

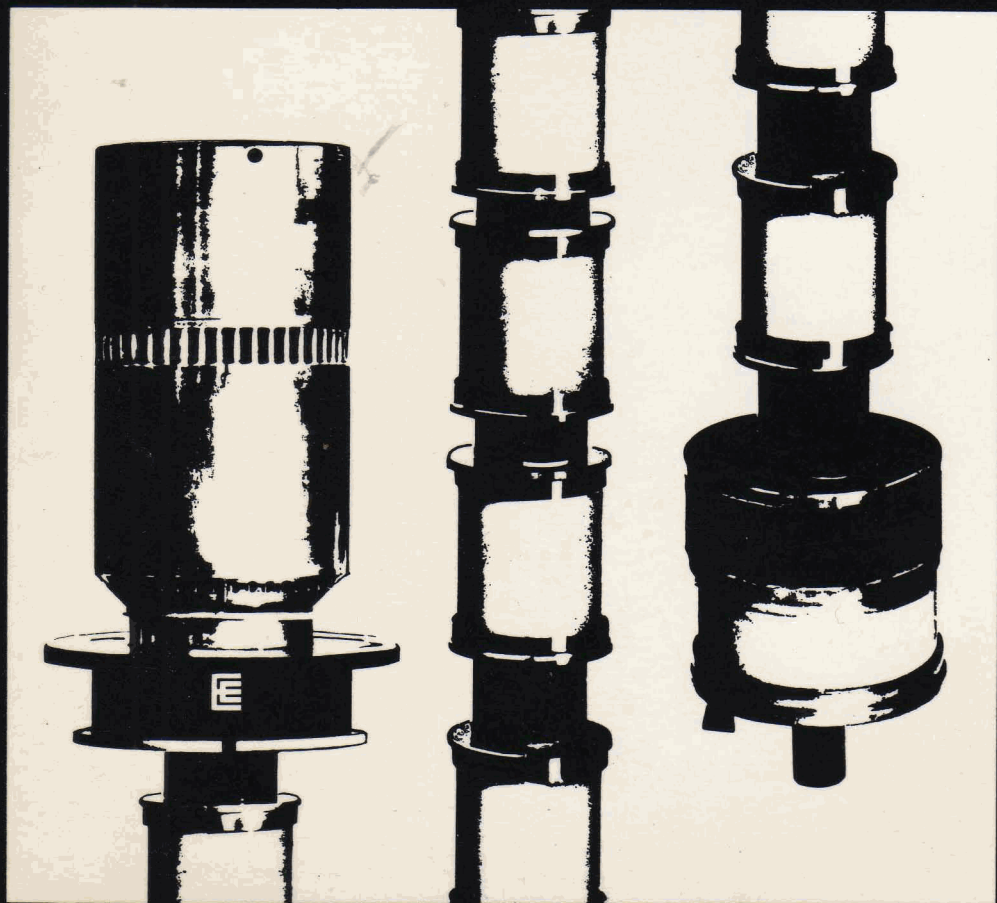
ENGLISH
ELECTRIC
VALVE
CO LTD



Product
Data

Amplifier Klystrons

1972



English Electric Valve Company Limited is a member of
THE GEC ELECTRONIC TUBE COMPANY LIMITED, a management company
which unites the activities of:

The M-O Valve Company Limited, Brook Green Works, Hammersmith, London W6 7PE
Telephone: 01 603-3431 Telex: 23435 Cables: Thermionic London

English Electric Valve Company Limited, Waterhouse Lane, Chelmsford, Essex. CM1 2QU
Telephone: Chelmsford (0245) 61777 Telex: 99103 Cables: Enelectico, Chelmsford.

**QUICK REFERENCE TABLES
AND EQUIVALENTS INDEX**



**CW AMPLIFIER KLYSTRONS
FOR TELEVISION SERVICE**



**CW AMPLIFIER KLYSTRONS FOR
TROPOSPHERIC SCATTER SERVICE**



PULSE AMPLIFIER KLYSTRONS



**OVERSEAS REPRESENTATIVES
AND DISTRIBUTORS**



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

- **IGNITRONS**
RECTIFIERS
INDUSTRIAL THYRATRONS
VOLTAGE STABILIZERS
OTHER PRODUCTS
- **TRIODES**
- **TETRODES AND PENTODE**
- **MODULATORS**
 Hydrogen Thyratrons
 Pulse Tetrodes
- **MAGNETRONS**
- **AMPLIFIER KLYSTRONS**
- **OSCILLATOR KLYSTRONS**
TRAVELLING WAVE TUBES
BACKWARD WAVE OSCILLATORS
- **DUPLEXER DEVICES**
MONITOR DIODES
NOISE TUBES
- **LIGHT CONVERSION DEVICES**
 Television Camera Tubes
 Storage Cathode Ray Tubes
 Laser and Flash Tubes
 Glow Modulators
- **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

AMPLIFIER KLYSTRONS

C.W. AMPLIFIER KLYSTRONS For Television Service

EEV type	Tuning range (MHz)	Sat. output power \ddagger (kW)	Cooling (see below)	Circuit assembly	Page number
K365	400-610	11	1,2	K4019A	11
K370	470-606	11.5	1,3	K4145	21
K371	606-742	12.0	1,3	K4146	21
K372	742-854	11.8	1,3	K4147	21
K376	470-610	28	1,2	K4054	41
K377	590-720	28	1,2	K4055	41
K383	470-610	6.2	1	K4140	57
K384	590-720	6.1	1	K4141	57
K385	700-860	6.1	1	K4142	57
K3004	470-610	7.5	1,3	K4145	77
K3005	590-720	7.5	1,3	K4146	77
K3006	700-860	7.6	1,3	K4147	77
K3014	470-610	28	1,2,3	K4102BDS	97
K3015	590-720	28	1,2,3	K4103BDS	97
K3016	700-860	28	1,2,3	K4104BDS	97

Continued on page 2

Perveance of K365 is 1×10^{-6} ; perveance of other types listed above is 2×10^{-6} .

\ddagger At klystron output flange; bandwidth 8MHz (K365 6MHz).

Cooling

- 1 Forced-air cooled.
- 2 Water cooled.
- 3 Vapour cooled.

TELEVISION AMPLIFIERS – continued

EEV type	Tuning range (MHz)	Sat. output power ‡ (kW)	Cooling (see below)	Circuit assembly	Page number
K3017	470–610	45	1,2,3	K4102BDS	123
K3018	590–720	45	1,2,3	K4103BDS	123
K3019	700–860	45	1,2,3	K4104BDS	123
		28			
K3082	470–610	45	1,2,3	K4102BDS	147
		28			
K3083	590–720	45	1,2,3	K4103BDS	147
		28			
K3084	700–860	45	1,2,3	K4104BDS	147

Perveance of types listed above is 2×10^{-6} .

C.W. AMPLIFIER KLYSTRONS For Tropospheric Scatter Service

EEV type	Tuning range (MHz)	Output power † (kW)	Cooling (see below)	Circuit assembly	Page number
3K3000LQ	610–985	2.8	1	—	173
3K50,000LF	570–720	10.7	1,2	—	177
4KM50,000LQ	610–985	10.5	1,2	—	181
4KM50,000LR	755–985	12	1,2	—	189
K386	755–985	11.5*	1,3	K4148	197

Perveance of K386 is 2×10^{-6} ; perveance of other types listed above is 1×10^{-6} .

‡ At klystron output flange; bandwidth 8MHz.

† Narrow band operation.

* At klystron output flange.

Cooling	1	Forced-air cooled.
	2	Water cooled.
	3	Vapour cooled.

PULSE AMPLIFIER KLYSTRONS

EEV type	Tuning range (MHz)	Output power (peak) (kW)	Gain (db)	Cooling (see below)	Focus mount	Page number
211	2998 ± 5 Fixed	7000	32	1,2	Integral	211
247A	580—615	600	33	1	—	219
290	2998 ± 5 Fixed	8000	42	1,2	K4001	231

- 1 Forced-air cooled.
- 2 Water cooled.

page 8 for Equivalents Index

EQUIVALENTS INDEX

AMPLIFIER KLYSTRONS

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
3K3000LQ	3K3000LQ	K383	K383
3K50,000LF	3K50,000LF	K384	K384
4KM100LA*	K376	K385	K385
4KM100LF*	K377	K386	K386
4KM50,000LA3*	K365	K390	K390
4KM50,000LQ	4KM50,000LQ	K3004	K3004
4KM50,000LR	4KM50,000LR	K3005	K3005
K211	K211	K3006	K3006
K347	K347A	K3014	K3014
K347A	K347A	K3015	K3015
K352	K390	K3016	K3016
K352B	K390	K3017	K3017
K365	K365	K3018	K3018
K370	K370	K3019	K3019
K371	K371	K3082	K3082
K372	K372	K3083	K3083
K376	K376	K3084	K3084
K377	K377	YK1000*	K365

* Near equivalent



**CW Amplifier Klystrons
for Television Service**



AMPLIFIER KLYSTRON

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystron, with separate tuning cavities, for u.h.f. television service. The collector is water cooled in an integral water jacket. A modulating anode is fitted which may be used for beam current control or as a protective device.

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range	400 to 610	MHz
Output power (peak sync.)	11	kW
Power gain (typical, 6.0MHz bandwidth)	30	db
Beam voltage	17	kV
Circuit assembly		K4019A
Output	3 ¹ / ₈ inch	50Ω coaxial line
Cooling (see page 2)		water and forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	7.5	V
Heater current range	38 to 42	A
Heater starting current (peak)	80	A max

Mechanical

Overall length	62.5 inches (159cm)	nom
Overall diameter	5.125 inches (13cm)	nom
Mounting position		vertical, cathode end up
Net weight of klystron	64 pounds (29kg)	approx

Circuit Assembly

Prefocus coil voltage	0 to 50	V
Prefocus coil current:		
maximum	1.5	A
typical	1.0	A
Body and collector coils voltage:		
range	0 to 600	V
typical	500	V
Body and collector coils current (typical)	2.6	A
R.F. input connector	UG-58/U	
R.F. output	3 ¹ / ₈ inch 50Ω coaxial line	
Load couplers	1 ⁵ / ₈ inch coaxial terminals	
Net weight with K365 klystron	831 pounds (378kg) approx	
Cavity tuning controls:		
total turns	55	
torque	1.67 lb-ft (0.231kg-m) max	
Output coupler control:		
total turns	25	
torque	0.83 lb-ft (0.115kg-m) max	

Cooling

At sea level and with an inlet air temperature of 20°C the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the klystron but this practice is not recommended.

Air flow to cathode	25	ft ³ /min
	0.71	m ³ /min
Air flow to output cavity	50	ft ³ /min
	1.42	m ³ /min
Water flow to klystron body	1.0	imp.gal/min
	4.5	l./min
Water flow to collector	25	imp.gal/min
	114	l./min
Outlet water temperature	70	°C max
The temperature of any external part of the klystron must not exceed	175	°C

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded

Beam voltage	20	kV max
Beam current (mean)	2.5	A max
Body current (mean):		
for continuous operation	0.15	A max
for tuning	0.25	A max
Focus electrode voltage (negative)	500	V max
Collector dissipation	50	kW max

TYPICAL OPERATION (Vision amplifier)

Frequency	500	MHz
Beam voltage	17	kV
Beam current	1.8	A
Bandwidth	6.0	MHz
Focus electrode voltage	-200	V
Body current (mean)	70	mA
Drive power (see note 1)	10	W
Second cavity power (see note 2)	25	W
Third cavity power (see note 2)	100	W
Output power (peak sync.)	11	kW

NOTES

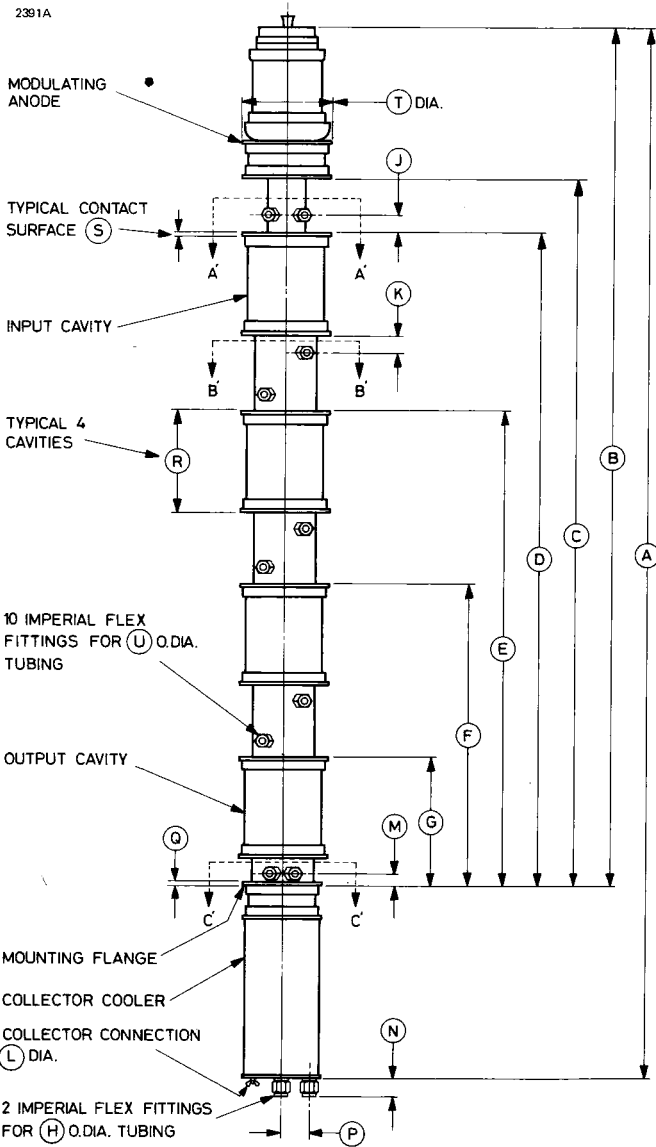
1. The drive power specified should be available if required.
2. For broad-band operation the cavities are loaded externally; the power specified is that dissipated in the external load.
3. The modulating anode is connected to the body of the klystron by a 10k Ω resistor.

X-RAYS

With the klystron operating under normal conditions, the stray X-ray radiation is below the minimum level which is hazardous to the health of operators.

OUTLINE

2391A



Outline Dimensions (All dimensions without limits are nominal)

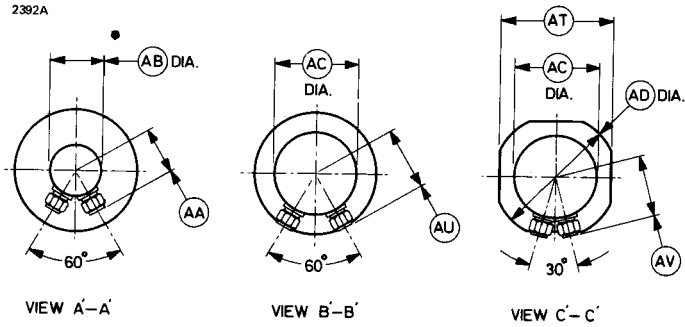
Ref	Inches	Millimetres
A	61.410 ± 0.255	1559.8 ± 6.5
B	49.900	1267.5
C	41.160	1045.5
D	38.100	967.7
E	27.900	708.7
F	17.700	449.6
G	7.500	190.5
H	0.750	19.05
J	1.000	25.40
K	0.875	22.23
L	0.250	6.35
M	0.675	17.15
N	1.125	28.58
P	1.625	41.28
Q	0.250	6.35
R	6.010	152.65
S	0.250	6.35
T	5.125	130.18
U	0.312	7.92

Millimetre dimensions have been derived from inches.

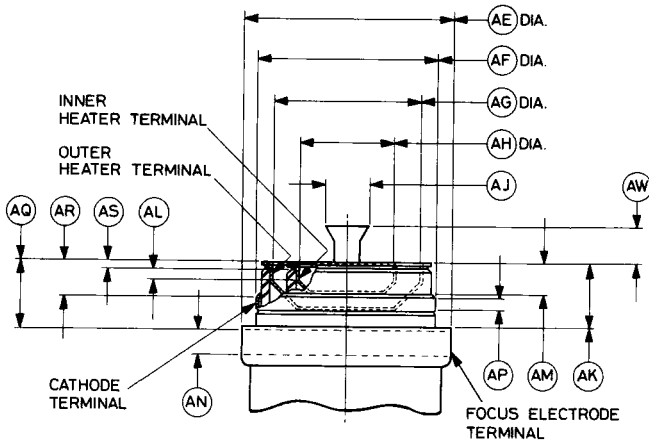
OUTLINE DETAILS

Detail of Body Sections

2392A



Detail of Cathode Terminals



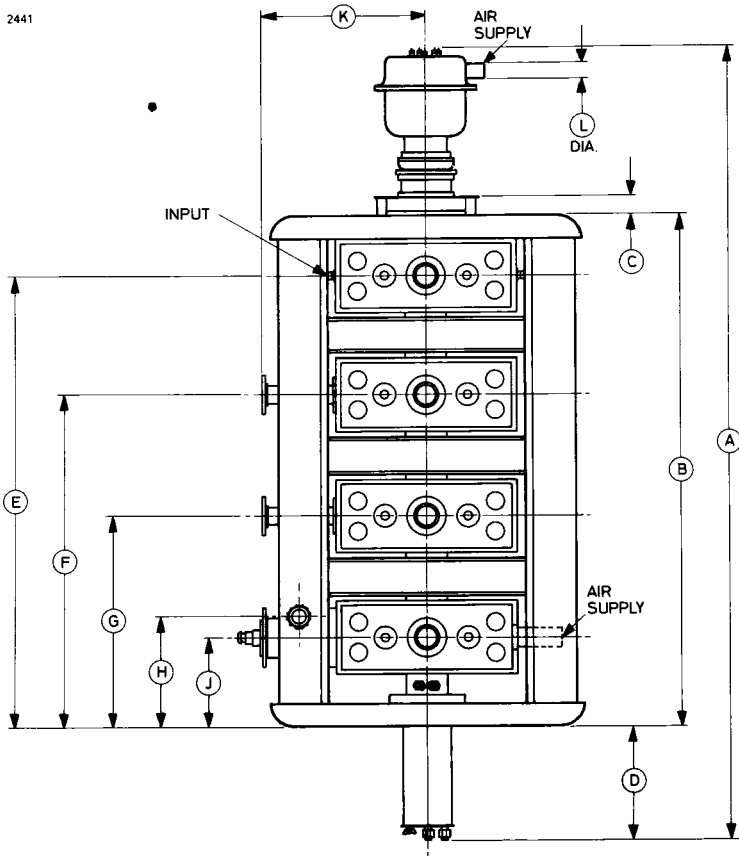
Outline Detail Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
AA	1.875	47.63
AB	2.120	53.85
AC	3.500	88.90
AD	5.125	130.18
AE	4.375	111.13
AF	3.750	95.25
AG	3.188	80.98
AH	1.938	49.23
AJ	1.125	28.58
AK	1.312	33.32
AL	0.250	6.35
AM	0.656	16.66
AN	0.500 min	12.70 min
AP	0.125 min	3.18 min
AQ	1.344	34.14
AR	0.750	19.05
AS	0.156 min	3.96 min
AT	4.625	117.48
AU	2.562	65.07
AV	2.563	65.10
AW	0.750 max	19.05 max

Millimetre dimensions have been derived from inches.

OUTLINE OF K4019A (All dimensions nominal)

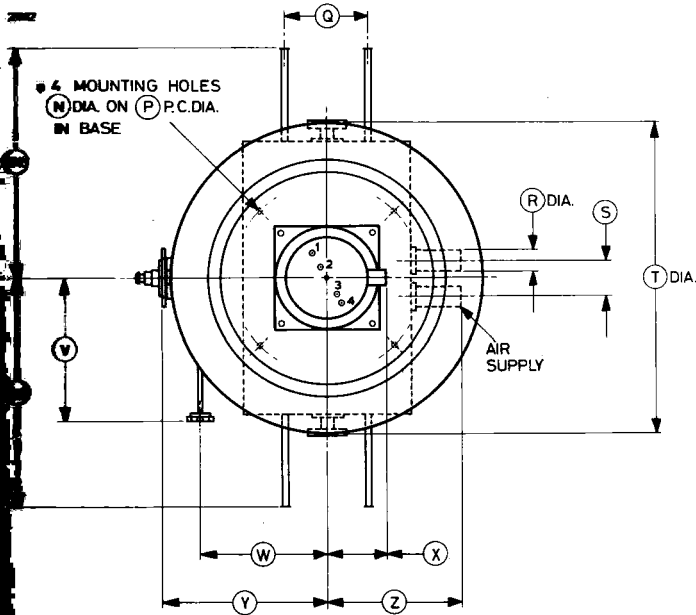
2441



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	66.500	1689	G	17.719	450.1
B	43.062	1094	H	9.312	236.5
C	1.625	41.27	J	7.500	190.5
D	9.625	244.5	K	13.688	347.7
E	38.125	968.4	L	1.500	38.10
F	27.906	708.8			

Millimetre dimensions have been derived from inches.

Top View of K4019A (All dimensions without limits are nominal)



Inches	Millimetres	Ref	Inches	Millimetres
19.250 max	489.0 max	U	19.250 max	489.0 max
0.438	11.12	V	12.000	304.8
16.250	412.8	W	10.625	269.9
6.940	176.3	X	5.062	128.6
1.875	47.62	Y	13.656	346.9
3.000	76.20	Z	11.312	287.3
26.250	666.8			

All dimensions have been derived from inches.

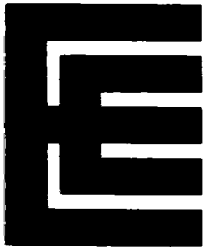
Connections

Focus electrode, threaded 6–32 U.N.C.

Heater, threaded ¼–20 U.N.C.

Heater, threaded ¼–20 U.N.C.

Cathode, threaded 6–32 U.N.C.



K370 K371 K372

HIGH POWER AMPLIFIER
KLYSTRONS for U.H.F.
TELEVISION SERVICE

FEATURING

- **Output Power** 12.5kW output, combined with long life and reliable performance.
- **High Gain** Fully compatible with solid state drive.
- **Bandwidth** 8MHz between 1db points over the tuning range.
- **High Stability** Air blown cavities ensure high operational stability.
- **Simple Installation** Pre-adjusted cavities — an integral part of the transmitter. Vacuum tube changes can be carried out by unskilled staff in less than 30 minutes.
- **Simple Vapour Cooling** Collector down configuration with vapour cooling — silent, self-circulating system; no pump.
- **Adjustable Cavity Loading** Adjustable loops to give optimum overall system performance on any channel.

DESCRIPTION

The K370, K371 and K372 are four-cavity amplifier klystrons for use in the output stages of sound and vision transmitters in u.h.f. television service. The three tubes operate in the frequency bands 470—606MHz, 606—742MHz and 742—854MHz respectively. A modulating anode is fitted, enabling the tubes to operate at lower power levels in sound transmitters but using the same beam voltage supply as the vision amplifier.

The tubes are electro-magnetically focused and their associated circuit assemblies are designed to reduce tube replacement time to a minimum. In this design, full use is made of the advantages of the external cavity construction. On initial installation the cavities can be tuned to a specific channel and the loading loops adjusted for optimum television performance. The cavities can be detached from the vacuum tube and refitted on a replacement tube without disturbing the tuning or the loading loop settings. At re-tuning, the replacement klystron will be coarse-tuned, requiring only a fine-tuning adjustment to meet the full specification.

November 1971

APPROVED CIRCUIT ASSEMBLIES

Klystron	Frequency in the range	Channels	Circuit Assembly
K370	470 to 606MHz	21-37	K4145
K371	606 to 742MHz	38-54	K4146
K372	742 to 854MHz	55-68	K4147

Note For operation of these tubes in circuit assemblies of the K4105, K4106, K4107 series, see data sheet K370, K371, K372 dated May 1969.

GENERAL

Electrical

Cathode	indirectly heated
Heater voltage (see note 1)	in the range 5.0 to 5.5 V
Heater current	38 to 44 A
Heater starting current (peak)	84 A max
Cathode heating time (minimum)	5 min

Mechanical

Overall length:	
K370	44.187 inches (112.2cm) max
K371, K372	40.162 inches (102.0cm) max
Overall diameter	8 inches (20.3cm) max
Mounting position	vertical, cathode end up
Net weight of klystron:	
K370	60 pounds (27kg) approx
K371, K372	55 pounds (25kg) approx

Circuit Assembly

Electro-magnet current, stabilized to $\pm 2\%$ (see note 2)	11 to 13	A
Electro-magnet resistance:		
cold (20°C)	5.7	Ω
hot (20°C ambient)	7.3	Ω max
R.F. input connector	type N coaxial	
R.F. output	quick release $1\frac{5}{8}$ inch 50Ω coaxial line	
Net weight of tuning cavities:		
for K370	102 pounds (46kg) approx	
for K371	83 pounds (38kg) approx	
for K372	64 pounds (29kg) approx	
Net weight of magnet assembly	784 pounds (356kg) approx	

Cooling

The klystron collector is vapour cooled. The boiler, which is part of the circuit assembly, is of the upward steam exit type and intended for use with a separate condenser.

The final drift tube and the four cavities are forced-air cooled. This is achieved by means of a single air inlet pipe on the circuit assembly, the air being directed to the required parts of the klystron by channeling within the circuit. Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

Air flow for cavity cooling (minimum)	100	ft ³ /min
	2.8	m ³ /min
Air flow to cathode terminal	5.0	ft ³ /min
	0.14	m ³ /min
Static pressure head at 100ft ³ /min (see note 3)	2.0	inches (51mm) w.g.
Inlet air temperature	45	°C max
Temperature of any external parts of the klystron must not exceed	175	°C max
Volume of steam produced by collector dissipation	1.5	ft ³ /min/kW
	0.043	m ³ /min/kW
Volume of water converted to steam	0.006	imp.gal/min/kW
	0.027	litre/min/kW

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Maximum voltage	14	kV max
Maximum current (mean)	3.5	A max
Maximum steady current:		
with no input power	50	mA max
at saturated output power	150	mA max
Maximum input power (saturated)	14	kW max
Maximum collector dissipation	45	kW max
Maximum v.s.w.r. (see note 4)	1.5:1	max

TYPICAL OPERATION

The operating conditions and performance figures given are for operation in a television transmitter giving a peak synchronous output power of 10kW. The klystrons are also suitable for transposer service.

Operating Conditions

Beam voltage	12.5	kV
Beam current	2.8	A
Electro-magnet current	12	A
Bandwidth (to 1db points)	8.0	MHz

K370 in K4145 Circuit

Frequency	470 to 478 (channel 21)	526 to 534 (channel 28)	598 to 606 (channel 37)	MHz
Body current:				
with no input power	15	15	15	mA
black level + sync. (10kW)	30	35	40	mA
at 11.25kW c.w. output, vision frequency	50	55	65	mA
Drive power:				
at 10kW output	1.2	0.8	0.65	W
at 11.25kW output	1.5	1.0	0.8	W
Saturated output power	11.5	12.0	12.0	kW

K371 in K4146 Circuit

Frequency	606 to 614 (channel 38)	670 to 678 (channel 46)	734 to 742 (channel 54)	MHz
Body current:				
with no input power	17	17	17	mA
black level + sync. (10kW)	21	25	35	mA
at 11.25kW c.w. output, vision frequency	25	35	55	mA
Drive power:				
at 10kW output	1.0	0.4	0.4	W
at 11.25kW output	1.3	0.6	0.6	W
Saturated output power	12.3	12.5	12.0	kW

K372 in K4147 Circuit

Frequency	742 to 750 (channel 55)	790 to 798 (channel 61)	846 to 854 (channel 68)	MHz
Body current:				
with no input power	17	17	17	mA
• black level + sync. (10kW)	25	28	26	mA
at 11.25kW c.w. output, vision frequency	40	55	40	mA
Drive power:				
at 10kW output	0.8	0.5	0.3	W
at 11.25kW output	1.0	0.7	0.5	W
Saturated output power	11.8	12.4	12.3	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 8 shows approximately the modulating anode voltage required for a given beam current (the voltage is expressed relative to cathode potential). Under these conditions the modulating anode current may vary between 0 and 1.5mA. If a potential divider network is used to supply the modulating anode it must allow for this variation.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K370 IN K4145 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	11 to 13	A
Frequency range	470 to 606	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	11.25	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Beam voltage (see note 7):			
frequency range 470 to 490MHz	—	13.5	kV
frequency range 490 to 606MHz	—	13.0	kV
Body current (see note 8)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 9)	—	1.5	W
Efficiency (see note 10):			
frequency range 470 to 490MHz	29	—	%
frequency range 490 to 606MHz	32	—	%

K371 IN K4146 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	11 to 13	A
Frequency range	606 to 742	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	11.25	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Beam voltage (see note 7)	—	13	kV
Body current (see note 8)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 9)	—	1.5	W
Efficiency (see note 10)	32	—	%

K372 IN K4147 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	11 to 13	A
Frequency range	742 to 854	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	11.25	kW

Range of Characteristics

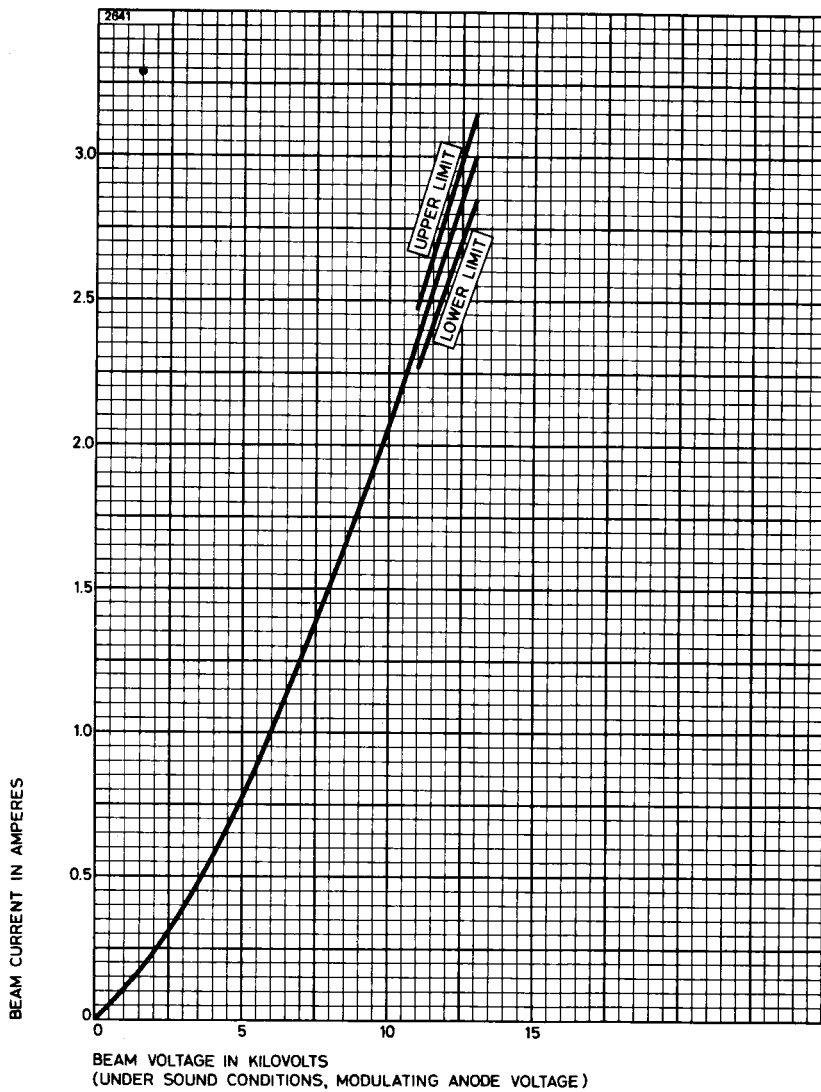
	Min	Max	
Heater current	38	44	A
Beam voltage (see note 7)	—	13	kV
Body current (see note 8)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 9)	—	1.5	W
Efficiency (see note 10)	32	—	%

NOTES

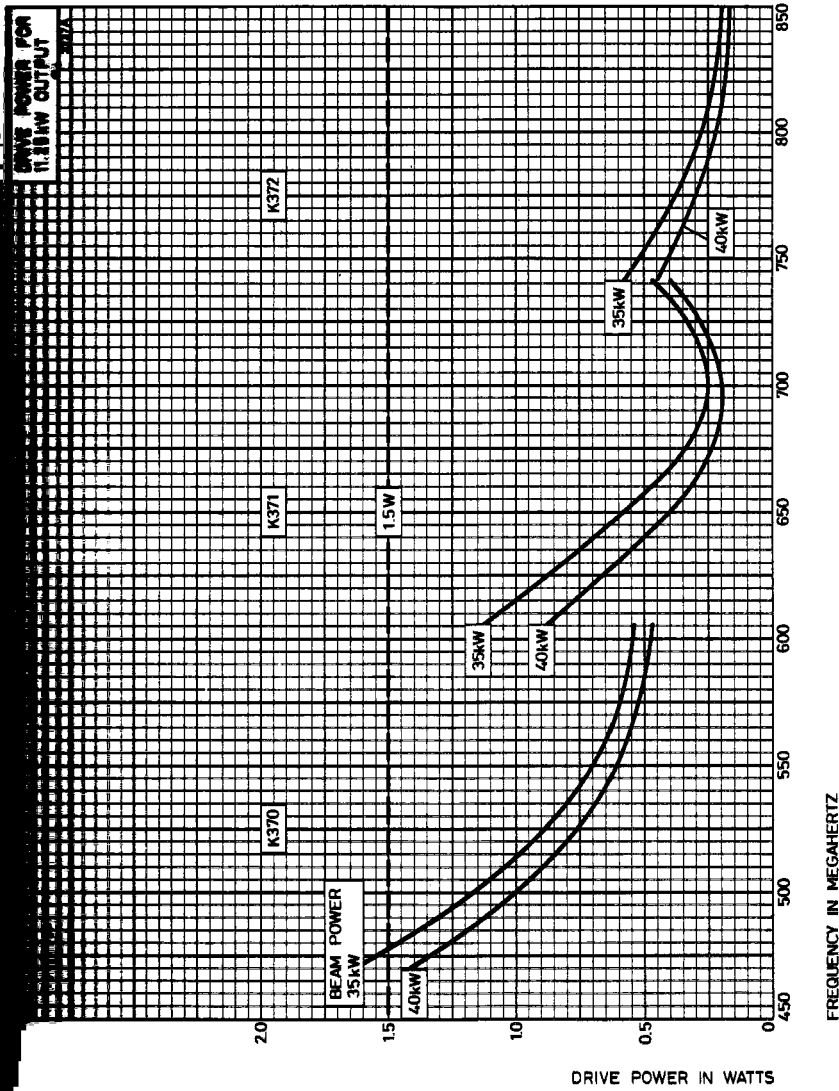
1. When a klystron is first installed it must be operated at 5.0V heater voltage.
2. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily within the specified range of electro-magnet current. Maximum stability is obtained by adjusting the magnet current within this range and stabilizing to $\pm 2\%$ about this optimum value.
Measured at the input to the circuit assembly.
This value applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
The klystron is tuned so that, for constant input power, the variation in output power is less than 1db over the specified bandwidth at all power levels between -2db and -14db with respect to the specified output power.
Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current will be within $\pm 5\%$ of the value given by the graph on page 8.
The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
The efficiency will not fall below the specified limit for any beam power in the range 30 to 40kW.



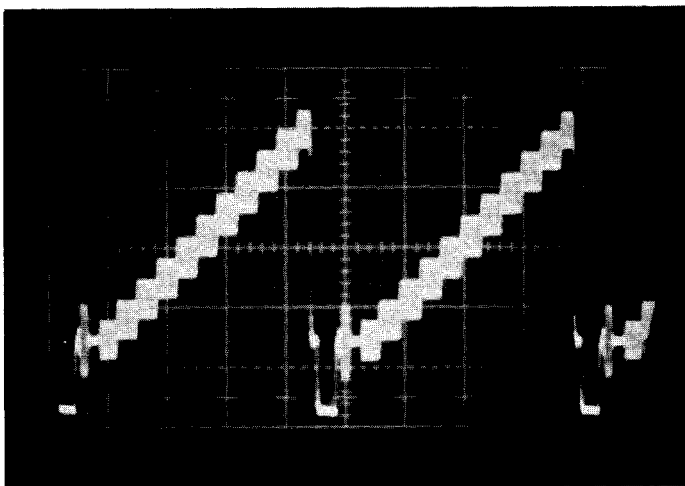
TYPICAL BEAM CHARACTERISTIC



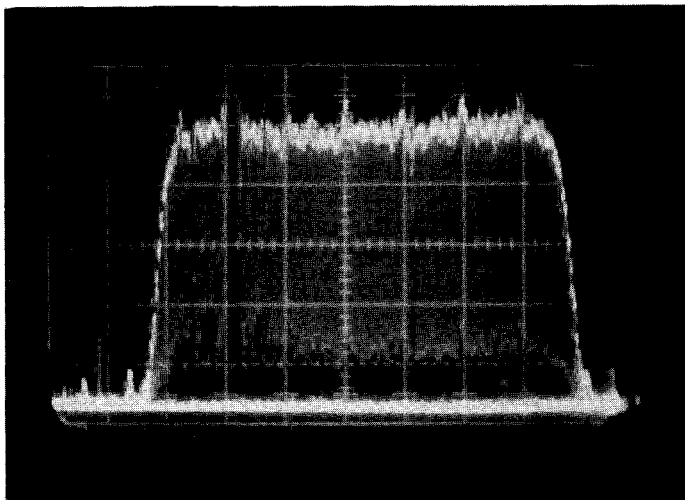
TYPICAL DRIVE REQUIREMENTS



TYPICAL TELEVISION PERFORMANCE

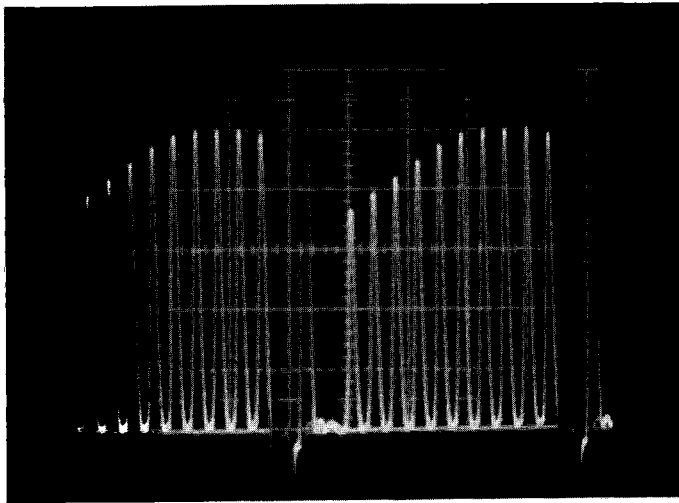


Test Waveform

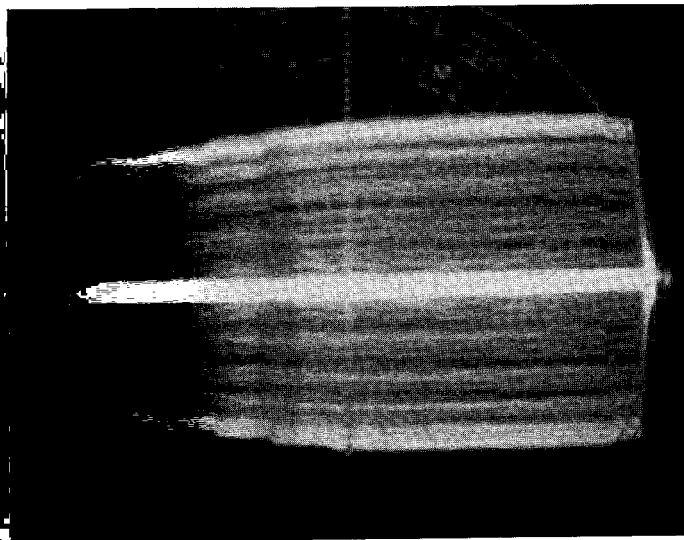


Output Frequency Response at Mid Grey

TYPICAL TELEVISION PERFORMANCE

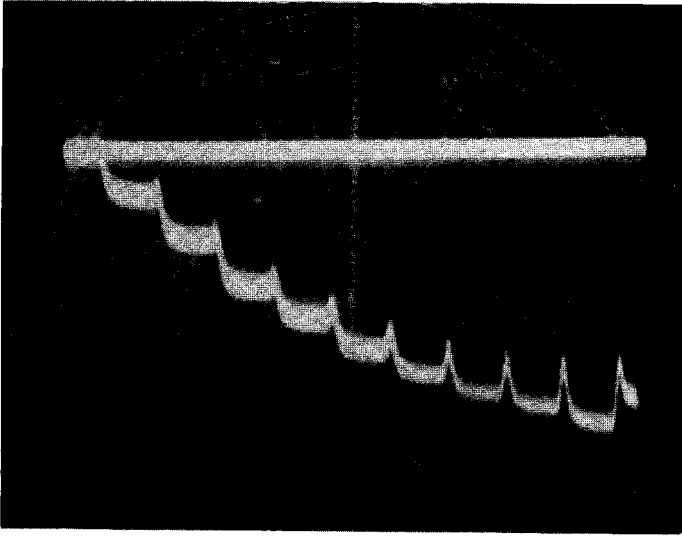


Linearity 70%



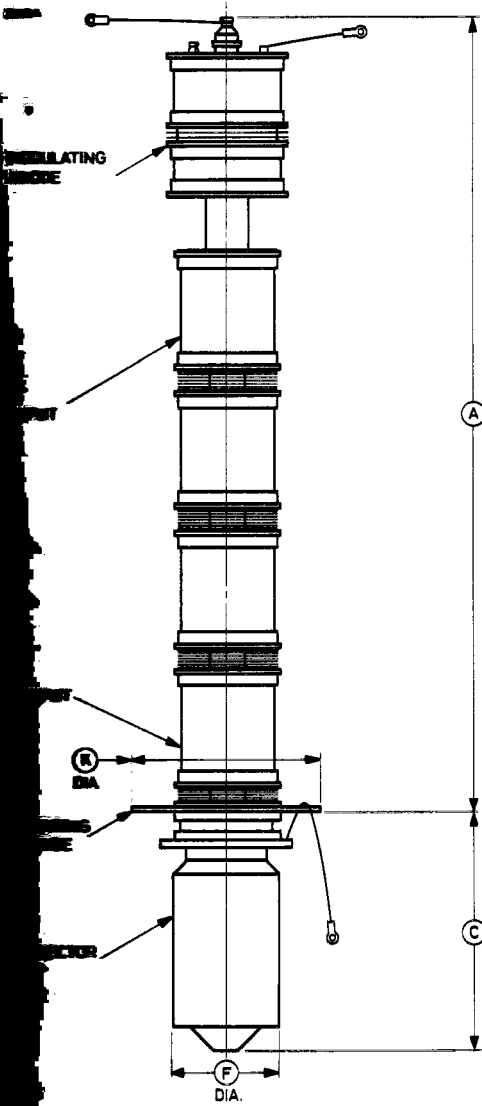
Differential Gain 78%

TYPICAL TELEVISION PERFORMANCE



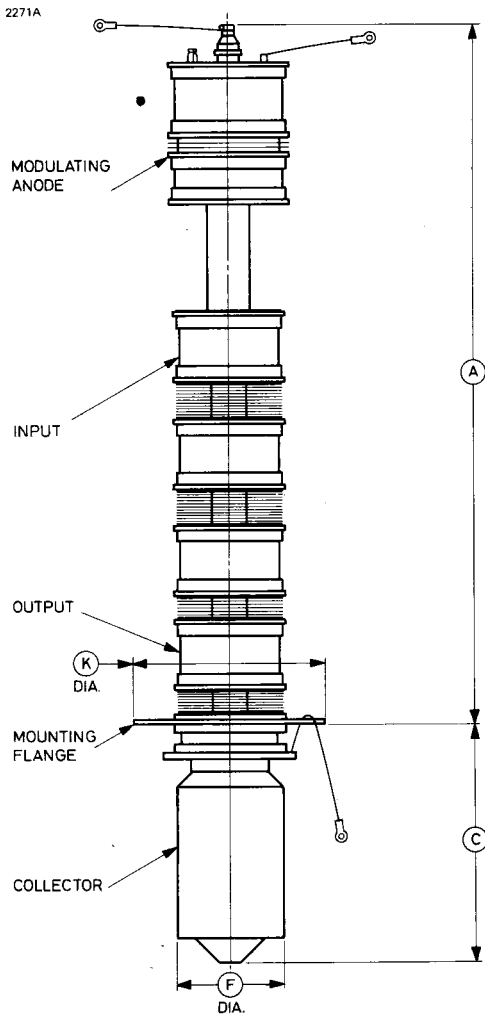
Differential Phase 8°

OUTLINE FOR K370



page 15 for outline details and dimensions

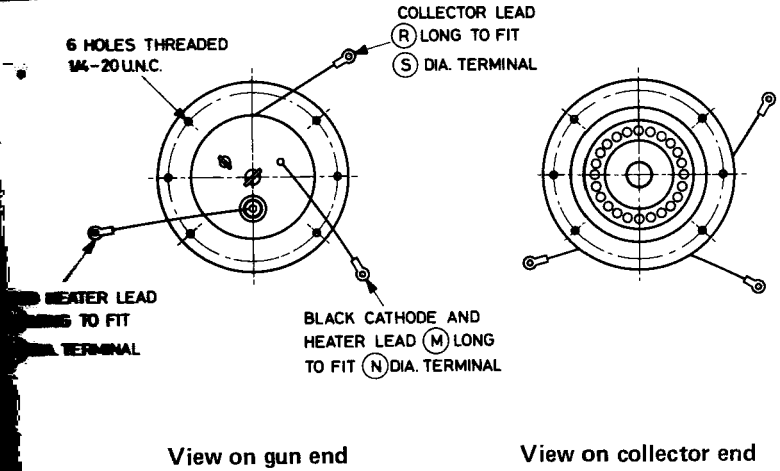
OUTLINE FOR K371 AND K372



This drawing is not to scale for the K371.

See page 15 for outline details and dimensions

Outline Details for K370, K371 and K372



Dimensions for K370 (All dimensions without limits are nominal)

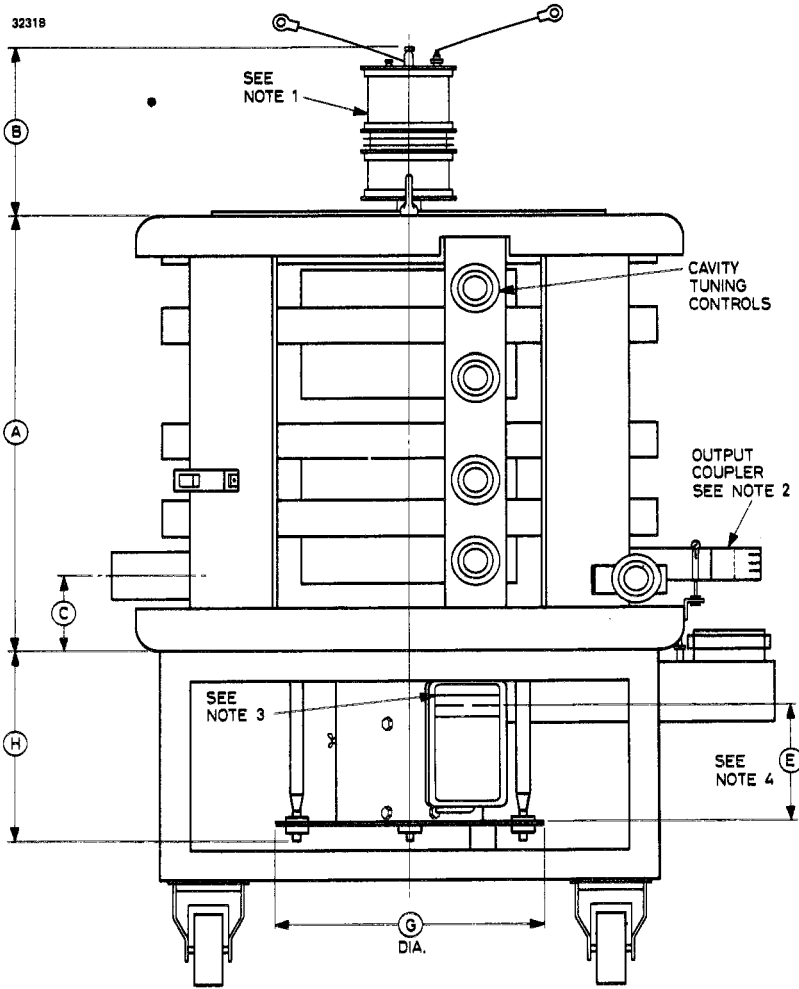
Inches	Millimetres
34.125 max	866.8 max
10.062 max	255.6 max
4.375	111.1
8.000 max	203.2 max
15.000 min	381.0 min
0.312	7.92
15.000 min	381.0 min
0.250	6.35
36.000 min	914.4 min
0.196	4.98

These dimensions have been derived from inches.

