OA2

VOLTAGE STABILIZER

Service Types CV1832, CV8161

The data to be read in conjunction with the Voltage Stabilizer Preamble.

DESCRIPTION

The OA2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 5.0 to 30mA.

GENERAL DATA

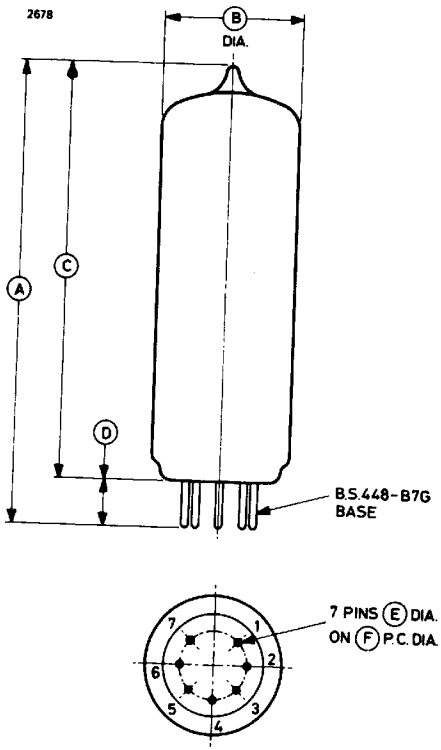
Characteristics

Striking voltage in normal lighting	185	V max
Striking voltage in total darkness	225	V max
Operating voltage (approx)	150	V
Operating voltage at 30mA	165	V max
Operating voltage at 5.0mA	142	V min
Cathode current range	5.0 to 30	mA
Regulation over current range 5.0 to 30mA	6.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA	5.0	mV max
Ambient temperature range	−55 to +90	°C

Mechanical

Overall length	2.618 inches (66.5mm) max
Seated height	2.366 inches (60.1mm) max
Overall diameter	0.748 inch (19.0mm) max
Mounting position	any
Base	B.S.448-B7G

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

OA2WA

VOLTAGE STABILIZER

Service Types CV4020, CV4100, CV8168

The data to be read in conjunction with the Voltage Stabilizer Preamble.

DESCRIPTION

The 0A2WA is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 5.0 to 30mA.

It is essentially a rugged and reliable version of the 0A2.

GENERAL DATA

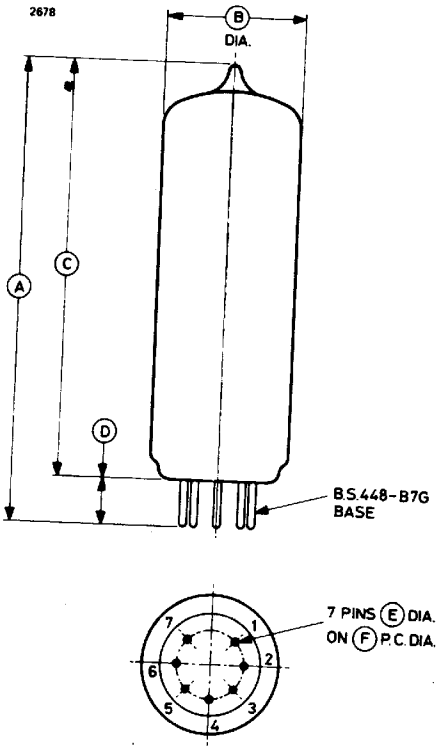
Characteristics

Striking voltage in normal lighting	165	V max
Striking voltage in total darkness	165	V max
Operating voltage (approx)	150	V
Operating voltage at 30mA	158	V max
Operating voltage at 5.0mA	142	V min
Cathode current range	5.0 to 30	mA
Regulation over current range 5.0 to 30mA	5.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA	5.0	mV max
Acceleration (continuous)	2.5	g max
Shock (short duration)	500	g max
Ambient temperature range	−55 to +90	°C
Bulb temperature	150	°C max
Altitude	120 000	ft max
	36.6	km max

Mechanical

Overall length	2.618 inches (66.5mm) max
Seated height	2.366 inches (60.1mm) max
Overall diameter	0.748 inch (19.0mm) max
Mounting position	any
Base	B.S.448-B7G

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

OB2

VOLTAGE STABILIZER

Service Types CV1833, CV8162

The data to be read in conjunction with the Voltage Stabilizer Preamble.

DESCRIPTION

The OB2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 108 volts over the current range 5.0 to 30mA.

GENERAL DATA

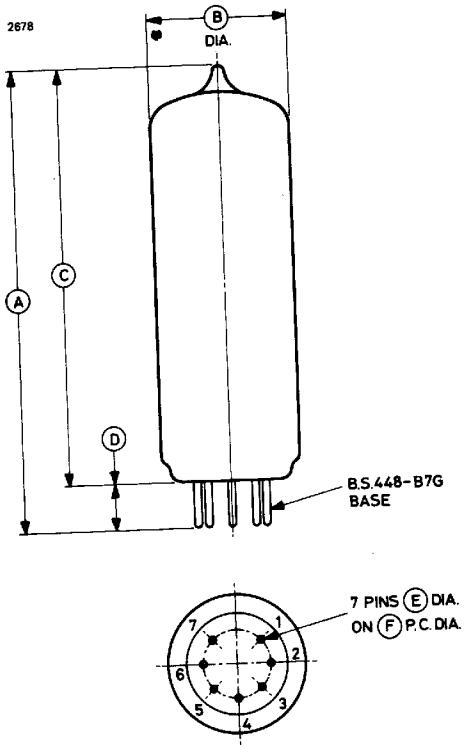
Characteristics

Striking voltage in normal lighting	127	V max
Striking voltage in total darkness	210	V max
Operating voltage (approx)	108	V
Operating voltage at 30mA	112	V max
Operating voltage at 5.0mA	105	V min
Cathode current range	5.0 to 30	mA
Regulation over current range	3.5	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA	5.0	mV max
Ambient temperature range	−55 to +90	°C

Mechanical

Overall length	2.618 inches (66.5mm) max
Seated height	2.366 inches (60.1mm) max
Overall diameter	0.748 inch (19.0mm) max
Mounting position	any
Base	B.S.448-B7G

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

OC2

VOLTAGE STABILIZER

Service Type CV8766

The data to be read in conjunction with the Voltage Stabilizer Preamble.

DESCRIPTION

The 0C2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 75 volts over the current range 5.0 to 30mA.

GENERAL DATA

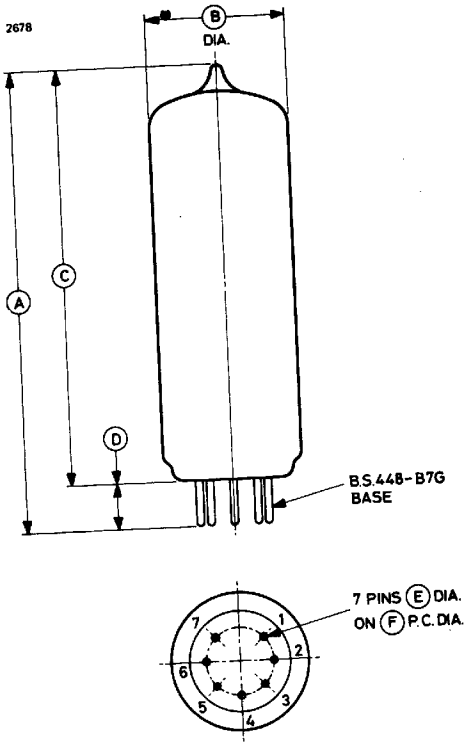
Characteristics

Striking voltage in normal lighting	115	V max
Striking voltage in total darkness	145	V max
Operating voltage (approx)	75	V
Operating voltage at 30mA	83	V max
Operating voltage at 5.0mA	68	V min
Cathode current range	5.0 to 30	mA
Regulation over current range	4.5	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA	10	mV max
Voltage jumps over the current range 5.0 to 30mA	1.0	V max
Ambient temperature range	−55 to +90	°C

Mechanical

Overall length	2.618 inches (66.5mm) max
Seated height	2.366 inches (60.1mm) max
Overall diameter	0.748 inch (19.0mm) max
Mounting position	any
Base	B.S.448-B7G

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

24B9

TRIGATRON

Service types CV6008 and CV6173

INTRODUCTION

The 24B9 is a gas-filled triggered spark gap intended for use in line-discharge modulators. It may be used as a direct replacement for the 24B1, with improved life.

GENERAL DATA

Overall length	156mm (6.142 inches) max
Overall diameter	70mm (2.756 inches) max
Base	CL3
Top cap	B.S.448–CT5
Mounting position	any
Net weight	7 ounces (200g) approx
Cooling	natural

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

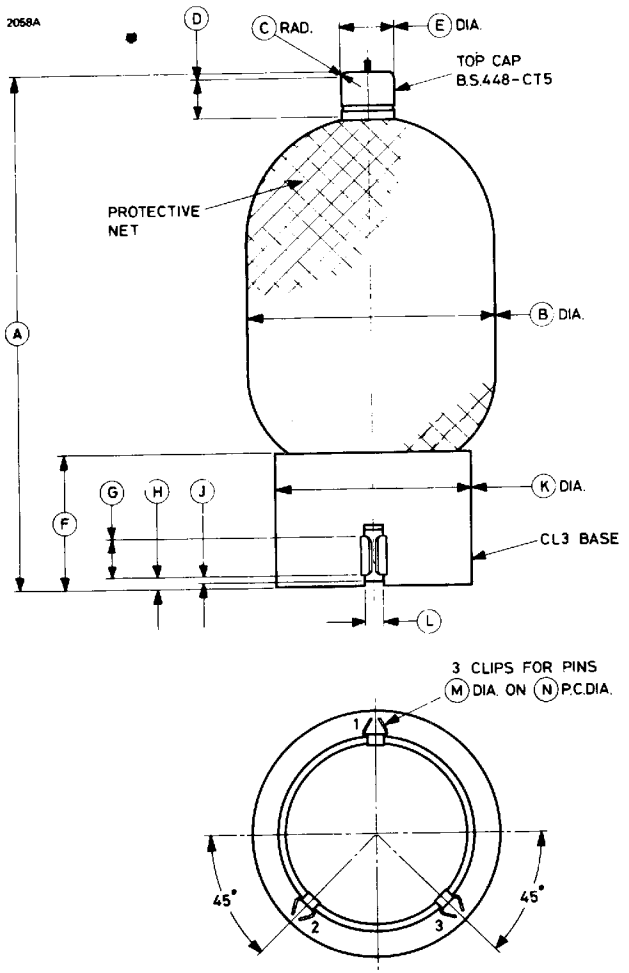
	Min	Max	
Main gap pulse voltage (anode positive)	6.6	10.5	kV
Pulse length	—	1.0	μs
Pulse repetition frequency	—	3000	p.p.s.

TYPICAL OPERATION

Main gap pulse voltage (anode positive)	7.2	kV
Average trigger voltage (see note)	3.2	kV
Peak power output	160	kW
Jitter	0.2	μs
Pulse length	0.5	μs
Pulse repetition frequency	1200	p.p.s.

Note With an open circuit voltage of 8.5kV, having a rise time of approximately 0.67μs.

OUTLINE


2058A
D
C RAD.
E DIA.
TOP CAP
B.S.448-CT5
PROTECTIVE
NET
A
B DIA.
F
G
H
J
K DIA.
CL3 BASE
L
3 CLIPS FOR PINS
M DIA. ON N P.C.DIA.
1
2
3
45°
45°

Outline Dimensions

Ref	Millimetres	Inches
A	145.8 max	5.740 max
B	70.00 max	2.756 max
C*	1.78 max	0.070 max
D*	11.94 min	0.470 min
E*	14.99 ± 0.13	0.590 ± 0.005
F	36.5 ± 2.5	1.437 ± 0.098
G	11.00 ± 0.20	0.433 ± 0.008
H	4.00 max	0.157 max
J	1.50 max	0.059 max
K	55.50 ± 0.30	2.185 ± 0.012
L	5.50 ± 0.13	0.217 ± 0.005
M	4.20	0.165
N	60.60 ± 0.25	2.386 ± 0.010

Inch dimensions have been derived from millimetres except where indicated thus *

Base Connections

Ref	Element
1	Trigger
2	Anode
3	No connection
Top cap	Cathode

2J30-2J34 inclusive

S-BAND MAGNETRONS

Service Types CV1807, CV1808 CV1809, CV1810

GENERAL DATA

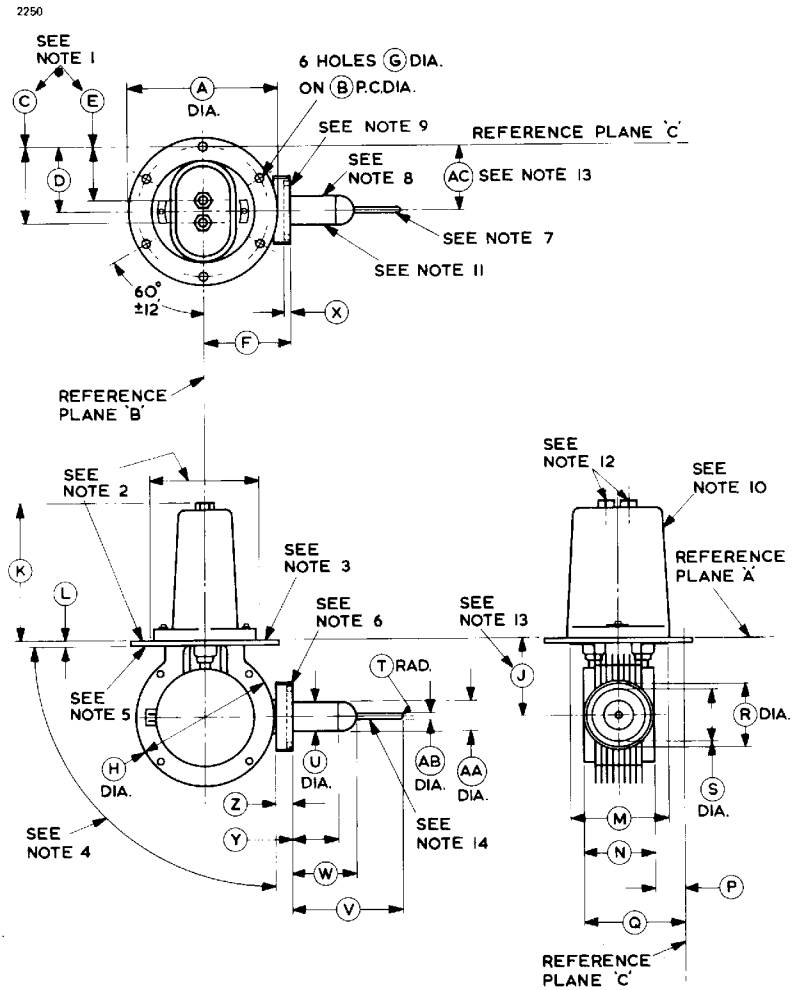
The 2J30–2J34 series comprises five pulse operated, fixed frequency magnetrons. They are maintenance types and therefore only abridged data are given on this sheet. Full information is available on request.

Frequency range:		
2J30	2860 to 2900	MHz
2J31 (CV1807)	2820 to 2860	MHz
2J32 (CV1808)	2780 to 2820	MHz
2J33 (CV1809)	2740 to 2780	MHz
2J34 (CV1810)	2700 to 2740	MHz

Typical Operation

Output power (peak)	300	kW
Anode voltage (peak)	20	kV
Anode current (peak)	30	A
Duty cycle	0.001	
Heater voltage	6.3	V
Heater current	1.5	A
Cathode heating time (minimum)	2.0	min
Magnetic field	1900	gauss
Magnet		separate
Output	Coaxial line. Internal diameter of outer conductor 0.812 inch, diameter of inner conductor 0.375 inch	
Cooling		forced-air

OUTLINE (See page 4 for outline notes)



OUTLINE DIMENSIONS

Ref	Inches	Millimetres
A	3.250 ± 0.031	82.55 ± 0.79
B	2.875 ± 0.006	73.03 ± 0.15
C	1.687	42.85
D	1.437	36.50
E	1.187	30.15
F	1.875 ± 0.047	47.63 ± 1.19
G	0.193 ± 0.003	4.902 ± 0.076
H	3.000 ± 0.062	76.20 ± 1.57
J	1.687 ± 0.010	42.85 ± 0.25
K	2.984 ± 0.062	75.79 ± 1.57
L	0.125	3.18
M	2.480 max	62.99 max
N	1.490 max	37.85 max
P	0.677 min	17.20 min
Q	2.197 max	55.80 max
R	1.375 ± 0.010	34.93 ± 0.25
S	1.122 ± 0.005	28.50 ± 0.13
T	0.062	1.57
U	0.647 ± 0.022	16.43 ± 0.56
V	2.438 ± 0.062	61.93 ± 1.57
W	1.406 ± 0.031	35.71 ± 0.79
X	0.125 ± 0.010	3.18 ± 0.25
Y	1.000	25.40
Z	$0.365^{+0.010}_{-0.000}$	$9.27^{+0.25}_{-0.00}$
AA	0.670 max	17.02 max
AB	$0.125^{+0.002}_{-0.005}$	$3.175^{+0.051}_{-0.127}$
AC	1.457 ± 0.010	37.01 ± 0.25

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The jack holes will be within a radius of 0.023 inch (0.58mm) of the location specified, but will be spaced 0.500 ± 0.010 inch (12.70 ± 0.25mm) with respect to each other. The centre lines of the holes will be perpendicular to reference plane 'A' within 3°.
2. Any portion of the assembly extending above this surface will be within 1.110 inches (28.19mm) radius of the true centre of the plate.
3. With the flange resting on a plane surface, the flatness of the mounting plate 0.500 inch (12.70mm) from the outer edge will be such that a feeler gauge 0.010 inch (0.25mm) thick and 0.125 inch (3.18mm) wide will not enter for a distance of more than 0.250 inch (6.35mm).
4. Areas between these planes will be painted with a black heat resistant non-corrosive paint.
5. Soldered joints in the mounting flange and coupling adapter will be vacuum tight so that the mounting flange may be used to provide a hermetic seal.
6. U.S.F. 1.500 – 18 thread, class 2 fit.
7. The centre line of the lead measured at this end will be concentric with the centre line of the coupling adapter within 0.020 inch (0.51mm).
8. The centre line of the output cylinder will be concentric with the centre line of the coupling adapter within 0.010 inch (0.25mm).
9. This surface of the coupling adapter will be parallel to Reference Plane 'B' within 1°.
10. The common cathode connection is indicated by letter 'C' on this surface.
11. The output cylinder will be of non-corrosive material or will be painted black; minimum plating 20mg/in^2 silver, or 10mg/in^2 gold.
12. Hexagon head banana pin jacks 0.406 inch (10.31mm) long with holes 0.169 ± 0.005 inch (4.29 ± 0.13mm) diameter.
13. This dimension applies to the coupling adapter.
14. Polished, or gold plated.

3B22

XENON FILLED RECTIFIER

Service Type CV3815 **American Designation 3B22**

INTRODUCTION

The 3B22 is a hot cathode, full wave, Xenon filled Rectifier with maximum ratings of 725V peak inverse voltage and 4·0A peak current.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	6·25 A	Approx
Min Filament Heating Time	20	secs
Ambient Temperature Range	−55 to +75	°C
Max Peak Inverse Voltage	725	V
Max Anode Current (per anode):		
Peak	4·0	A
Mean (4·5 secs averaging time)	0·5	A
Under Fault Conditions (0·1 second Max duration)	60	A
Max Power Supply Frequency	250	c/s

Mechanical

Overall Length	6·00 inches (153 mm)	Max
Overall Diameter	1·66 inches (42·1 mm)	Max
Net Weight	3 ounces (90 gm)	Approx
Mounting Position		Any
Base	Medium UX4 with bayonet	
Cooling		Natural

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XENON FILLED RECTIFIER

MAXIMUM OPERATING CONDITIONS

(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed H.T. switching

Circuit	* Diagram	Peak Inverse Voltage (up to 250c/s) V	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) V	Max D.C. Output	
			Peak	Mean‡		V	Amps
Single Phase Full Wave	A	725	4	0·5	255	230	1·0
Single Phase Full Wave Bridge	B	725	4	0·5	510	460	1·0
Three Phase Full Wave	D	725	4	0·5	295	690	1·5

* For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

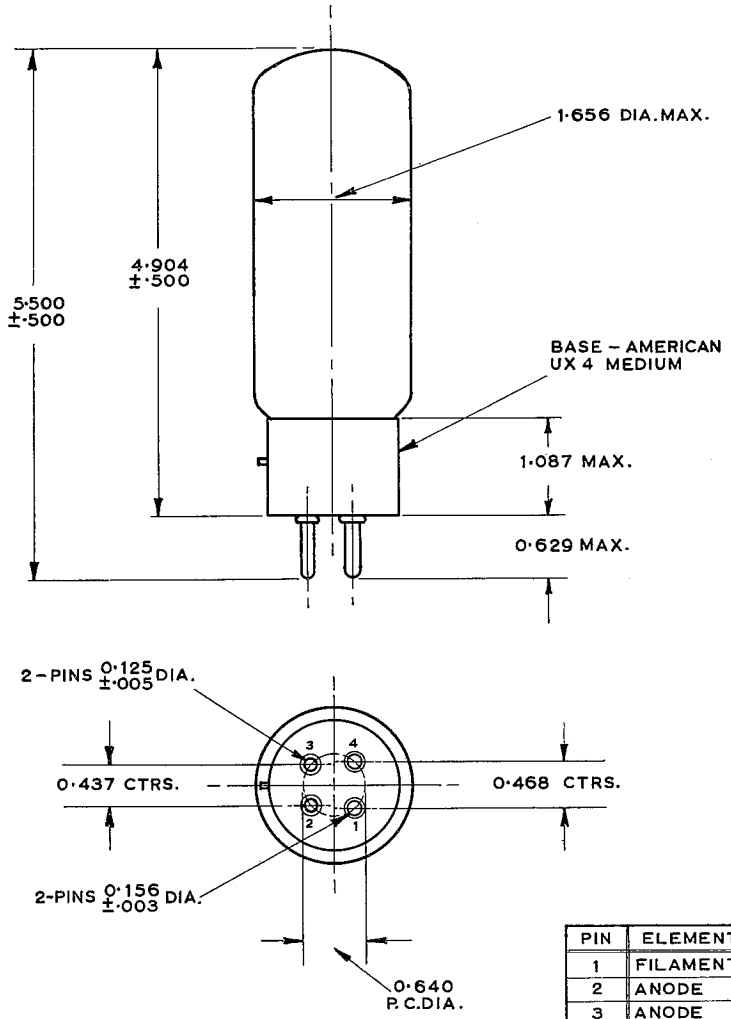
‡Mean anode currents are averaged over any period of 4·5 seconds.

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XENON FILLED RECTIFIER

OUTLINE

496



PIN	ELEMENT
1	FILAMENT
2	ANODE
3	ANODE
4	FILAMENT

ALL DIMENSIONS IN INCHES

HIGH VACUUM RECTIFIER

3B24W
(A239)

Service Type CV2858 **American Designation 3B24W**

INTRODUCTION

The 3B24W is a High Vacuum Rectifier with maximum ratings of 20kV peak inverse voltage and 300mA peak current. Small size and extremely rugged construction make this valve suitable for use in aircraft applications and other locations where vibration and shock must be met.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Thoriated Tungsten	
Filament Voltage	2·5 or 5·0	V
Filament Current	6·0 or 3·0	A
Max Peak Inverse Voltage	20·0	kV
Max Anode Current:		
Peak	300	mA
Mean	60	mA

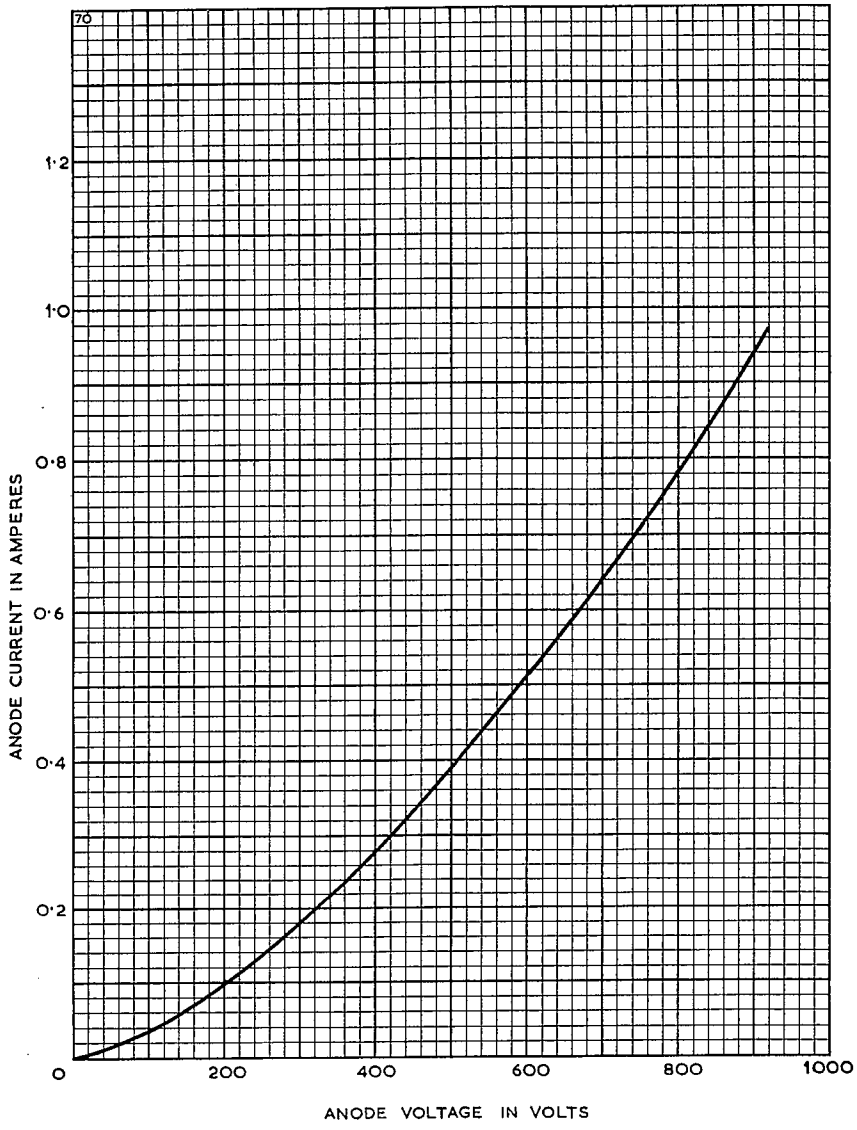
Mechanical

Overall Length	4·80 inches (122 mm)	Max
Overall Diameter	1·58 inches (40 mm)	Max
Net Weight	2 ounces (57 gm)	Approx
Base	Medium UX4	
Mounting Position	Vertical, base up or down	
Max Temperature of bulb	200°C	
Cooling	Natural	

If the valve is mounted well clear of other hot bodies and free circulation of cool air is not impeded, then natural cooling should maintain the bulb temperature below the permitted maximum. For this reason the use of a shrouded anode connector is not recommended. If the above conditions cannot be met some form of forced draught should be employed.

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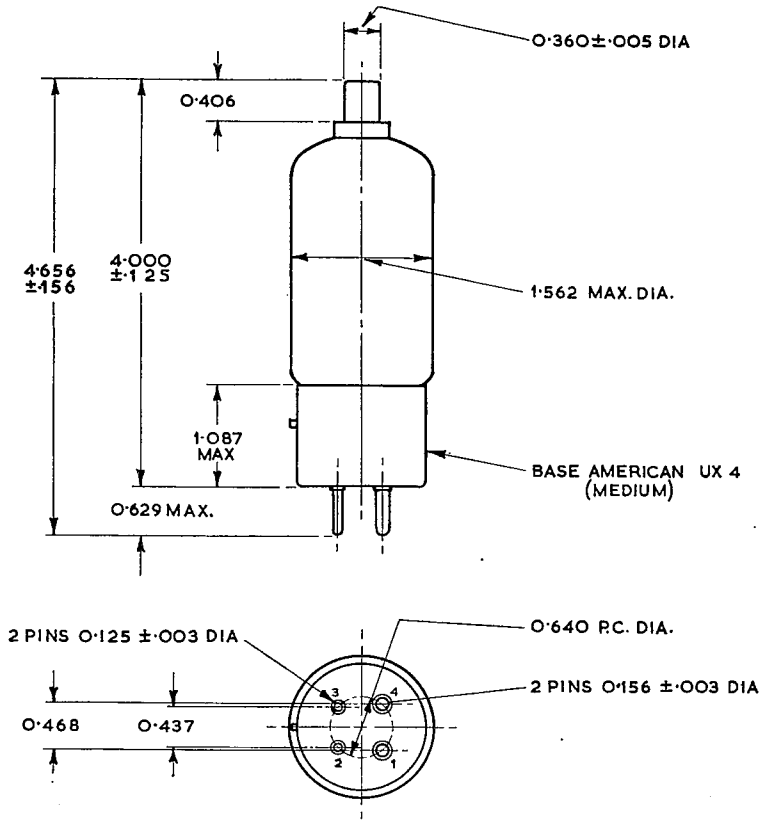
ANODE CHARACTERISTIC



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OUTLINE

71



PIN	ELEMENT
1	FILAMENT CENTRE TAP
2	FILAMENT
3	NO CONNECTION
4	FILAMENT
CAP	ANODE

ALL DIMENSIONS IN INCHES

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XENON FILLED RECTIFIER

3B28
(AX224)

Service Type CV1835 **American Designation 3B28**

INTRODUCTION

The 3B28 is a hot cathode, Xenon filled Rectifier with maximum ratings of 1A peak current at 10kV peak inverse voltage and 2A peak current at 5kV peak inverse voltage.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated		
Filament Voltage	2·5		V
Filament Current	5·0		A
Min Filament Heating Time	10		secs
Ambient Temperature Range	−55 to +75		°C
Max Peak Inverse Voltage	5·0	10·0	kV
Max Anode Current:			
Peak	2·0	1·0	A
Mean‡	0·5	0·25	A
Under fault conditions (0·1 second Max duration)	20	20	A
Max Power Supply Frequency	500	150	c/s

Mechanical

Overall Length	6·16 inches	(156 mm)	Max
Overall Diameter	2·07 inches	(53 mm)	Max
Net Weight	2 ounces	(57 gm)	Approx
Mounting Position	Any		
Base	Medium UX4 with bayonet		
Cooling	Natural		

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed H.T. switching

Circuit	* Diagram	Peak Inverse Voltage kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
			Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	● 10	1	0·25	3·5	3·1	0·5
		△ 5	2	0·5	1·7	1·5	1·0
Single Phase Full Wave Bridge	B	● 10	1	0·25	7·0	6·3	0·5
		△ 5	2	0·5	3·5	3·1	1·0
Three Phase Half Wave	C	● 10	1	0·25	4·1†	4·7†	0·75
		△ 5	2	0·5	2·0†	2·3†	1·5
Three Phase Full Wave	D	● 10	1	0·25	4·1	9·5	0·75
		△ 5	2	0·5	2·0	4·7	1·5

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

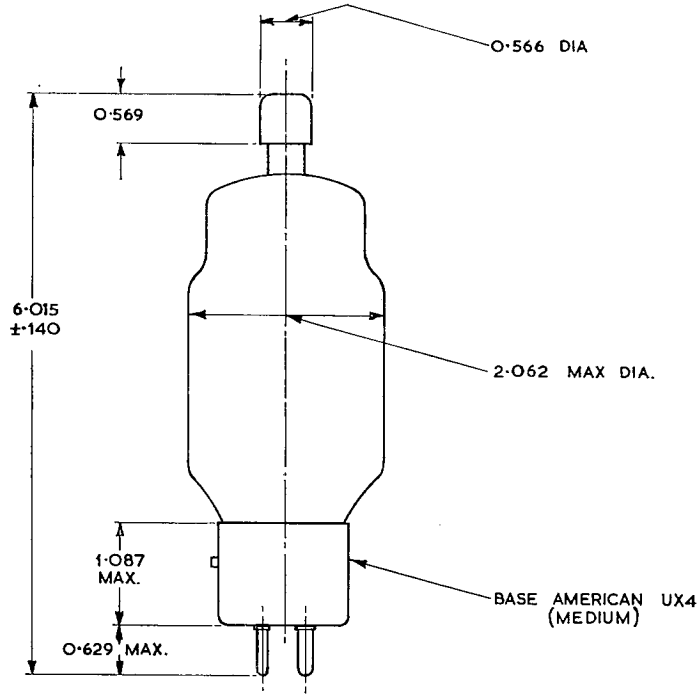
‡Mean anode currents are averaged over any period of 15 seconds maximum.

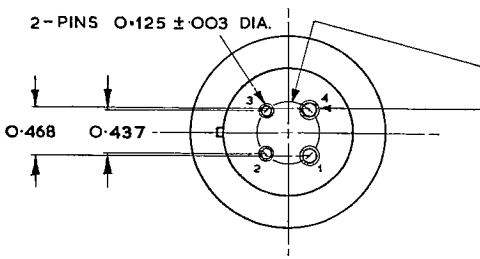
●For operation up to 150c/s.

△For operation up to 500c/s.

OUTLINE

105





PIN	ELEMENT
1	FILAMENT
2	NO CONNECTION
3	NO CONNECTION
4	FILAMENT & SHIELD
CAP	ANODE

ALL DIMENSIONS IN INCHES

Printed in England

3C24
(B1109)

R.F. POWER TRIODE

Service Types CV789, CV2736 (matched pairs)

The data should be read in conjunction with the Power Triode Preamble.

ABRIDGED DATA

Natural cooled power triode for use as an amplifier, oscillator or modulator

Anode dissipation	25	W max
Anode voltage	2.0	kV max
Frequency for full ratings	60	MHz max
Output power (class C unmodulated)	100	W

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage	6.3	V
Filament current	3.0	A
Amplification factor	25	
Mutual conductance (V_a = 1.0kV, I_a = 25mA)	2.5	mA/V
Inter-electrode capacitances:		
grid to anode	1.5	pF
grid to filament	1.7	pF
anode to filament	0.3	pF

Mechanical

Overall length	4.375 inches (111.1mm) max
Overall diameter	1.440 inches (36.6mm) max
Net weight	1½ ounces (42g) approx
Mounting position	vertical, either way up
Base	small UX4

Cooling . . . . . natural

Heat dissipating connections of large area are necessary for anode and grid.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
(Class B and Class AB)

MAXIMUM RATINGS (Absolute values)

Anode voltage	2000	V max
Anode current (maximum signal)	75	mA max
Anode dissipation	25	W max
Grid dissipation	7.0	W max

TYPICAL OPERATING CONDITIONS
(Class AB_2 – two valves)

Anode voltage	750	1000	1250	V
Grid voltage (see note 1)	−20	−30	−42	V
Anode current (zero signal)	43	32	24	mA
Anode current (maximum signal)	127	127	130	mA
Effective load (anode to anode)	12	17	21.4	kΩ
Peak a.f. grid voltage (per valve)	110	120	135	V
Peak driving power (maximum signal)	5.5	6.0	6.8	W
Nominal driving power (maximum signal)	2.8	3.0	3.4	W
Output power (maximum signal)	60	85	112	W

ANODE MODULATED R.F. POWER AMPLIFIER
(Class C telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	1600	V max
Anode current	60	mA max
Anode dissipation	17	W max
Grid dissipation	7.0	W max

TYPICAL OPERATING CONDITIONS

Anode voltage	1000	1250	1600	V
Grid voltage	−120	−140	−170	V
Anode current	60	60	52	mA
Grid current (approx)	14	13	11	mA
Anode dissipation	13	15	17	W
Grid dissipation	1.6	1.5	1.2	W
Driving power	3.3	3.3	3.1	W
Peak r.f. grid voltage	235	255	280	V
Output power	47	60	68	W

R.F. POWER AMPLIFIER AND OSCILLATOR

(Class C telegraphy, key-down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	2000	V max
Anode current	75	mA max
Anode dissipation	25	W max
Grid dissipation	7.0	W max

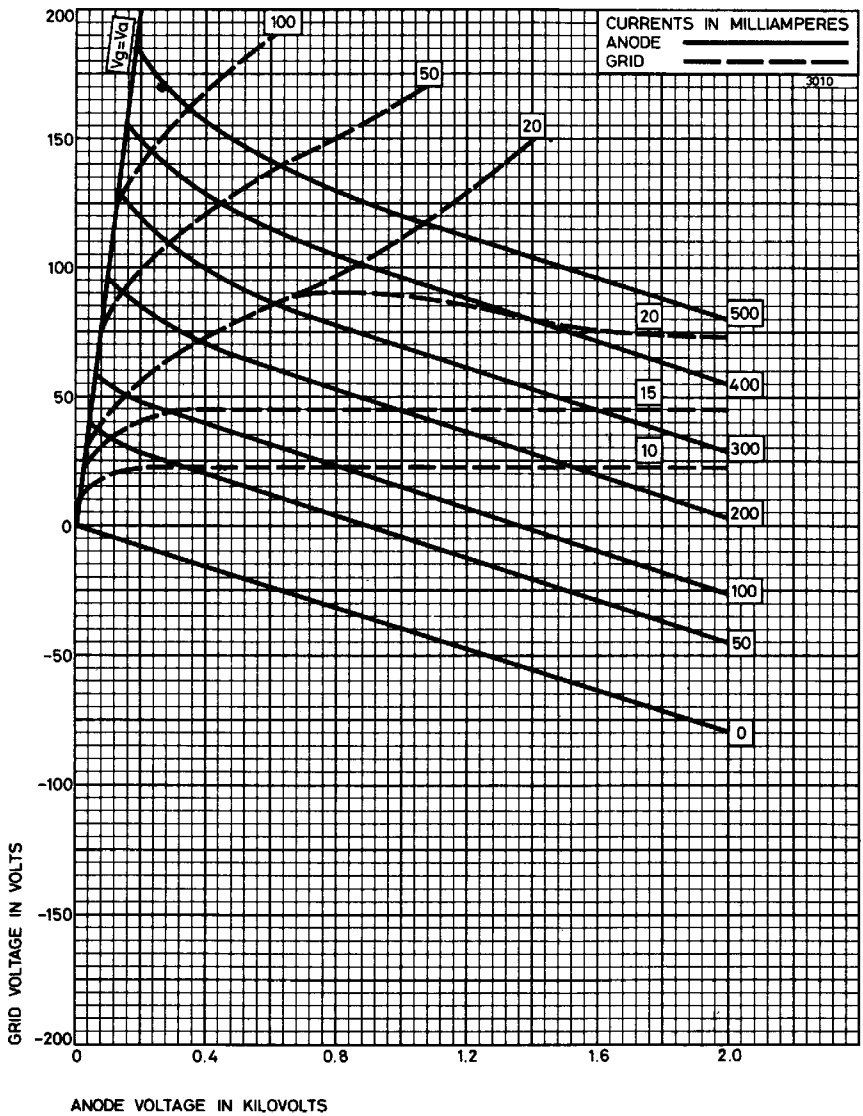
TYPICAL OPERATING CONDITIONS

Anode voltage	1000	1500	2000	V
Grid voltage	−70	−95	−130	V
Anode current	72	67	63	mA
Grid current (approx)	9.0	13	18	mA
Anode dissipation	25	25	25	W
Grid dissipation	0.9	1.3	2.1	W
Driving power	1.3	2.2	4.0	W
Peak r.f. grid voltage	170	195	245	V
Output power	47	75	100	W

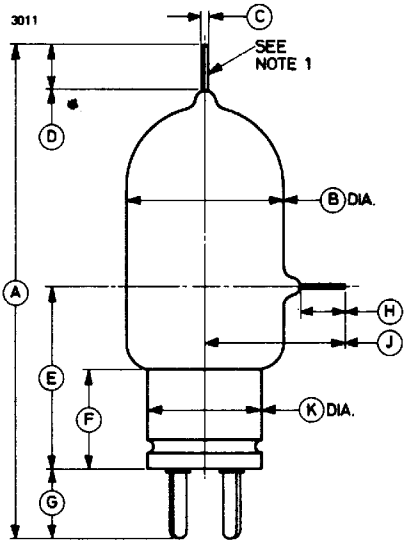
NOTES

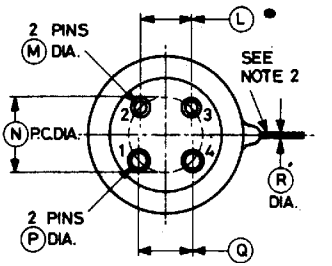
1. The grid voltage should be adjusted to give the stated zero-signal anode current.

TYPICAL CONSTANT CURRENT CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)





Pin	Element
1	Filament
2	No connection
3	No connection
4	Filament
Side lead	Grid
Top lead	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.187 ± 0.187	106.3 ± 4.8	J	1.200 ± 0.100	30.48 ± 2.54
B	1.375 ± 0.065	34.93 ± 1.65	K	1.151 ± 0.015	29.24 ± 0.38
C	0.048 ± 0.003	1.219 ± 0.076	L	0.437	11.10
D	0.375 ± 0.065	9.53 ± 1.65	M	0.125 ± 0.003	3.175 ± 0.076
E	1.562 ± 0.125	39.67 ± 3.18	N	0.640	16.26
F	0.843	21.41	P	0.156 ± 0.003	3.962 ± 0.076
G	0.596 max	15.14 max	Q	0.468	11.89
H	0.375 ± 0.065	9.53 ± 1.65	R	0.048 ± 0.003	1.219 ± 0.076

Millimetre dimensions have been derived from inches.

Outline Notes

1. The centre line through the anode pin will not deviate more than 0.125 inch (3.18mm) from the centre line of the tube and base.
2. Deviation from base centre line 3° max.

XENON FILLED RECTIFIER

4B32
(AX230)

Service Type CV2518 **American Designation 4B32**

INTRODUCTION

The 4B32 is a hot cathode, Xenon filled Rectifier with maximum ratings of 10kV peak inverse voltage and 5A peak current.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	5·0	V
Filament Current	7·1	A
Min Filament Heating Time	30	secs
Ambient Temperature Range	−55 to +70	°C
Max Peak Inverse Voltage	10·0	kV
Max Anode Current:		
Peak	5·0	A
Mean‡	1·25	A
Under fault conditions (0·1 second Max duration)	50	A
Max Power Supply Frequency	150	c/s

Mechanical

Overall Length	8·5 inches	(216 mm)	Max
Overall Diameter	2·32 inches	(59 mm)	Max
Net Weight	8 ounces	(230 gm)	Approx
Mounting Position			Any
Base			B4F
Cooling			Natural

ENGLISH ELECTRIC VALVE CO. LTD.
CHELMSFORD ESSEX, ENGLAND TECHNICAL PUBLICATIONS
Printed in England

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed H.T. switching

Circuit	* Diagram	Peak Inverse Voltage (up to 150c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
			Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	10	5	1·25	3·5	3·1	2·5
Single Phase Full Wave Bridge	B	10	5	1·25	7·0	6·3	2·5
Three Phase Half Wave	C	10	5	1·25	4·1†	4·7†	3·75
Three Phase Full Wave	D	10	5	1·25	4·1	9·5	3·75

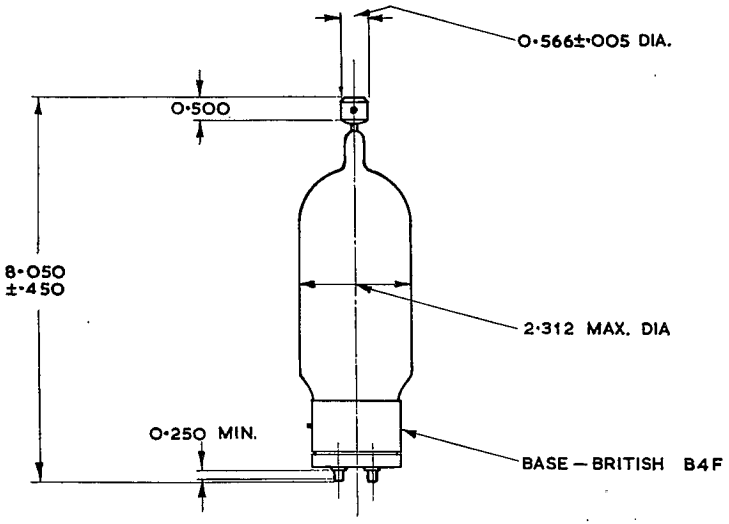
*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

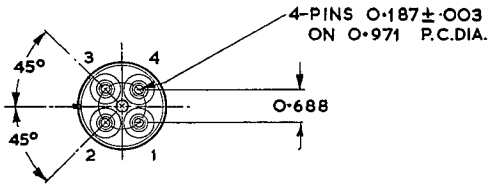
†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum.

OUTLINE

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PIN	ELEMENT
1	NO CONNECTION
2	FILAMENT
3	NO CONNECTION
4	FILAMENT
CAP	ANODE

ALL DIMENSIONS IN INCHES

4CX10,000D

R.F. POWER TETRODE

Service Type CV6184

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

Forced-air cooled tetrode, coaxial metal-ceramic envelope, for audio, linear single sideband, or screen-modulated r.f. amplifiers.

Anode dissipation (class C telegraphy)	10	kW max
Anode voltage	7.5	kV max
Frequency for full ratings	30	MHz max
Frequency at reduced ratings	110	MHz max
Output power (class C telegraphy)	16	kW

GENERAL

Electrical

Filament	thoriated tungsten				
Filament voltage (see note 1)	7.5				V
Filament current	75				A
Grid-screen amplification factor (V_a = 2.0kV, V_{g2} = 750V, I_a = 1.0A)	4.5				
Inter-electrode capacitances:	Grounded Filament		Grounded Grid and Screen		
	Min	Max	Min	Max	
input	108	122	48	58	pF
output	18	23	18	23	pF
feedback	—	1.0	—	0.16	pF

Mechanical

Overall length	9.125 inches (232mm) max
Overall diameter	7.050 inches (179.1mm) max
Net weight	12.2 pounds (5.5kg) approx
Mounting position	vertical, either way up

COOLING

Sufficient air must be passed over the concentric base terminals and through the radiator fins to maintain the temperatures of the ceramic to metal seals and the radiator core below the maximum rated value of 250°C. It is recommended that an air distribution socket MA87 and chimney type MA104A be used with the tube (see pages 10, 11 and 12).

The air flows required with the recommended air socket and chimney to maintain the seal temperatures at 200°C in an ambient temperature of 50°C at sea level and with an operating frequency of less than 30MHz are given

below. At higher ambient temperatures, altitudes or frequencies the rate of flow must be adjusted to give equivalent cooling and should be determined individually in each case. An allowance of 1000 watts for the power dissipated by the filament and grids has been made in the values given.

Anode dissipation (kW)	Air flow		Water pressure drop	
	ft^3/min	m^3/min	inches	mm
4.0	110	3.1	0.4	10.2
6.0	200	5.7	0.8	20.4
8.0	315	8.9	1.7	43
10	445	12.6	2.8	71
12	600	17.0	4.4	110

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.5	kV max
Anode current	4.0	A max
Anode dissipation	12	kW max
Screen voltage	1.5	kV max
Screen dissipation	250	W max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS (Class AB1, two valves)

Anode voltage	4.0	5.0	6.0	7.5	kV
Screen voltage	1.5	1.5	1.5	1.5	kV
Grid voltage	−315	−320	−330	−340	V
Peak a.f. voltage, grid to grid	305	310	320	330	V
Anode current (zero signal)	1.0	1.0	1.0	1.0	A
Anode current (max. signal)	6.66	6.66	6.66	6.66	A
Screen current (zero signal)	0	0	0	0	A
Screen current (max. signal)	0.33	0.32	0.30	0.25	A
Anode dissipation (maximum signal)	6.67	7.95	8.10	9.05	kW
Effective load (anode to anode)	0.94	1.32	1.70	2.28	kΩ
Nominal driving power (maximum signal)	0	0	0	0	W
Output power (max. signal)	13.3	17.5	23.8	31.9	kW

RADIO FREQUENCY LINEAR AMPLIFIER
(Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.5	kV max
Anode current	4.0	A max
Anode dissipation	12	kW max
Screen voltage	1.5	kV max
Screen dissipation	250	W max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS

(Peak envelope or modulation crest conditions, below 30MHz)

Anode voltage	7.5	kV
Screen voltage	1.5	kV
Grid voltage (see note 3)	–340	V
Peak r.f. grid voltage	330	V
Anode current (zero signal)	0.50	A
Anode current (maximum signal)	3.33	A
Screen current (maximum signal)	0.125	A
Anode dissipation	9.05	kW
Nominal driving power	0	W
Output power (see note 4)	15.95	kW

ANODE MODULATED R.F. POWER AMPLIFIER
(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.0	kV max
Anode current	2.5	A max
Anode dissipation (see note 5)	6.65	kW max
Screen voltage	1.0	kV max
Screen dissipation	250	W max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS (below 30MHz)

Anode voltage	5.0	kV
Screen voltage	500	V
Grid voltage	−400	V
Peak a.f. screen voltage (for 100% modulation)	450	V
Peak r.f. grid voltage	520	V
Anode current	1.4	A
Screen current	0.26	A
Grid current	0.05	A
Anode dissipation	1.1	kW
Nominal driving power	25	W
Output power	5.8	kW

R.F. POWER AMPLIFIER OR OSCILLATOR
(Class C Telegraphy, key down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

	Up to 30MHz	30–60MHz	60–110MHz	
Anode voltage	7.5	7.0	6.5	kV max
Anode current	3.0	2.8	2.6	A max
Anode dissipation	10	10	10	kW max
Screen voltage	1.5	1.5	1.5	kV max
Screen dissipation	250	250	250	W max
Grid dissipation	75	75	75	W max

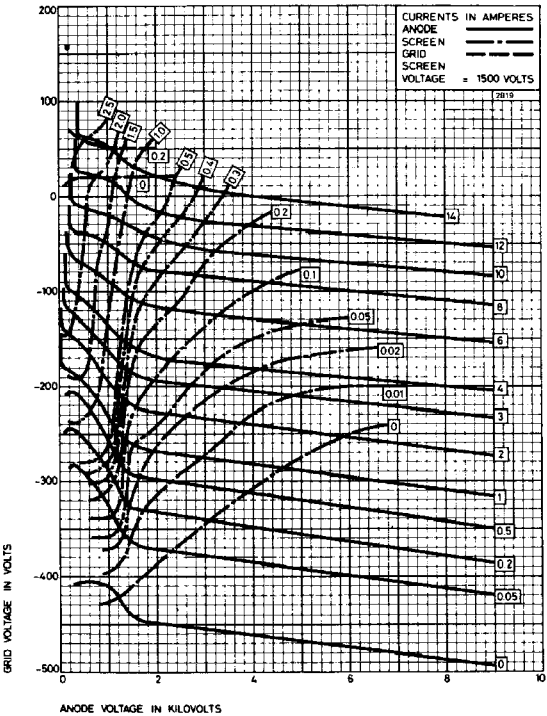
TYPICAL OPERATING CONDITIONS (below 30MHz)

Anode voltage	7.5	kV
Screen voltage	500	V
Grid voltage	−350	V
Peak r.f. grid voltage	590	V
Anode current	2.8	A
Screen current	0.5	A
Grid current	0.25	A
Anode dissipation	5.0	kW
Nominal driving power	150	W
Output power	16	kW

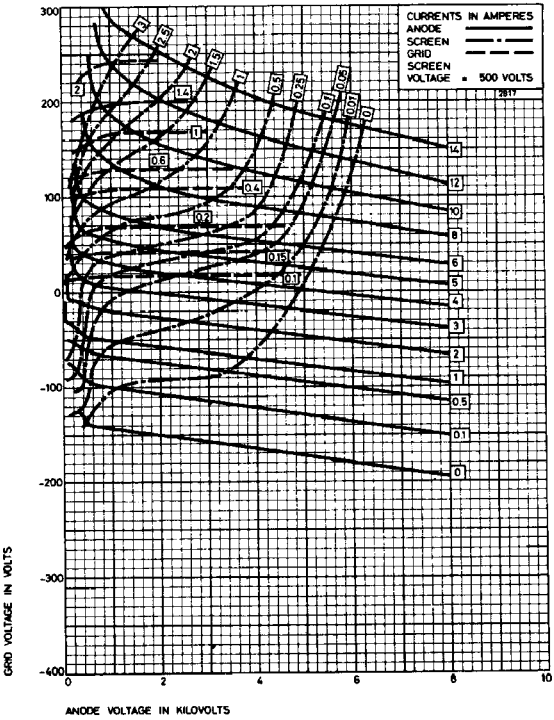
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed ±5%.
2. Grid current does not flow during any part of the audio frequency cycle.
3. The grid voltage is adjusted to obtain the specified zero-signal anode current.
4. The peak envelope or r.f. output power at the crest of the modulation envelope.
5. This corresponds to 10kW anode dissipation at 100% sine wave modulation.

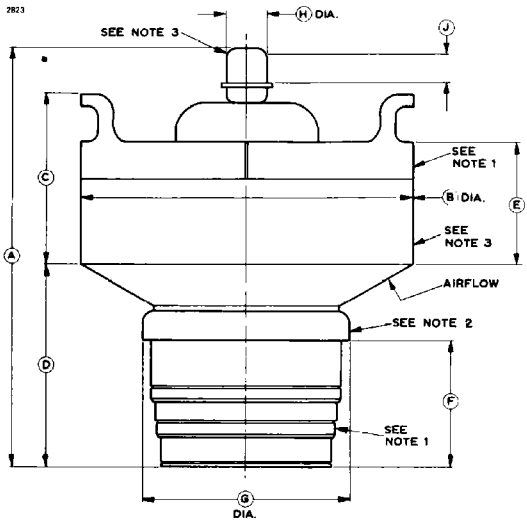
TYPICAL CONSTANT CURRENT CHARACTERISTICS



TYPICAL CONSTANT CURRENT CHARACTERISTICS



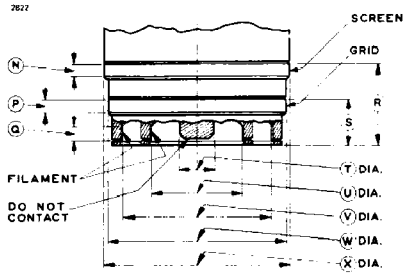
OUTLINE



Ref	Inches	Millimetres
A	8.875 ± 0.250	225.4 ± 6.4
B	6.989 ± 0.062	177.5 ± 1.6
C	3.600 ± 0.188	91.44 ± 4.80
D	4.375 ± 0.188	111.1 ± 4.8
E	2.600 ± 0.188	66.04 ± 4.80
F	2.750 ± 0.188	69.85 ± 4.80
G	4.425 max	112.4 max
H	0.875 ± 0.020	22.23 ± 0.51
J	0.375 min	9.53 min

Millimetre dimensions have been derived from inches.

OUTLINE DETAILS



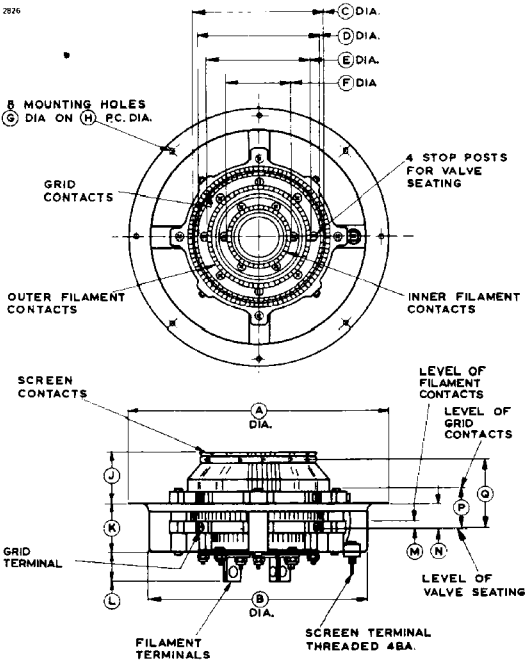
Ref	Inches	Millimetres
N	0.188 min	4.78 min
P	0.188 min	4.78 min
Q	0.188 min	4.78 min
R	1.795 ± 0.031	45.59 ± 0.79
S	1.018 ± 0.032	25.86 ± 0.81
T	0.740 ± 0.020	18.80 ± 0.51
U	1.916 ± 0.020	48.67 ± 0.51
V	3.153 ± 0.020	80.09 ± 0.51
W	3.812 ± 0.020	96.82 ± 0.51
X	4.000 ± 0.020	101.6 ± 0.5

Millimetre dimensions have been derived from inches.

Outline Notes

1. The eccentricity of the screen and filament contact surfaces will not exceed 0.040 inch (1.02mm) with respect to the anode and control grid contact surfaces when the valve is rotated on rollers at the points indicated by the arrows.
2. This surface must not be used as an electrical contact and it must not be clamped in any way.
3. This surface may be used for making electrical contact to the anode.

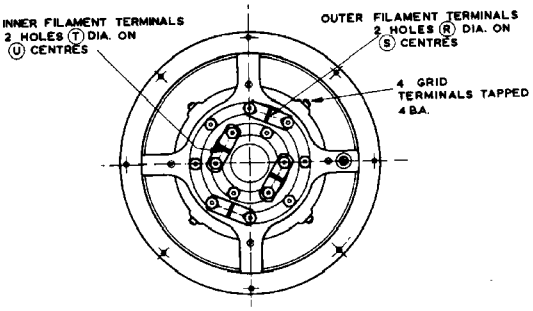
OUTLINE OF AIR DISTRIBUTION SOCKET MA87



OUTLINE DETAIL OF MA87

View from underside showing terminals

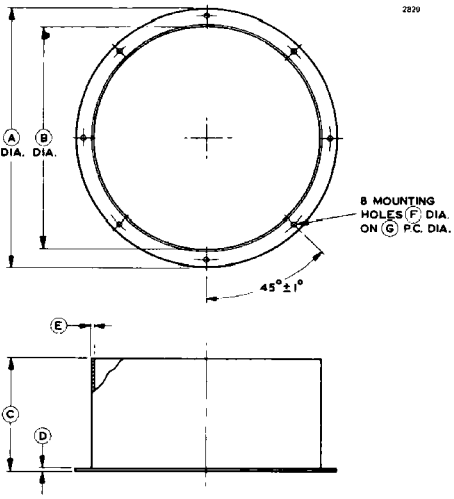
2827



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	8.266 max.	210.0 max	L	0.894 ± 0.031	22.71 ± 0.79
B	6.766 max	171.9 max	M	0.228 ± 0.012	5.79 ± 0.30
C	3.910 ± 0.030	99.31 ± 0.76	N	0.672 ± 0.017	17.07 ± 0.43
D	3.702 ± 0.030	94.03 ± 0.76	P	0.841 ± 0.015	21.36 ± 0.38
E	3.281 ± 0.030	83.34 ± 0.76	Q	1.626 ± 0.031	41.30 ± 0.79
F	2.031 ± 0.030	51.59 ± 0.76	R	0.250 ± 0.015	6.35 ± 0.38
G	0.147	3.73	S	1.562 ± 0.015	39.67 ± 0.38
H	7.750	196.9	T	0.250 ± 0.015	6.35 ± 0.38
J	1.125 ± 0.015	28.58 ± 0.38	U	0.937 ± 0.015	23.80 ± 0.38
K	1.489 ± 0.028	37.82 ± 0.71			

Millimetre dimensions have been derived from inches.

OUTLINE OF AIR CHIMNEY MA104A
(All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	8.250	209.6
B	$7.000^{+0.062}_{-0.000}$	$177.8^{+1.57}_{-0.00}$
C	3.625	92.08
D	0.093	2.36
E	0.125 ± 0.031	3.18 ± 0.79
F	0.157	4.00
G	7.750	196.8

Millimetre dimensions have been derived from inches except dimension F.

4CX35,000C

R.F. POWER TETRODE

Service Type CV11107

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

Forced-air cooled tetrode, coaxial metal-ceramic envelope, for audio amplifiers, r.f. linear amplifiers or class C amplifiers or oscillators.

Anode dissipation (class C telegraphy)	35	kW max
Anode voltage	20	kV max
Frequency for full ratings	30	MHz max
Output power (class C telegraphy)	82.5	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	10	V
Filament current	300	A
Grid-screen amplification factor	4.5	
Inter-electrode capacitances, grounded filament:		
grid to anode	2.4	pF
input	465	pF
output	55	pF

Mechanical

Overall length	17.500 inches (444.5mm) max
Overall diameter	9.750 inches (247.7mm) max
Net weight	50 pounds (23kg) approx
Mounting position	vertical, either way up

Accessories

Sockets (see pages 10- 12)	MA166A or MA166B
Clamping device to secure valve in socket (optional)	MA233

COOLING

Sufficient air must be passed over the base terminals and through the radiator fins to maintain the temperatures of the ceramic to metal seals and the radiator core below the maximum rated value of 250°C.

Using socket type MA166 or MA166B, 60 to 100ft^3/min (1.70 to 2.83m^3/min) of air will be required for base cooling. This should be blown horizontally through the socket from two diametrically opposed nozzles. It is also necessary to direct 2ft^3/min (0.06m^3/min) of air into the centre hole of the socket.

The air flows required to maintain the seal and radiator core temperatures at 225°C in an ambient temperature of 40°C at sea level and with an operating frequency of less than 30MHz are given below. The values specified are for air flowing in the direction from base to anode. At higher ambient temperatures or altitudes the rate of flow must be adjusted to give equivalent cooling and should be determined individually in each case. An allowance of 5250 watts for the power dissipated by the filament and grids has been made in the values given.

Anode dissipation	Air flow		Water pressure drop	
(kW)	ft^3/min	m^3/min	inches	mm
15	485	13.7	1.65	4.2
20	710	20.1	2.85	7.25
25	1000	28.3	5.1	13.0
30	1320	37.4	8.9	22.6
35	1650	46.7	14.5	36.8

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	20	kV max
Anode current	15	A max
Anode dissipation	35	kW max
Screen voltage	2.5	kV max
Screen dissipation	1750	W max
Grid dissipation	500	W max
Grid circuit resistance	0.1	MΩ max

TYPICAL OPERATING CONDITIONS (Class AB1, two valves)

Anode voltage	10	15	kV
Screen voltage	1.5	1.5	kV
Grid voltage	−290	−340	V
Peak a.f. voltage, grid to grid	270	310	V
Anode current (zero signal)	4.0	2.0	A
Anode current (maximum signal)	17.4	15.1	A
Screen current (zero signal)	0	0	A
Screen current (maximum signal)	0.77	0.62	A
Anode dissipation per tube (maximum signal)	33	30.5	kW
Effective load (anode to anode)	1.15	2.56	kΩ
Nominal driving power (maximum signal)	0	0	W
Output power (maximum signal)	110	165	kW

RADIO FREQUENCY LINEAR AMPLIFIER
(Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	20	kV max
Anode current	15	A max
Anode dissipation	35	kW max
Screen voltage	2.5	kV max
Screen dissipation	1750	W max
Grid dissipation	500	W max
Grid circuit resistance	0.1	MΩ max

TYPICAL OPERATING CONDITIONS
(Peak envelope or modulation crest conditions, below 30MHz)

Anode voltage	10	15	kV
Screen voltage	1.5	1.5	kV
Grid voltage (see note 3)	−290	−340	V
Peak r.f. grid drive voltage	270	310	V
Anode current (zero signal)	2.0	1.0	A
Anode current (maximum signal)	8.7	7.55	A
Screen current (maximum signal)	0.385	0.310	A
Anode dissipation	33	30.5	kW
Nominal driving power	0	0	W
Output power (see note 4)	55	82.5	kW

ANODE MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	17.5	kV max
Anode current	15	A max
Anode dissipation (see note 5)	23	kW max
Screen voltage	2.0	kV max
Screen dissipation	1750	W max
Grid dissipation	500	W max

TYPICAL OPERATING CONDITIONS (below 30MHz)

Anode voltage	7.5	10	15	kV
Screen voltage	750	750	750	V
Grid voltage	−460	−520	−540	V
Peak a.f. screen voltage (for 100% modulation)	640	675	630	V
Peak r.f. grid drive voltage	630	680	700	V
Anode current	7.0	6.6	6.45	A
Screen current	1.2	0.985	0.890	A
Grid current	0.375	0.370	0.355	A
Anode dissipation	10.5	11.0	14.5	kW
Nominal driving power	235	250	250	W
Output power	42	55	82.5	kW

R.F. POWER AMPLIFIER OR OSCILLATOR

(Class C Telegraphy, key down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	20	kV max
Anode current	15	A max
Anode dissipation	35	kW max
Screen voltage	2.5	kV max
Screen dissipation	1750	W max
Grid dissipation	500	W max

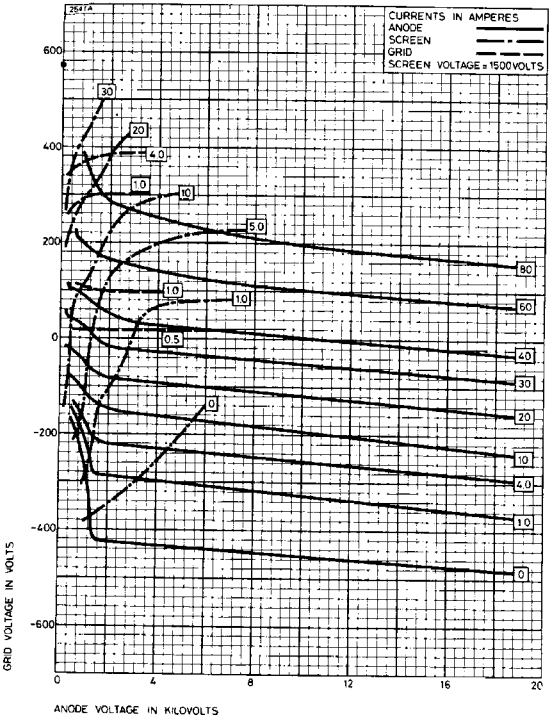
TYPICAL OPERATING CONDITIONS (below 30MHz)

Anode voltage	10	15	kV
Screen voltage	750	750	V
Grid voltage	−425	−480	V
Peak r.f. grid drive voltage	575	640	V
Anode current	6.70	6.45	A
Screen current	0.925	0.810	A
Grid current	0.320	0.355	A
Anode dissipation	12	14	kW
Nominal driving power	185	225	W
Output power	55	82.5	kW

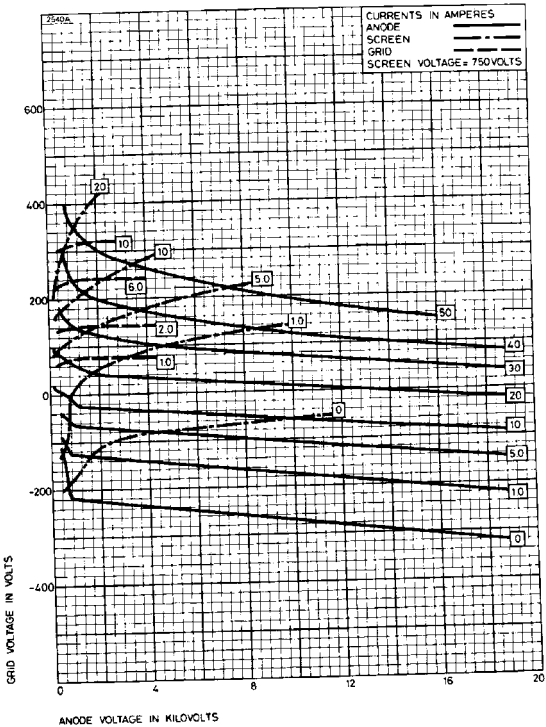
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed ±5%.
2. Grid current does not flow during any part of the drive cycle.
3. The grid voltage is adjusted to obtain the specified zero-signal anode current.
4. The peak envelope or r.f. output power at the crest of the modulation envelope.
5. This corresponds to an anode dissipation of 35kW at 100% sine wave modulation.

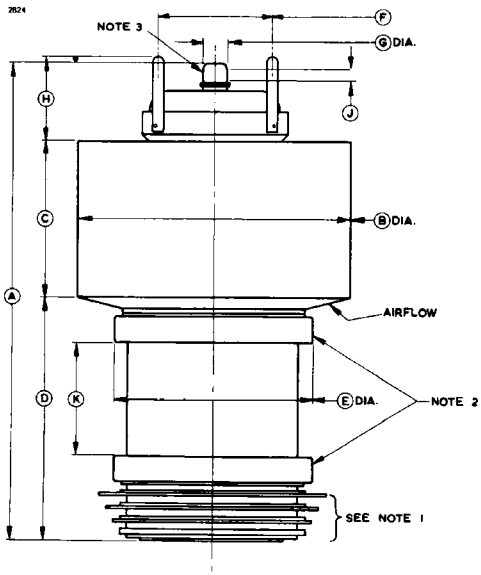
TYPICAL CONSTANT CURRENT CHARACTERISTICS



TYPICAL CONSTANT CURRENT CHARACTERISTICS



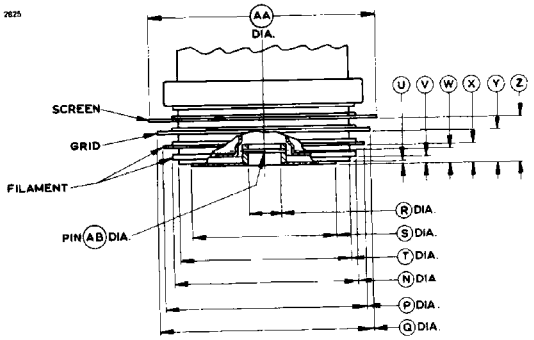
OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	16.855 ± 0.125	428.1 ± 3.2	F	4.000	101.6
B	9.625 ± 0.125	244.5 ± 3.2	G	0.875 ± 0.015	22.23 ± 0.38
C	5.500 ± 0.125	139.7 ± 3.2	H	3.062	77.78
D	8.567 ± 0.125	217.6 ± 3.2	J	0.500 ± 0.015	12.70 ± 0.38
E	7.062 max	179.4 max	K	4.000 min	101.6 min

Millimetre dimensions have been derived from inches.

OUTLINE DETAIL



Ref	Inches	Millimetres	Ref	Inches	Millimetres
N	6.530 ± 0.030	165.9 ± 0.8	V	0.197 ± 0.031	5.00 ± 0.79
P	7.000 ± 0.020	177.8 ± 0.5	W	0.510 ± 0.020	12.95 ± 0.51
Q	7.500 ± 0.020	190.5 ± 0.5	X	0.715 ± 0.025	18.16 ± 0.64
R	1.260 ± 0.010	32.00 ± 0.25	Y	1.245 ± 0.025	31.62 ± 0.64
S	5.000 ± 0.020	127.0 ± 0.5	Z	1.775 ± 0.025	45.08 ± 0.64
T	6.000 ± 0.020	152.4 ± 0.5	AA	7.995 ± 0.020	203.1 ± 0.5
U	0.060 ± 0.015	1.52 ± 0.38	AB	0.135	3.43

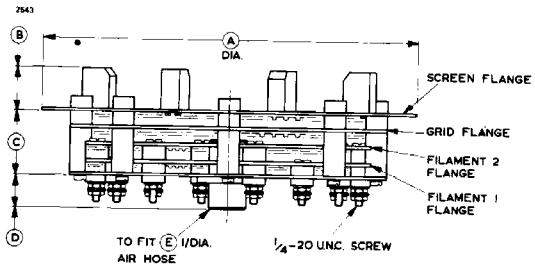
Millimetre dimensions have been derived from inches.

Outline Notes

1. The eccentricity of the filament, grid and screen contact surfaces will not exceed 0.125 inch (3.18mm) with respect to dimension R with the tube mounted on the bottom ceramic.
2. These surfaces must not be used for electrical contacts and must not be clamped in any way.
3. This surface may be used for making electrical contact to the anode.

OUTLINE OF SOCKETS MA166 AND MA166B

(See pages 11 and 12 for plan views)

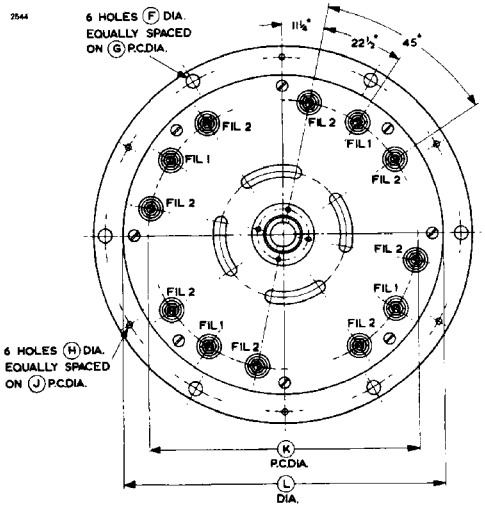


Ref	Inches	Millimetres
A	12.000 ± 0.015	304.8 ± 0.4
B	1.250 ± 0.156	31.75 ± 3.96
C	2.000 ± 0.020	50.80 ± 0.51
D	1.000 ± 0.020	25.40 ± 0.51
E	1.250	31.75
F	0.437	11.10
G	11.250	285.8
H	0.187	4.75
J	11.250	285.8
K	8.530	216.7
L	10.125 ± 0.031	257.2 ± 0.8
M	0.312	7.92
N	4.813	122.3

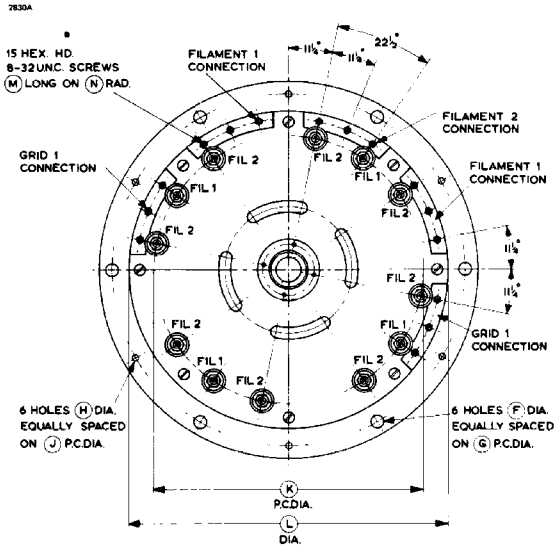
Millimetre dimensions have been derived from inches.

All dimensions without limits are nominal

Outline Detail of MA166 (See page 10 for dimensions)



Outline Detail of MA166B (See page 10 for dimensions)



4CX5000A

R.F. POWER TETRODE

Service Type CV8295

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

Forced-air cooled tetrode, coaxial metal-ceramic envelope, for audio, linear single sideband or screen-modulated r.f. amplifiers.

Anode dissipation (class C telegraphy)	5.0	kW max
Anode voltage	7.5	kV max
Frequency for full ratings	30	MHz max
Frequency at reduced ratings	110	MHz max
Output power (class C telegraphy)	16	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	7.5	V
Filament current	75	A
Grid-screen amplification factor (V_a = 2.0kV, V_{g2} = 750V, I_a = 1.0A)	4.5	

Inter-electrode capacitances:	Grounded Filament		Grounded Grid and Screen		
	Min	Max	Min	Max	
input	108	122	48	58	pF
output	18	23	18	23	pF
feedback	–	1.0	–	0.16	pF

Mechanical

Overall length	9.125 inches (232mm) max
Overall diameter	4.940 inches (125.5mm) max
Net weight	9.5 pounds (4.3kg) approx
Mounting position	vertical, either way up

COOLING

Sufficient air must be passed over the concentric base terminals and through the radiator fins to maintain the temperatures of the ceramic to metal seals and the radiator core below the maximum rated value of 250°C. It is recommended that an air distribution socket MA87 and chimney type MA104 be used with the tube (see pages 10, 11 and 12).

The air flows required with the recommended air socket and chimney to maintain the seal temperatures at 200°C in an ambient temperature of 50°C at sea level and with an operating frequency of less than 30MHz are given

below. At higher ambient temperatures, altitudes or frequencies the rate of flow must be adjusted to give equivalent cooling and should be determined individually in each case. An allowance of 1000 watts for the power dissipated by the filament and grids has been made in the values given.

Anode dissipation (kW)	Air flow		Water pressure drop	
	ft^3/min	m^3/min	inches	mm
2.0	75	2.1	0.4	10.2
3.0	105	3.0	0.7	17.8
4.0	145	4.1	1.1	28
5.0	190	5.4	1.5	38
6.0	230	6.5	2.0	51

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.5	kV max
Anode current	4.0	A max
Anode dissipation	6.0	kW max
Screen voltage	1.5	kV max
Screen dissipation	250	W max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS (Class AB1, two valves)

Anode voltage	4.0	5.0	6.0	7.0	kV
Screen voltage	1.25	1.25	1.25	1.25	kV
Grid voltage	−270	−280	−310	−325	V
Peak a.f. voltage, grid to grid	250	240	270	235	V
Anode current (zero signal)	1.25	1.00	0.83	0.70	A
Anode current (max. signal)	5.10	4.40	4.25	3.65	A
Screen current (zero signal)	0	0	0	0	A
Screen current (max. signal)	0.35	0.33	0.30	0.24	A
Anode dissipation (maximum signal)	4.2	4.2	4.2	4.2	kW
Effective load (anode to anode)	1.5	2.37	2.94	4.10	kΩ
Nominal driving power (maximum signal)	0	0	0	0	W
Output power (max. signal)	11.5	13.5	17	17.5	kW

RADIO FREQUENCY LINEAR AMPLIFIER

(Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.5	kV max
Anode current	4.0	A max
Anode dissipation	6.0	kW max
Screen voltage	1.5	kV max
Screen dissipation	250	W max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS

(Peak envelope or modulation crest conditions, below 30MHz)

Anode voltage	7.5	kV
Screen voltage	1.25	kV
Grid voltage (see note 3)	−300	V
Peak r.f. grid voltage	300	V
Anode current (zero signal)	0.5	A
Anode current (maximum signal)	1.9	A
Screen current (maximum signal)	0.2	A
Anode dissipation	4.2	kW
Nominal driving power	0	W
Output power (see note 4)	10	kW

SCREEN MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.5	kV max
Anode current	3.0	A max
Anode dissipation	5.0	kW max
Screen voltage	750	V max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS (below 30MHz)

Anode voltage	7.5	7.5	kV
Screen voltage	350	350	V
Grid voltage	−300	−300	V
Peak a.f. screen voltage for 100% modulation	550	550	V
Peak r.f. grid voltage	350	375	V
Anode current	0.9	1.14	A
Screen current (see note 5)	−10	−10	mA
Grid current	15	30	mA
Anode dissipation	4.0	5.0	kW
Effective load	2.0	1.6	kΩ
Nominal driving power	7.0	11	W
Output power	2.75	3.55	kW

ANODE MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.0	kV max
Anode current	2.5	A max
Anode dissipation (see note 6)	3.5	kW max
Screen voltage	1.0	kV max
Screen dissipation	250	W max
Grid dissipation	75	W max

TYPICAL OPERATING CONDITIONS (below 30MHz)

Anode voltage	5.0	kV
Screen voltage	500	V
Grid voltage	−400	V
Peak a.f. voltage (for 100% modulation)	450	V
Peak r.f. grid voltage	520	V
Anode current	1.4	A
Screen current	0.26	A
Grid current	0.05	A
Anode dissipation	1.1	kW
Nominal driving power	25	W
Output power	5.8	kW

R.F. POWER AMPLIFIER OR OSCILLATOR

(Class C Telegraphy, key down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

	Up to 30MHz	30–60MHz	60–110MHz	
Anode voltage	7.5	7.0	6.5	kV max
Anode current	3.0	2.8	2.6	A max
Anode dissipation	5.0	5.0	5.0	kW max
Screen voltage	1.5	1.5	1.5	kV max
Screen dissipation	250	250	250	W max
Grid dissipation	75	75	75	W max

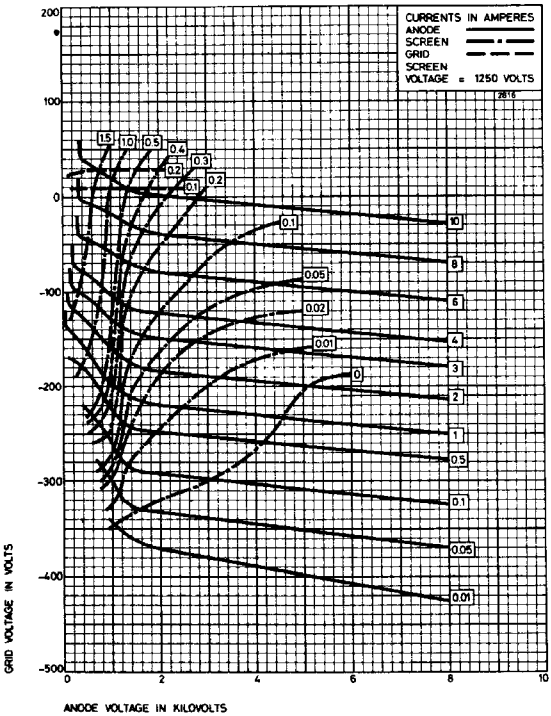
TYPICAL OPERATING CONDITIONS

	Up to 30MHz	88–108MHz	
Anode voltage	7.5	6.5	kV
Screen voltage	500	750	V
Grid voltage	−350	−350	V
Peak r.f. grid voltage	590	–	V
Anode current	2.8	2.3	A
Screen current	0.5	0.2	A
Grid current	0.25	0.05	A
Anode dissipation	5.0	–	kW
Nominal driving power	150	25	W
Output power	16	10	kW

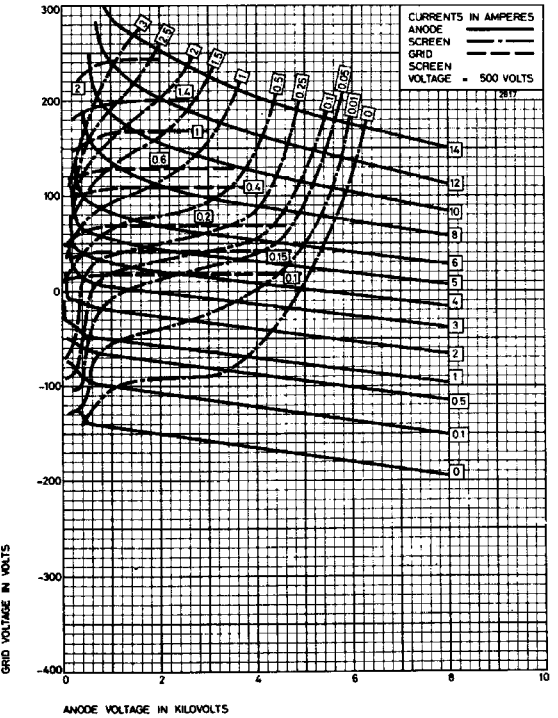
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed ±5%.
2. Grid current does not flow during any part of the audio frequency cycle.
3. The grid voltage is adjusted to obtain the specified zero-signal anode current.
4. The peak envelope or r.f. output power at the crest of the modulation envelope.
5. The screen current is a function of the loading; values from −20mA to +20mA may be considered typical at carrier level.
6. This corresponds to 5.0kW anode dissipation at 100% sine wave modulation.

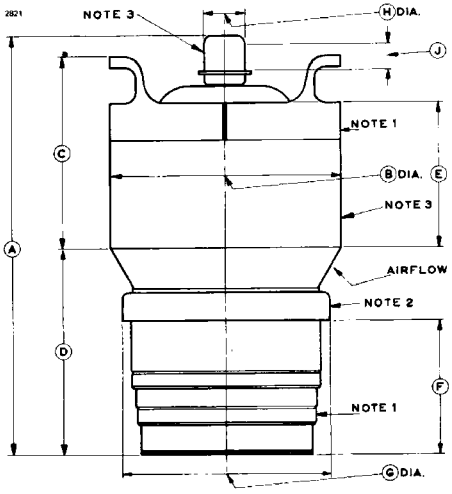
TYPICAL CONSTANT CURRENT CHARACTERISTICS



TYPICAL CONSTANT CURRENT CHARACTERISTICS



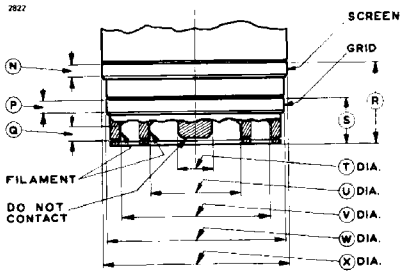
OUTLINE



Ref	Inches	Millimetres
A	8.875 ± 0.250	225.4 ± 6.4
B	4.875 ± 0.062	123.8 ± 1.6
C	4.062 ± 0.188	103.2 ± 4.8
D	4.375 ± 0.188	111.1 ± 4.8
E	3.062 ± 0.188	77.77 ± 4.80
F	2.750 ± 0.188	69.85 ± 4.80
G	4.425 max	112.4 max
H	0.875 ± 0.020	22.23 ± 0.51
J	0.375 min	9.53 min

Millimetre dimensions have been derived from inches.

OUTLINE DETAILS



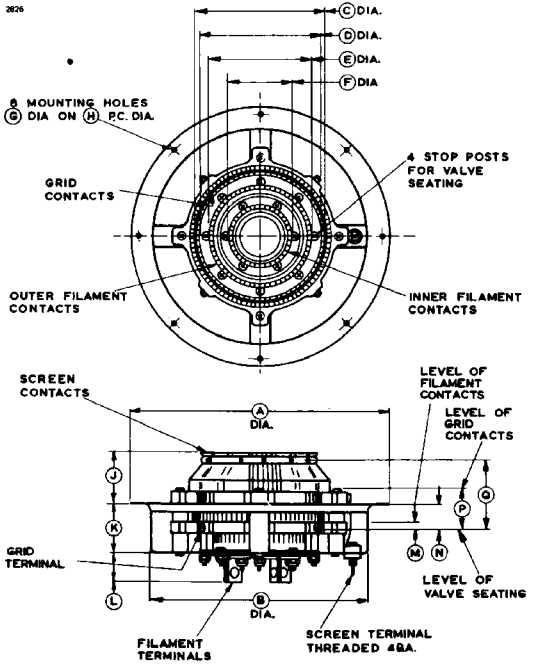
Ref	Inches	Millimetres
N	0.188 min	4.78 min
P	0.188 min	4.78 min
Q	0.188 min	4.78 min
R	1.795 ± 0.031	45.59 ± 0.79
S	1.018 ± 0.032	25.86 ± 0.81
T	0.740 ± 0.020	18.80 ± 0.51
U	1.916 ± 0.020	48.67 ± 0.51
V	3.153 ± 0.020	80.09 ± 0.51
W	3.812 ± 0.020	96.82 ± 0.51
X	4.000 ± 0.020	101.6 ± 0.5

Millimetre dimensions have been derived from inches.

Outline Notes

1. The eccentricity of the screen and filament contact surfaces will not exceed 0.040 inch (1.02mm) with respect to the anode and control grid contact surfaces when the valve is rotated on rollers at the points indicated by the arrows.
2. This surface must not be used as an electrical contact and it must not be clamped in any way.
3. This surface may be used for making electrical contact to the anode.

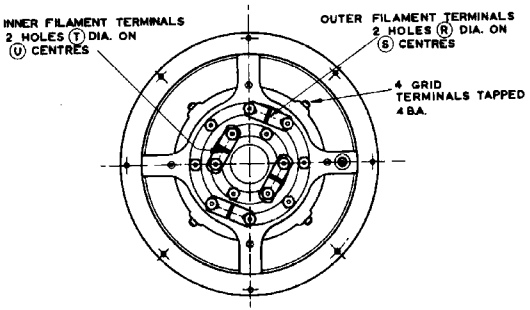
OUTLINE OF AIR DISTRIBUTION SOCKET MA87



OUTLINE DETAIL OF MA87

View from underside showing terminals

2827

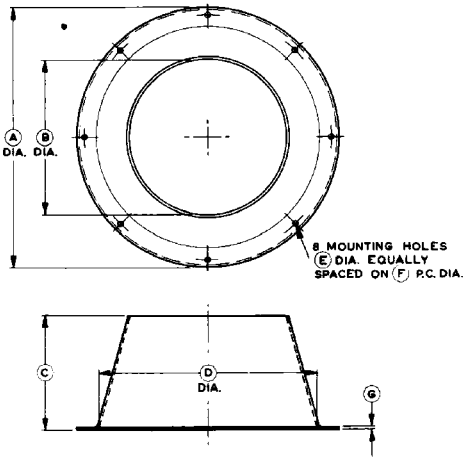


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	8.266 max	210.0 max	L	0.894 ± 0.031	22.71 ± 0.79
B	6.766 max	171.9 max	M	0.228 ± 0.012	5.79 ± 0.30
C	3.910 ± 0.030	99.31 ± 0.76	N	0.672 ± 0.017	17.07 ± 0.43
D	3.702 ± 0.030	94.03 ± 0.76	P	0.841 ± 0.015	21.36 ± 0.38
E	3.281 ± 0.030	83.34 ± 0.76	Q	1.626 ± 0.031	41.30 ± 0.79
F	2.031 ± 0.030	51.59 ± 0.76	R	0.250 ± 0.015	6.35 ± 0.38
G	0.147	3.73	S	1.562 ± 0.015	39.67 ± 0.38
H	7.750	196.9	T	0.250 ± 0.015	6.35 ± 0.38
J	1.125 ± 0.015	28.58 ± 0.38	U	0.937 ± 0.015	23.80 ± 0.38
K	1.489 ± 0.028	37.82 ± 0.71			

Millimetre dimensions have been derived from inches.

OUTLINE OF AIR CHIMNEY MA104
(All dimensions without limits are nominal)

2828



Ref	Inches	Millimetres
A	8.250	209.6
B	$4.891^{+0.062}_{-0.000}$	$124.2^{+1.57}_{-0.00}$
C	3.437	87.30
D	6.750	171.5
E	0.157	4.00
F	7.750	196.8
G	0.062	1.57

Millimetre dimensions have been derived from inches except dimension E.

4D32

R.F. POWER TETRODE

Service Type CV3543

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

Beam power transmitting tetrode

Anode dissipation	50	W max
Anode voltage	750	V max
Frequency for full ratings	60	MHz max
Output power (class C unmodulated)	140	W

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	3.75	A
Peak usable cathode current	2	A
Grid-screen amplification factor	10	
Inter-electrode capacitances:		
input	26	pF
output	13	pF
grid to anode	0.4	pF max

Mechanical

Overall length	5.750 inches (146mm) max
Overall diameter	2.312 inches (58.7mm) max
Net weight	6 ounces (170g) approx
Mounting position	any
Base	B.S.448-B7A
Cooling	natural

ANODE AND SCREEN MODULATED R.F. POWER AMPLIFIER

(Class C telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	600	V max
Screen voltage	350	V max
Grid voltage	−200	V max
Anode current	300	mA max
Grid current	15	mA max
Anode dissipation	50	W max
Screen dissipation	10	W max
Grid dissipation	0.75	W max
Frequency (for full ratings)	60	MHz max

TYPICAL OPERATING CONDITIONS

Anode voltage	600	V
Screen series resistor	10 000	Ω
Grid voltage	−100	V
Anode current	220	mA
Screen current (approx)	28	mA
Grid current (approx)	10	mA
Driving power (approx)	1.25	W
Output power (approx)	100	W

R.F. POWER AMPLIFIER AND OSCILLATOR

(Class C telegraphy, key-down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	750	V max
Screen voltage	350	V max
Grid voltage	−200	V max
Anode current	300	mA max
Grid current	15	mA max
Anode dissipation	50	W max
Screen dissipation	14	W max
Grid dissipation	0.75	W max
Frequency (for full ratings)	60	MHz max

TYPICAL OPERATING CONDITIONS

Anode voltage	750	V
Screen voltage	300	V
Grid voltage	−100	V
Anode current	250	mA
Screen current (approx)	34	mA
Grid current (approx)	12	mA
Anode dissipation	47	W
Screen dissipation	10	W
Peak r.f. voltage	119	V
Driving power (approx)	1.5	W
Output power	140	W
Efficiency	75	%

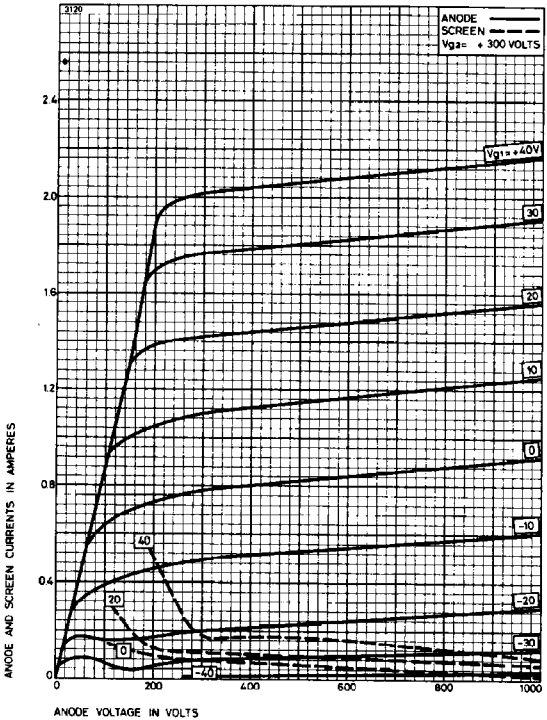
AUDIO FREQUENCY POWER AMPLIFIER (Class AB_1 and AB_2)

TYPICAL OPERATING CONDITIONS

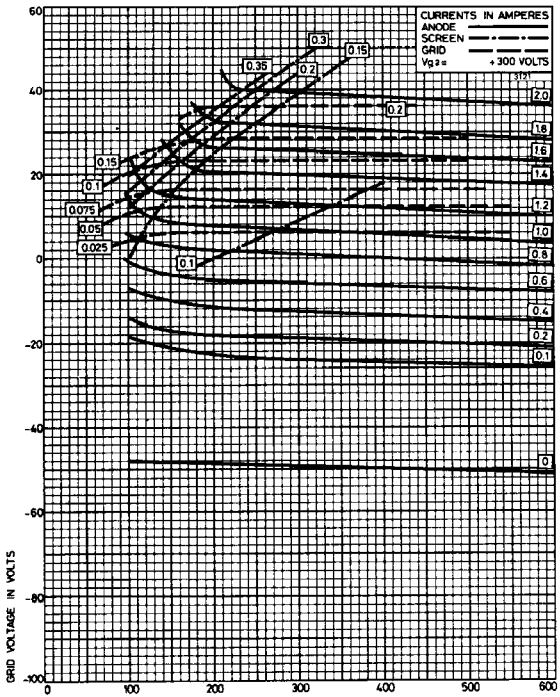
(Values are for 2 valves in push-pull unless otherwise stated)

Anode voltage	600	600	V
Grid voltage	−37.5	−25	V
Screen voltage	350	250	V
Peak a.f. input voltage (grid to grid)	74	70	V
Maximum-signal anode current	350	365	mA
Zero-signal anode current	100	100	mA
Maximum-signal screen current	46	26	mA
Effective load (anode to anode)	3000	3000	Ω
Driving power (maximum-signal, approx)	0	0.45	W
Output power (maximum-signal, approx)	112	125	W
Anode dissipation (per valve, approx)	49	47	W
Screen dissipation (per valve, approx)	8	3	W

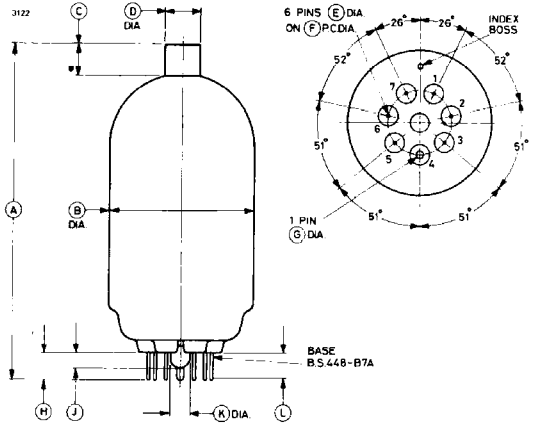
TYPICAL ANODE AND SCREEN CHARACTERISTICS



TYPICAL CONSTANT CURRENT CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimètres
A	5.250 ± 0.500	133.4 ± 12.7
B	2.312 max	58.72 max
C	0.500	12.70
D	0.566	14.38
E	$0.058^{+0.002}_{-0.006}$	$1.473^{+0.051}_{-0.152}$
F	1.000	25.40
G	0.125 ± 0.003	3.175 ± 0.076
H	0.438 ± 0.062	11.13 ± 1.57
J	0.375 max	9.53 max
K	0.375 max	9.53 max
L	0.312 min	7.92 min

Millimètre dimensions have been derived from inches.

Pin	Element
1	Heater
2	Screen
3	No connection
4	Cathode and beam plates
5	Cathode and beam plates
6	Grid
7	Heater
Cap	Anode

4J31-4J35 inclusive

S-BAND MAGNETRONS

Service Types CV1914, CV1916, CV1897, CV1898, CV2744

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
4J31 (CV1914)	2860 to 2900	MHz
4J32	2820 to 2860	MHz
4J33 (CV1916)	2780 to 2820	MHz
4J34 (CV1897)	2740 to 2780	MHz
CV2744 (selected 4J34)	2740 to 2765	MHz
4J35 (CV1898)	2700 to 2740	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any
Cooling (see note 6)	forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	13	10.5	V
Magnetic field (see note 8)	2150	2700	gauss
Anode current (peak)	56	70	A
Pulse length	1.0	1.0	μs
Pulse repetition rate	500	500	p.p.s.

Typical Performance

Anode voltage (peak)	22	28	kV
Output power (peak)	600	1000	kW
Output power (mean)	300	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	—	—	kV
Output power (mean)	400	—	—	—	W
Frequency:					
4J31 (CV1914)	2860	2900	—	—	MHz
4J32	2820	2860	—	—	MHz
4J33 (CV1916)	2780	2820	—	—	MHz
4J34 (CV1897)	2740	2780	—	—	MHz
CV2744*	2740	2765	—	—	MHz
4J35 (CV1898)	2700	2740	—	—	MHz
R.F. bandwidth at ¼ power	—	2.5	—	—	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	—	15	—	—	MHz
Stability (see note 9)	—	0.5	—	0.5	%
Heater current					see note 10
Temperature coefficient of frequency					see note 11

* Selected 4J34 with limited frequency band.

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

   The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   (b) The 4J31–4J35 types have hum-free heaters and have been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $Pi = i_{apk} \times v_{apk} \times Du$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of 45lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

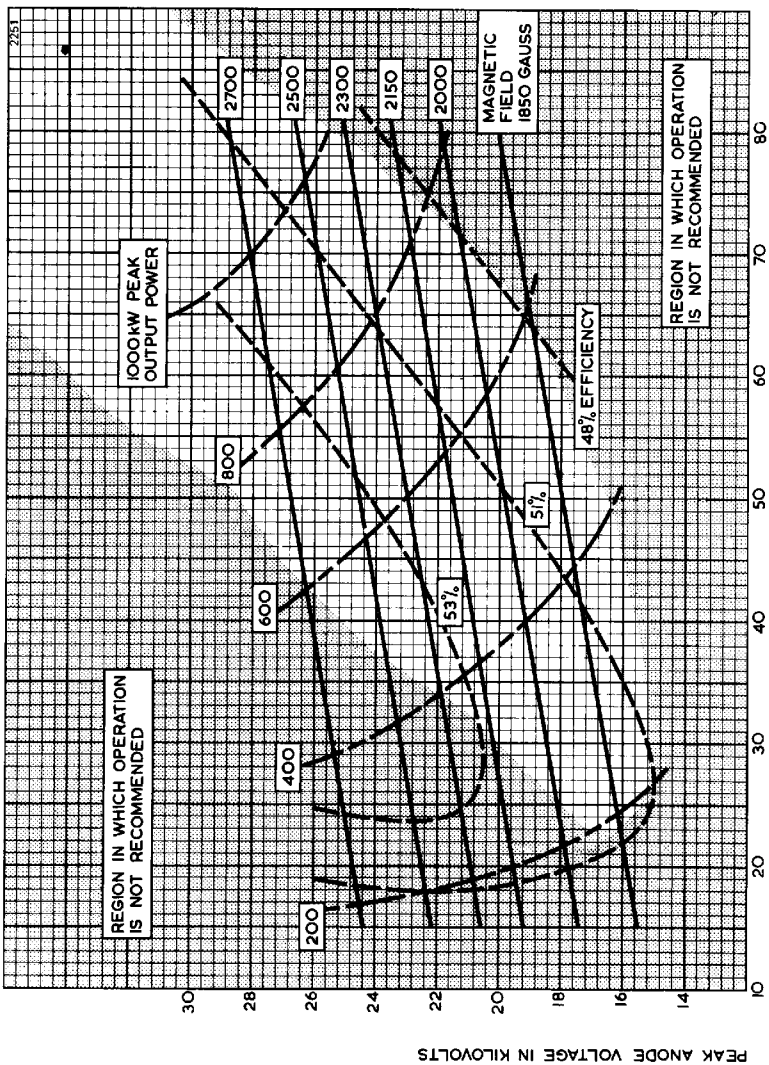
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

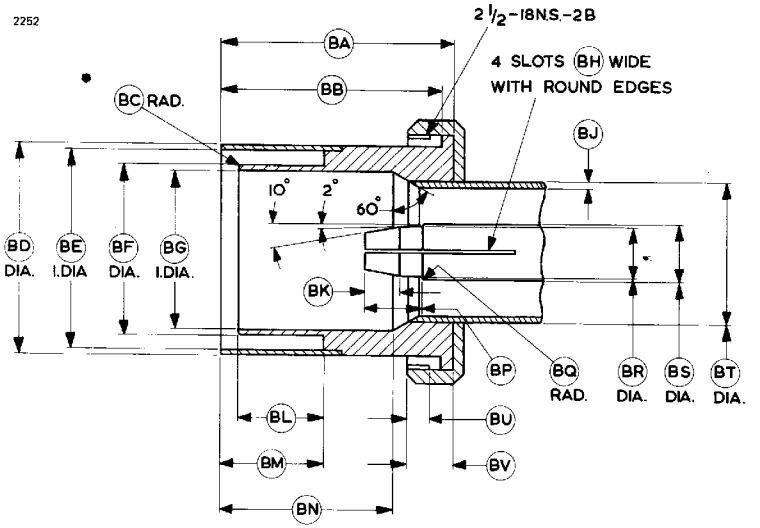
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07MHz/°C.

PERFORMANCE CHART



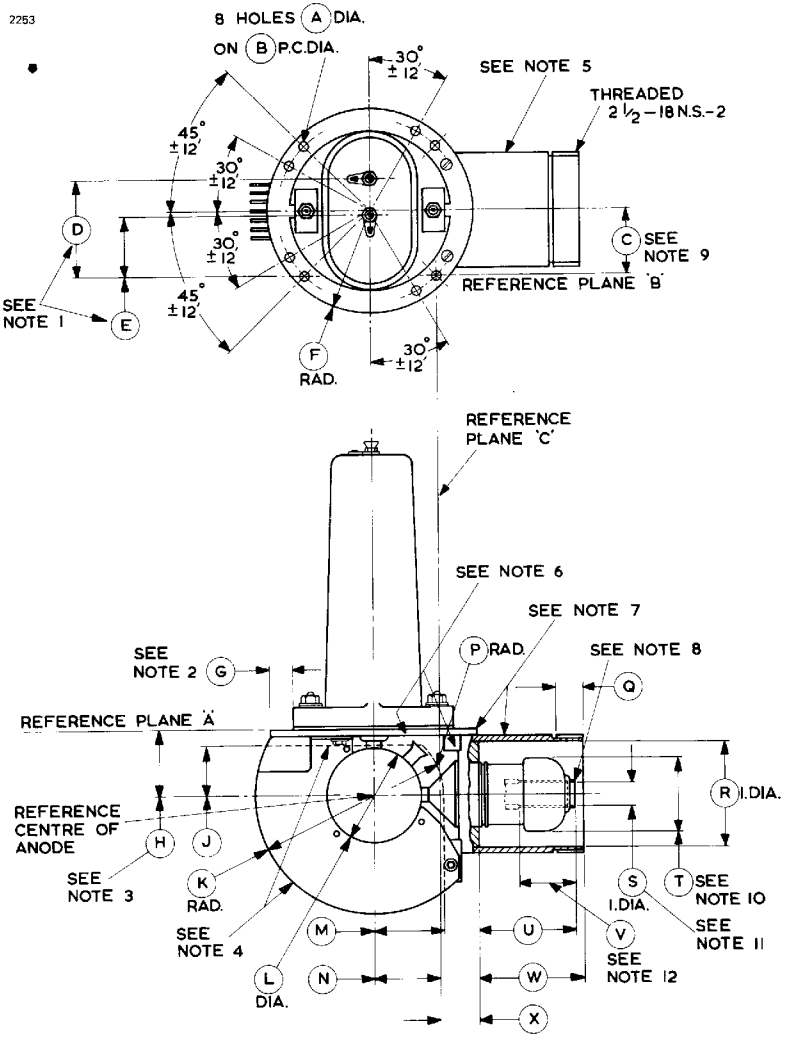
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE (See page 10 for outline notes)

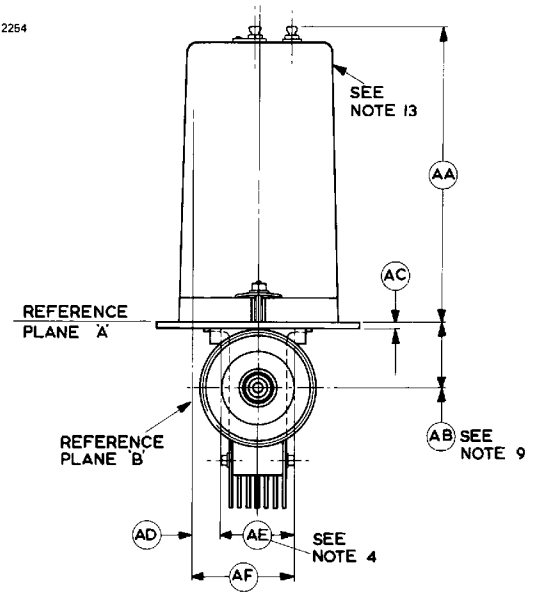


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

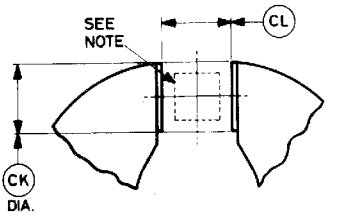
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION

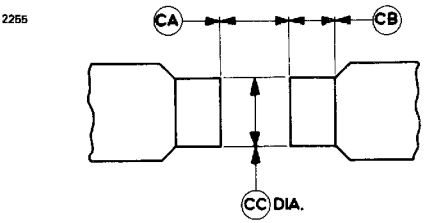


Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES



Ref	Inches	Millimetres
CA	$1.500^{+0.005}_{-0.000}$	$38.10^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

5557

MERCURY VAPOUR THYRATRON

Service Type CV2957

To be read in conjunction with the Rectifier and Thyratron Preamble.

