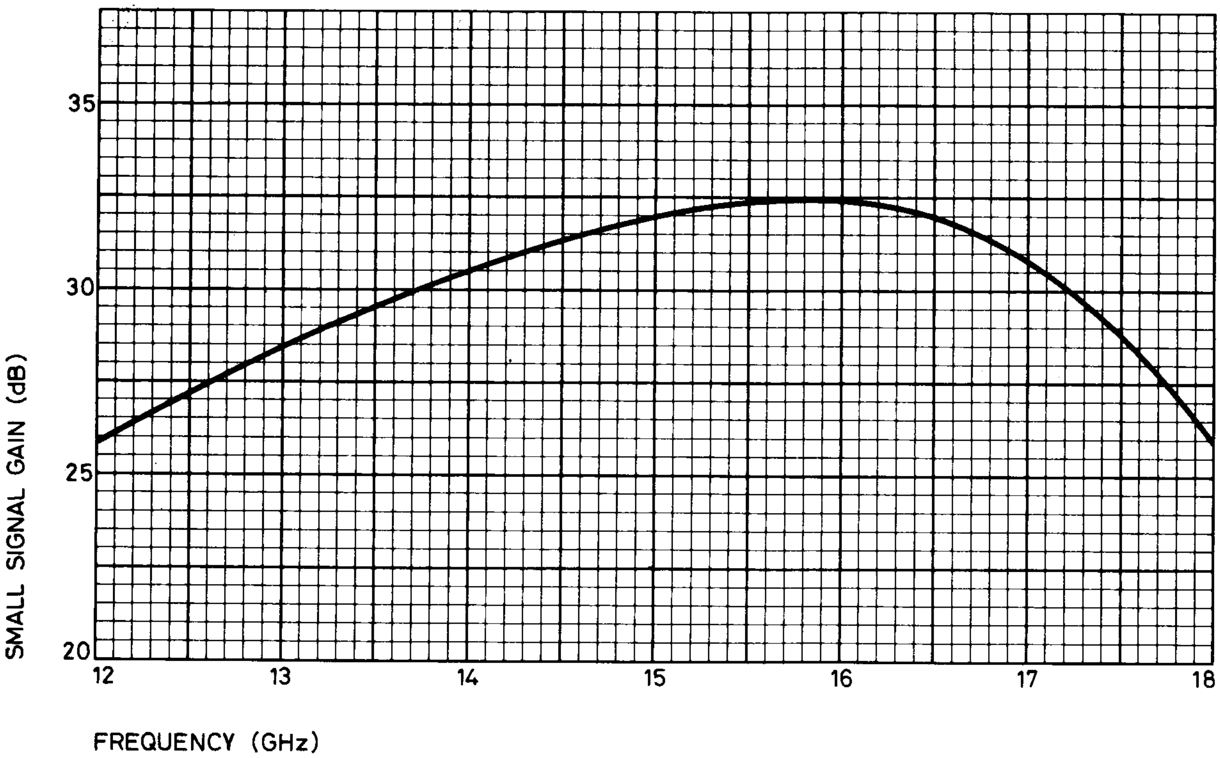
OUTLINE



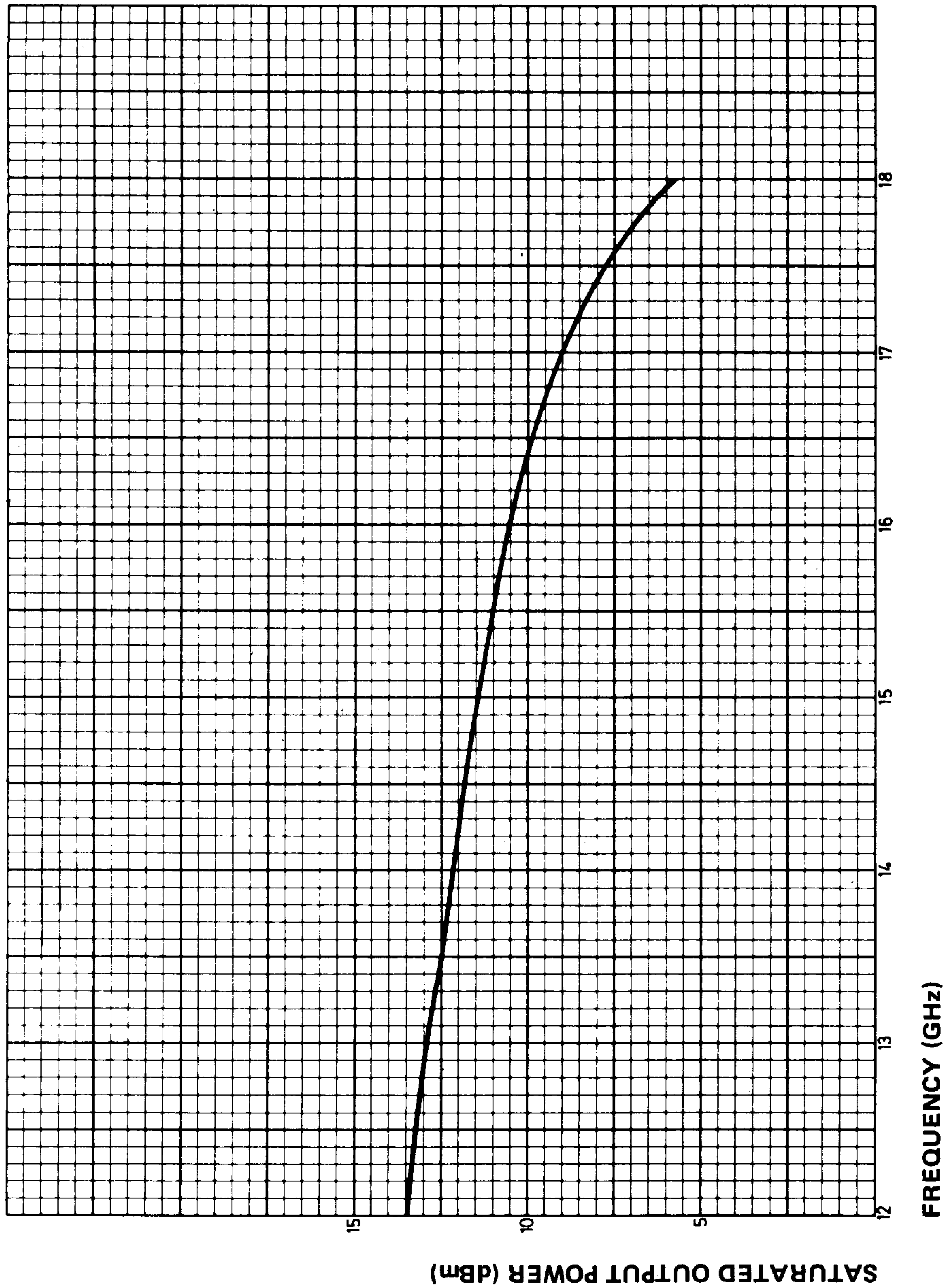
Dimensions are in mm and are maximum unless stated.

NOISE FACTOR AND GAIN – FREQUENCY

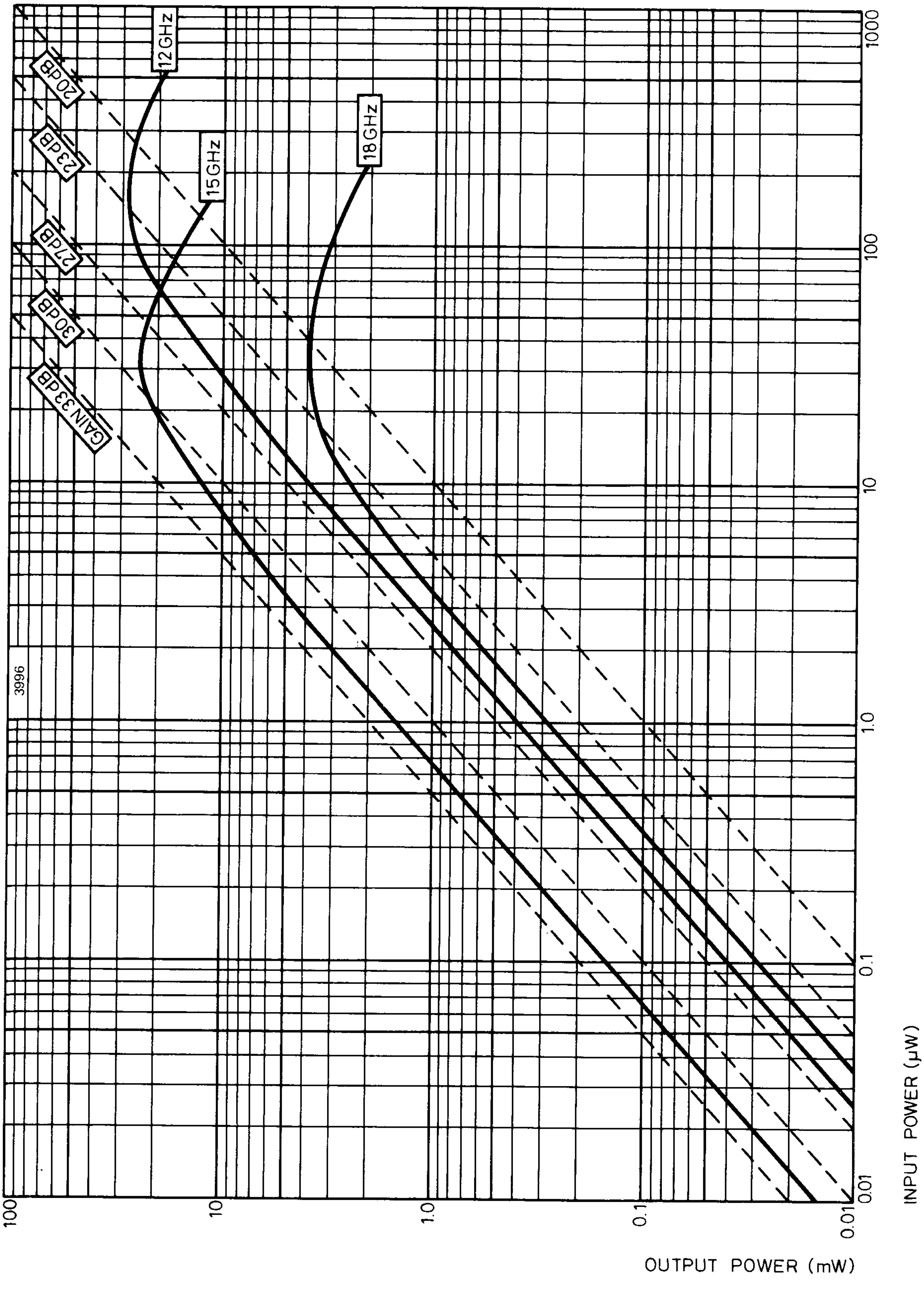




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise travelling wave amplifier with integral power supply giving a gain of 25 to 35dB over the frequency range 12.0 to 18.0GHz and a noise factor better than 15dB.

DESCRIPTION

Simplicity of installation and low cost replacement combined with excellent broadband performance has been achieved by combining a rugged travelling wave tube amplifier package with a stabilised power supply. Modular construction has been adopted, allowing considerable flexibility and space saving and, since the tube and power supply are separable, replacement costs are minimised. A built in correction circuit compensates for changes in performance with life so no adjustment is required in operation. The power input requirement is 115V or 240V a.c. at 50/60Hz or 28V d.c. at 1A.

The amplifier is normally adjusted at the factory for optimum broadband performance but it is possible for this to be upgraded at discrete frequencies on request. R.F. connections are made by means of waveguide WG 18.

Under broadband conditions the noise factor is typically better than the stated maximum. The dynamic range is 35dB for full bandwidth operation, increasing to 72dB for operation over 1MHz. The maximum gain variation over the frequency range is typically 7dB and the noise factor varies by less than 0.75dB.

Complete magnetic shielding allows tubes to be operated side by side and eliminates interference with companion equipment.

POWER SUPPLIES

The units can be supplied to operate from alternative inputs:-

1. 115V or 240V ± 10%
   Single phase
   50/60Hz

or

2. 28V d.c.
   at 1A

Connections

Plug type:	Bendix PTO 6E-8-4S (SR) Supplied
Pin A	Neutral
B.	Line
C.	Earth (connected to case)
D.	No connection

Controls

Power on/off switch with associated indicator light.
Remote switching facility can be provided to order.

TYPICAL OPERATION

Frequency range	12.0 to 18.0	GHz
Maximum noise factor	15	dB
Minimum small signal gain	25	dB
Maximum small signal gain	35	dB
Maximum gain variation over frequency range	8.5	dB
Minimum saturated power output	3	dBm
Maximum input VSWR (hot)	2.5:1	—
Maximum output VSWR (hot)	2.5:1	—
Minimum Isolation	55	dB

Note

A significant improvement in r.f. performance is available over narrow bandwidths (500 to 1000MHz). Details are available on request.

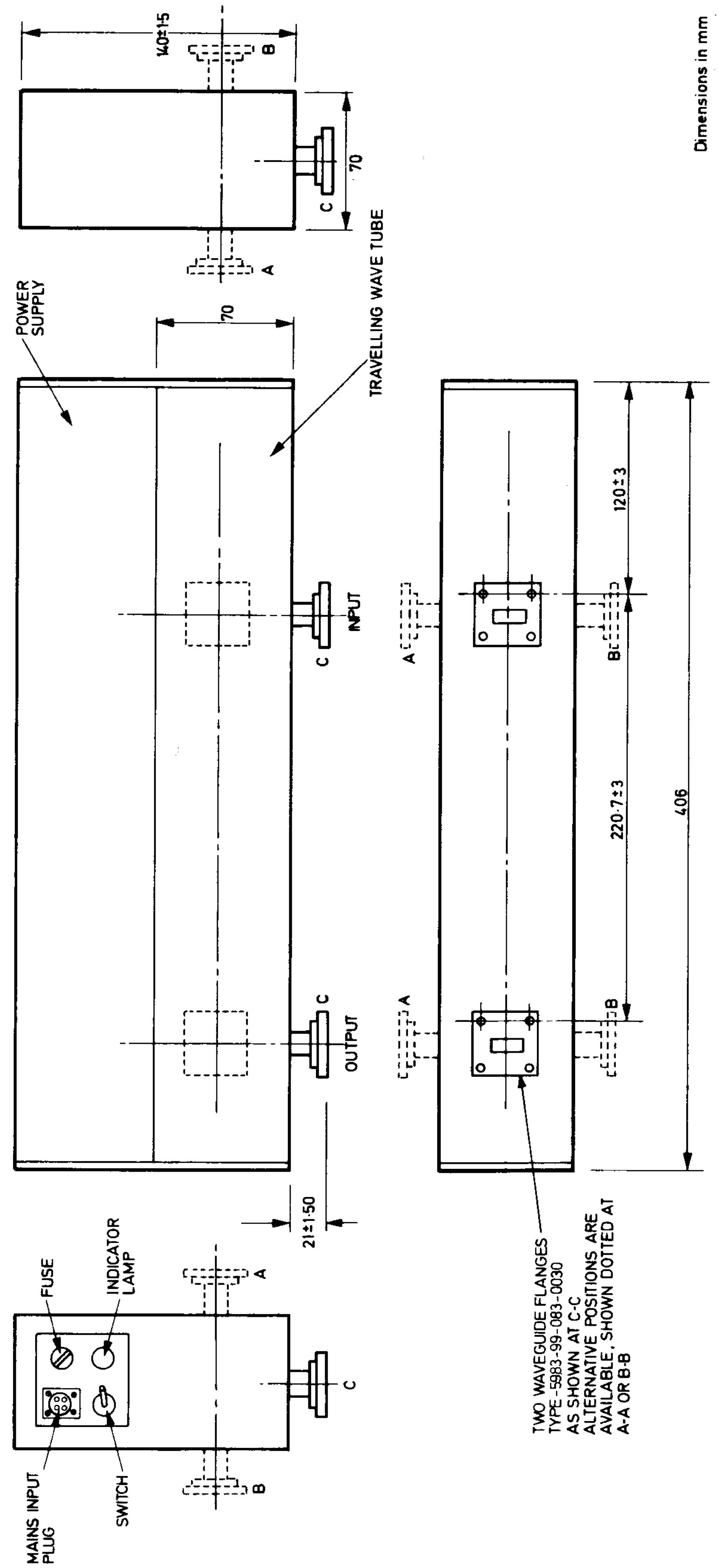
INSTALLATION

Apply mains input to the 4 pin bayonet connector on the front panel using the socket provided.
Connect r.f. input and output using standard waveguide WG18 connectors.
The r.f. input level should not be allowed to exceed 250mW c.w.
Switch on. The red indicator light will glow. After a 90 second automatic delay the amplifier will be operational.

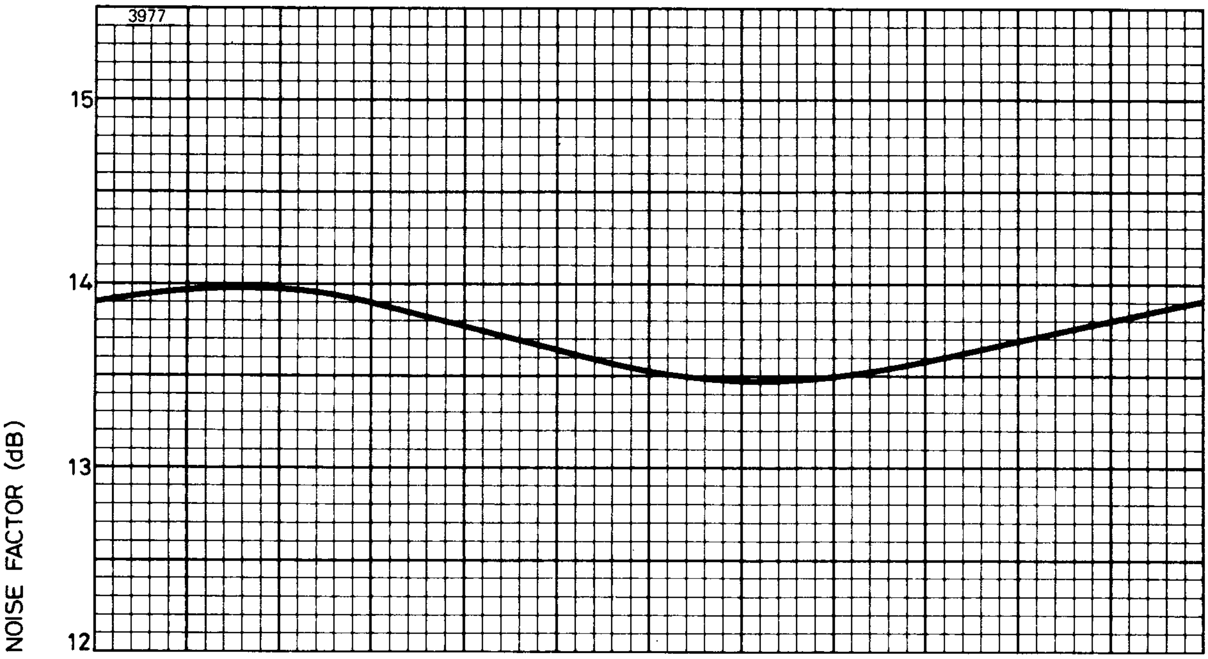
Warning

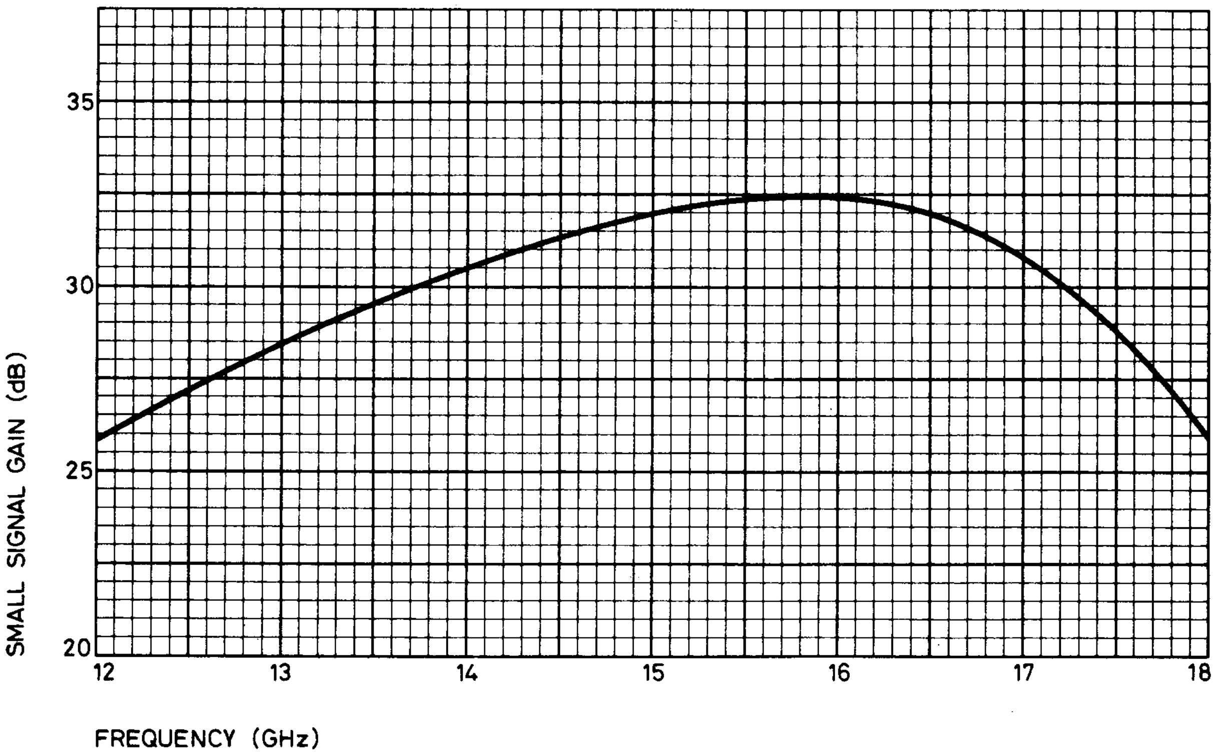
On no account should internal adjustments be made to the power supplies.
Alignment requires precision measuring facilities and broadband performance will be lost if power supply controls are adjusted indiscriminately. Damage to the power supply or the tube may be caused by random adjustment.

OUTLINE DRAWING OF INTEGRAL POWER SUPPLY AND T.W.T. PACKAGE

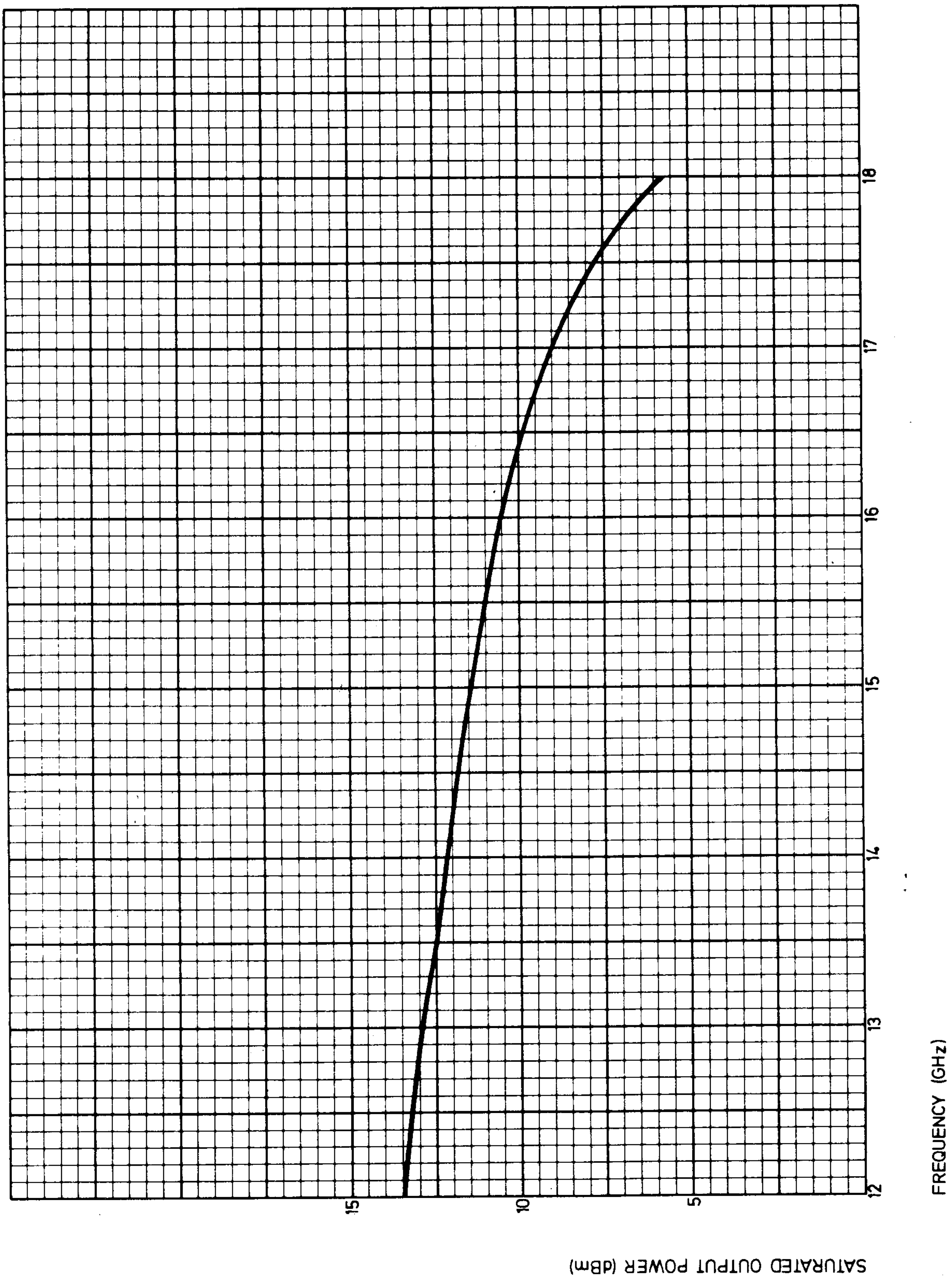


NOISE FACTOR AND GAIN – FREQUENCY

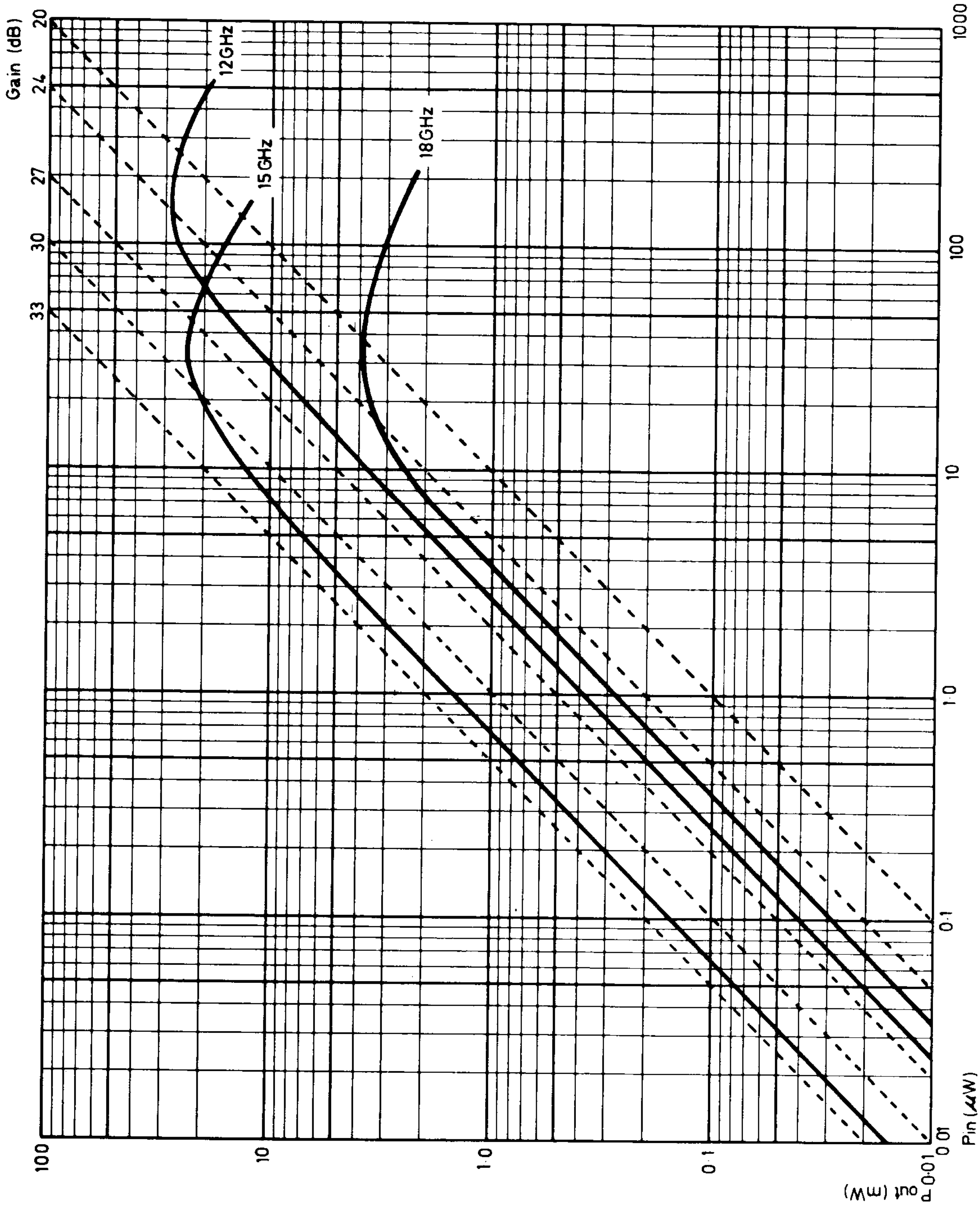




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMISED FOR BROAD BAND OPERATION



THE M-O VALVE
COMPANY LIMITED

TWJ 30

G.E.C.

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise amplifier giving a gain of 30 to 40dB and a noise factor better than 13.5dB over a frequency range of 12 to 18GHz.

DESCRIPTION

The use of Alnico 8 magnets in a periodic permanent magnet focusing stack, ensures light weight and stability of performance over a wide range of temperatures. By careful selection of magnets to reduce field asymmetry, the noise factor is typically maintained to within 2dB over an ambient temperature range of -10 to $+90^{\circ}$C. Complete magnetic shielding enables tubes to be mounted side by side and eliminates interference with adjacent equipment. The low power consumption, less than 3 watts including cathode heater supply, allows the tube to be mounted in any position without the necessity for forced air cooling.

The noise factor typically varies by less than 0.75dB over the frequency range and the gain is constant to within 6dB.

The vacuum envelope is of a rugged metal-ceramic construction permitting rigorous high temperature processing which ensures long life. This form of construction reduces unintentional variability and ensures maintenance of performance under severe environmental conditions.

RF connections are made by means of waveguide WG18, and power supplies to a BA15P plug (Ether Ltd). Alternative power supply connectors or flying leads can be provided to order. As an aid to the equipment designer the tube is fully insulated and cathode, helix or collector may be grounded.

HEATER

Vh	6.3 ±1%	V
Ih (approx)	0.25	A
Ih (surge) (max)	1.5	A

RATINGS (Absolute)

	Min.	Max.	
Vcoll	Vhelix	1650	V
Vhelix	1100	1400	V
Vg4	—	800	V
Vg3	—	600	V
Vg2	—	500	V
—Vg1	250	0	V
Ihelix	—	1.0	mA
Ig (on any grid)	—	50	μA
thk	2	—	min

TYPICAL OPERATION

			Notes
Frequency range	12.0 to 18.0	GHz	
Vcoll	Vhelix + 200	V	1,2,5
Vhelix	1100 to 1300	V	1,2,5
—Vg1	50 to 0	V	1,2,5
Vg2	0 to 200	V	1,2,3,5
Vg3	0 to 300	V	1,2,5
Vg4	75 to 400	V	1,2,5
Ihelix	0 to 200	μA	4
Icoll	300 to 600	μA	1,5
*Max. noise factor	13.5	dB	6
†Min. small signal gain	30	dB	6
†Max. small signal gain	40	dB	6
†Max. gain variation (12.0 to 18.0GHz)	6	dB	6
‡Min. power output (Saturated)	3	dBm	6
Max. v.s.w.r. (input)	2.5:1	—	6
Max. v.s.w.r. (output)	2.5:1	—	6

Notes

1. Specified for each tube. Voltage should be capable of adjustment over the range quoted.
2. All voltages with respect to cathode. Collector, helix or cathode may be earthed.
3. Adjust Vg2 to give the collector current specified for the tube.
4. It is advisable to provide a protection device to remove all voltage supplies, except heater, if the helix current exceeds ImA.

5. The necessary voltage installation accuracy and power supply stability will depend on the tolerable deviation from optimum r.f. performance. Information will be supplied on request.
6. A very significant improvement in r.f. performance is possible over narrow bandwidths (500–1000MHz). Details of performance are available on request.

*See Fig. 2.
†See Fig. 3 and 5.
‡See Fig. 4.

INSTALLATION AND ALIGNMENT

1. Connect power supply and waveguide to the tube.
2. Apply rated heater voltage for a period of two minutes. The full rated heater voltage may be applied instantaneously.
3. Set grid 2 to zero volts and all other voltages as shown on the tube label.
4. Increase the grid 2 voltage to the value shown on the tube label.
   Collector current should then agree approximately with that shown on the label.

After initial installation and setting of voltages, subsequent switching procedure may be as follows:-

a) As 2 above.
b) All other voltages may then be immediately applied at preset values providing that the grid 2 voltage is not achieved before the helix voltage.

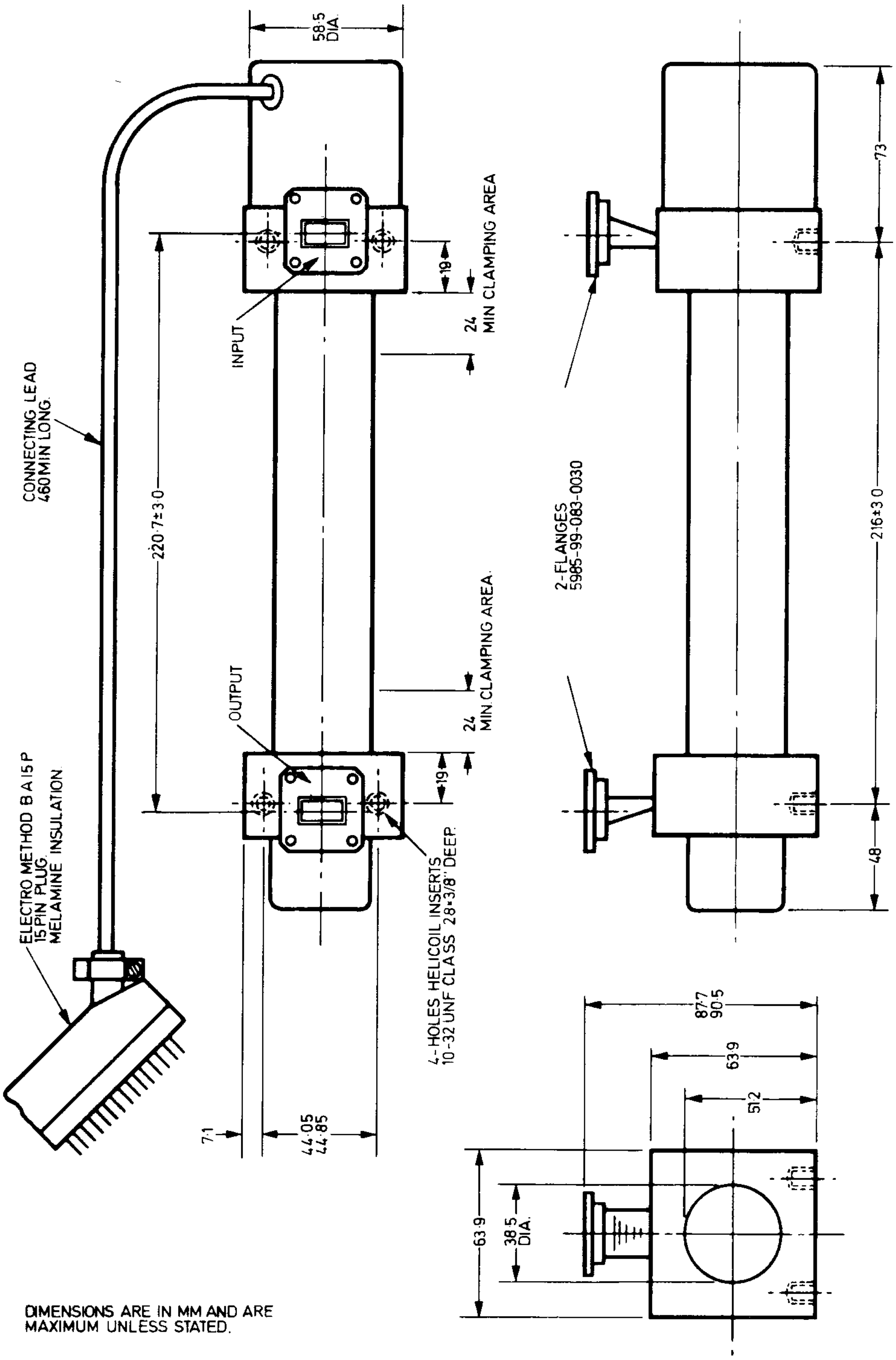
AMPLIFIER CONNECTIONS

Pin A:	NC
B:	NC
C:	Grid 1
D:	Helix
E:	Collector.
F:	Grid 4
H:	Grid 3
Pin J:	Grid 2
K:	NC
L:	Cathode
M:	Heater
N:	Heater/Cathode
P:	Capsule earth
R:	NC
S:	NC

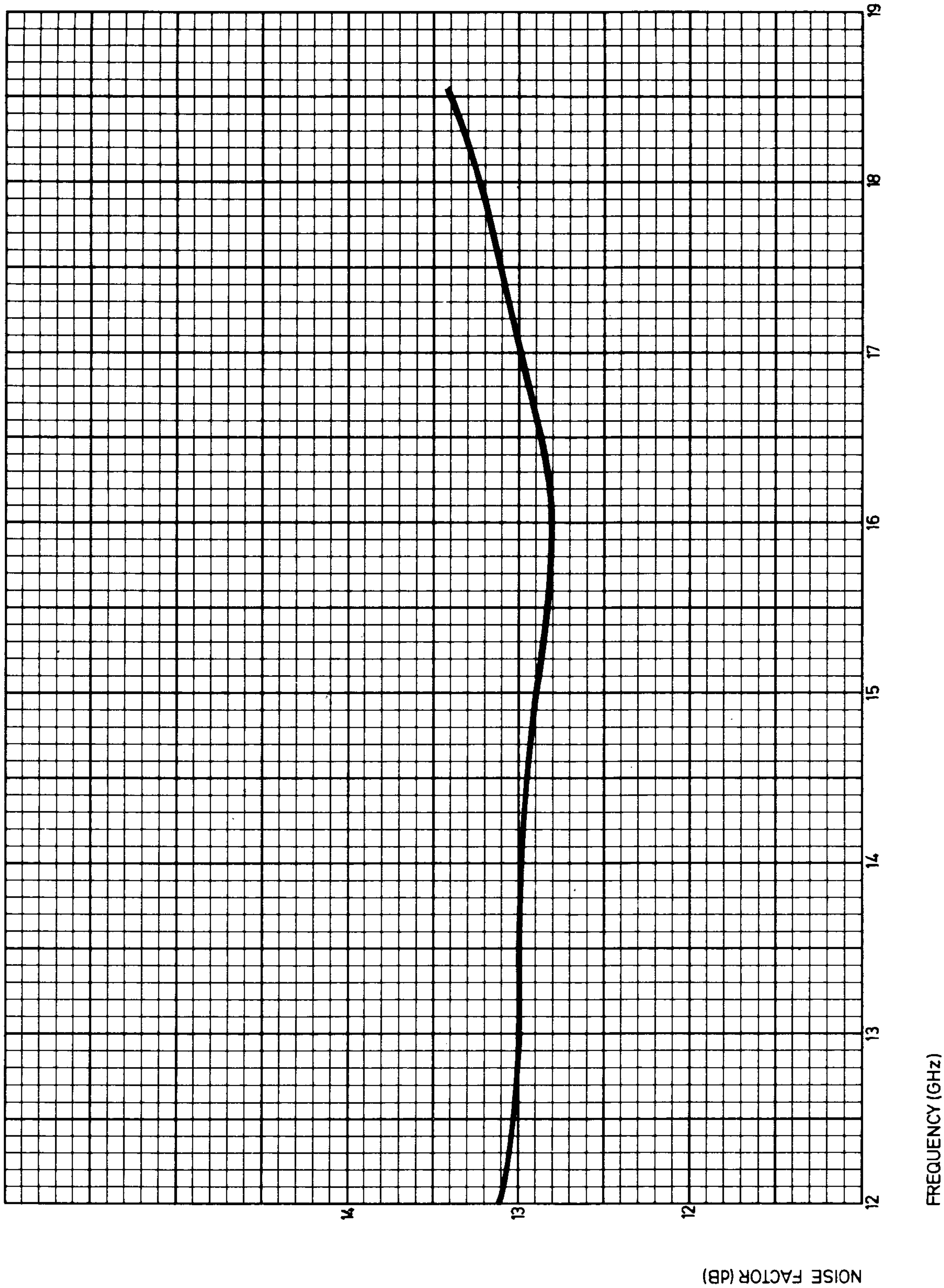
POWER SUPPLY

A suitable G.E.C. power supply is available from The M-O Valve Co. Ltd.

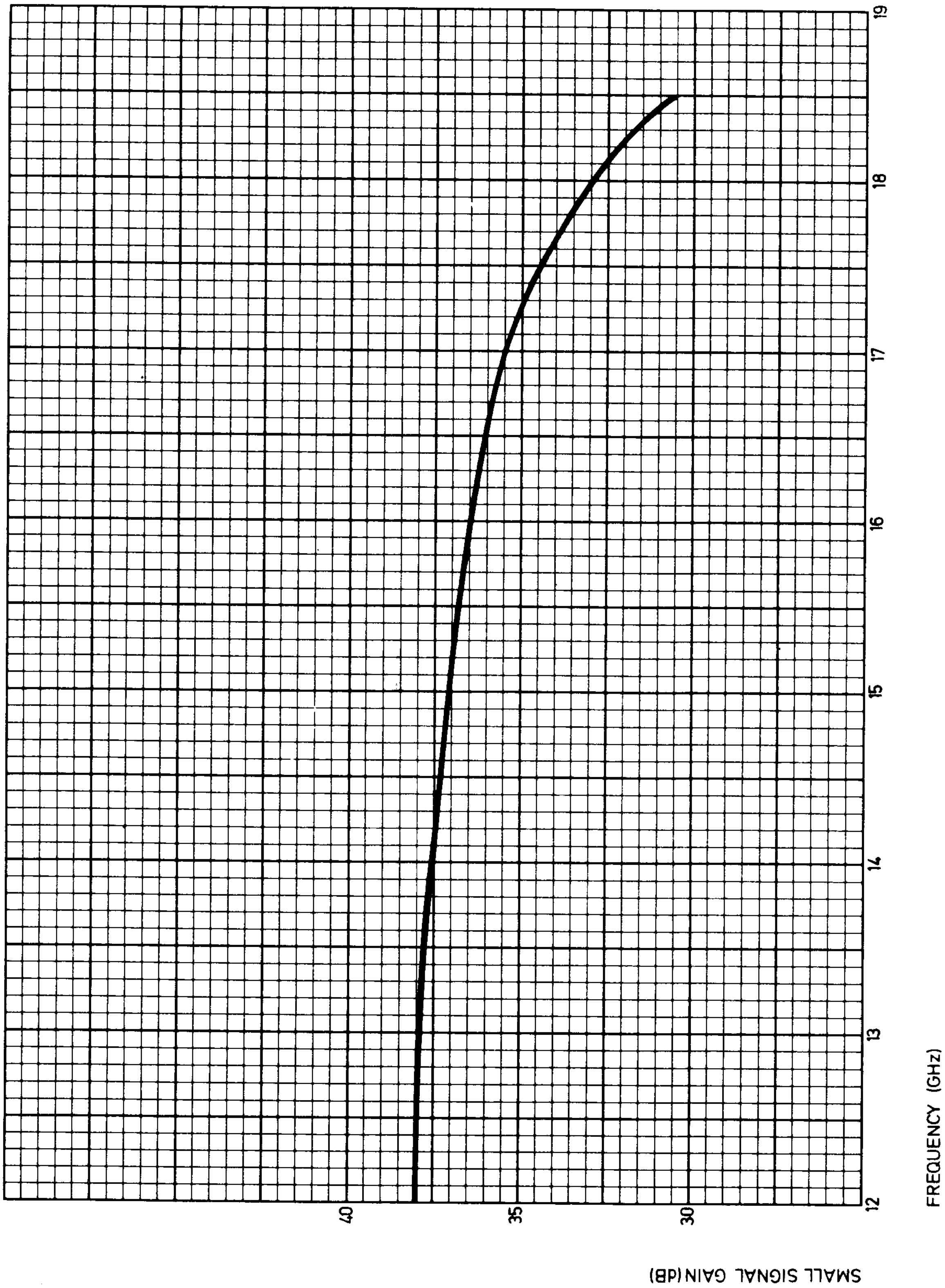
OUTLINE


58·5 DIA.
CONNECTING LEAD 460MIN LONG.
INPUT
OUTPUT
19
24 MIN CLAMPING AREA
24 MIN CLAMPING AREA.
220·7±3·0
ELECTRO METHOD B A15P 15PIN PLUG. MELAMINE INSULATION
4-HOLES HELICOIL INSERTS 10-32 UNF CLASS 2B×3/8" DEEP.
7·1
44·05 44·85
2-FLANGES 5985-99-083-0030
73
216±3·0
48
87·7 90·5
63·9
51·2
63·9
38·5 DIA.
DIMENSIONS ARE IN MM AND ARE MAXIMUM UNLESS STATED.

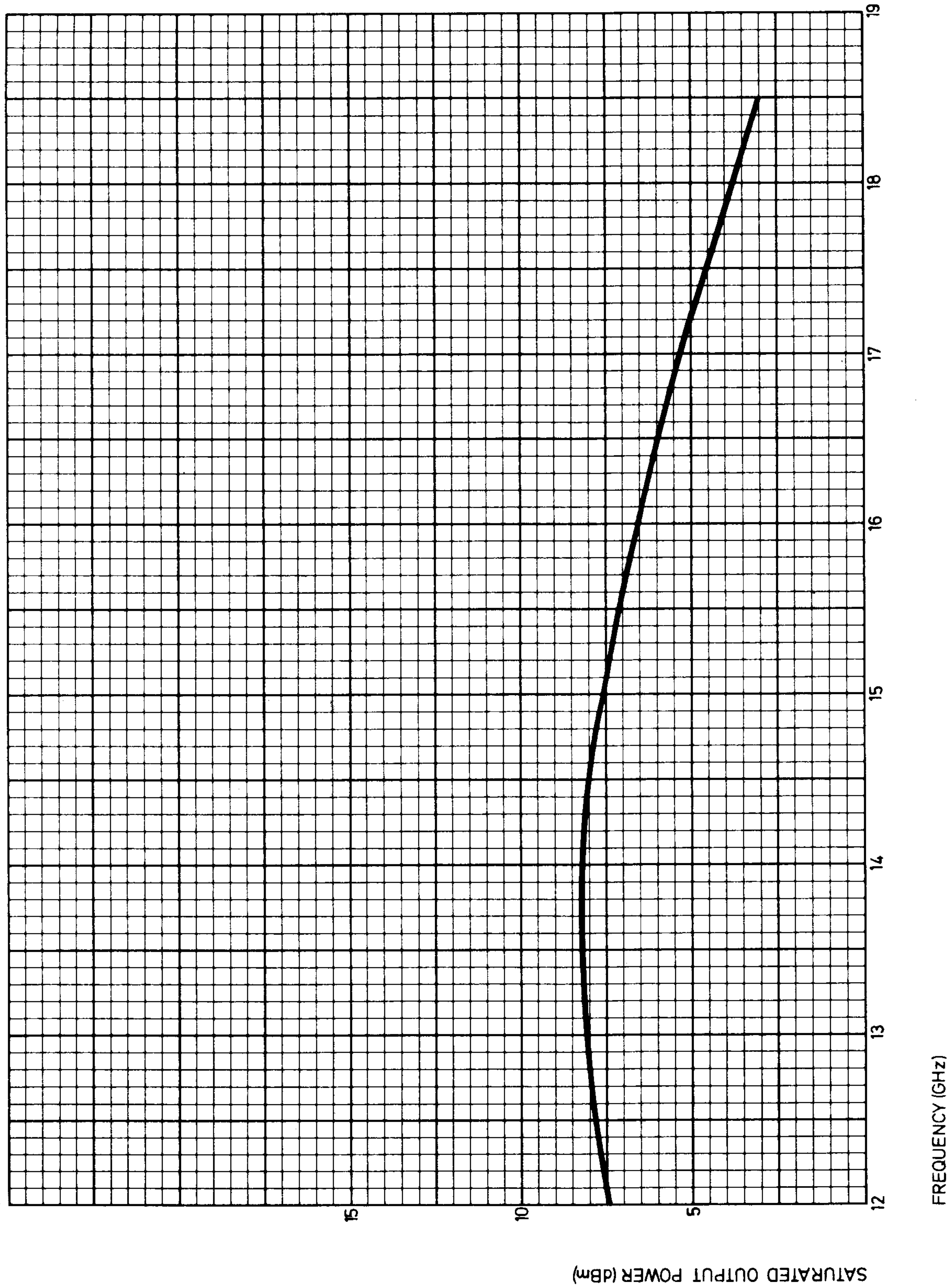
NOISE FACTOR – FREQUENCY



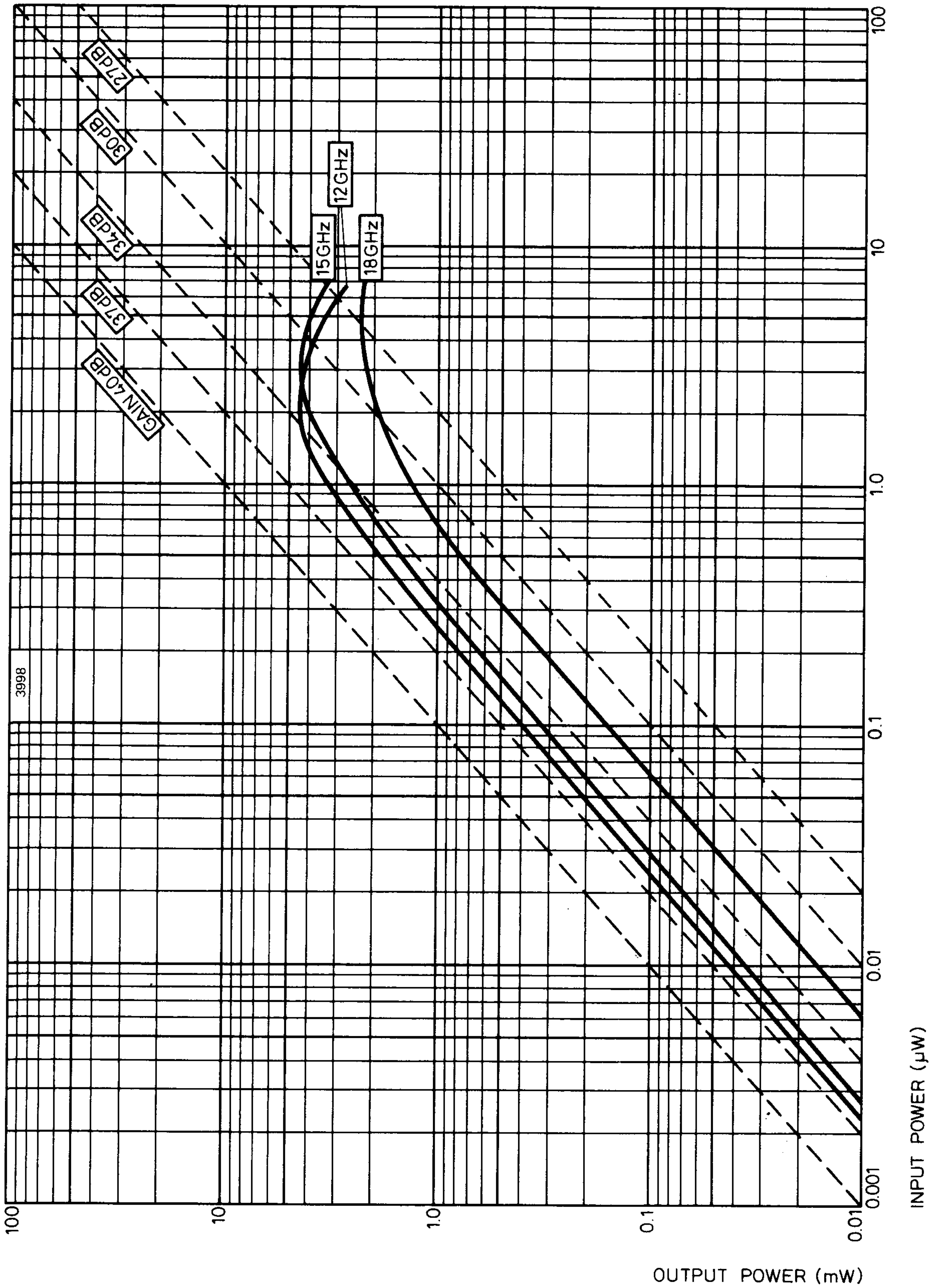
SMALL SIGNAL GAIN – FREQUENCY



SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



TWJ 33

G.E.C.

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise travelling wave amplifier with integral power supply giving a gain of 30 to 40dB over the frequency range 12.0 to 18.0GHz and a noise factor better than 13.5dB.

DESCRIPTION

Simplicity of installation and low cost replacement combined with excellent broadband performance has been achieved by combining a rugged travelling wave tube amplifier package with a stabilised power supply. Modular construction has been adopted, allowing considerable flexibility and space saving and, since the tube and power supply are separable, replacement costs are minimised. A built in correction circuit compensates for changes in performance with life so no adjustment is required in operation. The power input requirement is 115V or 240V a.c. at 50/60Hz or 28V d.c. at 1A. The amplifier is normally adjusted at the factory for optimum broadband performance but it is possible for this to be upgraded at discrete frequencies on request. R.F. connections are made by means of waveguide WG 18.

Under broadband conditions the noise factor is typically better than the stated maximum. The dynamic range is 30dB for full bandwidth operation, increasing to 67dB for operation over 1MHz. The maximum gain variation over the frequency range is typically 5.5dB and the noise factor varies by less than 0.75dB.

Complete magnetic shielding allows tubes to be operated side by side and eliminates interference with companion equipment.

POWER SUPPLIES

The units can be supplied to operate from alternative inputs:-

1. 115V or 240V ± 10%
   Single phase
   50/60Hz

or

2. 28V d.c.
   at 1A.

Connections

Plug type:	Bendix PTO 6E-8-4S (SR) Supplied
Pin A.	Neutral
B.	Line
C.	Earth (connected to case)
D.	No connection

Controls

Power on/off switch with associated indicator light. Remote switching facility can be provided to order.

TYPICAL OPERATION

Frequency range	12.0 to 18.0	GHz
Maximum noise factor	13.5	dB
Minimum small signal gain	30	dB
Maximum small signal gain	40	dB
Maximum gain variation over frequency range	6	dB
Minimum saturated power output	2	dBm
Maximum input VSWR (hot)	2.0:1	—
Maximum output VSWR (hot)	2.0:1	—
Minimum Isolation	55	dB

Notes

A significant improvement in r.f. performance is available over narrow bandwidths (500 to 1000MHz). Details are available on request.
The tube gives useful performance up to 18.5GHz (see performance characteristics).

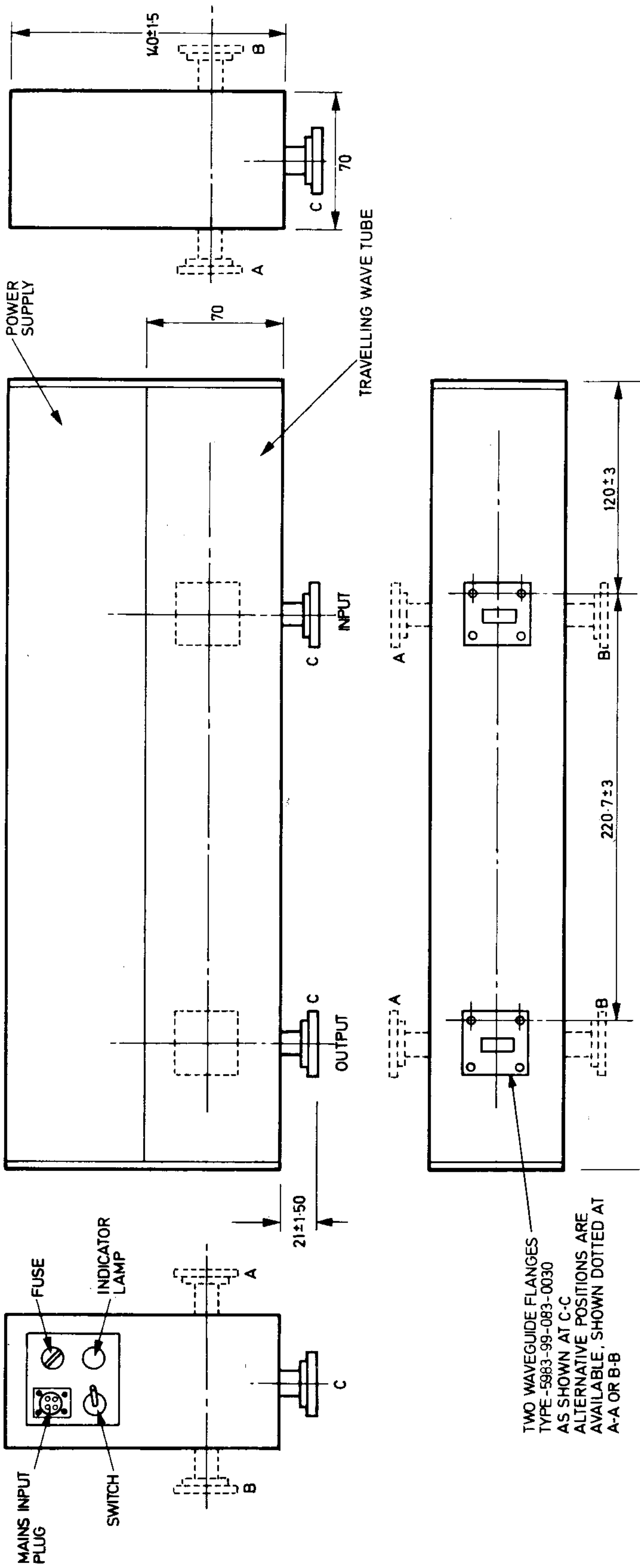
INSTALLATION

Apply mains input to the 4 pin bayonet connector on the front panel using the socket provided.
Connect r.f. input and output using standard waveguide WG18 connectors. The r.f. input level should not be allowed to exceed 250mW c.w.
Switch on. The red indicator light will glow. After a 90 second automatic delay the amplifier will be operational.

Warning

On no account should internal adjustments be made to the power supplies. Alignment requires precision measuring facilities and broadband performance will be lost if power supply controls are adjusted indiscriminately. Damage to the power supply or the tube may be caused by random adjustment.