For K371 and K372, dimension A is 30.100 inches (764.5mm) max; the other dimensions are as for K370.

The output cavity ceramic is beryllium oxide.

OUTLINE FOR K4145, K4146 AND K4147



Note The circuit assembly is shown mounted on a trolley. This trolley is not part of the circuit assembly.

See page 19 for Outline Dimensions

OUTLINE FOR K4145, K4146 AND K4147

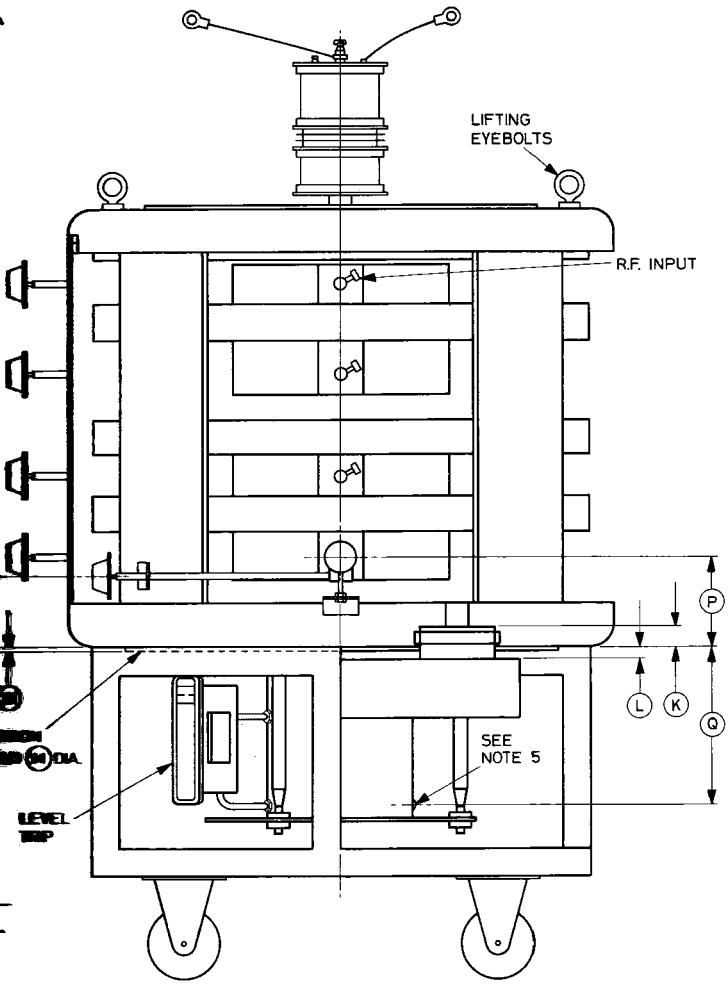
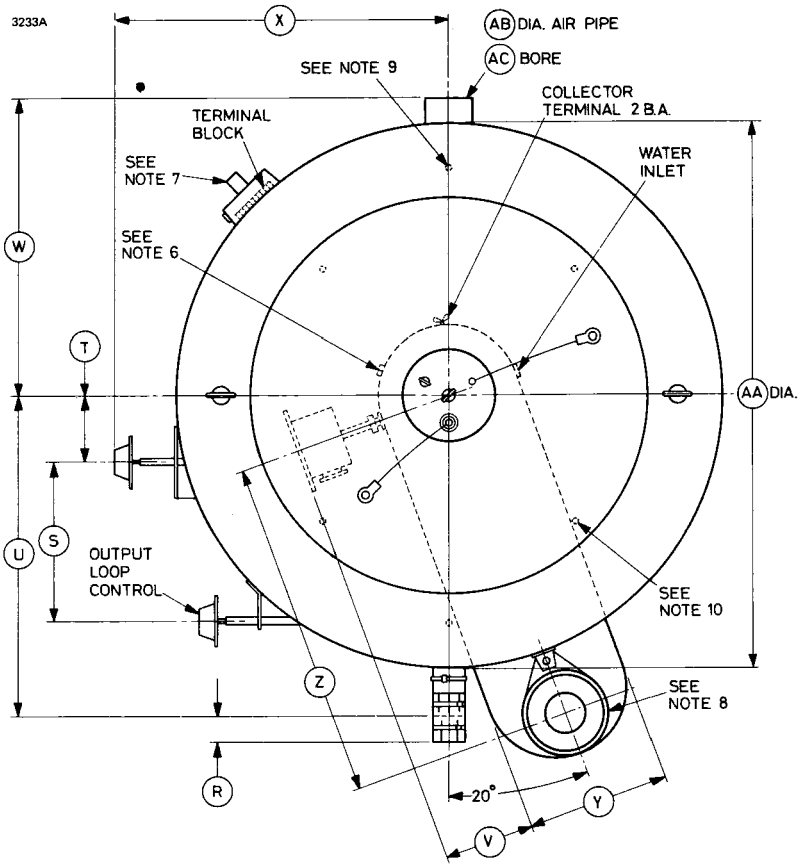


Figure 19 for Outline Dimensions

OUTLINE FOR K4145, K4146 AND K4147



Outline Notes

1. The klystron is shown installed for clarity.
2. Quick release 1⁵/₈ inch 50Ω coaxial line.
3. Recommended cold switch-on level.
4. The level trip is set up to this figure.
5. Water inlet 3/4 inch B.S.P.F. thread.

6. Pipe fittings for a water level control unit are provided and fitted with removable stoppers. They are 1/2 inch 'Kontite' couplings at 6.250 inch (158.8mm) centres. The water level control unit is not supplied as part of the circuit assembly.

7. Input connector, see page 20.

8. Steam outlet 4 1/2 inch diameter, 4 U.N. class 2A thread.

9. Four mounting holes in base threaded 3/8 - 16 U.N.C. equally spaced on 24 inch (609.6mm) P.C.D.

10. Four mounting holes in base, 3/8 inch (9.53mm) diameter equally spaced on 18.500 inch (470mm) P.C.D.



Dimensions for K4145 (All dimensions without limits are nominal)

Inches	Millimetres	Ref	Inches	Millimetres
27.000 max	685.8 max	R	1.094	27.79
8.750 max	222.3 max	S	8.500	215.9
4.000	101.6	T	3.500	88.90
5.900	149.9	U	17.000 ± 0.100	431.8 ± 2.5
14.000	355.6	V	4.000 max	101.6 max
10.750 max	273.1 max	W	15.625 ± 0.250	396.9 ± 6.4
3.700	93.98	X	17.500 max	444.5 max
1.000 ± 0.125	25.40 ± 3.18	Y	7.500	190.5
0.625 min	15.88 min	Z	18.000	457.2
22.750	577.9	AA	29.250 max	743.0 max
0.207	5.26	AB	2.625	66.68
4.625 ± 0.062	117.5 ± 1.6	AC	2.500	63.50
8.125	206.4			

Dimensions have been derived from inches.

K4146 and K4147, dimension A is 23.000 inches (584.2mm) max; the dimensions are as for K4145.

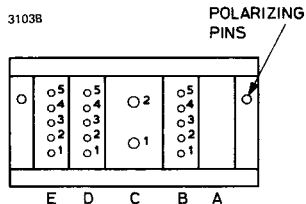
ELECTRICAL CONNECTIONS

All connections to the circuit assembly are made through a Smiths Hypertac connector. The mating socket is connected to a 10-way terminal block. The focus coils are wired through to the input connector; all other connections are to be made by the customer after assembling the circuit assembly and boiler. The body of the klystron is earthed through the circuit assembly and the heater, cathode, modulating anode and collector connections are made by flying leads.

Input Connector

(to be wired by customer)

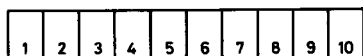
View on solder connections with cover removed



Water level trip	B1, B2
Collector	B3
Link	B4, B5
Focus coils:	
negative	C1
positive	C2
Water level control (see note 6 on page 19)	D1, D2
Earth	E3

Terminal Block

(to be wired by customer)



Water level trip	1, 2
Collector	3
Focus coils (wired by EEV):	
negative	4
positive	5
Water level control (see note 6 on page 19)	6, 7
Earth	10



AMPLIFIER KLYSTRONS

CONDIGED DATA

Each cavity, electro-magnetically focused amplifier klystrons with separate focusing cavities, for u.h.f. television service. The collector is water cooled in an integral water jacket. A modulating anode is fitted which may be used for beam current control or as a protective device.

Klystron	Frequency Range	Circuit Assembly
K376	470 to 610MHz	K4054
K377	590 to 720MHz	K4055

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	28	kW
Gain (typical):		
K376	42	db
K377	44	db
Operating voltage	18	kV
Modulating voltage	3 ¹ / ₈ inch 50Ω coaxial line	
Cooling (see page 2)		water and forced-air

GENERAL

Heating method		indirectly heated
Operating voltage	26	V
Operating current	11 to 13	A
Starting current (peak)	23	A max
Warm-up heating time	15	minutes

PHYSICAL

Overall length (see note 1)	62 inches (158cm)	nom
Overall diameter	10.00 inches (254mm)	nom
Mounting position		vertical, cathode end up
Weight of klystron	120 pounds (55kg)	approx



Circuit Assembly

Electro-magnet current (see note 2)	9 ± 1	A
Electro-magnet resistance:		
cold (20°C)	9.5 ± 1	Ω
hot (20°C ambient)	12	Ω max
R.F. input connector		type N coaxial
R.F. output	3 1/8 inch	50Ω coaxial line
Net weight of tuning cavities:		
for K376	120 pounds (54kg)	approx
for K377	90 pounds (41kg)	approx
Total lifting weight of klystron and cavities:		
K376	270 pounds (122kg)	approx
K377	240 pounds (109kg)	approx
Net weight of magnet assembly	1800 pounds (816kg)	approx

COOLING

At sea level and with an inlet air temperature of 20°C the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the klystron but this practice is not recommended.

Air flow to cathode	5.0	ft ³ /min
	0.14	m ³ /min
Air flow to output and penultimate cavities	50ft ³ /min (1.42m ³ /min)	each
Static pressure head (see note 4)		1 inch w.g.
Inlet air temperature	40	°C max
Water flow to body and electro-magnet in series (see note 3)	2.0	imp.gal/min
	9.0	l./min
Water flow to collector (see note 3)	25	imp.gal/min
	114	l./min
Collector pressure drop	7.5	lb/in ² max
	0.53	kg/cm ² max
Outlet water temperature	70	°C max
Inlet water pressure	100	lb/in ² max
	7.0	kg/cm ² max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage:

continuous	20	kV max
switch-on surge	24	kV max
Beam current (mean)	6.0	A max
Body current	150	mA max
Output power	30	kW max
Collector dissipation	100	kW max
Load v.s.w.r. (see note 5)	1.5:1	max
Temperature of any external part of the klystron	175	°C max

TYPICAL OPERATION (Vision amplifier)

Operating Conditions

Beam voltage	18.0	kV
Beam current	4.6	A
Micro-magnet current	9.0	A
Bandwidth (to 1db points)	8.0	MHz

6 IN K4054 CIRCUIT

Frequency	500	MHz
Drive power for 28kW output	2.0	W

7 IN K4055 CIRCUIT

Frequency	625	MHz
Drive power for 28kW output	1.0	W

Modulated Amplifier Service

Operation at the same beam voltage as the vision amplifier and one fifth the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 15 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the modulating anode current varies between 0 and 1.5mA. The potential divider network must be adjusted accordingly.

**RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN
K376 IN K4054 CIRCUIT, VISION AMPLIFIER**

Test Conditions

Heater voltage	26	V
Electro-magnet current	8 to 10	A
Frequency range	470 to 610	MHz
Bandwidth (see note 6)	8.0	MHz
Output power (see note 7)	25	kW

Range of Characteristics

	Min	Max	
Heater current	11	13	A
Beam voltage	—	18	kV
Body current (see note 8)	—	150	mA
R.F. drive power (see note 9)	—	3.0	W

K377 IN K4055 CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	26	V
Electro-magnet current	8 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 6)	8.0	MHz
Output power (see note 7)	25	kW

Range of Characteristics

	Min	Max	
Heater current	11	13	A
Beam voltage	—	18	kV
Body current (see note 8)	—	150	mA
R.F. drive power (see note 9)	—	3.0	W

WARNING

English Electric Valve Company Ltd. should be consulted regarding the design of protection circuits. Inadequate protection may result in the destruction of the klystron.

X-RAYS

With the klystrons operating normally, the stray X-ray radiation is below the minimum level which is hazardous to the health of operators.

GAS CHECK

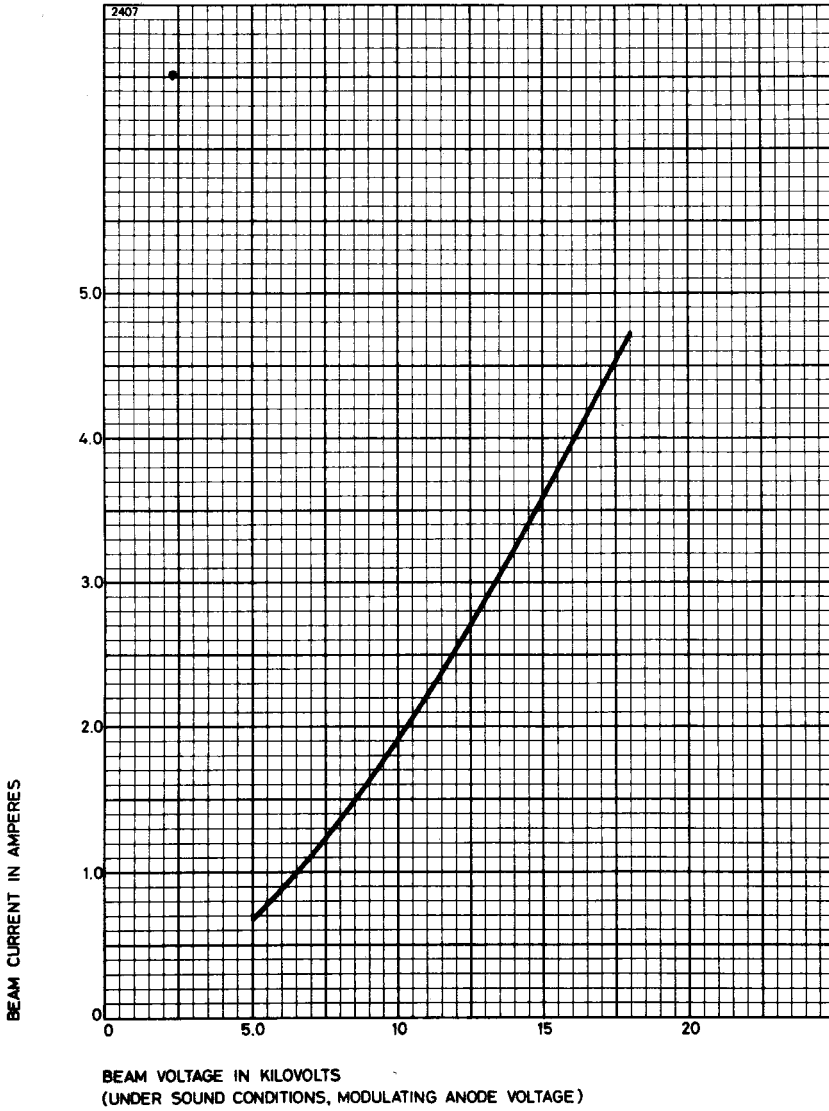
The internal gas pressure of the klystrons can be monitored during storage.

* K376, K377, page 4

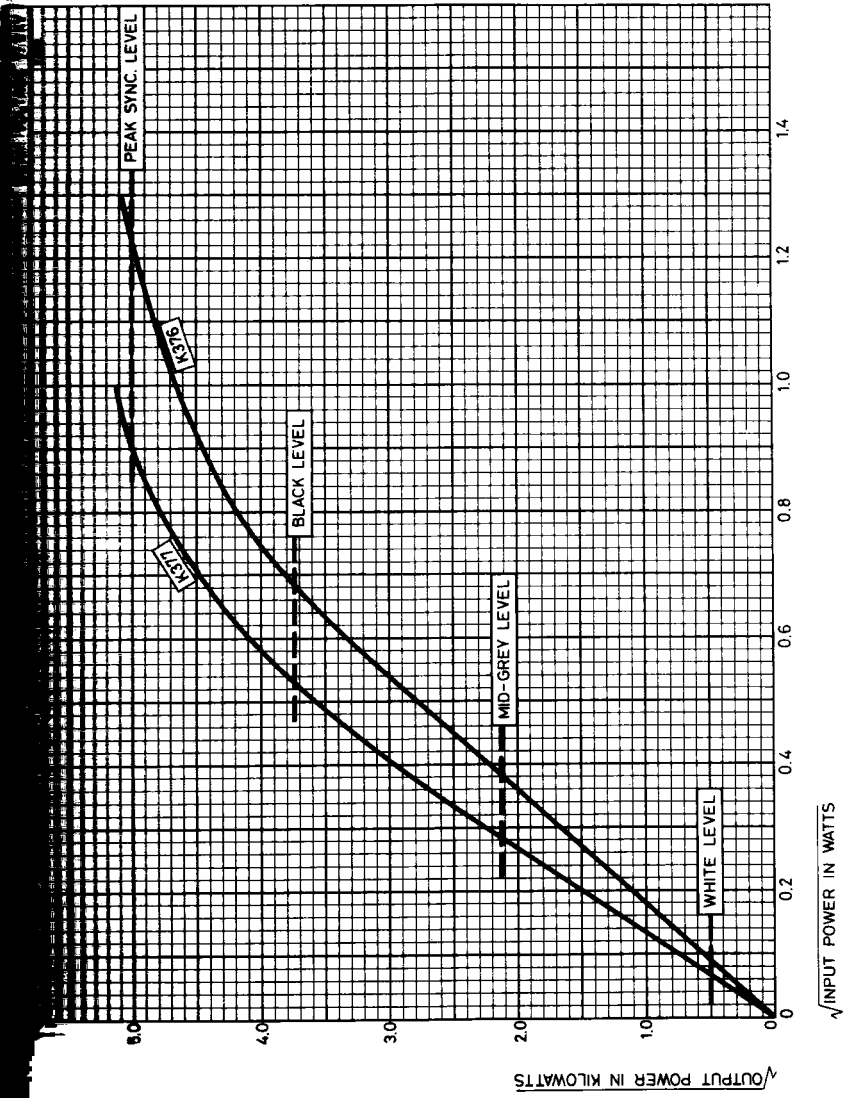
NOTES

1. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 126 inches (3.2m) is required. This is measured to the top of the lifting harness and does not include the hoist.
2. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily over the current range stated.
3. These values apply when the coolant used is distilled water with the dissolved oxygen removed. English Electric Valve Company Ltd. should be consulted if it is intended to use alternative coolants.
4. Measured at the input pipes to the circuit assembly.
5. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
6. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.
7. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
8. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
9. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.

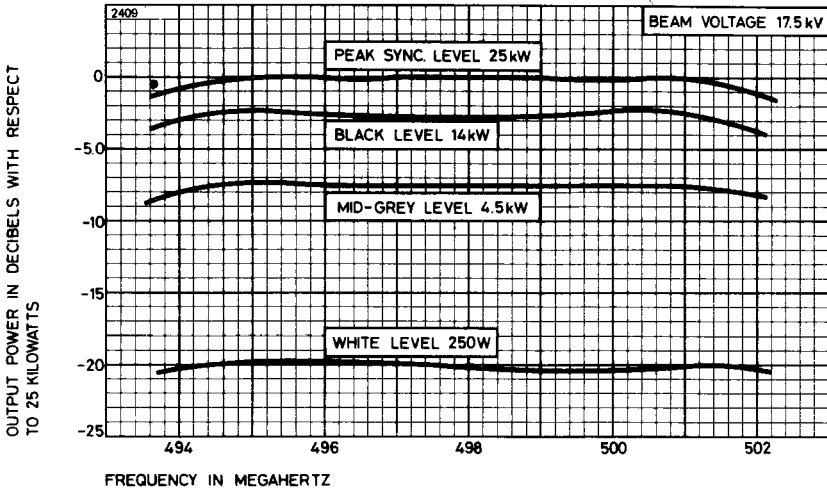
TYPICAL BEAM CHARACTERISTIC



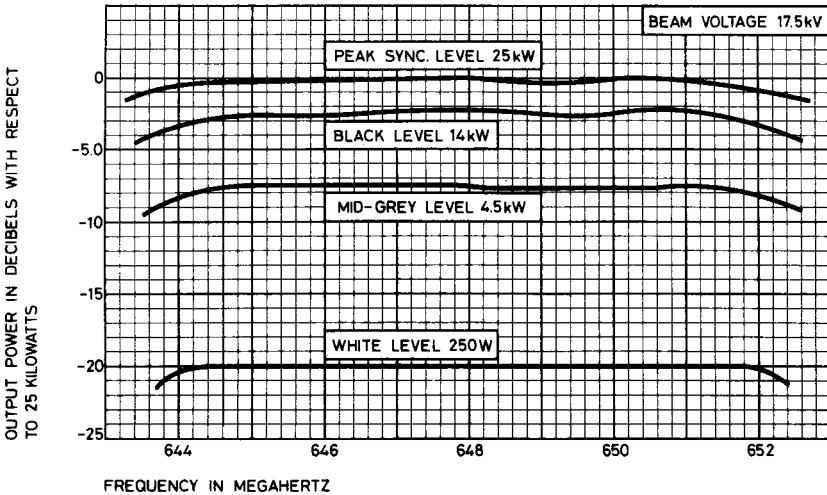
TYPICAL GAIN CHARACTERISTICS



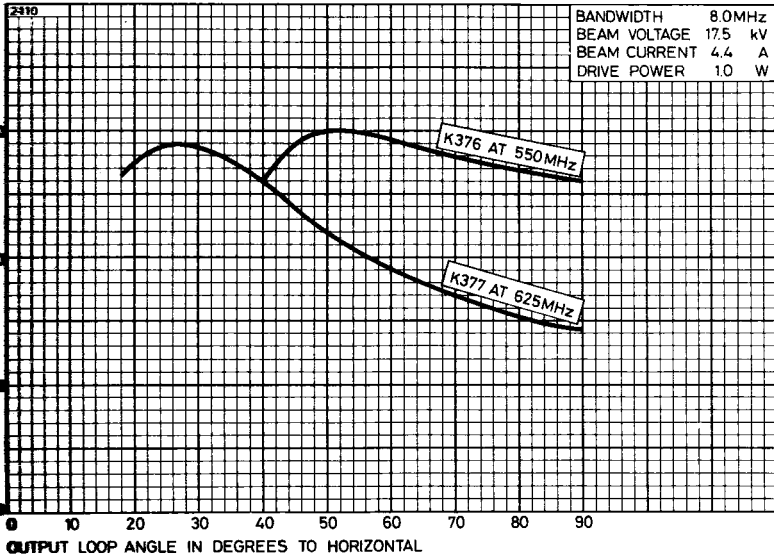
TYPICAL BANDWIDTH CHARACTERISTICS FOR K376



TYPICAL BANDWIDTH CHARACTERISTICS FOR K377

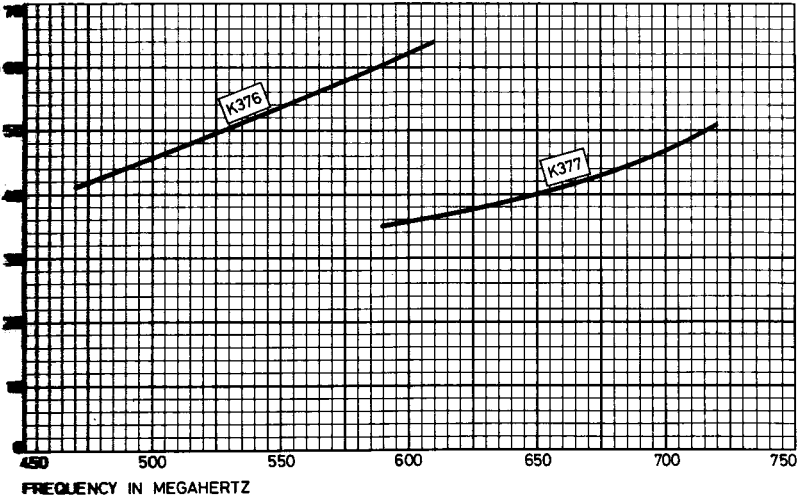


OUTPUT POWER – LOOP ANGLE CHARACTERISTICS

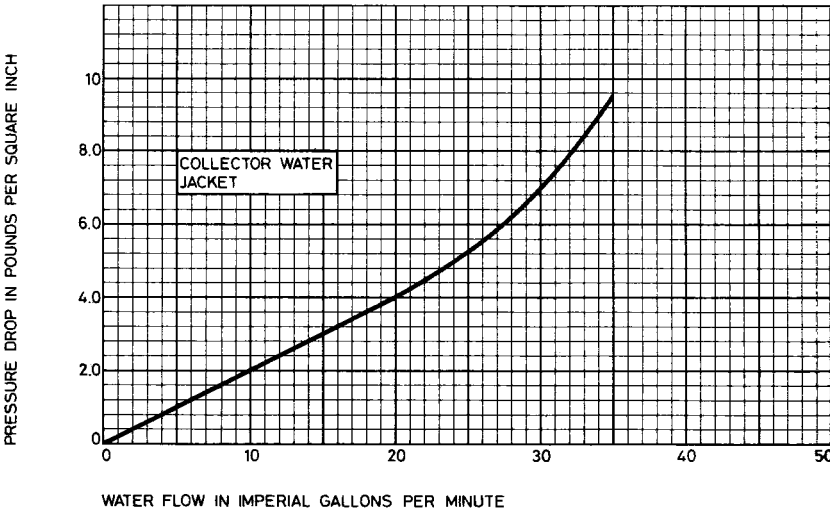
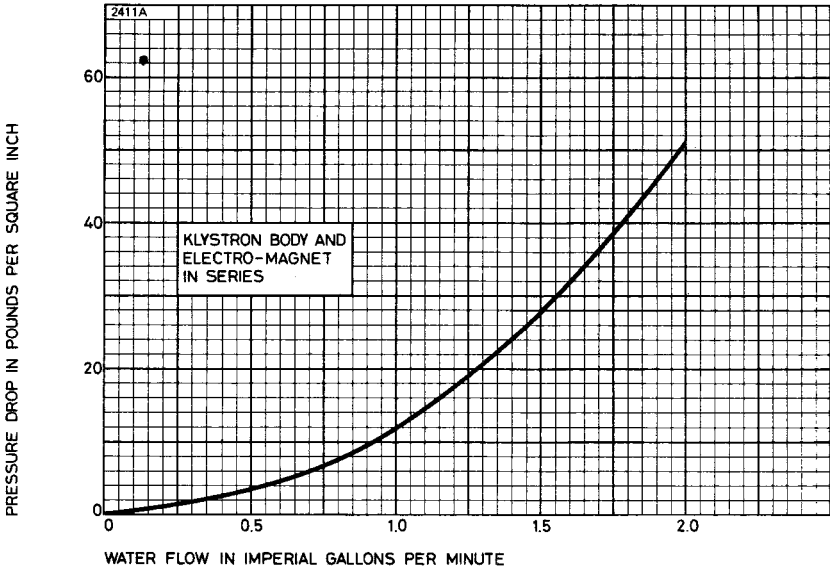


LOOP ANGLE – FREQUENCY CHARACTERISTICS

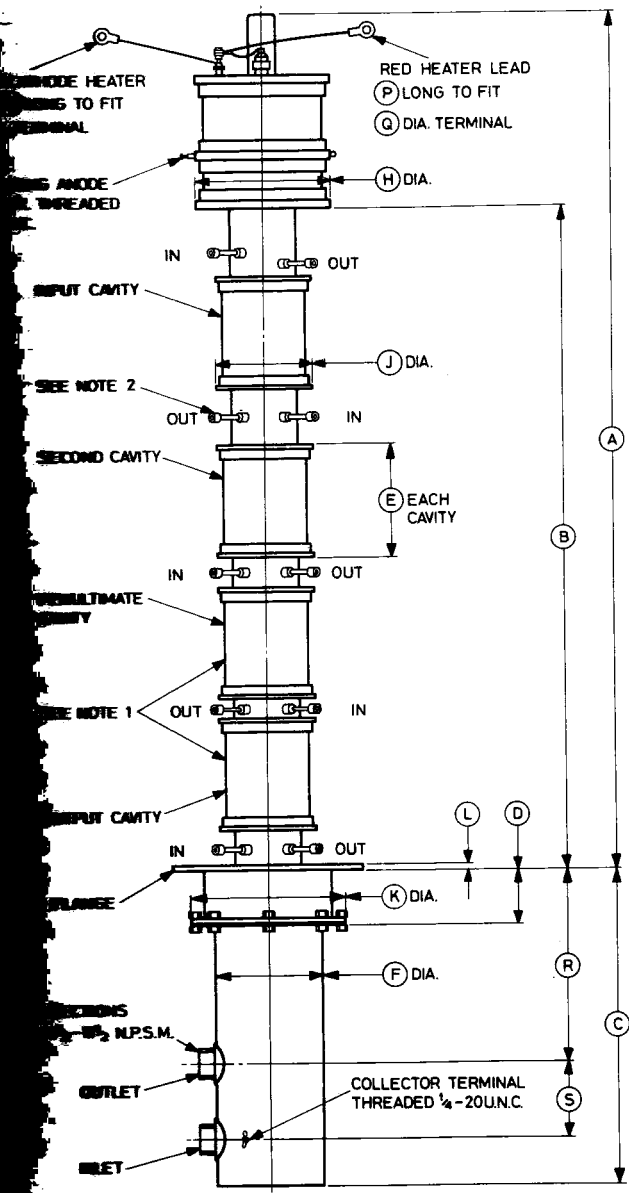
(Recommended loop angle for initial setting-up)



WATER FLOW CHARACTERISTICS



LINE FOR K376



Dimensions for K376 (All dimensions nominal)

	Millimetres	Ref	Inches	Millimetres
	1148	K	8.125	206.4
	875.5	L	0.375	9.53
	418.6	M	15.000	381.0
	73.96	N	0.312	7.92
	152.4	P	15.000	381.0
	139.7	Q	0.250	6.35
	254.0	R	10.35	262.9
	181.0	S	4.000	101.6
	130.2			

Dimensions have been derived from inches.

Dimensions for K377 (All dimensions nominal)

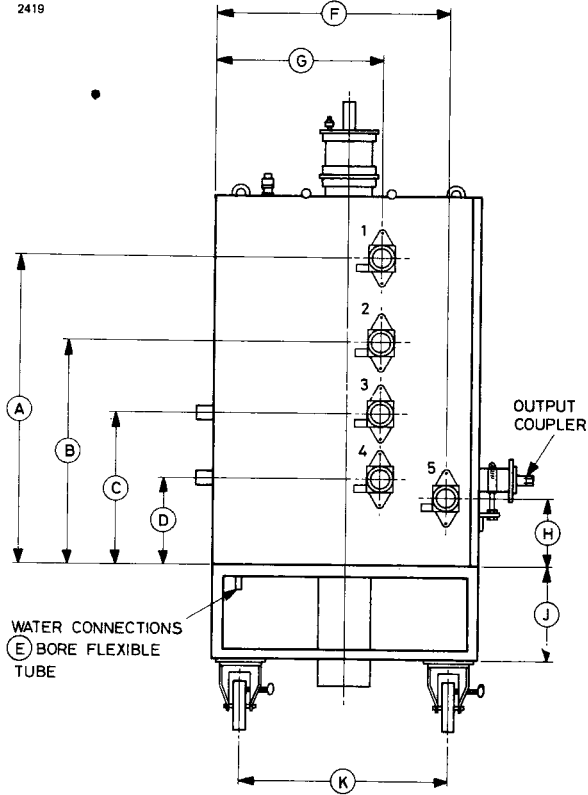
	Millimetres	Ref	Inches	Millimetres
	1148	K	8.125	206.4
	875.5	L	0.375	9.53
	418.6	M	15.000	381.0
	73.96	N	0.312	7.92
	127.0	P	15.000	381.0
	139.7	Q	0.250	6.35
	254.0	R	10.35	262.9
	181.0	S	4.000	101.6
	130.2			

Dimensions have been derived from inches.

Input and output cavity ceramics are beryllium oxide.
 The extensions are shown fitted to the klystron; they are supplied
 for the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$
 and a set of connecting pipes is included in the circuit assembly.

OUTLINE OF K4054 AND K4055

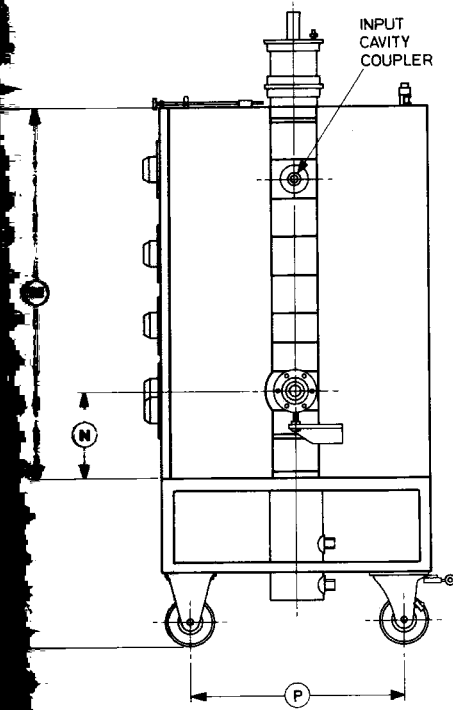
2419



Controls

- 1 Input cavity tuning
- 2 Second cavity tuning
- 3 Penultimate cavity tuning
- 4 Output cavity tuning
- 5 Output coupling

OUTLINE OF K4054 AND K4055 (All dimensions nominal)

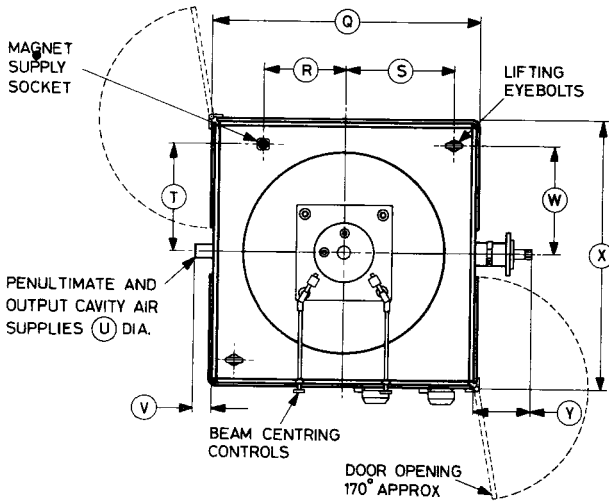


Inches	Millimetres	Ref	Inches	Millimetres
29.312	820.7	H	7.250	184.2
23.500	596.9	J	9.875	250.8
16.000	406.4	K	21.875	555.6
14.125	231.8	L	56.375	1432
1.500	12.70	M	38.875	987.5
9.531	623.1	N	9.125	231.8
17.500	444.5	P	22.25	565.2

These dimensions have been derived from inches.

OUTLINE OF K4054 AND K4055
(All dimensions without limits are nominal)

2420



Ref	Inches	Millimetres	Ref	Inches	Millimetres
Q	28.000 ± 0.125	711.2 ± 3.2	V	2.000	50.80
R	8.500 ± 0.125	215.9 ± 3.2	W	11.250	285.8
S	11.250	285.8	X	28.000 ± 0.125	711.2 ± 3.2
T	11.500 ± 0.125	292.1 ± 3.2	Y	5.625	142.9
U	1.750	44.45			

Millimetre dimensions have been derived from inches.



K383 K384 K385

HIGH POWER AMPLIFIER KLYSTRONS for U.H.F. TELEVISION SERVICE



FEATURES

- Output Power** 5.5kW output, combined with long life and reliable performance.
- High Gain** Fully compatible with solid state drive.
- Bandwidth** 8MHz between 1db points over the tuning range.
- High Stability** Air blown cavities ensure high operational stability.
- Simple Installation** Pre-adjusted cavities — an integral part of the transmitter. Vacuum tube changes can be carried out by unskilled staff in less than 30 minutes.
- Air-cooled Collector** Transverse air duct adaptors provided.
- Adjustable Cavity Loading** Adjustable loops to give optimum overall system performance on any channel.

DESCRIPTION

The K384 and K385 are four-cavity amplifier klystrons for use in the final stages of television transmitters in u.h.f. television service. The tubes operate in the frequency bands 470–610MHz, 590–720MHz and 700–860MHz respectively. A modulating anode is fitted, enabling the tubes to operate at lower power levels in sound transmitters but using the same voltage supply as the vision amplifier.

The tubes are electro-magnetically focused and their associated circuit components are designed to reduce tube replacement time to a minimum. In this design, full use is made of the advantages of the external cavity design. On initial installation the cavities can be tuned to a specific channel and the loading loops adjusted for optimum television performance. The cavities can be detached from the vacuum tube and refitted on a replacement tube without disturbing the tuning or the loading loop settings. At the time of replacement the replacement klystron will be coarse-tuned, requiring only a fine-tuning adjustment to meet the full specification.

APPROVED CIRCUIT ASSEMBLIES

Klystron	Frequency in the range	Channels	Circuit Assembly
K383	470 to 610MHz	21 to 37	K4140
K384	590 to 720MHz	36 to 51	K4141
K385	700 to 860MHz	50 to 68	K4142

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	in the range 5.0 to 5.5	V
Heater current	38 to 44	A
Heater starting current (peak)	84	A max
Cathode heating time (minimum)	5	min

Mechanical

Overall length:		
K383	44.742 inches (113.6cm) max	
K384, K385	40.717 inches (103.4cm) max	
Overall diameter	8.015 inches (20.4cm) max	
Mounting position	vertical, cathode end up	
Net weight of klystron:		
K383	60 pounds (27kg) approx	
K384, K385	55 pounds (25kg) approx	

Circuit Assembly

Electro-magnet current, stabilized to $\pm 2\%$ (see note 2):		
K383	10.5 ± 1.0	A
K384, K385	9.0 ± 1.0	A
Electro-magnet resistance:		
cold (20°C)	5.7	Ω
hot (20°C ambient)	7.3	Ω max
R.F. input connector	type N coaxial	
R.F. output (see note 16)	quick release $1\frac{5}{8}$ inch 50Ω coaxial line	
Net weight of tuning cavities:		
for K383	102 pounds (46kg) approx	
for K384	83 pounds (38kg) approx	
for K385	64 pounds (29kg) approx	
Net weight of magnet assembly	784 pounds (356kg) approx	

collector and cathode are separately forced-air cooled.

The final drift tube and the four cavities are forced-air cooled. This is achieved by means of a single air inlet pipe on the circuit assembly, the air being directed to the required parts of the klystron by channeling within the unit. Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

Air flow to collector	560	ft ³ /min
	15.9	m ³ /min
Pressure drop	8	inches (203mm) H ₂ O
Air flow for cavity cooling (minimum)	100	ft ³ /min
	2.8	m ³ /min
Static pressure head at 100ft ³ /min (see note 3)	1.5	inches (38mm) H ₂ O
Air flow to cathode terminal	5.0	ft ³ /min
	0.14	m ³ /min
Air temperature	40	°C max
Temperature of any external parts of the klystron must not exceed	175	°C max

The collector is fitted with a thermostat having contacts normally closed. This should be used to remove beam power from the klystron in the event of overheating. A thermocouple is supplied so that the collector temperature can be monitored during initial setting up. See page 11 for calibration curve.

MAXIMUM RATINGS (Absolute values)

Individual rating should be exceeded.

Operating voltage	12	kV max
Operating current (mean)	2.5	A max
Operating current (event):		
Maximum input power	50	mA max
Maximum generated output power	150	mA max
Maximum power dissipation	25	kW max
Beam current (see note 4)	1.5:1	max

TYPICAL OPERATION

The operating conditions and performance figures given are for operation in a television transmitter giving a peak synchronous output power of 5.0kW. The klystrons are also suitable for transposer service.

Operating Conditions

Beam voltage	9.5	kV
Beam current	1.9	A
Electro-magnet current:		
K383 in K4140 circuit	10.5	A
K384 in K4141 circuit	9.0	A
K385 in K4142 circuit	9.0	A
Bandwidth (to 1db points)	8.0	MHz

K383 in K4140 Circuit

Frequency	470 to 478 (channel 21)	526 to 534 (channel 28)	598 to 606 (channel 37)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (5.0kW)	25	25	30	mA
at 6.0kW c.w. output, vision frequency	45	40	45	mA
Drive power:				
at 5.0kW output	0.75	0.3	0.15	W
at 6.0kW output	0.9	0.4	0.4	W
Saturated output power	6.2	6.4	6.4	kW

K384 in K4141 Circuit

Frequency	590 to 598 (channel 36)	654 to 662 (channel 44)	710 to 718 (channel 51)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (5.0kW)	25	20	26	mA
at 6.0kW c.w. output, vision frequency	46	43	52	mA
Drive power:				
at 5.0kW output	0.5	0.4	0.2	W
at 6.0kW output	1.0	0.7	0.4	W
Saturated output power	6.5	6.1	6.2	kW

5 in K4142 Circuit

Frequency	702 to 710 (channel 50)	774 to 782 (channel 59)	846 to 854 (channel 68)	MHz
Beam current:				
Beam current with no input power	10	10	10	mA
Beam current at back level + sync. (5.0kW)	25	27	30	mA
Beam current at 6.0kW c.w. output,				
Beam current at vision frequency	40	36	38	mA
Beam current at 5.0kW output	1.0	0.75	0.65	W
Beam current at 6.0kW output	1.45	1.35	1.20	W
Beam current at rated output power	6.1	6.4	6.5	kW



Amplifier Service

operation at the same beam voltage as the vision amplifier and one fifth the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 70 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the modulating anode current varies between 0 and 1.5mA. If a potential divider network is used to supply the modulating anode it must allow for this variation.

**CHARACTERISTICS FOR EQUIPMENT DESIGN
K4140 CIRCUIT, VISION AMPLIFIER SERVICE**

Conditions

Beam voltage (see note 5)	5.0 to 5.5	V
Beam magnet current	9.5 to 11.5	A
Frequency range	470 to 610	MHz
Beam current (see note 6)	8.0	MHz
Beam power (see note 7)	5.5	kW

Beam Characteristics

	Min	Max	
Beam current	38	44	A
Beam voltage (see note 8)	—	10	kV
Beam current (see note 9)	—	150	mA
Modulating anode current	—	5.0	mA
Beam power (see note 10)	—	1.5	W
Frequency (see note 11)	30	—	%

K383 IN K4140 CIRCUIT, TRANSPOSER SERVICE

Test Conditions

Heater voltage (see note 5)	5.0 to 5.5	V
Electro-magnet current		see note 2
Beam voltage		see note 12
Frequency range	470 to 610	MHz
Bandwidth (see note 13)	8.0	MHz
Peak synchronous power (see note 14)	1.0	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Electro-magnet current	9.5	11.5	A
Beam voltage	8.5	10	kV
Intermodulation level (see note 15)	—	—52	dB
R.F. drive power (see note 10)	—	200	mW

K384 IN K4141 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage (see note 5)	5.0 to 5.5	V
Electro-magnet current	8.0 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 6)	8.0	MHz
Output power (see note 7)	5.5	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Beam voltage (see note 8)	—	10	kV
Body current (see note 9)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 10)	—	1.5	W
Efficiency (see note 11)	30	—	%

IN K4141 CIRCUIT, TRANSPOSER SERVICE

Conditions

Supply voltage (see note 5)	5.0 to 5.5	V
Control magnet current		see note 2
Control voltage		see note 12
Frequency range	590 to 720	MHz
Bandwidth (see note 13)	8.0	MHz
Transmitted power (see note 14)	1.0	kW

Table of Characteristics

	Min	Max	
Control current	38	44	A
Control magnet current	8.0	10	A
Control voltage	8.5	10	kV
Modulation level (see note 15)	—	-52	db
Transmitted power (see note 10)	—	200	mW

IN K4142 CIRCUIT, VISION AMPLIFIER SERVICE

Conditions

Supply voltage (see note 5)	5.0 to 5.5	V
Control magnet current	8.0 to 10	A
Frequency range	700 to 860	MHz
Bandwidth (see note 6)	8.0	MHz
Transmitted power (see note 7)	5.5	kW

Table of Characteristics

	Min	Max	
Control current	38	44	A
Control voltage (see note 8)	—	10	kV
Control current (see note 9)	—	150	mA
Control anode current	—	5.0	mA
Transmitted power (see note 10)	—	1.5	W
Efficiency (see note 11)	30	—	%

K385 IN K4142 CIRCUIT, TRANSPOSER SERVICE

Test Conditions

Heater voltage (see note 5)	5.0 to 5.5	V
Electro-magnet current		see note 2
Beam voltage		see note 12
Frequency range	700 to 860	MHz
Bandwidth (see note 13)	8.0	MHz
Peak synchronous power (see note 14)	1.0	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Electro-magnet current	8.0	10	A
Beam voltage	8.5	10	kV
Intermodulation level (see note 15)	—	−52	db
R.F. drive power (see note 10)	—	200	mW

NOTES

1. When a klystron is first installed it must be operated at 5.0V heater voltage.
2. Adjusted for minimum intermodulation product. This supply must be stabilized to within $\pm 2\%$.
3. Measured at the input to the circuit assembly.
4. This value applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
5. This supply must be stabilized to within $\pm 3\%$.
6. The klystron is tuned so that, for constant input power, the variation in output power is less than 1db over the specified bandwidth at all power levels between -2db and -14db with respect to the specified output power.
7. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output power.
8. With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current will be within $\pm 5\%$ of the value given by the graph on page 10.

The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.

Defined as the power delivered to a matched load substituted for the input cavity of the klystron.

The efficiency will not fall below the specified limit for any beam power in the range 15 to 20kW.

Adjusted for minimum intermodulation product. This supply must be stabilized to within $\pm 1\%$.

The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 1db over the specified bandwidth.

Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power adjusted to give the specified output.