ABRIDGED DATA

Mercury vapour thyratron for industrial control applications

Peak forward anode voltage	2.5	kV max
Peak inverse anode voltage	5.0	kV max
Peak anode current	2.0	A max
Mean anode current	0.5	A max

GENERAL

Electrical

Filament		oxide coated
Filament voltage	2.5	V
Filament current	5.0	A
Filament pre-heating time (minimum)	10	s
Inter-electrode capacitances:		
grid to anode	4.0	pF
grid to filament	8.0	pF

Mechanical

Overall length	6.250 inches (158.8mm) max
Overall diameter	2.156 inches (54.76mm) max
Net weight	3 ounces (85g) approx
Mounting position	vertical, base down
Base	B.S.448-B4G
Top cap	B.S.448-CT3

Cooling natural

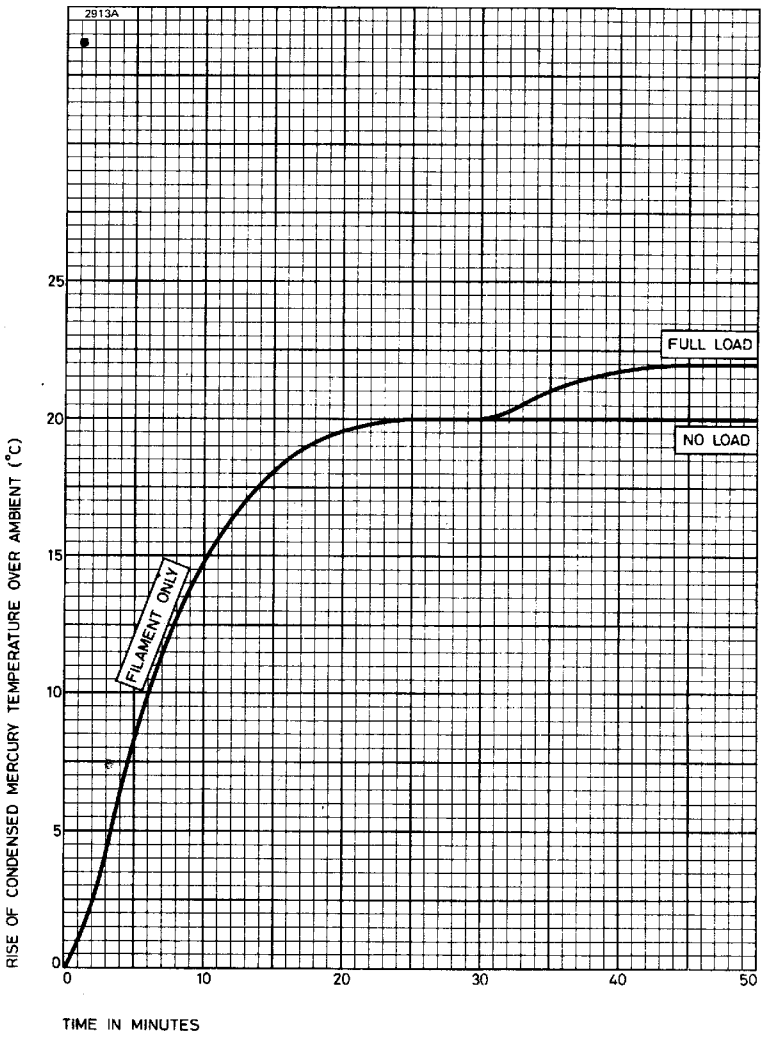
CHARACTERISTICS

Voltage drop	16	V approx
Ionization time	10	μs approx
Recovery time	1.0	ms approx
Condensed mercury temperature rise:		
at no load	20	°C approx
at full load	22	°C approx

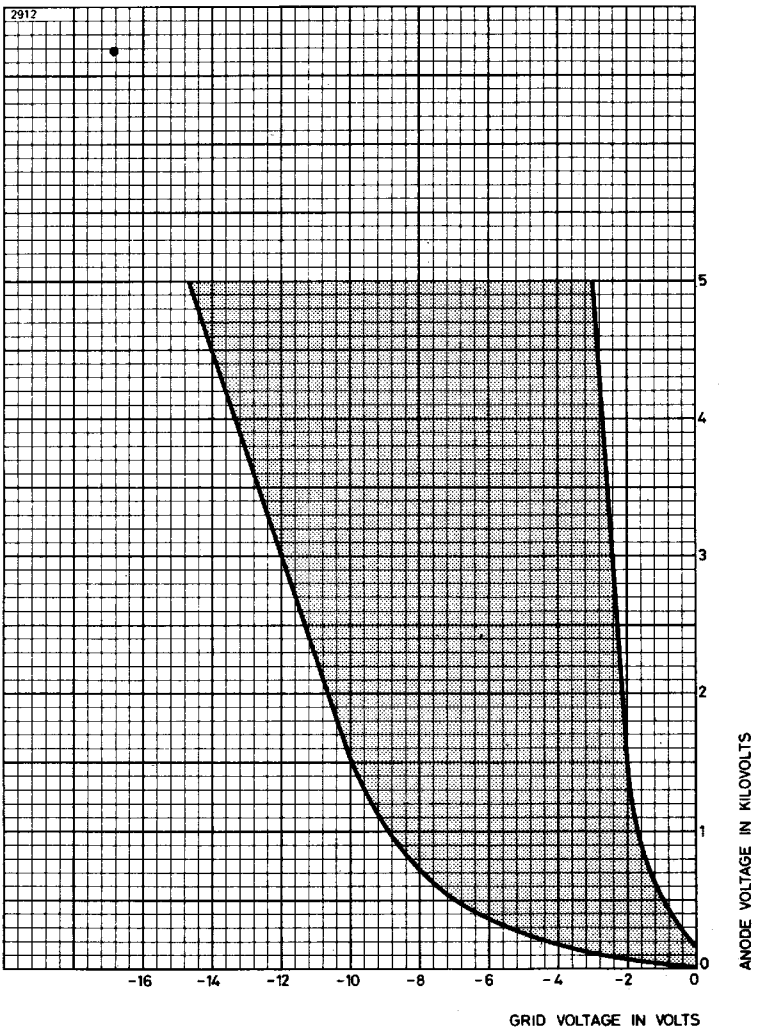
MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Peak forward anode voltage	–	2.5	kV
Peak inverse anode voltage	–	5.0	kV
Peak anode current	–	2.0	A
Mean anode current (averaging time 15s max)	–	0.5	A
Fault anode current (peak)	–	40	A
Duration of fault current	–	0.1	s
Condensed mercury temperature	40	80	°C
Negative grid voltage:			
before conduction	–	500	V
during conduction	–	10	V
Mean grid current	–	50	mA
Recommended grid resistor	10	100	kΩ
Filament pre-heating time	10	–	s
Power supply frequency	–	150	Hz

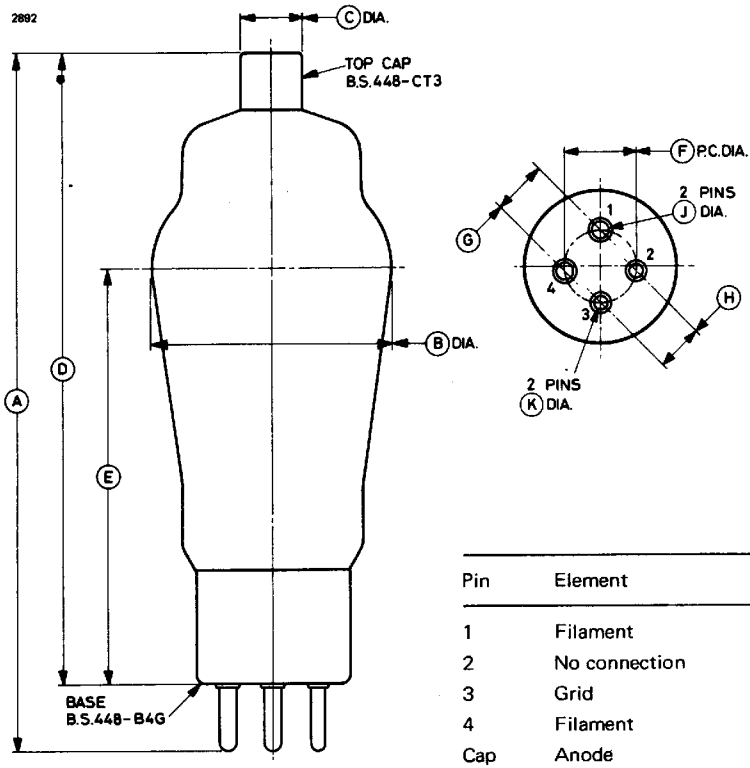
TYPICAL HEATING CHARACTERISTIC



CONTROL CHARACTERISTIC



OUTLINE (All dimensions without limits are nominal)



Pin	Element
1	Filament
2	No connection
3	Grid
4	Filament
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	6.250 max	158.8 max	F	0.640	16.26
B	2.125 ± 0.031	53.98 ± 0.79	G	0.468	11.89
C	0.566	14.38	H	0.437	11.10
D	5.625 ± 0.250	142.9 ± 6.4	J	0.156	3.96
E	3.625	92.08	K	0.125	3.18

Millimetre dimensions have been derived from inches.

5559

MERCURY VAPOUR THYRATRON

Service Type CV5027

To be read in conjunction with the Rectifier and Thyratron Preamble.

ABRIDGED DATA

Mercury vapour thyratron for industrial control or ignitor firing applications.

Peak forward anode voltage	1.0	kV max
Peak inverse anode voltage	1.5	kV max
Peak anode current	15	A max
Mean anode current	2.5	A max

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	5.0	V
Heater current (average)	4.7	A
Cathode pre-heating time (minimum)	5.0	min
Inter-electrode capacitances:		
grid to anode	3.0	pF
grid to cathode	6.0	pF

Mechanical

Overall length	184mm (7.244 inches) max
Overall diameter	65mm (2.559 inches) max
Net weight	5 ounces (140g) approx
Mounting position	vertical, base down
Base	B.S.448-B4G (USM4B)
Top cap	B.S.448-CT3

Cooling . . . . . natural

MAXIMUM AND MINIMUM RATINGS

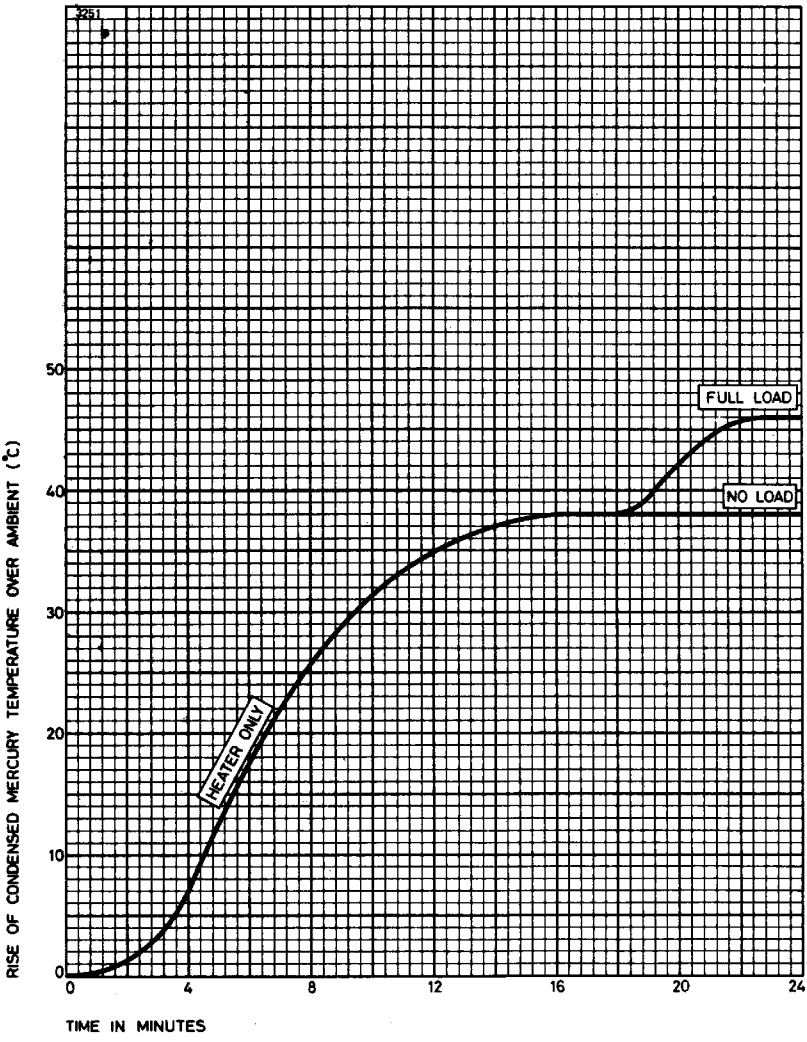
	Min	Max	
Peak forward anode voltage	–	1.0	kV
Peak inverse anode voltage	–	1.5	kV
Peak anode current (see note)	–	15	A
Mean anode current (averaging time 15s max)	–	2.5	A
Fault anode current (peak)	–	200	A
Duration of fault current	–	0.1	s
Condensed mercury temperature	40	80	°C
Negative grid voltage:			
before conduction	–	500	V
during conduction	–	10	V
Mean grid current	–	250	mA
Recommended grid resistor	10	100	kΩ
Cathode pre-heating time	5.0	–	min

CHARACTERISTICS

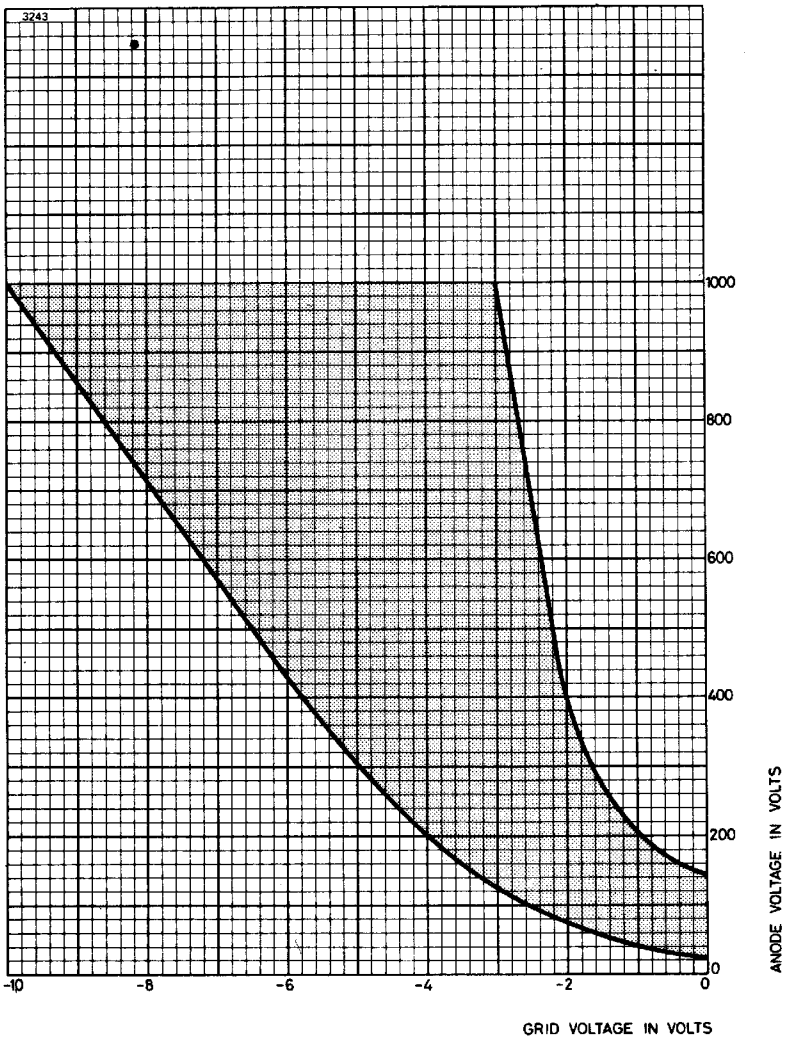
Voltage drop	16	V approx
Ionization time	10	μs approx
Recovery time	1.0	ms approx
Condensed mercury temperature rise:		
at no load	38	°C approx
at full load	46	°C approx

Note For ignitor firing service, the peak anode current rating is 40A max.

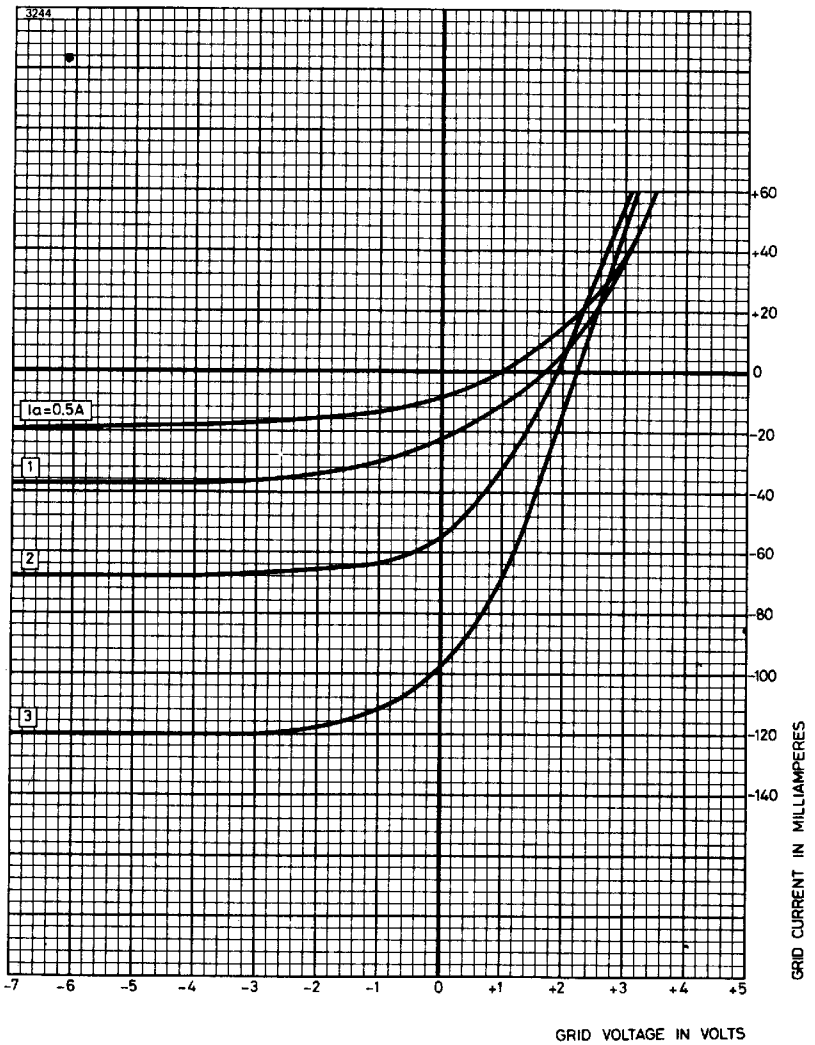
TYPICAL HEATING CHARACTERISTIC



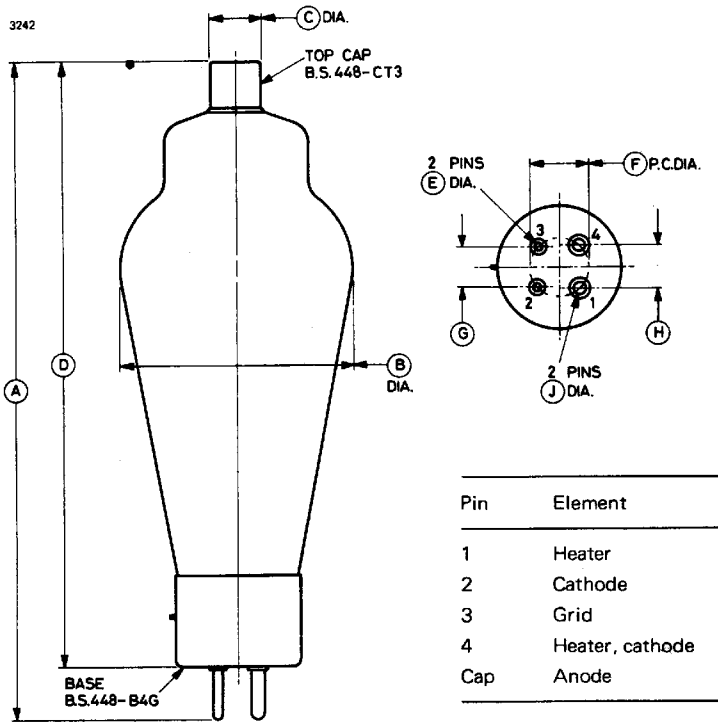
CONTROL CHARACTERISTIC



TYPICAL GRID CURRENT CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)



Pin	Element
1	Heater
2	Cathode
3	Grid
4	Heater, cathode
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	7.244 max	184.0 max	F	0.640	16.26
B*	2.559 max	65.0 max	G	0.437	11.10
C	0.566	14.38	H	0.468	11.89
D*	6.654 max	169.0 max	J	0.156	3.96
E	0.125	3.18			

Millimetre dimensions have been derived from inches except where marked*

5762
(BR191B)

R.F. POWER TRIODE

Service Type CV2383, CV5289

The data should be read in conjunction with the Power Triode Preamble.

ABRIDGED DATA

Forced-air cooled r.f. transmitting triode

Anode dissipation	4.0	kW max
Anode voltage	6.2	kV max
Frequency for full ratings	30	MHz max
Frequency at reduced ratings	220	MHz max
Output power (class C telegraphy)	6.0	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1):		
at frequencies up to 70MHz	12.6	V
at frequencies above 70MHz	11.8	V
Filament current	29	A
Surge filament current (peak) (see note 2)	175	A max
Filament cold resistance	52	mΩ
Peak usable cathode current	10	A
Amplification factor	29	
Inter-electrode capacitances:		
grid to anode	18.5	pF
grid to filament	19	pF
anode to filament	0.5	pF

Mechanical

Overall length (excluding flexible leads)	180mm (7.09 inches) max
Overall diameter	119mm (4.69 inches) max
Net weight	7 pounds (3.2kg) approx
Mounting position	vertical, either way up

February 1970

COOLING

Anode

The air cooling requirements are shown on page 11. The required air flow should be delivered through the radiator immediately before and during the application of any voltages. Filament power, anode power and air flow may be removed simultaneously.

The inlet air temperature must not exceed 45°C and the radiator temperature, measured on the core at the end opposite to the incoming air, must not exceed 180°C.

Filament and Grid Seals

The temperature of the filament and grid seals must not exceed 180°C. A flow of air of 10ft^3/min (0.28m^3/min) directed into the filament header via a 1-inch (25mm approx) diameter nozzle before and during the application of any voltages is usually adequate for limiting the temperature of these seals.

Anode Seal and Bulb

The anode seal and bulb temperatures must not exceed 180°C.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class B)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.2	kV max
Anode current	1.5	A max
Anode input power	8.7	kW max
Anode dissipation	4.0	kW max

TYPICAL OPERATING CONDITIONS (Class B, 2 valves)

Anode voltage	4.7	kV
Grid voltage	−200	V
Peak a.f. input voltage (grid to grid)	900	V
Maximum-signal anode current	2 x 1.4	A
Zero-signal anode current	2 x 0.15	A
Effective load (anode to anode)	3640	Ω
Drive power	195	W
Output power	8.8	kW

R.F. POWER AMPLIFIER
CLASS B TELEVISION SERVICE U.S.A. SYSTEM
(Synchronising level conditions unless otherwise stated)

MAXIMUM RATINGS (Absolute values)

	54 to 216MHz	
Anode voltage	4.5	kV max
Anode current	2.0	A max
Grid current (pedestal level)	0.325	A max
Anode input power	9.0	kW max
Anode dissipation	4.0	kW max

TYPICAL OPERATION IN GROUNDED-GRID CIRCUIT

Bandwidth	10	8.5	MHz
Anode voltage	3.0	3.2	kV
Grid voltage	−105	−110	V
Peak r.f. grid drive voltage:			
synchronising level	380	435	V
pedestal level	290	310	V
Anode current:			
synchronising level	1.8	1.8	A
pedestal level	1.36	1.35	A
Grid current:			
synchronising level	0.265	0.4	A
pedestal level	0.115	0.130	A
Driving power (see note 3):			
synchronising level	625	770	W
Output power:			
synchronising level	3.150	4.0	kW
pedestal level	1.8	2.3	kW

GRID MODULATED R.F. POWER AMPLIFIER
CLASS C TELEVISION SERVICE – U.S.A. SYSTEM
(Synchronising level conditions unless otherwise stated)

MAXIMUM RATINGS (Absolute values)

	54 to 216MHz	
Anode voltage	3.7	kV max
Grid voltage (white level)	–800	V max
Anode current	1.9	A max
Grid current (pedestal level)	0.225	A max
Anode input power	6.5	kW max
Anode dissipation	4.0	kW max

TYPICAL OPERATION IN GROUNDED-GRID CIRCUIT

Bandwidth	8.5	MHz
Anode voltage	3.2	kV
Grid voltage:		
synchronising level	–110	V
pedestal level	–220	V
white level	–520	V
Peak r.f. grid drive voltage	435	V
Anode current:		
synchronising level	1.8	A
pedestal level	1.25	A
Grid current (approx):		
synchronising level	0.40	A
pedestal level	0.13	A
Driving power (see note 3):		
synchronising level	770	W
Output power (approx):		
synchronising level	4.0	kW
pedestal level	2.3	kW

ANODE MODULATED R.F. POWER AMPLIFIER

(Class C telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

	up to 30MHz	at 110MHz	at 220MHz	
Anode voltage	5.0	4.2	3.6	kV max
Grid voltage (negative value)	1.0	1.0	0.6	kV max
Anode current	1.0	1.0	1.0	A max
Grid current	0.3	0.3	0.25	A max
Anode input power	5.0	4.2	3.6	kW max
Anode dissipation	2.7	2.7	2.7	kW max

TYPICAL OPERATION IN GROUNDED-FILAMENT CIRCUIT

	up to 30MHz	at 110MHz	
Anode voltage	4.7	4.0	kV
Grid voltage	−400	−350	V
from grid resistor	1425	1460	Ω
Peak r.f. grid drive voltage (see note 4)	675	600	V
Anode current	0.96	0.93	A
Grid current (approx)	0.28	0.24	A
Driving power (approx)	170	130	W
Output power (approx)	3.7	2.8	kW

TYPICAL OPERATION IN GROUNDED-GRID CIRCUIT

	up to 30MHz	at 110MHz	
Anode voltage	4.7	4.0	kV
Grid voltage	−400	−350	V
from grid resistor	1425	1460	Ω
Peak r.f. grid drive voltage	675	600	V
Anode current	0.96	0.93	A
Grid current (approx)	0.28	0.24	A
Driving power (approx)	720	600	W
Output power (approx)	4.2	3.2	kW

R.F. POWER AMPLIFIER OR OSCILLATOR

(Class C telegraphy – see note 5 – and class C f.m. telephony)

MAXIMUM RATINGS (Absolute values)

	up to 30MHz	at 110MHz	at 220MHz	
Anode voltage	6.2	5.2	4.4	kV max
Grid voltage	−1.0	−1.0	−0.6	kV max
Anode current	1.4	1.4	1.4	A max
Grid current	0.3	0.3	0.25	A max
Anode input power	8.7	7.3	6.2	kW max
Anode dissipation	4.0	4.0	4.0	kW max

TYPICAL OPERATION IN GROUNDED-FILAMENT CIRCUIT

	up to 30MHz	at 110MHz	
Anode voltage	6.0	5.0	kV
Grid voltage	−550	−525	V
from grid resistor	1900	1725	Ω
and cathode resistor	360	340	Ω
Peak r.f. grid drive voltage	875	850	V
Anode current	1.25	1.25	A
Grid current (approx)	0.29	0.29	A
Driving power (approx)	225	225	W
Output power (approx)	6.0	4.8	kW

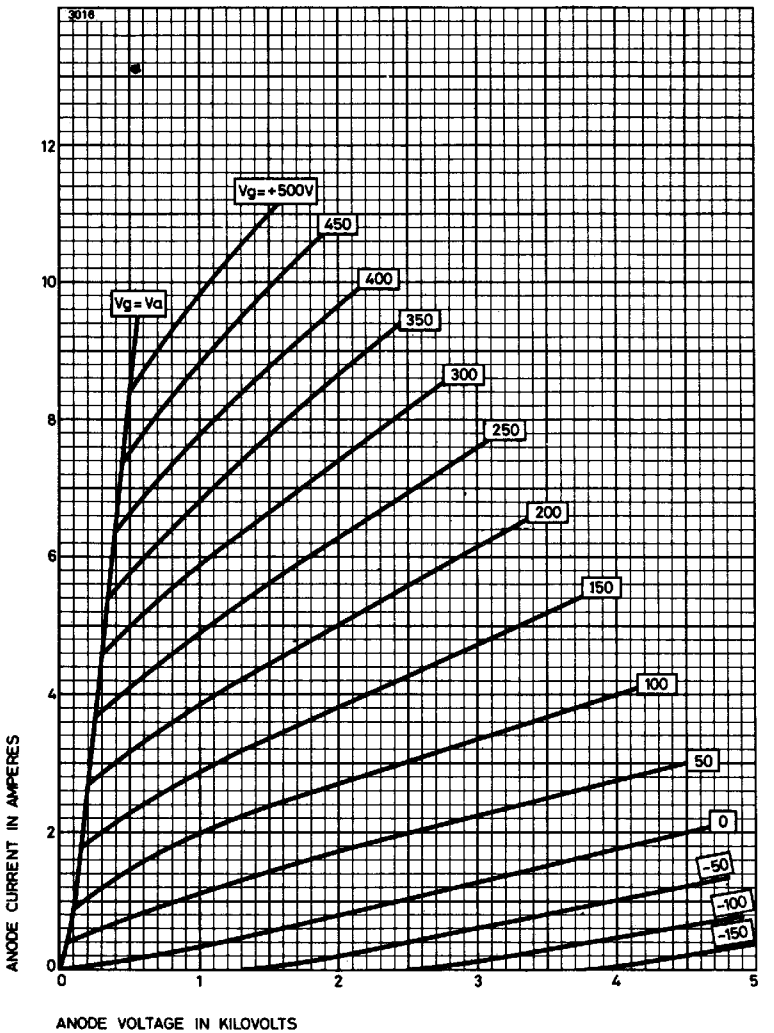
TYPICAL OPERATION IN GROUNDED-GRID CIRCUIT

	up to 30MHz	at 110MHz	at 220MHz	
Anode voltage	6.0	5.0	4.3	kV
Grid voltage	−550	−1000	−200	V
from grid resistor	1900	4100	807	Ω
and cathode resistor	360	740	134	Ω
Peak r.f. grid drive voltage	875	1350	432	V
Anode current	1.25	1.1	1.25	A
Grid current (approx)	0.290	0.245	0.25	A
Driving power (approx)	1225	1680	542	W
Output power (approx)	7.0	5.5	4.0	kW

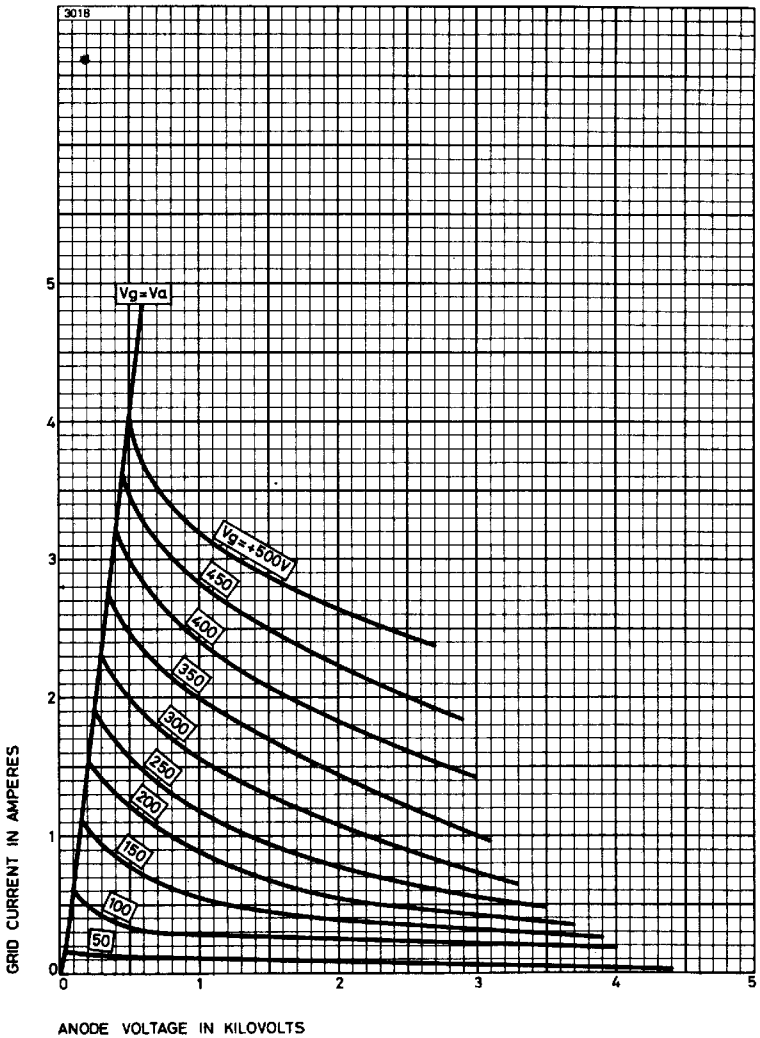
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed ±5%. The centre tap lead may be used for the anode current return but must not be used for the filament current supply.
2. The filament current must not exceed 175A, even momentarily, at any time.
3. Computed value to supply grid losses and feed-through power. Additional power will be required to supply circuit losses.
4. Driver modulated approximately 30%.
5. Key-down conditions per valve without amplitude modulation. Modulation essentially negative may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier conditions.

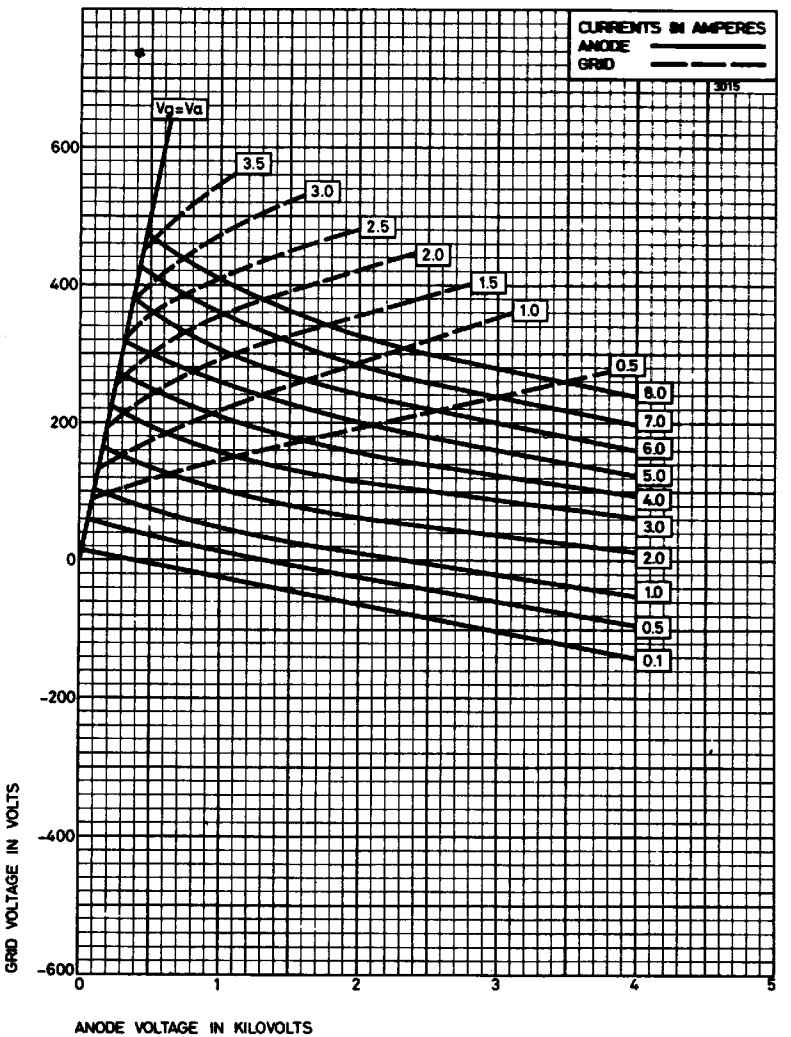
TYPICAL ANODE CHARACTERISTICS



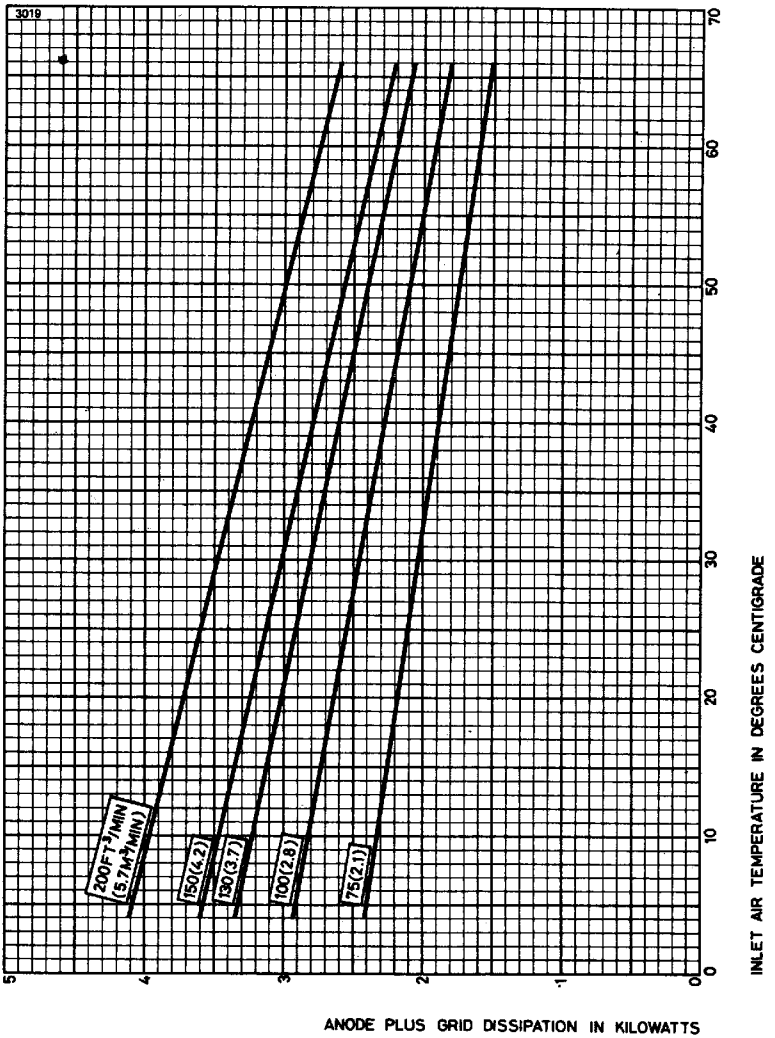
TYPICAL GRID CHARACTERISTICS



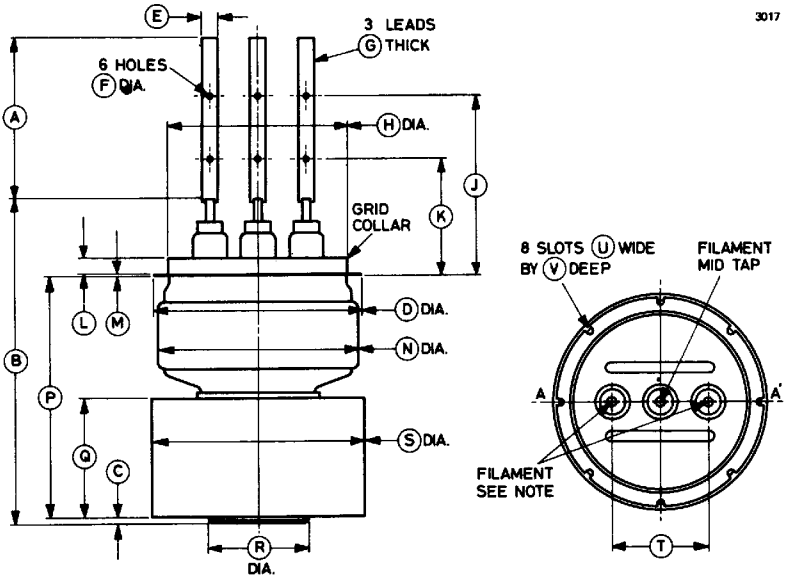
TYPICAL CONSTANT CURRENT CHARACTERISTICS



AIR COOLING REQUIREMENTS



OUTLINE



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	89.0 ± 2.0	3.504 ± 0.079	L	9.5	0.375
B	180.0 max	7.087 max	M	1.5 ± 0.2	0.059 ± 0.008
C	4.75 max	0.187 max	N	116.0 max	4.567 max
D	116.0 ± 0.5	4.567 ± 0.020	P	133.5 ± 3.0	5.256 ± 0.118
E	8.0 ± 0.5	0.315 ± 0.020	Q	70.0 max	2.756 max
F	3.6 ± 0.1	0.142 ± 0.004	R	57.0 max	2.244 max
G	4 x 0.25	4 x 0.010	S	117.5 ± 1.5	4.626 ± 0.059
H	100.0 max	3.937 max	T	54.0 ± 2.5	2.126 ± 0.098
J	100.0 ± 8.0	3.937 ± 0.315	U	4.62 ± 0.10	0.182 ± 0.004
K	65.0 ± 8.0	2.559 ± 0.315	V	5.2 ± 0.2	0.205 ± 0.008

Inch dimensions have been derived from millimetres.

Note The plane of the filament leads will be parallel to plane A-A' to within 3½°.

TUNGAR RECTIFIER

68504

ENGLISH ELECTRIC

INTRODUCTION

The 68504 is a hot cathode, full-wave, gas-filled Rectifier designed for use in low voltage battery charging equipment.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

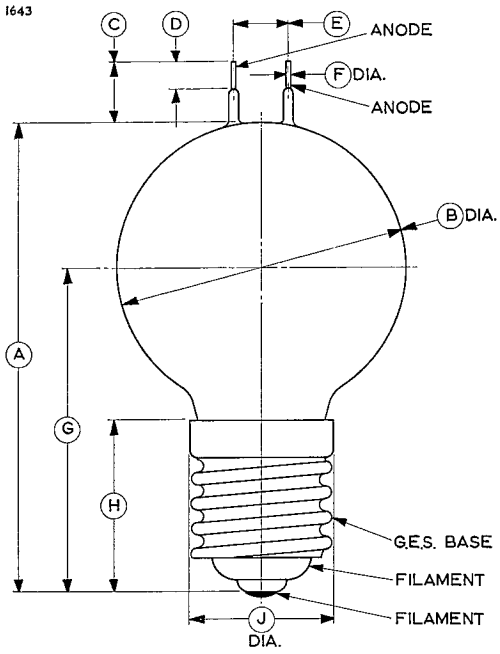
Cathode	Oxide Coated Filament	
Filament Voltage	2·3	V
Filament Current	18±2	A
Cathode Heating Time (Minimum)	30	s
Voltage Drop (Approx)	10	V
Ambient Temperature Range	−55 to +70	°C
D.C. Output as Full-Wave Rectifier:		
Voltage	30	V Max
Current	5·0	A Max

Mechanical

Overall Length	5·71 inches	(145 mm)	Max
Overall Diameter	3·03 inches	(77 mm)	Max
Net Weight	4 ounces	(112 gm)	Approx
Mounting Position			Any
Base			Goliath Edison Screw
Cooling			Convection

ENGLISH ELECTRIC

OUTLINE



Ref.	Inches	Millimetres
A	4·528±0·394	115·0±10·0
B	3·032 Max	77·0 Max
C	0·472±0·197	12·0±5·0
D	0·276 Min	7·0 Min
E	0·492±0·098	12·5±2·5
F	0·059	1·5
G	3·465±0·394	88·0±10·0
H	1·811 Max	46·0 Max
J	1·543 Max	39·2 Max

Inch dimensions have been derived from millimetres.

Mercury Vapour Rectifiers

June 1965

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

MERCURY VAPOUR RECTIFIER

869B

American Designation 869B

INTRODUCTION

The 869B is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 10A peak current. It will provide a d.c. output of 19kV 7·5A in a three phase full wave circuit.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated
Filament Voltage	5·0 V
Filament Current	19 A
Filament Heating Time	1 Minute
Condensed Mercury Temperature	(*See page* 2)
Maximum Peak Inverse Voltage	(*See page* 2)
Maximum Anode Current:	
Peak	(*See page* 2)
Mean (30 secs Max averaging time)	(*See page* 2)
Under fault conditions (0·1 second Max duration)	100 A

Mechanical

Overall Length	14·44 inches (366·7 mm)	Max
Overall Diameter	5·125 inches (130·2 mm)	Max
Net Weight	1¾ pounds (800 gm)	Approx
Mounting Position		Vertical, base down
Cap		JEDEC No. C1-9
Base	3-Pin Jumbo (JEDEC No. A3-20)	

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

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ENGLISH ELECTRIC

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	20	10	2·5	7·0	6·3	5·0
		30–50	15	10	2·5	5·3	4·7	5·0
		30–60	10	10	2·5	3·5	3·1	5·0
Single Phase Full Wave Bridge	B	30–40	20	10	2·5	14·0	12·6	5·0
		30–50	15	10	2·5	10·6	9·5	5·0
		30–60	10	10	2·5	7·0	6·3	5·0
Three Phase Half Wave	C	30–40	20	10	2·5	8·1†	9·5†	7·5
		30–50	15	10	2·5	6·1†	7·1†	7·5
		30–60	10	10	2·5	4·1†	4·7†	7·5
Three Phase Full Wave	D§	30–40	20	10	2·5	8·1	19·0	7·5
		30–50	15	20	5	6·1	14·2	15·0
		30–60	10	20	5	4·1	9·5	15·0

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The d.c. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 30 seconds maximum.

§With filament and anode supplies out of phase (60°–120°).

X-RAY WARNING

X-rays are produced when the 869B is operated with a peak inverse anode voltage above 16kV (absolute value). These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the valve.

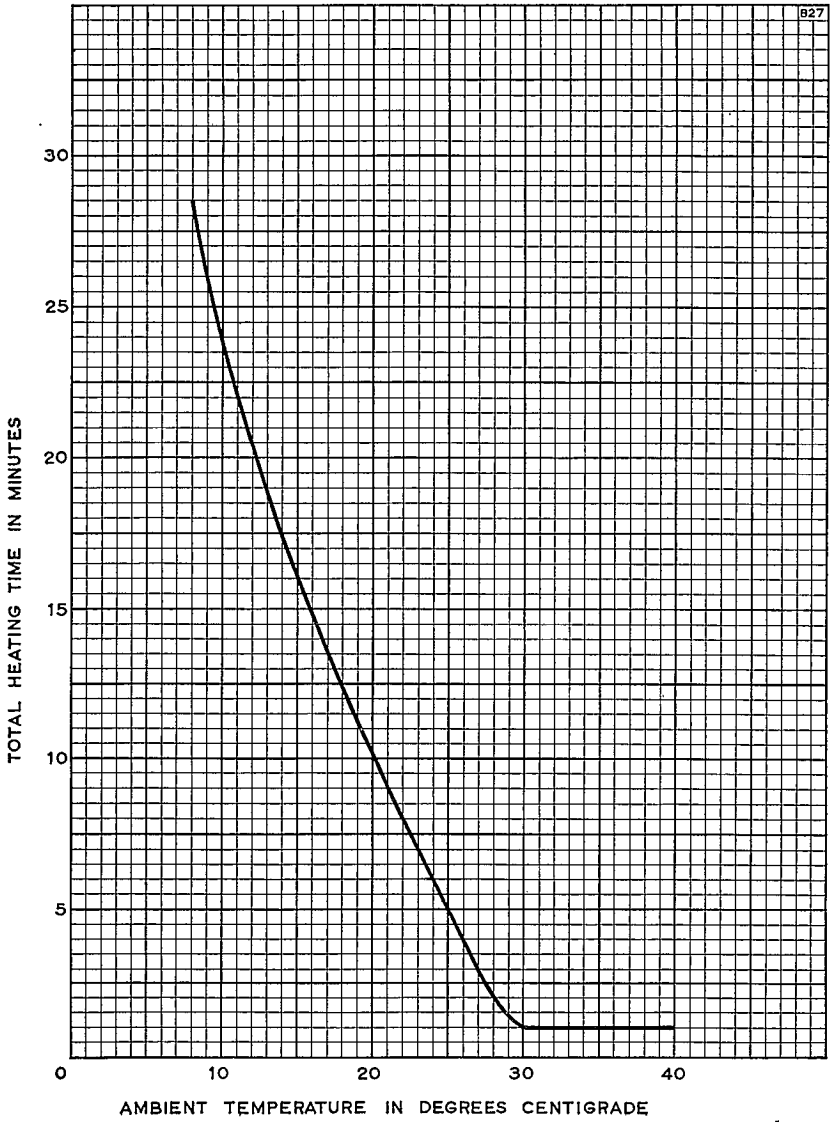
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TOTAL HEATING TIME CHARACTERISTIC



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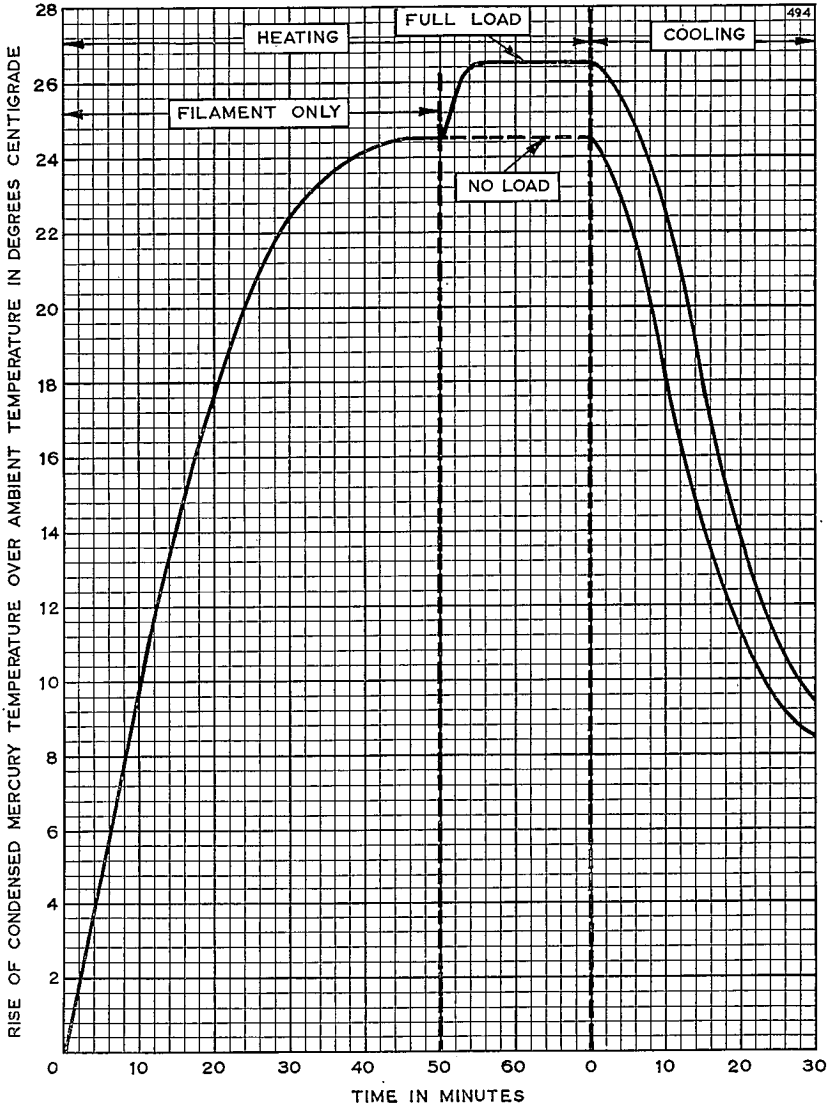
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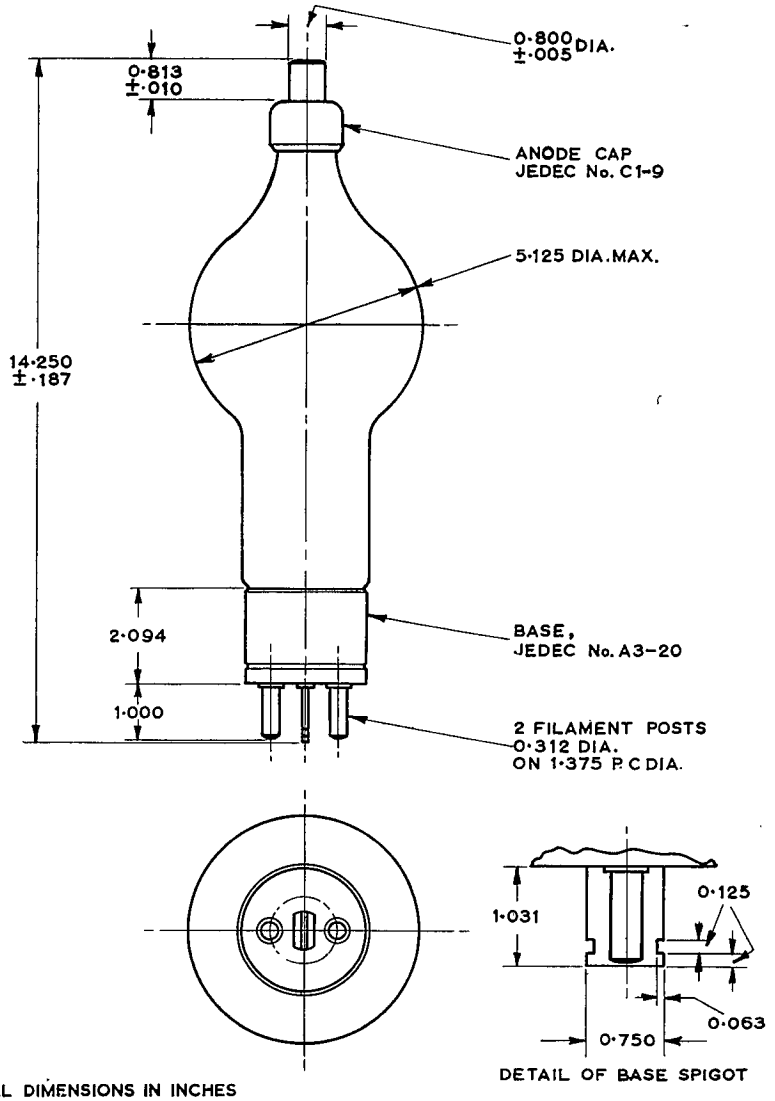
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OUTLINE

495A



DETAIL OF BASE SPIGOT

ALL DIMENSIONS IN INCHES

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MERCURY VAPOUR RECTIFIER

AH205/857B ←

Service Type CV2673 **American Equivalent 857B**

INTRODUCTION

The AH205/857B is a hot cathode Mercury Vapour Rectifier with maximum ratings of 22kV peak inverse voltage and 40A peak current. It will provide a D.C. output of 21kV 30A in a three phase full wave circuit or 7kV 20A in a single phase full wave circuit. ←

GENERAL DATA
(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	5·0	V
Filament Current	30	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	40	A
Mean (30 seconds Max averaging time)	10	A ←
Under fault conditions (0·2 seconds Max duration)	400	A

Mechanical

Overall Length	19·88 inches	(505 mm)	Max
Overall Diameter	7·63 inches	(194 mm)	Max
Net Weight	4·0 pounds	(1·8 kg)	Approx
Mounting Position	Vertical, base down		
Base	*(See outline drawing)*		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max. D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	22	40	10	7·7	7·0	20
		25–60	10	40	10	3·5	3·1	20
Single Phase Full Wave Bridge	B	30–40	22	40	10	15·5	14·0	20
		25–60	10	40	10	7·0	6·3	20
Three Phase Half Wave	C	30–40	22	40	10	9·0†	10·5†	30
		25–60	10	40	10	4·1†	4·7†	30
Three Phase Full Wave	D	30–40	22	40	10	9·0	21·0	30
		25–60	10	40	10	4·1	9·5	30

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 30 seconds maximum.

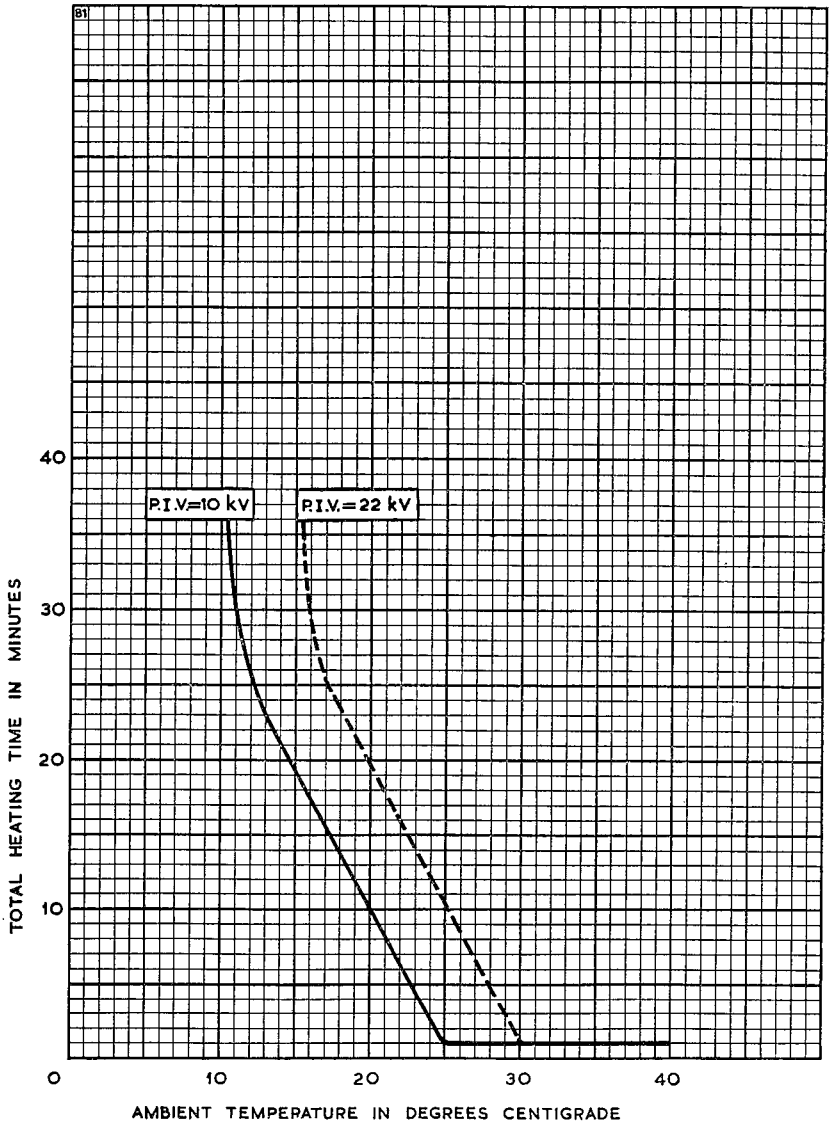
→ ## X-RAY WARNING

X-Rays are produced when the AH205/857B is operated with a peak inverse anode voltage above 16 kV (absolute value). These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the valve.

→ Indicates a change

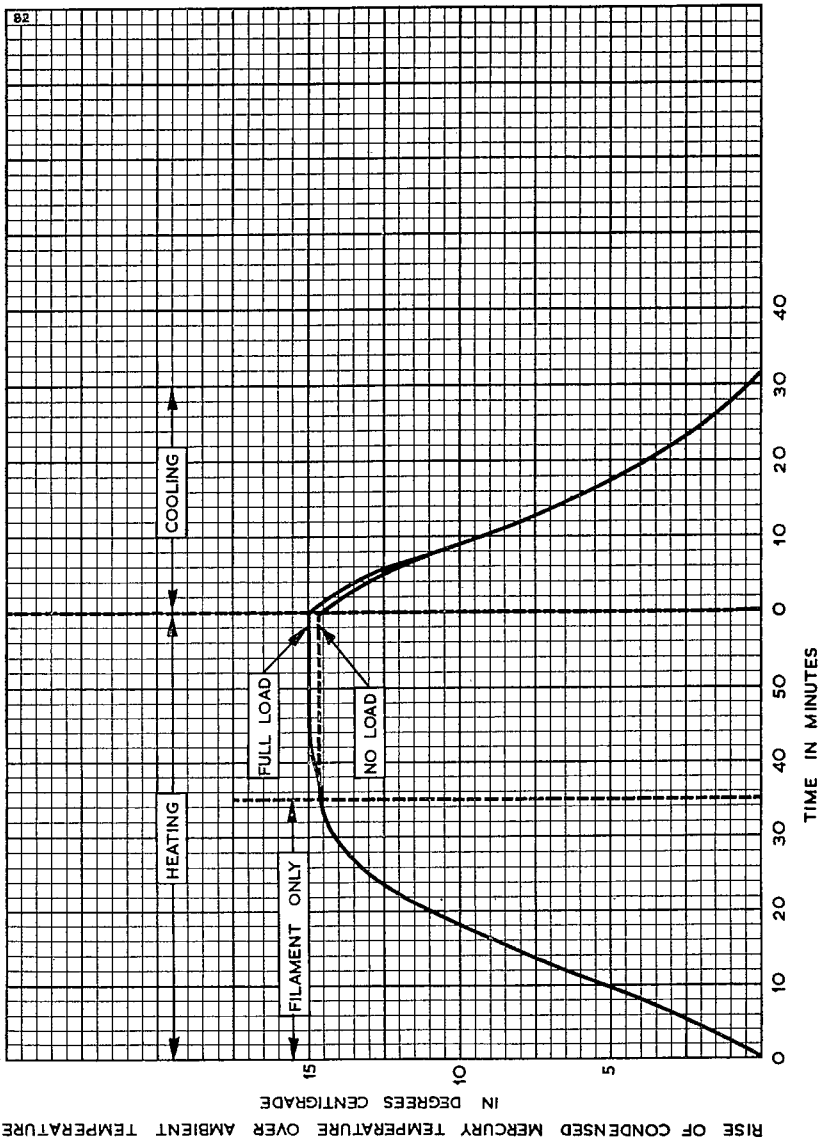
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TOTAL HEATING TIME CHARACTERISTIC



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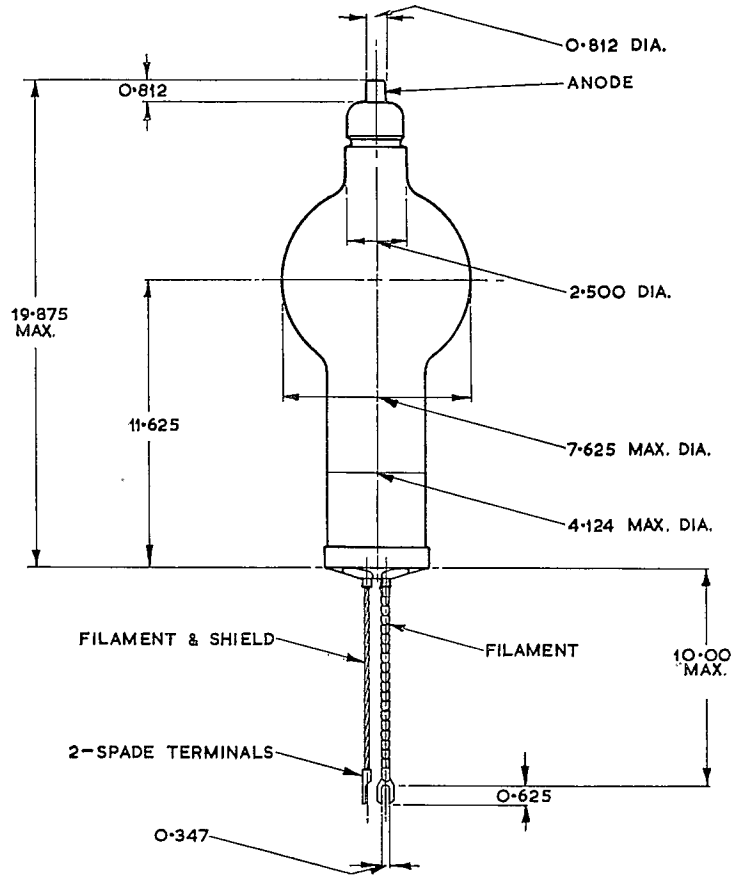
HEATING AND COOLING CHARACTERISTIC



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OUTLINE

83



ALL DIMENSIONS IN INCHES

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MERCURY VAPOUR RECTIFIER

AH200

INTRODUCTION

The AH200 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 10A peak current. It is similar to the AH213, differing only in filament rating and in terminal sizes.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	40	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	*(See page 2)*	
Mean‡	*(See page 2)*	
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	18·0 inches	(457 mm)	Max
Overall Diameter	5·25 inches	(133 mm)	Max
Net Weight	1·75 pounds	(800 gm)	Approx
Mounting Position	Vertical, base down		
Base	*(See outline drawing)*		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

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MAXIMUM OPERATING CONDITIONS
(absolute values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	20	10	2·5	7·0	6·3	5·0
		30–50	15	10	2·5	5·3	4·7	5·0
		30–60	10	10	2·5	3·5	3·1	5·0
Single Phase Full Wave Bridge	B	30–40	20	10	2·5	14·0	12·6	5·0
		30–50	15	10	2·5	10·6	9·5	5·0
		30–60	10	10	2·5	7·0	6·3	5·0
Three Phase Half Wave	C	30–40	20	10	2·5	8·1†	9·5†	7·5
		30–50	15	10	2·5	6·1†	7·1†	7·5
		30–60	10	10	2·5	4·1†	4·7†	7·5
Three Phase Full Wave	D§	30–40	20	10	2·5	8·1	19·1	7·5
		30–50	15	20	5	6·1	14·2	15·0
		30–60	10	20	5	4·1	9·5	15·0

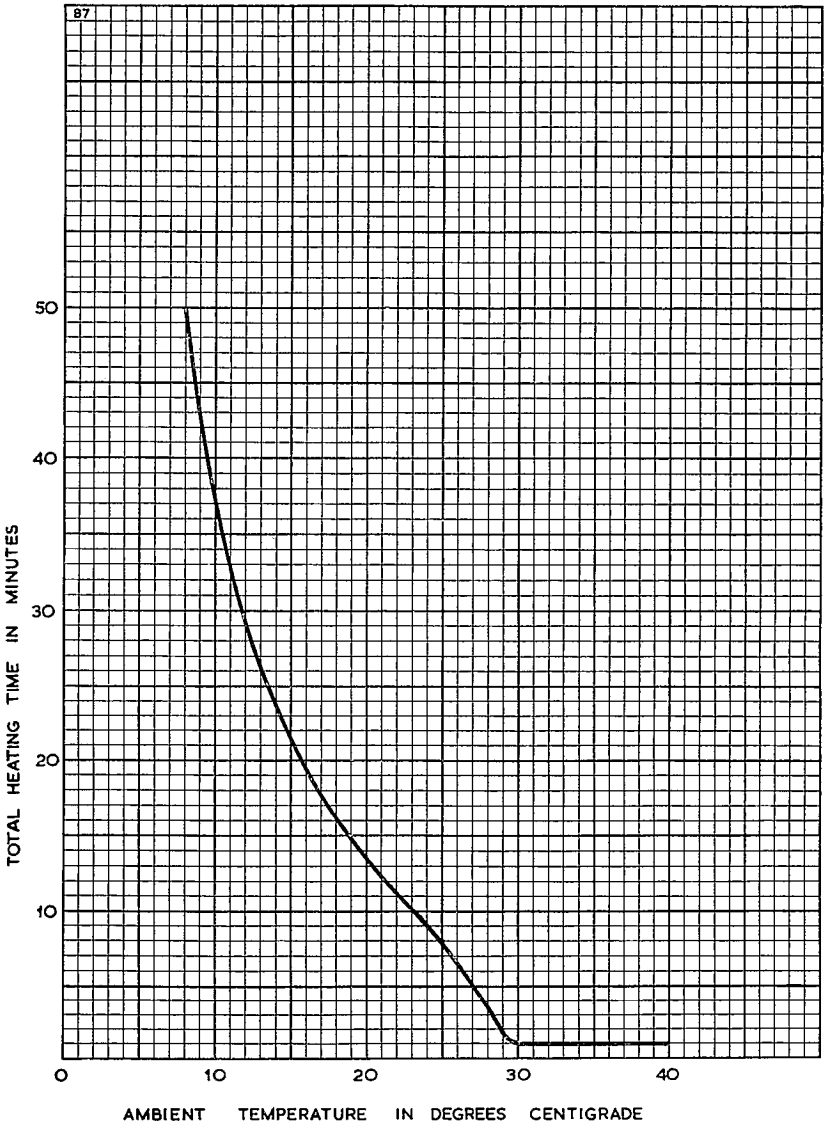
*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

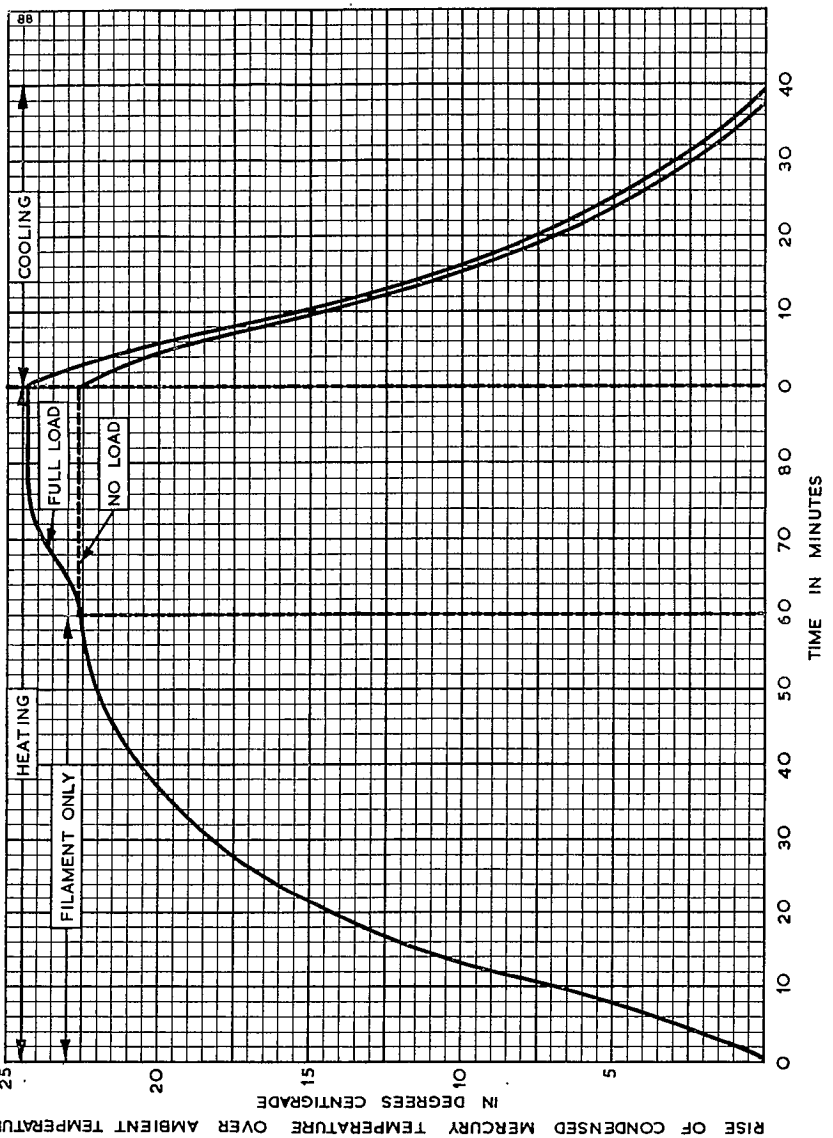
‡Mean anode currents are averaged over any period of 30 seconds maximum.

§With filament and anode supplies out of phase (60°–120°).

TOTAL HEATING TIME CHARACTERISTIC



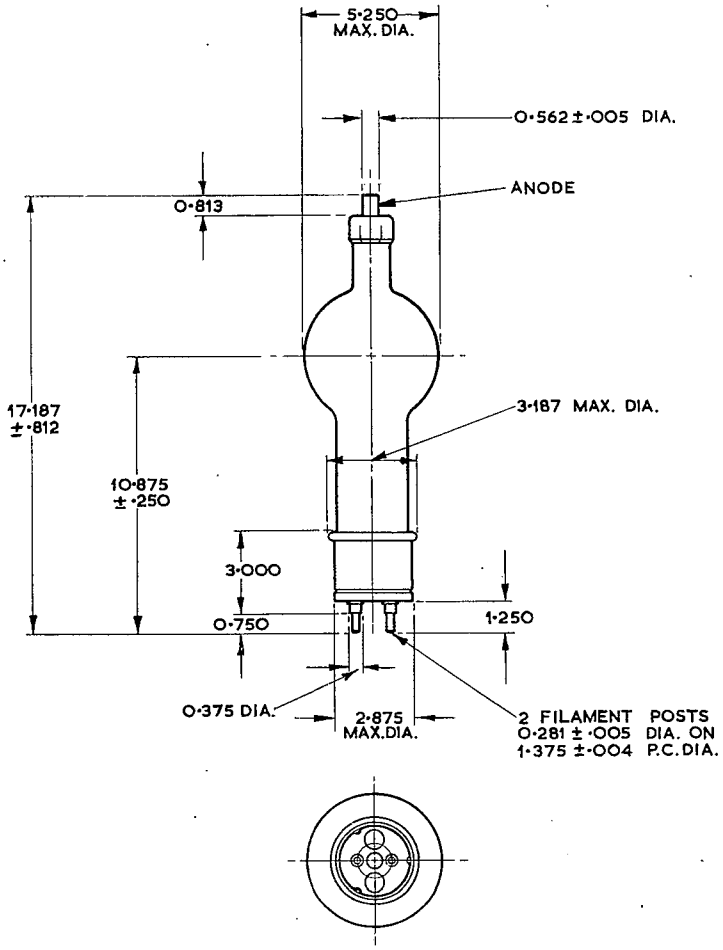
HEATING AND COOLING CHARACTERISTIC



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OUTLINE

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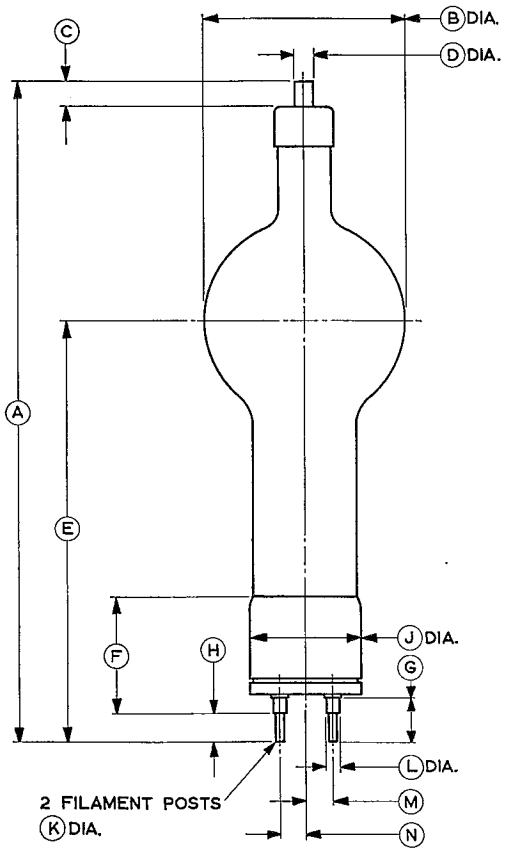


ALL DIMENSIONS IN INCHES

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OUTLINE

89A



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	17·187±0·812	436·5±20·62	H	0·750	19·05
B	5·250 Max	133·4 Max	J	2·875	73·03
C	0·812	20·62	K	0·281±0·005	7·14±0·13
D	0·562±0·005	14·27±0·13	L	0·375	9·53
E	10·875±0·250	276·2±6·35	M	0·687	17·45
F	3·000	76·20	N	0·687	17·45
G	1·125	28·58			

Millimetre dimensions have been derived from inches.

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MERCURY VAPOUR RECTIFIER

AH211

Service Type CV532

INTRODUCTION

The AH211 is a maintenance type only. For new designs the AH211A is recommended.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	30	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	25 to 50	°C
Max Peak Inverse Voltage	16	kV
Max Anode Current:		
Peak	8	A
Mean‡	2	A
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	12·38 inches	(314 mm)	Max
Overall Diameter	3·19 inches	(81 mm)	Max
Net Weight	1 pound	(460 gm)	Approx
Mounting Position		Vertical, base down	
Base		*(See outline drawing)*	

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

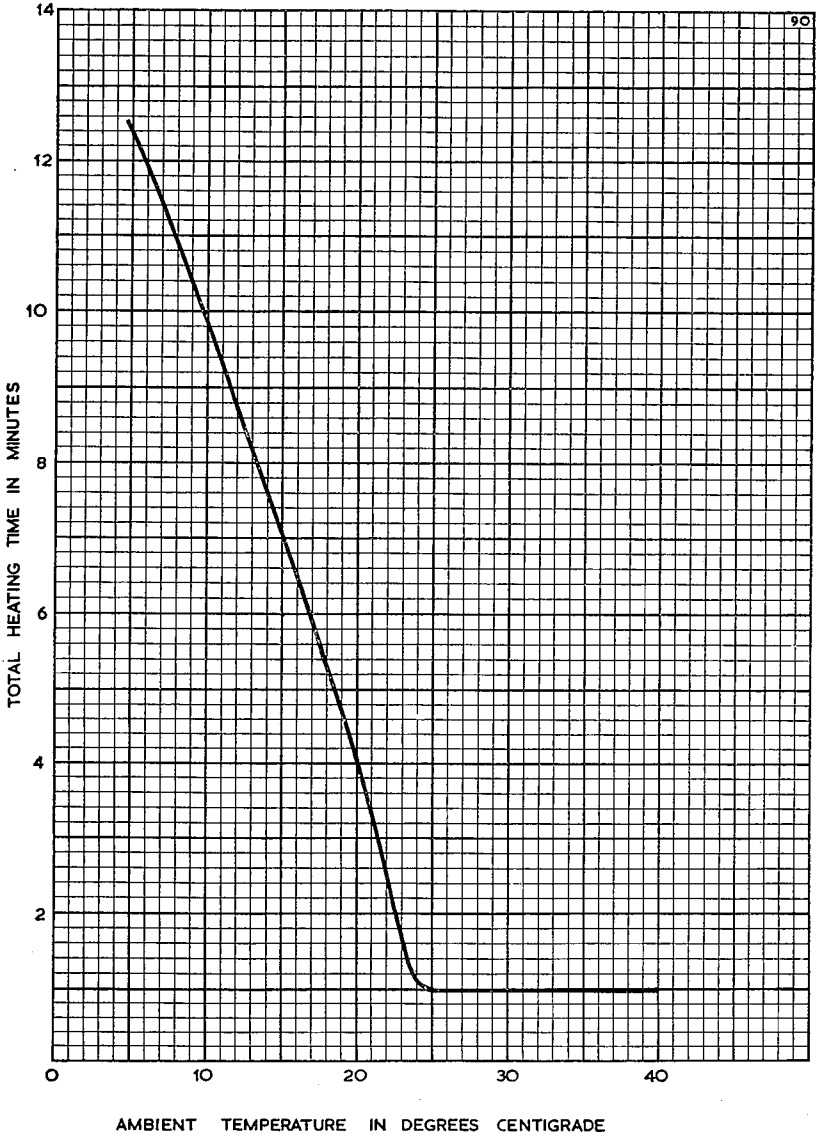
Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	25–50	16	8	2·0	5·6	5·0	4
Single Phase Full Wave Bridge	B	25–50	16	8	2·0	11·2	10·1	4
Three Phase Half Wave	C	25–50	16	8	2·0	6·5†	7·6†	6
Three Phase Full Wave	D	25–50	16	8	2·0	6·5	15·2	6

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

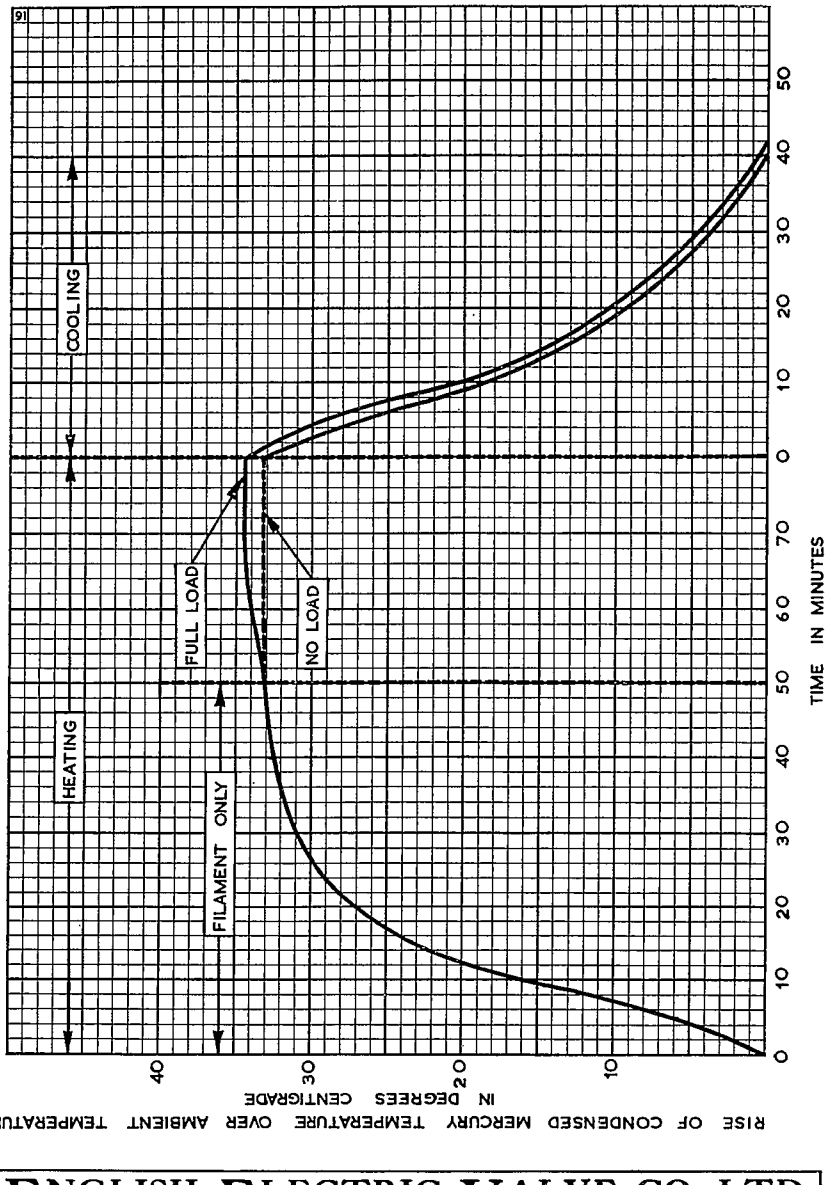
‡Mean anode currents are averaged over any period of 30 seconds maximum.

TOTAL HEATING TIME CHARACTERISTIC



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HEATING AND COOLING CHARACTERISTIC

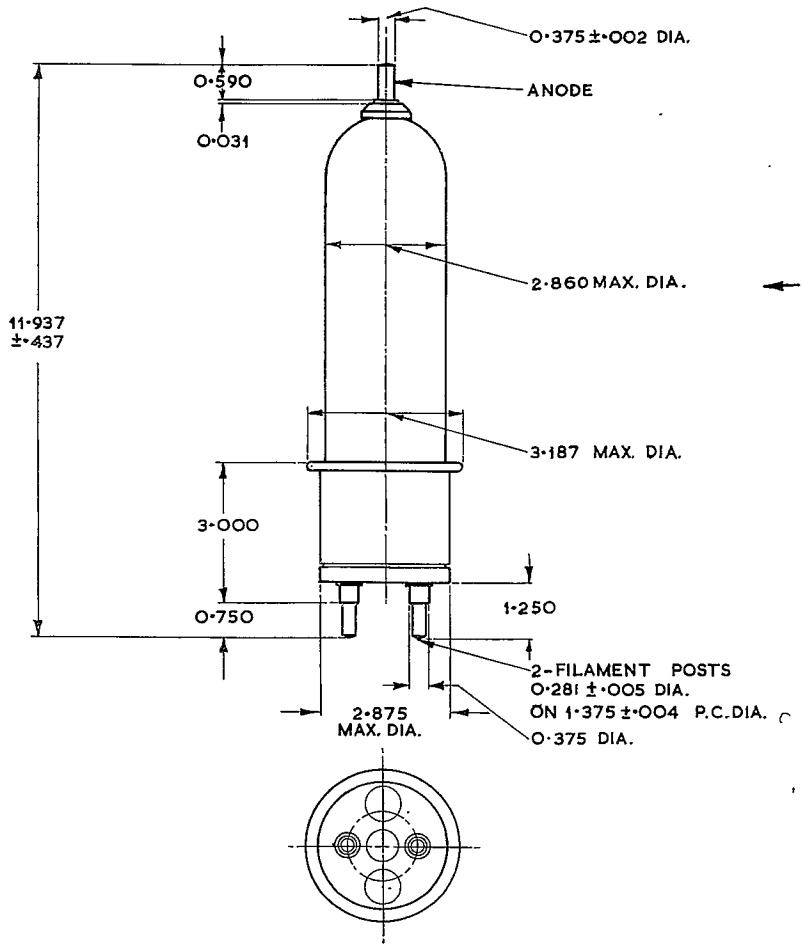


MERCURY VAPOUR RECTIFIER

AH211

OUTLINE

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ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

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MERCURY VAPOUR RECTIFIER

AH211A

Service Type CV532 ←

INTRODUCTION

The AH211A is a hot cathode Mercury Vapour Rectifier with maximum ratings of 16kV peak inverse voltage and 8A peak current. It will provide a D.C. output of 15kV 6A in a three phase full wave circuit.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	30	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	25 to 50	°C
Max Peak Inverse Voltage	16	kV
Max Anode Current:		
Peak	8	A
Mean (30 seconds Max averaging time)	2	A ←
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	13·38 inches	(340 mm)	Max
Overall Diameter	3·19 inches	(81 mm)	Max
Net Weight	1¼ pounds	(0·5 kg)	Approx
Mounting Position		Vertical, base down	
Base		*(See outline drawing)*	

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating time and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

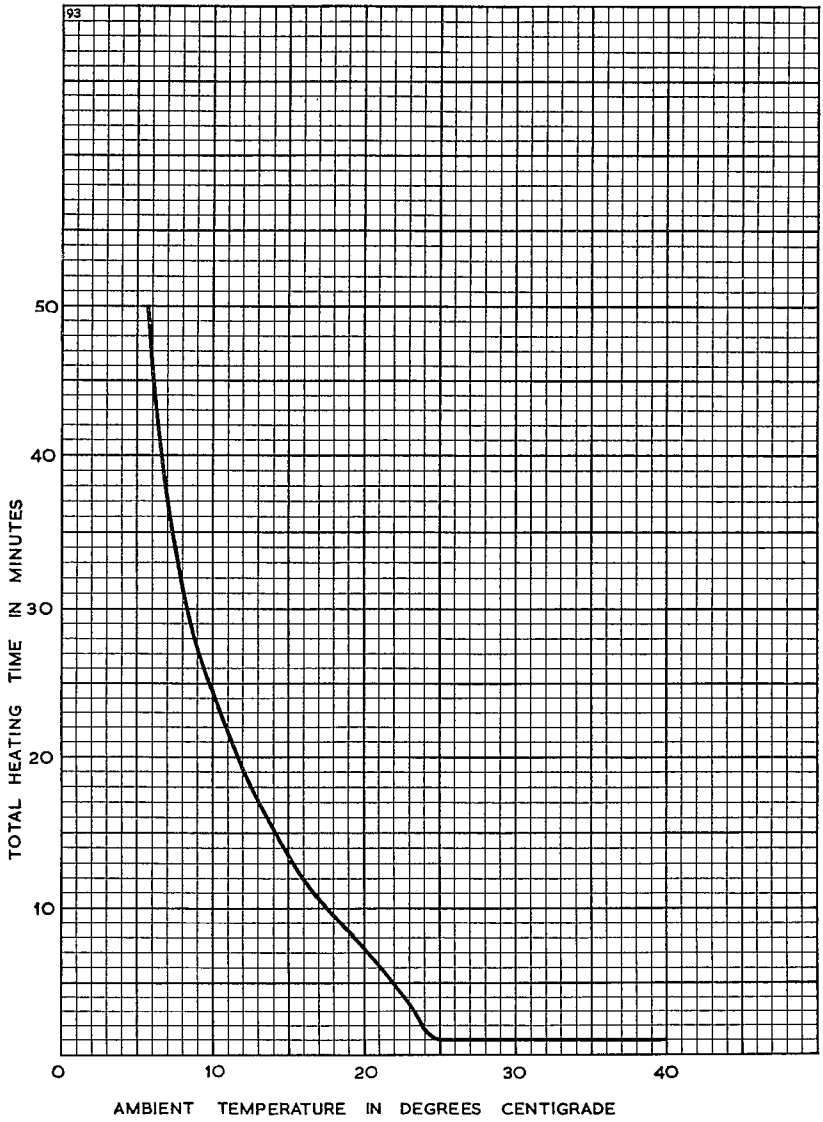
Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	25–50	16	8	2·0	5·6	5·0	4
Single Phase Full Wave Bridge	B	25–50	16	8	2·0	11·2	10·1	4
Three Phase Half Wave	C	25–50	16	8	2·0	6·5†	7·6†	6
Three Phase Full Wave	D	25–50	16	8	2·0	6·5	15·2	6

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased, the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

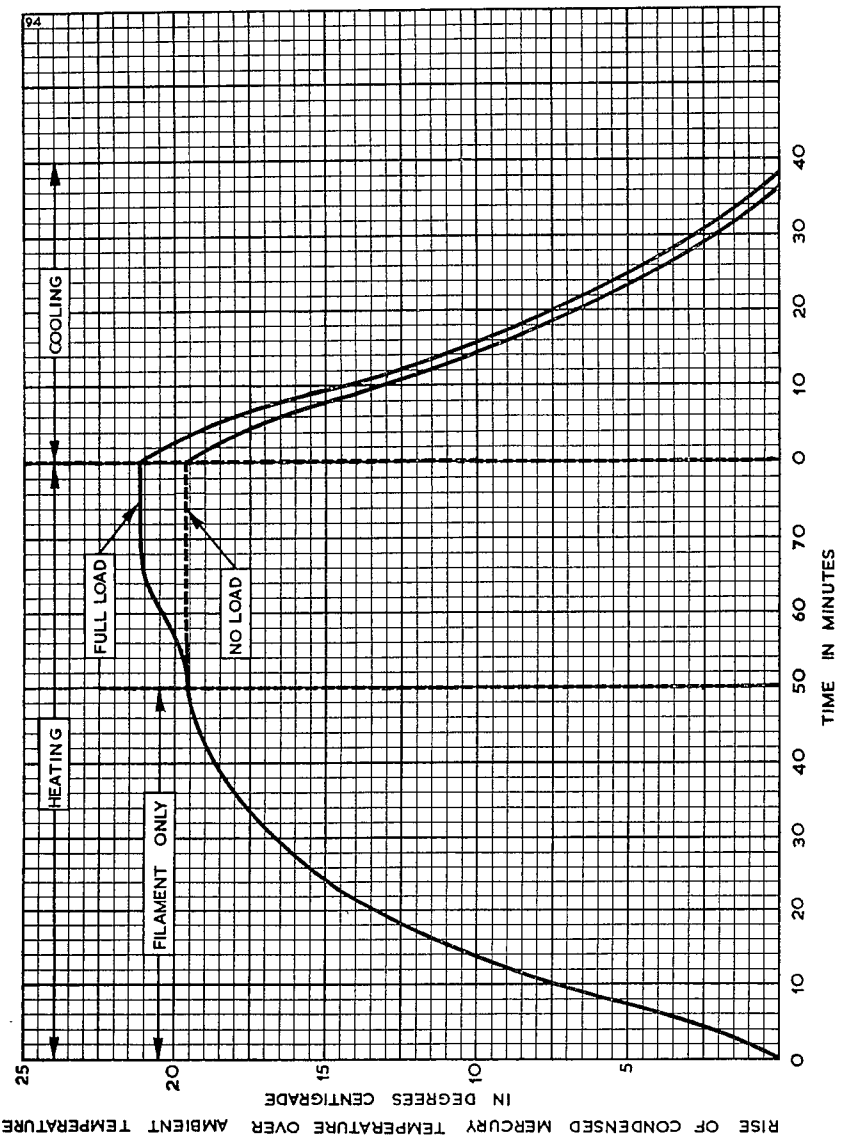
‡Mean anode currents are averaged over any period of 30 seconds maximum.

TOTAL HEATING TIME CHARACTERISTIC



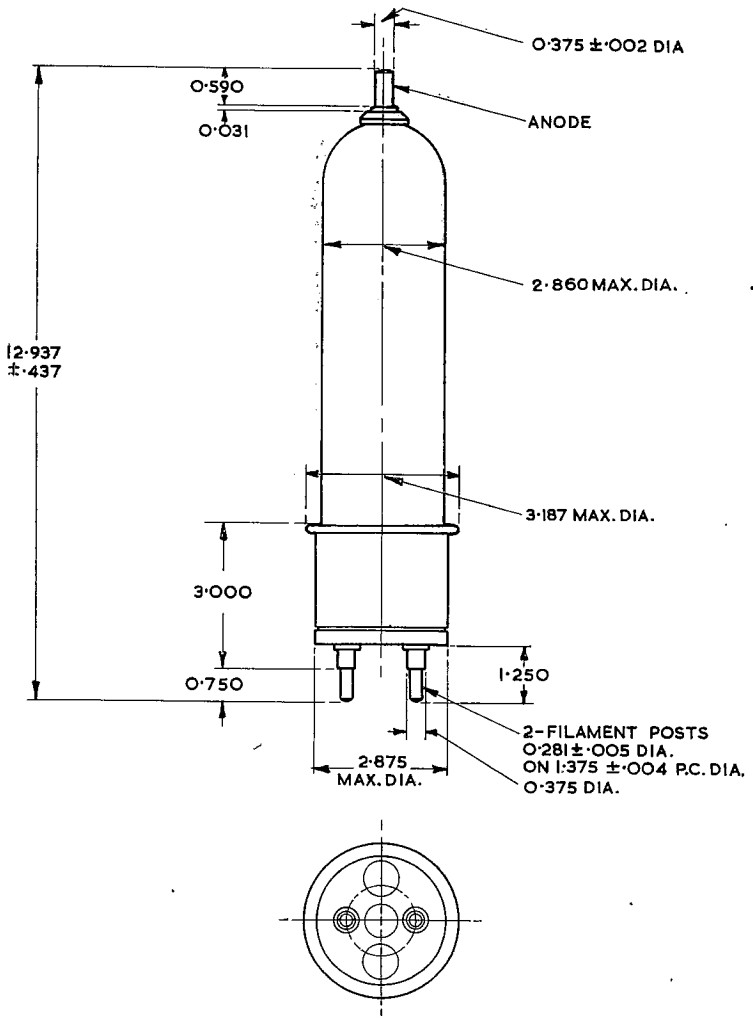
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HEATING AND COOLING CHARACTERISTIC



OUTLINE

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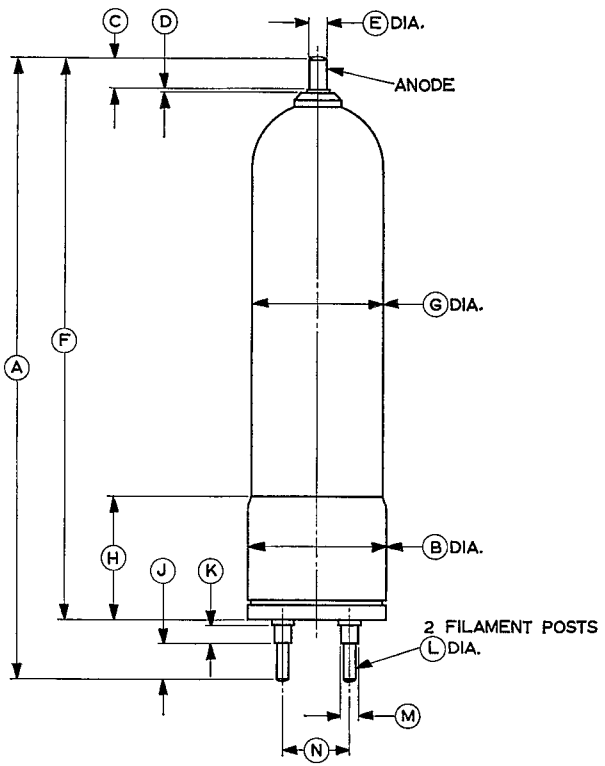


ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

OUTLINE

529A



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	12·937±0·437	328·6±11·10	H	2·563	65·10
B	2·875	73·03	J	0·750	19·05
C	0·590	14·99	K	0·375	9·53
D	0·031	0·79	L	0·281±0·005	7·14±0·13
E	0·375±0·002	9·525±0·051	M	0·375	9·53
F	11·687±0·437	296·8±11·10	N	1·375	34·93
G	2·860 Max	72·64 Max			

Millimetre dimensions have been derived from inches.

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MERCURY VAPOUR RECTIFIER

AH213

Service Type CV2723 **Electrically Equivalent to American 869B**

INTRODUCTION

The AH213 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 10A peak current. It is similar to the AH200, differing only in filament rating and in terminal sizes.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	5	V
Filament Current	19	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	*(See page 2)*	
Mean‡	*(See page 2)*	
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	18·0 inches	(457 mm)	Max
Overall Diameter	5·25 inches	(133 mm)	Max
Net Weight	1·75 pounds	(800 gm)	Approx
Mounting Position	Vertical, base down		
Base	*(See outline drawing)*		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	20	10	2·5	7·0	6·3	5·0
		30–50	15	10	2·5	5·3	4·7	5·0
		30–60	10	10	2·5	3·5	3·1	5·0
Single Phase Full Wave Bridge	B	30–40	20	10	2·5	14·0	12·6	5·0
		30–50	15	10	2·5	10·6	9·5	5·0
		30–60	10	10	2·5	7·0	6·3	5·0
Three Phase Half Wave	C	30–40	20	10	2·5	8·1†	9·5†	7·5
		30–50	15	10	2·5	6·1†	7·1†	7·5
		30–60	10	10	2·5	4·1†	4·7†	7·5
Three Phase Full Wave	D§	30–40	20	10	2·5	8·1	19·0	7·5
		30–50	15	20	5	6·1	14·2	15·0
		30–60	10	20	5	4·1	9·5	15·0

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

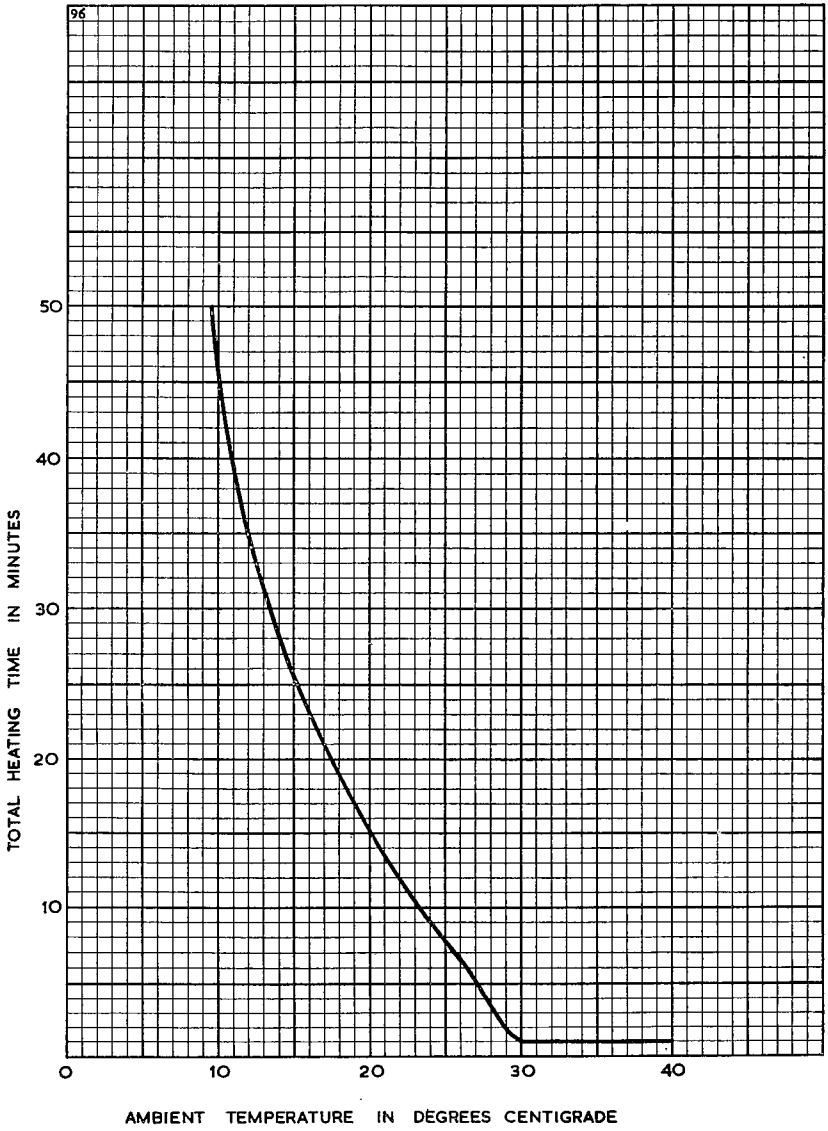
†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 30 seconds maximum.

§With filament and anode supplies out of phase (60°–120°).