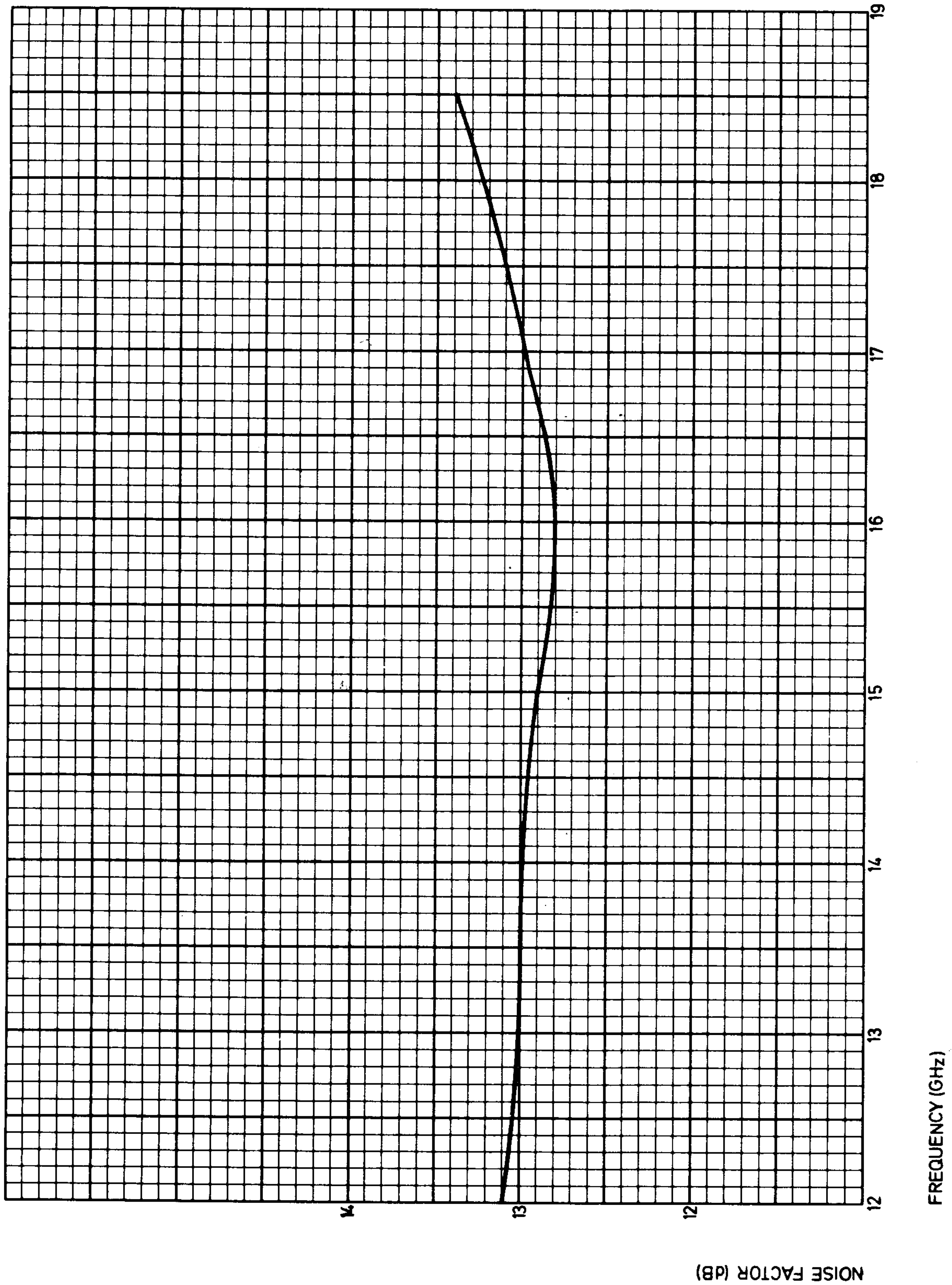
OUTLINE



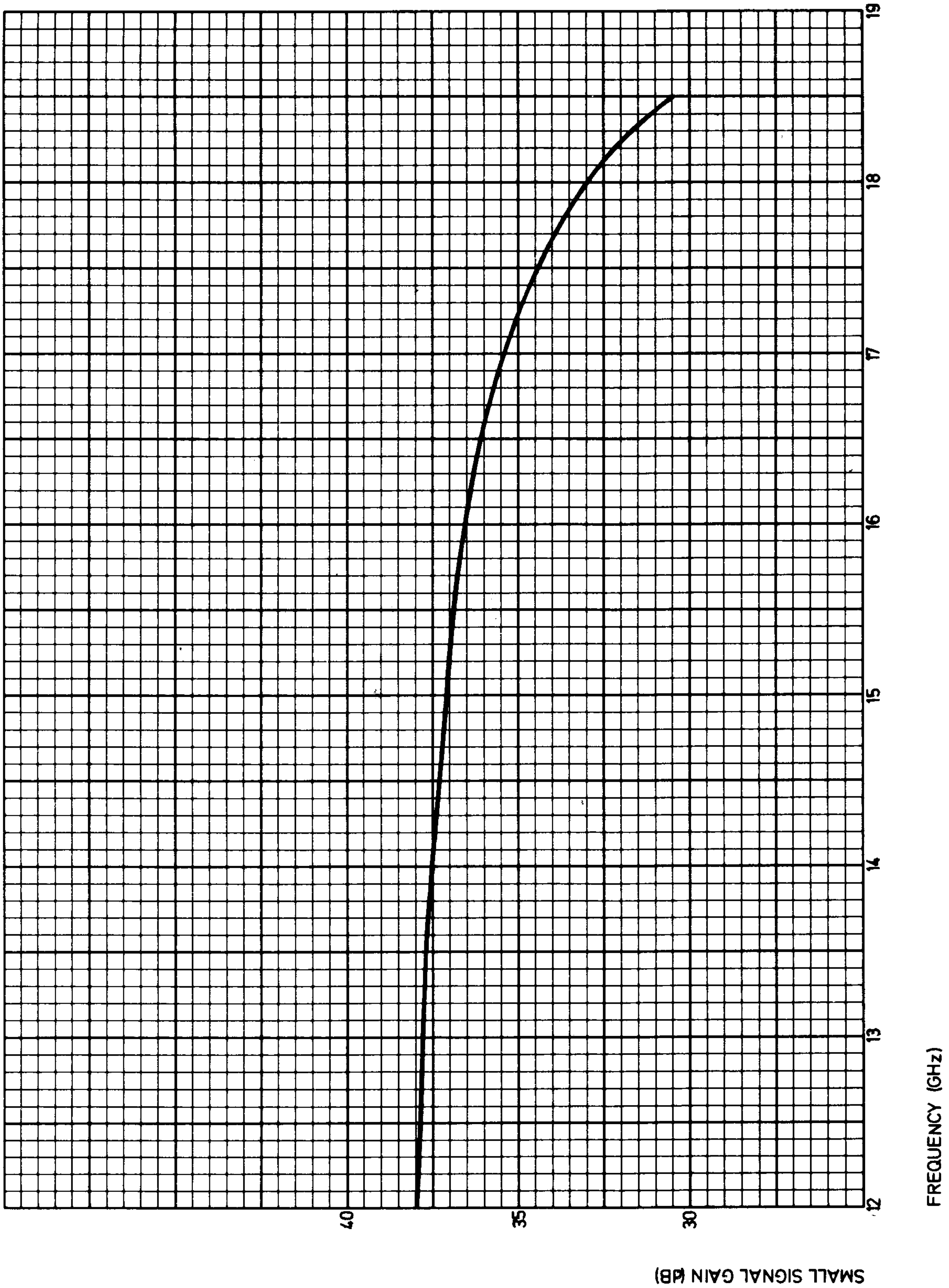
Dimensions in mm

OUTLINE DRAWING OF INTEGRAL POWER SUPPLY AND T.W.T. PACKAGE

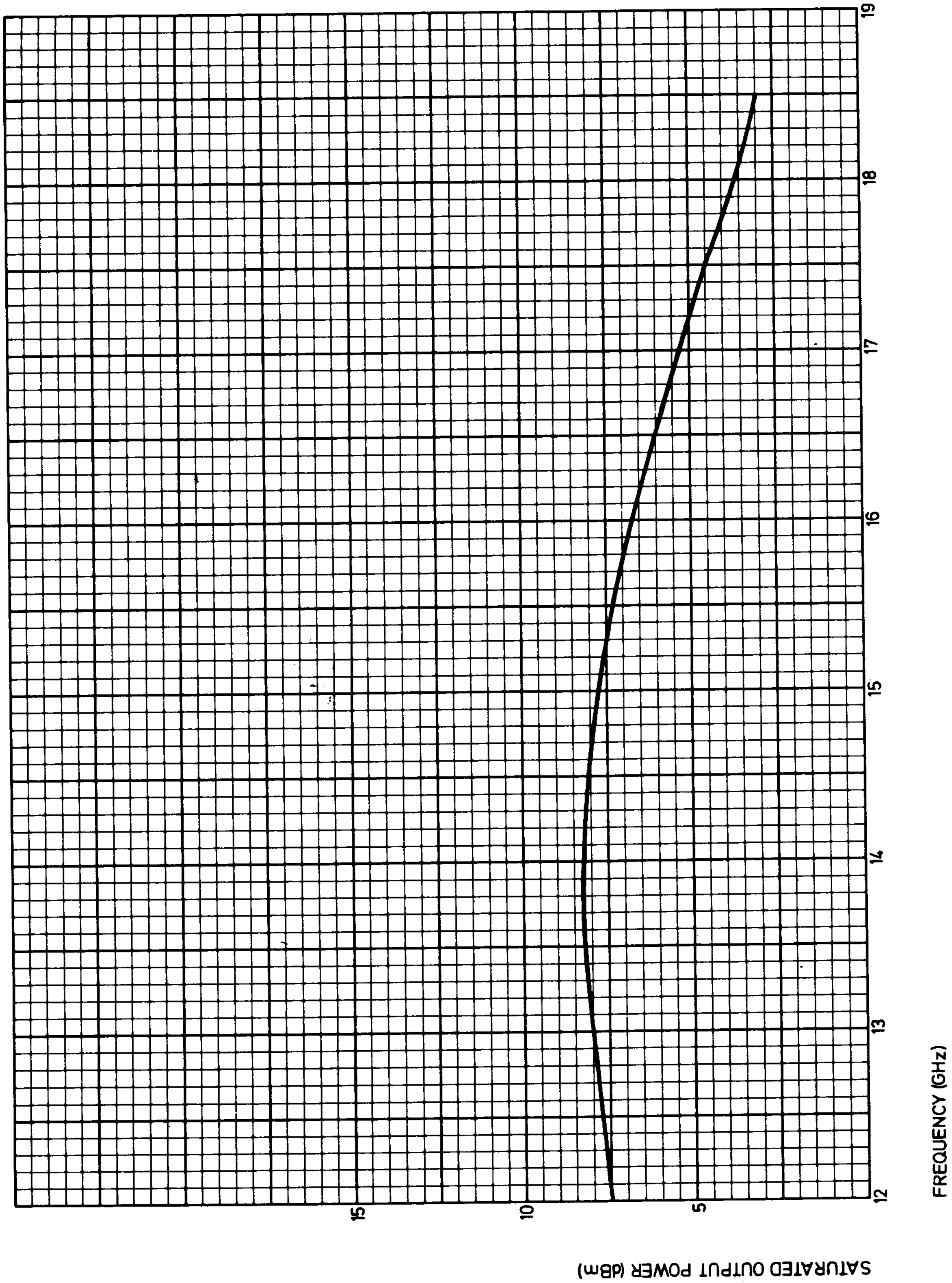
NOISE FACTOR – FREQUENCY



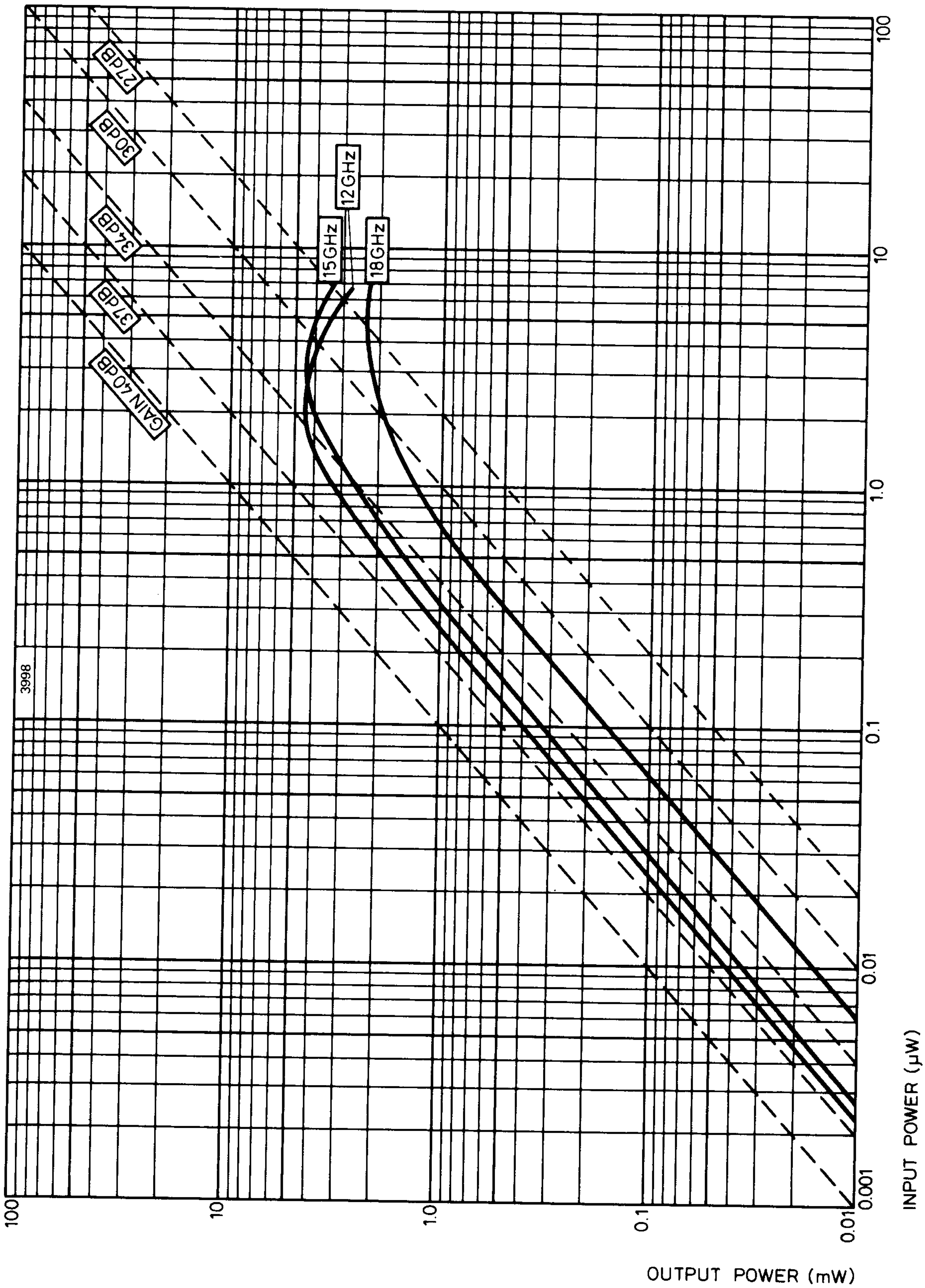
SMALL SIGNAL GAIN – FREQUENCY



SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

The TWS6 is an S-band travelling wave amplifier, having a gain of 20dB at a power output of 0.5W over a wide band centred on 3300MHz. It has a noise figure of less than 25dB.
The tube is supplied in a cylindrical capsule which greatly simplifies replacement in the solenoid and includes the r.f. couplings.
The capsule should be used in the recommended solenoid mount assembly, Type SMS6, described below.

HEATER

V_h	3.5 ± 3%	V
I_h (approx)	4	A

MAXIMUM RATINGS (Absolute)

*† V_{coll}	3.0	kV
*† V_{helix}	2.5	kV
† V_{g2}	2.5	kV
V_h	4.0	V
I_h (surge)	8.0	A
I_{coll}	20	mA
I_{helix}	1.5	mA
I_{g2}	1.5	mA
$T_{capsule}$	140	°C
t_{hk}	2	min
VSWR load	5:1	

*The collector voltage must be at least 50V positive with respect to the helix voltage.
†All voltages are measured with respect to cathode. The collector is normally earthed. Grid 2 voltage must not be applied before the helix voltage.

TYPICAL OPERATION (Using the recommended solenoid mount assembly over the frequency range 2.50 to 4.10GHz)

*V_{coll}	2.4	kV
*†V_{helix}	2.0–2.3	kV
‡V_{g2}	0.7–1.1	kV
I_{coll}	15	mA
§I_{helix}	0–1.0	mA
I_{g2}	0–1.0	mA
$I_{solenoid}$	4.0	A
$V_{solenoid}$ (approx)	16	V
Noise figure	21	dB
Power gain (at 0.5W output)(min)	20	dB
Saturated P_{out} (min)	1.0	W
Input and output VSWR (max)	3:1	

*The collector voltage must be at least 50V positive with respect to the helix voltage.

†Supply must be capable of continuous adjustment over the range 2.0 to 2.3kV. V_{helix} should be adjusted in operation for maximum output.

‡Supply must be capable of continuous adjustment over the range 0.4 to 2.0kV. V_{g2} should be adjusted in operation for I_{coll} = 15mA and must not be applied before the helix voltage.

§It is advisable to provide a relay to remove the high voltage supplies if I_{helix} exceeds 1.5mA.

BASE CONNECTIONS

Base: B8–0 (Octal)

1. heater
2. IC
3. NP
4. grid 2
5. IC
6. helix
7. NP
8. heater, cathode, grid 1

The capsule is connected to the collector.

R.F. connectors optional: Type C or Type N coaxial.

Dimensions: See outline

INSTALLATION

If the capsule is to be mounted with its axis other than in the horizontal plane, forced air cooling of the collector cooler may be required in order to keep within the maximum capsule temperature rating of 140°C.

The capsule should be used with the complete solenoid mount assembly, Type SMS6, shown on page 5. This assembly contains a low resistance solenoid and a cylindrical mount, into which the capsule slides, making connections into a fixed octal socket.

The position of the cylindrical mount in the solenoid may be adjusted for optimum focusing and when capsules are replaced only small adjustments, if any, should be required.

Under no circumstances should the voltage across the solenoid exceed 32V and the current through it exceed 8.0A.

Upon initial installation, after applying the supply to the solenoid, the full voltages quoted above may be applied to the collector and the helix, but only 400V should be applied to the grid 2. This voltage should then be increased to the full operating value found necessary to give the required collector current, while the helix current is observed and the focusing adjusted if necessary. Subsequently, it should be possible to apply all the high voltage supplies simultaneously, after the application of the supply to the solenoid.

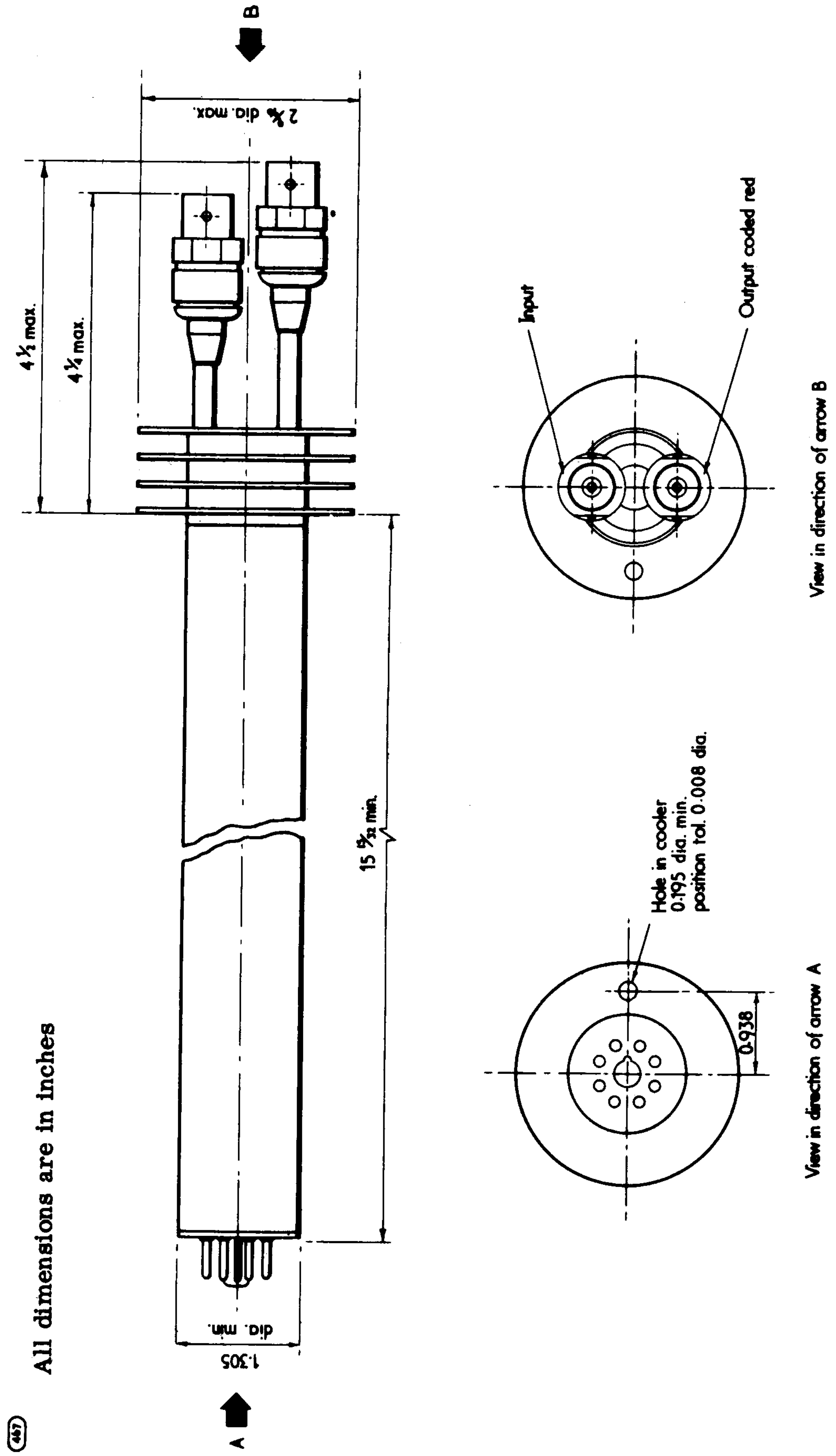
The solenoid mount assembly should be mounted by securing its smooth face so that it is in good thermal contact with an effective heat sink. The temperature of the outer surface of the solenoid mount assembly should not exceed 80°C. In certain environments, it may be necessary to provide forced air cooling for the solenoid mount assembly.

WEIGHT

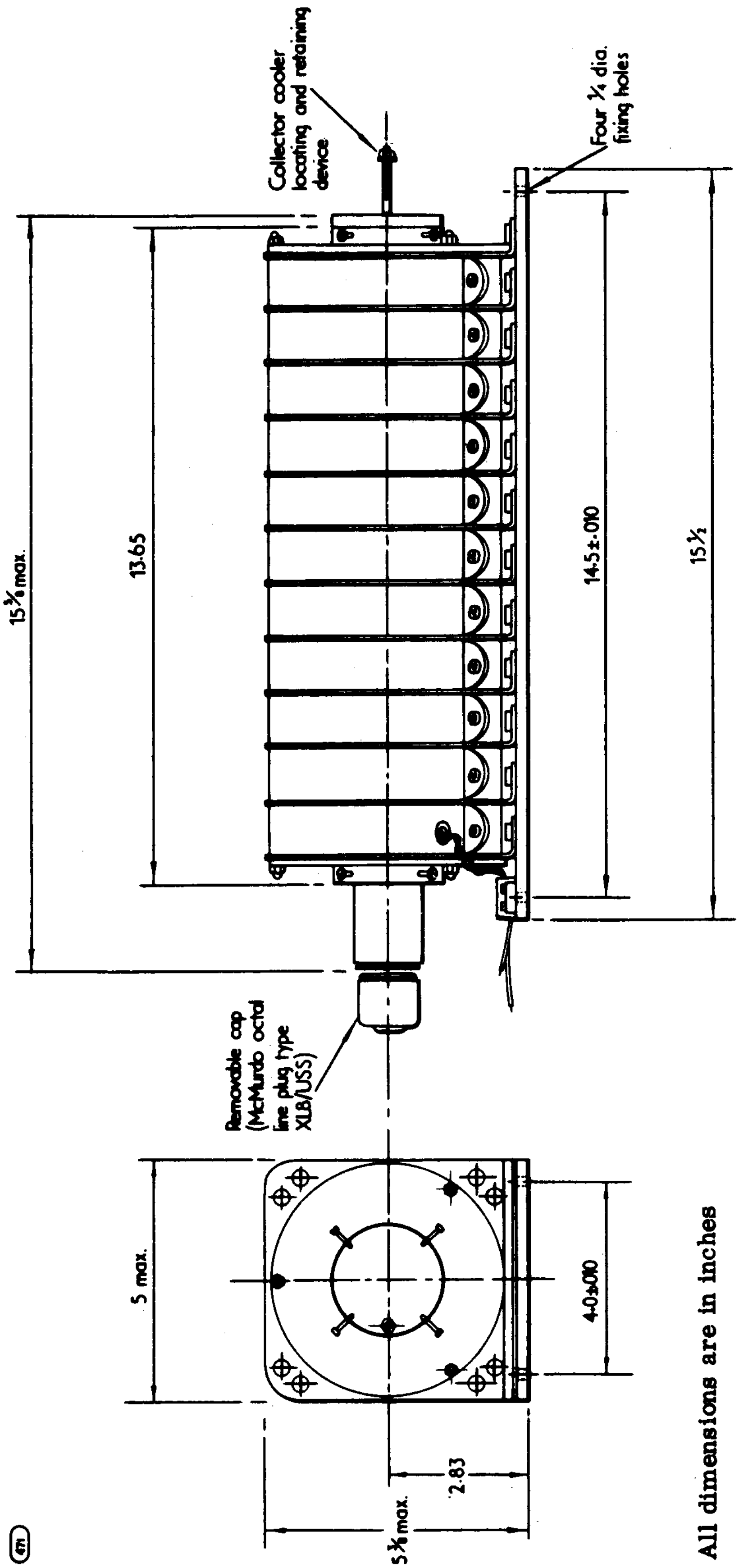
Tube and capsule : 1kg (2lb. 2oz.)

Tube in solenoid – Mount assembly : 19.75kg (43lb. 12oz.)

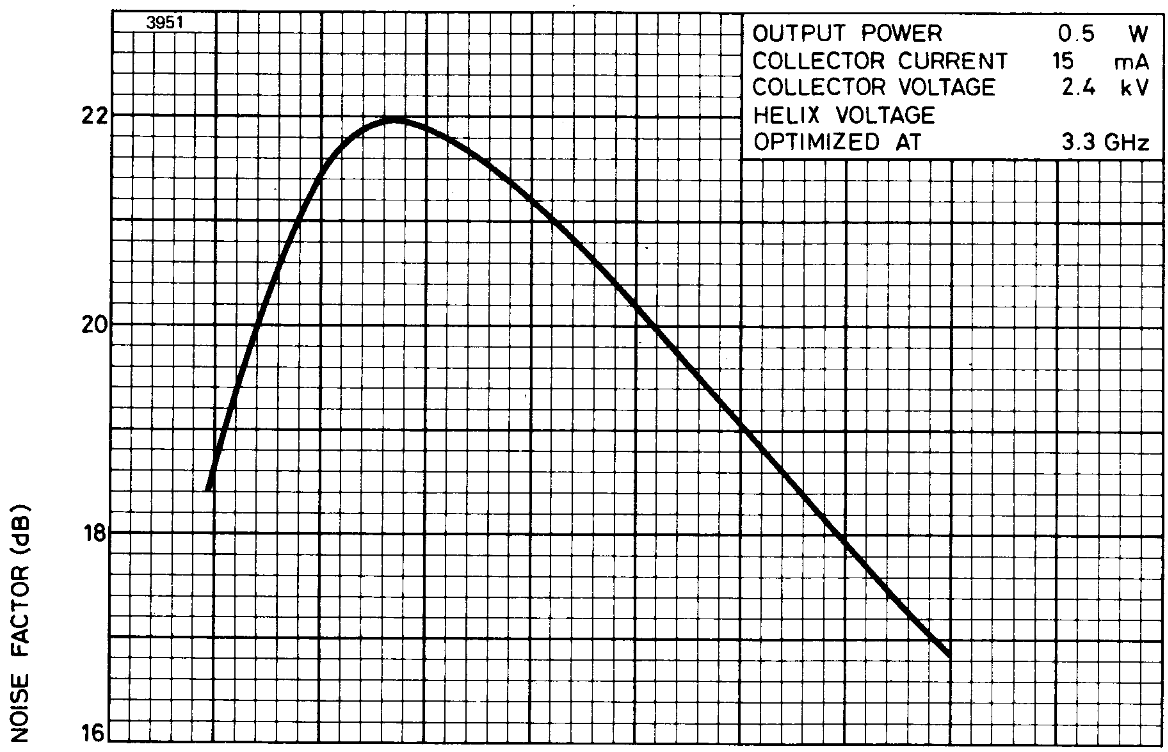
TUBE OUTLINE

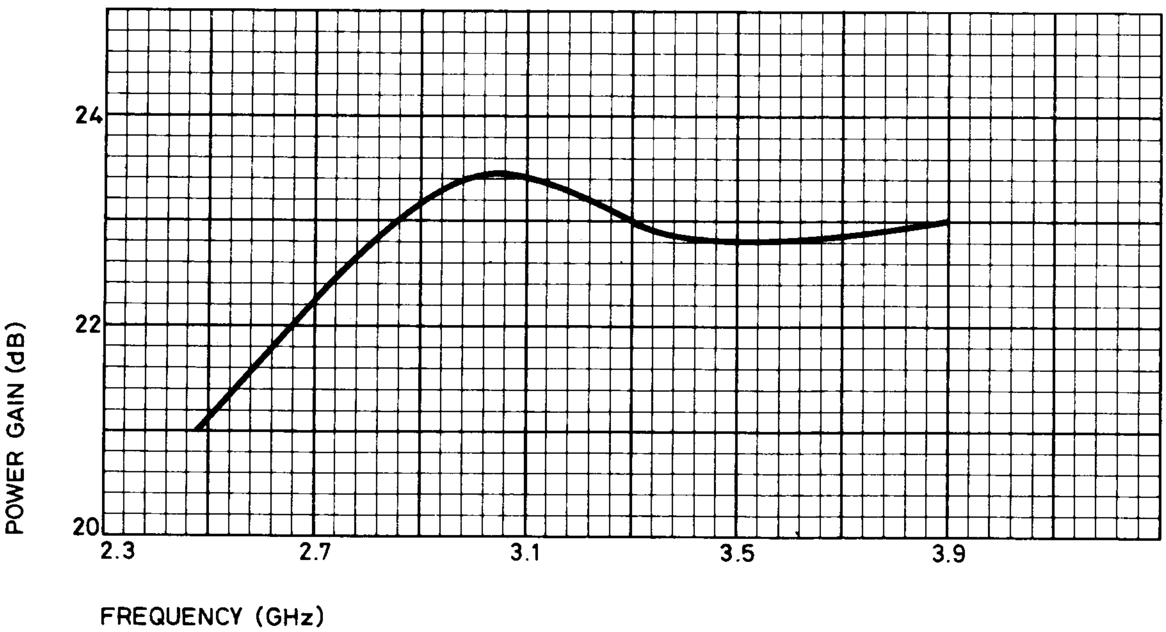


SOLENOID OUTLINE

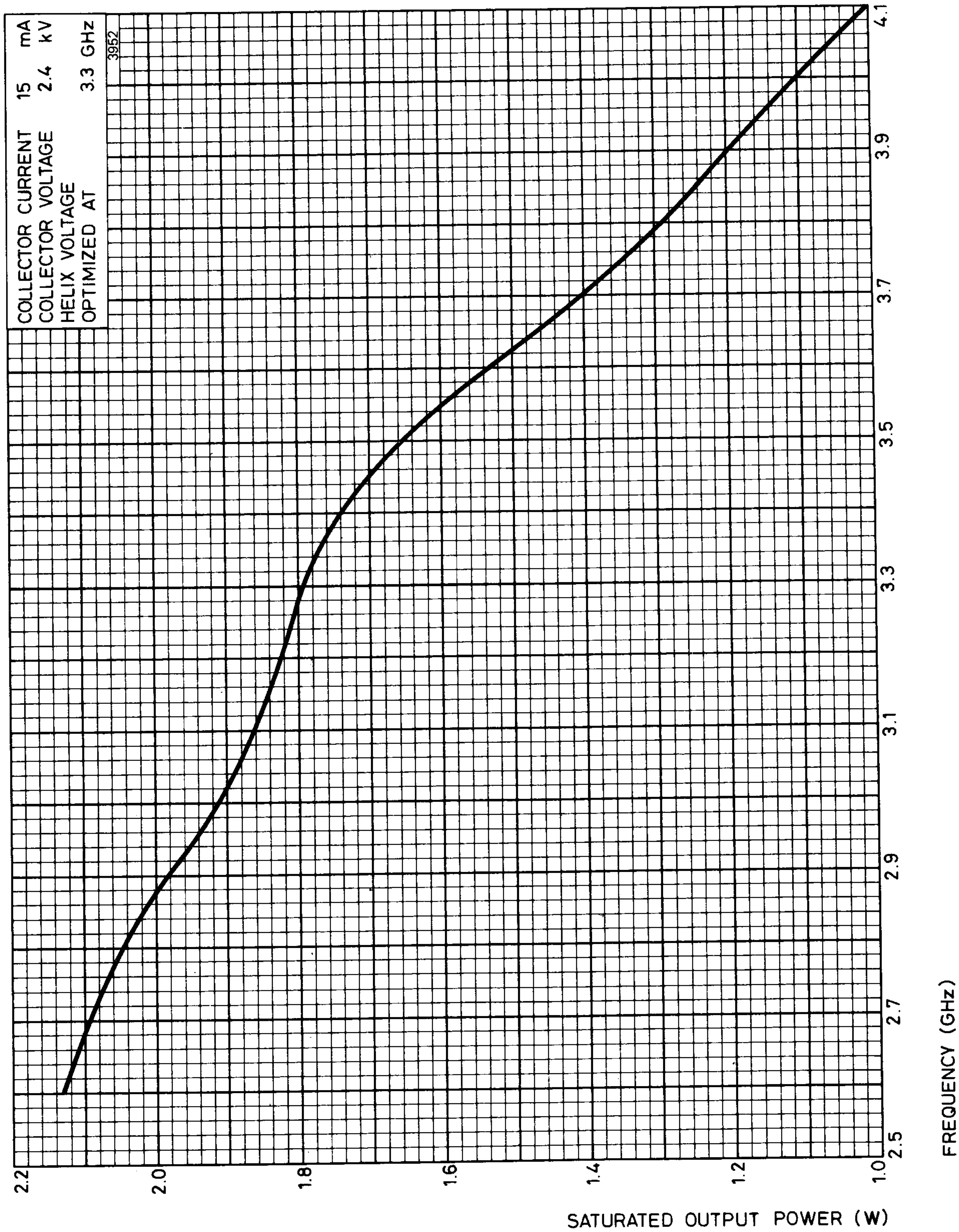


NOISE FACTOR AND POWER GAIN – FREQUENCY

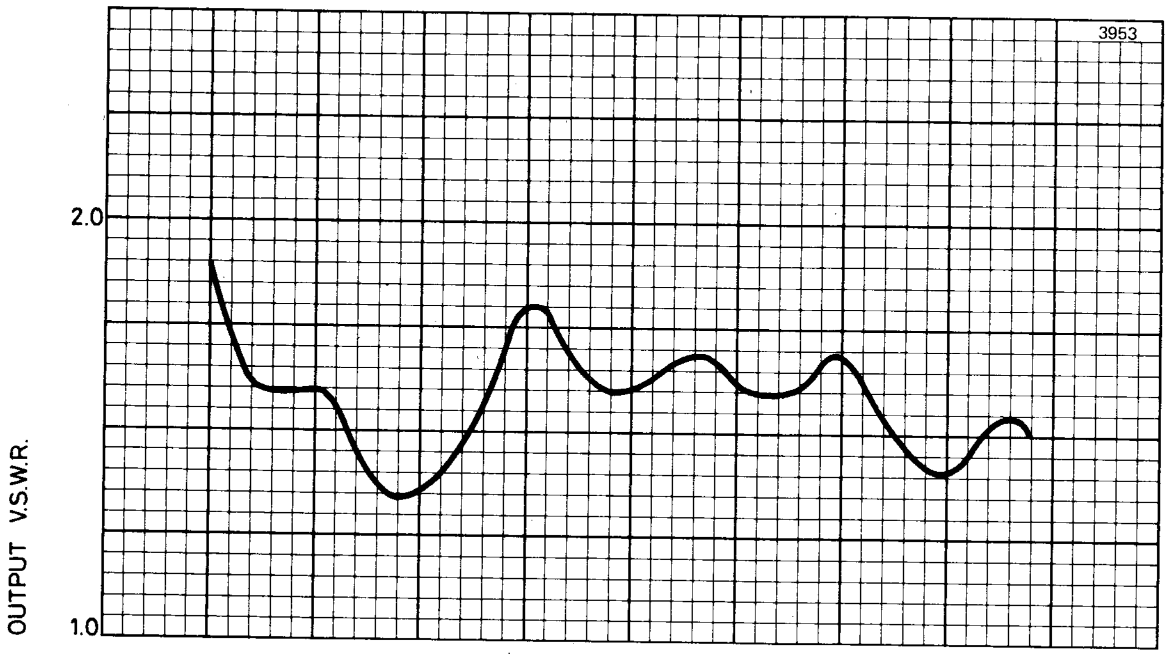


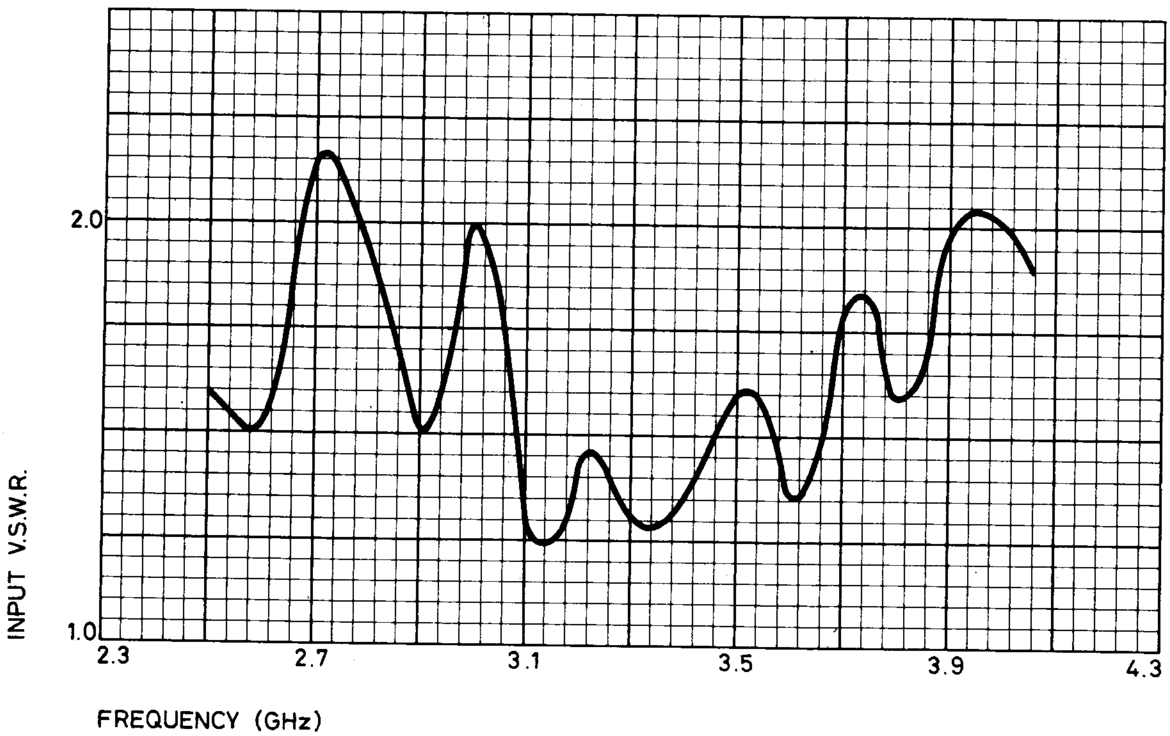


SATURATED OUTPUT POWER – FREQUENCY



MATCH – FREQUENCY (MEASURED COLD)





TWS7

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

The TWS7 is an S-band travelling wave amplifier, having a gain of 20dB at a power output of 2.0W over a 550MHz band centred on 3000MHz. The noise figure is less than 26dB.
The tube is supplied in a cylindrical capsule which includes the r.f. couplings and greatly simplifies replacement in the solenoid.
The capsule should be used in the recommended solenoid mount assembly, Type SMS7, described below.

HEATER

V_h	3.5 ± 3%	V
I_h (approx)	4.0	A

MAXIMUM RATINGS (Absolute)

$*V_{coll}$	3.0	kV
$*V_{helix}$	2.5	kV
$*V_{g2}$	2.5	kV
V_h	4.0	V
I_h (surge)	8.0	A
I_{coll}	25	mA
I_{helix}	1.5	mA
I_{g2}	1.5	mA
$T_{capsule}$	130	°C
t_{hk} (min)	2	min
VSWR load	5:1	

*All voltages are measured with respect to cathode. The collector is normally earthed. Grid 2 voltage must not be applied before the helix voltage.

TYPICAL OPERATION (Using the recommended solenoid mount assembly, over the frequency range 2.70 to 3.25GHz)

V_{coll}	2.4	kV
*V_{helix}	2.1–2.4	kV
†V_{g2}	0.8–1.4	kV
I_{coll}	22	mA
‡I_{helix}	0–1.5	mA
I_{g2}	0–1.0	mA
$I_{solenoid}$	6.0	A
$V_{solenoid}$ (approx)	24	V
Noise figure	23	dB
Power gain (at 2W output)(min)	20	dB
Saturated P_{out} (min)	3.0	W
Input and output VSWR (max)		
(over band 2.70–3.25GHz)	3:1	
(over band 2.80–3.10GHz)	2:1	
Gain flatness (over band 2.70–3.25GHz)	1.5	dB

*Supply must be capable of continuous adjustment over the range 2.1–2.4kV. V_{helix} should be adjusted in operation for maximum output.

†Supply must be capable of continuous adjustment over the range 0.8–1.4kV. V_{g2} should be adjusted in operation for I_{coll} = 22mA and must not be applied before the helix voltage.

‡It is advisable to provide a relay to remove the high voltage supplies if I_{helix} exceeds 1.5mA.

BASE CONNECTIONS

Base : B8–0 (Octal)

1. heater	5. IC
2. IC	6. helix
3. NP	7. NP
4. grid 2	8. heater, cathode, grid 1

The capsule is connected to the collector.

R.F. connectors optional : Type C or Type N coaxial.

Dimensions : See outline.

INSTALLATION

If the capsule is to be mounted with its axis other than in the horizontal plane, forced air cooling of the collector cooler may be required in order to keep within the maximum capsule temperature rating of 130°C.

The capsule should be used with the complete solenoid mount assembly, Type SMS7, shown on page 5. This assembly contains a low resistance solenoid and a cylindrical mount, into which the capsule slides, making connections into a fixed octal socket.

The position of the cylindrical mount in the solenoid may be adjusted for optimum focusing and when capsules are replaced only small adjustments, if any, should be required.

Under no circumstances should the voltage across the solenoid exceed 32V and the current through it exceed 8.0A.

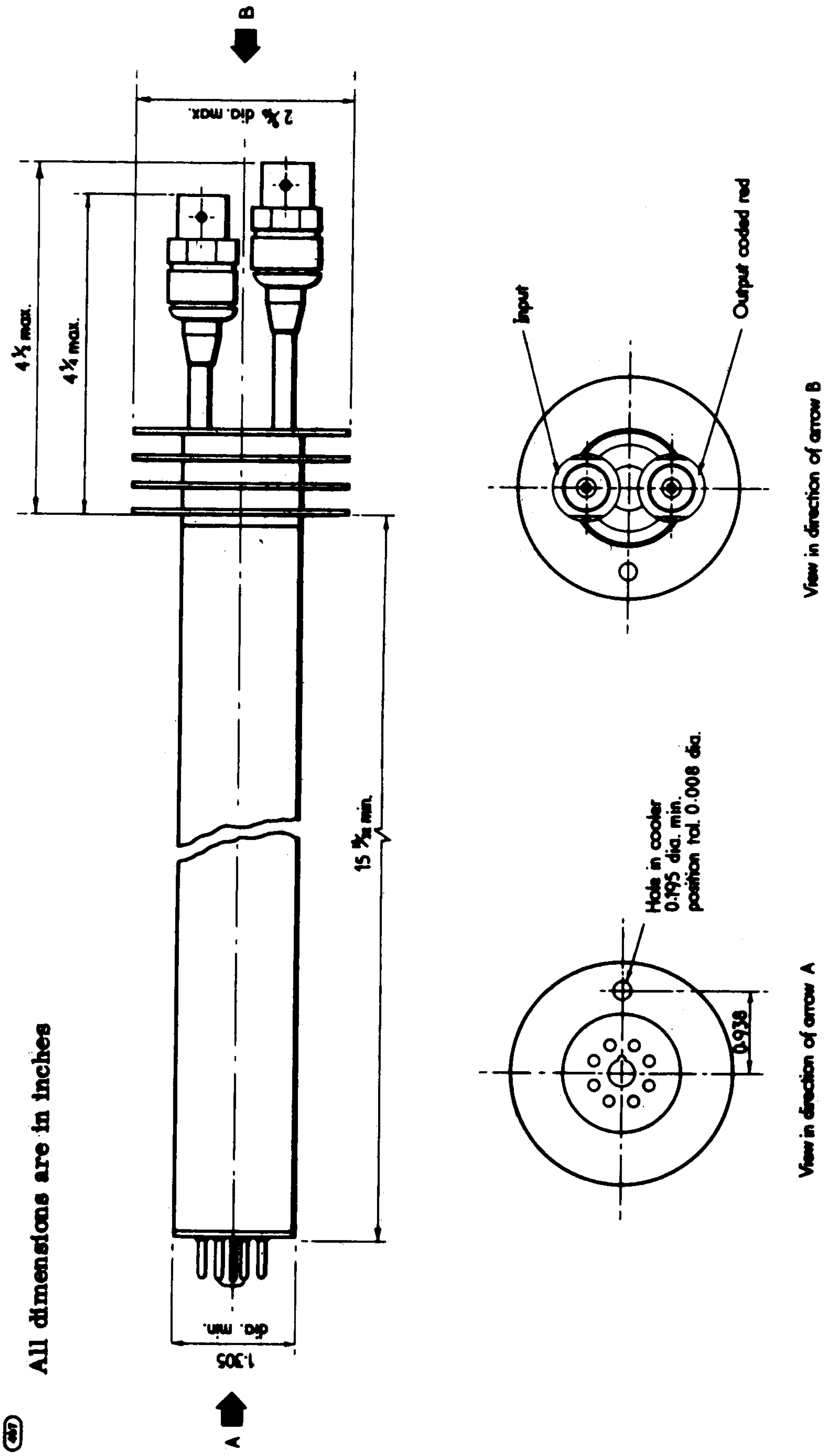
Upon initial installation, after applying the supply to the solenoid, the full voltages quoted above may be applied to the collector and the helix, but only 400V should be applied to the grid 2. This voltage should then be increased to the full operating value found necessary to give the required collector current, while the helix current is observed and the focusing adjusted if necessary. Subsequently, it should be possible to apply all the high voltage supplies simultaneously, after the application of the supply to the solenoid.

The solenoid mount assembly should be mounted by securing its smooth face so that it is in good thermal contact with an effective heat sink. The temperature of the outer surface of the solenoid mount assembly should not exceed 75°C. In certain environments, it may be necessary to provide forced air cooling for the solenoid mount assembly.

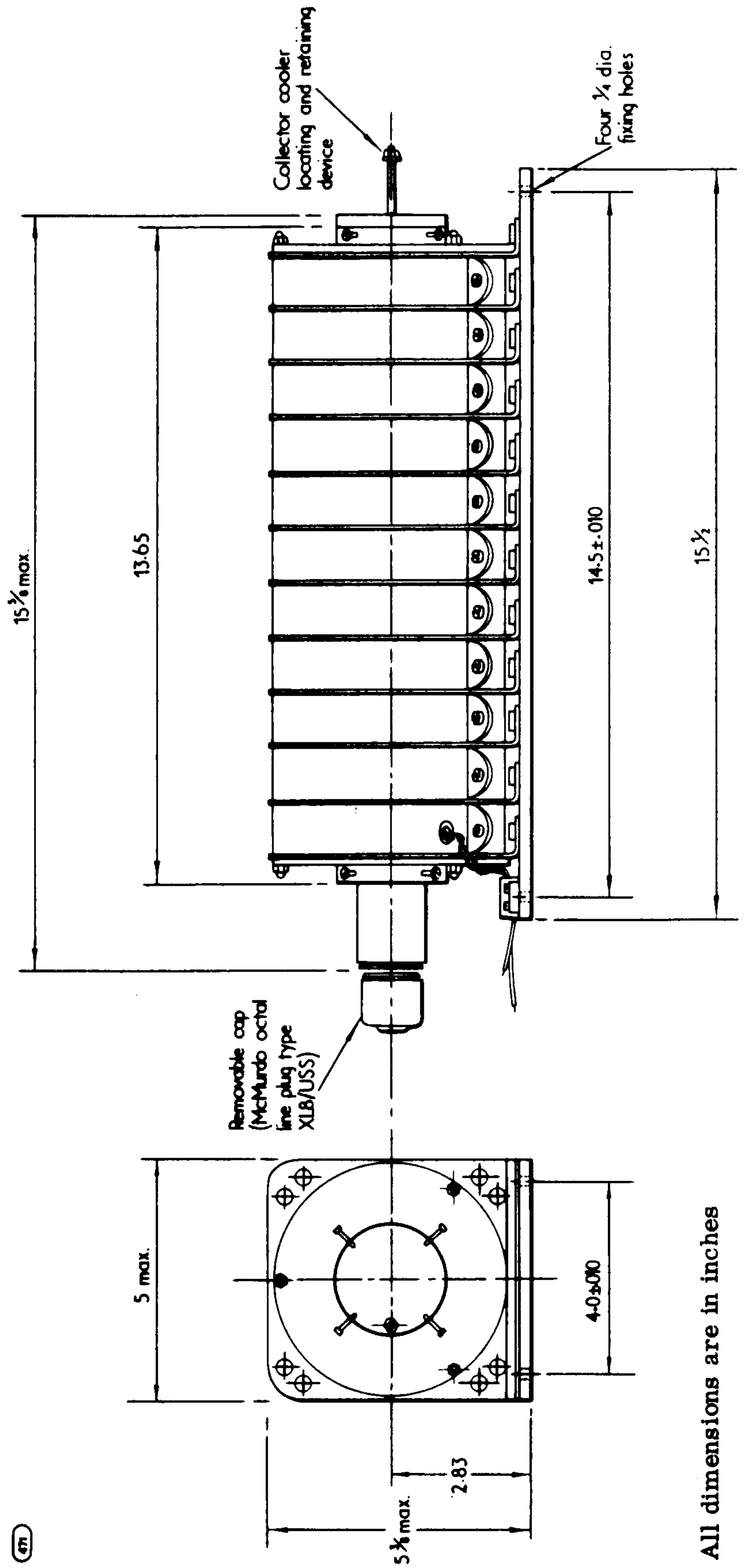
WEIGHT

Tube and capsule : 1kg (2lb. 2oz).
Tube in solenoid – Mount assembly : 19.75kg (43lb. 12oz.).

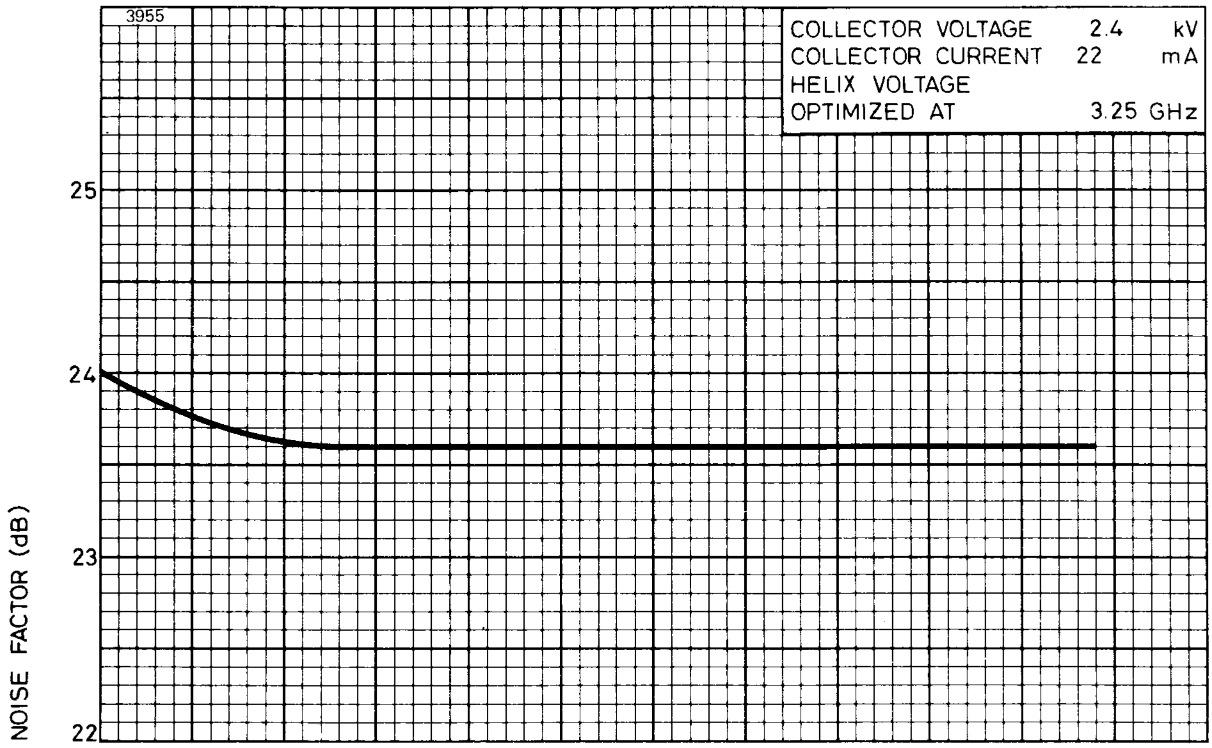
TUBE OUTLINE

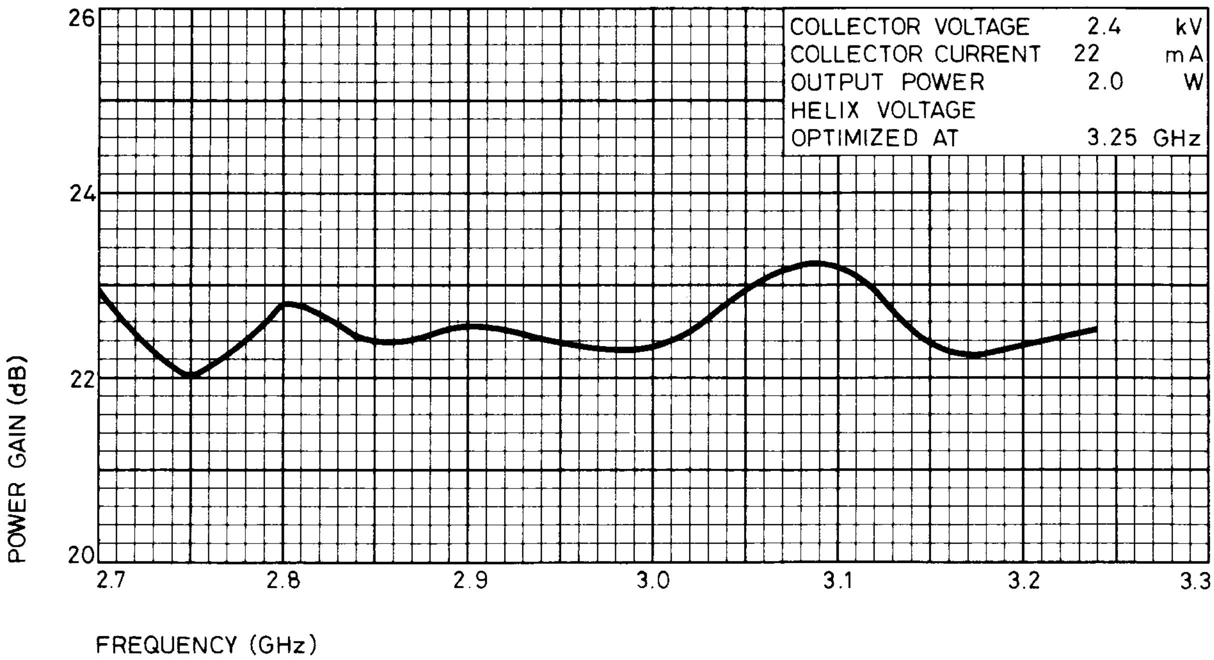


SOLENOID OUTLINE

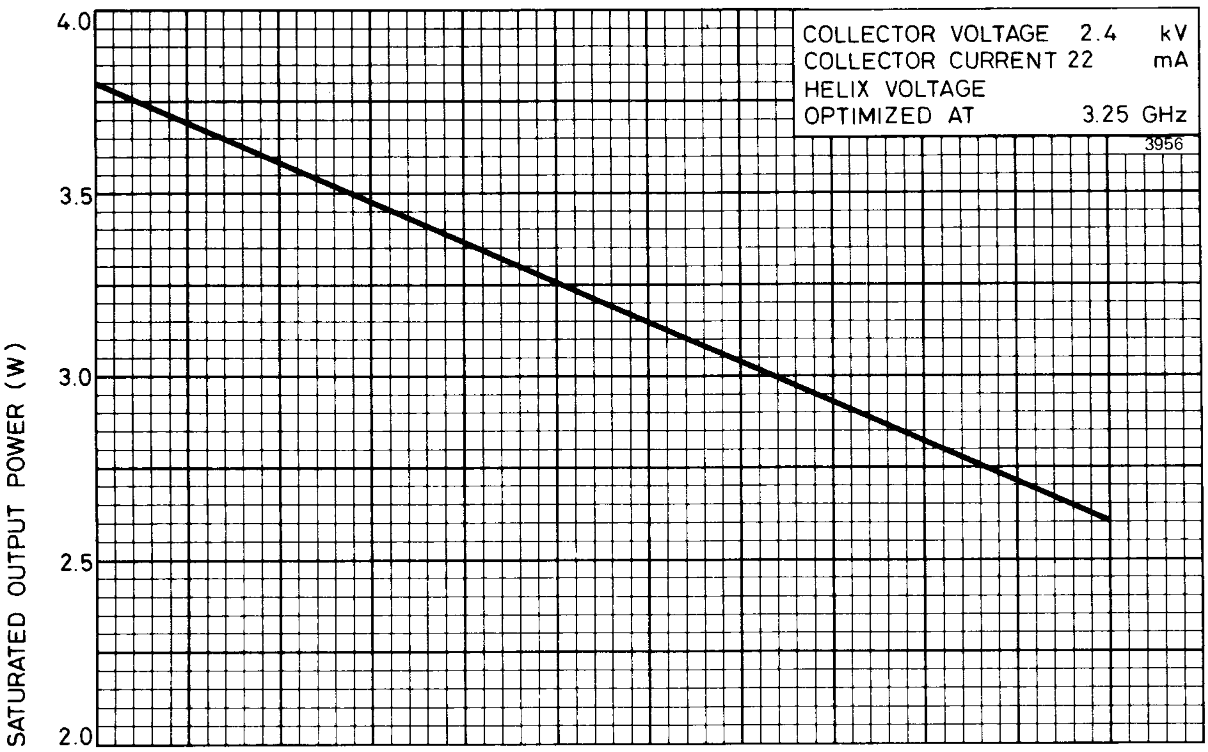


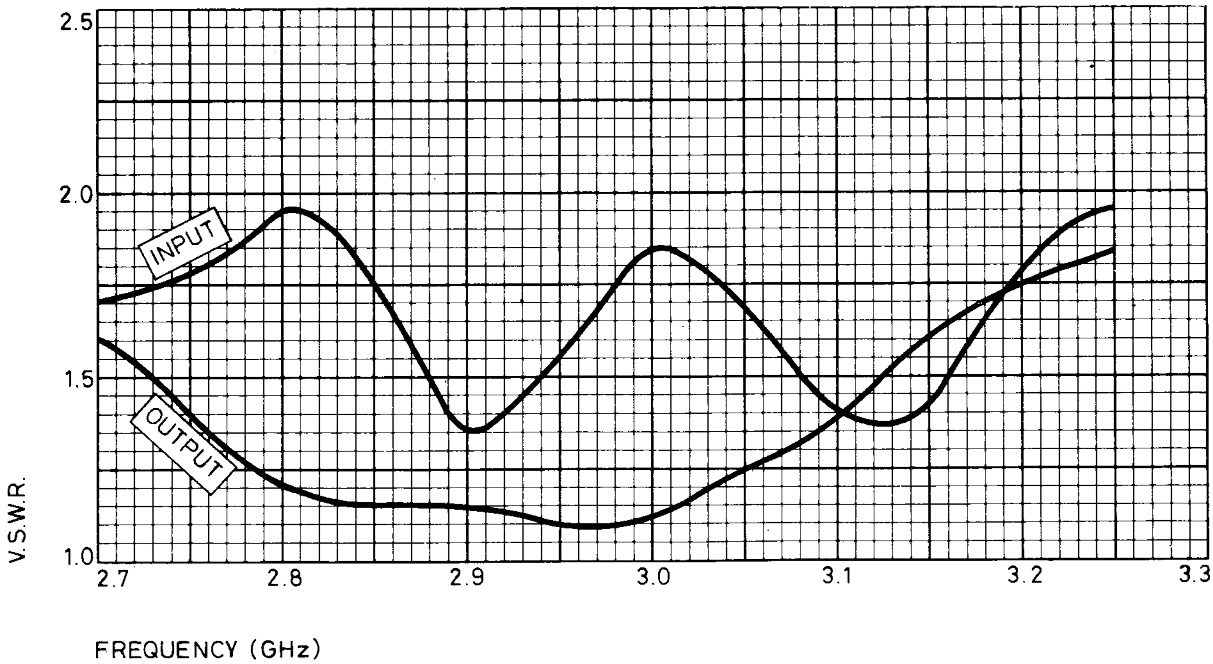
NOISE FACTOR AND POWER GAIN – FREQUENCY





SATURATED OUTPUT POWER AND COLD MATCH – FREQUENCY





THE M-O VALVE
COMPANY LIMITED

TWS10/7642

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

An S-band travelling wave power amplifier designed for use in telecommunications systems giving a small signal gain of better than 30dB and a minimum saturated output power of 18 watts in the frequency range 1.7GHz to 2.3GHz. The amplifier is designed for linear operation at output levels up to 10 watts and under these conditions reliability has been demonstrated by years of continuous use in world wide communications systems.
The amplifier is completely packaged in a periodic permanent magnet focusing assembly and coupled helix transitions to type N 50 ohm connectors ensure an excellent match which reduces fine structure gain variation and permits extended bandwidth operation at reduced gain over the frequency range 1.6GHz to 4.0GHz.
Rigorous processing schedules eliminate base-band noise peaks and the noise factor is typically better than 28dB.
Forced air cooling is required and a safety thermostat is incorporated which enables the tube power supplies to be removed in the event of a cooling failure.

AMPLIFIER CONNECTIONS

Connection of d.c. power supplies is by flying leads colour coded as follows:-

*Collector	Black
Helix	Orange
Grid 2	Blue
Heater	Brown
Heater/Cathode	Yellow
Grid 1	Green
*Thermostat	White (PTFE covered)

*These leads are at the collector end of the capsule.

RF connectors : Type N (50Ω) Male.

HEATER

V_h	6.3 ± 5%	V
I_h (approx)	1.75	A

MAXIMUM RATINGS (Absolute)

V_{coll} (see Note 1)	3.0	kV
V_{helix} (see Notes 1, 2)	2.5	kV
V_{g2} (see Notes 1, 2)	1.7	kV
V_{g1} (see Note 1)	−7	V
I_h (surge)	4.0	A
I_{coll}	75	mA
I_{helix} (see Note 3)	3	mA
I_{g2}	0.5	mA
p_{coll} (with forced air cooling)	175	W
P_{out} (mean)	12	W
T_{amb}	70	°C
t_{hk} (min)	5	min
Altitude	10,000	ft
Current rating for thermostat switch		
(at 110V a.c.)	4.0	A
(at 240V a.c.)	2.0	A
Interruption time for heater power (with other supplies on)	25	s

NOTES

1. All voltages are measured with respect to cathode. The collector is connected to the capsule and is normally earthed.
2. The grid 2 voltage must not be applied before the helix voltage.
3. It is advisable to provide a relay to remove high voltage supplies if the helix current exceeds 3.0mA.

TYPICAL OPERATION

Frequency range	1.7–2.3	GHz
V_{coll} (see Note 1)	2.0–2.3	kV
V_{helix} (see Notes 1, 2)	1.9–2.3	kV
V_{g2} (see Notes 1, 2, 3)	1.15–1.6	kV
V_{g1} (see Note 1)	−7.0 – 0	V
I_{coll} (see Note 3)	60–75	mA
I_{helix} (see Note 4)	0–3	mA
I_{g2}	0–0.2	mA
Power gain (small signal)(min)	30	dB
Saturated power output (min)(see Note 5)	18	W
Input VSWR (Hot)(max)	1.4:1	
Output VSWR (Hot)(max)	1.5:1	
Variation of power gain (over any 10MHz)	0.05	dB/MHz
Cold attenuation	50	dB
Noise factor	28	dB

NOTES

1. Specified for each tube. These voltages should be capable of adjustment over the ranges specified above.
2. Helix voltage adjusted within the range to give optimum performance. The value of helix voltage is specified on each tube and is such that it gives optimum conditions for power output and matches over the whole band 1.7 to 2.3GHz.
3. Grid 2 voltage adjusted within the range to give collector current specified on each tube.
4. It is advisable to provide a relay to remove high voltage supplies if helix current exceeds 3.0mA.
5. The tube is designed for linear operation at output levels up to 10 watts. Continuous operation at output power levels of greater than 12 watts will shorten the operational life.

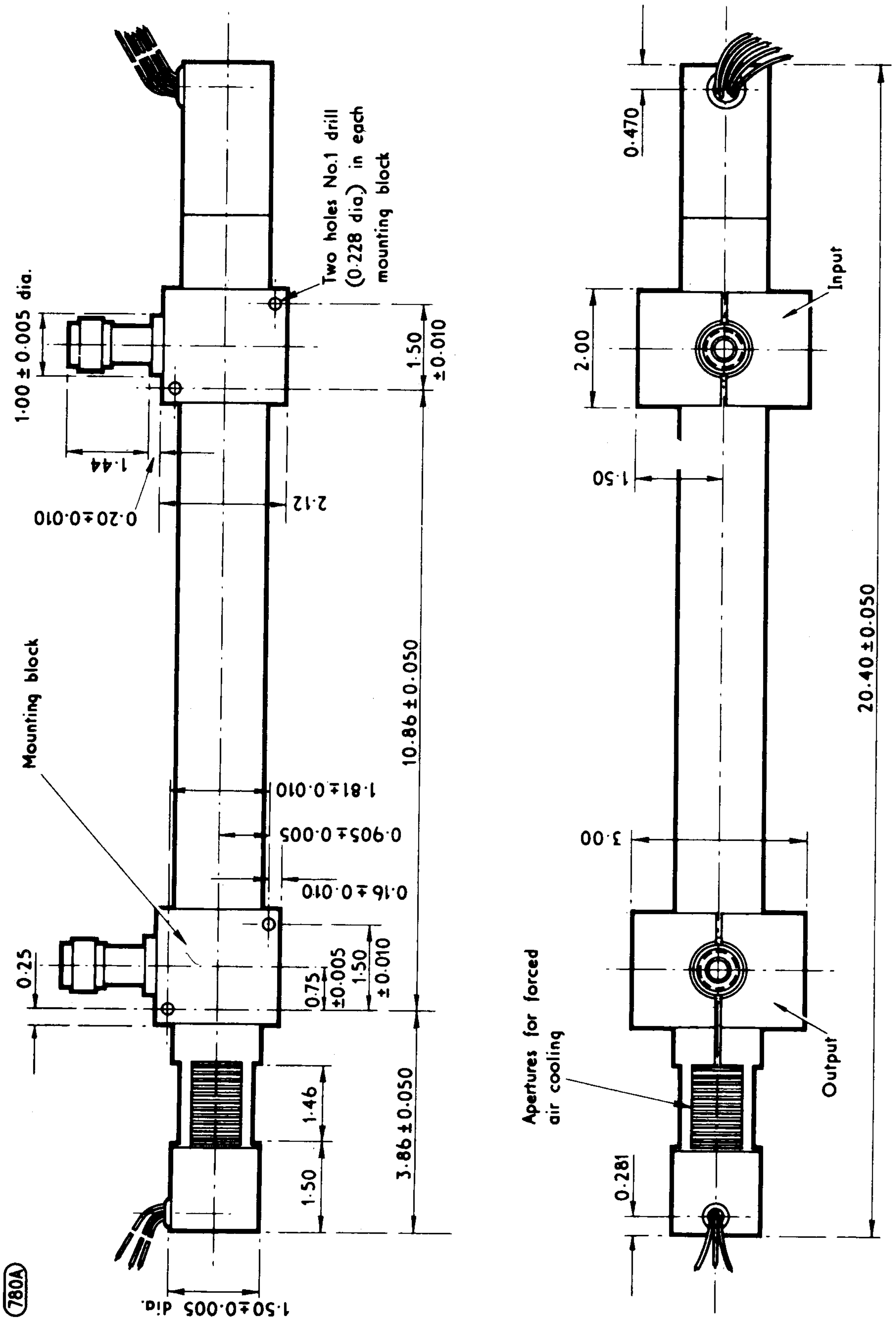
WEIGHT

The weight of the TWS10 is approximately 3kg (6lb. 12oz.).

INSTALLATION

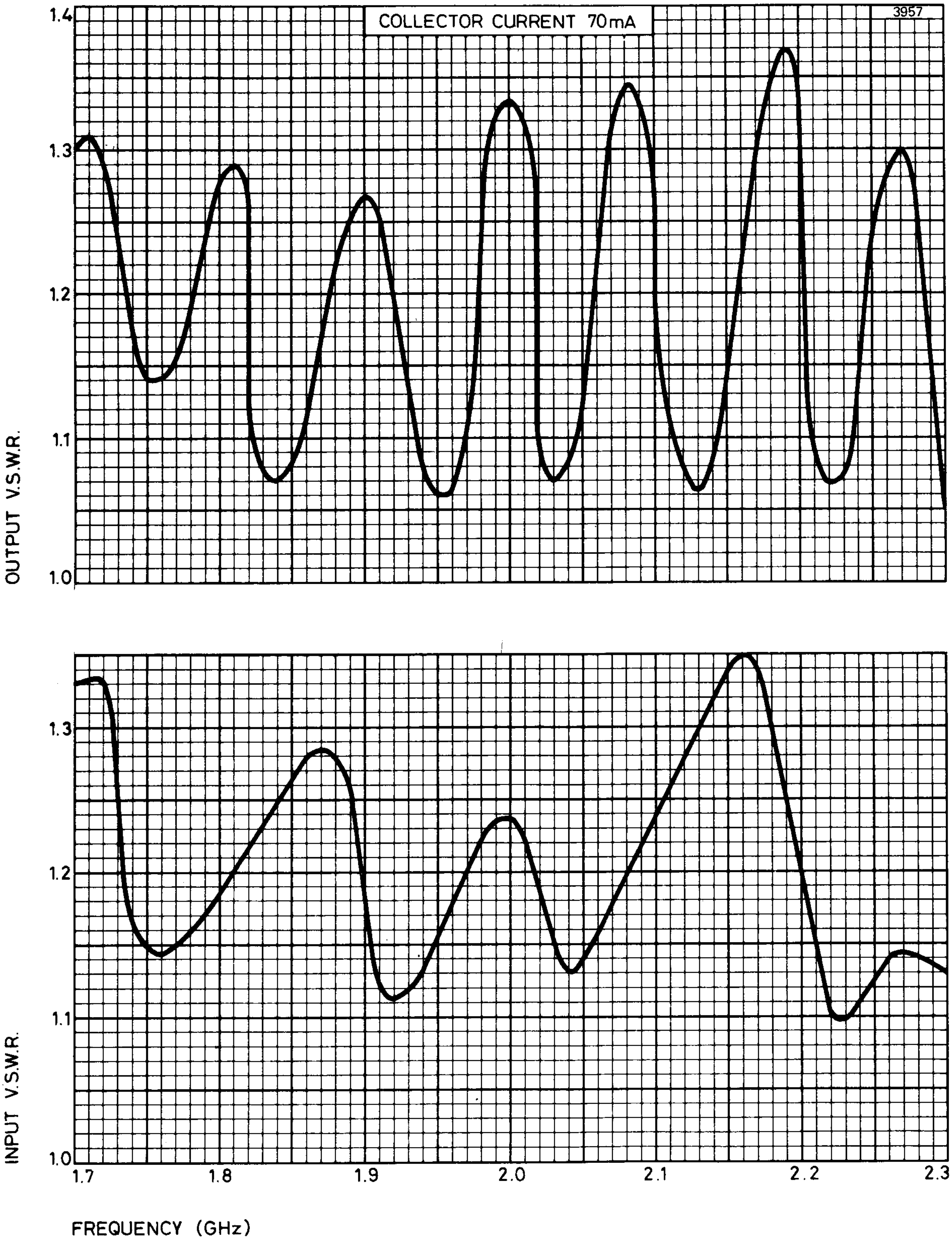
The thermostat switch leads should be connected so as to interrupt the primary side of the collector, helix and grid 2 voltage supplies, if the cooling fails.
Air cooling, delivered through a rectangular nozzle at right angles to the amplifier into one of the apertures shown in the outline drawing should be 25c.f.m.
The power amplifier should be installed on a non-magnetic panel and magnetic material should be kept at least eight inches away from the power amplifier.