The intermodulation is measured by driving the klystron with three signals as follows:

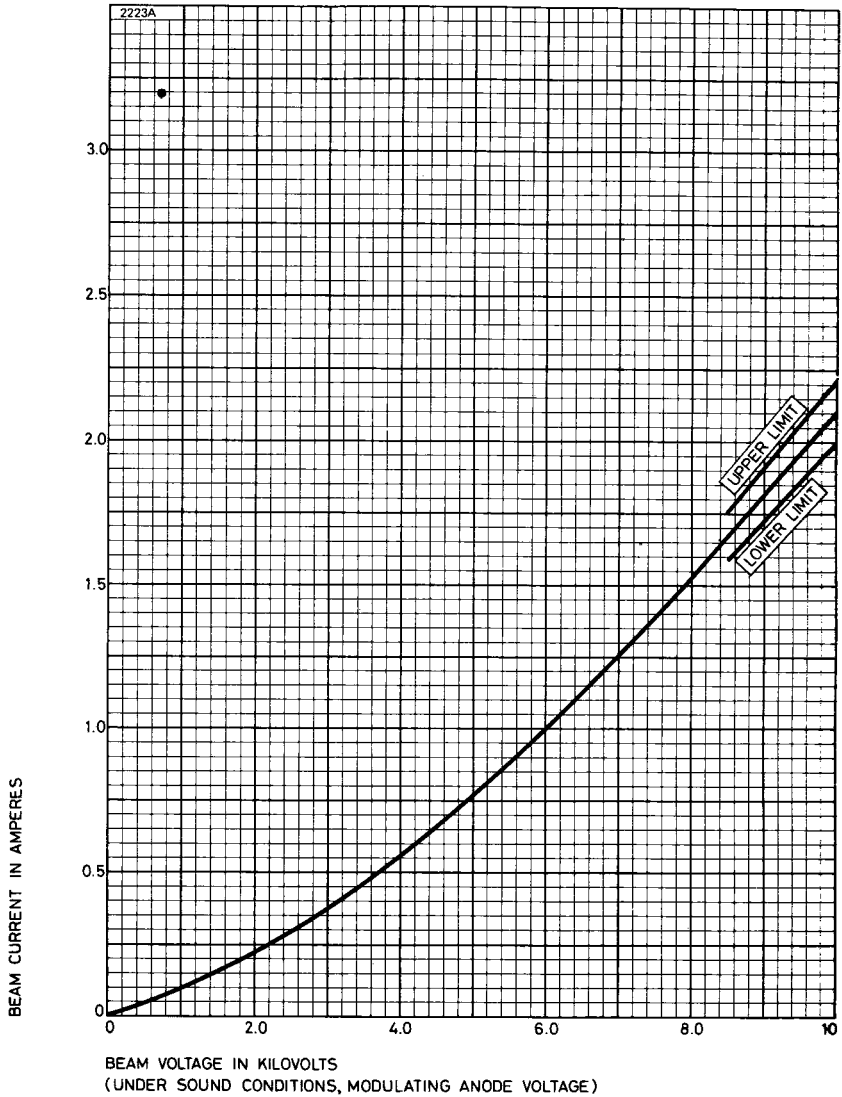
2.75MHz below channel centre	-8db
1.68MHz above channel centre	-17db
3.25MHz above channel centre	-7db

The drive levels are measured with respect to the drive power for 1kW output. The intermodulation level is measured with respect to 1kW.

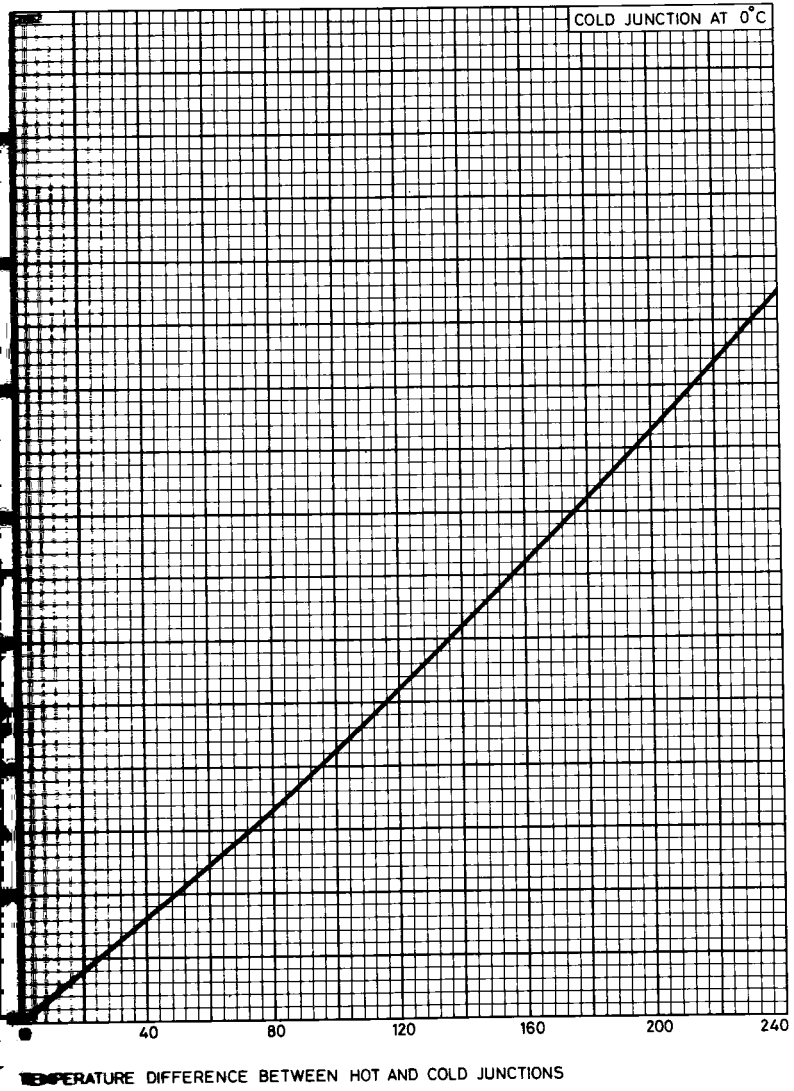
The circuit assemblies can be supplied to special order fitted with standard E.I.A. $1\frac{5}{8}$ inch flanged couplers. When these are required they must be specified in the order, using the numbers given below.

Circuit Assembly	Flanged Coupler
K4140	MA381
K4141	MA405
K4142	MA404

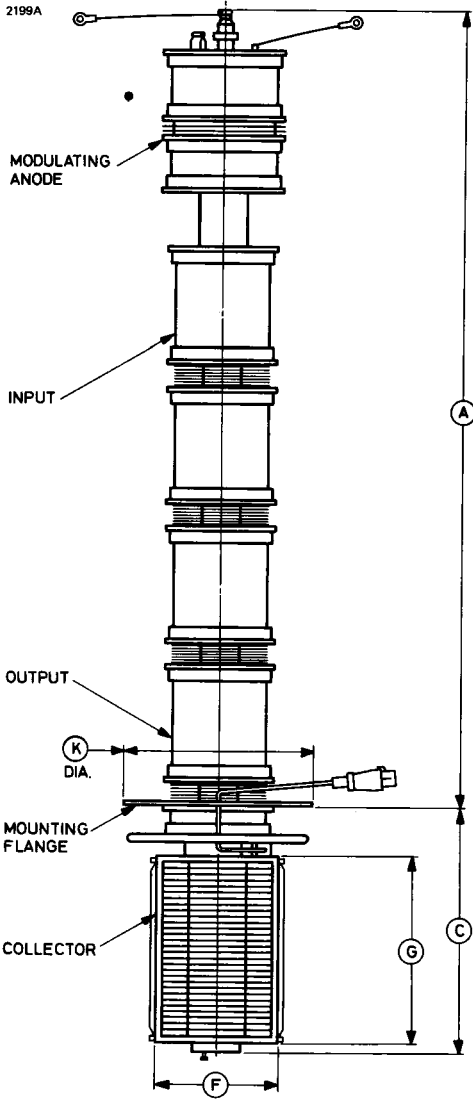
TYPICAL BEAM CHARACTERISTIC



TEMCOUPLER CALIBRATION CURVE

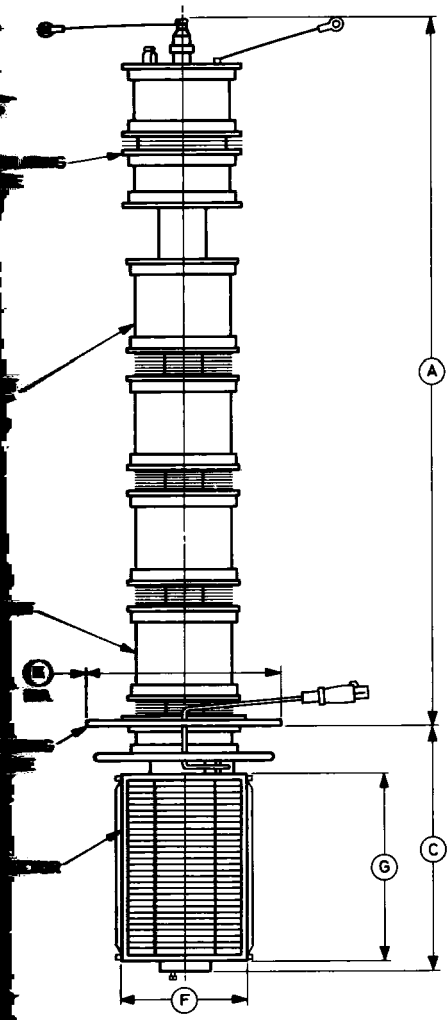


OUTLINE FOR K383



See page 15 for Outline Dimensions

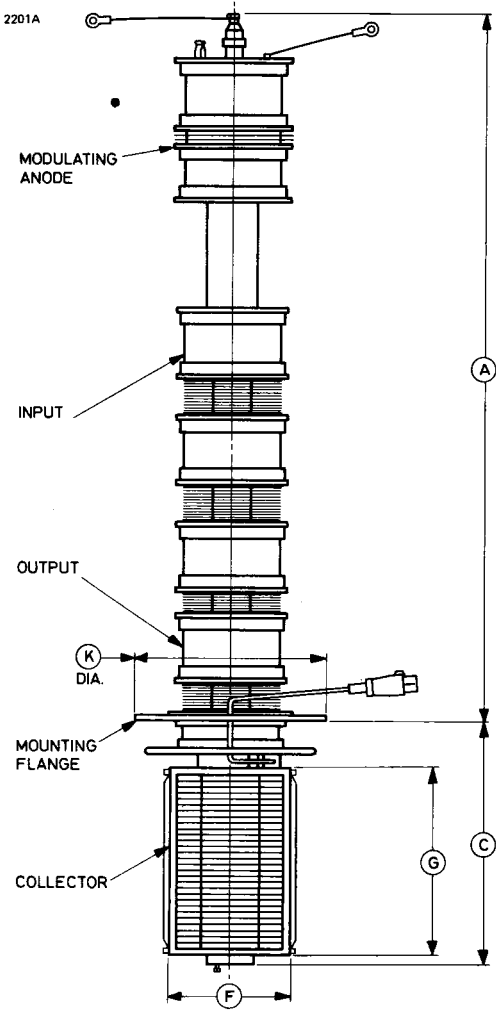
LINE FOR K384



Inches	Millimetres
30.100 max	764.5 max

dimensions as for K383 (see page 15).

OUTLINE FOR K385

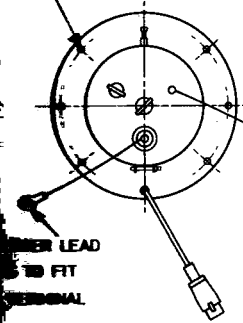


Ref	Inches	Millimetres
A	30.100 max	764.5 max

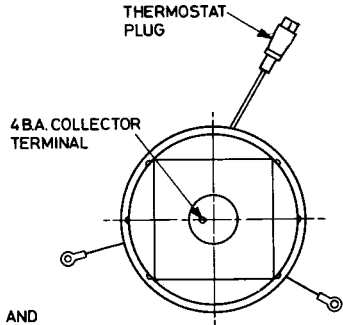
All other dimensions as for K383 (see page 15).

Details for K383, K384 and K385

HOLES THREADED
20-20UNC.



View on gun end



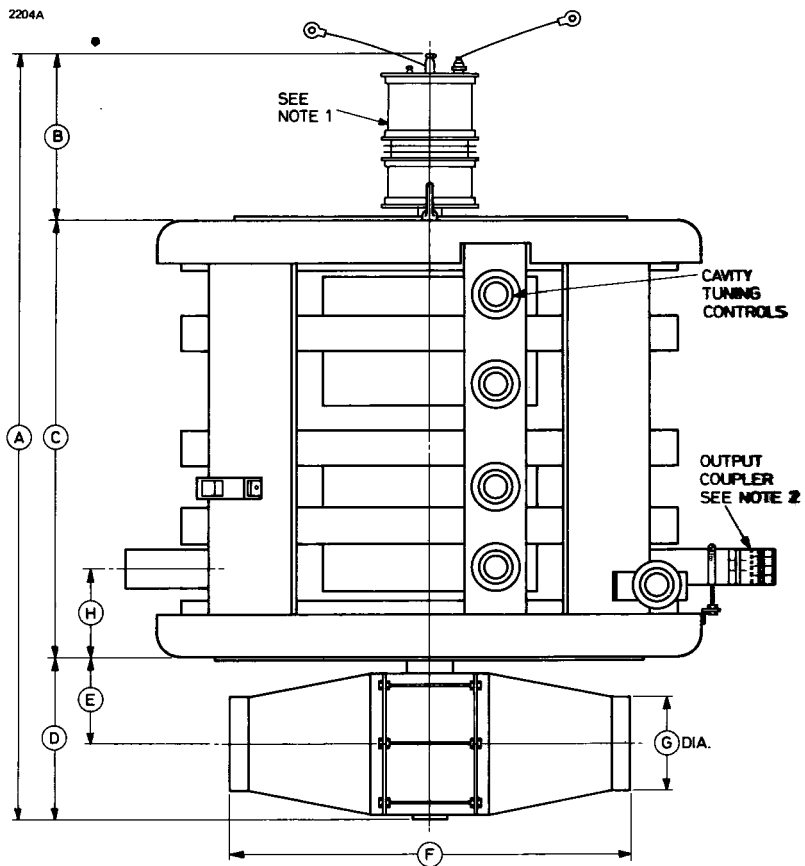
View on collector end

Dimensions for K383 (All dimensions without limits are nominal)

Inches	Millimetres
34.125 max	866.8 max
10.367 max	263.3 max
5.185 max	131.7 max
8.125 max	206.4 max
8.015 max	203.6 max
15.000 min	381.0 min
0.312	7.92
15.000 min	381.0 min
0.250	6.35

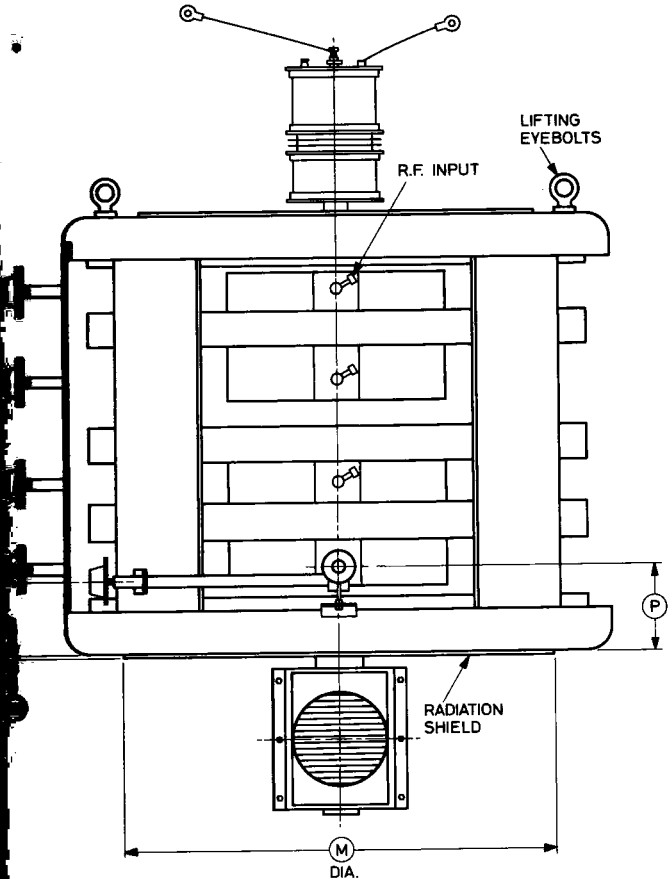
Dimensions have been derived from inches.

OUTLINE FOR K4140, K4141 AND K4142



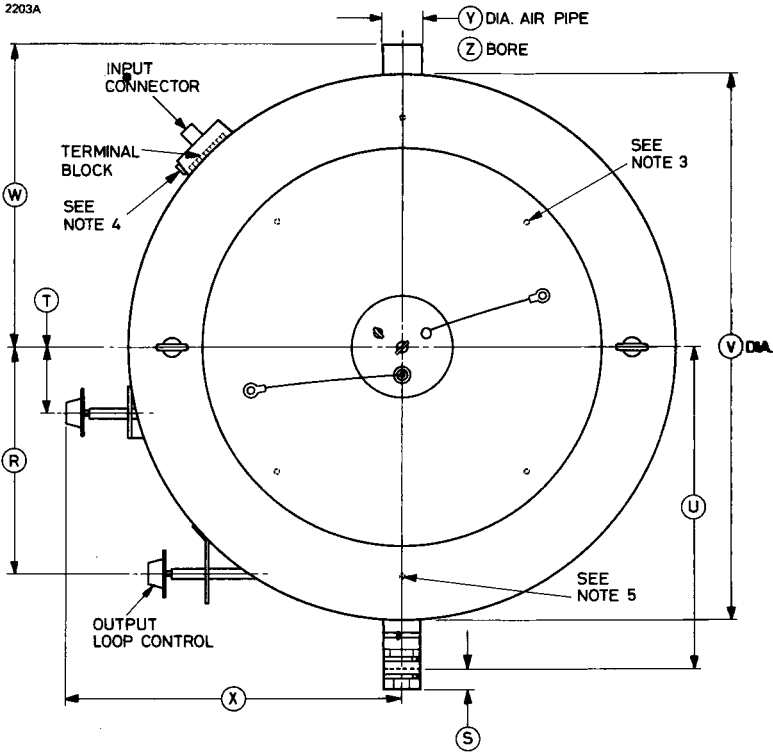
See page 19 for Outline Dimensions

LINE FOR K4140, K4141 AND K4142



19 for Outline Dimensions

OUTLINE FOR K4140, K4141 AND K4142



Outline Notes

1. The klystron is shown installed for clarity.
2. Quick release $1\frac{5}{8}$ inch 50Ω coaxial line. When the alternative E.I.A. coupler is fitted, it conforms to dimension U.
3. Four mounting holes in base, $\frac{3}{8}$ inch (9.53mm) diameter equally spaced on 18.500 inch (470mm) P.C.D.
4. Collector thermostat socket, see page 20 for connections.
5. Four mounting holes in base threaded $\frac{3}{8}$ -16 U.N.C. equally spaced on 24 inch (609.6mm) P.C.D.

Dimensions for K4140

Inches	Millimetres	Ref	Inches	Millimetres
4.500 max	1130.3 max	P	4.625 ± 0.062	117.5 ± 1.6
0.750 max	222.3 max	R	12.000	304.8
1.000 max	685.8 max	S	1.094	27.79
0.750 max	222.3 max	T	3.500	88.90
0.625	117.5	U	17.000 ± 0.100	431.8 ± 2.5
1.000	533.4	V	29.250 max	743.0 max
0.800	127.0	W	15.625 ± 0.250	396.9 ± 6.4
0.800	101.6	X	17.500	444.5
0.700	93.98	Y	2.625	66.68
2.750	577.9	Z	2.500	63.50
0.207	5.26			

These dimensions have been derived from inches.

Dimensions for K4141 and K4142

Inches	Millimetres	Ref	Inches	Millimetres
4.500 max	1028.7 max	P	4.625 ± 0.062	117.5 ± 1.6
0.750 max	222.3 max	R	12.000	304.8
1.000 max	584.2 max	S	1.094	27.79
0.750 max	222.3 max	T	3.500	88.90
0.625	117.5	U	17.000 ± 0.100	431.8 ± 2.5
1.000	533.4	V	29.250 max	743.0 max
0.800	127.0	W	15.625 ± 0.250	396.9 ± 6.4
0.800	101.6	X	17.500	444.5
0.700	93.98	Y	2.625	66.68
2.750	577.9	Z	2.500	63.50
0.207	5.26			

These dimensions have been derived from inches.

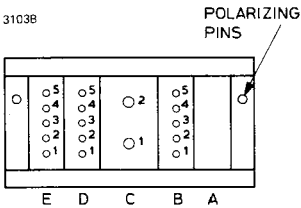
Dimensions without limits are nominal

ELECTRICAL CONNECTIONS

All connections to the circuit assembly are made through a Smiths Hypertac connector. The mating socket is connected to a 10-way terminal block and a five-pin receptacle which accepts the collector thermostat plug wired to the klystron. The focus coils and collector thermostat are wired through to the input connector; earth and collector connections are to be made by the customer after assembling the circuit assembly and klystron. The body of the klystron is earthed through the circuit assembly and the heater, cathode and modulating anode connections are made separately.

Input Connector (to be wired by customer)

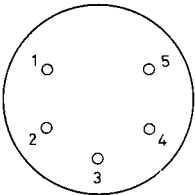
View on solder connections
with cover removed



Collector thermostat:	
positive	B1
negative	B2
Collector	B3
Link	B4, B5
Focus coils:	
negative	C1
positive	C2
Earth	E3

Five-pin Receptacle

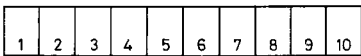
3532



Collector thermostat:	
positive	1
negative	2

Note If the thermostat circuit is operated on d.c., the polarity should be as shown above.

Terminal Block (to be wired by customer)



Collector	3
Focus coils (wired by EEV):	
negative	4
positive	5
Earth	10



K3004 K3005 K3006

HIGH POWER AMPLIFIER
KLYSTRONS for U.H.F.
TELEVISION SERVICE

FEATURING

- **Output Power** 7kW output, combined with long life and reliable performance.
- **High Gain** Fully compatible with solid state drive.
- **Bandwidth** 8MHz between 1db points over the tuning range.
- **High Stability** Air blown cavities ensure high operational stability.
- **Simple Installation** Pre-adjusted cavities — an integral part of the transmitter. Vacuum tube changes can be carried out by unskilled staff in less than 30 minutes.
- **Simple Vapour Cooling** Collector down configuration with vapour cooling — silent, self-circulating system; no pump.
- **Adjustable Cavity Loading** Adjustable loops to give optimum overall system performance on any channel.

DESCRIPTION

K3004, K3005 and K3006 are four-cavity amplifier klystrons for use in the output stages of sound and vision transmitters in u.h.f. television service. The three tubes operate in the frequency bands 470–610MHz, 590–720MHz and 700–860MHz respectively. A modulating anode is fitted, enabling the tubes to operate at lower power levels in sound transmitters but using the same beam voltage supply as the vision amplifier.

The tubes are electro-magnetically focused and their associated circuit assemblies are designed to reduce tube replacement time to a minimum. With this design, full use is made of the advantages of the external cavity klystron. On initial installation the cavities can be tuned to a specific channel and the loading loops adjusted for optimum television performance. The cavities can be detached from the vacuum tube and refitted on a replacement tube without disturbing the tuning or the loading loop settings. At switch-on, the replacement klystron will be coarse-tuned, requiring only a trimming adjustment to meet the full specification.

APPROVED CIRCUIT ASSEMBLIES

Klystron	Frequency in the range	Channels	Circuit Assembly
K3004	470 to 610MHz	21-37	K4145
K3005	590 to 720MHz	36-51	K4146
K3006 •	700 to 860MHz	50-68	K4147

Note For operation of these tubes in circuit assemblies of the K4105, K4106, K4107 series, see data sheet K3004, K3005, K3006 dated July 1969.

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	in the range 5.0 to 5.5	V
Heater current	38 to 44	A
Heater starting current (peak)	84	A max
Cathode heating time (minimum)	5	min

Mechanical

Overall length:		
K3004	44.187 inches (112.2cm) max	
K3005, K3006	40.162 inches (102.0cm) max	
Overall diameter	8 inches (20.3cm) max	
Mounting position	vertical, cathode end up	
Net weight of klystron:		
K3004	60 pounds (27kg) approx	
K3005 K3006	55 pounds (25kg) approx	

Circuit Assembly

Electro-magnet current, stabilized to $\pm 2\%$ (see note 2)	10 to 12	A
Electro-magnet resistance:		
cold (20°C)	5.7	Ω
hot (20°C ambient)	7.3	Ω max
R.F. input connector	type N coaxial	
R.F. output	quick release $1\frac{5}{8}$ inch 50Ω coaxial line	
Net weight of tuning cavities:		
for K3004	102 pounds (46kg) approx	
for K3005	83 pounds (38kg) approx	
for K3006	64 pounds (29kg) approx	
Net weight of magnet assembly	784 pounds (356kg) approx	

Cooling

The klystron collector is vapour cooled. The boiler, which is part of the circuit assembly, is of the upward steam exit type and intended for use with a separate condenser.

The final drift tube and the four cavities are forced-air cooled. This is achieved by means of a single air inlet pipe on the circuit assembly, the air being directed to the required parts of the klystron by channeling within the circuit. Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

Air flow for cavity cooling (minimum)	100	ft ³ /min
	2.8	m ³ /min
Air flow to cathode terminal	5.0	ft ³ /min
	0.14	m ³ /min
Static pressure head at 100ft ³ /min (see note 3)	1.5	inches (38mm) w.g.
Inlet air temperature	40	°C max
Temperature of any external parts of the klystron must not exceed	175	°C max
Volume of steam produced by collector dissipation	1.5	ft ³ /min/kW
	0.043	m ³ /min/kW
Volume of water converted to steam	0.006	imp.gal/min/kW
	0.027	litre/min/kW

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage	12.5	kV max
Beam current (mean)	3.0	A max
Body current:		
with no input power	50	mA max
at saturated output power	150	mA max
Output power (saturated)	8.0	kW max
Collector dissipation	35	kW max
Load v.s.w.r. (see note 4)	1.5:1	max

TYPICAL OPERATION

The operating conditions and performance figures given are for operation in a television transmitter giving a peak synchronous output power of 6.25kW. The klystrons are also suitable for transposer service.

Operating Conditions

Beam voltage	10.5	kV
Beam current	2.2	A
Electro-magnet current	11	A
Bandwidth (to 1db points)	8.0	MHz

K3004 in K4145 Circuit

Frequency	470 to 478 (channel 21)	526 to 534 (channel 28)	598 to 606 (channel 37)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (6.25kW)	30	27	29	mA
at 7.0kW c.w. output, vision frequency	48	43	48	mA
Drive power:				
at 6.25kW output	1.0	0.6	0.4	W
at 7.0kW output	1.2	0.7	0.5	W
Saturated output power	7.5	7.5	7.5	kW

K3005 in K4146 Circuit

Frequency	590 to 598 (channel 36)	654 to 662 (channel 44)	710 to 718 (channel 51)	MHz
Body current:				
with no input power	10	10	10	mA
black level + sync. (6.25kW)	28	24	30	mA
at 7.0kW c.w. output, vision frequency	46	45	50	mA
Drive power:				
at 6.25kW output	0.65	0.35	0.13	W
at 7.0kW output	1.0	0.6	0.35	W
Saturated output power	7.5	7.7	7.8	kW

K3006 in K4147 Circuit

Frequency	702 to 710 (channel 50)	774 to 782 (channel 59)	846 to 854 (channel 68)	MHz
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Body current:

with no input power	10	10	10	mA
black level + sync. (6.25kW)	27	28	26	mA
at 7.0kW c.w. output, vision frequency	45	50	40	mA

Drive power:

at 6.25kW output	1.1	0.5	0.5	W
at 7.0kW output	1.4	0.8	0.6	W
Saturated output power	7.6	7.8	7.9	kW



Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 8 shows approximately the modulating anode voltage required for a given beam current (the voltage is expressed relative to cathode potential). Under these conditions the modulating anode current may vary between 0 and 1.5mA. If a potential divider network is used to supply the modulating anode it must allow for this variation.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K3004 IN K4145 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	10 to 12	A
Frequency range	470 to 610	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	7.0	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Beam voltage (see note 7)	—	11	kV
Body current (see note 8)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 9)	—	1.5	W
Efficiency (see note 10)	30	—	%

K3005 IN K4146 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	10 to 12	A
Frequency range	590 to 720	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	7.0	kW

Range of Characteristics

	Min	Max	
Heater current	38	44	A
Beam voltage (see note 7)	—	11	kV
Body current (see note 8)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 9)	—	1.5	W
Efficiency (see note 10)	30	—	%

K3006 IN K4147 CIRCUIT, VISION AMPLIFIER SERVICE

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	10 to 12	A
Frequency range	700 to 860	MHz
Bandwidth (see note 5)	8.0	MHz
Output power (see note 6)	7.0	kW

Range of Characteristics

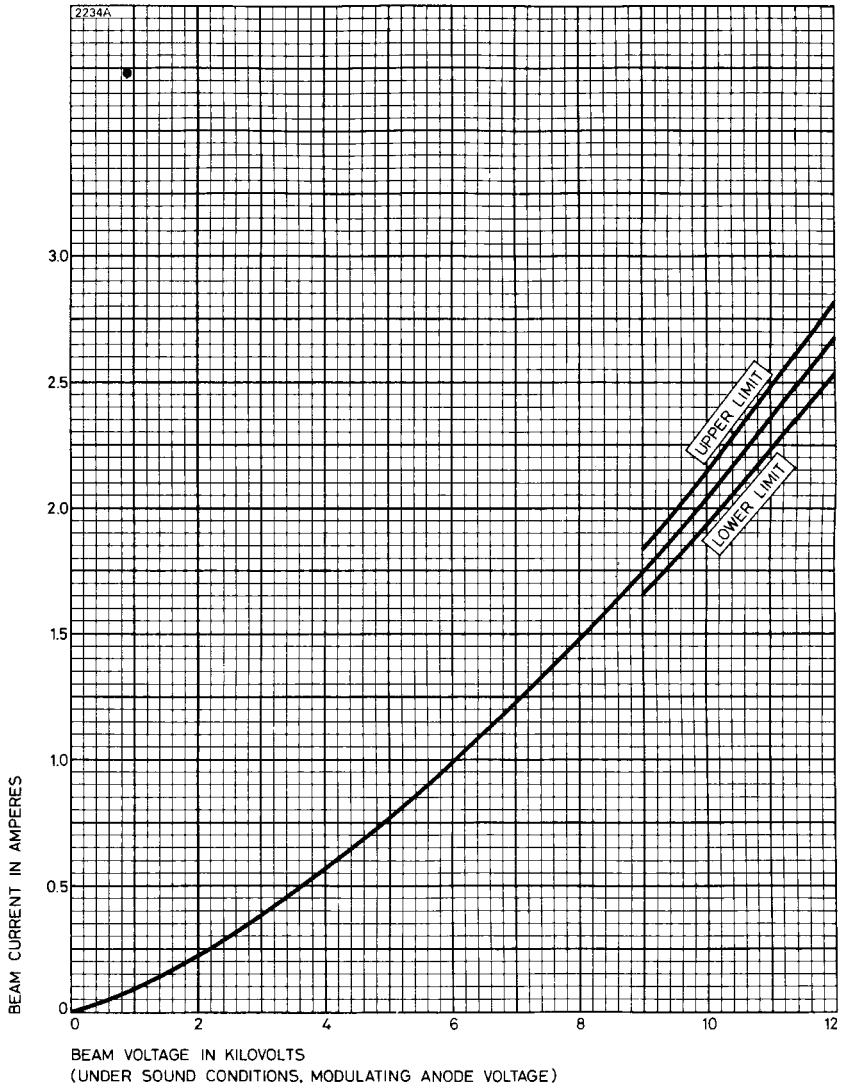
	Min	Max	
Heater current	38	44	A
Beam voltage (see note 7)	—	11	kV
Body current (see note 8)	—	150	mA
Modulating anode current	—	5.0	mA
R.F. drive power (see note 9)	—	1.5	W
Efficiency (see note 10)	30	—	%

NOTES

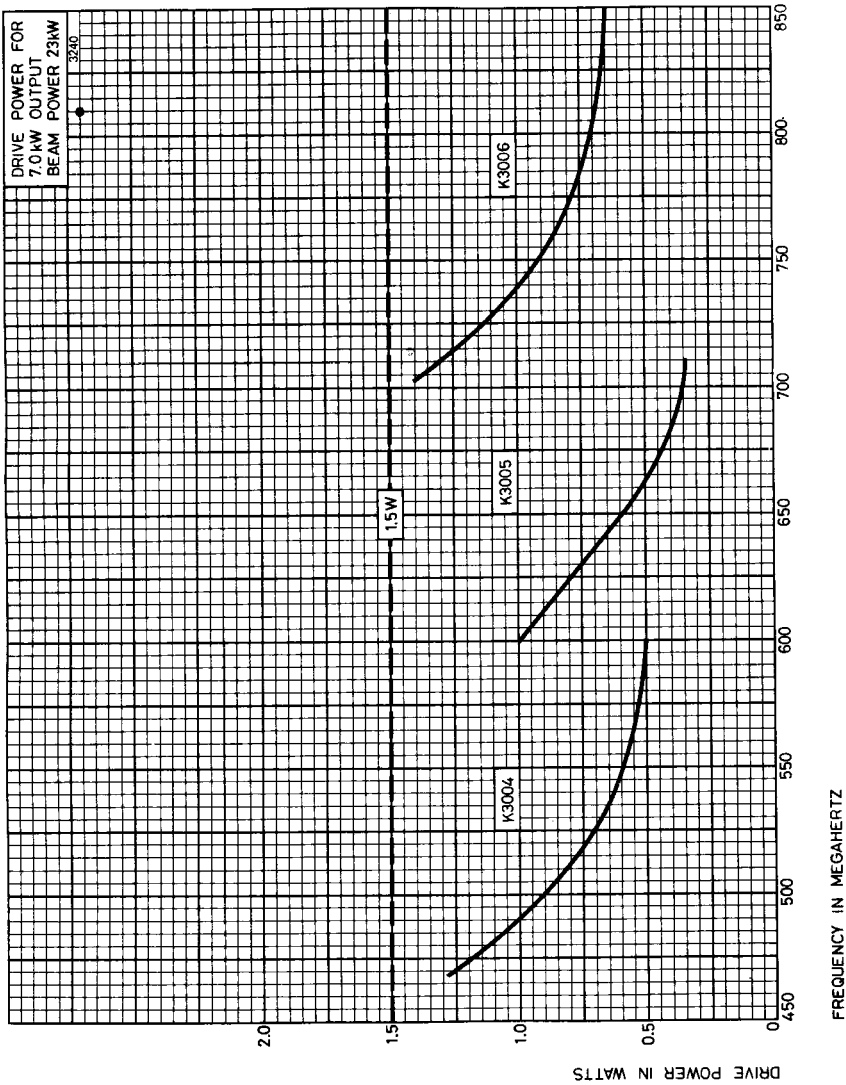
1. When a klystron is first installed it must be operated at 5.0V heater voltage.
2. Under T.V. picture conditions (black level + sync. pulses) the klystron
 - will focus satisfactorily within the specified range of electro-magnet current. Maximum stability is obtained by adjusting the magnet current within this range and stabilizing to $\pm 2\%$ about this optimum value.
3. Measured at the input to the circuit assembly.
4. This value applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
5. The klystron is tuned so that, for constant input power, the variation in output power is less than 1db over the specified bandwidth at all power levels between -2db and -14db with respect to the specified output power.
6. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
7. With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current will be within $\pm 5\%$ of the value given by the graph on page 8.
8. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
9. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
10. The efficiency will not fall below the specified limit for any beam power in the range 20 to 26kW.



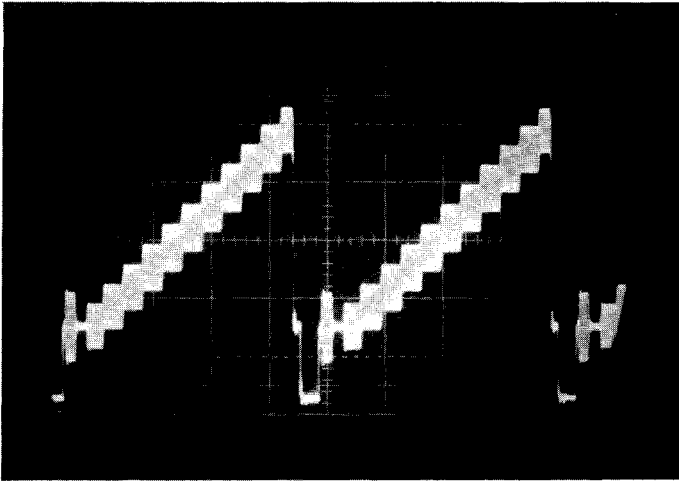
TYPICAL BEAM CHARACTERISTIC



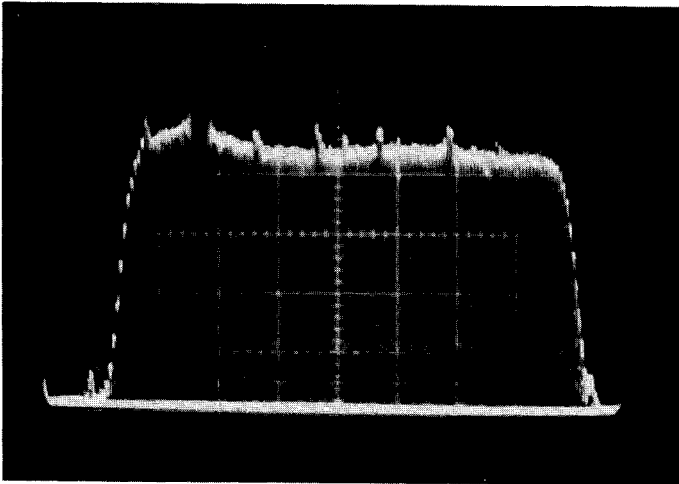
TYPICAL DRIVE REQUIREMENTS



TYPICAL TELEVISION PERFORMANCE

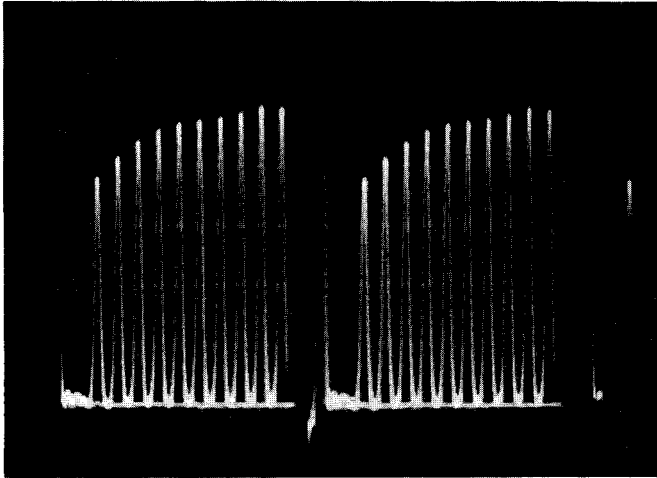


Test Waveform

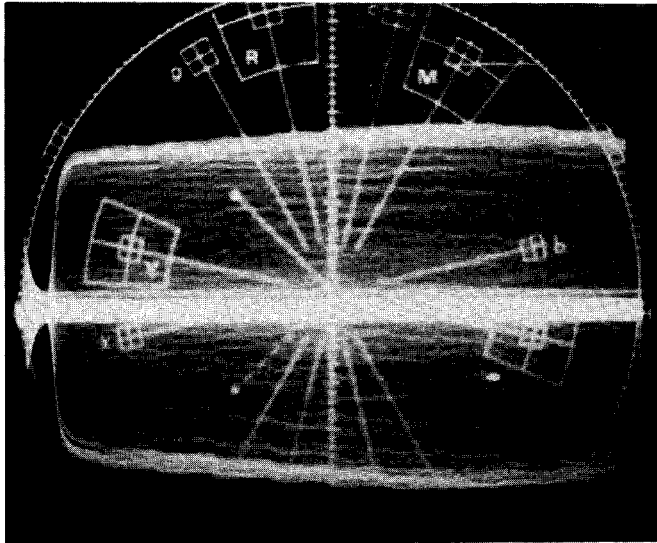


Output Frequency Response at Mid Grey

TYPICAL TELEVISION PERFORMANCE

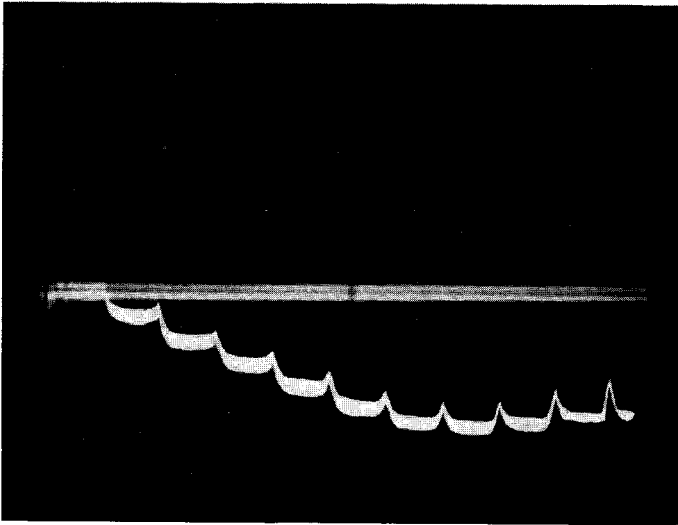


Linearity 74%



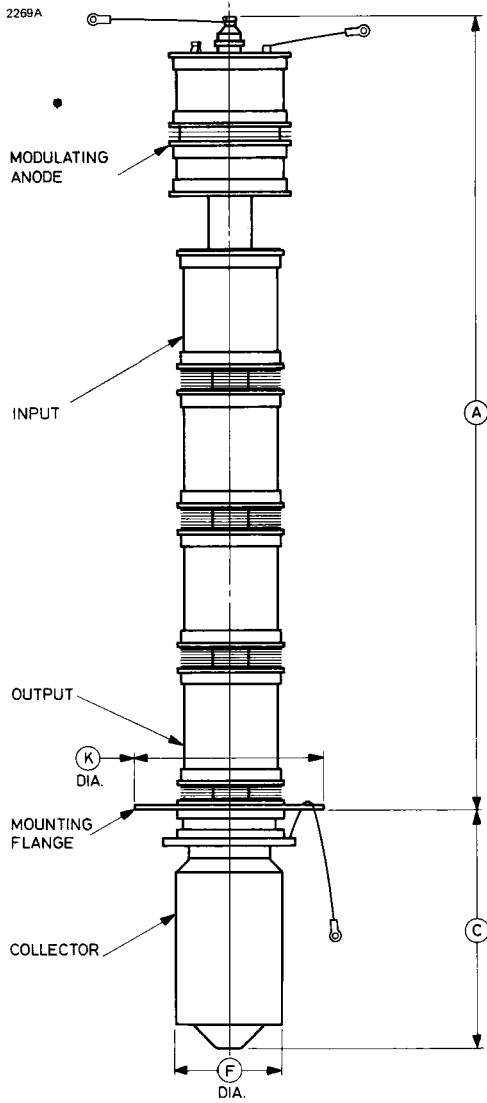
Differential Gain 82%

TYPICAL TELEVISION PERFORMANCE



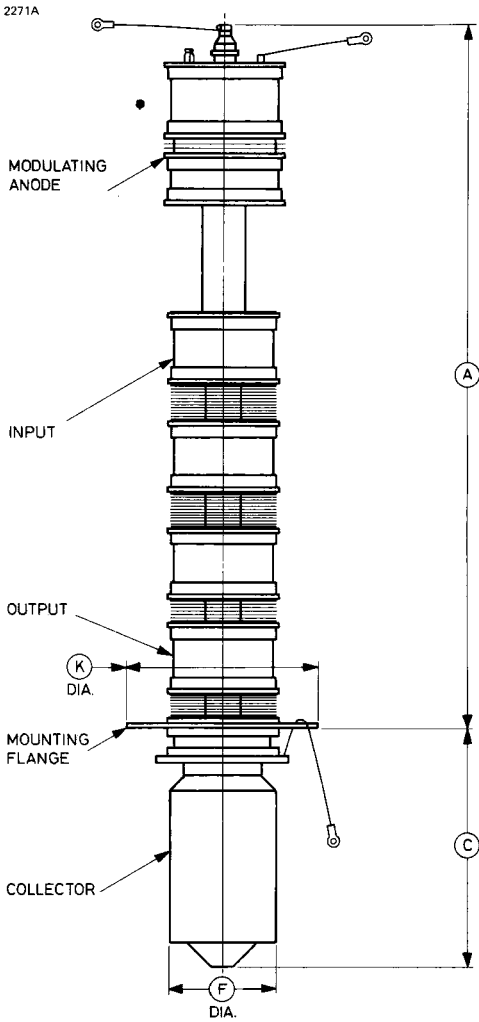
Differential Phase 6°

OUTLINE FOR K3004



See page 15 for outline details and dimensions

OUTLINE FOR K3005 AND K3006

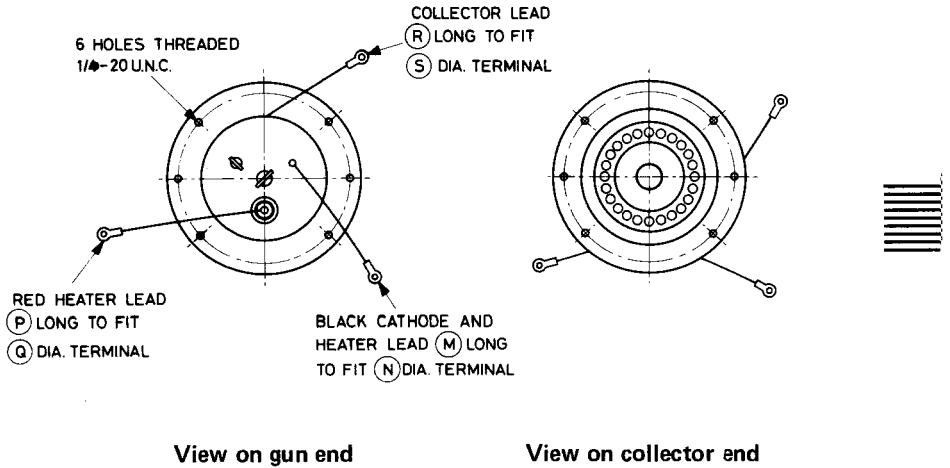


This drawing is not to scale for the K3005.

See page 15 for outline details and dimensions

Outline Details of K3004, K3005 and K3006

2106A



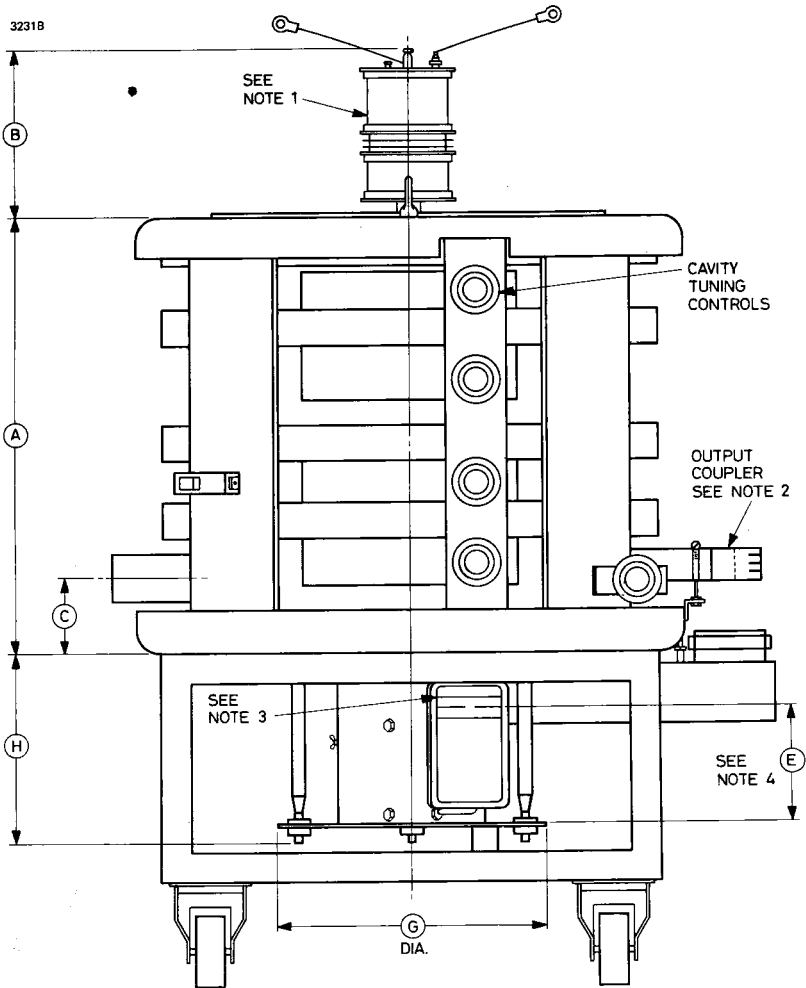
Outline Dimensions for K3004 (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A*	34.125 max	866.8 max
C	10.062 max	255.6 max
F	4.375	111.1
K	8.000 max	203.2 max
M	15.000 min	381.0 min
N	0.312	7.92
P	15.000 min	381.0 min
Q	0.250	6.35
R	36.000 min	914.4 min
S	0.196	4.98

Millimetre dimensions have been derived from inches.