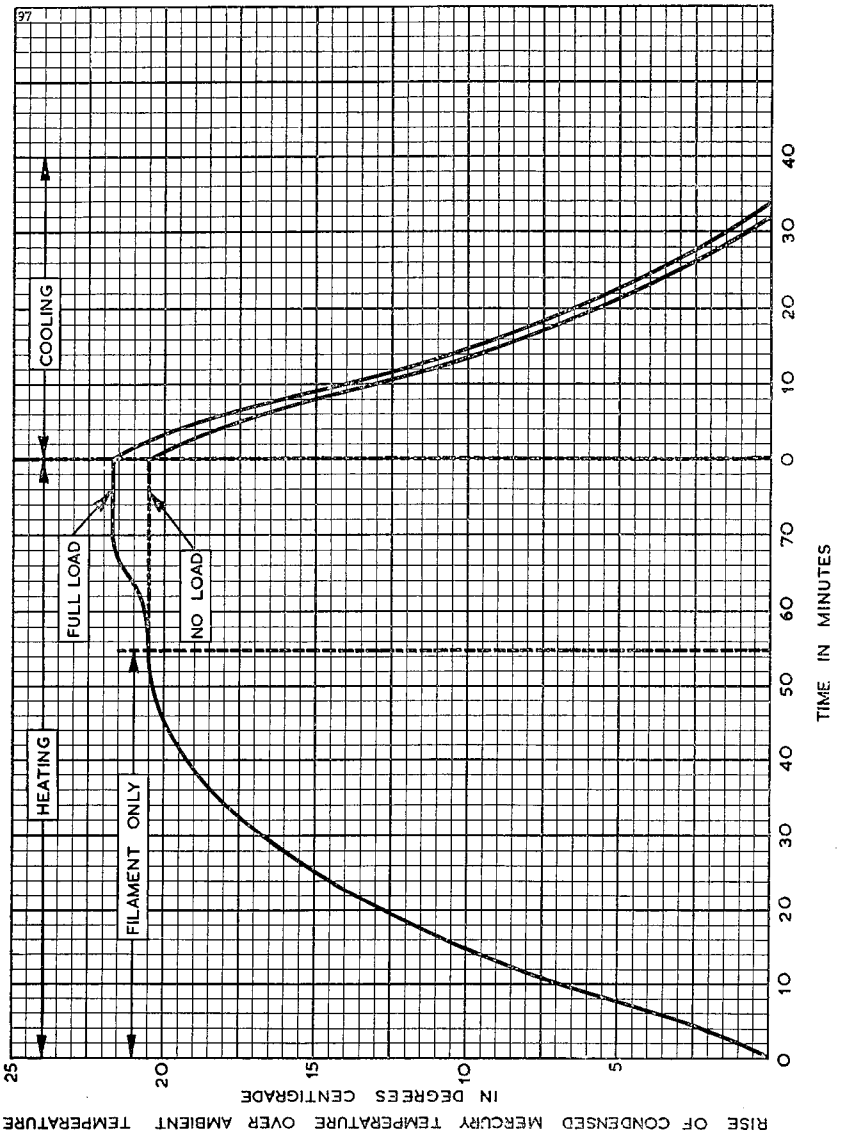
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TOTAL HEATING TIME CHARACTERISTIC



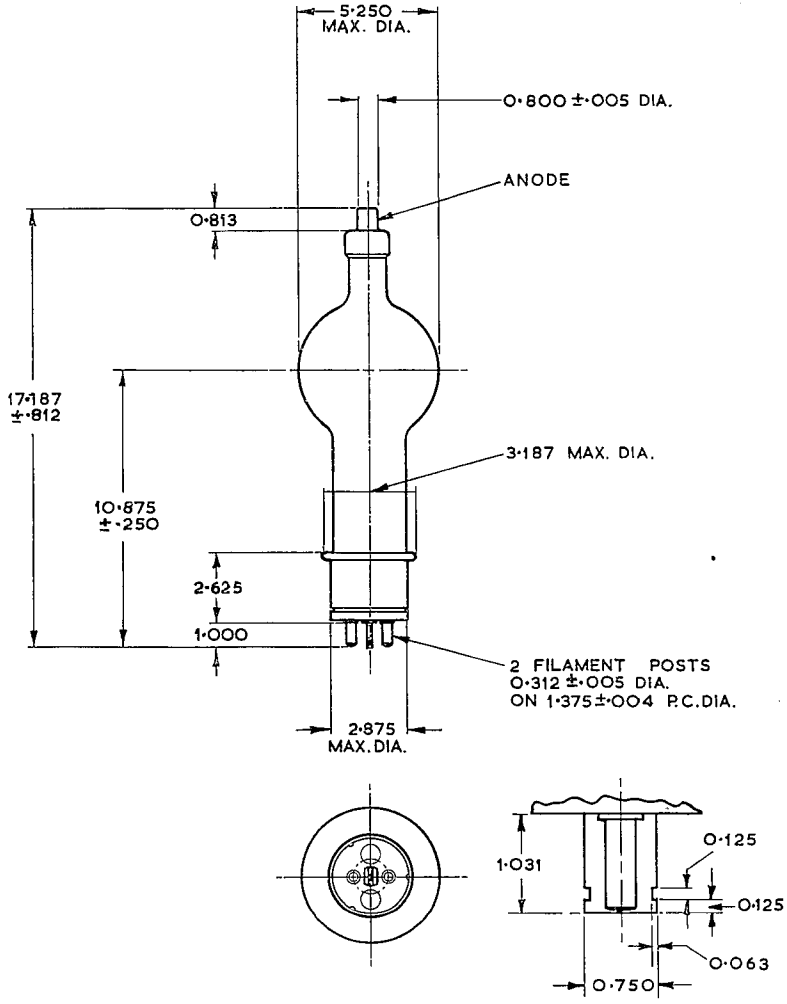
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HEATING AND COOLING CHARACTERISTIC



OUTLINE

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ALL DIMENSIONS IN INCHES

DETAIL OF BASE SPIGOT

MERCURY VAPOUR RECTIFIER

AH221

Service Types CV5 and CV1435 ←

INTRODUCTION

The AH221 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 5A peak current. It will provide a D.C. output of 19·0kV 3·75A in a three phase full wave circuit. ←

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	4·0	V
Filament Current	11	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	(*See Page* 2) ←	
Max Peak Inverse Voltage	(*See Page* 2) ←	
Max Anode Current:		
Peak	5·0	A
Mean‡	1·25	A
Under fault conditions (0·2 second Max duration)	50	A

Mechanical

Overall Length	10·63 inches	(270 mm)	Max
Overall Diameter	2·32 inches	(59 mm)	Max
Net Weight	8 ounces	(230 gm)	Approx
Mounting Position	Vertical, base down		
Base	Goliath Edison Screw		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.

2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	20–40 20–50	20 11	5·0 5·0	1·25 1·25	7·0 3·9	6·3 3·5	2·5 2·5
Single Phase Full Wave Bridge	B	20–40 20–50	20 11	5·0 5·0	1·25 1·25	14·0 7·75	12·6 7·0	2·5 2·5
Three Phase Half Wave	C	20–40 20–50	20 11	5·0 5·0	1·25 1·25	8·1† 4·4†	9·5† 5·2†	3·75 3·75
Three Phase Full Wave	D	20–40 20–50	20 11	5·0 5·0	1·25 1·25	8·1 4·4	19·0 10·4	3·75 3·75

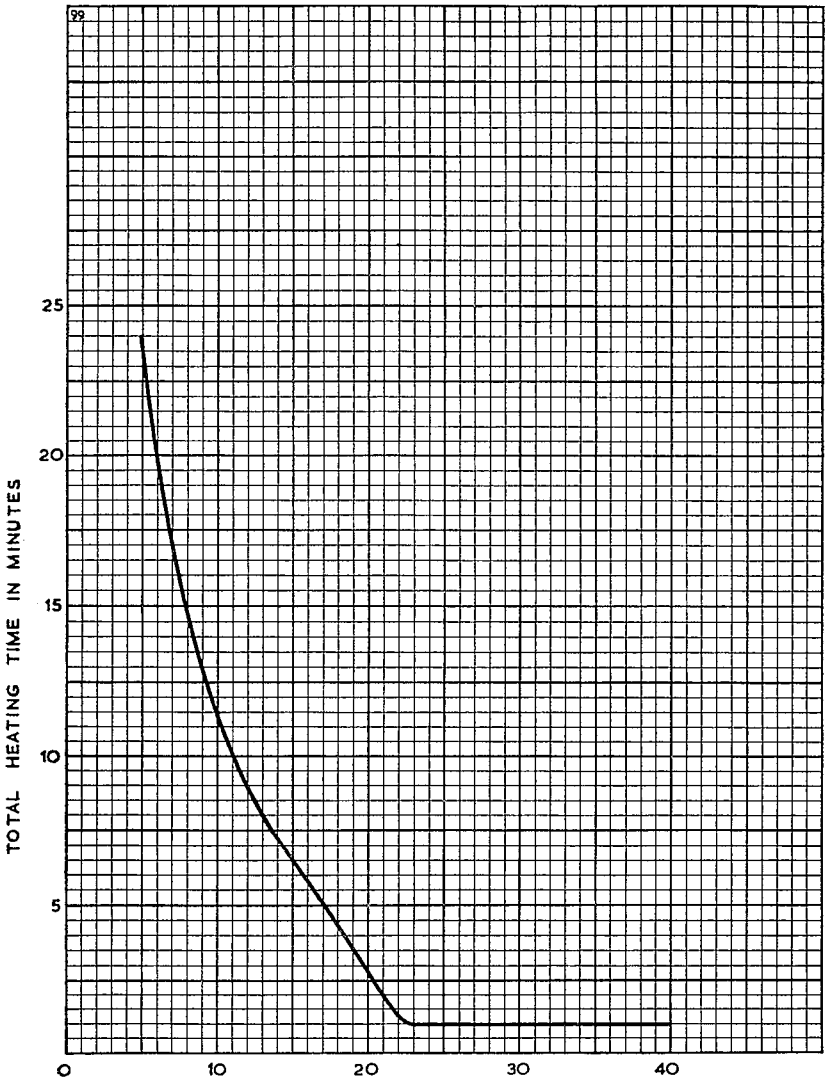
*For diagram see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum.

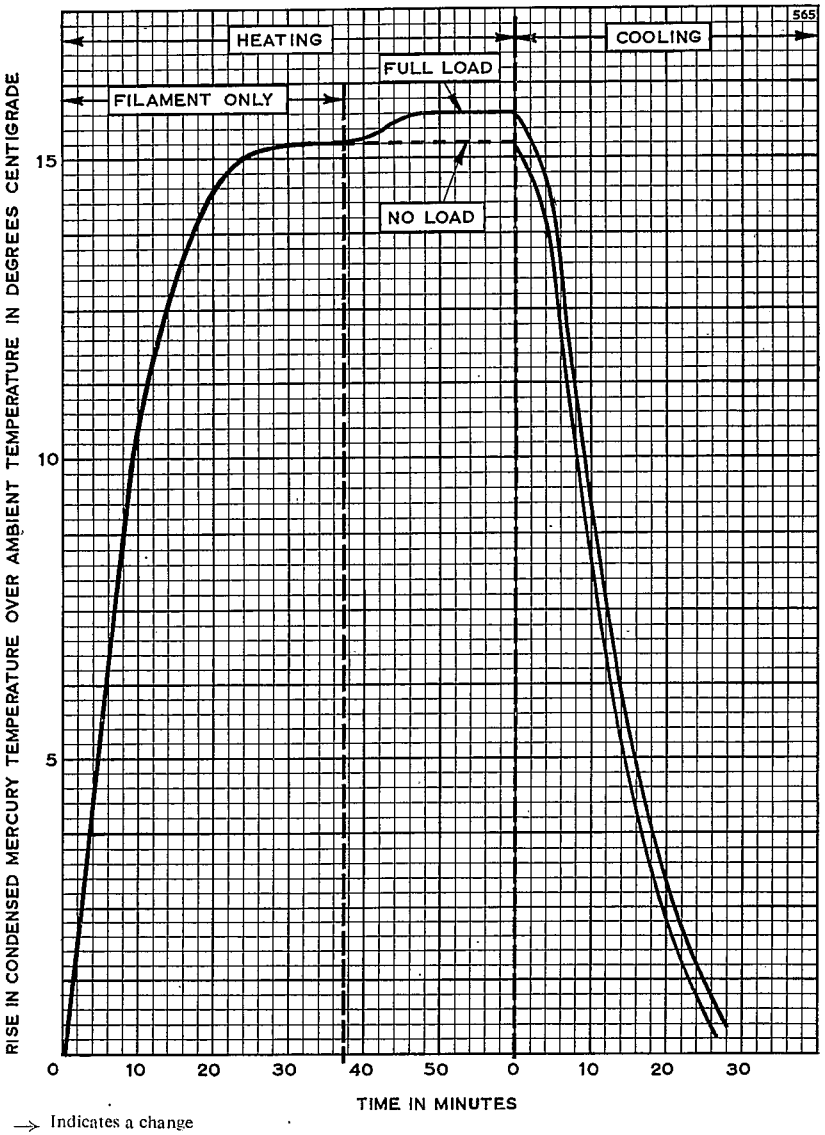
→ Indicates a change.

TOTAL HEATING TIME CHARACTERISTIC



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← HEATING AND COOLING CHARACTERISTIC

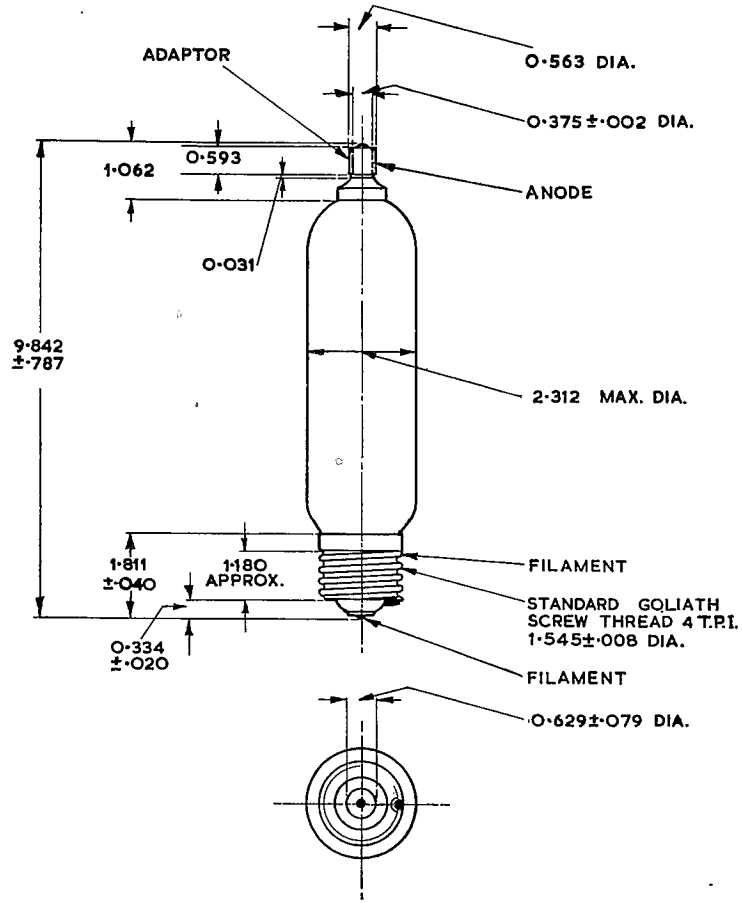


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OUTLINE

101A



ALL DIMENSIONS IN INCHES

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MERCURY VAPOUR RECTIFIER

AH238

ENGLISH ELECTRIC

Service Type CV1629

INTRODUCTION

The AH238 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 13kV peak inverse voltage and 5·0A peak current. It will provide a d.c. output of 12kV 3·7A in a three phase full wave circuit.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	4·0	V
Filament Current	7·0	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	5·0	A
Mean‡	1·25	A
Under fault conditions (0·1 second Max duration)	100	A

Mechanical

Overall Length	9·488 inches	(241mm)	Max←
Overall Diameter	2·312 inches	(58·7mm)	Max←
Net Weight	7 ounces	(200gm)	Approx
Mounting Position	Vertical, base down		
Base	Goliath Edison Screw		
Top Cap	B.S.448/CT9 fitted with screw terminal adaptor		←

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change

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ENGLISH ELECTRIC

MAXIMUM OPERATING CONDITIONS

(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	A
Single Phase Full Wave	A	25–55	13	5	1·25	4·5	4·1	2·5
		25–60	10	5	1·25	3·5	3·1	2·5
		25–65	8	5	1·25	2·8	2·5	2·5
Single Phase Full Wave Bridge	B	25–55	13	5	1·25	9·1	8·2	2·5
		25–60	10	5	1·25	7·0	6·3	2·5
		25–65	8	5	1·25	5·6	5·0	2·5
Three Phase Half Wave	C	25–55	13	5	1·25	5·3†	6·2†	3·75
		25–60	10	5	1·25	4·1†	4·7†	3·75
		25–65	8	5	1·25	3·2†	3·7†	3·75
Three Phase Full Wave	D	25–55	13	5	1·25	5·3	12·4	3·75
		25–60	10	5	1·25	4·1	9·5	3·75
		25–65	8	5	1·25	3·2	7·5	3·75

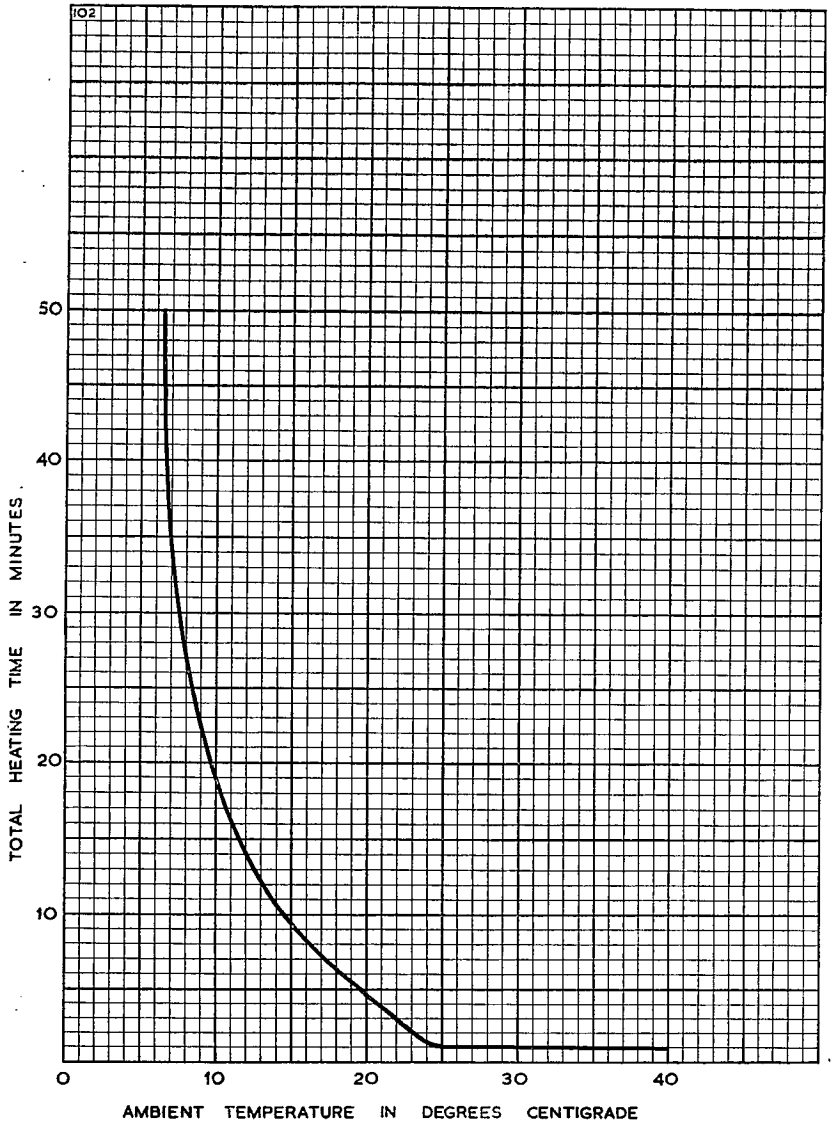
*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The d.c. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum.

ENGLISH ELECTRIC

TOTAL HEATING TIME CHARACTERISTIC



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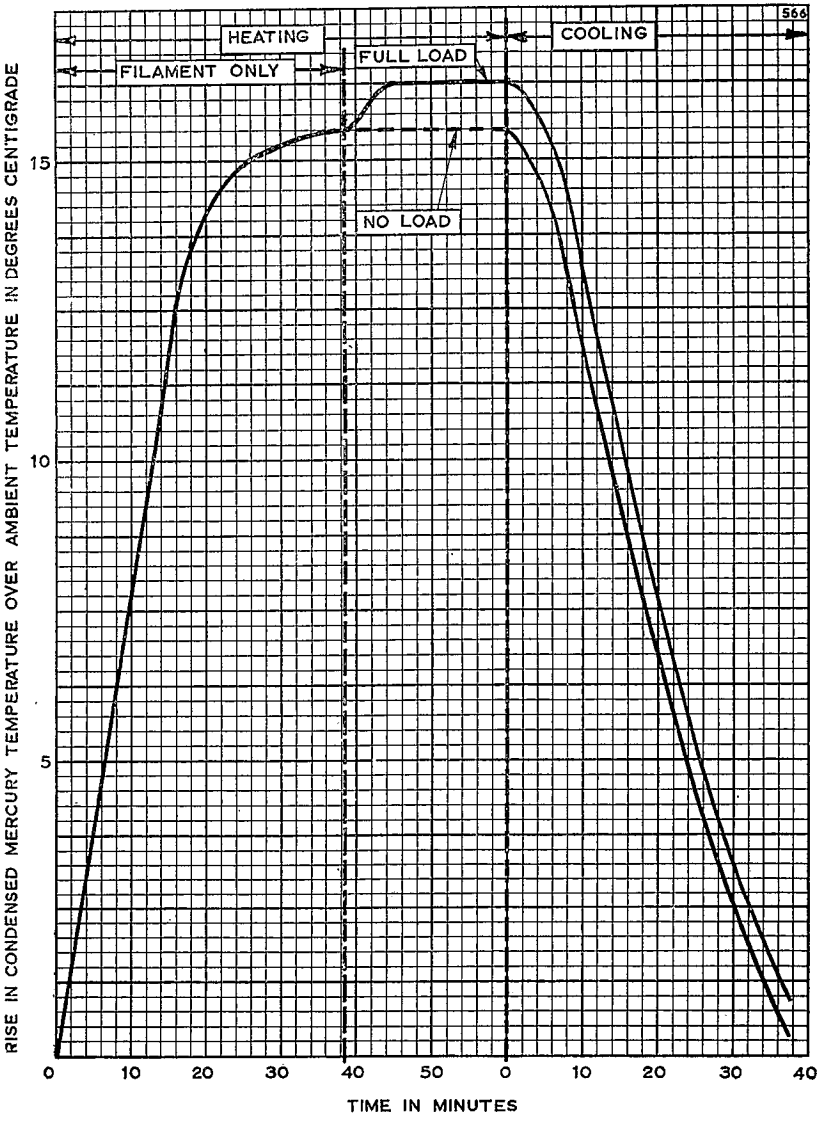
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ENGLISH ELECTRIC

HEATING AND COOLING CHARACTERISTIC



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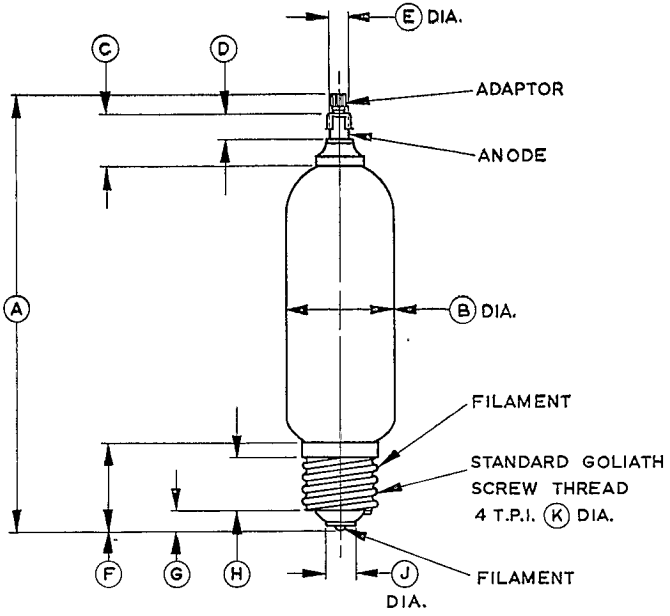
CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

OUTLINE

104C



Ref.	Inches	Millimetres
A	9·488 Max	241 Max
B	2·312 Max	58·72 Max
C	1·062	26·97
D	0·593	15·06
E	0·375±0·002	9·525±0·051
F	1·811±0·040	46·00±1·02
G	0·355±0·040	9·02±1·02
H	1·180	29·97
J	0·630±0·079	16·00±2·01
K	1·546±0·009	39·27±0·23

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
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Printed in England

AH2511

MERCURY VAPOUR RECTIFIER

JEDEC Type 6693

ABRIDGED DATA

Hot cathode mercury vapour rectifier		
Peak inverse anode voltage	15	kV max
Peak anode current (at 15kV p.i.v.)	12	A max
Mean anode current (at 15kV p.i.v.)	3.0	A max
Fault anode current (0.1s max)	120	A max
Frequency	150	Hz max

GENERAL

Electrical

Filament		oxide coated
Filament voltage	5.0	V
Filament current	11.5	A
Filament heating time (minimum)	1.0	min
Voltage drop (approx)	12	V
Condensed mercury temperature rise above ambient (approx):		
at no load	13	°C
at 2.5A load	23	°C

Mechanical

Overall length	308mm (12.126 inches) max
Overall diameter	72mm (2.835 inches) max
Net weight	450g (1 pound) approx
Mounting position	vertical, base down
Base	B4D with bayonet
Top cap	B.S.448/CT9 fitted with screw terminal adaptor

March 1969

MAXIMUM OPERATING CONDITIONS (Absolute values)

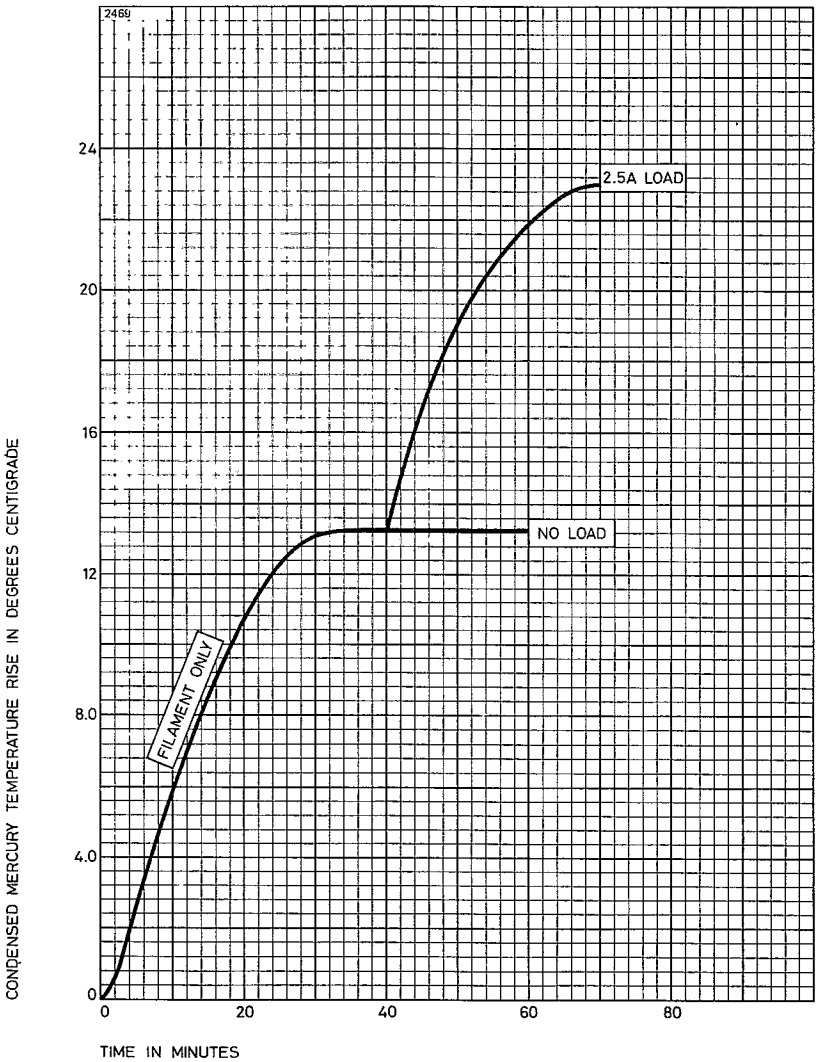
Circuit*	Condensed mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current in amperes peak	mean♦	Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output (kV)	(A)
A	25–55	15	12	3.0	5.3	4.8	6.0
Single phase	25–60	10	12	3.0	3.5	3.2	6.0
full wave	25–75	2.5	20	5.0	0.88	0.8	10
B	25–55	15	12	3.0	10.6	9.6	6.0
Single phase	25–60	10	12	3.0	7.1	6.4	6.0
bridge	25–75	2.5	20	5.0	1.77	1.6	10
C	25–55	15	12	3.0	6.1†	7.2†	9.0
Three phase	25–60	10	12	3.0	4.1†	4.8†	9.0
half wave	25–75	2.5	20	5.0	1.02†	1.2†	15
D	25–55	15	12	3.0	6.1	14.3	9.0
Three phase	25–60	10	12	3.0	4.1	9.5	9.0
full wave	25–75	2.5	20	5.0	1.02	2.4	15

* See Typical Rectifier Circuits for Choke input filters in the preamble to the Rectifier section of the Valve Data Book.

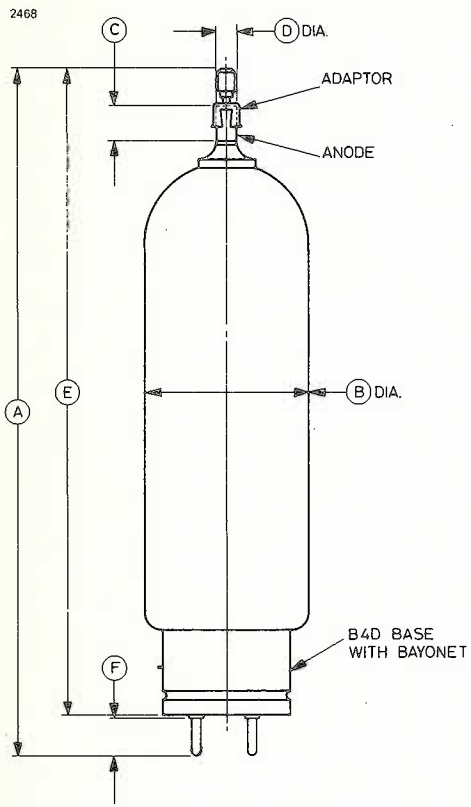
† For operation at constant full load. If the load is reduced, the peak inverse voltage on the valves will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

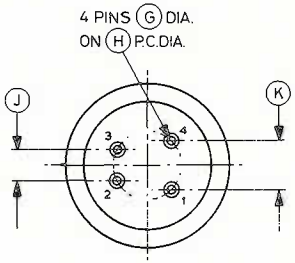
♦ Averaging time 15 seconds maximum.

HEATING CHARACTERISTIC



OUTLINE





VIEW ON BASE

Pin	Element
1	No connection
2	Filament
3	Filament
4	No connection

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	11.811 ± 0.315	300.0 ± 8.0	F	0.625	15.88
B*	2.835 max	72.0 max	G	0.187 ± 0.003	4.750 ± 0.076
C	0.593	15.06	H	1.000	25.40
D	0.375 ± 0.002	9.525 ± 0.051	J	0.562	14.27
E*	11.122 ± 0.236	282.5 ± 6.0	K	0.750	19.05

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

MERCURY VAPOUR RECTIFIER

BD12

ENGLISH ELECTRIC

ABRIDGED DATA

Hot Cathode Full Wave Mercury Vapour Rectifier

Peak Inverse Anode Voltage	1·0	kV Max
Peak Anode Current (per anode)	50	A Max
Mean Anode Current (per anode)	16·5	A Max

GENERAL

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Cathode	Indirectly Heated	
Heater Voltage	5·0	V
Heater Current	35	A
Cathode Heating Time (Minimum)	5·0	min
Voltage Drop (Approx)	12	V
Condensed Mercury Temperature Rise above Ambient (Approx):		
At no load	52	°C
At full load	60	°C

Mechanical

Overall Length (excluding leads)	16·437 inches	(417·5 mm)	Max
Overall Diameter	6·437 inches	(163·5 mm)	Max
Net Weight	3½ pounds	(1·6 kg)	Approx
Mounting Position		Vertical, base down	
Connections		Flexible leads	

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

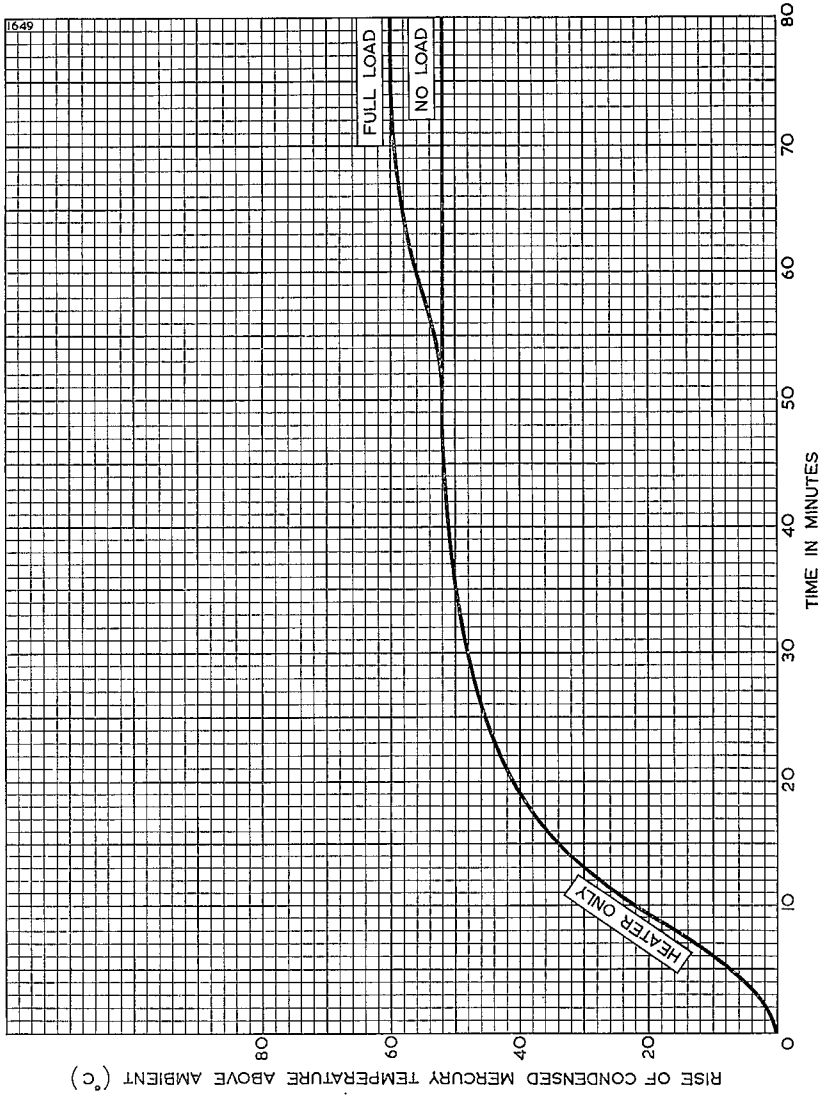
Peak Inverse Anode Voltage	1·0	kV Max
R.M.S. Voltage between Anodes	250	V Max
Peak Anode Current (per anode)	50	A Max
Mean Anode Current (per anode) (averaging time 30sec max)	16·5	A Max
Surge Anode Current (per anode) (0·1sec maximum duration)	500	A Max
Condensed Mercury Temperature (on load)	40	°C Min
	100	°C Max

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ENGLISH ELECTRIC

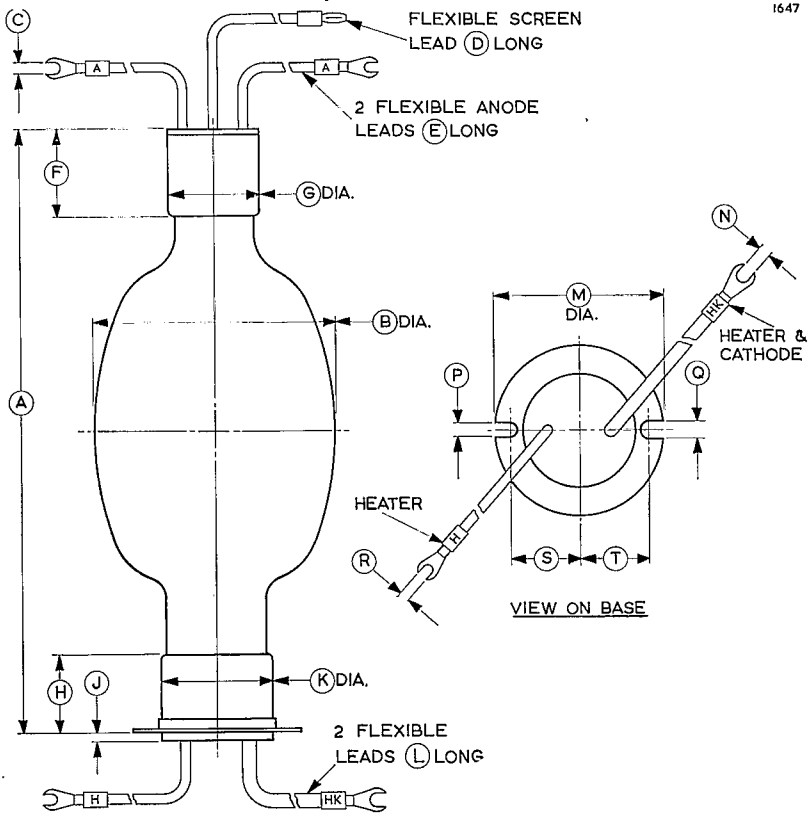
HEATING CHARACTERISTIC



Printed in England

OUTLINE

1647



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	15·625±0·500	396·9±12·70	K	2·875 Max	73·03 Max
B	6·437 Max	163·5 Max	L	7·750±0·250	196·9±6·35
C	0·265	6·73	M	4·375 Max	111·1 Max
D	6·250±0·250	158·8±6·35	N	0·328	8·33
E	7·750±0·250	196·9±6·35	P	0·344	8·74
F	2·250	57·15	Q	0·437	11·10
G	2·875 Max	73·03 Max	R	0·265	6·73
H	2·000	50·80	S	1·813	46·05
J	0·250±0·062	6·35±1·57	T	1·813	46·05

Millimetre dimensions have been derived from inches.

Xenon Filled Rectifiers

June 1965

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

3B22

XENON FILLED RECTIFIER

Service Type CV3815 **American Designation 3B22**

INTRODUCTION

The 3B22 is a hot cathode, full wave, Xenon filled Rectifier with maximum ratings of 725V peak inverse voltage and 4·0A peak current.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	6·25 A	Approx
Min Filament Heating Time	20	secs
Ambient Temperature Range	−55 to +75	°C
Max Peak Inverse Voltage	725	V
Max Anode Current (per anode):		
Peak	4·0	A
Mean (4·5 secs averaging time)	0·5	A
Under Fault Conditions (0·1 second Max duration)	60	A
Max Power Supply Frequency	250	c/s

Mechanical

Overall Length	6·00 inches (153 mm)	Max
Overall Diameter	1·66 inches (42·1 mm)	Max
Net Weight	3 ounces (90 gm)	Approx
Mounting Position		Any
Base	Medium UX4 with bayonet	
Cooling		Natural

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XENON FILLED RECTIFIER

MAXIMUM OPERATING CONDITIONS

(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed H.T. switching

Circuit	* Diagram	Peak Inverse Voltage (up to 250c/s) V	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) V	Max D.C. Output	
			Peak	Mean‡		V	Amps
Single Phase Full Wave	A	725	4	0·5	255	230	1·0
Single Phase Full Wave Bridge	B	725	4	0·5	510	460	1·0
Three Phase Full Wave	D	725	4	0·5	295	690	1·5

* For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

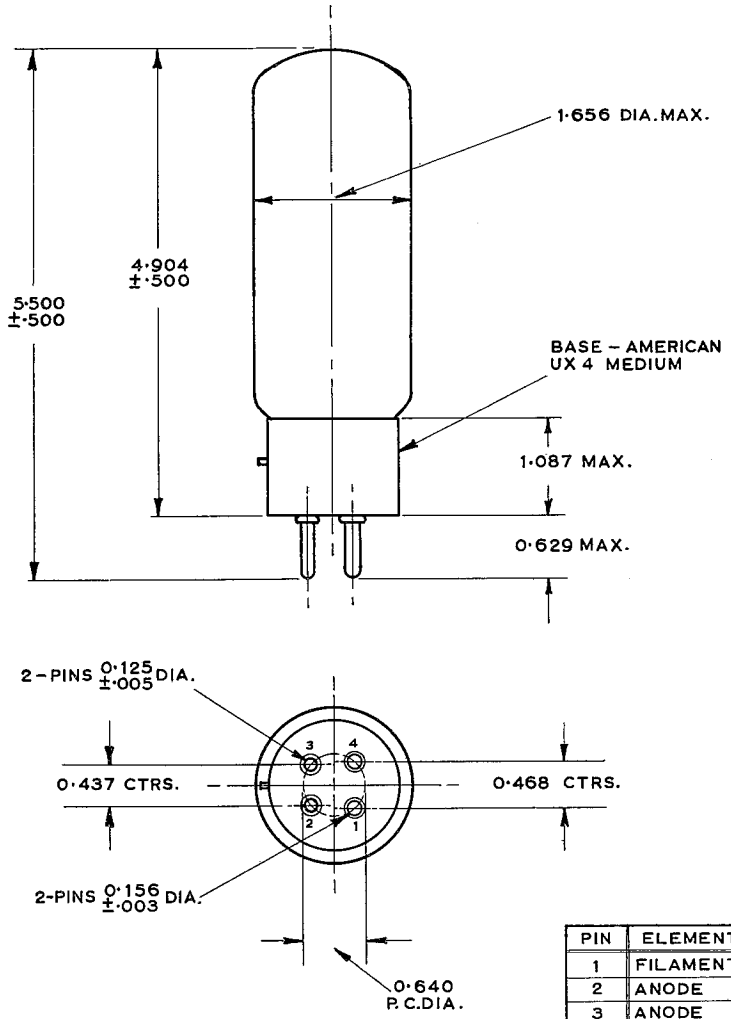
‡Mean anode currents are averaged over any period of 4·5 seconds.

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XENON FILLED RECTIFIER

OUTLINE

496



PIN	ELEMENT
1	FILAMENT
2	ANODE
3	ANODE
4	FILAMENT

ALL DIMENSIONS IN INCHES

XENON FILLED RECTIFIER

3B28
(AX224)

Service Type CV1835 **American Designation 3B28**

INTRODUCTION

The 3B28 is a hot cathode, Xenon filled Rectifier with maximum ratings of 1A peak current at 10kV peak inverse voltage and 2A peak current at 5kV peak inverse voltage.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated		
Filament Voltage	2·5		V
Filament Current	5·0		A
Min Filament Heating Time	10		secs
Ambient Temperature Range	−55 to +75		°C
Max Peak Inverse Voltage	5·0	10·0	kV
Max Anode Current:			
Peak	2·0	1·0	A
Mean‡	0·5	0·25	A
Under fault conditions (0·1 second Max duration)	20	20	A
Max Power Supply Frequency	500	150	c/s

Mechanical

Overall Length	6·16 inches	(156 mm)	Max
Overall Diameter	2·07 inches	(53 mm)	Max
Net Weight	2 ounces	(57 gm)	Approx
Mounting Position	Any		
Base	Medium UX4 with bayonet		
Cooling	Natural		

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed H.T. switching

Circuit	* Diagram	Peak Inverse Voltage kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
			Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	● 10	1	0·25	3·5	3·1	0·5
		△ 5	2	0·5	1·7	1·5	1·0
Single Phase Full Wave Bridge	B	● 10	1	0·25	7·0	6·3	0·5
		△ 5	2	0·5	3·5	3·1	1·0
Three Phase Half Wave	C	● 10	1	0·25	4·1†	4·7†	0·75
		△ 5	2	0·5	2·0†	2·3†	1·5
Three Phase Full Wave	D	● 10	1	0·25	4·1	9·5	0·75
		△ 5	2	0·5	2·0	4·7	1·5

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

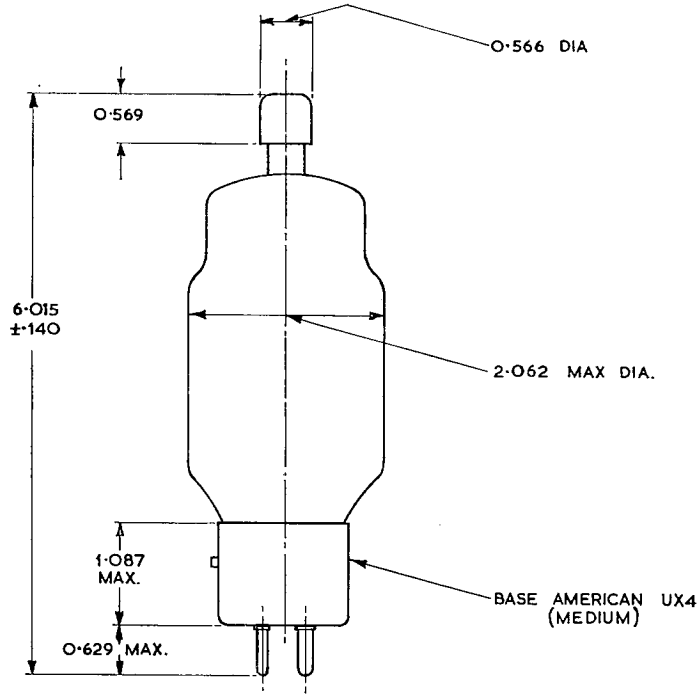
‡Mean anode currents are averaged over any period of 15 seconds maximum.

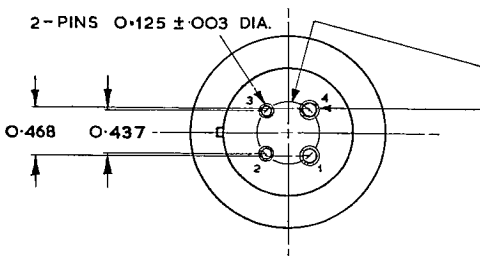
●For operation up to 150c/s.

△For operation up to 500c/s.

OUTLINE

105





PIN	ELEMENT
1	FILAMENT
2	NO CONNECTION
3	NO CONNECTION
4	FILAMENT & SHIELD
CAP	ANODE

ALL DIMENSIONS IN INCHES

Printed in England

XENON FILLED RECTIFIER

4B32
(AX230)

Service Type CV2518 **American Designation 4B32**

INTRODUCTION

The 4B32 is a hot cathode, Xenon filled Rectifier with maximum ratings of 10kV peak inverse voltage and 5A peak current.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	5·0	V
Filament Current	7·1	A
Min Filament Heating Time	30	secs
Ambient Temperature Range	−55 to +70	°C
Max Peak Inverse Voltage	10·0	kV
Max Anode Current:		
Peak	5·0	A
Mean‡	1·25	A
Under fault conditions (0·1 second Max duration)	50	A
Max Power Supply Frequency	150	c/s

Mechanical

Overall Length	8·5 inches	(216 mm)	Max
Overall Diameter	2·32 inches	(59 mm)	Max
Net Weight	8 ounces	(230 gm)	Approx
Mounting Position			Any
Base			B4F
Cooling			Natural

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed H.T. switching

Circuit	* Diagram	Peak Inverse Voltage (up to 150c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
			Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	10	5	1·25	3·5	3·1	2·5
Single Phase Full Wave Bridge	B	10	5	1·25	7·0	6·3	2·5
Three Phase Half Wave	C	10	5	1·25	4·1†	4·7†	3·75
Three Phase Full Wave	D	10	5	1·25	4·1	9·5	3·75

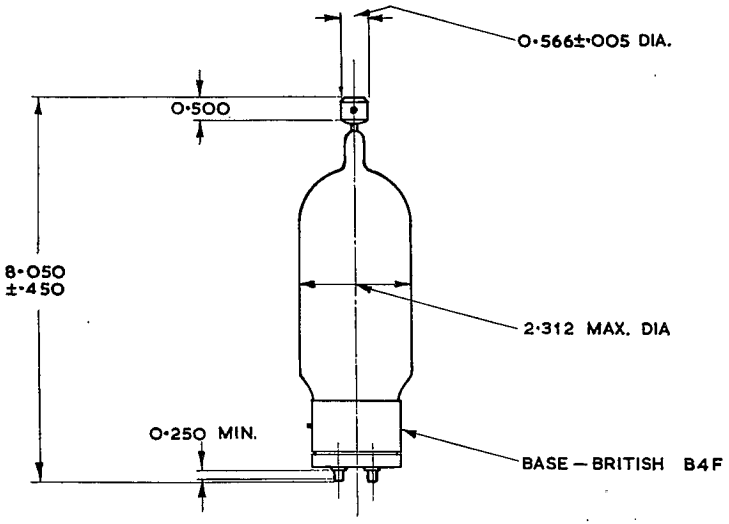
*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

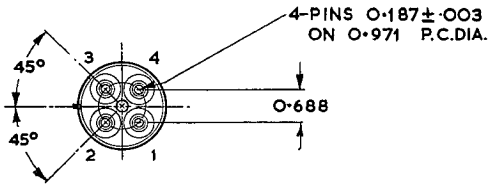
†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum.

OUTLINE

106





PIN	ELEMENT
1	NO CONNECTION
2	FILAMENT
3	NO CONNECTION
4	FILAMENT
CAP	ANODE

ALL DIMENSIONS IN INCHES

TUNGAR RECTIFIER

68504

ENGLISH ELECTRIC

INTRODUCTION

The 68504 is a hot cathode, full-wave, gas-filled Rectifier designed for use in low voltage battery charging equipment.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

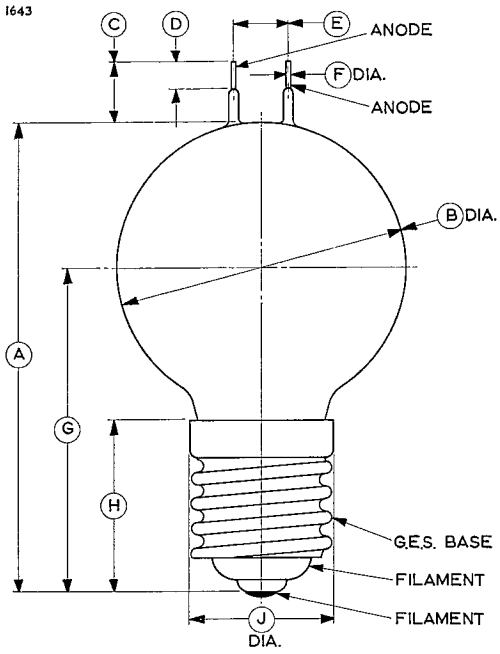
Cathode	Oxide Coated Filament	
Filament Voltage	2·3	V
Filament Current	18±2	A
Cathode Heating Time (Minimum)	30	s
Voltage Drop (Approx)	10	V
Ambient Temperature Range	−55 to +70	°C
D.C. Output as Full-Wave Rectifier:		
Voltage	30	V Max
Current	5·0	A Max

Mechanical

Overall Length	5·71 inches	(145 mm)	Max
Overall Diameter	3·03 inches	(77 mm)	Max
Net Weight	4 ounces	(112 gm)	Approx
Mounting Position			Any
Base			Goliath Edison Screw
Cooling			Convection

ENGLISH ELECTRIC

OUTLINE



Ref.	Inches	Millimetres
A	4·528±0·394	115·0±10·0
B	3·032 Max	77·0 Max
C	0·472±0·197	12·0±5·0
D	0·276 Min	7·0 Min
E	0·492±0·098	12·5±2·5
F	0·059	1·5
G	3·465±0·394	88·0±10·0
H	1·811 Max	46·0 Max
J	1·543 Max	39·2 Max

Inch dimensions have been derived from millimetres.

TUNGAR RECTIFIER

68506

ENGLISH ELECTRIC

INTRODUCTION

The 68506 is a hot cathode, half-wave, gas-filled Rectifier designed for use in low voltage battery charging equipment.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

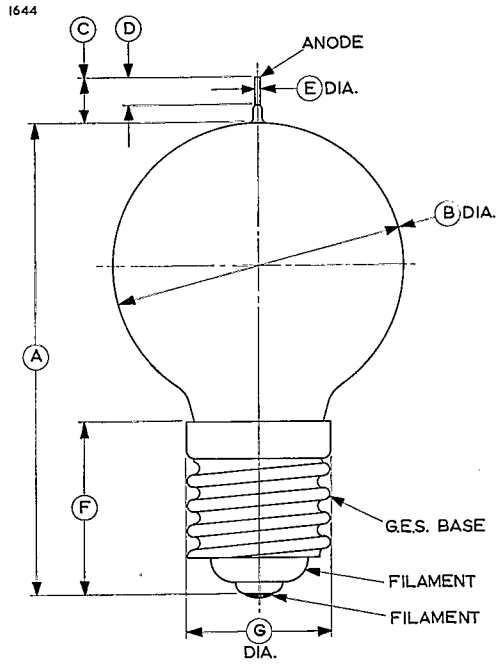
Cathode	Oxide Coated Filament	
Filament Voltage	2·3	V
Filament Current	18±2	A
Cathode Heating Time (Minimum)	30	s
Voltage Drop (Approx)	10	V
Ambient Temperature Range	−55 to +70	°C
D.C. Output as Half-Wave Rectifier:		
Voltage	75	V Max
Current	6·0	A Max

Mechanical

Overall Length	5·71 inches	(145 mm)	Max
Overall Diameter	3·03 inches	(77 mm)	Max
Net Weight	4 ounces	(112 gm)	Approx
Mounting Position			Any
Base			Goliath Edison Screw
Cooling			Convection

ENGLISH ELECTRIC

OUTLINE



Ref.	Inches	Millimetres
A	4·528±0·394	115·0±10·0
B	3·032 Max	77·0 Max
C	0·472±0·197	12·0±5·0
D	0·276 Min	7·0 Min
E	0·059	1·5
F	1·811 Max	46·0 Max
G	1·543 Max	39·2 Max

Inch dimensions have been derived from millimetres.

TUNGAR RECTIFIER

68530

ENGLISH ELECTRIC

INTRODUCTION

The 68530 is a hot cathode, full-wave, gas-filled Rectifier designed for use in low voltage battery charging equipment.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Cathode	Oxide Coated Filament	
Filament Voltage	2·0	V
Filament Current	8±1	A
Cathode Heating Time (Minimum)	30	s
Voltage Drop (Approx)	10	V
Ambient Temperature Range	−55 to +70	°C
D.C. Output as Full-Wave Rectifier:		
Voltage	30	V
Current	6·0	A

Mechanical

Overall Length	5·94 inches	(151 mm)	Max
Overall Diameter	3·19 inches	(81 mm)	Max
Net Weight	4 ounces	(112 gm)	Approx
Mounting Position			Any
Base			Special 4-pin
Cooling			Convection

ENGLISH ELECTRIC VALVE CO. LTD.

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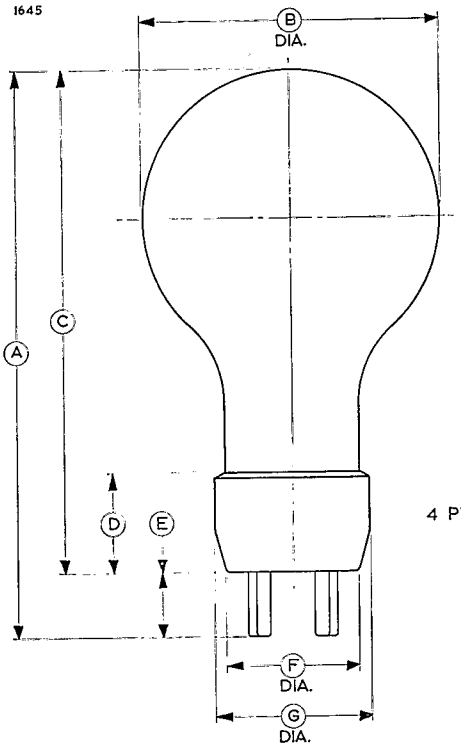
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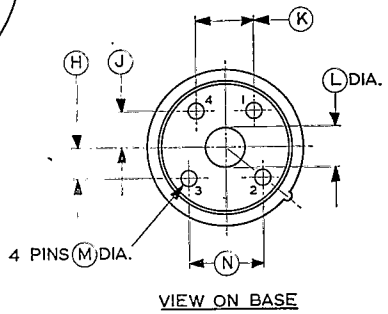
TUNGAR RECTIFIER

68530

ENGLISH ELECTRIC

OUTLINE





VIEW ON BASE

BASE CONNECTIONS

Pin	Element
1	Filament
2	Anode
3	Anode
4	Filament

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	5·688±0·25	144·5±6·35	H	0·312	7·94
B	3·125±0·063	79·38±1·60	J	0·375	9·53
C	5·125±0·125	130·2±3·18	K	0·594	15·09
D	1·062	27·00	L	0·375	9·53
E	0·625	15·88	M	0·156	3·96
F	1·375	34·93	N	0·781	19·84
G	1·625	41·28			

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

Printed in England

AX228

XENON FILLED RECTIFIER

Service Type CV2399

INTRODUCTION

The AX228 is a hot cathode, Xenon filled Rectifier with maximum ratings of 13kV peak inverse voltage and 6A peak current. The AX228 may be used as a replacement for the AH221 in applications where its peak inverse voltage rating is adequate, with the advantage that close control of ambient temperature is not required. →

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament		Oxide Coated	
Filament Voltage		4·0	V
Filament Current		11·0	A
Min Filament Heating Time		30	sec
Ambient Temperature Range		−55 to +70	°C
Max Peak Inverse Voltage	10	13	kV
Max Anode Current:			
Peak	6·0	6·0	A
Mean‡	1·5	1·25	A
Under fault conditions (0·1 second maximum duration)		50	A
Max Power Supply Frequency		150	c/s

Mechanical

Overall Length	10·16 inches	(258 mm)	Max
Overall Diameter	2·32 inches	(59 mm)	Max
Net Weight	8 ounces	(230 gm)	Approx
Mounting Position			Any
Base			Goliath Edison Screw
Cooling			Natural

→ Indicates a change.

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XENON FILLED RECTIFIER

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed h.t. switching

Circuit	* Diagram	Peak Inverse Voltage (up to 150c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
			Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	10	6·0	1·5	3·5	3·2	3·0
		13	6·0	1·25	4·6	4·1	2·5
Single Phase Full Wave Bridge	B	10	6·0	1·5	7·0	6·4	3·0
		13	6·0	1·25	9·2	8·2	2·5
Three Phase Half Wave	C	10	6·0	1·5	4·1†	4·7†	4·5
		13	6·0	1·25	5·3†	6·2†	3·75
Three Phase Full Wave	D	10	6·0	1·5	4·1	9·5	4·5
		13	6·0	1·25	5·3	12·3	3·75

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

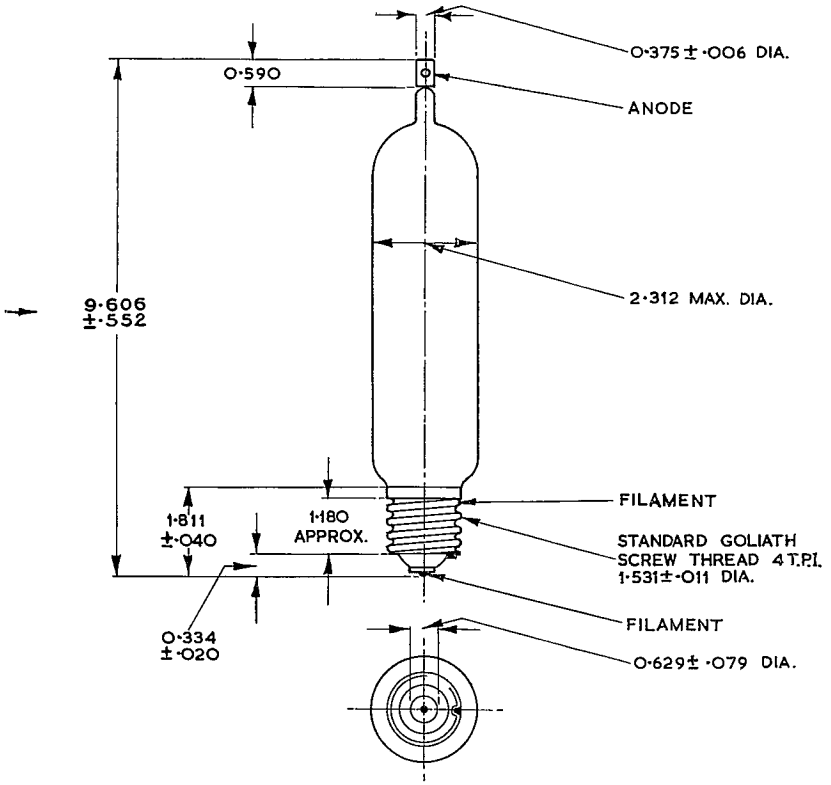
†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The d.c. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum

XENON FILLED RECTIFIER

OUTLINE

497



ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

ENGLISH ELECTRIC VALVE CO. LTD.
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POWER VALVES for Transmitters and R.F. Heaters

PREAMBLE

POWER TRIODES
- Complete list of types
- Natural Cooled
- Forced-air Cooled
- Water Cooled
- Vapour Cooled

POWER TETRODES
- Complete list of types
- Natural Cooled
- Water Cooled

ENGLISH ELECTRIC VALVE CO. LTD.
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TUNGAR RECTIFIER

68530

ENGLISH ELECTRIC

INTRODUCTION

The 68530 is a hot cathode, full-wave, gas-filled Rectifier designed for use in low voltage battery charging equipment.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Cathode	Oxide Coated Filament	
Filament Voltage	2·0	V
Filament Current	8±1	A
Cathode Heating Time (Minimum)	30	s
Voltage Drop (Approx)	10	V
Ambient Temperature Range	−55 to +70	°C
D.C. Output as Full-Wave Rectifier:		
Voltage	30	V
Current	6·0	A

Mechanical

Overall Length	5·94 inches	(151 mm)	Max
Overall Diameter	3·19 inches	(81 mm)	Max
Net Weight	4 ounces	(112 gm)	Approx
Mounting Position			Any
Base			Special 4-pin
Cooling			Convection

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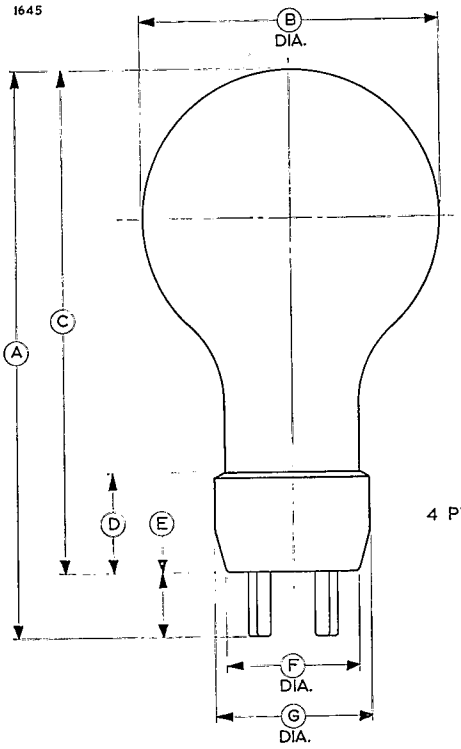
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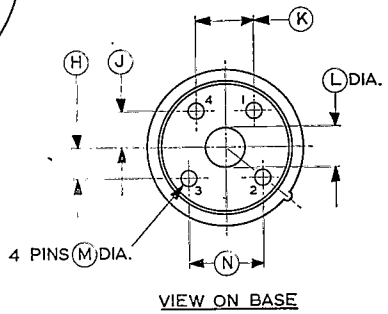
TUNGAR RECTIFIER

68530

ENGLISH ELECTRIC

OUTLINE





VIEW ON BASE

BASE CONNECTIONS

Pin	Element
1	Filament
2	Anode
3	Anode
4	Filament

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	5·688±0·25	144·5±6·35	H	0·312	7·94
B	3·125±0·063	79·38±1·60	J	0·375	9·53
C	5·125±0·125	130·2±3·18	K	0·594	15·09
D	1·062	27·00	L	0·375	9·53
E	0·625	15·88	M	0·156	3·96
F	1·375	34·93	N	0·781	19·84
G	1·625	41·28			

Millimetre dimensions have been derived from inches.

ENGLISH ELECTRIC VALVE CO. LTD.

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6861

LOW NOISE TRAVELLING WAVE TUBE

Service Type CV5362

ABRIDGED DATA

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

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

GENERAL

Electrical

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

Mechanical

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

April 1973

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

No individual rating to be exceeded

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

TYPICAL OPERATION (at 3.1GHz)

Operational Conditions (see note 1)

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

Typical Performance

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

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

Recommended Applied Conditions (see note 1)

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

Range of Characteristics (with recommended applied conditions)

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

NOTES

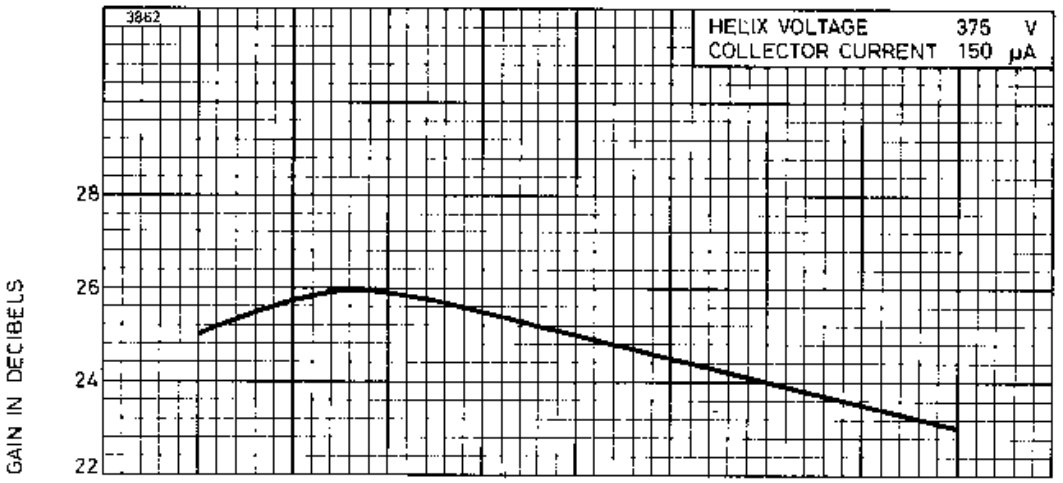
1. All voltages apart from the heater voltage are with respect to the cathode. It may sometimes be convenient to earth the collector and maintain the cathode at a negative potential.
2. During alignment in the magnetic focusing field this maximum value of helix current may be exceeded for short periods,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

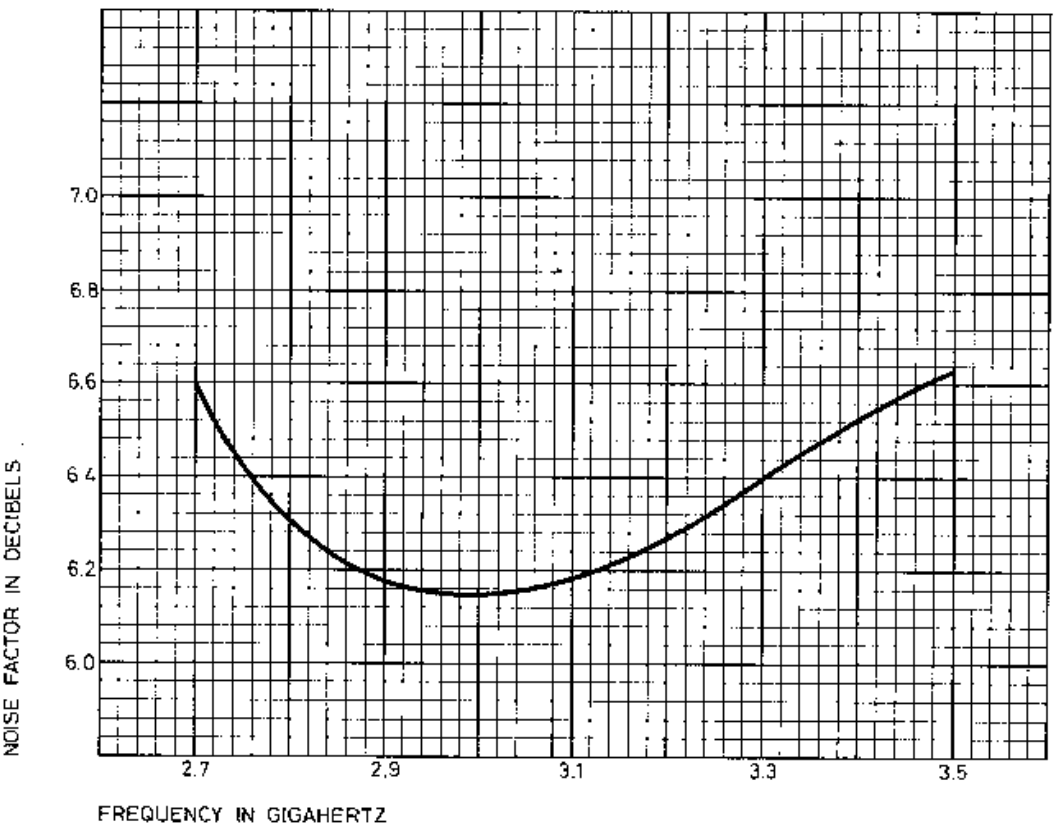
tube in the solenoid. An adjustment of ±0.100 inch (±2.54mm) about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the EEV lightweight solenoid type N4004 is recommended.

10. Tolerance ±5%.

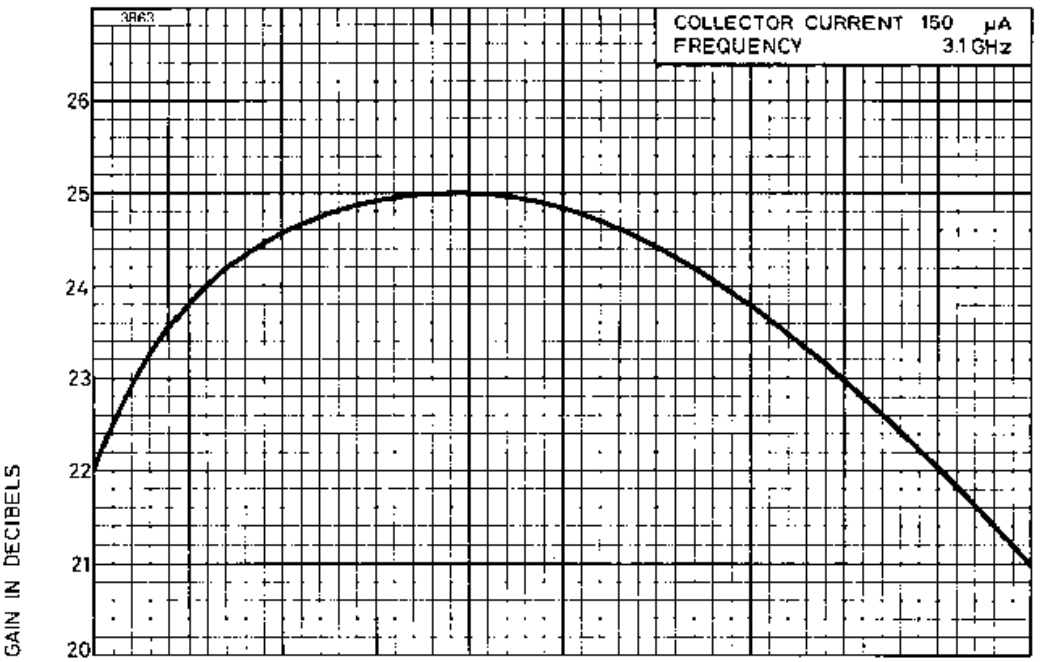
11. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

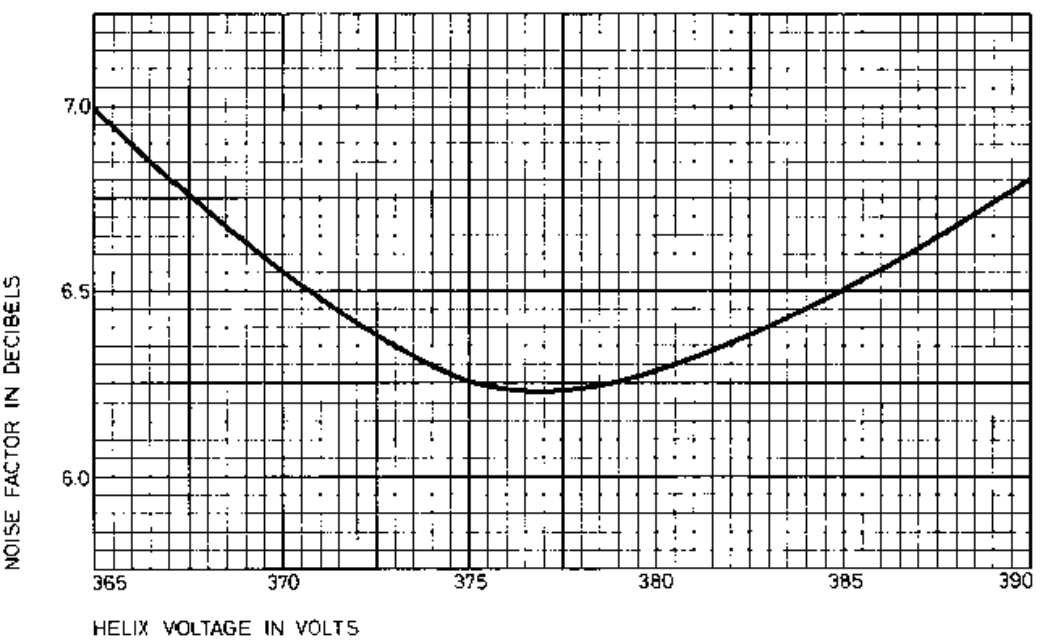
TYPICAL PERFORMANCE CHARACTERISTICS



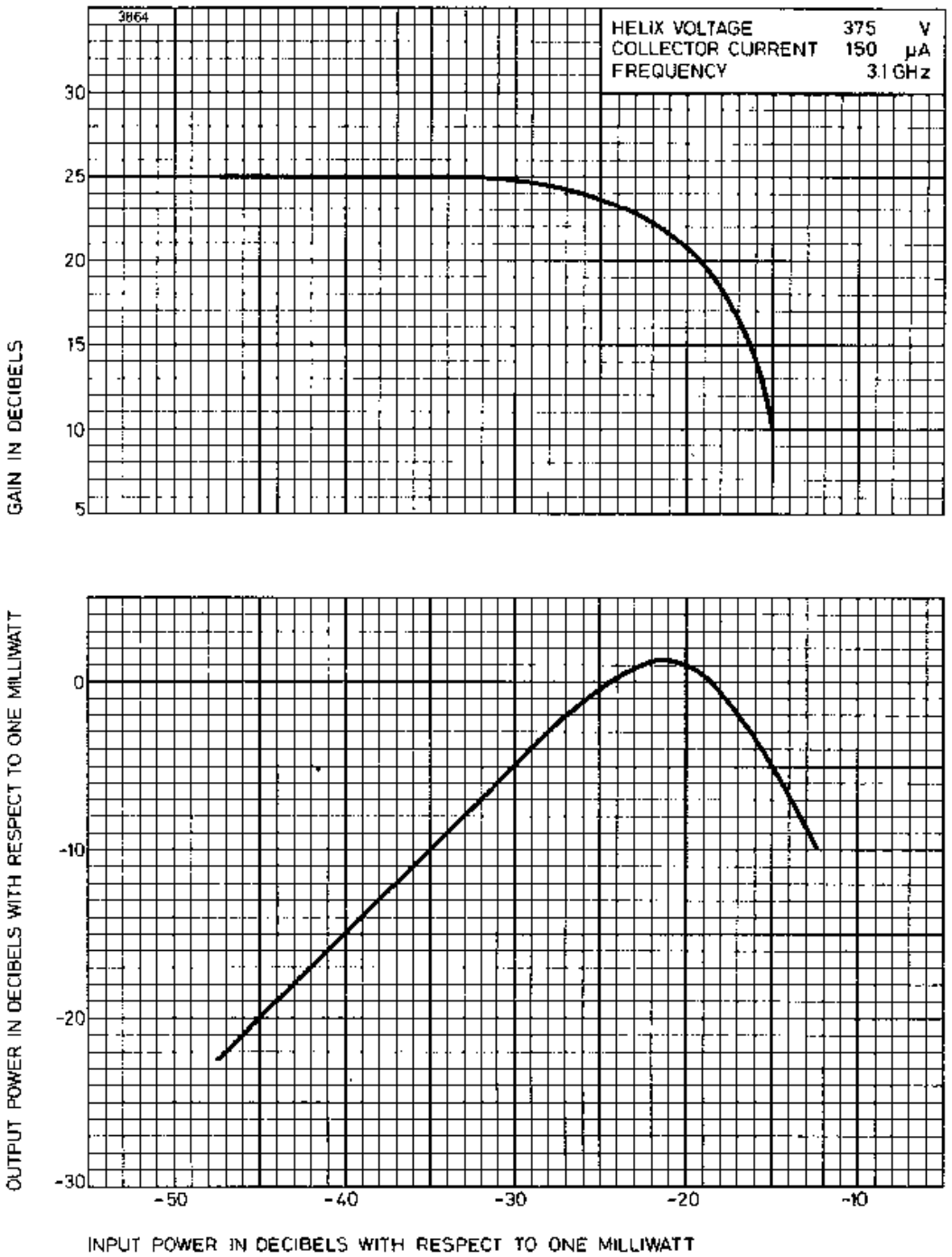


TYPICAL PERFORMANCE CHARACTERISTICS

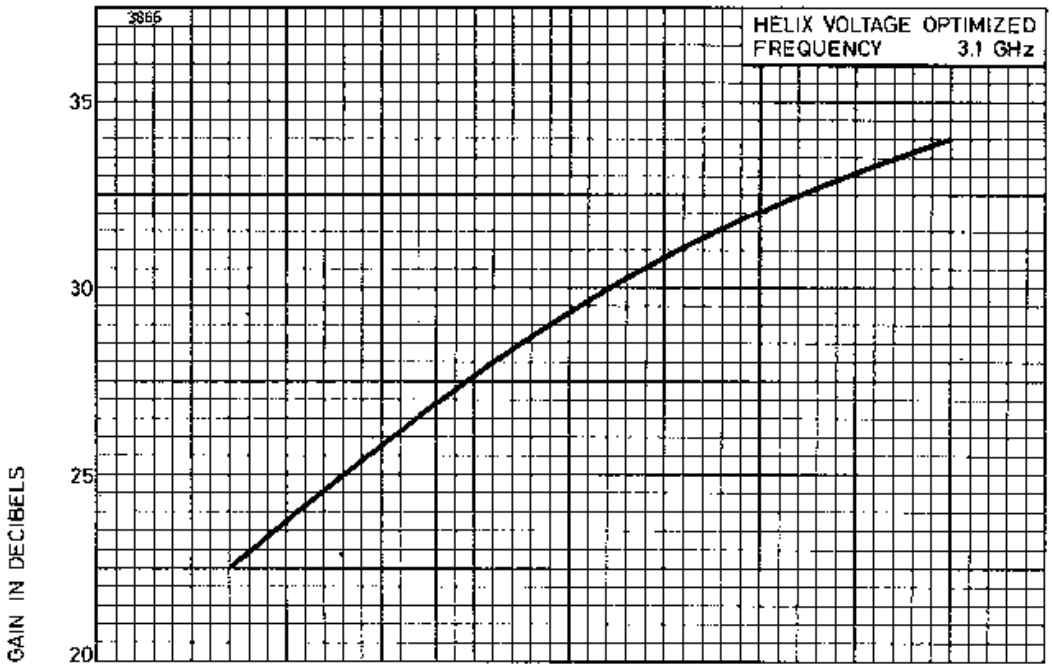


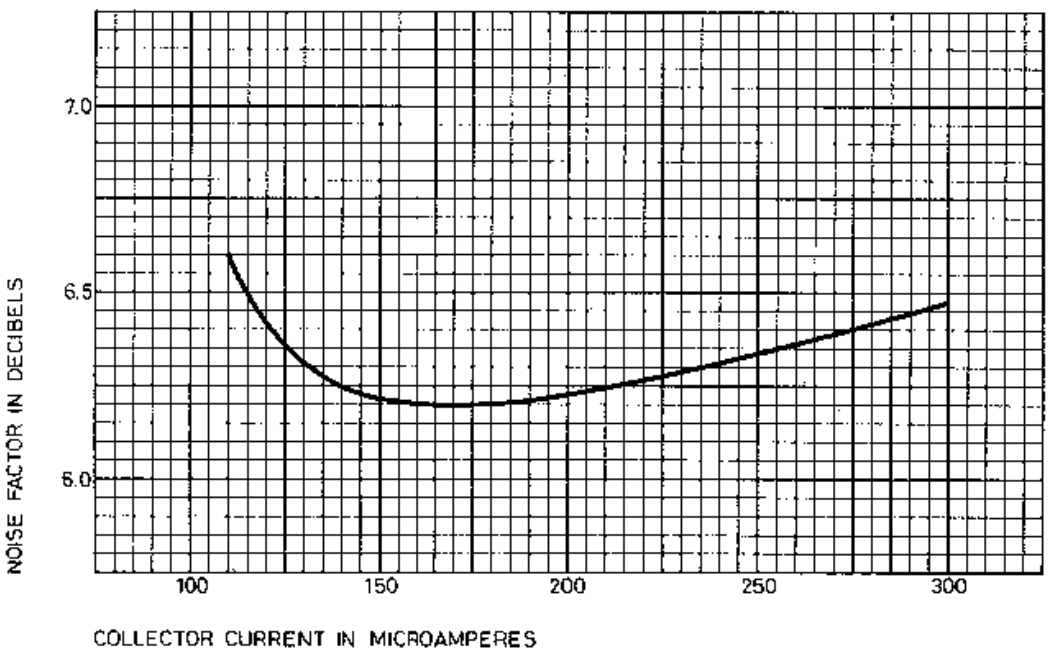


TYPICAL PERFORMANCE CHARACTERISTICS

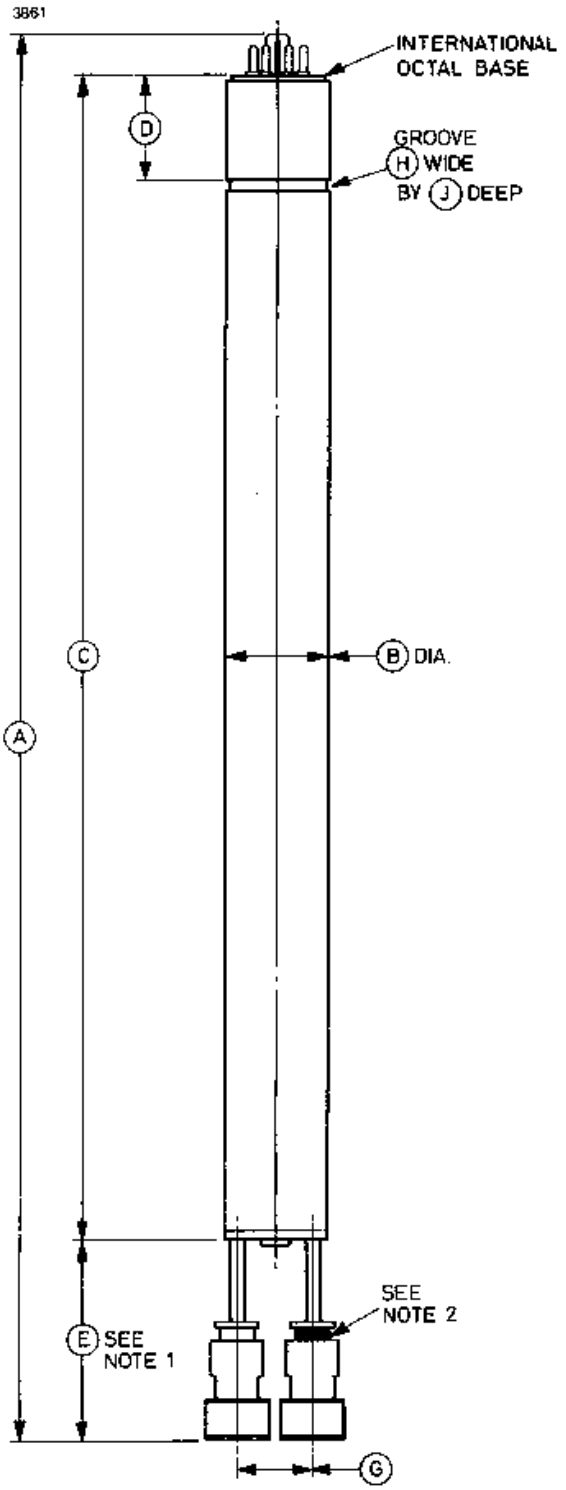


TYPICAL PERFORMANCE CHARACTERISTICS

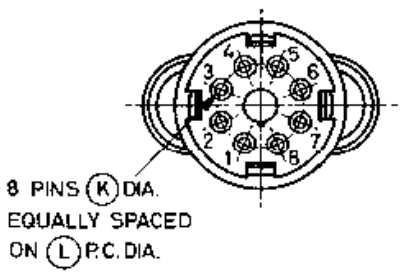




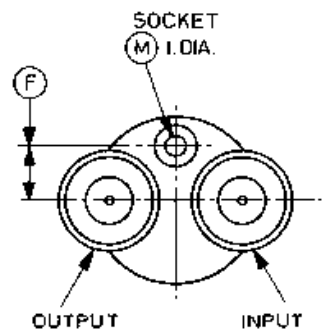
OUTLINE



Enlarged View on Base



Enlarged View on Connectors



Outline Dimensions (All dimensions without limits are nominal)

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

Millimetre dimensions have been derived from inches except dimension M.

Connections

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

Outline Notes

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

Printed in England

MAGNETRON

7182
(M543)

American Designation 7182

INTRODUCTION

The 7182 is a water and forced-air cooled, multi-resonator, pulse operated Magnetron with a peak input power rating of 6MW and operates at a fixed frequency within the limits of 2750 and 2860Mc/s when used under the conditions specified below.

The valve is designed for use with a separate water cooled electro-magnet and waveguide launching section, having dimensions as shown on pages 8 and 9. The user is invited to consult the English Electric Valve Co. Ltd. on the design of magnets.

The launching section is designed for waveguide No. 10 (2·840 inches × 1·340 inches internal dimensions).

The waveguide may be pressurised to 65lb/sq.in. absolute when the leakage will not exceed 0·03 litre (N.T.P.) per minute. The minimum waveguide pressure is 35lb/sq.in. absolute.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	12·0	V
Heater Current	15·0	A
Heater Starting Current:		
Peak Value, not to be exceeded	40	A
Cathode Heating Time (Minimum) (*See Note* 1)	3	minutes

Mechanical

Overall Dimensions	15·32 × 3·26 × 3·26 inches	Max
	390 × 82·9 × 82·9 mm	Max
Net Weight	9¾ pounds (4·5 kg)	Approx
Mounting Position		Vertical only

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

Any lubricants used on the anode should be sulphur free.

Cooling .. .. Water and Forced-air (high pressure)

Water-cooling of the anode is incorporated with the electro-magnet, the window is cooled by air at high pressure in the waveguide, while low pressure air cooling may be used on the cathode terminal. The minimum window cooling air flow is 3cu.ft/minute N.T.P., and the maximum air inlet temperature is 70°C.

The temperature rise across the water jacket should not exceed 15°C nor the ← water flow be less than 0·75 gallon per minute. The design maximum temperature of the outlet water should be 70°C; under no conditions must 80°C be exceeded.

← Indicates a change

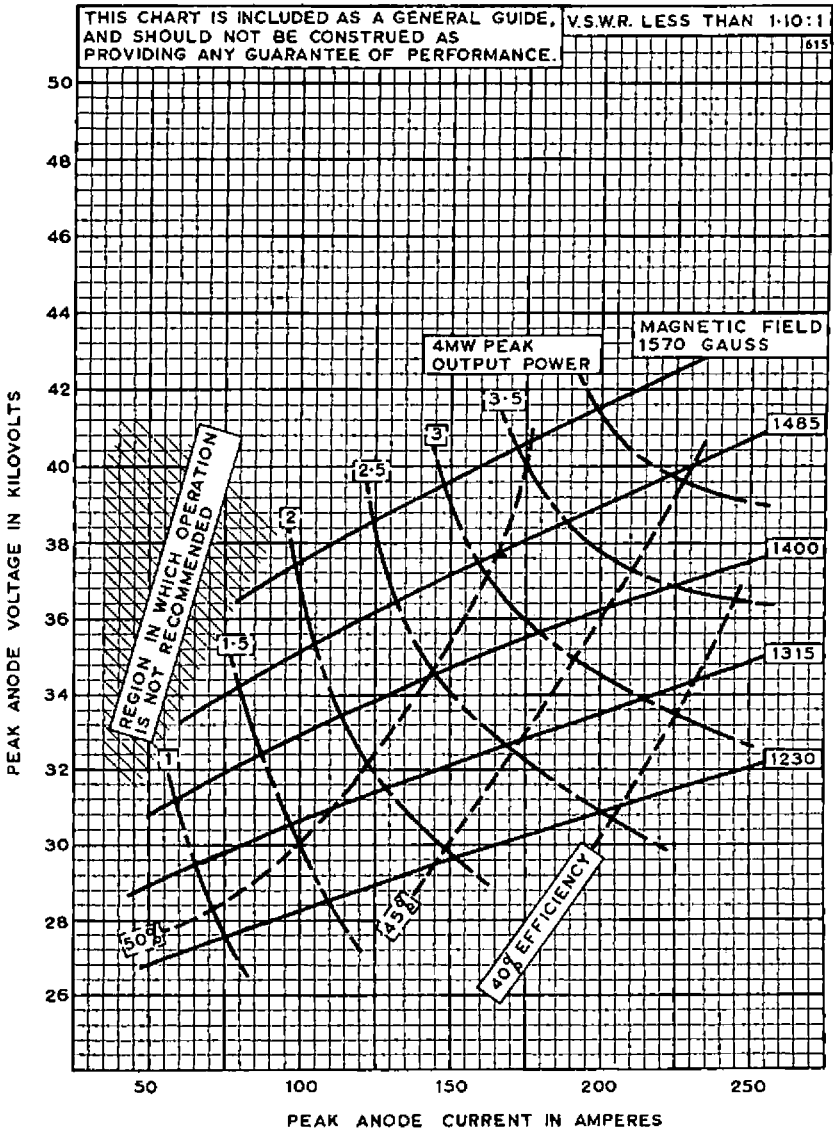
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from JEDEC release #3825, July 23, 1962

MAGNETRON

7182
(M543)

PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

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

	Min	*Max*	
Magnetic Field (*See Note* 3)	1340	1460	Gauss
Heater Voltage (*See Note* 1)	11·4	15·0	V
Heater Current at heater voltage 12·0V ..	13·0	15·0	A
Anode Voltage (Peak)	32	38	kV
Anode Current (Peak)	125	185	A
Input Power (Peak)	—	6	MW
Input Power (Mean) (*See Note* 14)	—	8·5	kW ←
Duty Cycle	—	0·0015	
Pulse Length (*See Note* 2)	0·5	5	μsec
Pulse Repetition Rate	—	600	p.p.s.
Rate of Rise of Voltage Pulse	100	150	kV/μsec
Anode Temperature (*See Note* 3)	—	150	°C
Cathode Terminal Temperature (*See Note* 3)	—	150	°C
Frequency Change with Anode Temperature Change (after warming)	—	−0·05	Mc/s/°C
V.S.W.R. at the output coupler (*See Note* 4) ..	—	1·5:1	

TYPICAL OPERATION

Heater Voltage	0	V
Magnetic Field	1400	Gauss
Anode Voltage (Peak)	35	kV
Anode Current (Peak)	157	A
Pulse Length	5·0	μsec
Pulse Repetition Rate	300	p.p.s. ←
Output Power (Peak)	2·5	MW
Output Power (Mean)	3·75	kW ←

← Indicates a change.

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

	Oscillation 1 (*See Note* 5) (*See Note* 6)	Oscillation 2 (*See Note* 5)	Oscillation 3	
Air Flow				
Magnetic Field (*See Note* 7)	1400	1400	1485	Gauss
Heater Voltage (for test) ..	0	0	0	V
Anode Current (Mean) ..	235	195	213	mA
Duty Cycle	0·0015	0·001	0·0015	
Pulse Length (*See Note* 2) ..	2·5	5·0	5·0	μsec
V.S.W.R. at the output coupler	(*See Note* 8)			
Rate of Rise of Voltage Pulse (*See Note* 9)	72 to 90	150 to 180	113 to 137	kV/μsec

	Limits						
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	
Anode Voltage (Peak) ..	33	37					kV
Output Power (Mean) ..	3375						W
Frequency	2750	2860					Mc/s
R.F. Bandwidth at ½ Power (*See Notes* 10 *and* 11) ..		1·0		0·5		0·5	Mc/s
Frequency Pulling (*See Note* 10)		7					Mc/s
Frequency Pushing (*See Note* 12)		1·0					Mc/s
Stability (*See Notes* 10, 11 *and* 13)		0·5		0·5		0·5	%

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be run continuously under different conditions, the English Electric Valve Co. Ltd. should be consulted to verify that the life of the valve will not be impaired.

Heater Voltage	0	V
Magnetic Field	1400	Gauss
Anode Current (Mean)	235	mA
Duty Cycle	0·0015	
Pulse Length	5	μsec
V.S.W.R. at the output coupler	1·1 : 1	Max
Rate of Rise of Voltage Pulse	113 to 137	kV/μsec

Switched off for 60 minutes every 24 hours.

Printed in England

END OF LIFE CRITERIA
(under Test Conditions Oscillation 1)

Output Power (Mean)	2700	W Min
R.F. Bandwidth at ½ Power (*See Notes* 10 *and* 11) ..	1·0	Mc/s Max
Frequency: Must be within Test Limits above, Oscillation 1		
Stability (*See Notes* 10, 11 *and* 13)	1·0	% Max

NOTES

1. With no anode input power.
   Prior to the application of anode voltage, the cathode shall be heated to the required initial temperature by the application of 12·0 volts to the heater for at least four minutes or by the application of 15·0 volts for three minutes. The heater voltage must not exceed 12·6 volts for longer than five minutes. Immediately after the application of anode voltage, the heater voltage shall be reduced according to the following formulæ:

   $V_h = 12{\cdot}0 - 0{\cdot}0010P_i$ for P_i less than 6000 watts

   $V_h = 30{\cdot}0 - 0{\cdot}0040P_i$ for P_i greater than 6000 watts

   where P_i = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

   The valve is normally tested with a heater supply frequency of 50c/s. The ← English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Tolerance ±10%.

3. Measured at the point specified on the electro-magnet and launching section (page 8).

4. A phase shifter should be incorporated into the waveguide immediately before the magnetron, and adjusted, if necessary, to give a satisfactory spectrum. The standing wave ratio between 3000 and 3100Mc/s should not exceed 2·0 : 1.

5. The modulator shall be such that the pulse energy delivered to the magnetron, followed by an arcing pulse, cannot greatly exceed the normal energy per pulse.

← Indicates a change.

6. During this test the waveguide air pressure shall not exceed 35lb/sq.in. absolute and the cooling air flow shall not exceed 3cu.ft/min free air volume. There shall be no evidence of breakdown in the output waveguide during this test.

7. The value of the axial magnetic field should not vary by more than ±4% from the value at the specified point of the valve, over a distance of 2in. in either direction along the axis. The sense of the field shall be such that a north-seeking pole at the specified point is attracted towards the cathode terminal of the magnetron.

8. The load termination of the magnetron during this test shall be a waveguide with a V.S.W.R. of less than 1·1 : 1 at the oscillation frequency and less than 1·5 : 1 between frequencies 3000 and 3100Mc/s, unless otherwise specified.

9. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude.

10. The valve shall be terminated by a mismatch giving a V.S.W.R. of at least 1·5 : 1 at the oscillating frequency. The mismatch shall be such that when the position of a voltage maximum is set to coincide with the launching section Reference Plane C–C′ (See Page 9) the position of the voltage minimum at a frequency of 3050Mc/s shall lie between ±10mm from the Reference Plane.

11. There shall be a range of at least $\lambda g/4$ where both the stability and bandwidth are less than the specified maxima, and they shall also be less than the maxima into a matched load.

12. The change in frequency when the mean input current is varied between the limits of 220 and 250mA shall be less than 1Mc/s. The current shall be varied continuously between the limits with a period not exceeding 5 seconds.

13. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 2750 to 2860Mc/s. Missing pulses are expressed as a percentage of the number of input pulses applied during any 5 minute interval of a 10 minute test period.

14. The various parameters are related by the formula:

$$P_i = i_{apk} \times Du \times 35 \times 1000$$

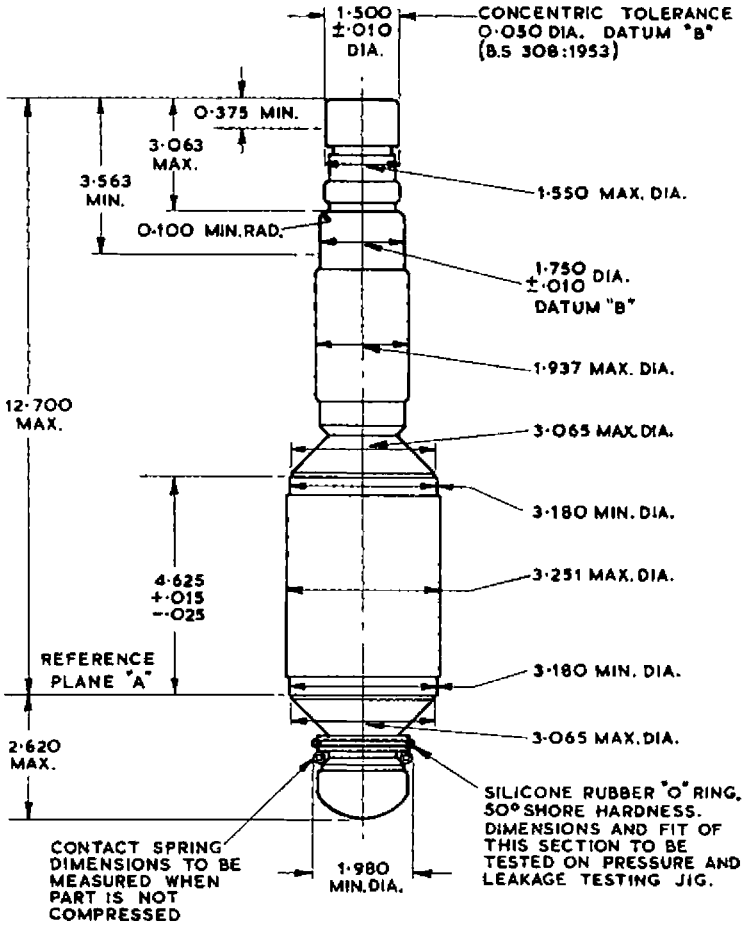
where P_i = mean input power in watts

i_{apk} = peak anode current

and Du = duty cycle.

OUTLINE

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ALL METAL SURFACES WILL BE NICKEL OR SILVER PLATED ←

LIMITS INCLUDE ANGULAR AS WELL AS LATERAL DEVIATIONS.

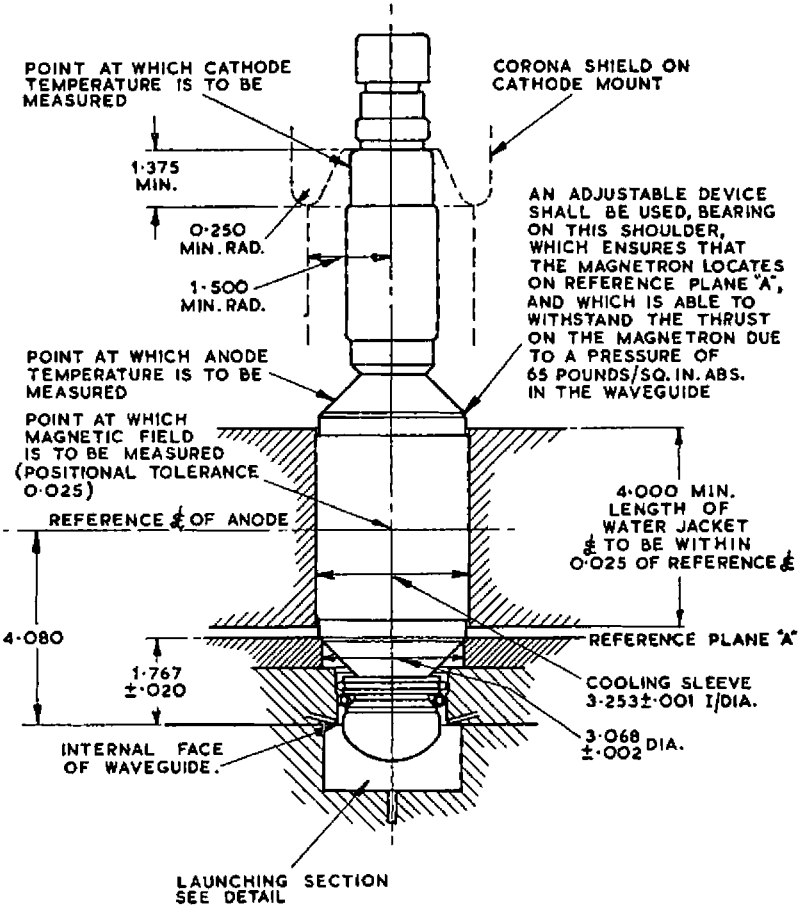
ALL DIMENSIONS IN INCHES

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ELECTRO-MAGNET AND LAUNCHING SECTION

230



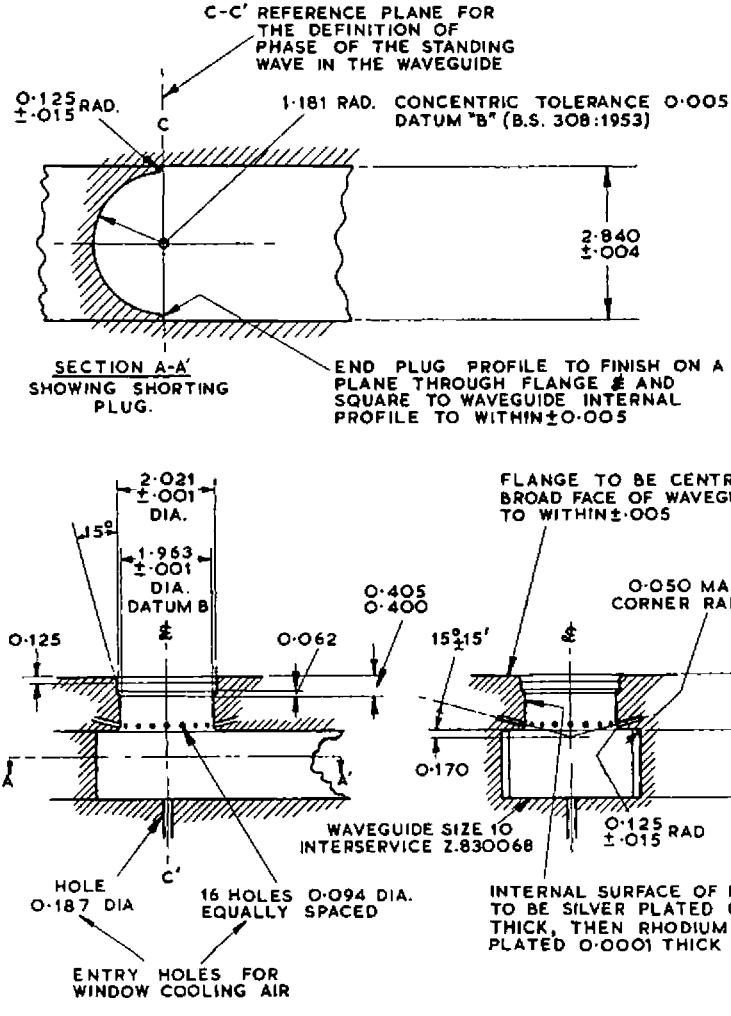
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DIMENSIONS SHOWN WITHOUT TOLERANCE TO BE WITHIN ±·005

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DETAIL OF LAUNCHING SECTION SHOWING MINIMUM REQUIREMENTS FOR INTERNAL PROFILE

120



MATERIAL – BRASS

HYDROGEN THYRATRON (Tetrode)

7384 (CX1119)

INTRODUCTION

The 7384 is a hydrogen-filled tetrode designed for pulse modulation duty where low pulse to pulse jitter and low anode delay time drift are important. By virtue of its good recovery characteristics it is suitable for operation at high pulse repetition rates. The precise triggering associated with these tetrodes enables them to be used in parallel for switching higher powers. They may also be used for switching long pulses provided the mean current rating is not exceeded.

GENERAL DATA

(See also Preamble to Thyratron Section of this catalogue)

Electrical

Cathode (connected internally to mid-point of heater)	Oxide Coated	
Heater Voltage	6·3	V
Heater Current	21·5	A
Cathode Heating Time (Minimum) (*See Note 7*)	5	minutes

Mechanical

Overall Length	12·5 inches	(318 mm)	Max
Overall Diameter	3·32 inches	(84 mm)	Max
Net Weight	1½ pounds	(0·7 kg)	Approx
Mounting Position (Clamping is permissible by the base only)			Any
Base	Pin spacing as B5F. Metal shell with micalex inset		
Top Cap (*See Note 1*)	B.S. 448/CT31		
Cooling	Natural		

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HYDROGEN THYRATRON (Tetrode)

7384 (CX1119)

MINIMUM AND MAXIMUM RATINGS
(Absolute Values)

	Min	*Max*	
Heater Voltage	5·58	6·75	V
Heater Current (at 6·3V)	18	25	A
Cathode Heating Time (*See Note* 7)	5	—	minutes
Ambient Temperature	−55 to +90		°C
Altitude	—	10 000	feet
Grid 1 Drive Pulse (*See Note* 2)	300	750	V
Grid 2 Drive Pulse (*See Note* 3)	200	750	V
Rate of Rise of Grid 1 Pulse (*See Note* 4)	1	—	kV/μsec
Rate of Rise of Grid 2 Pulse (*See Note* 4)	1	—	kV/μsec
Peak Inverse Grid 1 Voltage	—	450	V
Peak Inverse Grid 2 Voltage	—	450	V
D.C. Potential of Grid 1 (*See Note* 5)	−10 to +5		V
D.C. Potential of Grid 2 (*See Note* 5)	−120 to −50		V
Peak Grid 1 Drive Current	0·3	1·0	A
Grid 2 Pulse Delay (*See Note* 6)	0·5	3	μsec
Anode Take Over Voltage (*See Note* 9)	2·0	—	kV
Anode Delay Time (*See Note* 9)	—	0·2	μsec
Anode Delay Time Drift (*See Note* 9)	—	50	milli-μsec
Jitter (*See Note* 9)	—	5	milli-μsec
Peak Forward Anode Voltage (*See Note* 7)	—	25	kV
Peak Inverse Anode Voltage (*See Note* 8 *and Preamble*)	—	25	kV
Mean Anode Current	—	1·25	A
Peak Anode Current	—	1000	A
→ If the Pulse Repetition Rate is limited to 50 p.p.s. Max, then the Peak Anode Current may be increased to 2000A Max.			
Rate of Rise of Anode Current	—	5000	A/μsec
Heating Factor	—	$6{\cdot}25 \times 10^9$	V.A.p.p.s.
Recovery Time (*See Note* 3)	—	20	μsec

→ Indicates a change

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NOTES

1. A large area anode connector such as Ediswan Clix T.C. 833 is recommended.
2. The trigger pulse should be measured at the valve socket with the thyratron removed. The pulse length should be 1 μsec minimum at the 300 volt level and should overlap by 0·25 μsec minimum the 200 volt level of the Grid 2 pulse. The impedance of the trigger circuit should be such that for the grid 1 pulse at a drive voltage within the stated limits the peak current will be within the limits given. The D.C. resistance must not exceed 2000 ohms.
3. The trigger pulse should be measured at the valve socket with the thyratron removed. The pulse length should be 0·5 μsec minimum at the 200 volt level. The impedance of the trigger circuit should be in the range 50 to 800 ohms for the duration of the pulse. The D.C. resistance, calculated from the reduction in bias voltage at the grid terminal when a direct current of 5mA is being drawn, must not exceed 2000 ohms.