OUTLINE

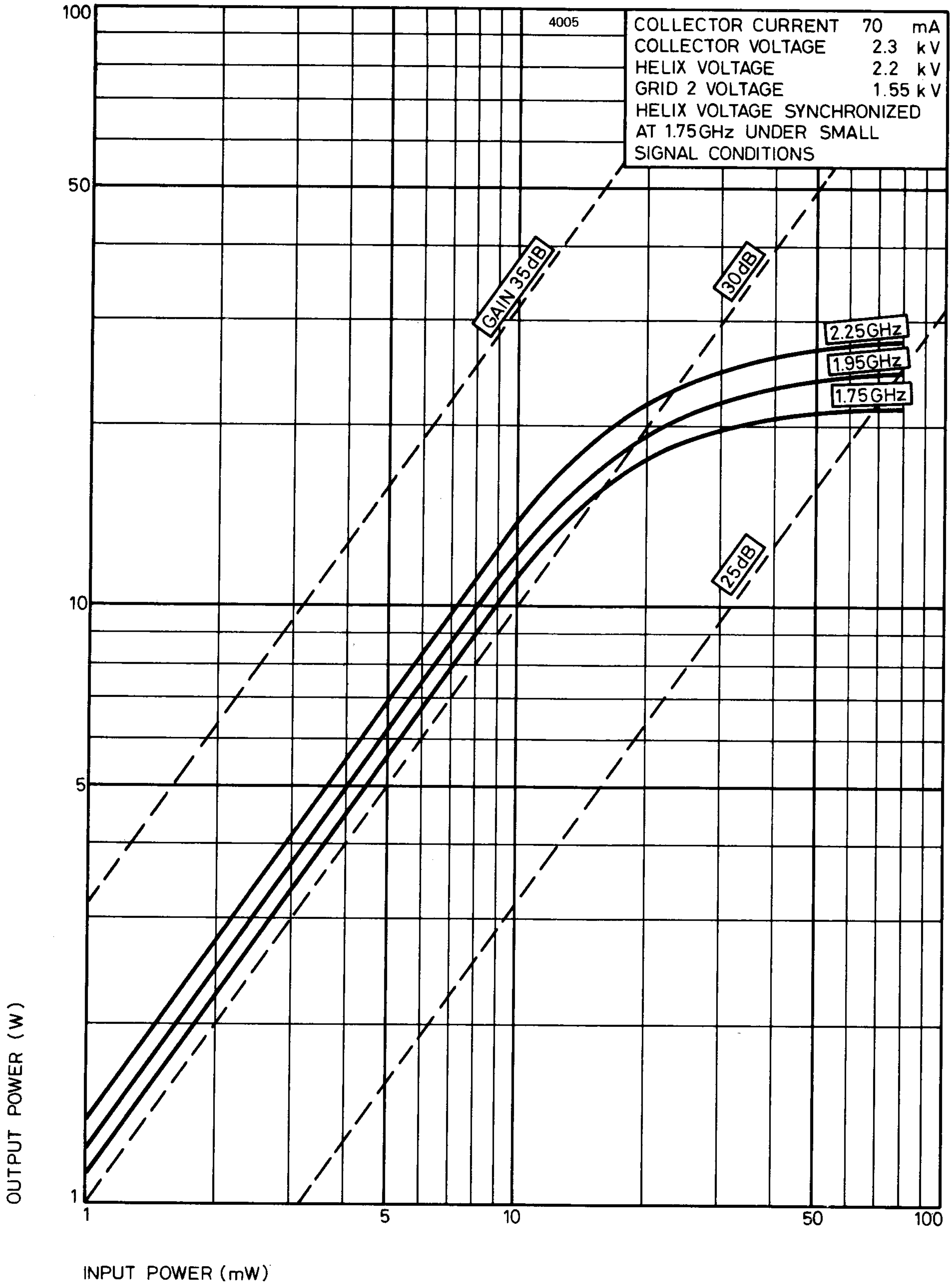


Dimensions in inches

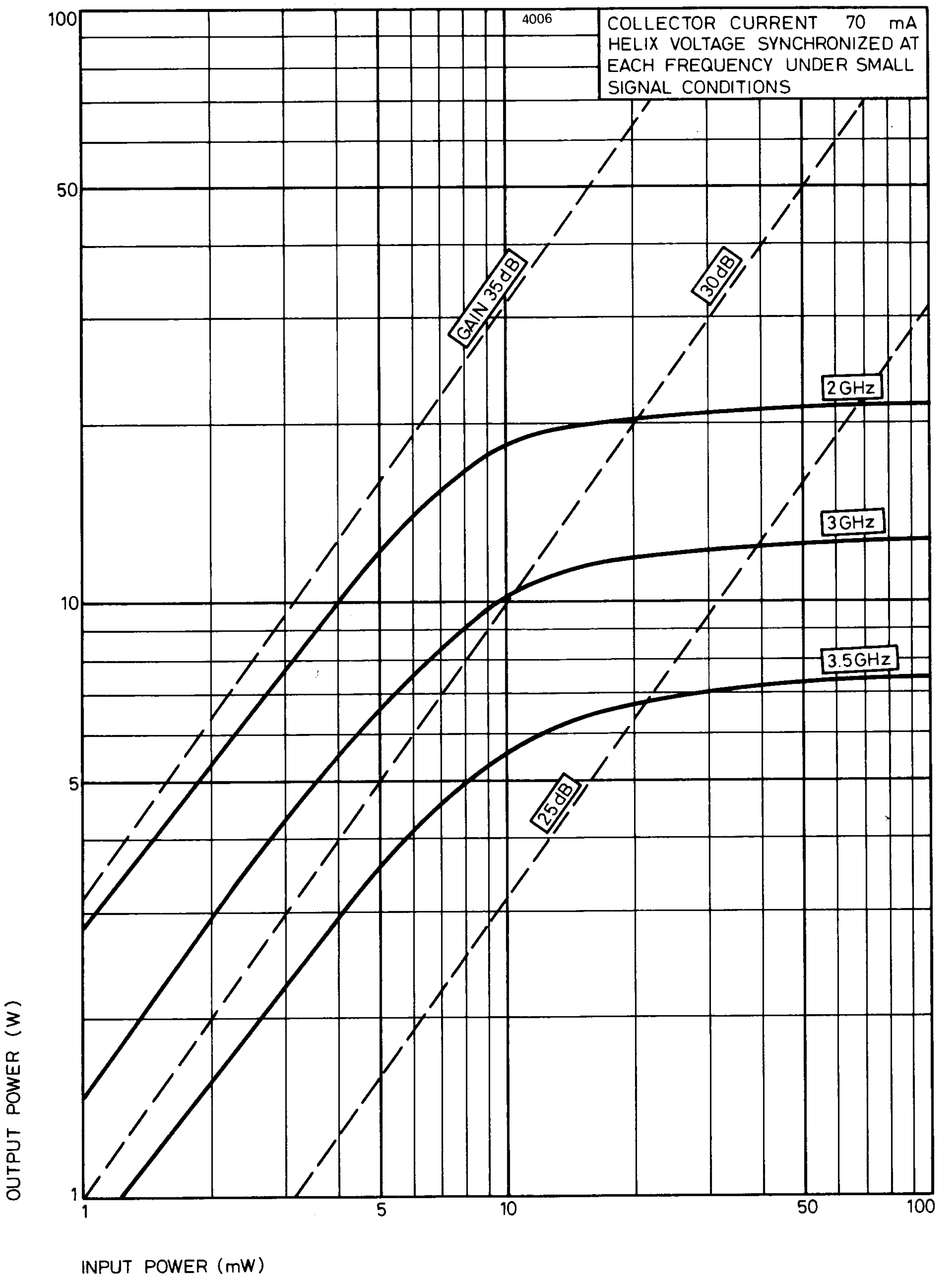
MATCH – FREQUENCY



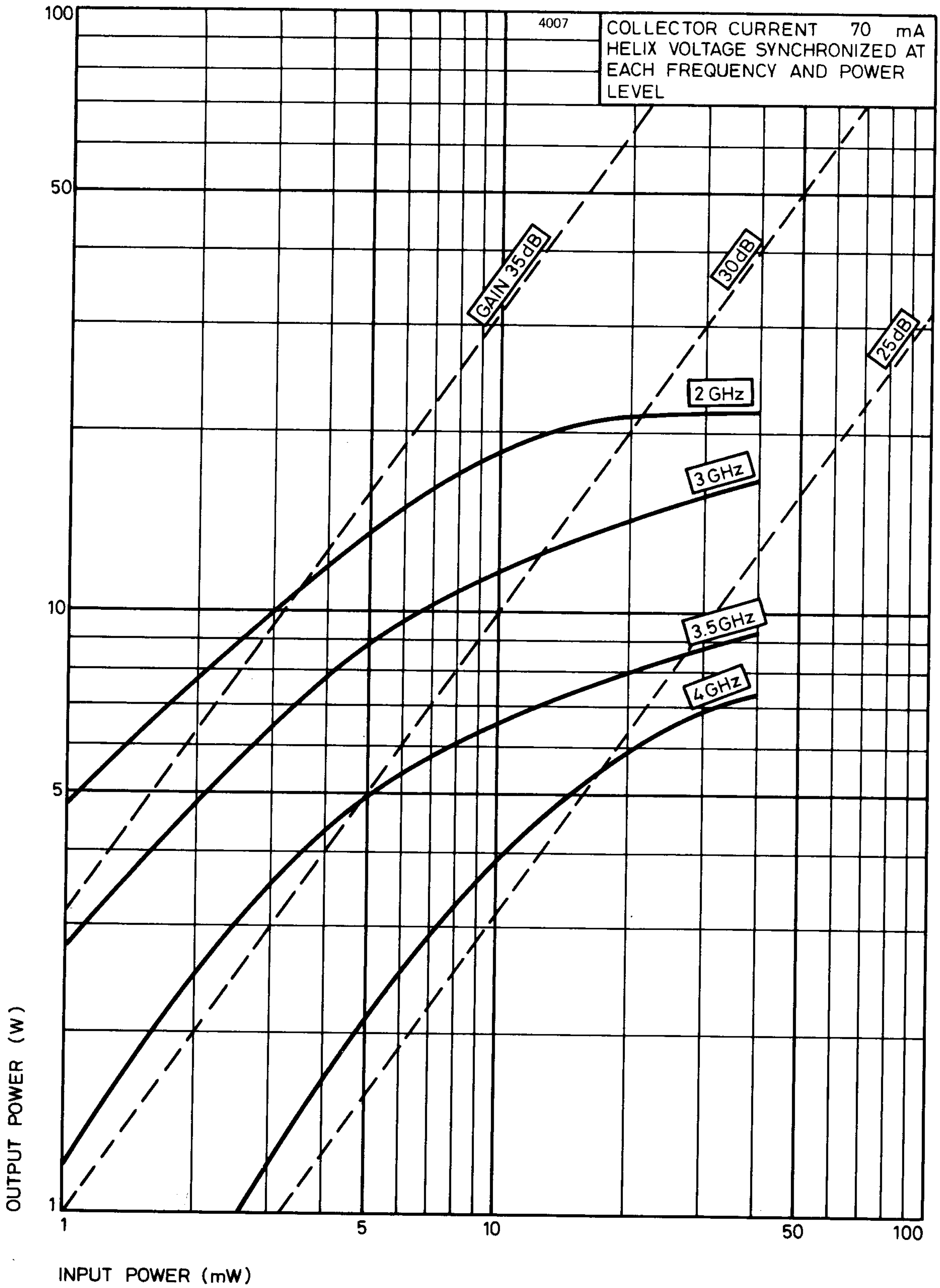
GAIN MEASURED OVER THE FREQUENCY BAND 1.75GHz TO 2.25GHz AT FIXED HELIX VOLTAGE



GAIN MEASURED OVER THE FREQUENCY BAND 2.0 TO 3.5GHz



GAIN MEASURED OVER THE FREQUENCY BAND 2.0 TO 4.0GHz



TWS12 TWS32

TRAVELLING WAVE AMPLIFIERS

BRIEF DATA

Two S-band travelling wave power amplifiers designed for use in communications systems covering the frequency range 1.7GHz to 2.7GHz. The minimum small signal gain is 33dB and the saturated power output is in excess of 20 watts. The two versions availabel are TWS12 cooled by forced air and TWS32 conduction cooled.

The amplifiers are designed for linear operation at output levels up to 12 watts and employ the basic production techniques of the TWS10, where reliability has been demonstrated by years of continuous operation in world-wide communications systems.

The amplifiers are completely packaged in periodic permanent magnet focusing assemblies and coupled helix r.f. transitions to type N 50 Ω connectors ensure an excellent match which reduces fine structure gain variation and permits extended bandwidth operation at reduced gain over the frequency range 1.6GHz to 4.0GHz.

Rigorous processing schedules eliminate base band noise peaks and the noise factor is typically better than 28dB.

The TWS12 requires forced air cooling and a thermostat can be incorporated on request which enables the tube power supplies to be removed in the event of a cooling failure. This adds approximately one inch to the tube length.

The TWS32 is cooled by conduction and is designed for mounting in any position except with the collector cooling block downwards. The cooling block should be bolted to a suitable heat sink in the user's equipment.

HEATER

V_h	6.3 ± 5%	V
I_h (approx)	1.75	A

AMPLIFIER CONNECTIONS

Connection of d.c. power supplies is by flying leads coloured coded as follows:-.

*Collector	Black
Helix	Orange
Grid 2	Blue
Heater	Brown
Heater/Cathode	Yellow
Grid 1	Green
*Thermostat	White (PTFE covered) (TWS12 only, if required)

*These leads are at the collector end of the capsule in the case of the TWS12.

RF connections : Type N (50 Ω) (Male).

MAXIMUM RATINGS (Absolute)

V_{coll} (see Note 1)	3.0	kV
V_{helix} (see Notes 1, 2)	2.5	kV
V_{g2} (see Notes 1, 2)	1.7	kV
V_{g1} (see Note 1)	−7	V
I_h (surge)	4.0	A
I_{coll}	75	mA
I_{helix} (see Note 3)	3	mA
I_{g2}	0.5	mA
p_{coll} (with specified cooling)	175	W
P_{out} (mean)	15	W
T_{amb}	70	°C
t_{hk} (min)	5	min
Altitude	10,000	ft
Interruption time for heater power (with other supplies on)	25	s

NOTES

1. All voltages are measured with respect to cathode. The collector is connected to the capsule and is normally earthed.
2. The grid 2 voltage must not be applied before the helix voltage.
3. It is advisable to provide a relay to remove high voltage supplies if helix current exceeds 3.0mA.

TYPICAL OPERATION

Frequency range	1.75–2.7	GHz
V_{coll}	2.2	kV
V_{helix} (see Notes 1, 2)	1.9–2.4	kV
V_{g2} (see Notes 1, 2, 3)	1.15–1.6	kV
V_{g1} (see Note 1)	–7.0 – 0	V
I_{coll} (see Note 3)	60–75	mA
I_{helix} (see Note 4)	0–3	mA
I_{g2}	0–0.2	mA
Power gain (small signal)		
(1.75 to 2.0GHz)	34	dB
(2.0 to 2.7GHz)	36	dB
Saturated power output (see Note 5)	>20	W
Input VSWR (Hot)(max)	1.7:1	
Output VSWR (Hot)(max)	1.7:1	
Variation of power gain (over any 10MHz)	0.05	dB/MHz
Cold attenuation	>60	dB
Noise factor	28	dB

NOTES

1. Specified for each tube. These voltages should be capable of adjustment over the ranges specified.
2. Helix voltage adjusted within the range to give optimum performance. The value of helix voltage is specified on each tube and is such that it gives optimum conditions for power output and matches the whole band 1.75 to 2.7GHz.
3. Grid 2 voltage adjusted within the range to give collector current specified on each tube.
4. It is advisable to provide a relay to remove high voltage supplies if helix current exceeds 3.0mA.
5. The tube is designed for linear operation at output levels up to 12 watts. Continuous operation at output levels of greater than 15 watts will shorten the operational life.

WEIGHT

The weight of the TWS12 is approximately 3kg (6lb. 12oz.).
The weight of the TWS32 is approximately 3.2kg (7lb.).

INSTALLATION

TWS12

Air cooling, delivered through a rectangular nozzle at right angles to the amplifier into one of the apertures shown in the outline drawing, should be 25 c.f.m.
If required, the tube can be supplied fitted with a thermostat so that the supplies can be automatically switched off in the event of failure of the cooling air. The length of the cooler is increased by approximately one inch when a thermostat is fitted.

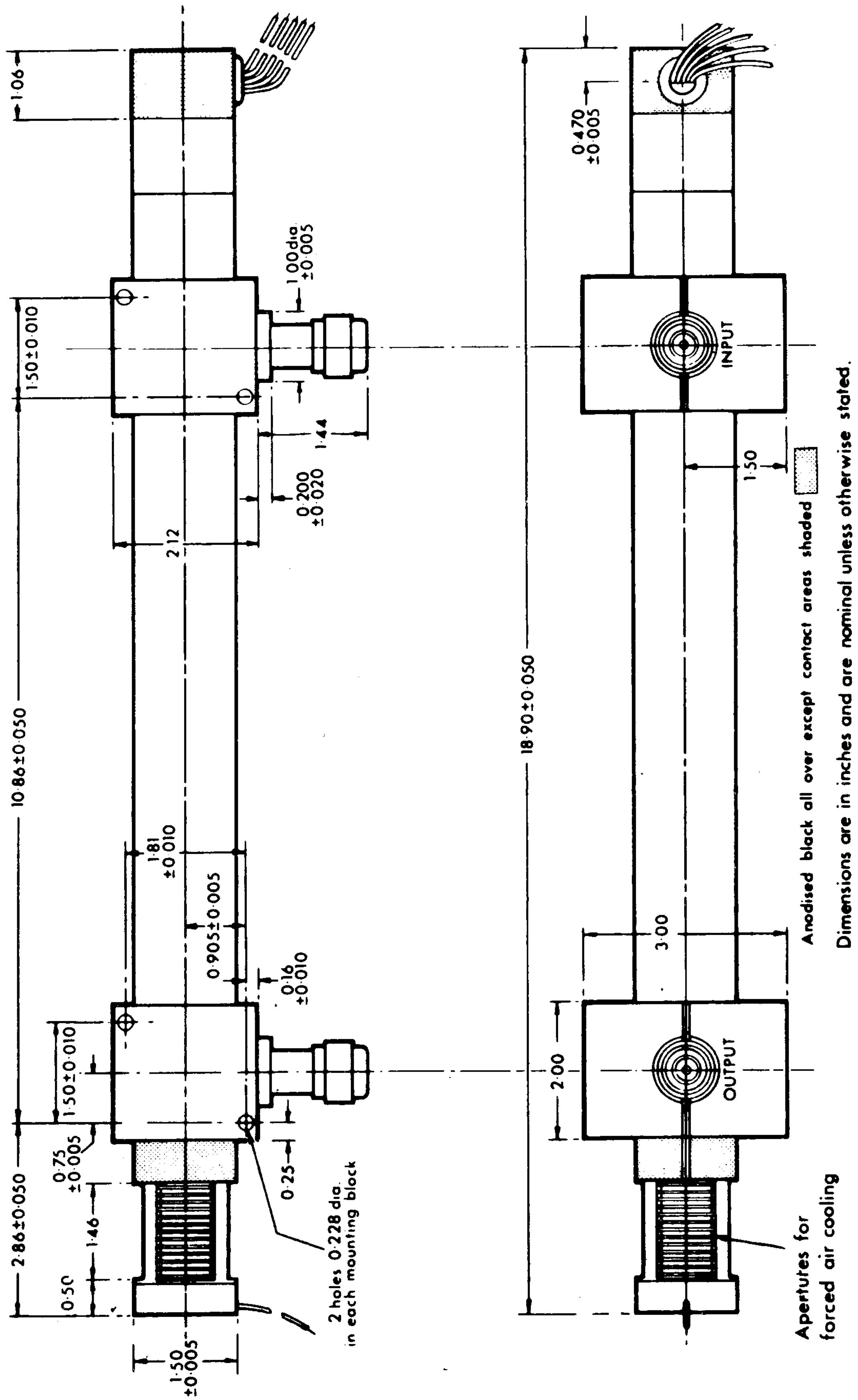
TWS32

The best mounting position is vertically with the collector cooling block uppermost and bolted to a suitable heat sink such that the block temperature measured at the point indicated on the outline drawing does not exceed 110°C under worst conditions. The amplifier should never be mounted vertically with the collector cooling block downwards.
Details of a suitable heat sink, which must be flat over the mating surfaces, are available on request. A heat conducting grease should be applied to the underside of the cooling block.

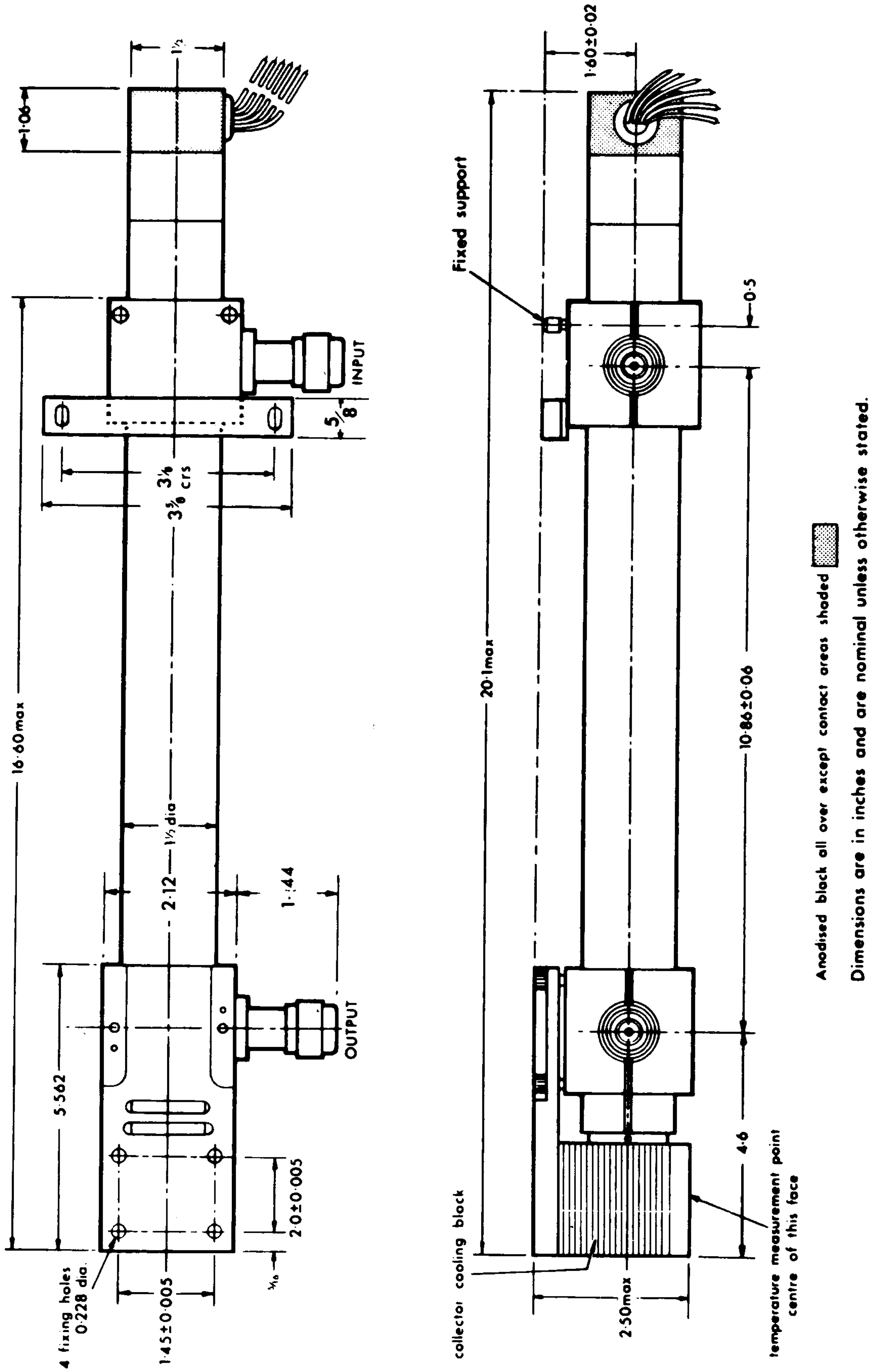
General

Both amplifiers should be installed on a non-magnetic panel and magnetic material should be kept at least eight inches away from the amplifier.

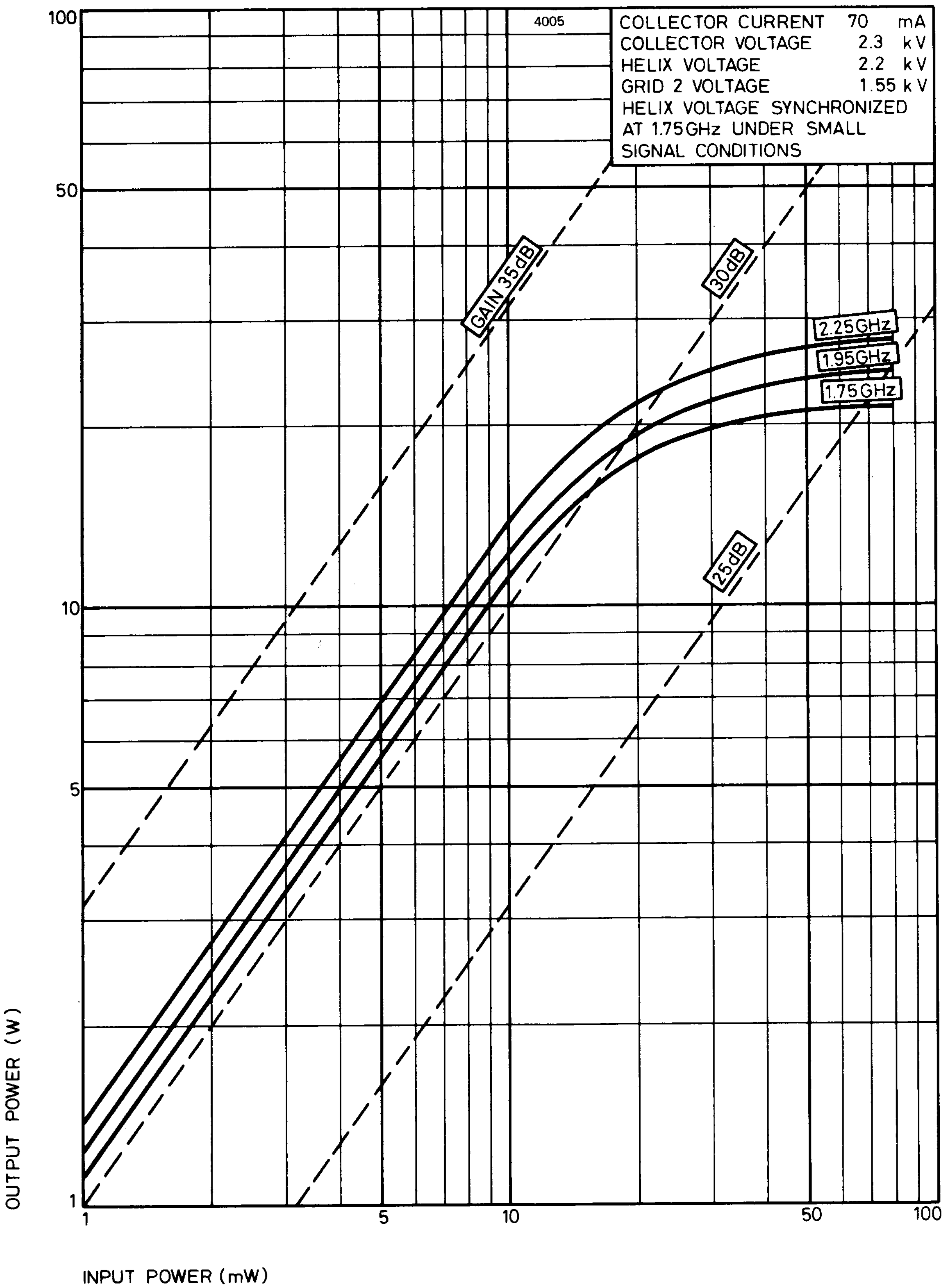
TWS12 OUTLINE



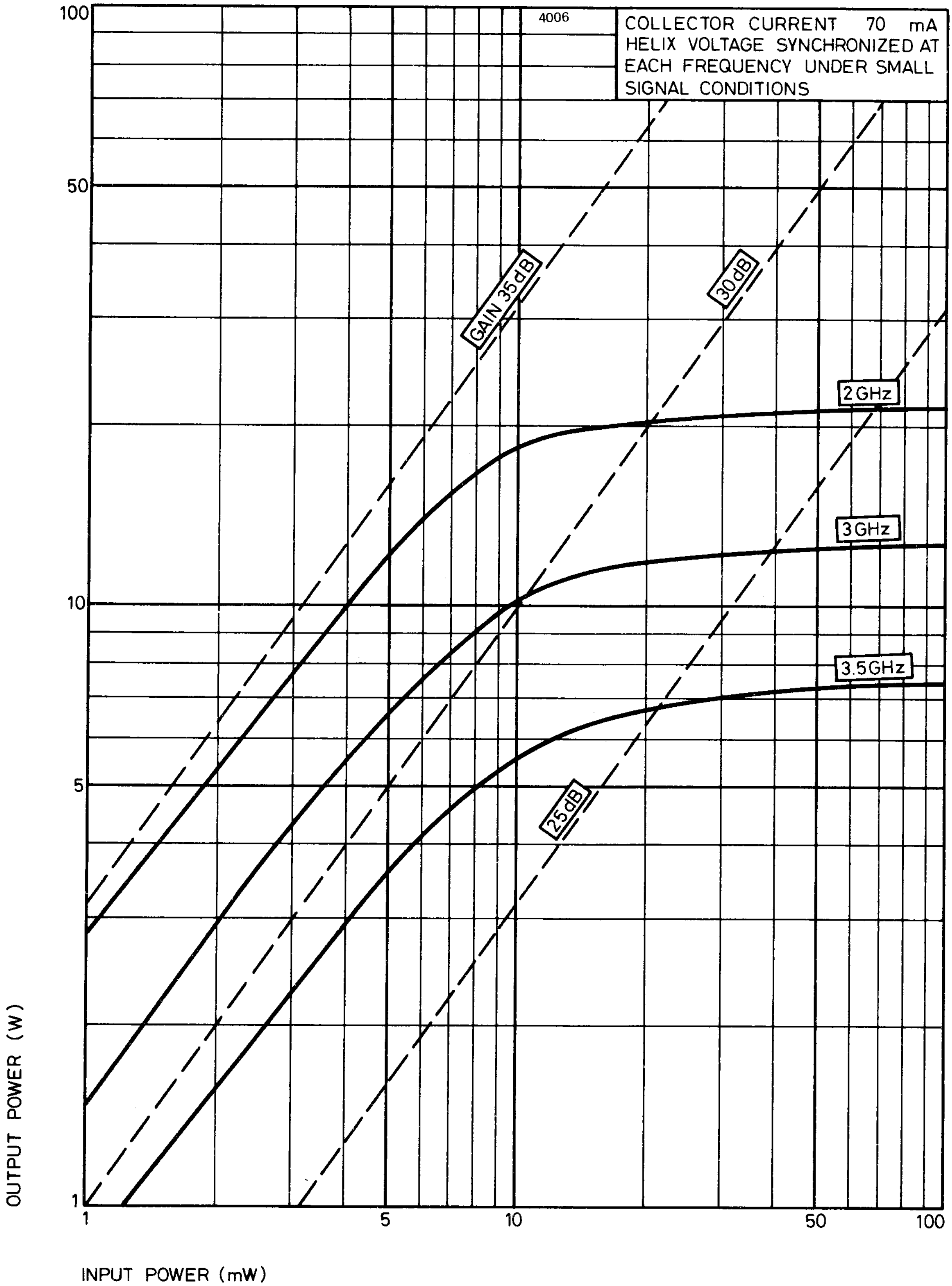
TWS32 OUTLINE



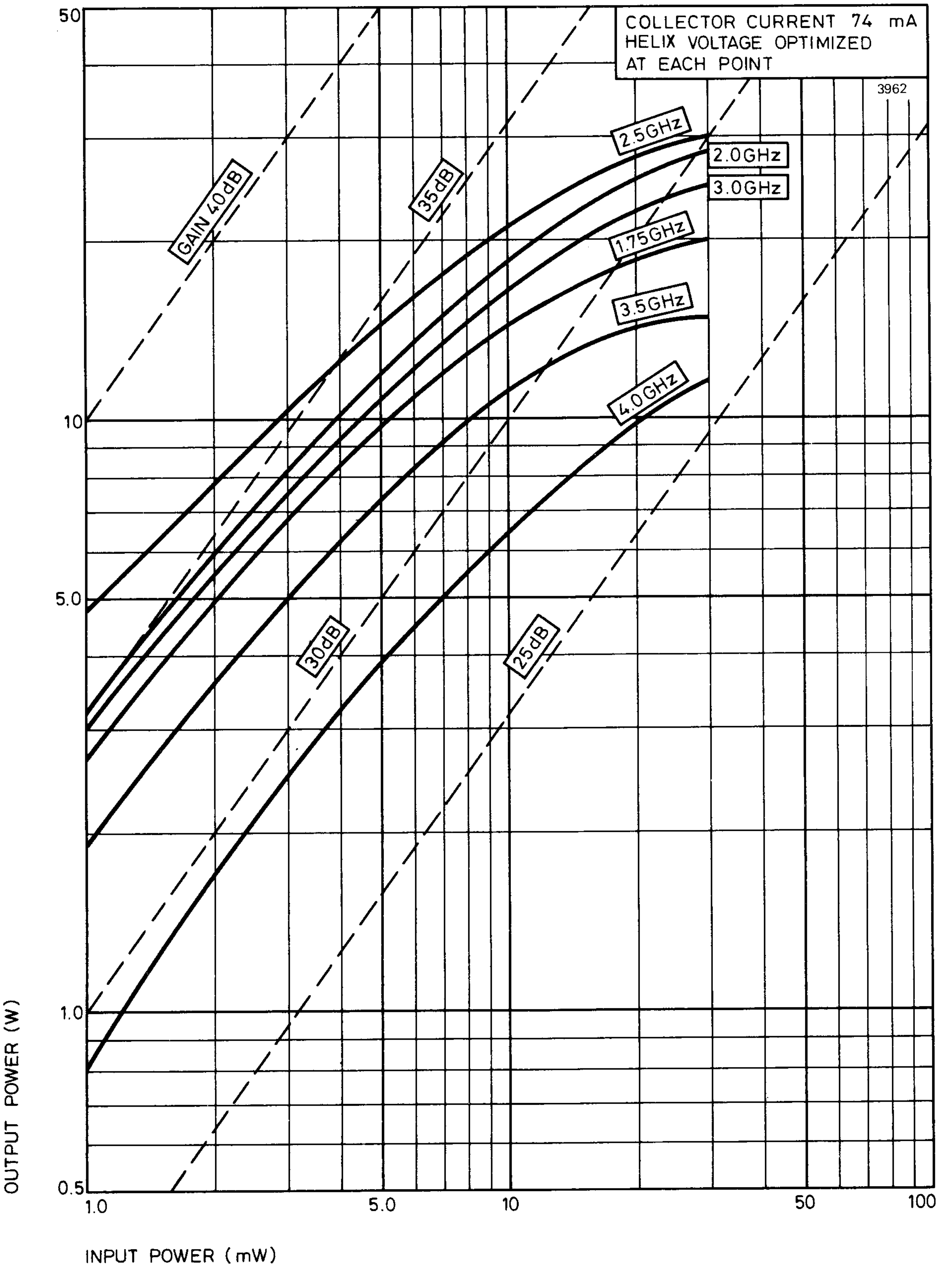
GAIN MEASURED OVER THE FREQUENCY BAND 1.75GHz TO 2.25GHz AT FIXED HELIX VOLTAGE



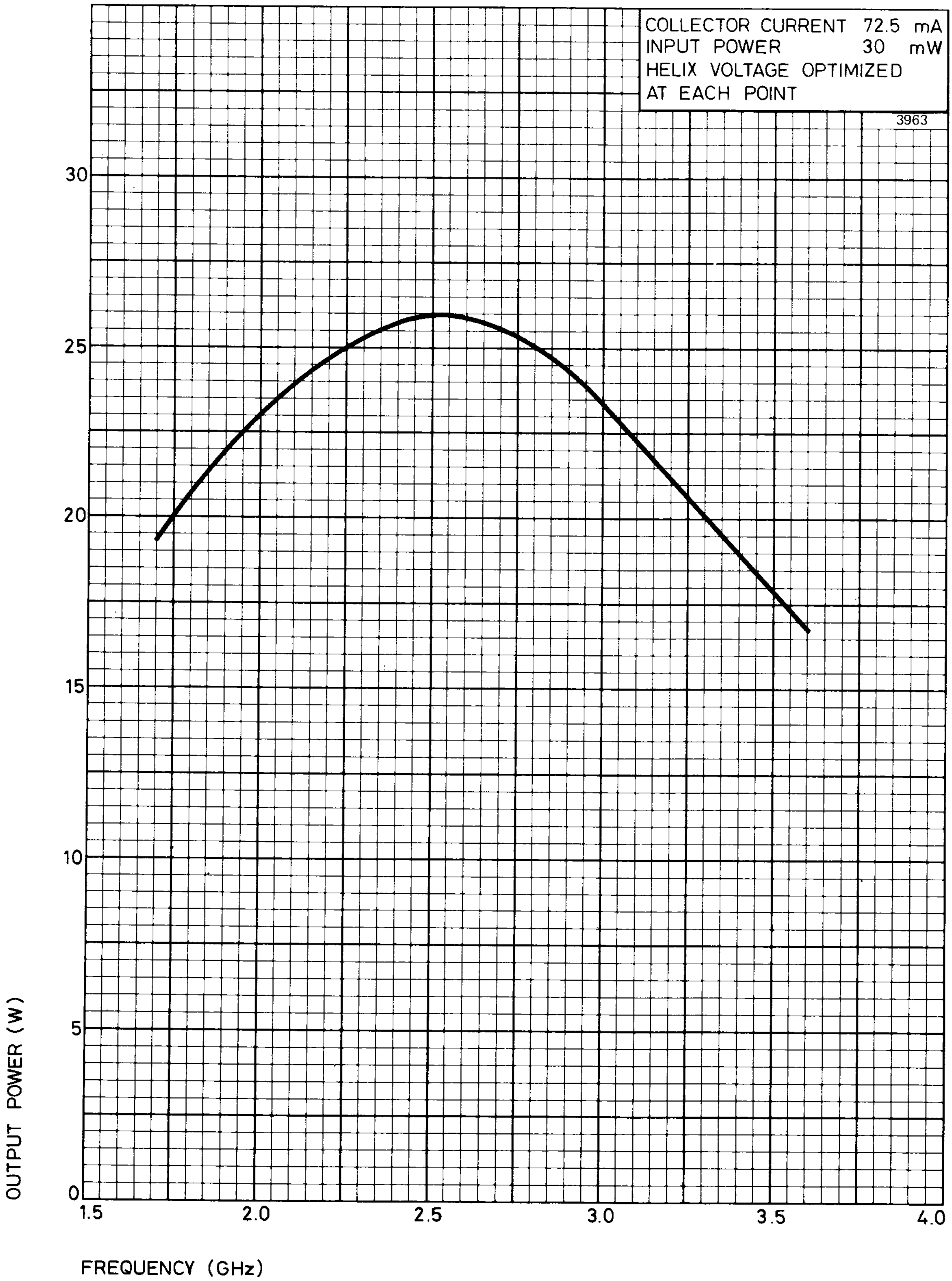
GAIN MEASURED OVER THE FREQUENCY BAND 2GHz TO 3.5GHz



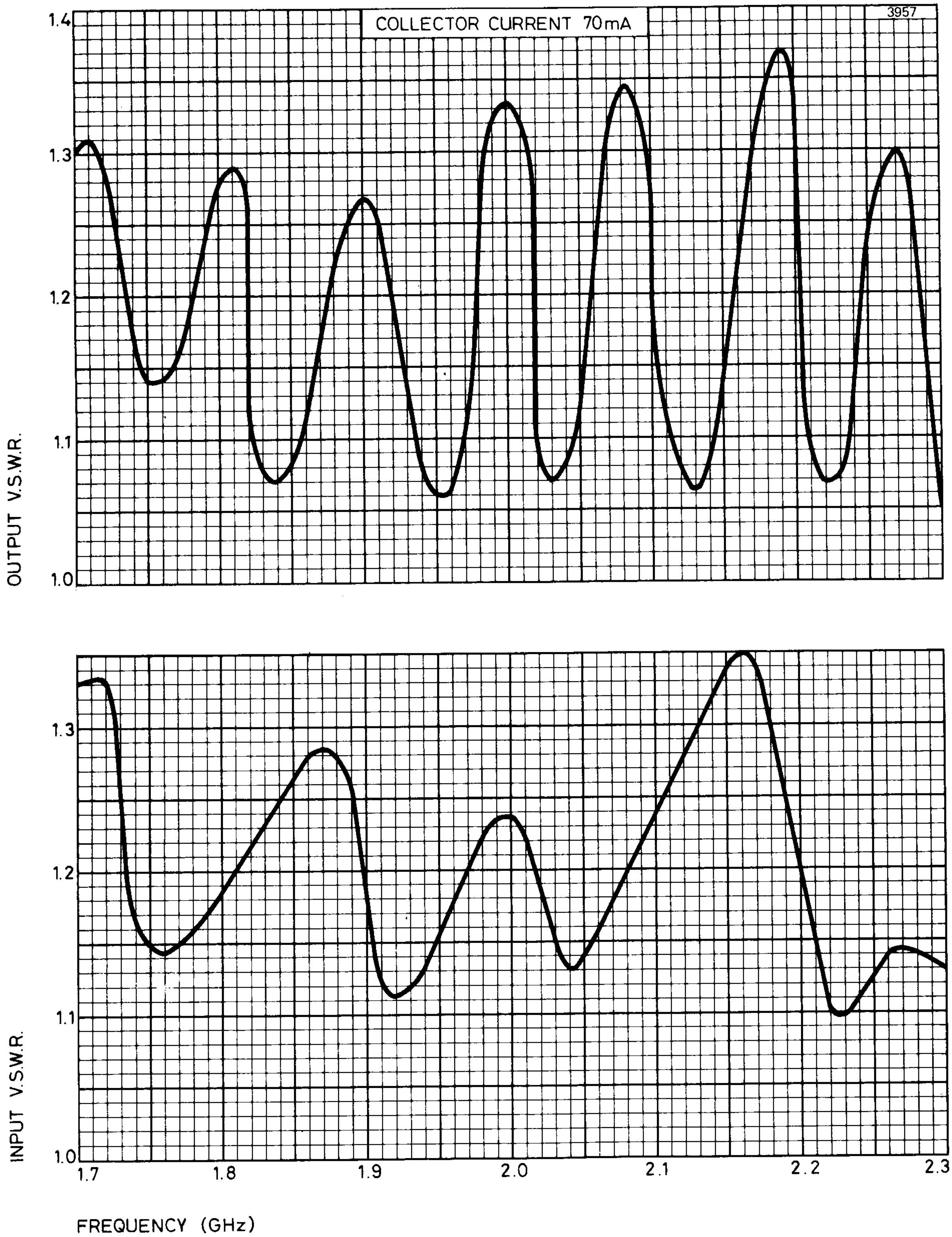
GAIN CHARACTERISTICS



OUTPUT POWER FOR EXTENDED FREQUENCY RANGE



MATCH – FREQUENCY



THE M-O VALVE
COMPANY LIMITED

TWS17

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise amplifier giving a gain of 35 to 42dB and a noise factor better than 11dB over a frequency range of 2.0 to 4.1GHz.

DESCRIPTION

A rugged low noise amplifier designed for use in severe environments. The noise factor typically varies by less than 0.75dB over the frequency range and the gain is constant to within 3dB. The dynamic range is 37dB at full bandwidth operation increasing to 70dB when operated over a bandwidth of 1MHz. The use of Alnico magnets of low magnetic temperature coefficient in a periodic permanent magnet focussing assembly ensures light weight and stability of performance over a wide operational temperature range. Complete magnetic shielding enables tubes to be mounted side by side and eliminates interference with adjacent equipment. The low power dissipation, less than 3 watts including the cathode heater supply, allows the tube to be mounted in any position without the necessity for forced air cooling.
R.F. connections are by means of 50Ω type N connectors but alternative connectors e.g. SMA coaxial can be supplied to special order. Power connection is by an Electromethods type BA15P plug or by flying leads; the tube is fully insulated so that cathode, helix, or collector may be grounded.
The amplifier is normally adjusted for optimum broadband performance but it is possible for the performance to be upgraded in restricted bandwidths. Similarly, performance outside the conventional octave bandwidth can be provided.
Considerable variation in the mechanical format is possible to special order.

HEATER

V_h	6.3	V
I_h (approx)	0.25	A
I_h (surge)(max)	1.5	A

RATINGS (Absolute)

	Min	Max	
V_{coll}	V_{helix}	850	V
V_{helix}	300	600	V
V_{g5}	—	500	V
V_{g4}	—	400	V
V_{g3}	—	200	V
V_{g2}	—	100	V
$-V_{g1}$	250	0	V
I_{helix}	—	1.0	mA
I_g (on any grid)	—	50	μA
t_{hk}	2	—	min

TYPICAL OPERATION

Frequency range	2.0–4.1	GHz
V_{coll} (see Note 1)	V_{helix} + 200	V
V_{helix} (see Note 1)	370–500	V
$-V_{g1}$ (see Note 1)	50–0	V
V_{g2} (see Notes 1, 2, 3)	0–50	V
V_{g3} (see Note 1)	0–100	V
V_{g4} (see Note 1)	0–200	V
V_{g5} (see Note 1)	100–365	V
I_{helix}	0–100	μA
I_{coll} (see Notes 2, 3)	400–800	μA
Max noise factor (see Note 3)	11	dB
Min small signal gain (see Note 3)	35	dB
Max small signal gain (see Note 3)	42	dB
Max gain variation (2.0–4.1GHz) (see Note 3)	3	dB
Min power output (saturated) (see Note 3)	7	dBm
Max v.s.w.r. (input) (see Note 3)	2.5:1	
Max v.s.w.r. (output) (see Note 3)	2.5:1	

NOTES

1. All voltages with respect to cathode. Collector, helix or cathode may be earthed.
2. Adjust V_{g2} to give the collector current specified for the tube.
3. A significant improvement in r.f. performance is possible over narrow bandwidths (500–1000MHz). Details of performance are available on request.

POWER REQUIREMENTS

The requirements in terms of voltage installation accuracy, voltage stability, and ripple level are dependant upon the performance requirements of the application but the following conditions define a power supply capable of minimising performance drift and spurious modulation levels. Where RF performance requirements are less severe, some degredation of the power supply is permissible. Further information will be supplied on request.

Electrode	Voltage Range Min		Voltage Range Max		Current Range Min	Current Range Max
Heater	6.24	Volts	6.36	Volts	0.19A	0.26A
Grid 1 . . .	−50	Volts	0	Volts	−10μA	20μA
Grid 2	0	Volts	50	Volts	−10μA	20μA
Grid 3	0	Volts	100	Volts	−10μA	20μA
Grid 4	0	Volts	200	Volts	−10μA	20μA
Grid 5 . . .	100	Volts	370	Volts	−10μA	20μA
Helix	370	Volts	500	Volts	−10μA	100μA
Collector. . .	V_{hel}	Volts	V_{hel} + 200		300μA	1500μA

Electrode	Installation Accuracy ±%	Stability ±%	Ripple Volts p−p
Heater	1.0	1.0	—
Grid 1	1.0	1.0	0.020
Grid 2	—	1.0	0.020
Grid 3	1.0	1.0	0.020
Grid 4	1.0	1.0	0.050
Grid 5	1.0	1.0	0.050
Helix	0.25	0.25	0.050
Collector . . .	1.0	5.0	10.0

NOTES

1. Stability includes power supply variations from all causes including temperature.
2. The tube may be operated with any one of the following elements at capsule (ground) potential:
   Cathode
   Helix
   Collector
3. The tube operating voltages and currents are listed on an affixed label.

INSTALLATION AND ALIGNMENT

1. Connect power supply and r.f. lines to the tube.
2. Apply rated heater voltage for a period of two minutes. The full rated heater voltage may be applied instantaneously.
3. Set grid 2 to zero volts and all other voltages as shown on tube label.
4. Increase the grid 2 voltage until the collector current reaches the value shown on the tube label. Grid 2 voltage should then agree approximately with that shown on the label. Collector current should be set to an accuracy of 1%.

After initial installation and setting of voltages, subsequent switching procedure may be as follows:-

a) As 2 above.
b) All other voltages may then be immediately applied at preset values providing that the grid 2 voltage is not achieved before the helix voltage.

AMPLIFIER CONNECTIONS (Use socket to mate with Electromethods Plug type BA15P)

Pin A:	NC	Pin J:	Grid 2
B:	NC	K:	Grid 5
C:	Grid 1	L:	Cathode
D:	Helix	M:	Heater
E:	Collector	N:	Heater/Cathode
F:	Grid 4	P:	Capsule earth
H:	Grid 3	R:	NC
		S:	NC

POWER SUPPLY

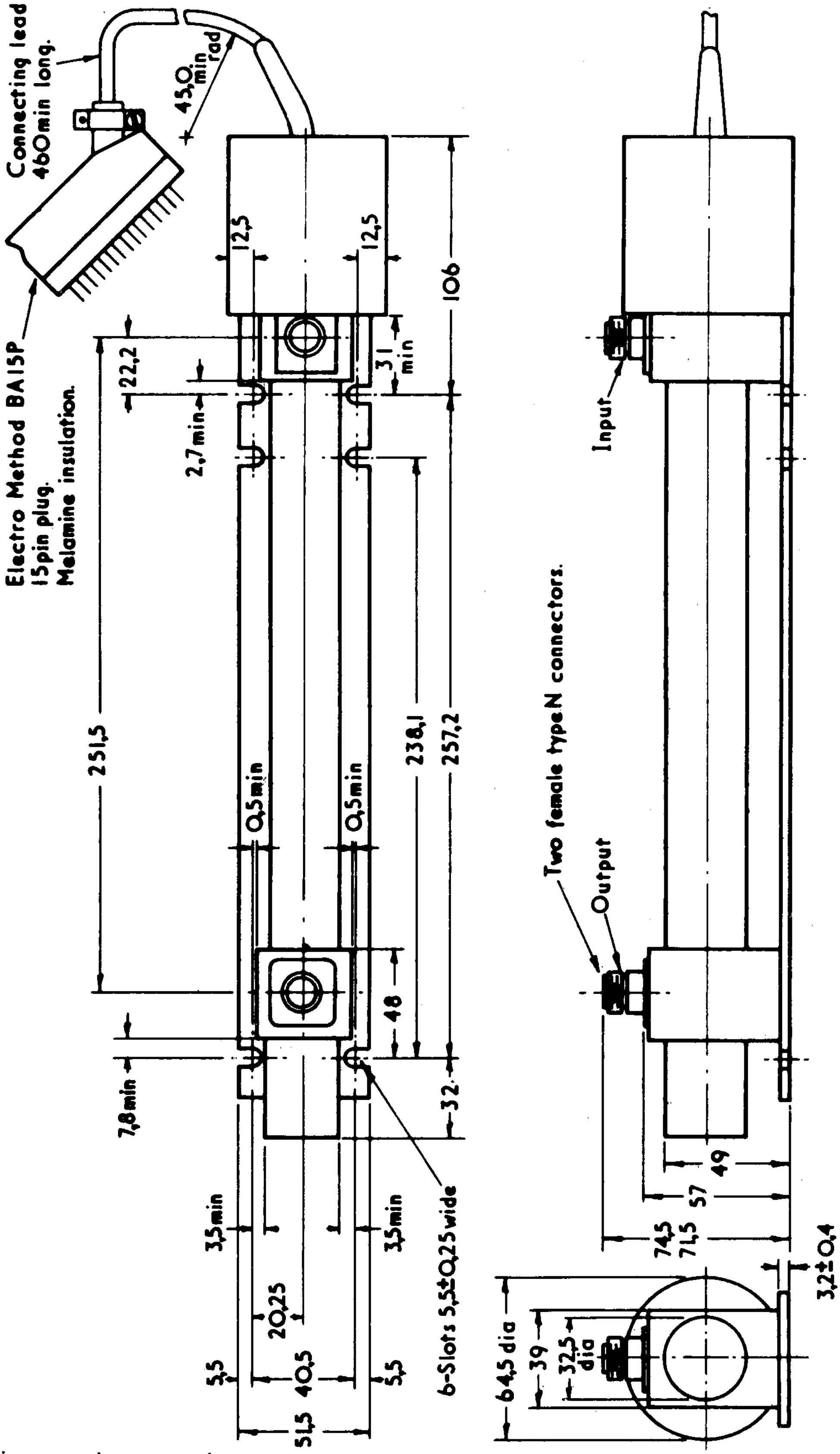
The tube can be supplied complete with a power supply in which case it has the type No. TWS26.

MECHANICAL

Dimensions See outline drawing
Weight 2.27kG (5lb.)

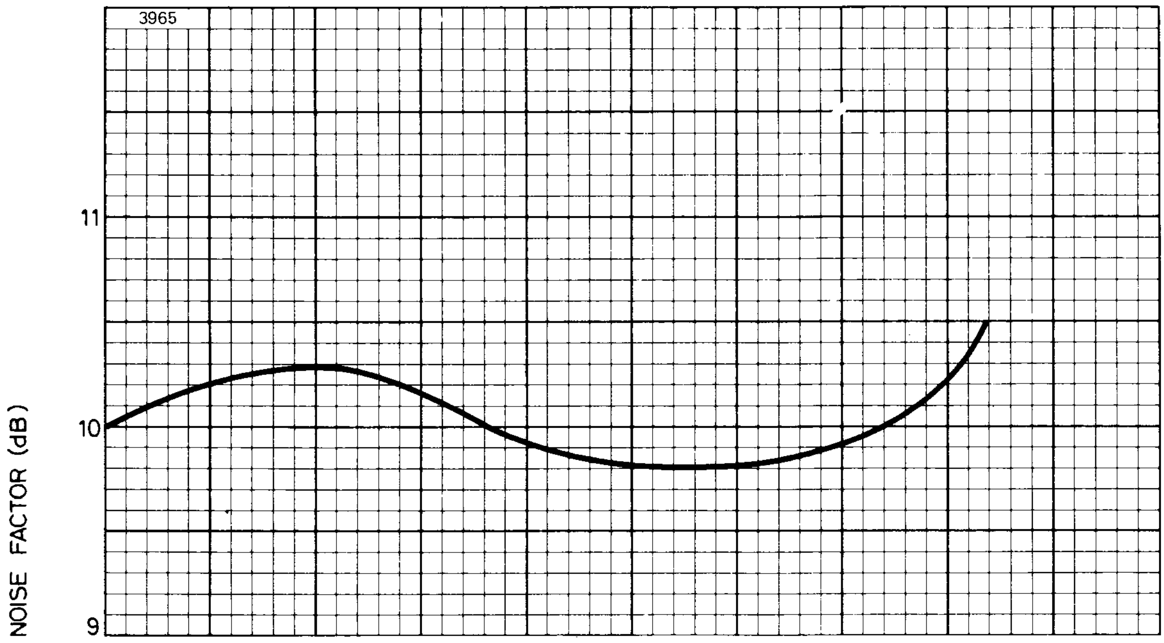
Note:- Variation in the mechanical configuration is possible. Further details will be supplied on request.

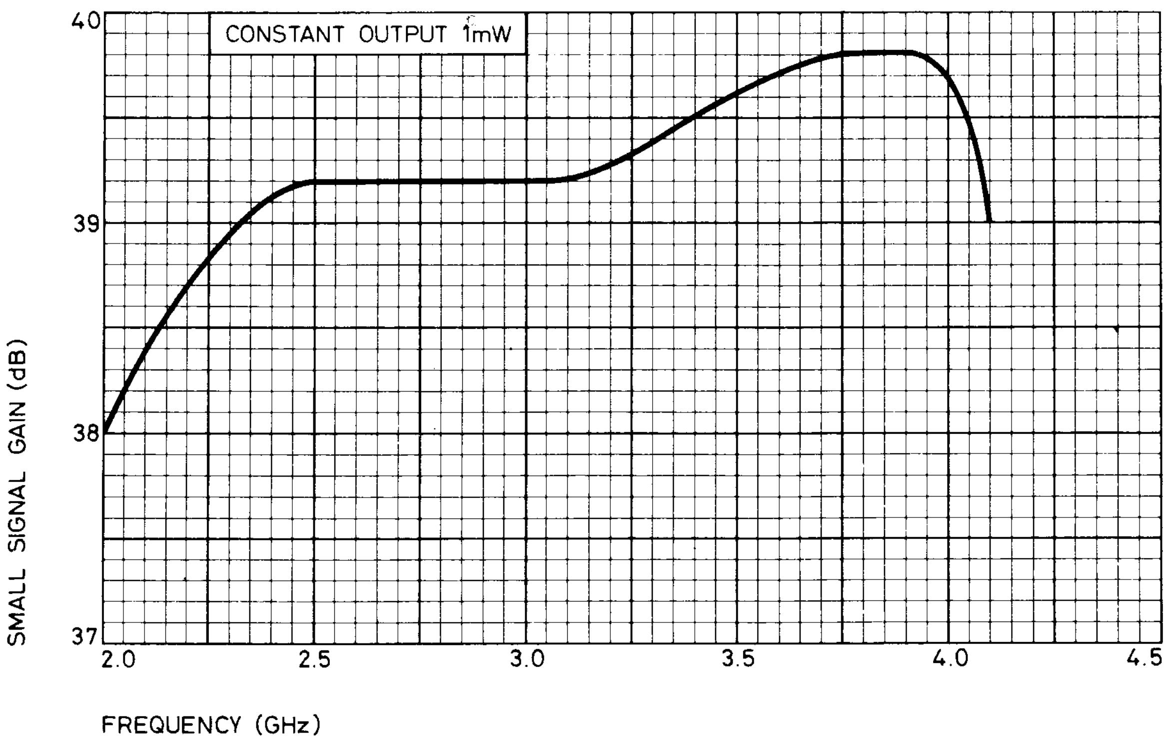
OUTLINE



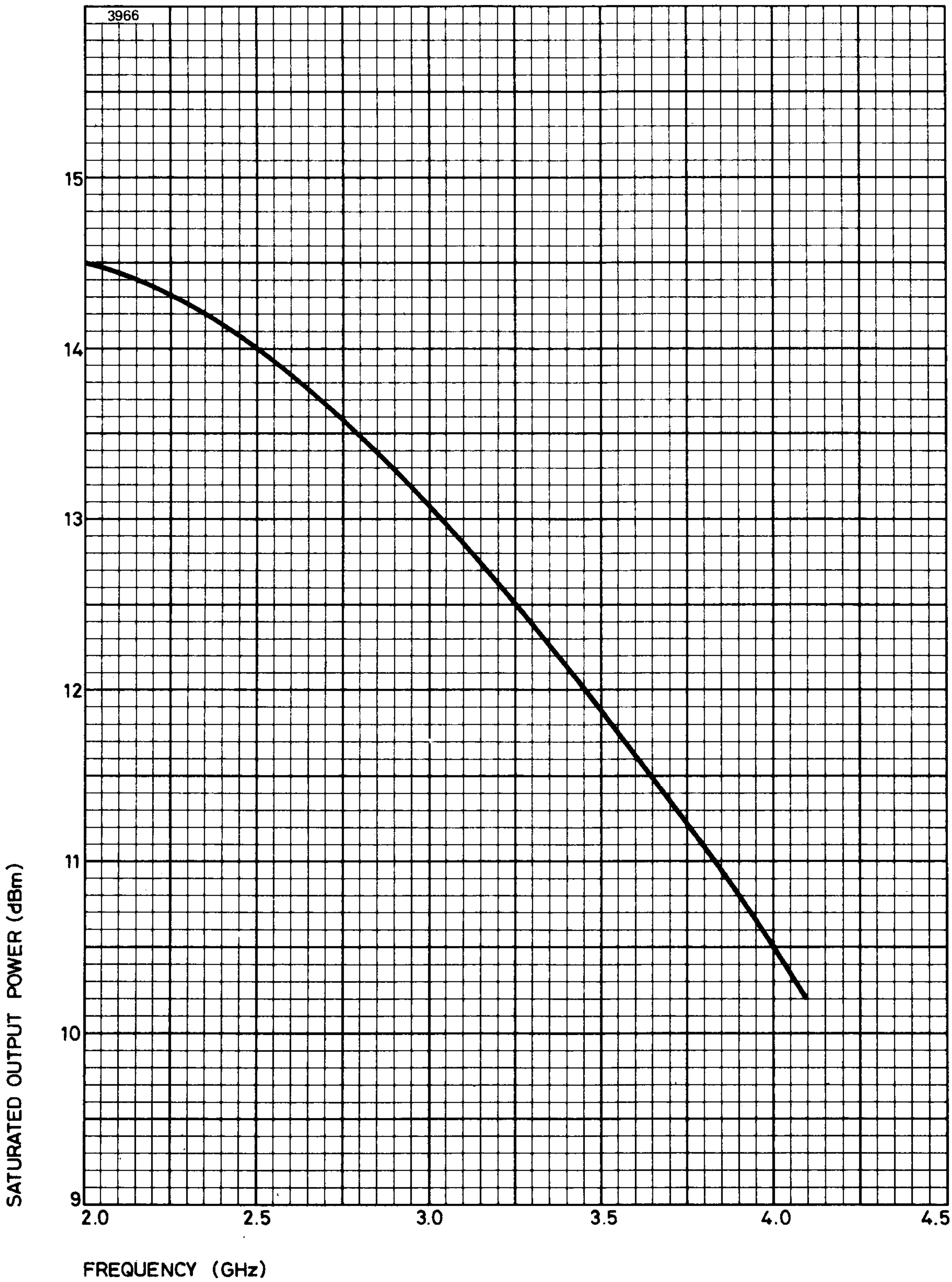
Dimensions are in mm and are maximum unless stated.

NOISE FACTOR AND GAIN – FREQUENCY

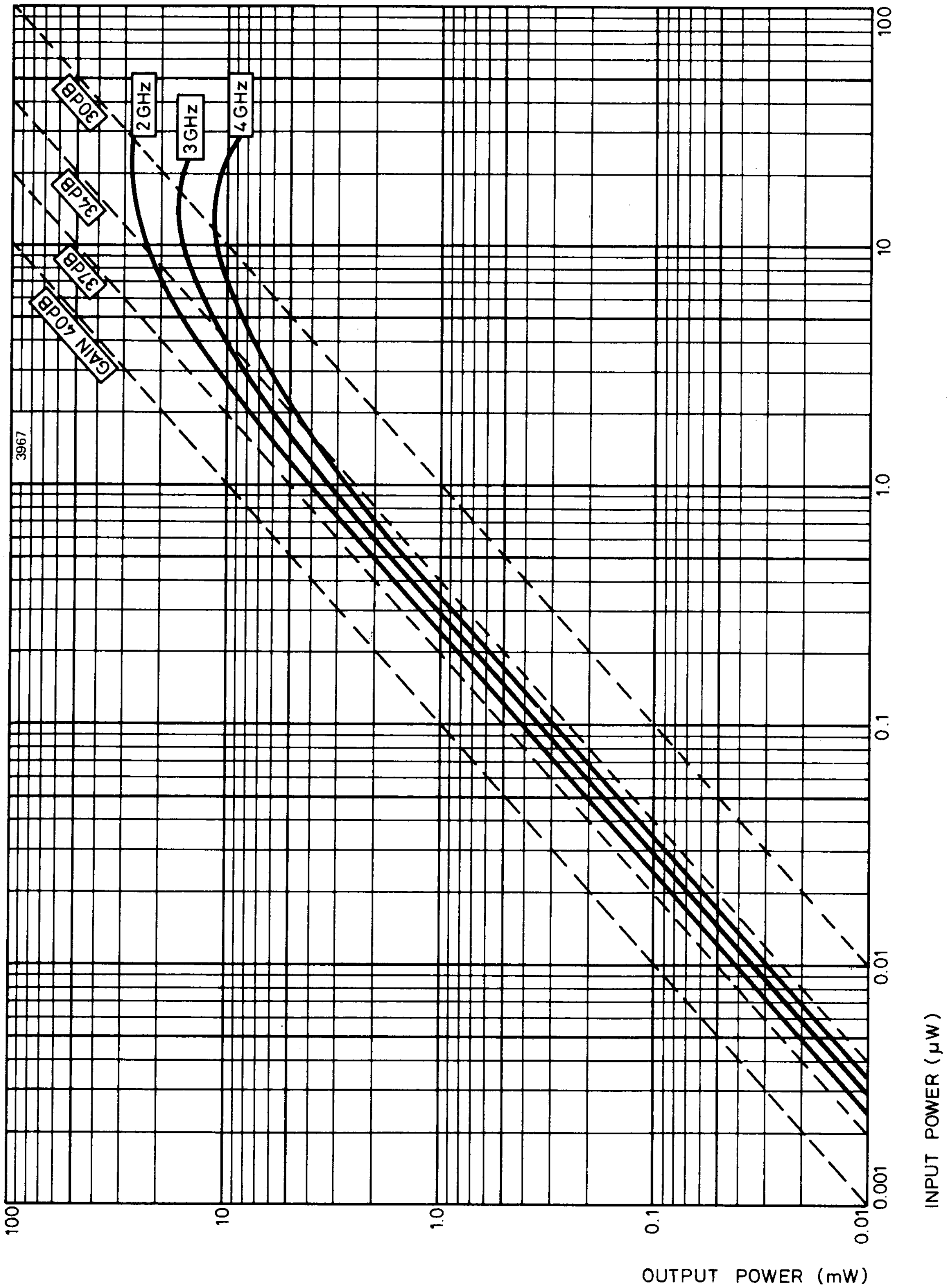




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



THE M-O VALVE
COMPANY LIMITED

TWS24 TWS25

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

Two conduction cooled S-band travelling wave amplifiers designed for use in communications systems.