* For K3005 and K3006, dimension A is 30.100 inches (764.5mm) max; the other dimensions are as for K3004.

OUTLINE FOR K4145, K4146 AND K4147

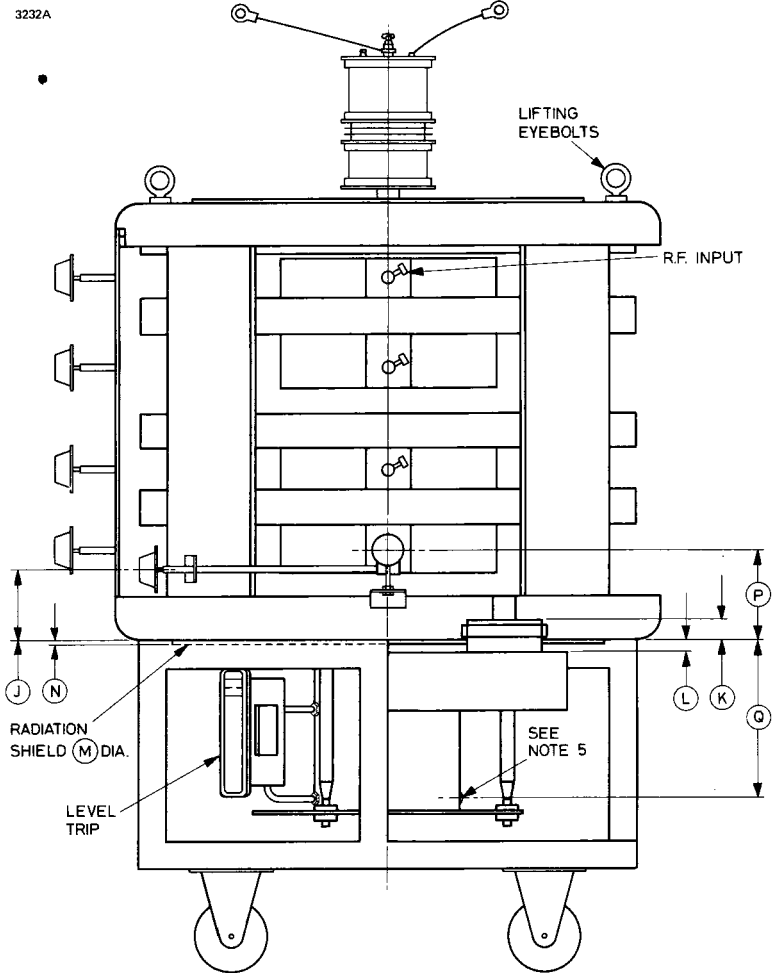


Note The circuit assembly is shown mounted on a trolley. This trolley is not part of the circuit assembly.

See page 19 for outline dimensions

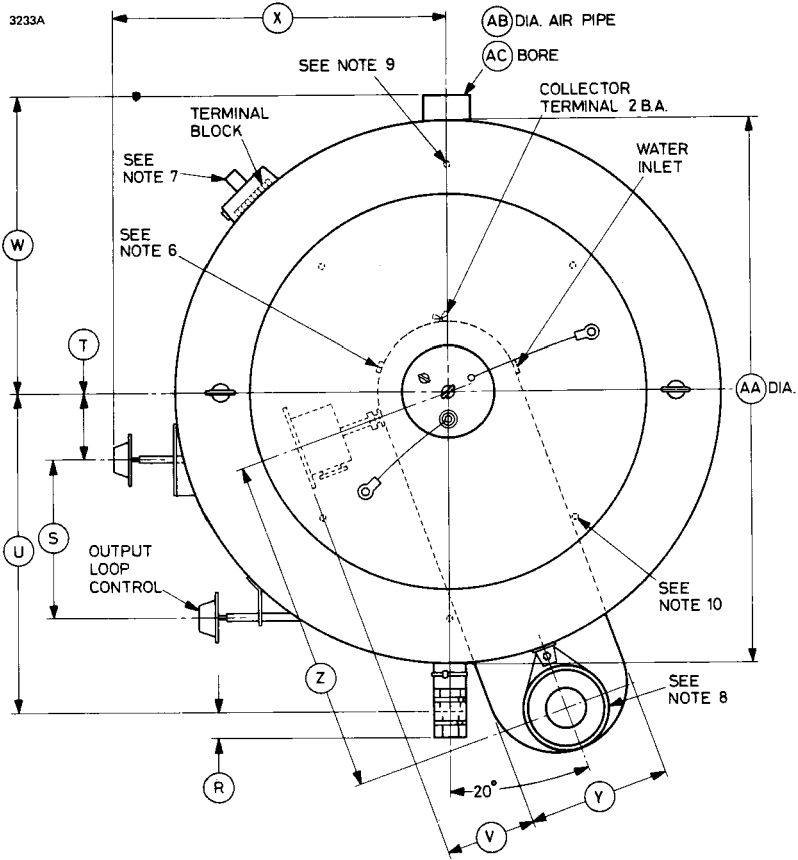
OUTLINE FOR K4145, K4146 AND K4147

3232A



See page 19 for outline dimensions

OUTLINE FOR K4145, K4146 AND K4147



Outline Notes

1. The klystron is shown installed for clarity.
2. Quick release 1⁵/₈ inch 50Ω coaxial line.
3. Recommended cold switch-on level.
4. The level trip is set up to this figure.
5. Water inlet 3/4 inch B.S.P.F. thread.

6. Pipe fittings for a water level control unit are provided and fitted with removable stoppers. They are 1/2 inch 'Kontite' couplings at 6.250 inch (158.8mm) centres. The water level control unit is not supplied as part of the circuit assembly.
7. Input connector, see page 20.
8. Steam outlet 4 1/2 inch diameter, 4 U.N. class 2A thread.
9. Four mounting holes in base threaded 3/8 - 16 U.N.C. equally spaced on 24 inch (609.6mm) P.C.D.
10. Four mounting holes in base, 3/8 inch (9.53mm) diameter equally spaced on 18.500 inch (470mm) P.C.D.



Outline Dimensions for K4145 (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	27.000 max	685.8 max	R	1.094	27.79
B	8.750 max	222.3 max	S	8.500	215.9
C	4.000	101.6	T	3.500	88.90
E	5.900	149.9	U	17.000 ± 0.100	431.8 ± 2.5
G	14.000	355.6	V	4.000 max	101.6 max
H	10.750 max	273.1 max	W	15.625 ± 0.250	396.9 ± 6.4
J	3.700	93.98	X	17.500 max	444.5 max
K	1.000 ± 0.125	25.40 ± 3.18	Y	7.500	190.5
L	0.625 min	15.88 min	Z	18.000	457.2
M	22.750	577.9	AA	29.250 max	743.0 max
N	0.207	5.26	AB	2.625	66.68
P	4.625 ± 0.062	117.5 ± 1.6	AC	2.500	63.50
Q	8.125	206.4			

Millimetre dimensions have been derived from inches.

* For K4146 and K4147, dimension A is 23.000 inches (584.2mm) max; the other dimensions are as for K4145.

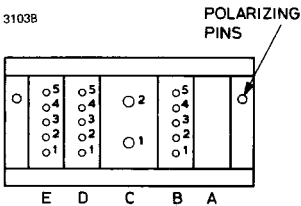
ELECTRICAL CONNECTIONS

All connections to the circuit assembly are made through a Smiths Hypertac connector. The mating socket is connected to a 10-way terminal block. The focus coils are wired through to the input connector; all other connections are to be made by the customer after assembling the circuit assembly and boiler. The body of the klystron is earthed through the circuit assembly and the heater, cathode, modulating anode and collector connections are made by flying leads.

Input Connector

(to be wired by customer)

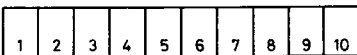
View on solder connections
with cover removed



Water level trip	B1, B2
Collector	B3
Link	B4, B5
Focus coils:	
negative	C1
positive	C2
Water level control (see note 6 on page 19)	D1, D2
Earth	E3

Terminal Block

(to be wired by customer)



Water level trip	1, 2
Collector	3
Focus coils (wired by EEV):	
negative	4
positive	5
Water level control (see note 6 on page 19)	6, 7
Earth	10



K3014 K3015 K3016

AMPLIFIER KLYSTRONS

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is vapour cooled in a boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.



Klystron	Frequency Range	Circuit Assembly
K3014	470 to 610MHz	K4102BDS
K3015	590 to 720MHz	K4103BDS
K3016	700 to 860MHz	K4104BDS

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	28	kW
Power gain (typical):		
K3014	41	db
K3015	44	db
K3016	44	db
Beam voltage	18	kV
Output	3 ¹ / ₈ inch 50Ω coaxial line	
Cooling (see page 2)	water, vapour and forced-air	

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	8.5 ± 3%	V
Heater current	37 to 46	A
Heater starting current (peak)	200	A max
Cathode heating time (see note 1)	5	minutes

Mechanical

Overall length (see note 2):		
K3014, K3015	63.75 inches (161.9cm)	max
K3016	59.5 inches (151.1cm)	max
Overall diameter	11.125 inches (283mm)	nom
Mounting position	vertical, collector end up	
Net weight of klystron:		
K3014, K3015	210 pounds (95kg)	approx
K3016	155 pounds (70kg)	approx

August 1971

Circuit Assembly

Electro-magnet current (see note 3)	9 ± 1	A		
Electro-magnet resistance:	K4102BDS	K4103BDS	K4104BDS	
cold (20°C)	9.5 ± 1	9.0 ± 1	8.5 ± 1	Ω
hot (20°C ambient)	13	13	12	Ω max
R.F. input connector				type N coaxial
R.F. output	3 1/8 inch			50Ω coaxial line
Net weight of tuning cavities:				
K4102BDS (for K3014)	120 pounds (54kg)			approx
K4103BDS (for K3015)	90 pounds (41kg)			approx
K4104BDS (for K3016)	70 pounds (32kg)			approx
Total lifting weight of klystron, cavities, boiler and mounting collar:				
K3014	440 pounds (200kg)			approx
K3015	410 pounds (186kg)			approx
K3016	335 pounds (152kg)			approx
Net weight of magnet assembly	1800 pounds (816kg)			approx
EEV arc detector type MA257 is fitted to the output cavity. See pages 24 to 26 for connection details and suggested operating circuit.				

Cooling

The klystron collector is vapour cooled in a boiler with an upward steam exit, intended for use with a separate condenser. The klystron body is water cooled; for best stability, the body water temperature must be stabilized. The gun and the output and penultimate cavities require forced air cooling.

Volume of steam produced by collector dissipation	1.5	ft ³ /min/kW (0.043m ³ /min/kW)
Volume of water converted to steam	0.006	imp.gal/min/kW (0.027 litre/min/kW)
Inlet water flow to body and collector in series (see note 4)	2.0	imp.gal/min (9 litres/min)
Body pressure drop at 2.0 imp.gal/min	28	lb/in ² (2.0kg/cm ²)
Inlet water temperature	80	°C max
Air flow to penultimate and output cavities	50	ft ³ /min (1.42m ³ /min) each
Static pressure head (see note 5)	1	inch (25mm) w.g.
Air flow to cathode	5.0	ft ³ /min (0.142m ³ /min)
Inlet air temperature	40	°C max
Temperature of any external part of the klystron must not exceed	175	°C max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage:		
continuous	20	kV max
switch-on surge	24	kV max
Beam current (mean)	6.0	A max
Body current	150	mA max
Output power	30	kW max
Collector dissipation	100	kW max
Load v.s.w.r. (see note 6)	1.5:1	max
Thermocouple e.m.f. (see note 7)	9.8	mV max



TYPICAL OPERATION (Vision amplifier)

Operating Conditions

Beam voltage	18	kV
Beam current	4.6	A
Electro-magnet current	9.0	A
Bandwidth (to 1db points)	8.0	MHz

K3014 IN K4102BDS CIRCUIT

Frequency	486 to 494 (channel 23)	542 to 550 (channel 30)	MHz
Body current:			
with no input power	15	15	mA
at 28kW c.w. output, vision frequency	60	55	mA
Drive power for 28kW output	2.0	2.0	W
Saturated output power	28	28	kW

K3015 IN K4103BDS CIRCUIT

Frequency	590 to 598 (channel 36)	710 to 718 (channel 51)	MHz
Body current:			
with no input power	15	15	mA
at 28kW c.w. output, vision frequency	55	60	mA
Drive power for 28kW output	1.0	1.2	W
Saturated output power	28	28	kW

K3016 IN K4104BDS CIRCUIT

Frequency	702 to 710 (channel 50)	846 to 854 (channel 68)	MHz
Body current:			
with no input power	15	15	mA
at 28kW c.w. output, vision frequency	75	80	mA
Drive power for 28kW output	0.8	1.5	W
Saturated output power	28	28	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 9 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the maximum value of the modulating anode current is 1.5mA. The potential divider network must be designed accordingly.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K3014 IN K4102BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	470 to 610	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	18.5	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	3.0	W
Efficiency (see note 13)	32	—	%

K3015 IN K4103BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	18.5	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	3.0	W
Efficiency (see note 13)	32	—	%

K3016 IN K4104BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	700 to 860	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	19	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	2.0	W
Efficiency (see note 13)	30	—	%



OPERATION WITH LOWER DRIVE POWER

The drive power required for this range of klystrons can be reduced by increasing the klystron beam voltage. This reduces the efficiency but makes possible the use of a solid state drive in place of the tube amplifier stages previously required. A drive power of 1.5 watts is given in the following specification but other values are possible dependent upon the beam voltage used.

K3014 IN K4102BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	470 to 610	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	20	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	1.5	W
Efficiency (see note 14)	28	—	%

K3015 IN K4103BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	590 to 720	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	19	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	1.5	W
Efficiency (see note 14)	30	—	%

K3016 IN K4104BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	8 to 10	A
Frequency range	700 to 860	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	28	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	19.5	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	1.5	W
Efficiency (see note 14)	30	—	%

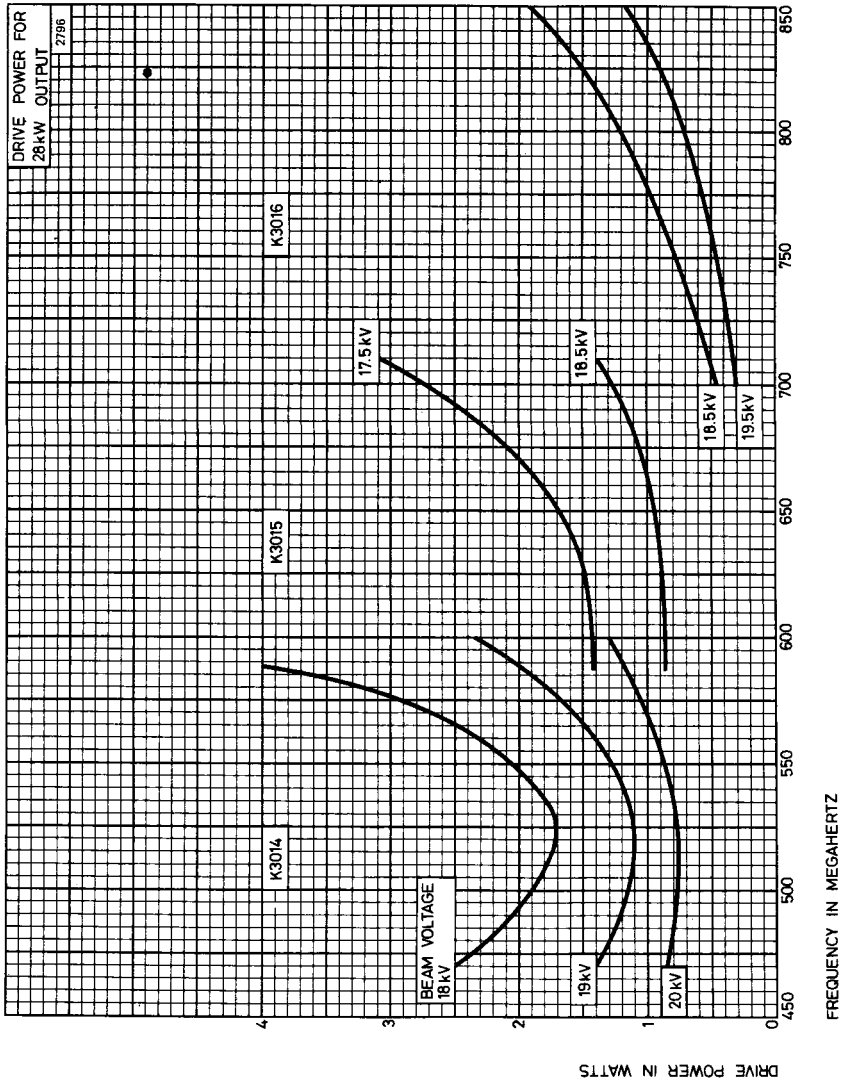
NOTES

1. For fast warm-up using a 'hot shot' technique, consult English Electric Valve Company Ltd.
2. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 135 inches (3.43m) is required. This is measured to the top of the harness and does not include the hoist.

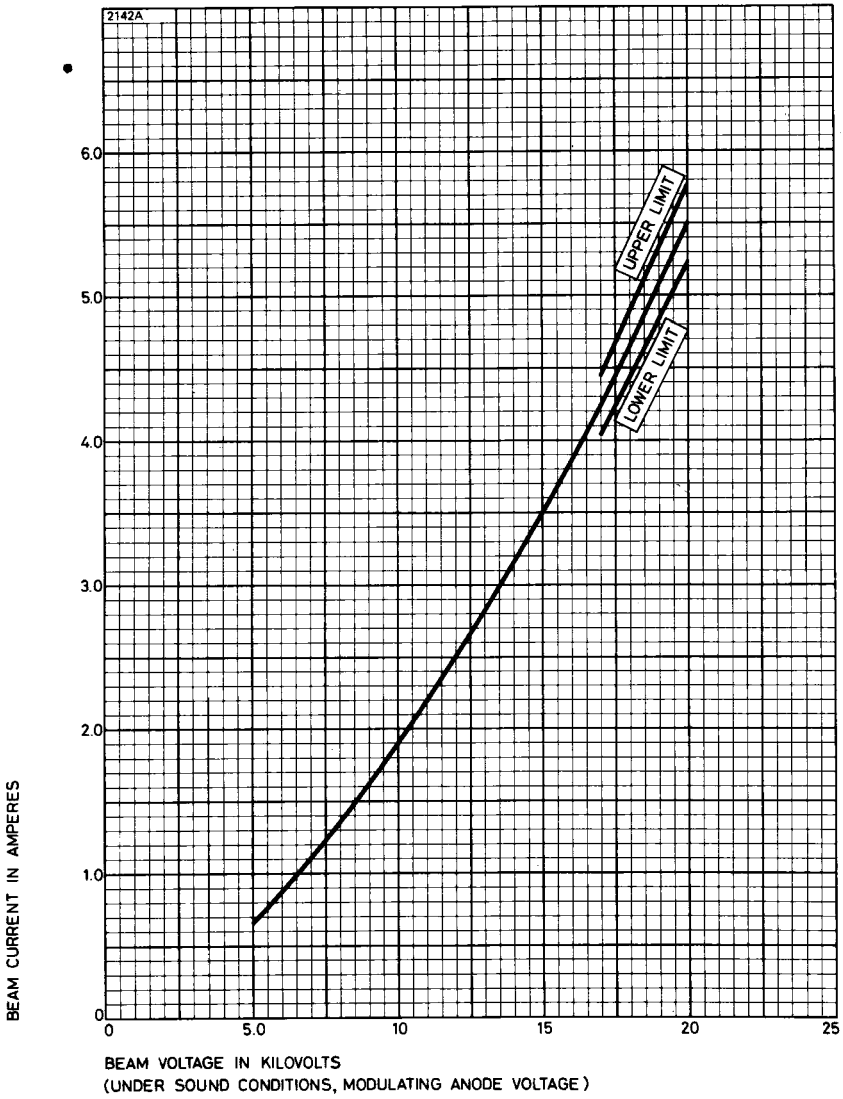
3. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily within an electro-magnet current range of 8.0 to 10A. Maximum stability is obtained by adjusting the magnet current within the above range and stabilizing to $\pm 2\%$ about this optimum value.
4. Alternative cooling arrangements can be used.
5. Measured at the input pipes to the circuit assembly.
6. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
7. The klystron is provided with three nickel chromium-nickel aluminium thermocouples fitted to the collector. On commissioning a new klystron the output of each must be monitored and the one reading the highest temperature used as a control for future monitoring.
8. The klystron is tuned so that, for constant input power, the variation in output power is less than 1db over the specified bandwidth at all power levels between -2db and -14db with respect to the specified output power.
9. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
10. With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current will be within $\pm 5\%$ of the value given by the graph on page 9.
11. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
12. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
13. The efficiency will not fall below the specified limit for any beam power in the range 75 to 95kW.
14. The efficiency will not fall below the specified limit for any beam power in the range 85 to 100kW.



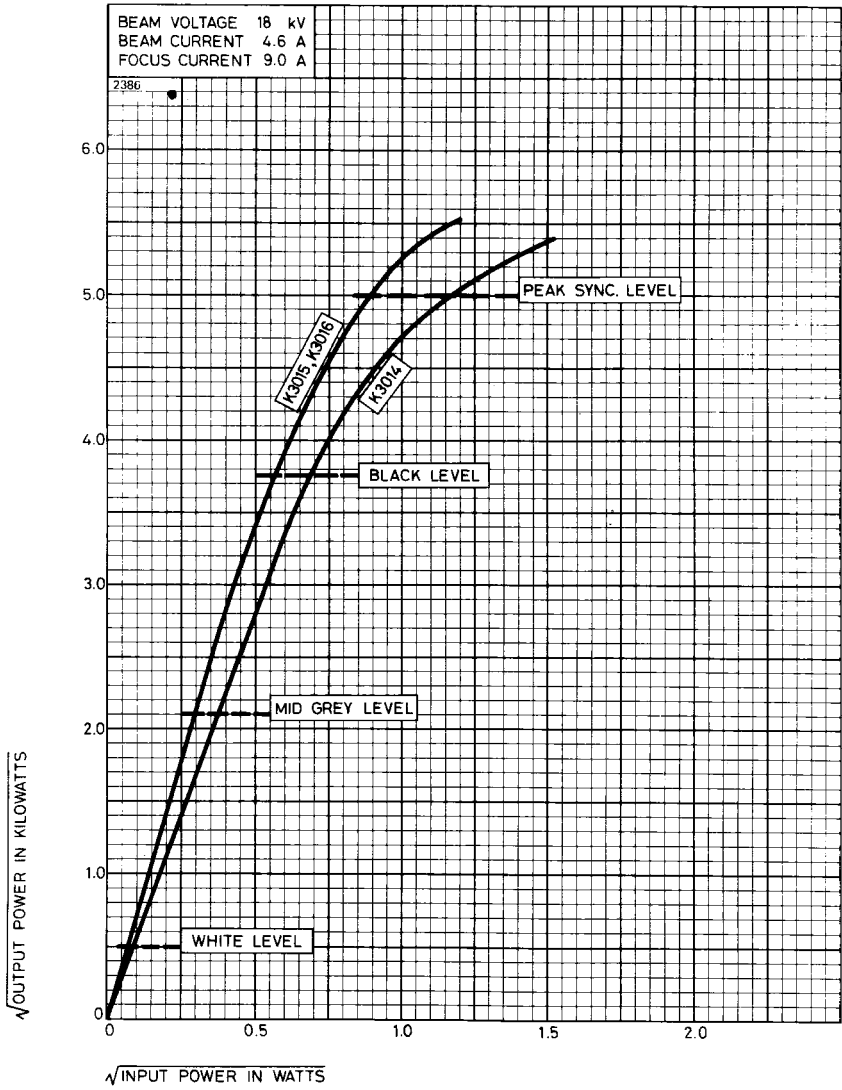
TYPICAL DRIVE REQUIREMENTS



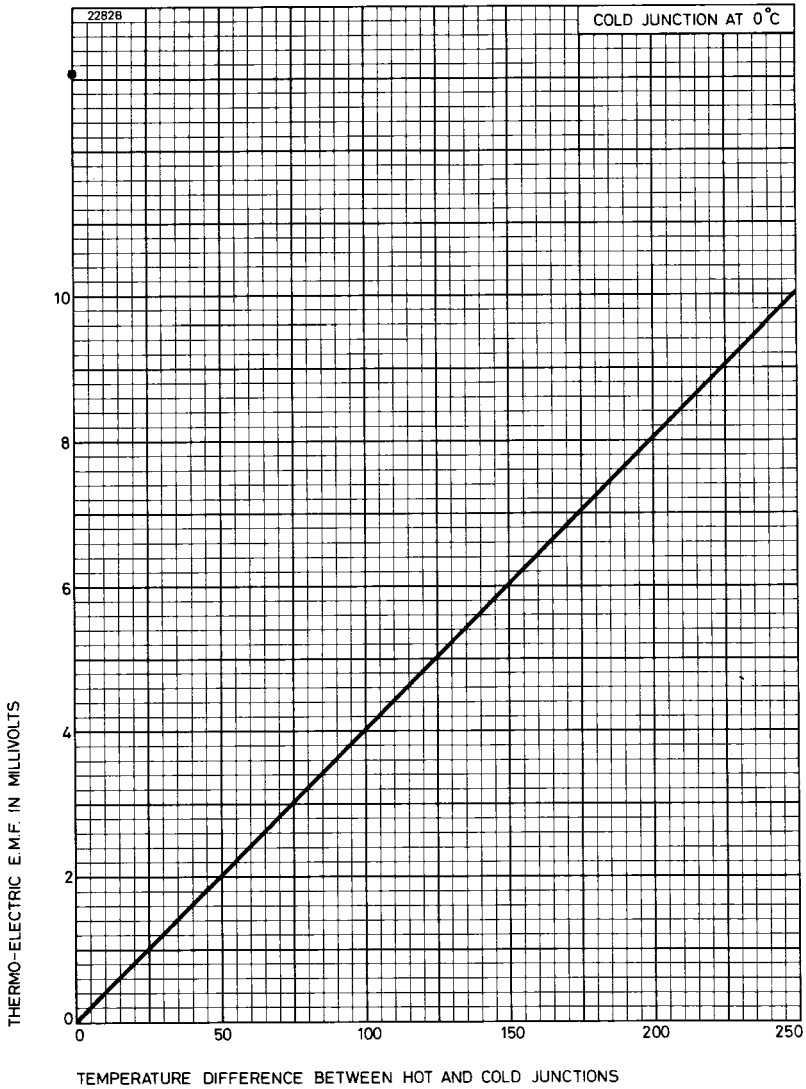
TYPICAL BEAM CHARACTERISTIC



TYPICAL GAIN CHARACTERISTICS

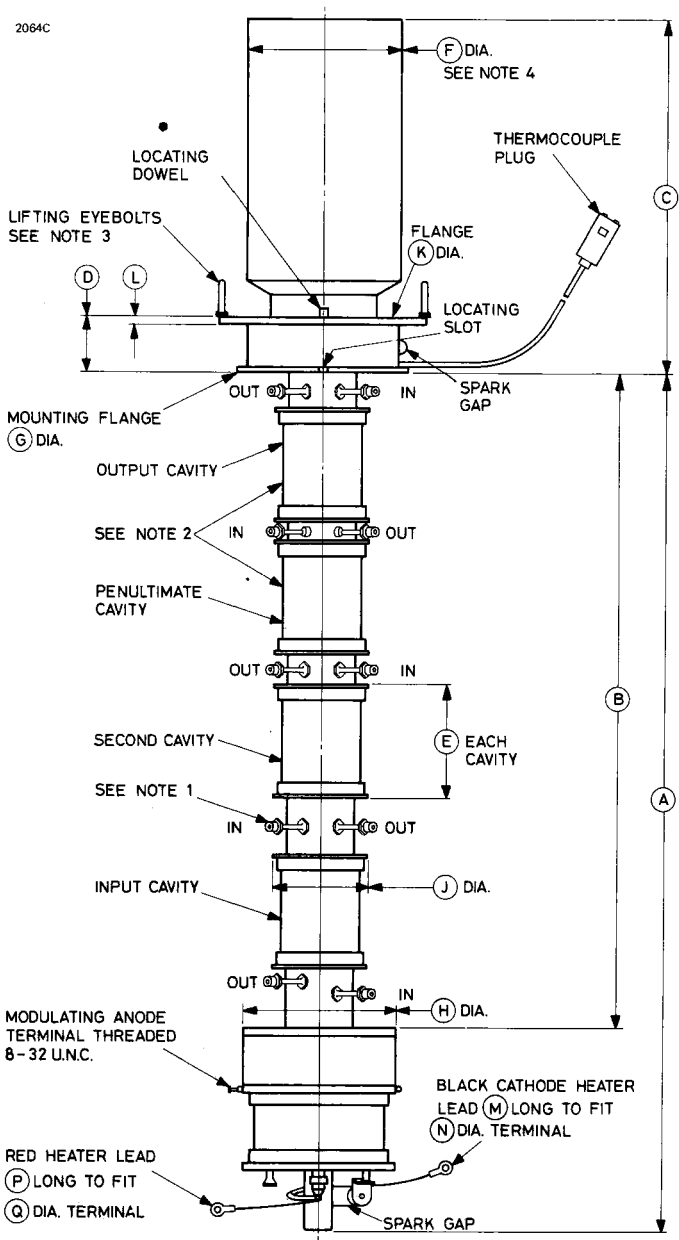


THERMOCOUPLE CALIBRATION CURVE



OUTLINE FOR K3014

2064C



Outline Dimensions for K3014 (All dimensions nominal)

Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	6.000	152.4
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35



Millimetre dimensions have been derived from inches.

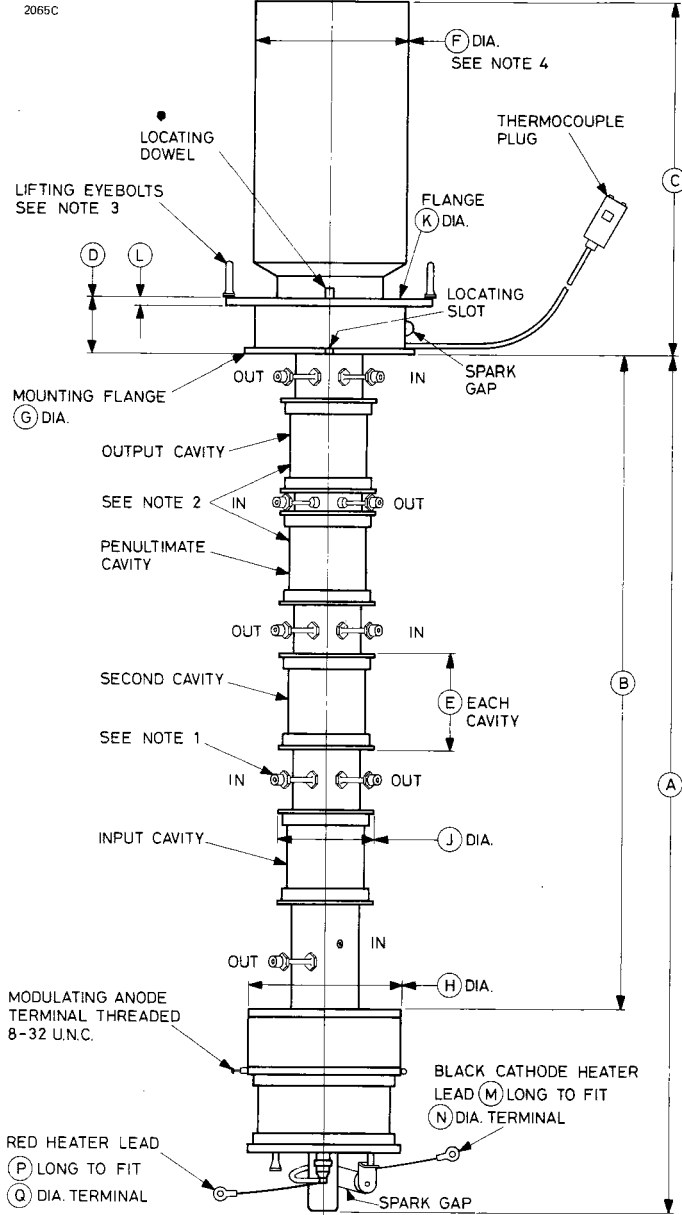
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA369 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR K3015



Outline Dimensions for K3015 (All dimensions nominal)

Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	5.000	127.0
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

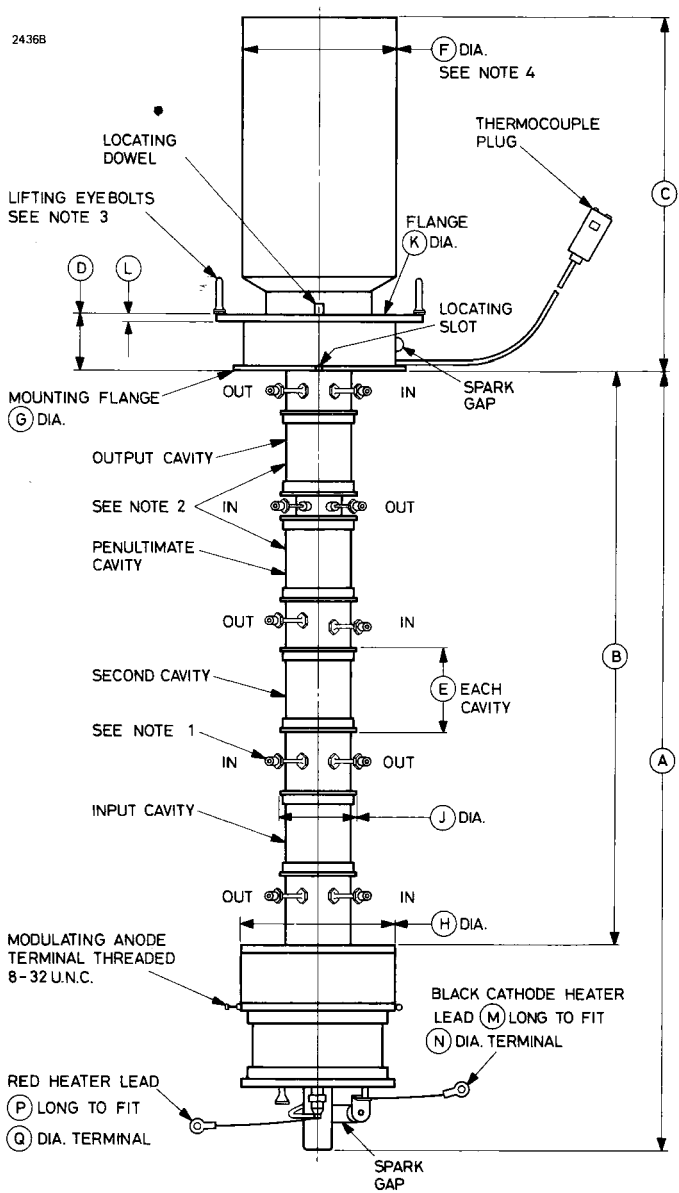
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA387 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR K3016



Outline Dimensions for K3016 (All dimensions nominal)

Ref	Inches	Millimetres
A	40.600	1031.2
B	29.875	758.8
C	18.500	469.9
D	3.000	76.20
E	4.500	114.3
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	4.125	104.8
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

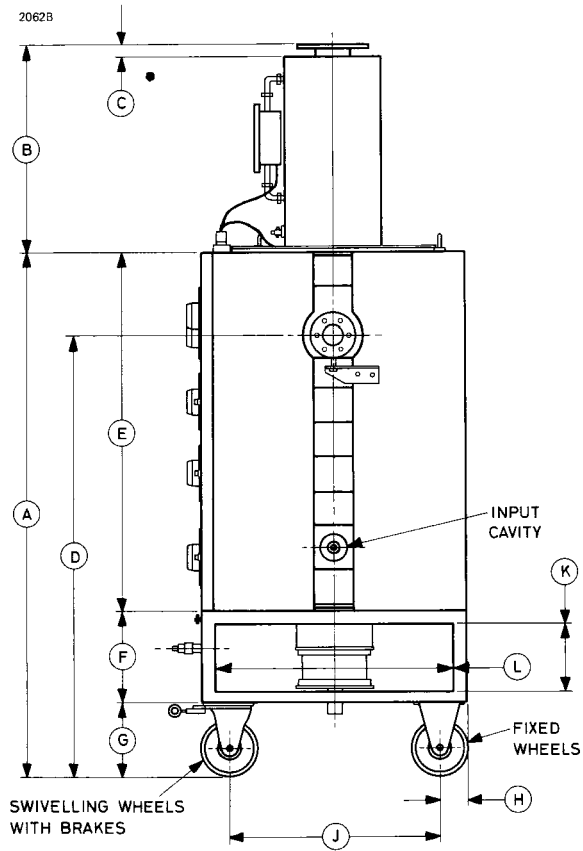


Millimetre dimensions have been derived from inches.

Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA369 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.
The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.
2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR CIRCUIT ASSEMBLIES

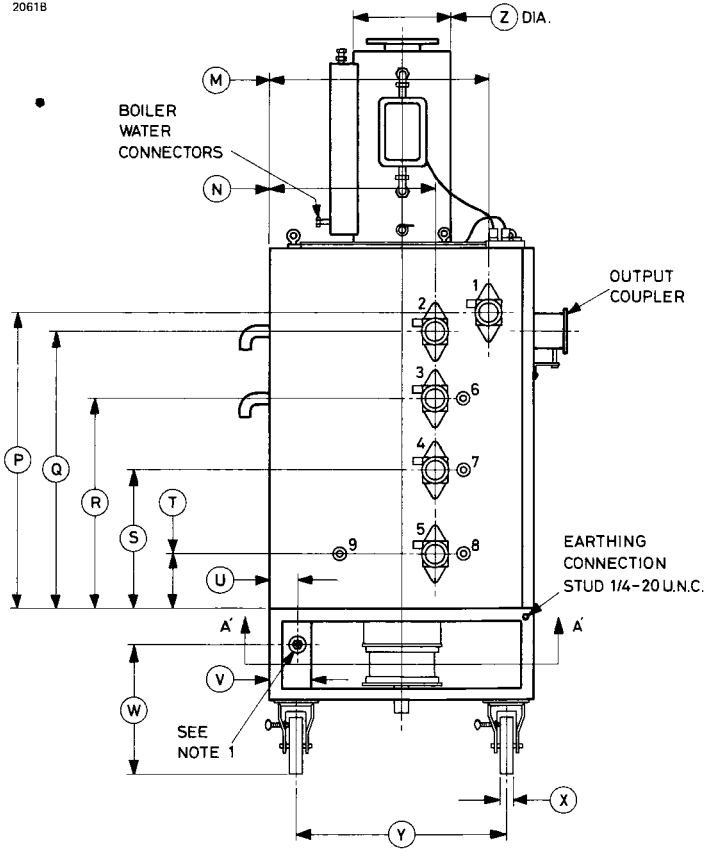


Note This drawing is not to scale for the K4104BDS.

See page 21 for Outline Dimensions

OUTLINE FOR CIRCUIT ASSEMBLIES

2061B



Controls

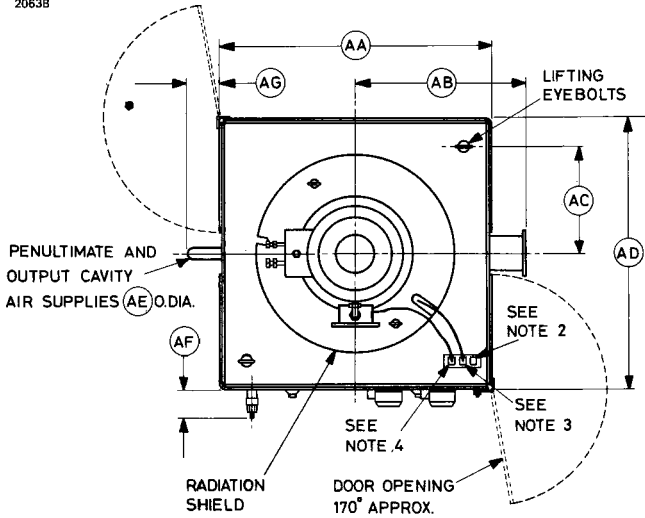
- | | | | |
|---|---------------------------|---|----------------------------|
| 1 | Output coupling | 6 | Penultimate cavity loading |
| 2 | Output cavity tuning | 7 | Second cavity loading |
| 3 | Penultimate cavity tuning | 8 | Input cavity coupling |
| 4 | Second cavity tuning | 9 | Input cavity loading |
| 5 | Input cavity tuning | | |

Note This drawing is not to scale for the K4104BDS.

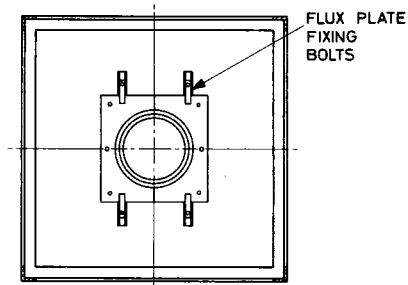
See page 21 for Outline Dimensions

OUTLINE FOR CIRCUIT ASSEMBLIES

2063B



VIEW FROM ABOVE



SECTION A'-A' SHOWING
CENTRING PLATE

Outline Notes

1. Water inlet connection Hitemp Minilock Self Sealing Coupling, threaded 1/2-inch B.S.P.
2. Connections to external circuits; see page 24.
3. Thermocouple socket, accepts plug wired to klystron.
4. Collector and level trip socket, accepts plug wired to boiler.

Outline Dimensions for K4102BDS and K4103BDS

(All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	55.125 ± 0.125	1400.2 ± 3.2	S	14.562	369.9
B	22.000 ± 0.125	558.8 ± 3.2	T	5.750	146.1
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	37.813 ± 0.062	960.5 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	9.688 ± 0.062	246.1 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.125	555.6 ± 3.2
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.750 ± 0.125	730.3 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.750 max	400.1 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.750 ± 0.125	730.3 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	30.813	782.7	AF	4.250	108.0
Q	28.937	735.0	AG	2.500	63.50
R	22.062	560.4			

Millimetre dimensions have been derived from inches.

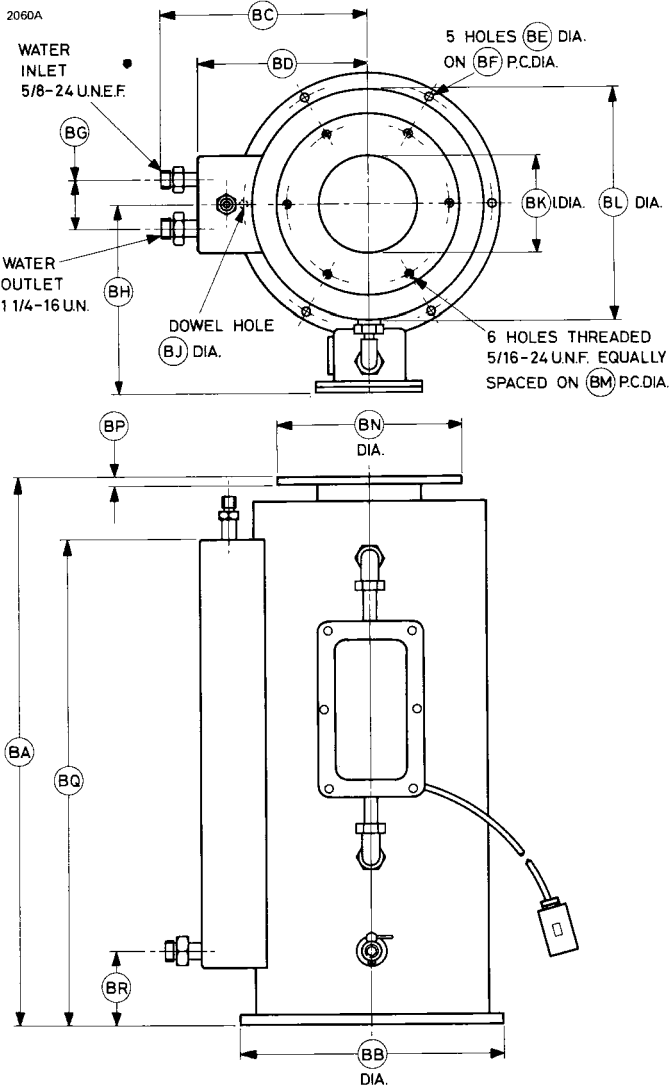
Outline Dimensions for K4104BDS

(All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	54.562 ± 0.125	1385.9 ± 3.2	S	12.625	320.7
B	22.000 ± 0.125	558.8 ± 3.2	T	5.125	130.2
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	33.375 ± 0.062	847.7 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	13.562 ± 0.062	344.5 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.125	555.6 ± 3.2
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.750 ± 0.125	730.3 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.5 max	393.7 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.750 ± 0.125	730.3 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	26.938	684.2	AF	4.250	108.0
Q	25.062	636.6	AG	2.250	57.15
R	19.562	496.9			

Millimetre dimensions have been derived from inches.

BOILER UNIT



Dimensions for Boiler Unit (All dimensions without limits are nominal)

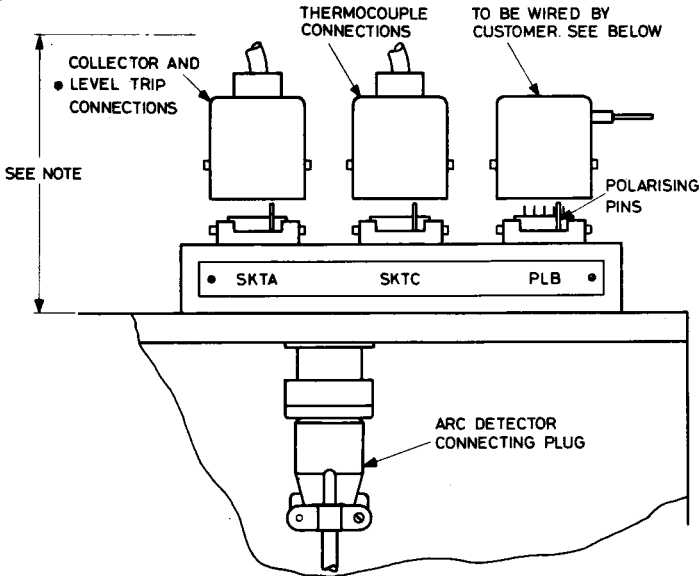
Ref	Inches	Millimetres
BA	● 23.125 ± 0.125	587.4 ± 3.2
BB	11.125 ± 0.125	282.6 ± 3.2
BC	8.250 ± 0.125	209.6 ± 3.2
BD	7.125 ± 0.125	181.0 ± 3.2
BE	0.312	7.92
BF	10.500	266.7
BG	2.000 ± 0.062	50.80 ± 1.57
BH	7.750	196.9
BJ*	0.394	10.0
BK	4.000	101.6
BL	9.750	247.7
BM	7.000	177.8
BN	7.750 ± 0.016	196.9 ± 0.4
BP	0.375	9.53
BQ	20.562	522.3
BR	2.938 ± 0.062	74.63 ± 1.57



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

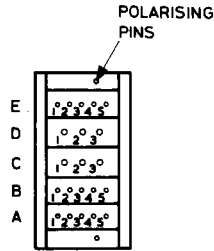
PLUG AND SOCKET CONNECTIONS

2115



Input Socket Connections (to be wired by customer)

- | | |
|--------------------------|--------|
| Water level trip circuit | B1, B2 |
| Collector connection | C1 |
| Thermocouple circuit: | |
| nickel chromium | B3 |
| nickel aluminium 1 | C2 |
| nickel aluminium 2 | D2 |
| nickel aluminium 3 | D1 |
| Arc detector circuit: | |
| photo resistor | E4, E5 |
| bulb | E2, E3 |
| screen and earth | E1 |
| link | B4, B5 |
| Focus coils: | |
| positive | C3 |
| negative | D3 |



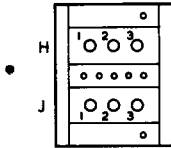
Input socket

View on solder connections with cover removed

Note Clearance for connector removal 5.750 inches (146mm) minimum.