   When the shortest recovery time is required it is important that the impedance of the trigger pulse generator be low throughout the recovery period. This impedance is defined as

$$\frac{e_{g2}-E_{cc2}}{i_{c2}}$$

   and must not exceed 1000 ohms, if the recovery time is to be within the limit stated.

   e_{g2} is the value of the Grid 2 voltage at any instant during the recovery period,

   i_{c2} is the value of the Grid 2 current at the same instant and

   E_{cc2} is the Grid 2 bias supply voltage

   Improved recovery time will be obtained if this latter impedance is reduced. A safe rule when a pulse transformer is used is to make the sum of the values of the secondary shunting resistor and the grid series resistor less than the limit stated for the recovery impedance.
4. The instantaneous rate of rise of voltage must not be less than the given values between the 50V and 300V levels (Grid 1 pulse) and between the 0 and 200V levels (Grid 2 pulse) relative to the cathode.
5. The limits apply to the potential of the grid during the period between the completion of recovery and the commencement of the succeeding grid pulse. No external bias may be applied to grid 1. Negative bias must be applied to Grid 2 to bring the D.C. potential at the grid during this period to within the limits stated.

6. Grid 2 pulse delay is defined as the time delay of the Grid 2 pulse after the Grid 1 pulse, measured at the 300V and 200V levels of the leading edges of the Grid 1 and Grid 2 pulses respectively. The measurement must be made with respect to the cathode at the valve socket with the thyratron removed.

7. To obtain best results in respect of anode delay time, drift and jitter the peak forward voltage should be greater than 6kV.
   The maximum permissible peak forward voltage for instantaneous starting is 18·0kV and must not be attained in less than 40 milli-seconds after a preheating period of 15 minutes.

8. The peak inverse voltage must not exceed 5kV for the first 25 micro-seconds after the anode pulse. See also under 'Effect of Load' in preamble.

9. These are test figures. Better values can generally be expected under normal triggering conditions.

→ **X-Ray Warning**

X-rays are produced when the 7384 is operated with a forward or peak inverse anode voltage above 16 kV (absolute value). These rays can constitute a health hazard unless the valve 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 valve.

→ Indicates a change

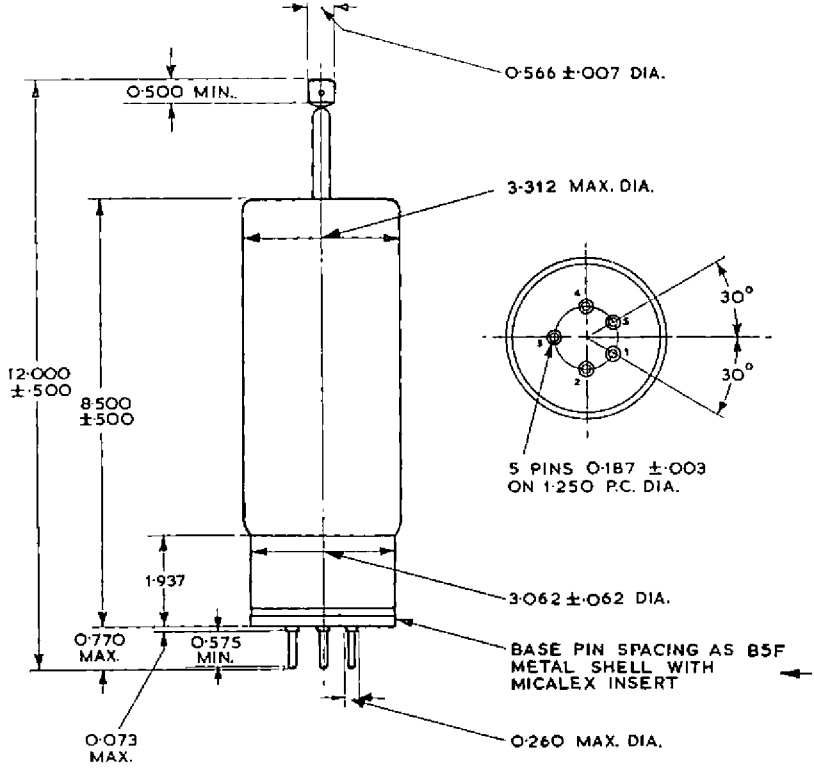
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HYDROGEN THYRATRON (Tetrode)

7384 (CX1119)

June 1959 Page 5

OUTLINE



516

PIN	ELEMENT
1	HEATER
2	CATHODE AND HEATER CENTRE TAP
3	GRID No 2
4	GRID No 1
5	HEATER
CAP	ANODE

←—INDICATES A CHANGE

ALL DIMENSIONS IN INCHES

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8503

HYDROGEN THYRATRON

Service Type CV6022

The data to be read in conjunction with the Hydrogen Thyratron Preamble.

ABRIDGED DATA

Hydrogen-filled triode thyratron, positive grid, for pulse operation. A hydrogen reservoir is incorporated. Electrically superior to 5C22 and ruggedized to meet the requirements of airborne applications. Environmental tests applied to the tube include linear acceleration at 12g, and vibration at ¼g minimum acceleration and 150Hz frequency or at the frequency of maximum resonance in the range between 10 and 150Hz.

Peak forward anode voltage	16	kV max
Peak anode current	325	A max
Average anode current	250	mA max
Anode heating factor	3.9×10^9	V.A.p.p.s. max
Peak output power	2.6	MW max

GENERAL

Electrical

Cathode (connected internally to one end of heater)		oxide coated
Heater voltage	6.3 + 7.5%	V
Heater current	10.6	A
Tube heating time (minimum)	3.0	min

Mechanical

Overall length	8.750 inches (222.3mm) max
Overall diameter	2.563 inches (65.1mm) max
Net weight	12 ounces (350g) approx
Mounting position	any
Clamping	see note 1
Base	B4D, bayonet
Top cap	B.S.448-CT3

Cooling natural

PULSE MODULATOR SERVICE

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Anode			
Peak forward anode voltage (see note 2)	–	16	kV
Peak inverse anode voltage (see note 3)	–	16	kV
Peak anode current	–	325	A
Average anode current	–	250	mA
Rate of rise of anode current (see note 4)	–	1500	A/μs
Anode heating factor	–	3.9×10^9	V.A.p.p.s.
Grid			
Unloaded grid drive pulse voltage (see note 5)	200	–	V
Grid pulse duration	2.0	–	μs
Rate of rise of grid pulse (see note 4)	180	–	V/μs
Peak inverse grid voltage	–	200	V
Loaded grid bias voltage	0	–120	V
Forward impedance of grid drive circuit	50	500	Ω
Cathode			
Heater voltage	$6.3 \pm 7\frac{1}{2}\%$		V
Tube heating time	3.0	–	min
Environmental			
Environmental performance			see note 6
Ambient temperature	–50	+90	°C
Altitude	–	10 000	ft
	–	3	km

CHARACTERISTICS

	Min	Typical	Max	
Critical d.c. anode voltage for conduction (see note 7)	–	0.3	1.0	kV
Anode delay time (see notes 7 and 8)	–	0.3	0.65	μs
Anode delay time drift (see notes 7 and 9)	–	0.05	0.1	μs
Time jitter (see notes 7 and 10)	–	3.0	5.0	ns
Recovery time			see note 11 and curves	
Heater current (at 6.3V)	9.6	10.6	11.6	A
Additional tests				see note 12

NOTES

1. The tube should preferably be clamped by the base only. Any clamps used on the bulb must not extend beyond 4¼ inches (108mm) above the top of the base and should be made from material of low thermal • conductivity.
2. This is the maximum forward hold-off voltage imposed on the thyratron in a pulse modulator circuit. Tubes are tested at 18kV peak forward anode voltage, with the charging reactor inductance and pulse forming network capacitance resonant at 1000p.p.s. For instantaneous starting applications the maximum permissible peak forward voltage is 13.5kV; this must not be reached in less than 0.04 second and there must be no overshoot.
3. In pulsed operation the peak inverse anode voltage, exclusive of a spike of 0.05 microsecond duration, must not exceed 5.0kV during the first 25 microseconds after the pulse.
4. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
5. Measured with respect to cathode potential.
6. All tubes are subjected to an acceleration of 10g at 50Hz before testing. In addition, samples are tested under the following conditions:

   (a) **Linear Acceleration** 12g (min) is applied and maintained for 1 minute at right angles to and in each direction along the major axis of the tube. A heater voltage of 6.3V is applied during the test.

   (b) **Resonance Search** Vibration is applied in two mutually perpendicular directions, one of which is parallel to the longitudinal axis of the tube. The frequency is swept at a rate not exceeding one octave per minute between 10 and 150Hz, with accelerations of ¼g (min). All resonances detectable visually or electrically are noted for information and also for use in test (c). Normal operating voltages are applied during the test.

   (c) **Vibration Fatigue** Each tube is subjected to vibration for two periods of ten hours. In one period the direction of vibration is parallel to the longitudinal axis of the tube, and in the other the direction is perpendicular to the longitudinal axis of the tube.

The acceleration is ¼g and the frequency is that of the strongest resonance detected during the resonance search. If no resonances were detected in the search, then a frequency of 150Hz is used. A heater voltage of 6,3V is applied during the test.

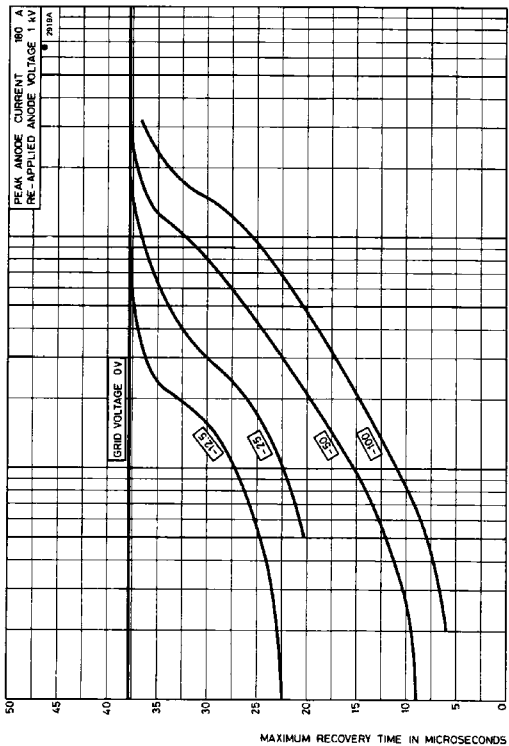
Tubes must pass operational tests after the above procedure has been completed.

7. The typical figures are obtained on test using conditions of minimum grid drive. Improved performance can be expected by increasing the grid drive.
8. The time interval between a point on the leading edge of the unloaded grid pulse at 25% of the pulse amplitude and the point where anode conduction takes place.
9. Normally taken as the drift in delay time over a 5-minute run at full ratings between the second and seventh minutes of operation.
10. The variation of firing time measured at 50% of current pulse amplitude.
11. The recovery characteristics are controlled on a sampling basis.
12. In addition to operational testing at pulse repetition rates of 800 and 1000p.p.s. on all tubes, an additional test at 2500p.p.s., 12.5kV, is performed on a sampling basis.

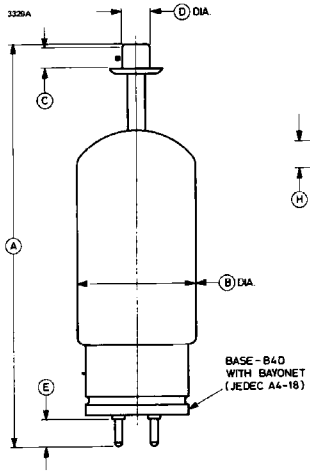
X-RAY WARNING

X-rays are emitted by the 8503 from the region of the anode, but the radiation is usually reduced to a safe level by the metal panels of the equipment in which the tube operates.

MAXIMUM RECOVERY CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	8.500 ± 0.250	215.9 ± 6.4
B	2.563 max	65.10 max
C	0.375 min	9.53 min
D	0.566 ± 0.007	14.38 ± 0.18
E	0.625	15.88
F	0.187 ± 0.003	4.750 ± 0.076
G	1.000	25.40
H	0.562	14.27
J	0.750	19.05

Millimetre dimensions have been derived from inches.

Pin	Element
1	Grid
2	Heater, cathode
3	Heater
4	Cathode
Top cap	Anode

English Electric Valve Company Limited
Chelmsford, Essex, England

MERCURY VAPOUR RECTIFIER

869B

American Designation 869B

INTRODUCTION

The 869B is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 10A peak current. It will provide a d.c. output of 19kV 7·5A in a three phase full wave circuit.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated
Filament Voltage	5·0 V
Filament Current	19 A
Filament Heating Time	1 Minute
Condensed Mercury Temperature	(*See page* 2)
Maximum Peak Inverse Voltage	(*See page* 2)
Maximum Anode Current:	
Peak	(*See page* 2)
Mean (30 secs Max averaging time)	(*See page* 2)
Under fault conditions (0·1 second Max duration)	100 A

Mechanical

Overall Length	14·44 inches (366·7 mm)	Max
Overall Diameter	5·125 inches (130·2 mm)	Max
Net Weight	1¾ pounds (800 gm)	Approx
Mounting Position		Vertical, base down
Cap		JEDEC No. C1-9
Base	3-Pin Jumbo (JEDEC No. A3-20)	

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	20	10	2·5	7·0	6·3	5·0
		30–50	15	10	2·5	5·3	4·7	5·0
		30–60	10	10	2·5	3·5	3·1	5·0
Single Phase Full Wave Bridge	B	30–40	20	10	2·5	14·0	12·6	5·0
		30–50	15	10	2·5	10·6	9·5	5·0
		30–60	10	10	2·5	7·0	6·3	5·0
Three Phase Half Wave	C	30–40	20	10	2·5	8·1†	9·5†	7·5
		30–50	15	10	2·5	6·1†	7·1†	7·5
		30–60	10	10	2·5	4·1†	4·7†	7·5
Three Phase Full Wave	D§	30–40	20	10	2·5	8·1	19·0	7·5
		30–50	15	20	5	6·1	14·2	15·0
		30–60	10	20	5	4·1	9·5	15·0

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The d.c. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 30 seconds maximum.

§With filament and anode supplies out of phase (60°–120°).

X-RAY WARNING

X-rays are produced when the 869B is operated with a peak inverse anode voltage above 16kV (absolute value). These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the valve.

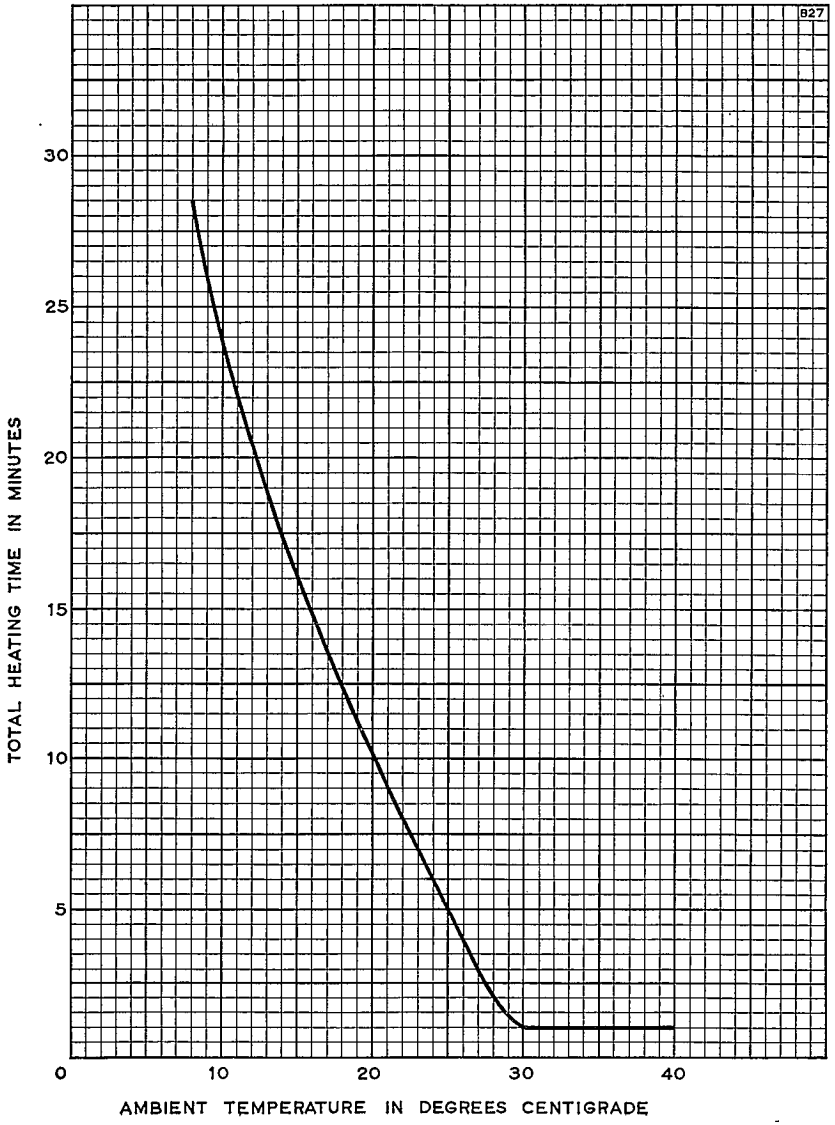
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TOTAL HEATING TIME CHARACTERISTIC



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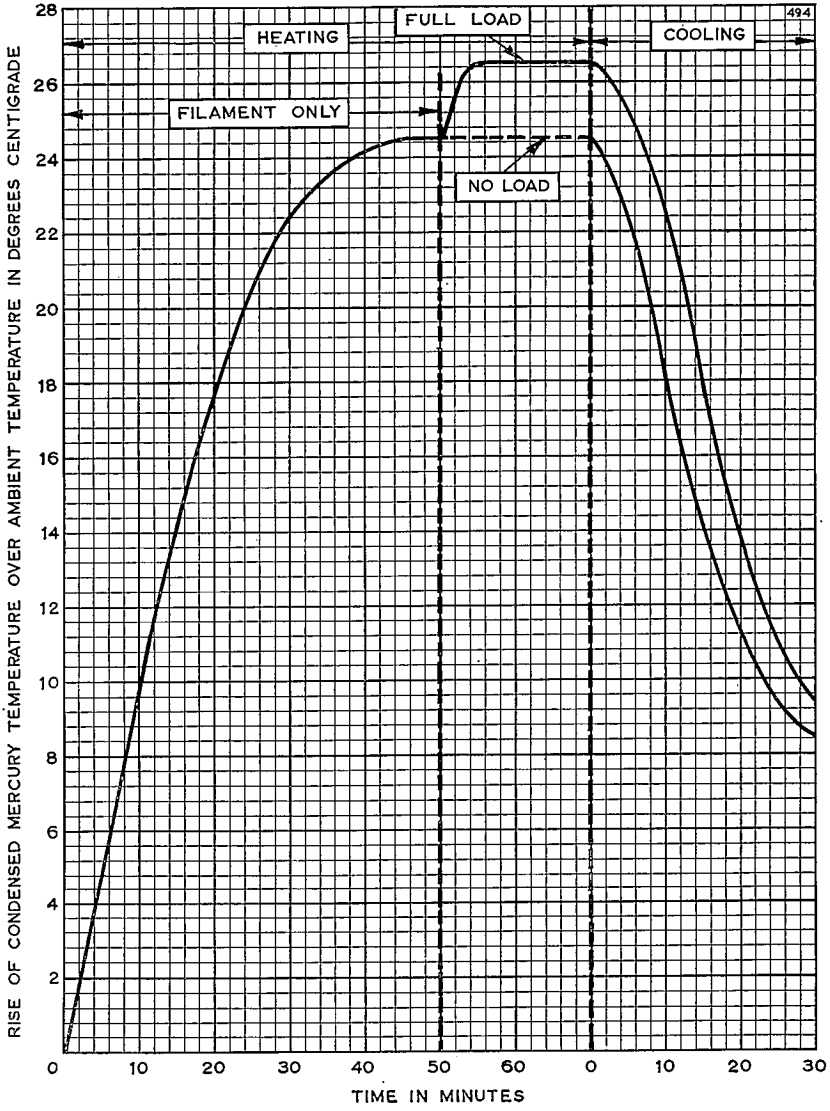
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ENGLISH ELECTRIC

HEATING AND COOLING CHARACTERISTIC



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A207

HIGH VACUUM RECTIFIER

Service Types CV2160, CV8051

To be read in conjunction with the Rectifier and Thyratron Preamble.

DESCRIPTION

High vacuum half-wave rectifier.

MAXIMUM RATINGS

Peak inverse anode voltage	45	kV max
Peak anode current	1.1	A max
Mean anode current	350	mA max
Anode dissipation	130	W max
Bulb temperature	200	°C max

GENERAL DATA

Electrical

Filament	thoriated tungsten	
Filament voltage	4.0	V
Filament current	12	A
Nominal impedance (at 300mA)	600	Ω

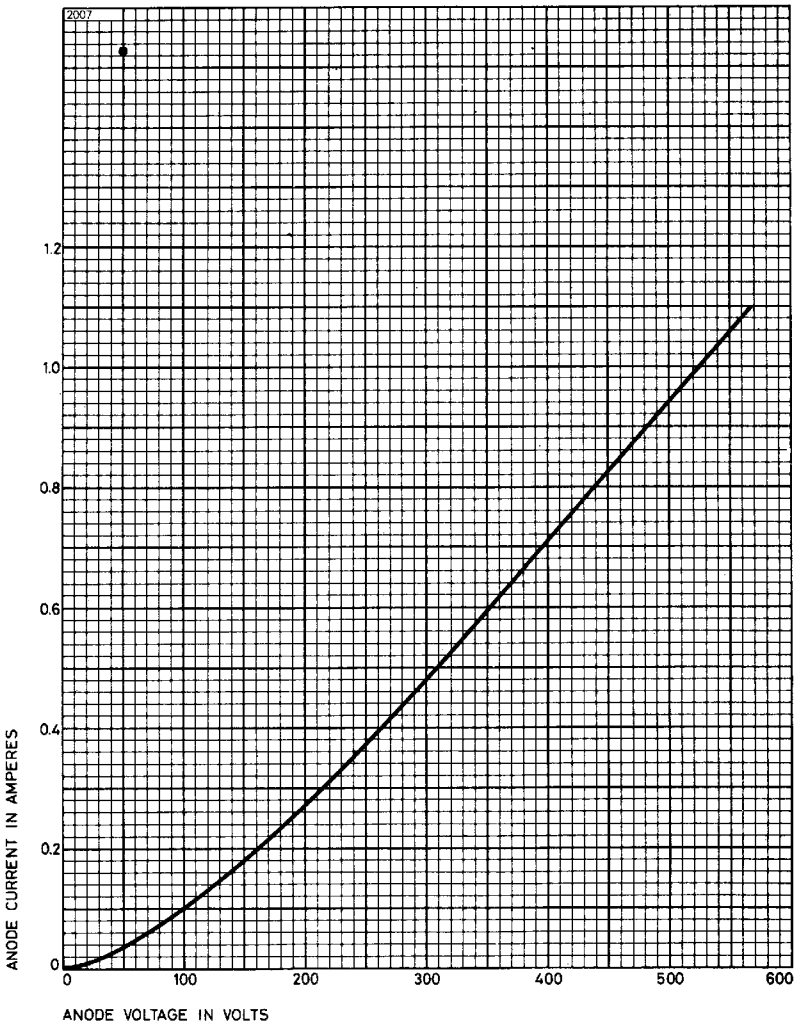
Mechanical

Overall length	9.842 inches (250mm) max
Overall diameter	2.362 inches (60mm) max
Net weight	11 ounces (310g) approx
Mounting position	vertical, base up or down
Base	Goliath Edison screw E40/45
Cooling	natural

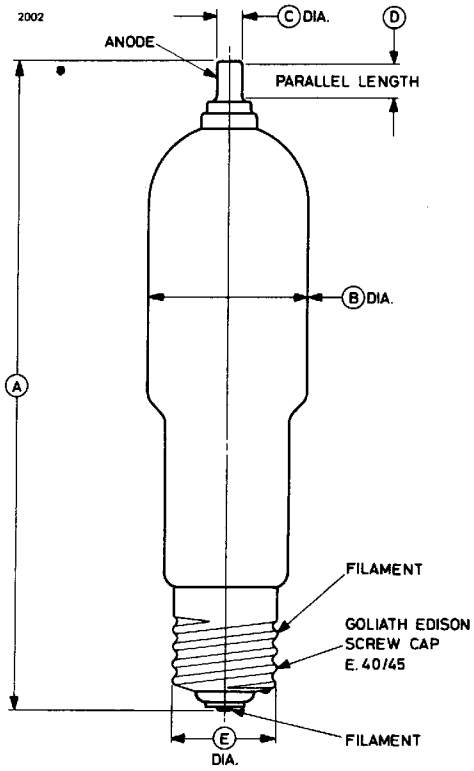
X-ray Warning

X-rays are emitted from the A207 if the peak inverse anode voltage exceeds 16kV. These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

TYPICAL ANODE CHARACTERISTIC



OUTLINE



Ref	Inches	Millimetres
A	9.842 max	250.0 max
B	2.362 max	60.0 max
C	0.375 ± 0.002	9.525 ± 0.051
D	0.500 min	12.70 min
E	1.531	38.89

Millimetre dimensions have been derived from inches.

HIGH VACUUM RECTIFIER

A235

November 1957 Page 1

American Equivalent 2–25A

INTRODUCTION

The A235 is a high vacuum rectifier with maximum ratings of 25kV peak inverse voltage and 500mA peak anode current. Small size and low filament power requirements make it suitable for a variety of high voltage applications.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Thoriated Tungsten	
Filament Voltage	6·3	V
Filament Current	3·0	A
Max Peak Inverse Voltage	25	kV
Max Anode Dissipation	15	W
Max Anode Current:		
Peak	500	mA
Mean	50	mA

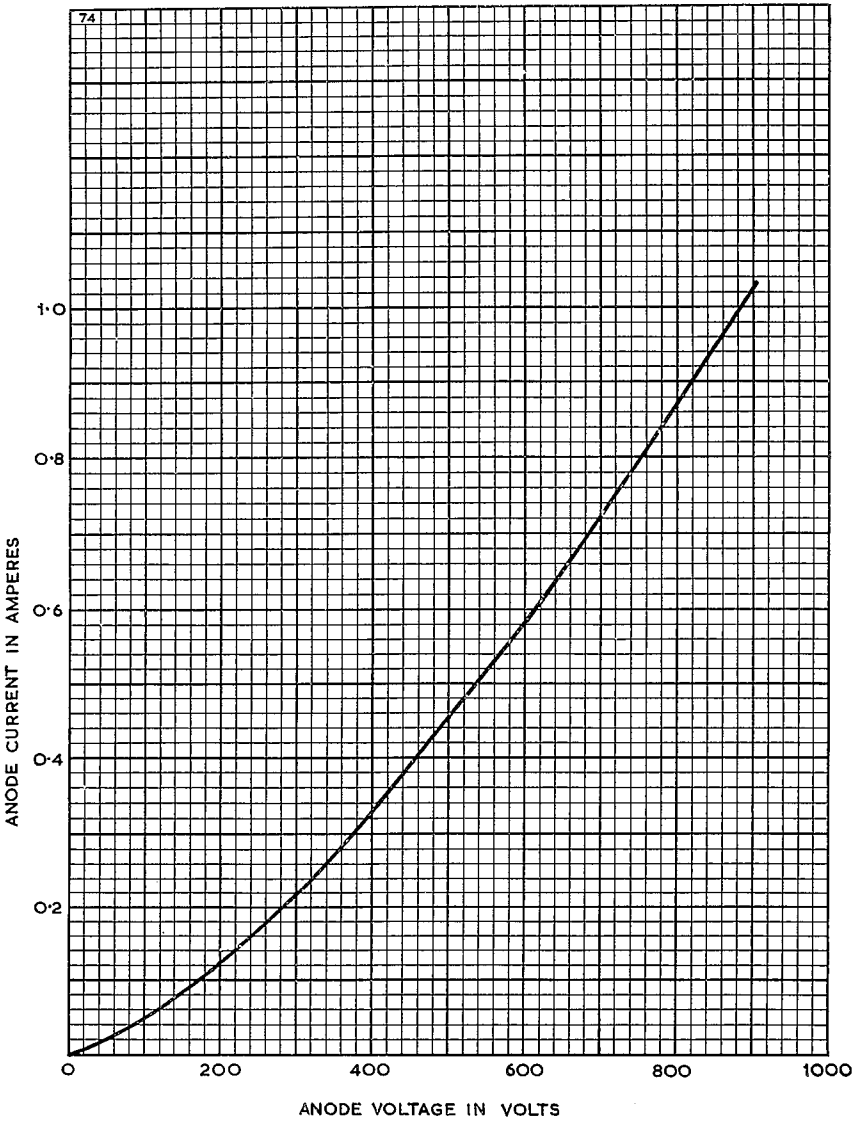
Mechanical

Overall Length	4·38 inches (111 mm)	Max
Overall Diameter	1·44 inches (36 mm)	Max
Net Weight	1·0 ounce (28 gm)	Approx
Base	Small UX4, metal shell	
Mounting Position	Vertical, base up or down	
Cooling	Natural	
Max temperature of anode seal	225	°C

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HIGH VACUUM RECTIFIER

ANODE CHARACTERISTIC

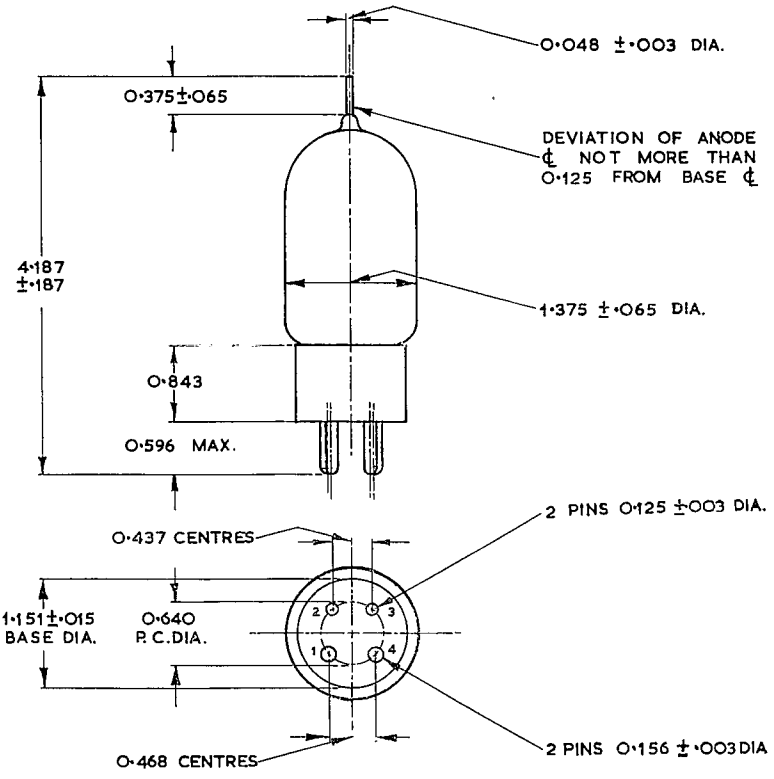


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HIGH VACUUM RECTIFIER

OUTLINE

75



PIN	ELEMENT
1	FILAMENT
2	NO CONNECTION
3	NO CONNECTION
4	FILAMENT
TOP	ANODE

ALL DIMENSIONS IN INCHES

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A237

HIGH VACUUM RECTIFIER

Service Type CV482

INTRODUCTION

The A237 is a high vacuum rectifier with maximum ratings (in air) of 65kV peak inverse voltage and 1·5A peak anode current. It is of compact construction and has been designed for very reliable operation at high voltage.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Thoriated Tungsten		
Filament Voltage	4·0		V
Filament Current	12·0		A
Max Peak Inverse Voltage	40	65	kV
Max Continuous Anode Dissipation:			
Natural Cooling	120	100	W
Forced-air Cooling (*See Note* 1)	160	100	W
Max Anode Current:			
Peak	1·5		A
Mean (*See Note* 2)	250		mA
Nominal Impedance (at 350mA)	1000		Ω

Mechanical

Overall Length	9·85 inches	(250 mm)	Max
Overall Diameter	2·37 inches	(60 mm)	Max
Net Weight	9 ounces	(260 gm)	Approx
Base	Goliath Edison Screw		
Mounting Position (*See Installation on page* 2)	Vertical		
Max Temperature of bulb	200		°C

NOTES

1. With forced-air cooling the continuous anode dissipation may be increased up to the absolute maximum of 160W provided that the peak inverse voltage does not exceed 40kV and also provided that the temperature of the glass envelope does not exceed 200°C at any point. Above 40kV the continuous anode dissipation must not exceed 100W under any conditions. The airflow ← must be such that all-round cooling is achieved and no part of the glass envelope must attain a temperature greater than 200°C. Normally the hottest part is the area round the anode, but the anode seal may also require attention.
2. The mean value of the anode current is a function of the waveform. It should ← be determined for each particular application and must be such that the maximum anode dissipation is not exceeded.

← Indicates a change

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HIGH VACUUM RECTIFIER

INSTALLATION

The valve should be operated in a vertical position, with the base screw at the bottom. The reversed position is permitted if overheating of the base can be avoided. The holder of the valve should be sprung to avoid the transmission of sharp shocks which might cause breakage of the thoriated tungsten filament.

In view of the low voltage high current filament supply it is essential that the valve is screwed tightly into the socket and that a very good contact is always maintained.

Sufficient clearance must be allowed to avoid sparking or corona at high voltages. It is also important that the air round the valve is not confined, but allowed to circulate freely to dissipate the heat generated. When working at or near the maximum rating for natural cooling it is advisable to provide channels in order to increase the convection by chimney effect.

→ X-RAY WARNING

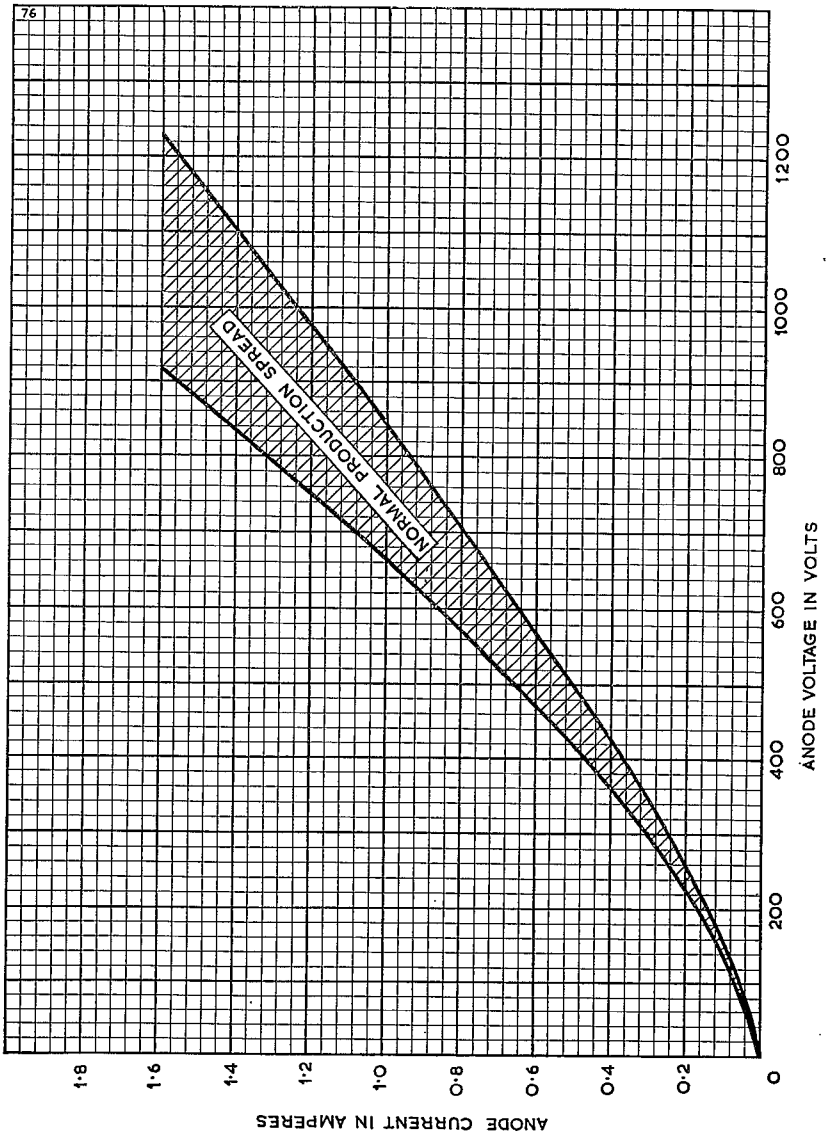
X-rays are produced when the A237 is operated with a peak inverse anode voltage above 16kV (absolute value). These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the valve.

→ Indicates a change

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HIGH VACUUM RECTIFIER

ANODE CHARACTERISTIC



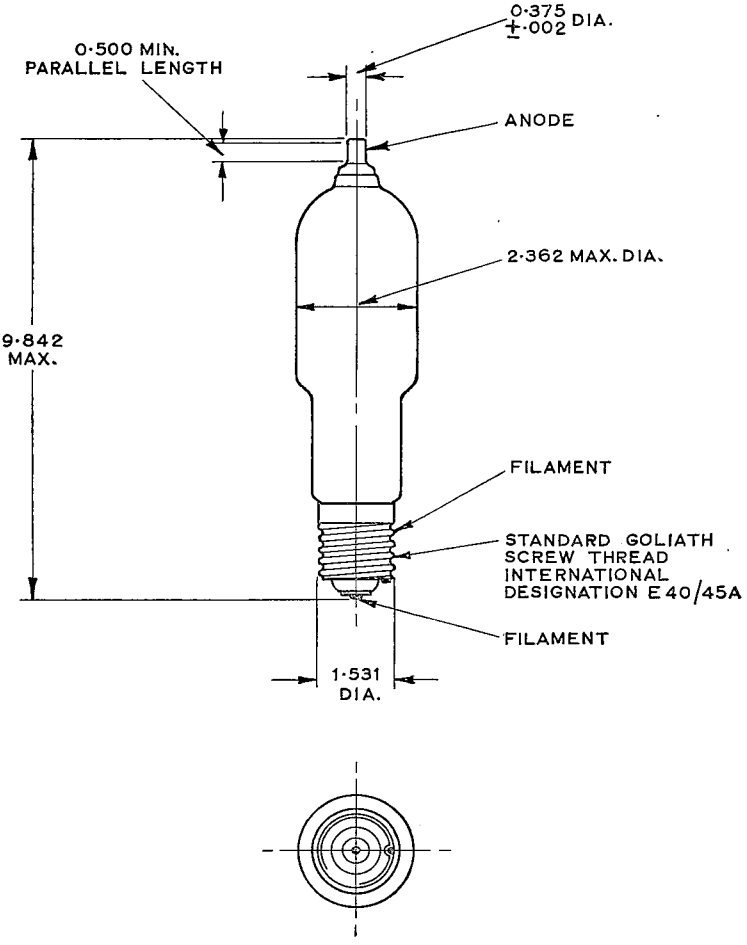
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A237

HIGH VACUUM RECTIFIER

OUTLINE

563



ALL DIMENSIONS IN INCHES

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A292

HIGH VACUUM RECTIFIER

Service Type CV5998

ABRIDGED DATA

External-anode rectifier for charging diode or overswing diode service in high power pulse modulators.

Peak inverse anode voltage	40	kV max
Peak anode current	75	A max
Mean anode current	1.5	A max

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage	12	V
Heater current	14 ± 1	A

Mechanical

Overall length	16.250 inches (412.8mm) max
Overall diameter	2.133 inches (54.18mm) max
Net weight	5¼ pounds (2.4kg) approx
Mounting position	any
Cooling (see note 1)	water or forced-air

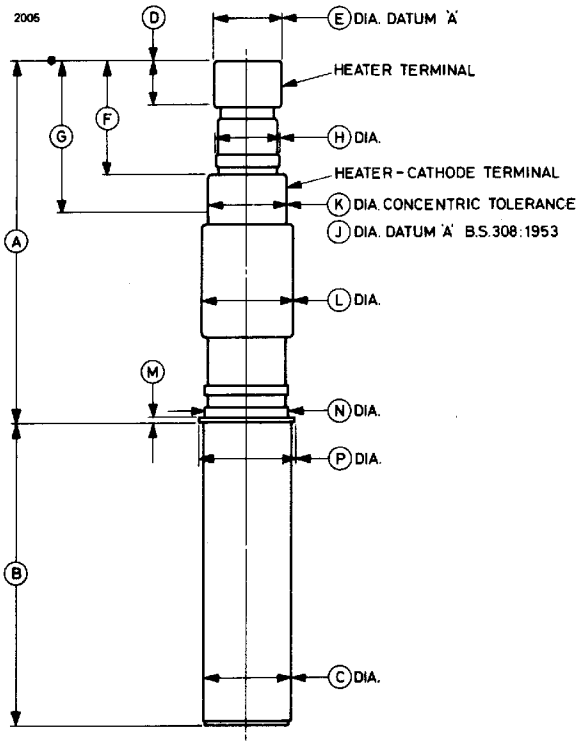
MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Heater voltage	11.4	12.6	V
Heater starting current (peak)	–	40	A
Cathode pre-heating time	6.0	–	min
Peak inverse anode voltage (see note 2)	–	40	kV
Anode current:			
peak (see note 3)	–	75	A
mean (see note 4)	–	1.5	A
Anode dissipation (see note 1)	–	2.0	kW
Anode temperature (see note 5)	–	150	°C
Cathode terminal temperature (see note 5)	–	150	°C

NOTES

1. The anode must be fitted in a cooling cylinder as described on page 4.
2. The cathode terminal must be fitted with a corona shield as described on page 4.
3. For overswing diode service.
4. For charging diode service.
5. Measured at the point specified on page 4.

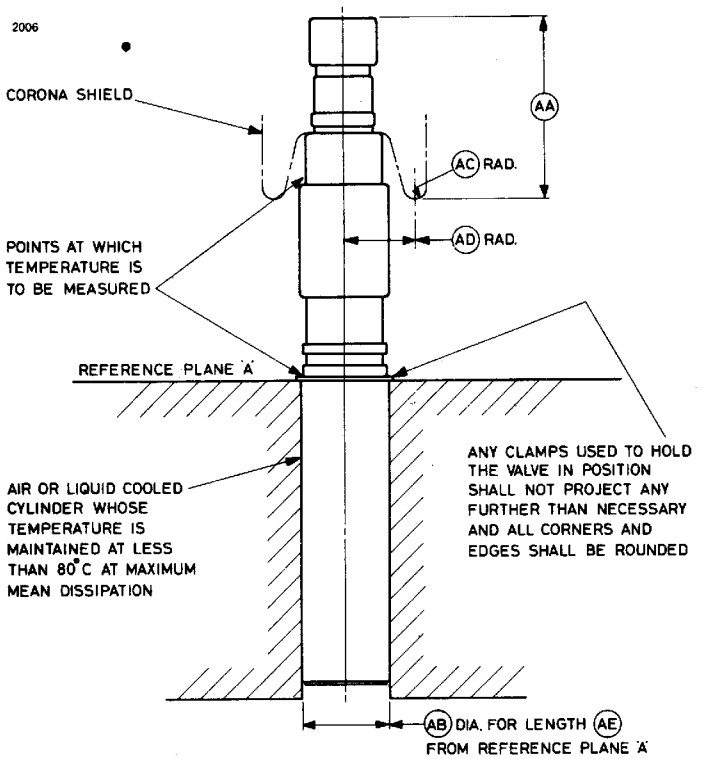
OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.500 max	241.3 max	H	1.550 max	39.37 max
B	6.750 max	171.5 max	J	0.050	1.27
C	1.946 max	49.43 max	K	1.750	44.45
D	0.375 min	9.53 min	L	1.937 max	49.20 max
E	1.500	38.10	M	0.125 ± 0.005	3.18 ± 0.13
F	3.063 max	77.80 max	N	1.820 max	46.23 max
G	3.563 min	90.50 min	P	2.125 ± 0.008	53.98 ± 0.20

Millimetre dimensions have been derived from inches.

COOLING CYLINDER AND CORONA SHIELD
(All dimensions without limits are nominal)



Ref	Inches	Millimetres
AA	4.000	101.6
AB	1.950 max 1.948 min	49.53 max 49.48 min
AC	0.250 min	6.35 min
AD	1.250 min	31.75 min
AE	6.750	171.5

Millimetre dimensions have been derived from inches.

HIGH VACUUM RECTIFIER

A296

ENGLISH ELECTRIC

INTRODUCTION

The A296 is a high vacuum rectifier with maximum ratings of 25kV peak inverse voltage and 6·5A peak anode current. It is designed for use in three phase rectifier circuits, giving a d.c. output of 3·0A at 23kV.

GENERAL DATA

Electrical

Filament	Thoriated Tungsten	
Filament Voltage	6·3	V
Filament Current	32·5	A
Maximum Peak Inverse Voltage	25	kV
Maximum Anode Current:		
Peak	6·5	A
Mean	1·25	A
Maximum Anode Dissipation:		
Natural Cooling	375	W
Forced-air Cooling	500	W
Nominal Impedance (at 3·0A)	130	Ω

Mechanical

Overall Length	9·85 inches (250 mm)	Max
Overall Diameter	5·20 inches (132·1 mm)	Max
Net Weight	1·5 pounds (0·68 kg)	Approx
Base	Flying Leads	
Mounting Position	Vertical, base down Use bulb supporting ring	
Maximum Bulb Temperature	350	°C
Maximum Anode or Base Seal Temperature	220	°C

A top cap radiator, with a minimum surface area of 8sq.in. perpendicular to the axis of the valve, should be used. The radiator should make good thermal contact with the entire length of the anode terminal.

X-RAY WARNING

X-rays are produced when the A296 is operated with a peak inverse anode voltage above 16kV (absolute value). These rays can constitute a health hazard unless the valve is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the valve.

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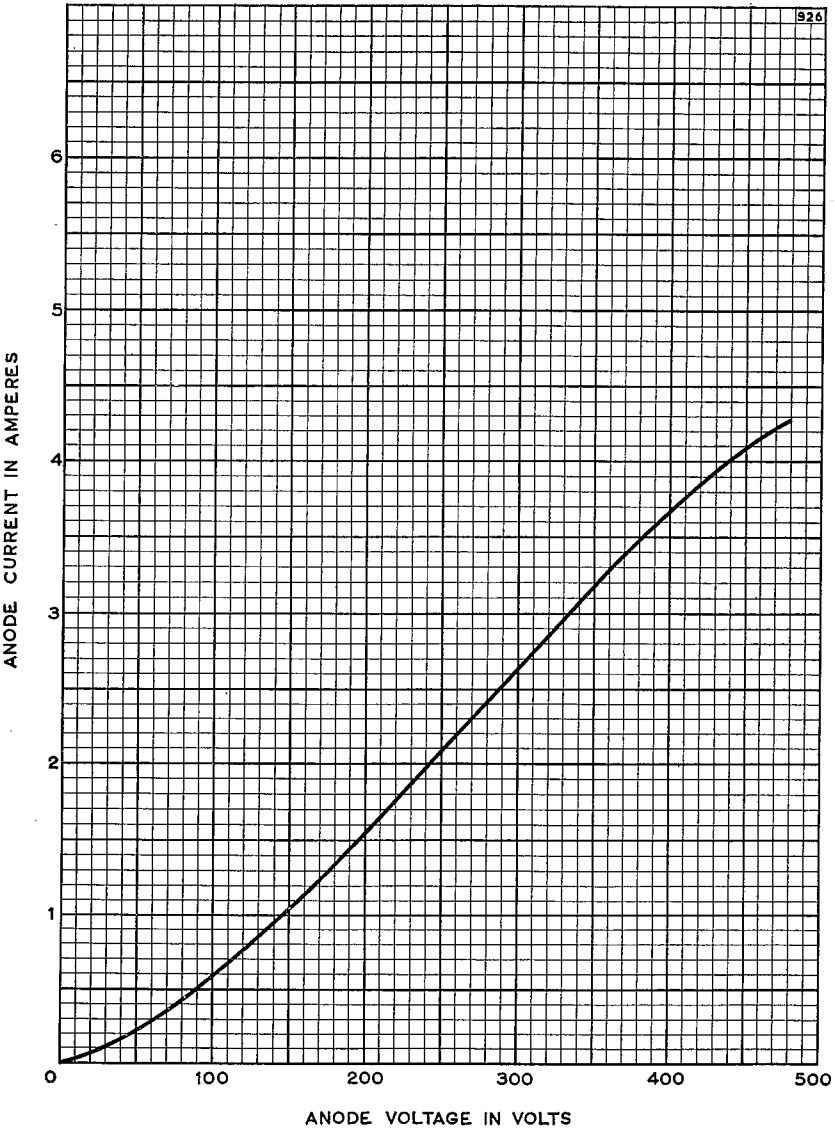
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ENGLISH ELECTRIC

ANODE CHARACTERISTIC



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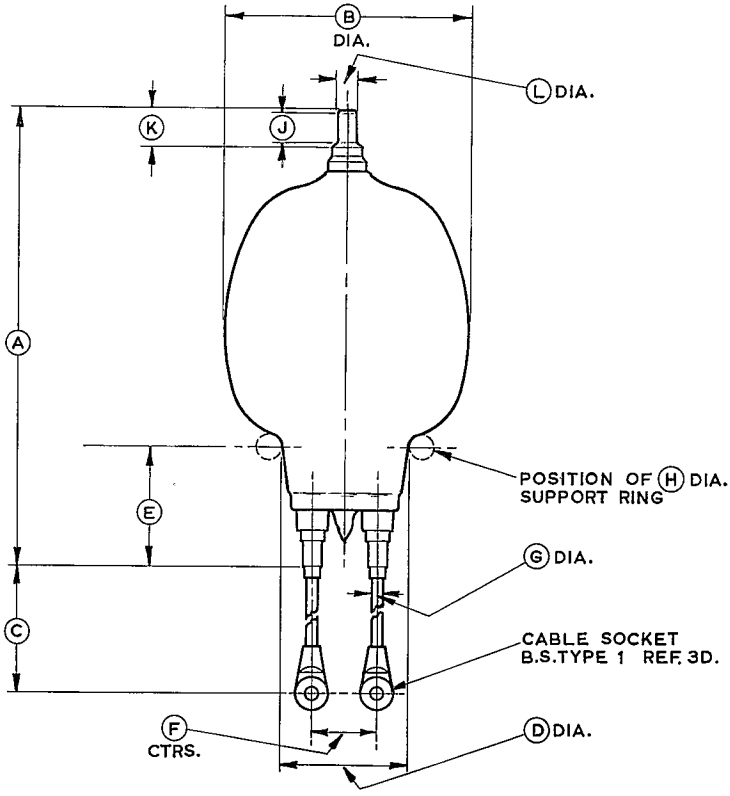
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OUTLINE

927



Ref.	Inches	Millimetres
A	9·850 Max	250 Max
B	5·200 Max	132·1 Max
C	4·000	101·6
D	2·687 Min	68·25 Min
E	2·500 (ref.)	63·50 (ref.)
F	1·339	34·01
G	0·187	4·750
H	0·500	12·7
J	0·500	12·7
K	0·750	19·05
L	0·375	9·525

Millimetre dimensions have been derived from inches.

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MERCURY VAPOUR RECTIFIER

AH200

INTRODUCTION

The AH200 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 10A peak current. It is similar to the AH213, differing only in filament rating and in terminal sizes.

GENERAL DATA

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	40	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	*(See page 2)*	
Mean‡	*(See page 2)*	
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	18·0 inches	(457 mm)	Max
Overall Diameter	5·25 inches	(133 mm)	Max
Net Weight	1·75 pounds	(800 gm)	Approx
Mounting Position	Vertical, base down		
Base	*(See outline drawing)*		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

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MAXIMUM OPERATING CONDITIONS
(absolute values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	20	10	2·5	7·0	6·3	5·0
		30–50	15	10	2·5	5·3	4·7	5·0
		30–60	10	10	2·5	3·5	3·1	5·0
Single Phase Full Wave Bridge	B	30–40	20	10	2·5	14·0	12·6	5·0
		30–50	15	10	2·5	10·6	9·5	5·0
		30–60	10	10	2·5	7·0	6·3	5·0
Three Phase Half Wave	C	30–40	20	10	2·5	8·1†	9·5†	7·5
		30–50	15	10	2·5	6·1†	7·1†	7·5
		30–60	10	10	2·5	4·1†	4·7†	7·5
Three Phase Full Wave	D§	30–40	20	10	2·5	8·1	19·1	7·5
		30–50	15	20	5	6·1	14·2	15·0
		30–60	10	20	5	4·1	9·5	15·0

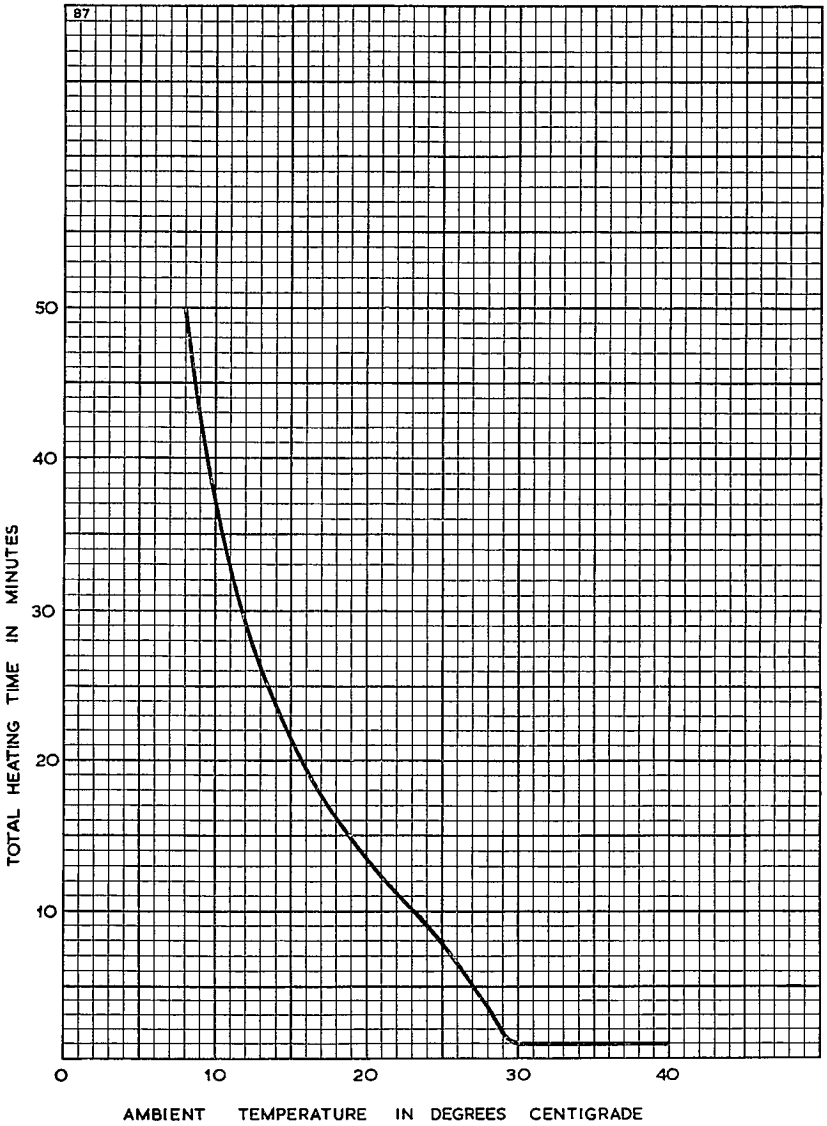
*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

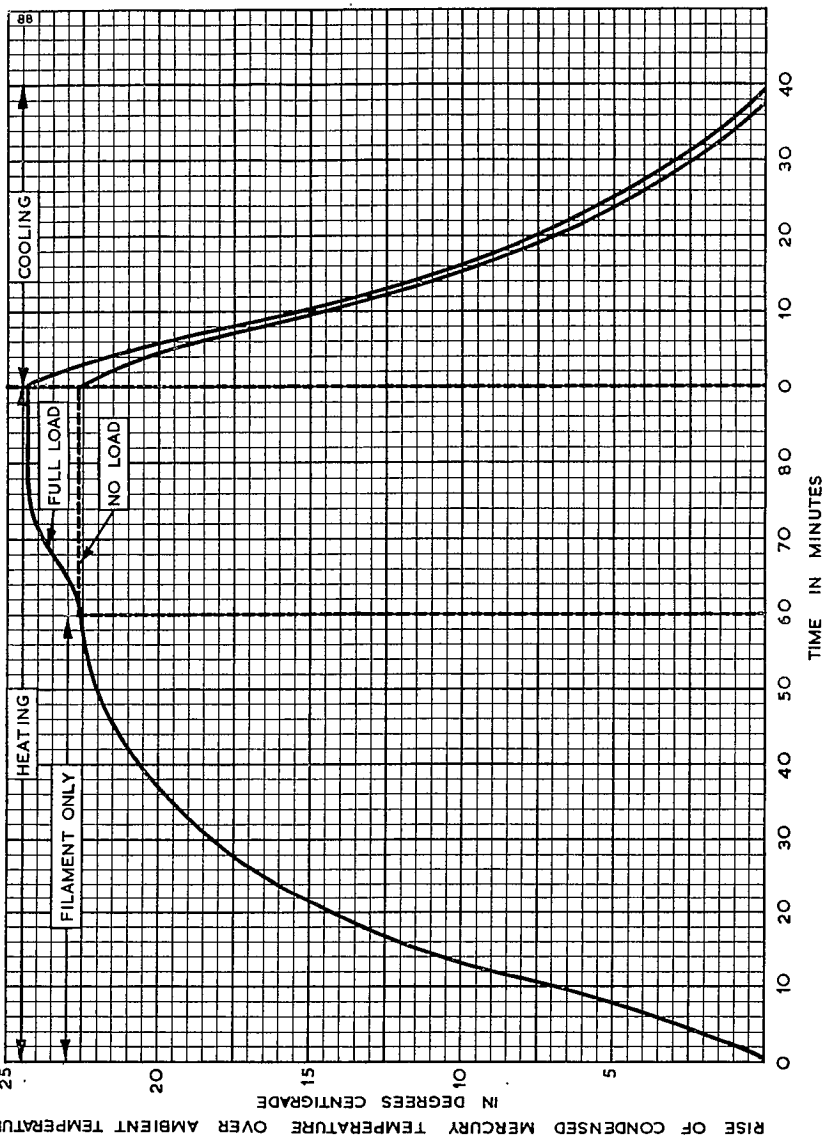
‡Mean anode currents are averaged over any period of 30 seconds maximum.

§With filament and anode supplies out of phase (60°–120°).

TOTAL HEATING TIME CHARACTERISTIC



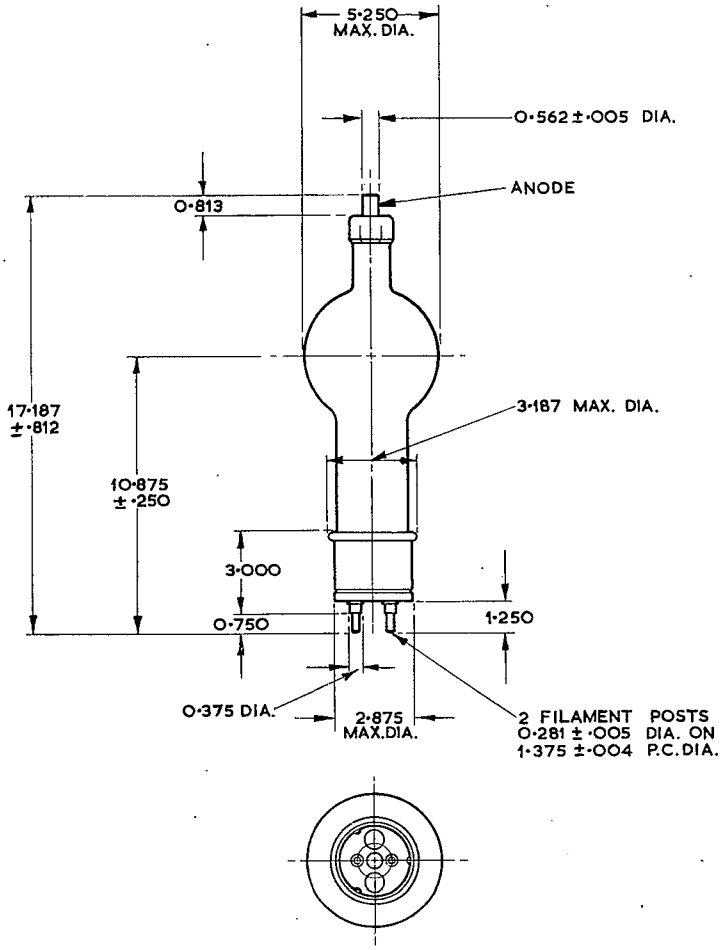
HEATING AND COOLING CHARACTERISTIC



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OUTLINE

89

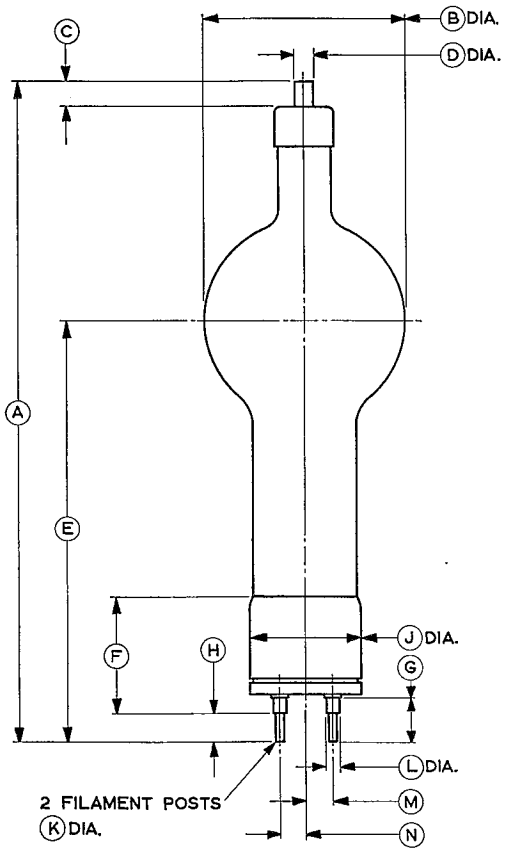


ALL DIMENSIONS IN INCHES

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89A



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	17·187±0·812	436·5±20·62	H	0·750	19·05
B	5·250 Max	133·4 Max	J	2·875	73·03
C	0·812	20·62	K	0·281±0·005	7·14±0·13
D	0·562±0·005	14·27±0·13	L	0·375	9·53
E	10·875±0·250	276·2±6·35	M	0·687	17·45
F	3·000	76·20	N	0·687	17·45
G	1·125	28·58			

Millimetre dimensions have been derived from inches.

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AH205/857B

MERCURY VAPOUR RECTIFIER

American Equivalent 857B **Service Type CV2673**

To be read in conjunction with the Rectifier and Thyratron Preamble.

ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage	22	kV max
Peak anode current (at 22kV p.i.v.)	40	A max
Mean anode current (at 22kV p.i.v.)	10	A max
Fault anode current (0.2s max)	400	A max

GENERAL

Electrical

Filament		oxide coated
Filament voltage	5.0	V
Filament current	30	A
Filament pre-heating time (minimum)	1.0	min

Mechanical

Overall length	19.875 inches (504.8mm) max
Overall diameter	7.625 inches (193.7mm) max
Net weight	4 pounds (1.8kg) approx
Mounting position	vertical, base down
Base connections	flexible leads
Top cap	see outline

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the Rectifier and Thyratron Preamble.

MAXIMUM OPERATING CONDITIONS (Absolute values)

Circuit*	Condensed mercury temp (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A) peak	Anode current (A) mean♦	Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output (kV)	Maximum d.c. output (A)
A							
Single phase	30–40	22	40	10	7.7	7.0	20
full wave	25–60	10	40	10	3.5	3.1	20
B							
Single phase	30–40	22	40	10	15.5	14.0	20
bridge	25–60	10	40	10	7.0	6.3	20
C							
Three phase	30–40	22	40	10	9.0†	10.5†	30
half wave	25–60	10	40	10	4.1†	4.7†	30
D							
Three phase	30–40	22	40	10	9.0	21.0	30
full wave	25–60	10	40	10	4.1	9.5	30

* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyratron Preamble.

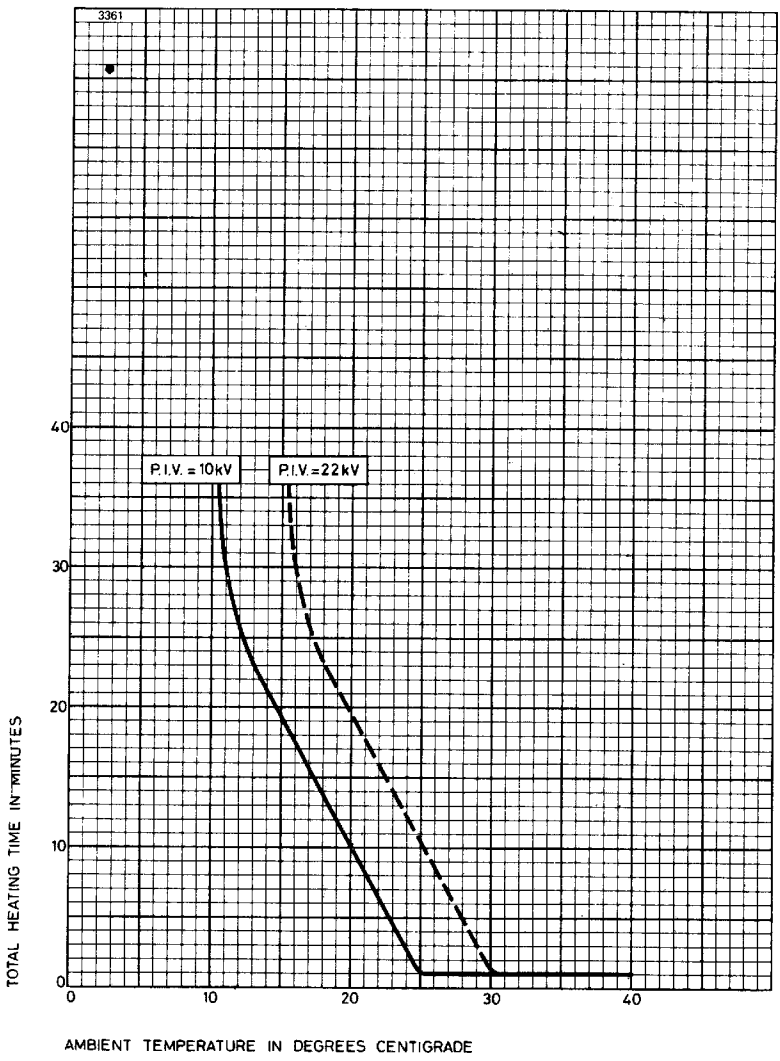
† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

♦ Averaging time 30 seconds maximum.

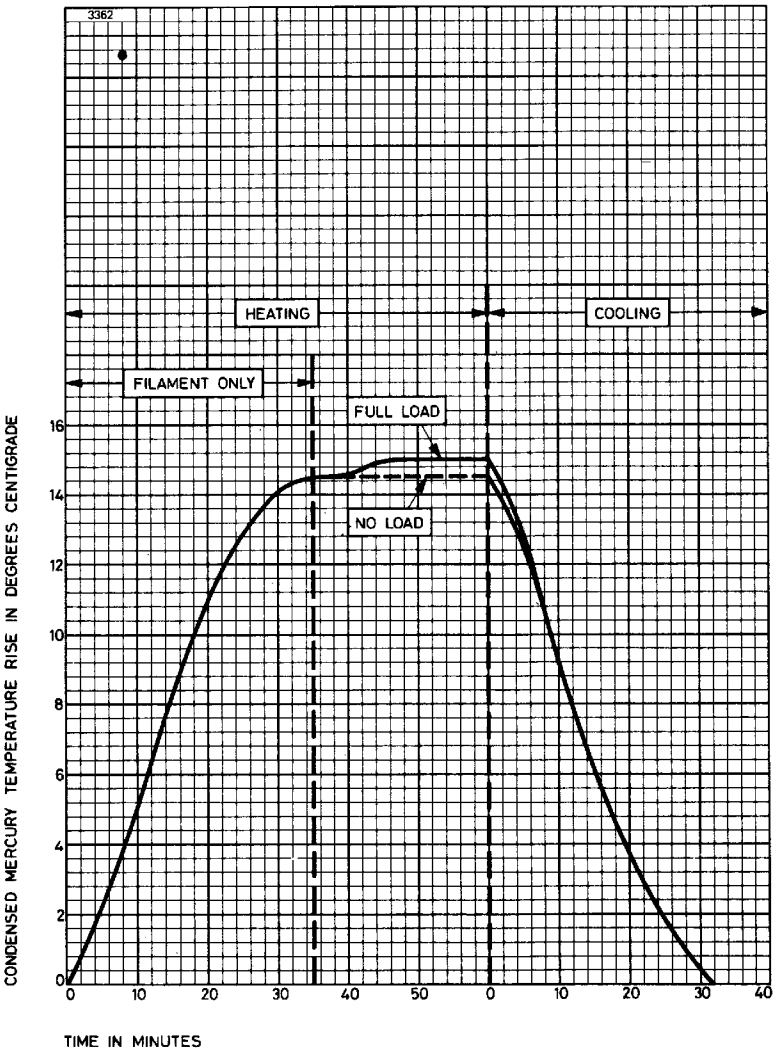
X-RAY WARNING

The AH205/857B emits X-rays when it is operated with a peak inverse anode voltage above 16kV absolute. These rays can constitute a health hazard unless adequate shielding is provided. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

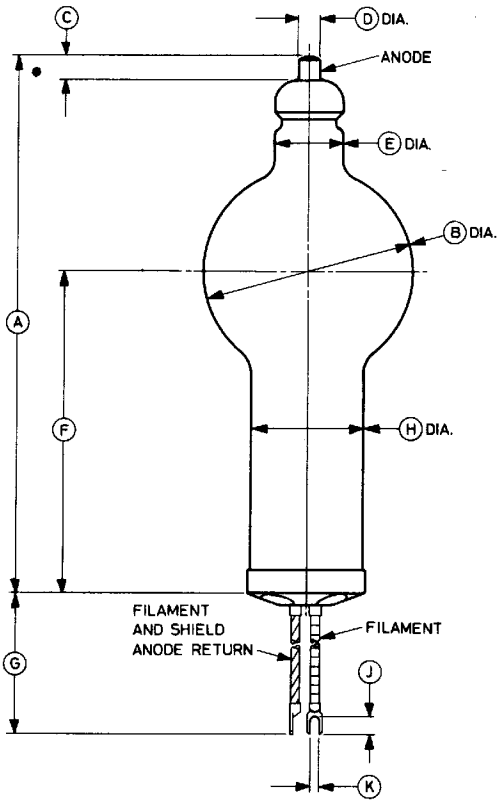
TOTAL HEATING TIME CHARACTERISTIC



TYPICAL HEATING AND COOLING CHARACTERISTIC



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	19.875 max	504.8 max	F	11.625	295.3
B	7.625 max	193.7 max	G	10.625 max	269.9 max
C	0.812	20.62	H	4.125 max	104.8 max
D	0.812	20.62	J	0.625	15.88
E	2.500	63.50	K	0.347	8.81

Millimetre dimensions have been derived from inches.

MERCURY VAPOUR RECTIFIER

AH211

Service Type CV532

INTRODUCTION

The AH211 is a maintenance type only. For new designs the AH211A is recommended.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	30	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	25 to 50	°C
Max Peak Inverse Voltage	16	kV
Max Anode Current:		
Peak	8	A
Mean‡	2	A
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	12·38 inches	(314 mm)	Max
Overall Diameter	3·19 inches	(81 mm)	Max
Net Weight	1 pound	(460 gm)	Approx
Mounting Position		Vertical, base down	
Base		*(See outline drawing)*	

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

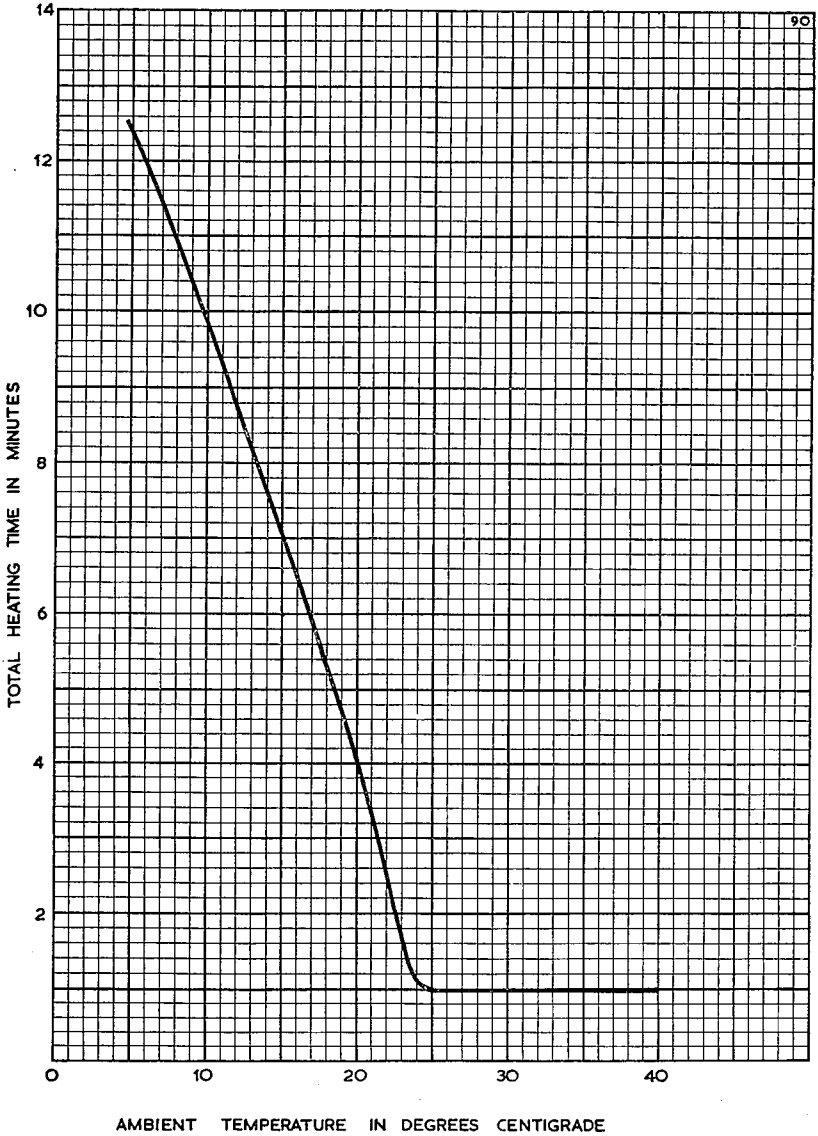
Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	25–50	16	8	2·0	5·6	5·0	4
Single Phase Full Wave Bridge	B	25–50	16	8	2·0	11·2	10·1	4
Three Phase Half Wave	C	25–50	16	8	2·0	6·5†	7·6†	6
Three Phase Full Wave	D	25–50	16	8	2·0	6·5	15·2	6

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

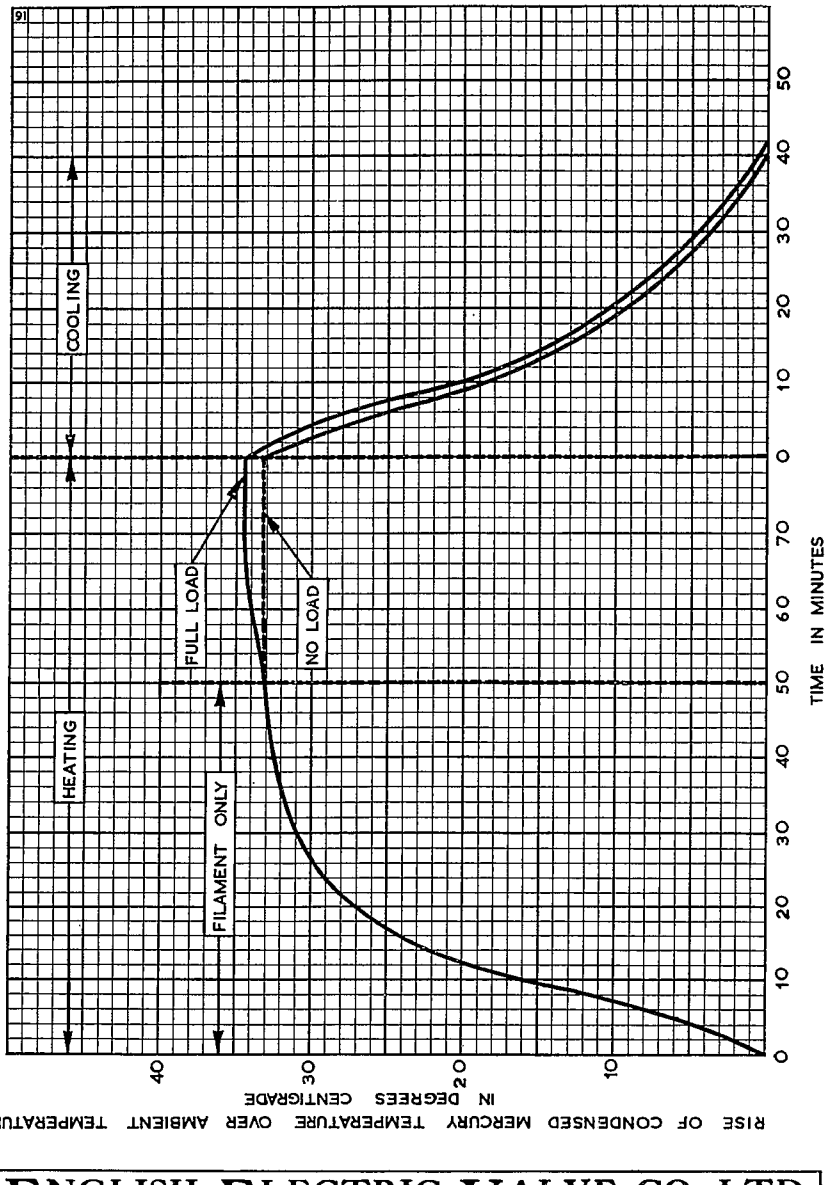
‡Mean anode currents are averaged over any period of 30 seconds maximum.

TOTAL HEATING TIME CHARACTERISTIC



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HEATING AND COOLING CHARACTERISTIC

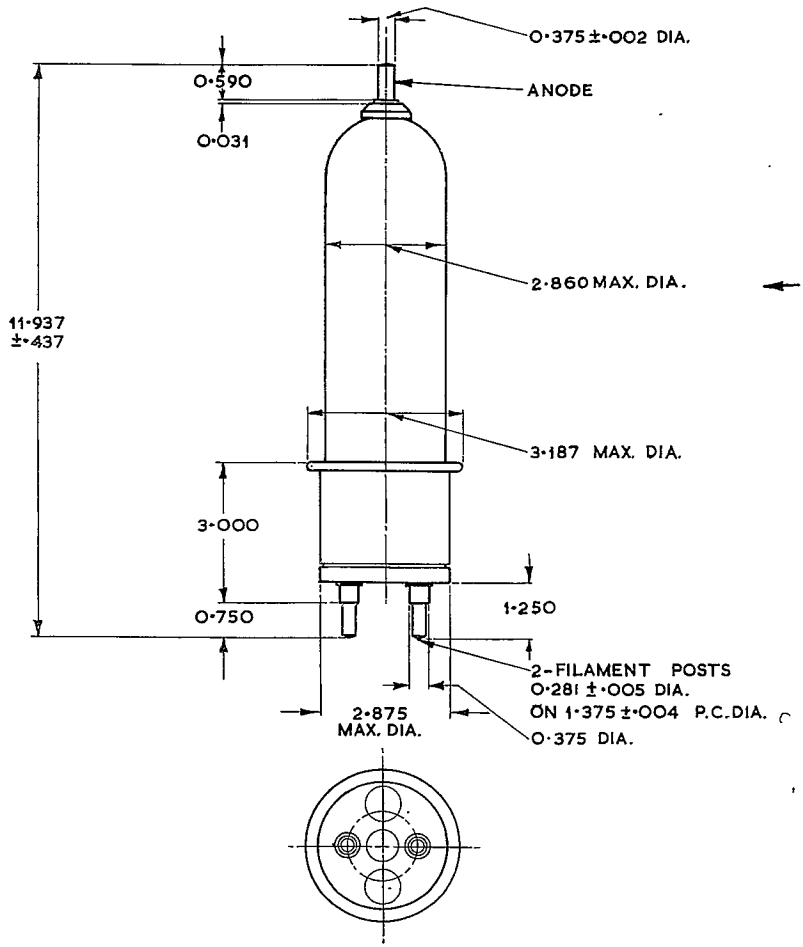


MERCURY VAPOUR RECTIFIER

AH211

OUTLINE

528



ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

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MERCURY VAPOUR RECTIFIER

AH211A

Service Type CV532 ←

INTRODUCTION

The AH211A is a hot cathode Mercury Vapour Rectifier with maximum ratings of 16kV peak inverse voltage and 8A peak current. It will provide a D.C. output of 15kV 6A in a three phase full wave circuit.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	2·5	V
Filament Current	30	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	25 to 50	°C
Max Peak Inverse Voltage	16	kV
Max Anode Current:		
Peak	8	A
Mean (30 seconds Max averaging time)	2	A ←
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	13·38 inches	(340 mm)	Max
Overall Diameter	3·19 inches	(81 mm)	Max
Net Weight	1¼ pounds	(0·5 kg)	Approx
Mounting Position		Vertical, base down	
Base		*(See outline drawing)*	

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating time and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

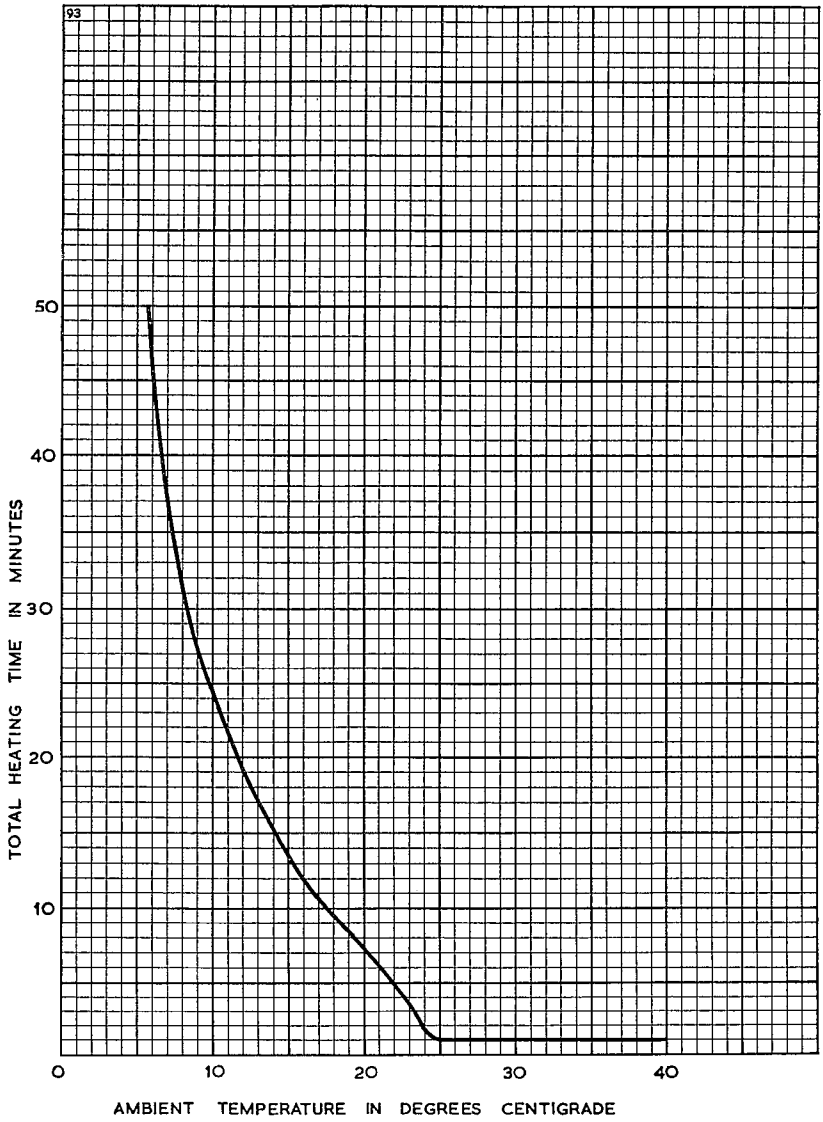
Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	25–50	16	8	2·0	5·6	5·0	4
Single Phase Full Wave Bridge	B	25–50	16	8	2·0	11·2	10·1	4
Three Phase Half Wave	C	25–50	16	8	2·0	6·5†	7·6†	6
Three Phase Full Wave	D	25–50	16	8	2·0	6·5	15·2	6

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased, the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

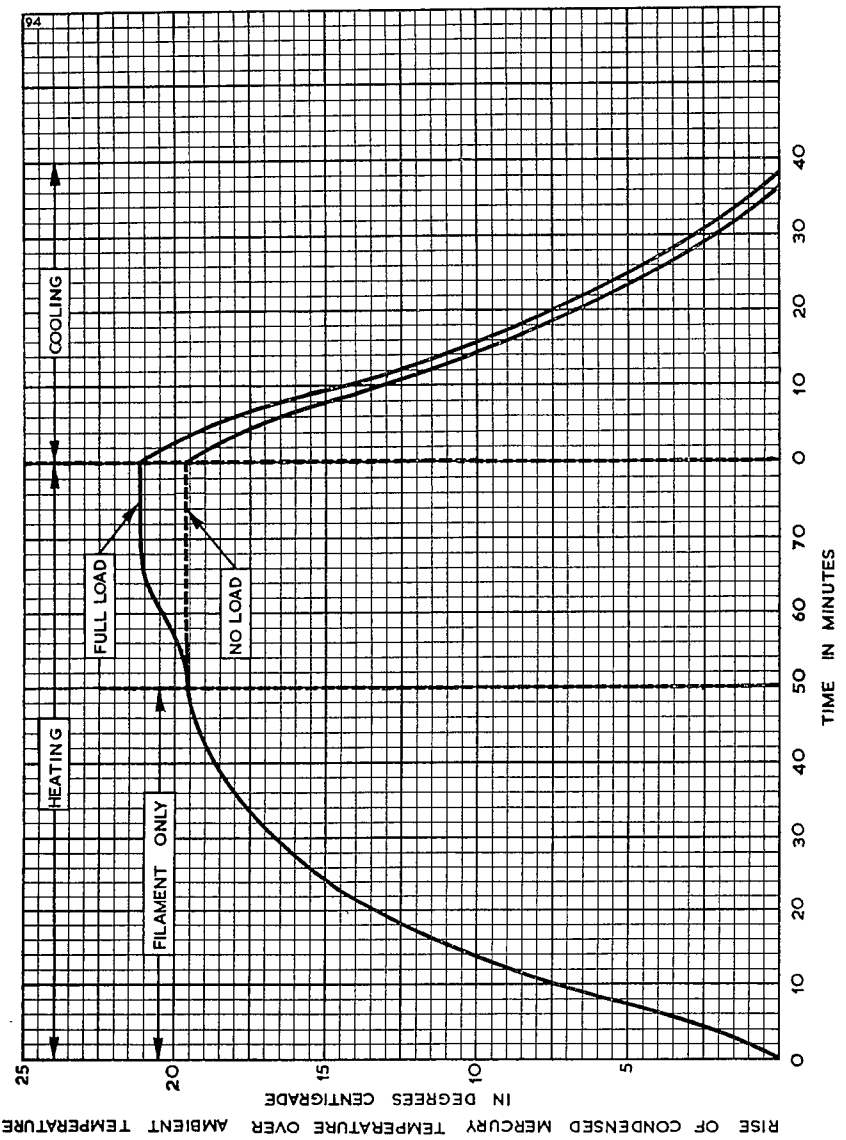
‡Mean anode currents are averaged over any period of 30 seconds maximum.

TOTAL HEATING TIME CHARACTERISTIC



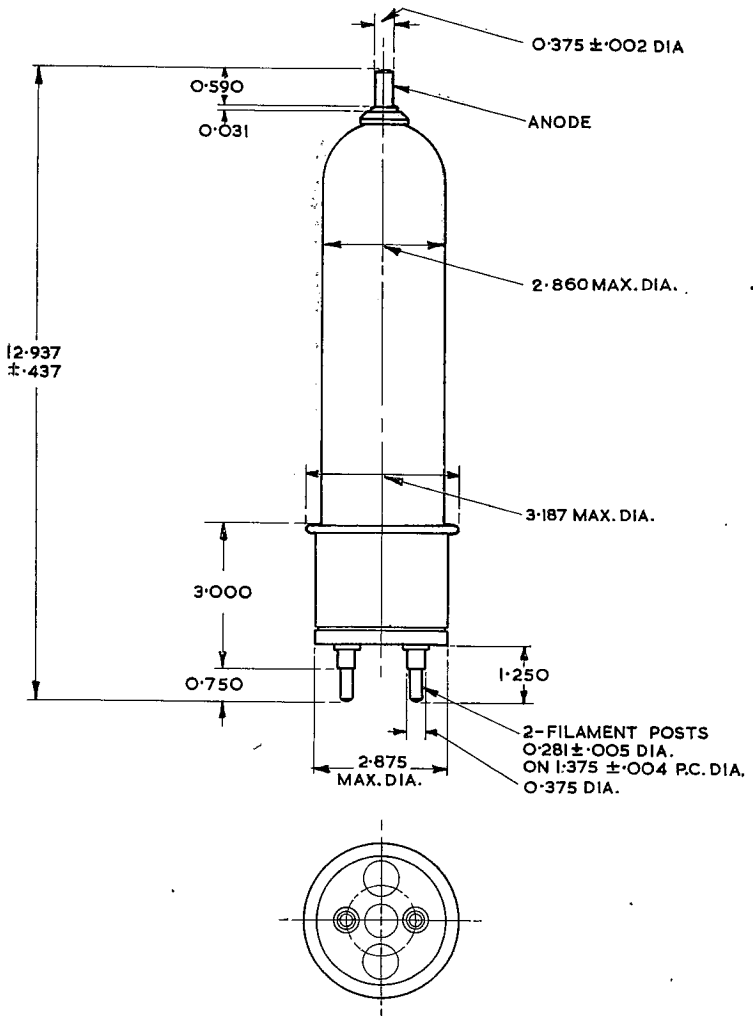
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HEATING AND COOLING CHARACTERISTIC



OUTLINE

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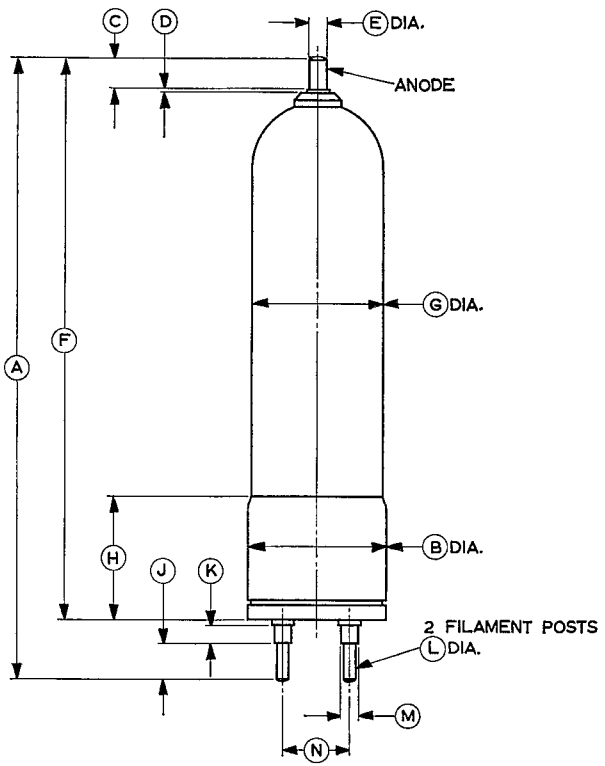


ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

OUTLINE

529A



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	12·937±0·437	328·6±11·10	H	2·563	65·10
B	2·875	73·03	J	0·750	19·05
C	0·590	14·99	K	0·375	9·53
D	0·031	0·79	L	0·281±0·005	7·14±0·13
E	0·375±0·002	9·525±0·051	M	0·375	9·53
F	11·687±0·437	296·8±11·10	N	1·375	34·93
G	2·860 Max	72·64 Max			

Millimetre dimensions have been derived from inches.

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MERCURY VAPOUR RECTIFIER

AH213

Service Type CV2723 **Electrically Equivalent to American 869B**

INTRODUCTION

The AH213 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 10A peak current. It is similar to the AH200, differing only in filament rating and in terminal sizes.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	5	V
Filament Current	19	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	*(See page 2)*	
Mean‡	*(See page 2)*	
Under fault conditions (0·1 seconds Max duration)	100	A

Mechanical

Overall Length	18·0 inches	(457 mm)	Max
Overall Diameter	5·25 inches	(133 mm)	Max
Net Weight	1·75 pounds	(800 gm)	Approx
Mounting Position	Vertical, base down		
Base	*(See outline drawing)*		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	30–40	20	10	2·5	7·0	6·3	5·0
		30–50	15	10	2·5	5·3	4·7	5·0
		30–60	10	10	2·5	3·5	3·1	5·0
Single Phase Full Wave Bridge	B	30–40	20	10	2·5	14·0	12·6	5·0
		30–50	15	10	2·5	10·6	9·5	5·0
		30–60	10	10	2·5	7·0	6·3	5·0
Three Phase Half Wave	C	30–40	20	10	2·5	8·1†	9·5†	7·5
		30–50	15	10	2·5	6·1†	7·1†	7·5
		30–60	10	10	2·5	4·1†	4·7†	7·5
Three Phase Full Wave	D§	30–40	20	10	2·5	8·1	19·0	7·5
		30–50	15	20	5	6·1	14·2	15·0
		30–60	10	20	5	4·1	9·5	15·0

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

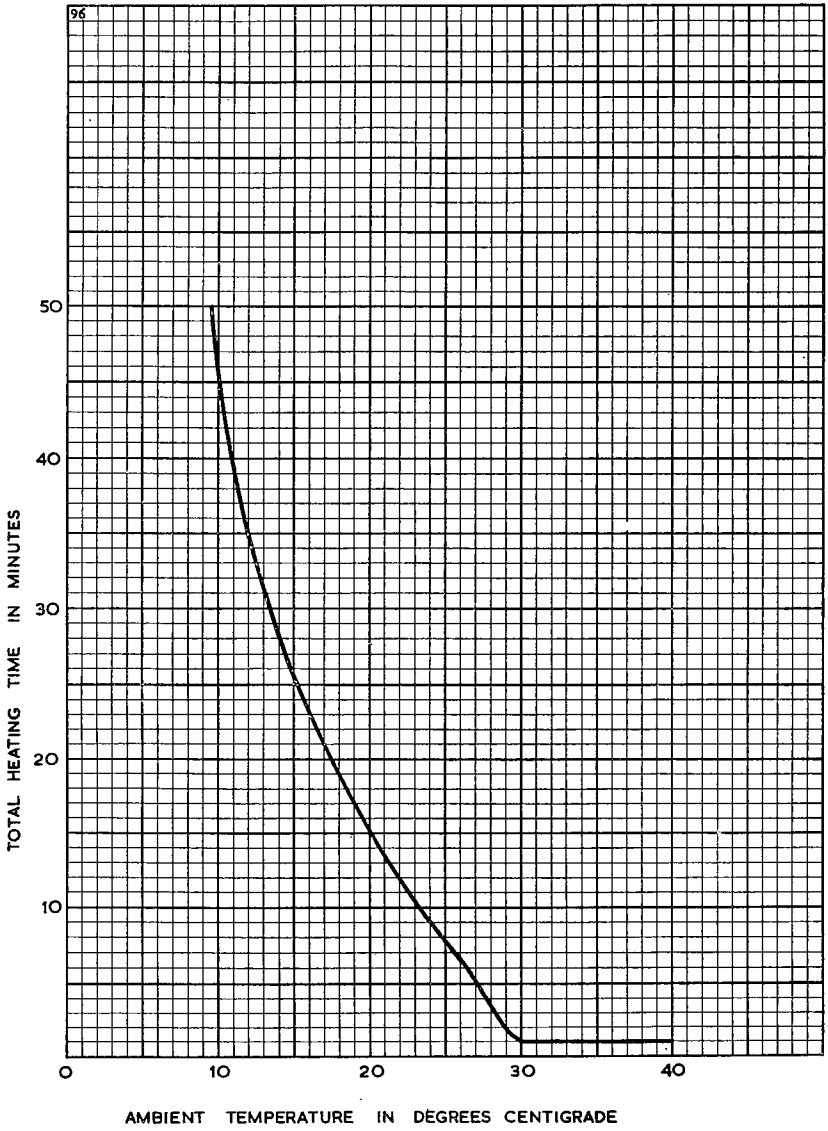
†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 30 seconds maximum.

§With filament and anode supplies out of phase (60°–120°).

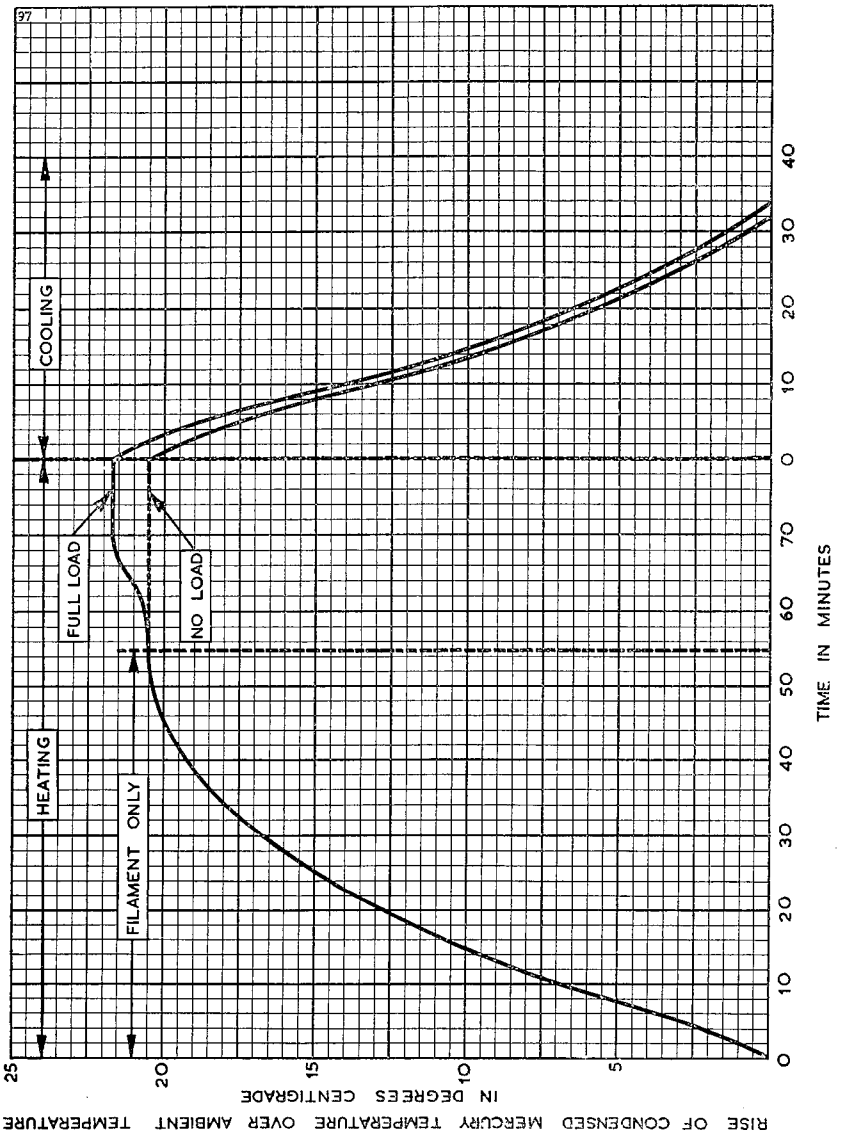
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TOTAL HEATING TIME CHARACTERISTIC



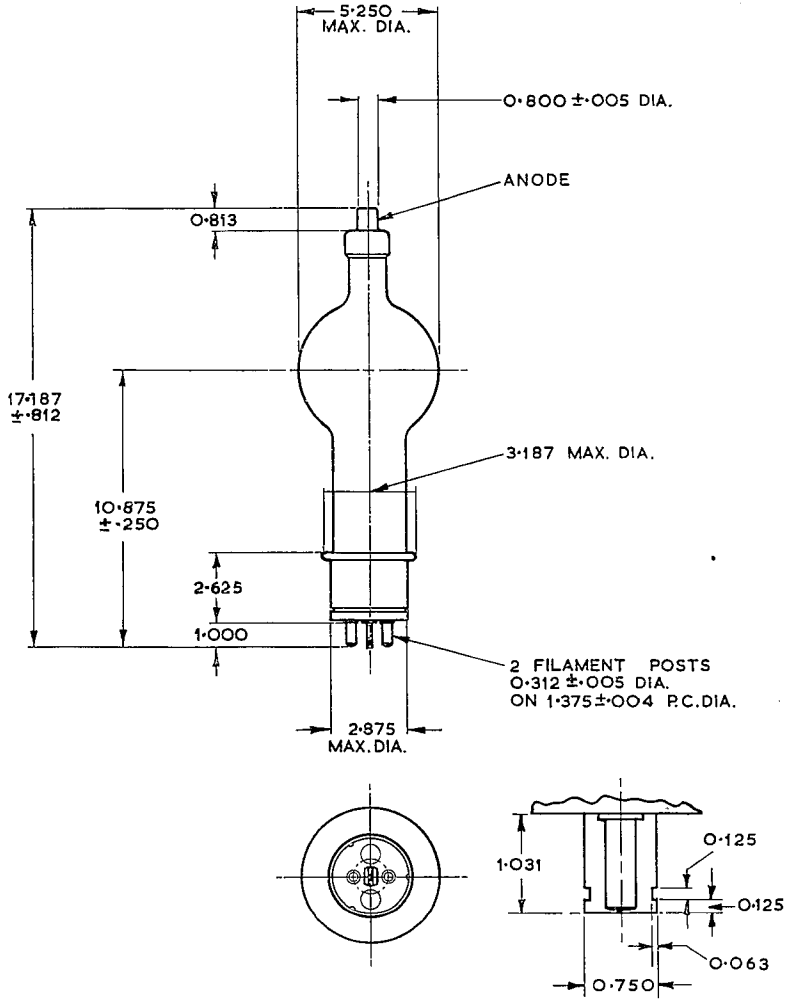
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HEATING AND COOLING CHARACTERISTIC



OUTLINE

98



ALL DIMENSIONS IN INCHES

DETAIL OF BASE SPIGOT

MERCURY VAPOUR RECTIFIER

AH221

Service Types CV5 and CV1435 ←

INTRODUCTION

The AH221 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 20kV peak inverse voltage and 5A peak current. It will provide a D.C. output of 19·0kV 3·75A in a three phase full wave circuit. ←

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	4·0	V
Filament Current	11	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	(*See Page* 2) ←	
Max Peak Inverse Voltage	(*See Page* 2) ←	
Max Anode Current:		
Peak	5·0	A
Mean‡	1·25	A
Under fault conditions (0·2 second Max duration)	50	A

Mechanical

Overall Length	10·63 inches	(270 mm)	Max
Overall Diameter	2·32 inches	(59 mm)	Max
Net Weight	8 ounces	(230 gm)	Approx
Mounting Position	Vertical, base down		
Base	Goliath Edison Screw		

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.

2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change.