The TWS24 gives a gain of 33dB at an output power of 12 watts in the frequency range 1.9 to 2.33GHz whilst the TWS25 gives a gain of 32dB at an output power of 10 watts in the frequency range 1.67 to 1.9GHz. They are designed for continuous operation at these power levels and employ the basic production techniques of the TWS10, whose reliability has been demonstrated by years of continuous operation in world wide communications systems.

These amplifiers are completely packaged in periodic permanent magnet focusing assemblies and coupled helix transitions to type N, 50 ohm, male connectors ensure an excellent match which allows useful performance to be obtained at frequencies outside the specified bandwidths. Rigorous processing schedules eliminate base-band noise peaks and the noise figure is typically better than 30dB.

Both the TWS24 and TWS25 are designed for mounting in any position, except with the collector cooling block downwards. The cooling block must be bolted to a suitable heat sink in the users' equipment.

ORDERING INFORMATION

Please note that the method of power connection, the operating frequency, and the RF coupler position must be specified with the order. Details are given in this data sheet.

HEATER

V_h	6.3 ± 5%	V
I_h (approx)	1.75	A

AMPLIFIER CONNECTIONS

Alternative methods of connection to power supplies are available to order.

a) flying leads colour coded as follows:-

Collector	Black
Helix	Orange
Grid 2	Blue
Heater	Brown
Heater/cathode	Yellow
Grid 1	Green

b) Use Electromethods BA7S socket (obtainable from Pye Connectors Ltd., Hitchin Street, Biggleswade, Bedfordshire, U.K.) to mate with corresponding plug fitted to tube.

Pin A	Grid 2
B	Heater
C	Helix
D	Grid 1
EF	Heater/cathode (common)
H	Collector and capsule (earth)

RF connectors:	Type N (50Ω) male

MAXIMUM RATINGS (Absolute)

V_{coll} (see Note 1)	3.0	kV
V_{helix} (see Notes 1, 2)	2.5	kV
V_{g2} (see Notes 1, 2)	1.7	kV
V_{g1} (see Note 1)	0	V
I_h (surge)	4.0	A
I_{coll}	75	mA
I_{helix} (see Note 3)	3	mA
I_{g2}	0.5	mA
p_{coll} (with specified cooling)	175	W
T_{amb}	70	°C
$T_{collector\ cooling\ block}$ (see Note 4)	110	°C
t_{hk} (min)	5	min
Altitude	10,000	ft
Interruption time for heater power (with other supplies on)	25	s

NOTES

1. All voltages are measured with respect to cathode. The collector is connected to the capsule and is normally earthed.
2. The grid 2 voltage must not be applied before the helix voltage.
3. It is advisable to provide a relay to remove high voltage supplies if the helix current exceeds 3.0mA.
4. See outline drawing for temperature measuring point.

OPERATING DATA

TWS24	Typical	Range	
Frequency (see Note 5)	2.1675	–	GHz
V_{coll} (see Note 6)	2.0	1.8–2.3	kV
V_{helix} (see Note 6)	2.1	1.9–2.4	kV
V_{g2} (see Notes 6, 7)	1.3	1.15–1.6	kV
V_{g1} (see Note 6)	0	–7 – 0	V
I_{coll} (see Note 7)	66	60–75	mA
I_{helix} (see Note 8)	0.4	0–3	mA
I_{g2}	0	0–0.2	mA
Power gain (small signal)	34.8	34–36	dB
Saturated power output	18.5	18 (min)	W
Input VSWR	1.5:1	–	
Output VSWR	1.5:1		
Variation of power gain (over any 10MHz)	0.05	–	dB/MHz
Cold attenuation	>60	–	dB
Noise factor at 12W output	30	–	dB

TWS25	Typical	Range	
Frequency (see Note 5)	1.7280	–	GHz
V_{coll} (see Note 6)	2.0	1.8–2.3	kV
V_{helix} (see Note 6)	2.1	1.9–2.4	kV
V_{g2} (see Notes 6, 7)	1.4	1.15–1.6	kV
V_{g1} (see Note 6)	0	–7 – 0	V
I_{coll} (see Note 7)	72.2	60–75	mA
I_{helix} (see Note 8)	0.4	0–3	mA
I_{g2}	0	0–0.2	mA
Power gain (small signal)	33	32–34	dB
Saturated power output	15.2	15 (min)	W
Input VSWR	1.5:1	–	
Output VSWR	1.5:1	–	
Variation of power gain (over any 10MHz)	0.05	–	dB/MHz
Cold attenuation	>60	–	dB
Noise factor at 10W output	30	–	dB

NOTES

5. The tube is normally adjusted in manufacture for optimum performance at specific frequencies. The normally manufactured frequency variants are as follows:-

TWS24	2.1675GHz	
TWS25	1.6845GHz	1.7425GHz
	1.7280GHz	1.7860GHz

   Alternative operational frequencies or tubes with broadband performance are available to special order. In the case of broadband tubes the RF performance may differ slightly from that given in OPERATING DATA. Details on request.
6. Specified for each tube. These voltages should be capable of adjustment over the ranges specified.
7. Grid 2 voltage adjusted within the range to give collector current specified on each tube.
8. It is advisable to provide a relay to remove high voltage supplies if helix current exceeds 3.0mA.

INSTALLATION AND ALIGNMENT

The best mounting position is with the tube vertical, collector cooling block uppermost and bolted to a suitable heat sink such that the temperature measured at point indicated on outline drawing, does not exceed 110°C. The mounting plate should be liberally smeared with heat conducting silicone compound (Midland Silicones Compound DP2623 is suitable) under the collector cooling block. Secure the tube at the other end by two fixing bolts. The bolts should be tightened to the point where the fixed support on the bottom of the tube just makes contact with the mounting surface. Excessive tightening will bend the tube support. Before connecting the tube pre-set the collector voltage supply to 2kV, the helix voltage supply to the value indicated on the tube label and the grid 2 voltage to approximately 1.0kV. Switch off all supplies and connect the tube. Apply the rated heater voltage for a minimum period of 5 minutes. Switch on collector voltage, helix voltage and grid 2 voltage simultaneously. Re-adjust collector voltage to 2.0kV. Increase grid 2 voltage until the collector current is the value indicated on the label. Re-adjust collector voltage to 2.0kV if necessary. Apply r.f. drive at a low level and adjust helix voltage for maximum power output. Increase the drive level and re-adjust helix voltage until the required output power is obtained.

The amplifiers should be installed on a non-magnetic panel and magnetic material should be kept at least eight inches away from the amplifier.

A suitable heat sink will be supplied to special order.

OPERATING NOTES

On initial installation the specified performance will be obtained at the collector current indicated on the tube label. During life compensation for falling gain may be made by increasing collector current up to a maximum of 75mA by adjusting grid 2 voltage. For optimum life the tube should be operated at the lowest collector current which gives the required output power.

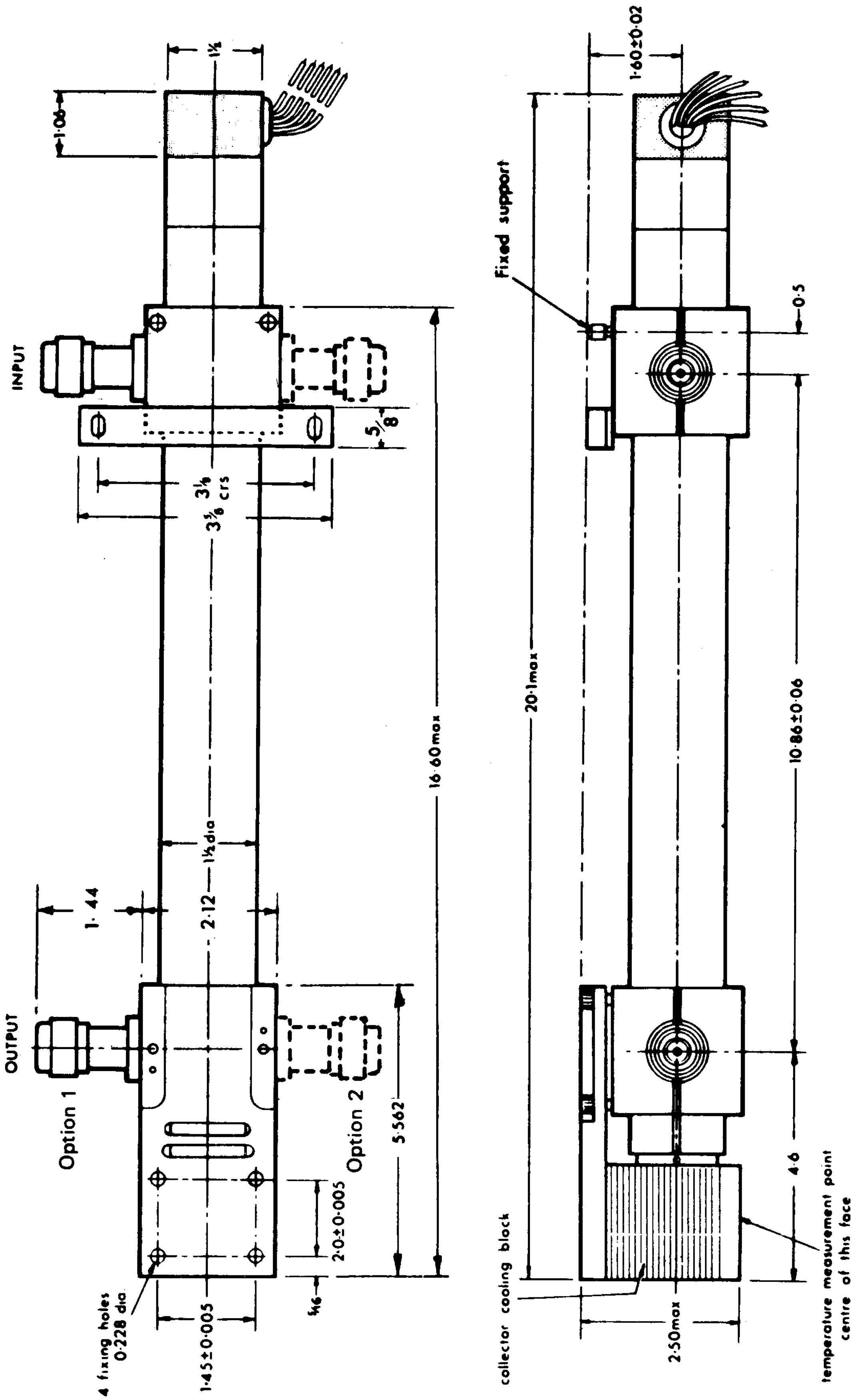
These tubes are not designed for continuous operation at power levels in excess of 12 watts output.

MECHANICAL

Weight (approx). 3.2kg (7lbs.)
Dimensions . . . . See outline drawing

Note:- Alternative positions of the RF couplers are available. The tube with coupler positions as indicated on the outline drawing should be ordered as TWS24 or TWS25 Option 1. The tube with the couplers displaced by 180° should be ordered as TWS24 or TWS25 Option 2.

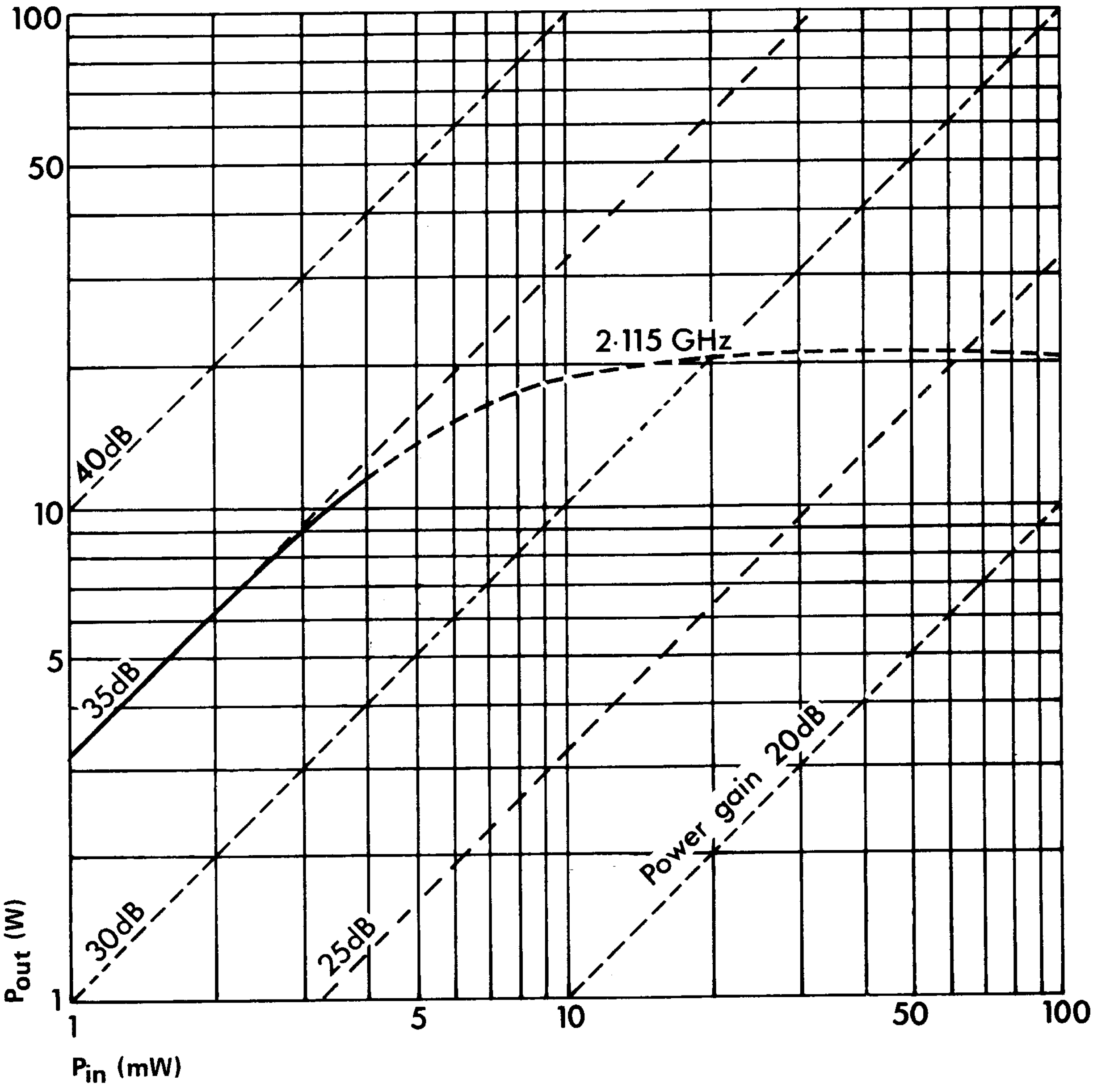
OUTLINE



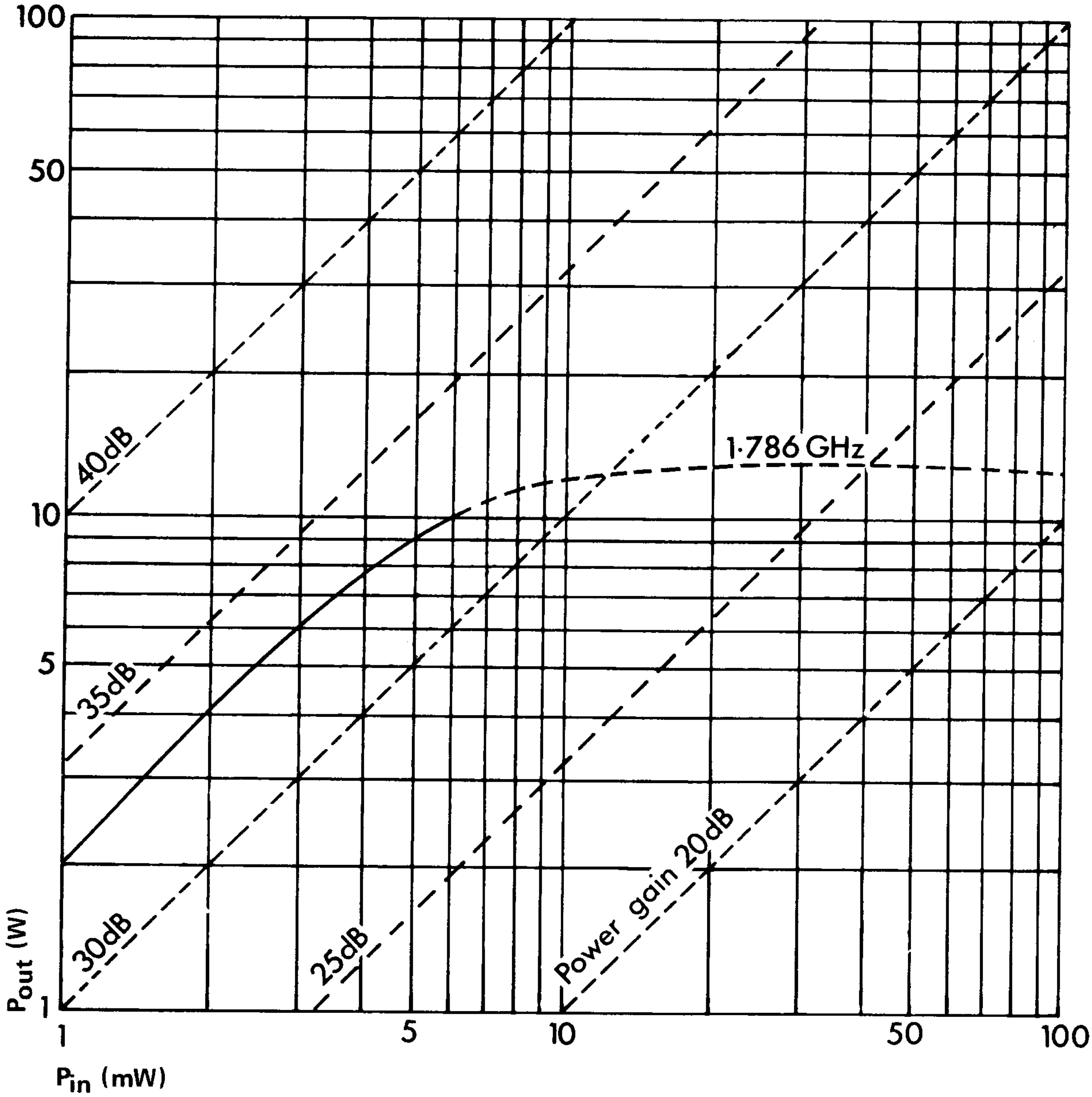
Anodised black all over except contact areas shaded

Dimensions are in inches and are nominal unless otherwise stated.

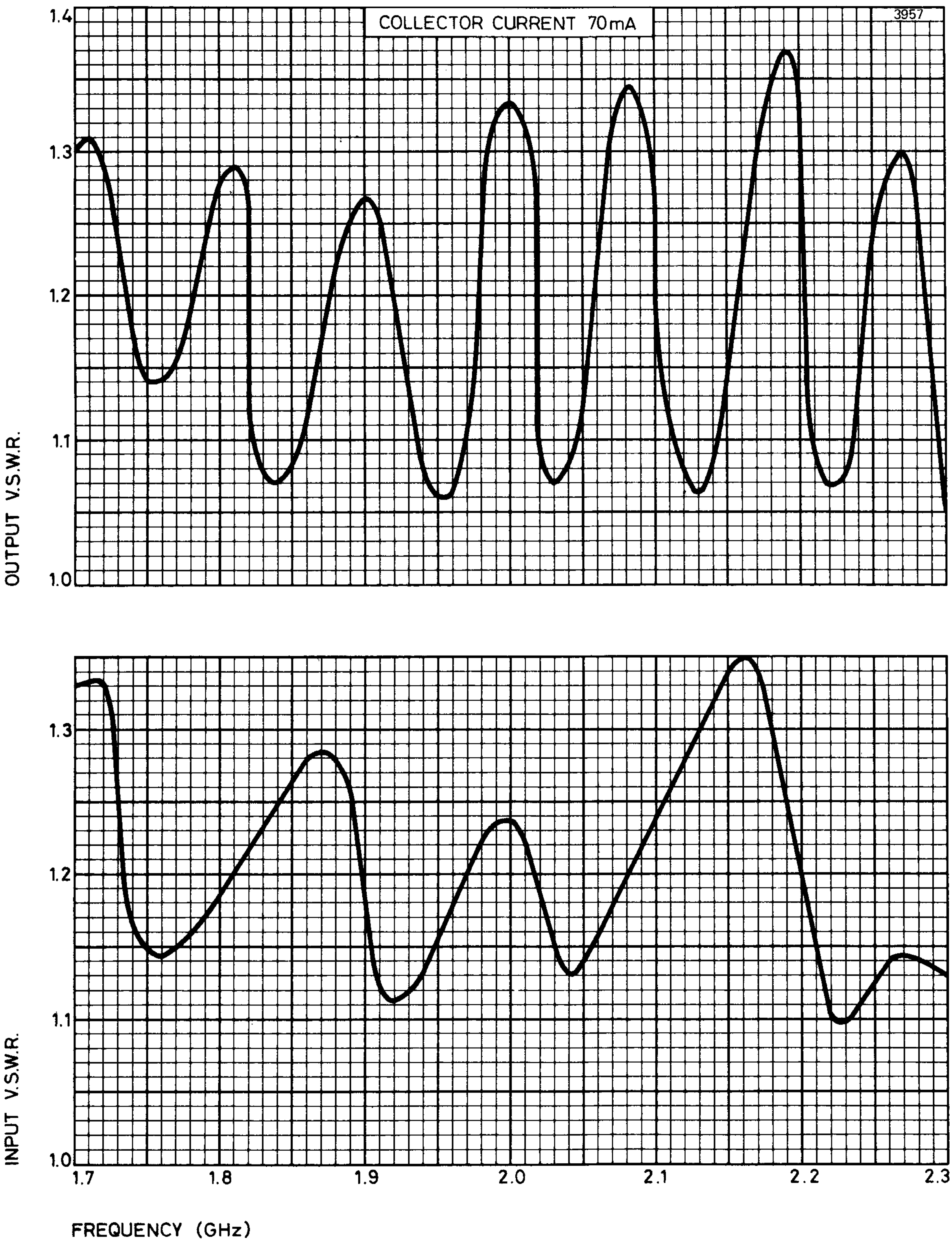
GAIN MEASURED WITH HELIX VOLTAGE ADJUSTED FOR MAXIMUM POWER OUTPUT FOR TWS24



GAIN MEASURED WITH HELIX VOLTAGE ADJUSTED FOR MAXIMUM POWER OUTPUT FOR TWS25



MATCH – FREQUENCY



TWS 26

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise travelling wave amplifier with integral power supply giving a gain of 35 to 42dB over the frequency range 2.0 to 4.1GHz and a noise factor better than 11dB.

DESCRIPTION

Simplicity of installation and low cost replacement combined with excellent broadband performance has been achieved by combining a rugged travelling wave tube amplifier package with a stabilised power supply. Modular construction has been adopted, allowing considerable flexibility and space saving and, since the tube and power supply are separable, replacement costs are minimised. A built in correction circuit compensates for changes in performance with life so no adjustment is required in operation. The power input requirement is 115V or 240V a.c. at 50/60Hz or 28V d.c. at 1A.

The amplifier is normally adjusted at the factory for optimum broadband performance but it is possible for this to be upgraded at discrete frequencies on request. R.F. connections are made by means of Type N 50ohm coaxial connectors.

Under broadband conditions the noise factor is typically better than the stated maximum. The dynamic range is 37dB for full bandwidth operation, increasing to 70dB for operation over 1MHz. The maximum gain variation over the frequency range is typically 3dB and the noise factor varies by less than 0.75dB. Complete magnetic shielding allows tubes to be operated side by side and eliminates interference with companion equipment.

POWER SUPPLIES

The units can be supplied to operate from alternative inputs:

1. 115V or 240 ± 10%
   Single phase
   50/60Hz

   or

2. 28V d.c.
   at 1A.

Connections

Plug type: Bendix PTO 6E-8-4S (SR) Supplied
Pin A. Neutral
B. Line
C. Earth (connected to case)
D. No connection

Controls

Power on/off switch with associated indicator light. Remote switching facility can be provided to order.

TYPICAL OPERATION

Frequency range	2.0 to 4.1	GHz
Maximum noise factor	11	dB
Minimum small signal gain	35	dB
Maximum small signal gain	42	dB
Maximum gain variation over frequency range	5	dB
Minimum saturated power output	7	dBm
Maximum input VSWR (hot)	2.5:1	–
Maximum output VSWR (hot)	2.5:1	–
Minimum isolation	55	dB

Note

A significant improvement in r.f. performance is available over narrow bandwidths (500 to 1000MHz). Details are available on request.

INSTALLATION

Apply mains input to the 4 pin bayonet connector on the front panel using the socket provided.

Connect r.f. input and output using type N connectors. The r.f. input level should not be allowed to exceed 250mW c.w.

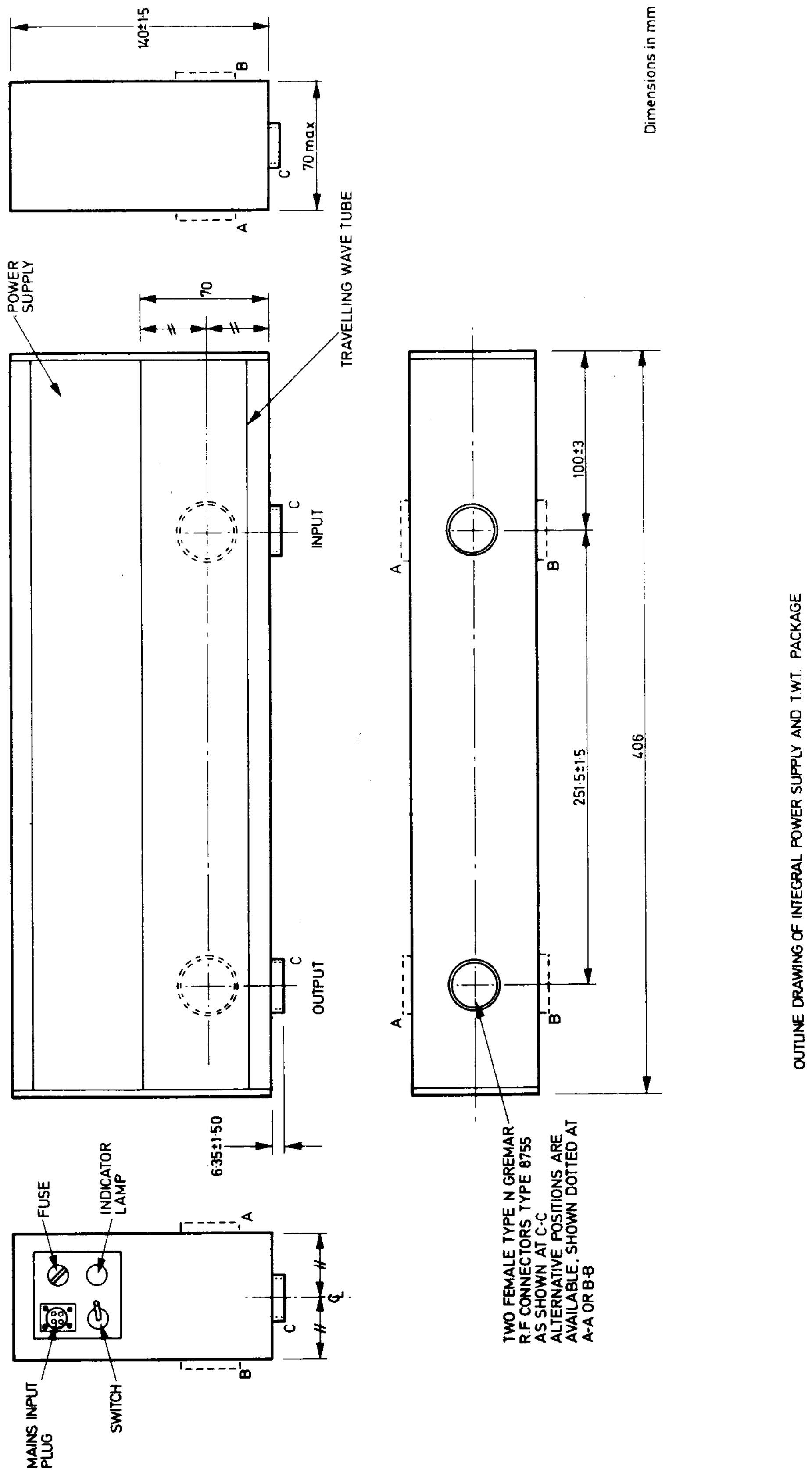
Switch on. The red indicator light will glow. After a 90 second automatic delay the amplifier will be operational.

Warning

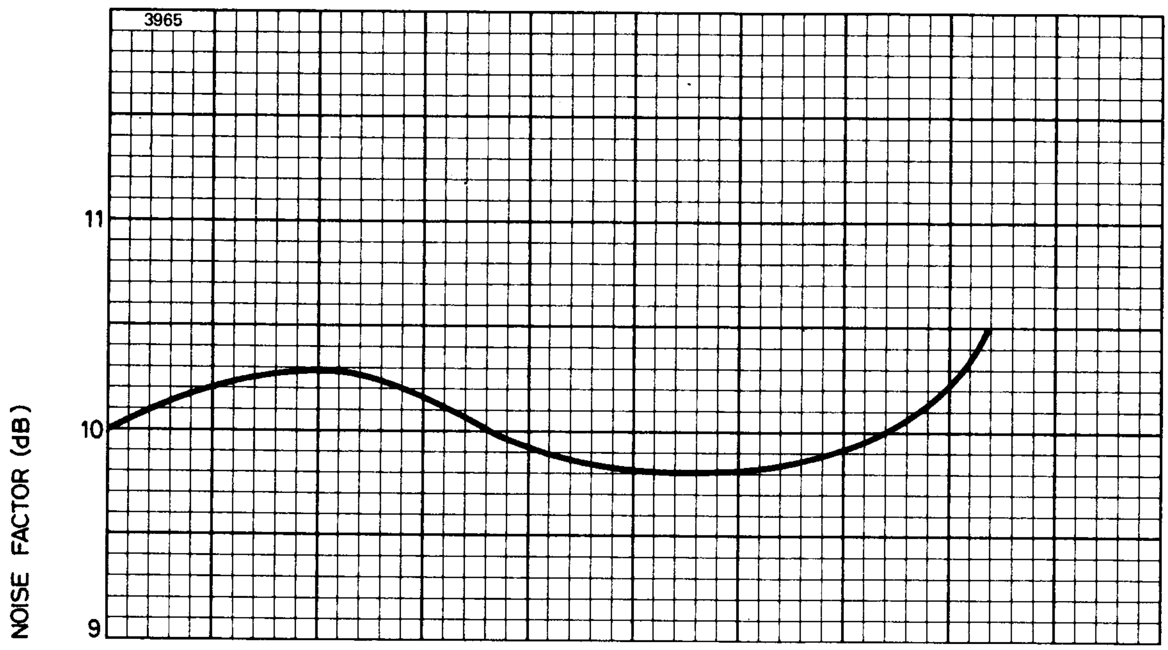
On no account should internal adjustments be made to the power supplies.

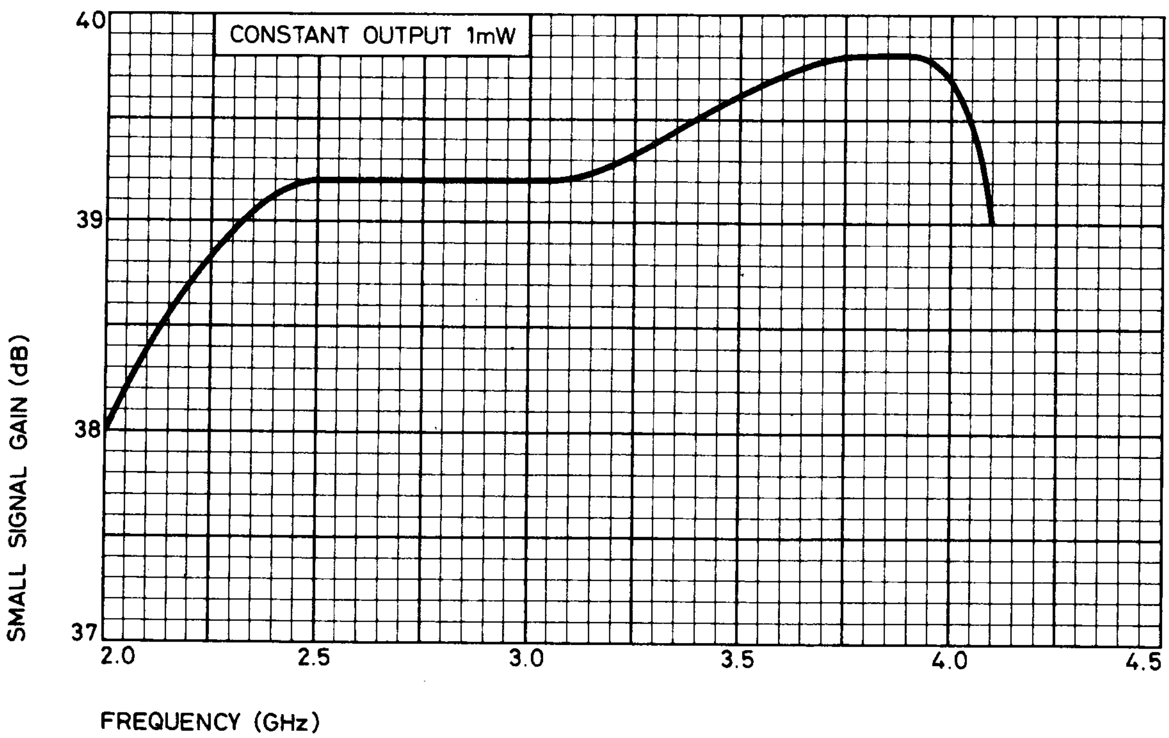
Alignment requires precision measuring facilities and broadband performance will be lost if power supply controls are adjusted indiscriminately. Damage to the power supply or the tube may be caused by random adjustment.

OUTLINE DRAWING OF INTEGRAL POWER SUPPLY AND T.W.T. PACKAGE

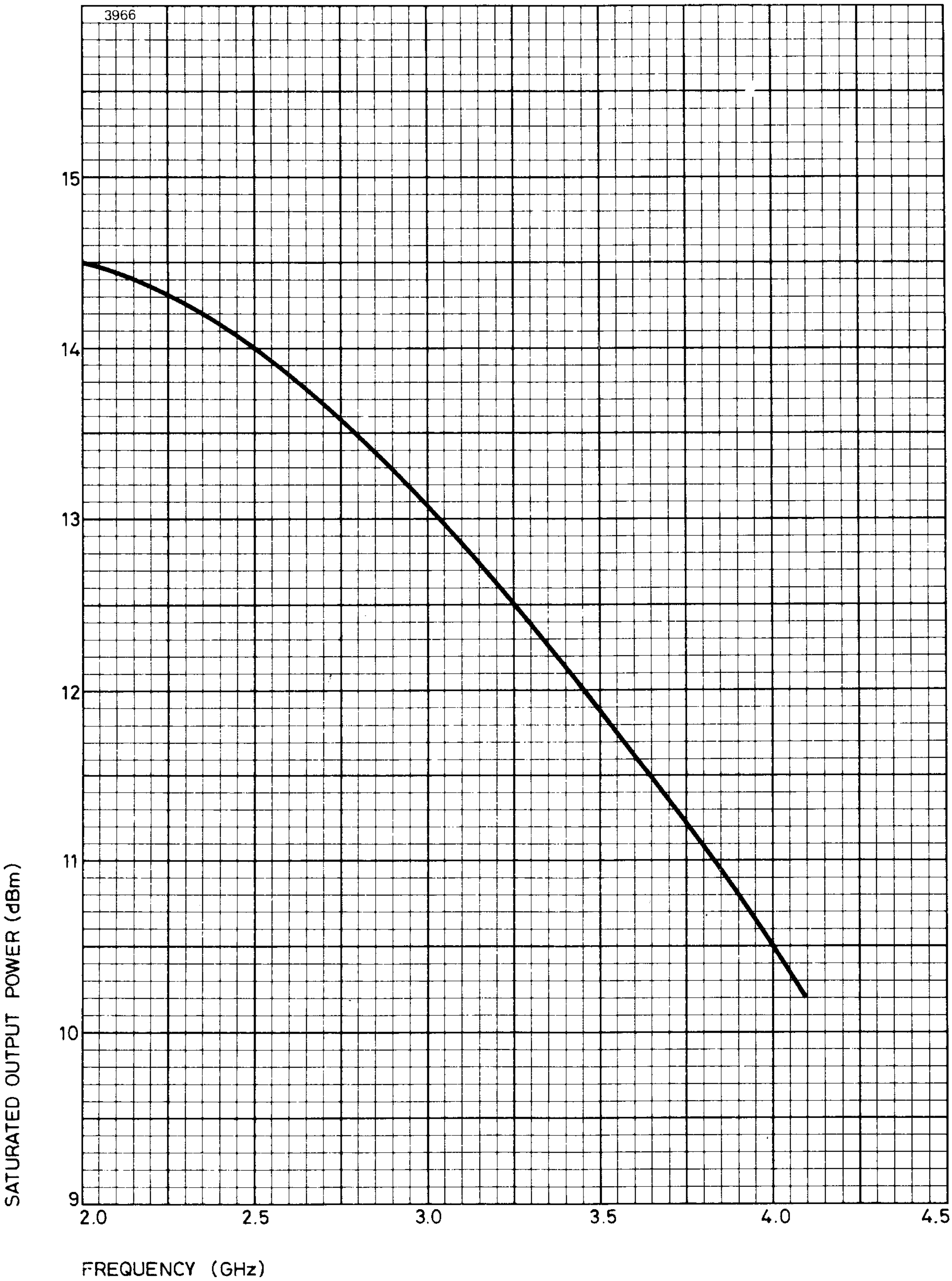


NOISE FACTOR AND GAIN – FREQUENCY

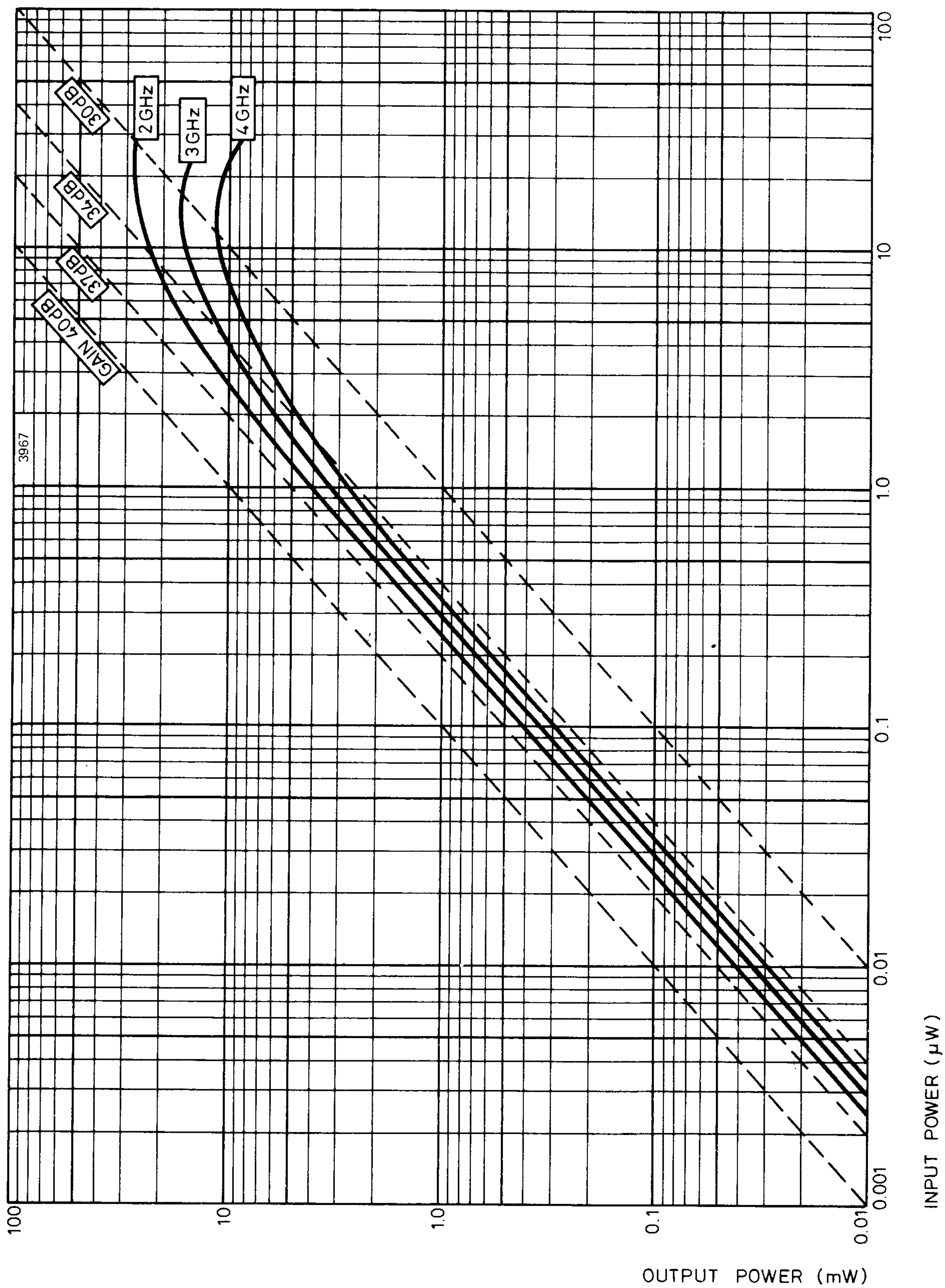




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



TWS 36

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

An S-band travelling wave power amplifier designed for use in telecommunications systems giving a small signal gain of better than 30dB and a minimum saturated output power of 18 Watts in the frequency range 1.7GHz to 2.3GHz. The amplifier is designed for linear operation at output levels up to 10 watts.
The amplifier is completely packaged in a periodic permanent magnet focusing assembly and coupled helix transitions to type N 50 ohm connectors ensure an excellent match which reduces fine structure gain variation and permits extended bandwidth operation at reduced gain over the frequency range 1.6GHz to 4.0GHz.
Rigorous processing schedules eliminate base-band noise peaks and the noise factor is typically better than 28dB.
The TWS36 is cooled by conduction and is designed for mounting in any position except with the collector block downwards. The cooling block should be bolted to a suitable heat sink in the users equipment.

AMPLIFIER CONNECTIONS

Connection of d.c. power supplies is by flying leads colour coded as follows:-

Collector/Capsule body	Black
Helix	Orange
Grid 2	Blue
Heater	Brown
Heater/Cathode	Yellow
Grid 1	Green

RF connectors: Type N (50Ω) Male

HEATER

V_h	6.3 ± 5%	V
I_h	1.75 (approx)	A

MAXIMUM RATINGS (Absolute)

V_{coll} (note 1)	3.0	kV
V_{helix} (notes 1, 2)	2.5	kV
V_{g2} (notes 1, 2)	1.7	kV
V_{g1} (note 1)	−7	V
I_h (surge)	4.0	A
I_{coll}	75	mA
I_{helix} (note 3)	3	mA
I_{g2}	0.5	mA
p_{coll} (with specified cooling)	175	W
P_{out} (mean)	12	W
T_{amb}	70	°C
t_{hk} (min)	5	min
Altitude	10,000	feet
Interruption time for heater power (with other supplies on)	25	s

TYPICAL OPERATION

Frequency range	1.7 to 2.3	GHz
V_{coll} (note 4)	2.0 to 2.3	kV
V_{helix} (notes 4, 5)	1.85 to 2.35	kV
V_{g2} (notes 4, 5, 6)	1.15 to 1.6	kV
V_{g1} (note 4)	−7 or 0	V
I_{coll} (note 6)	60 to 73	mA
I_{helix} (note 3)	0 to 3	mA
I_{g2}	0 to 0.2	mA
Power gain (small signal)	30 (min)	dB
Saturated power output (note 7)	18 (min)	W
Input VSWR (Hot)	1.4:1 (max)	
Output VSWR (Hot)	1.5:1 (max)	
Variation of power gain (over any 10MHz)	0.05	dB/MHz
Cold attenuation	50	dB
Noise factor	28	dB

NOTES

1. All voltages are measured with respect to cathode. The collector is connected to the capsule and is normally earthed.
2. The grid 2 voltage must not be applied before the helix voltage.
3. It is advisable to provide a relay to remove high voltage supplies if the helix current exceeds 3.0mA.

NOTES (contd)

4. Specified for each tube. These voltages should be capable of adjustment over the ranges specified above.
5. Helix voltage adjusted within the range to give optimum performance. The value of helix voltage is specified on each tube and is such that it gives optimum conditions for power output and matches over the whole band 1.7 to 2.3GHz.
6. Grid 2 voltage adjusted within the range to give collector current specified on each tube.
7. The tube is designed for linear operation at output levels up to 10 Watts. Continuous operation at output power levels of greater than 12 Watts will shorten the operational life.

WEIGHT

The weight of the TWS36 is approximately 3.2kg.

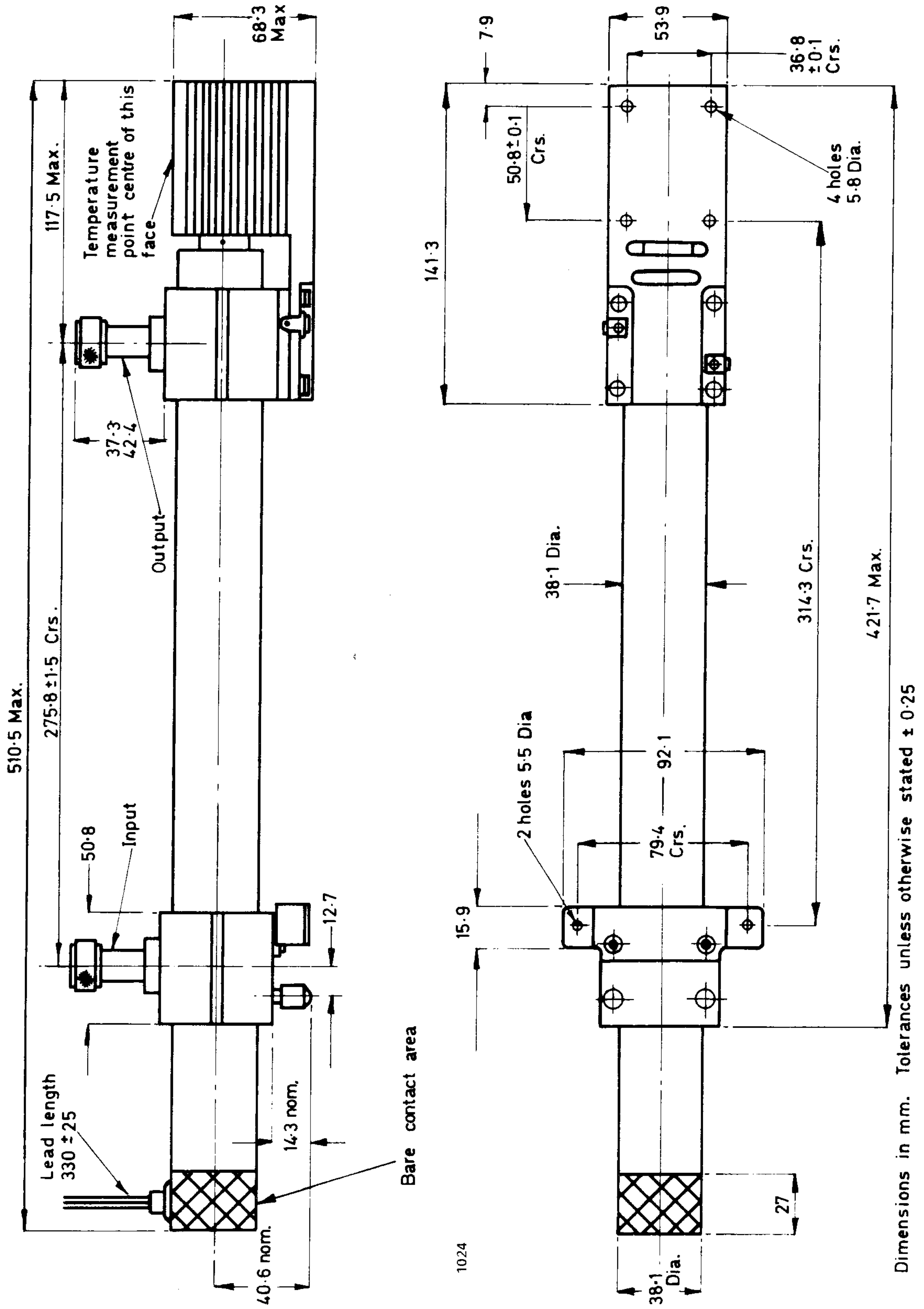
INSTALLATION

The best mounting position is vertically with the collector cooling block uppermost and bolted to a suitable heat sink such that the block temperature measured at the point indicated on the outline drawing does not exceed 110°C under worst conditions. The amplifier should never be mounted vertically with the collector cooling block downwards.
Details of a suitable heat sink, which must be flat over the mating surfaces, are available on request. A heat conducting compound should be applied to the underside of the cooling block.

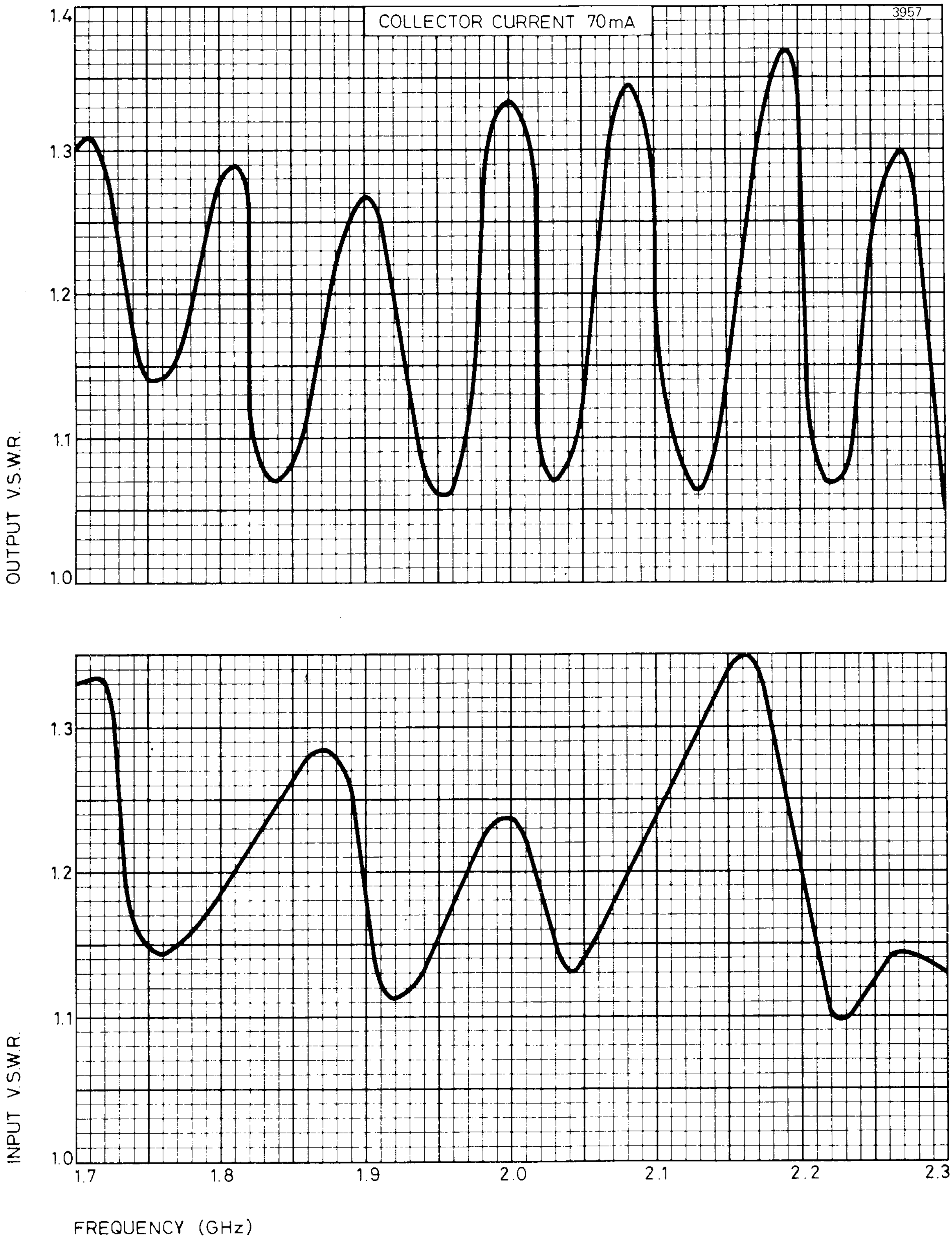
WARNING

The amplifier should be installed on a non-magnetic panel and magnetic material should be kept at least eight inches away from the amplifier.
A suitable load must be connected to the tube output at all times whilst the tube is connected to power supplies.

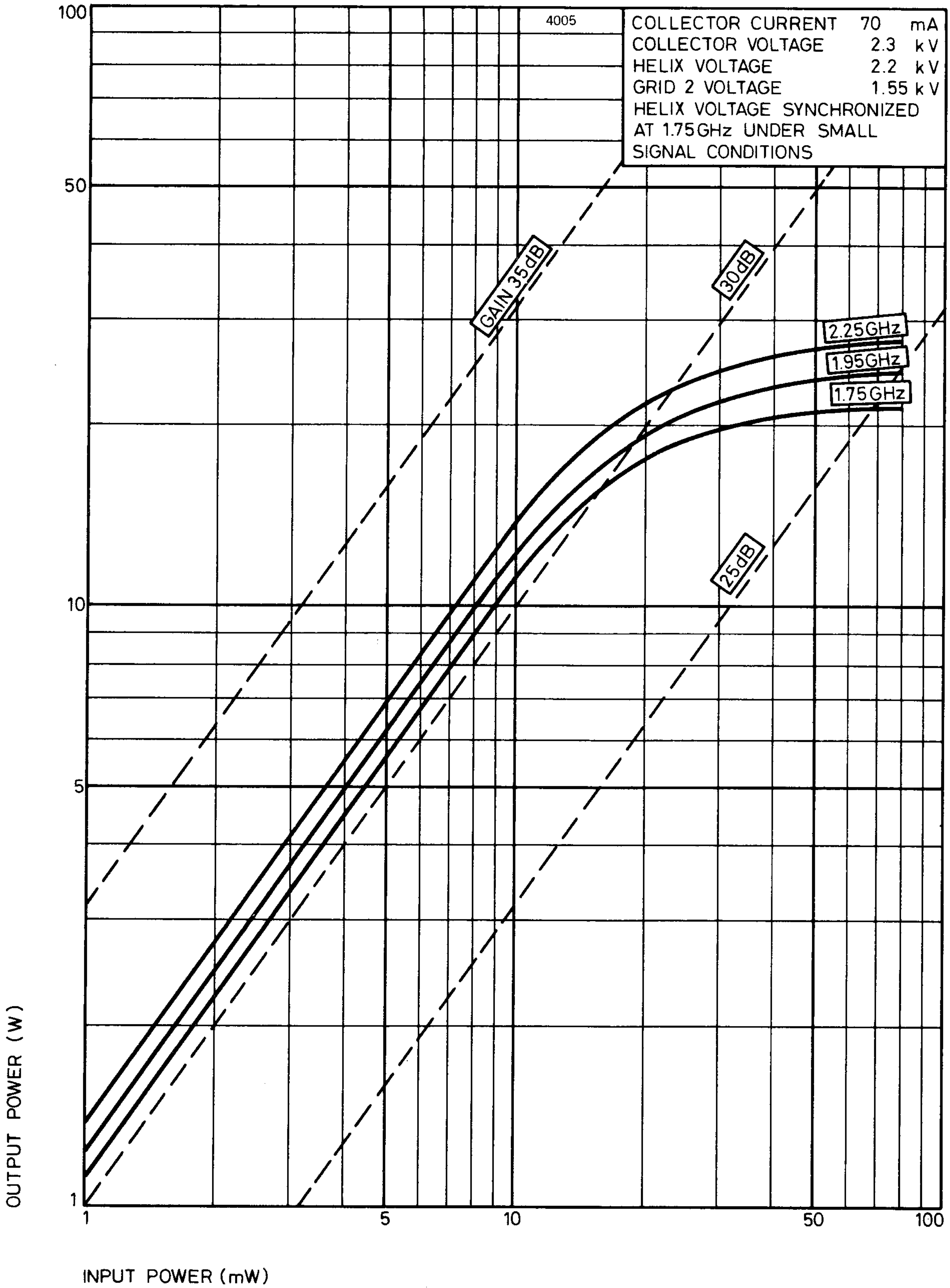
OUTLINE


68·3 Max
117·5 Max.
Temperature measurement point centre of this face
37·3
42·4
Output
510·5 Max.
275·8 ±1·5 Crs.
50·8
Input
12·7
Lead length 330 ±25
14·3 nom.
Bare contact area
40·6 nom.
7·9
53·9
36·8 ±0·1 Crs.
50·8±0·1 Crs.
4 holes 5·8 Dia.
141·3
38·1 Dia.
314·3 Crs.
421·7 Max.
2 holes 5·5 Dia
92·1
79·4 Crs.
15·9
27
38·1 Dia.
1024
Dimensions in mm. Tolerances unless otherwise stated ± 0·25

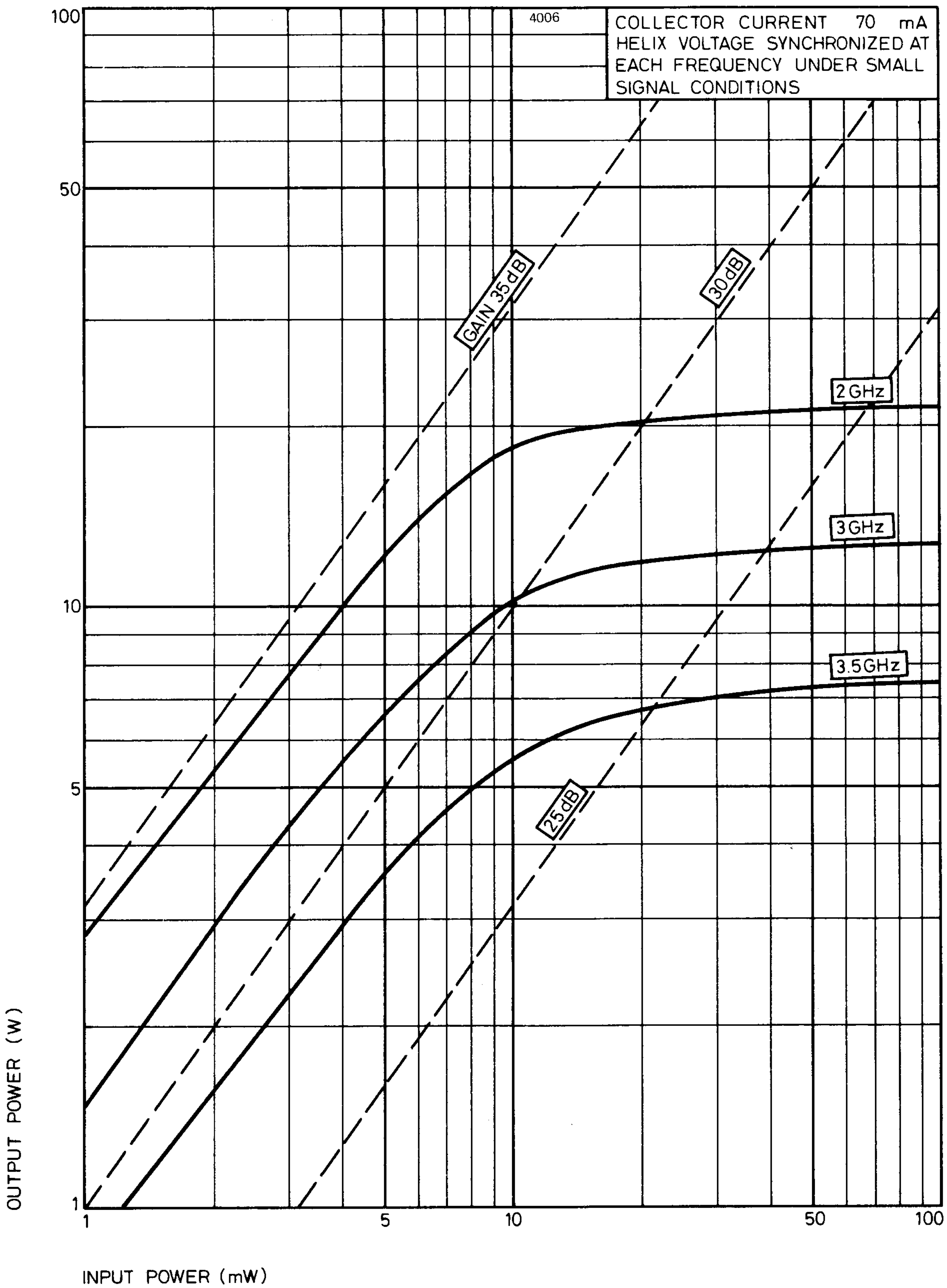
INPUT AND OUTPUT VSWR AT COLLECTOR CURRENT OF 70mA



GAIN MEASURED OVER THE FREQUENCY BAND 1.75GHz TO 2.25GHz AT FIXED HELIX VOLTAGE



GAIN MEASURED OVER THE FREQUENCY BAND 2GHz TO 3.5GHz



TRAVELLING WAVE AMPLIFIER

BRIEF DATA

The TWX8 is a general purpose X-band amplifier giving a minimum gain of 35dB and a saturated power output of 1 watt over the frequency range 7.5 to 11.0GHz. Useful performance is obtainable over the range 7.0 to 12.0GHz. (See page 6).
The tube is completely packaged and is normally convection cooled. Alternative versions are available in which the supply connections are brought out either to a plug or to flying leads.

AMPLIFIER CONNECTIONS

Supply connection plug, Type BA7P* or flying leads.

Pin A	Grid 2	Blue	Pin E	Heater	Brown
B	NC	–	F	Heater/Cathode	Yellow
C	Helix	Orange	H	Collector (body)	Black
D	Grid 1	Green			

R.F. connectors, WG16 plain flange. (Normally round but square available).

*Use with Electromethods socket type BA7S obtainable from Pye Connectors Ltd., Hitchin Street, Biggleswade, Beds.

HEATER

V_h	4.5 ± 5%	V
I_h	3.5–4.5	A

MAXIMUM RATINGS (Absolute)

V_{coll} (see Notes 1, 2)	2.8	kV
V_{helix} (see Notes 1, 2)	2.8	kV
V_{g2} (see Note 1)	1.0	kV
V_{g1}	0	V
V_h	6.0	V
I_h (surge)	10	A
I_{coll}	10	mA
I_{helix}	2.0	mA
I_{g2}	1.5	mA
t_{hk} (min)	2.0	min

TYPICAL OPERATION

Frequency range	7.0–11.5	GHz
V_{coll} (see Notes 1, 2).	2.7	kV
V_{helix} (see Notes 1, 2, 3, 4).	2.20–2.60	kV
V_{g1} (see Notes 4, 7)	−30 – 0	V
V_{g2} (see Notes 1, 5)	450–700	V
I_{coll} (see Note 4)	8.0	mA
I_{helix} (see Note 6).	0–1.0	mA
I_{g2}	0–1.0	mA
Noise factor (at 1.0W output)(max).	30	dB
P_{out} at 10GHz (min).	1.0	W
P_{out} at 8GHz (min)	0.75	W
P_{out} at 7 and 11GHz (min).	0.5	W
Power gain	see curves page 6	
Input and output VSWR (max)	3.1:1	

NOTES

1. All voltages are measured with respect to the cathode. The collector is normally earthed.
2. The collector voltage must never be less than the helix voltage.
3. It must be possible to reduce this voltage to zero and the supply must be capable of continuous adjustment over the range 2.2 to 2.6kV.
4. The operating helix and grid 1 voltage and the collector current for the best broad band performance are specified on each tube and should be reproduced with the following accuracies:-

Helix voltage	±1%
Grid 1 voltage	±15%
Collector current	±2%

   Helix voltage may need to be adjusted from that specified to obtain maximum output at any particular frequency.
5. Supply must be capable of continuous adjustment over the range 0 to 700V. V_{g2} should be adjusted in operation to obtain the specified collector current.
6. It is advisable to provide a relay to remove the high voltage supplies if helix current exceeds 2.0mA.
7. This voltage must be available at any value of collector current.