Collector Plug

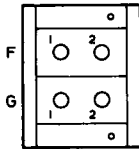
2116



Pin	Element
H1	Collector
H2	—
H3	—
J1	Water level trip
J2	Water level trip
J3	—

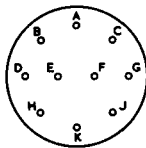


Thermocouple Plug



Pin	Element
F1	Nickel chromium
F2	Nickel aluminium 3
G1	Nickel aluminium 1
G2	Nickel aluminium 2

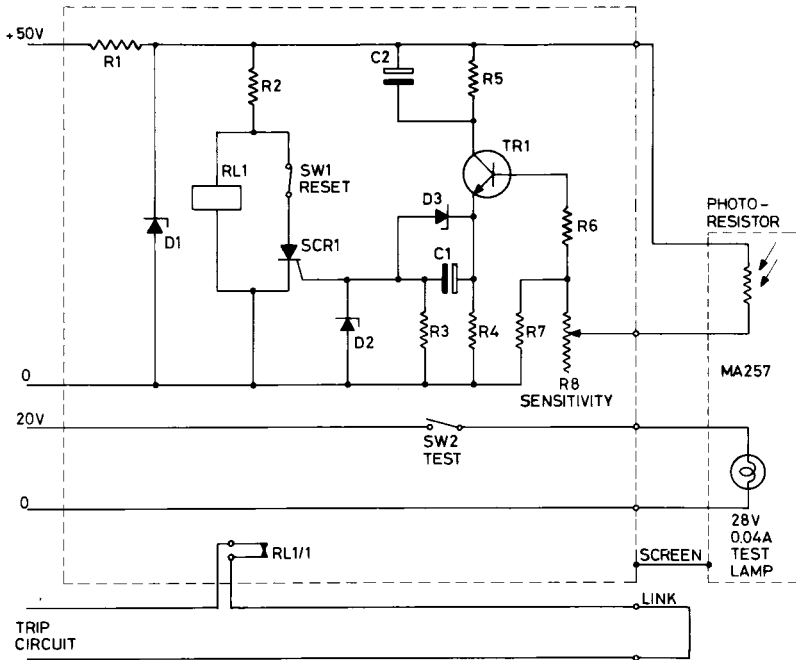
Arc Detector Plug



Pin	Element
A	Photo resistor
B	Photo resistor
C	Bulb
D	Link
E	Screen and earth
F	Screen and earth
G	Bulb
H	Link
J	No connection
K	No connection

SUGGESTED CIRCUIT FOR ARC DETECTOR

2139A





K3017 K3018 K3019

**AMPLIFIER
KLYSTRONS**

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is vapour cooled in a boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.



Klystron	Frequency Range	Circuit Assembly
K3017	470 to 610MHz	K4102BDS
K3018	590 to 720MHz	K4103BDS
K3019	700 to 860MHz	K4104BDS

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power (saturated) at klystron flange	45	kW
Power gain (typical):		
K3017	40	db
K3018	44	db
K3019	46	db
Beam voltage	21.5	kV
Output	3 ¹ / ₈ inch 50Ω coaxial line	
Cooling (see page 2)	water, vapour and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	8.5 ± 3%	V
Heater current range	37 to 46	A
Heater starting current (peak)	200	A max
Cathode heating time (see note 1)	5	minutes

Mechanical

Overall length (see note 2):		
K3017, K3018	63.75 inches (161.9cm)	max
K3019	59.5 inches (151.1cm)	max
Overall diameter	11.125 inches (283mm)	nom
Mounting position	vertical, collector end up	
Net weight of klystron:		
K3017, K3018	210 pounds (95kg)	approx
K3019	155 pounds (70kg)	approx

August 1971

Circuit Assembly

Electro-magnet current (see note 3)	11 ± 1	A		
Electro-magnet resistance:	K4102BDS	K4103BDS	K4104BDS	
cold (20°C)	9.5 ± 1	9.0 ± 1	8.5 ± 1	Ω
hot (20°C ambient)	13	13	12	Ω max
R.F. input connector	type N coaxial			
R.F. output	3 ¹ / ₈ inch 50Ω coaxial line			
Net weight of tuning cavities:				
K4102BDS (for K3017)	120 pounds (54kg) approx			
K4103BDS (for K3018)	90 pounds (41kg) approx			
K4104BDS (for K3019)	70 pounds (32kg) approx			
Total lifting weight of klystron, cavities, boiler and mounting collar:				
K3017	440 pounds (200kg) approx			
K3018	410 pounds (186kg) approx			
K3019	335 pounds (152kg) approx			
Net weight of magnet assembly	1800 pounds (816kg) approx			
EEV arc detector type MA257 is fitted to the output cavity. See pages 22 to 24 for connection details and suggested operating circuit.				

Cooling

The klystron collector is vapour cooled in a boiler with an upward steam exit, intended for use with a separate condenser. The klystron body is water cooled; for best stability, the body water temperature must be stabilized. The gun and the output and penultimate cavities require forced air cooling.

Volume of steam produced by collector dissipation	1.5	ft ³ /min/kW (0.043m ³ /min/kW)
Volume of water converted to steam	0.006	imp.gal/min/kW (0.027 litre/min/kW)
Inlet water flow to body and collector in series (see note 4)	2.0	imp.gal/min (9 litres/min)
Body pressure drop at 2.0 imp.gal/min	28	lb/in ² (2.0kg/cm ²)
Inlet water temperature	80	°C max
Air flow to penultimate and output cavities	50	ft ³ /min (1.42m ³ /min) each
Static pressure head (see note 5)	1	inch (25mm) w.g.
Air flow to cathode	5.0	ft ³ /min (0.142m ³ /min)
Inlet air temperature	40	°C max
Temperature of any external part of the klystron must not exceed	175	°C max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage:		
continuous	23	kV max
switch-on surge	27	kV max
Beam current (mean)	7.0	A max
Body current	150	mA max
Output power	50	kW max
Collector dissipation	150	kW max
Load v.s.w.r. (see note 6)	1.5:1	max
Thermocouple e.m.f. (see note 7)	9.8	mV max



TYPICAL OPERATION (Vision amplifier)

Operating Conditions

Beam voltage	21.5	kV
Beam current	6.2	A
Electro-magnet current	11	A
Bandwidth (to 1db points)	8.0	MHz

K3017 in K4102BDS Circuit

Frequency	470 to 478 (channel 21)	598 to 606 (channel 37)	MHz
Body current:			
with no input power	15	15	mA
at 45kW c.w. output, vision frequency	78	85	mA
Drive power for 45kW output	4.0	4.0	W
Saturated output power	45	47	kW

K3018 in K4103BDS Circuit

Frequency	590 to 598 (channel 36)	710 to 718 (channel 51)	MHz
Body current:			
with no input power	15	15	mA
at 45kW c.w. output, vision frequency	65	55	mA
Drive power for 45kW output	1.5	1.5	W
Saturated output power	45	47	kW

K3019 in K4104BDS Circuit

Frequency	702 to 710 (channel 50)	846 to 854 (channel 68)	MHz
Body current:			
with no input power	15	15	mA
at 45kW c.w. output, vision frequency	90	100	mA
Drive power for 45kW output	0.8	1.2	W
Saturated output power	47	45	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 7 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the maximum value of the modulating anode current is 1.5mA. The potential divider network must be designed accordingly.

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN K3017 IN K4102BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	10 to 12	A
Frequency range	470 to 610	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	45	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	22.5	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	5.0	W
Efficiency (see note 13)	32	—	%

K3018 IN K4103BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	10 to 12	A
Frequency range	590 to 720	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	45	kW

Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	22.5	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	3.0	W
Efficiency (see note 13)	32	—	%

K3019 IN K4104BDS CIRCUIT, VISION AMPLIFIER

Test Conditions

Heater voltage	8.5	V
Electro-magnet current	10 to 12	A
Frequency range	700 to 860	MHz
Bandwidth (see note 8)	8.0	MHz
Output power (see note 9)	45	kW


Range of Characteristics

	Min	Max	
Heater current	37	46	A
Beam voltage (see note 10)	—	22.5	kV
Body current (see note 11)	—	150	mA
Modulating anode current	—	6.0	mA
R.F. drive power (see note 12)	—	3.0	W
Efficiency (see note 13)	32	—	%

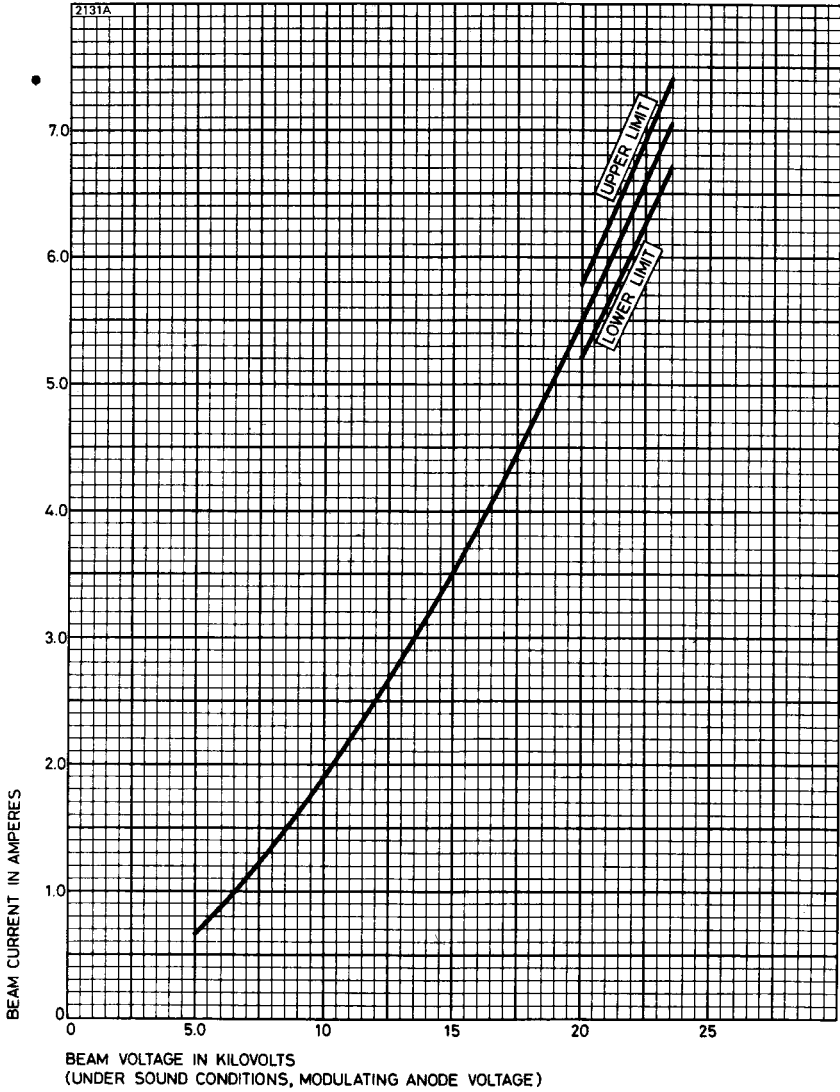


NOTES

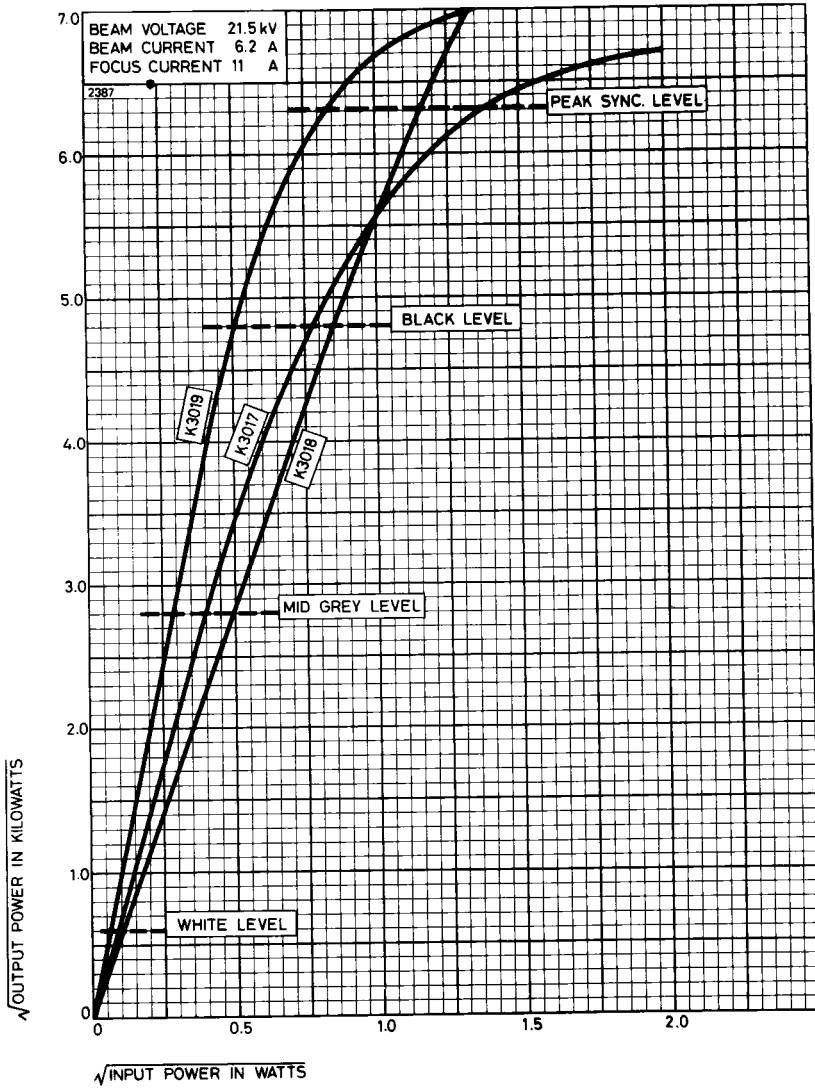
1. For fast warm-up using a 'hot shot' technique, consult English Electric Valve Company Ltd.
2. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 135 inches (3.43m) is required. This is measured to the top of the lifting harness and does not include the hoist.
3. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily within an electro-magnet current range of 10 to 12A. Maximum stability is obtained by adjusting the magnet current within the above range and stabilizing it to $\pm 2\%$ about this optimum value.
4. Alternative cooling arrangements can be used.
5. Measured at the input pipes to the circuit assembly.
6. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
7. The klystron is provided with three nickel chromium-nickel aluminium thermocouples fitted to the collector. On commissioning a new klystron the output of each must be monitored and the one reading the highest temperature used as a control for future monitoring.

- 
8. The klystron is tuned so that, for constant input power, the variation in output power is less than 1db over the specified bandwidth at all power levels between -2db and -14db with respect to the specified output power.
 9. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
 10. With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current will be within $\pm 5\%$ of the value given by the graph on page 7.
 11. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
 12. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
 13. The efficiency will not fall below the specified limit for any beam power in the range 120 to 150kW.

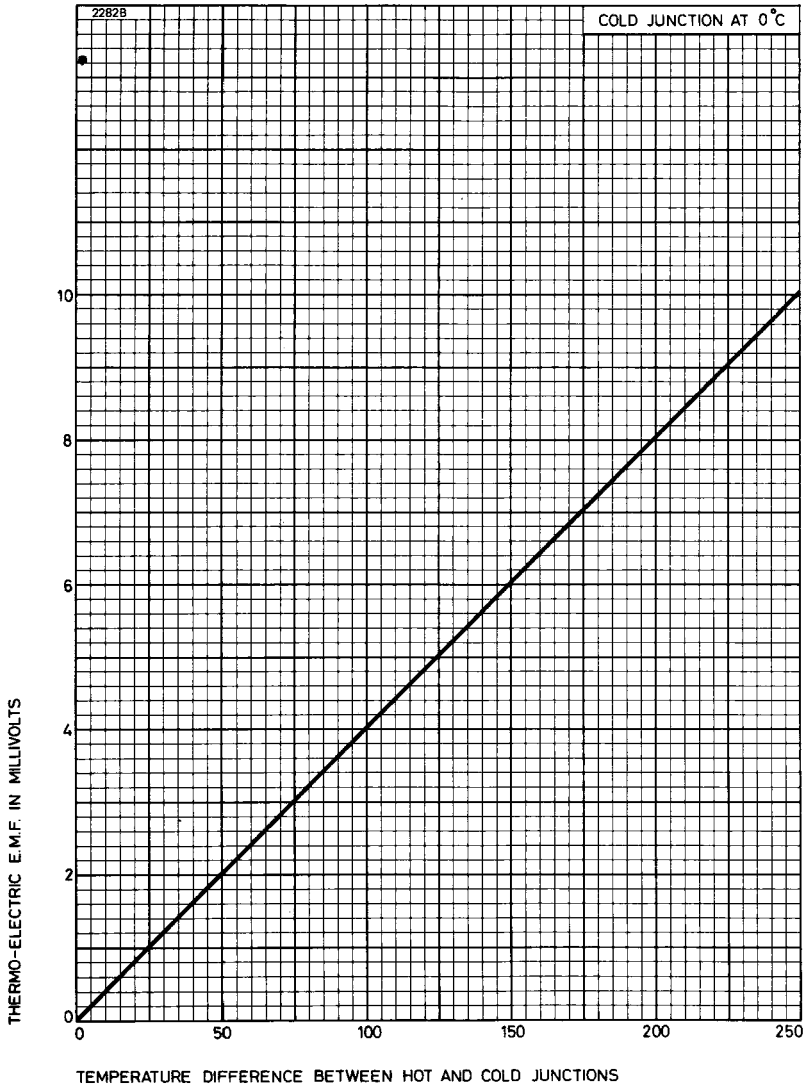
TYPICAL BEAM CHARACTERISTIC



TYPICAL GAIN CHARACTERISTICS

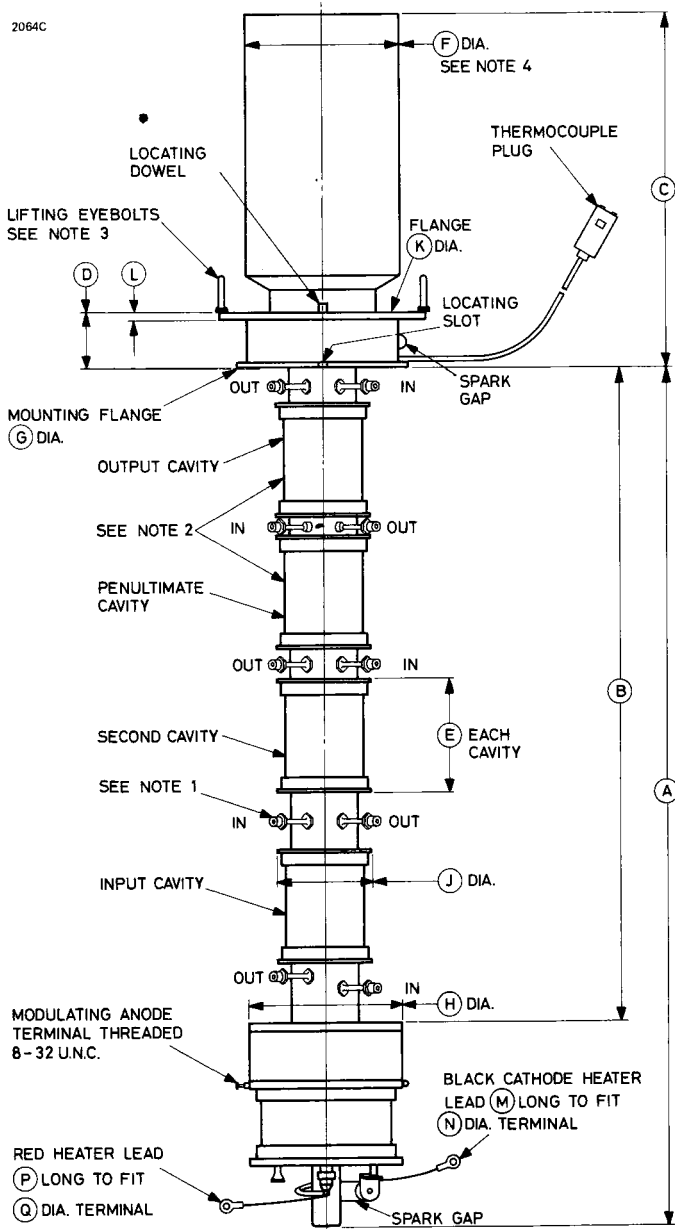


THERMOCOUPLE CALIBRATION CURVE



OUTLINE FOR K3017

2064C



Outline Dimensions for K3017 (All dimensions nominal)

Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	6.000	152.4
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35



Millimetre dimensions have been derived from inches.

Outline Notes

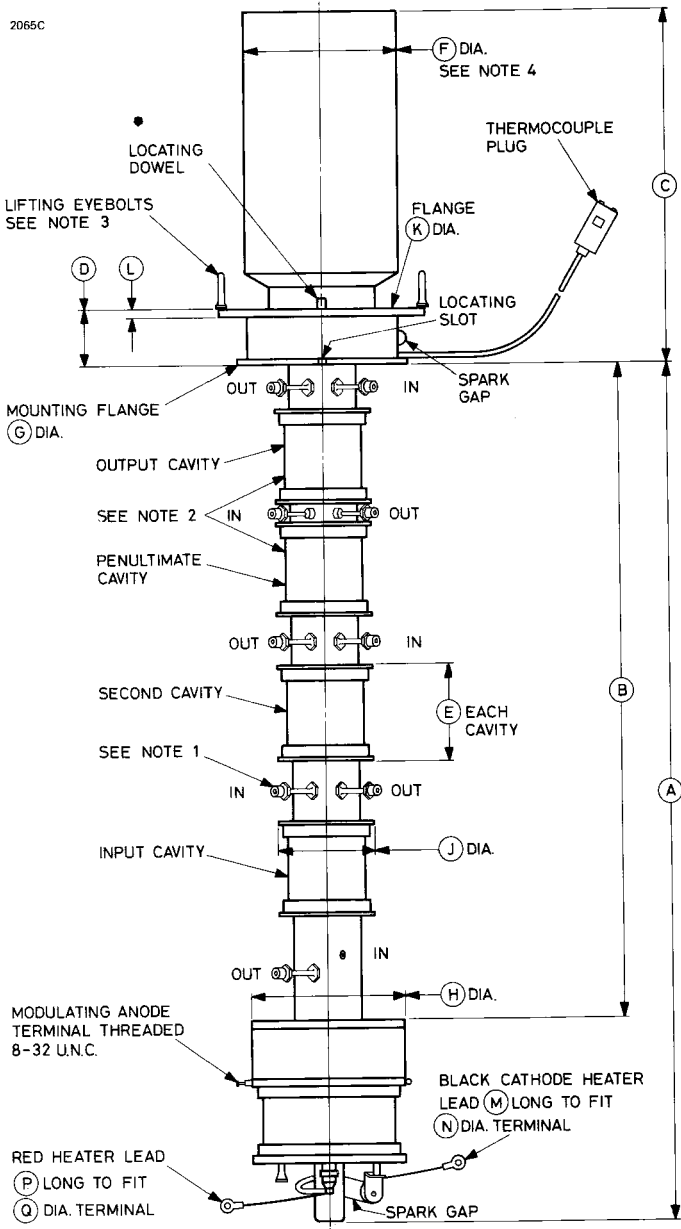
1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA369 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR K3018

2065C



Outline Dimensions for K3018 (All dimensions nominal)

Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	5.000	127.0
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

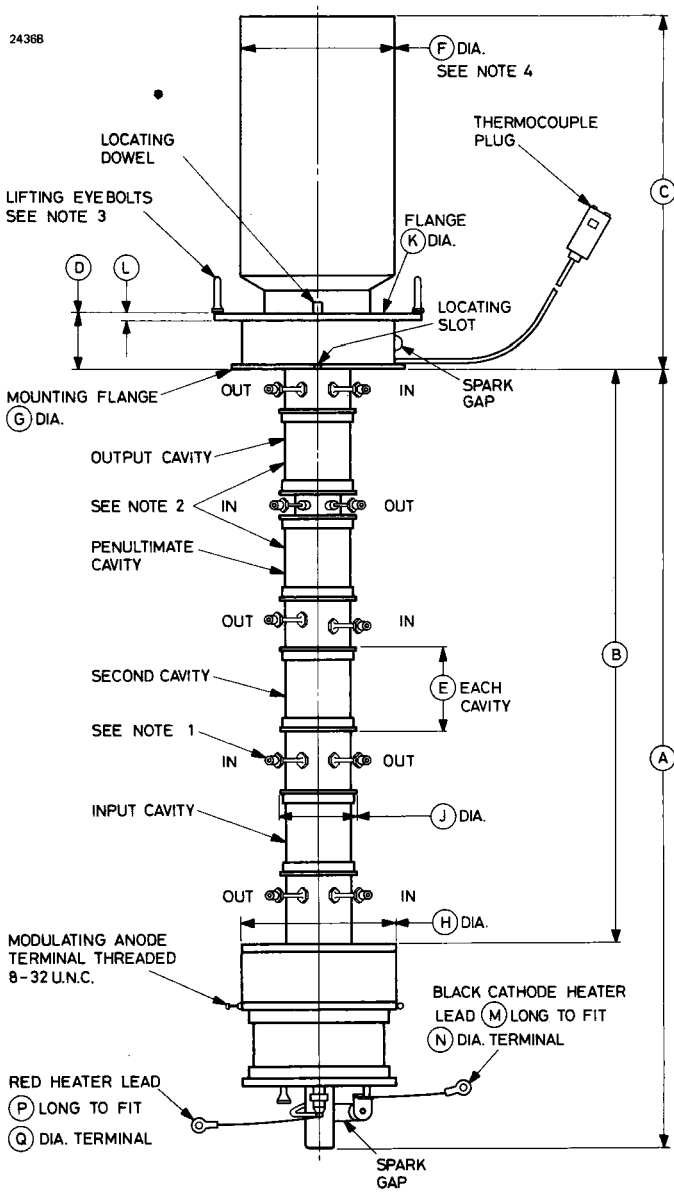
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA387 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR K3019



Outline Dimensions for K3019 (All dimensions nominal)

Ref	Inches	Millimetres
A	40.600	1031.2
B	29.875	758.8
C	18.500	469.9
D	3.000	76.20
E	4.500	114.3
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	4.125	104.8
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35



Millimetre dimensions have been derived from inches.

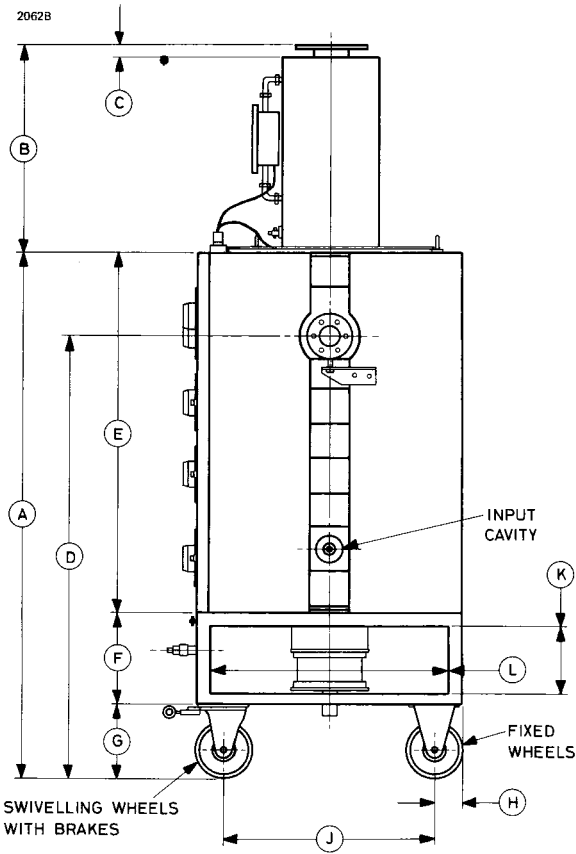
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA369 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR CIRCUIT ASSEMBLIES

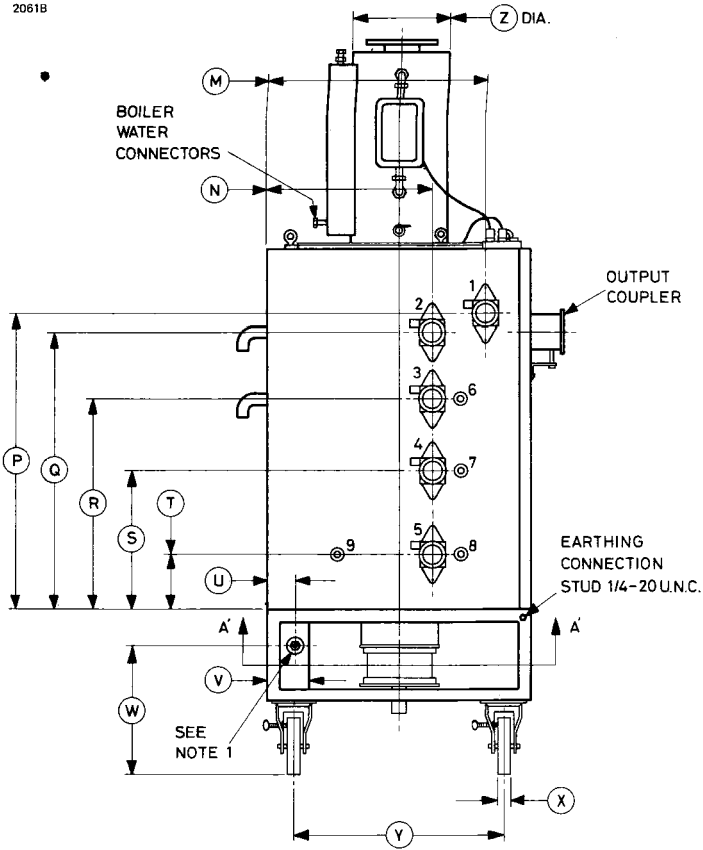


Note This drawing is not to scale for the K4104BDS.

See page 19 for Outline Dimensions

OUTLINE FOR CIRCUIT ASSEMBLIES

2061B



Controls

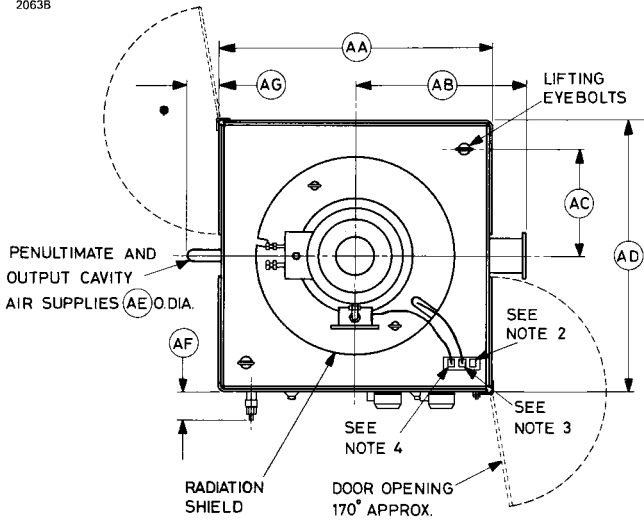
- | | | | |
|---|---------------------------|---|----------------------------|
| 1 | Output coupling | 6 | Penultimate cavity loading |
| 2 | Output cavity tuning | 7 | Second cavity loading |
| 3 | Penultimate cavity tuning | 8 | Input cavity coupling |
| 4 | Second cavity tuning | 9 | Input cavity loading |
| 5 | Input cavity tuning | | |

Note This drawing is not to scale for the K4104BDS.

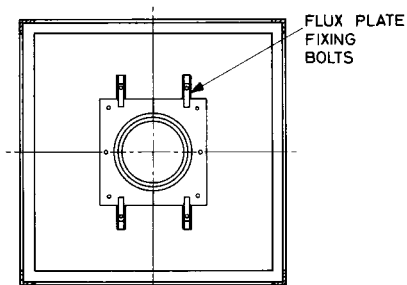
See page 19 for Outline Dimensions

OUTLINE FOR CIRCUIT ASSEMBLIES

2063B



VIEW FROM ABOVE



SECTION A-A—A' SHOWING
CENTRING PLATE

Outline Notes

1. Water inlet connection Hitemp Minilock Self Sealing Coupling, threaded $\frac{1}{2}$ -inch B.S.P.
2. Connections to external circuits; see page 22.
3. Thermocouple socket, accepts plug wired to klystron.
4. Collector and level trip socket, accepts plug wired to boiler.

Outline Dimensions for K4102BDS and K4103BDS
(All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	55.125 ± 0.125	1400.2 ± 3.2	S	14.562	369.9
B	22.000 ± 0.125	558.8 ± 3.2	T	5.750	146.1
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	37.813 ± 0.062	960.5 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	9.688 ± 0.062	246.1 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.125	555.6 ± 3.2
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.750 ± 0.125	730.3 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.750 max	400.1 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.750 ± 0.125	730.3 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	30.813	782.7	AF	4.250	108.0
Q	28.937	735.0	AG	2.500	63.50
R	22.062	560.4			

Millimetre dimensions have been derived from inches.

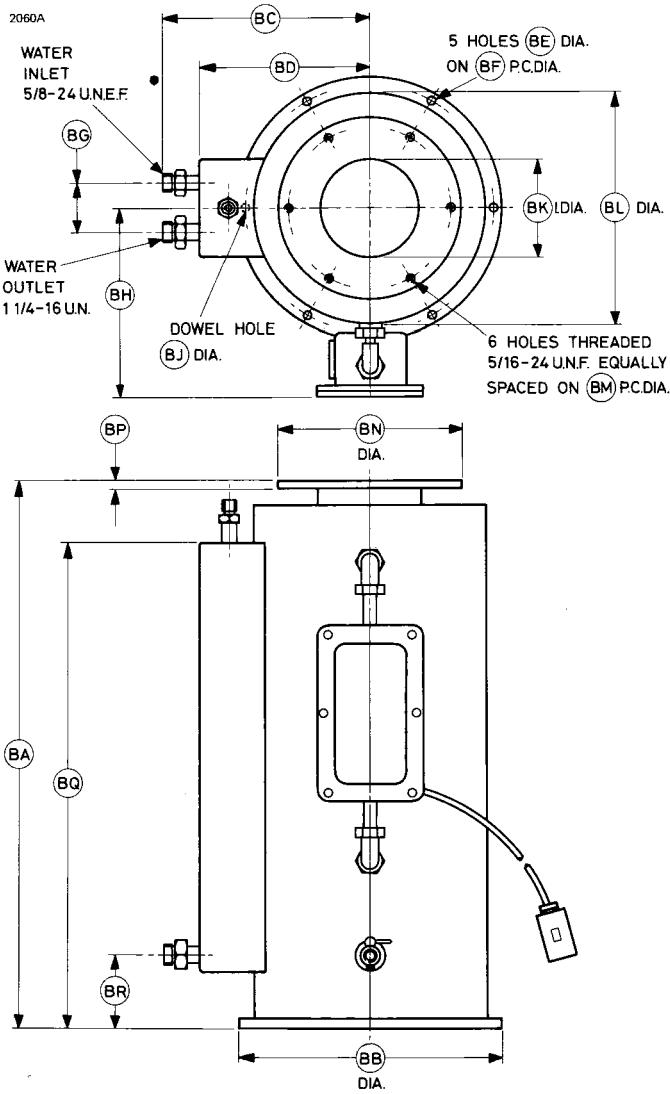
Outline Dimensions for K4104BDS
(All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	54.562 ± 0.125	1385.9 ± 3.2	S	12.625	320.7
B	22.000 ± 0.125	558.8 ± 3.2	T	5.125	130.2
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	33.375 ± 0.062	847.7 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	13.562 ± 0.062	344.5 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.125	555.6 ± 3.2
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.750 ± 0.125	730.3 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.5 max	393.7 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.750 ± 0.125	730.3 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	26.938	684.2	AF	4.250	108.0
Q	25.062	636.6	AG	2.250	57.15
R	19.562	496.9			

Millimetre dimensions have been derived from inches.



BOILER UNIT



Dimensions for Boiler Unit (All dimensions without limits are nominal)

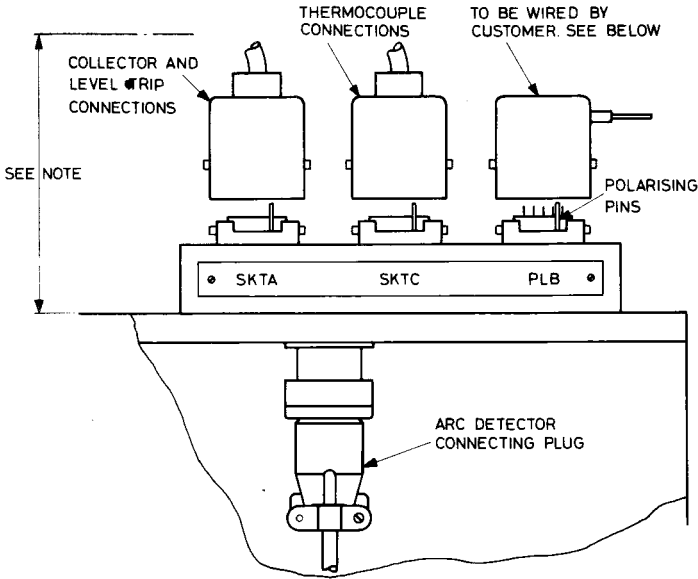
Ref	Inches	Millimetres
BA	23.125 ± 0.125	587.4 ± 3.2
BB	11.125 ± 0.125	282.6 ± 3.2
BC	8.250 ± 0.125	209.6 ± 3.2
BD	7.125 ± 0.125	181.0 ± 3.2
BE	0.312	7.92
BF	10.500	266.7
BG	2.000 ± 0.062	50.80 ± 1.57
BH	7.750	196.9
BJ*	0.394	10.0
BK	4.000	101.6
BL	9.750	247.7
BM	7.000	177.8
BN	7.750 ± 0.016	196.9 ± 0.4
BP	0.375	9.53
BQ	20.562	522.3
BR	2.938 ± 0.062	74.63 ± 1.57

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



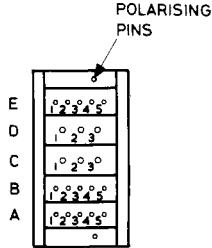
PLUG AND SOCKET CONNECTIONS

2115



Input Socket Connections (to be wired by customer)

Water level trip circuit	B1, B2
Collector connection	C1
Thermocouple circuit:	
nickel chromium	B3
nickel aluminium 1	C2
nickel aluminium 2	D2
nickel aluminium 3	D1
Arc detector circuit:	
photo resistor	E4, E5
bulb	E2, E3
screen and earth	E1
link	B4, B5
Focus coils:	
positive	C3
negative	D3



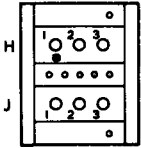
Input socket

View on solder connections with cover removed

Note Clearance for connector removal 5.750 inches (146mm) minimum.

Collector Plug

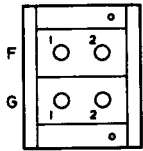
2116



Pin	Element
H1	Collector
H2	—
H3	—
J1	Water level trip
J2	Water level trip
J3	—

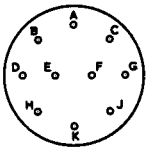


Thermocouple Plug



Pin	Element
F1	Nickel chromium
F2	Nickel aluminium 3
G1	Nickel aluminium 1
G2	Nickel aluminium 2

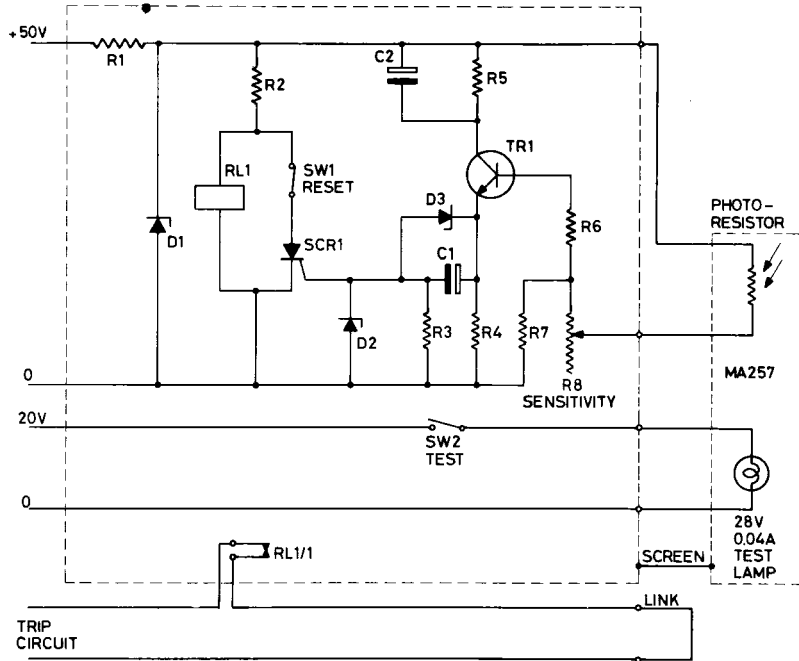
Arc Detector Plug

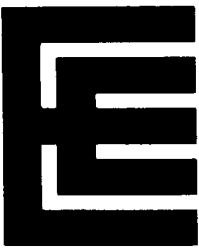


Pin	Element
A	Photo resistor
B	Photo resistor
C	Bulb
D	Link
E	Screen and earth
F	Screen and earth
G	Bulb
H	Link
J	No connection
K	No connection

SUGGESTED CIRCUIT FOR ARC DETECTOR

2139A





K3082 K3083 K3084

**AMPLIFIER
KLYSTRONS**

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystrons with separate tuning cavities, for u.h.f. television service. The collector is vapour cooled in a boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.



Klystron	Frequency Range	Circuit Assembly
K3082	470 to 610MHz	K4102BDS
K3083	590 to 720MHz	K4103BDS
K3084	700 to 860MHz	K4104BDS

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Output power at klystron flange	22.5	28	45	kW
Power gain (typical):				
K3082	44	45	47	db
K3083	43	44	47	db
K3084	43	44	47	db
Beam voltage	18	18.5	22	kV
Output				3 1/8 inch 50Ω coaxial line
Cooling (see page 2)				water, vapour and forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	8.5 ± 3%	V
Heater current range	37 to 46	A
Heater starting current (peak)	200	A max
Cathode heating time (see note 1)	5	minutes

Mechanical

Overall length (see note 2):		
K3082, K3083	63.75 inches (161.9cm)	max
K3084	59.5 inches (151.1cm)	max
Overall diameter	11.125 inches (283mm)	nom
Mounting position	vertical, collector end up	
Net weight of klystron:		
K3082, K3083	160 pounds (73kg)	approx
K3084	155 pounds (70kg)	approx

Circuit Assembly

Electro-magnet current, stabilised

to $\pm 2\%$ (see note 3)	10.5	A min
	12.0	A max

Electro-magnet resistance:	K4102BDS	K4103BDS	K4104BDS	
cold (20°C)	9.5 ± 1	9.0 ± 1	8.5 ± 1	Ω
hot (20°C ambient)	13	13	12	Ω max

R.F. input connector	type N coaxial
R.F. output	$3\frac{1}{8}$ inch 50Ω coaxial line

Net weight of tuning cavities:

K4102BDS (for K3082)	120 pounds (54kg) approx
K4103BDS (for K3083)	90 pounds (41kg) approx
K4104BDS (for K3084)	70 pounds (32kg) approx

Total lifting weight of klystron, cavities, boiler and mounting collar:

K3082	390 pounds (177kg) approx
K3083	360 pounds (164kg) approx
K3084	335 pounds (152kg) approx

Net weight of magnet assembly 1800 pounds (816kg) approx

EEV arc detector type MA257 is fitted to the output cavity. See pages 22 to 24 for connection details and suggested operating circuit.

Cooling

The klystron collector is vapour cooled in a boiler with an upward steam exit, intended for use with a separate condenser. The klystron body is water cooled; for best stability, the body water temperature must be stabilized. The gun and the output and penultimate cavities require forced air cooling.

Volume of steam produced by collector dissipation	1.5	$\text{ft}^3/\text{min}/\text{kW}$ ($0.043\text{m}^3/\text{min}/\text{kW}$)
Volume of water converted to steam	0.006	$\text{imp.gal}/\text{min}/\text{kW}$ ($0.027 \text{ litre}/\text{min}/\text{kW}$)

Inlet water flow to body and collector in series (see note 4)	2.0	$\text{imp.gal}/\text{min}$ (9 litres/min)
Body pressure drop at 2.0 $\text{imp.gal}/\text{min}$	28	lb/in^2 ($2.0\text{kg}/\text{cm}^2$)

Inlet water temperature	80	$^{\circ}\text{C}$ max
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Air flow to penultimate and output cavities	50	ft^3/min ($1.42\text{m}^3/\text{min}$) each
Static pressure head (see note 5)	1	inch (25mm) w.g.

Air flow to cathode	5.0	ft^3/min ($0.142\text{m}^3/\text{min}$)
Inlet air temperature	40	$^{\circ}\text{C}$ max

Temperature of any external part of the klystron must not exceed	175	$^{\circ}\text{C}$ max
--	-----	------------------------

MAXIMUM RATINGS (Absolute values)

No individual rating to be exceeded.

Beam voltage:		
continuous	23	kV max
switch-on surge	27	kV max
Beam current (mean)	7.0	A max
Body current	150	mA max
Output power	50	kW max
Collector dissipation	150	kW max
Load v.s.w.r. (see note 6)	1.5:1	max
Thermocouple e.m.f. (see note 7)	9.8	mV max



TYPICAL OPERATION (Vision amplifier)

Beam voltage	22	kV
Beam current	6.2	A
Electro-magnet current	11	A
Bandwidth (to 1db points)	8.0	MHz

K3082 in K4102BDS Circuit

Frequency	470 to 478 (channel 21)	526 to 534 (channel 28)	598 to 606 (channel 37)	MHz
Body current:				
with no input power	15	15	15	mA
at 45kW c.w. output, vision frequency	50	50	50	mA
Drive power for 45kW output	1.25	0.7	1.0	W
Saturated output power	49	50	48	kW

K3083 in K4103BDS Circuit

Frequency	590 to 598 (channel 36)	654 to 662 (channel 44)	710 to 718 (channel 51)	MHz
Body current:				
with no input power	15	15	15	mA
at 45kW c.w. output, vision frequency	65	60	55	mA
Drive power for 45kW output	1.0	0.85	1.0	W
Saturated output power	46	48	47	kW

K3084 in K4104BDS Circuit

Frequency	702 to 710 (channel 50)	774 to 782 (channel 59)	846 to 854 (channel 68)	MHz
Body current:				
with no input power	15	15	15	mA
at 45kW c.w. output, vision frequency	90	85	100	mA
Drive power for 45kW output	0.8	0.9	1.2	W
Saturated output power	47	46	45	kW

Sound Amplifier Service

For operation at the same beam voltage as the vision amplifier and one fifth of the output power, the beam current is reduced to one fifth that of the vision amplifier klystron by means of the modulating anode. The graph on page 7 shows approximately the modulating anode voltage required for a given beam current. Under these conditions the maximum value of the modulating anode current is 1.5mA. The potential divider network must be designed accordingly.



RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

K3082 IN K4102BDS CIRCUIT, VISION AMPLIFIER

Test Conditions (Tuning and output coupling optimised at the two output power test levels stated)

Output power (see note 8)	28	45	kW
Bandwidth (see note 9)	8.0	8.0	MHz
Frequency range	470 to 610	470 to 610	MHz
Electro-magnet current	10.5 to 12	10.5 to 12	A
Heater voltage	8.5	8.5	V

Range of Characteristics

	Min	Max	Min	Max	
Heater current	37	46	37	46	A
Body current (see note 10)	—	150	—	150	mA
Modulating anode current	—	6.0	—	6.0	mA
R.F. drive power (see note 11)	—	1.25	—	1.25	W
Efficiency:					
frequency range 494 to 606MHz	30	—	32	—	%
frequency range 470 to 494MHz	30	—	30	—	%
Beam voltage (see note 12):					
frequency range 494 to 606MHz	—	19.0	—	22.5	kV
frequency range 470 to 494MHz	—	19.0	—	23.0	kV

K3083 IN K4103BDS CIRCUIT, VISION AMPLIFIER

Test Conditions (Tuning and output coupling optimised at the two output power test levels specified)

Output power (see note 8)	28	45	kW
Bandwidth (see note 9)	8.0	8.0	MHz
Frequency range	590 to 720	590 to 720	MHz
Electro-magnet current	10.5 to 12	10.5 to 12	A
Heater voltage	8.5	8.5	V

Range of Characteristics

	Min	Max	Min	Max	
Heater current	37	46	37	46	A
Body current (see note 10)	—	150	—	150	mA
Modulating anode current	—	6.0	—	6.0	mA
R.F. drive power (see note 11)	—	1.25	—	1.25	W
Efficiency:					
frequency range 590 to 650MHz	30	—	32	—	%
frequency range 650 to 720MHz	28	—	32	—	%
Beam voltage (see note 12):					
frequency range 590 to 650MHz	—	19.0	—	22.5	kV
frequency range 650 to 720MHz	—	20.0	—	22.5	kV



K3084 IN K4104BDS CIRCUIT, VISION AMPLIFIER

Test Conditions (Tuning and output coupling optimised at the two output power test levels specified)

Output power (see note 8)	28	45	kW
Bandwidth (see note 9)	8.0	8.0	MHz
Frequency range	700 to 860	700 to 860	MHz
Electro-magnet current	10.5 to 12	10.5 to 12	A
Heater voltage	8.5	8.5	V

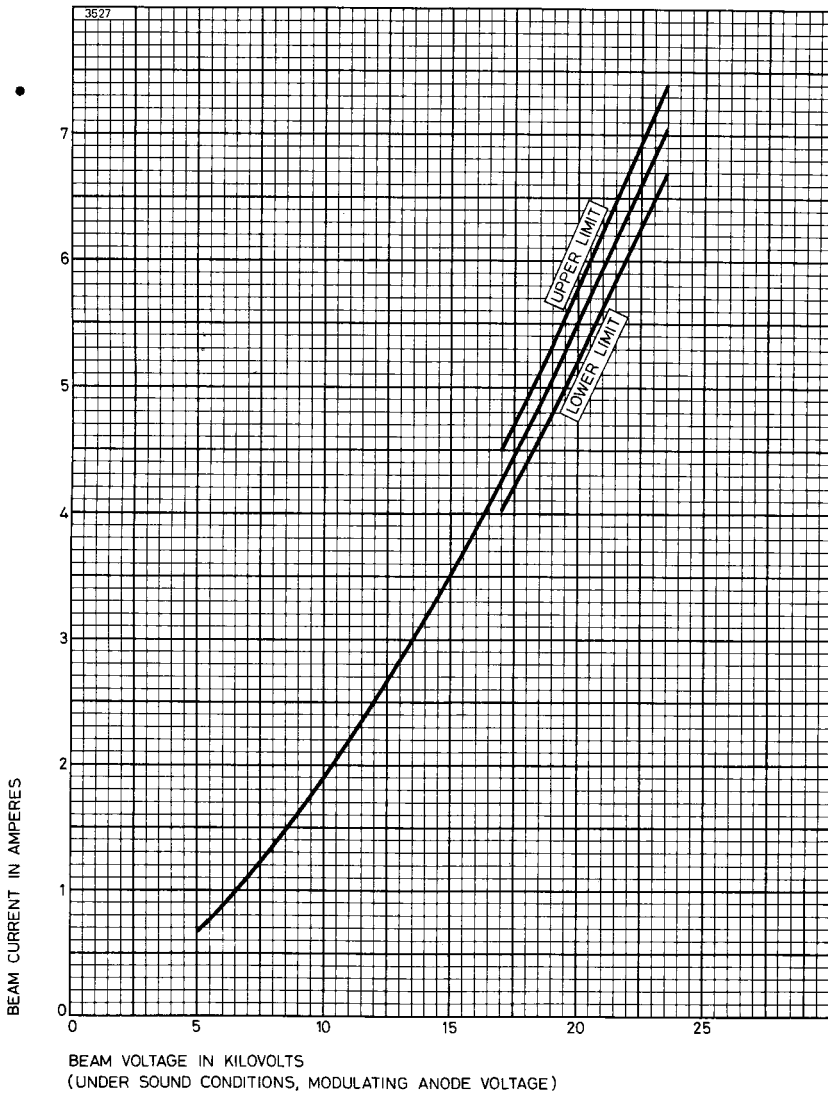
Range of Characteristics

	Min	Max	Min	Max	
Heater current	37	46	37	46	A
Body current (see note 10)	—	150	—	150	mA
Modulating anode current	—	6.0	—	6.0	mA
R.F. drive power (see note 11)	—	1.25	—	1.25	W
Efficiency:					
frequency range 700 to 790MHz	30	—	32	—	%
frequency range 790 to 860MHz	28	—	30	—	%
Beam voltage (see note 12):					
frequency range 700 to 790MHz	—	19.0	—	22.5	kV
frequency range 790 to 860MHz	—	20.0	—	23.0	kV

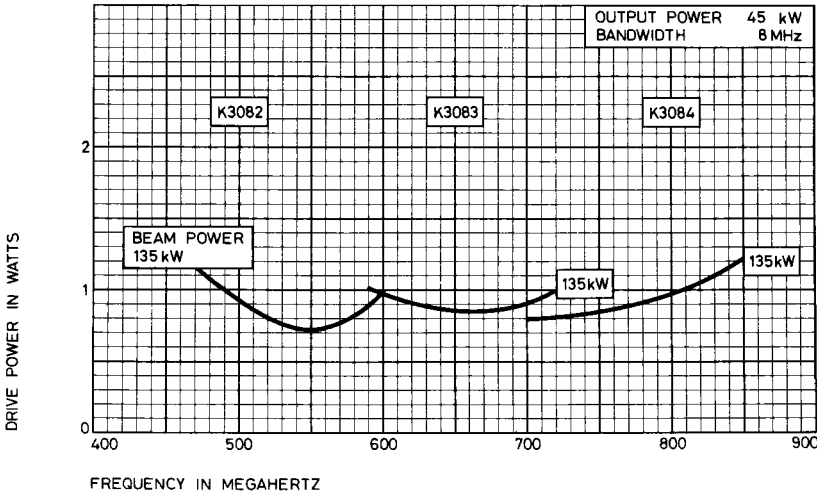
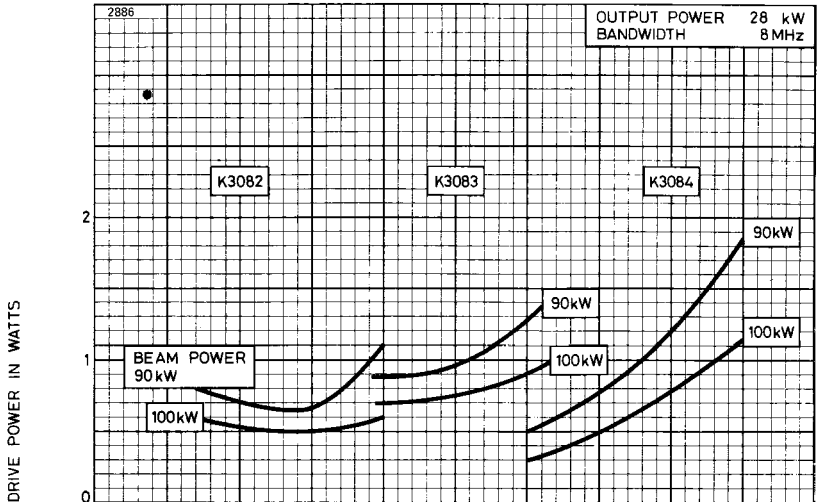
NOTES

1. For fast warm-up using a 'hot shot' technique, consult English Electric Valve Company Ltd.
2. To lift the klystron clear of the circuit assembly, using the lifting harness provided, a total height of 135 inches (3.43m) is required. This is measured to the top of the lifting harness and does not include the hoist.
3. Under T.V. picture conditions (black level + sync. pulses) the klystron will focus satisfactorily within an electro-magnet current range of 10.5 to 12.0A. Maximum stability is obtained by adjusting the magnet current within the above range and stabilizing to $\pm 2\%$ about this optimum value.
4. Alternative cooling arrangements can be used.
5. Measured at the input pipes to the circuit assembly.
6. This applies to television service. English Electric Valve Company Ltd. should be consulted regarding other conditions of service.
7. The klystron is provided with three nickel chromium-nickel aluminium thermocouples fitted to the collector. On commissioning a new klystron the output of each must be monitored and the one reading the highest temperature used as a control for future monitoring.
8. Input frequency set 2.75MHz below the centre of the 8MHz channel, and the input power and beam power adjusted to give the specified output.
9. The klystron is tuned so that, for constant input power, the variation in output power is less than 1db over the specified bandwidth at all power levels between -2db and -14db with respect to the specified output power.
10. The combined body current of one sound and one vision klystron in parallel will not exceed the limit specified.
11. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
12. With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current will be within $\pm 5\%$ of the value given by the graph on page 7.

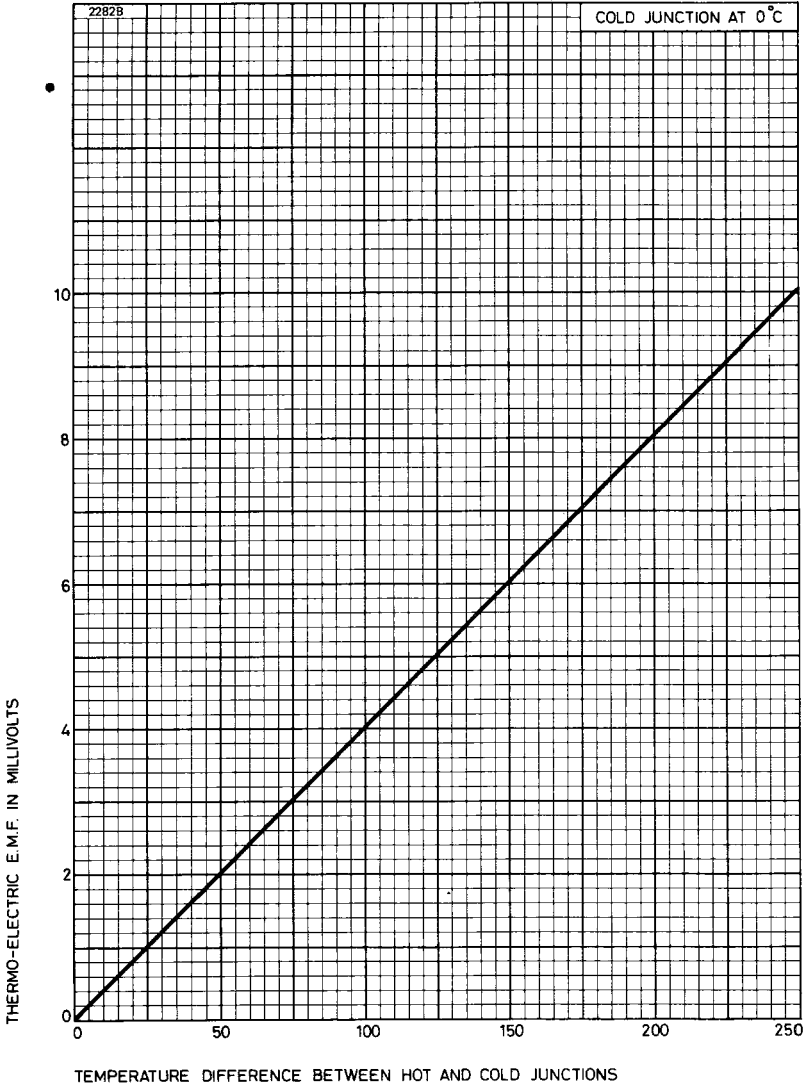
TYPICAL BEAM CHARACTERISTIC



TYPICAL DRIVE REQUIREMENTS

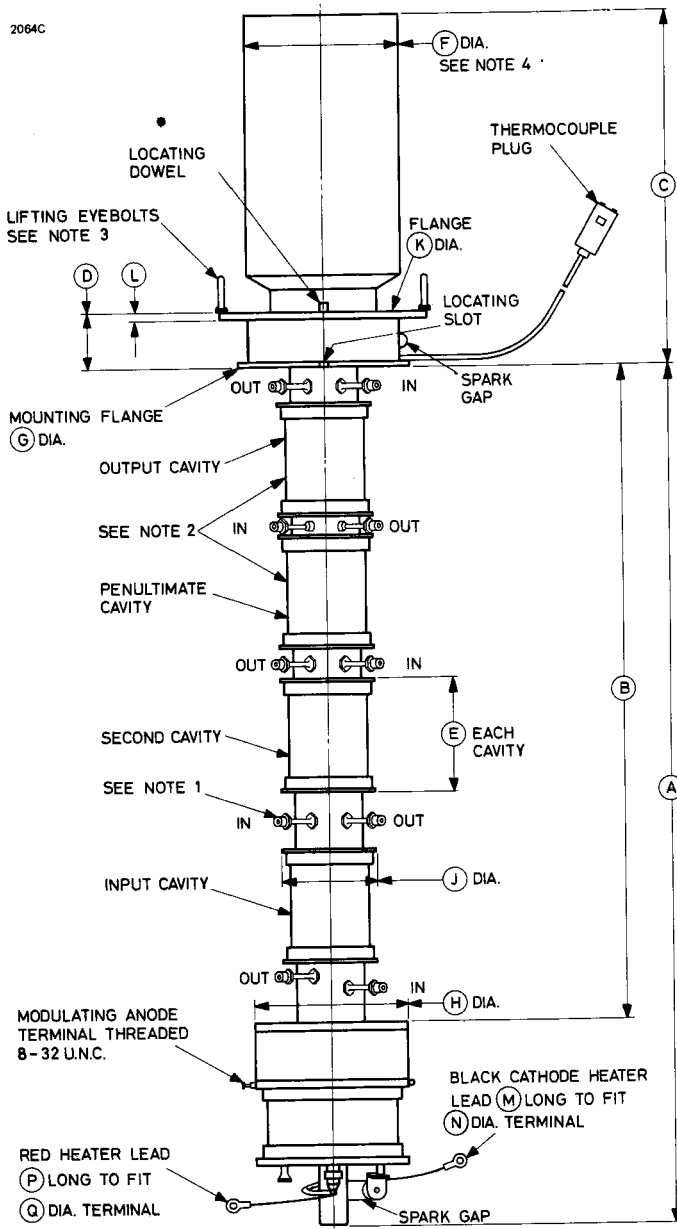


THERMOCOUPLE CALIBRATION CURVE



OUTLINE FOR K3082

2064C



Outline Dimensions for K3082 (All dimensions nominal)

Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	6.000	152.4
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35



Millimetre dimensions have been derived from inches.

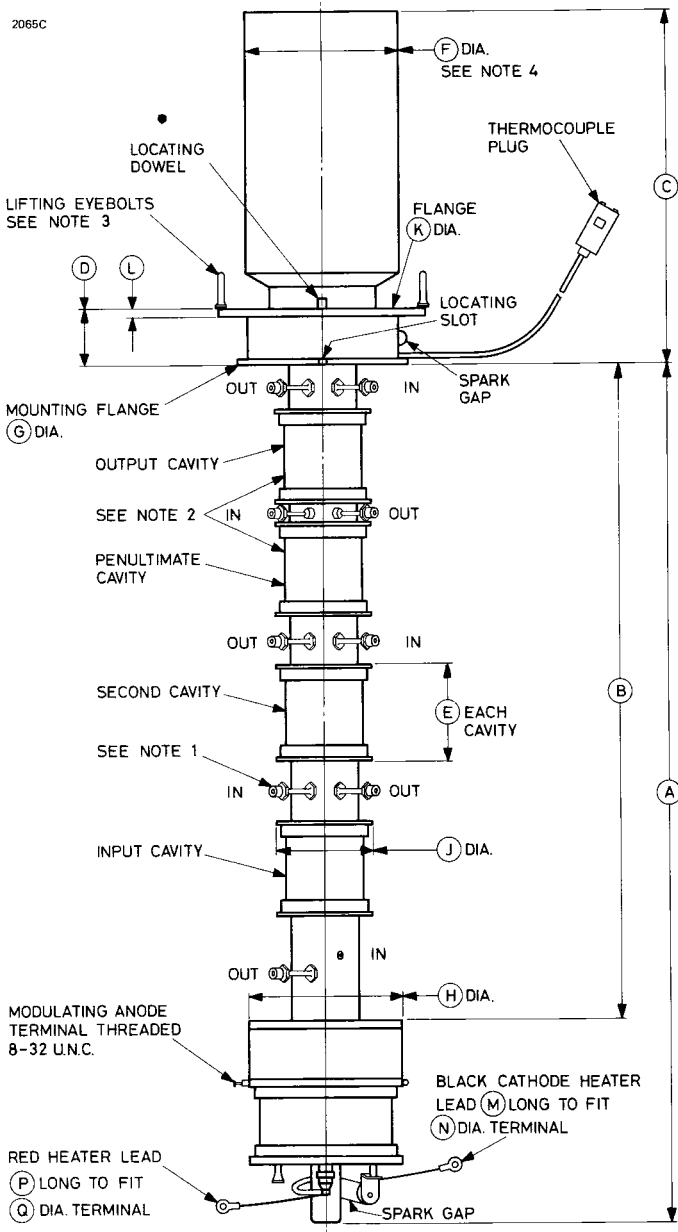
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA369 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR K3083



Outline Dimensions for K3083 (All dimensions nominal)

Ref	Inches	Millimetres
A	45.000	1143
B	34.100	866.1
C	18.500	469.9
D	3.000	76.20
E	5.000	127.0
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	5.125	130.2
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

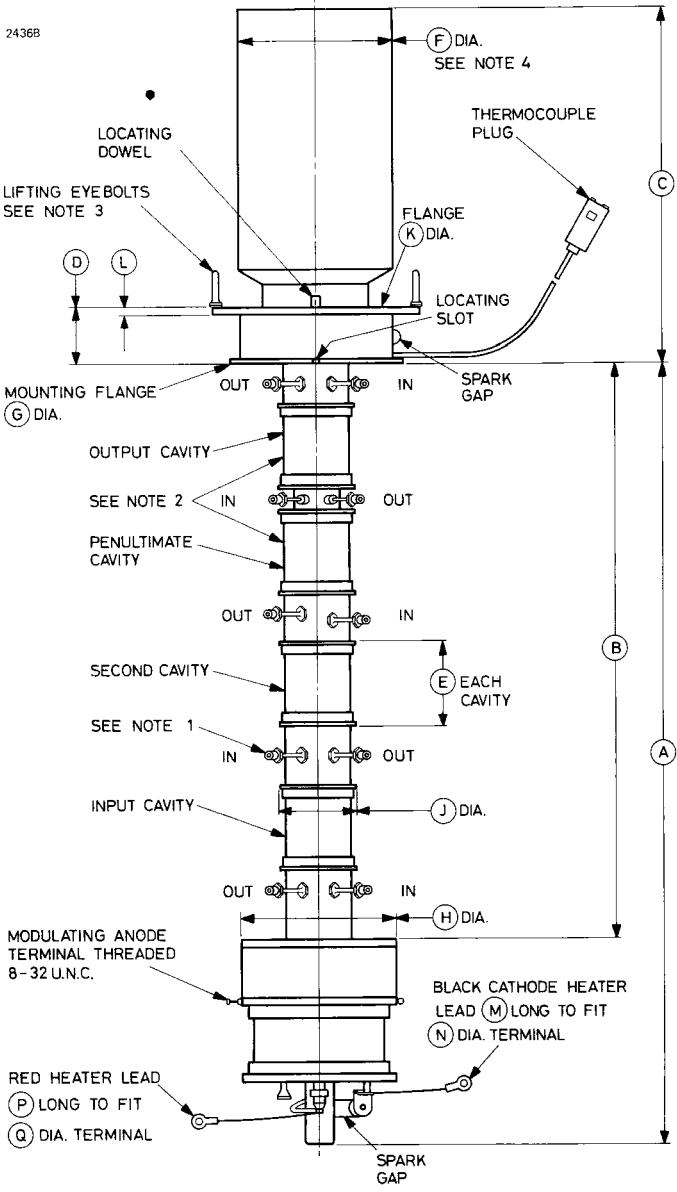
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA387 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR K3084



Outline Dimensions for K3084 (All dimensions nominal)

Ref	Inches	Millimetres
A	40.600	1031.2
B	29.875	758.8
C	18.500	469.9
D	3.000	76.20
E	4.500	114.3
F	8.000	203.2
G	9.125	231.8
H	8.100	205.7
J	4.125	104.8
K	11.125	282.6
L	0.500	12.70
M	23.000	584.2
N	0.313	7.95
P	23.000	584.2
Q	0.250	6.35

Millimetre dimensions have been derived from inches.

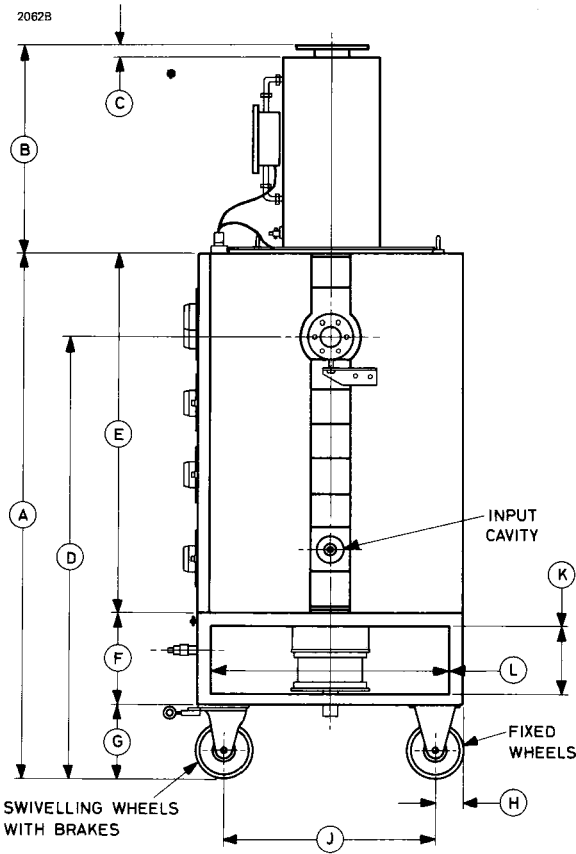
Outline Notes

1. The water extensions are shown fitted to the klystron; they are supplied with the klystron but are not fitted. The outer ends are threaded $\frac{5}{8}$ U.N.E.F. Two flexible water pipe assemblies are supplied with each klystron. They are marked with the klystron type and serial number, and must be used with that klystron only, throughout its life. Assembly MA369 connects the inlet water supply to the klystron body and MA370 connects the klystron body to the boiler.

The other connecting pipes necessary to complete the cooling system are included in the circuit assembly.

2. The penultimate and output cavity ceramics are beryllium oxide.
3. These eyebolts must be removed when the boiler is fitted.
4. The collector will lie within the volume shown.

OUTLINE FOR CIRCUIT ASSEMBLIES

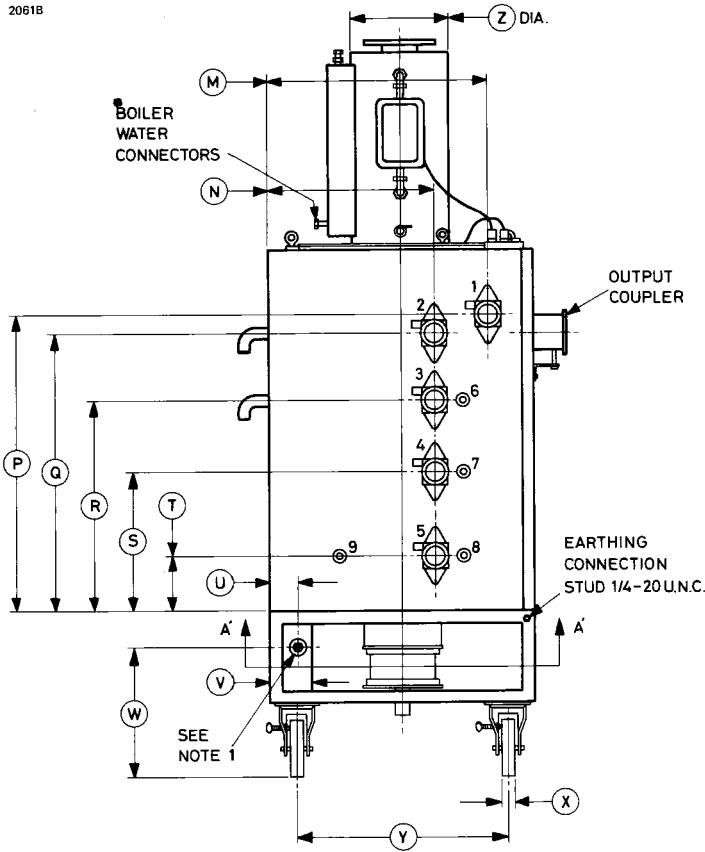


Note This drawing is not to scale for the K4104BDS.

See page 19 for Outline Dimensions

OUTLINE FOR CIRCUIT ASSEMBLIES

2061B



Controls

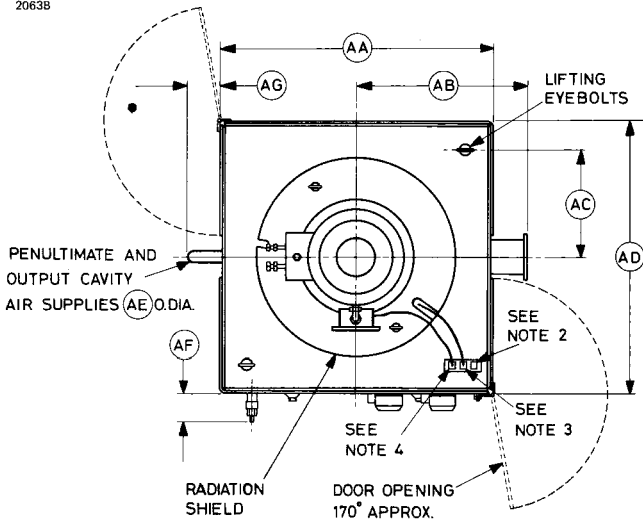
- | | | | |
|---|---------------------------|---|----------------------------|
| 1 | Output coupling | 6 | Penultimate cavity loading |
| 2 | Output cavity tuning | 7 | Second cavity loading |
| 3 | Penultimate cavity tuning | 8 | Input cavity coupling |
| 4 | Second cavity tuning | 9 | Input cavity loading |
| 5 | Input cavity tuning | | |

Note This drawing is not to scale for the K4104BDS.

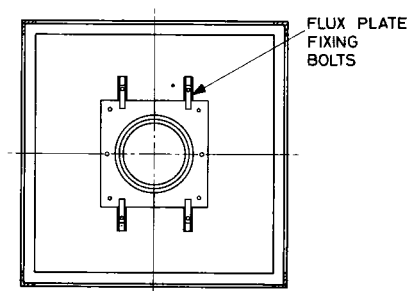
See page 19 for Outline Dimensions

OUTLINE FOR CIRCUIT ASSEMBLIES

2063B



VIEW FROM ABOVE



SECTION A-A' SHOWING
CENTRING PLATE

Outline Notes

1. Water inlet connection Hitemp Minilock Self Sealing Coupling, threaded ½-inch B.S.P.
2. Connections to external circuits; see page 22.
3. Thermocouple socket, accepts plug wired to klystron.
4. Collector and level trip socket, accepts plug wired to boiler.

Outline Dimensions for K4102BDS and K4103BDS

(All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	55.125 ± 0.125	1400.2 ± 3.2	S	14.562	369.9
B	22.000 ± 0.125	558.8 ± 3.2	T	5.750	146.1
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	37.813 ± 0.062	960.5 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	9.688 ± 0.062	246.1 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.125	555.6 ± 3.2
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.750 ± 0.125	730.3 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.750 max	400.1 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.750 ± 0.125	730.3 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	30.813	782.7	AF	4.250	108.0
Q	28.937	735.0	AG	2.500	63.50
R	22.062	560.4			

Millimetre dimensions have been derived from inches.

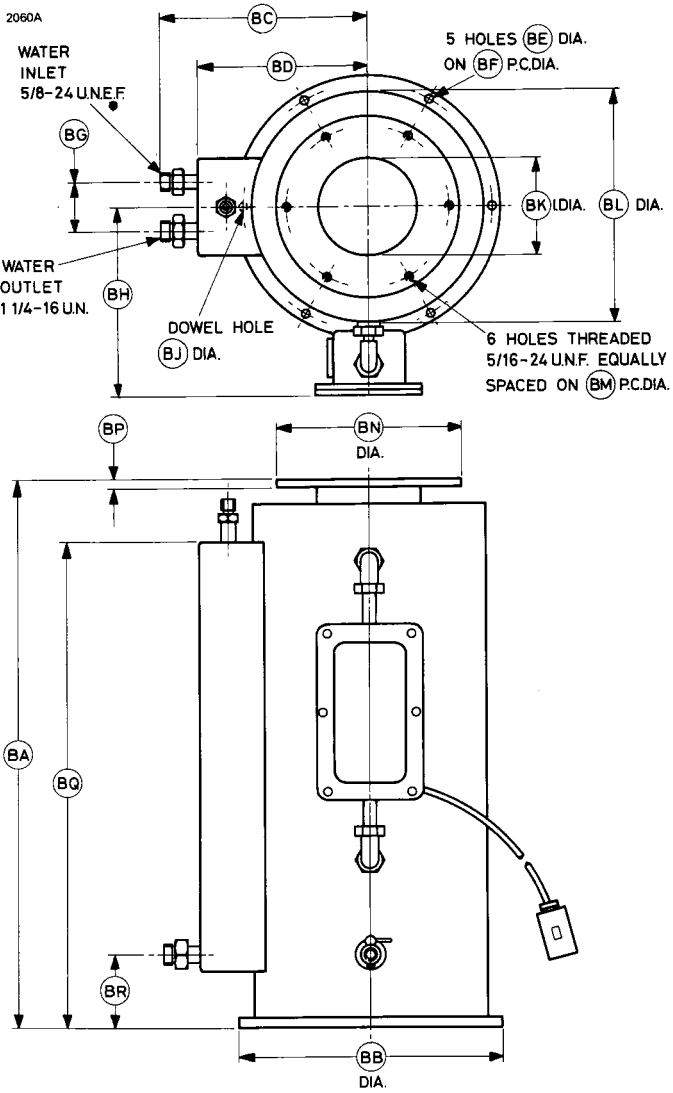
Outline Dimensions for K4104BDS

(All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	54.562 ± 0.125	1385.9 ± 3.2	S	12.625	320.7
B	22.000 ± 0.125	558.8 ± 3.2	T	5.125	130.2
C	1.000	25.40	U	3.000 ± 0.062	76.20 ± 1.57
D	46.250 ± 0.250	1174.8 ± 6.4	V	4.500 ± 0.062	114.3 ± 1.57
E	33.375 ± 0.062	847.7 ± 1.6	W	13.750 ± 0.250	349.3 ± 6.4
F	13.562 ± 0.062	344.5 ± 1.6	X	1.750 ± 0.016	44.45 ± 0.41
G	7.625 ± 0.062	193.7 ± 1.6	Y	21.875 ± 0.125	555.6 ± 3.2
H	3.500 ± 0.187	88.90 ± 4.75	Z	9.750	247.7
J	22.250 ± 0.062	565.2 ± 1.6	AA	28.750 ± 0.125	730.3 ± 3.2
K	5.688 ± 0.187	144.48 ± 4.75	AB	15.5 max	393.7 max
L	25.000 ± 0.187	635.0 ± 4.75	AC	11.250	285.8
M	24.931	633.2	AD	28.750 ± 0.125	730.3 ± 3.2
N	17.500	444.5	AE	1.687	42.85
P	26.938	684.2	AF	4.250	108.0
Q	25.062	636.6	AG	2.250	57.15
R	19.562	496.9			

Millimetre dimensions have been derived from inches.

BOILER UNIT



Dimensions for Boiler Unit

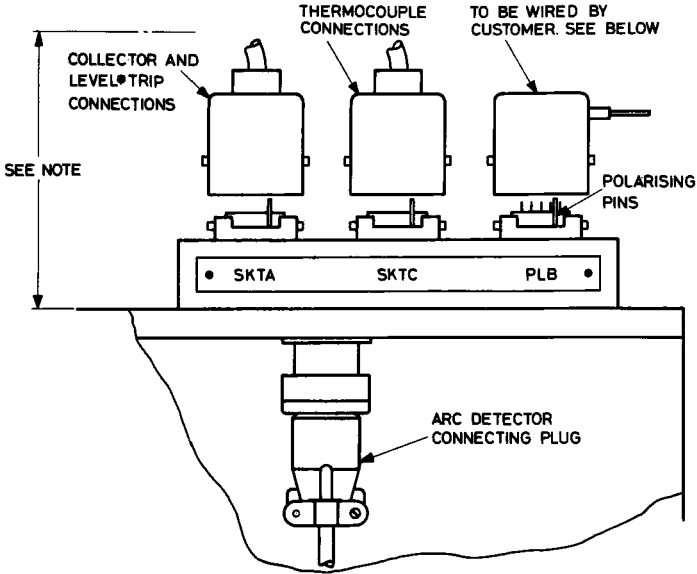
Ref	Inches	Millimetres
BA	23.125 ± 0.125	587.4 ± 3.2
BB	11.125 ± 0.125	282.6 ± 3.2
BC	8.250 ± 0.125	209.6 ± 3.2
BD	7.125 ± 0.125	181.0 ± 3.2
BE	0.312	7.92
BF	10.500	266.7
BG	2.000 ± 0.062	50.80 ± 1.57
BH	7.750	196.9
BJ*	0.394	10.0
BK	4.000	101.6
BL	9.750	247.7
BM	7.000	177.8
BN	7.750 ± 0.016	196.9 ± 0.4
BP	0.375	9.53
BQ	20.562	522.3
BR	2.938 ± 0.062	74.63 ± 1.57

Millimetre dimensions have been derived from inches except where marked thus *



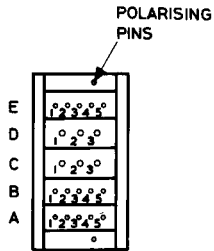
PLUG AND SOCKET CONNECTIONS

2115



Input Socket Connections (to be wired by customer)

Water level trip circuit	B1, B2
Collector connection	C1
Thermocouple circuit:	
nickel chromium	B3
nickel aluminium 1	C2
nickel aluminium 2	D2
nickel aluminium 3	D1
Arc detector circuit:	
photo resistor	E4, E5
bulb	E2, E3
screen and earth	E1
link	B4, B5
Focus coils:	
positive	C3
negative	D3



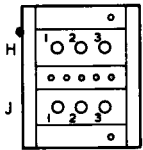
Input socket

View on solder connections with cover removed

Note Clearance for connector removal 5.750 inches (146mm) minimum.

Collector Plug

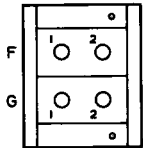
2116



Pin	Element
H1	Collector
H2	—
H3	—
J1	Water level trip
J2	Water level trip
J3	—

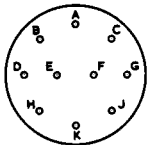


Thermocouple Plug



Pin	Element
F1	Nickel chromium
F2	Nickel aluminium 3
G1	Nickel aluminium 1
G2	Nickel aluminium 2

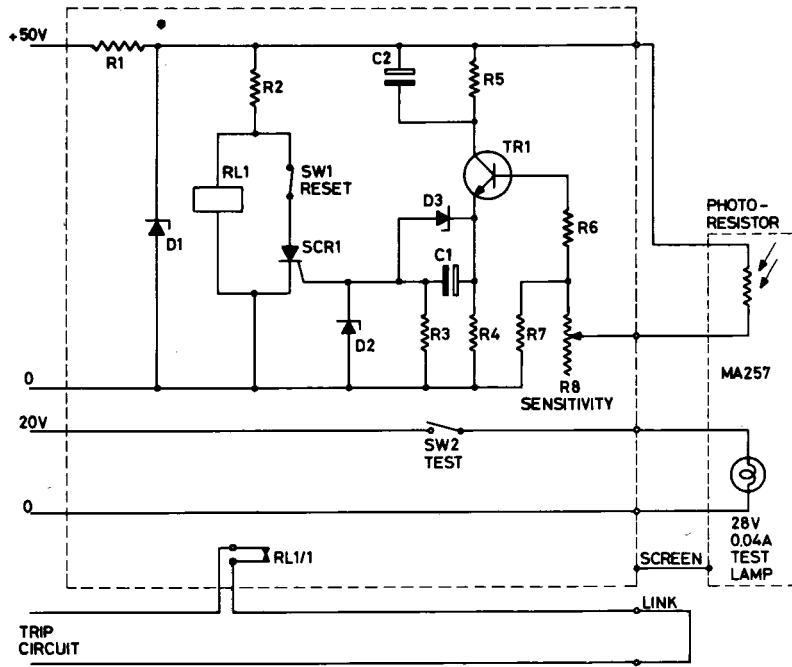
Arc Detector Plug



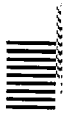
Pin	Element
A	Photo resistor
B	Photo resistor
C	Bulb
D	Link
E	Screen and earth
F	Screen and earth
G	Bulb
H	Link
J	No connection
K	No connection

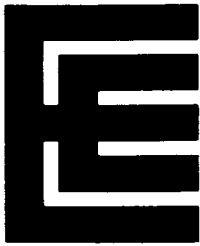
SUGGESTED CIRCUIT FOR ARC DETECTOR

2138A



**CW Amplifier Klystrons for
Tropospheric Scatter Service**





AMPLIFIER KLYSTRON

ABRIDGED DATA

Three cavity, electro-magnetically focused, forced-air cooled amplifier klystron with separate tuning cavities, for u.h.f. c.w. service. The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range	610 to 985	MHz
Output power (narrow-band)	2.0	kW min
Power gain (narrow-band)	25	db
Beam voltage	9.0	kV max
Cooling		forced-air



GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	5.0	V
Heater current	31	A
Heater starting current (peak)	60	A max
Cathode heating time (minimum)	5	min

Mechanical

Overall length	34.935 inches (887.3mm) max
Overall diameter	5.132 inches (130.4mm) max
Mounting position	vertical, cathode end up
Net weight	32 pounds (14.5kg) approx

Cooling

Air flow to collector	150ft ³ /min (4.2m ³ /min)
Collector pressure drop	1.6 inches (40.6mm) w.g.
Air flow to output cavity	50ft ³ /min (1.4m ³ /min)
Cavity pressure drop	1.0 inch (25mm) w.g.
Air flow to cathode	5ft ³ /min (0.14m ³ /min)
Cathode pressure drop	0.4 inch (10mm) w.g.
Inlet air temperature	20 °C

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded

Beam voltage	9.0	kV max
Beam current (mean)	0.75	A max
Body current:		
continuous	75	mA max
tuning	100	mA max
Focus electrode voltage (negative)	500	V max
Collector dissipation (see note)	3.0	kW max
Temperature of any external part of the klystron	175	°C max

TYPICAL OPERATION (Narrow-band c.w.)

Frequency	850	850	MHz
Beam voltage	7.0	9.0	kV
Beam current	375	580	mA
Focus electrode voltage	-200	-200	V
Body current	30	30	mA
Driving power	4.0	10	W
Output power	1300	2790	W
Power gain	25	24	db
Efficiency	50	54	%

NOTE Failure of the r.f. drive power while the klystron is running may result in the collector dissipation rating being exceeded. A thermal trip should be fitted to the collector to cut off the beam if the temperature exceeds 175°C.

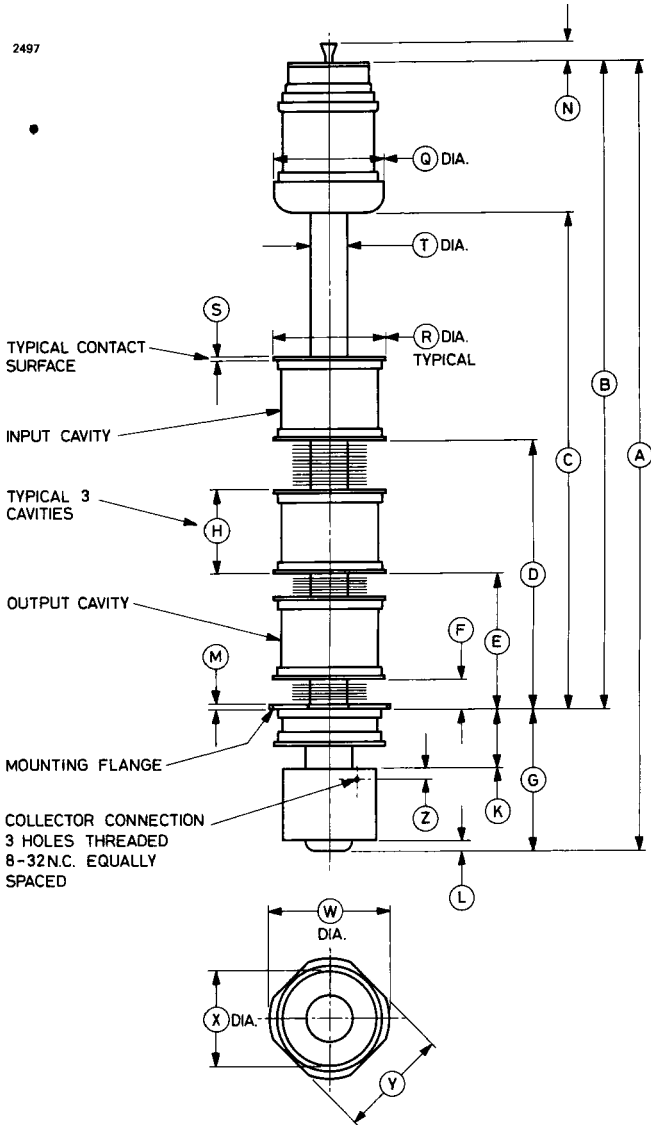
Outline Dimensions (All dimensions without limits are nominal)

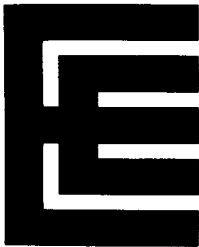
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	33.187	842.9	M	0.250	6.35
B	27.312	693.7	N	0.750 max	19.05 max
C	20.812	528.6	Q	4.625	117.5
D	11.312	287.3	R	4.625	117.5
E	5.812	147.6	S	0.245	6.22
F	1.312	33.32	T	1.500	38.10
G	5.875	149.2	W	5.125	130.2
H	3.500	88.90	X	4.125	104.8
K	2.500	63.50	Y	4.625	117.5
L	0.375	9.53	Z	0.430	10.92

Millimetre dimensions have been derived from inches.

OUTLINE

2497





3K50,000LF

AMPLIFIER KLYSTRON

ABRIDGED DATA

Three cavity, electro-magnetically focused amplifier klystron with separate tuning cavities, for u.h.f. c.w. service. The collector is water cooled in an integral water jacket. The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range	570 to 720	MHz
Output power (narrow-band)	10	kW
Power gain (narrow-band)	28	db
Beam voltage	16	kV
Cooling	water and forced-air	



GENERAL

Electrical

Cathode	indirectly heated
Heater voltage	7.5 V
Heater current	40 A
Heater starting current (peak)	80 A max
Cathode heating time	5 minutes

Mechanical

Overall length	47.75 inches (121.3cm) max
Overall diameter	5.135 inches (130.4mm) max
Mounting position	vertical, cathode end up
Net weight	51 pounds (23kg) approx

Cooling

Air flow to cathode	25ft ³ /min (0.71m ³ /min)
Air flow to output cavity	50ft ³ /min (1.42m ³ /min)
Water flow to klystron body	1.0imp. gal/min (4.5 l./min)
Water flow to collector	21imp. gal/min (95 l./min)
Outlet water temperature	70 °C max

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded

Beam voltage	20	kV max
Beam current (mean)	2.5	A max
Body current (mean):		
for continuous operation	150	mA max
for tuning	250	mA max
Focus electrode voltage (negative)	500	V max
Collector dissipation	50	kW max
Temperature of any external part of the klystron	175	°C max

TYPICAL OPERATION (Narrow band c.w.)

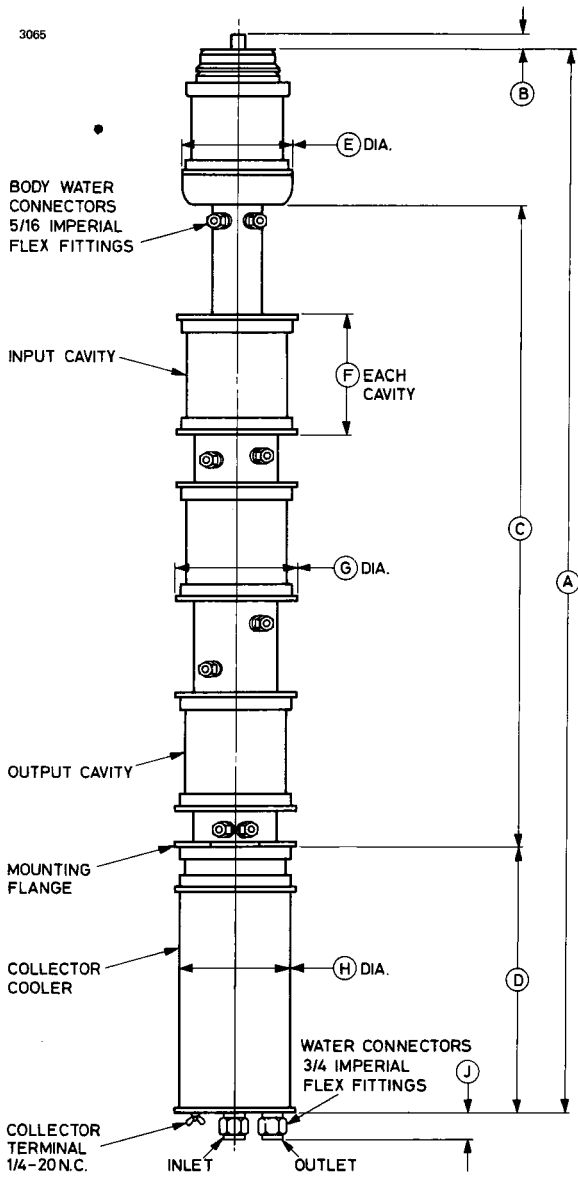
Frequency	640	MHz
Beam voltage	16	kV
Beam current	1.7	A
Focus electrode voltage	-200	V
Body current (mean)	90	mA
Drive power	17	W
Output power	10.7	kW
Power gain	28	db
Efficiency	40	%

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	45.500 max	1156 max
B	0.750	19.05
C	27.625 max	701.7 max
D	11.500	292.1
E	4.625	117.5
F	5.000	127.0
G	5.125	130.2
H	4.500	114.3
J	1.125	28.58

Millimetre dimensions have been derived from inches.