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MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	20–40 20–50	20 11	5·0 5·0	1·25 1·25	7·0 3·9	6·3 3·5	2·5 2·5
Single Phase Full Wave Bridge	B	20–40 20–50	20 11	5·0 5·0	1·25 1·25	14·0 7·75	12·6 7·0	2·5 2·5
Three Phase Half Wave	C	20–40 20–50	20 11	5·0 5·0	1·25 1·25	8·1† 4·4†	9·5† 5·2†	3·75 3·75
Three Phase Full Wave	D	20–40 20–50	20 11	5·0 5·0	1·25 1·25	8·1 4·4	19·0 10·4	3·75 3·75

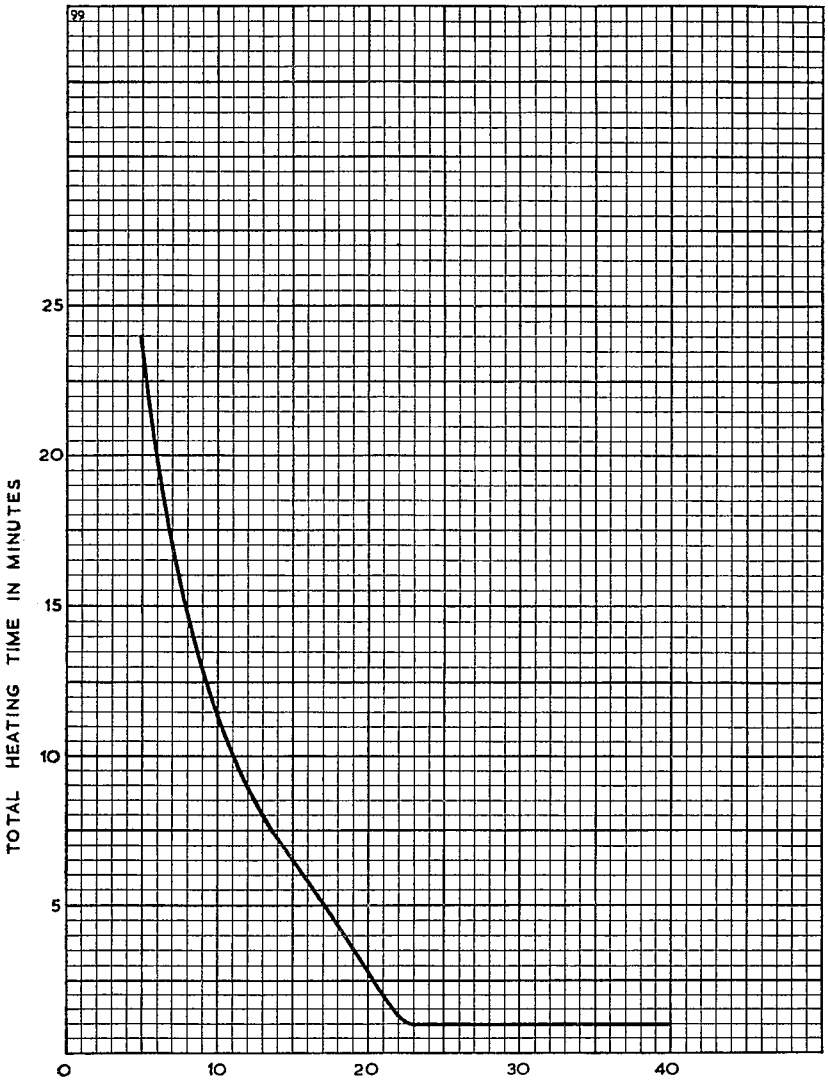
*For diagram see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The D.C. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum.

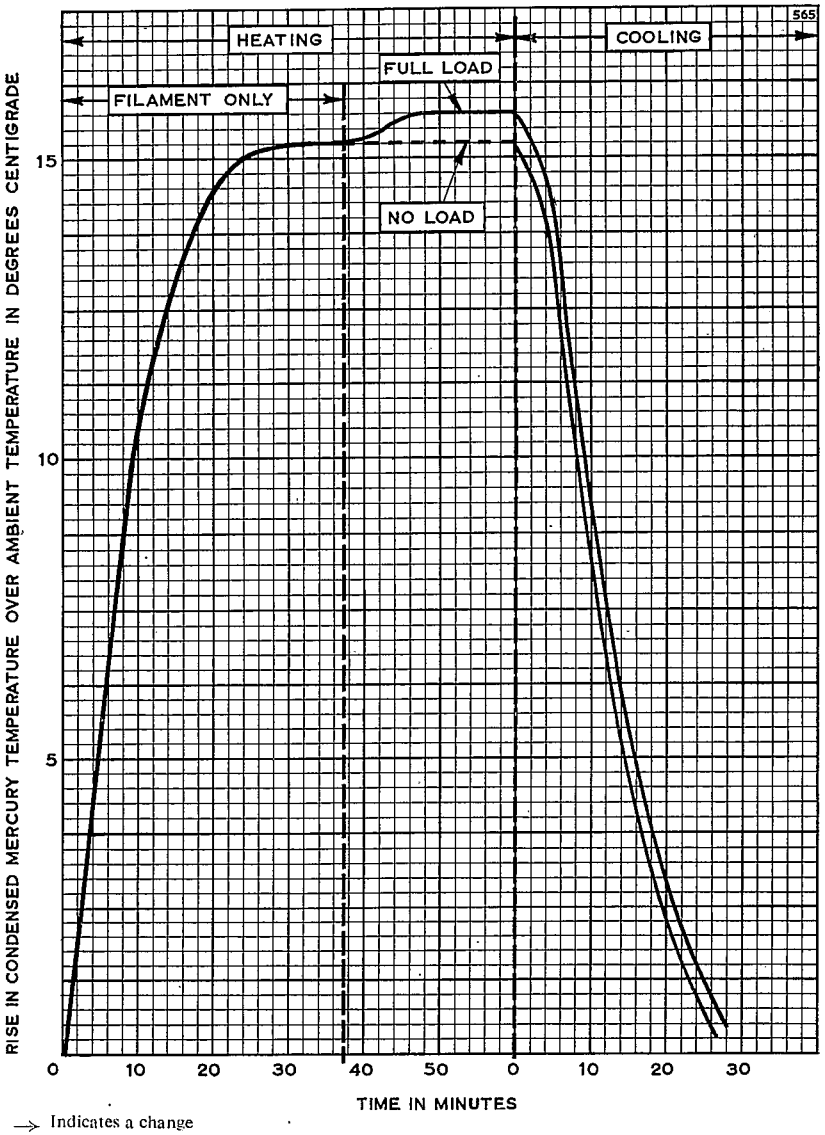
→ Indicates a change.

TOTAL HEATING TIME CHARACTERISTIC



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← HEATING AND COOLING CHARACTERISTIC

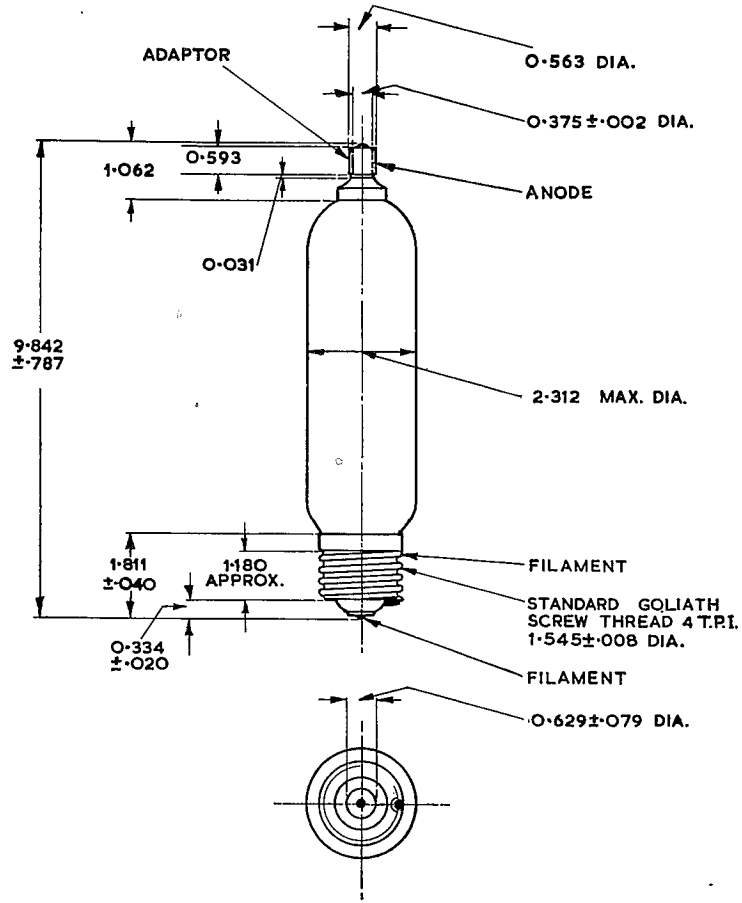


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OUTLINE

101A



ALL DIMENSIONS IN INCHES

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MERCURY VAPOUR RECTIFIER

AH238

ENGLISH ELECTRIC

Service Type CV1629

INTRODUCTION

The AH238 is a hot cathode Mercury Vapour Rectifier with maximum ratings of 13kV peak inverse voltage and 5·0A peak current. It will provide a d.c. output of 12kV 3·7A in a three phase full wave circuit.

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament	Oxide Coated	
Filament Voltage	4·0	V
Filament Current	7·0	A
Filament Heating Time	1	Minute
Condensed Mercury Temperature	*(See page 2)*	
Max Peak Inverse Voltage	*(See page 2)*	
Max Anode Current:		
Peak	5·0	A
Mean‡	1·25	A
Under fault conditions (0·1 second Max duration)	100	A

Mechanical

Overall Length	9·488 inches	(241mm)	Max←
Overall Diameter	2·312 inches	(58·7mm)	Max←
Net Weight	7 ounces	(200gm)	Approx
Mounting Position	Vertical, base down		
Base	Goliath Edison Screw		
Top Cap	B.S.448/CT9 fitted with screw terminal adaptor		←

CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the valve is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the preamble to this section of the catalogue.

← Indicates a change

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MAXIMUM OPERATING CONDITIONS

(Absolute Values—see Preamble)

Circuit	* Diagram	Condensed Mercury Temp. °C	Peak Inverse Voltage (50-60 c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
				Peak	Mean‡		kV	A
Single Phase Full Wave	A	25–55	13	5	1·25	4·5	4·1	2·5
		25–60	10	5	1·25	3·5	3·1	2·5
		25–65	8	5	1·25	2·8	2·5	2·5
Single Phase Full Wave Bridge	B	25–55	13	5	1·25	9·1	8·2	2·5
		25–60	10	5	1·25	7·0	6·3	2·5
		25–65	8	5	1·25	5·6	5·0	2·5
Three Phase Half Wave	C	25–55	13	5	1·25	5·3†	6·2†	3·75
		25–60	10	5	1·25	4·1†	4·7†	3·75
		25–65	8	5	1·25	3·2†	3·7†	3·75
Three Phase Full Wave	D	25–55	13	5	1·25	5·3	12·4	3·75
		25–60	10	5	1·25	4·1	9·5	3·75
		25–65	8	5	1·25	3·2	7·5	3·75

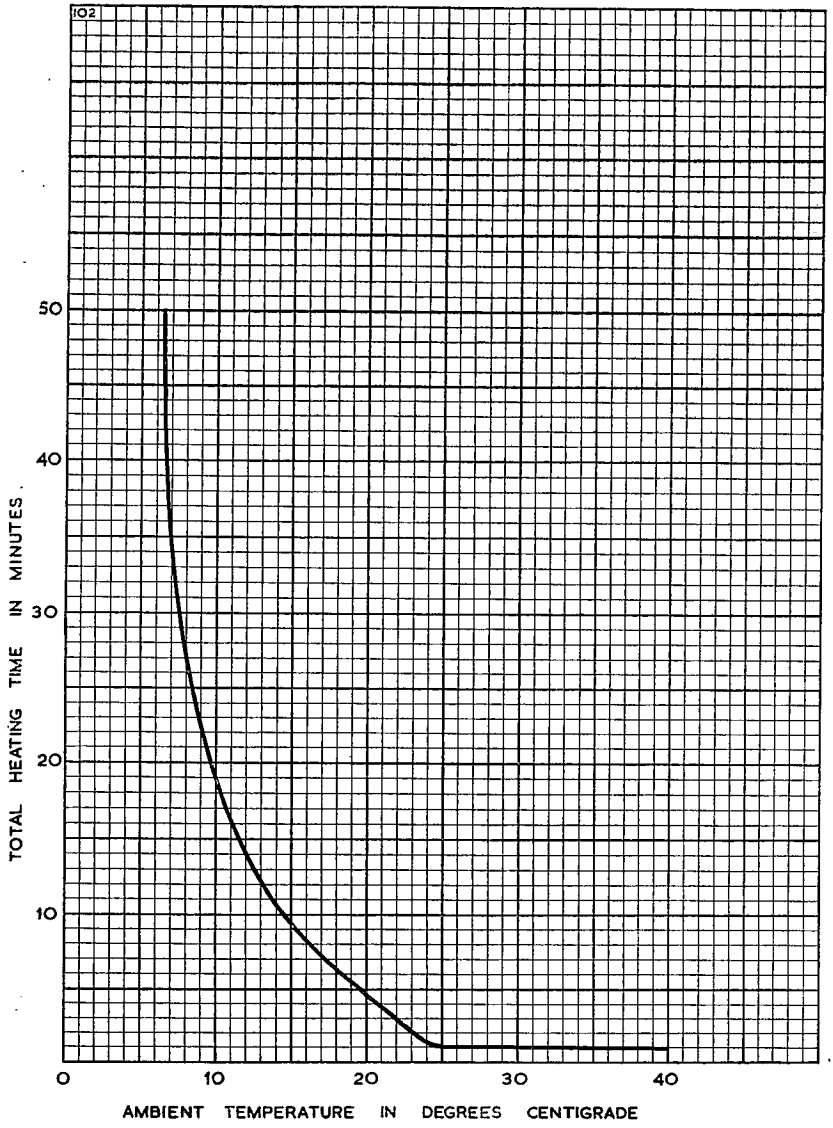
*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The d.c. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum.

ENGLISH ELECTRIC

TOTAL HEATING TIME CHARACTERISTIC



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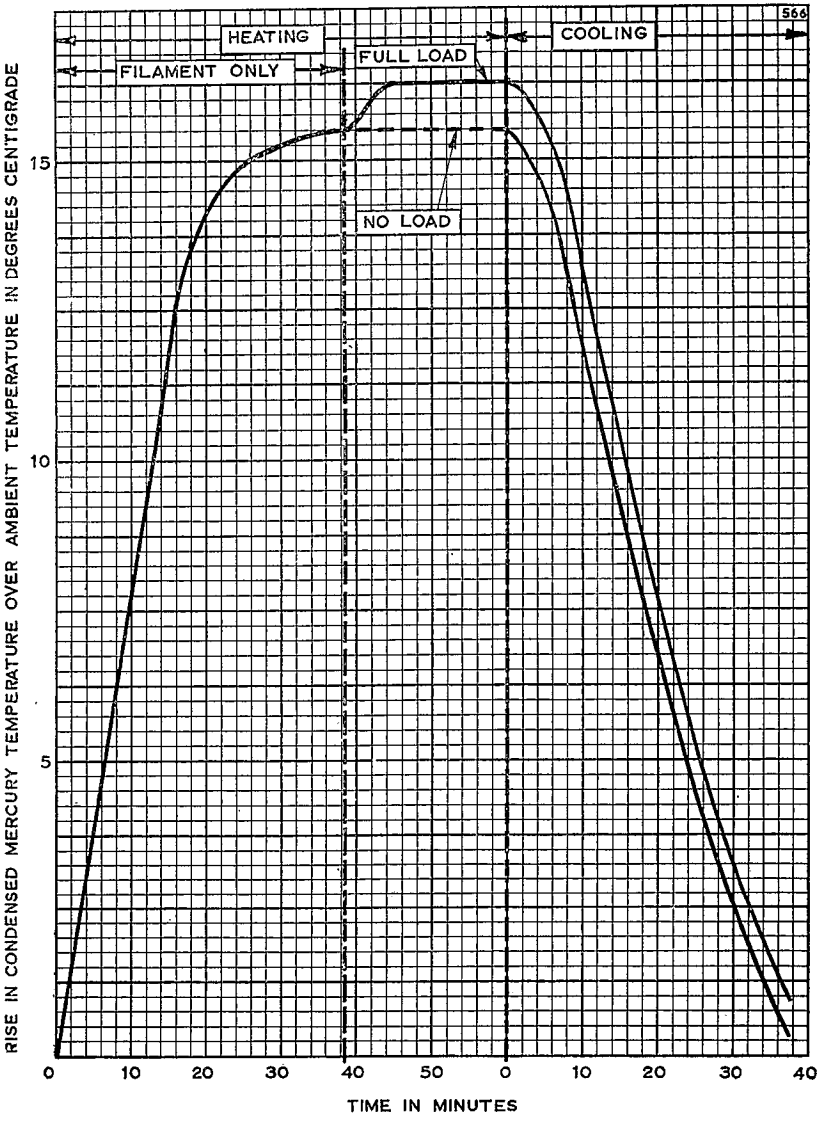
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HEATING AND COOLING CHARACTERISTIC



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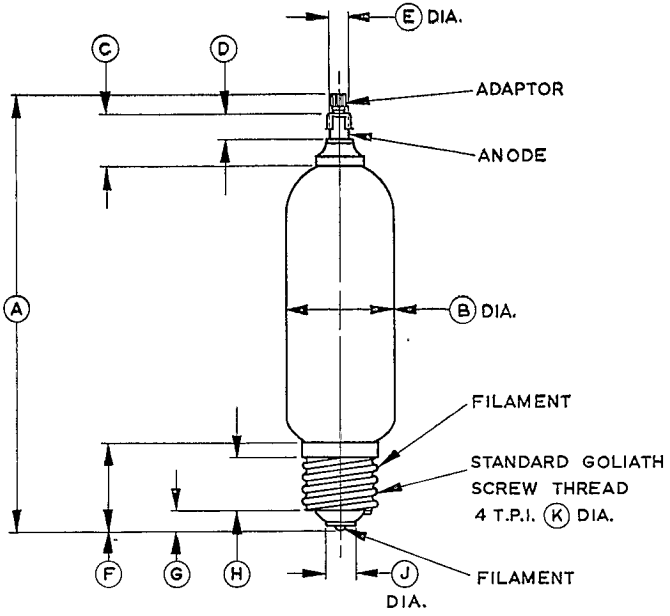
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OUTLINE

104C



Ref.	Inches	Millimetres
A	9·488 Max	241 Max
B	2·312 Max	58·72 Max
C	1·062	26·97
D	0·593	15·06
E	0·375±0·002	9·525±0·051
F	1·811±0·040	46·00±1·02
G	0·355±0·040	9·02±1·02
H	1·180	29·97
J	0·630±0·079	16·00±2·01
K	1·546±0·009	39·27±0·23

Millimetre dimensions have been derived from inches.

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AH2511

MERCURY VAPOUR RECTIFIER

JEDEC Type 6693

ABRIDGED DATA

Hot cathode mercury vapour rectifier		
Peak inverse anode voltage	15	kV max
Peak anode current (at 15kV p.i.v.)	12	A max
Mean anode current (at 15kV p.i.v.)	3.0	A max
Fault anode current (0.1s max)	120	A max
Frequency	150	Hz max

GENERAL

Electrical

Filament		oxide coated
Filament voltage	5.0	V
Filament current	11.5	A
Filament heating time (minimum)	1.0	min
Voltage drop (approx)	12	V
Condensed mercury temperature rise above ambient (approx):		
at no load	13	°C
at 2.5A load	23	°C

Mechanical

Overall length	308mm (12.126 inches) max
Overall diameter	72mm (2.835 inches) max
Net weight	450g (1 pound) approx
Mounting position	vertical, base down
Base	B4D with bayonet
Top cap	B.S.448/CT9 fitted with screw terminal adaptor

March 1969

MAXIMUM OPERATING CONDITIONS (Absolute values)

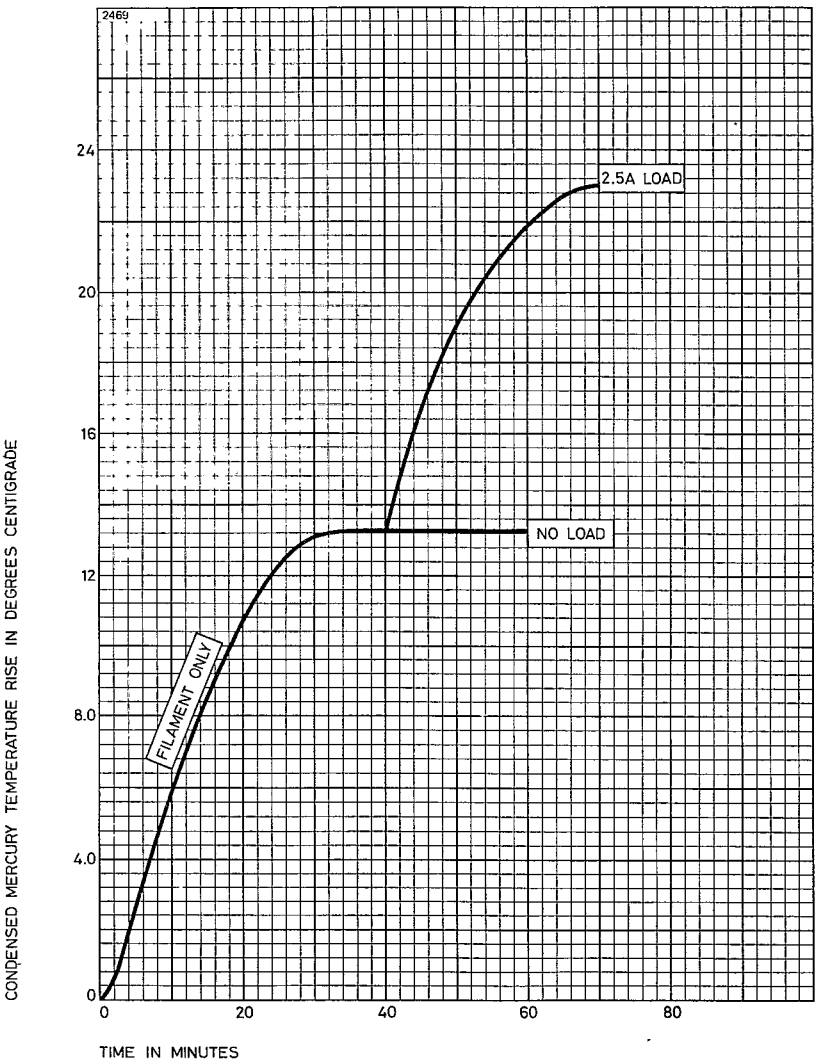
Circuit*	Condensed mercury temp. (°C)	Peak inverse voltage (50—60Hz) (kV)	Anode current in amperes peak	mean♦	Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output (kV)	(A)
A	25—55	15	12	3.0	5.3	4.8	6.0
Single phase	25—60	10	12	3.0	3.5	3.2	6.0
full wave	25—75	2.5	20	5.0	0.88	0.8	10
B	25—55	15	12	3.0	10.6	9.6	6.0
Single phase	25—60	10	12	3.0	7.1	6.4	6.0
bridge	25—75	2.5	20	5.0	1.77	1.6	10
C	25—55	15	12	3.0	6.1†	7.2†	9.0
Three phase	25—60	10	12	3.0	4.1†	4.8†	9.0
half wave	25—75	2.5	20	5.0	1.02†	1.2†	15
D	25—55	15	12	3.0	6.1	14.3	9.0
Three phase	25—60	10	12	3.0	4.1	9.5	9.0
full wave	25—75	2.5	20	5.0	1.02	2.4	15

* See Typical Rectifier Circuits for Choke input filters in the preamble to the Rectifier section of the Valve Data Book.

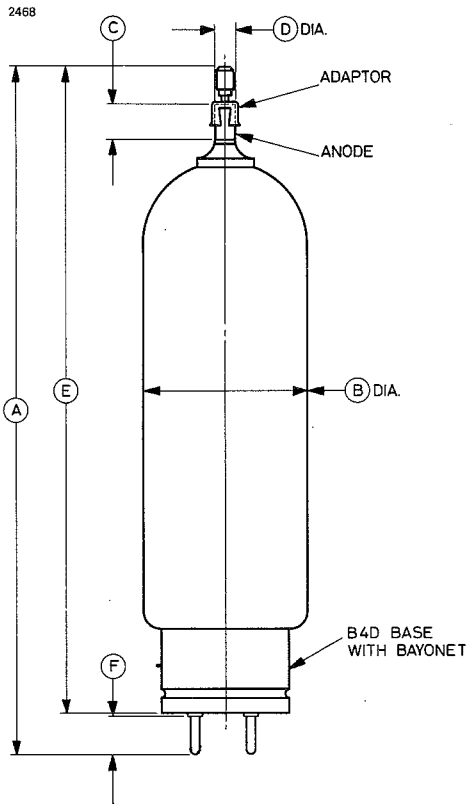
† For operation at constant full load. If the load is reduced, the peak inverse voltage on the valves will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

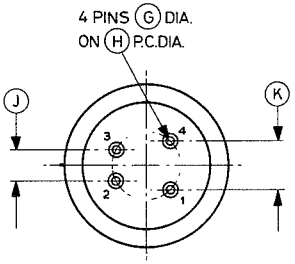
♦ Averaging time 15 seconds maximum.

HEATING CHARACTERISTIC



OUTLINE





VIEW ON BASE

Pin	Element
1	No connection
2	Filament
3	Filament
4	No connection

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	11.811 ± 0.315	300.0 ± 8.0	F	0.625	15.88
B*	2.835 max	72.0 max	G	0.187 ± 0.003	4.750 ± 0.076
C	0.593	15.06	H	1.000	25.40
D	0.375 ± 0.002	9.525 ± 0.051	J	0.562	14.27
E*	11.122 ± 0.236	282.5 ± 6.0	K	0.750	19.05

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

AX228

XENON FILLED RECTIFIER

Service Type CV2399

INTRODUCTION

The AX228 is a hot cathode, Xenon filled Rectifier with maximum ratings of 13kV peak inverse voltage and 6A peak current. The AX228 may be used as a replacement for the AH221 in applications where its peak inverse voltage rating is adequate, with the advantage that close control of ambient temperature is not required. →

GENERAL DATA

(See also Preamble to Rectifier Section of this catalogue)

Electrical

Filament		Oxide Coated	
Filament Voltage		4·0	V
Filament Current		11·0	A
Min Filament Heating Time		30	sec
Ambient Temperature Range		−55 to +70	°C
Max Peak Inverse Voltage	10	13	kV
Max Anode Current:			
Peak	6·0	6·0	A
Mean‡	1·5	1·25	A
Under fault conditions (0·1 second maximum duration)		50	A
Max Power Supply Frequency		150	c/s

Mechanical

Overall Length	10·16 inches	(258 mm)	Max
Overall Diameter	2·32 inches	(59 mm)	Max
Net Weight	8 ounces	(230 gm)	Approx
Mounting Position			Any
Base			Goliath Edison Screw
Cooling			Natural

→ Indicates a change.

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XENON FILLED RECTIFIER

MAXIMUM OPERATING CONDITIONS
(Absolute Values—see Preamble)

D.C. Output with choke input filter and delayed h.t. switching

Circuit	* Diagram	Peak Inverse Voltage (up to 150c/s) kV	Anode Current in Amperes		Transformer Secondary Voltage (R.M.S.) kV	Max D.C. Output	
			Peak	Mean‡		kV	Amps
Single Phase Full Wave	A	10	6·0	1·5	3·5	3·2	3·0
		13	6·0	1·25	4·6	4·1	2·5
Single Phase Full Wave Bridge	B	10	6·0	1·5	7·0	6·4	3·0
		13	6·0	1·25	9·2	8·2	2·5
Three Phase Half Wave	C	10	6·0	1·5	4·1†	4·7†	4·5
		13	6·0	1·25	5·3†	6·2†	3·75
Three Phase Full Wave	D	10	6·0	1·5	4·1	9·5	4·5
		13	6·0	1·25	5·3	12·3	3·75

*For diagrams see Typical Rectifier Circuits for Choke Input Filters in the preamble to this section of the catalogue.

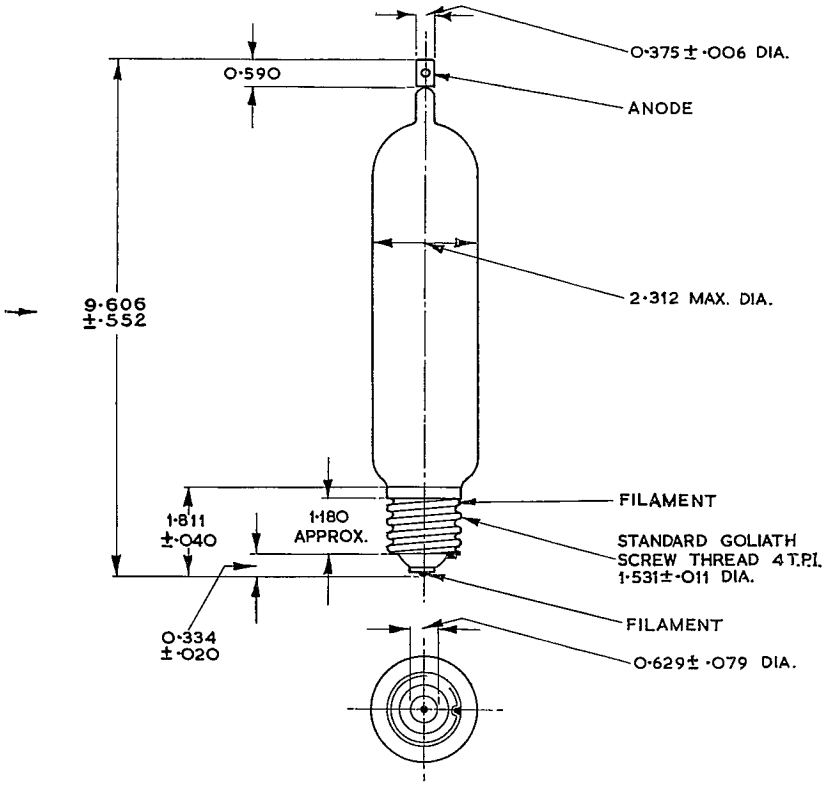
†For operation with constant full load. If the load resistance is increased the secondary voltage should be decreased (to avoid excessive peak inverse voltage) until at no load the reduction is 14%. The d.c. output voltage will be correspondingly decreased.

‡Mean anode currents are averaged over any period of 15 seconds maximum

XENON FILLED RECTIFIER

OUTLINE

497



ALL DIMENSIONS IN INCHES

INDICATES A CHANGE ←

ENGLISH ELECTRIC VALVE CO. LTD.
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MERCURY VAPOUR RECTIFIER

BD12

ENGLISH ELECTRIC

ABRIDGED DATA

Hot Cathode Full Wave Mercury Vapour Rectifier

Peak Inverse Anode Voltage	1·0	kV Max
Peak Anode Current (per anode)	50	A Max
Mean Anode Current (per anode)	16·5	A Max

GENERAL

(See also Preamble to Rectifier Section of this Catalogue)

Electrical

Cathode	Indirectly Heated	
Heater Voltage	5·0	V
Heater Current	35	A
Cathode Heating Time (Minimum)	5·0	min
Voltage Drop (Approx)	12	V
Condensed Mercury Temperature Rise above Ambient (Approx):		
At no load	52	°C
At full load	60	°C

Mechanical

Overall Length (excluding leads)	16·437 inches	(417·5 mm)	Max
Overall Diameter	6·437 inches	(163·5 mm)	Max
Net Weight	3½ pounds	(1·6 kg)	Approx
Mounting Position		Vertical, base down	
Connections		Flexible leads	

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

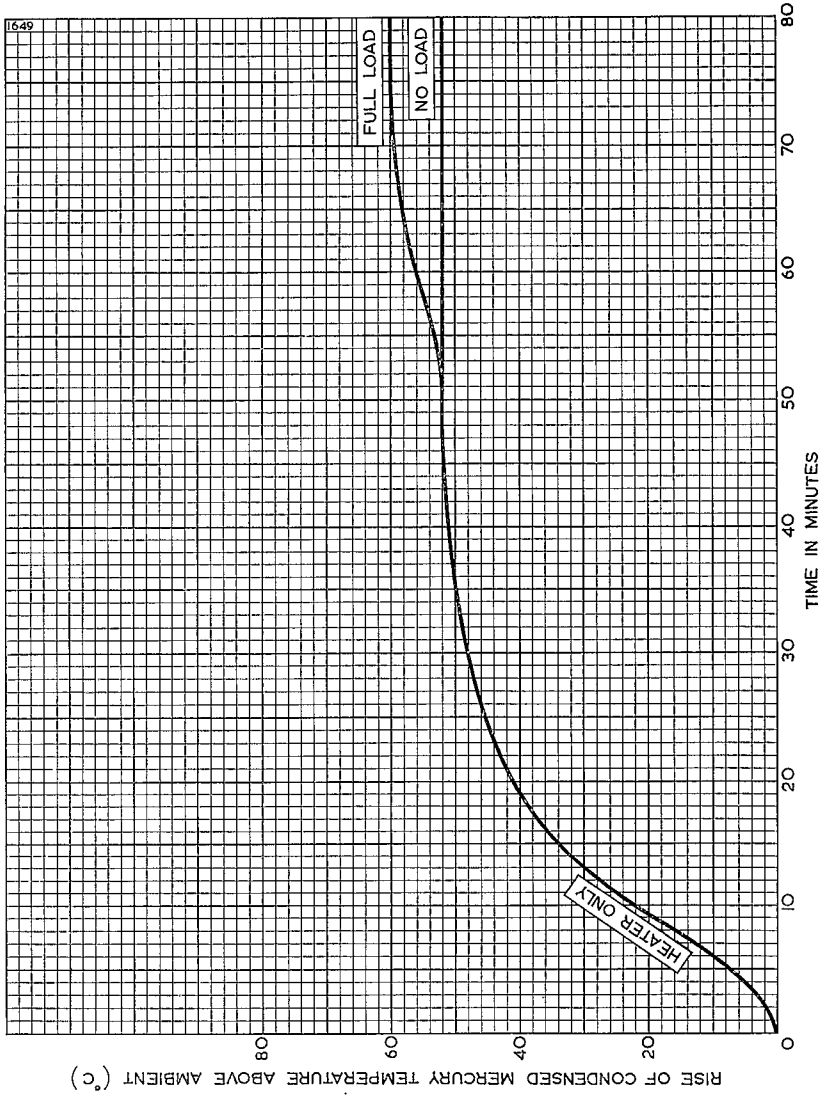
Peak Inverse Anode Voltage	1·0	kV Max
R.M.S. Voltage between Anodes	250	V Max
Peak Anode Current (per anode)	50	A Max
Mean Anode Current (per anode) (averaging time 30sec max)	16·5	A Max
Surge Anode Current (per anode) (0·1sec maximum duration)	500	A Max
Condensed Mercury Temperature (on load)	40	°C Min
	100	°C Max

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ENGLISH ELECTRIC

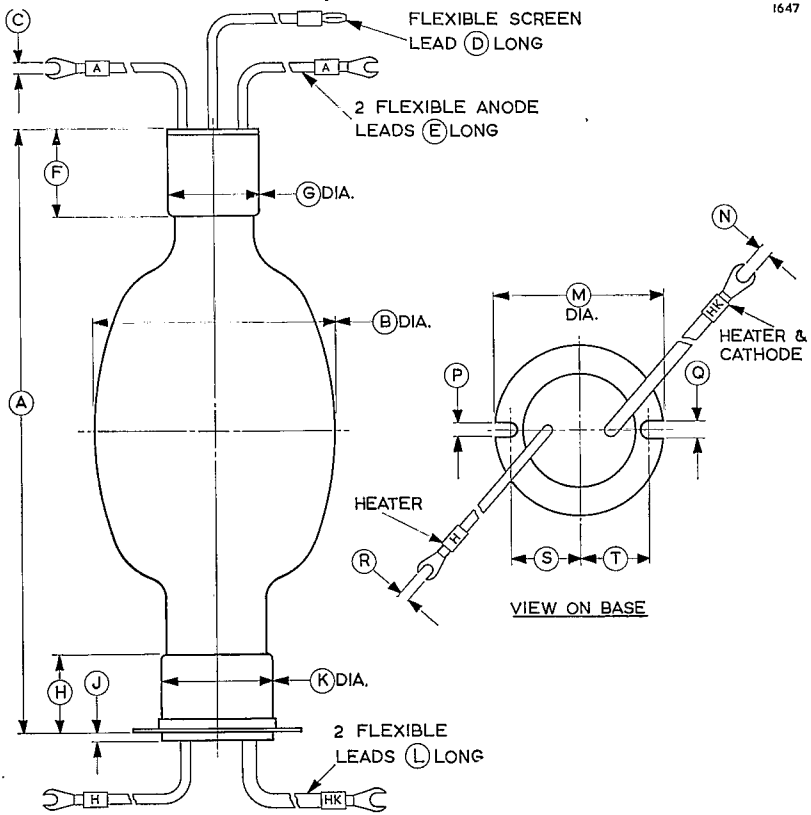
HEATING CHARACTERISTIC



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OUTLINE

1647



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	15·625±0·500	396·9±12·70	K	2·875 Max	73·03 Max
B	6·437 Max	163·5 Max	L	7·750±0·250	196·9±6·35
C	0·265	6·73	M	4·375 Max	111·1 Max
D	6·250±0·250	158·8±6·35	N	0·328	8·33
E	7·750±0·250	196·9±6·35	P	0·344	8·74
F	2·250	57·15	Q	0·437	11·10
G	2·875 Max	73·03 Max	R	0·265	6·73
H	2·000	50·80	S	1·813	46·05
J	0·250±0·062	6·35±1·57	T	1·813	46·05

Millimetre dimensions have been derived from inches.

BM1031

X-BAND MAGNETRON

Service Type CV2186

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9420 to 9500	MHz
Typical peak output power	40	kW
Magnet		separate
Output	British X-band waveguide (1.000 x 0.500 inch internal)	
Coupler		special
Cooling		forced-air

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.8	A
Heater starting current, peak value, not to be exceeded	2.5	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	9.077 x 3.400 x 3.240 inches max 230.6 x 86.36 x 82.30mm max	
Net weight	1½ pounds (0.7kg) approx	
Mounting position		any

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

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Magnetic field (see note 3)	4500	5200	gauss
Heater voltage (see note 1)	6.0	6.6	V
Heater starting current (peak)	–	2.5	A
Anode voltage (peak)	–	14	kV
Anode current (peak)	–	12	A
Input power (mean) (see note 4)	–	140	W
Duty cycle	–	0.001	
Pulse length	–	1.0	μs
Rate of rise of voltage pulse (see note 6)	–	200	kV/μs
Anode temperature (see note 2)	–	*100	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Magnetic field (see note 3)	4850 ± 50	4850 ± 50	gauss
Heater voltage	0	0	V
Anode current (peak)	10	10	A
Pulse length	1.0	0.25	μs
Pulse repetition rate	1000	1500	p.p.s.
Rate of rise of voltage pulse	200	200	kV/μs

Typical Performance

Anode voltage (peak)	13	13	kV
Output power (peak)	40	40	kW
Output power (mean)	40	15	W

TEST CONDITIONS AND LIMITS

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

Test Conditions

Magnetic field	4850	gauss
Heater voltage (for test)	0	V
Anode current (mean)	10	mA
Duty cycle	0.001	
Pulse length (see note 5)	1.0	μs
V.S.W.R. at the output coupler	1.1:1	
Rate of rise of voltage pulse (see note 6)	150	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	11	14	kV
Output power (mean)	30	—	W
Frequency (see note 7)	9420	9500	MHz
R.F. bandwidth at ¼ power	—	2.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	—	15	MHz
Stability (see note 8)	—	0.2	%
Heater current			see note 9
Temperature coefficient of frequency			see note 10

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be run continuously under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions above)

Anode voltage (peak)	10	kV min
Output power (mean)	25	W min
R.F. bandwidth at ¼ power	3.0	MHz max
Frequency	9420 to 9500	MHz
Stability (see note 8)	0.5	% max

NOTES

1. With no anode input power.

   The heater voltage must be reduced within 5 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\sqrt{1 - \frac{Pi}{150}} \text{ volts}$$

   where Pi = mean input power in watts.

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

3. The valve is designed for use with a separate magnet (not supplied). The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.

4. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

5. Tolerance $\pm$10%.

6. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

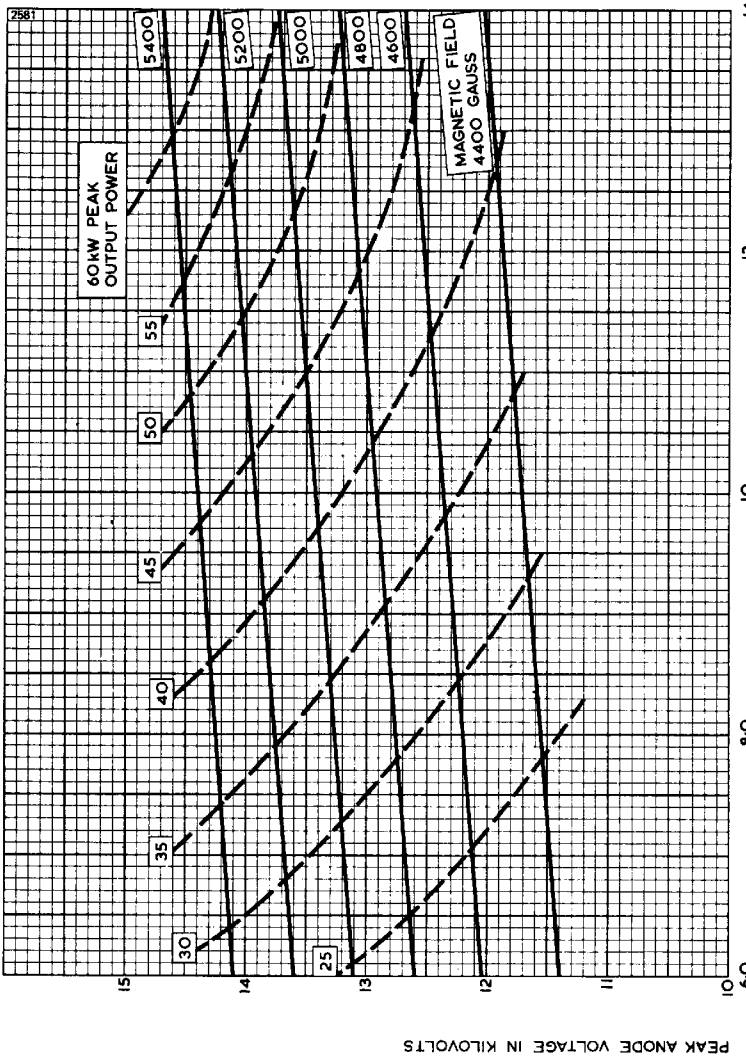
7. Other frequency ranges can be supplied on request.

8. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

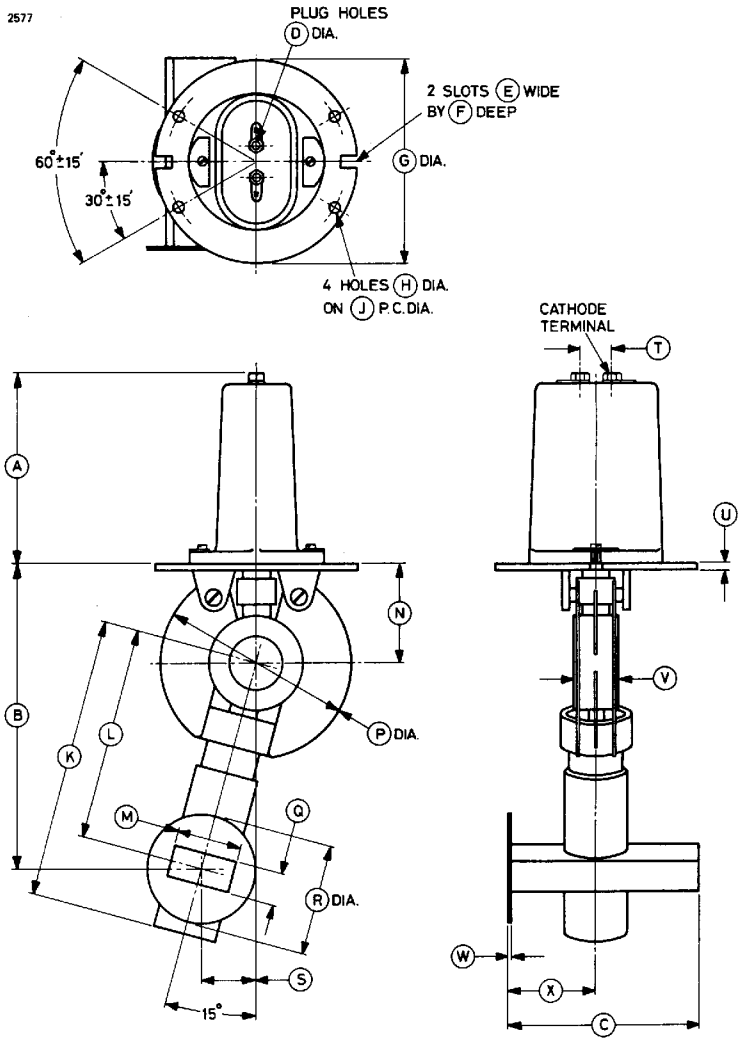
9. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.7A minimum, 0.9A maximum.

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

TYPICAL PERFORMANCE CHART



OUTLINE


2577
PLUG HOLES
D DIA.
2 SLOTS E WIDE
BY F DEEP
G DIA.
60°±15'
30°±15'
4 HOLES H DIA.
ON J P.C.DIA.
CATHODE
TERMINAL
T
A
U
N
B
V
P DIA.
K
L
M
Q
R DIA.
S
15°
W
X
C

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.000 ± 0.062	76.20 ± 1.57
B	4.800 ± 0.020	121.92 ± 0.51
C	3.062	77.77
D	0.169 ± 0.002	4.293 ± 0.051
E	0.188 ± 0.001	4.775 ± 0.025
F	0.312	7.92
G	3.240 ± 0.001	82.296 ± 0.025
H	0.201	5.11
J	2.875 ± 0.010	73.03 ± 0.25
K	4.437	112.7
L	3.355 ± 0.020	85.22 ± 0.51
M	1.000	25.40
N	1.562 ± 0.020	39.67 ± 0.51
P	3.000 ± 0.062	76.20 ± 1.57
Q	0.500	12.70
R	1.750	44.45
S	0.870 ± 0.020	22.10 ± 0.51
T	0.500 ± 0.010	12.70 ± 0.25
U	0.125	3.18
V	0.620 max	15.75 max
W	0.064	1.63
X	1.387 ± 0.020	35.23 ± 0.51

Millimetre dimensions have been derived from inches.

BR1160

R.F. POWER TRIODE

Service Type CV8730

The data should be read in conjunction with the Power Triode Preamble.

ABRIDGED DATA

Forced-air cooled r.f. triode for a.m., f.m. or television transmitters and for industrial applications.

Anode dissipation	5.0	kW max
Anode voltage	6.0	kV max
Operating frequency	220	MHz max
Output power:		
class B audio, per valve	6.65	kW
class C telegraphy, f.m. telephony	6.9	kW
class C television, per valve	4.5	kW
class C industrial oscillator	6.5	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	12.6	V
Filament current	33	A
Peak usable cathode current	8.5	A
Amplification factor (V_a = 4.0kV, I_a = 1.0A)	32	
Mutual conductance (V_a = 4.0kV, I_a = 1.0A)	17	mA/V
Inter-electrode capacitances:		
grid to anode	11	pF
grid to filament	16	pF
anode to filament	0.3	pF

Mechanical

Overall length (excluding flexible leads)	195mm (7.680 inches) max
Overall diameter	119mm (4.685 inches) max
Net weight	7½ pounds (3.4kg) approx
Mounting position	vertical, either way up

February 1970

COOLING

Anode

The air cooling requirements for BR1160 are given in the following table. The air flow should be delivered immediately before and during the application of any voltages.

Anode dissipation (kW)	Height above sea level (m)	Inlet temperature (max) (°C)	Rate of flow of air (min) (m^3/min)	Pressure drop (mm water)
1.0	0	35	3.0	8.0
1.0	0	45	3.1	8.0
1.0	1500	35	3.7	9.0
1.0	3000	25	4.1	10
3.0	0	35	5.2	23
3.0	0	45	6.1	29
3.0	1500	35	6.2	26
3.0	3000	25	6.6	26
5.0	0	35	9.2	68
5.0	0	45	10.7	90
5.0	1500	35	11.2	81
5.0	3000	25	11.6	79

Filament and Grid Seals

It may be necessary to direct a flow of air on to the filament and grid seals in order to maintain their temperatures within the following limits.

Temperature of filament seals . . . . . 220 °C max
Temperature of grid seal . . . . . 180 °C max

Anode Seal

The anode seal temperature must not exceed 180°C.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class B)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.5	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid dissipation	120	W max
Grid circuit resistance	15	kΩ max
Cathode current (peak)	5.7	A max

TYPICAL OPERATING CONDITIONS (Class B, 2 valves)

Anode voltage	3.0	3.5	4.0	kV
Grid voltage	−90	−100	−112	V
Peak a.f. grid drive voltage (per valve)	285	310	318	V
Anode current (zero signal)	2 x 65	2 x 75	2 x 100	mA
Anode current (maximum signal)	2 x 0.80	2 x 0.95	2 x 0.94	A
Grid current (maximum signal)	2 x 0.20	2 x 0.18	2 x 0.19	A
Effective load (anode to anode)	4.4	4.2	4.9	kΩ
Nominal driving power (maximum signal)	2 x 52	2 x 50	2 x 54	W
Anode dissipation	2 x 0.75	2 x 1.0	2 x 1.1	kW
Output power (maximum signal)	3.3	4.6	5.3	kW
Efficiency	69	70	71	%
Total distortion	3.3	2.9	2.6	%
Anode voltage	4.5	5.0	6.0	kV
Grid voltage	−125	−138	−165	V
Peak a.f. grid drive voltage (per valve)	327	330	455	V
Anode current (zero signal)	2 x 100	2 x 110	2 x 125	mA
Anode current (maximum signal)	2 x 0.92	2 x 0.91	2 x 1.50	A
Grid current (maximum signal)	2 x 0.19	2 x 0.14	2 x 0.28	A
Effective load (anode to anode)	6.1	6.4	4.9	kΩ
Nominal driving power (maximum signal)	2 x 27	2 x 42	2 x 115	W
Anode dissipation	2 x 1.15	2 x 1.25	2 x 2.35	kW
Output power (maximum signal)	6.0	6.6	13.3	kW
Efficiency	72	73	74	%
Total distortion	3.7	3.3	4.3	%

RADIO FREQUENCY POWER AMPLIFIER

(Class B telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.1	A max
Anode input power	6.6	kW max
Anode dissipation	5.0	kW max
Grid dissipation	120	W max
Cathode current (peak)	4.6	A max

TYPICAL OPERATING CONDITIONS (frequency 75MHz)

Anode voltage	5.0	6.0	kV
Grid voltage	−145	−180	V
Peak r.f. grid drive voltage	225	250	V
Anode current	900	990	mA
Grid current (100% modulation)	320	300	mA
Driving power (100% modulation)	160	170	W
Anode dissipation	3.0	4.0	kW
Output power	1.45	1.90	kW
Efficiency	32	32	%

RADIO FREQUENCY POWER AMPLIFIER

(Class C telegraphy, key down conditions, or F.M. telephony, per valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.5	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	1.0	kV max
Grid current	0.35	A max
Grid dissipation	120	W max
Cathode current (peak)	8.5	A max

TYPICAL OPERATING CONDITIONS
(Grounded Cathode)

Frequency	75	75	75	110	MHz
Anode voltage	4.0	5.0	6.0	5.0	kV
Grid voltage	−200	−300	−400	−300	V
Peak r.f. grid drive voltage	500	640	740	640	V
Anode current	1.37	1.50	1.50	1.25	A
Grid current	350	330	310	300	mA
Nominal driving power	190	240	275	250	W
Anode dissipation	1.5	1.9	2.1	1.45	kW
Output power	4.0	5.6	6.9	4.8	kW
Efficiency	73	75	76.5	70	%

TYPICAL OPERATING CONDITIONS
(Grounded Grid, 2 valves)

Frequency	75	110	110	220	MHz
Anode voltage	6.0	4.0	5.0	4.0	kV
Filament-grid voltage	400	200	300	200	V
Peak r.f. drive voltage, filament to filament	1480	1000	1280	900	V
Anode current	2 x 1.5	2 x 1.37	2 x 1.5	2 x 1.25	A
Grid current	2 x 310	2 x 350	2 x 330	2 x 220	mA
Nominal driving power	2 x 1190	2 x 705	2 x 965	2 x 395	W
Anode dissipation	2 x 2.1	2 x 1.7	2 x 2.2	2 x 2.5	kW
Output power (see note 2)	15.6	8.6	12	5.6	kW
Efficiency	77	69	71	50	%

ANODE MODULATED R.F. POWER AMPLIFIER

(Class C telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.0	kV max
Anode current	1.3	A max
Anode input power	6.5	kW max
Anode dissipation	3.4	kW max
Grid voltage (negative value)	1.0	kV max
Grid current	0.35	A max
Grid dissipation	120	W max
Cathode current (peak)	5.7	A max

TYPICAL OPERATING CONDITIONS

Frequency	75	75	75	MHz
Anode voltage	3.0	3.5	4.0	kV
Grid voltage	−250	−300	−300	V
Peak r.f. grid drive voltage	510	600	600	V
Anode current	1.0	1.2	1.2	A
Grid current	0.3	0.3	0.3	A
Nominal driving power	170	205	205	W
Anode dissipation	0.8	1.2	1.3	kW
Output power	2.2	3.0	3.5	kW
Efficiency	73	71.5	73	%

Frequency	75	75	110	MHz
Anode voltage	4.5	5.0	4.0	kV
Grid voltage	−350	−400	−350	V
Peak r.f. grid drive voltage	650	690	600	V
Anode current	1.2	1.2	0.93	A
Grid current	0.3	0.3	0.24	A
Nominal driving power	230	205	130	W
Anode dissipation	1.3	1.3	0.92	kW
Output power	4.1	4.7	2.8	kW
Efficiency	76	78	75	%

CLASS C TELEVISION SERVICE, GRID-MODULATED

MAXIMUM RATINGS (Absolute values)

Anode voltage:		
up to 75MHz	5.0	kV max
up to 220MHz	4.0	kV max
Anode current	1.9	A max
Anode input power	9.5	kW max
Anode dissipation (sync. level)	5.0	kW max
Grid voltage (negative value) (sync. level)	1.0	kV max
Grid current	0.25	A max
Grid dissipation (sync. level)	120	W max
Cathode current (peak)	10	A max

TYPICAL OPERATING CONDITIONS

(Negative modulation, positive synchronisation) (2 valves)

Frequency	48 to 75	170 to 220	MHz
Anode voltage	5.0	4.0	kV
Grid voltage:			
peak sync.	−200	−250	V
black level	−300	−225	V
white level	−550	−500	V
Peak r.f. grid to grid voltage (sync. level)	1.0	1.0	kV
Anode current:			
peak sync.	2 x 1.9	2 x 1.6	A
black level	2 x 1.3	2 x 1.3	A
Grid current:			
peak sync.	2 x 0.250	2 x 0.20	A
black level	2 x 0.175	2 x 0.11	A
Nominal driving power (sync. level)	2 x 250	2 x 400	W
Output power (sync. level)	9.0	6.0	kW
Power into load (sync. level) (see note 3)	6.3	4.2	kW
Bandwidth (see note 4):			
to −3db points	8.00	10	MHz
to −1.5db points	5.25	6.5	MHz

TYPICAL OPERATING CONDITIONS

(Positive modulation, negative synchronisation) (2 valves)

Frequency	48 to 75	MHz
Anode voltage	5.0	kV
Grid voltage:		
white level	−200	V
black level	−460	V
peak sync.	−580	V
Peak r.f. grid to grid voltage (white level)	1.0	kV
Anode current:		
white level	2 x 1.9	A
black level	2 x 0.4	A
Grid current:		
white level	2 x 250	mA
black level	0	mA
Nominal driving power (white level)	2 x 250	W
Output power (white level)	9.0	kW
Power into load (white level) (see note 3)	6.3	kW
Bandwidth (see note 4):		
to −3db points	8.0	MHz
to −1.5db points	5.25	MHz

RADIO FREQUENCY OSCILLATOR FOR INDUSTRIAL SERVICE

(Class C, anode supply from unfiltered two-phase half-wave rectifier)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.4	kV max
Anode current	1.35	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	900	V max
Grid current	0.31	A max
Grid dissipation	120	W max

TYPICAL OPERATING CONDITIONS

Output voltage (r.m.s.) from transformer	5.1	6.0	kV
Anode voltage	4.6	5.4	kV
Anode current	1.15	1.35	A
Grid current	0.27	0.31	A
Anode dissipation	1.84	2.3	kW
Grid resistor	1.1	1.3	kΩ
Nominal driving power	160	210	W
Output power	4.5	6.5	kW
Efficiency	70	72	%

RADIO FREQUENCY OSCILLATOR FOR INDUSTRIAL SERVICE

(Class C, anode supply unrectified a.c.)

MAXIMUM RATINGS (Absolute values)

Output voltage (r.m.s.) from transformer	6.8	kV max
Anode current	0.8	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	640	V max
Grid current	190	mA max
Grid dissipation	120	W max
Operating frequency	75	MHz max

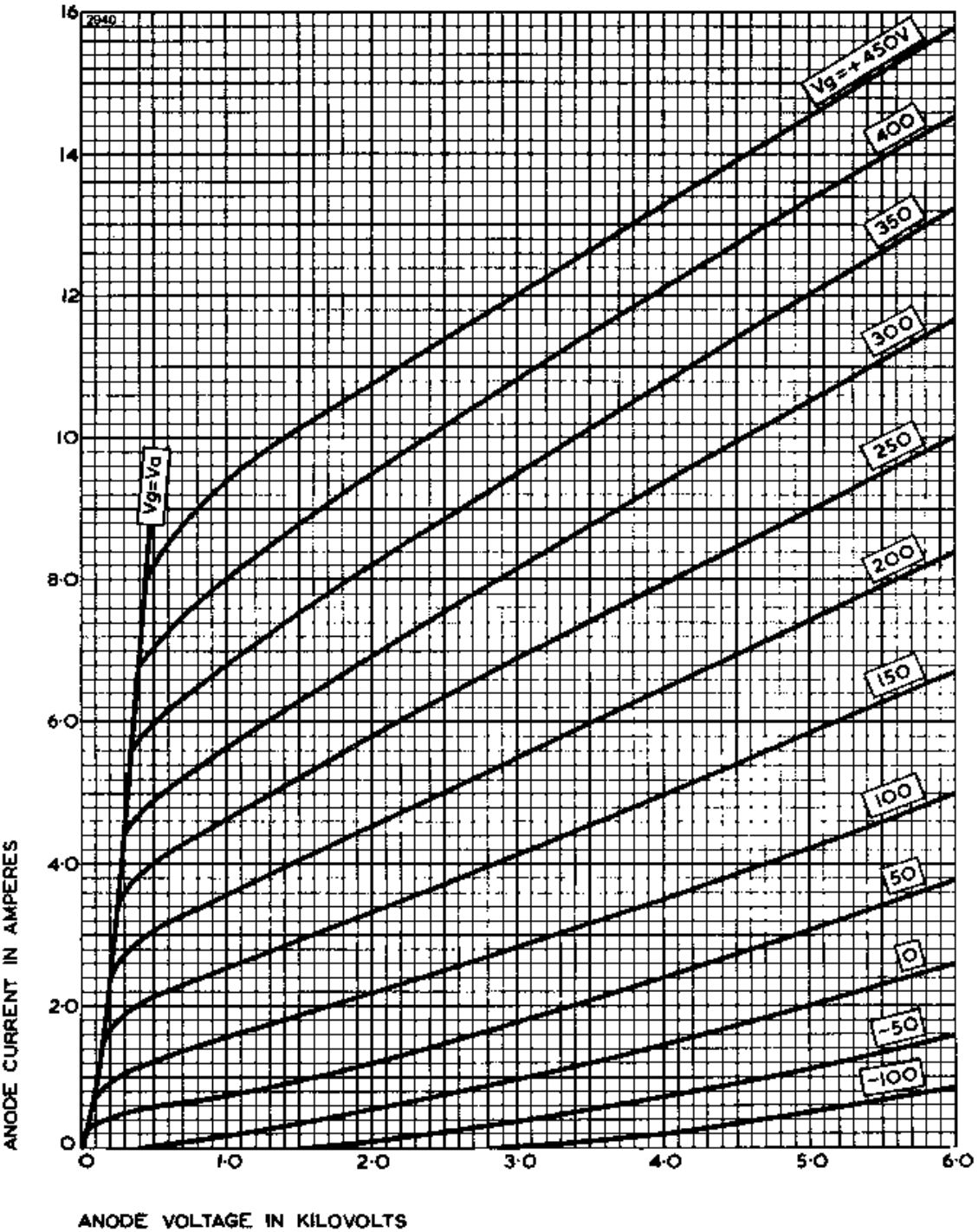
TYPICAL OPERATING CONDITIONS

Output voltage (r.m.s.) from transformer	5.9	6.8	kV
Grid voltage	−173	−200	V
from grid resistor	1050	1050	Ω
Anode current	0.7	0.8	A
Grid current (approx)	165	190	mA
Anode dissipation	1.24	1.5	kW
Output power	3.36	4.55	kW
Efficiency	73	75	%

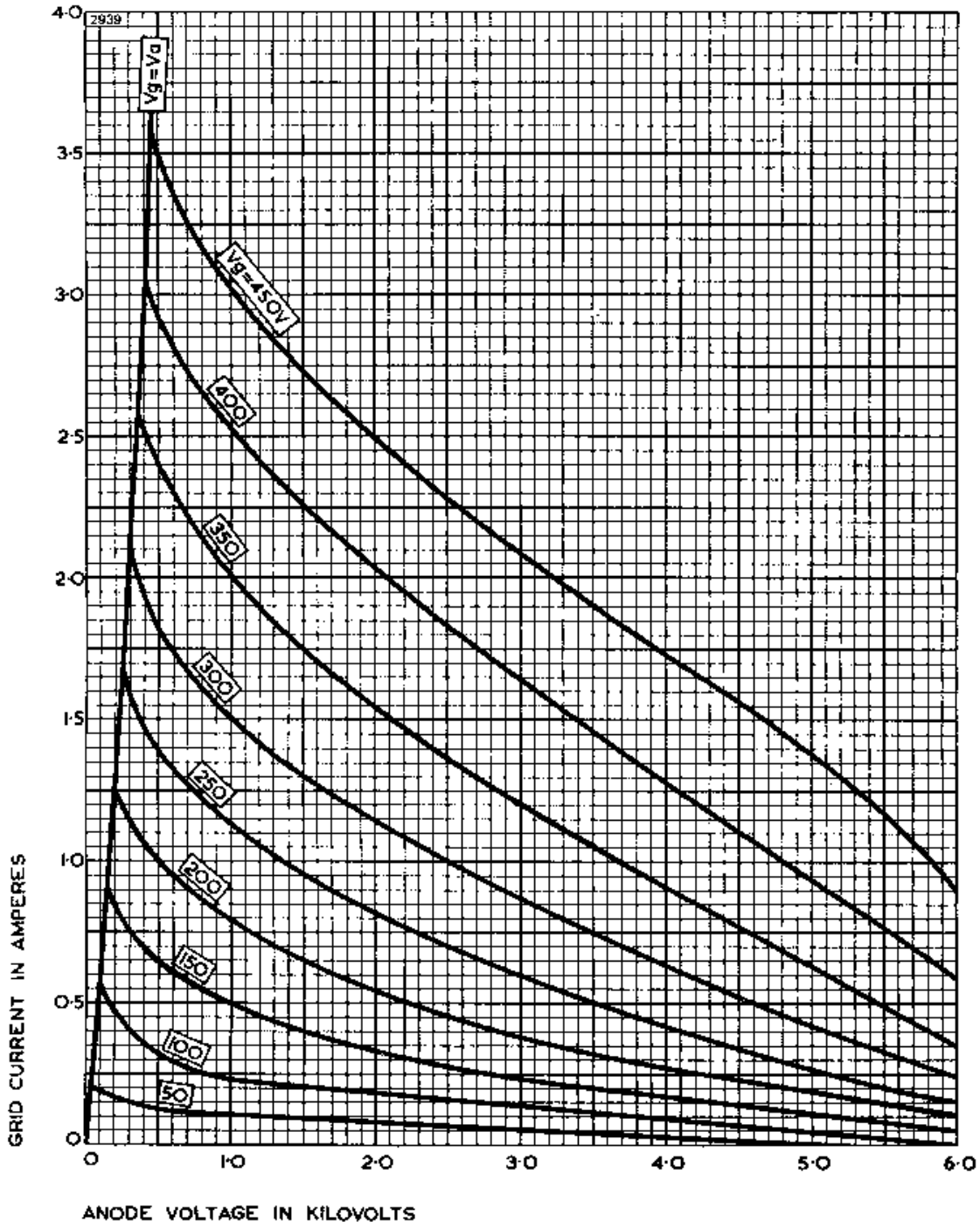
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed +5% or −10%. The centre-tap lead may be used for the anode current return but must not be used for the filament current supply. At frequencies above 30MHz, all three filament leads should be interconnected with suitable capacitors.
2. This includes the power transferred from the drive circuit.
3. Assuming circuit transfer efficiency of 70%.
4. For a bandwidth based on one inductor-capacitor circuit.

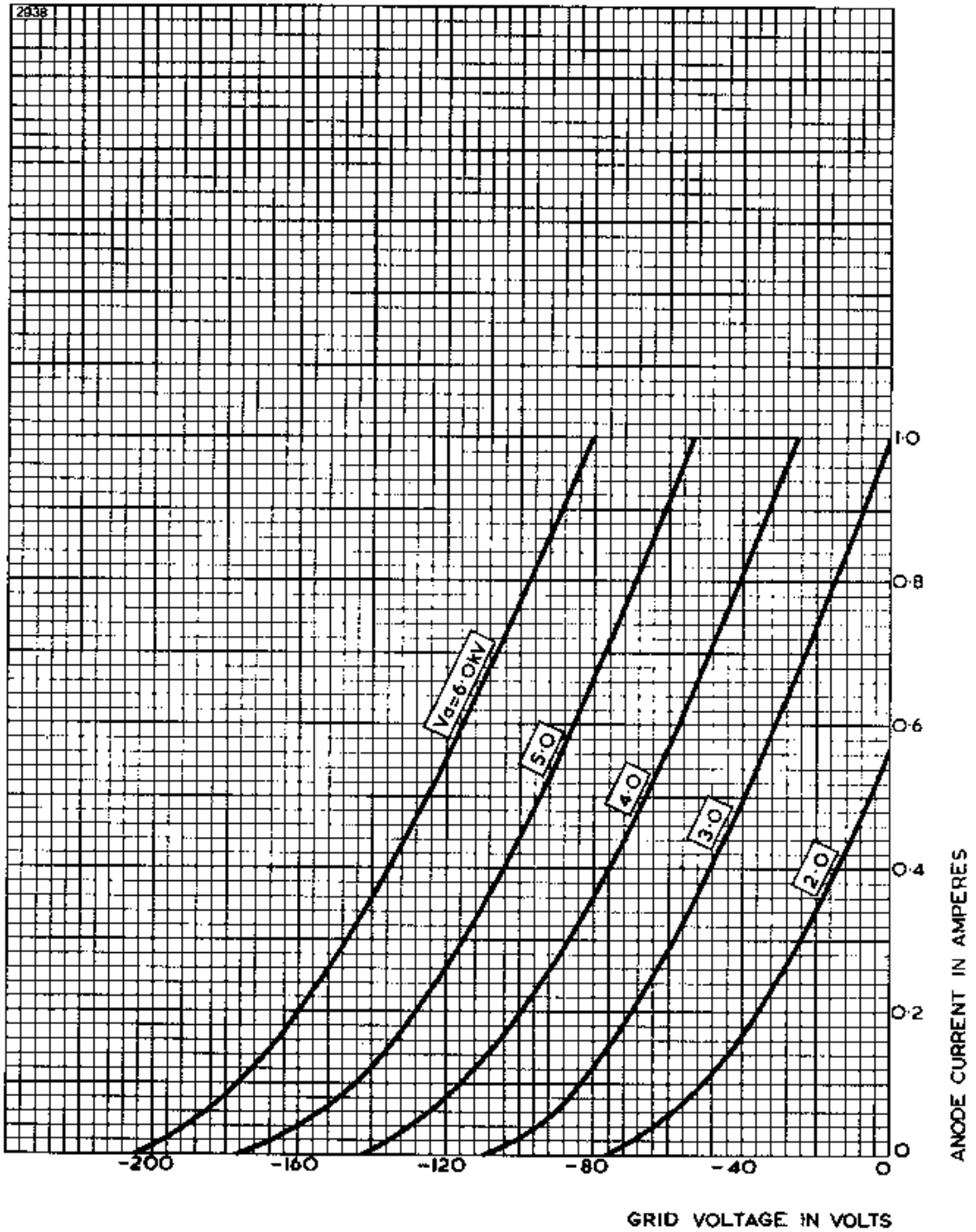
TYPICAL ANODE CHARACTERISTICS



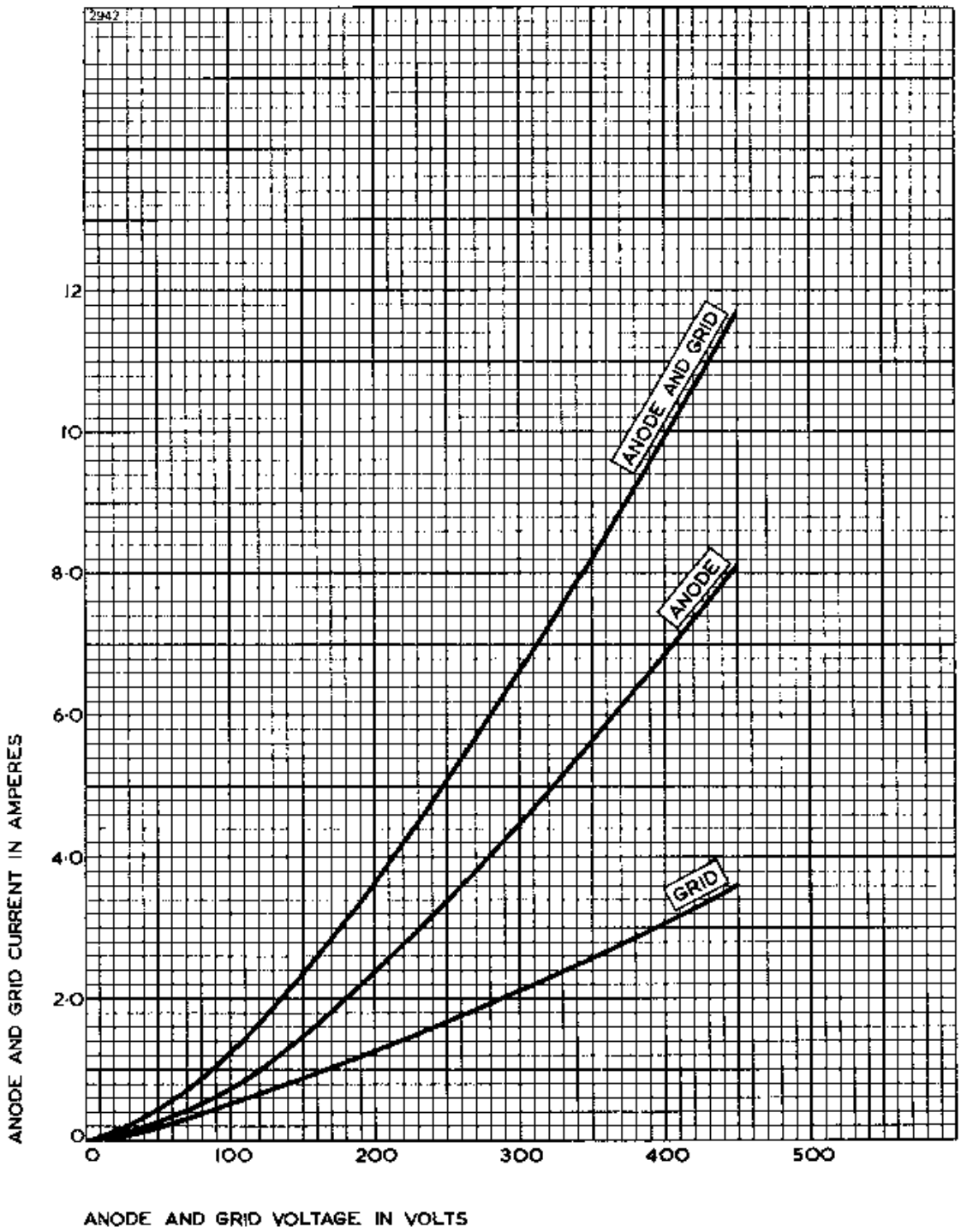
TYPICAL GRID CHARACTERISTICS



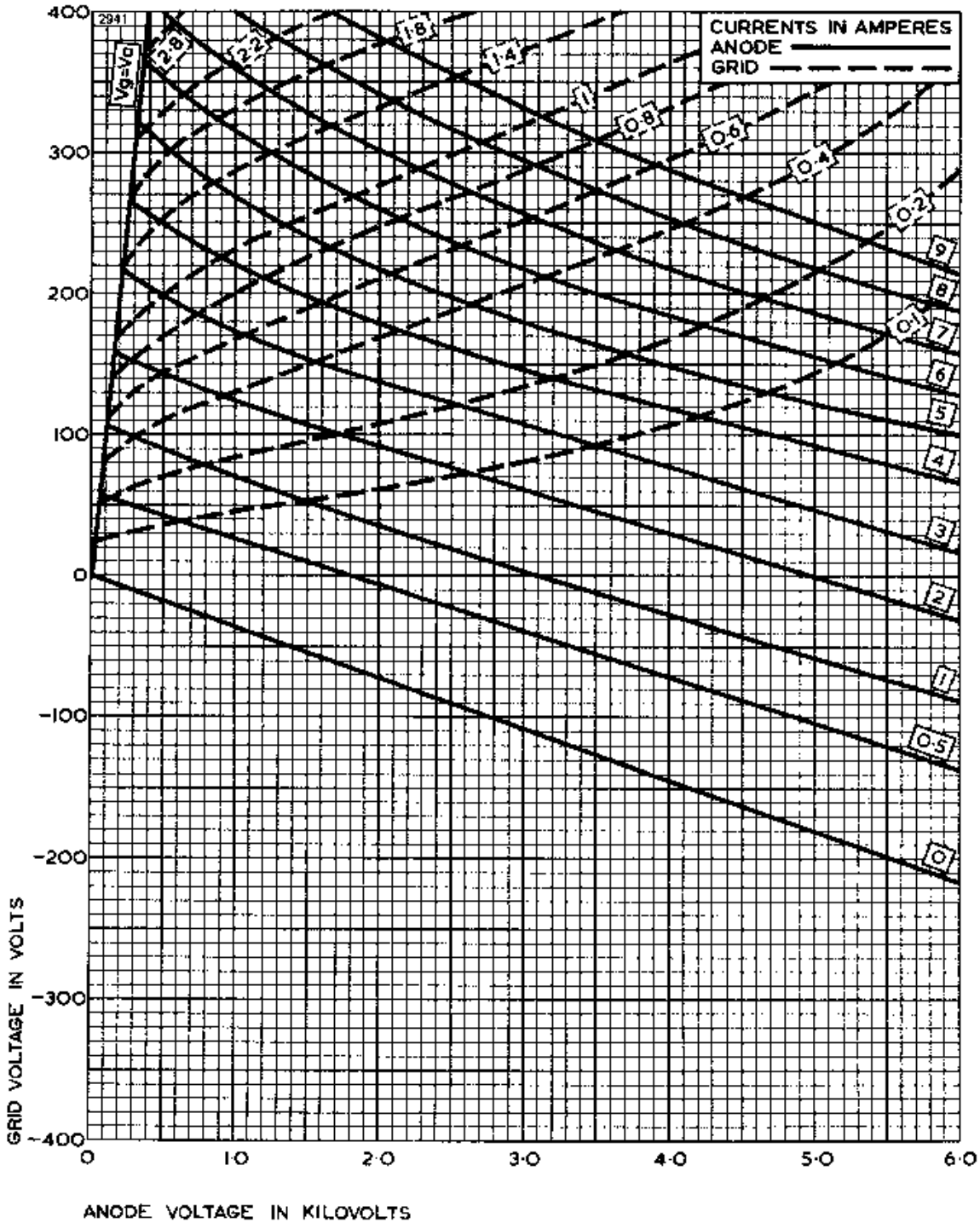
TYPICAL ANODE CURRENT – GRID VOLTAGE CHARACTERISTICS



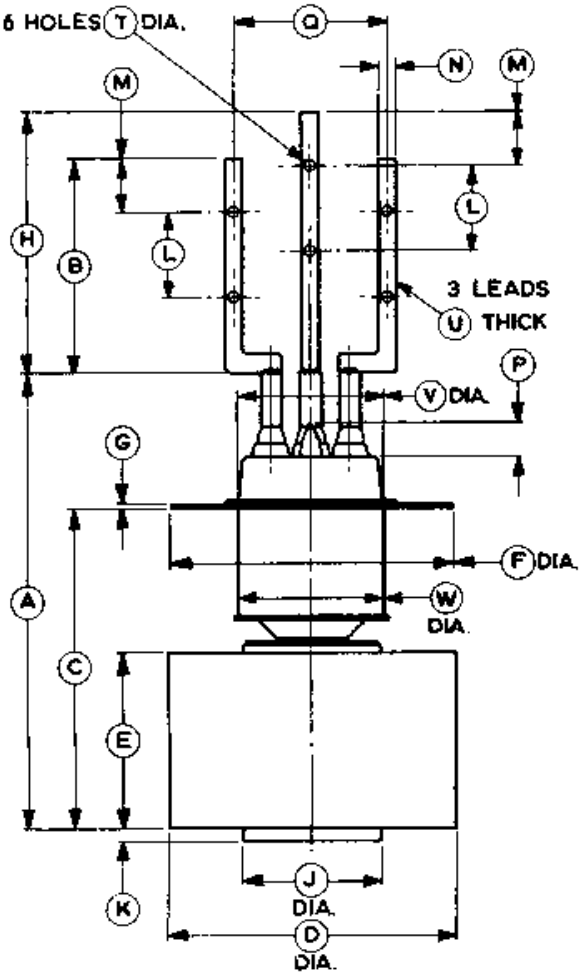
TYPICAL STRAPPED CHARACTERISTICS



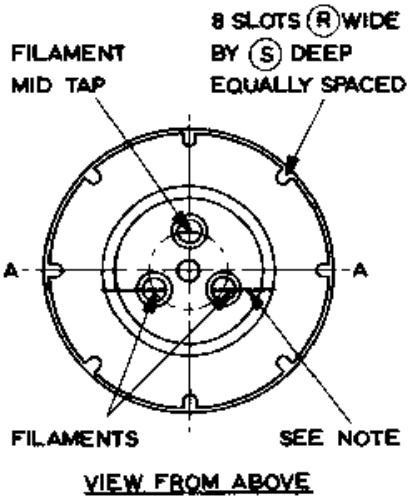
TYPICAL CONSTANT CURRENT CHARACTERISTICS



OUTLINE



2955



VIEW FROM ABOVE

Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	188.0 ± 2.0	7.402 ± 0.079	M	22.0 ± 2.0	0.866 ± 0.079
B	89.0 ± 2.0	3.504 ± 0.079	N	8.00 ± 0.50	0.315 ± 0.020
C	133.5 ± 3.5	5.256 ± 0.138	P	23.0 max	0.906 max
D	117.5 ± 1.5	4.626 ± 0.059	Q	62.5 ± 2.5	2.461 ± 0.098
E	73.0 max	2.874 max	R	4.62 ± 0.1	0.182 ± 0.004
F	116.0 ± 0.5	4.567 ± 0.020	S	5.20 ± 0.20	0.205 ± 0.008
G	1.50 ± 0.20	0.059 ± 0.008	T	3.60 ± 0.10	0.142 ± 0.004
H	108.0 ± 2.0	4.252 ± 0.079	U	4 x 0.25	4 x 0.010
J	57.0 max	2.244 max	V	59.0 max	2.323 max
K	4.50 ± 0.50	0.177 ± 0.020	W	64.0 max	2.520 max
L	35.0 ± 2.0	1.378 ± 0.079			

Inch dimensions have been derived from millimetres.

Note Plane of filament leads will be parallel to A-A to within 3½°.

BR/BW1162 Series

R.F. POWER TRIODES

Service Type (BR1162) CV5239

The data should be read in conjunction with the Power Triode Preamble.

ABRIDGED DATA

Three r.f. power triodes intended for transmitter and industrial applications. They differ only in the method of anode cooling.

Anode cooling:		
BR1162	forced-air	
BW1162	water; separate jacket	
BW1162J3	water; integral jacket	
Anode dissipation	6.0	kW max
Anode voltage	7.2	kV max
Operating frequency:		
class C telegraphy	30	MHz max
class C industrial oscillator	85	MHz max
Output power:		
class B audio, per tube	10	kW
class C telegraphy	9.5	kW
class C industrial oscillator	8.6	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	12.6	V
Filament current	33	A
Peak usable cathode current	14	A
Amplification factor (V_a = 6.0 kV, I_a = 1.0 A)	32	
Mutual conductance (V_a = 6.0 kV, I_a = 1.0 A)	15	mA/V
Inter-electrode capacitances:		
grid to anode	11	pF
grid to filament	16	pF
anode to filament	0.3	pF

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July 1978

Supersedes January 1970 Issue

Mechanical

Overall dimensions . . . . . see outline drawings
Net weight:
BR1162 . . . . . 10.1 pounds (4.6 kg) approx
BW1162 . . . . . 1 pound (0.45 kg) approx
BW1162J3 . . . . . 1.8 pounds (0.7 kg) approx
Mounting position:
BR1162, BW1162J3 . . . . . vertical, either way up
BW1162 . . . . . vertical, filament pins up

Accessories

Filament connectors (2 per tube) MA146A
Centre-tap heat dissipating connector, must be used MA146B
Grid connector MA147A
Insulating pedestal for BR1162 . . . . . MA149A
Water jacket for BW1162 . . . . . BW4088A
Sealing ring (supplied with BW1162) MA314

COOLING

Anode

The air cooling requirements for BR1162 are given in the following table. The air flow should be delivered immediately before and during the application of any voltages.

Anode dissipation (kW)	Height above sea level (m)	Inlet temperature (max) (°C)	Rate of flow of air (min) (m^3/min)	Pressure drop (mm water)
2.0	0	35	4.8	20
2.0	0	45	5.7	25
2.0	1500	35	5.7	23
2.0	3000	25	6.1	23
3.5	0	35	6.2	32
3.5	0	45	7.3	42
3.5	1500	35	7.3	36
3.5	3000	25	7.8	36
6.0	0	35	9.2	68
6.0	0	45	10.7	91
6.0	1500	35	11.2	81
6.0	3000	25	11.7	80

The BW1162 anode must be fitted into a water jacket for cooling, the recommended jacket being type BW4088A. The water cooling requirements are given in the following table.

Anode dissipation (kW)	Inlet temperature (°C)	Rate of flow of water		Pressure drop across jacket (atm)
		l./min	gal/min	
1.0	20	2.5	0.55	0.08
1.0	50	3.0	0.66	0.10
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.3
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.90
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

The BW1162J3 has an integral water jacket. Minimum water cooling requirements are shown on page 11; higher rates of flow should be used where possible. A thermal fuse may be fitted (see page 15).

Filament, Grid and Anode Seals

It may be necessary to direct a flow of air on to the filament and grid seals in order to maintain their temperatures within the following limits.

Temperature of filament seals	210	°C max
Temperature of grid and anode seals	180	°C max

Filament Centre-tap Pin

A heat dissipating connector such as MA146B must be used on the filament centre-tap pin.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class B)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.2	kV max
Anode current	2.2	A max
Anode input power	14	kW max
Anode dissipation	6.0	kW max
Grid dissipation	250	W max
Grid circuit resistance	15	kΩ max
Cathode current (peak)	10	A max

OPERATING CONDITIONS (Class B, 2 tubes)

Anode voltage	4.0	5.0	5.0	7.0	kV
Grid voltage	−135	−165	−165	−250	V
Peak a.f. grid drive voltage (per tube)	465	365	440	650	V
Anode current (zero signal)	2 x 0.10	2 x 0.15	2 x 0.15	2 x 0.20	A
Anode current (maximum signal)	2 x 1.25	2 x 1.10	2 x 1.25	2 x 2.00	A
Grid current (maximum signal)	2 x 0.36	2 x 0.22	2 x 0.33	2 x 0.53	A
Effective load (anode to anode)	3.8	5.5	4.8	4.15	kΩ
Nominal driving power (maximum signal)	2 x 135	2 x 70	2 x 130	2 x 310	W
Anode dissipation	2 x 1.45	2 x 1.50	2 x 1.70	2 x 4.00	kW
Output power (maximum signal)	7.1	8.0	9.0	20	kW
Efficiency	71	72.5	72.5	71.5	%

ANODE MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per tube for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.5	kV max
Anode current	1.8	A max
Anode dissipation	4.0	kW max
Grid voltage (negative value)	1.25	kV max
Grid current	0.6	A max
Grid dissipation	250	W max
Cathode current (peak)	12	A max
Frequency for above ratings	30	MHz max

OPERATING CONDITIONS (frequency 30 MHz)

Anode voltage	4.0	5.0	5.0	kV
Grid voltage	−300	−400	−400	V
Peak r.f. grid drive voltage	680	730	800	V
Anode current	1.6	1.4	1.6	A
Grid current	0.6	0.5	0.5	A
Nominal driving power	367	328	432	W
Anode dissipation	1.4	1.4	1.6	kW
Output power	5.0	5.6	6.4	kW
Efficiency	78	80	80	%

RADIO FREQUENCY POWER AMPLIFIER

(Class C Telegraphy, key down conditions, or F.M. Telephony, one tube)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.2	kV max
Anode current	2.2	A max
Anode input power	14	kW max
Anode dissipation	6.0	kW max
Grid voltage (negative value)	1250	V max
Grid current	0.6	A max
Grid dissipation	250	W max
Cathode current (peak)	14	A max
Frequency for above ratings	30	MHz max

OPERATING CONDITIONS (frequency 30 MHz)

Anode voltage	5.0	6.0	6.5	kV
Grid voltage	−300	−400	−450	V
Peak r.f. grid drive voltage	660	780	820	V
Anode current	2.0	2.0	2.0	A
Grid current	0.5	0.5	0.5	A
Nominal driving power	207	350	370	W
Anode dissipation	2.9	3.5	3.5	kW
Output power	7.1	8.5	9.5	kW
Efficiency	71	71	73	%

RADIO FREQUENCY POWER OSCILLATOR

(Class C, anode supply from unfiltered three phase half-wave rectifier)

MAXIMUM RATINGS (Absolute values)

Anode voltage	7.0	kV max
Anode current	1.8	A max
Anode input power	11	kW max
Anode dissipation	6.0	kW max
Grid voltage (negative value)	1250	V max
Grid current (unloaded)	0.7	A max
Grid current (loaded)	0.5	A max
Grid dissipation	250	W max
Grid circuit resistance	10	kΩ max
Cathode current (peak)	11	A max
Operating frequency for full ratings	55	MHz max
Anode voltage for operation at 85 MHz max	6.5	kV max

OPERATING CONDITIONS

Frequency	55	85	85	MHz
Output voltage (r.m.s.) from transformer	5.55	5.13	4.27	kV
Anode voltage	6.5	6.0	5.0	kV
Anode current	1.7	1.5	1.7	A
Grid current (unloaded)	0.7	0.7	0.7	A
Grid current (loaded)	0.5	0.4	0.45	A
Anode dissipation	2.4	2.5	2.4	kW
Anode load resistance	2.0	2.3	1.6	kΩ
Grid resistor	0.9	1.0	0.85	kΩ
Feedback ratio (see note 2)	0.15	0.15	0.19	
Nominal drive power	350	300	350	W
Output power	8.6	6.5	6.1	kW
Effective output power to load (see note 3)	7.0	5.5	5.0	kW
Efficiency	78	72	72	%

NOTES

1. The tube must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed +5% or −10%. The centre-tap pin may be used for the anode current return but must not be used for the filament current supply. At frequencies above 30 MHz, all three filament pins should be interconnected with suitable capacitors.

2. The feedback ratio is defined as $\frac{v_{g\ (pk)}}{v_{a\ (pk)}}$

   where $v_{g\ (pk)}$ = peak r.f. grid voltage in volts
   and $v_{a\ (pk)}$ = peak r.f. anode voltage in volts.

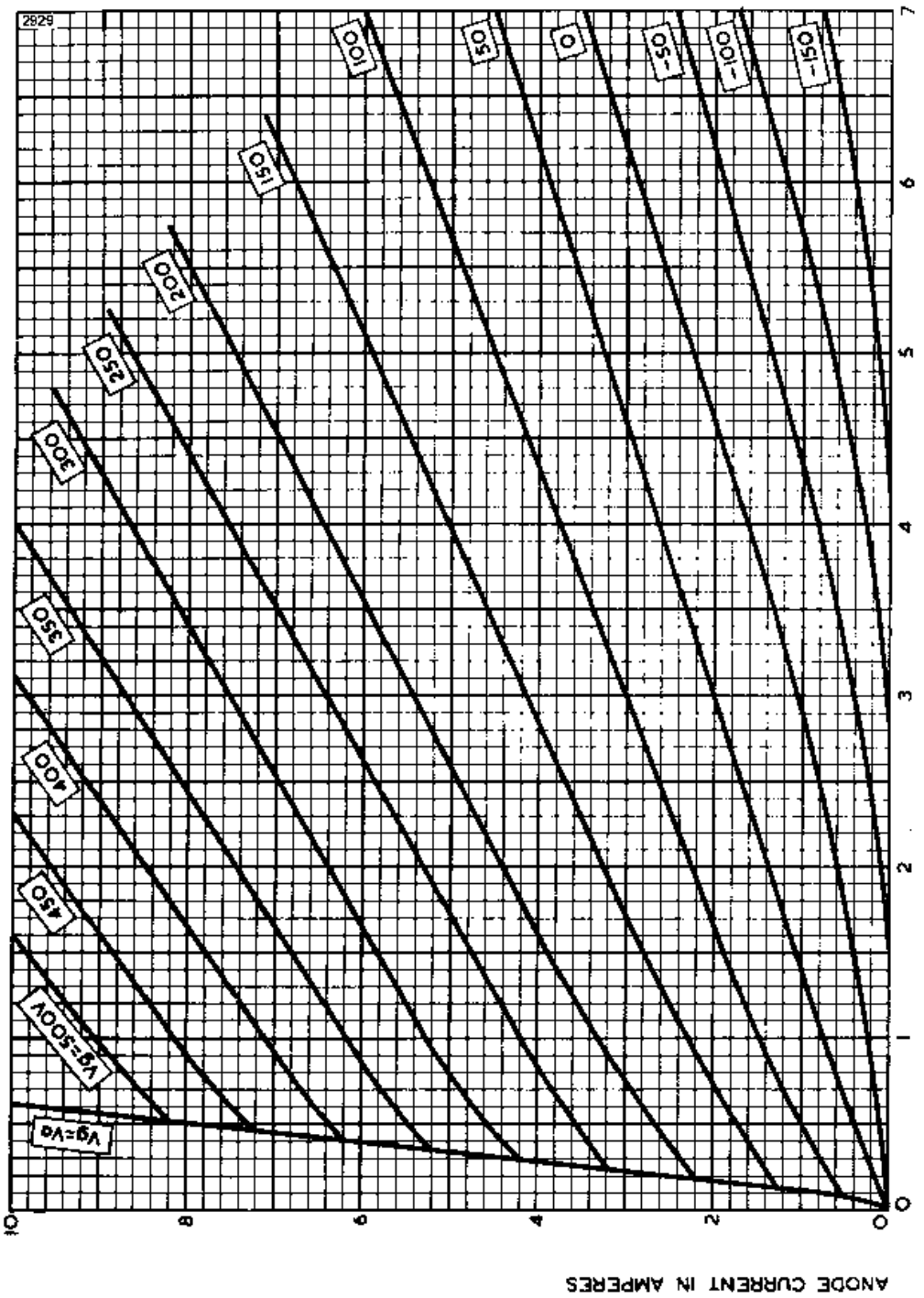
3. Effective output power to load = $\eta_a\ (P_{out} - P_{drive})$

   where η_a = efficiency of anode circuit = 85% (typical value)

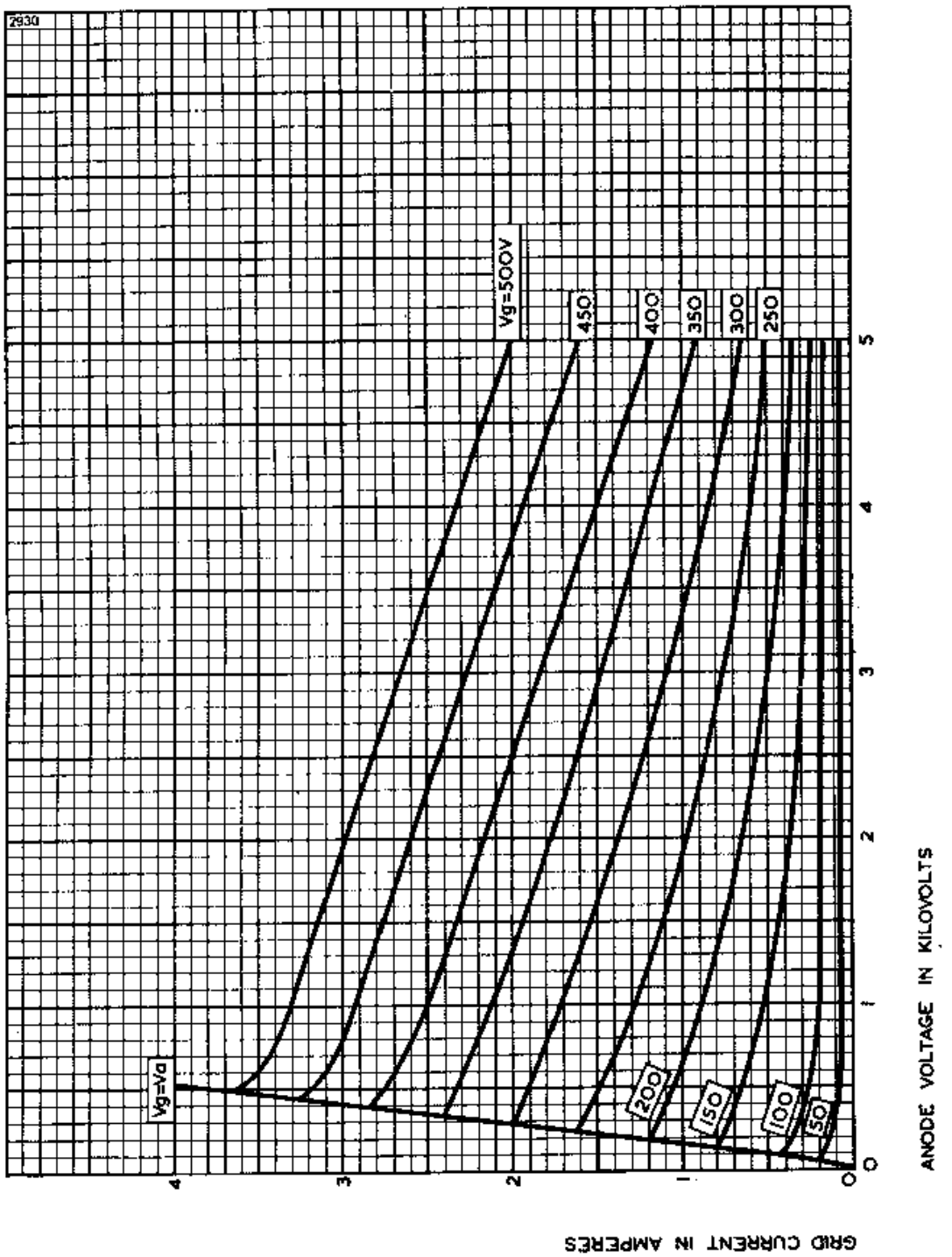
   P_{out} = output power of valve to anode circuit

   P_{drive} = drive power fed back to grid circuit.

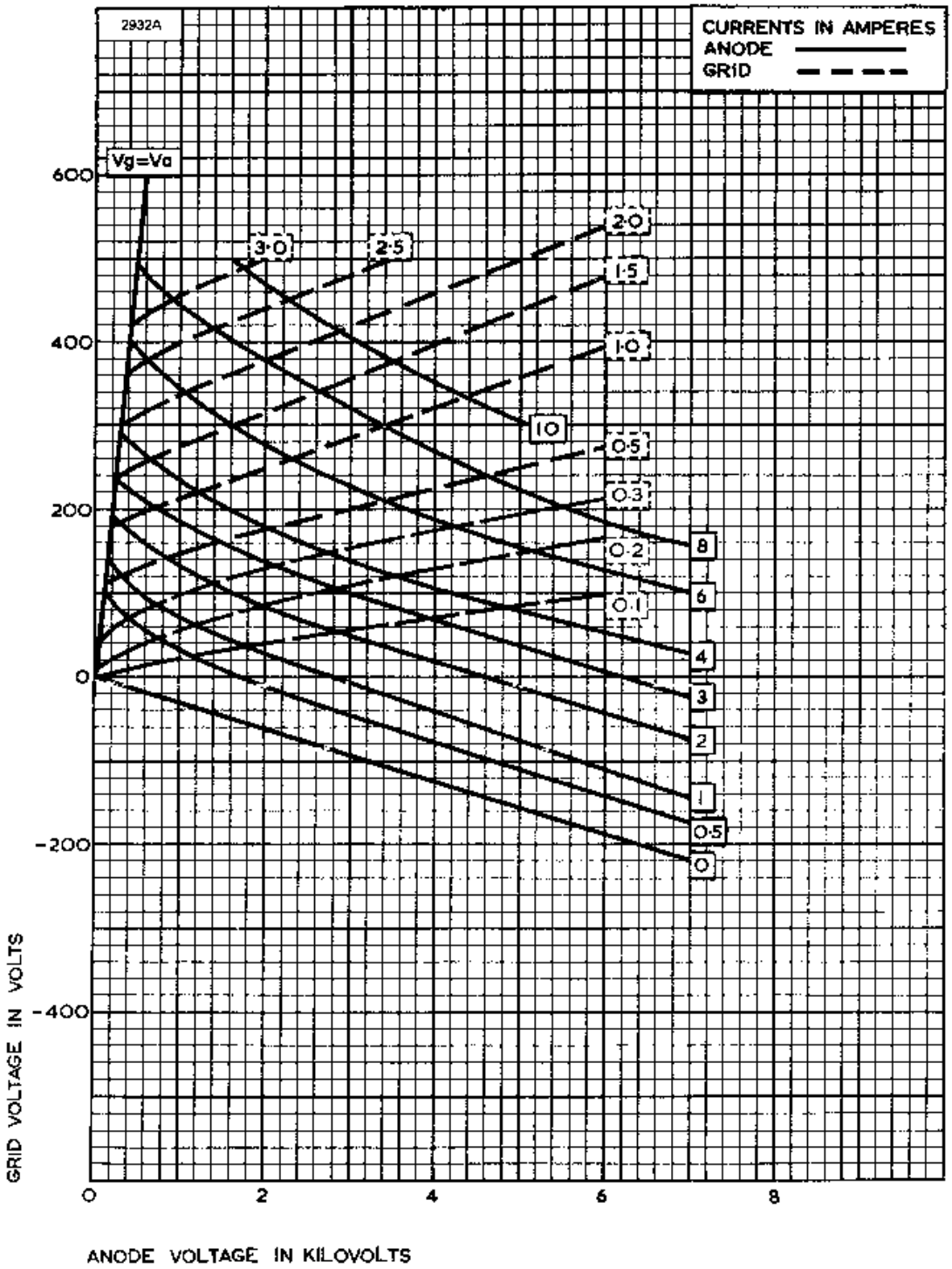
TYPICAL ANODE CHARACTERISTICS



TYPICAL GRID CHARACTERISTICS

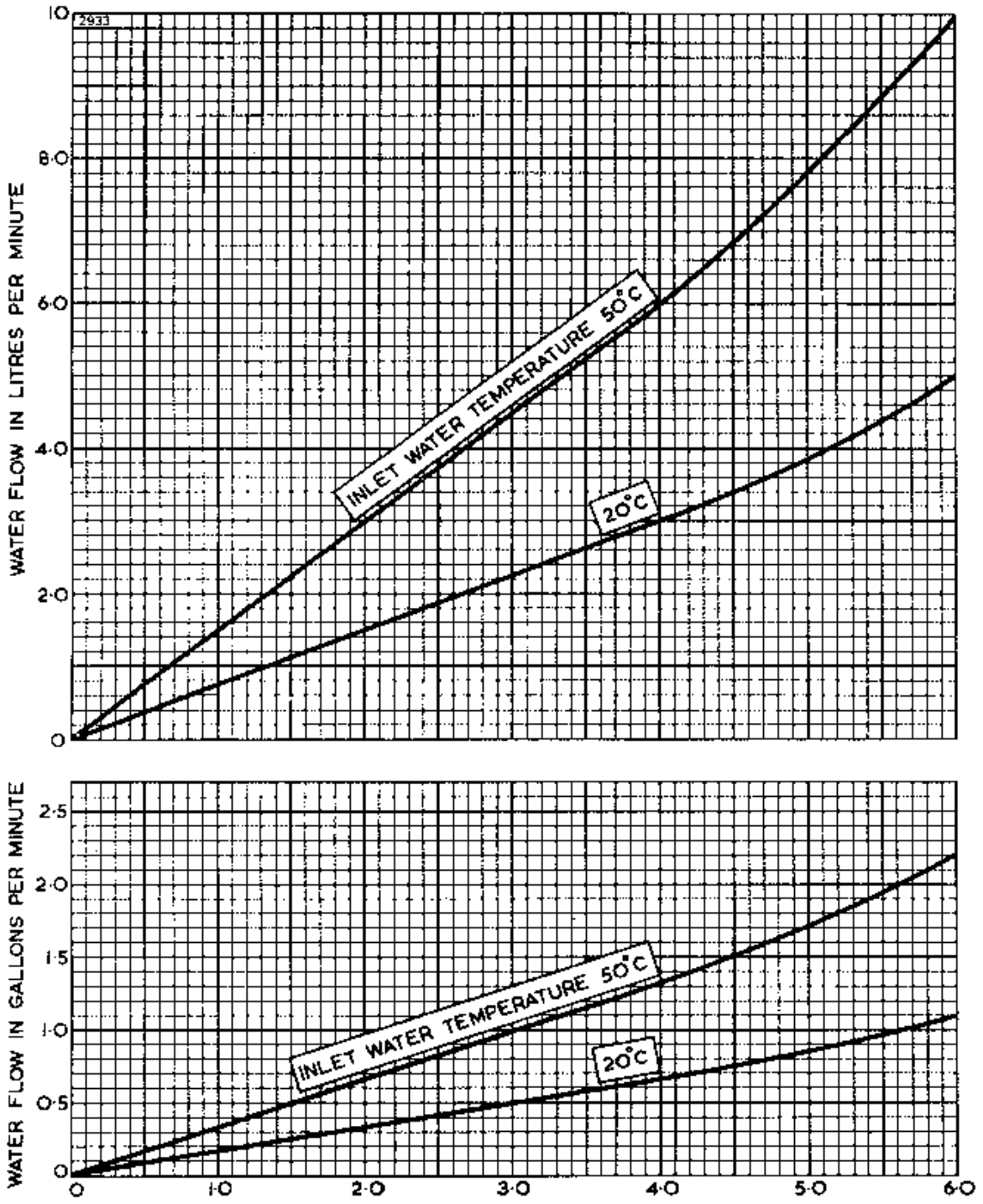


TYPICAL CONSTANT CURRENT CHARACTERISTICS

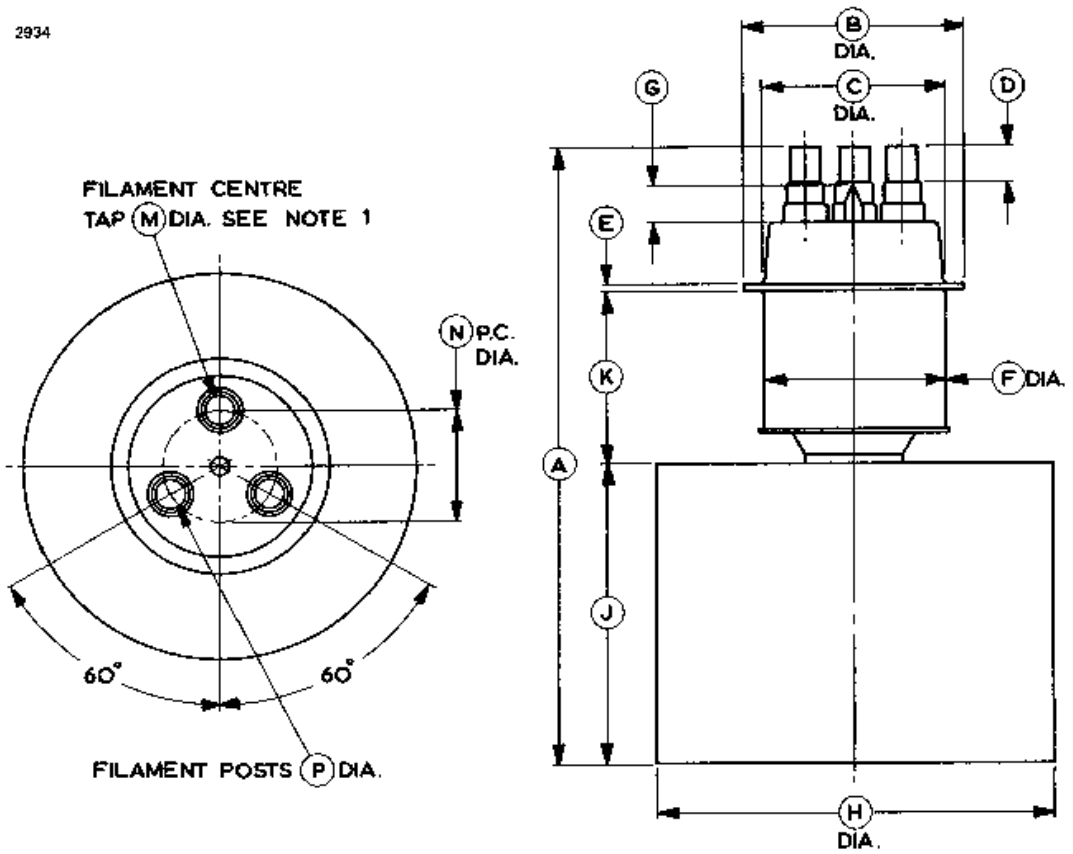


WATER COOLING REQUIREMENTS FOR BW1162J3

Higher rates of flow should be used where possible.