WEIGHT

The weight of the TWX8 is 2.3kg (5lb.).

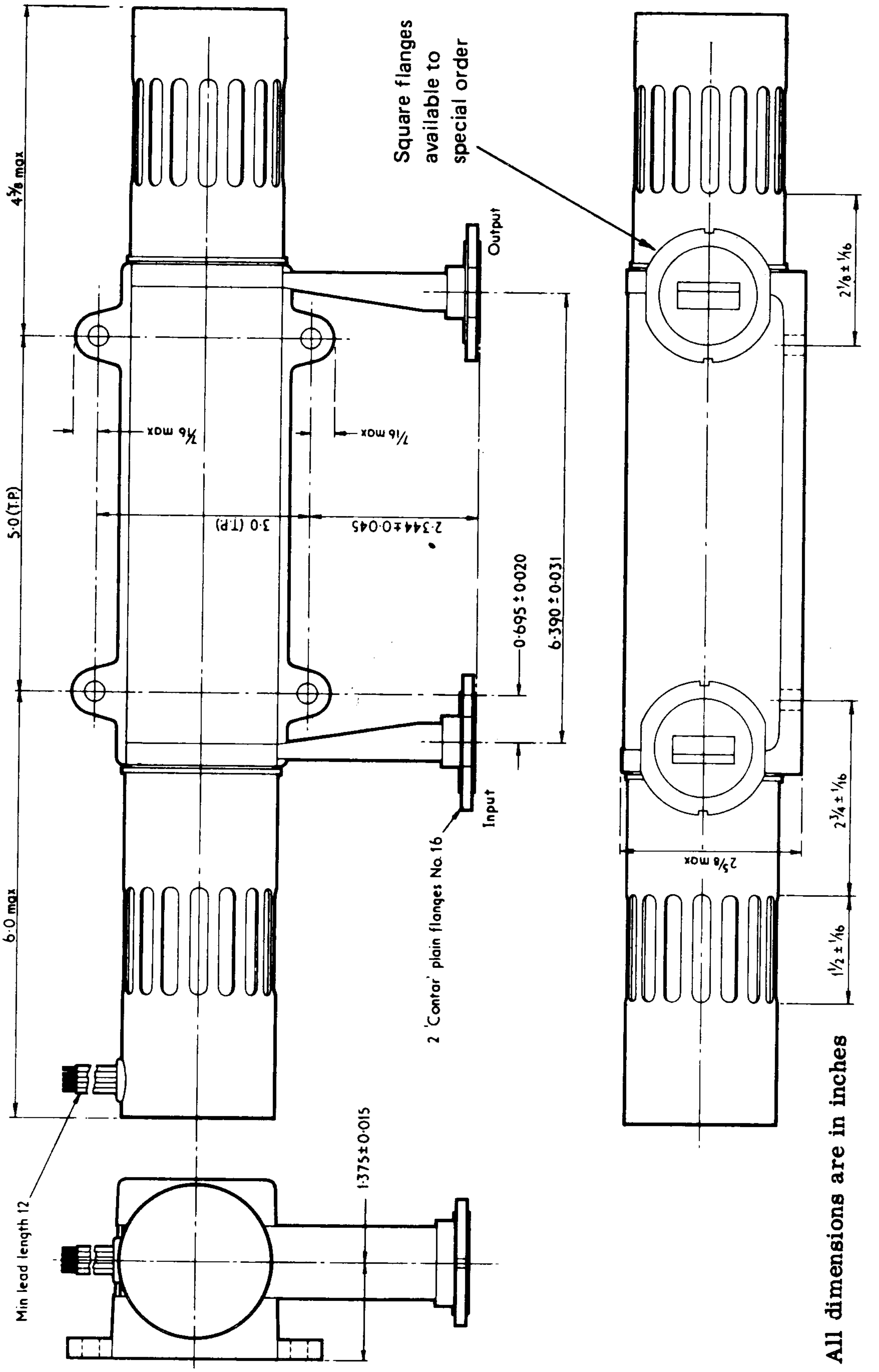
INSTALLATION

The tube is designed to be mounted horizontally and in such a position that air can circulate freely over the collector cooling fins. If mounted other than horizontally, forced air cooling may be necessary. Upon installation the full operating voltages may be applied instantaneously to collector, helix, and grid 1 but grid 2 voltage should be increased from zero.

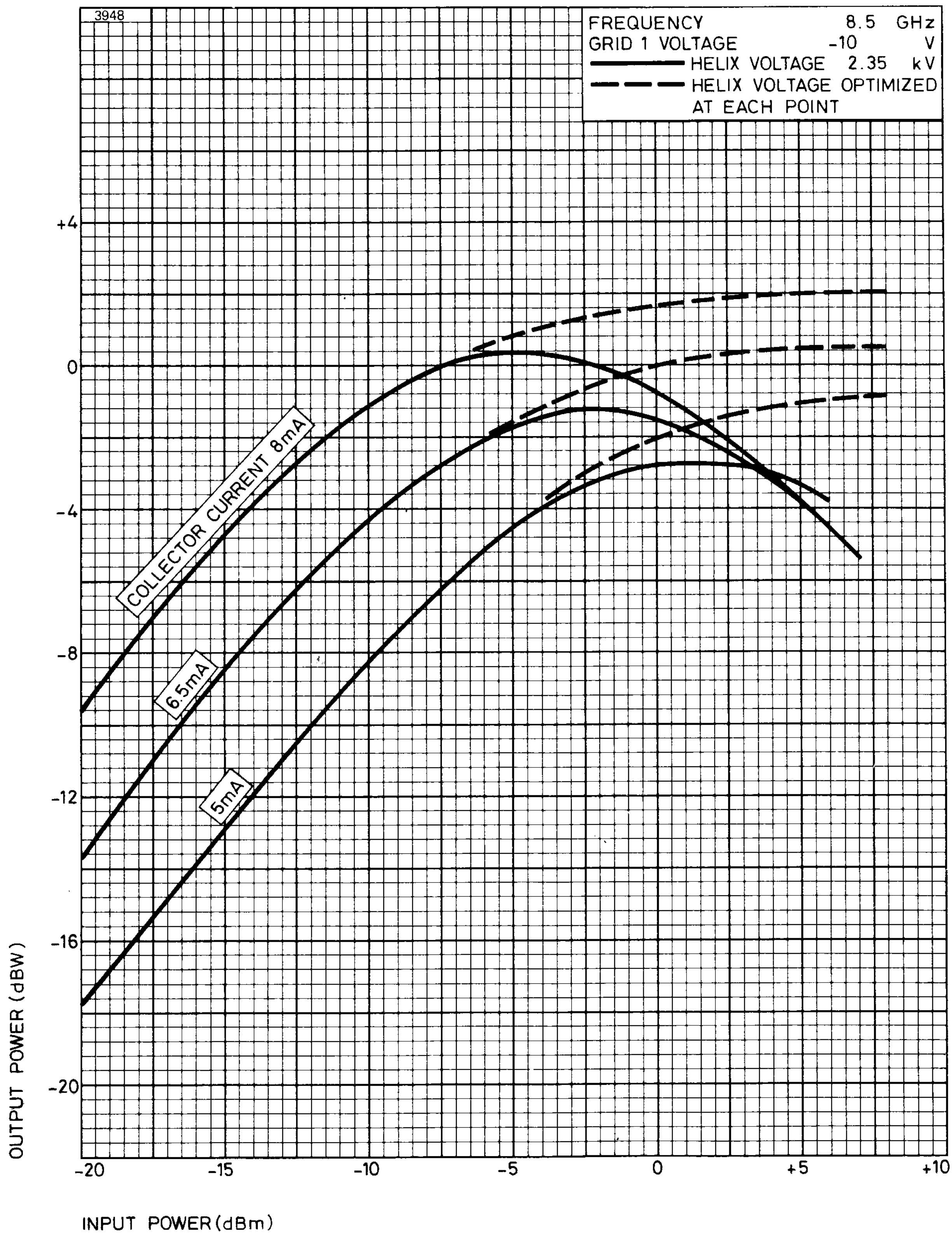
SETTING UP PROCEDURE

1. Turn up or switch on the heater supply ensuring that the surge current does not exceed 6 amps. Wait for 3 minutes.
2. Set grid 1 voltage to the value indicated on the tube.
3. Set the collector voltage to 2.7kV.
4. Set the helix voltage to the value indicated on the tube.
5. Increase grid 2 voltage until collector current can be observed. Alternately, increase grid 2 voltage and adjust grid 1 voltage until the indicated collector current is obtained at minimum helix current.
6. Apply r.f. input at approximately the centre frequency of the operating band and adjust helix voltage for maximum r.f. output. Readjust grid 2 and grid 1 voltages to maintain the indicated collector current at minimum helix current.

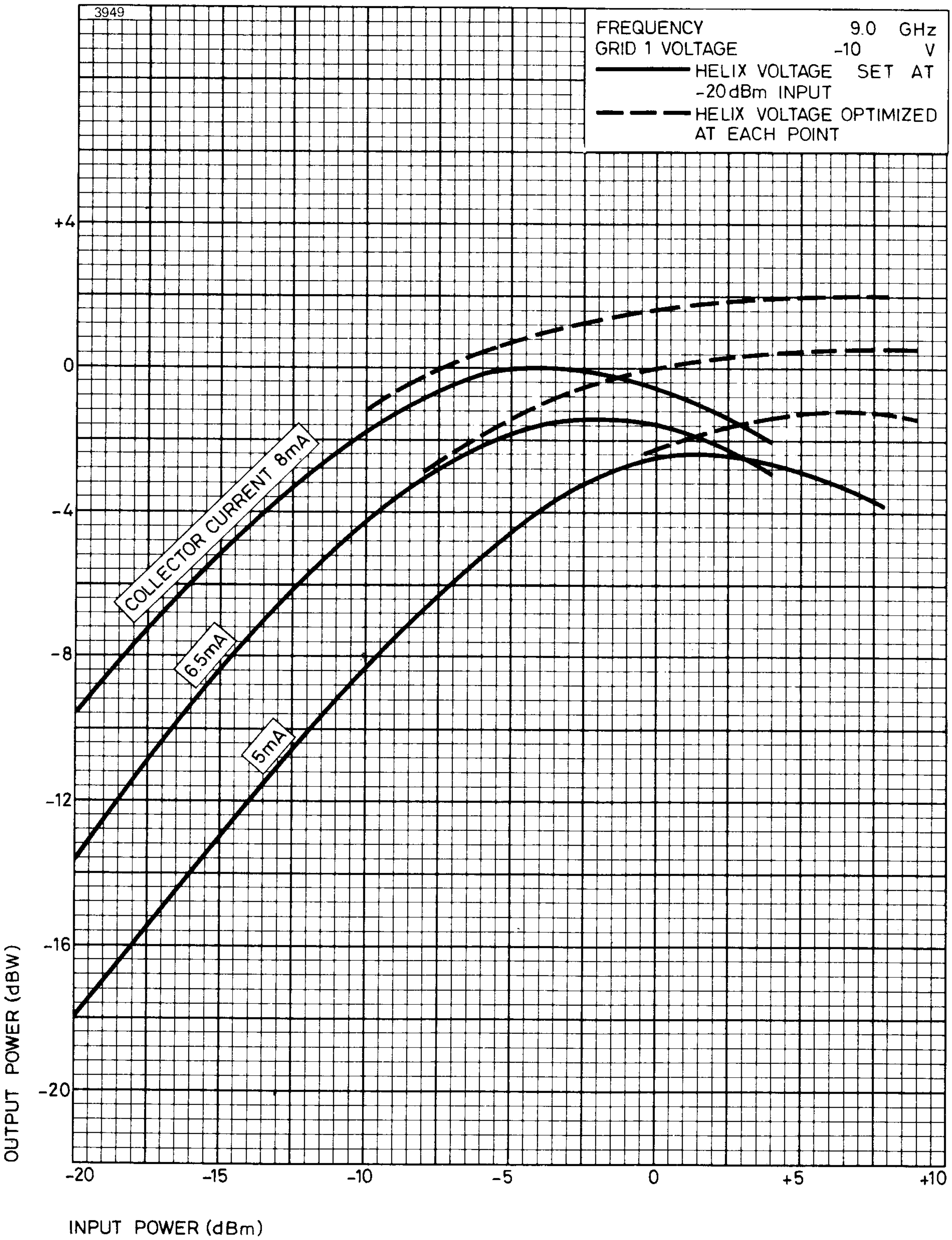
OUTLINE


Square flanges available to special order
Output
Input
2 'Contar' plain flanges No. 16
Min lead length 12
4⅝ max
5·0 (T.P.)
6·0 max
7/16 max
3·0 (T.P.)
2·344±0·045
0·695 ± 0·020
6·390 ± 0·031
1·375±0·015
2⅛ ± 1/16
2¾ ± 1/16
1½ ± 1/16
2⅝ max
All dimensions are in inches

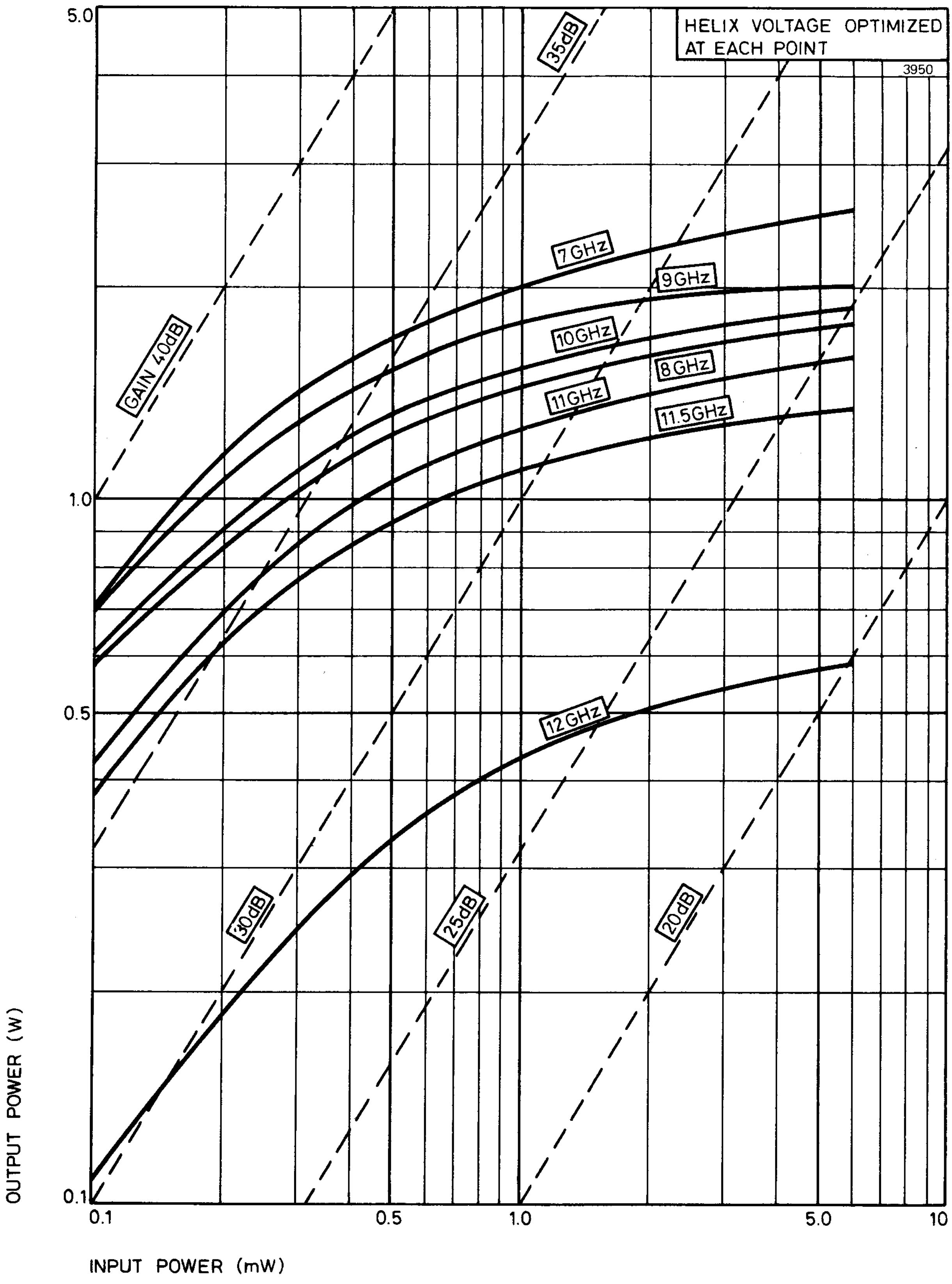
POWER CHARACTERISTIC CURVES



POWER CHARACTERISTIC CURVES



PERFORMANCE OVER FREQUENCY RANGE 7–12GHz



TWX16

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A high power pulsed travelling wave amplifier giving over 40dB gain at 5kW peak output power, 30W mean power and 5–20kW saturated peak power, over a bandwidth of 500MHz in the range 8,000–9,300MHz.

DESCRIPTION

The tube is of rugged metal-ceramic construction and uses a ring and bar slow wave structure giving freedom from unwanted oscillations. Focusing is achieved by operation in a solenoid mount assembly type SMX16 which incorporates the r.f. couplings and provides conduction cooling of the tube by means of a collector clamp liquid cooled in series with the coil cooling. The helix is electrically connected to the body of the tube which is normally earthed through the solenoid mount assembly. The collector is insulated from the body so that the body (helix) current can be monitored and to permit the use of a depressed collector if required. The tube is rigidly held in the solenoid by the collector clamp and by four fixing screws at the gun end. The overall length of the tube is 528mm and the weight, including the solenoid, is approximately 36kg, the tube weighing 1.8kg.

PERFORMANCE

Tunable frequency range	8,000–9,300	MHz
Bandwidth	500–800	MHz
Saturated r.f. output (peak)	5–20	kW
Saturated gain	42–45	dB
Maximum duty ratio	0.006	
Maximum pulse length	10	μs
Maximum input VSWR	2.5:1	
Maximum output VSWR	2.5:1	

RATINGS (Absolute maximum and operational)

	(Max) (Absolute)	Operation (Range)	Operation (Typical)	
Heater voltage	7.0	5.5–6.5	6.0	V
Heater current (surge)	9.0	–	–	A
Heater current (continuous)	6.0	4.5–5.0	4.6	A
Grid 1 voltage negative	400	0–300	50	V
Grid 2 voltage	25	15–23	18–23	kV
Grid 2 current (mean)	1.0	0–0.7	0.1	mA
Helix voltage	25	15–23	18–23	kV
Helix current (mean)	2.5	0–2.0	1.5	mA
Collector voltage	25	15–23	18–23	kV
Collector current (peak)	8	3–6	4–6	A
Collector current (mean)	50	15–30	25	mA
Current pulse length	10	0–6.5	6.0	μs
R.F. input at either terminal (mean)	10	–	0.3	W
Solenoid voltage	50	–	45	V
Solenoid current	48	44–46	45	A
Cooling liquid	3.0 litre/minute minimum			

NOTES

1. The tube is operated in a solenoid mount assembly type SMX16.
2. The cold heater resistance is approximately 0.21 ohms.
3. The minimum period between switching on the heater and application of the h.t. voltages is 3 minutes.
4. All voltages are specified with respect to that of the cathode which is normally operated negative with respect to earth.
5. Modulation is controlled by pulsing either the grid 2 or the cathode.
6. The grid 2 must be held to a negative voltage of at least 250 volts relative to the cathode during the non-operating period if the helix voltage is maintained outside the pulse.
7. The helix and tube body are connected to the waveguide output and solenoid body which is normally earthed.

CONNECTIONS

Cooling

¼ inch BSP connectors, on the solenoid mount assembly.

R.F. Input and Output

W.G. 15JAN UG/51/U flanges on the solenoid mount assembly.

Collector

When the tube is fixed in the solenoid mount assembly, the collector is in electrical contact with the clamp and the connector is a Type N socket mounted on the solenoid mount assembly.

Helix

The helix is internally connected to the body which carries a flying lead colour coded orange. This lead should be connected to the Belling Lee terminal on the body of the solenoid which is normally earthed. A type N socket is provided on the body of the solenoid to facilitate the monitoring of helix current using a screened lead.

Heater

Flying lead – Brown

Cathode and Heater

Flying lead – Yellow

Grid 1

Flying lead – Green

Grid 2

Flying lead – Blue

D.C. Input to Solenoid

Plessey UK AW20/4 Plug. Pins A and B are connected to form one terminal with pins C and D connected together to form the other terminal.

PRECAUTIONS

It is recommended that interlocks should be provided so that the h.t. supplies are broken if:-

1. The grid 2 or helix mean current ratings are exceeded.
2. The cooling liquid flow falls below the recommended value.

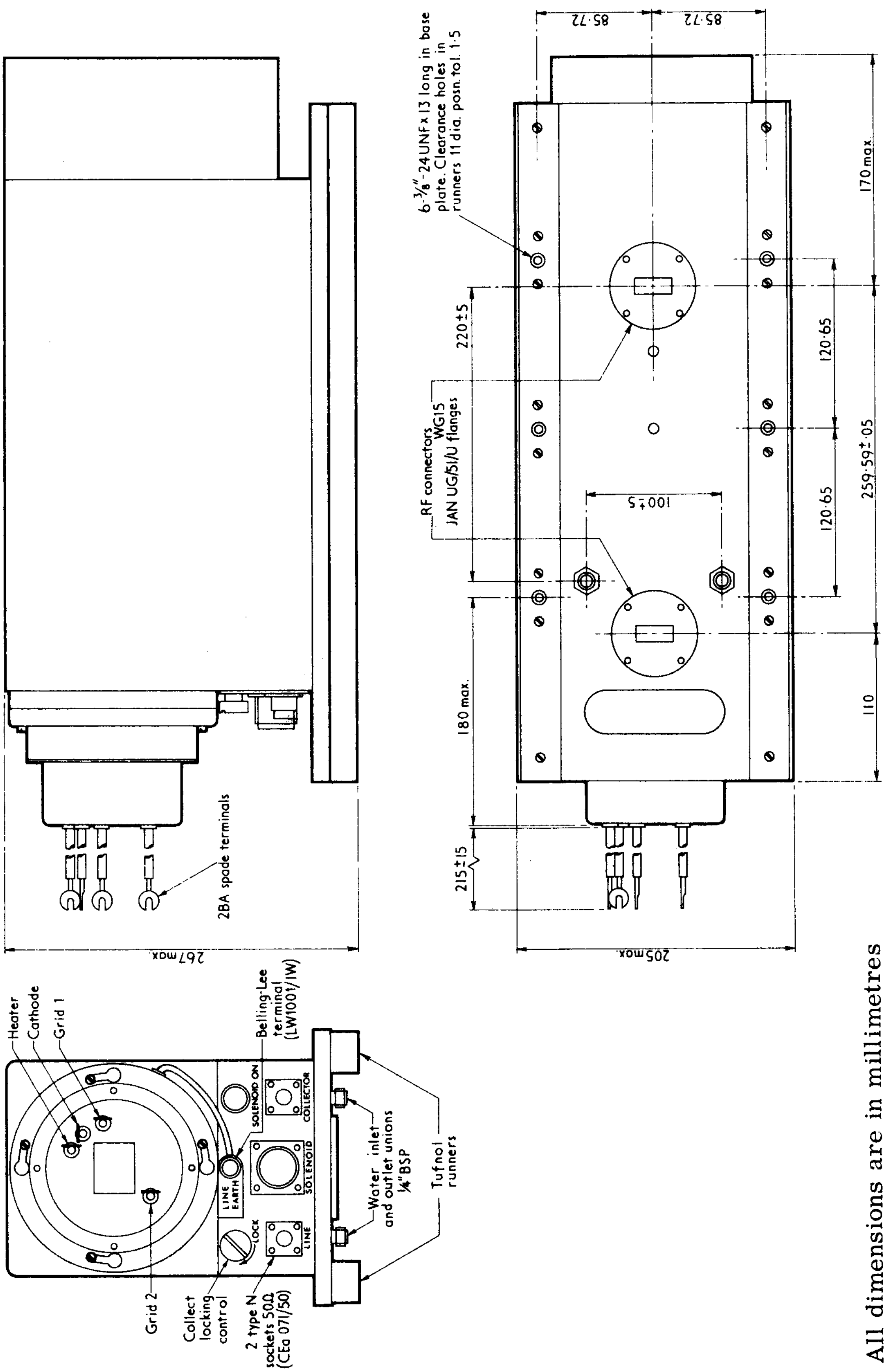
INSTALLATION

1. Make sure that the collector clamp on the solenoid is fully open.
2. Insert the tube fully home in the solenoid in the correct orientation determined by the tube fixing screws on the solenoid mating with the holes in the tube mounting flange.
3. Rotate the tube counter clockwise to the fullest extent allowed by the slots in the tube mounting flange.
4. Lock the gun end in position using the four fixing pins.
5. Lock the collector clamp by rotating the control knob on the front of the solenoid, counter-clockwise.
6. Connect the helix (orange) lead to the Belling Lee terminal.

RUNNING UP

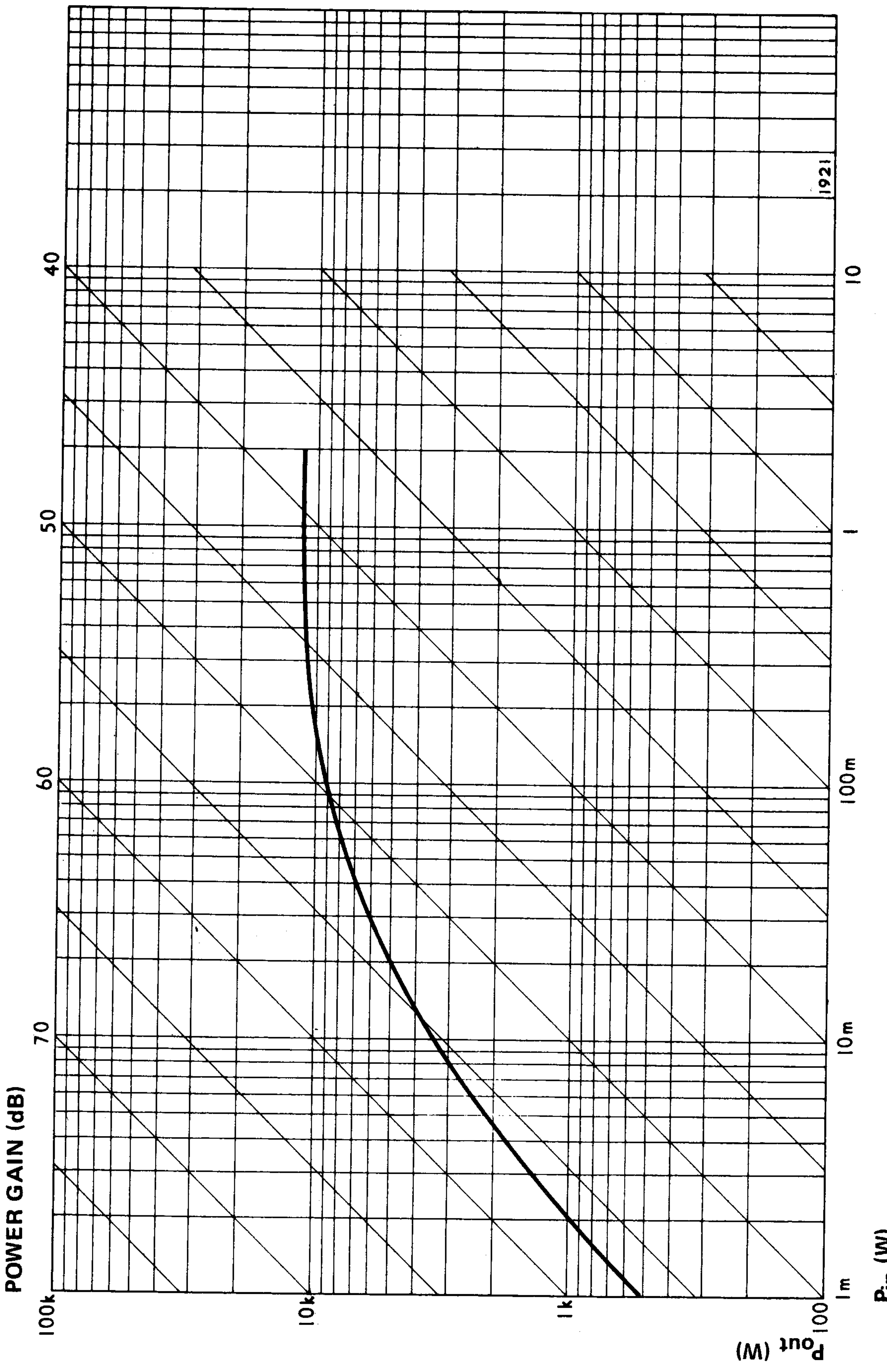
1. Make sure that the tube is correctly located in the solenoid and that the collector is firmly clamped.
2. Turn on the cooling liquid to the required flow.
3. Turn on the solenoid supply and increase the current to the required value.
4. Turn on the tube heater supply.
5. After 3 minutes apply the grid 1, helix, collector and grid 2 voltages and adjust to give maximum power over the frequency band.

OUTLINE: TUBE IN SOLENOID MOUNT ASSEMBLY

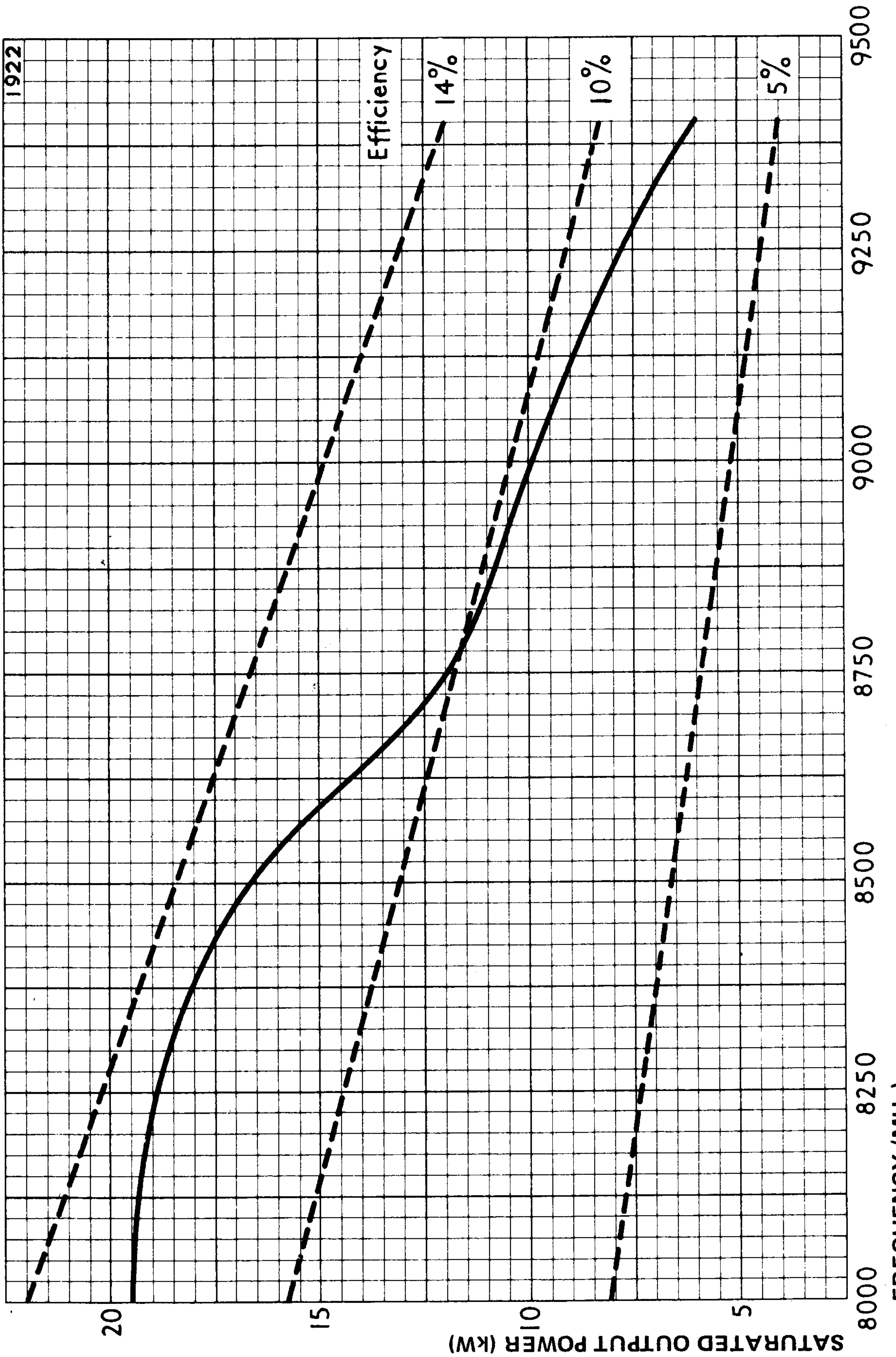


All dimensions are in millimetres

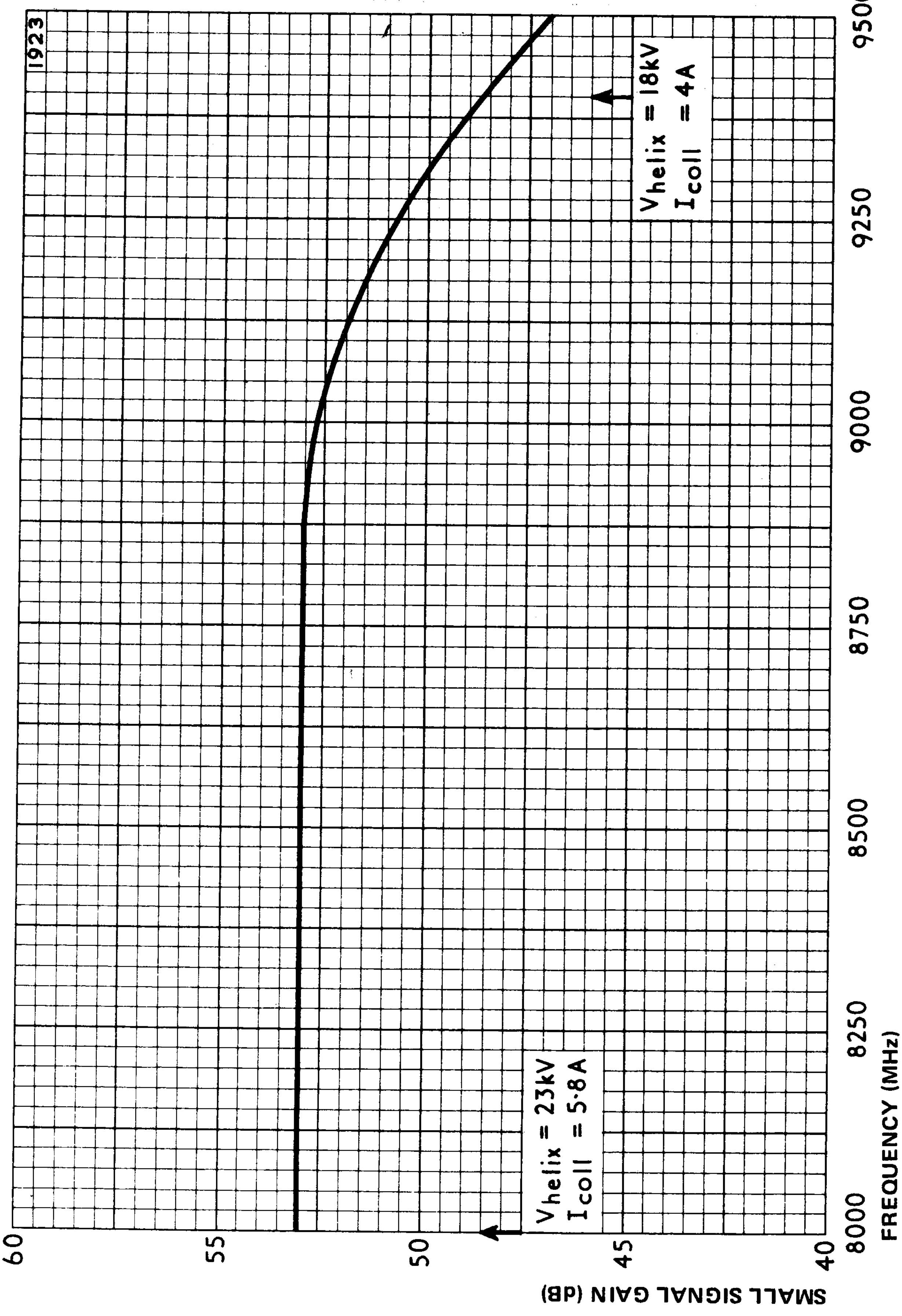
CHARACTERISTIC CURVE WITH FIXED HELIX VOLTAGE, AT 8.5GHz



SATURATED OUTPUT POWER – FREQUENCY



SMALL SIGNAL GAIN – FREQUENCY



TWX19

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise amplifier giving a gain of 35 to 42dB and a noise factor better than 11dB over a frequency range of 7.0 to 11.0GHz. The noise factor is less than 12dB and the gain greater than 30dB up to 12.0GHz.

DESCRIPTION

A rugged low noise amplifier designed for use in severe environments. The noise factor typically varies by less than 0.75dB over the frequency range and the gain is constant to within 4dB. The dynamic range is 36dB at full bandwidth operation increasing to 71dB when operated over a bandwidth of 1MHz. The use of Alnico magnets of low magnetic temperature coefficient in a periodic permanent magnet focussing assembly ensures light weight and stability of performance over a wide operational temperature range. Complete magnetic shielding enables tubes to be mounted side by side and eliminates interference with adjacent equipment. The low power dissipation, less than 3 watts including the cathode heater supply, allows the tube to be mounted in any position without the necessity for forced air cooling.
R.F. connections are by means of 50Ω type N connectors but alternative connectors e.g. SMA coaxial can be supplied to special order. Power connection is by an Electromethods type BA15P plug or by flying leads; the tube is fully insulated so that cathode, helix, or collector may be grounded.
The amplifier is normally adjusted for optimum broadband performance but it is possible for the performance to be upgraded in restricted bandwidths. Similarly, performance outside the conventional octave bandwidth can be provided.
Considerable variation in the mechanical format is possible to special order.

HEATER

V_h	6.3	V
I_h (approx)	0.25	A
I_h (surge)(max)	1.5	A

RATINGS (Absolute)

	Min	Max	
V_{coll}	V_{helix}	1500	V
V_{helix}	950	1500	V
V_{g4}	–	1000	V
V_{g3}	–	500	V
V_{g2}	–	150	V
$-V_{g1}$	250	0	V
I_{helix}	–	1.0	mA
I_g (on any grid)	–	50	μA
t_{hk}	2	–	min

TYPICAL OPERATION

Frequency range (see Note 3)	7.0–11.0	GHz
V_{coll} (see Note 1)	V_{helix} + 200	V
V_{helix} (see Note 1)	1100–1300	V
$-V_{g1}$ (see Note 1)	50–0	V
V_{g2} (see Notes 1, 2, 3)	0–100	V
V_{g3} (see Note 1)	0–250	V
V_{g4} (see Note 1)	75–500	V
I_{helix}	0–100	μA
I_{coll} (see Notes 2, 3)	400–1000	μA
Max noise factor (see Note 3)	11	dB
Min small signal gain (see Note 3)	35	dB
Max small signal gain (see Note 3)	42	dB
Max gain variation (7.0–11.0GHz)(see Note 3)	4	dB
Min power output (saturated)(see Note 3)	7	dBm
Max v.s.w.r. (input)(see Note 3)	2.5:1	
Max v.s.w.r. (output)(see Note 3)	2.5:1	
Minimum isolation	55	dB

NOTES

1. All voltages with respect to cathode. Collector, helix or cathode may be earthed.
2. Adjust V_{g2} to
3. A significant improvement in r.f. performance is possible over narrow bandwidths (500–1000MHz). Details of performance are available on request. The normal tube may be used up to 12.0GHz with slightly degraded performance. The maximum noise factor between 11.0 and 12.0GHz is 12dB and the minimum gain is 30dB.

POWER REQUIREMENTS

The requirements in terms of voltage installation accuracy, voltage stability, and ripple level are dependant upon the performance requirements of the application but the following conditions define a power supply capable of minimising performance drift and spurious modulation levels. Where RF performance requirements are less severe, some degredation of the power supply is permissible. Further information will be supplied on request.

Electrode	Voltage Range Min	Voltage Range Max	Current Range Min	Current Range Max
Heater	6.24 Volts	6.36 Volts	0.19A	0.26A
Grid 1	−50 Volts	0 Volts	−10μA	20μA
Grid 2	0 Volts	50 Volts	−10μA	20μA
Grid 3	0 Volts	250 Volts	−10μA	20μA
Grid 4	75 Volts	500 Volts	−10μA	20μA
Helix	1100 Volts	1300 Volts	−10μA	100μA
Collector. . . .	V_{hel} Volts	V_{hel} + 200	300μA	1500μA

Electrode	Installation Accuracy ±%	Stability ±%	Ripple Volts p−p
Heater	1.0	1.0	–
Grid 1	1.0	1.0	0.020
Grid 2	–	1.0	0.020
Grid 3	1.0	1.0	0.020
Grid 4	1.0	1.0	0.050
Helix	0.25	0.25	0.050
Collector	1.0	5.0	10.0

NOTES

1. Stability includes power supply variations from all causes including temperature.
2. The tube may be operated with any one of the following elements at capsule (ground) potential:
   Cathode
   Helix
   Collector
3. The tube operating voltages and currents are listed on an affixed label.

INSTALLATION AND ALIGNMENT

1. Connect power supply and r.f. lines to the tube.
2. Apply rated heater voltage for a period of two minutes. The full rated heater voltage may be applied instantaneously.
3. Set grid 2 to zero volts and all other voltages as shown on tube label.
4. Increase the grid 2 voltage until the collector current reaches the value shown on the tube label. Grid 2 voltage should then agree approximately with that shown on the label. Collector current should be set to an accuracy of 1%.

After initial installation and setting of voltages, subsequent switching procedure may be as follows:-

a) As 2 above.
b) All other voltages may then be immediately applied at preset values providing that the grid 2 voltage is not achieved before the helix voltage.

AMPLIFIER CONNECTIONS (Use socket to mate with Electromethods Plug type BA15P)

Pin A:	NC	Pin J:	Grid 2
B:	NC	K:	NC
C:	Grid 1	L:	Cathode
D:	Helix	M:	Heater
E:	Collector	N:	Heater/Cathode
F:	Grid 4	P:	Capsule earth
H:	Grid 3	R:	NC
		S:	NC

POWER SUPPLY

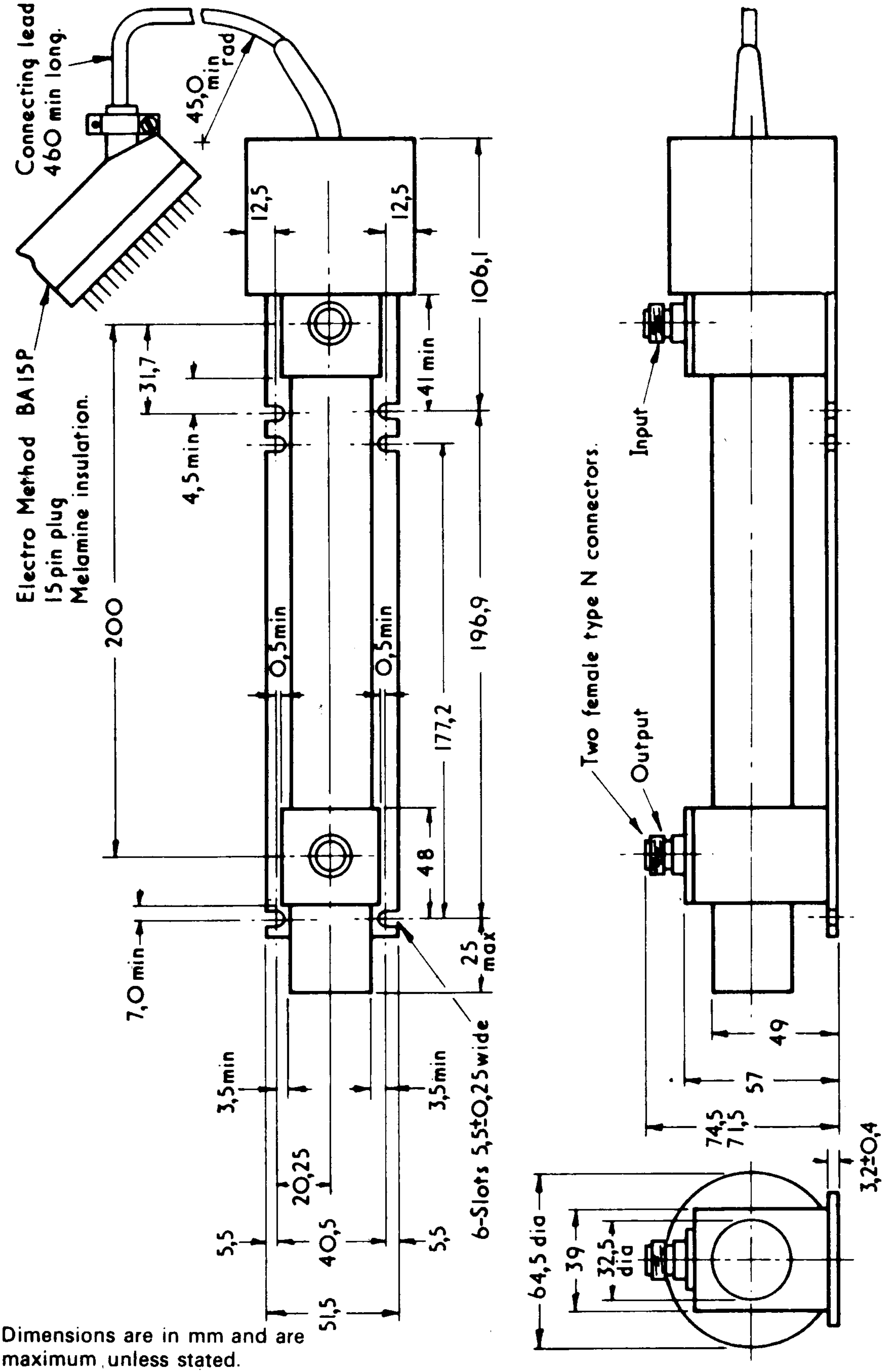
The tube can be supplied complete with a power supply in which case it has the type No. TWX28.

MECHANICAL

Dimensions See outline drawing
Weight 2.5kg (5.5lb.)

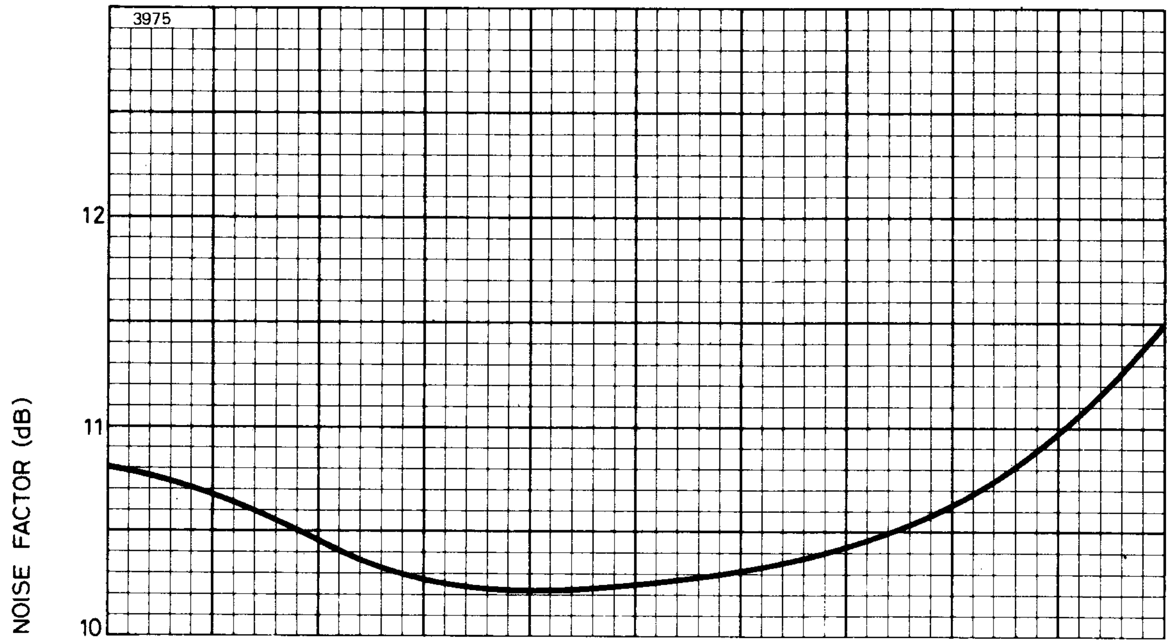
Note:- Variation in the mechanical configuration is possible. Further details will be supplied on request.

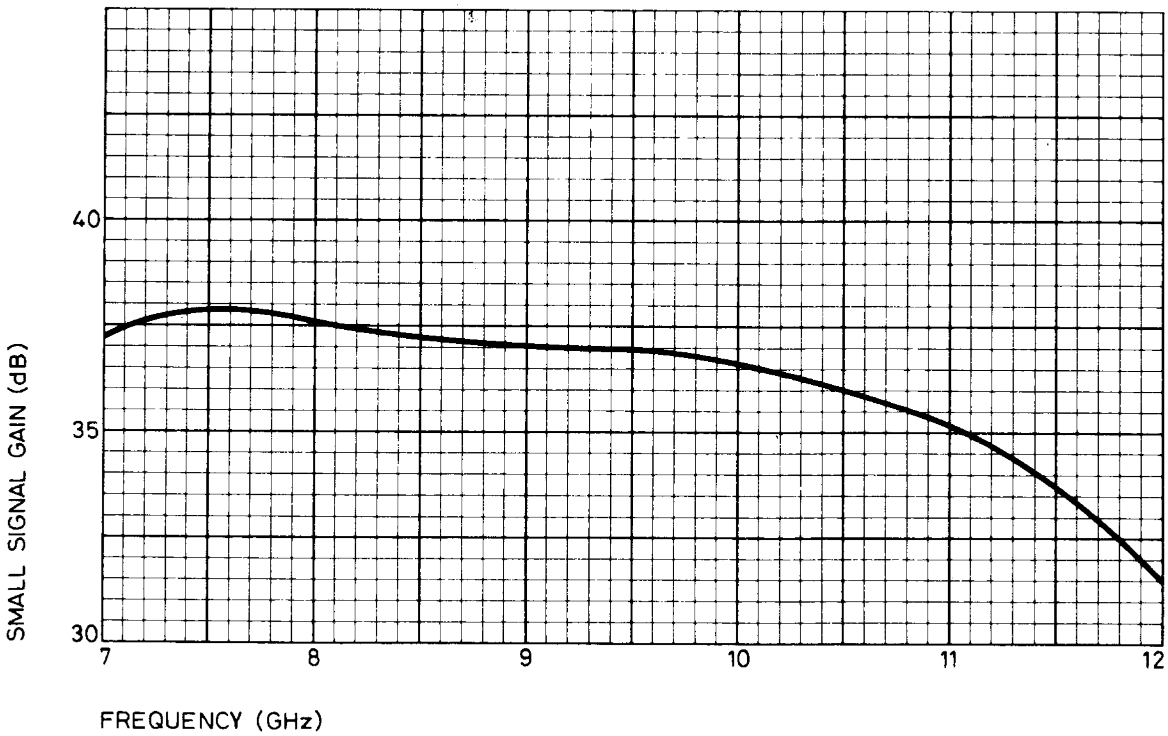
OUTLINE



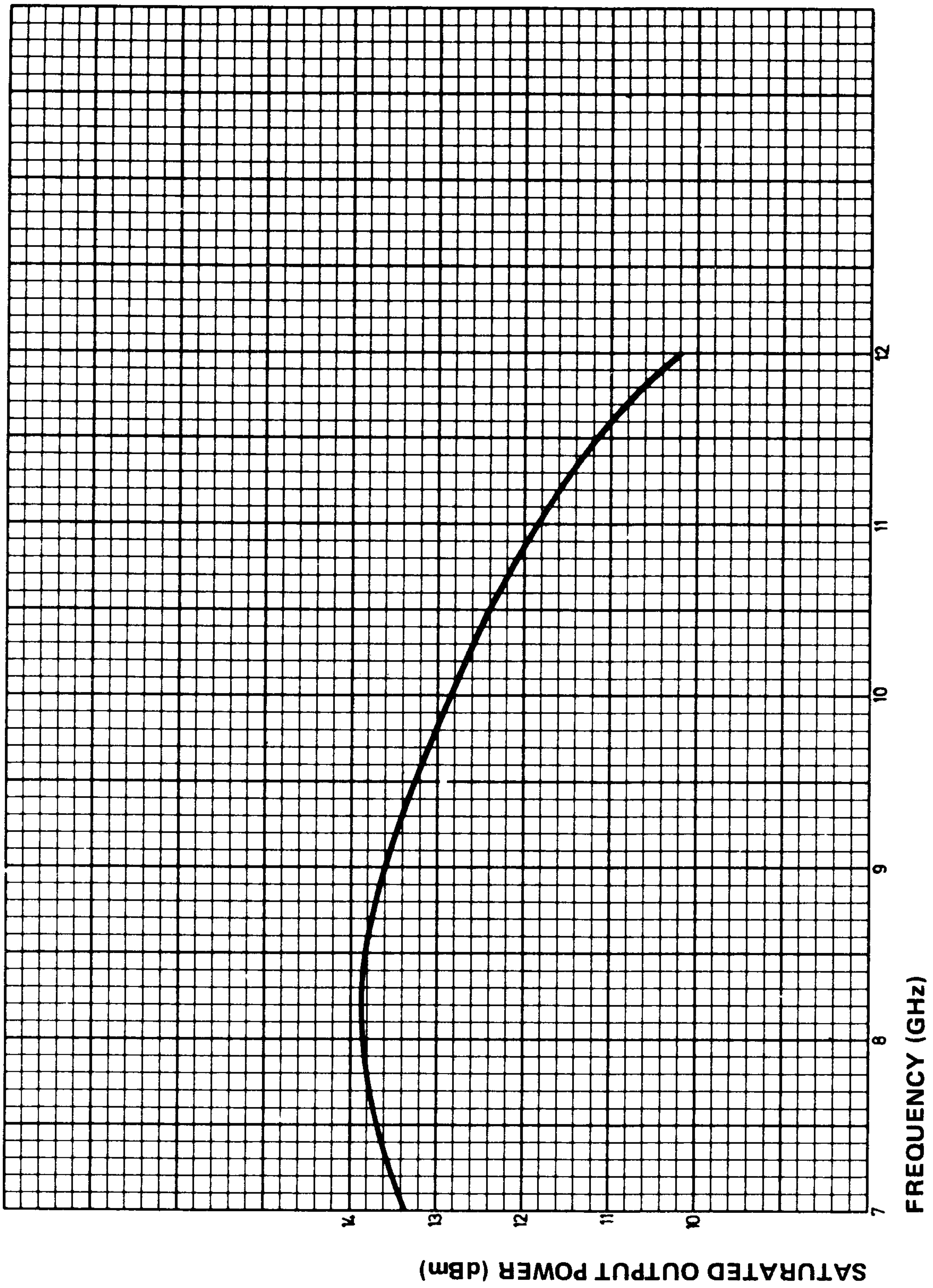
Dimensions are in mm and are maximum unless stated.

NOISE FACTOR AND GAIN – FREQUENCY

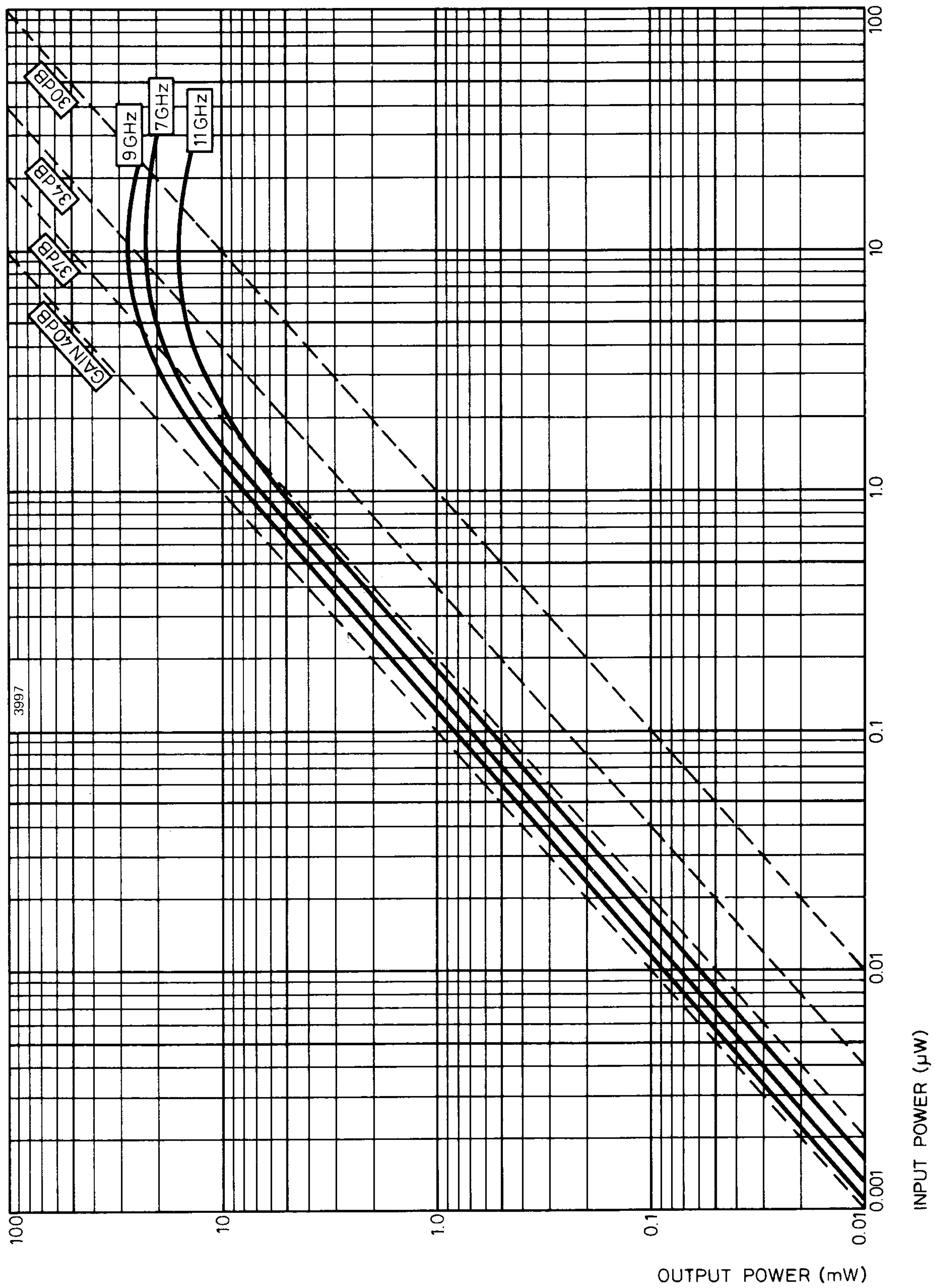




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

The TWX22 is an X-band travelling wave amplifier giving a minimum gain of 35dB and a saturated power output of 1 watt over the frequency range 7.5 to 11.0GHz. Useful performance is obtainable over the range 7.0 to 12GHz.
Employing the well tested basic design parameters of the TWX8, modifications have been incorporated to improve efficiency and permit operation and transportation in severe environmental conditions. A typical application is as an intermediate driver stage in the ground station of a transportable satellite communications system, where continuous operation in ambient temperatures of up to 60°C and ability to withstand shock, vibration and high humidity conditions are required.
A low wattage oxide coated cathode has been incorporated and total power supply consumption under full r.f. drive conditions is less than 25 watts. Power supply connections are by flying leads, but other types of connection can be provided on request.
R.F. connections are to WG16 (WR90).
The tube is designed to be mounted horizontally with free convection cooling, but any mounting position is permissible provided that adequate air cooling is provided.

AMPLIFIER CONNECTIONS

Connection of d.c. power supplies is by flying leads colour coded as follows:-

Collector (body)	Black
Helix	Orange
Grid 2	Blue
Heater	Brown
Heater/Cathode	Yellow
Grid 1	Green

RF connectors, WG16 plain flange.

HEATER

V_h	4.5 ± 0.15	V
I_h	0.8–1.2	A

MAXIMUM RATINGS (Absolute)

V_{coll} (see Note 1)	3.0	kV
V_{helix} (see Notes 1, 2)	2.8	kV
V_{g2} (see Note 1)	1.0	kV
V_{g1} (upper limit) (see Notes 1, 3)	0	V
V_{g1} (lower limit) (see Note 1)	−50	V
I_{coll}	10.0	mA
I_{helix} (see Notes 6, 7)	2.0	mA
I_{g2}	1.5	mA
t_{hk} (min)	3	min
T_{amb}	+70	°C

TYPICAL OPERATION

Frequency range	7.9–8.1	GHz
V_{coll} (see Note 1)	2.6	kV
V_{helix} (see Notes 1, 2, 5)	2.0–2.6	kV
V_{g1} (see Notes 1, 3, 4, 5)	−15 – 0	V
V_{g2} (see Notes 1, 4)	350–700	V
I_{coll} (see Note 5)	6–8	mA
I_{helix}	0–1.0	mA
I_{g2}	0–0.5	mA
Harmonic output	<−50	dBW
Phase variation	<±0.2	°MHz
Spurious AM (see Note 5)	<0.25	%pk-pk
Spurious PM sidebands (see Note 5)	<40	dB

NOTES

1. All voltages are with respect to the cathode, the collector is connected to the body which should be earthed.
2. Helix voltage should never exceed collector voltage.
3. Grid 1 voltage should never be positive.
4. It must be possible to reduce this voltage to zero.
5. The operating grid 1 and helix voltages and collector current are marked on each tube. The indicated grid 1 voltage must be available at all values of collector current. The spurious AM and PM limits are based on the following power supply ripple requirements:-

Electrode	Power Supply Requirement	Stability	Max Ripple (pk-pk)
V_h	4.5V	± 0.15V	–
V_{g1}	−15 – 0V	± 0.15%	20mV
V_{g2}	350–700V	± 1.0%	0.02%
V_{helix}	2.0–2.6kV	± 1.0%	0.02%
V_{coll}	2.6kV	± 5.0%	5.0%

The power supply specification in terms of stability and permissible ripple is less stringent where spurious modulation limits are not so severe. Details on request.

6. The helix current may momentarily exceed 1mA during the running up procedure.
7. It is advisable to provide a relay to remove the high voltage supplies if the helix current exceeds 2mA.

WEIGHT

The weight of the TWX22 is 2.85kg (6lb. 4oz.).

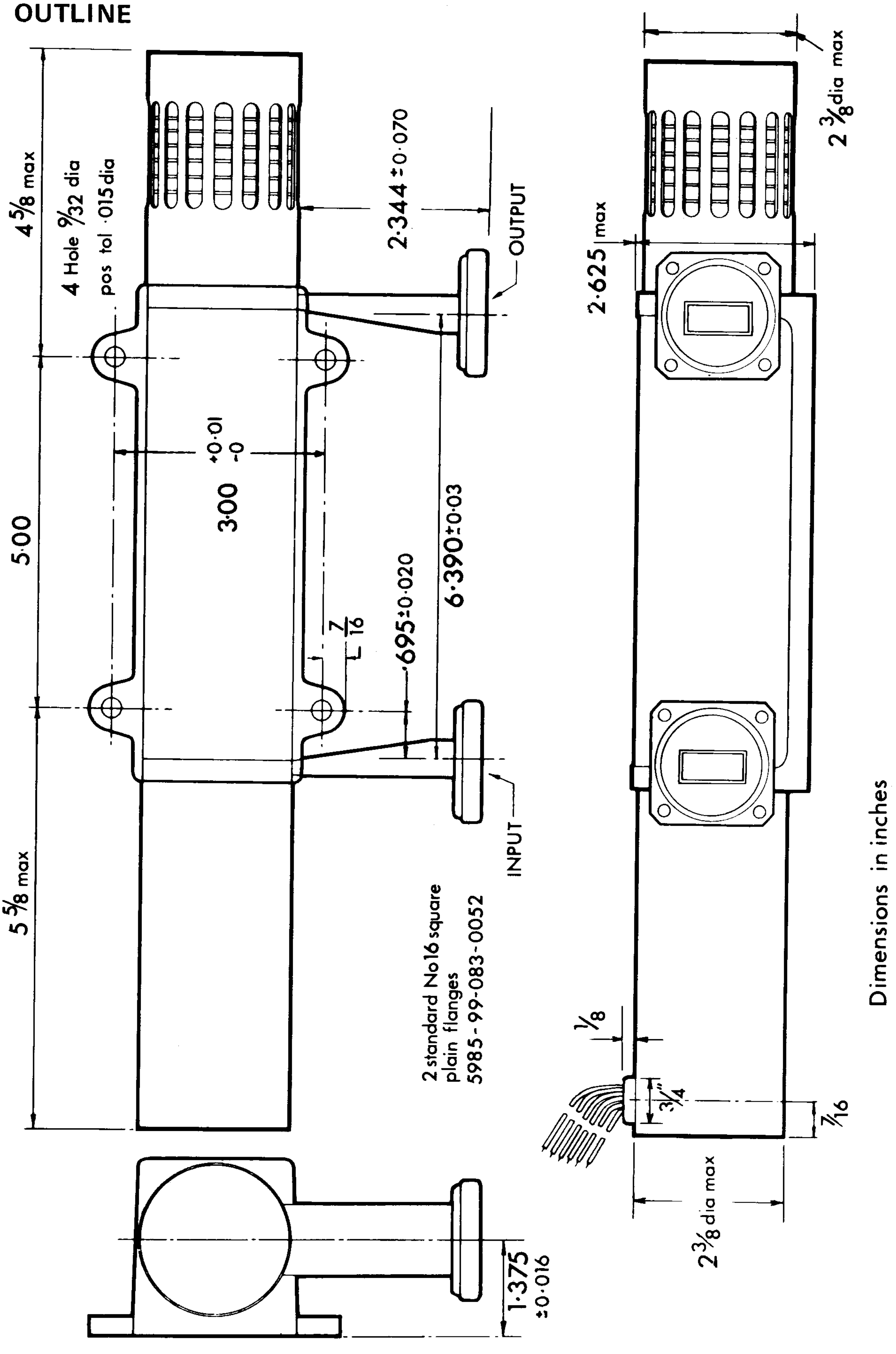
INSTALLATION

The tube is designed to be mounted horizontally and bolted to a heat sink of temperature not greater than 60°C and in such a position that air can circulate freely over the collector cooling fins. If mounted other than horizontally forced air cooling may be necessary.
Upon initial installation the full operating voltages may be applied instantaneously to collector, helix and grid 1 but grid 2 voltage should be increased from zero following the application of all other voltages at the indicated values.