OUTLINE





4KM50,000LQ

**AMPLIFIER
KLYSTRON**

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystron with separate tuning cavities, for u.h.f. c.w. service. A modulating anode is fitted which may be used for beam current control or as a protective device.

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range	610 to 985	MHz
Output power	10.5	kW
Power gain (narrow-band)	50	db
Beam voltage	17	kV
Cooling	water and forced-air	



GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	7.5	V
Heater current range	38 to 42	A
Heater starting current (peak)	80	A max

Mechanical

Overall length	47.75 inches (121.3cm) nom	
Overall diameter (excluding water fittings)	5.125 inches (13.02cm) nom	
Net weight	55 pounds (25kg) approx	
Mounting position	vertical, cathode end up	

Cooling

At sea level and with an inlet air temperature of 20°C, the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the klystron, but this practice is not recommended.

Air flow to cathode	25	ft ³ /min
	0.71	m ³ /min
Air flow to output cavity	50	ft ³ /min
	1.42	m ³ /min
Water flow to klystron body	1.0	imp.gal/min
	4.5	l./min
Water flow to collector	25	imp.gal/min
	114	l./min
Outlet water temperature	70	°C max
The temperature of any external part of the klystron must not exceed	175	°C

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded

Beam voltage	20	kV max
Beam current (mean)	2.5	A max
Body current (mean):		
for continuous operation	100	mA max
for tuning	150	mA max
Focus electrode voltage (negative)	500	V max
Collector dissipation	50	kW max

TYPICAL OPERATION

Narrow-band c.w.

Frequency	610	970	MHz
Beam voltage	17	17	kV
Beam current	1.8	1.8	A
Focus electrode voltage	-205	-235	V
Modulating anode voltage			see note 1
Body current	90	80	mA
Driving power	50	50	mW
Output power	10.5	11.4	kW
Power gain	53.2	53.6	db
Efficiency	34.3	37.3	%

Broad-band c.w.

Frequency		900	MHz
Bandwidth to 3db points		4.0	MHz
Beam voltage		17	kV
Beam current (mean)		1.7	A
Focus electrode voltage		-250	V
Modulating anode voltage			see note 1
Body current (mean) (see note 2)		35	mA
Driving power (see note 3)		1.0	W
Second cavity power (see note 4)		15	W
Third cavity power (see note 4)		150	W
Output power		10.5	kW
Beam efficiency		36.3	%



NOTES

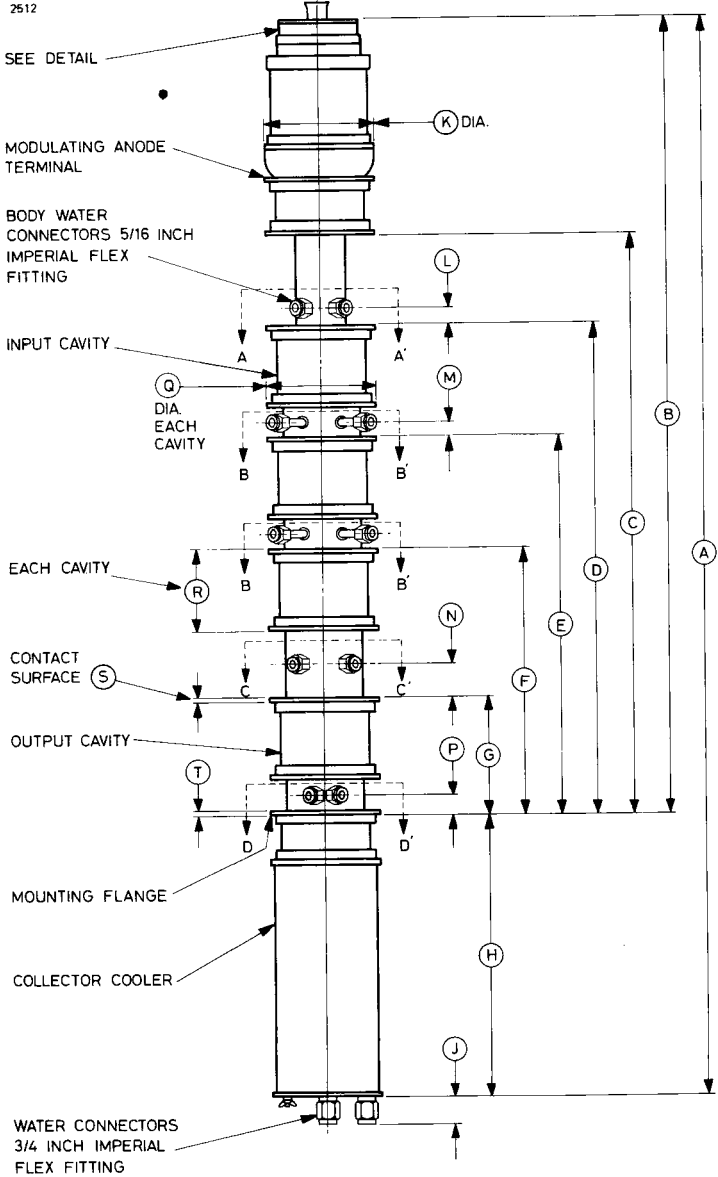
1. The modulating anode is connected to the body of the klystron by a 10k Ω resistor.
2. Correct focusing (i.e. minimum body current) can only be achieved when the klystron is accurately aligned along the axis of the magnetic field.
3. The figure specified is the drive power which should be available.
4. For broad band operation it is normal to load the cavities externally. The powers specified are those dissipated in the loads.

X-RAYS

With the klystron operating under normal conditions, the stray X-ray radiation is below the minimum level which is hazardous to the health of operators.

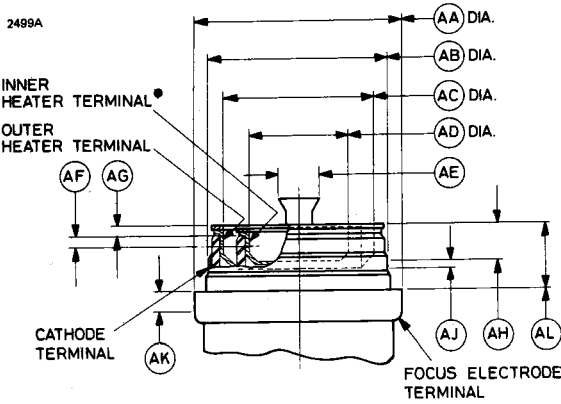
OUTLINE

2512

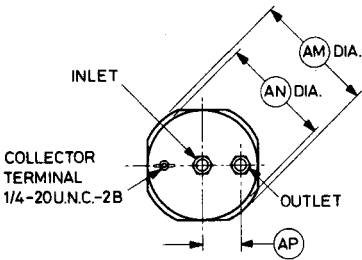




Outline Details (All dimensions without limits are nominal)



Detail of Cathode End



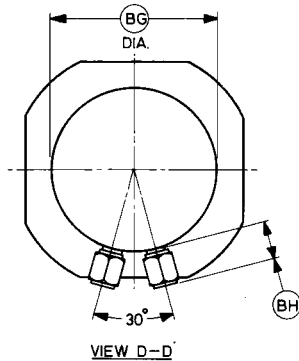
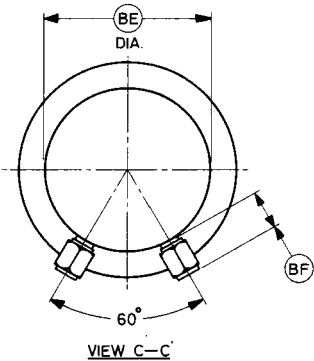
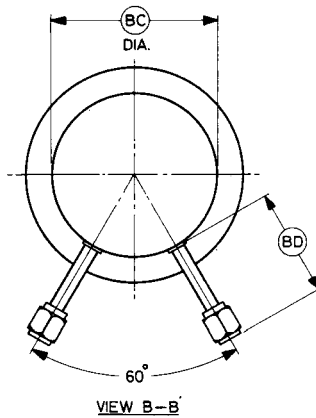
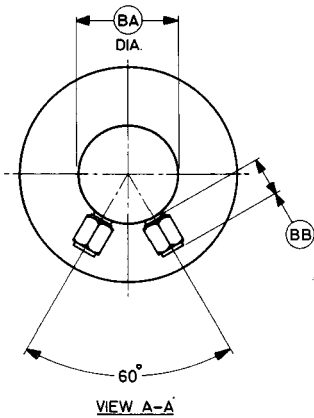
View on Collector End

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	4.375	111.1	AH	0.750	19.05
AB	3.800	96.52	AJ	0.125 min	3.18 min
AC	3.187	80.95	AK	0.500 min	12.70 min
AD	1.937	49.20	AL	1.312	33.32
AE	1.250	31.75	AM	5.125	130.2
AF	0.250	6.35	AN	4.625	117.5
AG	0.150	3.81	AP	1.625	41.28

Millimetre dimensions have been derived from inches.

Outline Details (All dimensions nominal)

2513



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.120	53.85	BE	3.250	82.55
BB	0.850	21.59	BF	0.850	21.59
BC	3.250	82.55	BG	3.250	82.55
BD	2.250	57.15	BH	0.850	21.59

Millimetre dimensions have been derived from inches.



4KM50,000LR

**AMPLIFIER
KLYSTRON**

ABRIDGED DATA

Four cavity, electro-magnetically focused amplifier klystron with separate tuning cavities, for u.h.f. c.w. service. A modulating anode is fitted which may be used for beam current control or as a protective device.

The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range	755 to 985	MHz
Output power	10	kW
Power gain (narrow-band)	53	db
Beam voltage	17	kV
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	7.5	V
Heater current	40	A
Heater starting current (peak)	80	A max
Cathode heating time (minimum)	5	min

Mechanical

Overall length	47.75 inches (121.3cm) nom	
Overall diameter (excluding water fittings)	5.125 inches (13.02cm) nom	
Net weight	55 pounds (25kg) approx	
Mounting position	vertical, cathode end up	

Cooling

At sea level and with an inlet air temperature of 20°C, the water and air flow rates given below are adequate for operation at maximum ratings. The air and water flows should be started before the cathode heater voltage is applied and should be continued for at least two minutes after the removal of power. The simultaneous removal of cooling and power supplies will not normally damage the klystron, but this practice is not recommended.

Air flow to cathode	25	ft ³ /min
	0.71	m ³ /min
Cathode pressure drop	1.0	inch (25mm) w.g.
Air flow to output cavity	50	ft ³ /min
	1.42	m ³ /min
Cavity pressure drop	1.5	inches (38mm) w.g.
Water flow to klystron body	1.0	imp.gal/min
	4.5	l/min
Body pressure drop	28	lb/in ² (2kg/cm ²)
Water flow to collector	21	imp.gal/min
	95.5	l/min
Collector pressure drop	28	lb/in ² (2kg/cm ²)

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded

Beam voltage	20	kV max
Beam current (mean)	2.5	A max
Body current (mean):		
for continuous operation	100	mA max
for tuning	150	mA max
Focus electrode voltage (negative)	500	V max
Collector dissipation	50	kW max
Inlet water pressure	50	lb/in ² max
	3.52	kg/cm ² max
Temperature of any external part of the klystron	175	°C max

TYPICAL OPERATION

Narrow-band c.w.

Frequency	755	985	MHz
Beam voltage	17	17	kV
Beam current (mean)	1.8	1.8	A
Focus electrode voltage	-200	-200	V
Body current (mean)	30	40	mA
Drive power	50	50	mW
Output power	12.1	11.5	kW
Power gain	53.8	53.6	db
Efficiency	39.5	37.6	%

Broad-band c.w.

Frequency	762	MHz
Beam voltage	17	kV
Beam current (mean)	1.8	A
Bandwidth to 3db points	7.0	MHz
Focus electrode voltage	-200	V
Body current (mean)	50	mA
Drive power	10	W
Output power	10	kW
Power gain	30	db
Efficiency	32.7	%

X-RAYS

With the klystron operating under normal conditions, the stray X-ray radiation is below the minimum level which is hazardous to the health of operators.

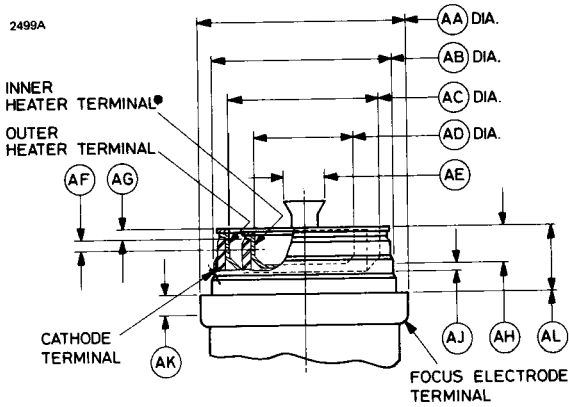
Outline Dimensions (All dimensions nominal)

Ref	Inches	Millimetres
A	44.875	1139.8
B	33.375	847.7
C	26.963	684.9
D	24.375	619.1
E	20.625	523.9
F	14.375	365.1
G	9.687	246.0
H	5.000	127.0
J	11.500	292.1
K	1.125	28.58
L	4.725	120.0
M	1.750	44.45
N	0.687	17.45
P	1.375	34.93
Q	0.594	15.09
R	0.687	17.45
S	4.625	117.5
T	3.500	88.90
U	0.250	6.35
V	0.250	6.35

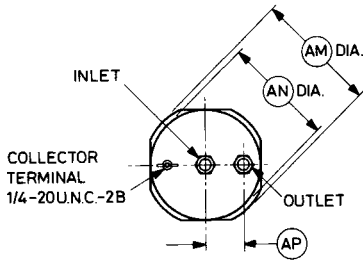


Millimetre dimensions have been derived from inches.

Outline Details (All dimensions without limits are nominal)



Detail of Cathode End

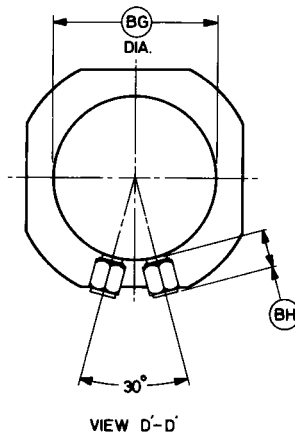
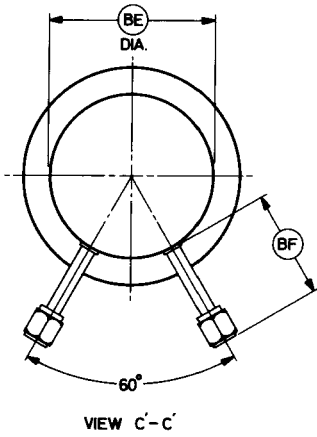
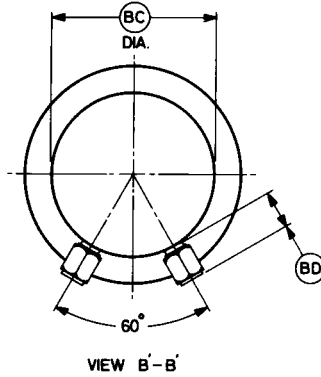
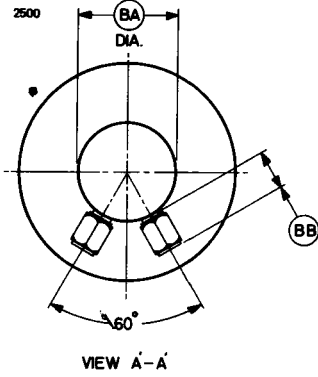


View on Collector End

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	4.375	111.1	AH	0.750	19.05
AB	3.800	96.52	AJ	0.125 min	3.18 min
AC	3.187	80.95	AK	0.500 min	12.70 min
AD	1.937	49.20	AL	1.312	33.32
AE	1.250	31.75	AM	5.125	130.2
AF	0.250	6.35	AN	4.625	117.5
AG	0.150	3.81	AP	1.625	41.28

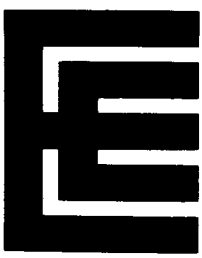
Millimetre dimensions have been derived from inches.

Outline Details (All dimensions nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.120	53.85	BE	3.250	82.55
BB	0.850	21.59	BF	2.250	57.15
BC	3.250	82.55	BG	3.250	82.55
BD	0.850	21.59	BH	0.850	21.59

Millimetre dimensions have been derived from inches.



AMPLIFIER KLYSTRON

ABRIDGED DATA

Four cavity amplifier klystron with separate tuning cavities, for tropospheric scatter service. The collector is vapour cooled in a separate boiler with upward steam exit. A modulating anode is fitted which may be used for beam current control or as a protective device.

The tube is electro-magnetically focused and its associated circuit assembly is designed to reduce tube replacement time to a minimum. With this design, full use is made of the advantages of the external cavity klystron. On initial installation the cavities can be tuned to a specific channel and the coupling loops adjusted for optimum performance. The cavities can be detached from the vacuum tube and refitted on a replacement tube without disturbing the tuning or the coupling loop settings. At switch-on, the replacement klystron will be coarse-tuned, requiring only a trimming adjustment to meet the full specification.



The operation of the klystron is guaranteed only when it is used with an approved circuit assembly.

Frequency range (in circuit assembly K4148)	. . . . .	755 to 985	MHz
Bandwidth to 3db	. . . . .	8.0	MHz
Output power	. . . . .	11	kW min
Power gain at 11kW output	. . . . .	40	db min
Beam voltage for 11kW output	. . . . .	12.5	kV max
Output	. . . . .	3 ¹ / ₈ inch	50Ω coaxial line
Cooling (see page 2)	. . . . .	vapour and forced-air	

GENERAL

Electrical

Cathode	. . . . .	indirectly heated	
Heater voltage	. . . . .	in the range 5.0 to 5.5	V
Heater current	. . . . .	38 to 44	A
Heater starting current (peak)	. . . . .	84	A max
Cathode heating time (minimum)	. . . . .	5	minutes

Mechanical

Overall length	39.6 inches (100.6cm) nom
Overall diameter	8 inches (20.3cm) nom
Mounting position	vertical, cathode end up
Net weight of klystron	55 pounds (25kg) approx

Circuit Assembly K4148

Electro-magnet current	11 ± 1	A
Electro-magnet resistance:		
cold	5.7	Ω
hot	7.3	Ω max
R.F. input connector		type N coaxial
R.F. output	3 1/8 inch	50Ω coaxial line
Net weight of magnet assembly	770 pounds (349kg) approx	
Weight of cavities	60 pounds (27kg) approx	

Cooling

The klystron collector is vapour cooled. The boiler, which is part of the circuit assembly, is of the upward steam exit type and intended for use with a separate condenser.

The final drift tube and the output cavity are forced-air cooled. This is achieved by means of a single air inlet pipe on the circuit assembly. Cooling air must be adequately filtered to avoid electrostatic precipitation of dust.

Air flow for cavity cooling (minimum)	60	ft ³ /min
	1.7	m ³ /min
Air flow to cathode terminal	5.0	ft ³ /min
	0.14	m ³ /min
Static pressure head at 60ft ³ /min (see note 1)	1.5	inches (38mm) w.g.
Inlet air temperature	55	°C max
Temperature of any external parts of the klystron must not exceed	175	°C max
Volume of steam produced by collector dissipation	1.5	ft ³ /min/kW
	0.043	m ³ /min/kW
Volume of water converted to steam	0.006	imp.gal/min/kW
	0.027	litre/min/kW

MAXIMUM RATINGS (Absolute values)

No individual rating should be exceeded.

Beam voltage	14	kV max
Beam current (mean)	3.5	A max
Body current:		
• with no input power	50	mA max
at saturated output power	150	mA max
Output power	12	kW max
Collector dissipation	45	kW max
Load v.s.w.r.	1.5:1	max

TYPICAL OPERATION

The values given are for operation in a 10kW tropospheric-scatter transmitter.

Beam voltage	12	kV		
Beam current	2.7	A		
Electro-magnet current	11	A		
Bandwidth to 3db	8.0	MHz		
Centre frequency	760 870 980	MHz		
Body current:				
with no input power	15	15	15	mA
at saturation	70	50	35	mA
Drive power	0.8	0.5	0.2	W
Saturated output power	11.4	11.5	11.0	kW



RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater voltage	5.0 to 5.5	V
Electro-magnet current	10 to 12	A
Frequency range	755 to 985	MHz
Bandwidth (see note 2)	8.0	MHz
Output power (see note 3)	11	kW

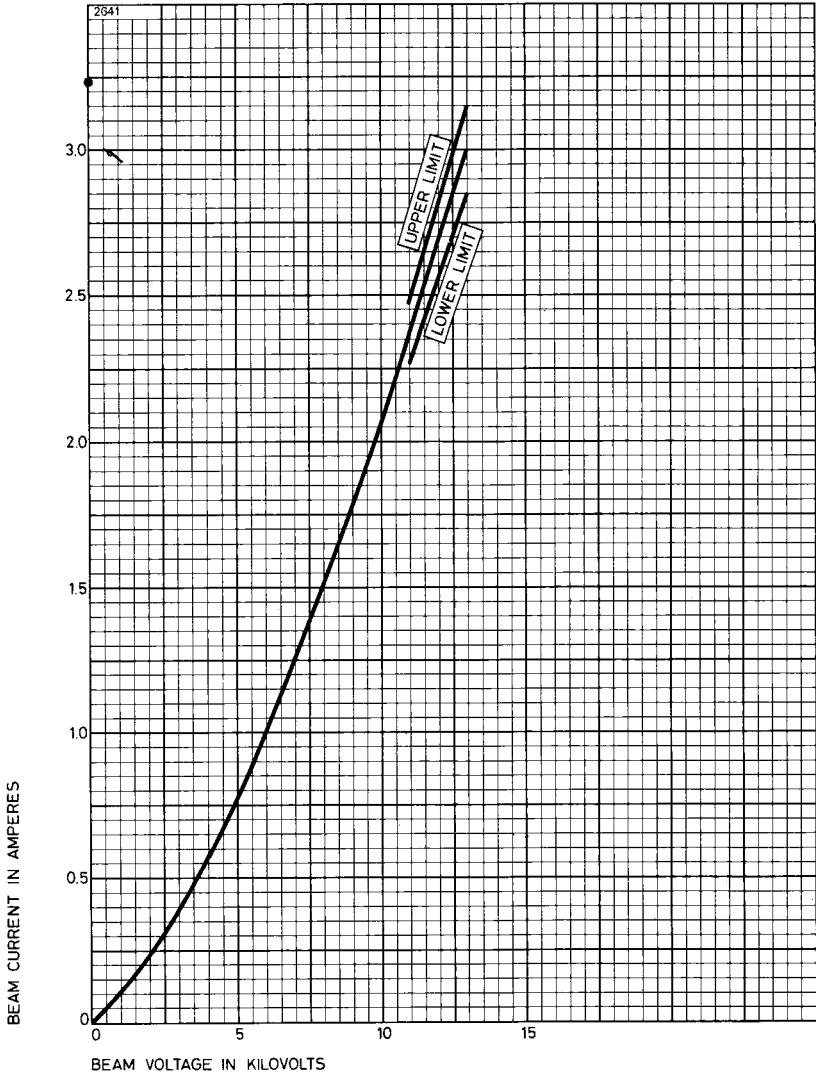
Range of Characteristics

	Min	Max	
Heater current	38	44	A
Beam voltage (see note 4)	—	12.5	kV
Body current	—	150	mA
R.F. drive power (see note 5)	—	1.1	W
Efficiency (see note 6)	32	—	%

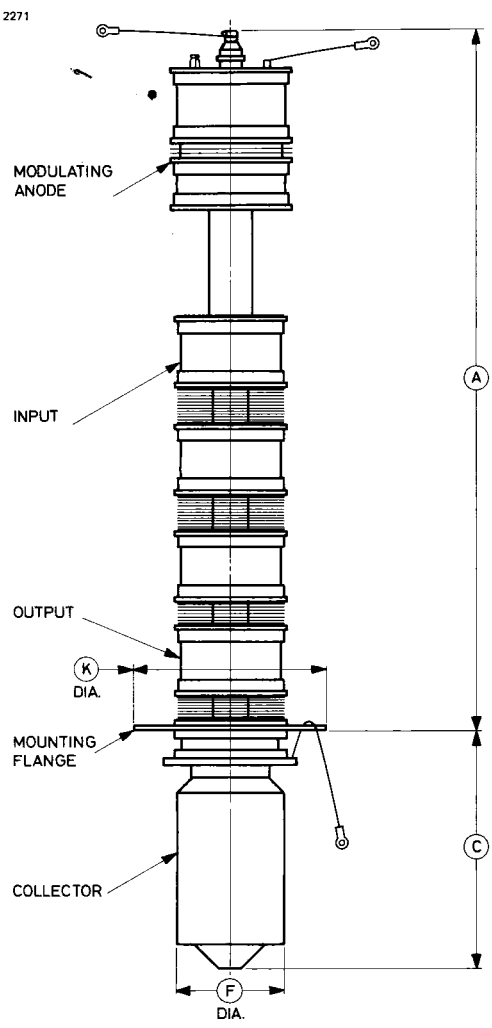
NOTES

1. Measured at the input to the circuit assembly.
2. The klystron cavities shall be tuned so that, for constant input power, the variation in output power at the klystron flange will be less than 3db over the specified bandwidth.
3. Input frequency set to band centre.
4. With the modulating anode connected to the body via a $10\text{k}\Omega$ resistor the beam current limits will be within $\pm 5\%$ of the value given by the graph on page 5.
5. Defined as the power delivered to a matched load substituted for the input cavity of the klystron.
6. The efficiency will not fall below the specified limit for any beam power in the range 30 to 37.5kW.

BEAM CURRENT LIMITS

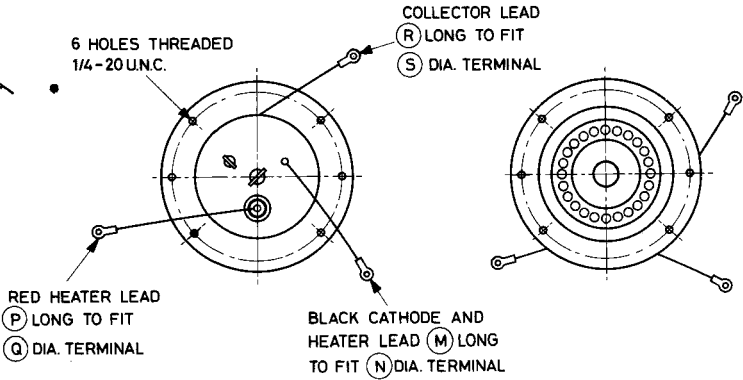


OUTLINE



Outline Details (All dimensions without limits are nominal)

2106A



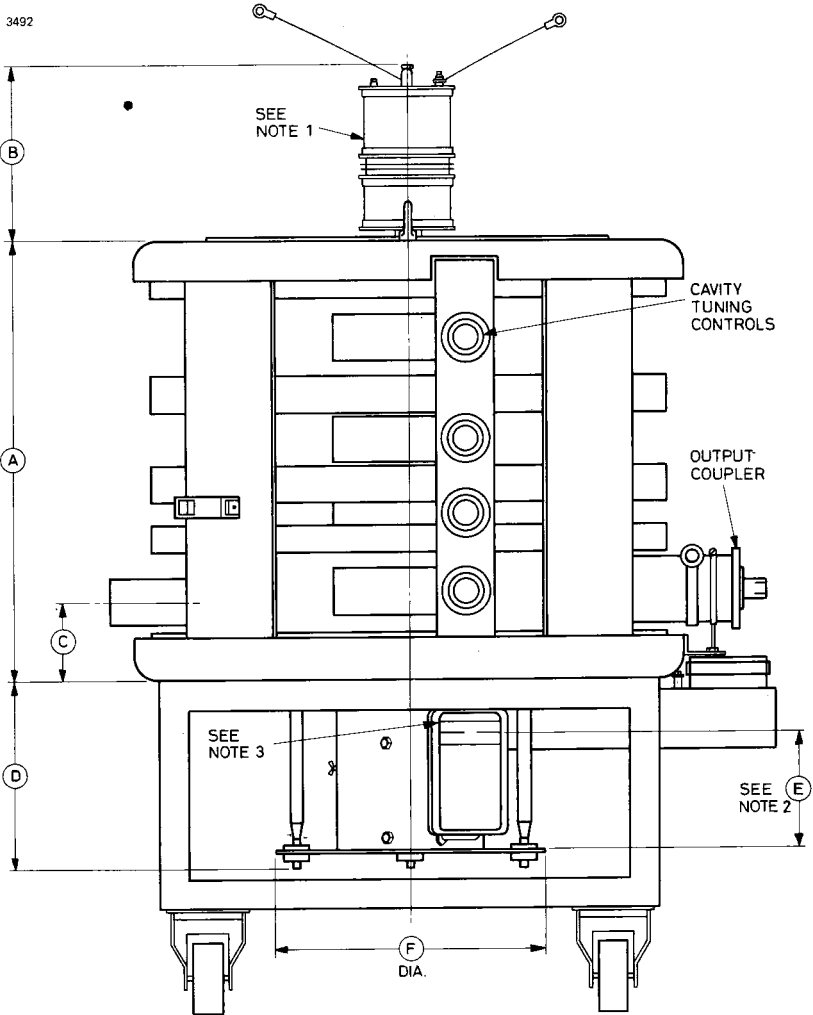
View on Gun End

View on Collector End

Ref	Inches	Millimetres
A	29.600 ± 0.500	751.8 ± 12.7
C	10.000 ± 0.062	254.0 ± 1.6
F	4.375	111.1
K	8.000	203.2
M	15.000 min	381 min
N	0.312	7.92
P	15.000 min	381 min
Q	0.250	6.35
R	36.000 min	914.4 min
S	0.196	4.98

Millimetre dimensions have been derived from inches.

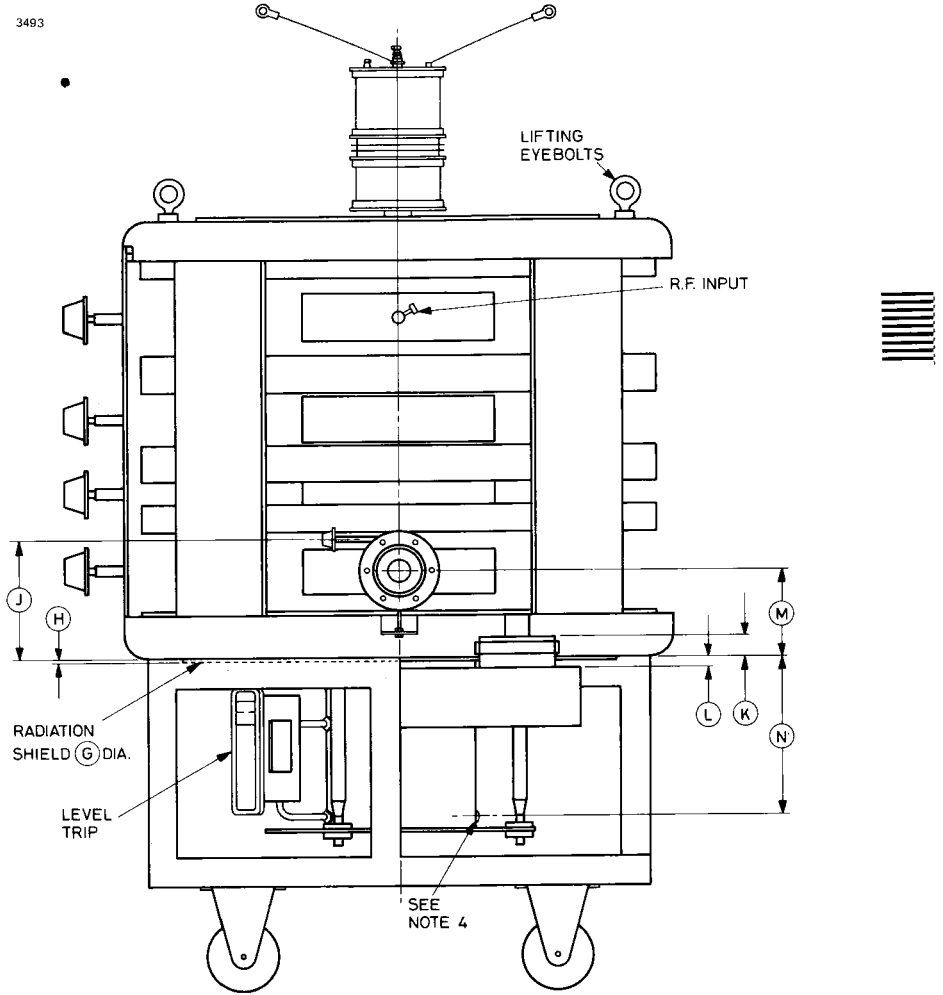
OUTLINE OF CIRCUIT ASSEMBLY K4148



See page 11 for dimensions and notes.

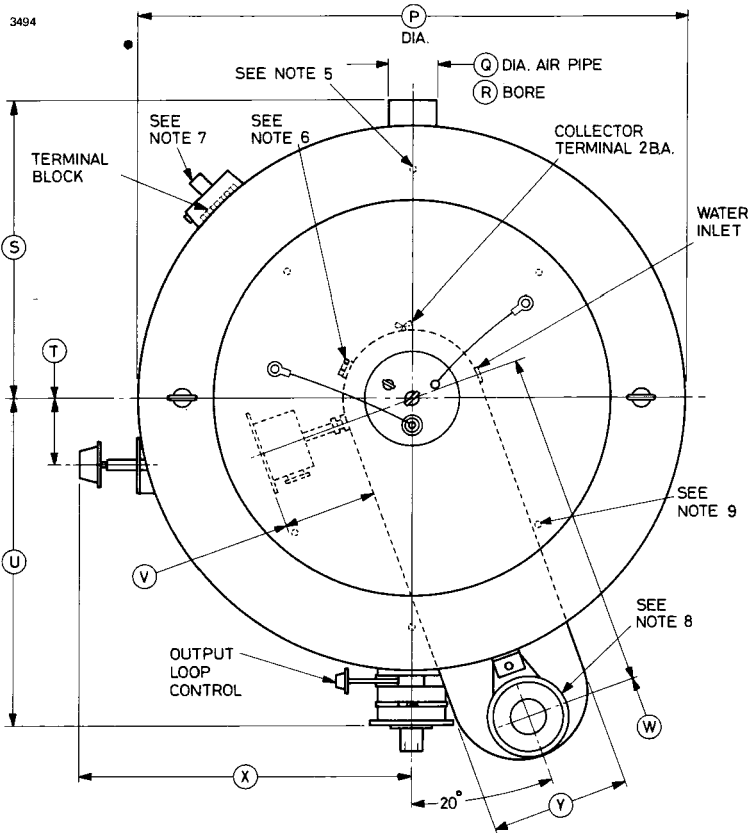
Note The circuit assembly is shown mounted on a trolley. This trolley is not part of the circuit assembly.

OUTLINE OF CIRCUIT ASSEMBLY K4148



See page 11 for dimensions and notes.

OUTLINE OF CIRCUIT ASSEMBLY K4148



K4148 Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	23.000 max	584.2 max	N	8.125	206.4
B	8.750 max	222.3 max	P	29.250 max	743.0 max
C	4.650 \pm 0.100	118.1 \pm 2.5	Q	1.600	40.64
D	10.750 max	273.1 max	R	1.500	38.10
E	5.900	149.9	S	14.375 \pm 0.125	365.1 \pm 3.2
F	14.000	355.6	T	3.500	88.90
G	22.750	577.9	U	17.125 \pm 0.100	435.0 \pm 2.5
H	0.207	5.26	V	4.000 max	101.6 max
J	6.293	159.8	W	18.000	457.2
K	1.000 \pm 0.125	25.40 \pm 3.18	X	17.500 max	444.5 max
L	0.625 min	15.88 min	Y	7.500	190.5
M	4.650 \pm 0.100	118.1 \pm 2.5			

Millimetre dimensions have been derived from inches.

K4148 Outline Notes

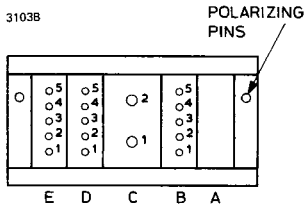
1. The klystron is shown installed for clarity.
2. The level trip is set up to this figure.
3. Recommended cold switch-on level.
4. Water inlet $\frac{3}{4}$ inch B.S.P.F. thread.
5. Four mounting holes in base threaded $\frac{3}{8}$ –16 U.N.C. equally spaced on 24 inch (609.6mm) P.C.D.
6. Pipe fittings for a water level control unit are provided and fitted with removable stoppers. They are $\frac{1}{2}$ inch 'Kontite' couplings at 6.250 inch (158.8mm) centres. The water level control unit is not supplied as part of the circuit assembly.
7. Input connector, see page 12.
8. Steam outlet $4\frac{1}{2}$ inch diameter, 4 U.N. class 2A thread.
9. Four mounting holes in base, $\frac{3}{8}$ inch (9.53mm) diameter equally spaced on 18.500 inch (470mm) P.C.D.

ELECTRICAL CONNECTIONS

All connections to the mount are made through a Smiths Hypertac connector. The mating socket is connected to a 10-way terminal block. The focus coils are wired to the terminal block; all other connections are to be made by the customer after assembling the circuit assembly and boiler. The tables below show the connections to the terminal block and input connector.

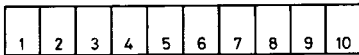
Input Connector (to be wired by customer)

View on solder connections
with cover removed



Water level trip	B1, B2
Collector	B3
Link	B4, B5
Focus coils:	
negative	C1
positive	C2
Water level control (see note 6 on page 11)	D1, D2
Earth	E3

Terminal Block

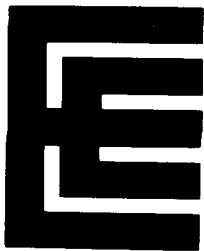


Water level trip	1, 2
Collector	3
Focus coils (wired by EEV):	
negative	4
positive	5
Water level control (see note 6 on page 11)	6, 7
Earth	10

•

Pulse Amplifier Klystrons



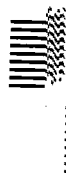


AMPLIFIER KLYSTRON

ABRIDGED DATA

Pulse amplifier klystron for linear accelerators and long range radars.

Cavities (three)		integral
Frequency (see note 1)	2998	MHz
Typical peak output power	7.0	MW
Typical power gain	32	db
Focusing	electro-magnetic focusing coils integral with klystron	
Output	no. 10 waveguide	
Coupler	UG-54A/U	
Cooling	water and forced-air	



GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 2)	3.8	V
Heater current	86	A
Heater starting current (peak value, not to be exceeded)	200	A

Mechanical

Overall length	42.862 inches (1089mm) max
Overall width	14.000 inches (356mm) max
R.F. input connection	series N coaxial socket
R.F. output coupler	UG-54A/U
Net weight	198 pounds (90kg) approx
Mounting position	see note 3

Cooling

Water flow to body (see note 4)	0.8imp.gal/min (3.64 l./min) min
Water flow to collector (see note 4)	4.5imp.gal/min (20.5 l./min) min
Air flow to output window (N.T.P.) (see note 5)	3ft ³ /min (0.085m ³ /min) min
Cooling air excess pressure	30 lb/in ² (2.1kg/cm ²) min
Resistivity of cooling water	50 000 ohm-cm min

Cooling (continued)

The temperature of the cooling water at the outlet must not exceed 65°C. All dissolved oxygen should be removed from the cooling water. The dew point of the cooling air must be at least 5°C below ambient and oil vapour or any other impurity harmful to satisfactory window operation must be reduced to a safe level by an approved means.

The air and water flows must be started before the heater and electro-magnet power is switched on and should be maintained for at least two minutes after these supplies have been switched off.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

Pulsed Operation (See note 6)

No individual rating should be exceeded

	Min	Max	
Heater voltage (see note 2)	3.4	4.6	V
Heater current	—	105	A
Collector and body voltage (peak) (see note 7)	—	210	kV
Beam current (peak)	—	105	A
Collector and body current (mean)	—	180	mA
Collector and body dissipation	—	22.5	kW
Beam input power (peak)	—	20	MW
R.F. input power (peak)	—	7.5	kW
Output power (peak)	—	8.0	MW
Output power (mean) (see note 5)	—	10.5	kW
Duty cycle (see note 5):			
beam	—	0.00175	
r.f.	—	0.0015	
Pulse length	—	3.0	µs
V.S.W.R. of load	—	1.2:1	
Electro-magnet current	24	32	A

TYPICAL OPERATION (See note 6)

Operational Conditions

Frequency	2998	MHz
Heater current	86	A
Collector and body voltage (peak) (see note 7)	197	kV
Pulse length	2.5	µs
Pulse repetition rate	600	p.p.s.
Electro-magnet current (see note 8)	27.5	A
R.F. input power (peak)	4.0	kW

Typical Performance

Beam current (peak)	. . . . .	93	A
Collector and body current (mean)	. . . . .	160	mA
Gain	. . . . .	32	db
Output power:			
peak	. . . . .	7.0	MW
mean	. . . . .	10.5	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Pulsed operation (See note 6)

Test Conditions

Frequency	. . . . .	2998	MHz
Pulse length	. . . . .	2.5	μ s
Pulse repetition rate	. . . . .	600	p.p.s.
Output power:			
peak	. . . . .	7.0	MW
mean	. . . . .	10.5	kW



Range of Characteristics

	Min	Max	
Heater voltage	3.0	4.6	V
Collector and body voltage (peak) (see note 7)	—	210	kV
Beam current (peak)	—	105	A
Collector and body current (mean)	—	180	mA
R.F. input power (peak)	—	7.5	kW
Electro-magnet current (see note 8)	24	32	A

PROTECTION CIRCUITS

The equipment in which the klystron is to operate must provide protection from damage caused by

- (a) Failure of the heater supply.
- (b) A reduction below minimum in the flow of cooling water to the klystron body or collector.
- (c) A reduction below minimum in either the cooling air flow or pressure to the output window.
- (d) A failure of the electro-magnet current.
- (e) Excessive collector and body current.
- (f) Voltage breakdown in the pressurized output waveguide system.

NOTES

1. The klystron can be set before delivery to operate at any frequency within the range $2998 \pm 5\text{MHz}$.
2. The heater power should be applied at least 5 minutes before the beam voltage is switched on. The heater must not be operated continuously for periods exceeding 1 hour without the beam voltage applied. The heater voltage quoted is the approximate value required to obtain the specified heater current.
3. The klystron should be supported vertically from the mounting flange with the cathode end down. The base socket must allow for the complete immersion in oil of the cathode insulator and must incorporate corona flares designed to protect the insulator against electrical breakdown.
4. At this flow rate the pressure drop does not exceed 60 lb/in^2 (4.2kg/cm^2).
5. The klystron can be supplied without output window cooling nozzles for use in pressurized waveguide systems at r.f. duty cycles not exceeding 0.00015. Under these conditions, some reduction in collector cooling may also be tolerated.

The customer is advised to consult the manufacturer before operation under reduced cooling conditions is attempted.
6. All voltages apart from the heater voltage are with respect to cathode.
7. When the klystron is put into service after storage, it must be conditioned by increasing the beam voltage gradually until steady operation at the full rating is obtained. Klystrons held in store for long periods require conditioning at regular intervals; the procedure for this will be agreed from time to time with the user.
8. The hot resistance of the electro-magnet coils is approximately 2Ω . The electro-magnet current should be adjusted to give maximum r.f. output power. It should not be possible to apply h.t. in the absence of electro-magnet current.

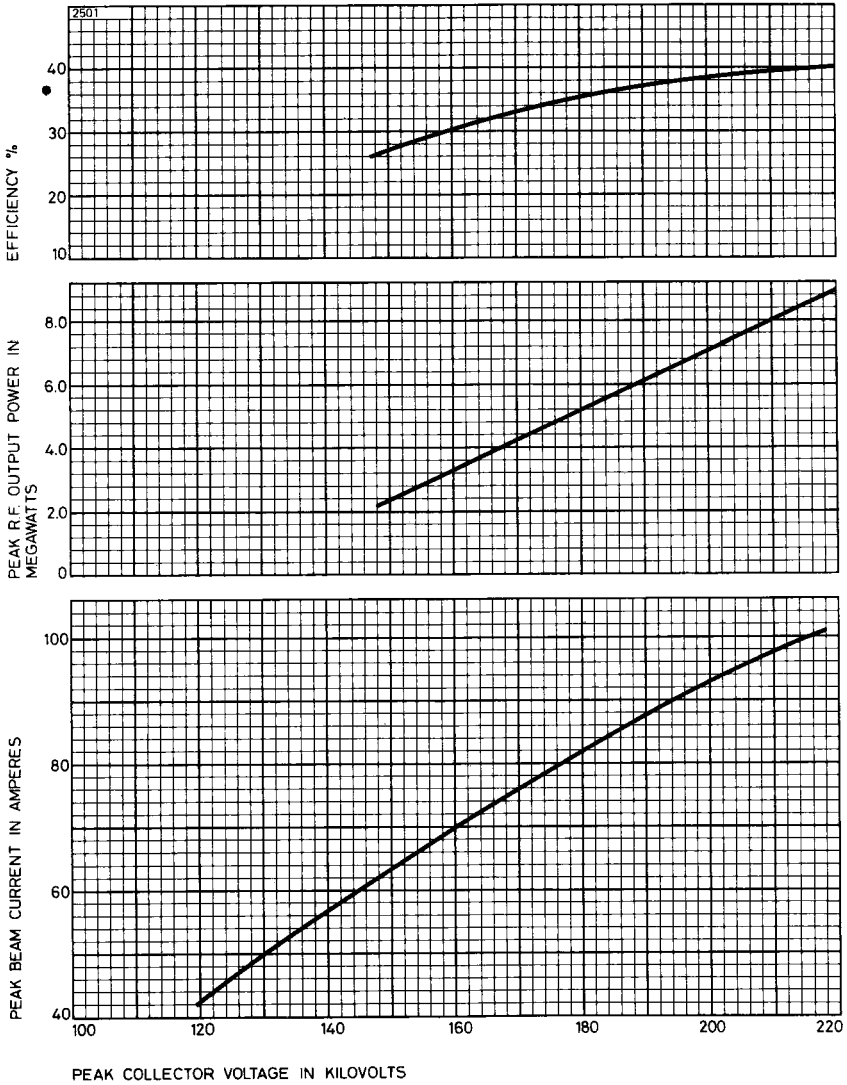
X-RAY WARNING

The klystron is supplied with lead shielding around the collector and output cavity, but this is not adequate to render it safe for personnel to work in the vicinity of the klystron during normal operation.