OUTLINE FOR BR1162 (All dimensions without limits are nominal)

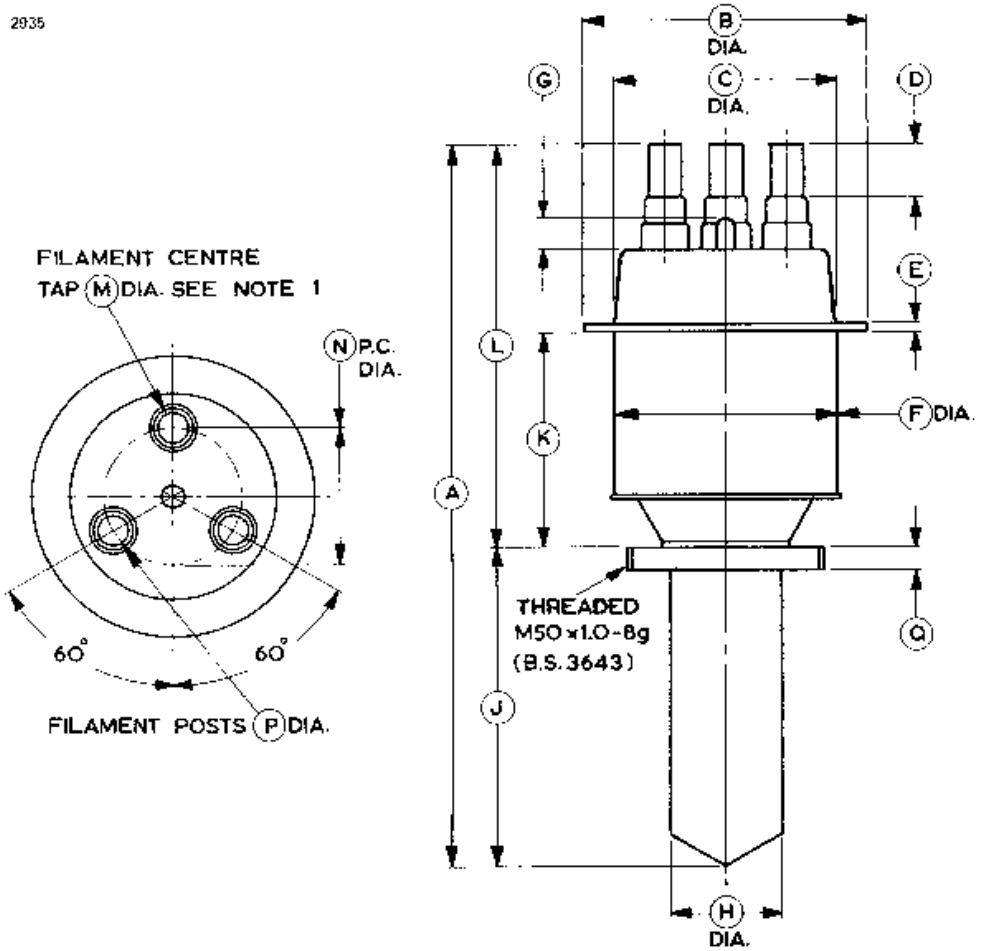


Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	195.0 max	7.677 max	H	122.3 ± 0.5	4.815 ± 0.020
B	70.00 ± 0.50	2.756 ± 0.020	J	94.00	3.701
C	59.00 max	2.323 max	K	54.00 ± 0.50	2.126 ± 0.020
D	12.00 min	0.472 min	M	10.50	0.413
E	2.50	0.098	N	35.00 ± 1.00	1.378 ± 0.040
F	64.00 max	2.520 max	P	9.10	0.358
G	20.00 max	0.787 max			

Inch dimensions have been derived from millimetres.

Note The filament centre tap pin is marked O.

OUTLINE FOR BW1162 (All dimensions without limits are nominal)

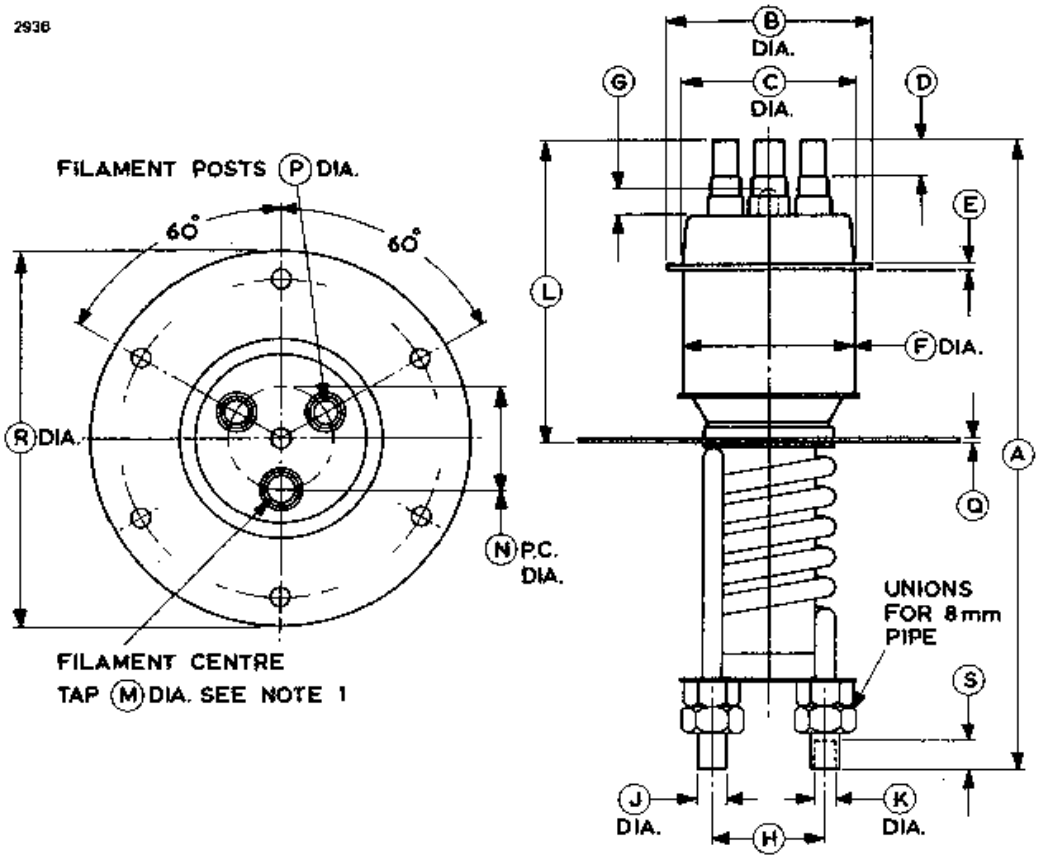


Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	190.0 max	7.480 max	J	83.00 max	3.268 max
B	70.00 ± 0.50	2.756 ± 0.020	K	56.00	2.205
C	59.00 max	2.323 max	L	106.0	4.173
D	12.00 min	0.472 min	M	10.50	0.413
E	2.50	0.098	N	35.00 ± 1.00	1.378 ± 0.040
F	64.00 max	2.520 max	P	9.10	0.358
G	20.00 max	0.787 max	Q	6.25	0.246
H	30.00 max	1.181 max			

Inch dimensions have been derived from millimetres.

Note The filament centre tap pin is marked O.

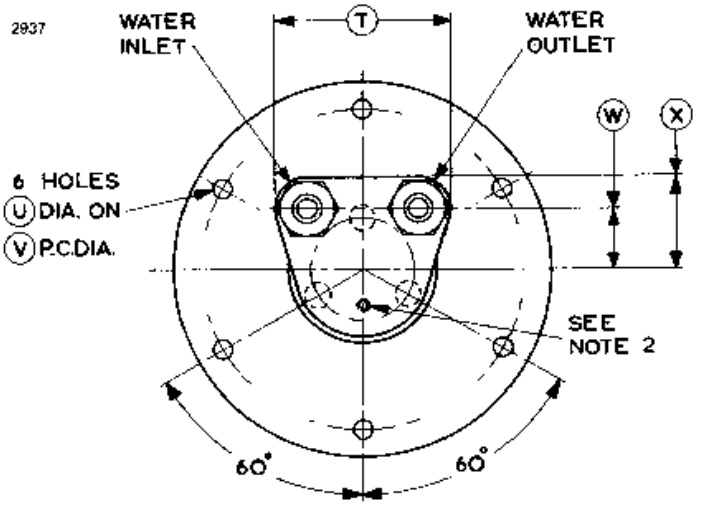
OUTLINE FOR BW1162J3 (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	218.0 max	8.583 max	K	8.20	0.323
B	70.00 ± 0.50	2.756 ± 0.020	L	105.0	4.134
C	59.00 max	2.323 max	M	10.50	0.413
D	12.00 min	0.472 min	N	35.00 ± 1.00	1.378 ± 0.040
E	2.50	0.098	P	9.10	0.358
F	64.00 max	2.520 max	Q	2.00	0.079
G	20.00 max	0.787 max	R	130.0 ± 0.5	5.118 ± 0.020
H	39.00	1.535	S	10.0	0.394
J	10.00	0.394			

Inch dimensions have been derived from millimetres.

View of BW1162J3 from below



Ref	Millimetres	Inches
T	61.00 max	2.402 max
U	6.50	0.256
V	110.0 ± 1.0	4.331 ± 0.040
W	21.00	0.827
X	32.00	1.260

Inch dimensions have been derived from millimetres.

Outline Notes for BW1162J3

1. The filament centre tap pin is marked O.
2. Hole threaded 4B.A. to accept thermal fuse.

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Printed in England

BR/BW1165 Series

R.F. POWER TRIODES

Service Type (BR1165) CV3926

The data should be read in conjunction with the Power Triode Preamble.

ABRIDGED DATA

Three r.f. power triodes intended for a.m., f.m. or television transmitters and for industrial applications. They differ only in anode dissipation and in the method of anode cooling.

Anode cooling:		
BR1165	forced-air	
BW1165	water; separate jacket	
BW1165J3	water; integral jacket	
Anode dissipation:		
BR1165	5.0	kW max
BW1165, BW1165J3	6.0	kW max
Anode voltage	6.0	kV max
Operating frequency	220	MHz max
Output power:		
class B audio, per valve	6.65	kW
class C telegraphy, f.m. telephony	6.9	kW
class C television, per valve	4.5	kW
class C industrial oscillator	6.5	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	12.6	V
Filament current	33	A
Peak usable cathode current	8.5	A
Amplification factor (V_a = 4.0kV, I_a = 1.0A)	32	
Mutual conductance (V_a = 4.0kV, I_a = 1.0A)	17	mA/V
Inter-electrode capacitances:		
grid to anode	11	pF
grid to filament	16	pF
anode to filament	0.3	pF

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May 1976

Supersedes January 1970 Issue

Mechanical

Overall dimensions . . . . . see outline drawings
Net weight:
BR1165 . . . . . 10.1 pounds (4.6kg) approx
BW1165 . . . . . 1 pound (0.45kg) approx
BW1165J3 . . . . . 1.8 pounds (0.7kg) approx
Mounting position:
BR1165, BW1165J3 . . . . . vertical, either way up
BW1165 . . . . . vertical, filament pins up

Accessories

Filament connectors MA146A
Centre-tap dissipating connector MA146A
Grid connector (above 30MHz) MA147A
Grid connector (below 30MHz) MA148A
Insulating pedestal for BR1165 . . . . . MA149A
Water jacket for BW1165 . . . . . BW4088A
Sealing ring (supplied with BW1165) MA314

COOLING

Anode

The air cooling requirements for BR1165 are given in the following table. The air flow should be delivered immediately before and during the application of any voltages.

Anode dissipation (kW)	Height above sea level (m)	Inlet temperature (max) (°C)	Rate of flow of air (min) (m^3/min)	Pressure drop (mm water)
1.0	0	35	3.0	8.0
1.0	0	45	3.1	8.0
1.0	1500	35	3.7	9.0
1.0	3000	25	4.1	10
3.0	0	35	5.2	23
3.0	0	45	6.1	29
3.0	1500	35	6.2	26
3.0	3000	25	6.6	26
5.0	0	35	9.2	68
5.0	0	45	10.7	90
5.0	1500	35	11.2	81
5.0	3000	25	11.6	79

The BW1165 anode must be fitted into a water jacket for cooling, the recommended jacket being type BW4088A. The water cooling requirements are given in the following table.

Anode dissipation (kW)	Inlet temperature (°C)	Rate of flow of water l./min	gal/min	Pressure drop across jacket (atm)
1.0	20	2.5	0.55	0.08
1.0	50	3.0	0.66	0.10
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.30
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.90
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

The BW1165J3 has an integral water jacket. Minimum water cooling requirements are shown on page 16; higher rates of flow should be used where possible. A thermal fuse may be fitted (see page 20).

Filament, Grid and Anode Seals

It may be necessary to direct a flow of air on to the filament and grid seals in order to maintain their temperatures within the following limits.

Temperature of filament seals	210	°C max
Temperature of grid and anode seals	180	°C max

Filament Centre-tap Pin

A heat dissipating connector such as MA146A must be used on the filament centre-tap pin.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class B)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.5	A max
Anode input power	9.0	kW max
Anode dissipation	6.0	kW max
Grid dissipation	120	W max
Grid circuit resistance	15	kΩ max
Cathode current (peak)	5.7	A max

TYPICAL OPERATING CONDITIONS (Class B, 2 valves)

Anode voltage	3.0	3.5	4.0	kV
Grid voltage	−90	−100	−112	V
Peak a.f. grid drive voltage (per valve)	285	310	318	V
Anode current (zero signal)	2 x 65	2 x 75	2 x 100	mA
Anode current (maximum signal)	2 x 0.80	2 x 0.95	2 x 0.94	A
Grid current (maximum signal)	2 x 0.20	2 x 0.18	2 x 0.19	A
Effective load (anode to anode)	4.4	4.2	4.9	kΩ
Nominal driving power (maximum signal)	2 x 52	2 x 50	2 x 54	W
Anode dissipation	2 x 0.75	2 x 1.0	2 x 1.1	kW
Output power (maximum signal)	3.3	4.6	5.3	kW
Efficiency	69	70	71	%
Total distortion	3.3	2.9	2.6	%
Anode voltage	4.5	5.0	6.0	kV
Grid voltage	−125	−138	−165	V
Peak a.f. grid drive voltage (per valve)	327	330	455	V
Anode current (zero signal)	2 x 100	2 x 110	2 x 125	mA
Anode current (maximum signal)	2 x 0.92	2 x 0.91	2 x 1.50	A
Grid current (maximum signal)	2 x 0.19	2 x 0.14	2 x 0.28	A
Effective load (anode to anode)	6.1	6.4	4.9	kΩ
Nominal driving power (maximum signal)	2 x 27	2 x 42	2 x 115	W
Anode dissipation	2 x 1.15	2 x 1.25	2 x 2.35	kW
Output power (maximum signal)	6.0	6.6	13.3	kW
Efficiency	72	73	74	%
Total distortion	3.7	3.3	4.3	%

RADIO FREQUENCY POWER AMPLIFIER

(Class B Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.1	A max
Anode input power	6.6	kW max
Anode dissipation	5.0	kW max
Grid dissipation	120	W max
Cathode current (peak)	4.6	A max

TYPICAL OPERATING CONDITIONS (frequency 75MHz)

Anode voltage	5.0	6.0	kV
Grid voltage	−145	−180	V
Peak r.f. grid drive voltage	225	250	V
Anode current	900	990	mA
Grid current (100% modulation)	320	300	mA
Driving power (100% modulation)	160	170	W
Anode dissipation	3.0	4.0	kW
Output power	1.45	1.90	kW
Efficiency	32	32	%

RADIO FREQUENCY POWER AMPLIFIER

(Class C Telegraphy, key down conditions, or F.M. Telephony, per valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.5	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	1.0	kV max
Grid current	0.35	A max
Grid dissipation	120	W max
Cathode current (peak)	8.5	A max

TYPICAL OPERATING CONDITIONS
(Grounded Cathode)

Frequency	75	75	75	110	MHz
Anode voltage	4.0	5.0	6.0	5.0	kV
Grid voltage	−200	−300	−400	−300	V
Peak r.f. grid drive voltage	500	640	740	640	V
Anode current	1.37	1.50	1.50	1.25	A
Grid current	350	330	310	300	mA
Nominal driving power	190	240	275	250	W
Anode dissipation	1.5	1.9	2.1	1.45	kW
Output power	4.0	5.6	6.9	4.8	kW
Efficiency	73	75	76.5	70	%

TYPICAL OPERATING CONDITIONS
(Grounded Grid, 2 valves)

Frequency	75	110	110	220	MHz
Anode voltage	6.0	4.0	5.0	4.0	kV
Filament-grid voltage	400	200	300	200	V
Peak r.f. drive voltage, filament to filament	1480	1000	1280	900	V
Anode current	2 x 1.5	2 x 1.37	2 x 1.5	2 x 1.25	A
Grid current	2 x 310	2 x 350	2 x 330	2 x 220	mA
Nominal driving power	2 x 1190	2 x 705	2 x 965	2 x 395	W
Anode dissipation	2 x 2.1	2 x 1.7	2 x 2.2	2 x 2.5	kW
Output power (see note 2)	15.6	8.6	12	5.6	kW
Efficiency	77	69	71	50	%

ANODE MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.0	kV max
Anode current	1.3	A max
Anode input power	6.5	kW max
Anode dissipation	3.4	kW max
Grid voltage (negative value)	1.0	kV max
Grid current	0.35	A max
Grid dissipation	120	W max
Cathode current (peak)	5.7	A max

TYPICAL OPERATING CONDITIONS

Frequency	75	75	75	MHz
Anode voltage	3.0	3.5	4.0	kV
Grid voltage	−250	−300	−300	V
Peak r.f. grid drive voltage	510	600	600	V
Anode current	1.0	1.2	1.2	A
Grid current	0.3	0.3	0.3	A
Nominal driving power	170	205	205	W
Anode dissipation	0.8	1.2	1.3	kW
Output power	2.2	3.0	3.5	kW
Efficiency	73	71.5	73	%

Frequency	75	75	110	MHz
Anode voltage	4.5	5.0	4.0	kV
Grid voltage	−350	−400	−350	V
Peak r.f. grid drive voltage	650	690	600	V
Anode current	1.2	1.2	0.93	A
Grid current	0.3	0.3	0.24	A
Nominal driving power	230	205	130	W
Anode dissipation	1.3	1.3	0.92	kW
Output power	4.1	4.7	2.8	kW
Efficiency	76	78	75	%

CLASS C TELEVISION SERVICE, GRID-MODULATED

MAXIMUM RATINGS (Absolute values)

	Up to 75MHz	Up to 220MHz	
Anode voltage	5.0	4.0	kV max
Anode current	1.9	1.6	A max
Anode input power	9.5	6.5	kW max
Anode dissipation (sync. level)	5.0	4.0	kW max
Grid voltage (negative value) (sync. level)	1.0	1.0	kV max
Grid current	0.25	0.25	A max
Grid dissipation (sync. level)	120	120	W max
Cathode current (peak)	10	10	A max

TYPICAL OPERATING CONDITIONS

(Negative modulation, positive synchronisation) (2 valves)

Frequency	48 to 75	170 to 220	MHz
Anode voltage	5.0	4.0	kV
Grid voltage:			
peak sync.	−200	−150	V
black level	−300	−225	V
white level	−550	−500	V
Peak r.f. grid to grid voltage (sync. level)	1.0	1.0	kV
Anode current:			
peak sync.	2 x 1.9	2 x 1.6	A
black level	2 x 1.3	2 x 1.3	A
Grid current:			
peak sync.	2 x 0.250	2 x 0.20	A
black level	2 x 0.175	2 x 0.11	A
Nominal driving power (sync. level)	2 x 250	2 x 400	W
Output power (sync. level)	9.0	6.0	kW
Power into load (sync. level) (see note 3)	6.3	4.2	kW
Bandwidth (see note 4):			
to −3db points	8.00	10	MHz
to −1.5db points	5.25	6.5	MHz

TYPICAL OPERATING CONDITIONS

(Positive modulation, negative synchronisation) (2 valves)

Frequency	48 to 75	MHz
Anode voltage	5.0	kV
Grid voltage:		
white level	−200	V
black level	−460	V
peak sync.	−580	V
Peak r.f. grid to grid voltage (white level)	1.0	kV
Anode current:		
white level	2 x 1.9	A
black level	2 x 0.4	A
Grid current:		
white level	2 x 250	mA
black level	0	mA
Nominal driving power (white level)	2 x 250	W
Output power (white level)	9.0	kW
Power into load (white level) (see note 3)	6.3	kW
Bandwidth (see note 4):		
to −3db points	8.0	MHz
to −1.5db points	5.25	MHz

RADIO FREQUENCY OSCILLATOR FOR INDUSTRIAL SERVICE

(Class C, anode supply from unfiltered two-phase half-wave rectifier)

MAXIMUM RATINGS (Absolute values)

Anode voltage	5.4	kV max
Anode current	1.35	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	900	V max
Grid current	0.31	A max
Grid dissipation	120	W max

TYPICAL OPERATING CONDITIONS

Output voltage (r.m.s.) from transformer	5.1	6.0	kV
Anode voltage	4.6	5.4	kV
Anode current	1.15	1.35	A
Grid current	0.27	0.31	A
Anode dissipation	1.84	2.3	kW
Grid resistor	1.1	1.3	kΩ
Nominal driving power	160	210	W
Output power	4.5	6.5	kW
Efficiency	70	72	%

RADIO FREQUENCY OSCILLATOR FOR INDUSTRIAL SERVICE

(Class C, anode supply unrectified a.c.)

MAXIMUM RATINGS (Absolute values)

Output voltage (r.m.s.) from transformer	6.8	kV max
Anode current	0.8	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	640	V max
Grid current	190	mA max
Grid dissipation	120	W max
Operating frequency	75	MHz max

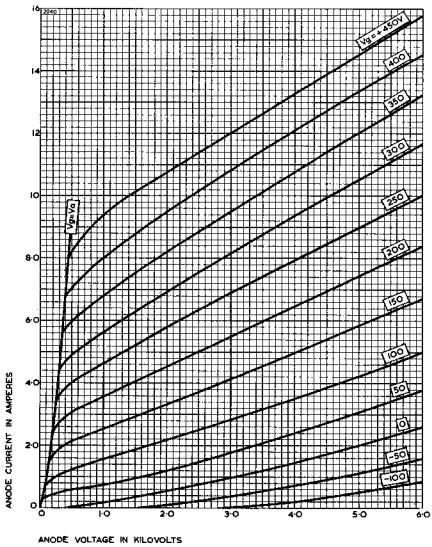
TYPICAL OPERATING CONDITIONS

Output voltage (r.m.s.) from transformer	5.9	6.8	kV
Grid voltage	−173	−200	V
from grid resistor	1050	1050	Ω
Anode current	0.7	0.8	A
Grid current (approx)	165	190	mA
Anode dissipation	1.24	1.5	kW
Output power	3.36	4.55	kW
Efficiency	73	75	%

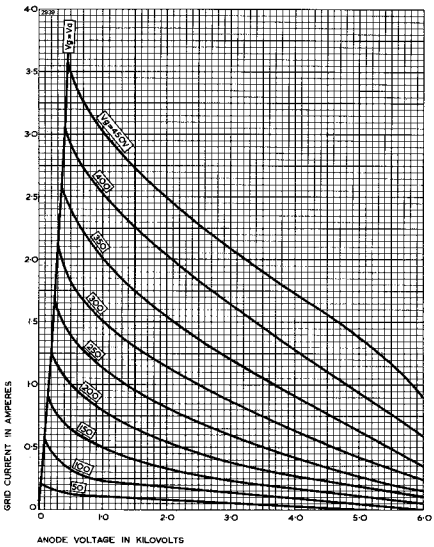
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed +5% or −10%. The centre-tap pin may be used for the anode current return but must not be used for the filament current supply. At frequencies above 30MHz, all three filament pins should be interconnected with suitable capacitors.
2. This includes the power transferred from the drive circuit.
3. Assuming circuit transfer efficiency of 70%.
4. For a bandwidth based on one inductor-capacitor circuit.

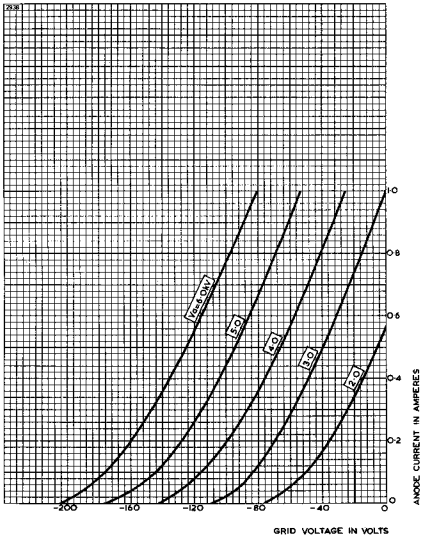
TYPICAL ANODE CHARACTERISTICS



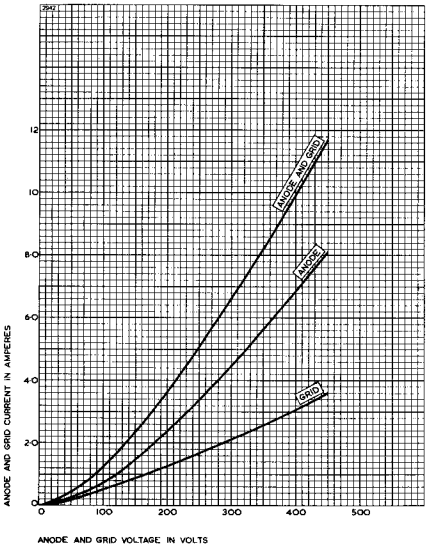
TYPICAL GRID CHARACTERISTICS



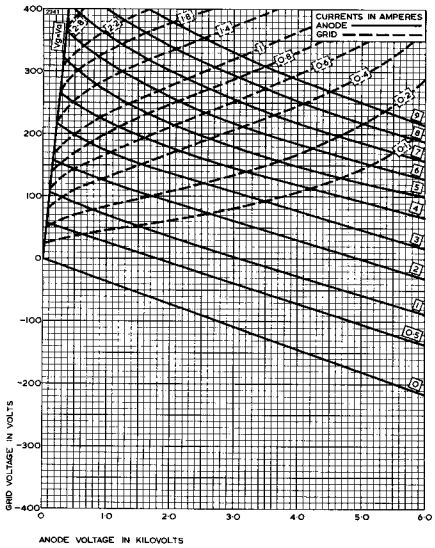
TYPICAL ANODE CURRENT – GRID VOLTAGE CHARACTERISTICS



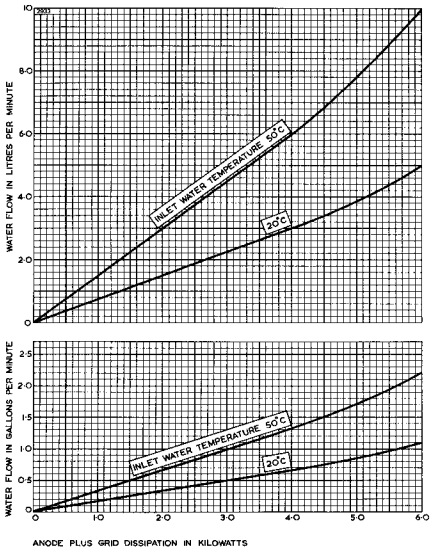
TYPICAL STRAPPED CHARACTERISTICS



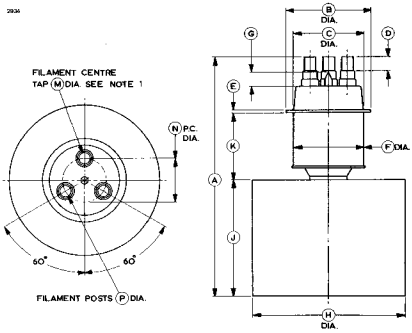
TYPICAL CONSTANT CURRENT CHARACTERISTICS



MINIMUM WATER COOLING REQUIREMENTS FOR BW1165J3
Higher rates of flow should be used where possible.



OUTLINE FOR BR1165 (All dimensions without limits are nominal)

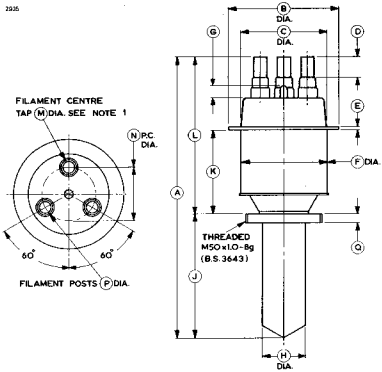


Ref	Millimetres	Inches
A	195.0 max	7.677 max
B	70.00 ± 0.50	2.756 ± 0.020
C	59.00 max	2.323 max
D	12.00 min	0.472 min
E	2.50	0.098
F	64.00 max	2.520 max
G	20.00 max	0.787 max
H	122.3 ± 0.5	4.815 ± 0.020
J	94.00	3.701
K	54.00 ± 0.50	2.126 ± 0.020
M	9.10	0.358
N	35.00 ± 1.00	1.378 ± 0.040
P	9.10	0.358

Inch dimensions have been derived from millimetres.

Note The filament centre tap pin is marked O.

OUTLINE FOR BW1165 (All dimensions without limits are nominal)

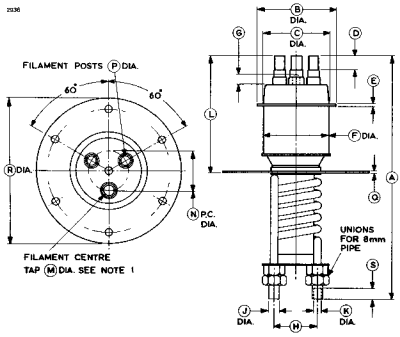


Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	190.0 max	7.480 max	J	83.00 max	3.268 max
B	70.00 ± 0.50	2.756 ± 0.020	K	56.00	2.205
C	59.00 max	2.323 max	L	106.0	4.173
D	12.00 min	0.472 min	M	9.10	0.358
E	2.50	0.098	N	35.00 ± 1.00	1.378 ± 0.040
F	64.00 max	2.520 max	P	9.10	0.358
G	20.00 max	0.787 max	Q	6.25	0.246
H	30.00 max	1.181 max			

Inch dimensions have been derived from millimetres.

Note The filament centre tap pin is marked O.

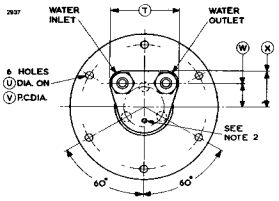
OUTLINE FOR BW1165J3 (All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	218.0 max	8.583 max	K	8.20	0.323
B	70.00 ± 0.50	2.756 ± 0.020	L	105.0	4.134
C	59.00 max	2.323 max	M	9.10	0.358
D	12.00 min	0.472 min	N	35.00 ± 1.00	1.378 ± 0.040
E	2.50	0.098	P	9.10	0.358
F	64.00 max	2.520 max	Q	2.00	0.079
G	20.00 max	0.787 max	R	130.0 ± 0.5	5.118 ± 0.020
H	38.00	1.535	S	10.0	0.394
J	10.00	0.394			

Inch dimensions have been derived from millimetres.

View of BW1165J3 from below



Ref	Millimetres	Inches
T	61.00 max	2.402 max
U	6.50	0.256
V	110.0 ± 1.00	4.331 ± 0.040
W	21.00	0.827
X	32.00	1.260

Inch dimensions have been derived from millimetres.

Outline Notes for BW1165J3

1. The filament centre tap pin is marked O.
2. Hole threaded 4B.A. to accept thermal fuse.

English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

BR/BW189
BY189A

R.F. POWER TRIODES

Service Type (BR189) CV5218

The data should be read in conjunction with the Power Triode Preamble.

ABRIDGED DATA

Three r.f. transmitting triodes differing only in anode dissipation and the method of anode cooling. The tubes have grid terminals suitable for cathode drive operation.

Anode cooling:		
BR189	forced-air	
BW189	water; separate jacket	
BY189A	vapour; separate boiler unit	
Anode dissipation:		
BR189	27	kW max
BW189, BY189A	35	kW max
Anode voltage	15	kV max
Frequency for full ratings	5.0	MHz max
Frequency at reduced ratings	50	MHz max
Output power (class C telegraphy)	80	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	9.0	V
Filament current	240	A
Surge filament current (peak) (see note 2)	600	A max
Filament cold resistance	4.6	mΩ
Peak usable cathode current	70	A
Perveance	1.6	$mA/V^{3/2}$
Amplification factor (V_a = 9.0kV, I_a = 2.0A)	34	
Mutual conductance (V_a = 9.0kV, I_a = 2.0A)	27.5	mA/V
Inter-electrode capacitances:		
grid to anode	61	pF
grid to filament	68	pF
anode to filament	1.5	pF

Mechanical

Overall dimensions	see outline drawings
Net weights:	
BR189	109 pounds (50kg) approx
BW189	23 pounds (10.5kg) approx
BY189A	70 pounds (32kg) approx
Mounting position	vertical, filament end up

Accessories

Filament leads	MA130
Grid connector	MA66
Water jacket for BW189	BW4050
Sealing ring (supplied with BW189)	MA254
Single boiler unit, separate condenser required, for BY189A	BY4037A
Single boiler unit, integral condenser, for BY189A	BY4038
Double boiler unit, integral condenser, for BY189A	BY4038A
Sealing ring (supplied with BY189A)	MA255
Thermal fuse, 2 supplied with BY189A	MA85C

COOLING

Anode

The BR189 air cooling requirements are shown on pages 10 and 11. The required air flow should be delivered through the radiator before and during the application of any voltages. Filament power, anode power and air flow may be removed simultaneously.

The anode of the BW189 must be fitted into a water jacket for cooling, the recommended jacket being type BW4050. A flow of water of 10 to 15imp.gal/min (45 to 68 l./min) is required; the temperature of the cooling water at the outlet must not exceed 65°C, nor should the temperature rise across the jacket exceed 15°C.

The BY189A is vapour cooled and may be operated either singly in boiler unit BY4037A or BY4038, or in pairs in boiler unit BY4038A. In BY4038 and BY4038A, the steam generated by the anode is condensed by means of an internal water cooled condenser. The steam produced in BY4037A is led away by suitably insulated tubing for condensation at some convenient point external to the boiler unit.

Two thermal fuses (part number MA85C) are provided with each BY189A to give protection against anode overheating; only one fuse at a time need be used. Alternative positions for mounting the thermal fuse are provided by four threaded holes equally spaced round the top surface of the anode ring. It should be screwed into the desired position and connected by a non-

conducting cord passing over the anode corona ring to a suitable switching device; a tension of about 1 lb (450g) should be applied to the fuse via the cord. If the temperature exceeds a safe limit, the fuse core is pulled outwards; this should actuate the switching device and remove all electrical supplies from the valve. Replacement fuses can be supplied to order.

Filament and Grid Seals

The temperature of the filament and grid seals must not exceed 140°C. A flow of air of 20ft^3/min (0.57m^3/min) directed into the filament header via a 1-inch (25mm approx) diameter nozzle before and during the application of any voltages is usually adequate for limiting the temperature of these seals.

Anode Seal and Bulb

The anode seal and bulb temperatures must not exceed 180°C. The BW189 anode seal requires cooling and this may be done via holes in a corona ring fitted to the water jacket, when an air pressure of 1-inch (25mm) water gauge should provide sufficient flow.

R.F. POWER AMPLIFIER AND OSCILLATOR
(Class C telegraphy, key down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	15	kV max
Anode current	7.0	A max
Anode dissipation:		
BR189	27	kW max
BW189, BY189A	35	kW max
Grid dissipation	1.25	kW max
Operating frequency (for full ratings)	5.0	MHz max

TYPICAL OPERATING CONDITIONS (For amplifier)

Anode voltage	12	15	kV
Grid voltage	−900	−900	V
Peak r.f. grid drive voltage	1650	1650	V
Anode current	6.4	6.6	A
Grid current (approx)	0.83	0.7	A
Anode dissipation	15	18	kW
Grid dissipation	640	530	W
Driving power	1370	1150	W
Output power	62	80	kW
Efficiency	80	80	%

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

	Min	Max	
Filament current at filament voltage 9.0V	217	256	A
Amplification factor (V_a = 9.0kV, I_a = 2.0A)	30	38	
Mutual conductance (V_a = 9.0kV, I_a = 2.0A)	22.5	29.5	mA/V
Grid voltage (negative value) (V_a = 10kV, I_a = 0.1A)	—	380	V
Grid voltage (negative value) (V_a = 9.0kV, I_a = 2.0A)	125	193	V
Anode current (V_a = 4.0kV, V_g = +400V)	18	24	A
Grid current (V_a = 4.0kV, V_g = +400V)	−1.2	—	A

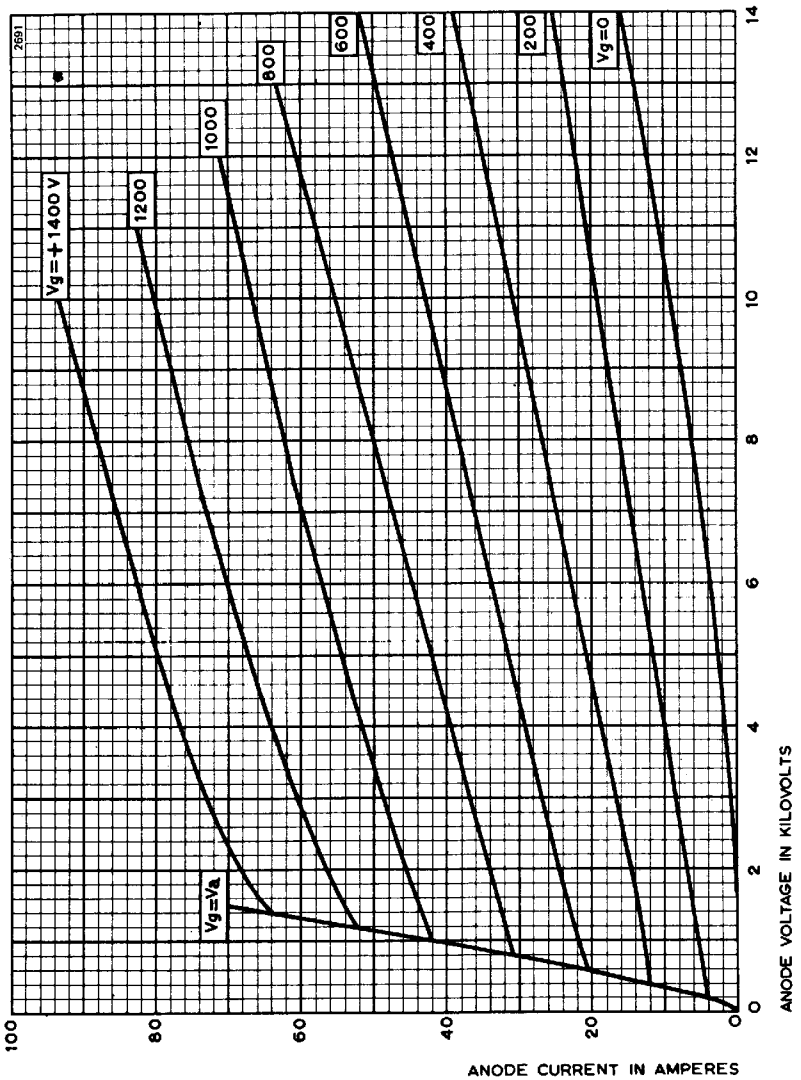
MAXIMUM ANODE VOLTAGE AGAINST FREQUENCY

Operating frequency (MHz)	Max anode voltage c.w. (kV)	Max anode voltage with anode modulation (kV)
5	15	13.5
30	13.5	12
50	8.0	6.5

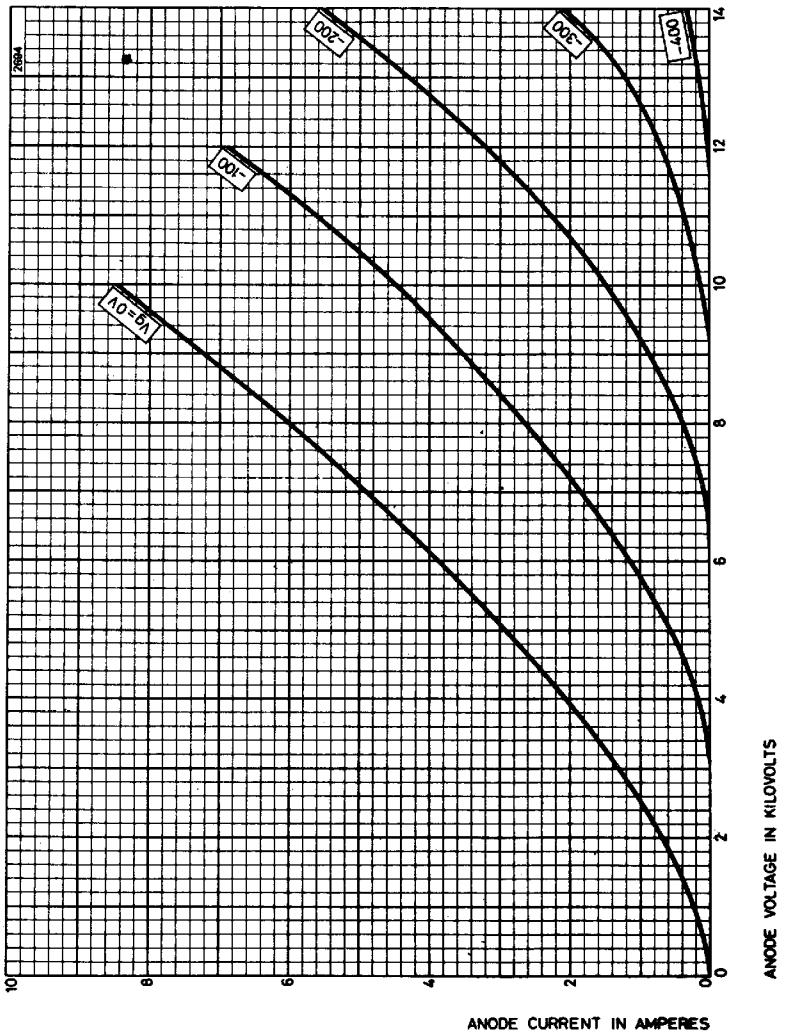
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed ±5%.
2. The filament current must not exceed 600A, even momentarily, at any time.

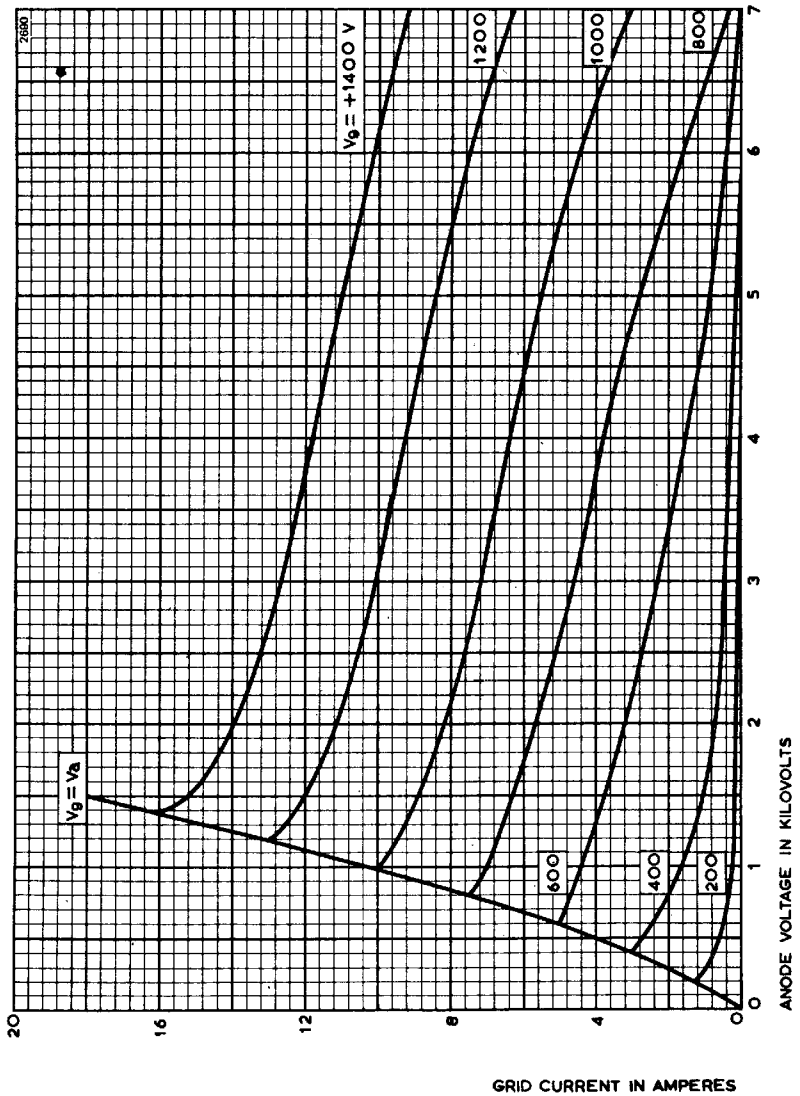
TYPICAL ANODE CHARACTERISTICS



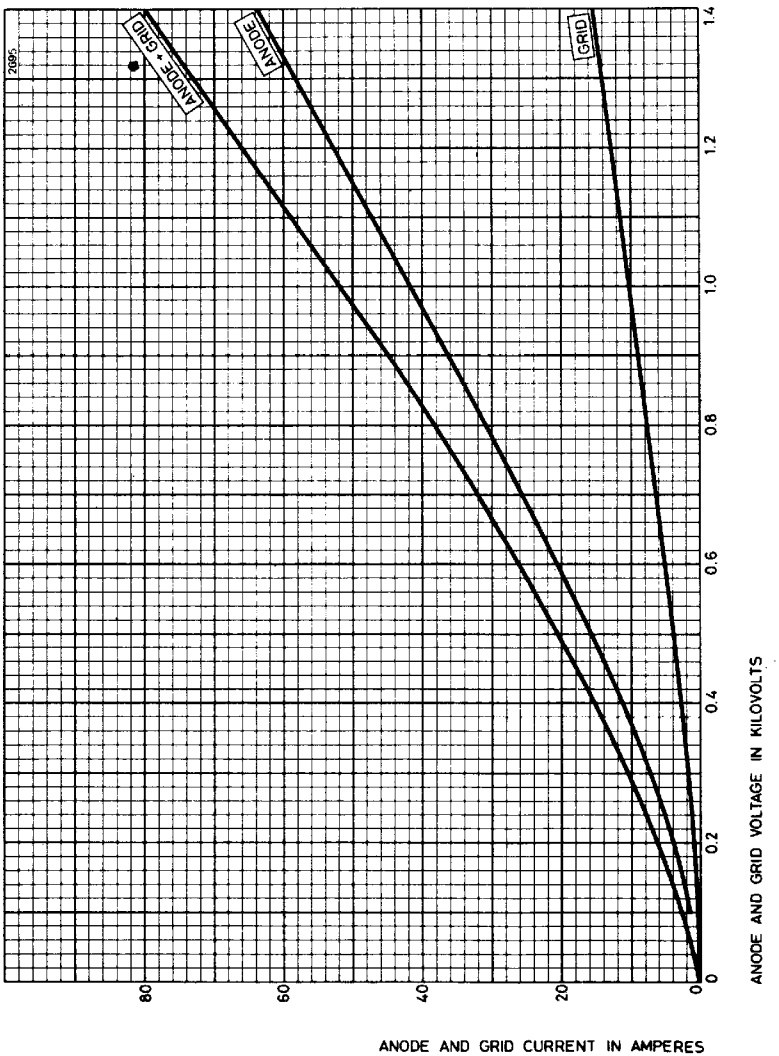
TYPICAL ANODE CHARACTERISTICS (Negative Grid)



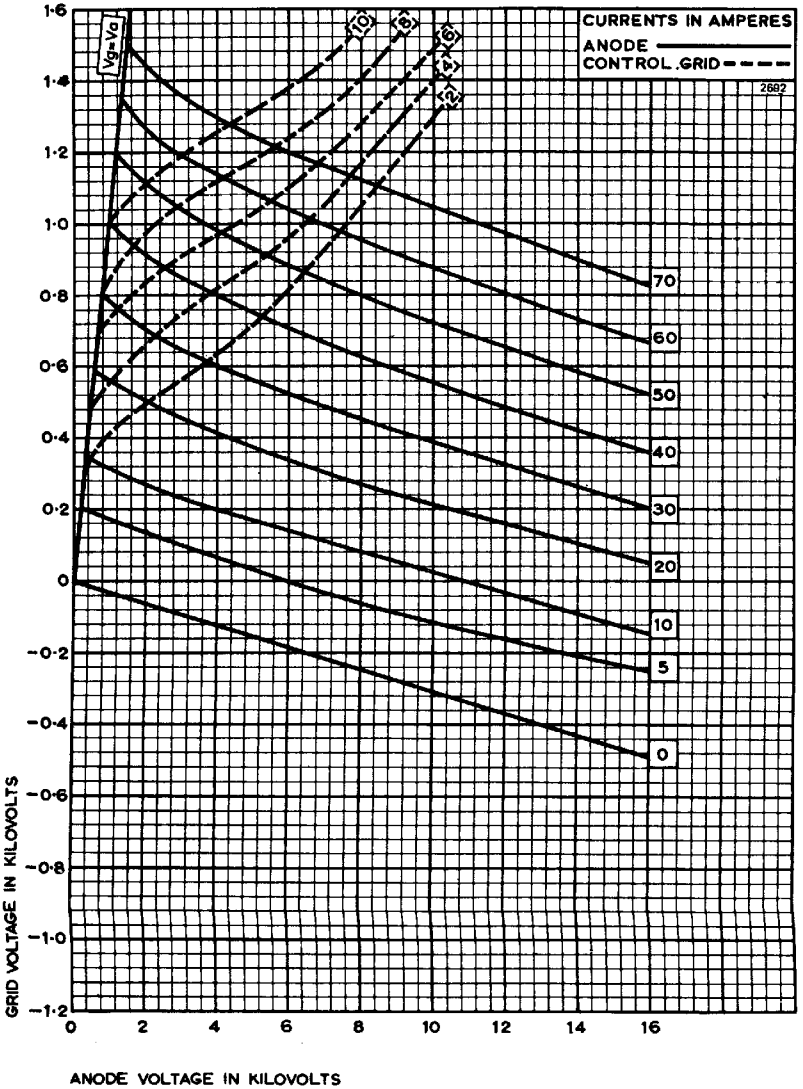
TYPICAL GRID CHARACTERISTICS



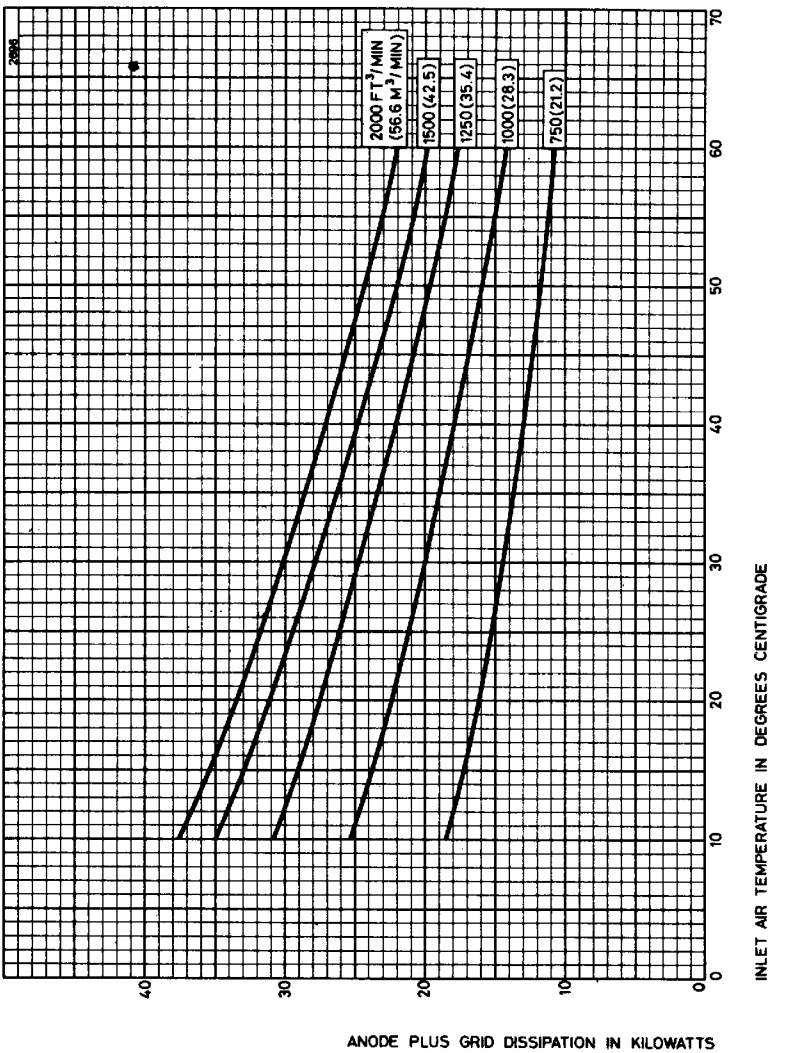
TYPICAL STRAPPED CHARACTERISTICS



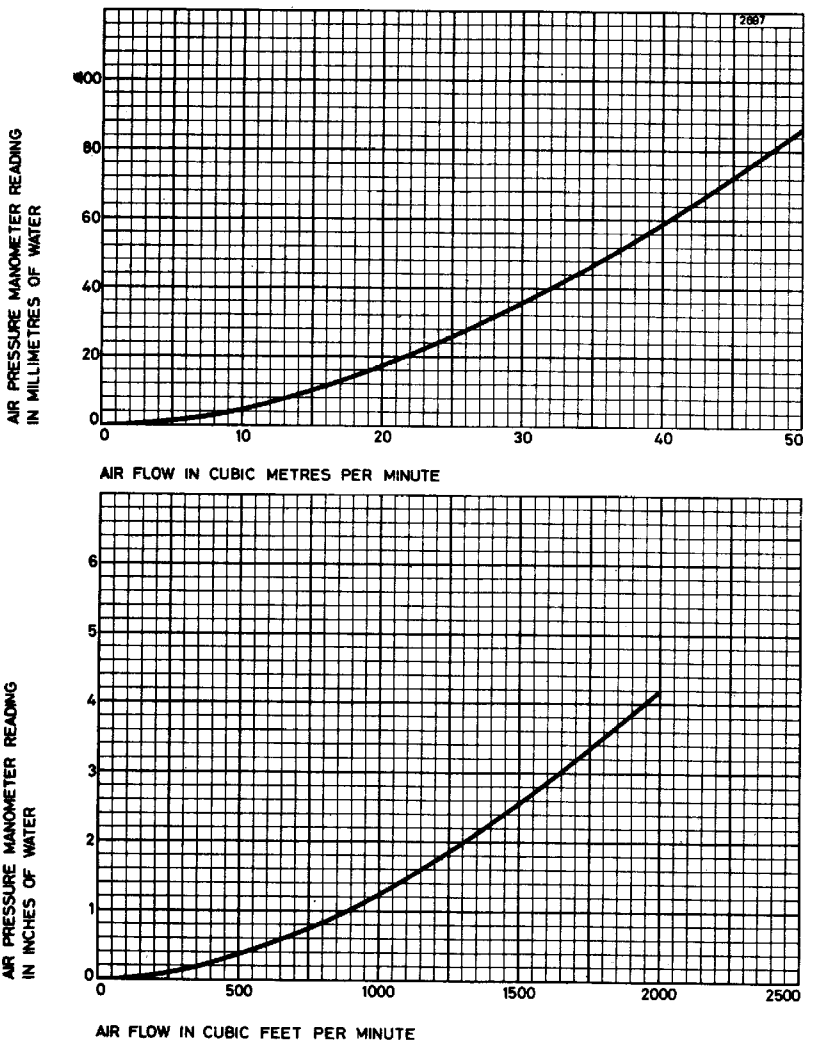
TYPICAL CONSTANT CURRENT CHARACTERISTICS



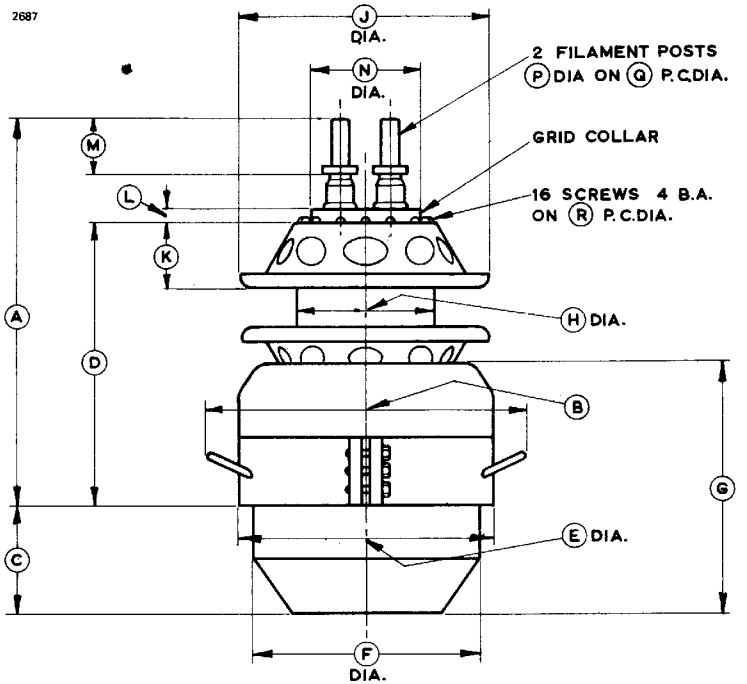
AIR COOLING REQUIREMENTS FOR BR189



AIR FLOW CHARACTERISTIC FOR BR189



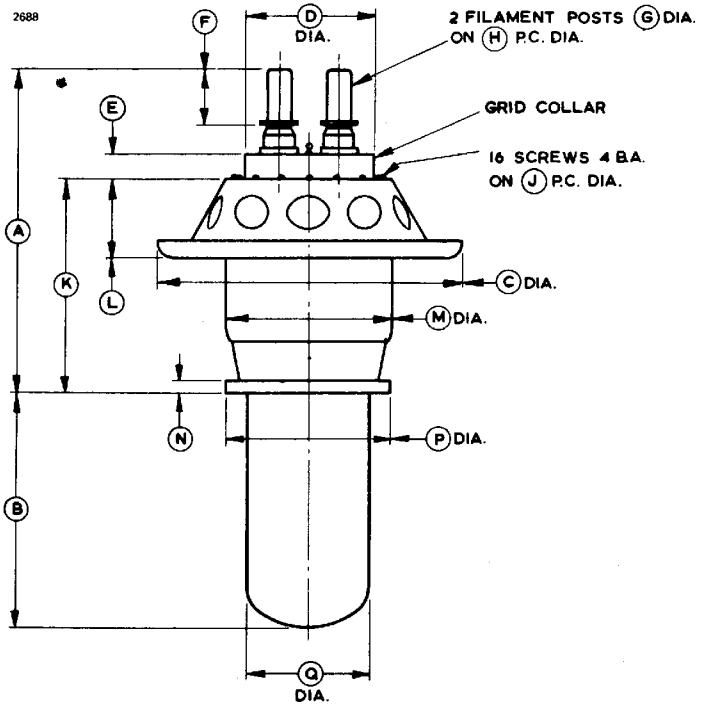
OUTLINE FOR BR189 (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	16.750 max	425.5 max	J	11.000 max	279.4 max
B	14.000 max	355.6 max	K	2.906 max	73.81 max
C	4.750	120.7	L	0.687	17.45
D	12.875 max	327.0 max	M	2.000	50.80
E	11.000	279.4	N	4.703	119.5
F	10.062 max	255.6 max	P	0.875	22.23
G	11.000	279.4	Q	2.250	57.15
H	6.000	152.4	R	5.375	136.5

Millimetre dimensions have been derived from inches.

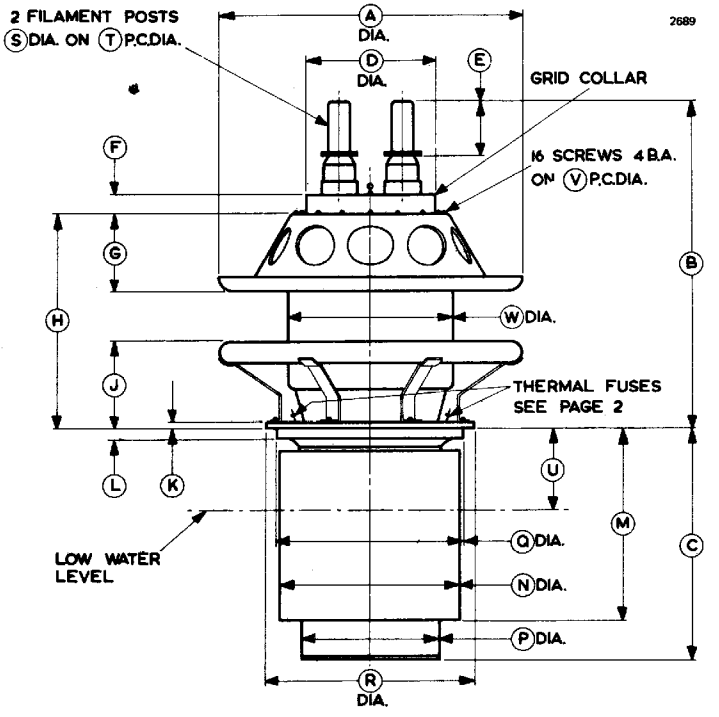
OUTLINE FOR BW189 (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	12.000 max	304.8 max	J	5.375	136.5
B	8.625	219.1	K	7.875 max	200.0 max
C	11.000 max	279.4 max	L	2.906 max	73.81 max
D	4.703	119.5	M	6.000	152.4
E	0.687	17.45	N	0.500	12.70
F	2.000	50.80	P	5.760 max	146.3 max
G	0.875	22.23	Q	4.500	114.3
H	2.250	57.15			

Millimetre dimensions have been derived from inches.

OUTLINE FOR BY189A (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	11.000 max	279.4 max	M	7.000	177.8
B	12.109 max	307.6 max	N	6.562	166.7
C	8.452	214.7	P	5.240	133.1
D	4.703	119.5	Q	6.937	176.2
E	2.000	50.80	R	7.500	190.5
F	0.687	17.45	S	0.875	22.23
G	2.906 max	73.81 max	T	2.250	57.15
H	8.053 max	204.5 max	U	3.000	76.20
J	3.326 max	84.48 max	V	5.375	136.5
K	0.250	6.35	W	6.000	152.4
L	0.375	9.53			

Millimetre dimensions have been derived from inches.

BS204

S-BAND TR TUBE

Service Type CV5990

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3000 to 3050	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.906 x 5.906 x 5.083 inches max 150.0 x 150.0 x 129.1mm max
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

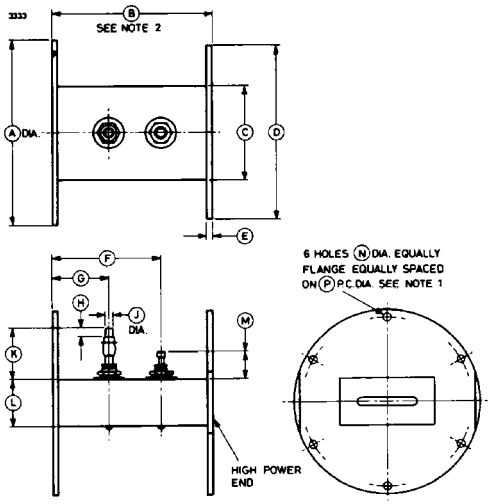
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 0.001 duty factor.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.016	149.2 ± 0.4
B	5.073 ± 0.010	128.9 ± 0.3
C	3.000 ± 0.031	76.20 ± 0.79
D	5.500 ± 0.031	139.7 ± 0.8
E	0.156 ± 0.031	3.96 ± 0.79
F	3.400	86.36
G	1.750	44.45
H	0.250	6.35
J	0.250	6.35
K	1.625 max	41.28 max
L	1.500 ± 0.031	38.10 ± 0.79
M	0.875 max	22.23 max
N	0.264 max	6.70 max
	0.257 min	6.53 min
P	5.375	136.5

Millimetre dimensions have been derived from inches except dimension N.

OUTLINE



Outline Notes

1. The flange holes fit a gauge with six parallel pegs, each 0.250 inch (6.35mm) diameter, equally spaced on 5.375 inch (136.5mm) pitch circle diameter. The corresponding holes of the flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm) within a circle of 5.125 inch (130.2mm) diameter concentric with the pitch circle of the flange holes.

Printed in England

BS310

X-BAND
TB TUBE

Service Type CV6070

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9375	MHz
Loaded Q	6.5	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.1	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	4.0	250	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

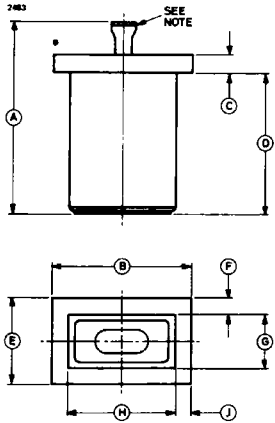
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

Printed in England

BS390

S-BAND TR TUBE

Service Type CV9442

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	2925 to 3075	MHz
V.S.W.R. (see note 1)	1.33:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	—	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	—	300	kN/m^2
	—	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	4.470 x 4.760 x 3.880 inches nom 113.5 x 120.9 x 98.55mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

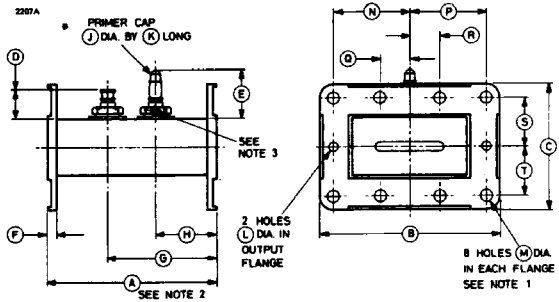
1. Measured at a power level below 10mW over the frequency range on a matched T junction.
2. Measured at 1.0MW peak power 1.0μs pulse length and 500p.p.s.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.470	113.5	L	$0.250^{+0.002}_{-0.000}$	$6.350^{+0.051}_{-0.000}$
B	4.760 ± 0.010	120.9 ± 0.25			
C	3.260 ± 0.010	82.80 ± 0.25	M	0.260 ± 0.004	6.6 ± 0.1
D	0.875 max	22.23 max	N	2.031	51.59
E	1.250 ± 0.125	31.75 ± 3.18	P	2.031	51.59
F	0.250 min	6.35 min	Q	0.750	19.05
G	3.062 ± 0.062	77.77 ± 1.57	R	0.750	19.05
H	1.500 ± 0.062	38.10 ± 1.57	S	1.281	32.54
J	0.250	6.35	T	1.281	32.54
K	0.250	6.35			

Millimetre dimensions have been derived from inches except dimension M.

OUTLINE



Outline Notes

1. The corresponding holes of both flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm). The flanges mate with coupler NATO S.N. 5985-99-083-0058.
3. Hole each side, 3.8mm diameter, to accept primer cap spring.

BS426

S-BAND TR TUBE

Service Type CV9443

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3600 to 3780	MHz
V.S.W.R. (see note 1)	1.33:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	—	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	—	300	kN/m^2
	—	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	3.600 x 4.760 x 3.630 inches nom 91.44 x 120.9 x 92.20mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

1. Measured at a power level below 10mW over the frequency range on a matched T junction.
2. Measured at 1.0MW peak power, 1.0μs pulse length and 500p.p.s.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

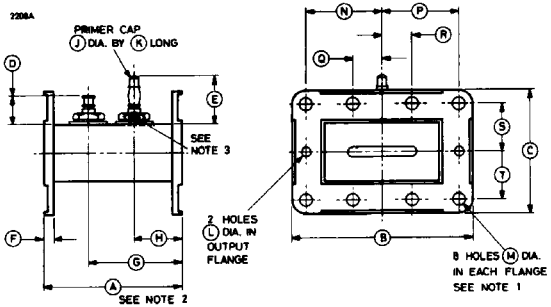


Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.600	91.44	L	$0.250^{+0.002}_{-0.000}$	$6.350^{+0.051}_{-0.000}$
B	4.760 ± 0.010	120.9 ± 0.25			
C	3.260 ± 0.010	82.80 ± 0.25	M	0.260 ± 0.004	6.6 ± 0.1
D	0.875 max	22.23 max	N	2.031	51.59
E	1.250 ± 0.125	31.75 ± 3.18	P	2.031	51.59
F	0.250 min	6.35 min	Q	0.750	19.05
G	2.375 ± 0.062	60.33 ± 1.57	R	0.750	19.05
H	1.250 ± 0.062	31.75 ± 1.57	S	1.281	32.54
J	0.250	6.35	T	1.281	32.54
K	0.250	6.35			

Millimetre dimensions have been derived from inches except dimension M.

OUTLINE



Outline Notes

1. The corresponding holes of both flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm). The flanges mate with coupler NATO S.N. 5985-99-083-0058.
3. Hole each side, 3.8mm diameter, to accept primer cap spring.

Printed in England

BS430

S-BAND TR TUBE

Service Type CV9444

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	3230 to 3380	MHz
V.S.W.R. (see note 1)	1.33:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 2)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	25	μs max
Insertion loss (see note 3)	1.0	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 4)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	4.470 x 4.760 x 3.630 inches nom 113.5 x 120.9 x 98.55mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-0058
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4¼ pounds (1,9kg) approx

NOTES

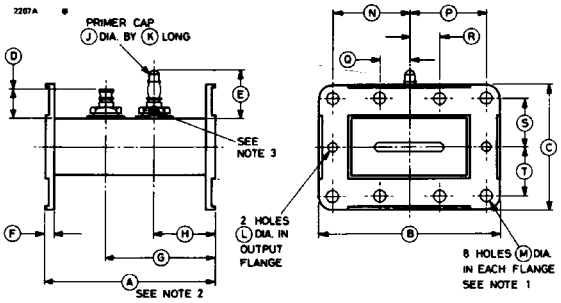
1. Measured at a power level below 10mW over the frequency range on a matched T junction.
2. Measured at 1.0MW peak power 1.0μs pulse length and 500p.p.s.
3. Measured at a power level below 10mW at the centre of the frequency range.
4. Distance of the effective r.f. short circuit behind front flange.
5. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.470	113.5	L	$0.250^{+0.002}_{-0.000}$	$6.350^{+0.051}_{-0.000}$
B	4.760 ± 0.010	120.9 ± 0.25			
C	3.260 ± 0.010	82.80 ± 0.25	M	0.260 ± 0.004	6.6 ± 0.1
D	0.875 max	22.23 max	N	2.031	51.59
E	1.250 ± 0.125	31.75 ± 3.18	P	2.031	51.59
F	0.250 min	6.35 min	Q	0.750	19.05
G	2.875 ± 0.062	73.01 ± 1.57	R	0.750	19.05
H	1.625 ± 0.062	41.28 ± 1.57	S	1.281	32.54
J	0.250	6.35	T	1.281	32.54
K	0.250	6.35			

Millimetre dimensions have been derived from inches except dimension M.

OUTLINE



Outline Notes

1. The corresponding holes of both flanges are in alignment within 0.020 inch (0.51mm).
2. The two flange faces are flat and parallel within 0.005 inch (0.13mm). The flanges mate with coupler NATO S.N. 5985-99-083-0058.
3. Hole each side, 3.8mm diameter, to accept primer cap spring.

BS440

X-BAND TR TUBE

Service Type CV6132

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	8500 to 9100	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	20	nJ/pulse
total power (see note 3)	100	mW
low power	250	mW
Recovery period to −3db (see note 3)	2.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max
Position of short circuit (see notes 3 and 5)	0.021 ± 0.007 inch (0.53 ± 0.18mm)	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 6)	1.0	200	kW
Primer supply voltage (negative) (see note 7)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	—	300	kN/m^2
	—	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

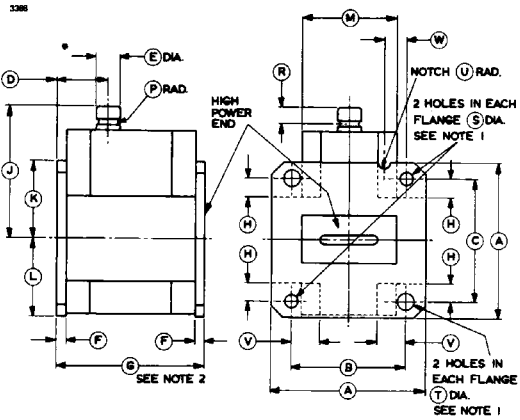
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
7. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.625	41.28
B	1.220 ± 0.004	30.988 ± 0.102
C	1.280 ± 0.004	32.512 ± 0.102
D	0.531	13.49
E	0.250	6.35
F	0.109 ± 0.016	2.77 ± 0.41
G	1.555 ± 0.002	39.497 ± 0.051
H	0.187 min	4.75 min
J	1.375 ± 0.031	34.93 ± 0.79
K	1.125 max	28.58 max
L	0.828 max	21.03 max
M	1.000 max	25.40 max
P	0.030	0.76
R	0.170	4.32
S*	0.150 ± 0.004	3.8 ± 0.1
T*	0.169 ± 0.004	4.3 ± 0.1
U	0.062 ± 0.031	1.57 ± 0.79
V	0.219 min	5.56 min
W	0.235 ± 0.010	5.97 ± 0.52

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

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS456

S-BAND TR TUBE

Service Type CV2351

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR cell.

CHARACTERISTICS

Frequency range	2850 to 3050	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 3)	100	mW
low power	500	mW
Recovery period to −3db (see note 2)	15	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 2)	0.8	db max
Position of short circuit (see notes 2 and 5)	0.062 inch (1.6mm) nom	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	1250	kW
Primer supply voltage (negative) (see note 6)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	5.890 x 5.890 x 4.469 inches nom 149.6 x 149.6 x 113.5mm nom
Waveguide size	no. 10 (2.840 x 1.340 inches internal)
Coupler	NATO S.N. 5985-99-083-1560
Finish	flange faces tin or nickel plated
Mounting position	any
Net weight	4¼ pounds (1.9kg) approx

NOTES

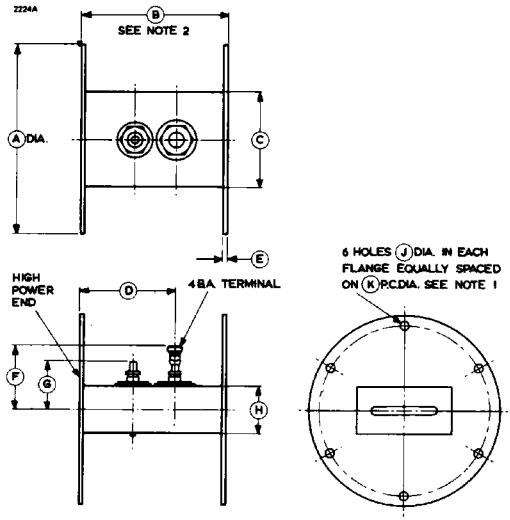
1. Measured at a power level below 10mW over the frequency range.
2. Measured at 250kW peak power, 1.0μs pulse length and 0.001 duty factor.
3. For 1.0μs pulse.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Distance of the effective r.f. short circuit behind front flange.
6. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	5.875 ± 0.015	149.2 ± 0.38
B	4.469 ± 0.004	113.5 ± 0.1
C	3.000	76.20
D	3.000 ± 0.094	76.20 ± 2.39
E	0.156	3.96
F	2.500 max	63.50 max
G	1.500 max	38.10 max
H	1.500	38.10
J	0.260 ± 0.004	6.60 ± 0.10
K	5.375	136.5

Millimetre dimensions have been derived from inches except dimension J.

OUTLINE



Outline Notes

1. The holes are equally spaced on the pitch circle diameter within 0.006 inch (0.15mm) positional tolerance zone diameter with respect to each other. The holes in each flange will be within 1° of twist and 0.020 inch (0.51mm) of lateral displacement.

   The flanges mate with NATO S.N. 5985-99-083-1560.

2. The two flange faces are flat and parallel within 0.004 inch (0.10mm).

BS462

X-BAND TR TUBE

Service Type CV3840

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable high Q TR tube, intended for marine radar.

CHARACTERISTICS

Frequency range	9000 to 9300	MHz
V.S.W.R. at resonance (see note 1)	1.4:1	max
Maximum leakage:		
spike energy (see note 2)	8.0	nJ/pulse
total power (see note 3)	30	mW
low power	250	mW
Recovery period to −3db (see note 3)	6.0	μs max
Insertion loss at resonance (see note 1)	1.0	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	–	75	kW
Primer supply voltage (negative) (see note 4)	700	1500	V
Primer current	100	200	μA
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.000 x 1.625 x 3.813 inches nom 25.40 x 41.28 x 96.85mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	brass flanges
Mounting position	any
Net weight	6 ounces (170g) approx

NOTES

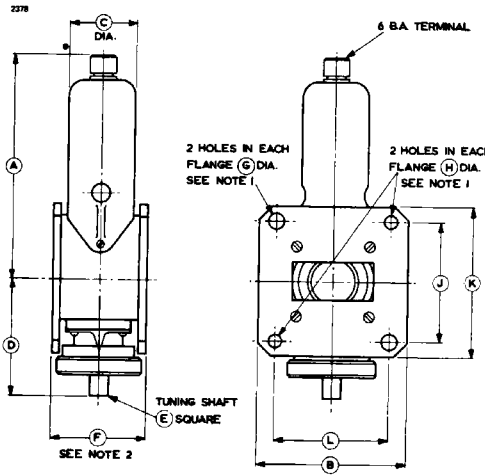
1. Measured at a power level below 10mW.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current must be limited by a series resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer terminal.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	2.375 max	60.33 max
B	1.625	41.28
C	0.722 max	18.34 max
D	1.437 max	36.50 max
E	0.187	4.75
F	1.000 ± 0.005	25.40 ± 0.13
G	0.170 ± 0.002	4.318 ± 0.051
H	0.150 ± 0.002	3.810 ± 0.051
J	1.280 ± 0.003	32.512 ± 0.076
K	1.625	41.28
L	1.220 ± 0.003	30.988 ± 0.076

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.010 inch (0.25mm).

BS48

X-BAND TB TUBE

Service Type CV460

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

X-Band TB tube.

CHARACTERISTICS

Resonant frequency	9410	MHz
Loaded Q	6.0	max
Equivalent susceptance	±0.06	max
Equivalent conductance	0.045	max
Firing time (see notes 1 and 2)	10	s max
V.S.W.R. (see note 3)	1.1:1	max
Recovery loss at 2μs (see note 4)	2.0	db max
Arc loss (see note 1)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	4.0	50	kW
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

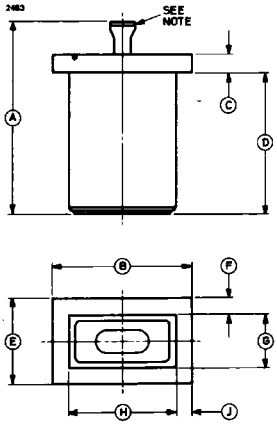
GENERAL

Overall dimensions	1.813 x 1.303 x 0.803 inches max 46.05 x 33.10 x 20.40mm max
Finish	tin or silver plated
Mounting position	any

NOTES

1. Measured at 4.0kW peak power, 1.0μs pulse width and 1000p.p.s.
2. This test is performed at least 24 hours after any previous discharge.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at 12 to 15kW peak power (derived from a higher power source through an attenuator of at least 6db), 1.0μs pulse length and 1000p.p.s.
5. The tube can be used at higher powers but a somewhat reduced life may result.

OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.813 max	46.05 max	F	0.142 min	3.61 min
B	$1.303^{+0.000}_{-0.006}$	$33.10^{+0.00}_{-0.15}$	G	$0.510^{+0.000}_{-0.020}$	$12.95^{+0.00}_{-0.51}$
C	$0.133^{+0.000}_{-0.016}$	$3.38^{+0.00}_{-0.41}$	H	$1.010^{+0.000}_{-0.020}$	$25.65^{+0.00}_{-0.51}$
D	1.299 ± 0.005	32.99 ± 0.13	J	0.142 min	3.61 min
E	$0.803^{+0.000}_{-0.006}$	$20.40^{+0.00}_{-0.15}$			

Millimetre dimensions have been derived from inches.

Note The seal-off will pass through a hole 0.375 inch (9.53mm) diameter, centred on the centre of the flange.

BS502

X-BAND MONITOR DIODE

Service Type CV6005

The data should be read in conjunction with the Monitor Diode Preamble.

DESCRIPTION

The BS502 is a monitor diode operating in the frequency range 8.5 to 10GHz. It is used with monitor diode mount type BS512 and power supply and indicator unit type BS600.

GENERAL DATA

Mechanical

Overall dimensions		see Outline
Mounting position		see note 1
Ambient temperature	70	°C max

Electrical

Frequency range (see note 2)	8.5 to 10	GHz
V.S.W.R. (see note 2)	1.3:1	max
Heater voltage (pre-heat)	6.3 ± 0.5	V
Heater voltage (operating)	see note 3	
Heater current at 6.3V	1.2 ± 0.1	A
Load resistance	68 ± 1%	Ω
Power sensitivity (see note 4)	14.1 to 17.3	kW

MAXIMUM RATINGS

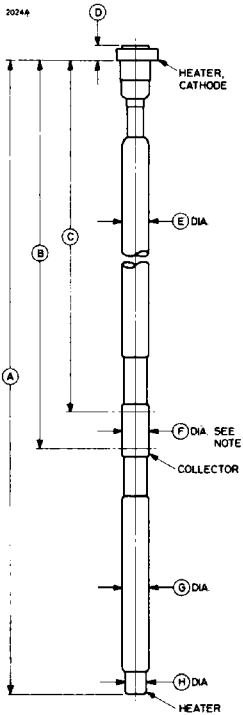
Input power (peak)	20	kW
Input power (mean)	18	W
Pulse length	2	μs

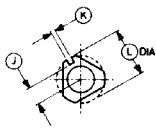
NOTES

1. The diode and mount may be mounted in any position provided there is free convection of the surrounding air.
2. In a standard mount type BS512. By adjustment of the position of the matching piston in the mount it is possible to obtain a v.s.w.r. of less than 1.3:1 at any frequency in the range.
3. The maximum diode life will be obtained if the heater voltage is reduced when the diode is operating with r.f. power input. The reduced voltage should be 10% to 20% above the value at which the amplitude of the diode output voltage begins to decrease.

4. The diode is tested in a standard mount at a pulse repetition rate of 1000p.p.s. and pulse length of 1μs ± 1%. Sensitivity is measured by setting the pulse output to 100V ± 1V across a 68Ω ± 1% load resistance.

OUTLINE





VIEW ON TOP

Ref	Inches	Millimetres
A	10.700 ± 0.150	271.8 ± 3.8
B	6.800 min	172.7 min
C	6.375 max	161.9 max
D	0.250 max	6.35 max
	0.187 min	4.75 min
E	0.428 max	10.87 max
F	$0.435^{+0.001}_{-0.004}$	$11.049^{+0.025}_{-0.102}$
G	0.428 max	10.87 max
H	0.364	9.25
J	0.280 max	7.11 max
K	0.063 ± 0.003	1.600 ± 0.076
L	0.750 ± 0.005	19.05 ± 0.13

Millimetre dimensions have been derived from inches.

Note Diameter F will be maintained between dimensions B and C.

BS510

S-BAND MONITOR DIODE

Service Type CV6107

The data should be read in conjunction with the Monitor Diode Preamble.

DESCRIPTION

The BS510 is a monitor diode operating in the frequency range 2.5 to 6.5GHz. The diode may be used in a suitable mount at any frequency within this range, the bandwidth and v.s.w.r. depending on the design of the mount. The following table gives brief details of the range of mounts currently available for use with the BS510; full data on each are available separately.

Type	Frequency Range (GHz)	V.S.W.R. (max)	Waveguide Flange NATO Stock No.	Notes
BS514	2.6 to 3.2	1.3:1	5985-99-083-0010	Tunable
BS524			-0009	
BS534			-0058	
BS516	2.8 to 3.2	1.5:1	5985-99-083-0009	Fixed-tuned,
BS522			-0058	screened load
BS530	2.7 to 2.95	1.3:1	5985-99-083-0058	Fixed-tuned
BS532	2.95 to 3.2	1.3:1	5985-99-083-0058	Fixed-tuned

GENERAL DATA

Mechanical

Overall dimensions	see outline drawing
Mounting position	see note 1
Ambient temperature	70 °C max

Electrical

Frequency range	2.5 to 6.5 GHz
V.S.W.R.	1.5:1 max
Heater voltage (pre-heat)	6.3 ± 0.5 V
Heater voltage (operating)	see note 2
Heater current at 6.3V	1.2 ± 0.1 A
Load resistance	68 ± 1% Ω
Power sensitivity	see note 3

MAXIMUM RATINGS

Input power (peak)	20	kW
Input power (mean)	18	W
Pulse length (see note 4)	15	μs

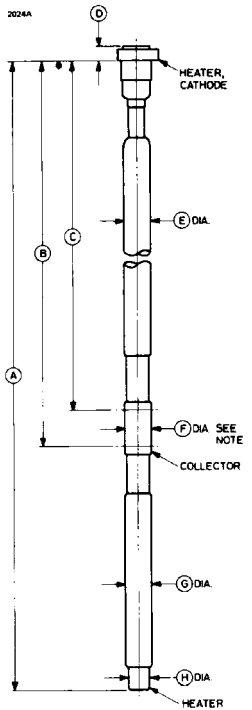
NOTES

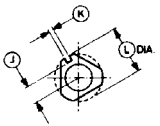
1. The diode and mount may be mounted in any position provided there is free convection of the surrounding air.
2. The maximum diode life will be obtained if the heater voltage is reduced when the diode is operating with r.f. power input. The reduced voltage should be 10% to 20% above the value at which the amplitude of the diode output voltage begins to decrease.
3. The diode is tested for sensitivity under the following conditions:

Pulse length	10 ± 1		μs
Pulse repetition rate	250		p.p.s.
Load resistance	$68 \pm 1\%$		Ω
Output voltage (peak)	$9 \pm 1\%$		V
Mount type	BS530	BS532	
Frequency	2.8	3.1	GHz
Input power (peak)	235 to 290	250 to 305	W

4. English Electric Valve Company Ltd. should be consulted if operation at pulse lengths exceeding 15μs is required.

OUTLINE





VIEW ON TOP

Ref	Inches	Millimetres
A	15.600 ± 0.150	396.2 ± 3.8
B	11.400 min	289.6 min
C	10.750 max	273.1 max
D	0.250 max 0.187 min	6.35 max 4.75 min
E	0.428 max	10.87 max
F	$0.435^{+0.001}_{-0.004}$	$11.049^{+0.025}_{-0.102}$
G	0.428 max	10.87 max
H	0.364	9.25
J	0.280 max	7.11 max
K	0.063 ± 0.003	1.600 ± 0.076
L	0.750 ± 0.005	19.05 ± 0.13

Millimetre dimensions have been derived from inches.

Note Diameter F will be maintained between dimensions B and C.

BS52

X-BAND TR TUBE

Service Type CV1841

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR tube.

CHARACTERISTICS

Frequency range	9320 to 9500	MHz
V.S.W.R. (see note 1)	1.2:1	max
Maximum leakage:		
spike energy (see note 2)	25	nJ/pulse
total power (see note 3)	100	mW
low power	500	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.7	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	5.0	200	kW
Primer supply voltage (negative) (see note 5)	900	1100	V
Primer current	70	150	μA
Waveguide pressure	—	300	kN/m^2
	—	44	lb/in^2
Ambient temperature (non-operating)	−40	+100	°C

GENERAL

Overall dimensions	1.555 x 1.625 x 2.187 inches nom 39.50 x 41.28 x 55.55mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	4 ounces (110g) approx

NOTES

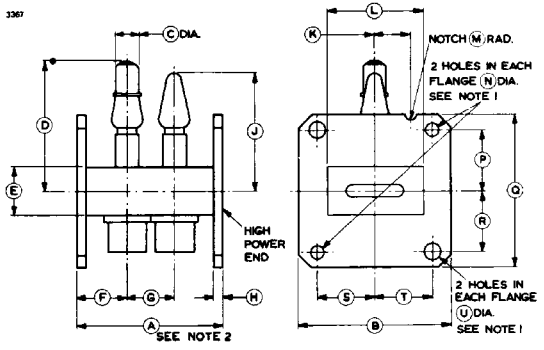
1. Measured at a power level below 10mW over the frequency range 9320 to 9500MHz.
2. Measured at 40kW peak power, 0.1μs pulse length and 3000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at the centre of the frequency range.
5. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap.

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	1.555 ± 0.002	39.497 ± 0.051
B	1.625	41.28
C	0.250	6.35
D	1.375 max	34.93 max
E	0.500	12.70
F	0.531	13.49
G	0.500	12.70
H	0.094 min	2.39 min
J	1.250 max	31.75 max
K	0.375 ± 0.005	9.53 ± 0.13
L	1.000	25.40
M	0.062 ± 0.031	1.57 ± 0.79
N	0.147	3.73
P	0.640 ± 0.002	16.256 ± 0.051
Q	1.625	41.28
R	0.640 ± 0.002	16.256 ± 0.051
S	0.610 ± 0.002	15.494 ± 0.051
T	0.610 ± 0.002	15.494 ± 0.051
U	0.1695 ± 0.004	4.305 ± 0.102

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping. The notch at the top of the flange may be used to locate the input (high power) end against a peg and prevent accidental insertion of the tube the wrong way round.
2. The two flanges are flat and parallel within 0.002 inch (0.051mm).

BS714

PLUG-IN
TR TUBE

Service Type CV6129

The data should be read in conjunction with the Duplexer Device Preamble

DESCRIPTION

Plug-in, primerless TR tube.

CHARACTERISTICS (See note 1)

Frequency range	2600 to 3950	MHz
Centre frequency (see note 2)	3600 to 3645	MHz
V.S.W.R. (see note 3)	1.1:1	max
Maximum leakage		
spike energy (see note 4)	1.0	μJ/pulse
high power total (see note 5)	3.6	W
low power	10	W
Attenuation recovery period to 3db (see note 5)	30	μs max
Insertion loss (see note 3)	0.2	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.01	5.0	kW
Transmitter power (mean)	—	5.0	W
Ambient temperature (non-operating)	−40	+100	°C

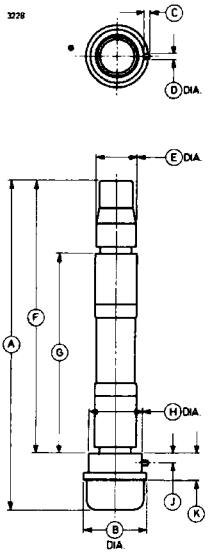
GENERAL

Overall dimensions	see Outline
Finish	metal parts silver or nickel plated
Mounting position	any
Net weight	120g (4.2 ounces) approx

NOTES

1. The tube is designed for use in a no. 10 or no. 11 waveguide mount. The frequency and performance characteristics depend on the design of the mount, which should have a loaded Q of 6.0 max. with the tube installed.
2. The geometric mean of the frequencies at which the v.s.w.r. is 1.33:1.
3. Measured at a low power level, at 3620MHz.
4. Measured at 5.0kW peak power, 0.1μs pulse length and 1000p.p.s.
5. Measured at 5.0kW peak power, 1.0μs pulse length and 1000p.p.s.

OUTLINE



Ref	Millimetres	Inches
A	132.0 ± 5.0	5.197 ± 0.197
B	25.40 max	1.000 max
C	1.40 ± 0.13	0.055 ± 0.005
D	1.40 ± 0.13	0.055 ± 0.005
E	15.85 max	0.624 max
	15.77 min	0.621 min
F	112.0 max	4.409 max
G	82.4 ± 0.9	3.244 ± 0.035
H	21.50 ± 0.05	0.846 ± 0.002
J	3.95 ± 0.15	0.156 ± 0.006
K	11.0 ± 0.3	0.433 ± 0.012

Inch dimensions have been derived from millimetres.

BS810

X-BAND TR TUBE

Service Type CV1923

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Tunable high Q TR tube, intended for marine radar.

CHARACTERISTICS

Frequency range (see note 1)	9245 to 9575	MHz
V.S.W.R. at resonance (see note 2)	1.4:1	max
Maximum leakage:		
spike energy (see note 3)	8.0	nJ/pulse
total power (see note 4)	30	mW
low power, primed (see note 5)	100	mW
low power, unprimed (see note 5)	250	mW
Recovery period to −6db:		
at 2.5kW peak power		see note 6
at 25kW peak, 0.1μs pulse length, 1000p.p.s.	1.5	μs max
Insertion loss at resonance (see note 2)	0.8	db max
Arc loss (see note 7)	0.15	db max
Position of short circuit (see note 8):		
with gap discharge	0.240 ± 0.020 inch (6.10 ± 0.51mm)	
with window discharge	0.189 ± 0.020 inch (4.80 ± 0.51mm)	
Loaded Q	125 to 170	

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak)	0.001	75	kW
Primer supply voltage (negative) (see note 9)	700	1500	V
Primer current	100	200	μA
Primer operating voltage	250	450	V
Temperature range:			
non-operating	−40	+100	°C
operating	−25	+80	°C

GENERAL

Overall dimensions	1.000 x 1.625 x 3.813 inches nom 25.40 x 41.28 x 96.85mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flanges brass
Mounting position	any
Net weight	7 ounces (200g) approx

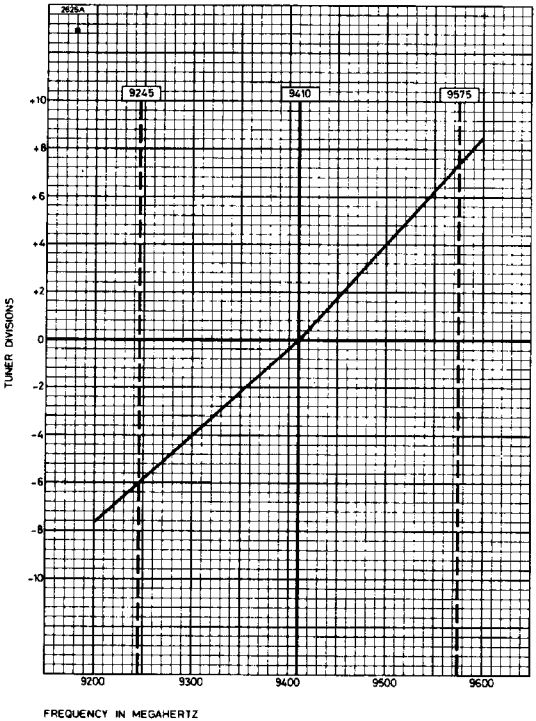
NOTES

1. Tuning knob set to 9410MHz against pointer on leaving factory. Approximate frequency corresponding to knob scale is given on page 3.
2. Measured at power level below 10mW at centre frequency of 9410MHz.
3. Measured at 25kW peak power, 0.1μs pulse length and 1000p.p.s. Primer current set to 150μA.
4. Measured at 25kW peak power, 1.0μs pulse length and 1000p.p.s. Primer current set to 150μA.
5. Primed and unprimed low power breakthrough are measured by increasing the incident r.f. power at 1.0μs pulse length and 1000p.p.s. from zero until breakdown occurs inside the TR tube.
6. The recovery characteristic is determined by measuring the transmission through a peak response tuned TR tube of a low level c.w. signal at the transmitter frequency, which will be within the range 9410 ± 65MHz, following a transmitter pulse of 0.1μs duration at 3000p.p.s.

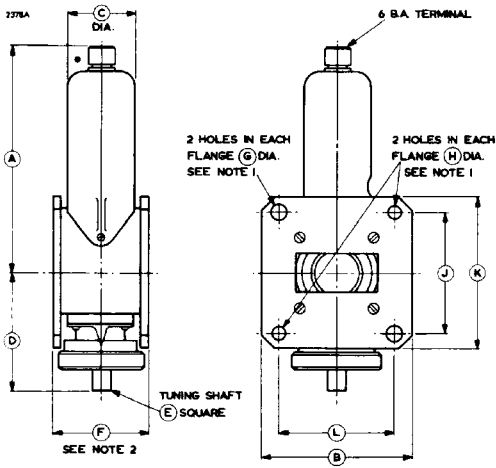
Time after end of pulse, μs	Maximum attenuation, db
0.1	40
0.2	30
0.4	20
0.6	15
0.9	10
1.4	6

7. Measured at 1.5kW peak power, 0.1μs pulse length and 3000p.p.s. at a TR tube frequency of 9410MHz. Sample test only.
8. Transition of v.s.w. minimum from cone gap to windows occurs at following conditions approximately.
   9kW peak power, 1.0μs pulse length and 1000p.p.s.
   10.5kW peak power, 1.0μs pulse length and 500p.p.s.
   17.5kW peak power, 0.5μs pulse length and 1000p.p.s.
9. The primer supply voltage must be applied at least 5 seconds before the tube is required to operate. The primer current should be adjusted to 150μA by means of series resistance, around the value of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap terminal.

TYPICAL TUNER CHARACTERISTIC



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.375 max	60.33 max	G*	0.169 ± 0.004	4.3 ± 0.1
B	1.625	41.28	H*	0.150 ± 0.004	3.8 ± 0.1
C	0.750	19.05	J	1.280 ± 0.003	32.512 ± 0.076
D	1.437 max	36.50 max	K	1.625	41.28
E	0.187	4.75	L	1.220 ± 0.003	30.988 ± 0.076
F	1.000 ± 0.005	25.40 ± 0.13			

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

Outline Notes

1. The corresponding holes in both flanges will be coaxial. Two of the diametrically opposite holes are suitable for locating on dowel pegs, while the remaining two are used for clamping.
2. The two flanges are flat and parallel within 0.008 inch (0.20mm).

BS814

X-BAND TR LIMITER

Service Type CV6192

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9000 to 9700	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

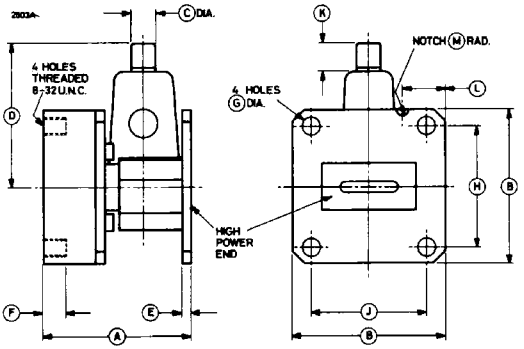
GENERAL

Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.36	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS816

X-BAND TR LIMITER

Service Type CV6178

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	8500 to 9100	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

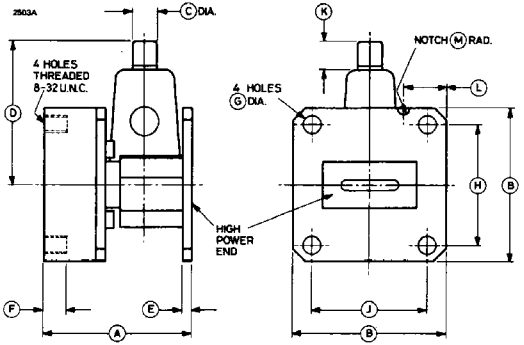
GENERAL

Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.35	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS818

X-BAND TR LIMITER

Service Type CV6206

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9400 to 10 000	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	–	300	kN/m^2
	–	44	lb/in^2
Ambient temperature (non-operating)	−40	+70	°C

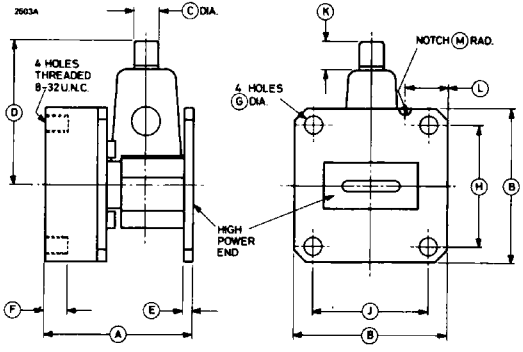
GENERAL

Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

NOTES

1. Measured at a power level below 2mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 2mW at the centre of the frequency range.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.173 ± 0.004	4.4 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.437	11.10
F	0.250	6.35	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS826

X-BAND TR LIMITER

Service Type CV6207

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band single primer TR limiter.

CHARACTERISTICS

Frequency range	9300 to 9900	MHz
V.S.W.R. (see note 1)	1.3:1	max
Maximum leakage:		
spike energy (see note 2)	2.0	nJ/pulse
total power (see note 3)	30	mW
low power	50	mW
Recovery period to −3db (see note 3)	3.0	μs max
Insertion loss (see note 4)	0.8	db max
Arc loss (see note 3)	0.8	db max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (peak) (see note 5)	1.0	200	kW
Primer supply voltage (negative) (see note 6)	950	1100	V
Primer current	70	150	μA
Waveguide pressure	—	300	kN/m²
	—	44	lb/in²
Ambient temperature (non-operating)	−40	+70	°C

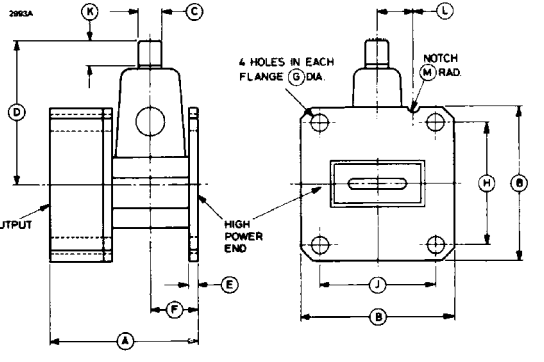
GENERAL

Overall dimensions	1.555 x 1.625 x 2.437 inches nom 39.50 x 41.28 x 61.90mm nom
Waveguide size	no. 16 (0.900 x 0.400 inch internal)
Coupler	UG-39/U
Finish	flange faces tin or silver plated
Mounting position	any
Net weight	8 ounces (230g) approx

NOTES

1. Measured at a power level below 1.0mW over the frequency range.
2. Measured at 40kW peak power, 0.1μs pulse length and 1000p.p.s.
3. Measured at 40kW peak power, 1.0μs pulse length and 1000p.p.s.
4. Measured at a power level below 10mW at 9300, 9600 and 9900MHz.
5. Operation at power levels above 50kW results in reduced life and it is recommended that in such cases the tube be preceded by a pre-TR tube.
6. Connected to the primer via a resistance of 5.5MΩ, of which at least 0.5MΩ must be adjacent to the primer top cap. The primer supply voltage must be applied at least 5 seconds before the magnetron fires.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	1.555 ± 0.005	39.50 ± 0.13	G	0.177 ± 0.004	4.5 ± 0.1
B	1.625	41.28	H	1.280	32.51
C	0.250	6.35	J	1.220	30.99
D	1.625 max	41.28 max	K	0.250 min	6.35 min
E	0.094 min	2.39 min	L	0.375 ± 0.005	9.53 ± 0.13
F	0.500	12.70	M	0.062 ± 0.031	1.57 ± 0.79

Millimetre dimensions have been derived from inches except dimension G.

BS834

PLUG-IN PRE-TR TUBE

Service Type CV6028

The data should be read in conjunction with the Duplexer Device Preamble.

DESCRIPTION

Broad-band, low loss, plug-in pre-TR tube with no external connections.