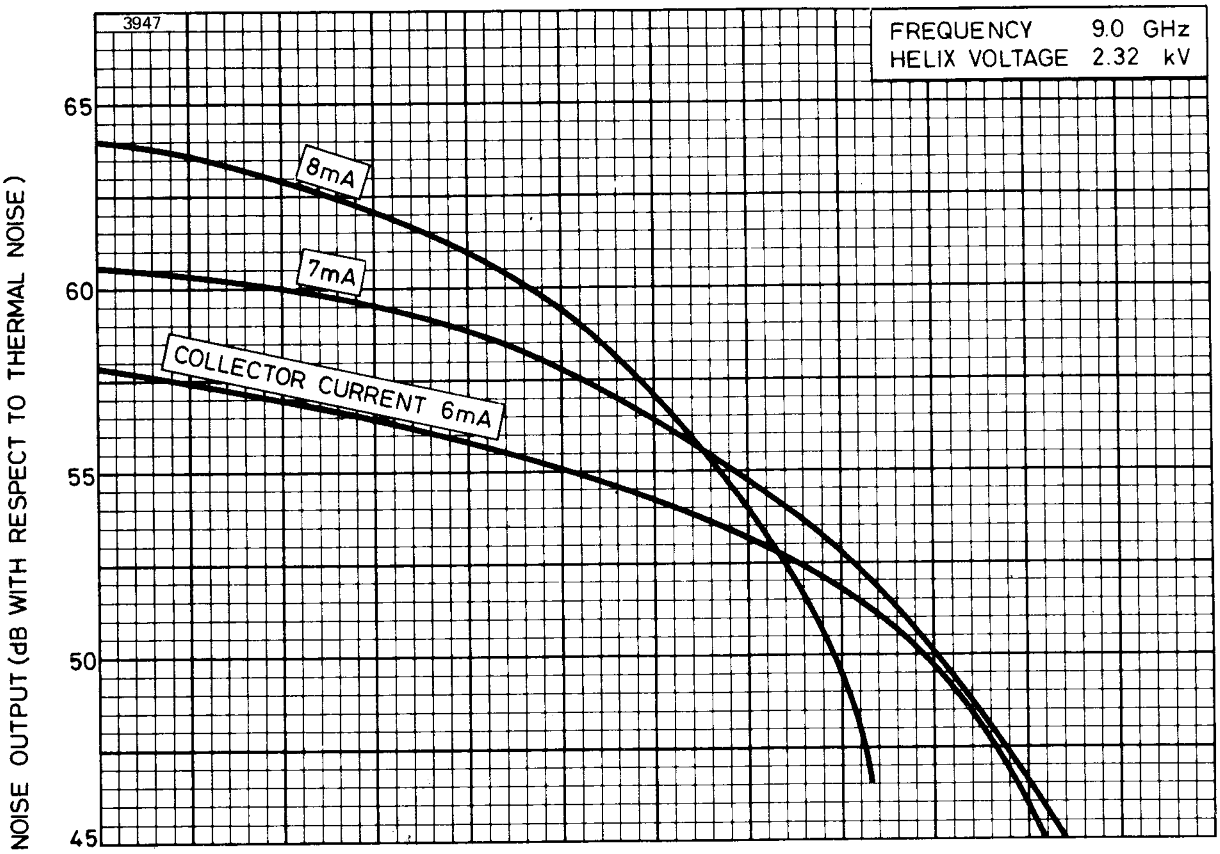
SETTING UP PROCEDURE

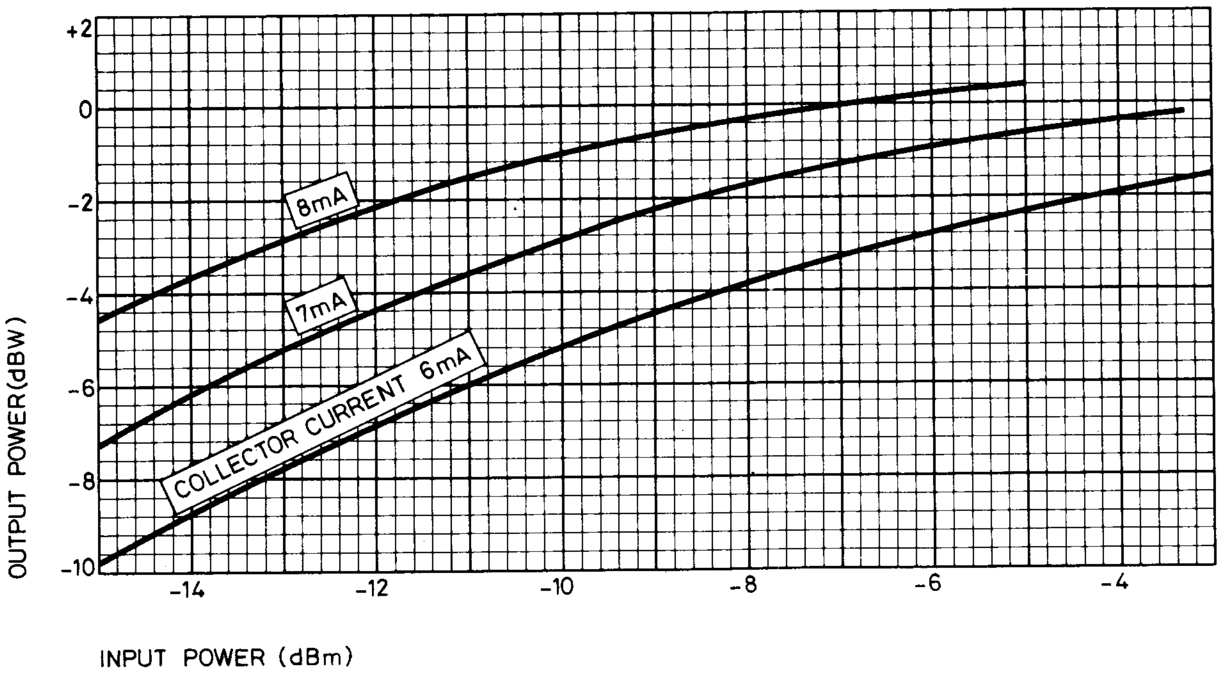
1. Turn up or switch on the heater supply ensuring that the surge current does not exceed 3 amps. Wait for 3 minutes.
2. Set grid 1 voltage to the value indicated on the tube.
3. Set collector voltage to 2.6kV.
4. Set helix voltage to the value indicated on the tube.
5. Increase grid 2 voltage until collector current can be observed. Alternately, increase grid 2 voltage and adjust grid 1 voltage until the indicated collector current is obtained at minimum helix current.
6. Apply r.f. input at approximately the centre frequency of the operating band and tune helix voltage for maximum r.f. output. Readjust grid 2 and grid 1 voltages to maintain the indicated collector current at minimum helix current.

OUTLINE

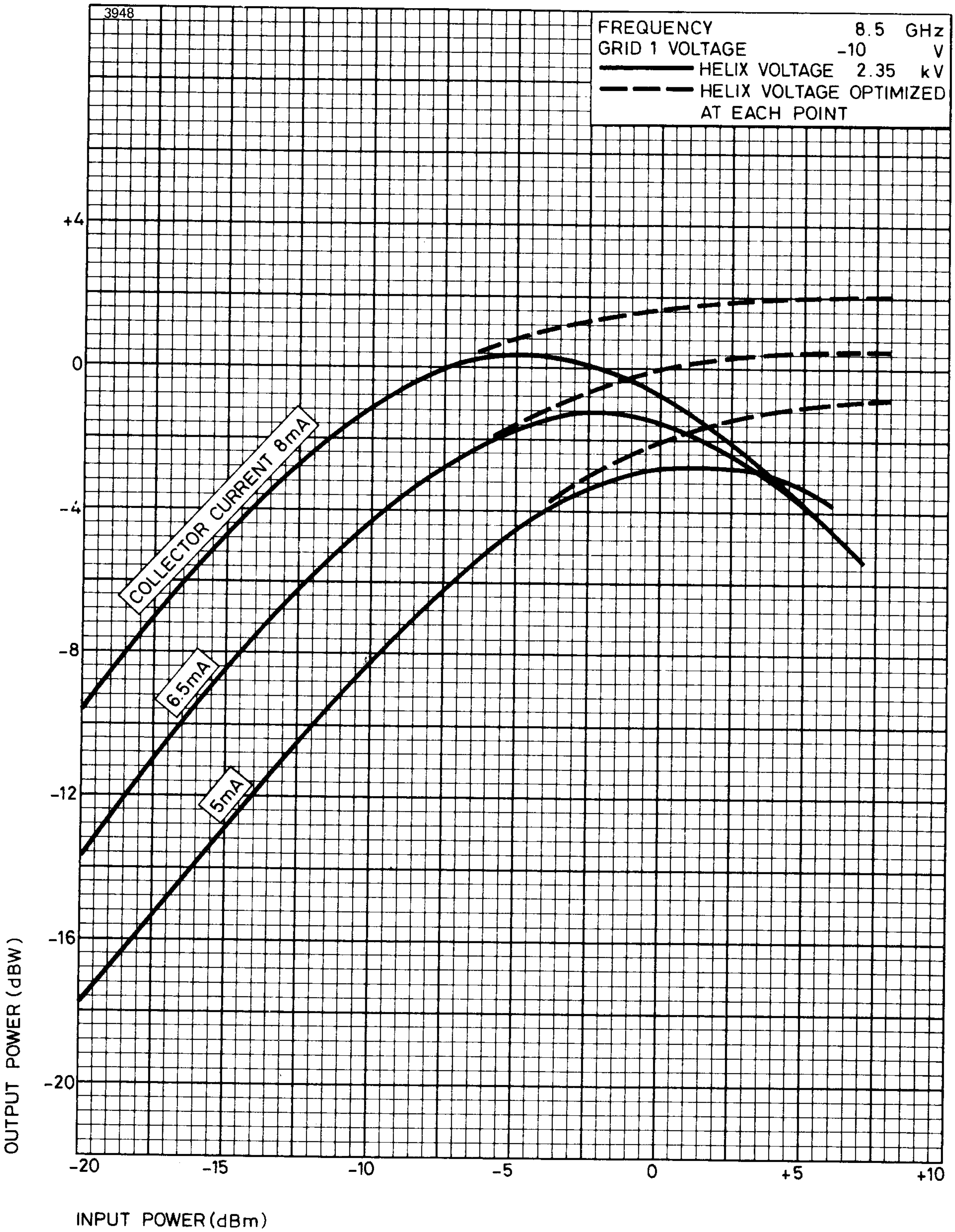

4 5/8 max
4 Hole 9/32 dia
pos tol ·015 dia
5·00
5 5/8 max
3·00 +0·01 -0
2·344 ±0·070
OUTPUT
INPUT
6·390±0·03
·695±0·020
7/16
2 standard No16 square
plain flanges
5985-99-083-0052
1·375 ±0·016
2·625 max
2 3/8 dia max
1/8
3/4"
7/16
2 3/8 dia max
Dimensions in inches

OUTPUT POWER AND NOISE OUTPUT – INPUT POWER
(Helix voltage at small signal optimum)

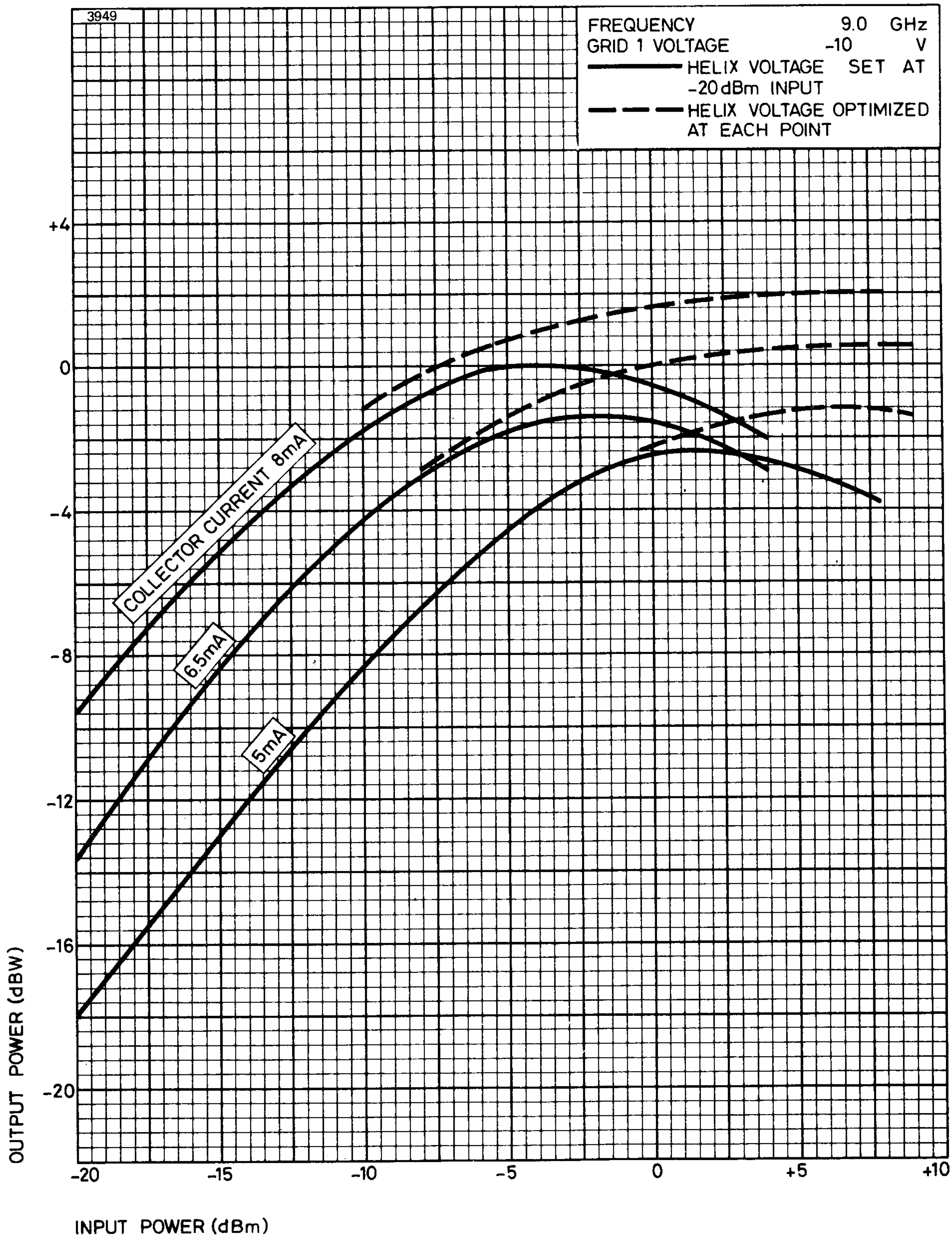




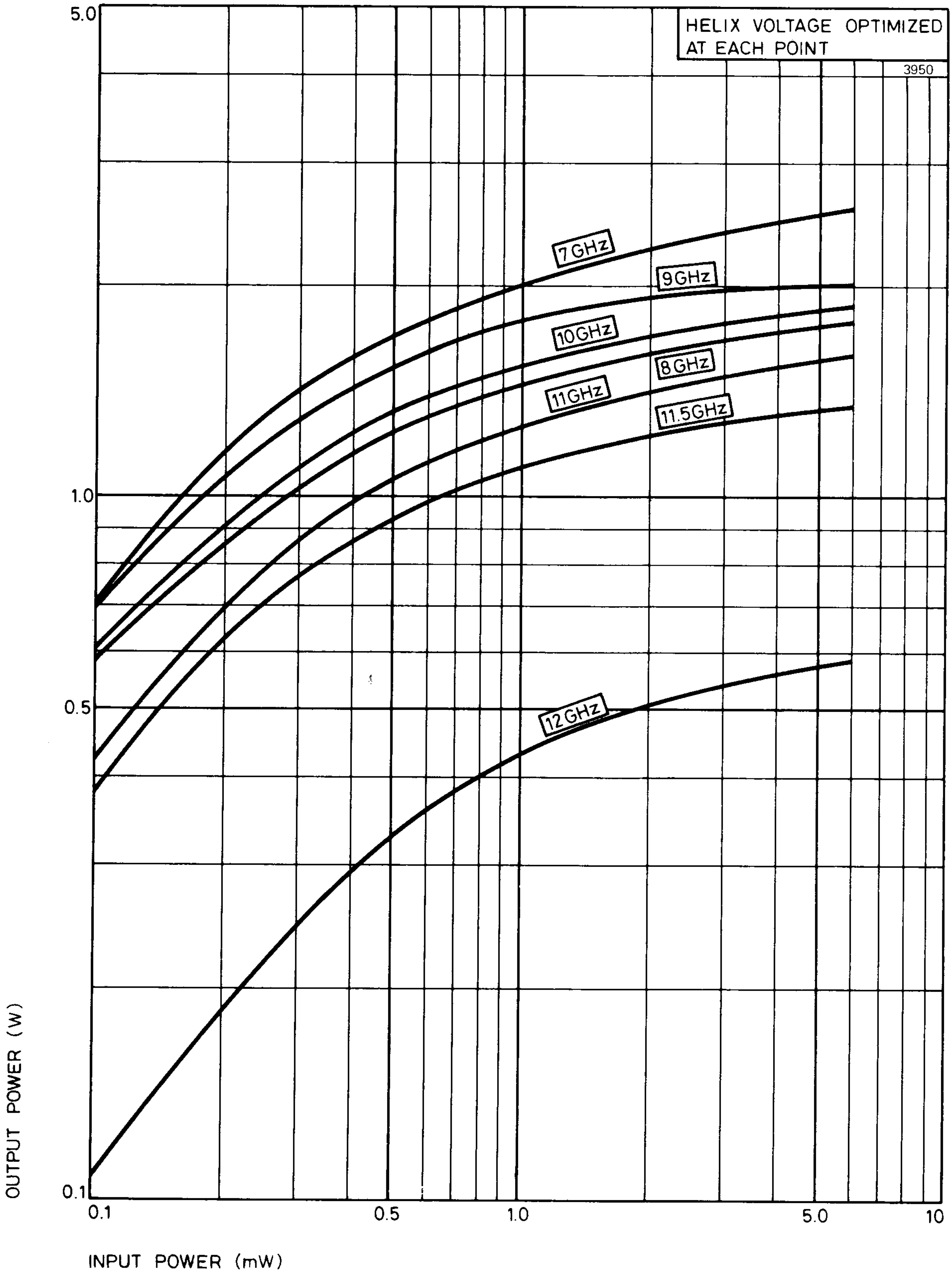
POWER CHARACTERISTIC CURVES



POWER CHARACTERISTIC CURVES



POWER CHARACTERISTIC CURVES



TWX28

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

A broadband low noise travelling wave amplifier with integral power supply giving a gain of 35 to 42dB over the frequency range 7.0 to 11.0GHz and a noise factor better than 11dB.

DESCRIPTION

Simplicity of installation and low cost replacement combined with excellent broadband performance has been achieved by combining a rugged travelling wave tube amplifier package with a stabilised power supply. Modular construction has been adopted, allowing considerable flexibility and space saving and, since the tube and power supply are separable, replacement costs are minimised. A built in correction circuit compensates for changes in performance with life so no adjustment is required in operation. The power input requirement is 115V or 240V a.c. at 50/60Hz or 28V d.c. at 1A.

The amplifier is normally adjusted at the factory for optimum broadband performance but it is possible for this to be upgraded at discrete frequencies on request. R.F. connections are made by means of Type N 50ohm coaxial connectors.

Under broadband conditions the noise factor is typically better than the stated maximum. The dynamic range is 36dB for full bandwidth operation, increasing to 71dB for operation over 1MHz. The maximum gain variation over the frequency range is typically 4dB and the noise factor varies by less than 0.75dB.

Complete magnetic shielding allows tubes to be operated side by side and eliminates interference with companion equipment.

POWER SUPPLIES

The units can be supplied to operate from alternative inputs:-

1. 115V or 240V ± 10%
   Single phase
   50/60Hz

or

2. 28V d.c.
   at 1A.

Connections

Plug type:	Bendix PTO 6E-8-4S (SR) Supplied
Pin A.	Neutral
B.	Line
C.	Earth (connected to case)
D.	No connection

Controls

Power on/off switch with associated indicator light.
Remote switching facility can be provided to order.

TYPICAL OPERATION

Frequency range	7.0 to 11.0	GHz
Maximum noise factor	11	dB
Minimum small signal gain	35	dB
Maximum small signal gain	42	dB
Maximum gain variation over frequency range	5	dB
Minimum saturated power output	7	dBm
Maximum input VSWR (hot)	2.5:1	–
Maximum output VSWR (hot)	2.5:1	–
Minimum Isolation	55	dB

Notes

A significant improvement in r.f. performance is available over narrow bandwidths (500 to 1000MHz). Details are available on request.
The tube may be used up to 12.0GHz with slightly degraded performance. The maximum noise factor between 11.0 and 12.0GHz is 12dB and the minimum gain in 30dB.

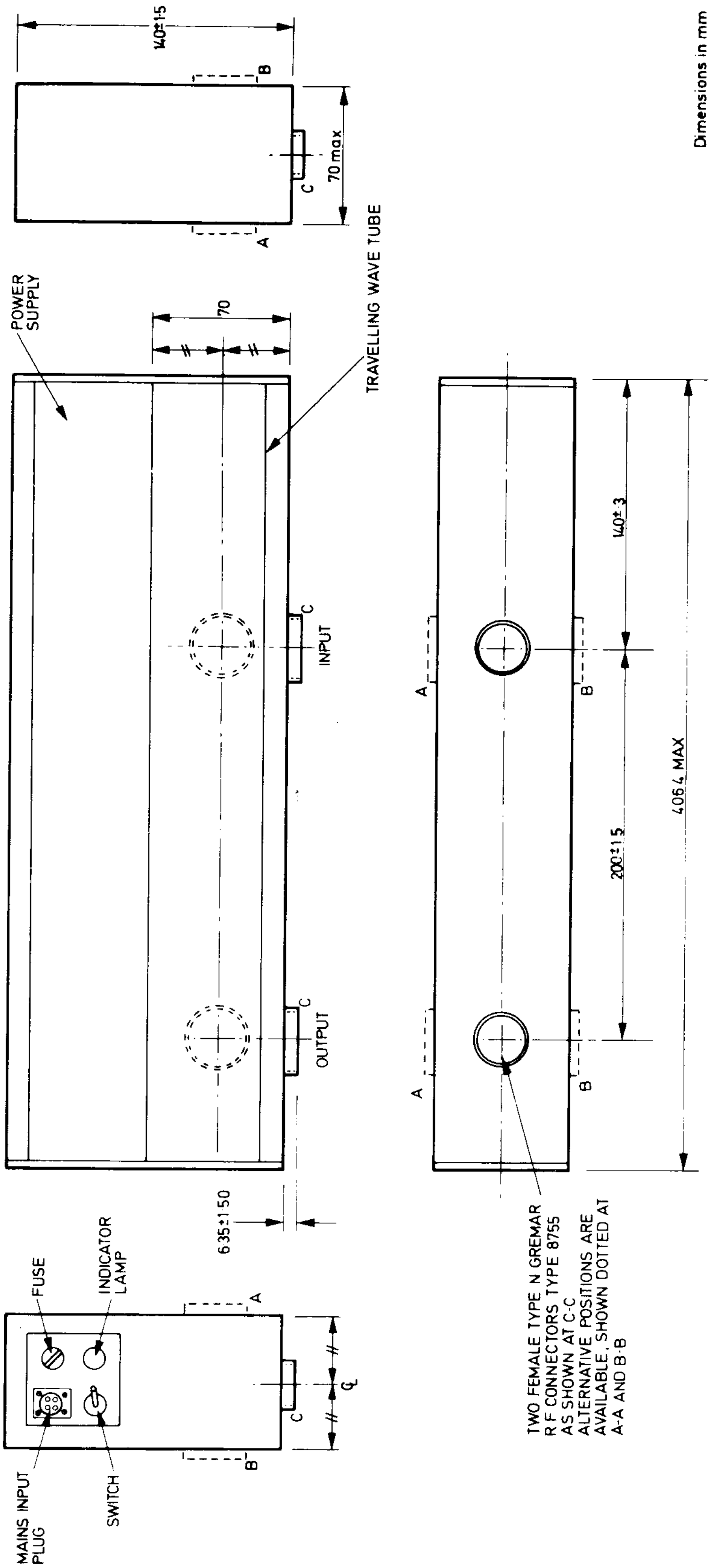
INSTALLATION

Apply mains input to the 4 pin bayonet connector on the front panel using the socket provided.
Connect r.f. input and output using Type N connectors.
The r.f. input level should not be allowed to exceed 250mW c.w.
Switch on. The red indicator light will glow. After a 90 second automatic delay the amplifier will be operational.

Warning

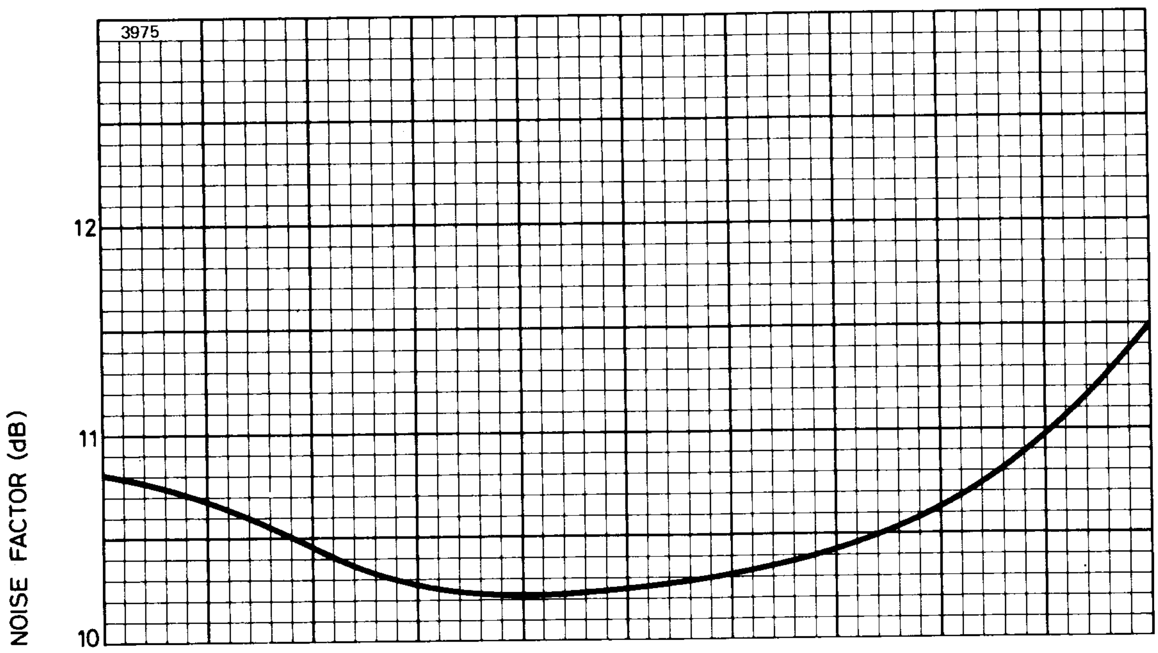
On no account should internal adjustments be made to the power supplies. Alignment requires precision measuring facilities and broadband performance will be lost if power supply controls are adjusted indiscriminately. Damage to the power supply or the tube may be caused by random adjustment.

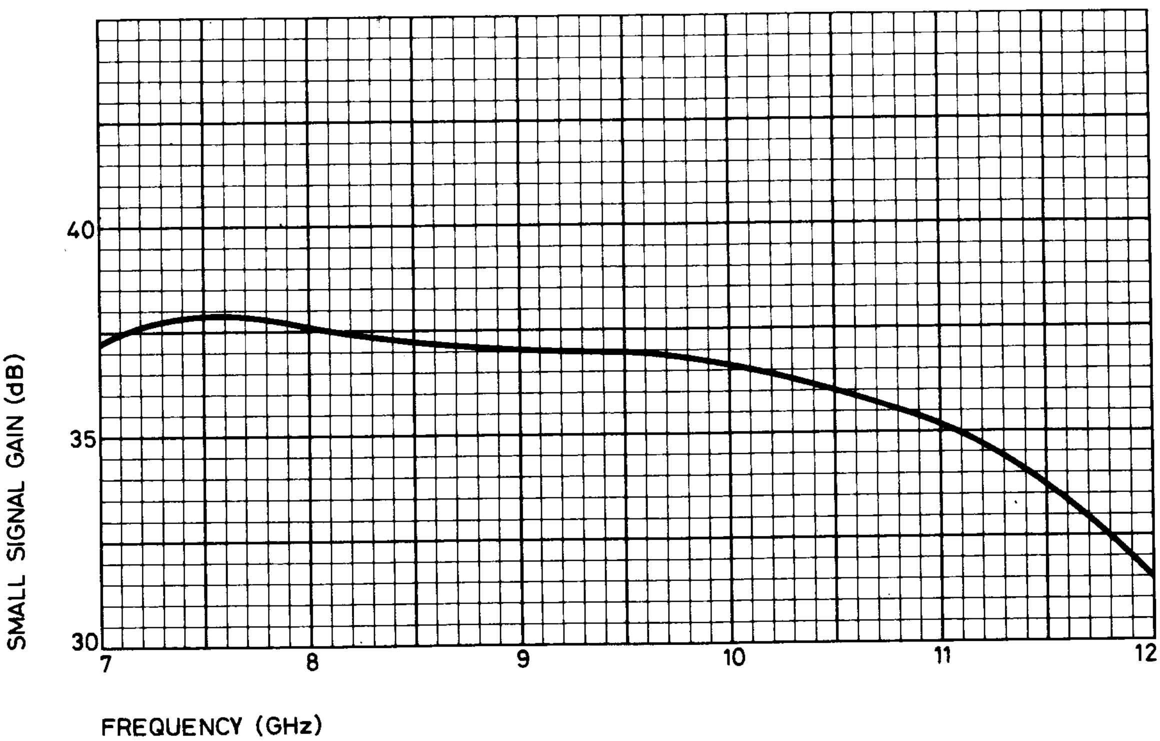
OUTLINE DRAWING OF INTERNAL POWER SUPPLY AND T.W.T. PACKAGE



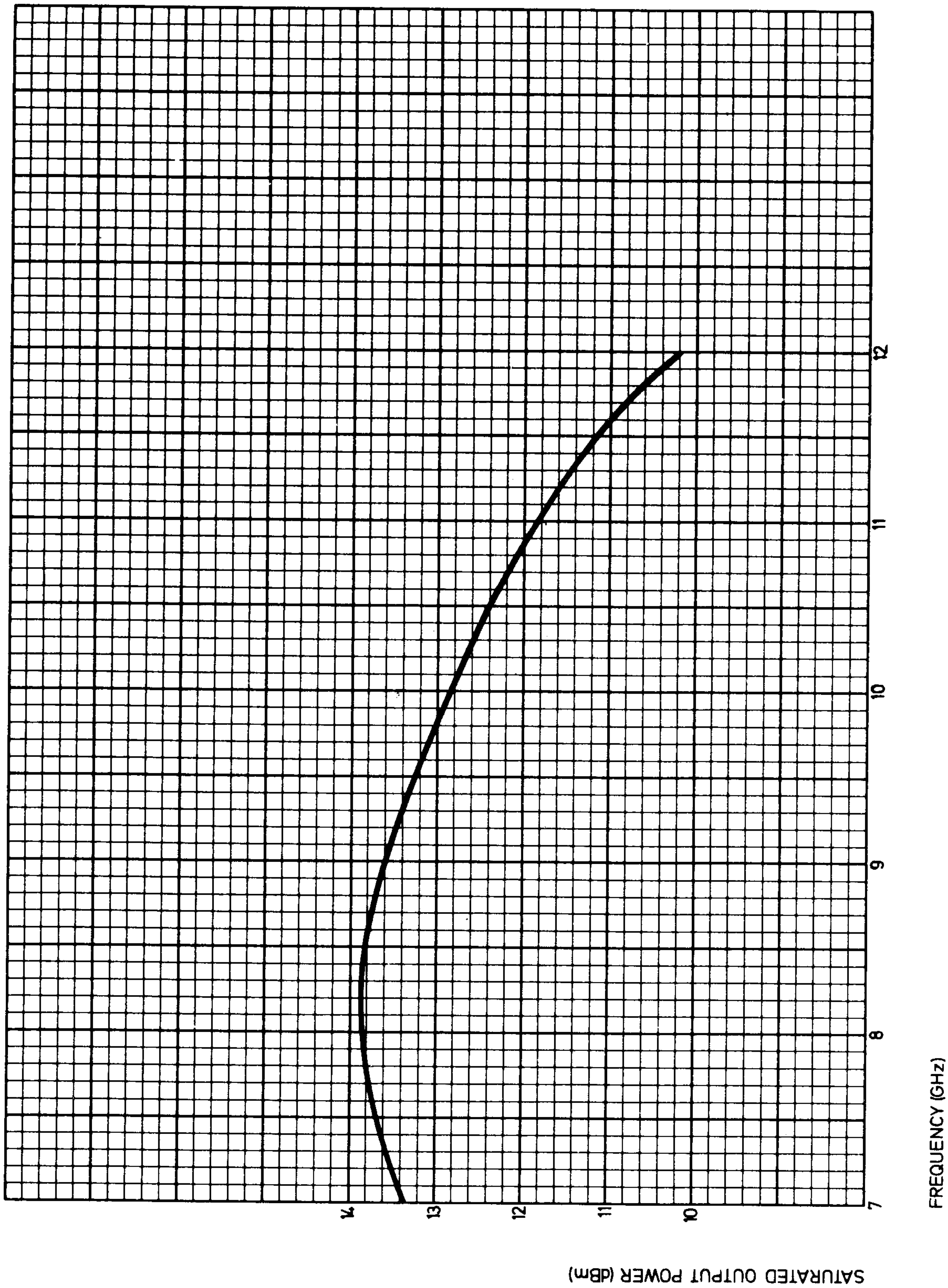
OUTLINE DRAWING OF INTEGRAL POWER SUPPLY AND T.W.T. PACKAGE

NOISE FACTOR AND GAIN – FREQUENCY

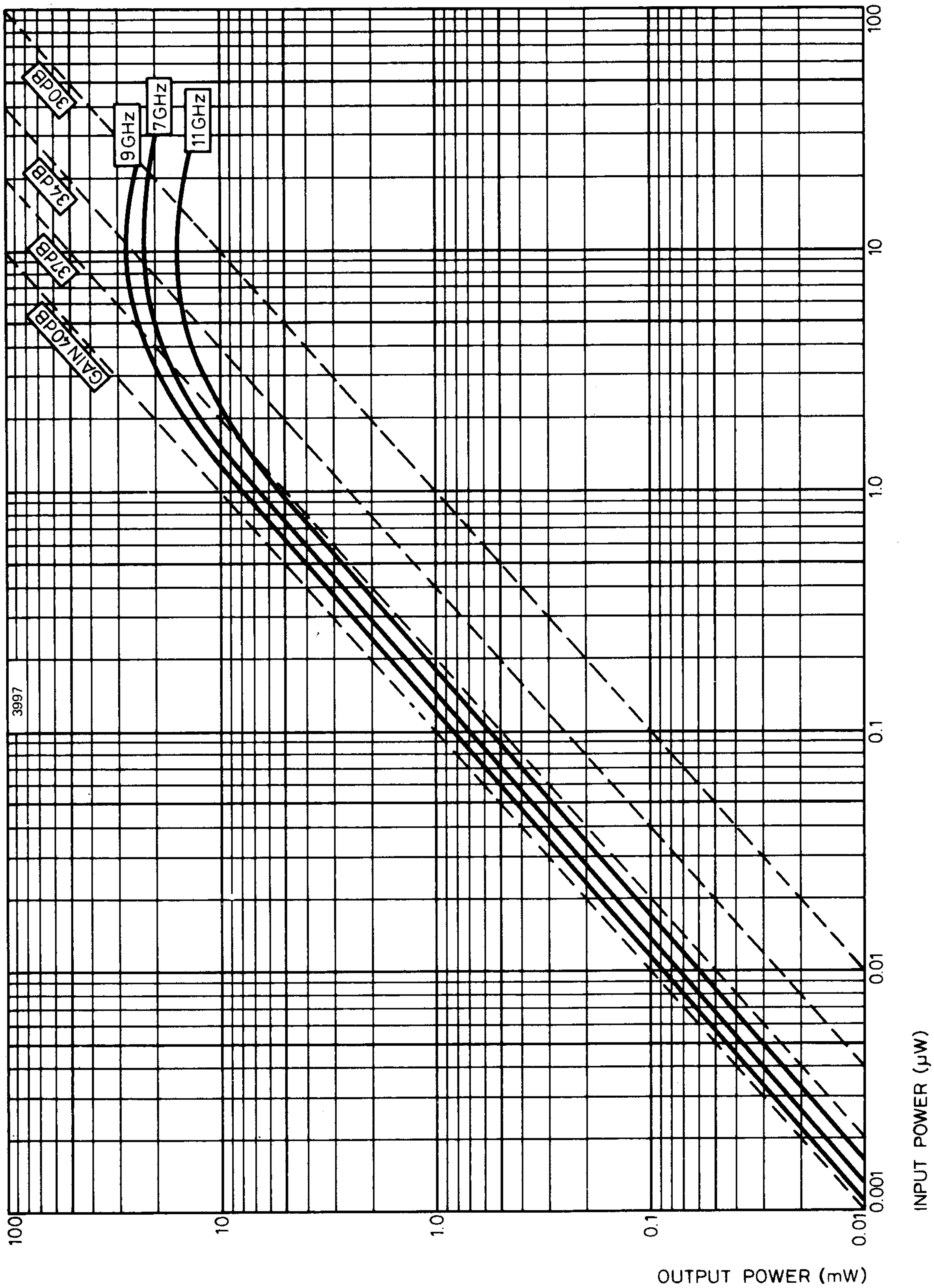




SATURATED OUTPUT POWER – FREQUENCY



POWER TRANSFER CHARACTERISTICS WITH HELIX VOLTAGE OPTIMIZED FOR BROAD BAND OPERATION



TWX34

GEC

TRAVELLING WAVE AMPLIFIER

BRIEF DATA

The TWX34 is an X-band travelling wave amplifier giving a minimum gain of 35dB and a saturated power output of 1 watt over the frequency range 7.5 to 11.0GHz. Useful performance is obtainable over the range 7.0 to 12GHz.
Employing the well tested basic design parameters of the TWX8 and TWX22 modifications have been incorporated to improve efficiency, reduce size and weight and permit operation and transportation in severe environmental conditions. A typical application is as an intermediate driver stage in the ground station of a transportable satellite communications system, where continuous operation in ambient temperatures of up to 60°C and ability to withstand shock, vibration and high humidity conditions are required.
A low wattage oxide coated cathode has been incorporated and total power supply consumption under full r.f. drive conditions is less than 25 watts.
Power supply connections are by flying leads, but other types of connection can be provided on request.
R.F. connections are to WG16 (WR90).
The tube is designed to be mounted horizontally with free convection cooling, but any mounting position is permissible provided that adequate air cooling is provided.

AMPLIFIER CONNECTIONS

Connection of d.c. power supplies is by flying leads colour coded as follows:-

Collector (body)	Black
Helix	Orange
Grid 2	Blue
Heater	Brown
Heater/Cathode	Yellow
Grid 1	Green

RF connectors WG16 plain flange.

HEATER

V_h	4.5 ± 0.15	V
I_h	0.8–1.2	A

MAXIMUM RATINGS (Absolute)

V_{coll} (see Note 1)	3.0	kV
V_{helix} (see Notes 1, 2)	2.8	kV
V_{g2} (see Note 1)	1.0	kV
V_{g1} (upper limit)(see Notes 1, 3)	0	V
V_{g1} (lower limit)(see Note 1)	−50	V
I_{coll}	10.0	mA
I_{helix} (see Notes 6, 7)	2.0	mA
I_{g2}	1.5	mA
t_{hk} (min)	3	min
T_{amb}	+70	°C

TYPICAL OPERATION

Frequency range	7.9–8.1	GHz
V_{coll} (see Note 1)	2.6	kV
V_{helix} (see Notes 1, 2, 5)	2.0–2.6	kV
V_{g1} (see Notes 1, 3, 4, 5)	−15.0 – 0	V
V_{g2} (see Notes 1, 4)	350–700	V
I_{coll} (see Note 5)	6–8	mA
I_{helix}	0–1.0	mA
I_{g2}	0–0.5	mA
Harmonic output	<−50	dBW
Phase variation	<±0.2	°MHz
Spurious AM (see Note 5)	<0.25	%pk-pk
Spurious PM sidebands (see Note 5)	<40	dB

NOTES

1. All voltages are with respect to the cathode, the collector is connected to the body which should be earthed.
2. Helix voltage should never exceed collector voltage.
3. Grid 1 voltage should never be positive.
4. It must be possible to reduce this voltage to zero.

5. The operating grid 1 and helix voltages and collector current are marked on each tube. The indicated grid 1 voltage must be available at all values of collector current. The spurious AM and PM limits are based on the following power supply ripple requirements:-

Electrode	Power Supply Requirement	Stability	Max Ripple (pk-pk)
V_h	4.5V	± 0.15V	–
V_{g1}	–15.0 – 0V	± 0.15%	20mV
V_{g2}	350–700V	± 1.0%	0.02%
V_{helix} . . .	2.0–2.6kV	± 1.0%	0.02%
V_{coll}	2.6kV	± 5.0%	5.0%

The power supply specification in terms of stability and permissible ripple are less stringent where spurious modulation requirements are not so severe. Details on request.

6. The helix current may momentarily exceed 1mA during the running up procedure.
7. It is advisable to provide a relay to remove the high voltage supplies if the helix current exceeds 2mA.

WEIGHT

The weight of the TWX34 is 2kgm (4lb. 8oz.).

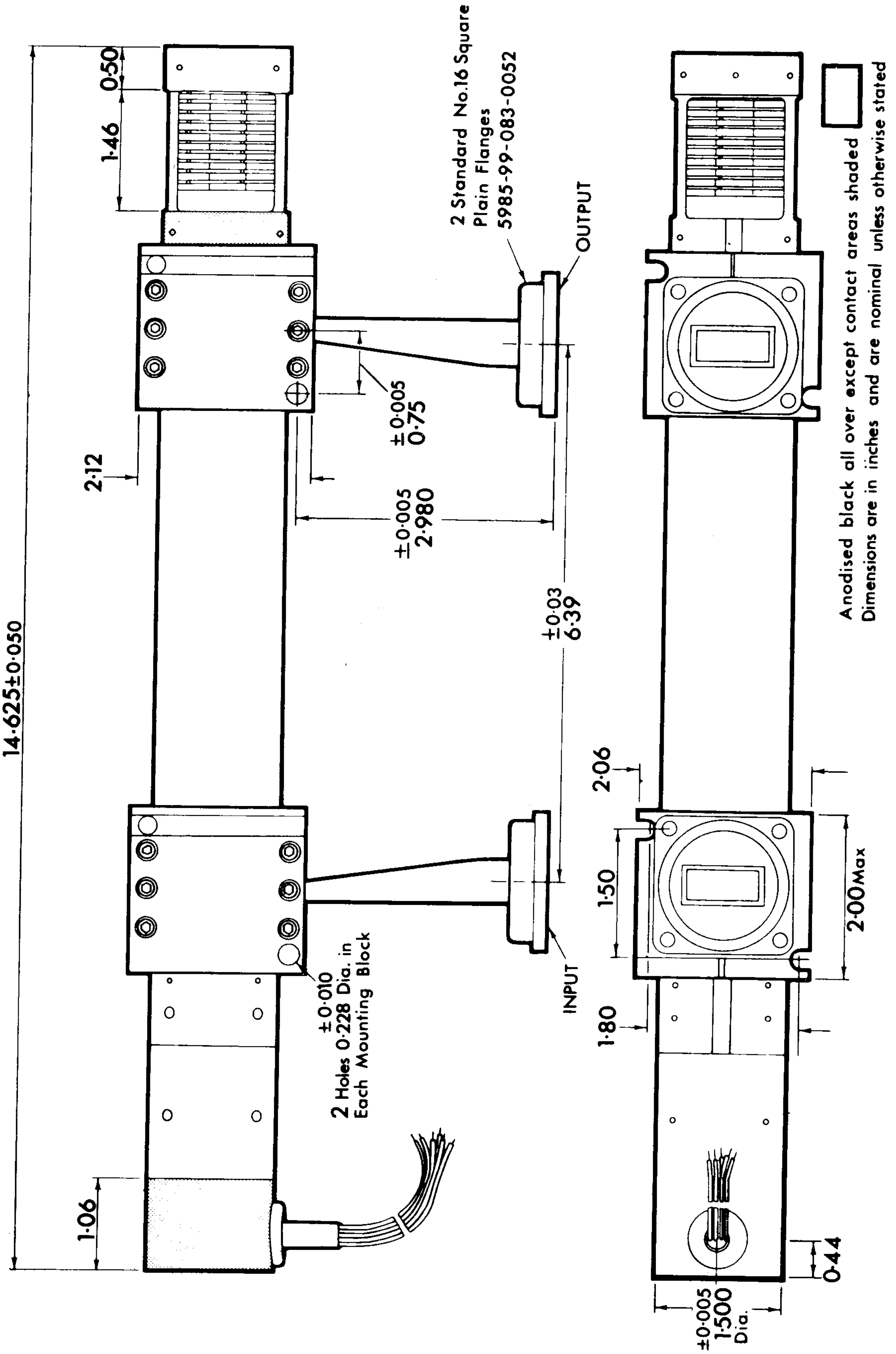
INSTALLATION

The tube is designed to be mounted horizontally and in such a position that air can circulate freely over the collector cooling fins. If mounted other than horizontally forced air cooling may be necessary.
Upon initial installation the full operating voltages may be applied instantaneously to collector, helix and grid 1 but grid 2 voltage should be increased from zero following the application of all other voltages at the indicated values.

SETTING UP PROCEDURE

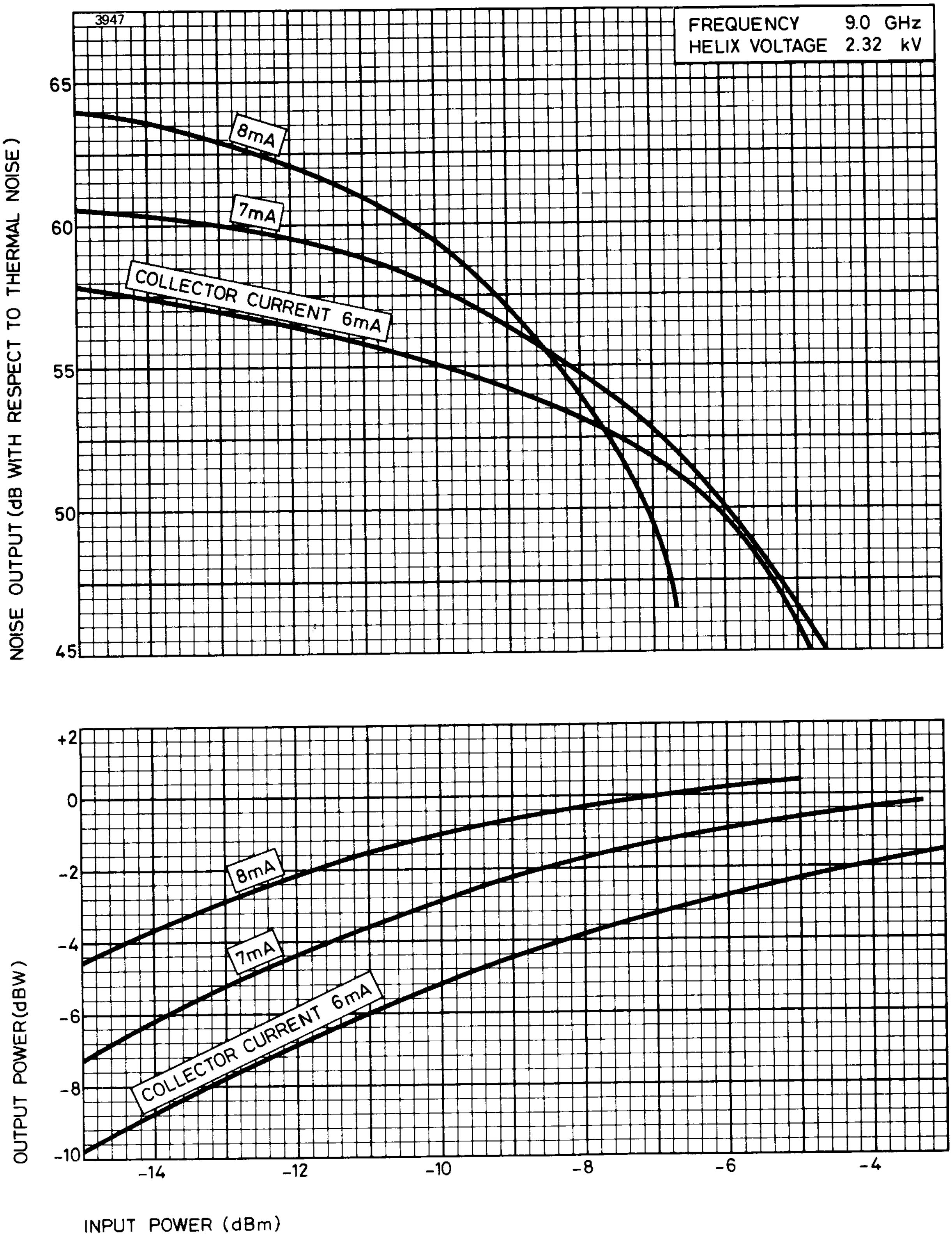
1. Turn up or switch on the heater supply ensuring that the surge current does not exceed 3 amps. Wait for 3 minutes.
2. Set grid 1 voltage to the value indicated on the tube.
3. Set collector voltage to 2.6kV.
4. Set helix voltage to the value indicated on the tube.
5. Increase grid 2 voltage until collector current can be observed. Alternately, increase grid 2 voltage and adjust grid 1 voltage until the indicated collector current is obtained at minimum helix current.
6. Apply r.f. input at approximately the centre frequency of the operating band and tune helix voltage for maximum r.f. output. Readjust grid 2 and grid 1 voltages to maintain the indicated collector current at minimum helix current.

OUTLINE

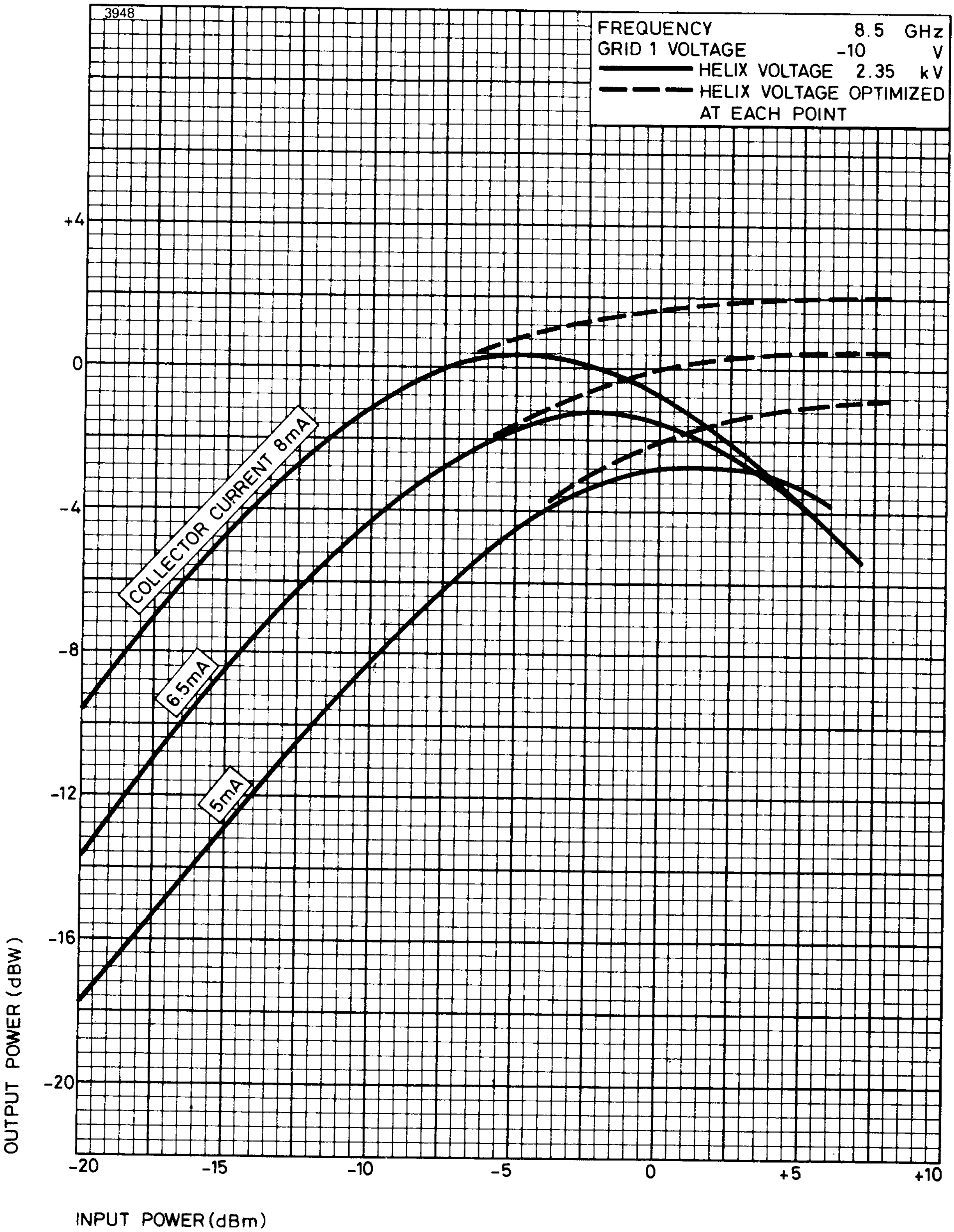


2 Standard No.16 Square Plain Flanges 5985-99-083-0052
OUTPUT
INPUT
0·50
1·46
2·12
±0·005 0·75
±0·005 2·980
±0·03 6·39
14·625±0·050
2 Holes 0·228 Dia. in Each Mounting Block ±0·010
1·06
2·06
1·50
2·00 Max
1·80
0·44
1·500 ±0·005 Dia.
Anodised black all over except contact areas shaded
Dimensions are in inches and are nominal unless otherwise stated

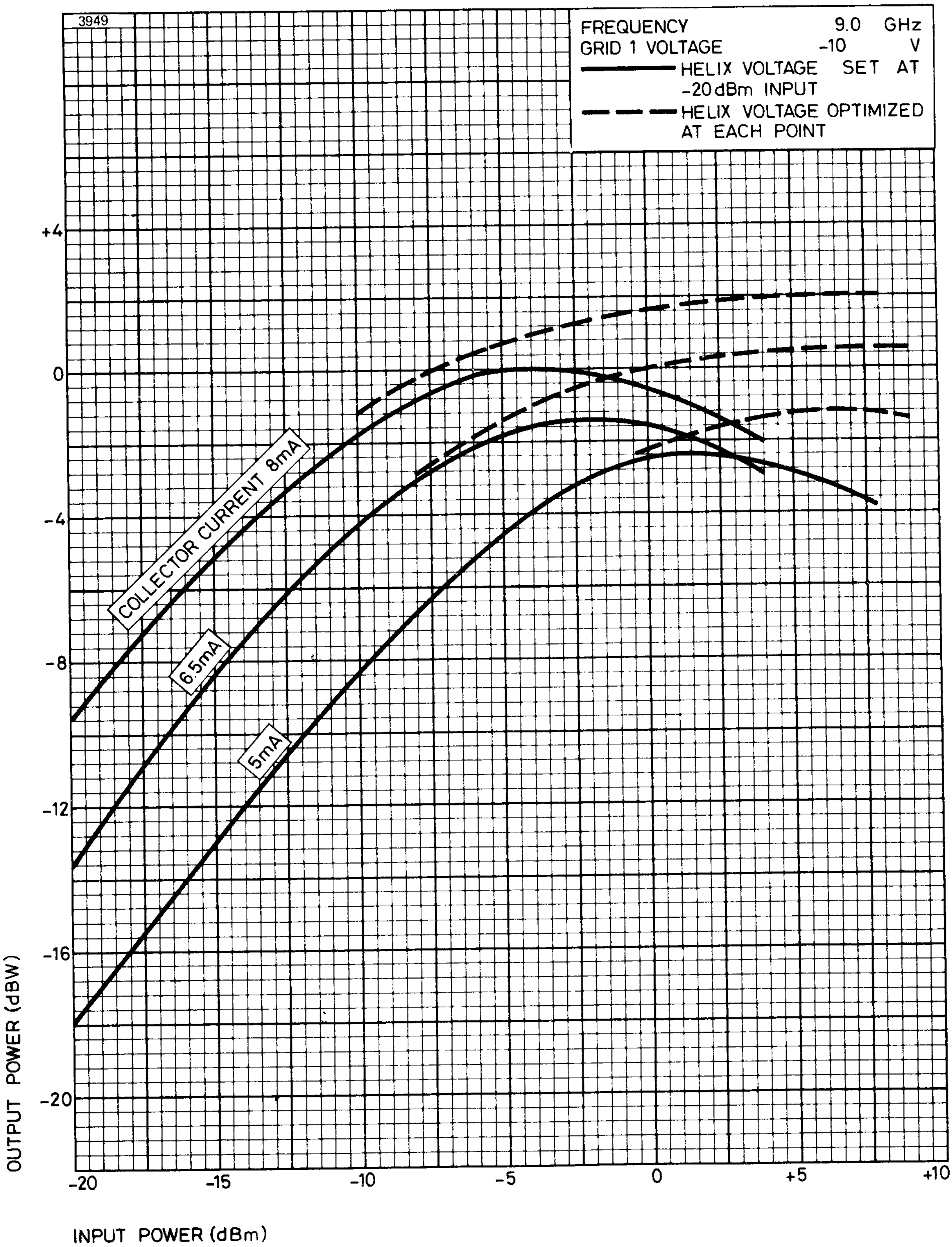
OUTPUT POWER AND NOISE OUTPUT — INPUT POWER
(Helix voltage at small signal optimum)



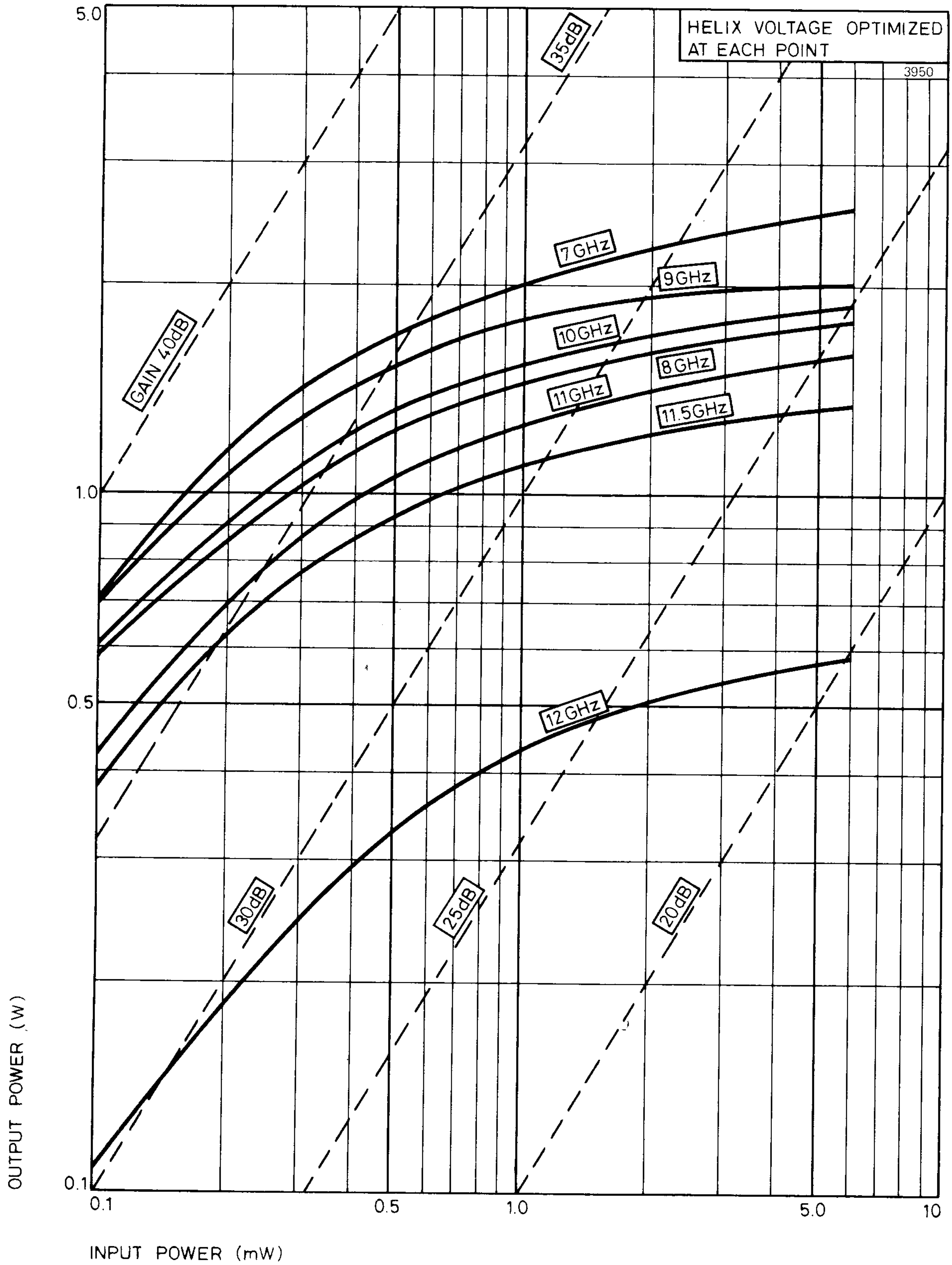
POWER CHARACTERISTIC CURVES



POWER CHARACTERISTIC CURVES



POWER CHARACTERISTIC CURVES



Backward Wave Oscillators

GEC

BACKWARD WAVE OSCILLATOR

BRIEF DATA

The BWS1 is an S-band 'M' type backward wave oscillator designed to give more than 150W c.w. between 2.5 and 3.1GHz. The tube is electronically tunable by variation of the line voltage between 3 and 5kV.

The line current and hence r.f. output power is controlled by variation of the plate voltage. The tube may be amplitude modulated using this electrode. The grid voltage is set at some value between zero and about 300V negative with respect to the cathode to give optimum performance.

The line current is nominally 350mA; the plate and grid currents are less than 2mA and the sole current is negative, i.e. electrons flow to the sole which is negative with respect to the cathode.

During normal operation of a backward wave oscillator the sole slowly expands due to heating by the sole current. This causes a frequency drift of over 100MHz, the tube taking up to an hour to settle down. The BWS1 is fitted with a sole heater which may be used to raise the sole temperature to the normal operating value in 10 minutes. The residual frequency drift may be controlled to a few MHz by this device. Fig. 4 shows the effect of sole pre-heating using the sole heater. A plot of frequency against time without preheating is also given for comparison.

The tube is normally supplied packaged in a suitable permanent magnet.

PHYSICAL CHARACTERISTICS

Weight

19kg. (42lb.) (approx).

Output

50Ω coaxial line plug to 7/8 in. line.

Input

The input is via a special six-pin socket which allows operation without flashover at pressures down to 50 torr (6650 Nm^{-2}).

Cooling

Liquid cooling must be provided for the block. Connection to block is by ¼in. BSP water unions. For water at an inlet temperature of 20°C, a minimum flow rate of 2 litres/min is recommended, corresponding to a pressure head of 0.1kg cm^{-2}. The block temperature must not be allowed to rise above 60°C.

RATINGS

The BWS1 must be operated at the voltages given on the data sheet supplied with each tube. For circuit designers' information the limiting values of the operating conditions are as follows:-

	Max	Min	
Filament voltage	8	–	V
Filament current	2.25	–	A
Line voltage	5.1	2	kV
Line current	350	–	mA
R.F. power output	–	150	W
Plate voltage	1.3	–	kV
Plate current	2	–0.15	mA
Sole voltage	–600	–850	V
Sole current	–	–80	mA
Grid voltage	–	–300	V
Frequency	3.1	2.5	GHz
Sole heater voltage	30	–	V
Sole heater current	3.5	–	A

All voltages (except sole heater) are referred to the cathode.

The tube is usually operated with the line earthed.

Typical interelectrode capacitances are as follows:-

Plate to other electrodes	18	pF
Grid to other electrodes	20	pF
Sole to other electrodes	56	pF

OPERATION

Equipment

1. The operating equipment should be provided with interlocks to function as follows:-
a) To remove plate voltage in case of line voltage failure.
b) To remove all voltages except the heater should an arc occur in any electrode circuit.
2. The heater circuit should limit the current under short-circuit conditions to less than 2.5A.

Starting the Tube (Without Sole Heater)

The operations must be carried out in the order shown.

1. Turn on block cooling.
2. Set heater voltage to required value.
3. Switch on sole voltage.
4. Allow five minutes for cathode to reach operating temperature.
5. Increase line voltage to about 2kV. At this stage the line current should be less than 50mA.
6. Increase plate voltage until a line current of about 200mA is obtained, taking care that the line voltage does not fall below 2kV as the line current increases.
7. Increase grid voltage to the value indicated on the data sheet enclosed with the tube.
8. Adjust plate voltage until the required line current (350mA max) is obtained.
9. The line voltage may then be varied to cover the frequency range 2.5 to 3.1GHz.