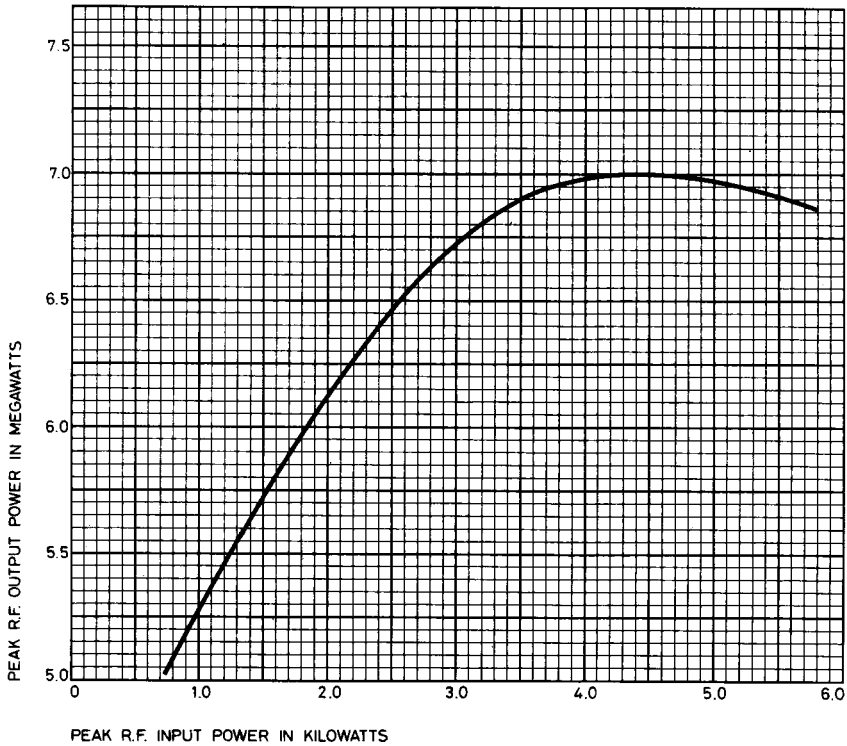
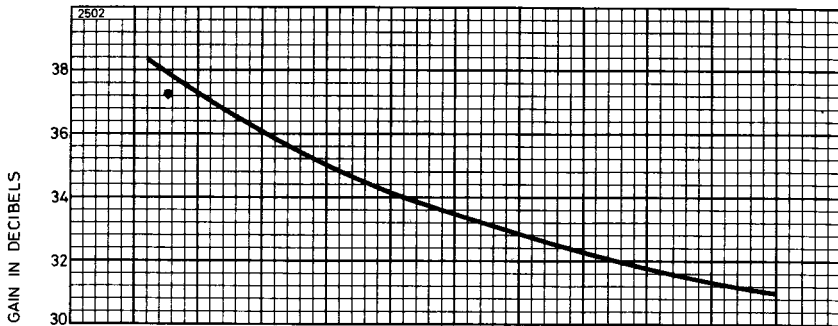
The equipment designer is responsible for ensuring that sufficient additional shielding is provided to satisfy the safety requirements for any given installation.

This radiation is entirely a function of high voltage devices and does not reflect on the design of the klystron.

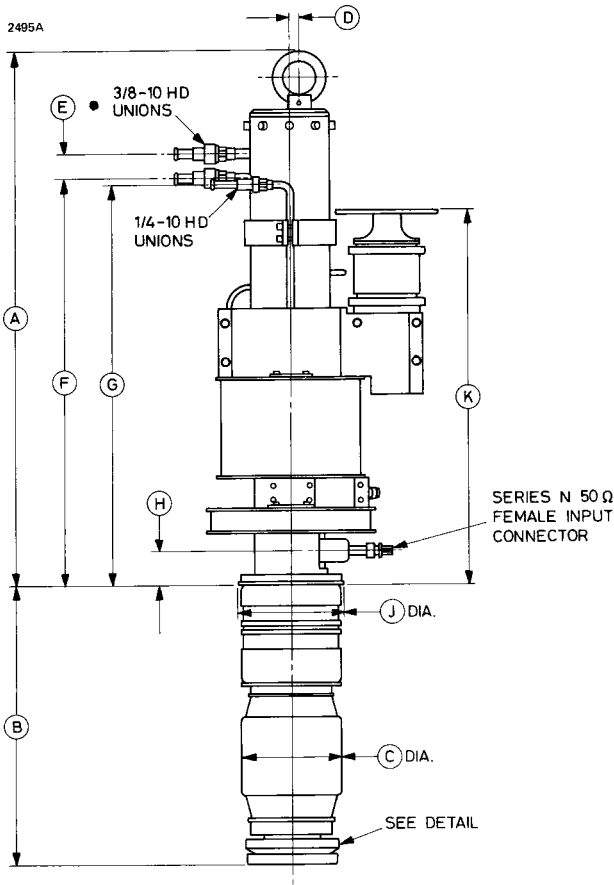
TYPICAL BEAM VOLTAGE CHARACTERISTICS



TYPICAL POWER AND GAIN CHARACTERISTICS



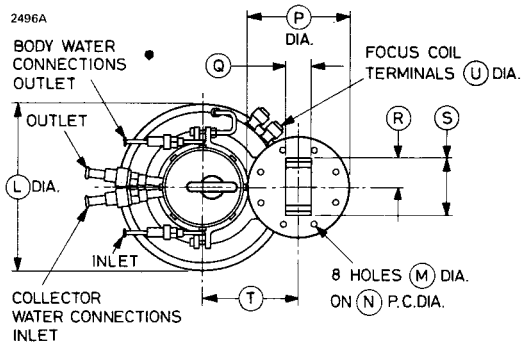
OUTLINE (All dimensions without limits are nominal)



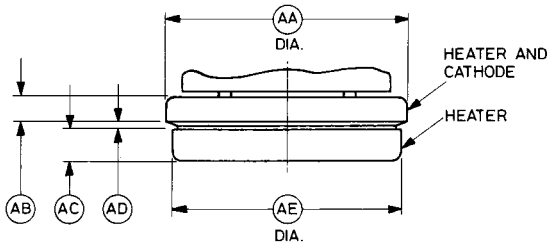
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	28.125 max	714.4 max	F	21.312	541.3
B	14.677 ± 0.060	372.8 ± 1.52	G	20.937	531.8
C	5.118 max	130.0 max	H	1.812	46.02
D	0.672	17.07	J	5.745 ± 0.005	145.92 ± 0.13
E	1.062	26.97	K	19.625 ± 0.060	498.5 ± 1.52

Millimetre dimensions have been derived from inches.

Outline Details (All dimensions without limits are nominal)
Top View



Detail of Heater and Cathode Connections



Ref	Inches	Millimetres	Ref	Inches	Millimetres
L	8.812	223.8	T	5.043 ± 0.015	128.1 ± 0.38
M	0.281	7.14	U	0.312	7.92
N	4.750	120.7	AA	5.062	128.6
P	5.312 ± 0.015	134.9 ± 0.38	AB	0.562	14.27
Q	1.340	34.04	AC	0.719	18.26
R	1.420	36.07	AD	0.125	3.18
S	2.840	72.14	AE	4.812	122.2

Millimetre dimensions have been derived from inches.



AMPLIFIER KLYSTRON

ABRIDGED DATA

Three cavity, electro-magnetically focused amplifier klystron, with separate tuning cavities, for pulsed operation. The operation of the klystron is guaranteed only when used with approved tuning cavities and magnet assembly.

The K347A is similar to the K347 but has the focus electrode connected internally to the cathode.

Frequency range (see note 1)	580 to 615	MHz
Output power (peak)	600	kW
Beam voltage (peak)	75	kV
Efficiency	40	%
Power gain	33	db
Cooling	forced-air	



GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	7.0	V
Heater current range (see note 2)	32 to 39	A
Heater starting current (peak value, not to be exceeded)	100	A
Magnetic focusing field	35mT (350 gauss)	

Mechanical

Overall length	62.875 inches (1597mm) max
Overall diameter	8.004 inches (203.3mm) max
Net weight	65 pounds (29.6kg) approx
Mounting position	vertical

Cooling

Air flow to collector and final drift tube 250 ft³/min
 7.1 m³/min

Inlet air temperature 55 °C max

Air pressure manometer reading 4.5 inches (114.3mm) w.g.

A supplementary air flow is required to cool the cathode end of the klystron.

The required airflows must be delivered before and during the application of h.t. voltage. H.T. power and air supplies may be removed simultaneously.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

	Min	Max	
Heater voltage	6.5	7.3	V
Collector voltage (peak) (see note 4)	—	80	kV
Total current (collector + body) (peak) (see note 5)	—	23	A
Collector current (peak)	—	20	A
Collector dissipation	—	4.0	kW
Body voltage (peak) (see note 4)	—	80	kV
Body current (peak) with no r.f. drive (see note 6)	—	5.0	A
Pulse length	—	10	μs
Load v.s.w.r.	—	1.5:1	
Temperature of any external part of the klystron (see note 3)	—	180	°C

TYPICAL OPERATION

Operating Conditions

Frequency	600	MHz
Load v.s.w.r.	1.1:1	max
Total current (collector + body) (peak)	20	A
Magnetic field	35	mT
	350	gauss
Pulse length	6.0	μs
Pulse repetition rate	400	p.p.s.

Typical Performance

Collector voltage (peak) (see note 4)	75	kV
Collector current (peak)	10	A
Body voltage (peak) (see note 4)	75	kV
Body current (peak)	10	A
Gain	33	db
Output power	600	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Test Conditions

Heater voltage	7.0	V
Total current (collector + body) (peak)	20	A
Magnetic field	35	mT
	350	gauss
Duty cycle	0.0024	
Pulse length	4.0	μ s
Pulse repetition rate	600	p.p.s.



Range of Characteristics

	Min	Max	
Heater current	32	39	A
Collector voltage (peak)	73	78	kV
Body voltage (peak)	73	78	kV
Body current (peak)	—	12	A
Mechanical tuning range (see note 1)	580	615	MHz
Gain for maximum efficiency	30	35	db
Interpulse noise (below output power)	180	—	db
Output power (peak)	500	—	kW

NOTES

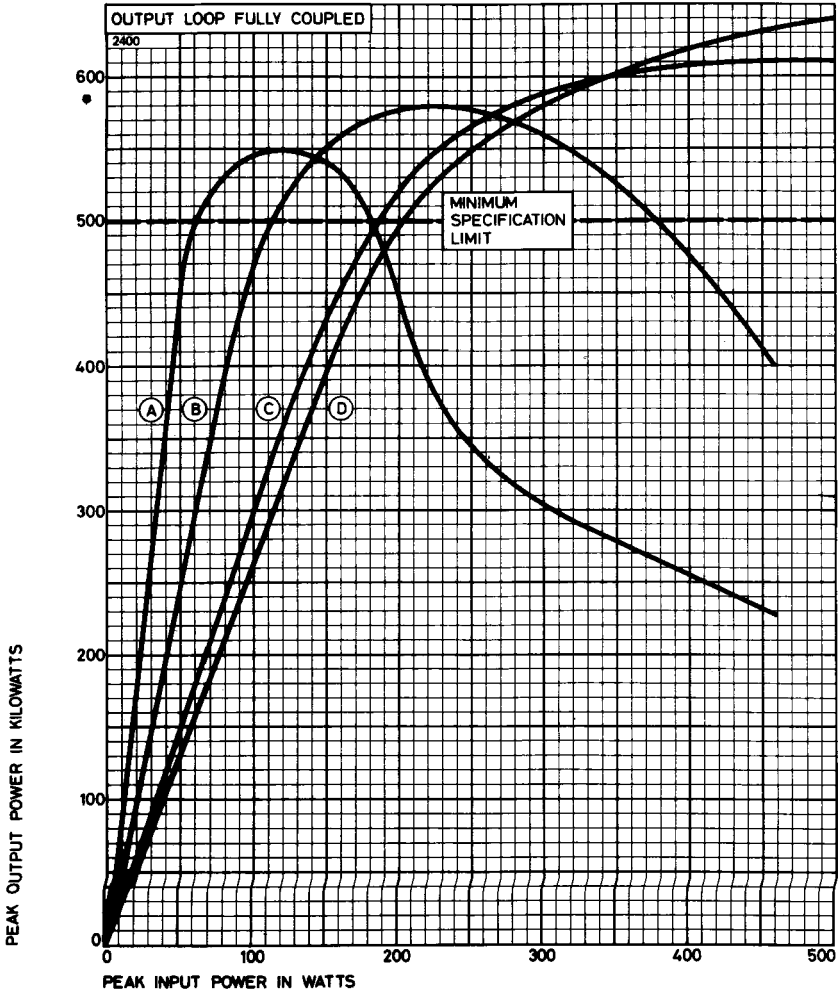
1. The tuning range depends on the external cavities.
2. An additional supply of 3V, 15A is required for the internal getter whilst the klystron is in use. It can be derived from the heater supply and is applied between the red painted heater terminal and the cathode.
3. The drift tube temperature may be measured by the copper-constantan thermocouple attached to the klystron. A temperature of 180°C corresponds to 5.5mV approx. with a cold junction temperature of 55°C.

4. When klystrons have been stored for long periods it is necessary to condition them by increasing the h.t. voltage gradually over a period which should not in general take longer than 2 hours to complete.
5. Provision should be made for monitoring both the body and collector currents; heavy duty shunts are advised. The body must be earthed.
6. With r.f. drive on, the body current may exceed 5A provided that the drift tube temperature is below 180°C.

X-RAY WARNING

X-rays are emitted by the K347A under normal operating conditions. These rays can constitute a health hazard unless the klystron is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the tube.

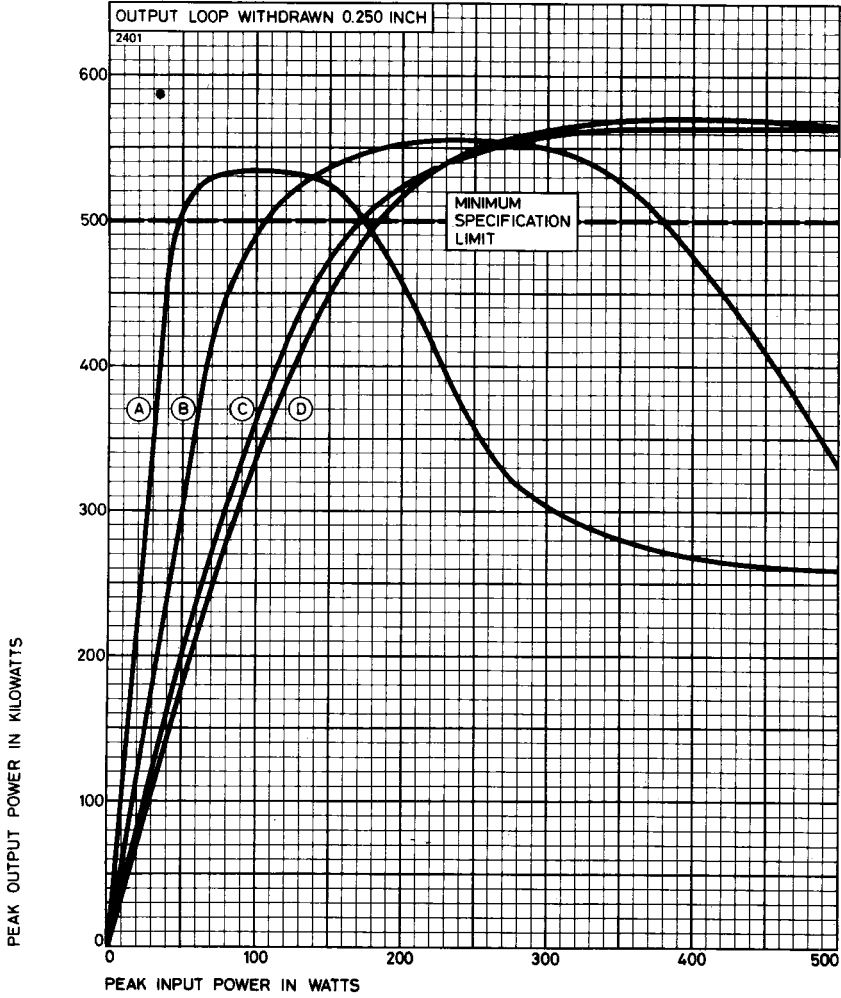
POWER CHARACTERISTICS



Measured with beam voltage 75kV, frequency 600MHz and magnetic field 35mT (350 gauss). Cavities tuned for maximum output power at peak input powers of:

- A 100W
- B 200W
- C 300W
- D 400W

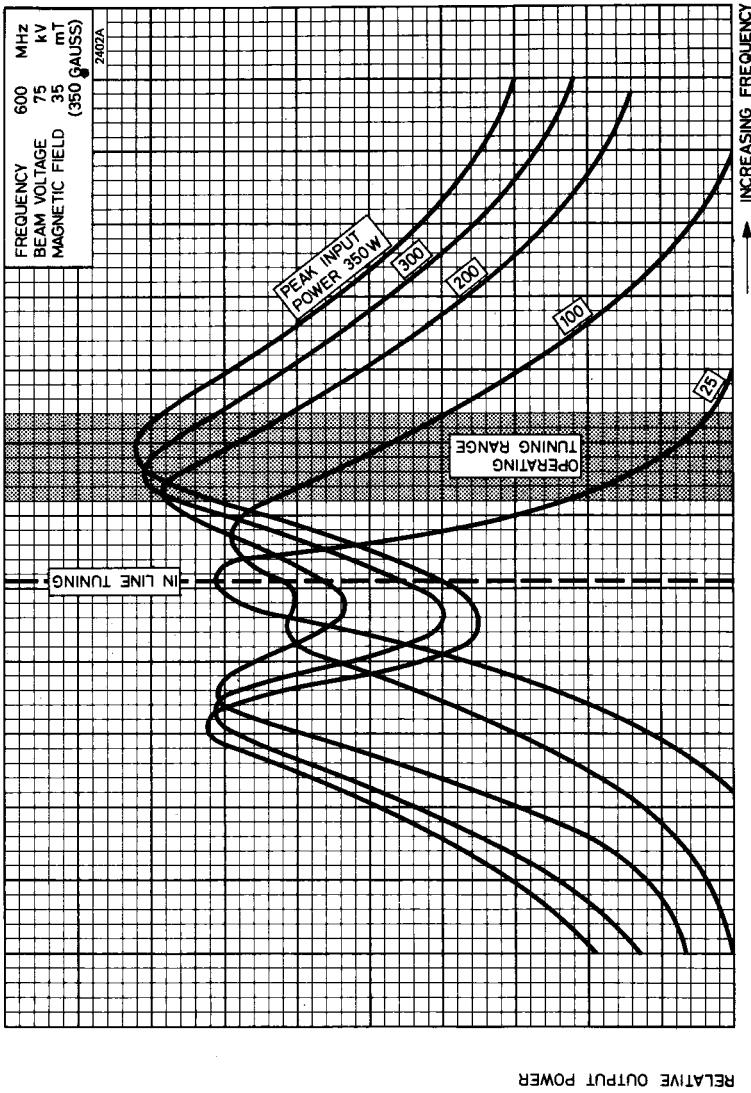
POWER CHARACTERISTICS



Measured with beam voltage 75kV, frequency 600MHz and magnetic field 35mT (350 gauss). Cavities tuned for maximum output power at peak input powers of:

- A 100W
- B 200W
- C 300W
- D 400W

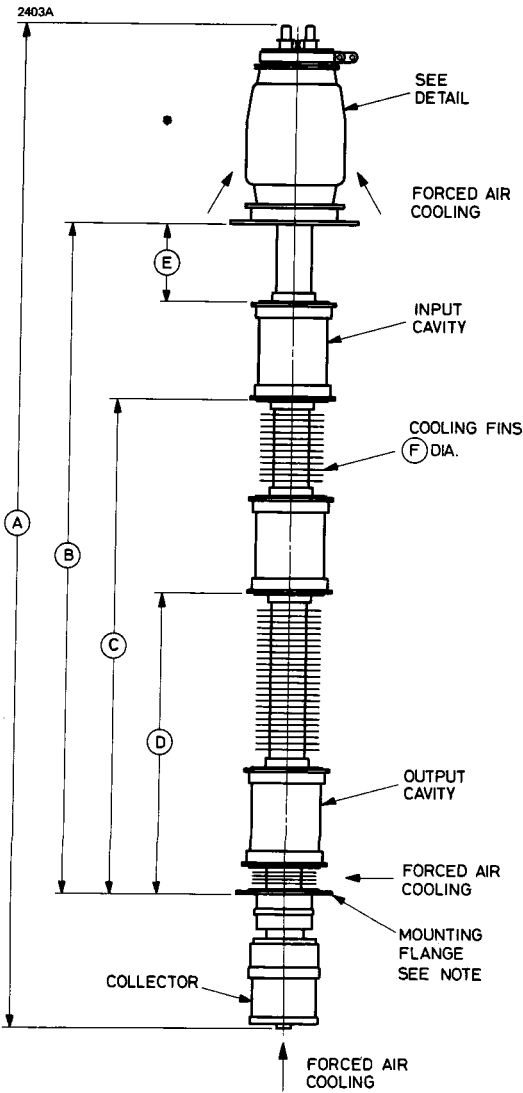
INTERMEDIATE CAVITY TUNING CHARACTERISTICS



INTERMEDIATE CAVITY TUNING

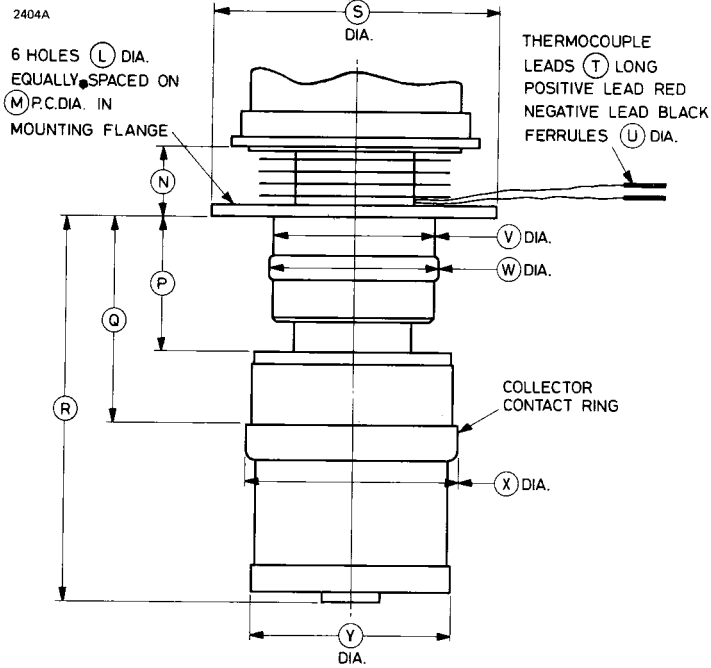


OUTLINE



Note Square tolerance of lower face at edge 0.010 inch (0.25mm) wide. Datum, centre line of lifting flange and mounting flange.

Detail of Collector (All dimensions without limits are nominal)

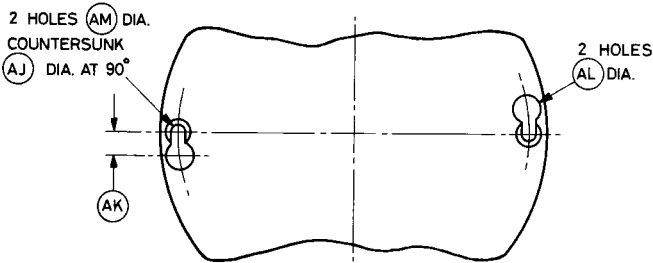
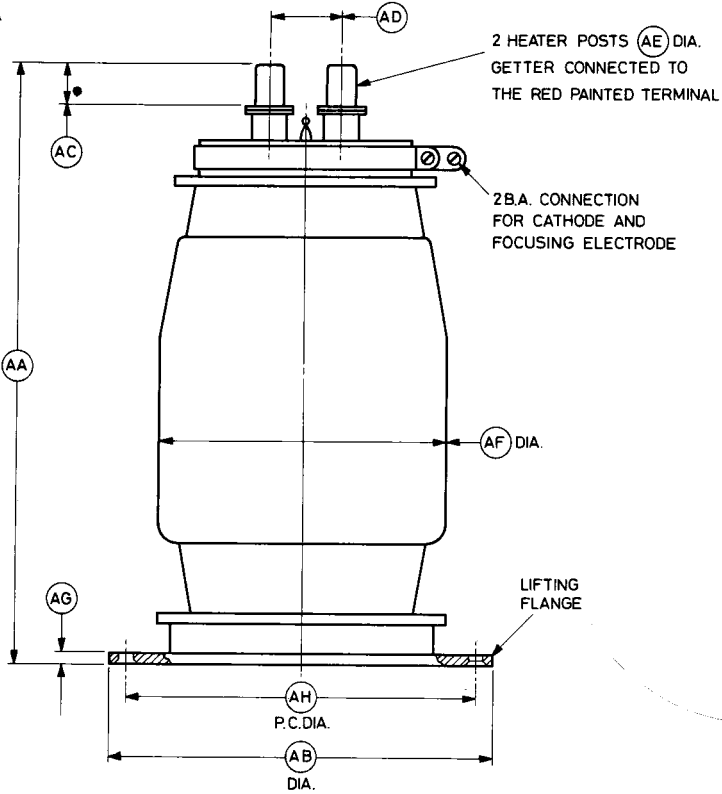


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	62.875 max	1597 max	Q	4.560 ± 0.080	115.8 ± 2.0
B	41.250 ± 0.160	1047.8 ± 4.1	R	8.375 max	212.7 max
C	30.440 ± 0.080	773.2 ± 2.0	S	5.994 ± 0.003	152.248 ± 0.076
D	18.440 ± 0.050	468.4 ± 1.3	T	14.000	355.6
E	4.812 ± 0.031	122.2 ± 0.8	U	0.156	3.96
F	3.900 max	99.06 max	V	3.400 max	86.36 max
L	0.264	6.71	W	3.650 max	92.71 max
M	5.562 ± 0.010	141.27 ± 0.25	X	4.437 ± 0.004	112.700 ± 0.102
N	1.438 ± 0.030	36.53 ± 0.76	Y	4.100 max	104.1 max
P	2.500 min	63.50 min			

Millimetre dimensions have been derived from inches.

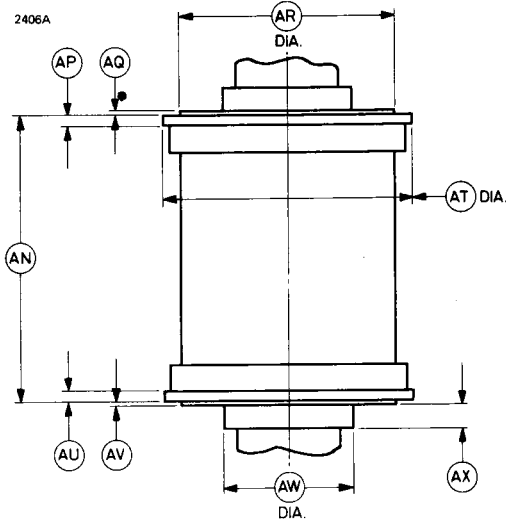
Details of Cathode Terminals and Lifting Flange
(All dimensions without limits are nominal)

2405A



See page 11 for dimensions.

Details of Typical Cavity Assembly



Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	12.500	317.5	AM	0.250	6.35
AB	8.000 ± 0.004	203.200 ± 0.102	AN	$5.990 \begin{matrix} + 0.033 \\ - 0.037 \end{matrix}$	$152.15 \begin{matrix} + 0.84 \\ - 0.94 \end{matrix}$
AC	0.885 min	22.48 min	AP	0.250 ± 0.008	6.35 ± 0.20
AD	1.500	38.10	AQ	0.050 max	1.27 max
AE	0.625 ± 0.002	15.875 ± 0.051	AR	4.500 ± 0.050	114.3 ± 1.3
AF	6.188 max	157.2 max	AT	5.245 ± 0.010	133.22 ± 0.25
AG	0.250	6.35	AU	0.250 ± 0.008	6.35 ± 0.20
AH	7.250	184.2	AV	0.050 max	1.27 max
AJ	0.500	12.70	AW	2.750 ± 0.004	69.850 ± 0.102
AK	0.500	12.70	AX	0.500	12.70
AL	0.516	13.11			

Millimetre dimensions have been derived from inches.



AMPLIFIER KLYSTRON

ABRIDGED DATA

Pulse amplifier klystron for linear accelerators and long range radars.

Cavities (four)	integral
Frequency (see note 1)	2998 MHz
Typical peak output power	8.0 MW
Typical power gain	42 db
Focusing	electro-magnet focus mount type K4001
Output	no. 10 waveguide
Coupler	UG-54A/U
Cooling	water and forced-air

GENERAL

Electrical

Cathode	indirectly heated
Heater voltage (see note 2)	3.4 V
Heater current	86 A
Heater starting current, peak value, not to be exceeded	200 A

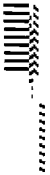
Mechanical

Overall length	48.25 inches (122.6cm) max
Overall width	13.41 inches (34.1cm) max
R.F. input connection	coaxial socket, Amphenol type 82-815
R.F. output coupler	UG-54A/U
Net weight	75 pounds (34kg) approx
Mounting position	vertical, cathode down
Socket	see note 3

Cooling Requirements

Water flow to body (see note 4)	1 imp.gal/min (4.55 l./min) min
Water flow to collector (see note 4)	7.5 imp.gal/min (34.1 l./min) min
Air flow to output window (N.T.P.)	3ft ³ /min (0.085m ³ /min) min
Cooling air excess pressure	30 lb/in ² (2.1kg/cm ²) min
Resistivity of cooling water	50 000 ohm-cm min

Continued on page 2



The temperature of the cooling water at the outlet must not exceed 65°C. All dissolved oxygen should be removed from the cooling water. The dew point of the cooling air must be at least 5°C below ambient and oil vapour or any other impurity harmful to satisfactory window operation must be reduced to a safe level by an approved means.

The air and water flows must be started before the heater power is switched on and should be maintained for at least two minutes after the heater power has been switched off.

Focus Mount

The K4001 is a water cooled electro-magnet focus mount. It operates from a single variable voltage d.c. supply, connection being made to the terminals marked 'D.C. Supply'. A bucking coil is connected internally to the d.c. supply terminals and requires a controlling potentiometer and ammeter; these must be connected in series to the terminals marked 'B Coil'.

Overall length (see note 5)	18.25 inches (46.4cm) approx
Overall diameter	23.00 inches (58.4cm) approx
Net weight	400 pounds (182kg) approx
Minimum cooling water flow	1 imp.gal/min (4.55 l./min)
Maximum pressure drop at 1 imp.gal/min flow	25 lb/in ² (1.76kg/cm ²)
Maximum cooling water inlet temperature	30 °C max

Protection against water supply failure must be provided.

	Min	Max	
Bucking coil resistance	52	65	Ω
Main coil resistance:			
cold	1.375	1.625	Ω
hot (see note 6)	1.75	2.00	Ω

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

K4001

	Min	Max	
D.C. supply voltage	30	80	V
D.C. supply current	20	40	A
D.C. bucking coil current	—	1.0	A

Continued on page 3

MAXIMUM AND MINIMUM RATINGS – Continued
(Pulsed operation, see note 7)

K390

	Min	Max	
Heater voltage (see note 2)	3.2	4.2	V
Heater current	—	105	A
Collector voltage (peak) (see note 8)	—	205	kV
Beam current (peak)	—	105	A
Collector current (mean)	—	175	mA
Collector dissipation	—	35	kW
Body voltage (peak) (see note 8)	—	205	kV
Body current (mean)	—	40	mA
Beam input power (peak)	—	20	MW
R.F. input power (peak)	—	5.0	kW
Output power (peak)	—	8.8	MW
Output power (mean)	—	10.5	kW
Duty cycle:			
beam	—	0.00175	
r.f.	—	0.0015	
Pulse length	—	3.0	μs
V.S.W.R. of load	—	1.2:1	



TYPICAL OPERATION (See note 7)

Operational Conditions (in focus mount K4001)

Frequency	2998	MHz
Heater voltage (see note 2)	3.4	V
Collector voltage (peak) (see note 8)	196	kV
Body voltage (peak) (see note 8)	196	kV
Pulse length:		
beam	3.0	μs
r.f.	2.5	μs
Duty cycle:		
beam	0.0015	
r.f.	0.00125	
Electro-magnet current (see note 9):		
main coil	38	A
bucking coil	0.6	A

Typical Performance

Beam current (peak)	96	A
Collector current (mean)	144	mA
Body current (mean)	25	mA
R.F. input power (peak)	700	W
Output power:		
peak	8.0	MW
mean	10	kW

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

(Pulsed Operation) (See Note 7)

Test Conditions (in focus mount K4001)

Frequency	2998	MHz
Pulse length (r.f.)	2.5	μ s
Duty cycle (r.f.)	0.00125	
Output power:		
peak	8.0	MW
mean	10	kW

Range of Characteristics

	Min	Max	
Heater voltage	3.0	4.6	V
Collector voltage (peak) (see note 8)	—	200	kV
Beam current (peak)	—	100	A
Collector current (mean)	—	175	mA
Body voltage (peak) (see note 8)	—	200	kV
Body current (mean)	—	40	mA
R.F. input power (peak)	—	5	kW
Electro-magnet current:			
main coil	25	45	A
bucking coil	—	1.0	A

PROTECTION CIRCUITS

The equipment in which the klystron is to operate must provide protection from damage caused by:

- (a) Failure of the heater supply.
- (b) A reduction below minimum in the flow of cooling water to the klystron body or collector.
- (c) A reduction below minimum in either the cooling air flow or pressure to the output window.
- (d) A failure of the focusing coil currents.
- (e) Excessive collector current.
- (f) Excessive body current.
- (g) Voltage breakdown in the pressurized output waveguide system.

NOTES

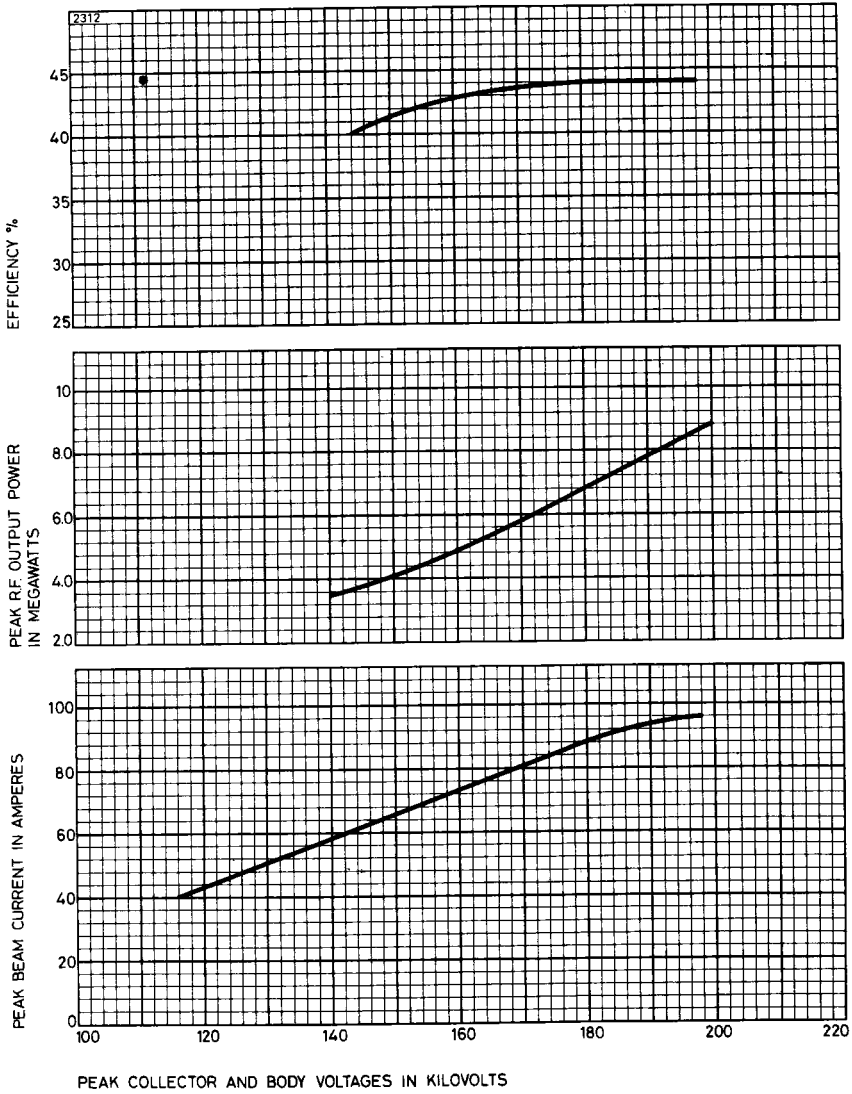
1. The klystron can be set before delivery to operate at any frequency within the range 2993 to 3003MHz.
2. The heater power should be applied at least 5 minutes before the beam voltage is switched on. The heater must not be operated continuously for periods exceeding 1 hour without the beam voltage applied.
3. The klystron should be supported vertically from the mounting flange with the cathode end down. The socket must allow for the complete immersion in oil of the cathode insulator and must incorporate corona flares designed to protect the insulator against electrical breakdown.
4. At this flow the pressure drop does not exceed 25 lb/in² (1.76kg/cm²).
5. The overall length will depend upon the socket details.
6. Measured after 3 hours operation at 40A, with cooling water flow at rated minimum value.
7. All voltages apart from the heater voltage are with respect to cathode.
8. When the klystron is put into service after storage, it must be conditioned by increasing the beam voltage gradually until steady operation at the full rating is obtained. Klystrons held in store for long periods require conditioning at regular intervals; the procedure for this will be agreed from time to time with the user.
9. Optimum focusing is obtained by independent adjustment of the main and bucking coil currents and no mechanical adjustments are necessary. Recommended current settings for operation in K4001 are quoted on the test sheet supplied with each klystron.
10. Routine inspection of the collector is required, the collector water jacket being removable for this purpose. The procedure for this will be agreed from time to time with the user.
11. The klystron is fitted with an appendage pump which should be used whenever the klystron is operated. Further details may be obtained from English Electric Valve Company Ltd.



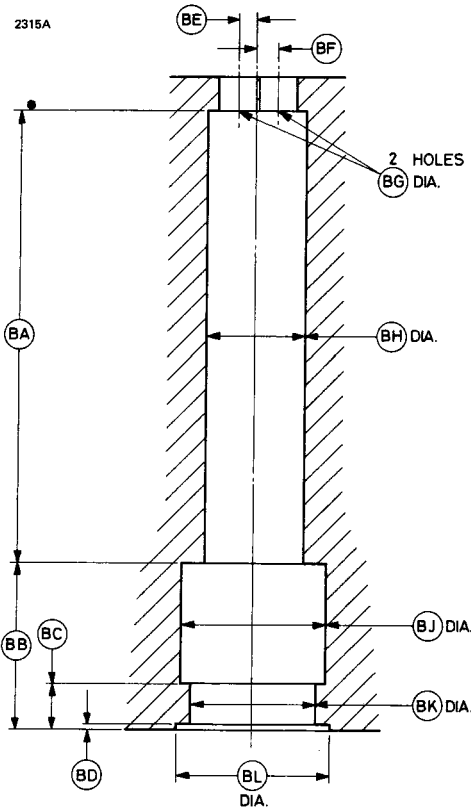
X-RAY WARNING

X-rays are produced by the klystron under normal operating conditions. These rays can constitute a health hazard unless the klystron is adequately shielded for X-radiation (the collector gauge drawing will assist in the design of the collector shielding). X-radiation is emitted by all high voltage devices and its presence does not reflect on the design of the klystron.

BEAM VOLTAGE CHARACTERISTICS



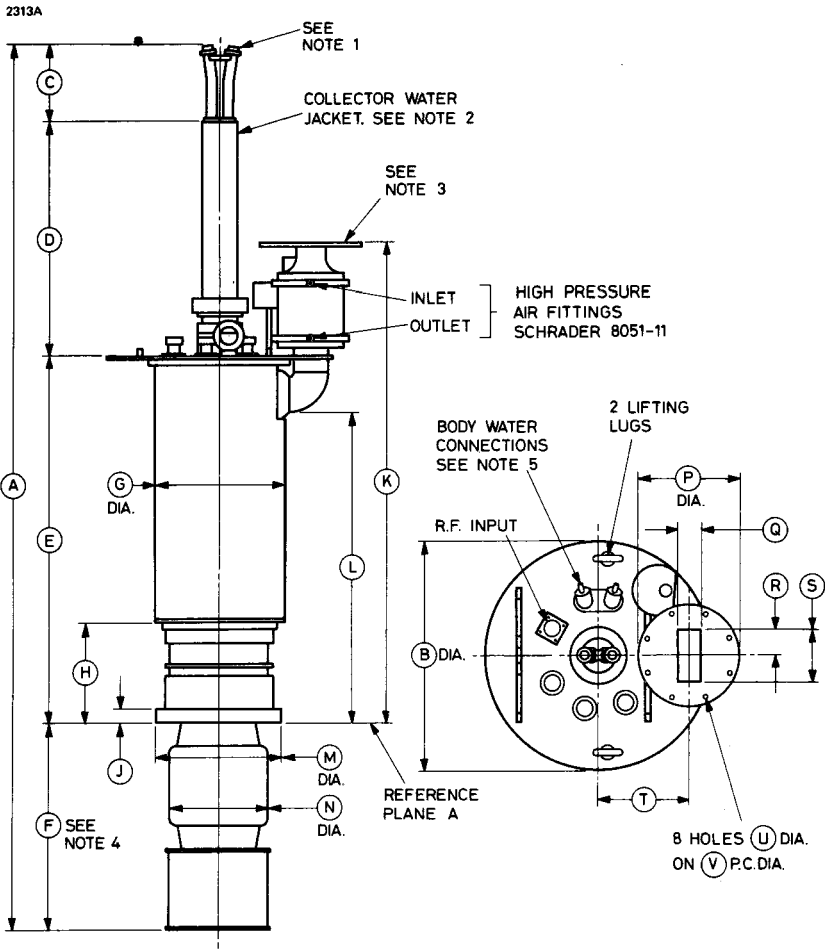
COLLECTOR GAUGE (All dimensions nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	9.500	241.3	BG	0.750	19.05
BB	3.500	88.90	BH	2.010	51.05
BC	1.000	25.40	BJ	3.015	76.58
BD	0.125	3.18	BK	2.600	66.04
BE	0.375	9.53	BL	3.312	84.12
BF	0.437	11.10			

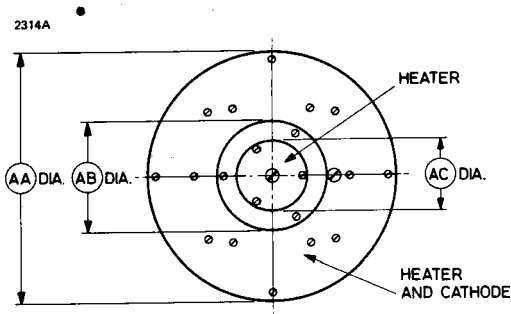
Millimetre dimensions have been derived from inches.

OUTLINE (See page 10 for outline notes)



OUTLINE DETAIL

Heater and Cathode Connection Surfaces



Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	48.250 max	1225.6 max	N	5.500 max	139.7 max
B	11.980 ± 0.015	304.29 ± 0.38	P	5.312 ± 0.015	134.92 ± 0.38
C	4.000	101.6	Q	1.340	34.04
D	12.156 ± 0.219	308.76 ± 5.56	R	1.420	36.07
E	19.140 ± 0.130	486.16 ± 3.30	S	2.840	72.14
F	10.640 ± 0.078	270.26 ± 1.98	T	4.750	120.65
G	6.800	172.7	U	0.281	7.14
H	5.265 ± 0.065	133.73 ± 1.65	V	4.750	120.65
J	0.750 ± 0.010	19.05 ± 0.25	AA	5.375	136.5
K	25.000 ± 0.125	635.00 ± 3.18	AB	2.250	57.15
L	15.750 min	400.0 min	AC	1.500	38.10
M	6.625 ± 0.025	168.28 ± 0.64			

Millimetre dimensions have been derived from inches.

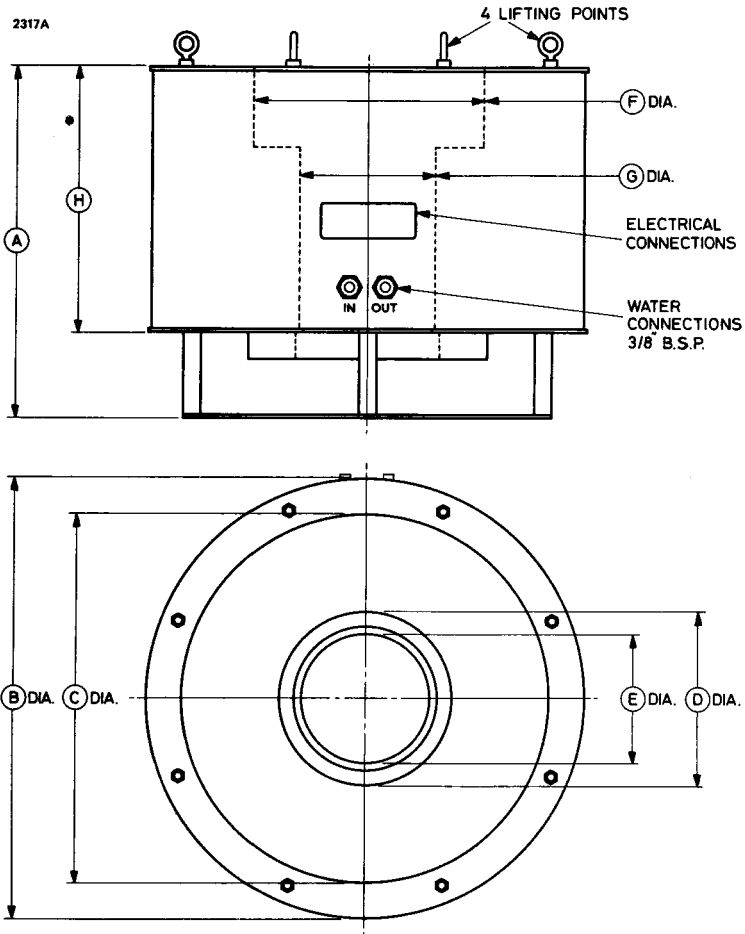
Outline Notes

1. Collector water connections. $\frac{3}{8}$ -inch 'Yorkshire' fittings with male $\frac{1}{2}$ -inch B.S.P. parallel thread suitable for use with $\frac{3}{8}$ -inch 'Yorkshire' cup and leather connector and 'O' ring type no. OS.10 (B.S.1806:1951).

The collector water jacket seats on to 'O' ring type no. OS.32 (B.S.1806:1951) 0.210 inch (5.33mm) thick.

2. Concentricity and length of collector are such that it will fit into collector gauge shown on page 7.
3. Parallel tolerance 0.040 inch (1.02mm) wide. Datum-reference plane A (B.S.308:1953).
4. No diameter over this length will exceed the diameter of the cathode insulator.
5. Body water connections. $\frac{1}{4}$ -inch 'Yorkshire' cone fitting with male $\frac{3}{8}$ -inch B.S.P. parallel thread.

OUTLINE FOR FOCUS MOUNT K4001 (All dimensions nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	18.250	463.6	E	6.765	171.8
B	23.000	584.2	F	12.000	304.8
C	19.250	489.0	G	7.000	177.8
D	9.030	229.4	H	13.870	352.3

Millimetre dimensions have been derived from inches.

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Canada	English Electric Valve North America Ltd.	Rexdale, Ontario
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Thailand	Vichien Pathana Ltd. Partnership	Bangkok
Trinidad & Tobago, and Guyana	Telecomm Ltd.	Port-of-Spain, Trinidad
Turkey	Ratel Radio Telecommunication Co. Ltd.	Istanbul
United States of America	Camera Tubes: English Electric Valve North America Ltd., 1051 Clinton Street General Distributors: Calvert Electronics International Inc.	Buffalo, N.Y. New York and Santa Clara, Calif.
Uruguay	Pellmar S.A.	Montevideo
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