CHARACTERISTICS (See note 1)

Frequency range (see note 2)	2.0 to 12	GHz
Breakdown power (see note 3)	20	kW max
Recovery period to −3db (see note 4)	25	μs max

MAXIMUM AND MINIMUM RATINGS

	Min	Max	
Transmitter power (see note 5):			
peak	–	2.5	MW
mean	–	3.0	kW
Pulse length	–	2.5	μs
Waveguide pressure	–	300	kN/m²
	–	44	lb/in²
Ambient temperature	−50	+100	°C

GENERAL

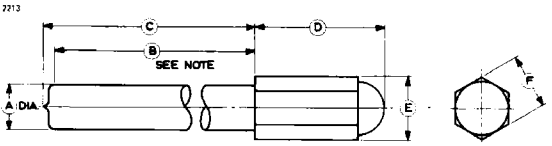
Overall dimensions	see Outline
Radio-active content (see note 6)	10 microcuries approx
Mounting position (see note 7)	any
Net weight	10g approx

NOTES

1. The tube is tested at 9.5 ± 0.5GHz in a balanced duplexer in WG16 waveguide; the maximum v.s.w.r. looking outwards from the duplexer does not exceed 1.2:1 on any arm. A pulse length of 0.2μs ± 10% at a duty cycle of 0.0002 ± 10% is used.
2. The tube may be used in a suitable waveguide mount at any frequency within this range. The bandwidth and matching are determined by the design of the mount.

3. The power incident on a balanced duplexer.
4. Measured with peak input power 50kW ± 10%.
5. The power incident on a balanced duplexer where two tubes are each operating across both arms of the duplexer.
6. The radio-activity is low energy β emission, which is completely absorbed by the silica envelope of the tube.
7. The hole through which the tube passes should be 0.3576 ± 0.0005 inch (9.083 ± 0.013mm) diameter.

OUTLINE



Ref	Inches	Millimetres
A	0.3568 ± 0.0002	9.063 ± 0.005
B	6.500 min	165.1 min
C	7.000 max	177.8 max
D	1.000 ± 0.010	25.40 ± 0.25
E	0.505 max	12.83 max
F	0.434 ± 0.003	11.024 ± 0.076

Millimetre dimensions have been derived from inches.

Outline Note Dimension B refers to the ground length.

BT95

MERCURY VAPOUR THYRATRON

Service Type CV5141

To be read in conjunction with the Rectifier and Thyratron Preamble.

ABRIDGED DATA

Mercury vapour thyratron for high voltage industrial control applications.

Peak forward anode voltage	15	kV max
Peak inverse anode voltage	15	kV max
Peak anode current	12	A max
Average anode current	1.5	A max

GENERAL

Electrical

Filament		oxide coated
Filament voltage	2.5	V
Filament current	20	A
Filament pre-heating time (minimum)	5.0	min
Inter-electrode capacitances:		
grid to anode	8.0	pF
grid to filament	18	pF

Mechanical

Overall length (excluding flexible leads)	11.000 inches (279.4mm) max
Overall width	4.000 inches (101.6mm) nom
Net weight	1 pound (0.5kg) approx
Mounting position	vertical, base down
Base	flying leads
Top cap	see outline

Cooling natural

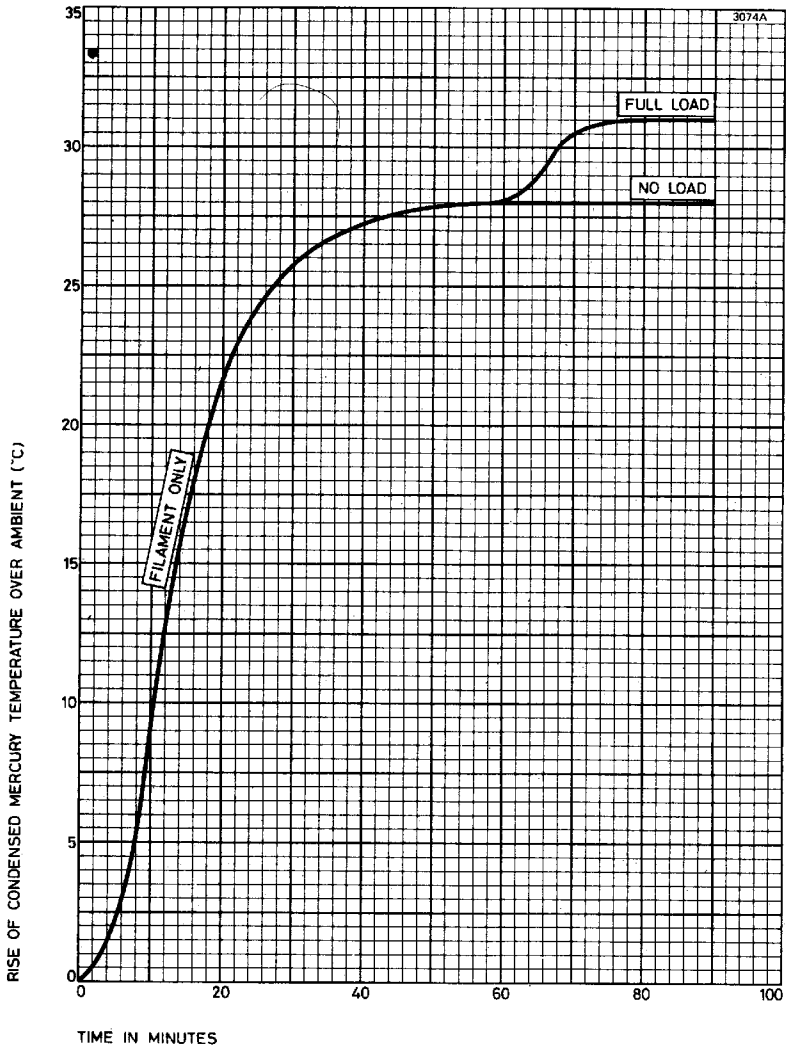
MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	Min	Max	
Peak forward anode voltage	–	10	–	15	kV
Peak inverse anode voltage	–	10	–	15	kV
Peak anode current	–	16	–	12	A
Average anode current (averaging time 15s max)	–	2.0	–	1.5	A
Fault anode current (peak)	–	200	–	200	A
Duration of fault current	–	0.1	–	0.1	s
Condensed mercury temperature	40	75	40	70	°C
Negative grid voltage:					
before conduction			–	500	V
during conduction			–	10	V
Average grid current			–	250	mA
Recommended grid resistor			5.0	50	kΩ
Filament pre-heating time			5.0	–	min

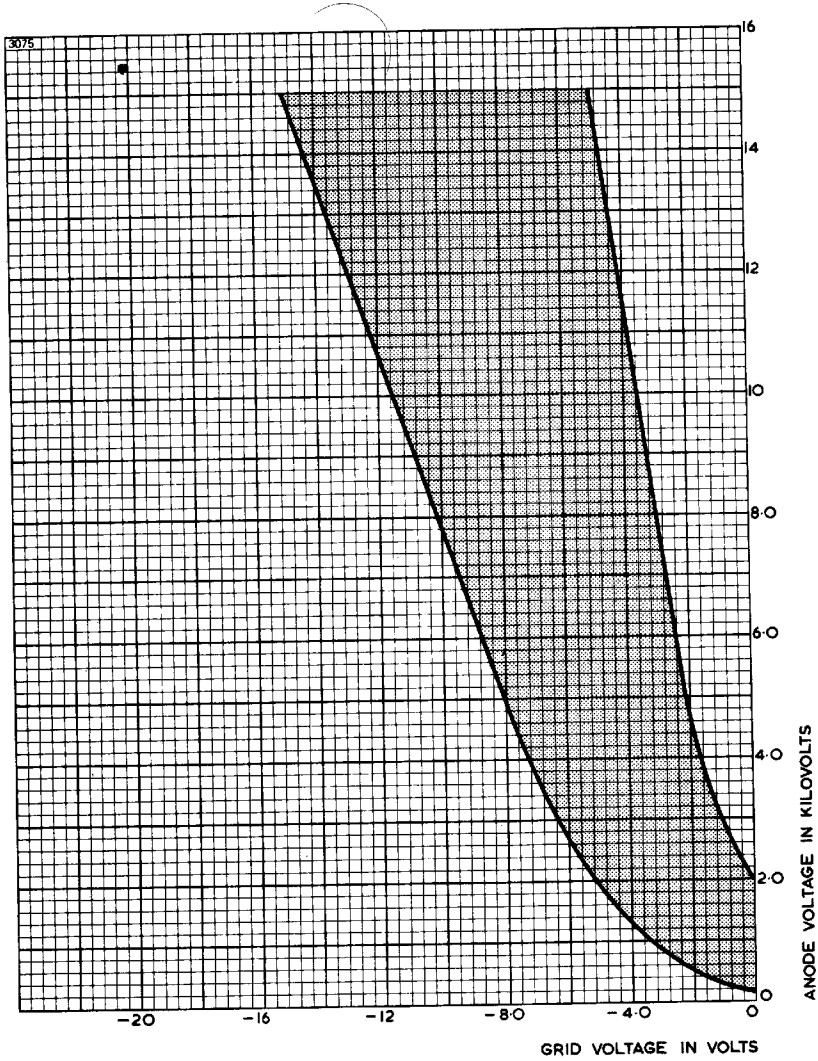
CHARACTERISTICS

Voltage drop (approx)	16	V
Ionization time (approx)	10	μs
Recovery time (approx)	1.0	ms
Condensed mercury temperature rise:		
at no load (approx)	28	°C
at full load (approx)	31	°C

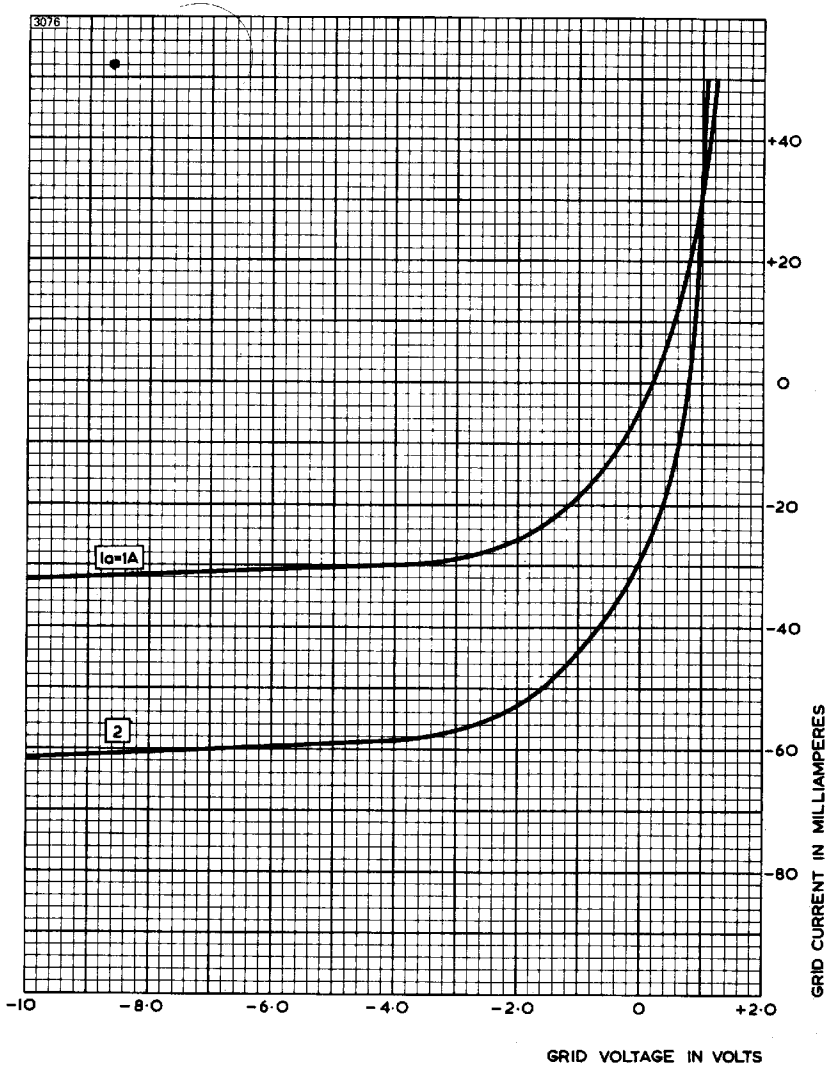
TYPICAL HEATING CHARACTERISTIC



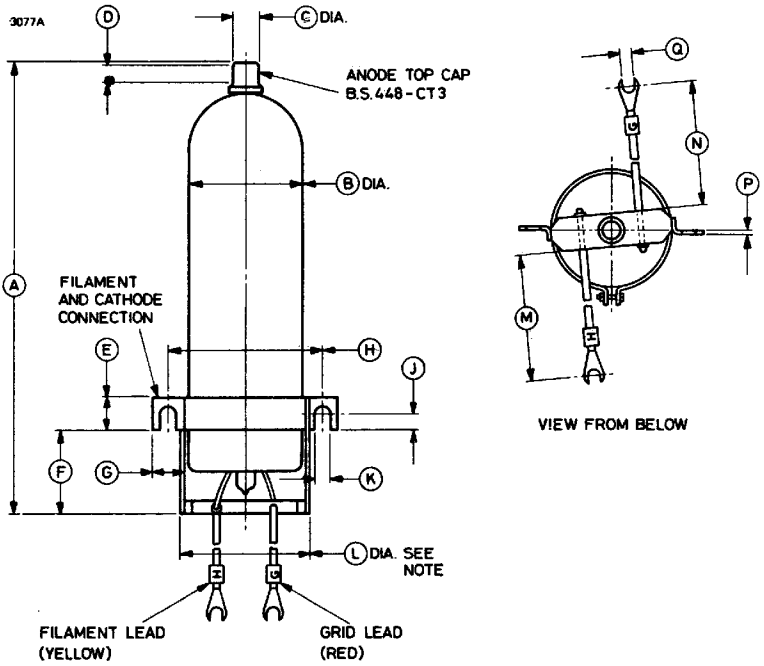
CONTROL CHARACTERISTIC



TYPICAL GRID CURRENT CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.750 ± 0.500	247.7 ± 12.7	J	0.375	9.53
B	2.500	63.50	K	0.250	6.35
C	0.566 ± 0.015	14.38 ± 0.38	L	2.875	73.03
D	0.380 min	9.65 min	M	4.312 ± 0.250	109.5 ± 6.4
E	0.750 ± 0.031	19.05 ± 0.79	N	4.562 ± 0.250	115.9 ± 6.4
F	1.750	44.45	P	0.080	2.03
G	0.750	19.05	Q	0.265	6.73
H	3.406 ± 0.062	86.51 ± 1.57			

Millimetre dimensions have been derived from inches.

Note The base will pass through a hole of this diameter up to the terminal lugs.

C1134

BEAM POWER DOUBLE TETRODE

Service Type CV2799

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

V.H.F. double tetrode, with centre-tapped heater for series or parallel operation.

Anode dissipation	2 x 10	W max
Anode voltage	600	V max
Frequency for full ratings	150	MHz max
Frequency at reduced ratings	600	MHz max
Output power (class C telegraphy, 2 sections in push-pull)	48	W

GENERAL

Electrical

Cathode . . . . . indirectly heated, oxide coated

	Series	Parallel	
Heater voltage	12.6	6.3	V
Heater current	0.65	1.3	A
Grid-screen amplification factor (each unit) (I_a = 20mA)		8.0	
Mutual conductance (each unit) (I_a = 20mA)		2.5	mA/V
Inter-electrode capacitances (see note 1):			
grid to anode*		0.04	pF
input		7.5	pF
output		2.6	pF
input (two sections in push-pull)		4.4	pF
output (two sections in push-pull)		1.6	pF

* Internally neutralized for push-pull operation.

Mechanical

Overall length	86mm (3.38 inches) max
Overall diameter	46mm (1.81 inches) max
Net weight	2 ounces (60g) approx
Mounting position	vertical, base up or down

Horizontal operation is permitted with fixed station operation when the anode pins are in a horizontal plane.

Base . . . . . B.S.448-B7A (JEDEC no. E7-2)

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August 1974

COOLING

The temperature of the seals must not exceed the values given below:

Anode seal or bulb temperature	200	°C max
Base pin seal temperature	180	°C max

A heat dissipating anode connector of large surface area or high heat conduction is necessary.

Natural cooling is normally sufficient at maximum ratings for frequencies up to 150MHz. At higher frequencies it may be necessary to direct an air flow of up to $5ft^3$/min ($0.14m^3$/min) on to the anode and base seals.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR (Class B)

MAXIMUM RATINGS (Absolute values)

Anode voltage	600	V max
Anode dissipation	2 x 10	W max
Screen voltage	300	V max
Screen input power	2 x 1.5	W max
Grid voltage (negative value)	75	V max
Grid dissipation	2 x 0.5	W max
Grid resistor (fixed bias)	50	kΩ max
Grid resistor (cathode bias)	100	kΩ max
Cathode current (peak)	2 x 120	mA max
Cathode current (mean)	2 x 55	mA max
Peak heater to cathode voltage	100	V max

TYPICAL OPERATING CONDITIONS (Class B, 2 valves)

Anode voltage	300	500	V
Screen voltage	250	250	V
Grid voltage	−25	−26	V
Peak a.f. input voltage (grid to grid)	49	52	V
Effective load (anode to anode)	11	20	kΩ
Maximum-signal anode current	2 x 35	2 x 36.5	mA
Zero-signal anode current	2 x 12.5	2 x 12.5	mA
Maximum-signal screen current	2 x 9.5	2 x 8.1	mA
Zero-signal screen current	2 x 0.6	2 x 0.35	mA
Anode dissipation	2 x 3.9	2 x 6.5	W
Output power	13.2	23.5	W
Efficiency	63	64.5	%
Total distortion	3.5	3.5	%

PUSH-PULL R.F. POWER AMPLIFIER AND OSCILLATOR
(Class C telegraphy, key-down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	600	V max
Anode dissipation	2 x 10	W max
Screen voltage	300	V max
Screen input power	2 x 1.5	W max
Grid voltage (negative value)	75	V max
Grid current	2 x 2.5	mA max
Grid resistor (fixed bias)	50	kΩ max
Grid resistor (cathode bias)	100	kΩ max
Cathode current (mean)	2 x 55	mA max
Cathode current (peak)	2 x 260	mA max
Peak heater to cathode voltage	100	V max

TYPICAL OPERATING CONDITIONS

Frequency	**200**	**200**	**200**	**200**	**MHz**
Anode voltage	200	300	400	600	V
Screen voltage (see note 2)	200	250	250	250	V
Grid voltage	−30	−40	−50	−60	V
Anode current	2 x 50	2 x 50	2 x 50	2 x 50	mA
Screen current	2 x 4.0	2 x 4.5	2 x 4.0	2 x 4.0	mA
Grid current (approx)	2 x 1.0	2 x 0.7	2 x 0.7	2 x 0.7	mA
Driving power (approx)	<1.0	<1.0	1.0	1.5	W
Output power	13	21	30	48	W

Frequency	**400**	**400**	**400**	**600**	**MHz**
Anode voltage	200	300	400	400	V
Screen voltage (see note 2)	200	250	250	250	V
Grid voltage	−30	−40	−50	−50	V
Anode current	2 x 50	2 x 50	2 x 50	2 x 50	mA
Screen current	2 x 3.0	2 x 2.5	2 x 2.5	2 x 2.5	mA
Grid current (approx)	2 x 0.5	2 x 0.6	2 x 0.7	2 x 0.7	mA
Driving power (approx)	1.0	1.5	2.0	6.0	W
Output power	11	17	25	20	W

FREQUENCY TREBLER

TYPICAL OPERATING CONDITIONS

Output frequency	**200**	**400**	**MHz**
Anode voltage	300	300	V
Screen voltage	250	250	V
Grid voltage	−175	−175	V
Anode current	2 x 45	2 x 45	mA
Screen current	2 x 3.0	2 x 2.8	mA
Grid current (approx)	2 x 1.5	2 x 1.2	mA
Driving power (approx)	4.0	5.0	W
Output power	10	8.0	W

R.F. POWER AMPLIFIER – ANODE AND SCREEN MODULATED

(Class C telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	600	V max
Anode dissipation	2 x 6.7	W max
Screen voltage	300	V max
Screen input power	2 x 1.2	W max
Grid voltage (negative value)	100	V max
Grid current	2 x 2.5	mA max
Grid dissipation	2 x 0.5	W max
Cathode current (peak)	2 x 400	mA max
Cathode current (mean)	2 x 50	mA max
Peak heater to cathode voltage	100	V max

TYPICAL OPERATING CONDITIONS

Frequency	**200**	**200**	**200**	**400**	**MHz**
Anode voltage	300	500	600	300	V
Screen voltage	250	250	250	250	V
Grid voltage	−50	−80	−80	−50	V
Anode current	2 x 40	2 x 40	2 x 40	2 x 40	mA
Screen current	2 x 4.0	2 x 4.0	2 x 4.0	2 x 3.0	mA
Grid current (approx)	2 x 1.0	2 x 1.0	2 x 1.0	2 x 1.0	mA
Driving power (approx)	1.5	3.0	3.0	2.5	W
Anode dissipation	2 x 3.5	2 x 4.0	2 x 5.0	2 x 4.5	W
Output power	17	31	38	15	W
Efficiency	71	78	79	63	%

MAXIMUM ANODE VOLTAGE AGAINST FREQUENCY

Natural Cooling

Operating frequency (MHz)	Max. anode voltage c.w. (V)	Max. anode voltage with anode modulation (V)
150	600	600
200	500	500
450	300	300
600	250	250

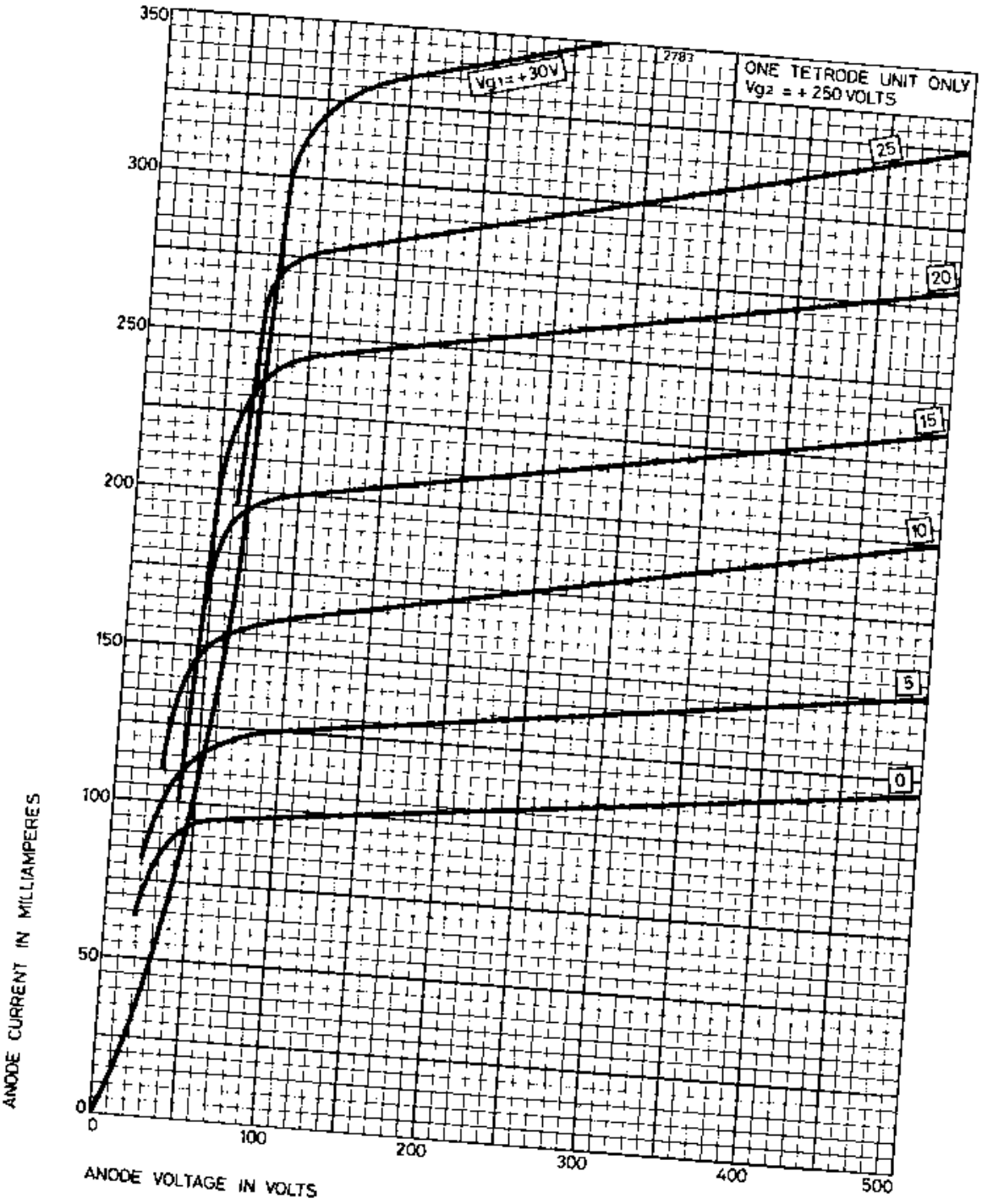
Forced-air Cooling

Operating frequency (MHz)	Max. anode voltage c.w. (V)	Max. anode voltage with anode modulation (V)
250		600
300	600	
600	400	400

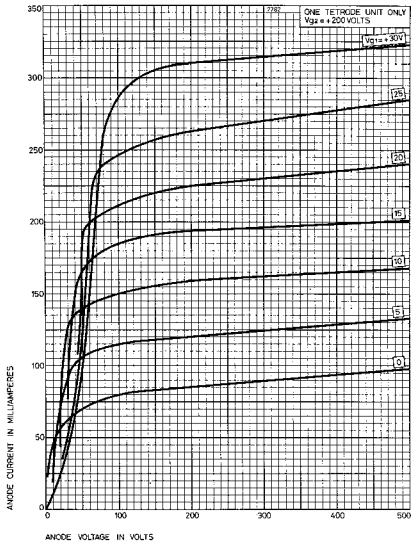
NOTES

1. Inter-electrode capacitances are for each unit except where otherwise indicated.
2. The screen voltage may be obtained from a separate source, or from the anode supply with a potential divider or through a series resistor. The screen voltage must not exceed 600V under key-up conditions.

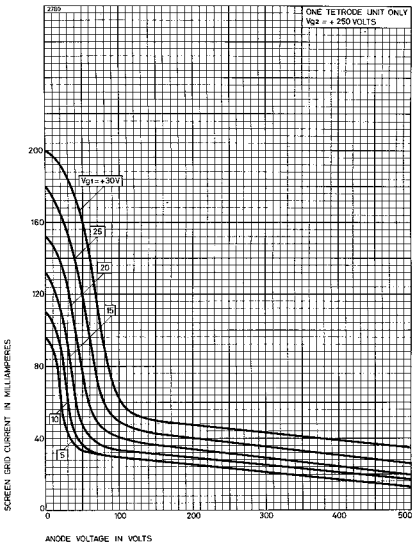
TYPICAL ANODE CHARACTERISTICS



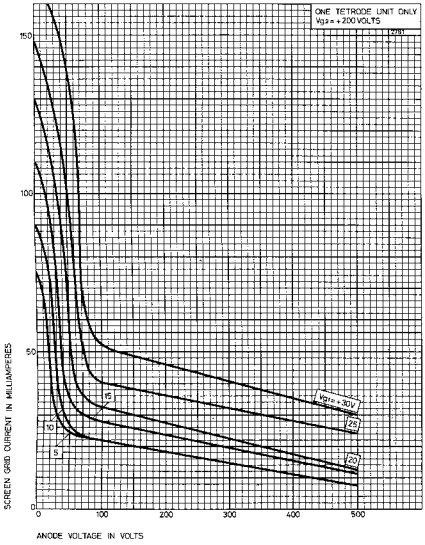
TYPICAL ANODE CHARACTERISTICS



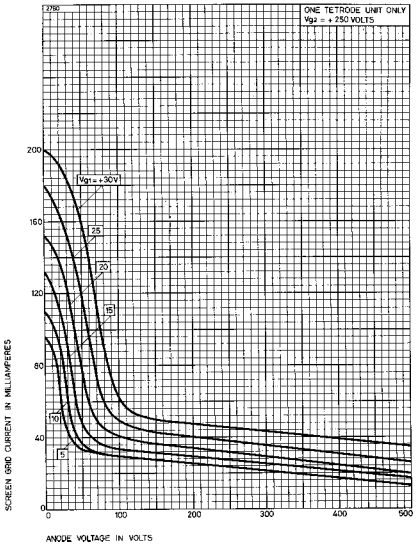
TYPICAL SCREEN CHARACTERISTICS



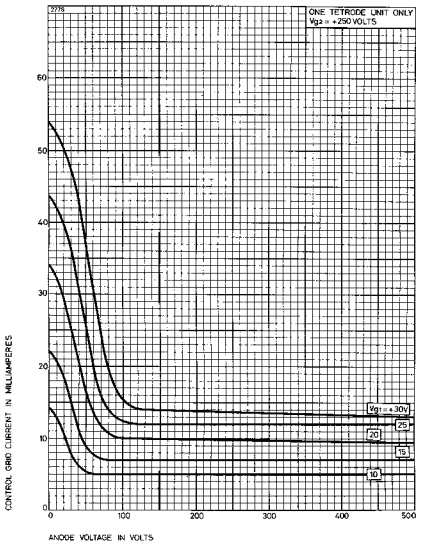
TYPICAL SCREEN CHARACTERISTICS



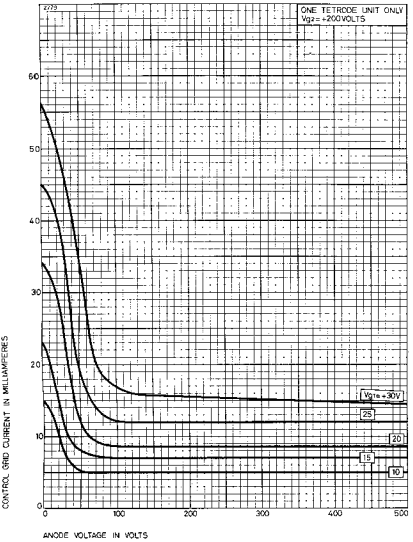
TYPICAL SCREEN CHARACTERISTICS



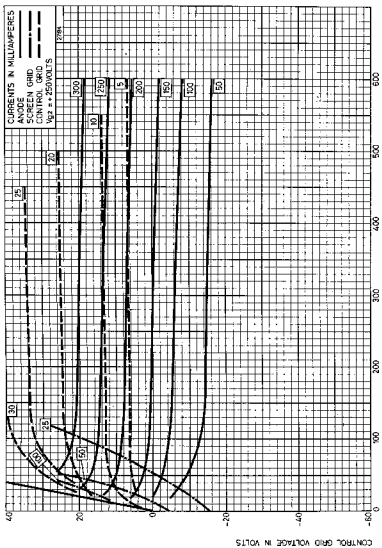
TYPICAL GRID CHARACTERISTICS



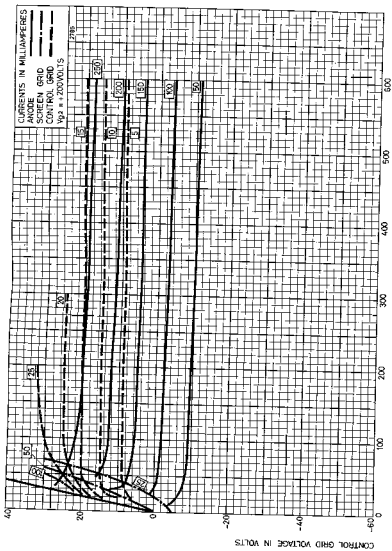
TYPICAL GRID CHARACTERISTICS



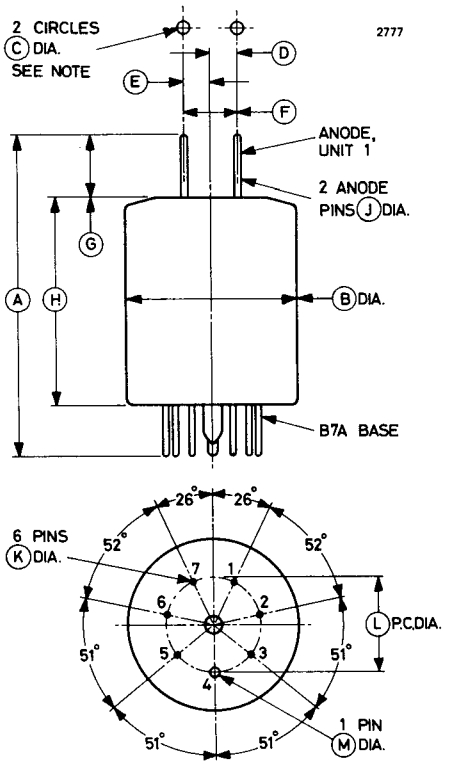
TYPICAL CONSTANT CURRENT CHARACTERISTICS



TYPICAL CONSTANT CURRENT CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)



Pin	Element
1	Heater
2	Grid, unit 1
3	Screen, common
4	Cathode, beam plates, shield
5	Heater centre tap
6	Grid, unit 2
7	Heater

Note The location of the anode pins will be within the two circles.

Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	85.5 max	3.366 max	H	55.0 max	2.165 max
B	46.0 max	1.811 max	J	2.0	0.079
C	3.6	0.142	K*	$1.473^{+0.051}_{-0.152}$	$0.058^{+0.002}_{-0.006}$
D	7.0	0.276			
E	7.0	0.276	L*	25.4	1.000
F	14.0 ± 1.0	0.550 ± 0.040	M*	3.175 ± 0.076	0.125 ± 0.003
G	16.5 ± 1.5	0.650 ± 0.059			

Inch dimensions have been derived from millimetres except where marked *.

C1136

R.F. POWER TETRODE

Service Type CV5959

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

V.H.F. radial beam tetrode for amplifier, oscillator or modulator applications.

Anode dissipation	400	W max
Anode voltage	4.0	kV max
Frequency for full ratings	110	MHz max
Output power (class C unmodulated conditions)	1.1	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage	5.0	V
Filament current	14.5	A
Peak usable cathode current	2.2	A
Perveance	0.65	$mA/V^{3/2}$
Grid-screen amplification factor (V_a = 2.5kV, V_{g2} = 500V, I_a = 100mA)	5.1	
Mutual conductance (V_a = 2.5kV, V_{g2} = 500V, I_a = 100mA)	4.0	mA/V
Inter-electrode capacitances:		
input	12.7	pF
output	4.9	pF
grid to anode	0.12	pF

Mechanical

Overall length	151mm (5.944 inches) max
Overall diameter	87mm (3.425 inches) max
Net weight	230g (8 ounces) approx
Mounting position	vertical, base up or down
Base	B.S.448-B5F

COOLING

An adequate flow of air must be provided to maintain the temperatures of the glass to metal seals and the envelope below the maximum values given below.

Where the anode dissipation is less than 250W, an air flow of at least $5ft^3$/min ($0.14m^3$/min) should be directed at the valve base. Up to $14ft^3$/min ($0.4m^3$/min) will be required when the anode dissipation exceeds 150W and a glass chimney should be used in order to assist circulation.

Anode seal temperature	220	°C max
Base pin seal temperature	180	°C max
Bulb temperature	350	°C max

A heat dissipating anode connector of large surface area is necessary.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class AB)

MAXIMUM RATINGS (Absolute values)

Anode voltage	4.0	kV max
Anode dissipation	400	W max
Screen voltage	800	V max
Screen dissipation	35	W max
Grid voltage (negative value)	500	V max
Grid dissipation	10	W max
Grid to filament resistance	250	kΩ max
Cathode current (mean)	400	mA max

TYPICAL OPERATING CONDITIONS
(Class AB without grid current, 2 valves)

Anode voltage	3.0	3.5	4.0	kV
Screen voltage	750	750	750	V
Grid voltage	−137	−145	−150	V
Peak a.f. input voltage (grid to grid)	275	290	300	V
Maximum-signal anode current	2 x 318	2 x 305	2 x 292	mA
Zero-signal anode current	2 x 80	2 x 70	2 x 60	mA
Maximum-signal screen current	2 x 13	2 x 16	2 x 20	mA
Effective load (anode to anode)	8.9	11.5	14.5	kΩ
Anode dissipation	2 x 400	2 x 400	2 x 400	W
Output power	1.11	1.33	1.54	kW
Efficiency	58	62	66	%

Continued on page 3

TYPICAL OPERATING CONDITIONS (Class AB with grid current, 2 valves)

Anode voltage	3.0	3.5	4.0	kV
Screen voltage	500	500	500	V
Grid voltage	−80	−85	−90	V
Peak a.f. input voltage (grid to grid)	290	304	304	V
Maximum-signal anode current	2 x 350	2 x 350	2 x 319	mA
Zero-signal anode current	2 x 90	2 x 80	2 x 80	mA
Maximum-signal screen current	2 x 20	2 x 19	2 x 16	mA
Grid current	2 x 3.0	2 x 3.0	2 x 3.0	mA
Effective load (anode to anode)	10	11.3	15	kΩ
Anode dissipation	2 x 362	2 x 400	2 x 400	W
Nominal driving power	2 x 4.5	2 x 5.0	2 x 3.5	W
Output power	1.375	1.65	1.75	kW
Efficiency	65	67	69	%

ANODE AND SCREEN MODULATED R.F. POWER AMPLIFIER
(Class C telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute values)

Anode voltage	3.2	kV max
Anode dissipation	270	W max
Screen voltage	600	V max
Screen dissipation	35	W max
Grid voltage (negative value)	500	V max
Grid dissipation	10	W max
Grid to filament resistance	50	kΩ max
Cathode current (mean)	330	mA max
Frequency for above ratings	75	MHz max

TYPICAL OPERATING CONDITIONS (for frequencies up to 75MHz)

Anode voltage	2.0	2.5	3.0	kV
Screen voltage	500	500	500	V
Grid voltage	−220	−220	−220	V
Peak r.f. grid voltage	305	305	305	V
Peak screen modulating voltage (modulation factor 1.0)	400	400	400	V
Anode current	275	275	275	mA
Screen current	30	28	26	mA
Grid current	6.0	6.0	6.0	mA
Anode dissipation	170	178	195	W
Screen dissipation	15	14	13	W
Nominal driving power	3.5	3.5	3.5	W
Output power	380	510	630	W
Efficiency	69	74	76	%

R.F. POWER AMPLIFIER OR OSCILLATOR
(Class C telegraphy, key-down conditions, one valve)

MAXIMUM RATINGS (Absolute values)

Anode voltage	4.0	kV max
Anode dissipation	400	W max
Screen voltage	600	V max
Screen dissipation	35	W max
Grid voltage (negative value)	500	V max
Grid dissipation	10	W max
Grid to filament resistance	50	kΩ max
Cathode current (mean)	420	mA max
Frequency for above ratings	110	MHz max

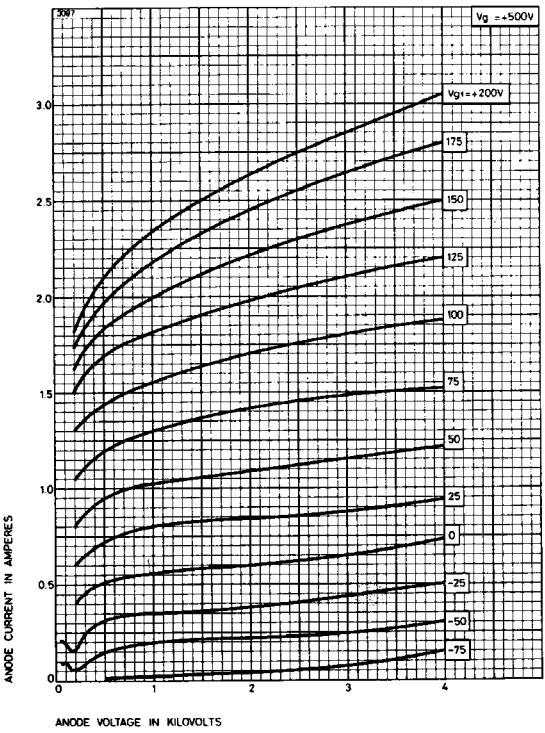
TYPICAL OPERATING CONDITIONS

Frequency	<75	<75	<75	MHz
Anode voltage	2.5	3.0	4.0	kV
Screen voltage	500	500	500	V
Grid voltage	−200	−220	−220	V
Peak r.f. grid voltage	290	305	305	V
Anode current	350	350	350	mA
Screen current	46	46	40	mA
Grid current	6.5	6.0	6.0	mA
Anode dissipation	235	250	300	W
Screen dissipation	17.5	15	12.5	W
Nominal driving power	12	12	12	W
Output power	640	800	1100	W
Efficiency	73	76	79	%

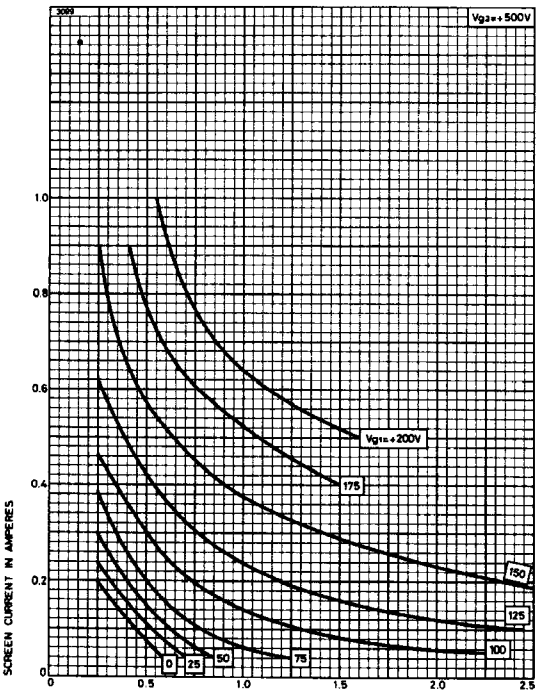
TYPICAL OPERATING CONDITIONS

Frequency	100	100	MHz
Anode voltage	3.5	4.0	kV
Screen voltage	500	500	V
Grid voltage	−170	−170	V
Peak r.f. grid voltage	235	240	V
Anode current	250	270	mA
Screen current	17	15.5	mA
Grid current	9.0	10	mA
Anode dissipation	225	280	W
Screen dissipation	30	30	W
Nominal driving power	20	20	W
Output power	650	800	W
Efficiency	74	74	%

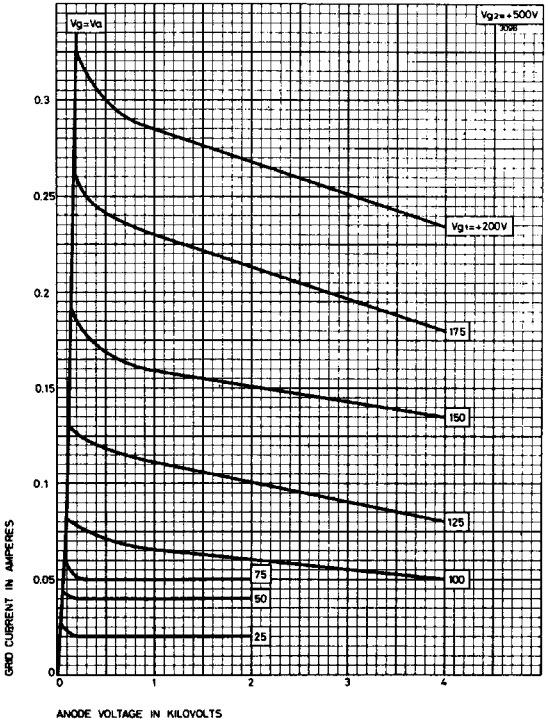
TYPICAL ANODE CHARACTERISTICS



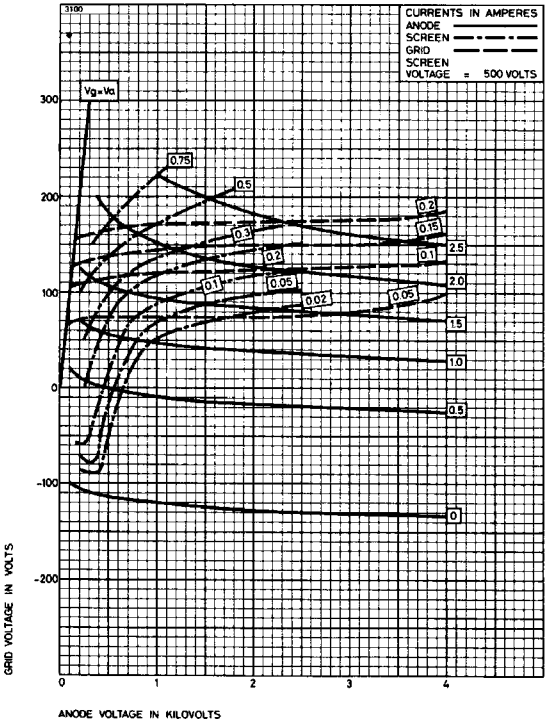
TYPICAL SCREEN CHARACTERISTICS



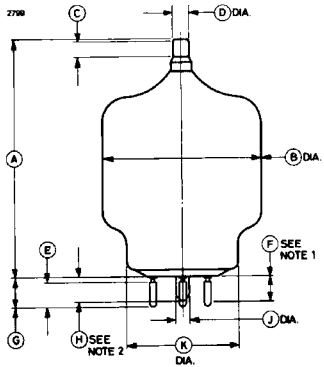
TYPICAL GRID CHARACTERISTICS

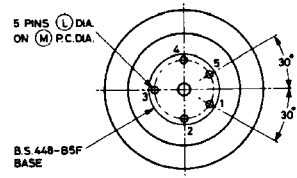


TYPICAL CONSTANT CURRENT CHARACTERISTICS



OUTLINE





Outline Notes

1. Limit of parallel portion of pins.
2. Seal-off length.

Pin	Element
1	Filament
2	Screen
3	Grid
4	Screen
5	Filament
Cap	Anode

Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	127.0 ± 6.0	5.000 ± 0.236	G	18.00 max	0.708 max
B	87.00 max	3.425 max	H	15.00 max	0.590 max
C	9.00 min	0.354 min	J	7.50 max	0.295 max
D	9.00 ± 0.13	0.354 ± 0.005	K	62.00 max	2.440 max
E	14.94 ± 0.25	0.588 ± 0.010	L	4.750 ± 0.076	0.187 ± 0.003
F	15.00 min	0.590 min	M	31.75	1.250 –

Inch dimensions have been derived from millimetres.

C1149A

PULSE AMPLIFIER TETRODES

ABRIDGED DATA

C1149/1 is a high vacuum, radial beam tetrode designed primarily for the output stage in power amplifier pulse modulators. It is of rugged construction and is a development of the C1149, being identical electrically but having a modified envelope design to give improved mechanical characteristics.

The C1149/1 may be used as a replacement for type 4PR60B, having equivalent electrical characteristics, and it also replaces types 715C, 5D21 and CV427 with a generous margin of safety.

C1149A is a version of C1149/1 with improved X-ray shielding.

Anode voltage	20	kV max
Pulse anode current	18	A max
Duty cycle (at 18 A peak anode current)	0.001	
Typical pulse output power	330	kW

GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	26	V
Heater current	2.15	A
Cathode pre-heating time (minimum)	3.0	min
Inter-electrode capacitances:		
grid to anode	0.36	pF
input	43	pF
output	6.5	pF

Mechanical

Overall length	6.000 inches (152.4 mm) max
Overall diameter	3.062 inches (77.77 mm) max
Net weight	9 ounces (255 g) approx
Base	B.S.448-B4A
Top cap	see note 1
Mounting position	any
Cooling (see note 1)	natural

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May 1982

Supersedes June 1977 Issue

PULSE MODULATOR SERVICE

MAXIMUM RATINGS (Absolute values)

Duty cycle		see note 2
Anode voltage (see note 3)	20	kV max
Screen voltage (see notes 3 and 4)	1.5	kV max
Grid voltage (see note 5)	−1.0	kV max
Peak positive grid voltage	300	V max
Pulse anode current (see notes 2 and 6)	18	A max
Peak anode voltage	25	kV max
Anode dissipation	60	W max
Screen dissipation	8.0	W max
Seal temperature (see note 1)	200	°C max
Vibration		see note 7

TYPICAL OPERATING CONDITIONS

Duty cycle (see note 2)	0.001	
Pulse length	2.0	μs
Anode voltage	20	kV
Screen voltage	1.25	kV
Grid voltage	−600	V
Pulse positive grid voltage	150	V
Pulse anode current	18	A
Pulse screen current (approx)	1.7	A
Pulse grid current (approx)	0.3	A
Pulse input power	360	kW
Pulse output power	330	kW

NOTES

1. To keep the anode seal at a safe temperature, it is necessary to use an anode connector with good heat dissipation characteristics. The use of a spring type anode connector is recommended; where a connector using grub screw clamping is employed, care must be taken to avoid overtightening the screw or applying excessive side thrust to the top cap.

2. For the pulse current given under maximum ratings, the duty cycle must not exceed 0.001. At higher duty cycles the pulse current must be reduced in proportion. For pulse currents exceeding 5.0 A, the product of pulse current in amperes and pulse duration in microseconds must not exceed 40 and the tube must not be operated for longer than 5 microseconds in any 100 microsecond interval. For pulse currents of less than 5.0 A, the anode dissipation of 60 W determines the permissible pulse length.

3. Occasional internal discharges may occur during operational life. The power in such discharges should be limited and it is recommended that a series resistor should be included in the anode circuit to limit the short circuit current to 500 mA or less. A resistor of about 100 ohms value should be connected in series with the screen as close to the pin of the tube as possible. A 0.5 μF by-pass capacitor should be connected between the supply side of the 100 ohm resistor and earth.

4. The screen decoupling resistance must not be less than 20 kΩ.

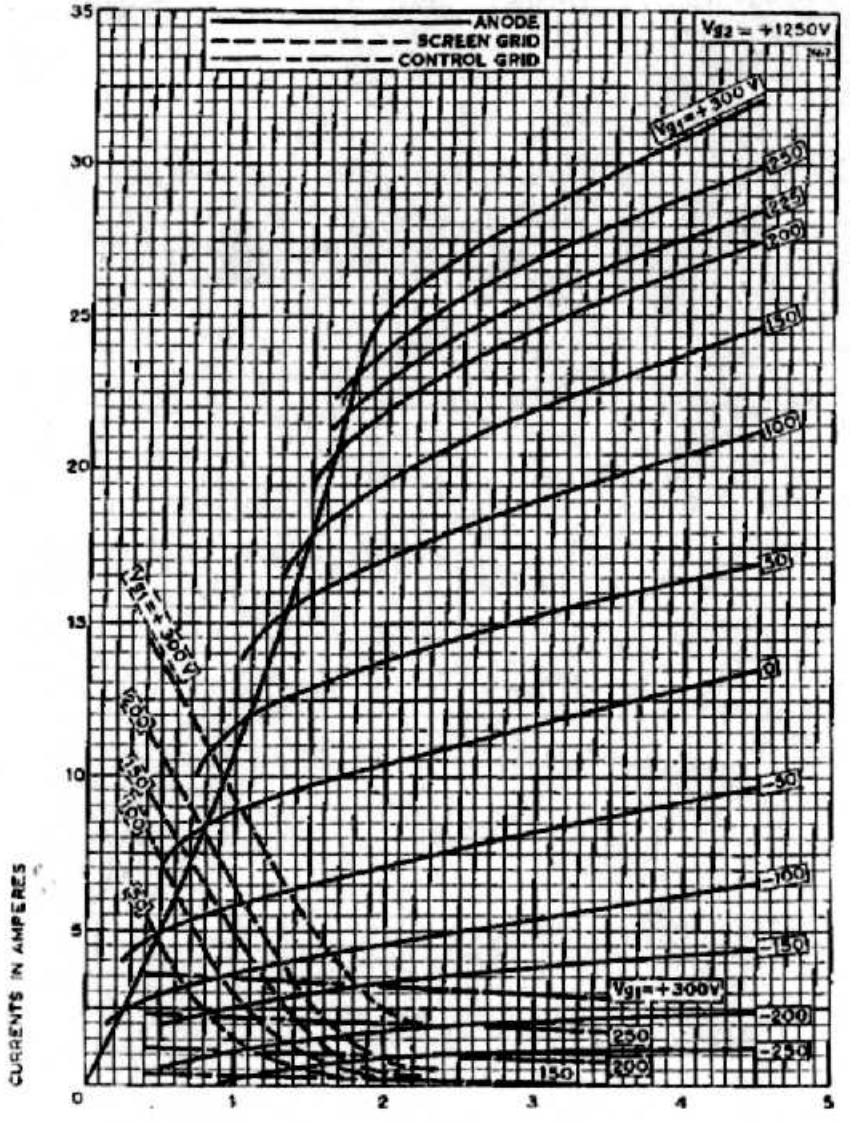
5. The total resistance of the grid circuit must not exceed 0.1 MΩ.

6. The rating specified for pulse anode current refers to the maximum amplitude of the flat portion of the pulse following an initial spike on the leading edge which must not exceed 25 A.

7. The tube will withstand vibration at 5 g from 30 to 1500 Hz for short periods but it should not be operated continuously under these conditions.

8. In the inter-pulse period the anode voltage gives rise to focusing effects which concentrate the anode dissipation in small areas of the anode. Consequently the published anode dissipation must not be used as a criterion for the permissible inter-pulse anode current, which must be cut-off by the provision of ample negative bias (see page 6).

TYPICAL ANODE AND GRID CHARACTERISTICS



HEALTH AND SAFETY HAZARDS

EEV electronic devices are safe to handle and operate, provided that the precautions stated are observed. English Electric Valve Company does not accept responsibility for damage or injury resulting from the use of electronic devices it produces. Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipments incorporating EEV devices and in operating manuals.

High Voltage

Equipment must be designed so that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals must be enclosed and fail-safe interlock switches must be fitted to disconnect the primary power supply and discharge all high voltage capacitors and stored energy in the electronic devices before allowing access. Interlock switches must not be bypassed to allow operation with access doors open.

X-Ray Radiation

This device, when operating at voltages above 5 kV, produces progressively more dangerous X-rays as the voltage is increased; the radiation varies greatly during life. The device envelope provides only limited protection and further shielding may be required. A metal equipment cabinet with overlapping joints will usually provide sufficient shielding, but if there is any doubt an expert in this field should perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches 'cheated' and cabinet doors open to help locate an equipment malfunction can result in serious X-ray exposure.

Implosion

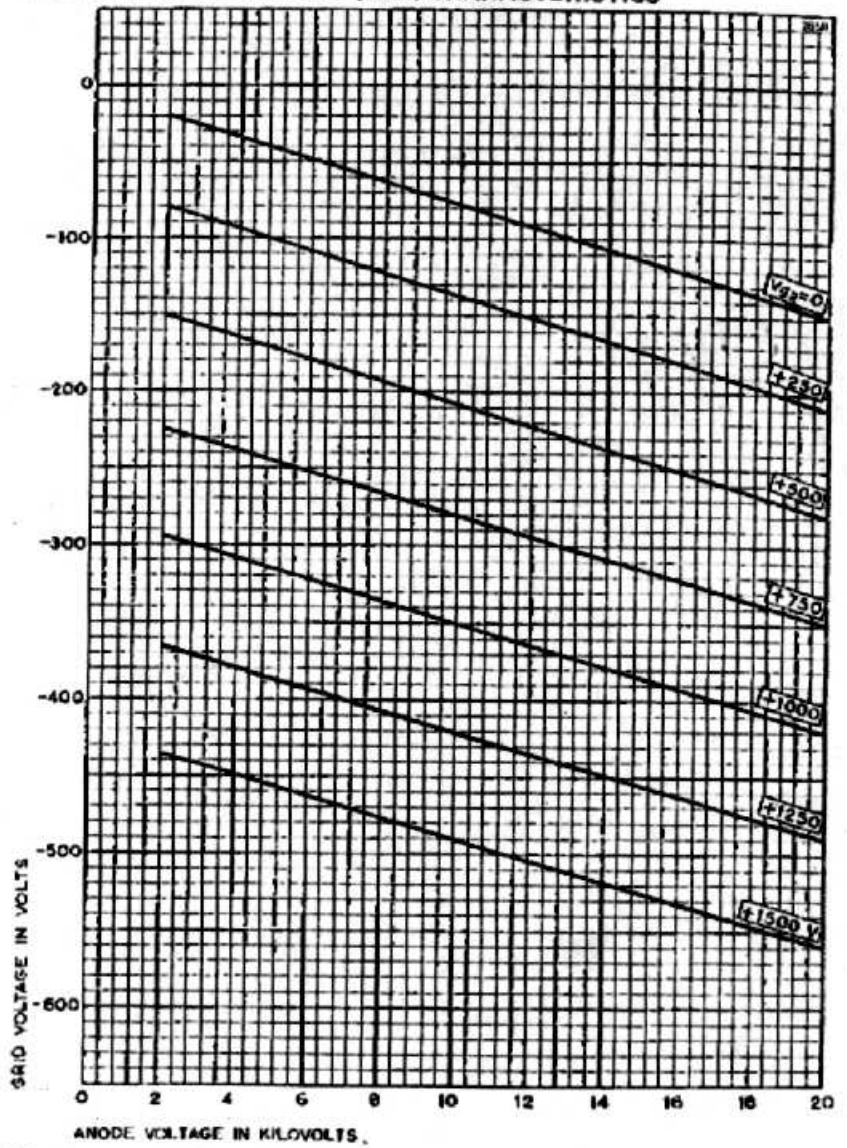
This tube stores potential energy by virtue of its vacuum. The energy level is low, but there is some hazard from flying fragments if the tube is dropped or subjected to violent impact.

The tube must be stored and transported in its approved puck. During installation or replacement the tube must not be scratched or damaged in any way likely to reduce the strength of the glass envelope.

References

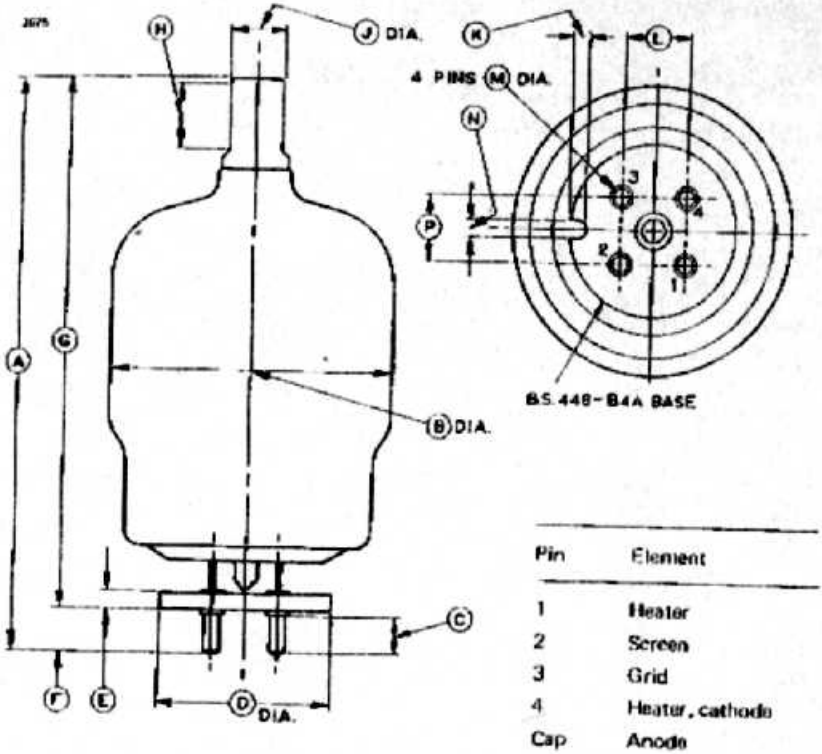
1. BS 3192. Specification for safety requirements for radio (including television) transmitting apparatus.
2. JEDEC Publication no. 81. Recommended practice on X-radiation detection and measurements for high power tubes.

ANODE CURRENT CUT-OFF (1mA) CHARACTERISTICS



The above graph is for an average tube. To allow for variations between tubes and to cover changes during life the working bias voltage shown on the graph should be exceeded by at least 20% (see note 8 on page 3).

OUTLINE (All dimensions without limits are nominal)



Pin	Element
1	Heater
2	Screen
3	Grid
4	Heater, cathode
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.875 ± 0.125	149.23 ± 3.18	H	0.437 min	11.10 min
B	3.062 max	77.77 max	J	0.567	14.40
C	0.328 min	8.33 min	K	0.187	4.75
D	1.813 max	46.05 max	L	0.687	17.45
E	0.187	4.75	M	0.187 ± 0.004	4.750 ± 0.102
F	0.500 max	12.70 max	N	0.187	4.75
G	5.419 ± 0.125	137.6 ± 3.18	P	0.687	17.45

Millimetre dimensions have been derived from inches.

English Electric Valve Company Limited
Chelmsford, Essex, England

C1158
(7972)

POWER TETRODE

Service Type CV6045

The data should be read in conjunction with the Power Tetrode Preamble.

DESCRIPTION

The C1158 is a low impedance beam tetrode intended for use in d.c. control equipment. It may be triode connected and is suitable for pulse operation.

GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated		
	Parallel	**Series**	
Heater voltage	13	26	V
Heater current	2.6	1.3	A
Mutual conductance (triode connected) (V_a = 150V, I_a = 0.5A)	35		mA/V
Amplification factor (triode connected) (V_a = 150V, I_a = 0.5A)	4.5		
Anode resistance (triode connected) (V_a = 150V, I_a = 0.5A)	130		Ω
Inter-electrode capacitances:			
grid to anode	1.3		pF
input	56		pF
output	20.4		pF

Mechanical

Overall length	5.395 inches (137mm) max
Overall diameter	2.560 inches (65mm) nom
Net weight	6 ounces (170g) approx
Base	B.S.448-B7A
Mounting position	vertical

COOLING

Natural cooling is normally adequate but the bulb and base temperatures must not exceed the values given below

Bulb temperature	200	°C
Base temperature	150	°C

MAXIMUM RATINGS (Absolute values)

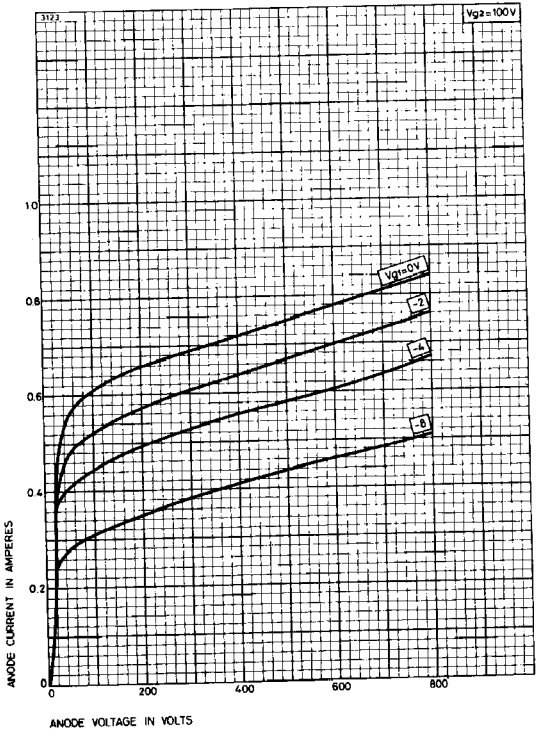
D.C. Ratings

Anode voltage	800	V max
Anode dissipation	90	W max
Anode and screen dissipation (triode connected)	95	W max
Screen voltage	300	V max
Screen dissipation	10	W max
Grid voltage (negative)	100	V max
Grid dissipation	1.0	W max
Cathode current	800	mA max
Heater to cathode voltage (heater negative)	300	V max

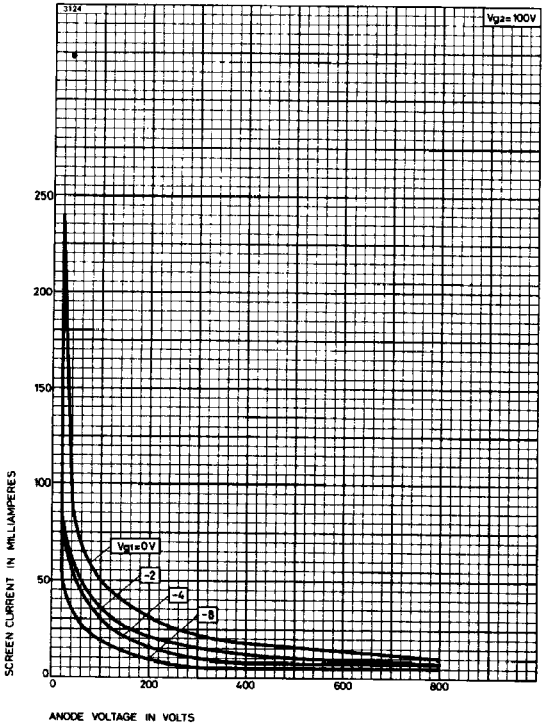
Pulse Ratings

Anode voltage (peak)	1500	V max
Cathode current (peak)	5.0	A max
Duty cycle (averaging time 100μs)	0.05	max
Product of peak current and pulse length (for peak currents exceeding 2.0A)	10	A.μs max

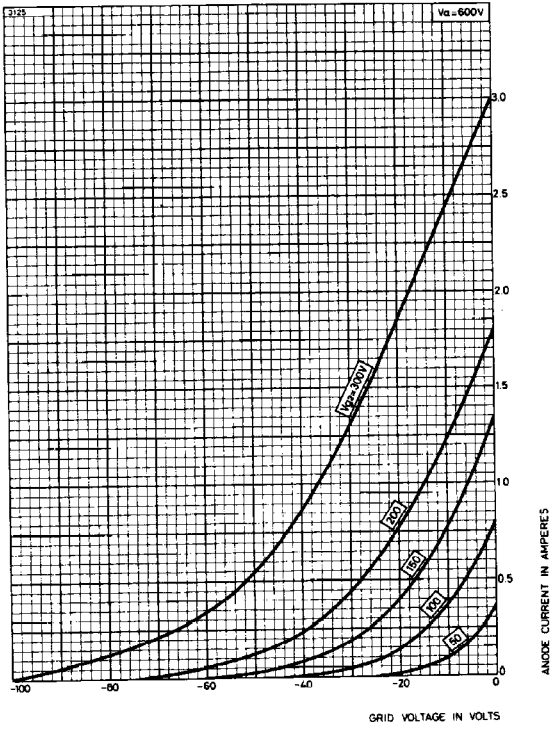
TYPICAL ANODE CURRENT – ANODE VOLTAGE CHARACTERISTICS



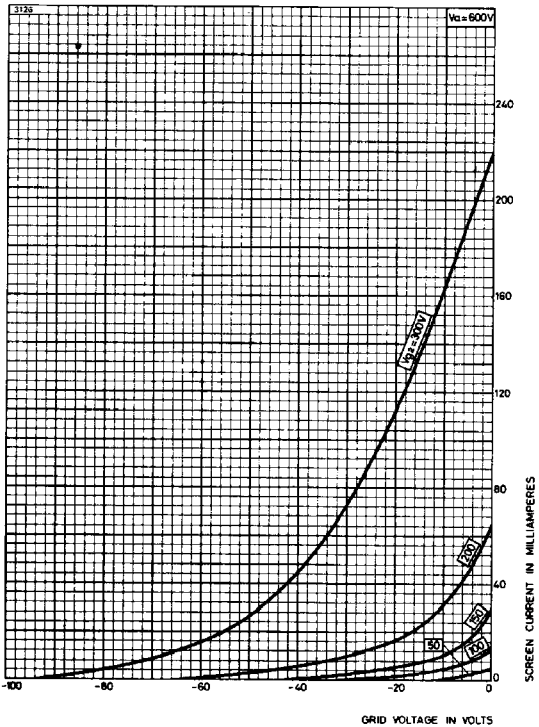
TYPICAL SCREEN CURRENT – ANODE VOLTAGE CHARACTERISTICS



TYPICAL ANODE CURRENT – GRID VOLTAGE CHARACTERISTICS



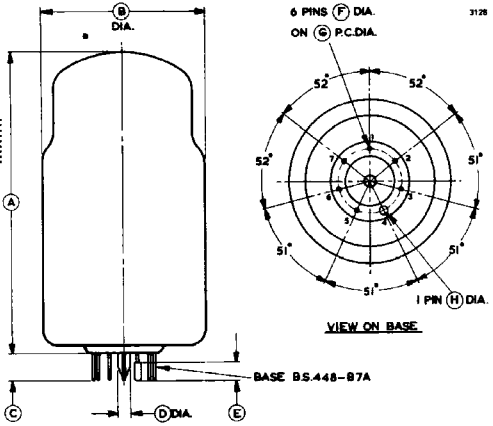
TYPICAL SCREEN CURRENT – GRID VOLTAGE CHARACTERISTICS



TYPICAL TRIODE CHARACTERISTICS



OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A*	4.724	120.0
B*	2.560	65.00
C	0.437 ± 0.062	11.10 ± 1.58
D	0.276 max	7.01 max
E	0.312	7.93
F	0.060	1.52
G	1.000	25.40
H	0.125	3.18

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

Pin	Element
1	Heater
2	Heater centre tap
3	Grid
4	Cathode
5	Screen
6	Anode
7	Heater

CR192A

V.H.F. POWER TETRODE

American equivalent 6166A* **Service Type CV8244**

The data should be read in conjunction with the Power Tetrode Preamble.

ABRIDGED DATA

Forced-air cooled tetrode with coaxial metal-ceramic envelope, for television and other applications at frequencies up to 220MHz.

Anode dissipation	10	kW max
Anode voltage	6.9	kV max
Frequency for full ratings:		
class C telegraphy or f.m. telephony	60	MHz max
class B or class C television service	216	MHz max
Output power:		
television service (synchronising level)	12	kW
class C telegraphy or f.m. telephony (216MHz)	9.0	kW

GENERAL

Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	5.0	V
Filament current	175	A
Surge filament current (peak) (see note 2)	400	A max
Filament cold resistance	3.8	mΩ
Peak usable cathode current	20	A
Grid-screen amplification factor (V_a = 2.0kV, V_{g2} = 1.0kV, I_a = 2.0A)	10	
Mutual conductance (V_a = 2.0kV, V_{g2} = 1.0kV, I_a = 2.0A)	25	mA/V

Continued on page 2

* CR192A is a direct replacement for types 6166 and 6166A, except that the filament posts are larger in diameter. Suitable filament adaptors are available to facilitate replacement of 6166 or 6166A in existing equipments (see page 20).

Electrical (continued)

Inter-electrode capacitances:

grid to anode (see note 3)	0.6	pF max
grid to filament	44	pF
anode to filament (see note 3)	0.08	pF max
grid to screen grid	60	pF
screen grid to anode	21	pF

Mechanical

Overall length	11.625 inches (295.3mm) max
Overall diameter	6.410 inches (162.8mm) max
Net weight	17 pounds (7.8kg) approx
Mounting position	vertical, either way up

COOLING

The required quantity of air through the radiator for cooling the anode is indicated on the graphs (pages 17 and 18) and should be delivered by a blower through the radiator before and during the application of any voltages. It should enter at the envelope end and some of the flow should be used to cool the screen-grid seal.

In addition, a flow of about 50ft^3/min (1.42m^3/min) should be directed at the filament and grid terminals.

The temperature of anode, screen, grid and filament seals must not exceed 180°C.

Power and air supplies may be removed simultaneously.

R.F. POWER AMPLIFIER

(Class B Television Service, U.S.A. System)

(Synchronising-level conditions per valve unless otherwise specified. Voltages are referred to cathode unless otherwise specified)

MAXIMUM RATINGS (Absolute values) (Frequency 54 to 216MHz)

Anode voltage	6.0	kV max
Screen voltage	2.0	kV max
Anode current	4.0	A max
Anode input power	22	kW max
Screen input power	400	W max
Anode dissipation	10	kW max
Grid dissipation	300	W max

TYPICAL OPERATION IN GRID-DRIVE CIRCUIT
(at 216MHz and bandwidth 8.5MHz – see note 4)

Anode voltage	5.8	kV
Screen voltage	1.2	kV
Grid voltage	−130	V
Peak r.f. grid voltage:		
synchronising level	375	V
pedestal level	290	V
Anode current:		
synchronising level	3.45	A
pedestal level	2.60	A
Screen current (pedestal level)	207	mA
Grid current (approx):		
synchronising level	350	mA
pedestal level	170	mA
Driving power (approx, see note 5):		
synchronising level (see note 6)	800	W
pedestal level	450	W
Output power (approx):		
synchronising level	12	kW
pedestal level	6.8	kW

TYPICAL OPERATION IN CATHODE-DRIVE CIRCUIT
(at 216MHz and bandwidth 8.5MHz – see note 4)

Anode voltage	5.8	kV
Screen voltage	800	V
Grid voltage	−85	V
Peak r.f. grid voltage:		
synchronising level	330	V
pedestal level	260	V
Anode current:		
synchronising level	3.45	A
pedestal level	2.60	A
Screen current (pedestal level)	152	mA
Grid current (approx):		
synchronising level	405	mA
pedestal level	220	mA
Driving power (approx, see note 7):		
synchronising level (see note 8)	1.3	kW
pedestal level	700	W
Output power (approx):		
synchronising level	12	kW
pedestal level	6.8	kW

GRID-MODULATED R.F. POWER AMPLIFIER
(Class C Television Service, U.S.A. System)

(Synchronising-level conditions per valve unless otherwise specified)

MAXIMUM RATINGS (Absolute Values) (frequency 54 to 216MHz)

Anode voltage	6.0	kV max
Screen voltage	2.0	kV max
Grid voltage (white level)	−1.0	kV max
Anode current	4.0	A max
Anode input power	22	kW max
Screen input power	400	W max
Anode dissipation	10	kW max
Grid dissipation	300	W max

TYPICAL OPERATION IN GRID-DRIVE CIRCUIT
(at 216MHz and bandwidth 8.5MHz, See Note 4)

Anode voltage	5.8	kV
Screen voltage	1.2	kV
Grid voltage:		
synchronising level	−130	V
pedestal level	−195	V
white level	−350	V
Peak r.f. grid voltage	375	V
Anode current:		
synchronising level	3.45	A
pedestal level	2.42	A
Screen current (pedestal level)	148	mA
Grid current (approx):		
synchronising level	350	mA
pedestal level	190	mA
Driving power (approx, see note 5):		
synchronising level (see note 6)	800	W
pedestal level	425	W
Output power (approx):		
synchronising level	12	kW
pedestal level	6.8	kW

ANODE-MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

MAXIMUM RATINGS (Absolute Values. See Note 9)

Anode voltage	5.0	kV max
Screen voltage	2.0	kV max
Grid voltage	−1.0	kV max
Anode current	2.0	A max
Grid current	600	mA max
Anode input power	10	kW max
Screen input power	270	W max
Anode dissipation	6.6	kW max

TYPICAL OPERATION IN GRID-DRIVE CIRCUIT

(at frequencies up to 60MHz)

Anode voltage	4.7	kV
Screen voltage (modulated 100%, see note 10)	800	V
Grid voltage (see note 11)	−280	V
Peak r.f. grid voltage	485	V
Anode current	1.56	A
Screen current	217	mA
Grid current (approx)	300	mA
Driving power (approx. See note 12)	180	W
Output power (approx)	5.5	kW

R.F. POWER AMPLIFIER AND OSCILLATOR

(Class C Telegraphy, key-down conditions per valve, see Note 19)
AND R.F. POWER AMPLIFIER (Class C, F.M. Telephony)

MAXIMUM RATINGS (Absolute Values. See Note 9)

Anode voltage	6.9	kV max
Screen voltage	2.0	kV max
Grid voltage	−1.0	kV max
Anode current	2.75	A max
Grid current	600	mA max
Anode input power	18	kW max
Screen input power	400	W max
Anode dissipation	10	kW max

TYPICAL OPERATION IN GRID-DRIVE CIRCUIT

Frequency	up to 60	216	216	MHz
Anode voltage	6.4	5.8	5.8	kV
Screen voltage (see note 13)	1.2	1.2	1.2	kV
Grid voltage (see note 14)	−310	−130	−175	V
Peak r.f. grid voltage	560	230	370	V
Anode current	2.75	1.8	2.6	A
Screen current	300	100	267	mA
Grid current (approx)	280	100	222	mA
Driving power (approx) (see note 5)	75	*300	†750	W
Output power (approx)	11.6	6.0	9.0	kW

* See note 15 † See note 16

MAXIMUM PERMISSIBLE ANODE VOLTAGES AND INPUTS

(expressed as a percentage of maximum values quoted)

	Frequency	
	60MHz	220MHz
Class C telephony, anode modulated	100%	90%
Class C telegraphy and f.m. telephony		
Class B television service	Full ratings 54 to 216MHz	
Class C television service		

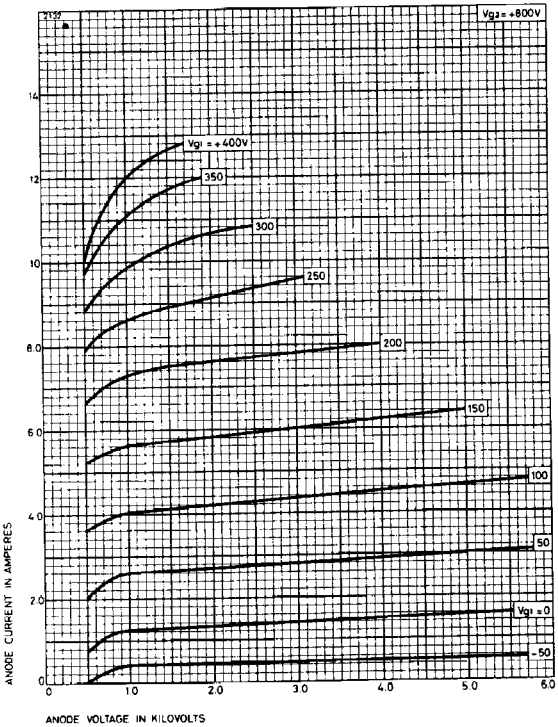
NOTES

1. The valve must be operated at the stated filament voltage. Fluctuations must not exceed ±5%.
2. The filament current must not exceed 400A, even momentarily, at any time.
3. Measured with external flat metal shield 12 inches (305mm) square having a centre hole 4.312 inches (109.5mm) diameter located in the plane of the screen grid terminal, perpendicular to the valve axis, and connected to the screen grid.
4. Computed between half-power points and based on valve output capacitance only.
5. The driver stage is required to supply valve losses and r.f. circuit losses. The driver stage should be designed to provide an excess of power

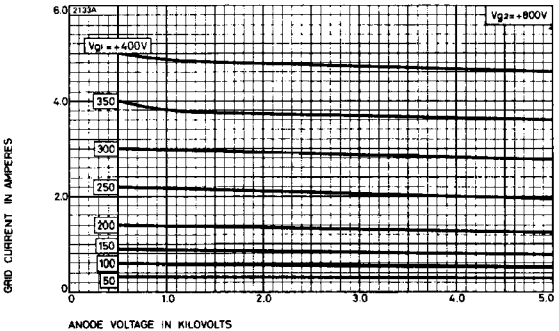
above the indicated value to take care of variations in line voltage, components, initial valve characteristics, and valve characteristics during life.

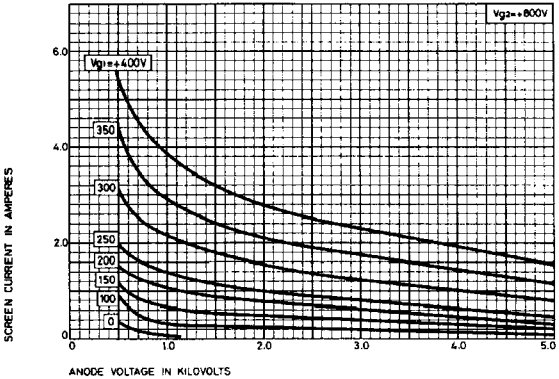
6. This value includes 700W of r.f. circuit loss at 216MHz.
7. The driver stage is required to supply the r.f. power added to the anode circuit in addition to the losses indicated under Note 5.
8. This value includes 300W of r.f. circuit loss at 216MHz and 900W added to anode circuit.
9. These ratings apply for operation up to 60MHz; for ratings at higher frequencies, see table on page 6.
10. Obtained preferably from a separate source.
11. Obtained preferably from a combination of 365 ohms control grid resistor and −170V fixed bias.
12. This value includes 50W of r.f. circuit loss at 30MHz.
13. Obtained preferably from a separate source, or from the anode supply voltage with a voltage divider, or through a series resistor. A series screen resistor should not be used if the tube or a preceding stage is keyed. In this case, the regulation of the source should be sufficient to prevent the screen voltage from rising above 2000V under key-up conditions and additional fixed grid bias must be provided to limit the anode current.
14. Obtained from fixed supply, by grid resistor, by cathode resistor, or by combination methods.
15. This value includes 270W of r.f. circuit loss.
16. This value includes 675W of r.f. circuit loss.
17. In Class B and Class C television circuits, the valve should be supplied with its grid bias voltage from a source of good regulation – not from a grid resistor. In anode-modulated Class C operation, the grid bias may be obtained from a grid resistor or part from a grid resistor and the balance from either a cathode bias resistor or a fixed voltage. In Class C telegraphy or Class C f.m. telephony operation, the bias may be obtained by any convenient method.
18. With Class B and Class C television circuits, or with Class C f.m. operation the screen should be supplied from a source having good regulation. With anode-modulated Class C operation the screen voltage may preferably be obtained from a separate source and the screen grid should be modulated so as to keep the ratio of screen to anode voltages constant. With Class C telegraphy any convenient method may be used.
19. Modulation essentially negative may be used if the positive peak of the a.f. envelope does not exceed 115% of the carrier conditions.

TYPICAL ANODE CHARACTERISTICS

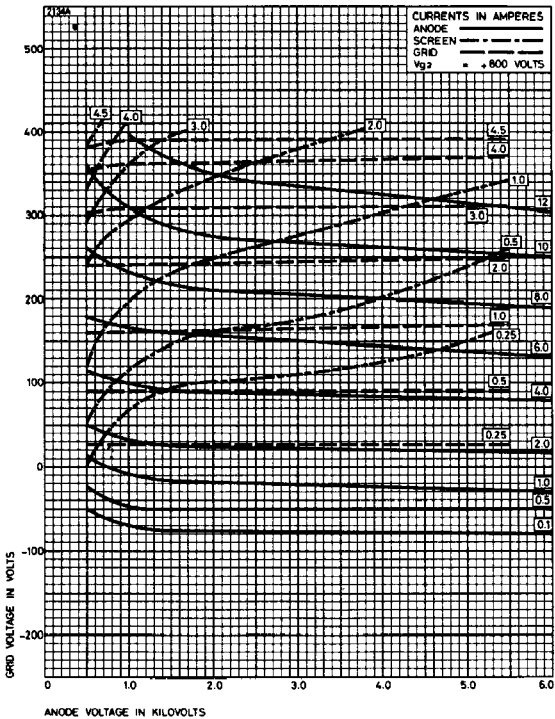


TYPICAL GRID AND SCREEN CHARACTERISTICS

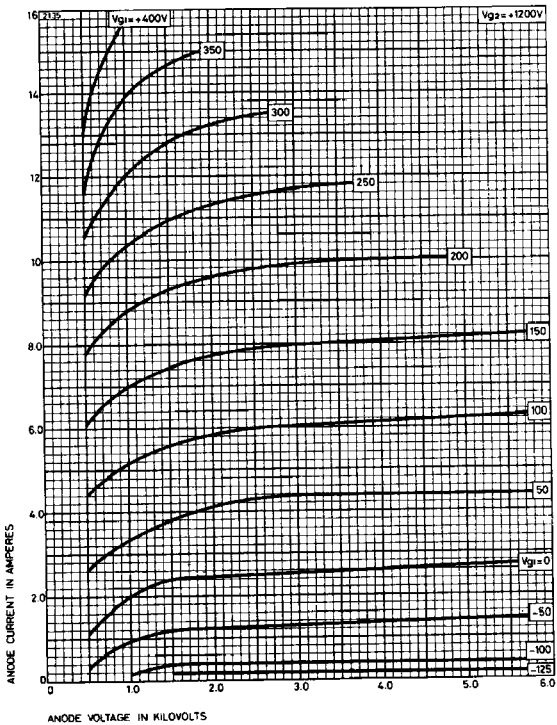




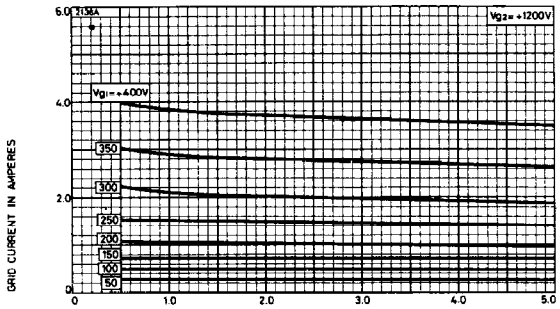
TYPICAL CONSTANT CURRENT CHARACTERISTICS

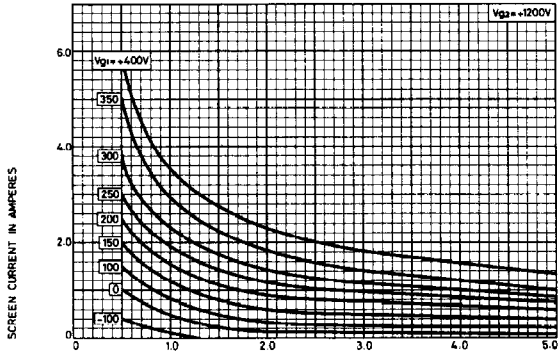


TYPICAL ANODE CHARACTERISTICS

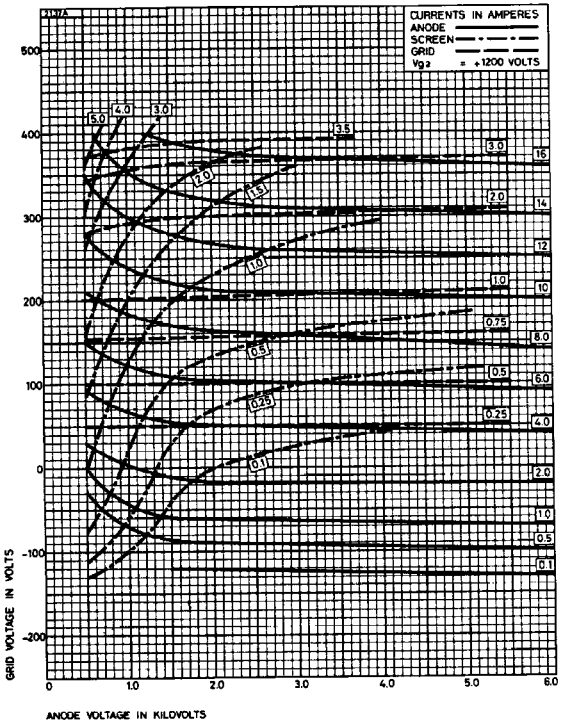


TYPICAL GRID AND SCREEN CHARACTERISTICS

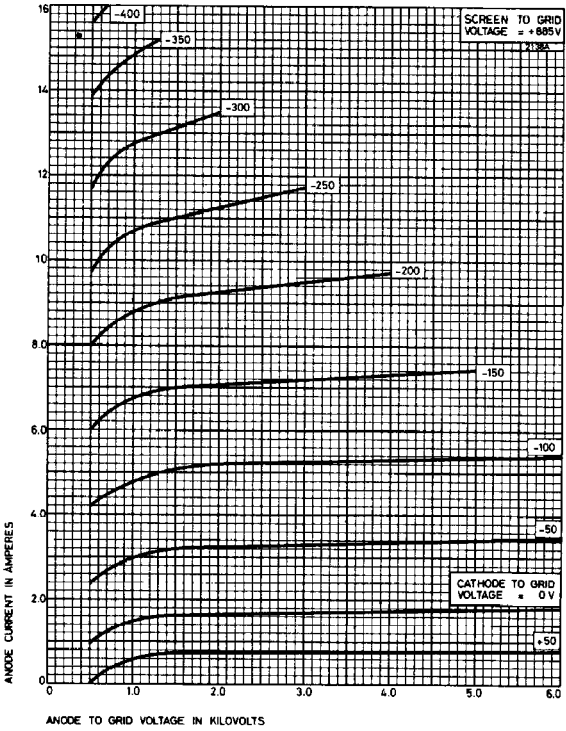




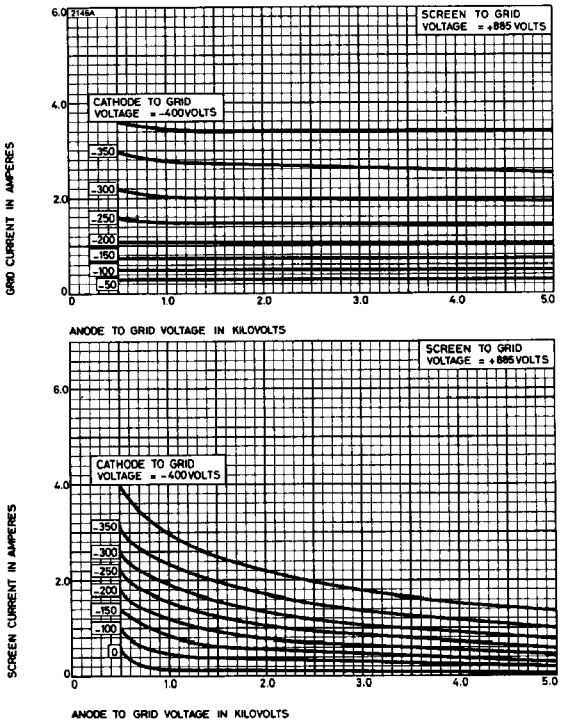
TYPICAL CONSTANT CURRENT CHARACTERISTICS



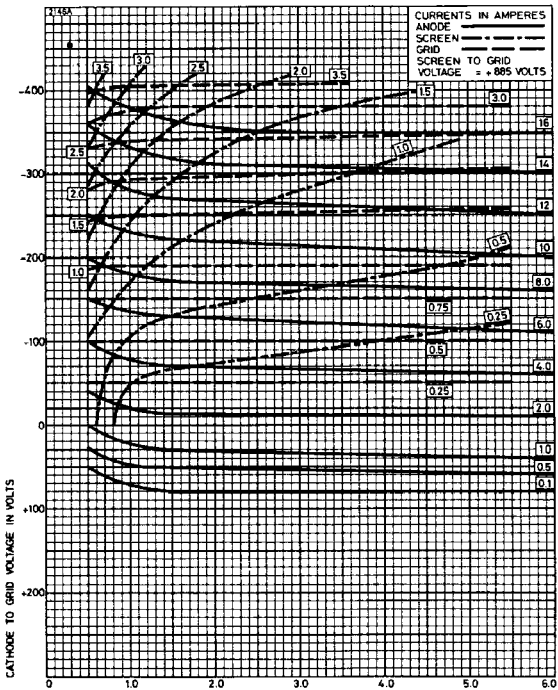
TYPICAL ANODE CHARACTERISTICS



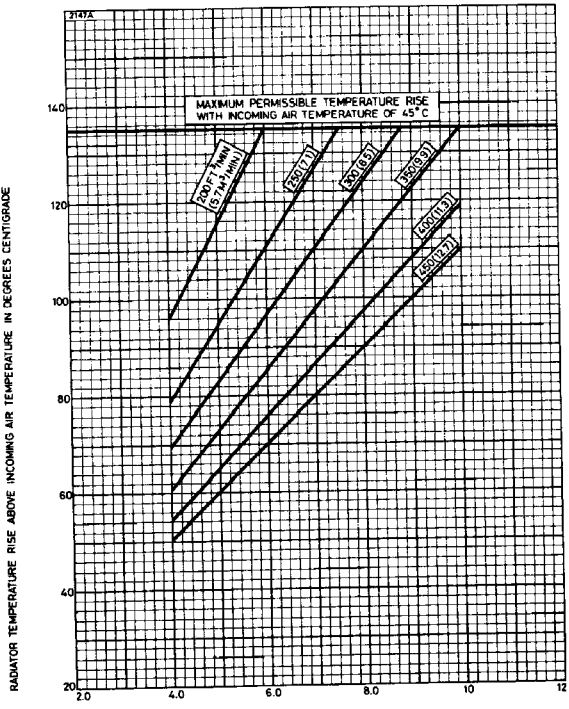
TYPICAL GRID AND SCREEN CHARACTERISTICS



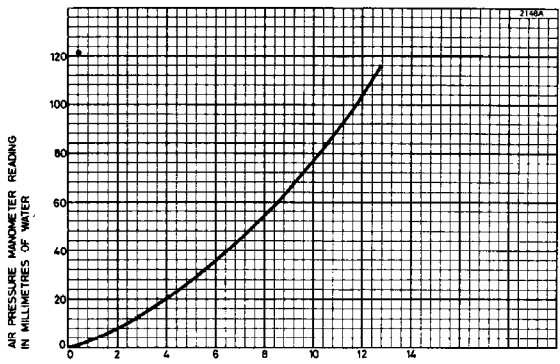
TYPICAL CONSTANT CURRENT CHARACTERISTICS

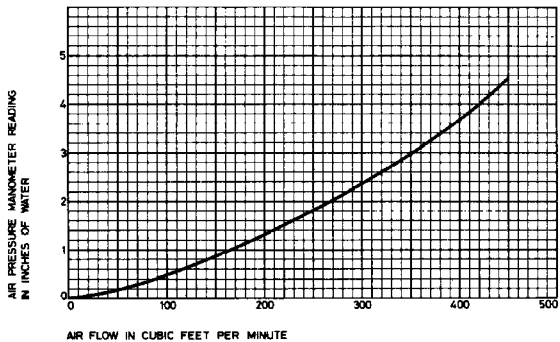


AIR COOLING REQUIREMENTS

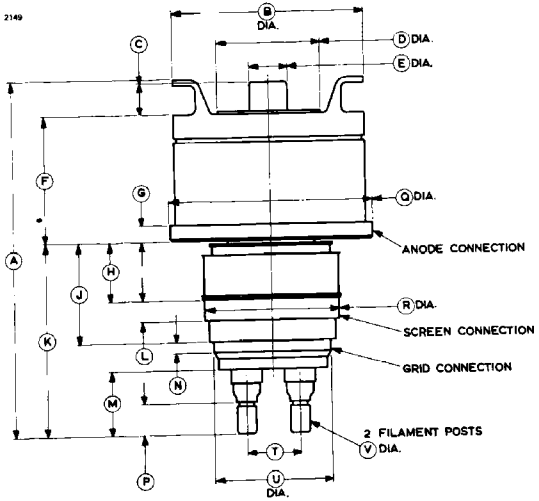


TYPICAL AIR FLOW CHARACTERISTIC





OUTLINE



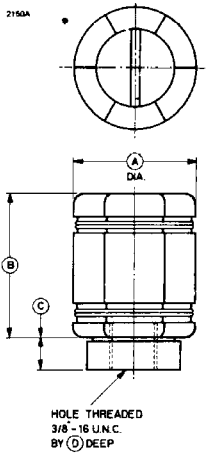
Ref	Inches	Millimetres
A	11.625 max	295.3 max
B	6.000 ± 0.094	152.4 ± 2.39
C	1.150 max	29.21 max
D	3.375 max	85.73 max
E	1.187	30.15
F	4.094 max	104.0 max
G	0.500 ± 0.031	12.70 ± 0.79
H	1.846 ± 0.050	46.89 ± 1.27
J	3.151 ± 0.070	80.04 ± 1.79
K	6.094 ± 0.156	154.8 ± 3.96

Ref	Inches	Millimetres
L	0.500 min	12.70 min
M	1.907 min	48.44 min
N	0.350 min	8.89 min
P	0.812 min	20.62 min
Q	6.375 ± 0.031	161.9 ± 0.79
R	4.248 ± 0.020	107.9 ± 0.51
T	1.710 ± 0.040	43.43 ± 1.02
U	3.685 ± 0.025	93.60 ± 0.64
V	0.625 ± 0.002	15.875 ± 0.051

Millimetre dimensions have been derived from inches.

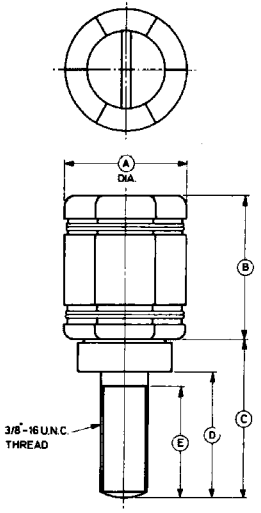
PUSH-ON FILAMENT ADAPTORS (Dimensions without limits are nominal)

MA136



Ref	Inches	Millimetres
A	0.980	24.89
B	1.125	28.58
C	0.250	6.35
D	0.312	7.92

MA137



Ref	Inches	Millimetres
A	0.980	24.89
B	1.125	28.58
C	1.250	31.75
D	1.000	25.40
E	0.875 min	22.22 min

Millimetre dimensions have been derived from inches.

CX1140

HYDROGEN THYRATRON

Service Type CV8563

The data to be read in conjunction with the Hydrogen Thyratron Preamble.

ABRIDGED DATA

Hydrogen-filled tetrode thyratron, featuring low jitter and low anode delay time drift. Suitable for use at high pulse repetition rates, in parallel for switching higher powers, or for switching long pulses. A reservoir operating from the cathode heater supply is incorporated. The CX1140 replaces many less sophisticated thyratrons of similar rating when used with base adaptors obtainable from EEV. Details of these adaptors are given on page 5.

Peak forward anode voltage	25	kV max
Peak anode current (see page 2)	1000	A max
Average anode current	1.25	A max
Anode heating factor	9.0×10^9	V.A.p.p.s. max
Peak output power	12.5	MW max

GENERAL

Electrical

Cathode (connected internally to mid-point of heater)	oxide coated	
Heater voltage	$6.3 \pm 5\%$	V
Heater current	22	A
Tube heating time (minimum)	5.0	min
Inter-electrode capacitances (approximate):		
anode to grid 2 (grid 1 and cathode not connected)	13	pF
anode to grid 1 (grid 2 and cathode not connected)	7.5	pF
anode to cathode (grid 1 and grid 2 not connected)	26	pF

Mechanical

Overall length	12.500 inches (317.5mm) max
Overall diameter	3.312 inches (84.12mm) max
Net weight	1½ pounds (0.7kg) approx
Mounting position (see note 1)	any
Base	pin spacing as B5F; metal shell with micalex insert
Top cap (see note 2)	B.S.448-CT3

Cooling natural

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July 1975

Supersedes January 1972 Issue

PULSE MODULATOR SERVICE

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Anode			
Peak forward anode voltage (see note 3)	–	25	kV
Peak inverse anode voltage (see note 4)	–	25	kV
Peak anode current	–	1000	A
Peak anode current (pulse repetition rate limited to 60p.p.s. max)	–	2000	A
Average anode current	–	1.25	A
Rate of rise of anode current (see note 5)	–	5000	A/μs
Anode heating factor	–	9.0×10^9	V.A.p.p.s.
Grid 2			
Unloaded grid 2 drive pulse voltage (see note 6)	200	1000	V
Grid 2 pulse duration	1.0	–	μs
Rate of rise of grid 2 pulse (see note 5)	1.0	–	kV/μs
Grid 2 pulse delay	0.5	3.0	μs
Peak inverse grid 2 voltage	–	450	V
Loaded grid 2 bias voltage	−50	−150	V
Forward impedance of grid 2 drive circuit	50	800	Ω
Grid 1 – D.C. Primed (See note 7)			
D.C. grid 1 unloaded priming voltage	75	150	V
D.C. grid 1 priming current	50	100	mA
Grid 1 – Pulsed			
Unloaded grid 1 drive pulse voltage (see note 6)	300	1000	V
Grid 1 pulse duration	2.0	–	μs
Rate of rise of grid 1 pulse (see note 5)	1.0	–	kV/μs
Peak inverse grid 1 voltage	–	450	V
Loaded grid 1 bias voltage			see note 8
Peak grid 1 drive current	0.3	1.0	A
Cathode			
Heater voltage		6.3 ± 5%	V
Tube heating time	5.0	–	min
Environmental			
Ambient temperature	−50	+90	°C
Altitude	–	10 000	ft
	–	3	km

CHARACTERISTICS

	Min	Typical	Max	
Critical d.c. anode voltage for conduction (see note 9)	–	0.5	2.0	kV
Anode delay time (see notes 9 and 10)	–	0.15	0.25	μs
Anode delay time drift (see notes 9, 11 and 12)	–	20	50	ns
Time jitter (see notes 9 and 12)	–	1.0	5.0	ns
Recovery time			see note 13 and curves	
Heater current (at 6.3V)	18	22	25	A

RATINGS FOR SINGLE SHOT OR CROWBAR SERVICE (See note 7)

D.C. forward anode voltage	25	kV max
Peak anode current	15 000	A max
Product of peak current and pulse length	0.6	A.s max
Repetition frequency	1 pulse per 10s max	

NOTES

1. Clamping is only permissible by the base.
2. A large area anode connector EEV type MA360 is recommended.
3. The maximum permissible peak forward voltage for instantaneous starting is 20kV and there must be no overshoot.
4. The peak inverse voltage must not exceed 10kV for the first 25 microseconds after the anode pulse.
5. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
6. Measured with respect to cathode. In certain cases the maximum drive pulse voltage may be exceeded without damage to the tube; a maximum value of 2.5kV is then recommended. When grid 1 is pulse driven, the last 0.25μs of the top of the grid 1 pulse must overlap the corresponding first 0.25μs of the top of the delayed grid 2 pulse.

7. When d.c. priming is used on grid 1, a negative bias of 100 to 200V must be applied to grid 2 to ensure anode voltage hold-off. D.C. priming is recommended for crowbar service.

8. D.C. negative bias voltages must not be applied to grid 1. When grid 1 is pulse driven, the potential of grid 1 may vary between −10 and +5V with respect to cathode potential during the period between the completion of recovery and the commencement of the succeeding grid pulse.

9. Typical figures are obtained on test using conditions of minimum grid drive. Improved performance can be expected by increasing the grid drive.

10. The time interval between the instant at which the rising unloaded grid 2 pulse reaches 25% of its pulse amplitude and the instant when anode conduction takes place.

11. The drift in delay time over a period from 10 seconds to 10 minutes after reaching full voltage.

12. For equipment where jitter and anode delay time drift are not important, the tube may be triggered by applying a single pulse to grid 2 and connecting grid 1 to grid 2 via a 100pF capacitor shunted by a 10MΩ resistor. These components are incorporated in adaptor assemblies MA92 and MA179 (see page 5).

13. The recovery characteristics are controlled on a sampling basis.

X-RAY WARNING

X-rays are emitted by the CX1140 from the region of the anode, but the radiation is usually reduced to a safe level by the steel panels of the equipment in which the tube operates.

ADAPTOR ASSEMBLIES

In addition to standard top cap connectors and base sockets, a number of adaptor assemblies are available from English Electric Valve Company Ltd. They assist in the replacement of other types of thyratron by CX1140, as indicated below.

MA91 For replacing GHT3/CV5721.

A five-contact socket fitted with flexible leads and terminal tags, and mounted on an insulating base plate. It provides a conversion from base to flange type mounting.

MA92 For replacing 1754/5948 (CV3518).

Similar to MA91 but incorporates an RC network and is designed for use with CX1140 where a single pulse drive and flying lead connections are required. Where CX1140 and MA92 replace 1754/5948 (CV3518), it should be noted that no lead is provided for a hydrogen reservoir connection as the CX1140 does not require a separate supply.

MA179 For replacing 1754/5948 and with tube clamping.

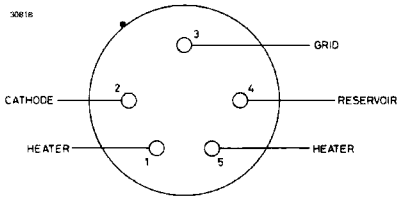
A five-contact socket with flexible leads and terminal tags, mounted on an insulating base plate; it is fitted with a base clamp. It incorporates an RC network and is designed for use with CX1140 where a single pulse drive and flying lead connections are required.

See page 6 for conversion of 5949/1907 or 5949A socket to use CX1140.

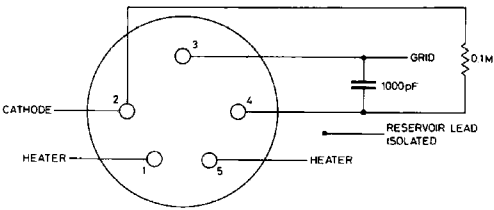
Further information is contained in the leaflet 'Accessories for Hydrogen Thyratrons'.

Conversion of 5949/1907 or 5949A socket to use CX1140/CV8563

1) View of 5949/1907 or 5949A socket from underneath



2) View of 5949/1907 or 5949A socket modified to use CX1140



3) Conversion Procedure

The following components are required; they should be rated to withstand the existing grid drive power.

One 0.1MΩ resistor.

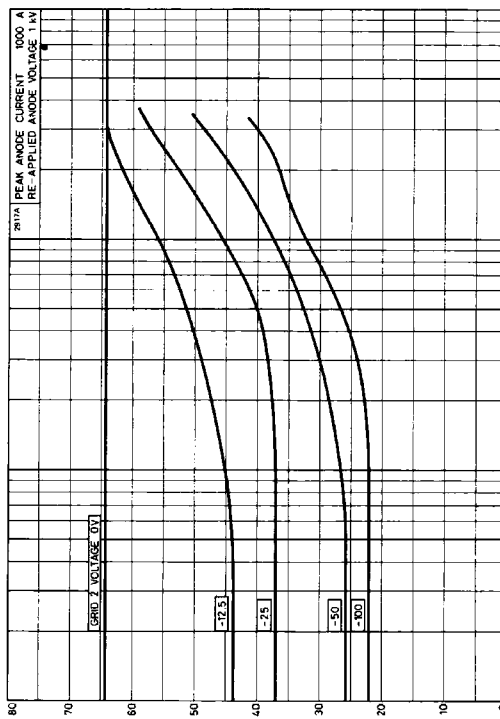
One 1000pF mica capacitor.

a) Remove reservoir lead from pin 4 and isolate.

b) Connect the 0.1MΩ resistor and 1000pF capacitor in parallel between pins 3 and 4.