Stopping the Tube

1. Decrease line voltage to 2kV.
2. Reduce plate voltage to zero.
3. After plate voltage has been turned off, switch off line voltage.
4. Turn off the sole, grid, heater and water cooling.

Precautions

1. Avoid jarring the tube and avoid stressing the output connection.
2. Never operate the tube without proper cooling and proper load.
3. Provide suitable overload protection on all supplies.
4. The line voltage must always be greater than 2kV when the plate is switched on.
5. The grid must never be positive with respect to the cathode. If a grid voltage is not applied the grid should be tied to the cathode.
6. The tube should not be operated either above 3.1GHz or above 5.1kV.

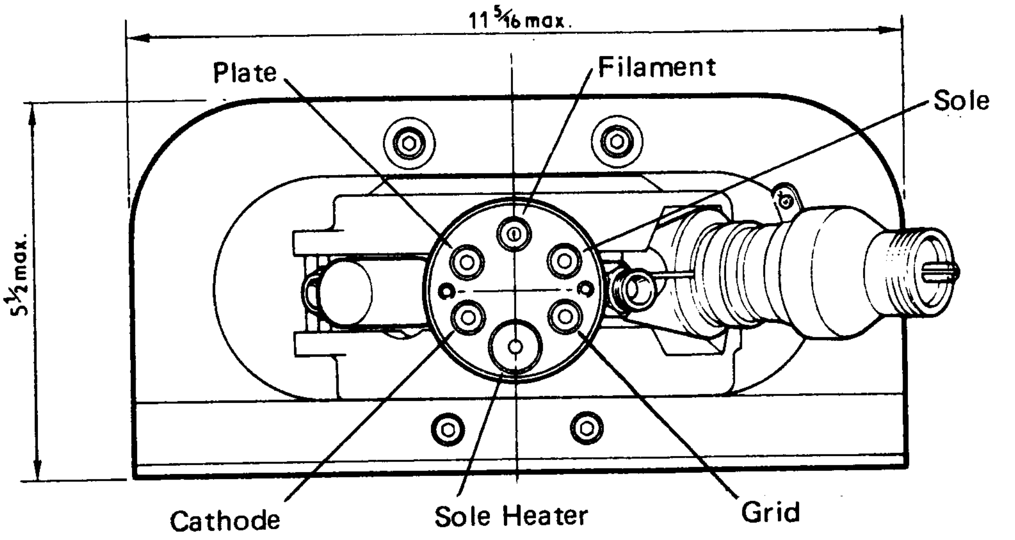
Starting the Tube (With Sole Heater)

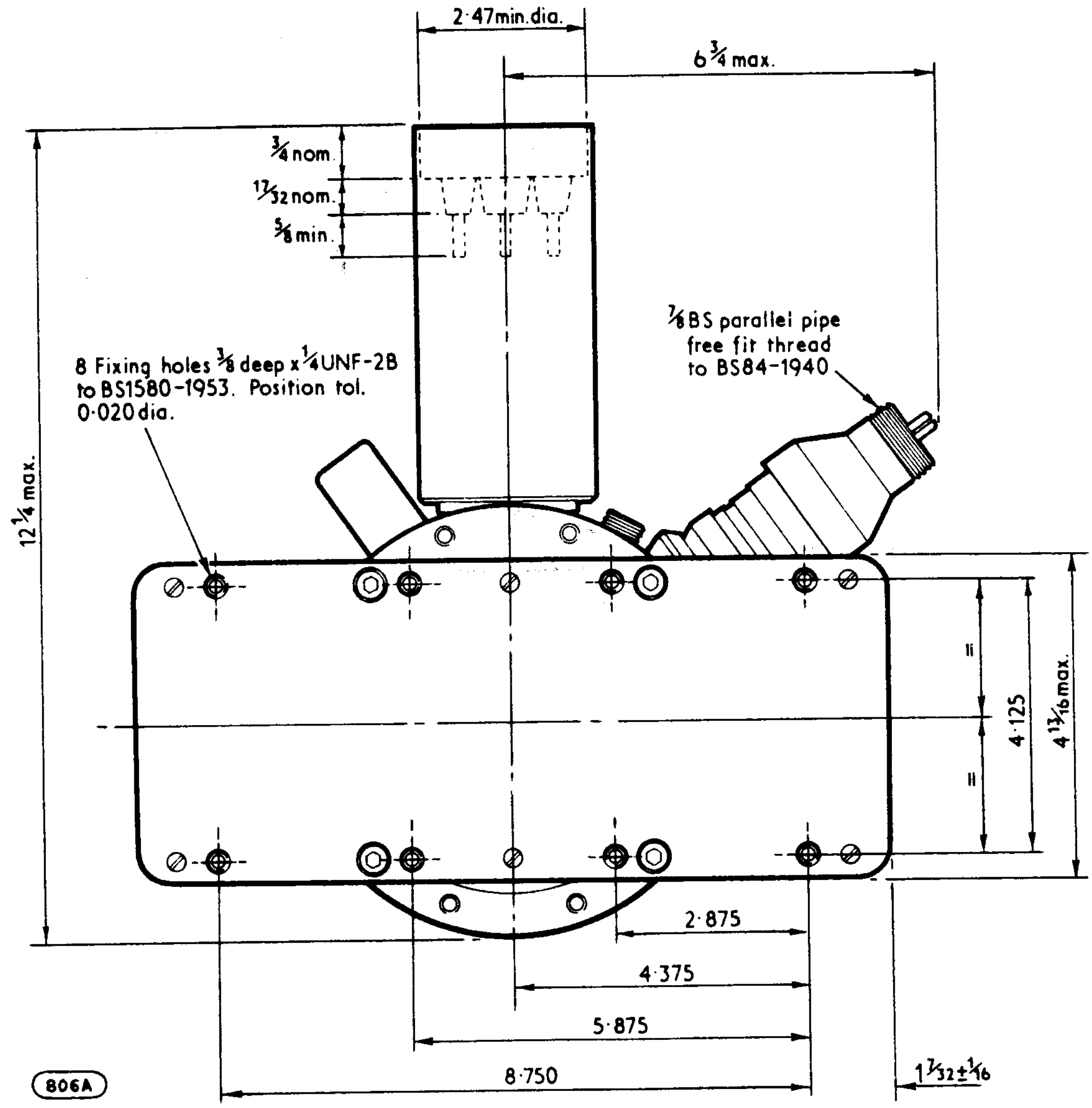
If a tube is used as described above, the frequency at a given value of line voltage will drift about 100MHz over about an hour from first switching on, due to heating of the sole. This frequency drift may be eliminated by using the sole heater. The sole heater should be switched on at the same time as the cathode heater with normal tube cooling operating. After about 15 minutes the sole will be at normal operating temperature and the sole, line, plate and grid may be switched on. As soon as the line current has reached the desired value the sole heater should be switched off. The residual frequency drift should then be less than ±10MHz. The sole heater dissipation (75W max) and pre-heating time may be adjusted to give zero residual frequency drift at any spot frequency within the band: the exact dissipation and time can best be found by a series of experiments.

If the tube is switched off the sole will cool down and so the frequency-voltage characteristic will change. The sole can be kept at operating temperature indefinitely by leaving the sole heater switched on at reduced power. The required value of sole heater power can best be found by experiment.

The sole heater must always be switched off when the tube is operating at full power.

FIG. 1 OUTLINE





806A

PERFORMANCE AT CONSTANT LINE CURRENT (350mA)

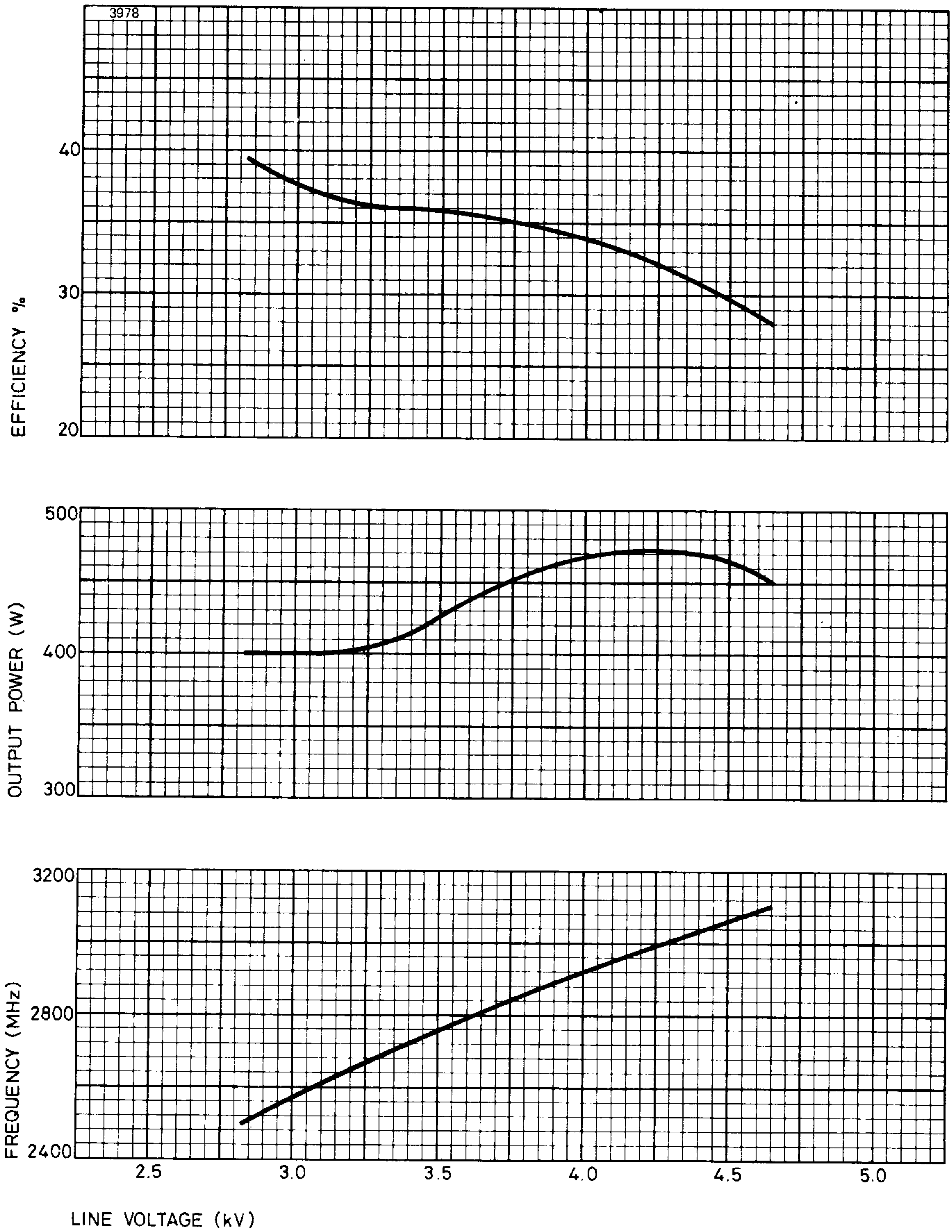
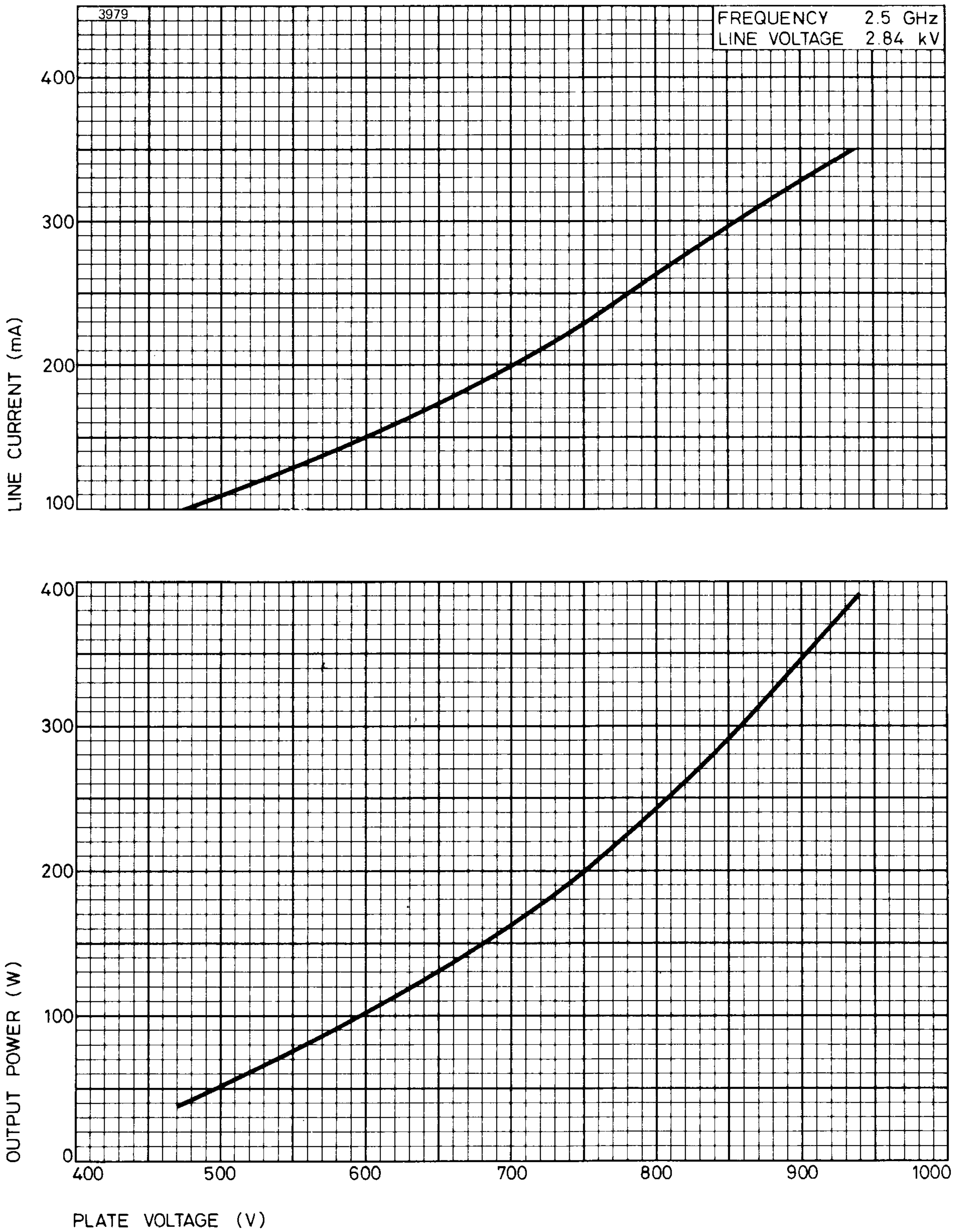
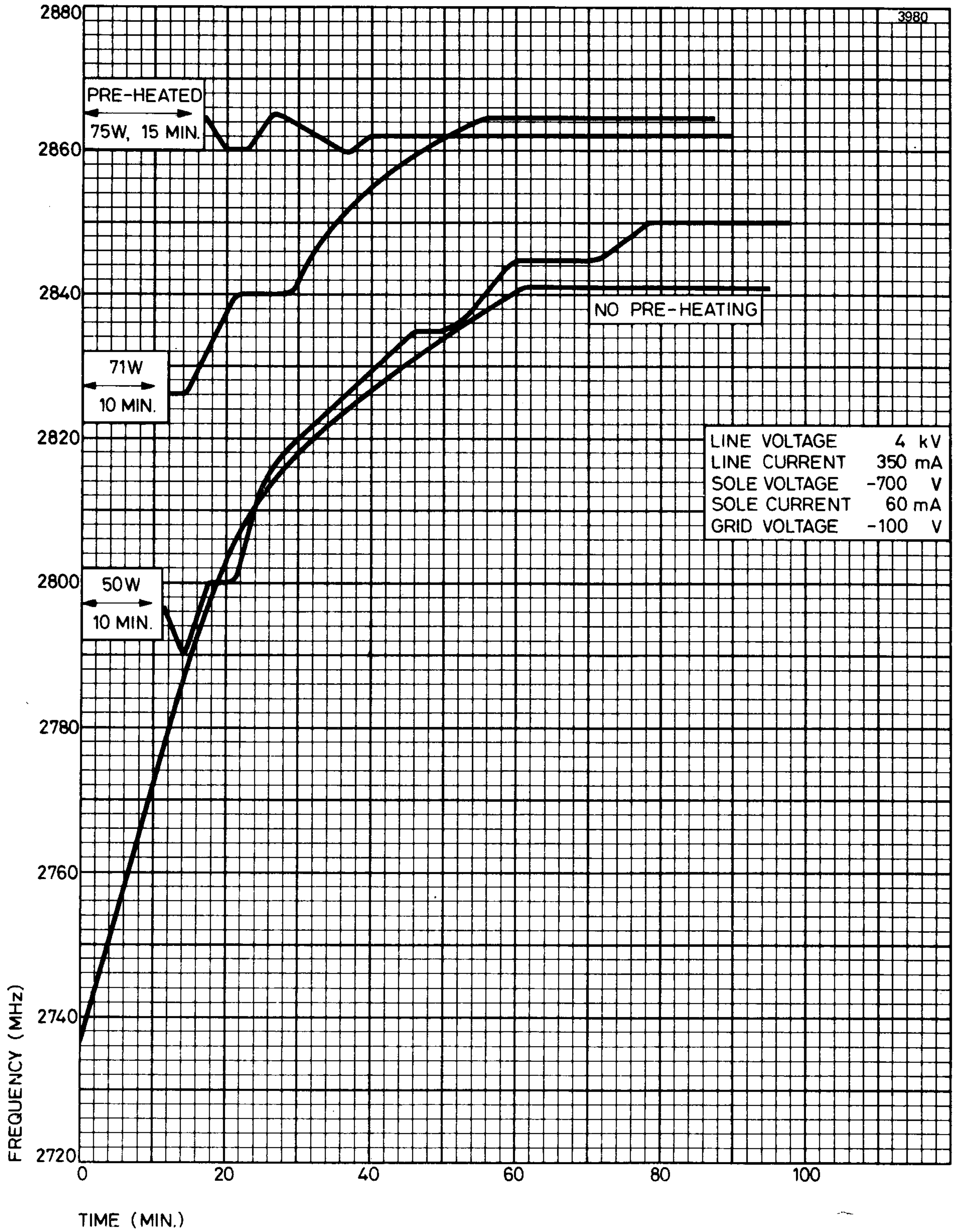


PLATE CHARACTERISTICS AT CONSTANT LINE VOLTAGE



FREQUENCY DRIFT OF A TYPICAL BWS1



BWS2

BACKWARD WAVE OSCILLATOR

BRIEF DATA

The BWS2 is an S-band 'M' type backward wave oscillator designed to give more than 150W c.w. between 3.0 and 4.0GHz. The tube is electronically tunable by variation of the line voltage between 2.5 and 5kV.

The line current and hence r.f. output power is controlled by variation of the plate voltage. The tube may be amplitude modulated using this electrode. The grid voltage is set at some value between zero and about 300V negative with respect to the cathode to give optimum performance.

The line current is nominally 350mA; the plate and grid currents are less than 2mA and the sole current is negative, i.e. electrons flow to the sole which is negative with respect to the cathode.

During normal operation of a backward wave oscillator the sole slowly expands due to heating by the sole current. This causes a frequency drift of over 100MHz, the tube taking up to an hour to settle down. The BWS2 is fitted with a sole heater which may be used to raise the sole temperature to the normal operating value in 10 minutes. The residual frequency drift may be controlled to a few MHz by this device. Fig. 4 shows the effect of sole preheating using the sole heater. A plot of frequency against time without preheating is also given for comparison.

The tube is normally supplied packaged in a suitable permanent magnet.

PHYSICAL CHARACTERISTICS

Weight

19kg (42lb)(approx).

Output

50Ω coaxial line plug to 7/8 in. line.

Input

The input is via a special six-pin socket which allows operation without flash-over at pressures down to 50 torr (6650Nm^{-2}).

Cooling

Liquid cooling must be provided for the block. Connection to block is by ¼ in. BSP water unions. For water at an inlet temperature of 20°C, a minimum flow rate of 2 litres/min is recommended, corresponding to a pressure head of 0.1kg cm^{-2}. The block temperature must not be allowed to rise above 60°C.

RATINGS

The BWS2 must be operated at the voltages given on the data sheet supplied with each tube. For circuit designers' information the limiting values of the operating conditions are as follows:-

	Max	Min	
Filament voltage	8	–	V
Filament current	2.25	–	A
Line voltage	5.1	2	kV
Line current	350	–	mA
R.F. power output	–	150	W
Plate voltage	1.3	–	kV
Plate current	2	–0.15	mA
Sole voltage	–600	–850	V
Sole current	–	–80	mA
Grid voltage	–	–300	V
Frequency	4.0	3.0	GHz
Sole heater voltage	30	–	V
Sole heater current	3.5	–	A

All voltages (except sole heater) are referred to the cathode.

The tube is usually operated with the line earthed.

Typical interelectrode capacitances are as follows:-

Plate to other electrodes	18	pF
Grid to other electrodes	20	pF
Sole to other electrodes	56	pF

OPERATION

Equipment

1. The operating equipment should be provided with interlocks to function as follows:-
a) To remove plate voltage in case of line voltage failure.
b) To remove all voltages except the heater should an arc occur in any electrode circuit.
2. The heater circuit should limit the current under short-circuit conditions to less than 2.5A.

Starting the Tube (Without Sole Heater)

The operations must be carried out in the order shown.
1. Turn on block cooling.
2. Set heater voltage to required value.
3. Switch on sole voltage.
4. Allow five minutes for cathode to reach operating temperature.
5. Increase line voltage to about 2kV. At this stage the line current should be less than 50mA.
6. Increase plate voltage until a line current of about 200mA is obtained, taking care that the line voltage does not fall below 2kV as the line current increases.
7. Increase grid voltage to the value indicated on the data sheet enclosed with the tube.
8. Adjust plate voltage until the required line current (350mA max) is obtained.
9. The line voltage may then be varied to cover the frequency range 3.0 to 4.0GHz.

Stopping the Tube

1. Decrease line voltage to 2kV.
2. Reduce plate voltage to zero.
3. After plate voltage has been turned off, switch off line voltage.
4. Turn off the sole, grid, heater and water cooling.

Precautions

1. Avoid jarring the tube and avoid stressing the output connection.
2. Never operate the tube without proper cooling and proper load.
3. Provide suitable overload protection on all supplies.
4. The line voltage must always be greater than 2kV when the plate is switched on.
5. The grid must never be positive with respect to the cathode. If a grid voltage is not applied the grid should be tied to the cathode.
6. The tube should not be operated either above 4.0GHz or above 5.1kV.

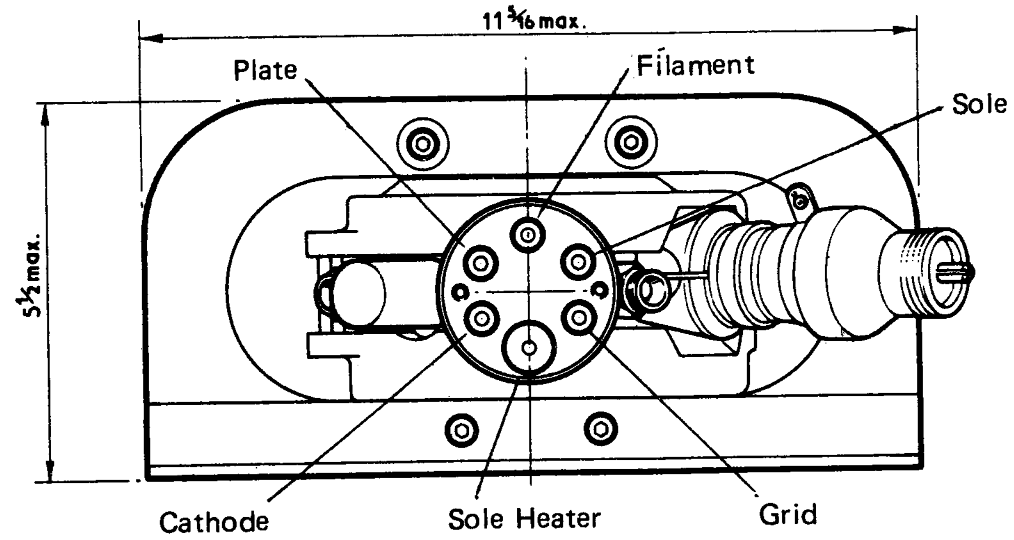
Starting the Tube (With Sole Heater)

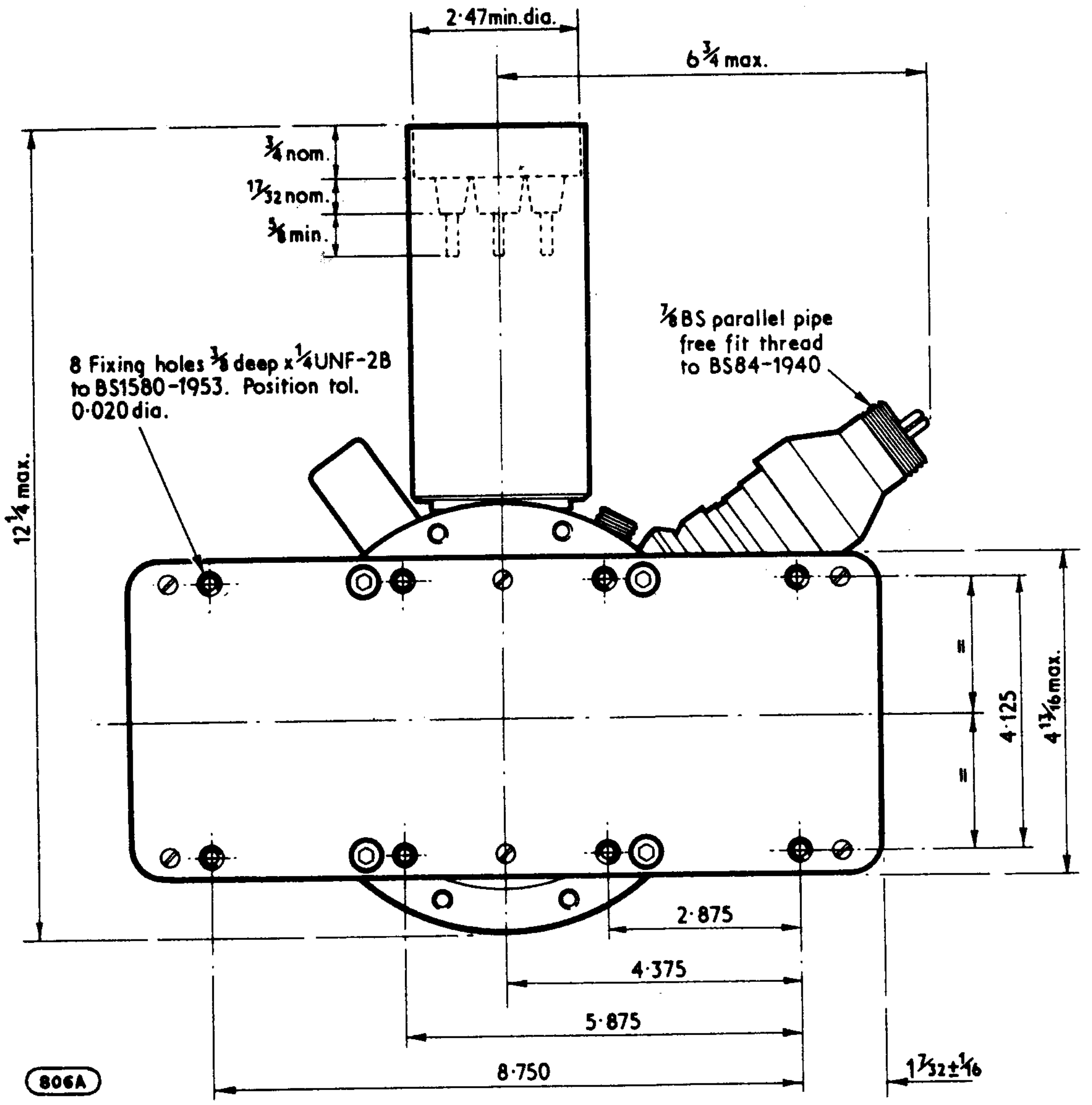
If a tube is used as described above, the frequency at a given value of line voltage will drift about 100MHz over about an hour from first switching on, due to heating of the sole. This frequency drift may be eliminated by using the sole heater. The sole heater should be switched on at the same time as the cathode heater with normal tube cooling operating. After about 15 minutes the sole will be at normal operating temperature and the sole, line, plate and grid may be switched on. As soon as the line current has reached the desired value the sole heater should be switched off. The residual frequency drift should then be less than ±10MHz. The sole heater dissipation (75W max) and pre-heating time may be adjusted to give zero residual frequency drift at any spot frequency within the band: the exact dissipation and time can best be found by a series of experiments.

If the tube is switched off the sole will cool down and so the frequency-voltage characteristic will change. The sole can be kept at operating temperature indefinitely by leaving the sole heater switched on at reduced power. The required value of sole heater power can best be found by experiment.

The sole heater must always be switched off when the tube is operating at full power.

FIG. 1 OUTLINE





PERFORMANCE AT CONSTANT LINE CURRENT (350mA)

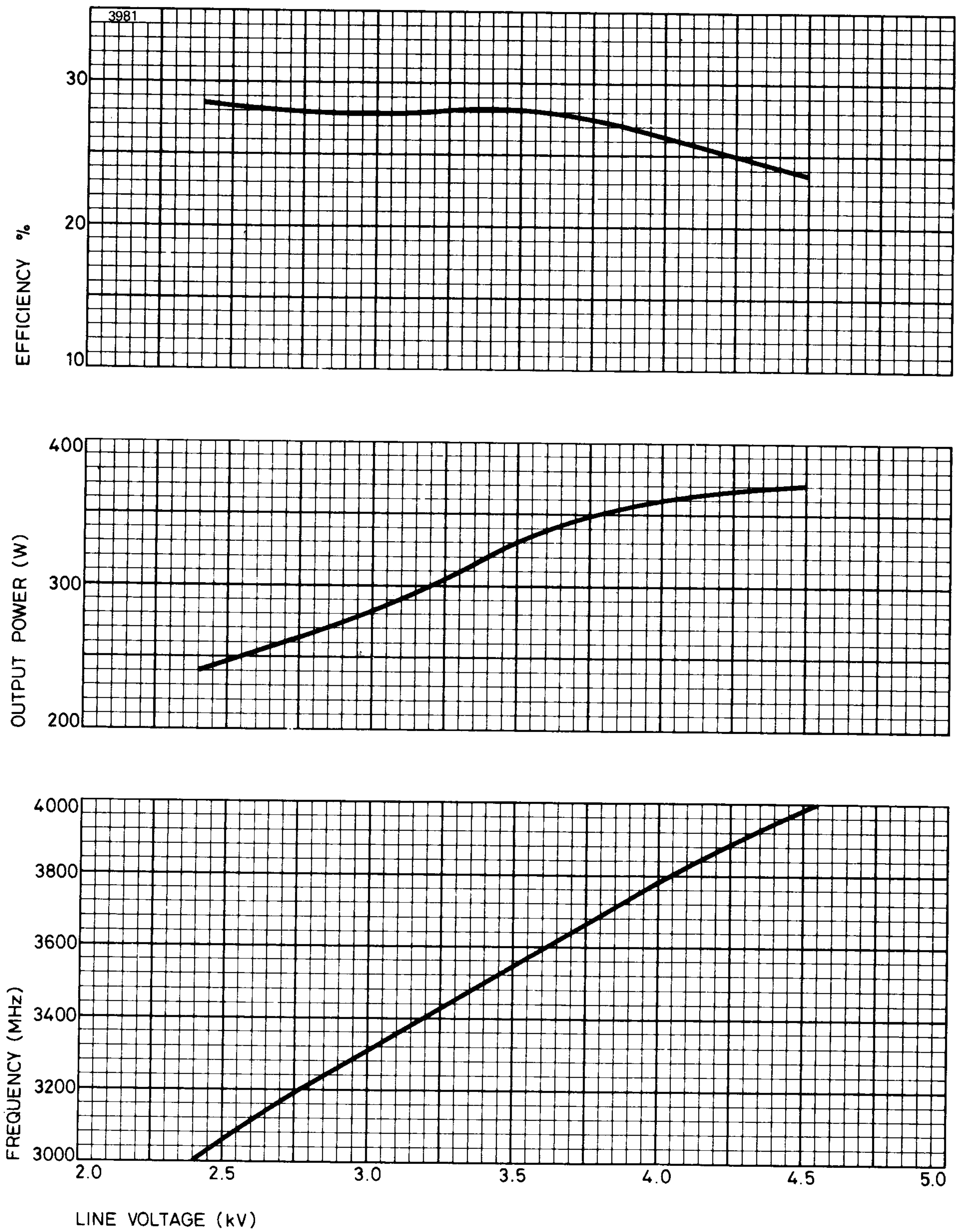
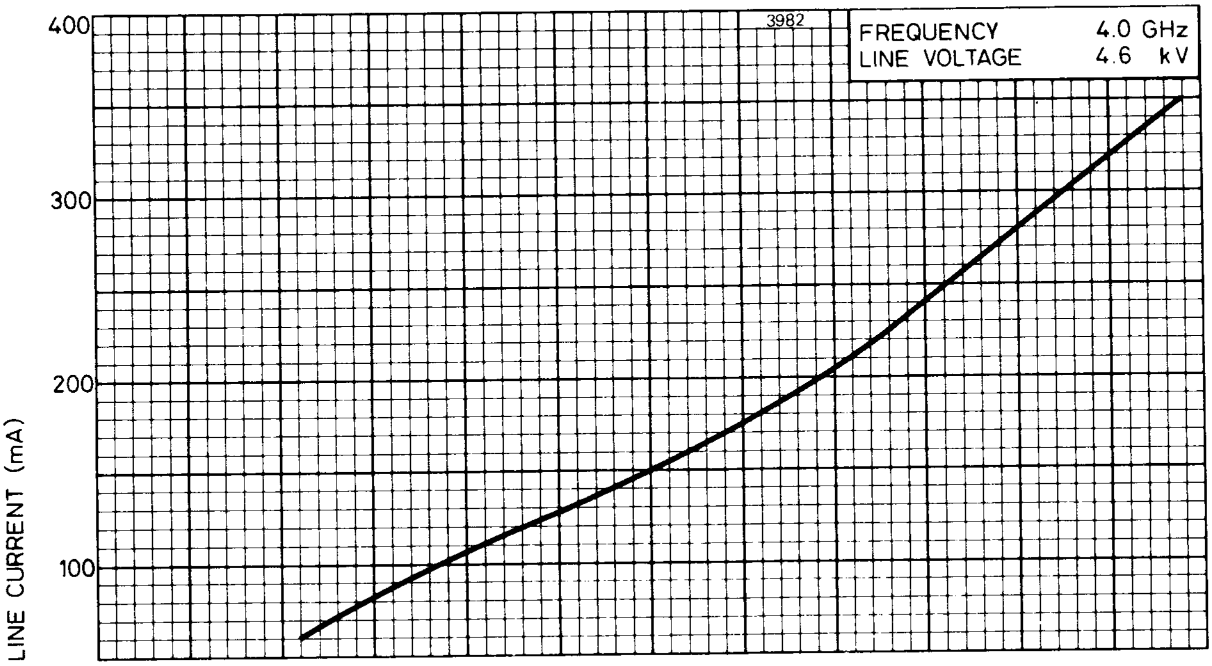
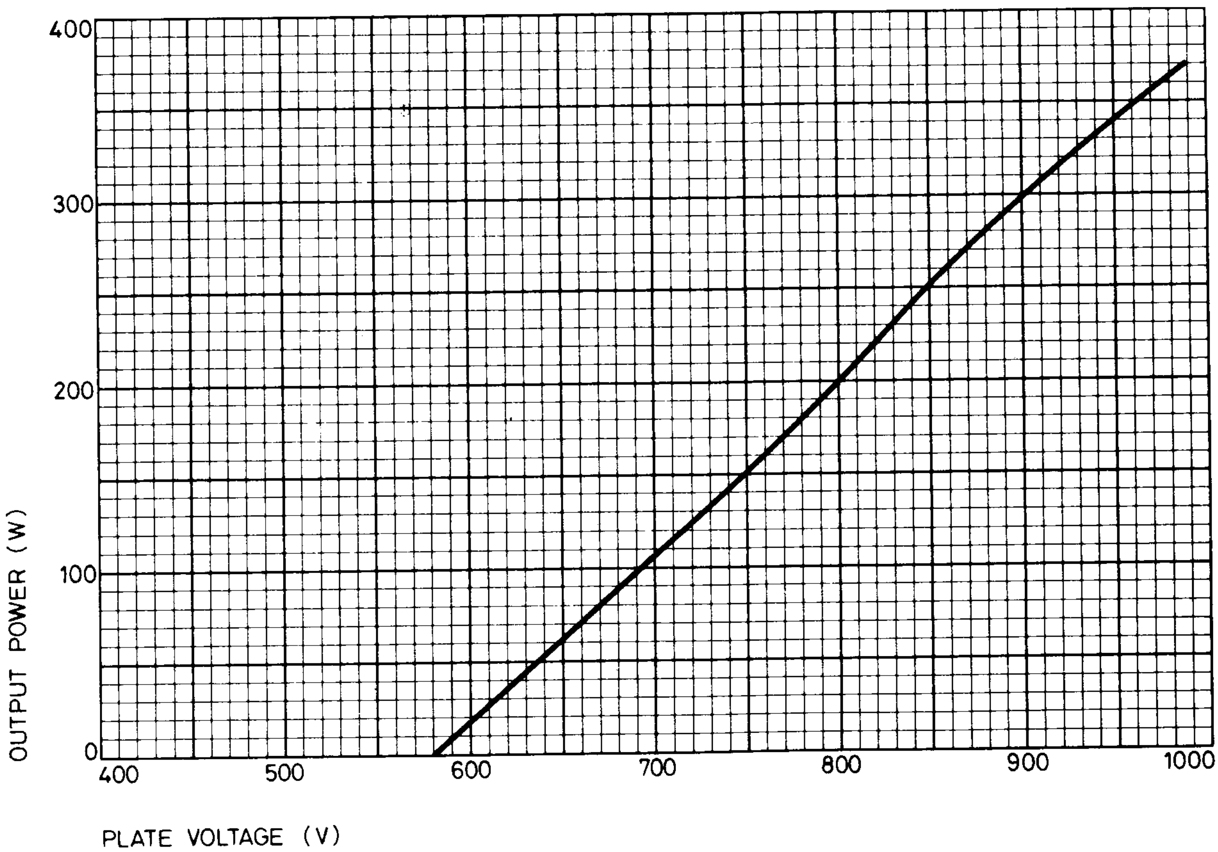
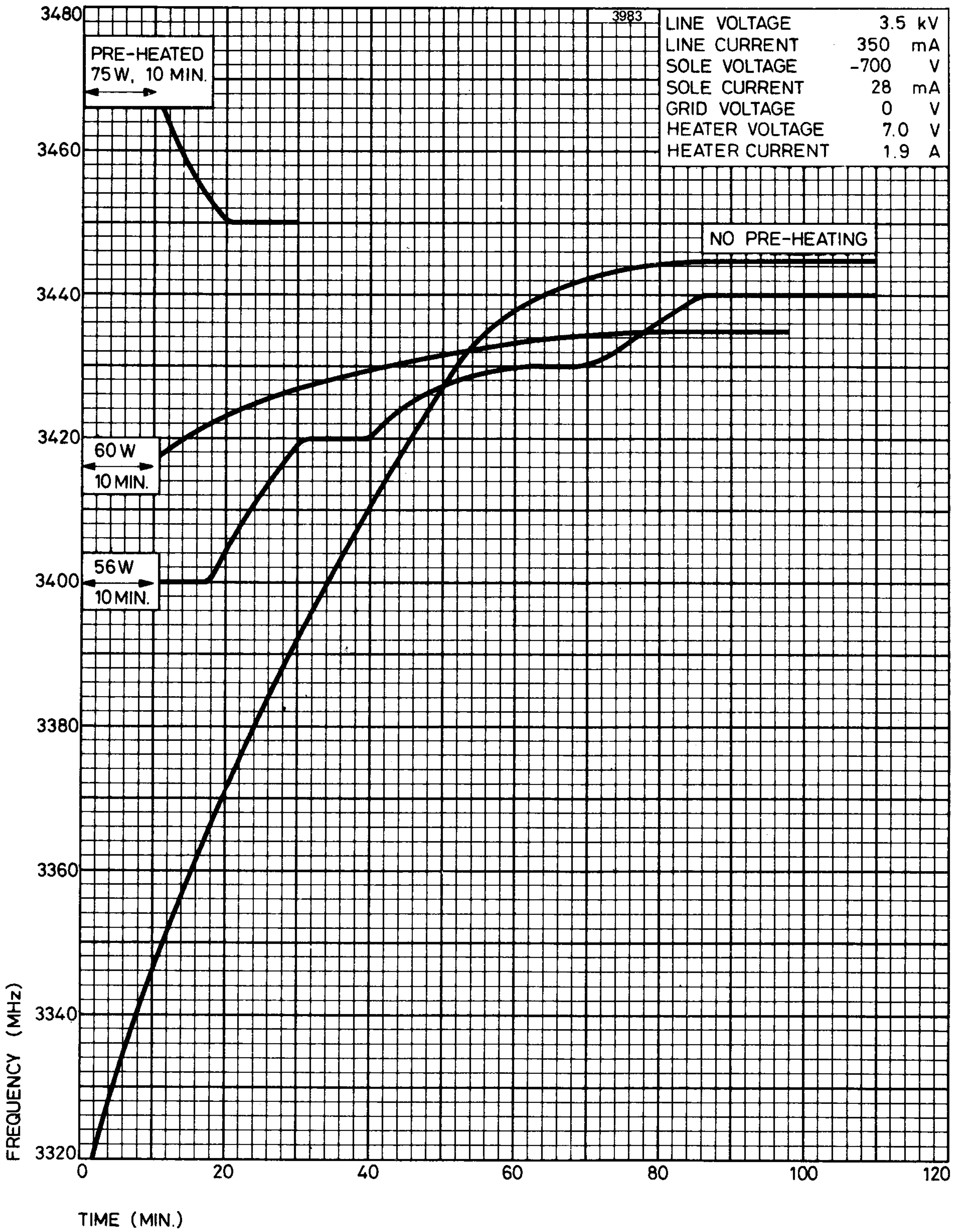


PLATE CHARACTERISTICS AT CONSTANT LINE VOLTAGE





FREQUENCY DRIFT OF TYPICAL BWS2



GEC

BACKWARD WAVE OSCILLATOR

BRIEF DATA

A liquid cooled 'M' type backward wave oscillator giving more than 100W c.w. between 7.6 and 10.4GHz, for a line voltage variation from 2.0kV to 5.0kV. Sole tuning over 500MHz.

DESCRIPTION

The tube uses an interdigital delay line designed to give a tuning range of 1.15MHz/V so that the range of 7.6 to 10.4GHz is covered by a variation in line voltage from 2.0kV to 5.0kV. The output is a broadband finned waveguide ceramic window system, terminating in a standard WG16 (RG52/U) waveguide flange. No separate output cooling is required.

The frequency drift is less than 0.1% in the first two minutes of operation by using a sole construction which achieves a low thermal impedance between the sole and the delay line. The delay line is cooled directly by the block cooling, so that no separate sole cooling is required. The construction has the added advantage of a rugged sole-block assembly giving good vibration performance.

The line current and hence r.f. output power is controlled by variation of the plate (accelerator) voltage. The tube may be amplitude modulated by using this electrode.

The line current is nominally 350mA, the plate current is less than 2mA and the sole current is between +5mA and −10mA. No grid supply is required.

PHYSICAL CHARACTERISTICS

Weight

Less than 9kg. (20lb).

Output

WG16 (RG52/U) waveguide. Flange connection UG39/U. Recommended mating flange 5985–99–083–0052 (UG39/U).

Input

Special socket.

Magnetic Field

Permanent magnet.

Cooling

Block cooling may be provided by 9 litres/min. of water or water/Glycol mixture. The head loss across the tube at 20°C will be less than 0.21kg cm^{-2} Maximum temperature of coolant can be 65°C, corresponding to a block temperature of 70°C. No other cooling is required.

RATINGS

Provisional limiting values of the operating conditions are as follows:-

	Max	Min	
Heater voltage	6.3	3.0	V
Heater current	2.5	1.4	A
Line voltage	5.0	2	kV
Line current	375	270	mA
R.F. power output	—	100	W
Plate (accelerator) voltage	2	1	kV
Plate (accelerator) current	2	–0.15	mA
Sole voltage	–1.2	–2.0	kV
Sole current	+5	–10	mA
Frequency	10.4	7.6	GHz

All voltages are referred to the cathode.

Positive current is defined as flowing from a positive to a negative potential in the circuit of the power supply.

The line is internally connected to the terminal marked "earth".

An information sheet giving exact ratings is supplied with each tube.

OPERATION

Equipment

The operating equipment should be provided with interlocks to function as follows:-

a) To remove plate (accelerator) voltage in case of line voltage failure.
b) To remove all voltages except the heater should an arc occur in any electrode circuit.
c) To remove all voltages except the heater should the plate (accelerator) current exceed 4mA.

Switching On

The operation must be carried out in the order shown.

1. Turn on the block cooling.
2. Set the heater voltage to the marked value.
3. Switch on the sole voltage to the marked value.
4. Allow three minutes for the cathode to reach operating temperature.
5. Increase the line voltage to the required value. At this stage the line current should be less than 50mA.
6. Adjust the plate (accelerator) voltage until the marked line current (375mA max) is obtained.
7. The line voltage may then be varied to cover the frequency range 7.5 to 10.4GHz.

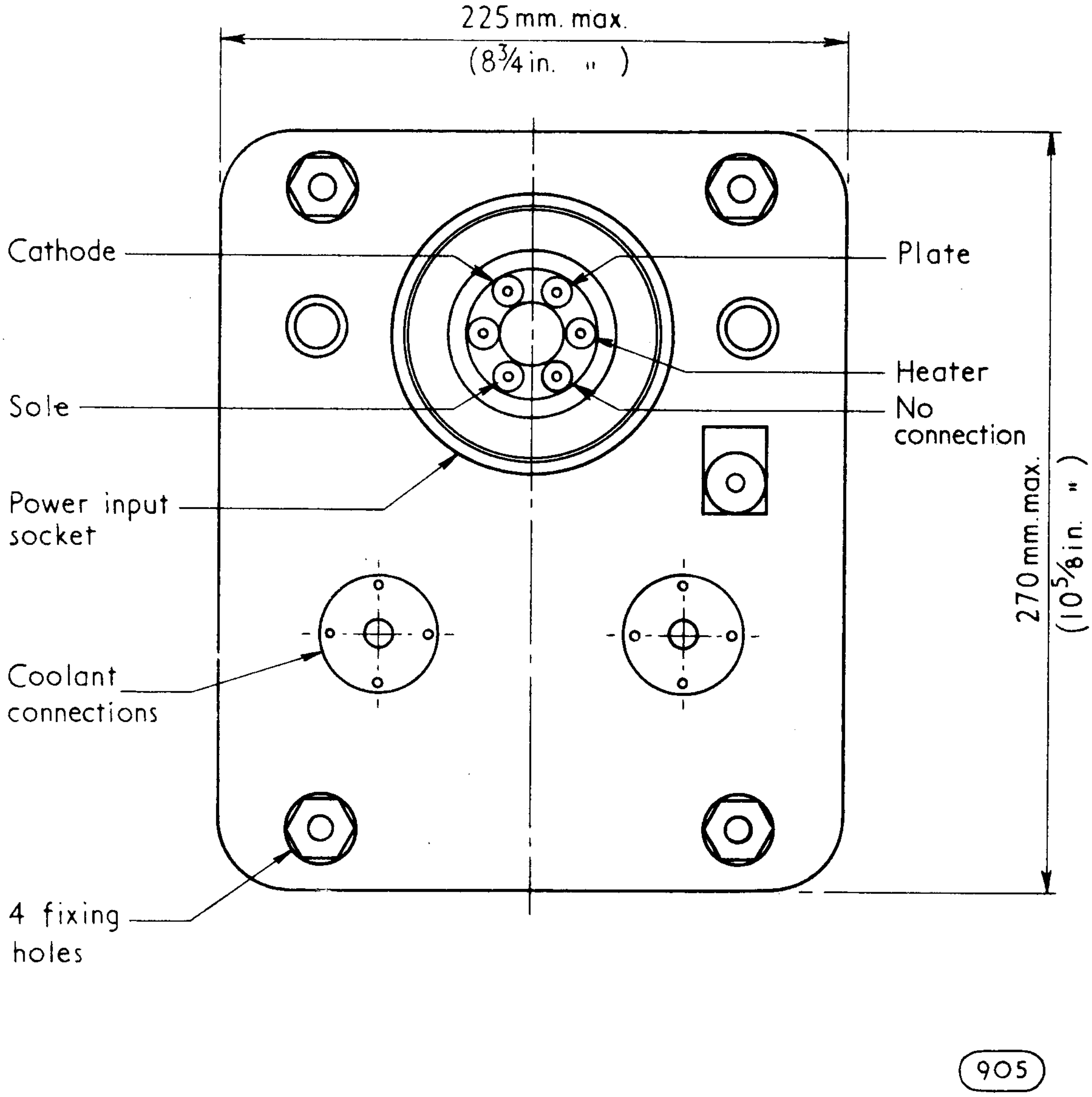
Switching Off

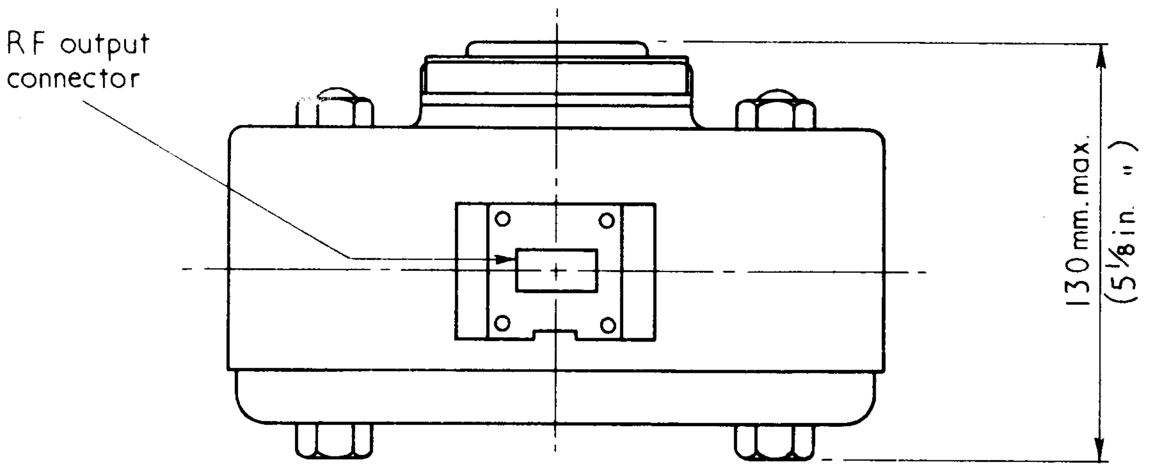
1. Reduce the plate (accelerator) voltage to zero.
2. After the plate (accelerator) voltage has been turned off, switch off the line voltage.
3. Turn off the sole and heater voltages.
4. Turn off block cooling.

Precautions

1. Keep all iron, steel or other magnets at least 20cm (8 ins.) from the magnet.
2. Avoid jarring the tube.
3. Never operate the tube without proper cooling and proper load.
4. Provide suitable overload protection on the supplies.
5. The line voltage must always be greater than 1.5kV when the plate (accelerator) voltage is switched on.
6. The tube should not be operated either above 10.4GHz or above 5.1kV.
7. The tube should not be operated at block coolant temperatures above 65°C.

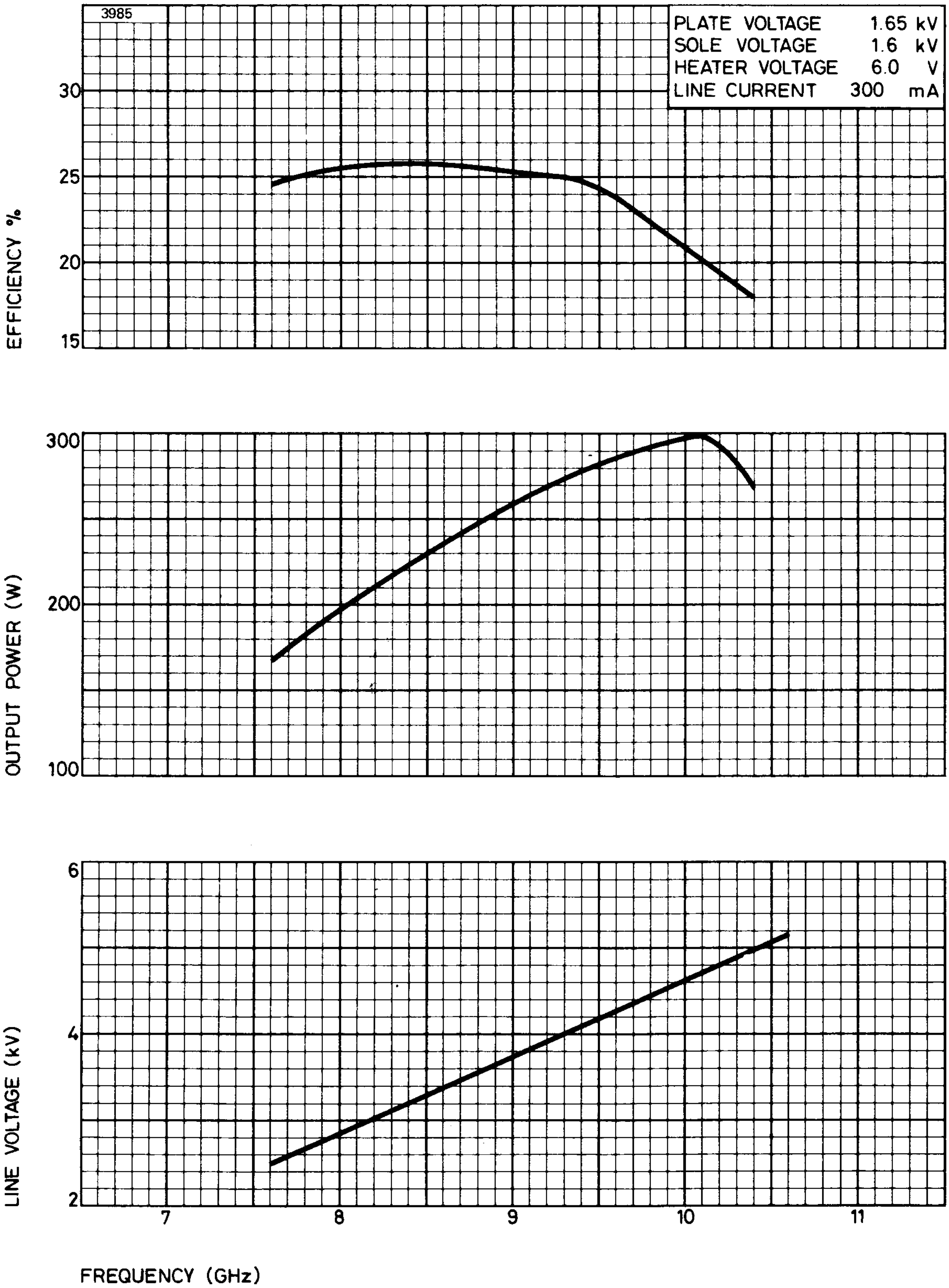
OUTLINE


225 mm. max.
(8¾ in. ")
Cathode
Plate
Heater
Sole
No connection
Power input socket
270 mm. max.
(10⅝ in. ")
Coolant connections
4 fixing holes
905

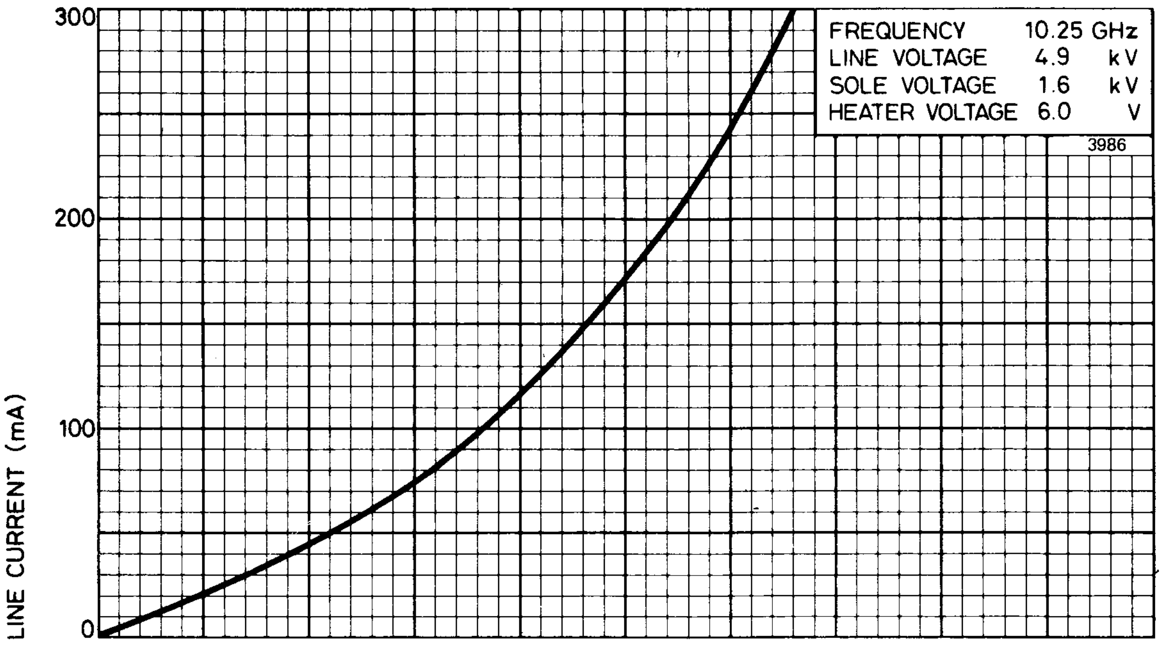

RF output connector
130 mm. max.
(5⅛ in. ")

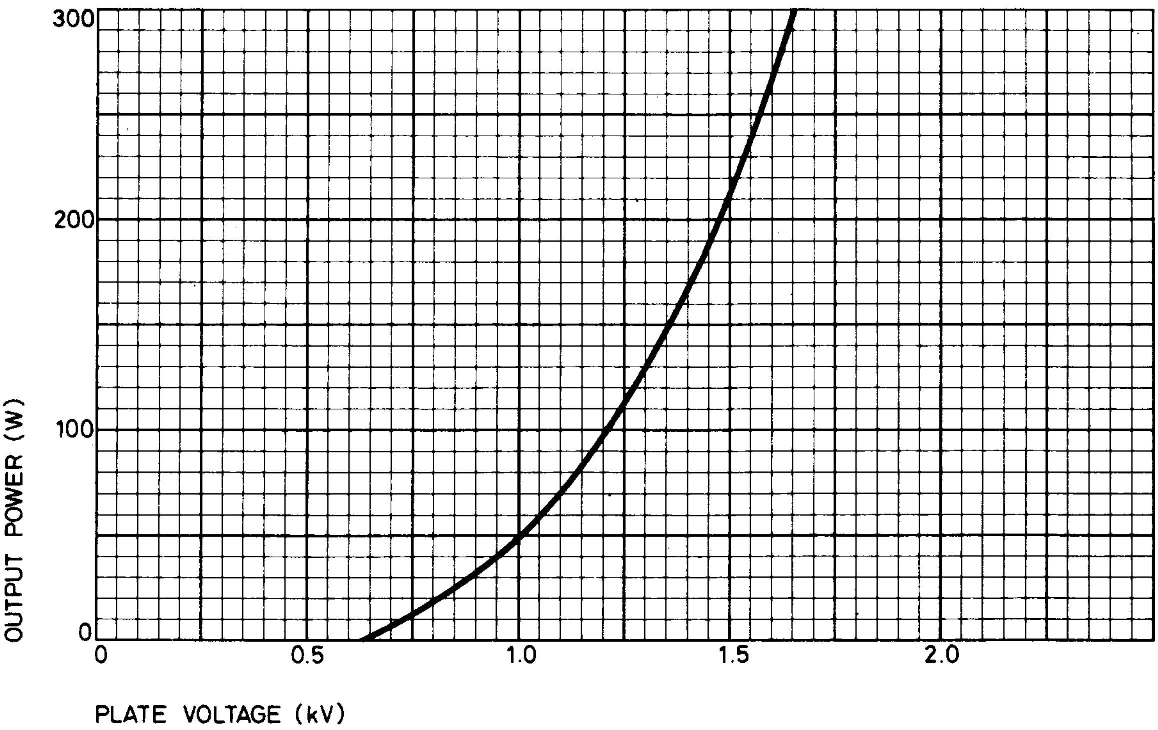
FREQUENCY DRIFT

TYPICAL LINE CHARACTERISTICS WITH CONSTANT PLATE VOLTAGE



TYPICAL PLATE CHARACTERISTICS WITH CONSTANT LINE VOLTAGE





N1010A N1010S

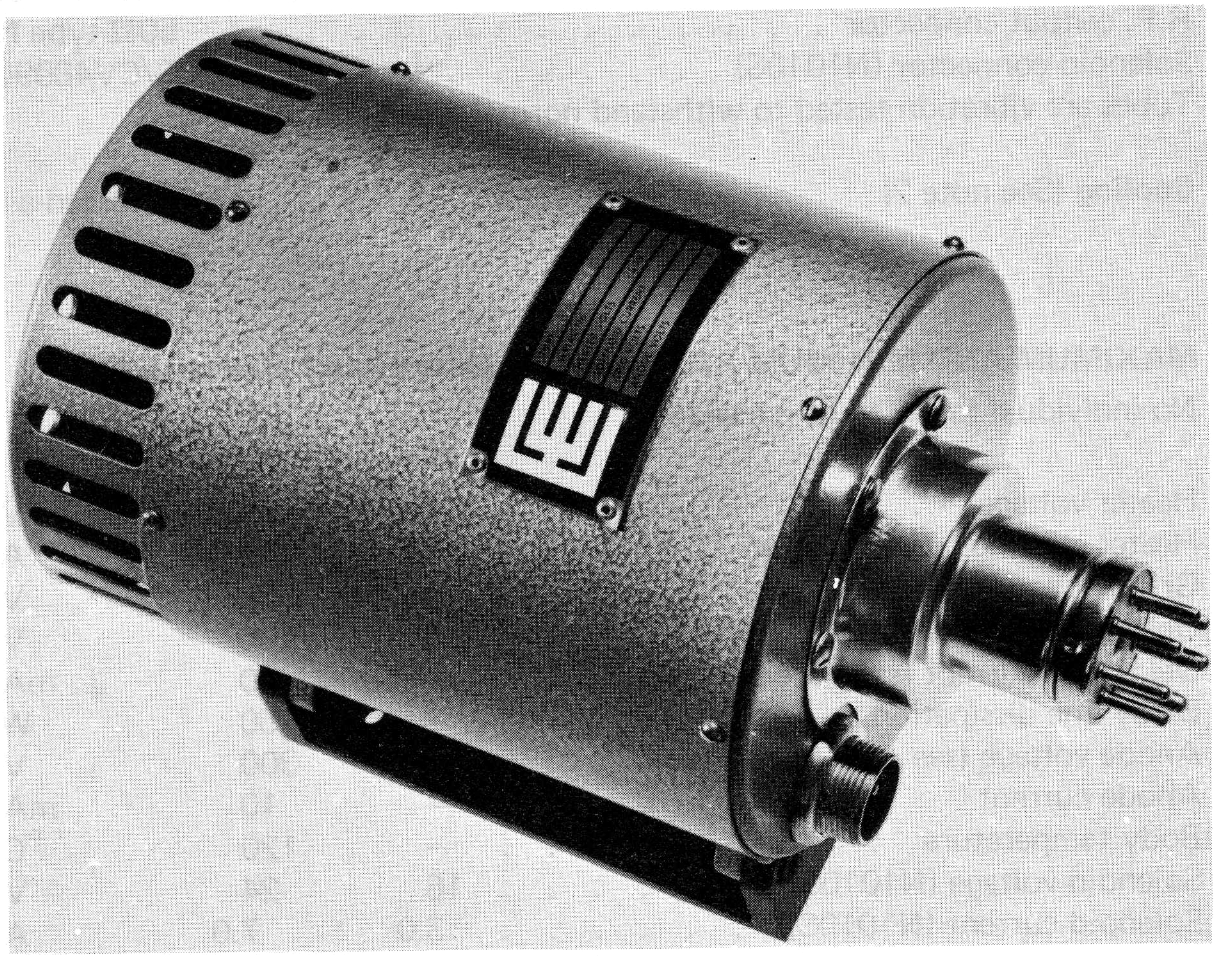
BACKWARD WAVE OSCILLATORS

Service types CV2393 (N1010A), CV6024 (N1010S)

ABRIDGED DATA

O-type backward wave oscillators for wide band microwave receivers and oscillators, suitable for pulse or amplitude modulation.

Frequency range	7.0 to 11.5	GHz
Typical output power over band	40 to 130	mW
Integral focusing:		
N1010A	permanent magnet	
N1010S	solenoid	
Output connector	50Ω type N coaxial	



August 1973

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	2.3	A
Cathode pre-heating time (minimum)	2.0	min
Inter-electrode capacitances:		
cathode to grid, anode and delay line	10	pF
grid to cathode, anode and delay line	15	pF
anode to cathode, grid and delay line	15	pF
delay line to cathode, grid and anode	10	pF
delay line to outer shell	300	pF
Solenoid power supply (N1010S)	24V, 4.5A	d.c.

Mechanical

Overall dimensions	see outline drawings
Net weight	11 pounds (5kg) approx
Mounting position (see note 1)	any
Base	medium 7-pin (JEDEC A7-13)
R.F. output connector	50Ω type N
Solenoid connector (N1010S)	AP208600/CV48992

Tubes are vibration tested to withstand normal service conditions.

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

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.8	V
Heater starting current (peak)	–	4.0	A
Grid voltage (see note 4)	0	–250	V
Delay line voltage	250	1700	V
Delay line current (see note 5)	–	40	mA
Delay line dissipation	–	50	W
Anode voltage (see note 6)	–	300	V
Anode current	–	1.0	mA
Body temperature	–	120	°C
Solenoid voltage (N1010S)	16	24	V
Solenoid current (N1010S)	3.0	7.0	A

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions (See note 3)

Heater voltage	6.3	V
Grid voltage	0	V
Load v.s.w.r.	1.2:1	max

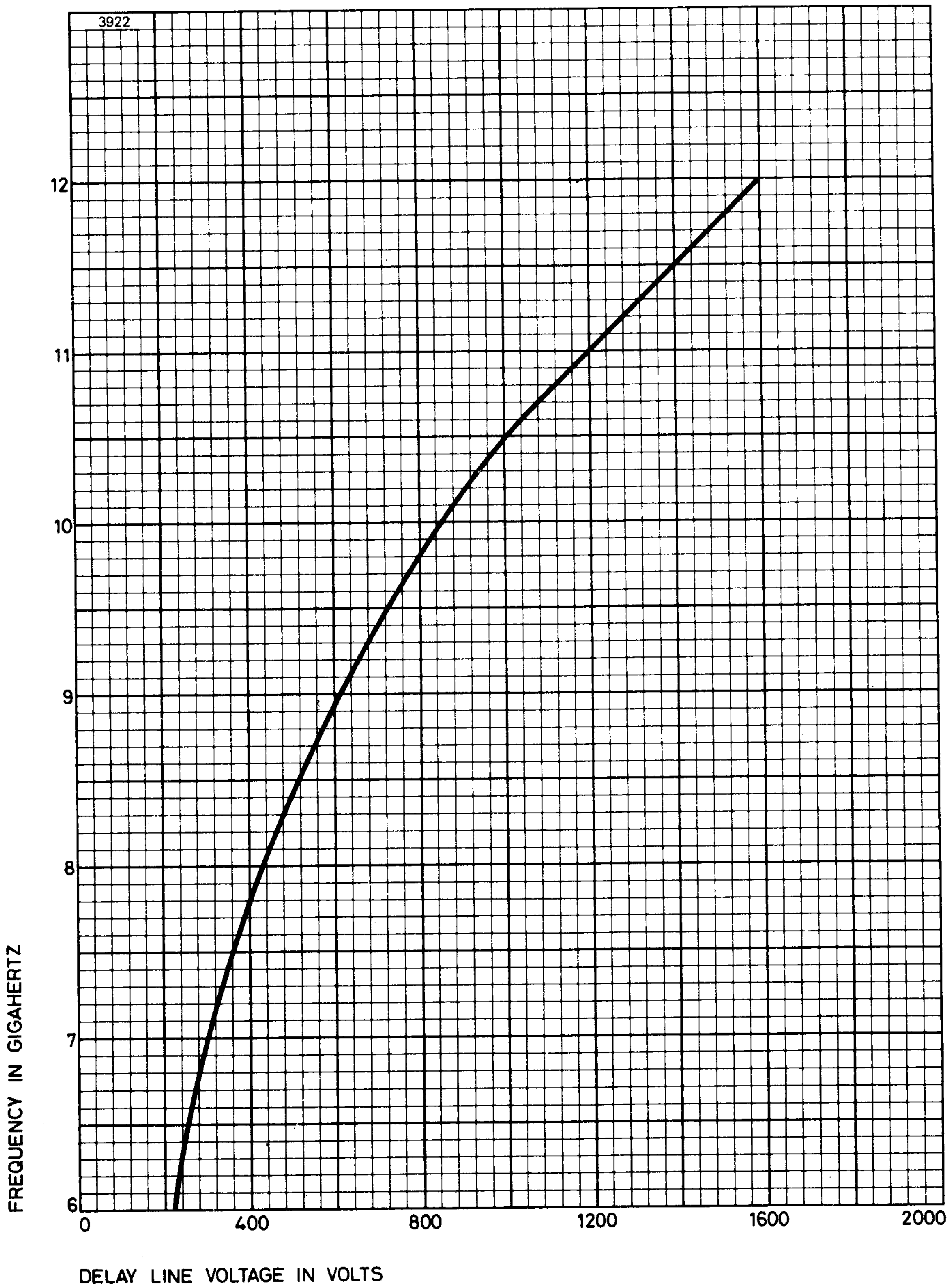
Typical Performance

	Min	Typical	Max	
Heater current	2.0	2.3	2.5	A
Delay line voltage:				
at 7GHz	300	315	350	V
at 9GHz	580	615	700	V
at 11.5GHz	1300	1400	1500	V
Delay line current:				
at 7GHz	–	22	25	mA
at 9GHz	–	25	30	mA
at 11.5GHz	–	33	35	mA
Anode voltage (see note 7)	100	150	200	V
Anode current	–	2.0	10	mA
Solenoid current for N1010S (see note 7)	3.0	4.5	7.0	A
Solenoid voltage	16	23	24	V
Grid cut-off voltage (see note 8)	–	–70	–100	V
Output power:				
at 7GHz	20	40	–	mW
at 9GHz	20	80	–	mW
at 11.5GHz	20	130	–	mW
Frequency pulling (see note 9)	–	6.0	8.0	MHz
Signal to noise ratio (see note 10)	150	155	–	db/Hz

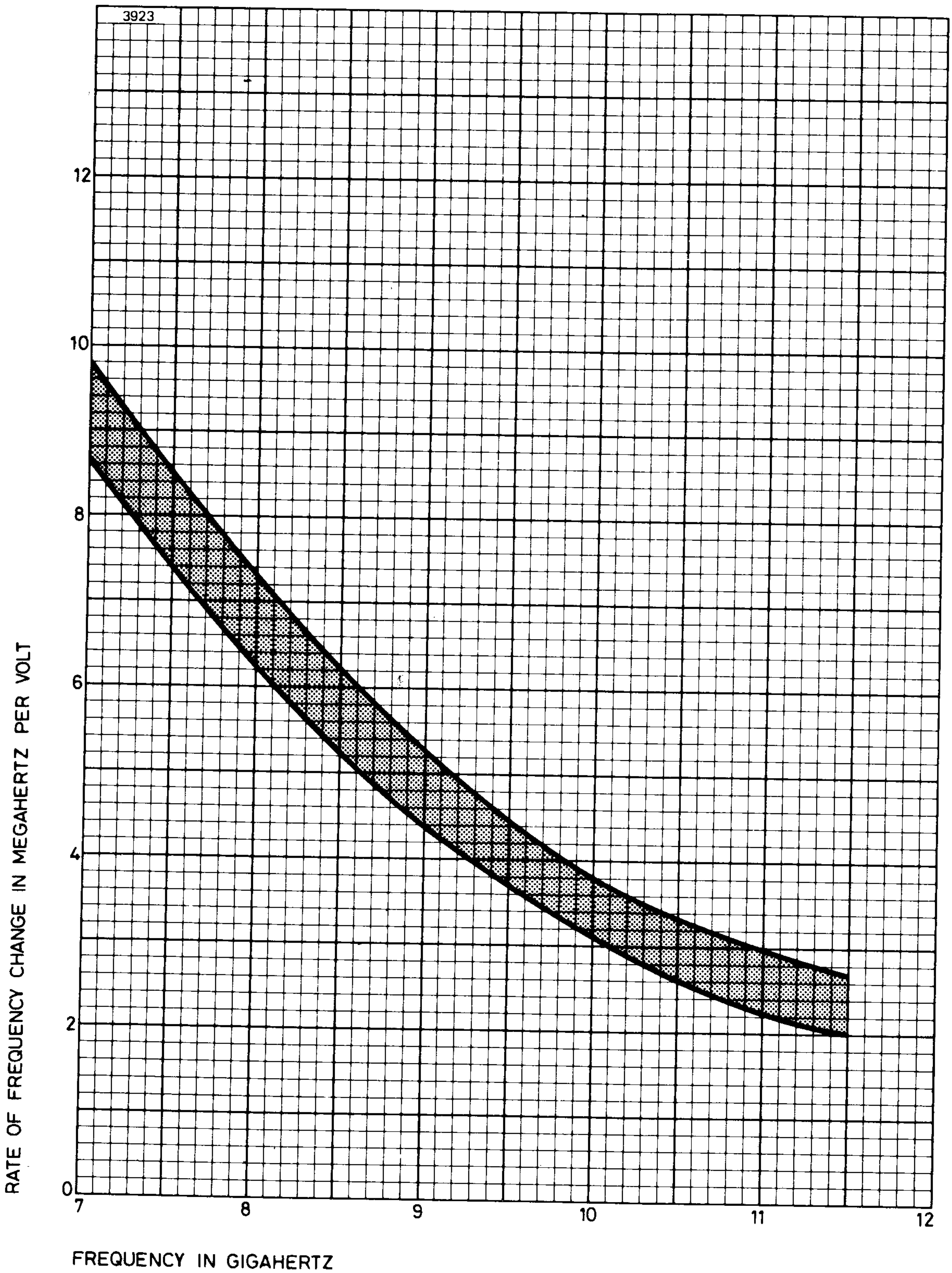
NOTES

1. Any magnetic materials must at all times be kept at least 8 inches (20cm) away from the N1010A, or a permanent loss of performance may result.
2. For the N1010A an airflow of $10ft^3$/min ($0.28m^3$/min) is required, directed at the radiator; for the N1010S $20ft^3$/min ($0.57m^3$/min), directed at the radiator and the sides of the solenoid. The pressure drop is less than 1 inch w.g.
3. All voltages except the heater voltage are with respect to cathode.
4. The grid must never become positive with respect to cathode. For normal c.w. operation the grid is connected to cathode.
5. The delay line and collector are internally connected.
6. Anode voltage must never be applied before the delay line voltage.
7. The optimum anode voltage and solenoid current (for N1010S) are marked on each tube.
8. The grid voltage at which oscillation ceases.
9. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
10. Measured as the ratio of the signal to the average noise in a 10MHz bandwidth, centred at least 20MHz from the carrier. For low noise performance the N1010A should be at least 18 inches (460mm) from any magnetic materials. Either the cathode, anode or delay line should be earthed.

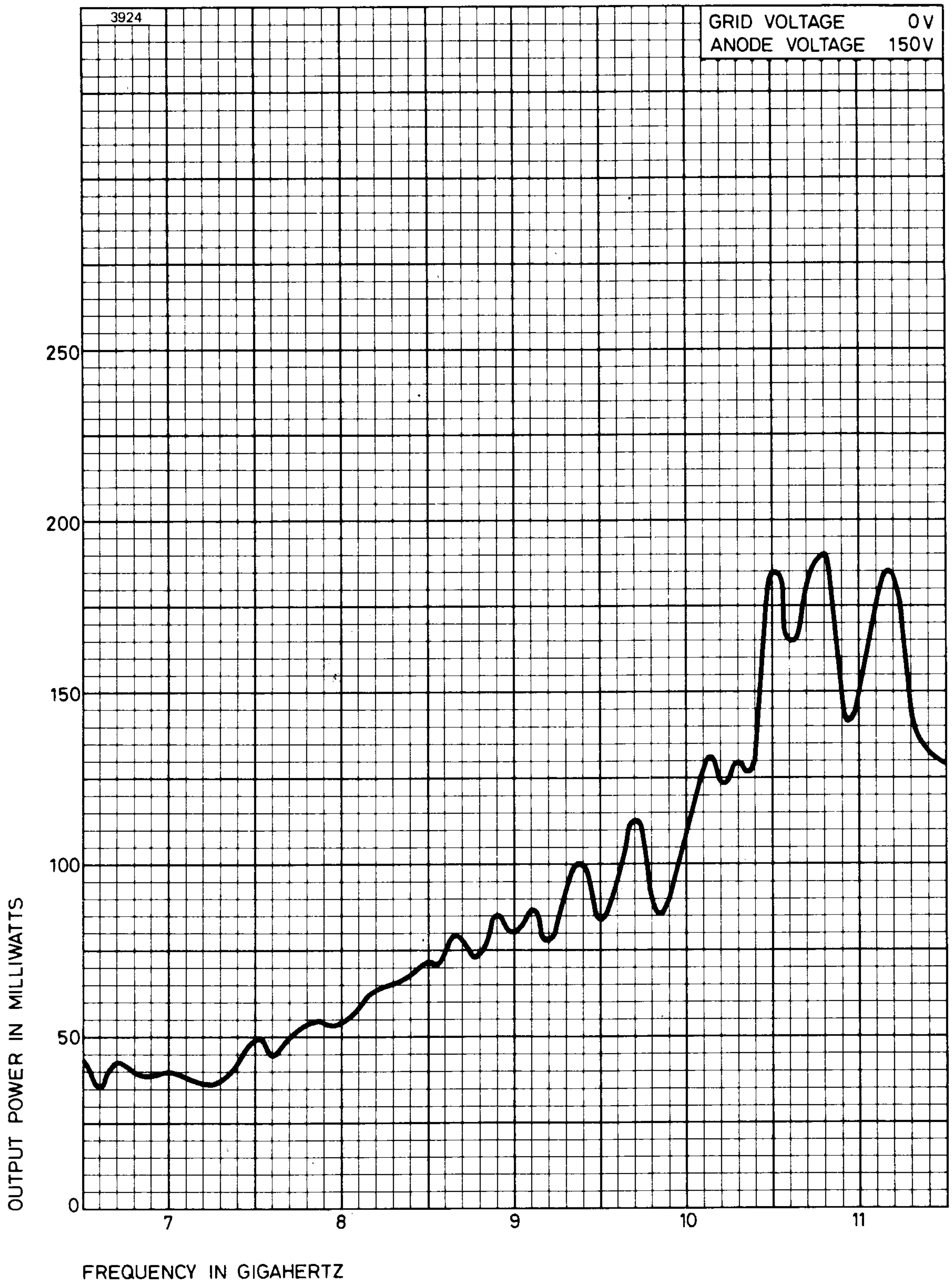
TYPICAL DELAY LINE VOLTAGE CHARACTERISTIC



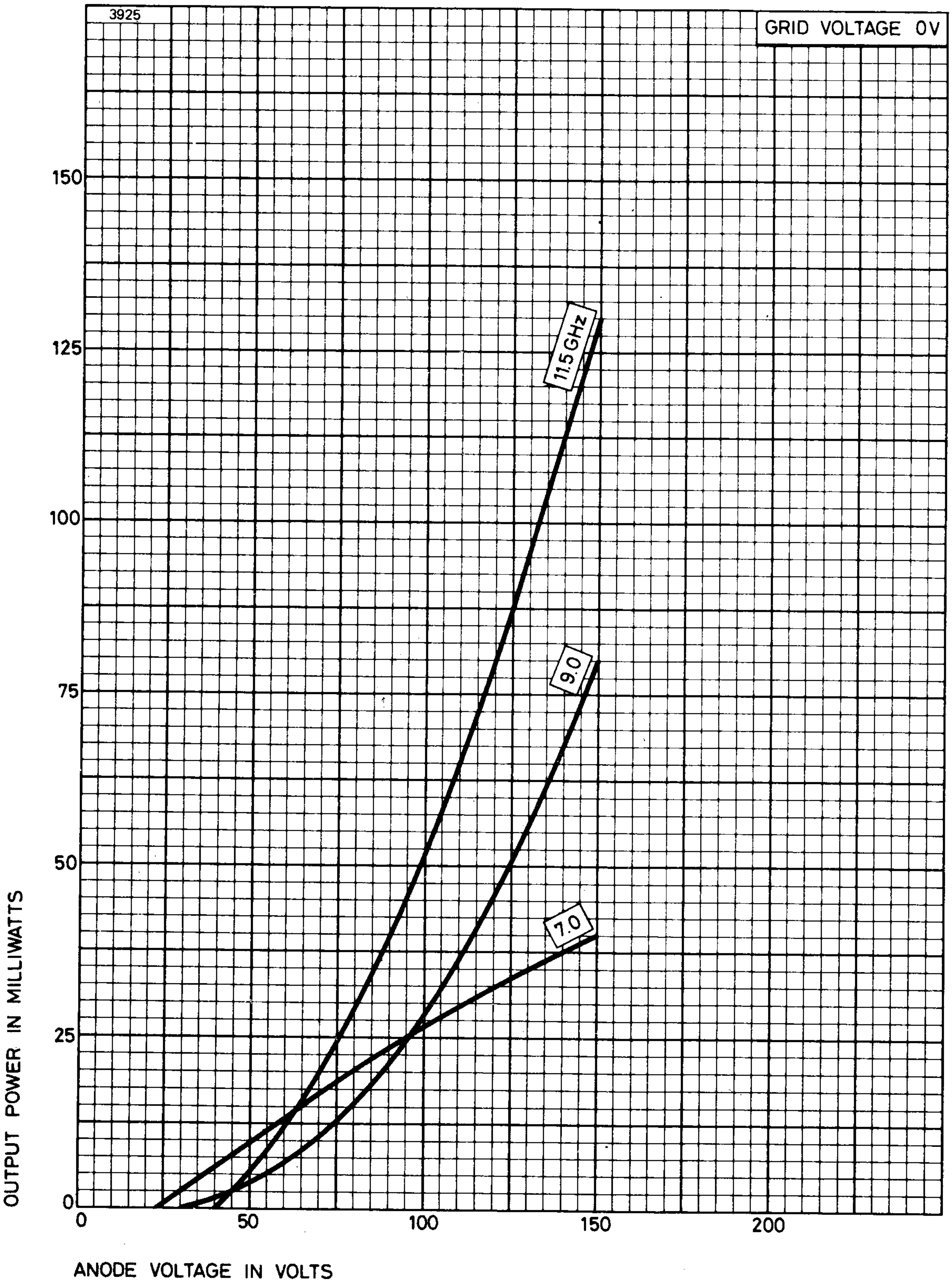
FREQUENCY CHANGE CHARACTERISTIC



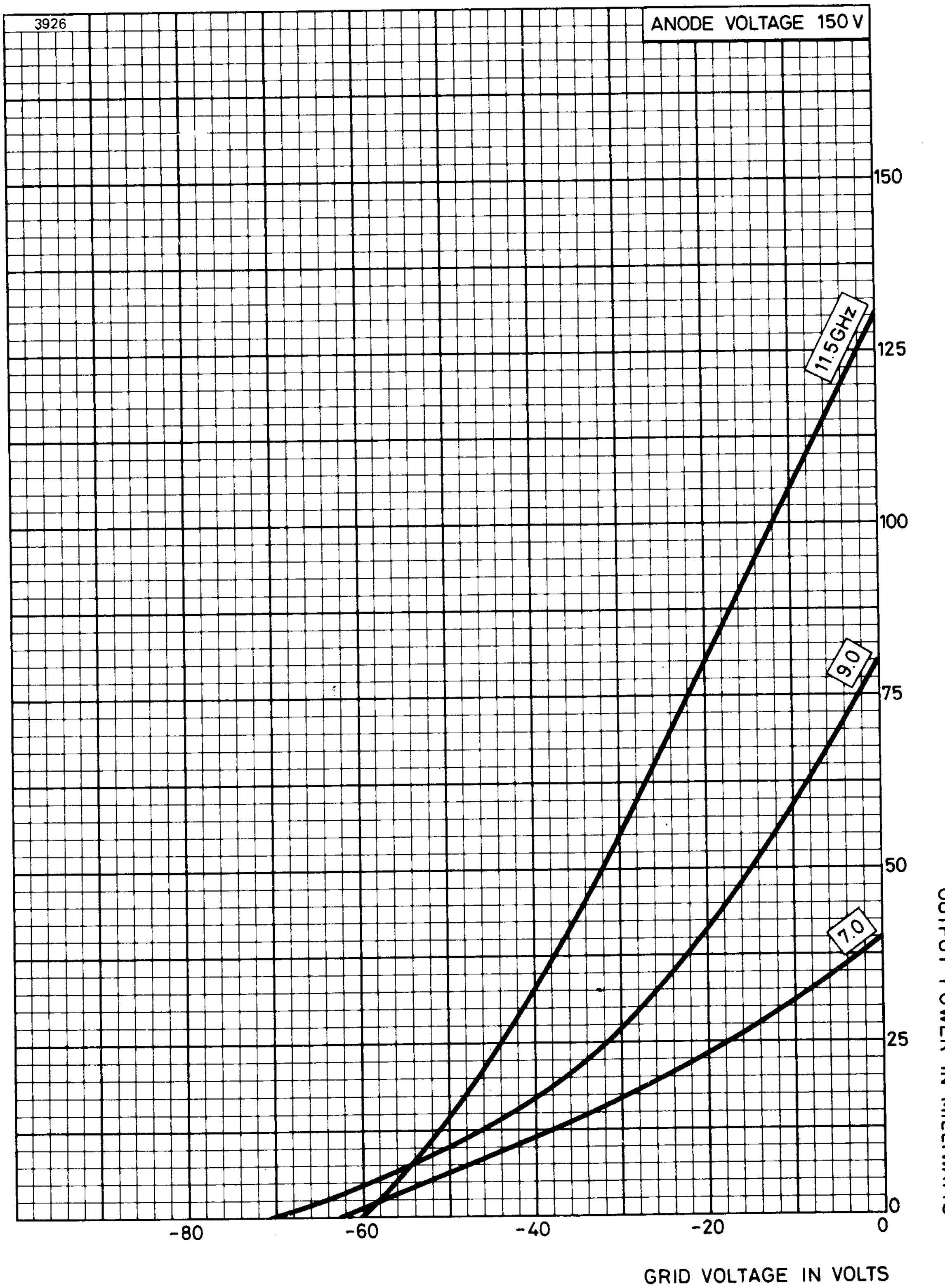
TYPICAL POWER CHARACTERISTIC



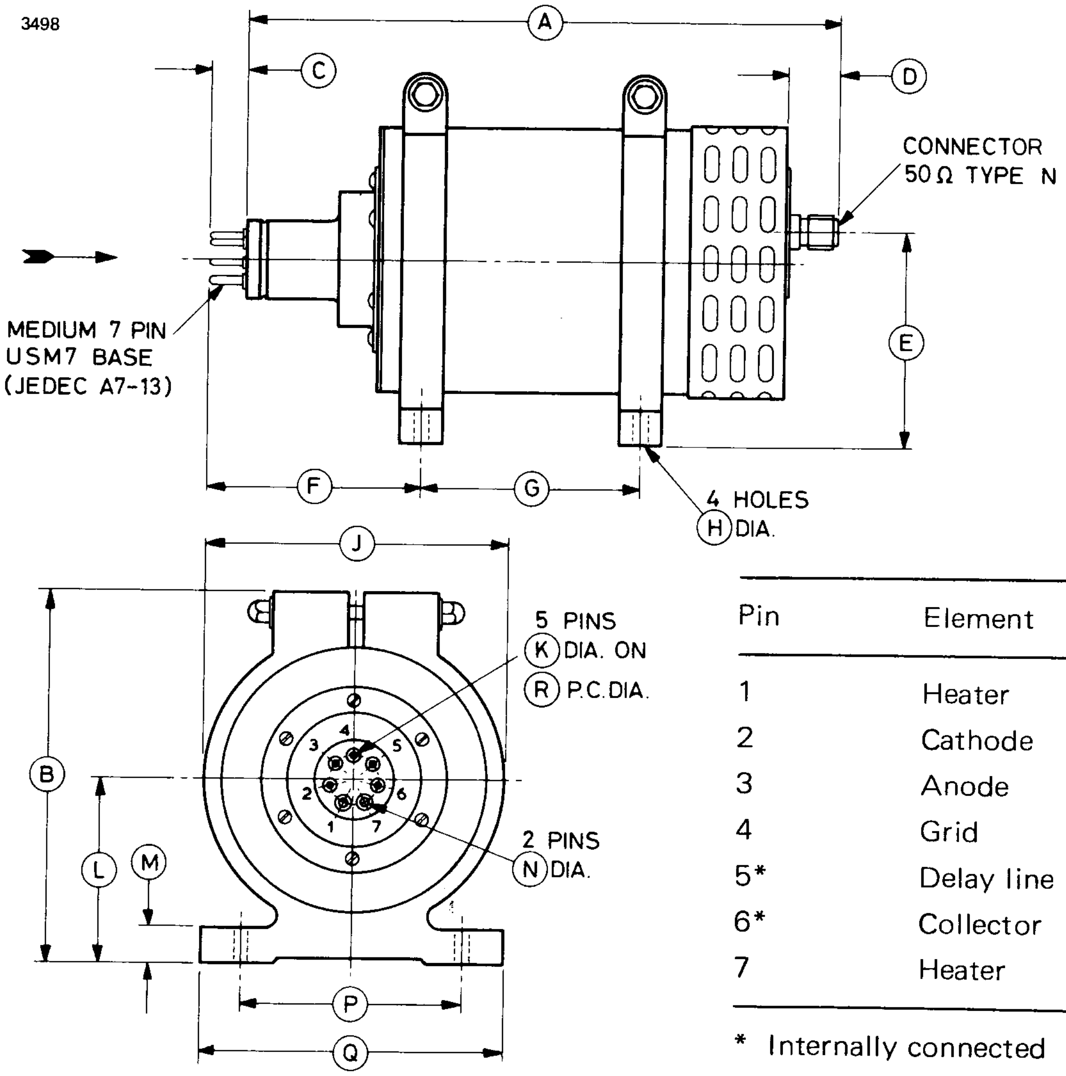
TYPICAL ANODE MODULATION CHARACTERISTICS



TYPICAL GRID MODULATION CHARACTERISTICS



OUTLINE OF N1010A (All dimensions without limits are nominal)



VIEW IN DIRECTION OF ARROW

Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

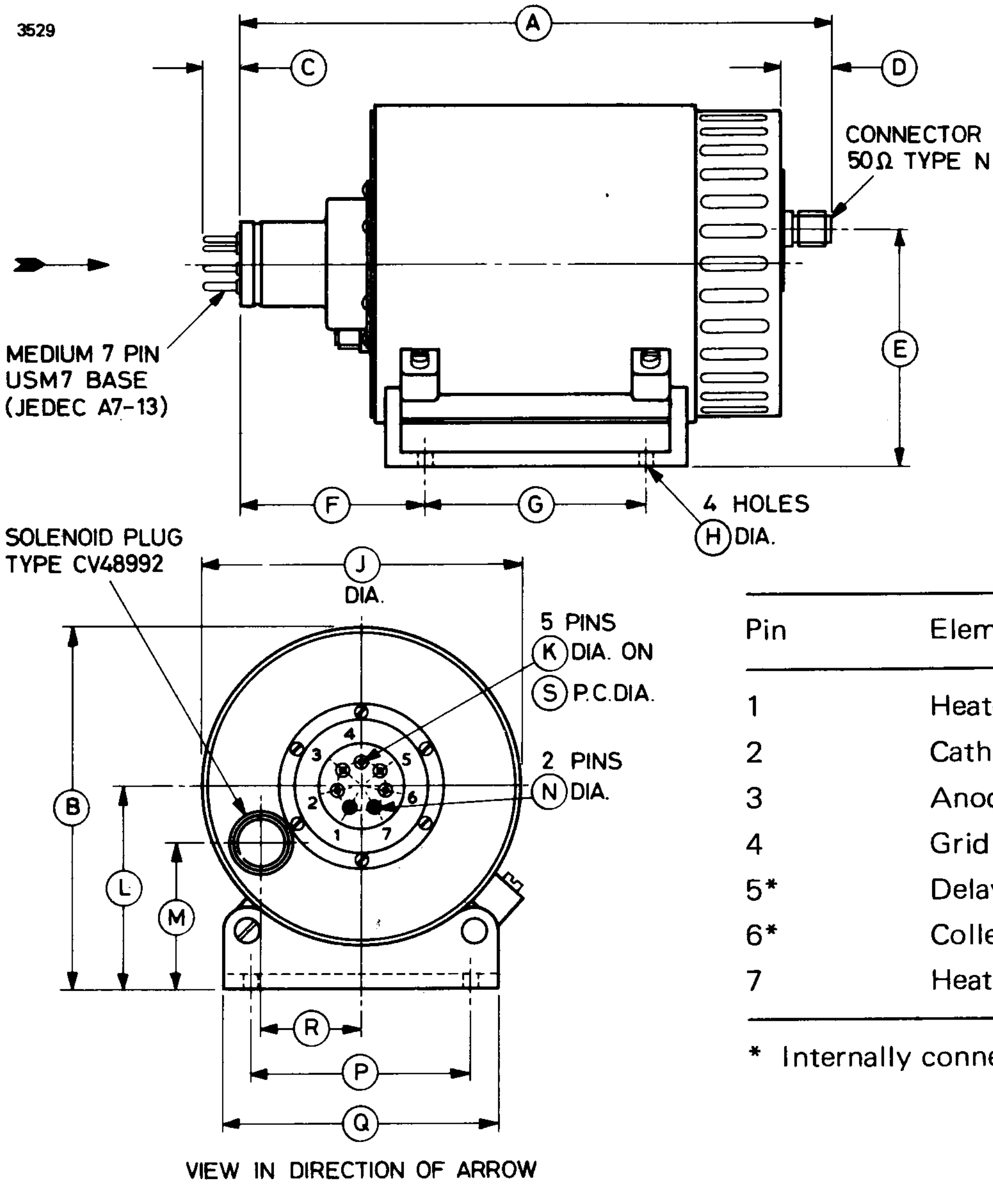
* Internally connected

Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4
B	6.000 max	152.4 max
C	0.625 max	15.88 max
D	0.813	20.65
E	3.504	89.00
F	3.460 ± 0.375	87.88 ± 9.53
G	3.543 ± 0.010	89.99 ± 0.25
H	0.217	5.51

Ref	Inches	Millimetres
J	4.961 ± 0.062	126.0 ± 1.6
K	0.125 ± 0.003	3.175 ± 0.076
L	2.953	75.01
M	0.400	10.16
N	0.156 ± 0.003	3.962 ± 0.076
P	3.543 ± 0.010	89.99 ± 0.25
Q	4.961 ± 0.062	126.0 ± 1.6
R	1.000	25.40

Millimetre dimensions have been derived from inches.

OUTLINE OF N1010S (All dimensions without limits are nominal)



Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4
B	5.860 ± 0.125	148.8 ± 3.2
C	0.625 max	15.88 max
D	0.813	20.65
E	3.801 ± 0.187	96.55 ± 4.75
F	3.000 ± 0.250	76.20 ± 6.35
G	3.543 ± 0.010	89.99 ± 0.25
H	0.218	5.54
J	5.181 ± 0.015	131.6 ± 0.4

Ref	Inches	Millimetres
K	0.125 ± 0.003	3.175 ± 0.076
L	3.270 ± 0.031	83.06 ± 0.79
M	2.343 ± 0.187	59.51 ± 4.75
N	0.156 ± 0.003	3.962 ± 0.076
P	3.543 ± 0.010	89.99 ± 0.25
Q	4.500 ± 0.031	114.3 ± 0.8
R	1.606 ± 0.187	40.79 ± 4.75
S	1.000	25.40

Millimetre dimensions have been derived from inches.

N1034A N1034S

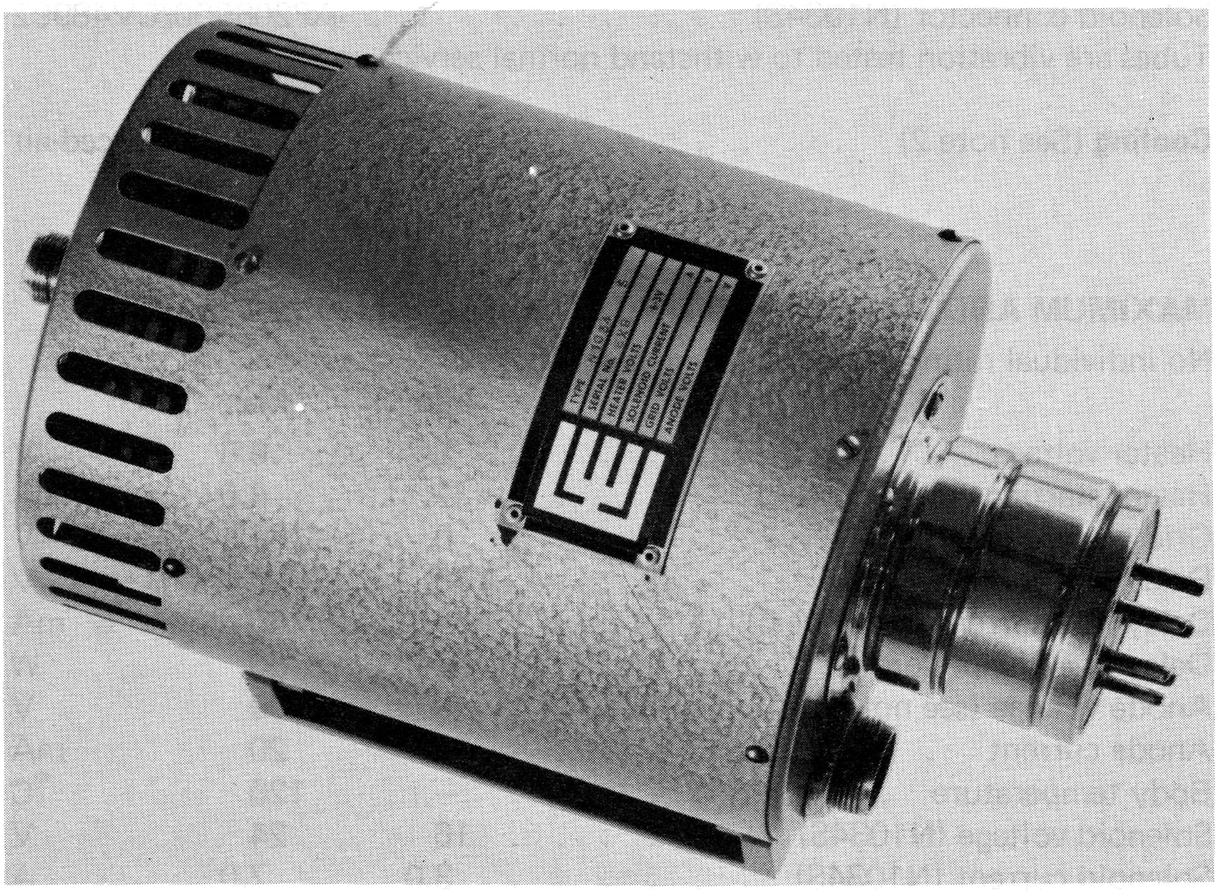
BACKWARD WAVE OSCILLATORS

Service types CV2381 (N1034A), CV6023 (N1034S)

ABRIDGED DATA

O-type backward wave oscillators for wide band microwave receivers and oscillators, suitable for pulse or amplitude modulation.

Frequency range	2.4 to 4.5	GHz
Typical output power over band	90 to 400	mW
Integral focusing:		
N1034A		permanent magnet
N1034S		solenoid
Output connector		50Ω type N coaxial



August 1973

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	2.4	A
Cathode pre-heating time (minimum)	2.0	min
Inter-electrode capacitances:		
cathode to grid, anode and delay line	10	pF
grid to cathode, anode and delay line	15	pF
anode to cathode, grid and delay line	15	pF
delay line to cathode, grid and anode	10	pF
delay line to outer shell	300	pF
Solenoid power supply (N1034S)	24V, 4A	d.c.

Mechanical

Overall dimensions	see outline drawings
Net weight	11 pounds (5kg) approx
Mounting position (see note 1)	any
Base	B.S.448-B7D (JEDEC A7-17)
R.F. output connector	50Ω type N
Solenoid connector (N1034S)	AP208600/CV48992

Tubes are vibration tested to withstand normal service conditions.

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

MAXIMUM AND MINIMUM RATINGS (Absolute values) (See note 3)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.8	V
Heater starting current (peak)	–	4.0	A
Grid voltage (see note 4)	0	–150	V
Delay line voltage	150	1500	V
Delay line current (see note 5)	–	50	mA
Delay line dissipation	–	50	W
Anode voltage (see note 6)	–	200	V
Anode current	–	20	mA
Body temperature	–	120	°C
Solenoid voltage (N1034S)	16	24	V
Solenoid current (N1034S)	3.0	7.0	A

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions (See note 3)

Heater voltage	6.3	V
Grid voltage	0	V
Load v.s.w.r.	1.2:1	max

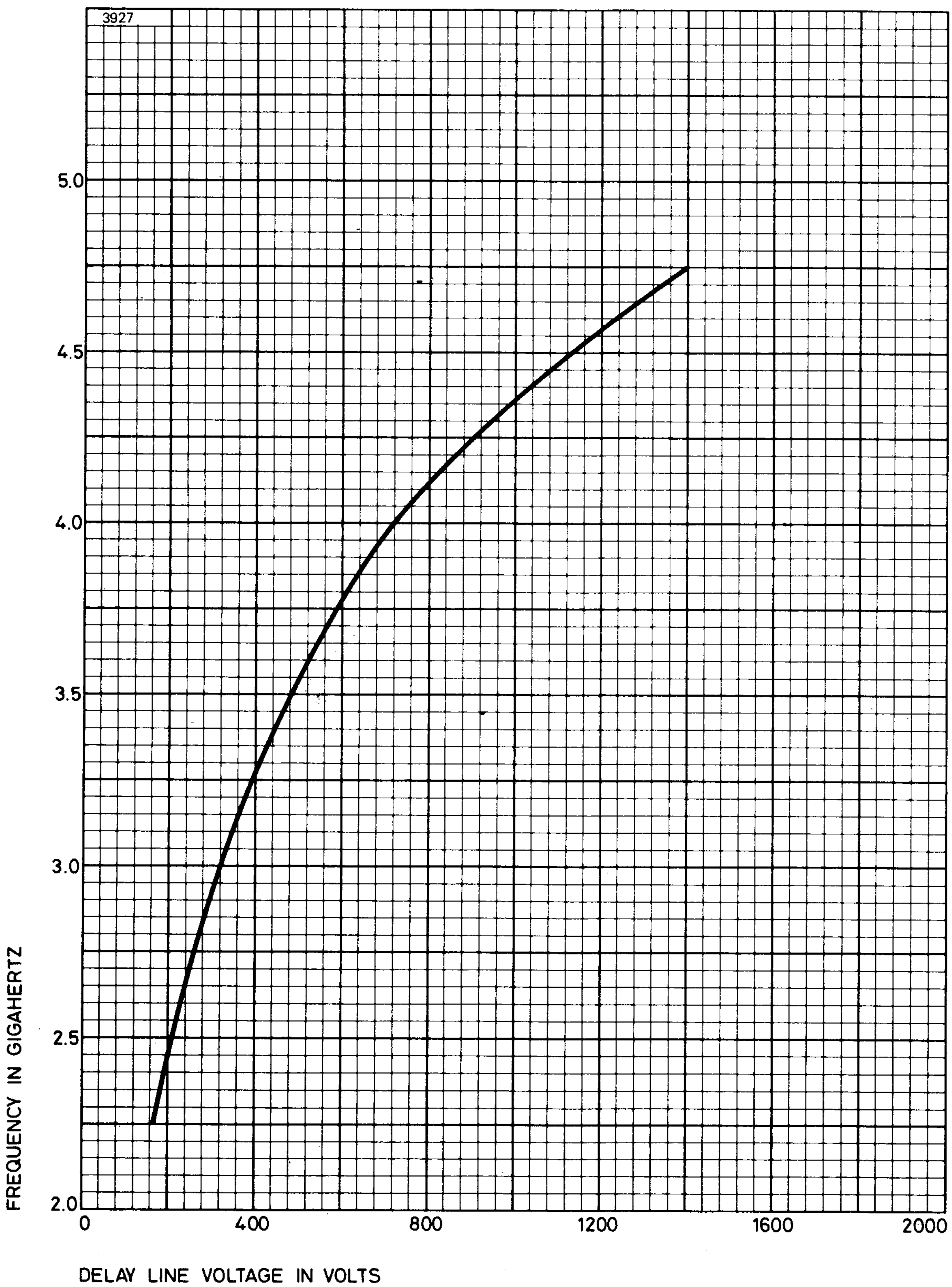
Typical Performance

	Min	Typical	Max	
Heater current	2.1	2.4	2.6	A
Delay line voltage:				
at 2.4GHz	150	190	200	V
at 2.6GHz	180	225	235	V
at 3.4GHz	400	440	460	V
at 4.5GHz	1030	1130	1170	V
Delay line current:				
at 2.4GHz	16	35	40	mA
at 2.6GHz	–	36	–	mA
at 3.4GHz	30	38	50	mA
at 4.5GHz	30	45	50	mA
Anode voltage (see note 7) . .	100	150	200	V
Anode current	–	3.0	20	mA
Solenoid current for N1034S (see note 7)	3.0	4.0	7.0	A
Solenoid voltage	16	21	24	V
Grid cut-off voltage (see note 8) .	–	–50	–100	V
Output power:				
at 2.4GHz	20	90	–	mW
at 2.6GHz	50	160	–	mW
at 3.4GHz	150	340	–	mW
at 4.5GHz	250	400	–	mW
Frequency pulling (see note 9) . .	–	6.0	7.0	MHz
Signal to noise ratio (see note 10)	150	155	–	db/Hz

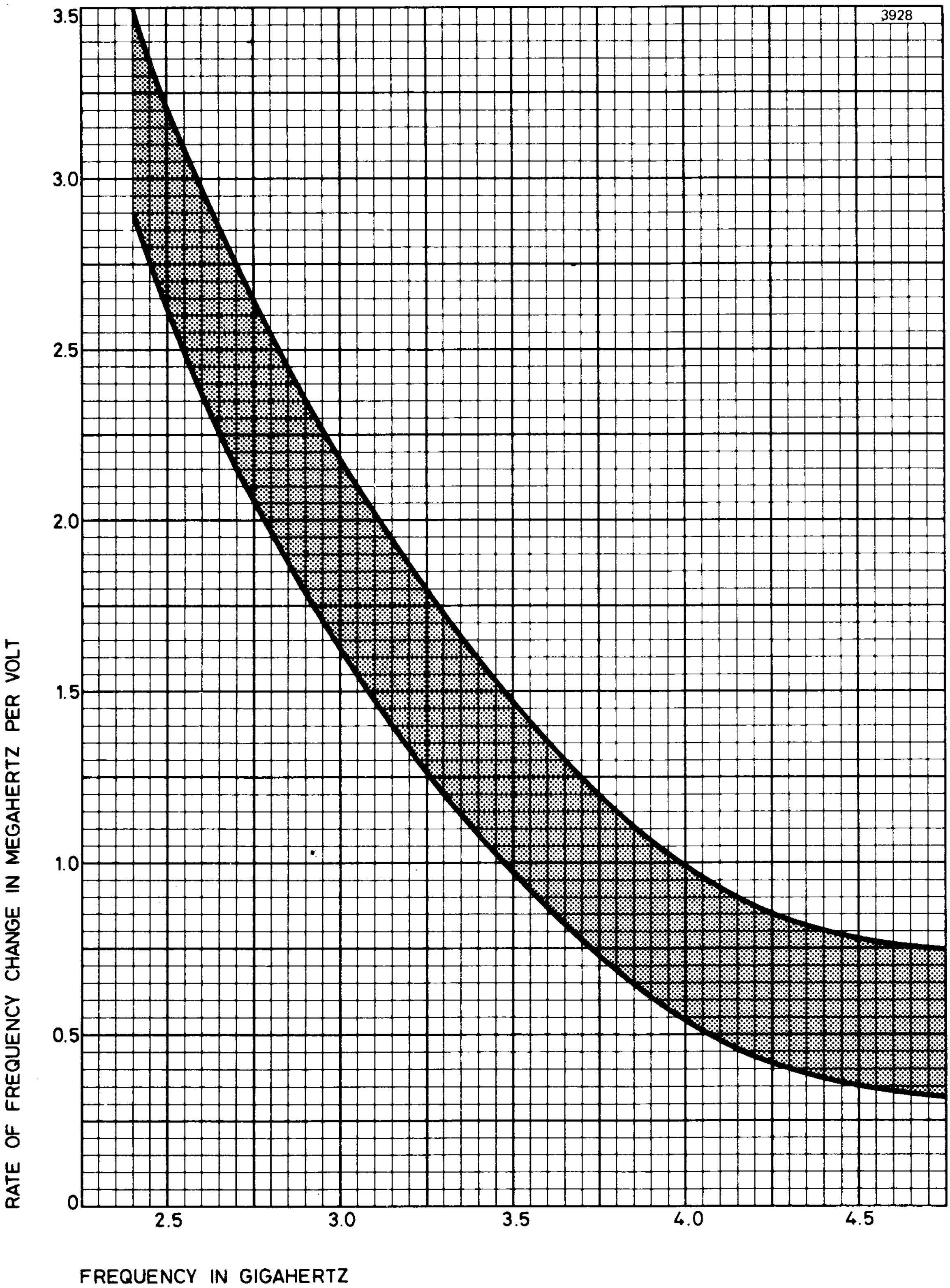
NOTES

1. Any magnetic materials must at all times be kept at least 8 inches (20cm) away from the N1034A, or a permanent loss of performance may result.
2. For the N1034A an airflow of $10ft^3/min$ ($0.28m^3/min$) is required, directed at the radiator; for the N1034S $20ft^3/min$ ($0.57m^3/min$), directed at the radiator and the sides of the solenoid. The pressure drop is less than 1 inch w.g.
3. All voltages except the heater voltage are with respect to cathode.
4. The grid must never become positive with respect to cathode. For normal c.w. operation the grid is connected to cathode.
5. The delay line and collector are internally connected.
6. Anode voltage must never be applied before the delay line voltage.
7. The optimum anode voltage and solenoid current (for N1034S) are marked on each tube.
8. The grid voltage at which oscillation ceases.
9. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
10. Measured as the ratio of the signal to the average noise in a 10MHz bandwidth, centred at least 20MHz from the carrier. For low noise performance the N1034A should be at least 18 inches (460mm) from any magnetic materials. Either the cathode, anode or delay line should be earthed.

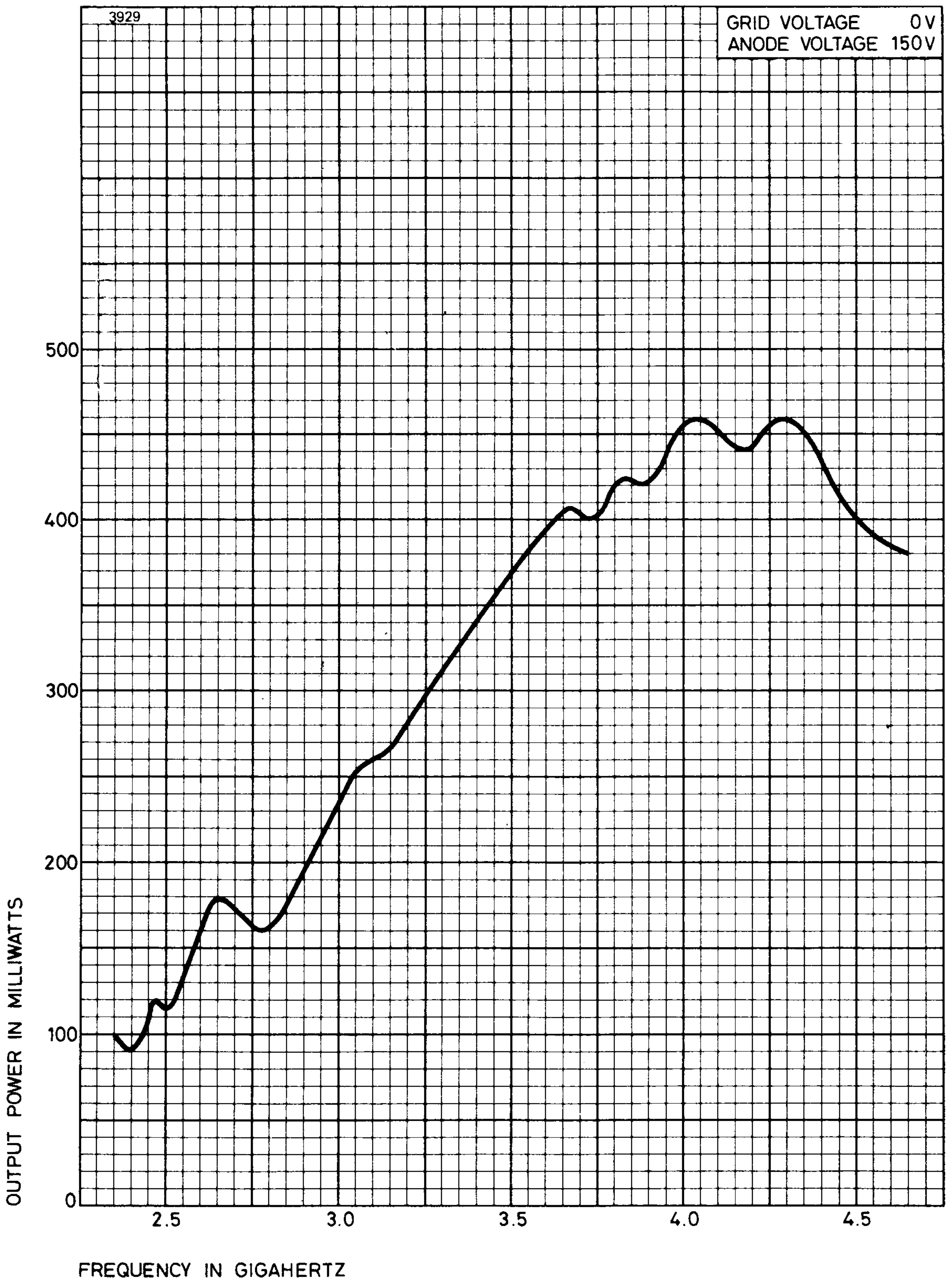
TYPICAL DELAY LINE VOLTAGE CHARACTERISTIC



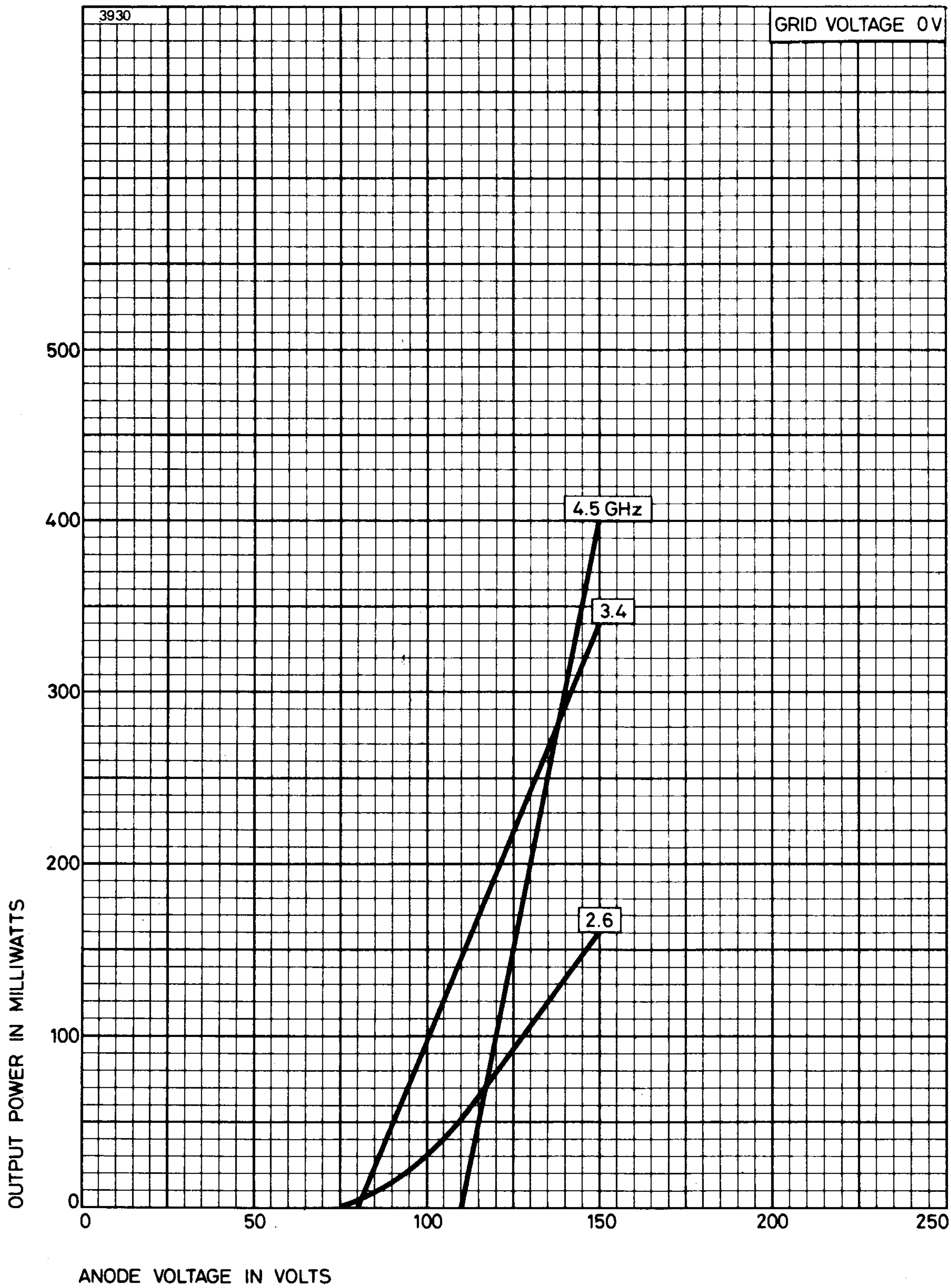
FREQUENCY CHANGE CHARACTERISTIC



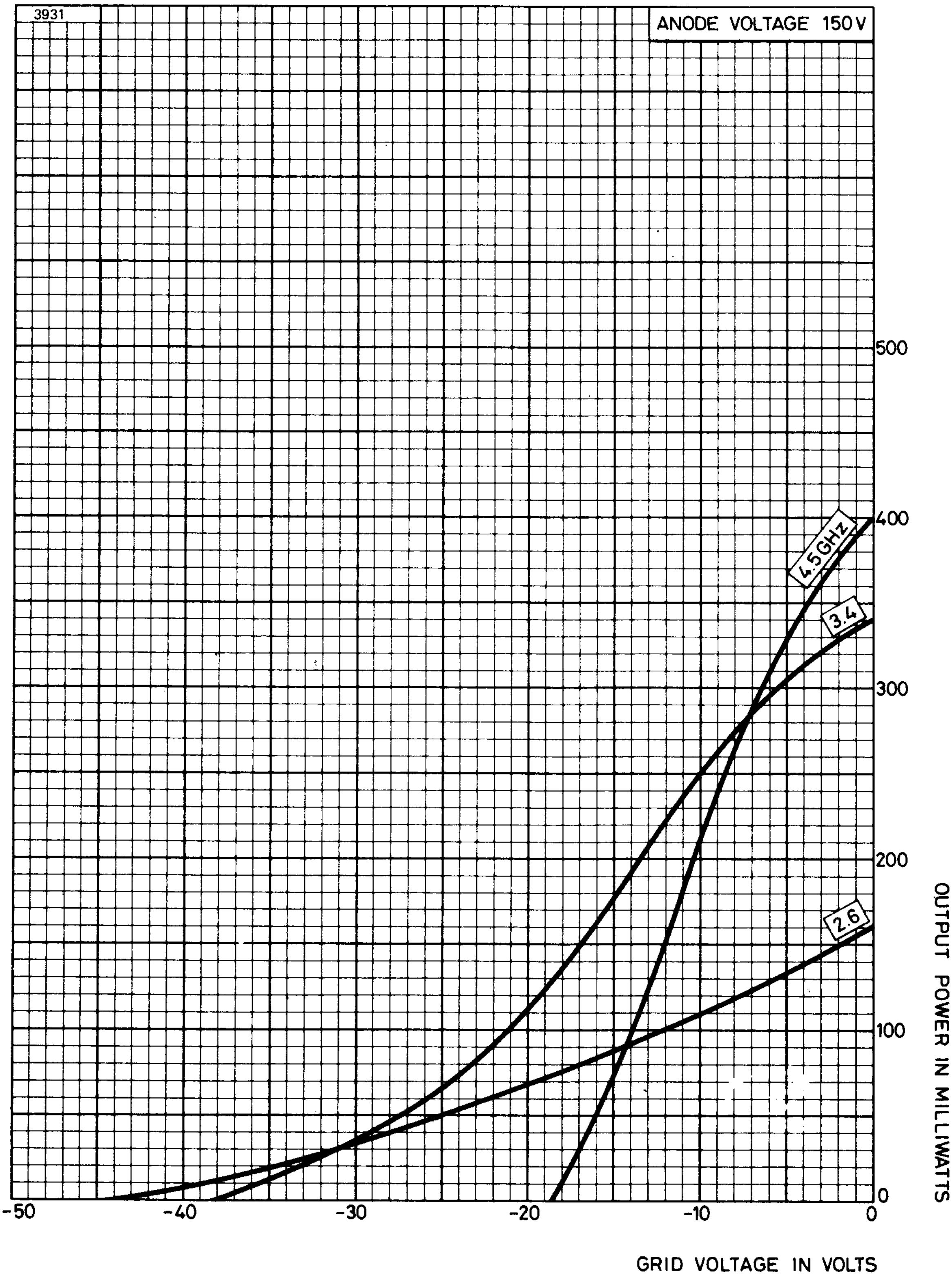
TYPICAL POWER CHARACTERISTIC



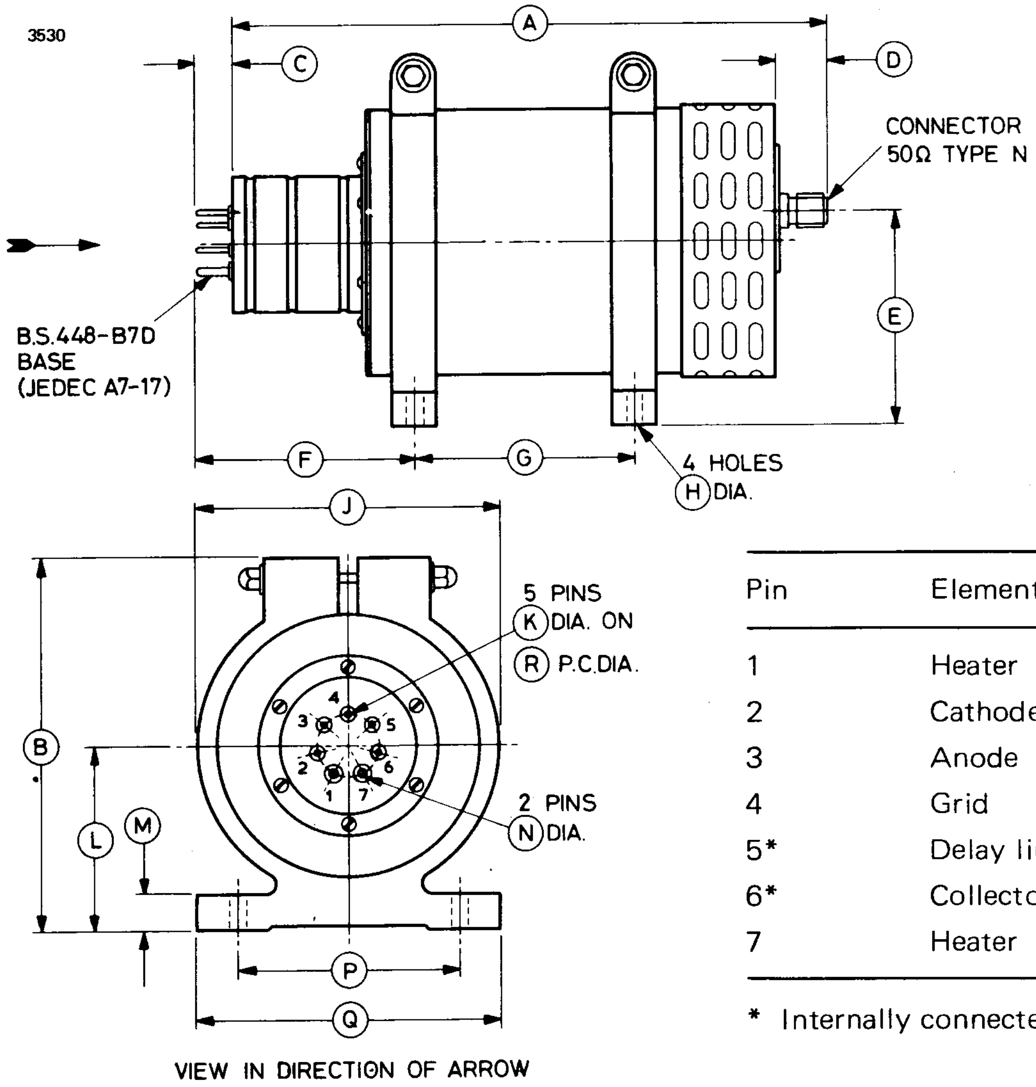
TYPICAL ANODE MODULATION CHARACTERISTICS



TYPICAL GRID MODULATION CHARACTERISTICS



OUTLINE OF N1034A (All dimensions without limits are nominal)



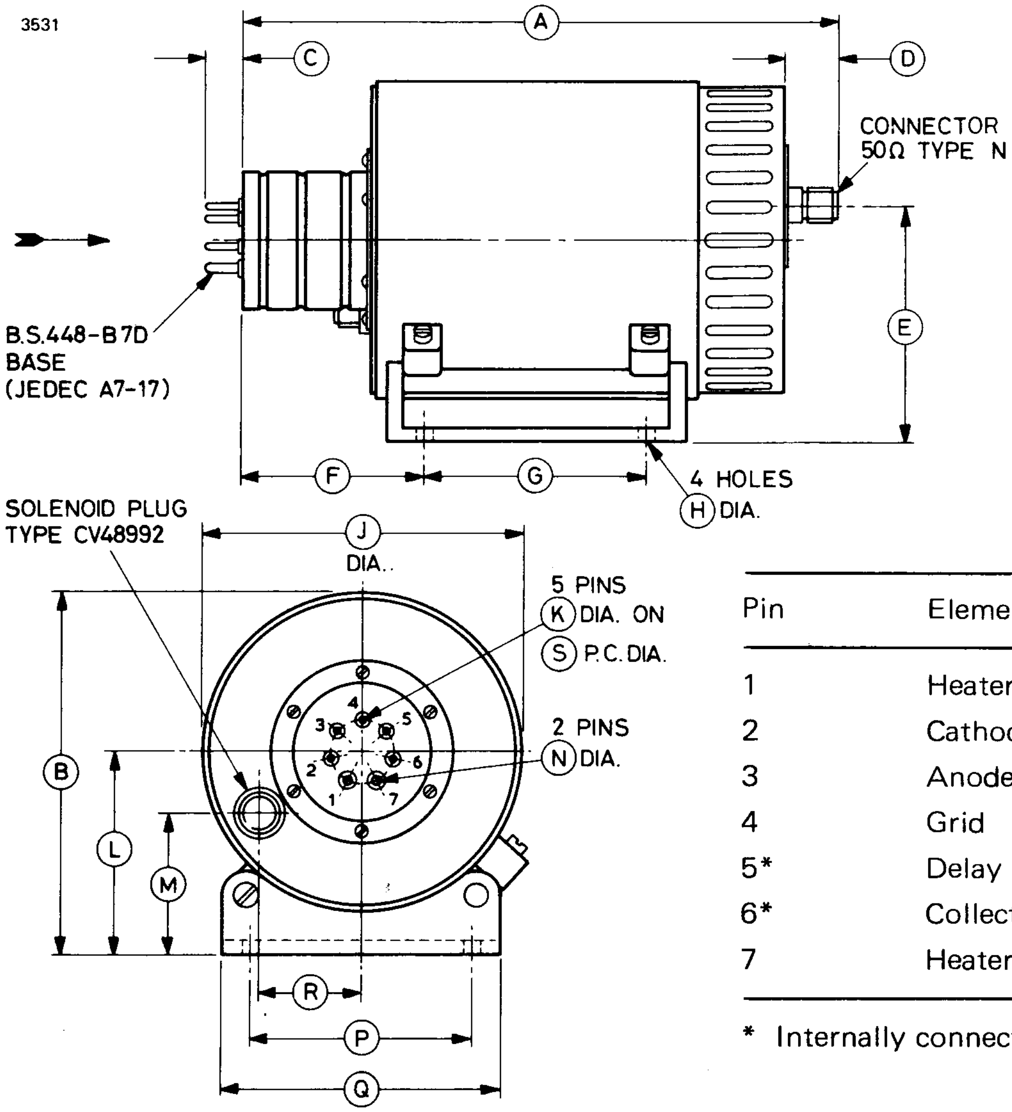
Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4	J	4.961 ± 0.062	126.0 ± 1.6
B	6.000 max	152.4 max	K	0.125 ± 0.003	3.175 ± 0.076
C	0.625 max	15.88 max	L	2.953	75.01
D	0.813	20.65	M	0.400	10.16
E	3.504	89.00	N	0.156 ± 0.003	3.962 ± 0.076
F	3.460 ± 0.375	87.88 ± 9.53	P	3.543 ± 0.010	89.99 ± 0.25
G	3.543 ± 0.010	89.99 ± 0.25	Q	4.961 ± 0.062	126.0 ± 1.6
H	0.217	5.51	R	1.000	25.40

Millimetre dimensions have been derived from inches.

OUTLINE OF N1034S (All dimensions without limits are nominal)



VIEW IN DIRECTION OF ARROW

Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4	K	0.125 ± 0.003	3.175 ± 0.076
B	5.860 ± 0.125	148.8 ± 3.2	L	3.270 ± 0.031	83.06 ± 0.79
C	0.625 max	15.88 max	M	2.343 ± 0.187	59.51 ± 4.75
D	0.813	20.65	N	0.156 ± 0.003	3.962 ± 0.076
E	3.801 ± 0.187	96.55 ± 4.75	P	3.543 ± 0.010	89.99 ± 0.25
F	3.000 ± 0.250	76.20 ± 6.35	Q	4.500 ± 0.031	114.3 ± 0.8
G	3.543 ± 0.010	89.99 ± 0.25	R	1.606 ± 0.187	40.79 ± 4.75
H	0.218	5.54	S	1.000	25.40
J	5.181 ± 0.015	131.6 ± 0.4			

Millimetre dimensions have been derived from inches.

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