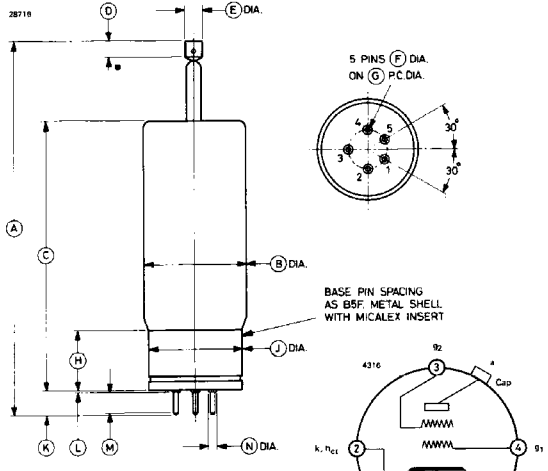
c) Plug in CX1140.

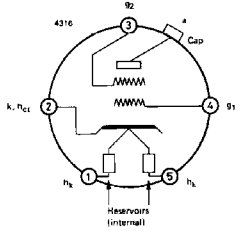
MAXIMUM RECOVERY CHARACTERISTICS



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OUTLINE (All dimensions without limits are nominal)





Ref	Inches	Millimetres
A	12.000 ± 0.500	304.8 ± 12.7
B	3.312 max	84.12 max
C	8.500 ± 0.500	215.9 ± 12.7
D	0.500 min	12.70 min
E	0.566 ± 0.007	14.38 ± 0.18
F	0.187 ± 0.003	4.750 ± 0.076
G	1.250	31.75
H	1.937	49.20
J	3.062 ± 0.062	77.77 ± 1.57
K	0.770 max	19.56 max
L	0.073 max	1.85 max
M	0.575 min	14.60 min
N	0.260 max	6.60 max

Millimetre dimensions have been derived from inches.

Pin	Element
1	Heater
2	Cathode, connected internally to heater mid-point
3	Grid 2
4	Grid 1
5	Heater
Top cap	Anode

English Electric Valve Company Limited
Chelmsford, Essex, England

CX1157

HYDROGEN-FILLED CERAMIC THYRATRON

Service Type CV6241

The data to be read in conjunction with the Hydrogen Thyratron Preamble.

ABRIDGED DATA

Hydrogen-filled tetrode thyratron with ceramic envelope, featuring low jitter and low anode delay time drift. Suitable for use at high pulse repetition rates and in applications requiring ruggedness and compactness. A hydrogen reservoir operating from the heater supply is incorporated.

Peak forward anode voltage	20	kV max
Peak anode current	350	A max
Average anode current	500	mA max
Anode heating factor	7.0×10^9	V.A.p.p.s. max
Peak output power	3.5	MW max

GENERAL

Electrical

Cathode (connected internally to one end of heater)	oxide coated	
Cathode heater voltage	6.3 ± 7½%	V
Cathode heater current	7.5	A
Reservoir heater voltage (see note 1)	6.3 ± 7½%	V
Reservoir heater current	1.5	A
Tube heating time (minimum)	3.0	min

Mechanical

Seated height	3.000 inches (76.20mm) max
Clearance required below mounting flange	1.250 inches (31.75mm) min
Overall diameter (mounting flange)	2.250 inches (57.15mm) nom
Net weight	10 ounces (284g) approx
Mounting position (see note 2)	any
Tube connections	see outline

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Cooling . . . . . natural, forced-air or liquid

Where natural cooling is insufficient to maintain the envelope temperatures below the specified rated values, cooling by forced-air, or by oil or coolant immersion may be used.

The temperature of the anode terminal and the base, measured at the points indicated on the outline drawing, must not exceed the values specified below.

Anode terminal	250	°C max
Base	220	°C max

PULSE MODULATOR SERVICE

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Anode			
Peak forward anode voltage (see note 3) . .	–	20	kV
Peak inverse anode voltage (see note 4) . .	–	20	kV
Peak anode current	–	350	A
Average anode current	–	500	mA
Rate of rise of anode current (see notes 5 and 6)	–	2500	A/μs
Anode heating factor	–	7.0×10^9	V.A.p.p.s.
Grid 2			
Unloaded grid 2 drive pulse voltage (see note 7)	200	750	V
Grid 2 pulse duration	1.0	–	μs
Rate of rise of grid 2 pulse (see note 6) . .	1.0	–	kV/μs
Grid 2 pulse delay	0.5	3.0	μs
Peak inverse grid 2 voltage	–	200	V
Loaded grid 2 bias voltage (see note 8) .	−50	−200	V
Forward impedance of grid 2 drive circuit	100	1000	Ω
Grid 1 – D.C. Primed (See note 9)			
D.C. grid 1 unloaded priming voltage . . .	75	150	V
D.C. grid 1 priming current	50	150	mA

MAXIMUM AND MINIMUM RATINGS – continued

Grid 1 – Pulsed	Min	Max	
Unloaded grid 1 drive pulse voltage (see note 7)	300	750	V
Grid ¶ pulse duration	2.0	–	μs
Rate of rise of grid 1 pulse (see note 6)	1.0	–	kV/μs
Peak inverse grid 1 voltage	–	200	V
Loaded grid 1 bias voltage		see note 10	
Peak grid 1 drive current	0.15	0.5	A

Cathode			
Heater voltage	6.3 ± 7½%		V
Heating time	3.0	–	min

Reservoir			
Heater voltage (see note 1)	6.3 ± 7½%		V
Heating time	3.0	–	min

Environmental (See note 11)			
Ambient temperature	–55	+130	°C
Altitude	–	10 000	ft
	–	3	km

CHARACTERISTICS

	Min	Typical	Max	
Critical d.c. anode voltage for conduction (see note 12)	–	0.2	0.3	kV
Anode delay time (see notes 12 and 13)	–	0.15	0.25	μs
Anode delay time drift (see notes 12 and 14)	–	20	50	ns
Time jitter (see note 12)	–	1.0	5.0	ns
Recovery time		see note 15 and curves		
Heater and reservoir current (at 6.3V)	7.5	9.0	10.5	A

SINGLE SHOT OR CROWBAR SERVICE

In applications requiring a very rapid rate of rise of anode current, the CX1157 geometry allows it to be mounted in a coaxial structure in order to minimize the total circuit inductance. Operation of the tube under the following ratings results in short anode delay times and very low time jitter.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Typical	Max	
Anode				
Peak forward anode voltage (see note 16)	–	–	20	kV
Peak anode current (see note 17)	–	–	3000	A
Average anode current	–	–	300	mA
Grid 2				
Unloaded grid 2 drive pulse voltage	0.5	1.0	2.0	kV
Grid 2 pulse duration	0.25	–	5.0	μs
Rate of rise of grid 2 pulse (unloaded)	10	30	–	kV/μs
Loaded grid 2 bias voltage	−50	−150	−200	V
Forward impedance of grid 2 drive circuit	50	50	500	Ω
Grid 1				
Grid 1 drive current (d.c.)	50	70	100	mA
Cathode				
Heater voltage	5.8	6.8	7.0	V
Reservoir				
Heater voltage	5.8	6.8	7.0	V

CHARACTERISTICS

Anode delay time (see note 18)	–	30	75	ns
Rate of rise of anode current (see notes 18 and 19)	–	100	–	kA/μs
Time jitter (see note 20)	–	<1.0	2.0	ns

NOTES

1. The reservoir heater supply must be obtained either from the cathode heater supply or if a separate supply is used it must be decoupled to avoid damage to the reservoir.
2. • The tube must be mounted by means of its mounting flange.
3. The maximum permissible peak forward voltage for instantaneous starting is 16kV and there must be no overshoot.
4. The peak inverse voltage including spike must not exceed 5.0kV for the first 25 microseconds after the anode pulse.
5. For single shot or burst mode applications this parameter can exceed 100kA/μs. The ultimate value which can be attained depends to a large extent upon the external circuit.
6. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
7. Measured with respect to cathode. When grid 1 is pulse driven, the last 0.25μs of the top of the grid 1 pulse must overlap the corresponding first 0.25μs of the top of the delayed grid 2 pulse.
8. The tube may be operated with a loaded grid 2 bias voltage of 0 to −50V provided that care is taken to ensure that the peak grid 1 drive current is sufficiently low to prevent triode firing (tube control by the grid 1 pulse).
9. When d.c. priming is used on grid 1, a negative bias of 100 to 200V must be applied to grid 2 to ensure anode voltage hold-off. D.C. priming is especially suitable in crowbar service.
10. D.C. negative bias voltages must not be applied to grid 1. When grid 1 is pulse driven, the potential of grid 1 may vary between −10 and +5V with respect to cathode potential during the period between the completion of recovery and the commencement of the succeeding grid pulse.
11. To ensure a high standard of ruggedness, all tubes are subjected to the following tests. After each mechanical test all the tubes must then satisfy all electrical tests.

    (a) Vibration — The tubes are vibrated at 50Hz with acceleration of 10g for one minute in the direction of the cathode axis and then in one direction perpendicular to the cathode axis. See note 2.

    (b) Recovery Time — The tubes are tested for recovery at zero grid 2 bias voltage with a maximum limit of 35μs.

The tubes are subjected to the following tests on a sampling basis.

(c) Operation under Vibration – The tubes are vibrated at 10g in each of three planes at a sweep rate of one octave per minute from 20 to 500 to 20Hz, under normal operating conditions. See note 2.

(d) Survival under Vibration and Heater Cycling – The tubes are vibrated at 10g at a sweep rate of one octave per minute from 5 to 500Hz for 70 hours in each plane together with heater cycling of a 10 minute on/off cycle. See note 2.

(e) Long Duration Shock – The tubes are tested at 125g for ten milliseconds with two blows in each plane. See note 2.

(f) High Temperature Test – The tubes are tested at a base temperature of 220°C and an anode temperature of 250°C under normal operating conditions for 5 hours. This implies an ambient temperature of 130°C.

(g) Low Temperature Instant Start – The tubes are cooled to −20°C and subjected to a 3-minute warm up period with 5.8V on the heater. The tubes must withstand a snap start at 10kV and operate satisfactorily.

(h) Standby-Life – The tubes are run with 6.3V heater voltage applied for 500 hours.

12. Typical figures are obtained on test using conditions of minimum grid drive. Improved performance can be expected by increasing grid drive.

13. The time interval between the instant when the unloaded grid 2 voltage passes cathode potential and the instant when anode conduction takes place.

14. The drift in delay time over a period from 10 seconds to 10 minutes after reaching full voltage.

15. The recovery characteristics are controlled on a sampling basis.

16. For crowbar applications where the tube is required to hold off d.c. anode voltage for longer than 20ms, the maximum peak forward anode voltage is 16kV. If the reservoir voltage is increased above normal, the d.c. hold-off voltage may be reduced.

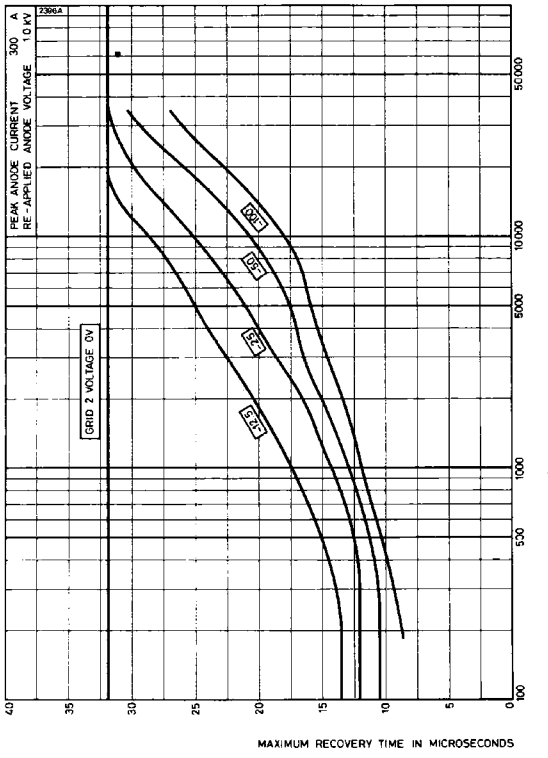
17. For pulse durations not exceeding 0.25μs.

18. Shorter anode delay time and higher rate of rise of anode current may be obtained by increasing the cathode and reservoir heater voltages from 6.3 to 6.8V.
19. The rate of rise of anode current obtainable is also dependent on the total circuit inductance and transmission line type matching.
20. With the grid drive conditions specified, the anode delay time jitter will normally be less than 1.0ns.

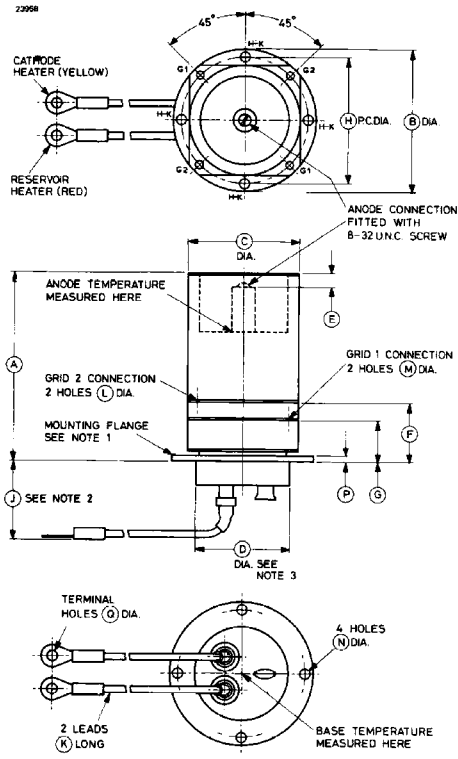
X-RAY WARNING

X-rays may be emitted by the CX1157 but the radiation is usually reduced to a safe level by the metal panels of the equipment in which the tube operates.

MAXIMUM RECOVERY CHARACTERISTICS



OUTLINE


23958
45°
45°
H-K
CATHODE HEATER (YELLOW)
G1
G2
H-K
H-K
(H) P.C.DIA.
(B) DIA.
RESERVOIR HEATER (RED)
G2
G1
H-K
ANODE CONNECTION FITTED WITH 8-32 U.N.C. SCREW
(C) DIA.
ANODE TEMPERATURE MEASURED HERE
(E)
(A)
GRID 1 CONNECTION 2 HOLES (M) DIA.
GRID 2 CONNECTION 2 HOLES (L) DIA.
MOUNTING FLANGE SEE NOTE 1
(F)
(J) SEE NOTE 2
(P)
(G)
(D) DIA. SEE NOTE 3
TERMINAL HOLES (Q) DIA.
4 HOLES (N) DIA.
2 LEADS (K) LONG
BASE TEMPERATURE MEASURED HERE

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.000 max	76.20 max
B	2.250	57.15
C	1.750 ± 0.031	44.45 ± 0.79
D	1.437	36.50
E	0.220 ± 0.015	5.59 ± 0.38
F	0.940	23.88
G	0.658	16.71
H	2.031 ± 0.010	51.59 ± 0.25
J	1.250 min	31.75 min
K	6.000	152.4
L	0.120	3.05
M	0.120	3.05
N	0.165	4.19
P	0.100	2.54
Q	0.165	4.19

Millimetre dimensions have been derived from inches.

Outline Notes

1. The mounting flange is the connection for the cathode, cathode heater return and reservoir heater return.
2. A minimum clearance of 1.250 inches (31.75mm) must be allowed below the flange.
3. The recommended mounting hole is 1.500 inches (38.10mm) diameter.

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English Electric Valve Company Limited
Chelmsford, Essex, England

CX1159

DEUTERIUM THYRATRON

Service Type CV9080

The data to be read in conjunction with the Hydrogen Thyratron Preamble.

ABRIDGED DATA

Deuterium-filled tetrode thyratron, featuring low jitter and low anode delay time drift. Suitable for use at high pulse repetition rates, in parallel for switching higher powers, or for switching long pulses. A reservoir operating from the cathode heater supply is incorporated.

Peak forward anode voltage	33	kV max
Peak anode current (see page 2)	1000	A max
Average anode current	1.25	A max
Anode heating factor	14×10^9	V.A.p.p.s. max
Peak output power	16.5	MW max

GENERAL

Electrical

Cathode (connected internally to mid-point of heater)		oxide coated
Heater voltage	6.3 ± 5%	V
Heater current	22	A
Tube heating time (minimum)	5.0	min
Inter-electrode capacitances (approximate):		
anode to grid 2 (grid 1 and cathode not connected)	13	pF
anode to grid 1 (grid 2 and cathode not connected)	7.5	pF
anode to cathode (grid 1 and grid 2 not connected)	26	pF

Mechanical

Overall length	12.500 inches (317.5mm) max
Overall diameter	3.312 inches (84.12mm) max
Net weight	1½ pounds (0.7kg) approx
Mounting position (see note 1)	any
Base	pin spacing as B5F; metal shell with micalex insert
Base adaptors	see page 5
Top cap (see note 2)	B.S.448-CT3
Cooling	natural

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July 1975

Supersedes January 1972 Issue

PULSE MODULATOR SERVICE

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Anode			
Peak forward anode voltage (see note 3)	–	33	kV
Peak inverse anode voltage (see note 4)	–	25	kV
Peak anode current	–	1000	A
Peak anode current (pulse repetition rate limited to 60p.p.s. max)	–	2000	A
Average anode current (see note 14)	–	1.25	A
Rate of rise of anode current (see note 5)	–	5000	A/μs
Anode heating factor	–	14×10^9	V.A.p.p.s.
Grid 2			
Unloaded grid 2 drive pulse voltage (see note 6)	200	1000	V
Grid 2 pulse duration	1.0	–	μs
Rate of rise of grid 2 pulse (see note 5)	1.0	–	kV/μs
Grid 2 pulse delay	0.5	3.0	μs
Peak inverse grid 2 voltage	–	450	V
Loaded grid 2 bias voltage	−50	−150	V
Forward impedance of grid 2 drive circuit	50	800	Ω
Grid 1 – D.C. Primed (See note 7)			
D.C. grid 1 unloaded priming voltage	75	150	V
D.C. grid 1 priming current	50	100	mA
Grid 1 – Pulsed			
Unloaded grid 1 drive pulse voltage (see note 6)	300	1000	V
Grid 1 pulse duration	2.0	–	μs
Rate of rise of grid 1 pulse (see note 5)	1.0	–	kV/μs
Peak inverse grid 1 voltage	–	450	V
Loaded grid 1 bias voltage			see note 8
Peak grid 1 drive current	0.3	1.0	A
Cathode			
Heater voltage	$6.3 \pm 5\%$		V
Tube heating time	5.0	–	min
Environmental			
Ambient temperature	−50	+90	°C
Altitude	–	10 000	ft
	–	3	km

CHARACTERISTICS

	Min	Typical	Max	
Critical d.c. anode voltage for conduction (see note 9)	–	0.5	2.0	kV
Anode delay time (see notes 9 and 10)	–	0.15	0.25	μs
Anode delay time drift (see notes 9, 11 and 12)	–	20	50	ns
Time jitter (see notes 9 and 12)	–	1.0	5.0	ns
Recovery time		see note 13 and curves		
Heater current (at 6.3V)	18	22	25	A

RATINGS FOR SINGLE SHOT OR CROWBAR SERVICE (See note 7)

D.C. forward anode voltage	30	kV max
Peak anode current	15 000	A max
Product of peak current and pulse length	0.6	A.s max
Repetition frequency	1 pulse per 10s	max

NOTES

1. Clamping is only permissible by the base.
2. A large area anode connector EEV type MA360 is recommended.
3. The maximum permissible peak forward voltage for instantaneous starting is 20kV and there must be no overshoot.
4. The peak inverse voltage must not exceed 10kV for the first 25 microseconds after the anode pulse.
5. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
6. Measured with respect to cathode. In certain cases the maximum drive pulse voltage may be exceeded without damage to the tube; a maximum value of 2.5kV is then recommended. When grid 1 is pulse driven, the last 0.25μs of the top of the grid 1 pulse must overlap the corresponding first 0.25μs of the top of the delayed grid 2 pulse.

7. When d.c. priming is used on grid 1, a negative bias of 100 to 200V must be applied to grid 2 to ensure anode voltage hold-off. D.C. priming is recommended for crowbar service.

8. D.C. negative bias voltages must not be applied to grid 1. When grid 1 is pulse driven, the potential of grid 1 may vary between −10 and +5V with respect to cathode potential during the period between the completion of recovery and the commencement of the succeeding grid pulse.

9. Typical figures are obtained on test using conditions of minimum grid drive. Improved performance can be expected by increasing the grid drive.

10. The time interval between the instant at which the rising unloaded grid 2 pulse reaches 25% of its pulse amplitude and the instant when anode conduction takes place.

11. The drift in delay time over a period from 10 seconds to 10 minutes after reaching full voltage.

12. For equipment where jitter and anode delay time drift are not important, the tube may be triggered by applying a single pulse to grid 2 and connecting grid 1 to grid 2 via a 100pF capacitor shunted by a 10MΩ resistor. These components are incorporated in adaptor assemblies MA92 and MA179 (see page 5).

13. The recovery characteristics are controlled on a sampling basis.

14. For inverter type applications where the peak current does not exceed 50A, the maximum average anode current may be increased to 2.5A; EEV should be consulted.

X-RAY WARNING

X-rays are emitted by the CX1159 from the region of the anode, but the radiation is usually reduced to a safe level by the steel panels of the equipment in which the tube operates.

ADAPTOR ASSEMBLIES

In addition to standard top cap connectors and base sockets, a number of adaptor assemblies are available from English Electric Valve Company Ltd.

MA91

A five-contact socket fitted with flexible leads and terminal tags, and mounted on an insulating base plate. It provides a conversion from base to flange type mounting.

MA92

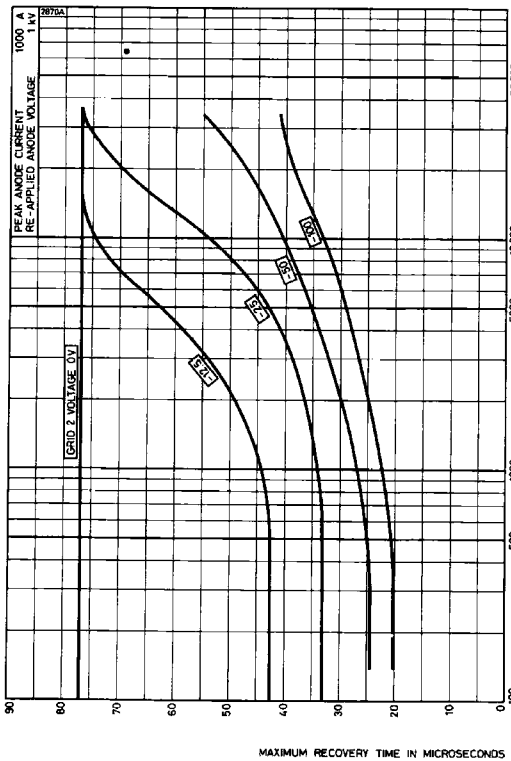
Similar to MA91 but incorporates an RC network and is designed for use with CX1159 where a single pulse drive and flying lead connections are required.

MA179

A five-contact socket with flexible leads and terminal tags, mounted on an insulating base plate; it is fitted with a base clamp. It incorporates an RC network and is designed for use with CX1159 where a single pulse drive and flying lead connections are required.

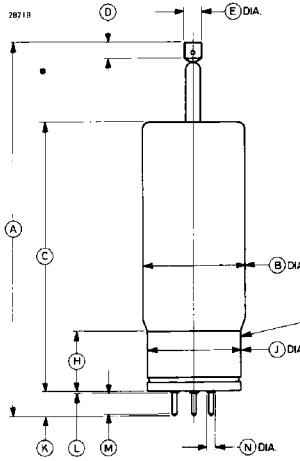
Further information is contained in the leaflet 'Accessories for Hydrogen Thyratrons'.

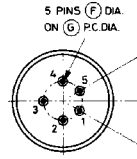
MAXIMUM RECOVERY CHARACTERISTICS

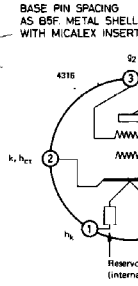


Whilst EEV has taken care to ensure the accuracy of the information contained herein it accepts no responsibility for the consequences of any use thereof and also reserves the right to change the specification of goods without notice. EEV accepts no liability beyond that set out in its standard conditions of sale in respect of infringement of third party patents arising from the use of tubes or other devices in accordance with information contained herein.

OUTLINE (All dimensions without limits are nominal)







Ref	Inches	Millimetres
A	12.000 ± 0.500	304.8 ± 12.7
B	3.312 max	84.12 max
C	8.500 ± 0.500	215.9 ± 12.7
D	0.500 min	12.70 min
E	0.566 ± 0.007	14.38 ± 0.18
F	0.187 ± 0.003	4.750 ± 0.076
G	1.250	31.75
H	1.937	49.20
J	3.062 ± 0.062	77.77 ± 1.57
K	0.770 max	19.56 max
L	0.073 max	1.85 max
M	0.575 min	14.60 min
N	0.260 max	6.60 max

Millimetre dimensions have been derived from inches.

Pin	Element
1	Heater
2	Cathode, connected internally to heater mid-point
3	Grid 2
4	Grid 1
5	Heater
Top cap	Anode

E702A
E702E

DIRECT VIEW STORAGE TUBES

Service Type CV5877 (E702A)

The data should be read in conjunction with the Storage Tube Preamble.

INTRODUCTION

The E702A and E702E are direct view storage tubes with a useful viewing screen diameter of 4 inches (102mm). They are designed to provide very bright displays of information ranging from single transients and recurrent waveforms to half-tone pictures. The writing gun beam is electrostatically deflected, and high stored writing speeds, 1.0 inch per microsecond, can be achieved.

The two types are of the same construction but the E702E is selected for improved uniformity of erasure.

The tubes have two electron guns, one for writing the signal on to the storage surface and the other, the flood gun, for displaying written information on the viewing screen. The writing gun is similar to that in a conventional cathode ray tube, except that it need only be operated for a single trace. In writing, a charge pattern is deposited on the storage surface, which consists of an insulator coating on a metal mesh (the backing electrode). Low velocity electrons from the flood gun approach the storage mesh normally and at constant current density over the useful area. They penetrate the mesh in those areas where a charge pattern has been written, the number doing so being determined by the amount of charge deposited, and are then accelerated to the viewing screen where they produce an image.

Since the flood gun is normally continuously operative, the image on the viewing screen persists without deterioration for one to two minutes, and is visible for periods up to ten minutes. The charge pattern written on the storage surface can be retained for extended periods by switching off the flood beam until viewing is required, provided that no writing takes place while the flood gun is inoperative. The image can be completely erased in a fraction of a second by applying a small positive pulse to the backing electrode; controlled persistence can be obtained by varying the duration of shorter repetitive pulses.

GENERAL

Electrical and General

	Writing Gun	Flood Gun	
Cathodes, indirectly heated, oxide coated	one	one	
Heater voltage	6.3	6.3	V
Heater current	0.6	0.6	A
Cathode heating time (minimum)	see note 1	45	s
Inter-electrode capacitances:			
cathode to all other electrodes	4.0	—	pF
grid 1 to all other electrodes	7.0	24	pF
X1 plate to all other electrodes	11.5	—	pF
X2 plate to all other electrodes	11.5	—	pF
Y1 plate to all other electrodes	6.5	—	pF
Y2 plate to all other electrodes	9.5	—	pF
X1 to X2 plates*	2.0	—	pF
Y1 to Y2 plates*	2.0	—	pF
writing gun grid 1 to writing gun cathode*	1.5	—	pF
backing electrode to all other electrodes	—	74	pF
screen to all other electrodes	—	32	pF
Focus method	electrostatic	electrostatic	
Deflection method	electrostatic	none	
Phosphor	—	aluminised P20	
Fluorescent colour (see spectral characteristic)		yellow-green	

Mechanical

Overall length	15.500 inches (393.7mm) max
Overall diameter (excluding flexible lead)	5.437 inches (138.1mm) max
Bulb diameter	5.312 inches (134.9mm) max
Useful viewing screen diameter	4.000 inches (101.6mm) min
Net weight	2½ pounds (1.15kg) approx
Mounting position	any
Base	31-pin small button thirty-fivar (JEDEC no. E31-36)
Bulb cavity caps (six)	B.S.448-CT8 (JEDEC no. J1-21)
Viewing screen connection	flexible lead

* With all other electrodes earthed

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

All voltages are.with respect to the flood gun cathode unless otherwise stated

Writing Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Grid 4 voltage			see note 2
Grid 3 voltage (negative value)	—	2500	V
Grid 2 voltage	—	200	V
Grid 1 voltage:			
negative bias*	0	200	V
positive peak*	—	2.0	V
Cathode voltage (negative value)	—	2800	V
Peak heater to cathode voltage:			
heater positive with respect to cathode	—	125	V
heater negative with respect to cathode	—	125	V
Cathode current (peak)	—	1.0	mA
Grid to cathode circuit impedance	—	1.0	MΩ
Deflection plate circuit impedance	—	0.1	MΩ

Flood Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Viewing screen voltage	—	12	kV
Backing electrode voltage (peak) (see note 3)	—	20	V
Grid 4 (collector mesh) voltage	—	300	V
Grid 3 voltage	—	300	V
Grid 2 voltage (see note 2)	—	200	V
Grid 1 voltage:			
negative bias (never positive)	2.0	150	V
Peak heater to cathode voltage:			
heater positive with respect to cathode	—	125	V
heater negative with respect to cathode	—	125	V
Cathode current (mean)	—	2.0	mA
Viewing screen dissipation	—	6.0	W
Backing electrode supply impedance	—	5000	Ω
Grid to cathode circuit impedance	—	0.5	MΩ
Viewing screen supply impedance (see note 4)	1.0	5.0	MΩ

* With respect to Writing Gun Cathode.

TYPICAL OPERATION

All voltages are with respect to the flood gun cathode unless otherwise stated

WRITING GUN

Operational Conditions

Grid 4 voltage	see note 2	
Grid 3 voltage (usual range for focus)*	550 to 850	V
Grid 2 voltage	0	V
Grid 1 voltage (range for writing beam cut-off)*	−60 to −140	V
Cathode voltage	−2300	V

Typical Performance

Writing beam current (50V modulation) (see note 5)	41	μA
Cathode current (50V modulation)	550	μA
Deflection factor, X plates	110	V/inch
Deflection factor, Y plates	105	V/inch
Stored writing speed (see note 5)	1	inch/μs

FLOOD GUN

Operational Conditions

Screen voltage	7.0	kV
Backing electrode d.c. voltage	2.0	V
Erase pulse amplitude for screen cut-off (see notes 6 and 7)	3.3	V
Grid 4 (collector mesh) voltage	210	V
Grid 3 voltage (see note 8)	85	V
Grid 2 voltage	105	V
Grid 1 voltage (see note 8)	−15	V
Grid 1 voltage (cut-off)	−100	V
Cathode voltage	0	V

Typical Performance

Screen current for full brightness	0.3	mA
Cathode current	1.0	mA
Screen luminance (see note 9)	900	ft-lamberts
	3087	cd/m^2
Viewing time (see note 10)	60	s min
Resolution (see note 11)	100	lines/inch
Erase uniformity (see note 12):		
E702A	0.7	max
E702E	0.4	max

* With respect to Writing Gun Cathode.

NOTES

1. To prevent the occurrence of transients when switching on or off, the writing gun heater voltage may be applied simultaneously with, or after, the other writing gun voltages, and switched off before these voltages are removed, provided the writing gun is biased to beyond cut-off.
2. Grid 4 (writing gun) is internally connected to grid 2 (flood gun).
3. Except when the faults mentioned under Pulse Erasure, part (c), of the General Instructions on page 7 are being corrected.
4. The viewing screen supply impedance should be less than 5MΩ to prevent excessive changes in screen voltage during erasure.
5. Writing is a charge deposition process and the current required for a given brightness level is proportional to the writing speed and inversely proportional to the number of times the information is written in one place.
6. With manual erasure (approximately 1 second) and the screen voltage simultaneously removed.
7. Maximum screen brightness is obtained when the storage mesh surface has stabilized at approximately zero potential, i.e. flood gun cathode potential. The application of a positive manual erase pulse to the backing electrode produces a corresponding positive increase in the storage mesh surface potential. This surface potential is reduced to near flood gun cathode potential by flood beam electrons. When the erase pulse is removed the surface acquires a negative potential relative to that at full brightness and equal in value to the erase pulse amplitude.
8. To achieve collimation of the flood beam, the voltages applied to the flood gun grids 2, 3 and 4 should be preset to the fixed values given on page 4. The voltage of grid 1 should then be adjusted to just give maximum uniform display over the screen. The voltage of grid 3 should then be adjusted to give the most uniform erasure when a train of erasing pulses is applied to the backing electrode. Slight readjustment of grid 1 voltage may assist in obtaining the most uniform erasure.
9. The meter used for measuring screen luminance has been corrected to the frequency response of the human eye.
10. Time for background to rise from cut-off to 10% of maximum brightness. An increase in viewing time can be obtained by switching off the

flood beam by pulses at a frequency sufficiently high to prevent flicker, the apparent brightness of the display being proportionately reduced.

11. Using a test card C pattern produced from a monoscope generator and written for one frame only at a level to display all five half-tones.

12. With the screen at uniform full brightness a train of erase pulses is applied such that all parts of the screen are just black in 10 seconds (t_2). The screen is then returned to full brightness and with the same train of erase pulses applied, the time (t_1) for the first part of the screen larger than a circle of 0.500 inch (12.7mm) diameter to become black is noted. From this the erase uniformity is calculated as follows:—

$$\text{Erase uniformity} = \frac{t_2 - t_1}{t_2}$$

It should be noted that with perfect erase uniformity the value obtained would be zero; lower grades of uniformity give values approaching unity.

GENERAL INSTRUCTIONS

Handling

The tube should be transported screen upwards to prevent particles falling on the storage elements. It should be handled with care to avoid damage to the metal seals and the encapsulated screen lead.

Magnetic Shielding

Because of the low voltage of the flood gun beam, it is essential to shield the whole of the viewing section from magnetic fields; shielding of the writing gun is also advisable. Details of suitable Mumetal shields are available from English Electric Valve Company Ltd.

Demagnetization

The tube may become magnetized during transportation and this will cause non-uniform illumination under full brightness conditions. In this event, a degaussing coil should be drawn slowly over the tube taking one minute for the operation. Such a coil may be made up of 900 turns of no. 16 s.w.g. enamelled wire wound on a 6½-inch diameter former 2 inches long. The coil supply voltage should be 115 volts 50 to 60Hz a.c. Stronger fields should not be used.

Pulse Erasure

(a) The speed of erasure is controlled by the adjustment of the pulse duration in conjunction with the pulse repetition rate, which should be sufficiently high to prevent flicker, and preferably in the range between 100 and 2000 pulses per second. By increasing the pulse duration or the pulse repetition rate, the erasure time may be reduced proportionately. The pulse amplitude also alters the erase rate but primarily determines the final potential to which the storage mesh is driven in the absence of writing (see pages 11 and 12). Normally a pulse amplitude two to three times the manual erase value is applied, which gives an approximately uniform rate of erasure for visible signals but tends to suppress small non-integrating signals such as noise. A much lower pulse amplitude must be used if the grey scale is to be preserved with no loss of information.

(b) If it can be conveniently arranged for the screen h.t. to be switched off simultaneously with either manual or pulse train erase then two advantages will ensue:

(i) Contrast during pulse train erase will improve.

(ii) The time taken for erasure will decrease.

(c) The normal erasure procedure may be inadequate or ineffective under the following conditions:

(i) When writing beam electrons have penetrated the surface of the storage insulator and have built up charges within it. Low velocity flood beam electrons cannot neutralize these charges and after the normal erasure procedure has been carried out the original screen image may still be faintly visible as the background illumination increases.

(ii) When parts of the storage mesh surface are driven so positive that the number of secondary electrons produced by the flood beam exceeds those arriving at the surface. This condition is known as runaway charging and can occur when a pulse exceeding 20 volts in amplitude is applied to the backing electrode. It can also occur when an excessively high writing charge is deposited, e.g. with a stationary spot or line and particularly when writing takes place in the absence of flood beam current. Damage may be done to the storage mesh if this fault is not quickly corrected.

Both faults can be corrected by operating a switch to disconnect the backing electrode from its supply and connecting it to the flood gun grid 4 through a protective resistor; this switch must make and break quickly and need

be operated once only. The screen should then be at uniform full brilliance and normal erasure will prepare the tube for operation. Care should be taken to ensure that this switch cannot be left in the 'on' condition. The above procedure is known as 'clearance'.

Flood Gun

The flood gun supplies must be held relatively stable. The flood gun grid 2 is internally connected to the writing gun grid 4 and the potential of this point relative to earth is normally fixed by the mean potential of the deflecting system (see Deflection Supplies below).

To prevent the occurrence of runaway charging, the flood gun beam must always be operative before the writing gun supplies are switched on.

Writing Gun

The writing gun cathode is operated at a potential in the region of −1.5 to −2.8kV; consequently the heater supply should be adequately insulated. The cathode supply must be free from ripple to prevent modulation of the writing beam and have good stability to maintain constant modulation depth and focus.

Care should be taken to prevent heavy transient writing beam currents when switching on. The writing beam should be adjusted so that the highlight brightness of the display is not saturated as this will result in a rapid deterioration in resolution.

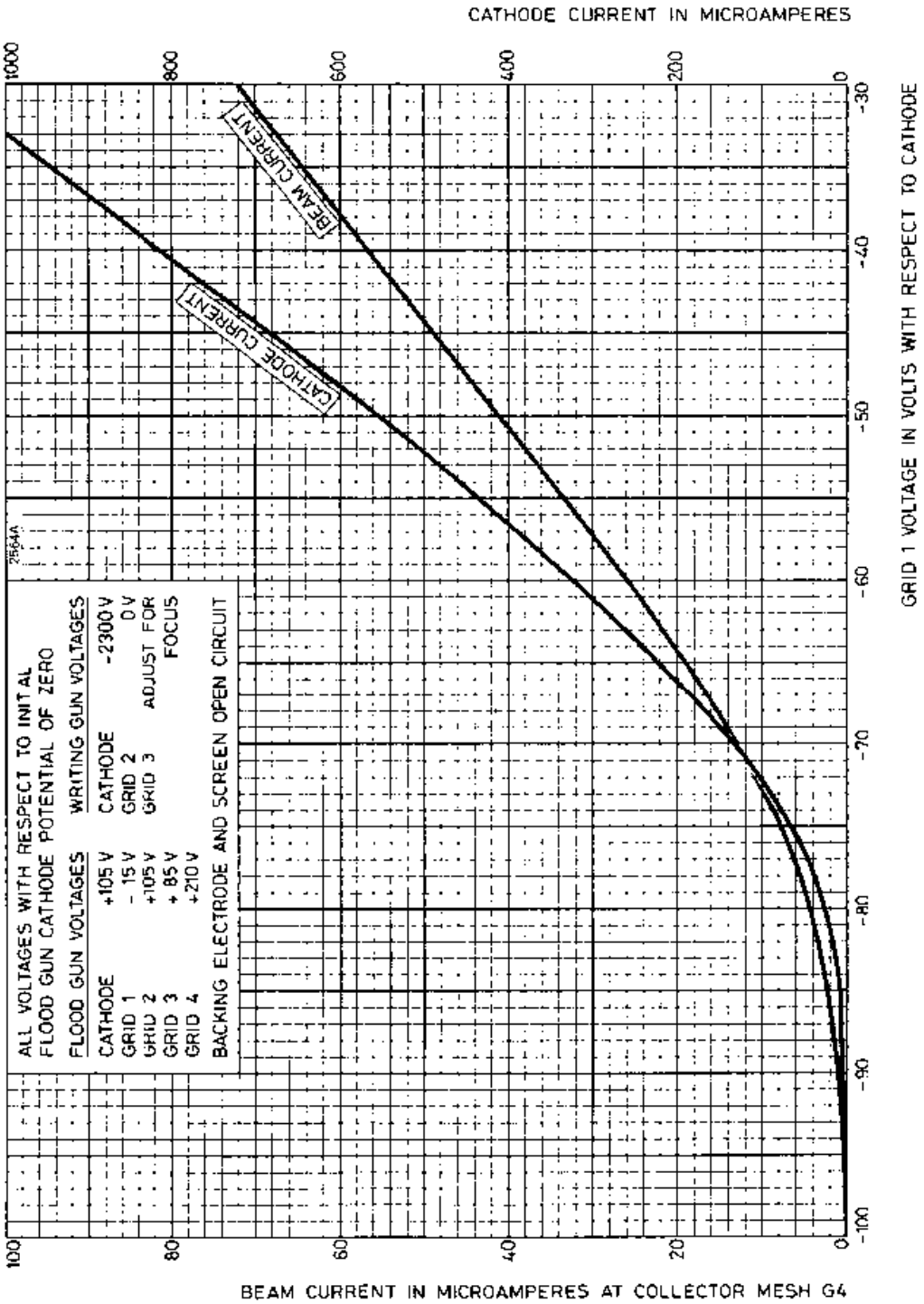
Deflection Supplies

The mean potentials of the deflecting plates should be held very close to the writing gun grid 4 voltage, and astigmatism of the writing beam may be minimized by small adjustments of the potential differences between them.

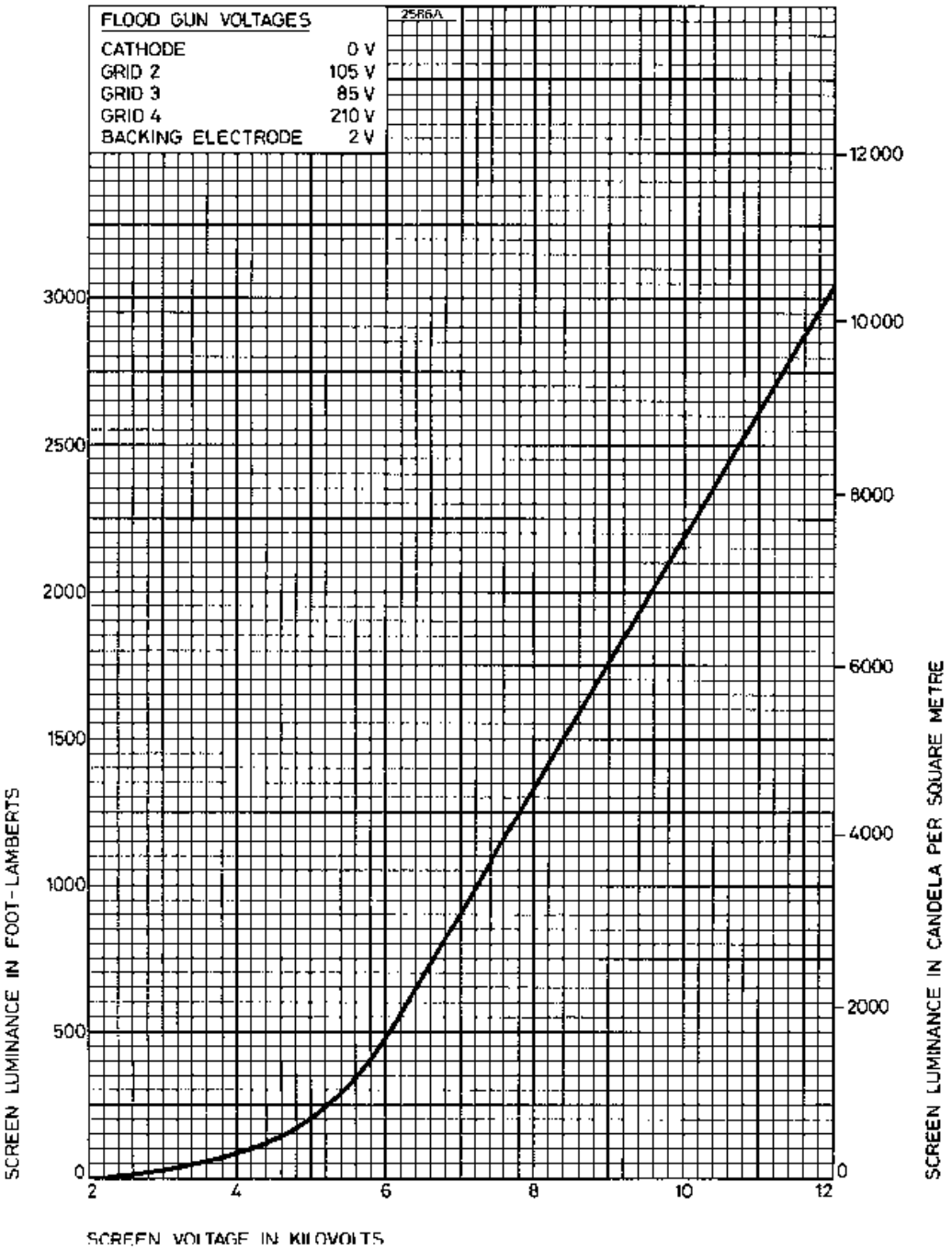
The undeflected writing beam will normally focus to a spot at the centre of the storage mesh. To compensate for variations between individual tubes, however, an adjustable and reversible supply to the deflection plates should be provided for centring the writing beam spot.

Any failure of the deflection drive that may result in the production of a stationary spot or line may cause runaway charging, even with the flood beam on. Provision should be made for automatically cutting off the writing gun beam in the event of any such failure.

TYPICAL WRITING GUN CHARACTERISTIC

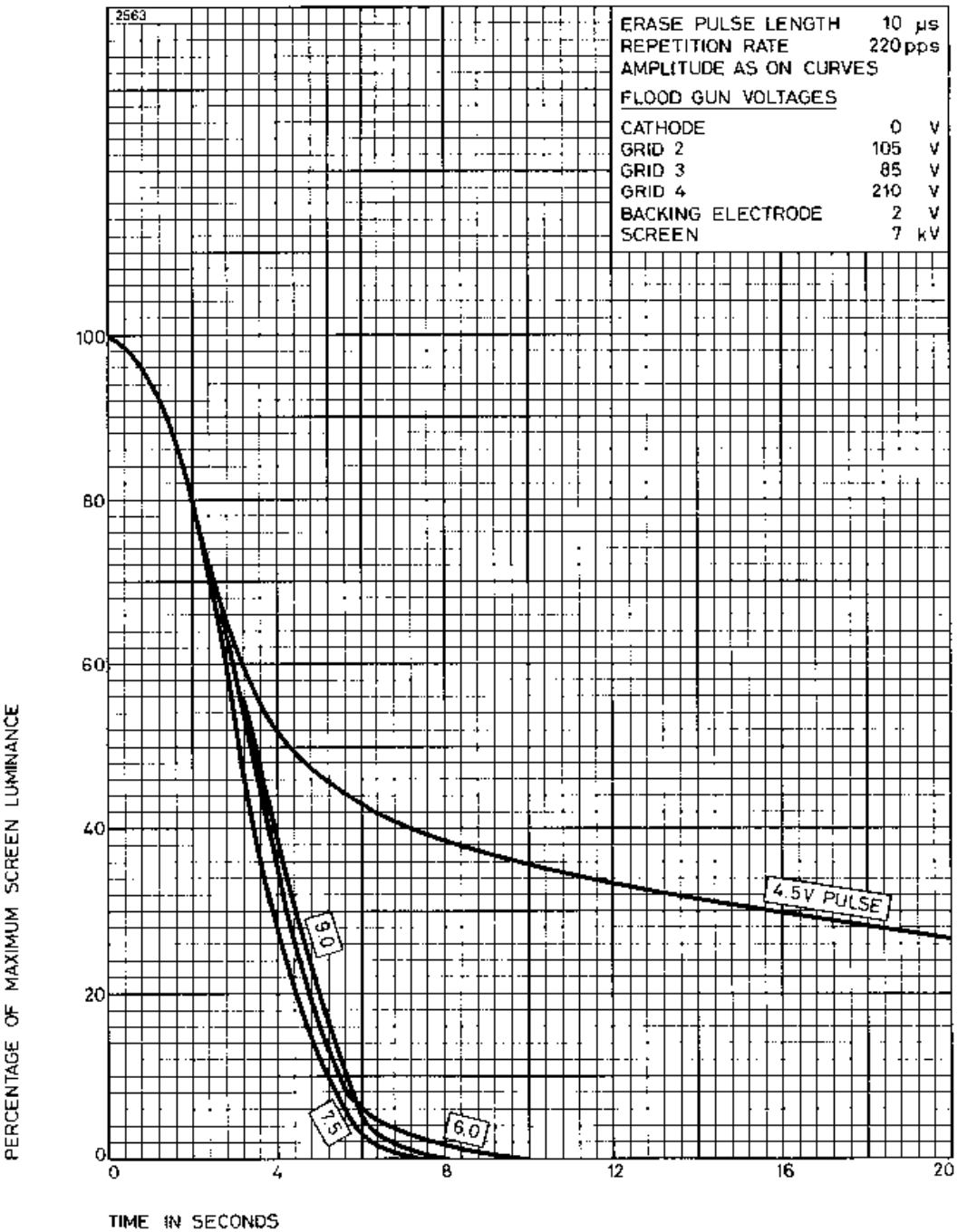


TYPICAL SCREEN BRIGHTNESS CHARACTERISTIC



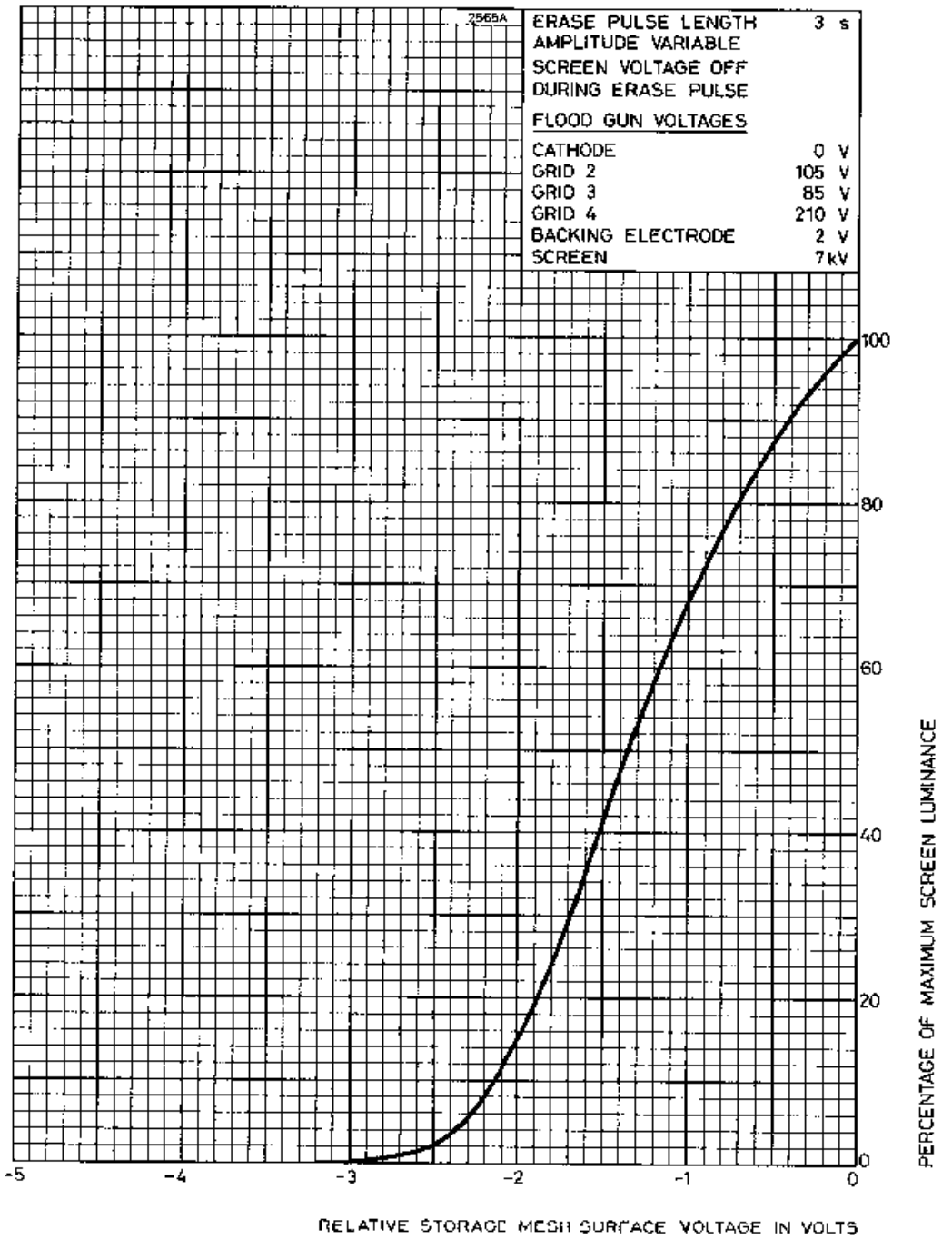
TYPICAL RELATIVE BRIGHTNESS CHARACTERISTICS

Obtained by applying repetitive erase pulses



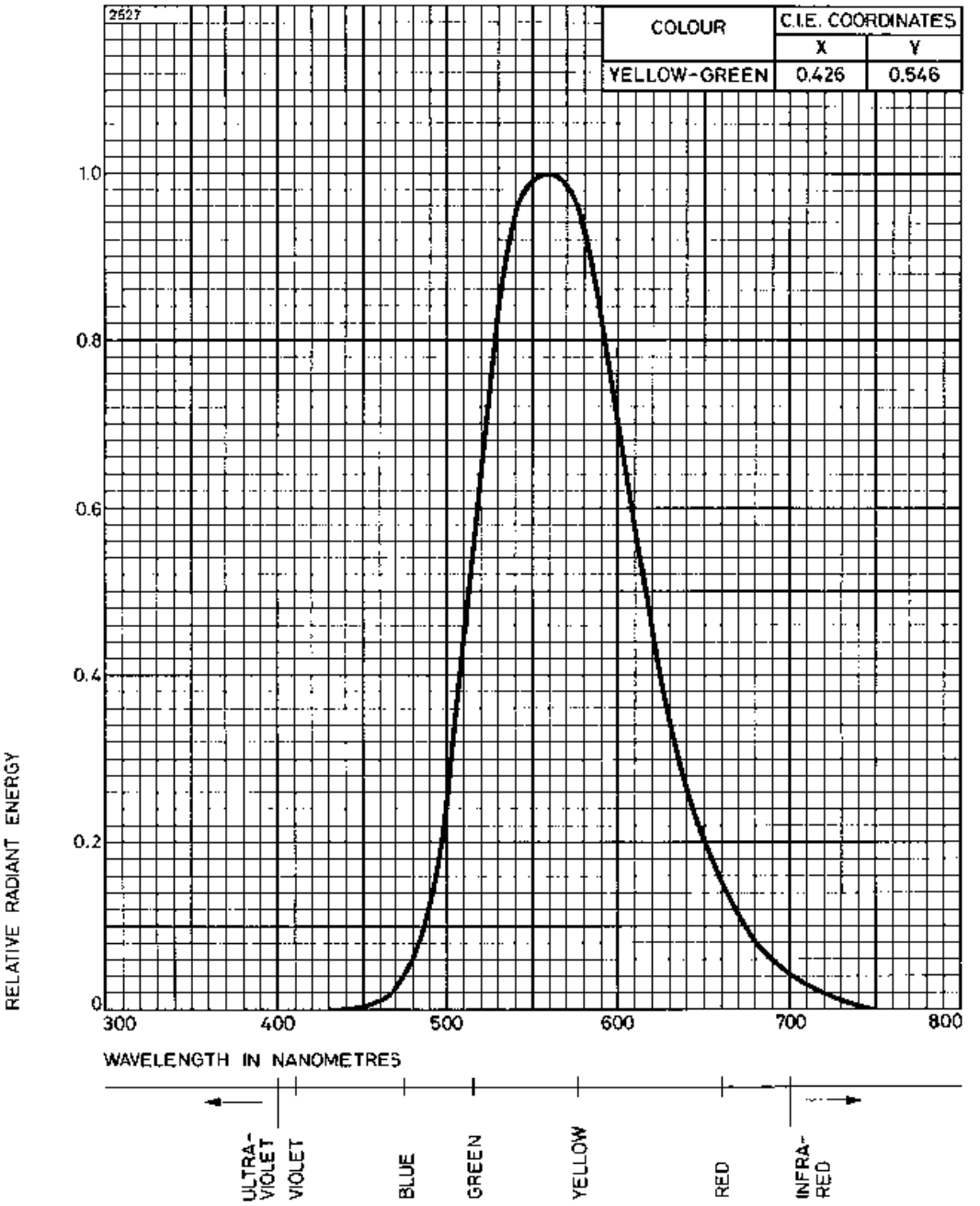
TYPICAL STORAGE MESH CHARACTERISTIC

Obtained by applying manual erase pulses

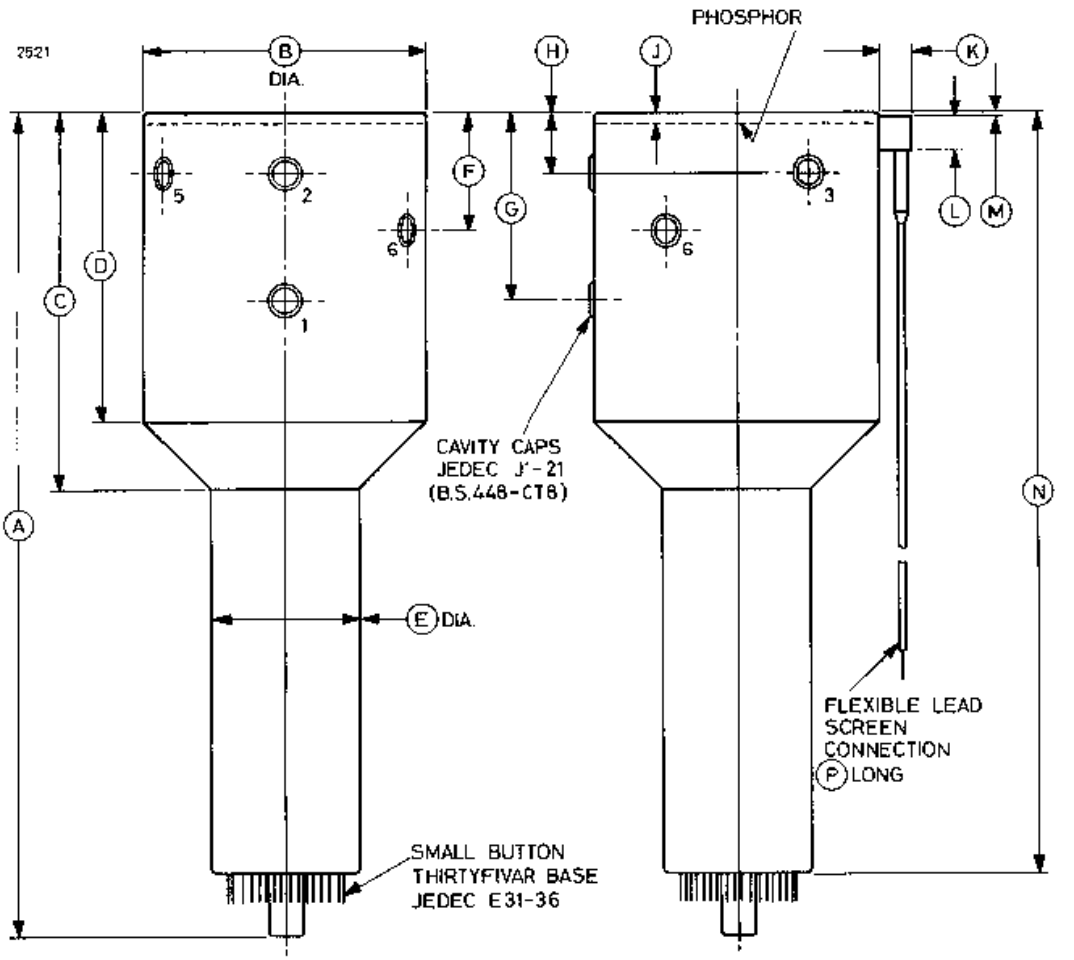


The storage mesh surface potential is arbitrarily considered zero at full brightness for the purpose of this graph.

TYPICAL SPECTRAL OUTPUT CHARACTERISTIC FOR P20 PHOSPHOR



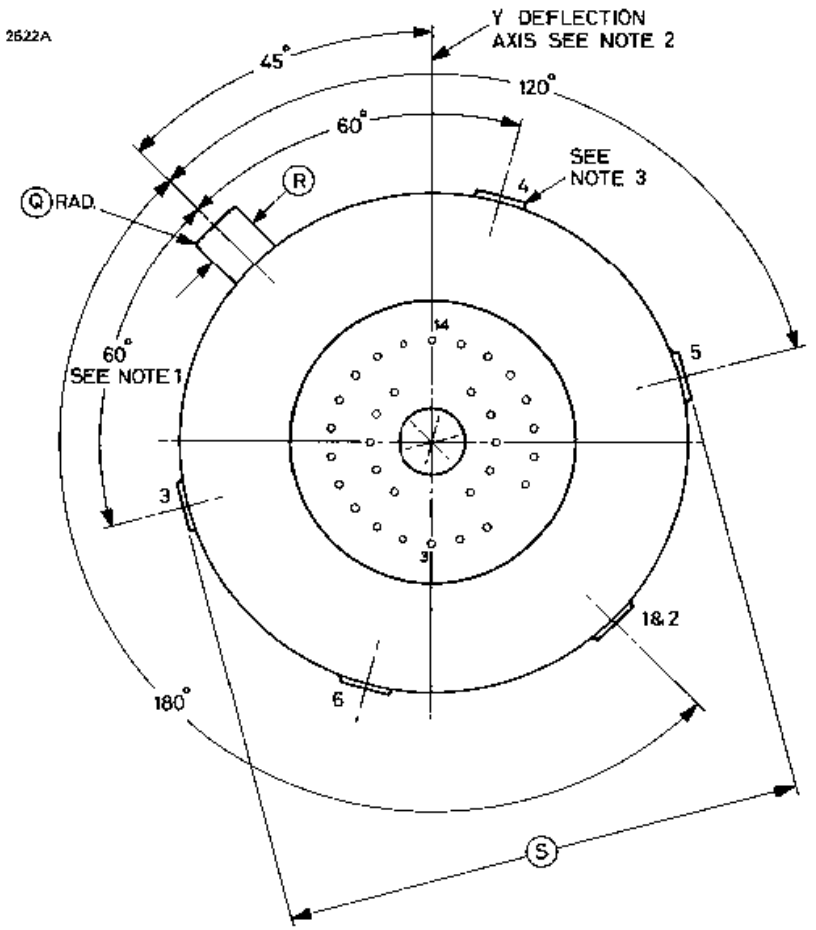
OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.250 ± 0.250	387.4 ± 6.4	K	0.625 max	15.88 max
B	5.312 max	134.9 max	L	0.563 max	14.30 max
C	7.000 max	177.8 max	M	0.062	1.58
D	5.750 max	146.1 max	N	14.125 ± 0.250	358.8 ± 6.4
E	3.094 max	78.59 max	P	22.5	571.5
F	2.188 ± 0.125	55.58 ± 3.18	Q	0.062 max	1.58 max
G	3.500 ± 0.125	88.90 ± 3.18	R	0.625 max	15.88 max
H	1.125 ± 0.125	28.58 ± 3.18	S	5.437 max	138.1 max
J	0.250 ± 0.025	6.35 ± 0.64			

Millimetre dimensions have been derived from inches.

OUTLINE



Outline Notes

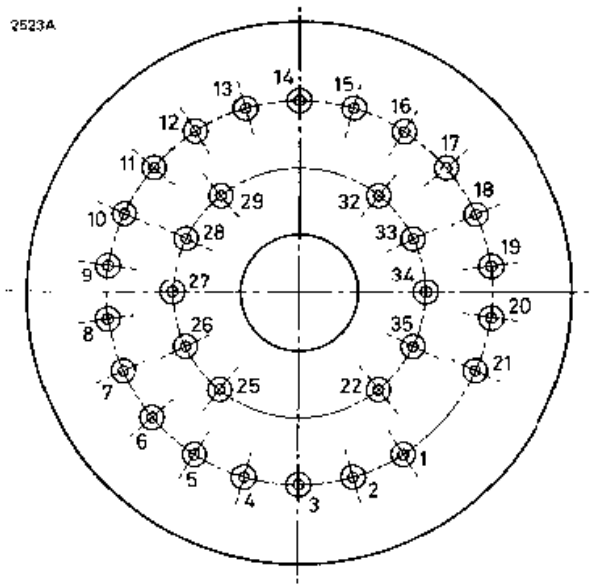
1. Tolerance on angles $\pm 7^{\circ}$.
2. The centre line passing through base pins 3 and 14 and the Y-deflection axis are in line within 10°.
3. Cavity cap 4 is on the same plane as cavity caps 2, 3 and 5.

Cavity Cap Connections

Cap	Element
1	Grid 3 (flood gun)
2	Grid 4 (flood gun)
3	Grid 4 (flood gun)

Cap	Element
4	Grid 4 (flood gun)
5	Backing electrode
6	Grid 3 (flood gun)

Base Connections



Pin	Element	Pin	Element
1	No connection	19	No connection
2	No connection	20	Internal connection.
3	Deflection plate X1		Do not use
4	Deflection plate X2	21	No connection
5	No connection	22	Heater (flood gun)
6	Grid 3 (writing gun)	23	Omitted
7	Internal connection.	24	Omitted
	Do not use	25	No connection
8	Heater (writing gun)	26	Internal connection.
9	Heater (writing gun)		Do not use
10	Grid 1 (writing gun)	27	Cathode (writing gun)
11	No connection	28	Internal connection.
12	No connection		Do not use
13	Deflection plate Y1	29	No connection
14	Deflection plate Y2	30	Omitted
15	Grid 2 (writing gun)	31	Omitted
16	No connection	32	Grid 1 (flood gun)
17	Grid 2 (flood gun) and	33	Cathode (flood gun)
	grid 4 (writing gun)	34	No connection
18	No connection	35	Heater (flood gun)

English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

E702B

DIRECT VIEW STORAGE TUBE

Service Type CV5987

The data should be read in conjunction with the Storage Tube Preamble.

INTRODUCTION

The E702B is a direct view storage tube with a useful viewing screen diameter of 4 inches (102mm). It is designed to provide very bright displays of information ranging from single transients and recurrent waveforms to half-tone pictures. The writing gun beam is electrostatically deflected, and high stored writing speeds, 1.0 inch per microsecond, can be achieved. The tube is of ruggedized construction and is recommended for airborne and other radar applications where vibration and low pressure conditions may be encountered.

The tube has two electron guns, one for writing the signal on to the storage surface and the other, the flood gun, for displaying written information on the viewing screen. The writing gun is similar to that in a conventional cathode ray tube, except that it need only be operated for a single trace. In writing, a charge pattern is deposited on the storage surface, which consists of an insulator coating on a metal mesh (the backing electrode). Low velocity electrons from the flood gun approach the storage mesh normally and at constant current density over the useful area. They penetrate the mesh in those areas where a charge pattern has been written, the number doing so being determined by the amount of charge deposited, and are then accelerated to the viewing screen where they produce an image.

Since the flood gun is normally continuously operative, the image on the viewing screen persists without deterioration for one to two minutes, and is visible for periods up to ten minutes. The charge pattern written on the storage surface can be retained for extended periods by switching off the flood beam until viewing is required, provided that no writing takes place while the flood gun is inoperative. The image can be completely erased in a fraction of a second by applying a small positive pulse to the backing electrode; controlled persistence can be obtained by varying the duration of shorter repetitive pulses.

GENERAL

Electrical and General

	Writing Gun	Flood Gun	
Cathodes, indirectly heated, oxide coated	one	one	
Heater voltage	6.3	6.3	V
Heater current	0.6	0.6	A
Cathode heating time (minimum)	see note 1	45	s
Inter-electrode capacitances:			
cathode to all other electrodes	4.0		pF
grid 1 to all other electrodes	7.0	24	pF
X1 plate to all other electrodes	11.5	—	pF
X2 plate to all other electrodes	11.5	—	pF
Y1 plate to all other electrodes	6.5	—	pF
Y2 plate to all other electrodes	9.5	—	pF
X1 to X2 plates*	2.0	—	pF
Y1 to Y2 plates*	2.0	—	pF
writing gun grid 1 to writing gun cathode*	1.5	—	pF
backing electrode to all other electrodes	—	74	pF
screen to all other electrodes	—	32	pF
Focus method	electrostatic	electrostatic	
Deflection method	electrostatic	none	
Phosphor	—	aluminized P20	
Fluorescent colour (see spectral characteristic)		yellow-green	

Mechanical

Overall length	15.500 inches (393.7mm) max
Overall diameter (excluding flexible lead)	5.437 inches (138.1mm) max
Bulb diameter	5.312 inches (134.9mm) max
Useful viewing screen diameter	4.000 inches (101.6mm) min
Net weight	2½ pounds (1.15kg) approx
Mounting position	any
Base	31-pin small button thirty-fivar (JEDEC no. E31-36)
Bulb cavity caps (six)	B.S.448-CT8 (JEDEC no. J1-21)
Viewing screen connection	flexible lead

* With all other electrodes earthed

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

All voltages are with respect to the flood gun cathode unless otherwise stated

Writing Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Grid 4 voltage			see note 2
Grid 3 voltage (negative value)	—	2500	V
Grid 2 voltage	—	200	V
Grid 1 voltage:			
negative bias*	0	200	V
positive peak*	—	2.0	V
Cathode voltage (negative value)	—	2800	V
Peak heater to cathode voltage:			
heater positive with respect to cathode	—	125	V
heater negative with respect to cathode	—	125	V
Cathode current (peak)	—	1.0	mA
Grid to cathode circuit impedance	—	1.0	MΩ
Deflection plate circuit impedance	—	0.1	MΩ

Flood Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Viewing screen voltage	—	12	kV
Backing electrode voltage (peak) (see note 3)	—	20	V
Grid 4 (collector mesh) voltage	—	300	V
Grid 3 voltage	—	300	V
Grid 2 voltage (see note 2)	—	200	V
Grid 1 voltage:			
negative bias (never positive)	2.0	150	V
Peak heater to cathode voltage:			
heater positive with respect to cathode	—	125	V
heater negative with respect to cathode	—	125	V
Cathode current (mean)	—	2.0	mA
Viewing screen dissipation	—	6.0	W
Backing electrode supply impedance	—	5000	Ω
Grid to cathode circuit impedance	—	0.5	MΩ
Viewing screen supply impedance (see note 4)	1.0	5.0	MΩ

* With respect to Writing Gun Cathode.

TYPICAL OPERATION

All voltages are with respect to the flood gun cathode unless otherwise stated

WRITING GUN

Operational Conditions

Grid 4 voltage	see note 2	
Grid 3 voltage (usual range for focus)*	450 to 650	V
Grid 2 voltage	0	V
Grid 1 voltage (range for writing beam cut-off)*	−45 to −110	V
Cathode voltage	−1800	V

Typical Performance

Writing beam current (50V modulation) (see note 5)	49	μA
Cathode current (50V modulation)	700	μA
Deflection factor, X plates	90	V/inch
Deflection factor, Y plates	87	V/inch
Stored writing speed (see note 5)	1	inch/μs

FLOOD GUN

Operational Conditions

Screen voltage	10	kV
Backing electrode d.c. voltage	2.0	V
Erase pulse amplitude for screen cut-off (see notes 6 and 7)	3.9	V
Grid 4 (collector mesh) voltage	225	V
Grid 3 voltage (see note 8)	90	V
Grid 2 voltage	150	V
Grid 1 voltage (see note 8)	35	V
Cathode voltage	0	V

Typical Performance

Screen current for full brightness	0.48	mA
Cathode current	1.3	mA
Screen luminance (see note 9)	2150	ft-lamberts
	7375	cd/m^2
Viewing time (see note 10):		
minimum	30	s
typical	60	s
Resolution (see note 11)	100	lines/inch

* With respect to Writing Gun Cathode.

NOTES

1. To prevent the occurrence of transients when switching on or off, the writing gun heater voltage may be applied simultaneously with, or after, the other writing gun voltages, and switched off before these voltages are removed, provided the writing gun is biased to beyond cut-off.
2. Grid 4 (writing gun) is internally connected to grid 2 (flood gun).
3. Except when the faults mentioned under Pulse Erasure, part (c), of the General Instructions on page 7 are being corrected.
4. The viewing screen supply impedance should be less than 5MΩ to prevent excessive changes in screen voltage during erasure.
5. Writing is a charge deposition process and the current required for a given brightness level is proportional to the writing speed and inversely proportional to the number of times the information is written in one place.
6. With manual erasure (approximately 1 second) and the screen voltage simultaneously removed.
7. Maximum screen brightness is obtained when the storage mesh surface has stabilized at approximately zero potential, i.e. flood gun cathode potential. The application of a positive manual erase pulse to the backing electrode produces a corresponding positive increase in the storage mesh surface potential. This surface potential is reduced to near flood gun cathode potential by flood beam electrons. When the erase pulse is removed the surface acquires a negative potential relative to that at full brightness and equal in value to the erase pulse amplitude.
8. To achieve collimation of the flood beam, the voltages applied to the flood gun grids 2, 3 and 4 should be preset to the fixed values given on page 4. The voltage of grid 1 should then be adjusted to just give maximum uniform display over the screen. The voltage of grid 3 should then be adjusted to give the most uniform erasure when a train of erasing pulses is applied to the backing electrode. Slight readjustment of grid 1 voltage may assist in obtaining the most uniform erasure.
9. The meter used for measuring screen luminance has been corrected to the frequency response of the human eye.

10. Time for background to rise from cut-off to 10% of maximum brightness. An increase in viewing time can be obtained by switching off the flood beam by pulses at a frequency sufficiently high to prevent flicker, the apparent brightness of the display being proportionately reduced.

11. Using a test card C pattern procuced from a monoscope generator and written for one frame only at a level to display all five half-tones.

GENERAL INSTRUCTIONS

Handling

The tube should be transported screen upwards to prevent particles falling on the storage elements. It should be handled with care to avoid damage to the metal seals and the encapsulated screer lead.

Magnetic Shielding

Because of the low voltage of the flood gun beam, it is essential to shield the whole of the viewing section from magnetic fields; shielding of the writing gun is also advisable. Details of suitable Mumetal shields are available from English Electric Valve Company Ltd.

Demagnetization

The tube may become magnetized during transportation and this will cause non-uniform illumination under full brightness conditions. In this event, a degaussing coil should be drawn slowly over the tube taking one minute for the operation. Such a coil may be made up of 900 turns of no. 16 s.w.g. enamelled wire wound on a 6½-inch diameter former 2 inches long. The coil supply voltage should be 115 volts 50 to 60Hz a.c. Stronger fields should not be used.

Pulse Erasure

(a) The speed of erasure is controlled by the adjustment of the pulse duration in conjunction with the pulse repetit on rate, which should be sufficiently high to prevent flicker, and preferably in the range between 100 and 2000 pulses per second. By increasing the pulse duration or the pulse repetition rate, the erasure time may be reduced proportionately. The pulse amplitude also alters the erase rate but primarily determines the final potential to which the storage mesh is driven in the absence of writing (see pages 11 and 12).

Normally a pulse amplitude two to three times the manual erase value is applied, which gives an approximately uniform rate of erasure for visible signals but tends to suppress small non-integrating signals such as noise. A much lower pulse amplitude must be used if the grey scale is to be preserved with no loss of information.

(b) If it can be conveniently arranged for the screen h.t. to be switched off simultaneously with either manual or pulse train erase then two advantages will ensue:

(i) Contrast during pulse train erase will improve.

(ii) The time taken for erasure will decrease.

(c) The normal erasure procedure may be inadequate or ineffective under the following conditions:

(i) When writing beam electrons have penetrated the surface of the storage insulator and have built up charges within it. Low velocity flood beam electrons cannot neutralize these charges and after the normal erasure procedure has been carried out the original screen image may still be faintly visible as the background illumination increases.

(ii) When parts of the storage mesh surface are driven so positive that the number of secondary electrons produced by the flood beam exceeds those arriving at the surface. This condition is known as runaway charging and can occur when a pulse exceeding 20 volts in amplitude is applied to the backing electrode. It can also occur when an excessively high writing charge is deposited, e.g. with a stationary spot or line and particularly when writing takes place in the absence of flood beam current. Damage may be done to the storage mesh if this fault is not quickly corrected.

Both faults can be corrected by operating a switch to disconnect the backing electrode from its supply and connecting it to the flood gun grid 4 through a protective resistor; this switch must make and break quickly and need be operated once only. The screen should then be at uniform full brightness and normal erasure will prepare the tube for operation. Care should be taken to ensure that this switch cannot be left in the 'on' condition. The above procedure is known as 'clearance'.

Flood Gun

The flood gun supplies must be held relatively stable. The flood gun grid 2 is internally connected to the writing gun grid 4 and the potential of this point relative to earth is normally fixed by the mean potential of the deflecting system (see Deflection Supplies below).

To prevent the occurrence of runaway charging, the flood gun beam must always be operative before the writing gun supplies are switched on.

Writing Gun

The writing gun cathode is operated at a potential in the region of −1.5 to −2.8kV; consequently the heater supply should be adequately insulated. The cathode supply must be free from ripple to prevent modulation of the writing beam and have good stability to maintain constant modulation depth and focus.

Care should be taken to prevent heavy transient writing beam currents when switching on. The writing beam should be adjusted so that the highlight brightness of the display is not saturated as this will result in a rapid deterioration in resolution.

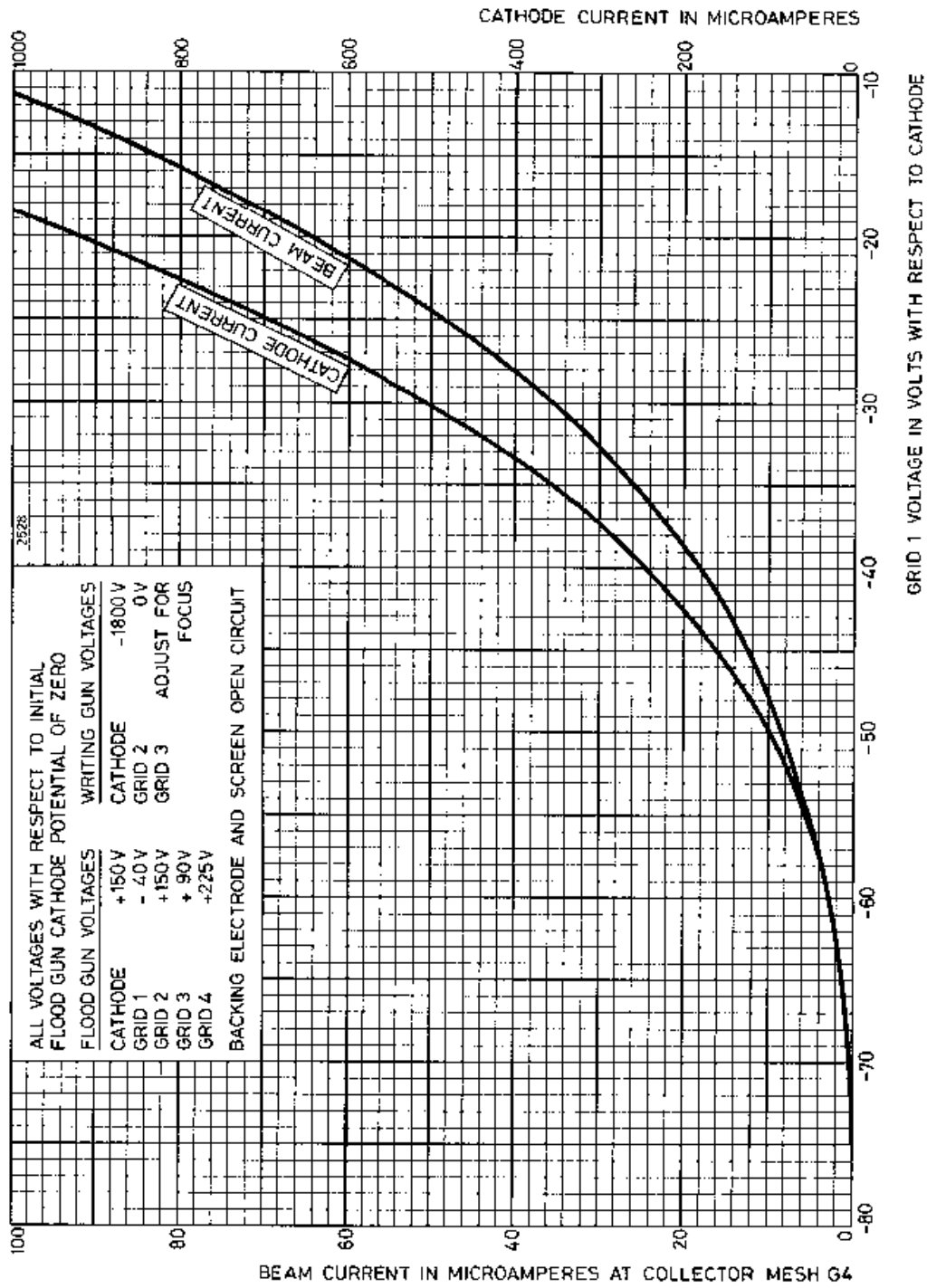
Deflection Supplies

The mean potentials of the deflecting plates should be held very close to the writing gun grid 4 voltage, and astigmatism of the writing beam may be minimized by small adjustments of the potential differences between them.

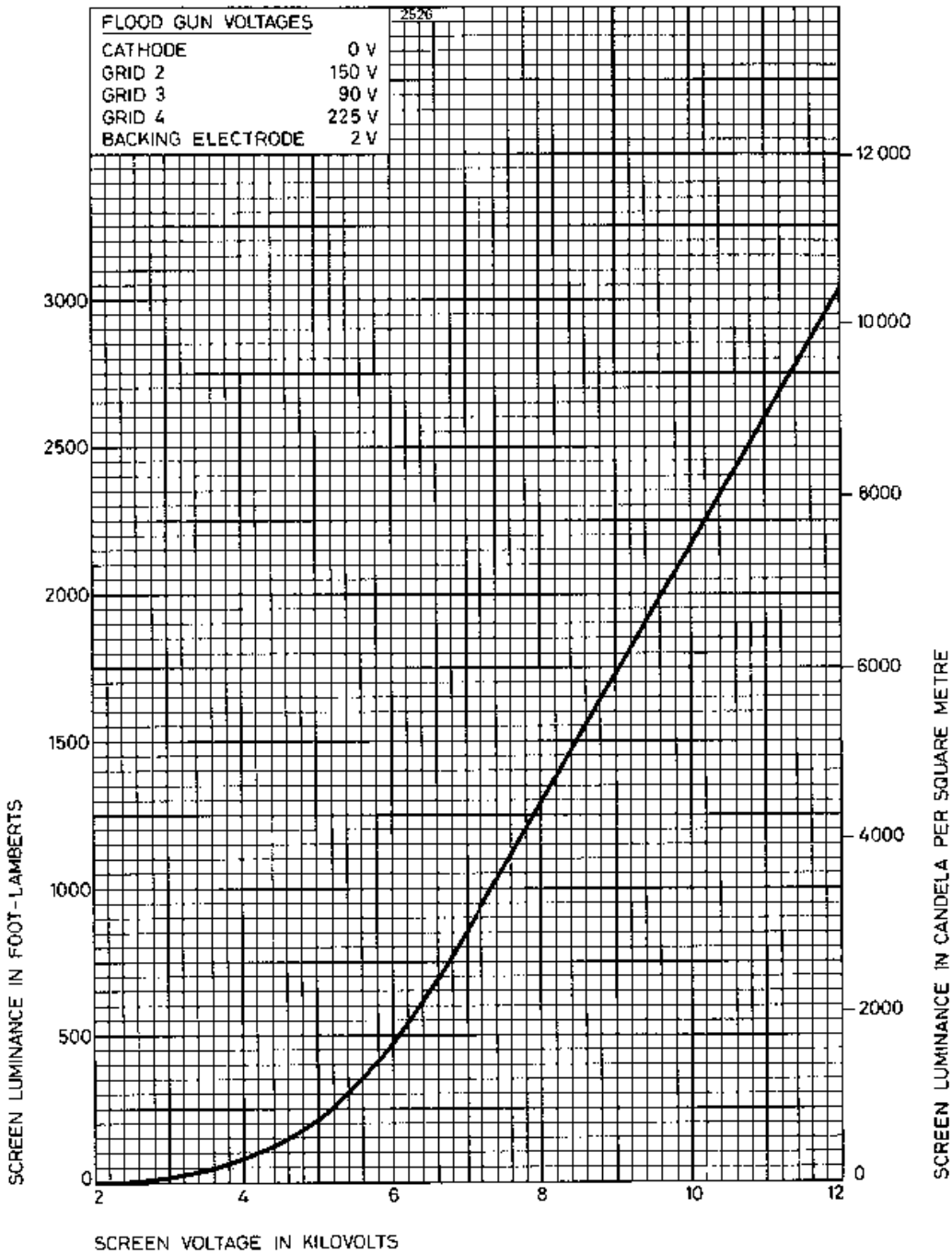
The undeflected writing beam will normally focus to a spot at the centre of the storage mesh. To compensate for variations between individual tubes, however, an adjustable and reversible supply to the deflection plates should be provided for centring the writing beam spot.

Any failure of the deflection drive that may result in the production of a stationary spot or line may cause runaway charging, even with the flood beam on. Provision should be made for automatically cutting off the writing gun beam in the event of any such failure.

TYPICAL WRITING GUN CHARACTERISTIC

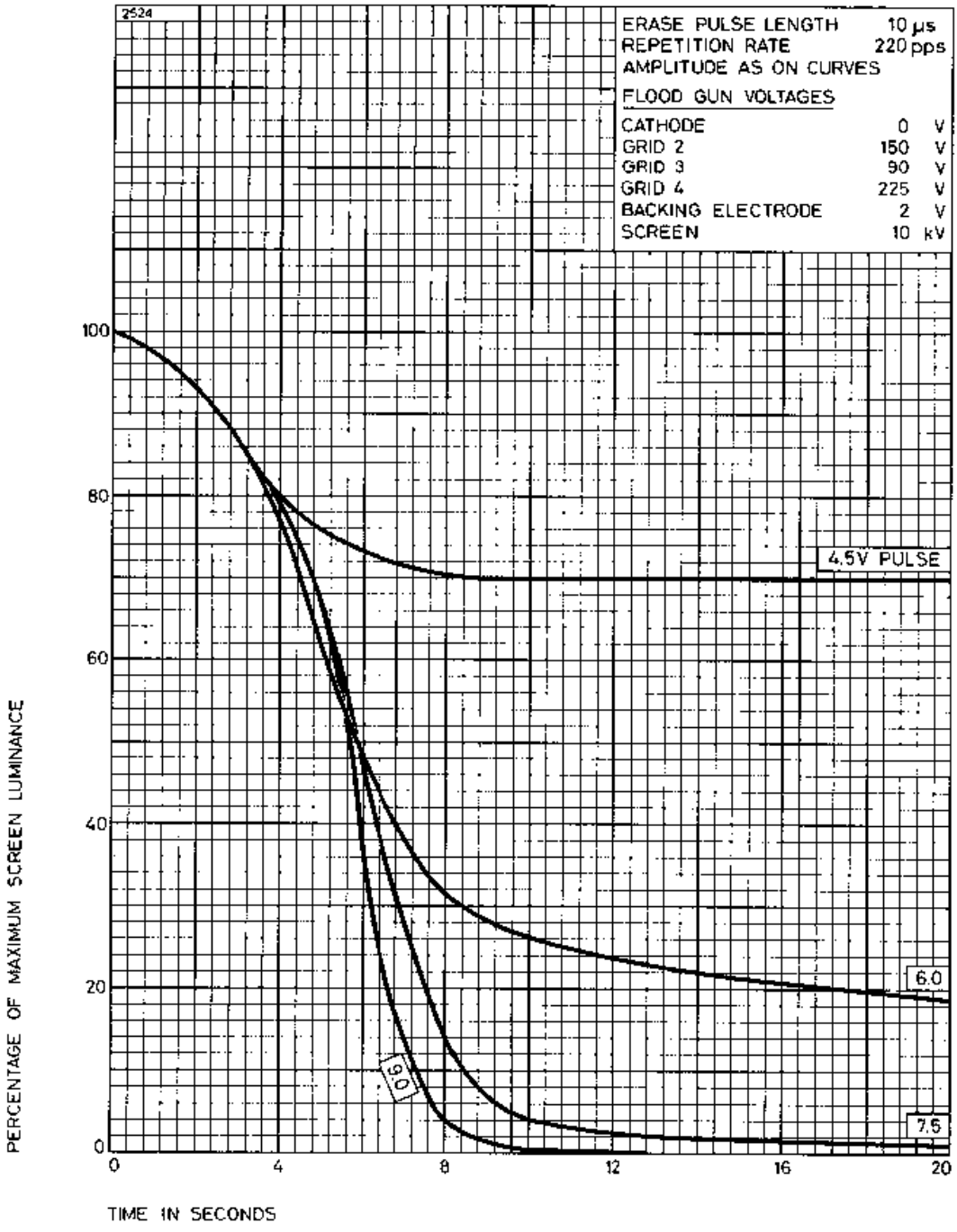


TYPICAL SCREEN BRIGHTNESS CHARACTERISTIC



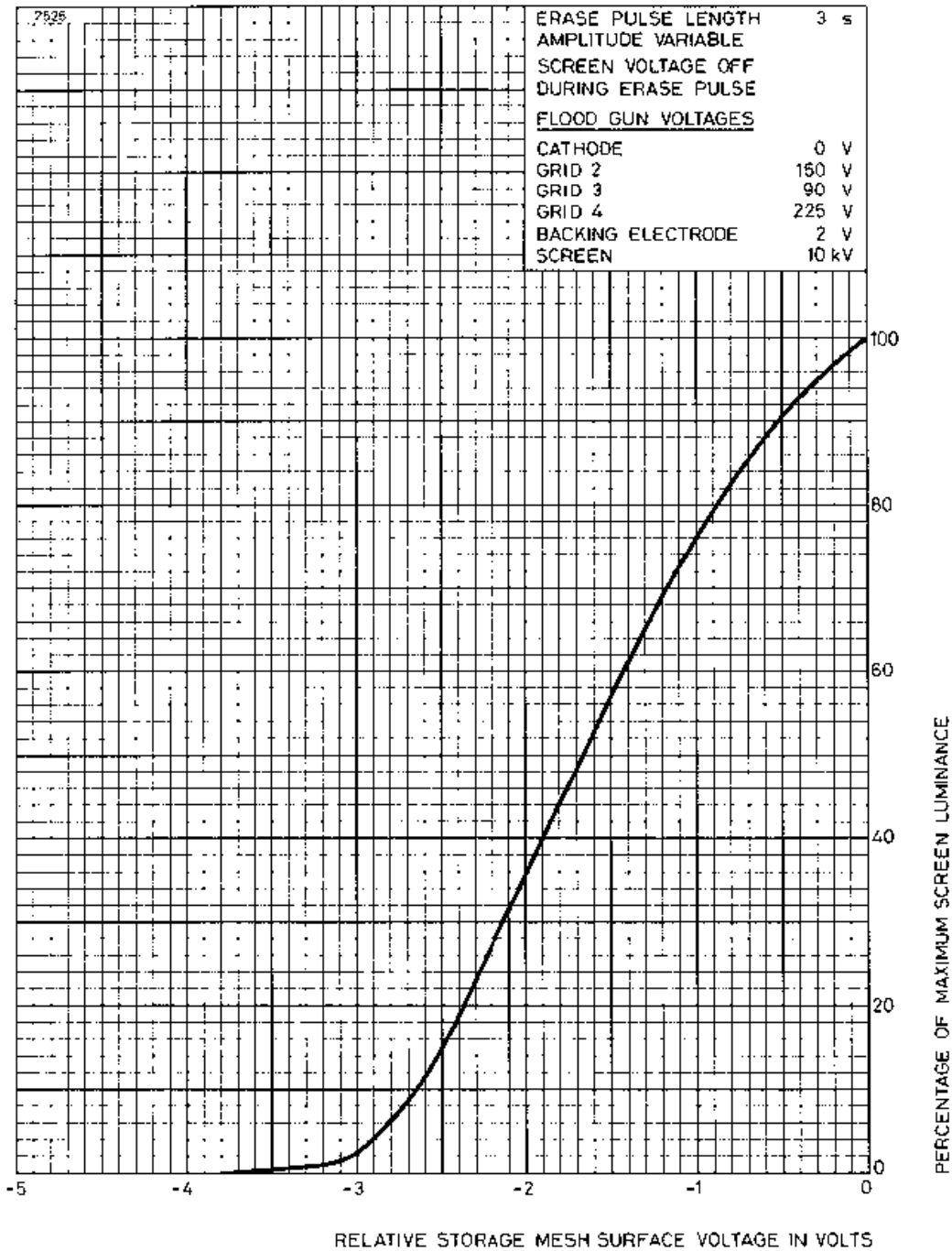
TYPICAL RELATIVE BRIGHTNESS CHARACTERISTICS

Obtained by applying repetitive erase pulses



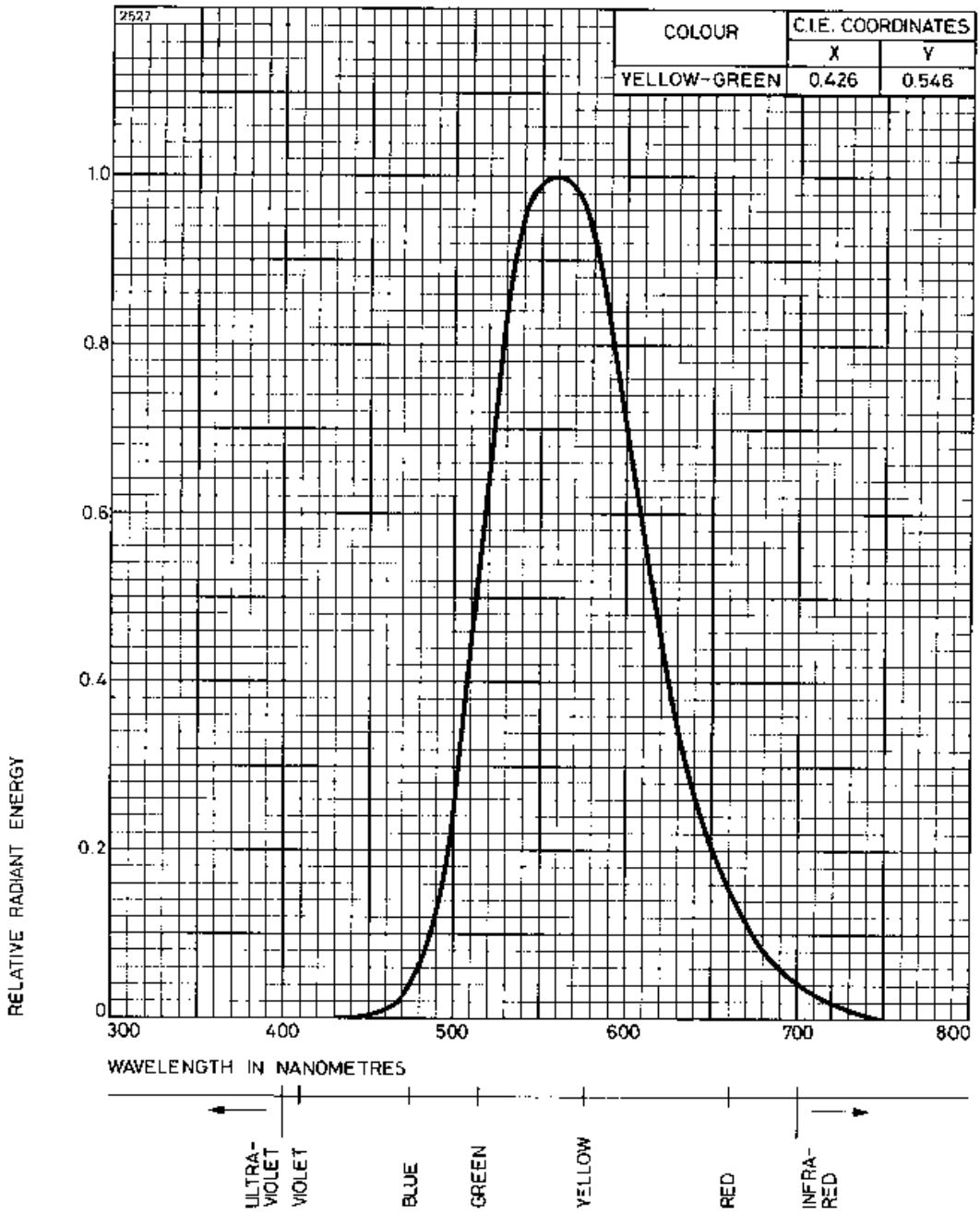
TYPICAL STORAGE MESH CHARACTERISTIC

Obtained by applying manual erase pulses

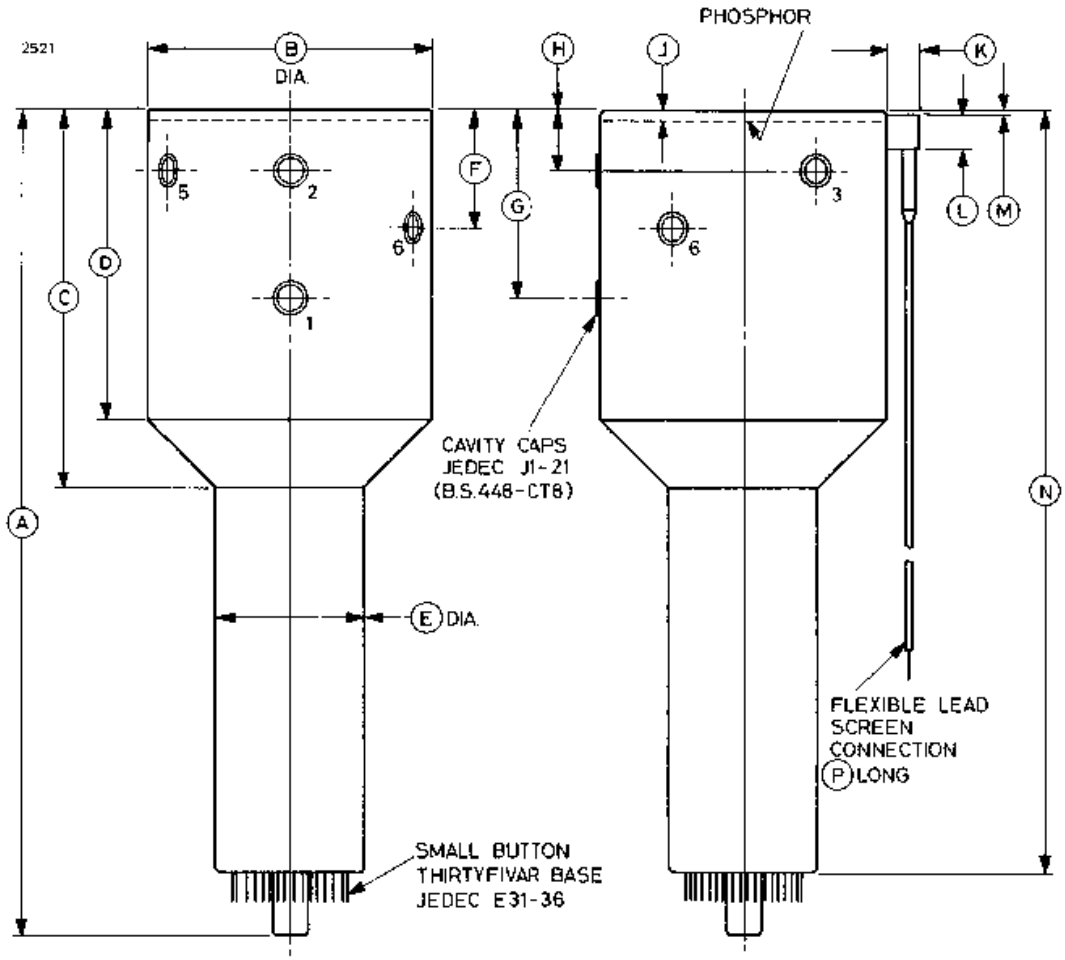


The storage mesh surface potential is arbitrarily considered zero at full brightness for the purpose of this graph.

TYPICAL SPECTRAL OUTPUT CHARACTERISTIC FOR P20 PHOSPHOR



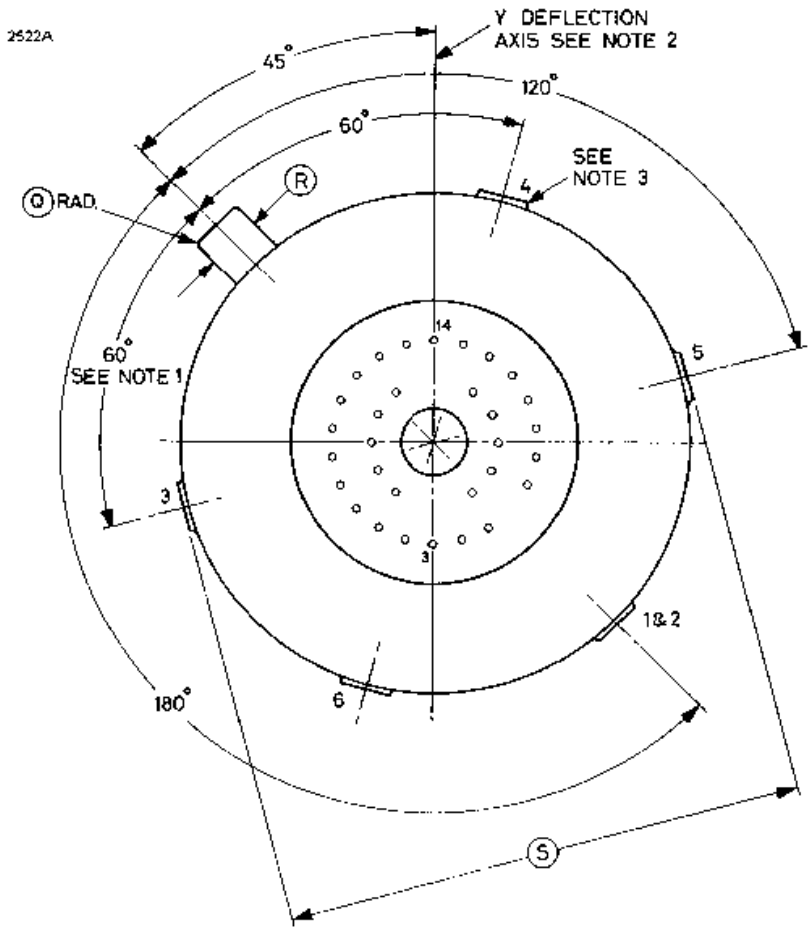
OUTLINE



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.250 ± 0.250	387.4 ± 6.4	K	0.625 max	15.88 max
B	5.312 max	134.9 max	L	0.563 max	14.30 max
C	7.000 max	177.8 max	M	0.062	1.58
D	5.750 max	146.1 max	N	14.125 ± 0.250	358.8 ± 6.4
E	3.094 max	78.59 max	P	22.5	571.5
F	2.188 ± 0.125	55.58 ± 3.18	Q	0.062 max	1.58 max
G	3.500 ± 0.125	88.90 ± 3.18	R	0.625 max	15.88 max
H	1.125 + 0.125	28.58 ± 3.18	S	5.437 max	138.1 max
J	0.250 ± 0.025	6.35 ± 0.64			

Millimetre dimensions have been derived from inches.

OUTLINE



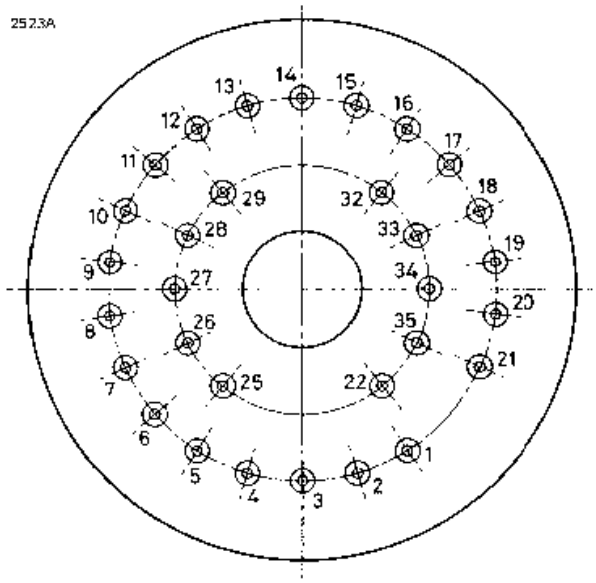
Outline Notes

1. Tolerance on angles $\pm 7^{\circ}$.
2. The centre line passing through base pins 3 and 14 and the Y-deflection axis are in line within 10°.
3. Cavity cap 4 is on the same plane as cavity caps 2, 3 and 5.

Cavity Cap Connections

Cap	Element	Cap	Element
1	Grid 3 (flood gun)	4	Grid 4 (flood gun)
2	Grid 4 (flood gun)	5	Backing electrode
3	Grid 4 (flood gun)	6	Grid 3 (flood gun)

Base Connections



Pin	Element
1	No connection
2	No connection
3	Deflection plate X1
4	Deflection plate X2
5	No connection
6	Grid 3 (writing gun)
7	Internal connection.
	Do not use
8	Heater (writing gun)
9	Heater (writing gun)
10	Grid 1 (writing gun)
11	No connection
12	No connection
13	Deflection plate Y1
14	Deflection plate Y2
15	Grid 2 (writing gun)
16	No connection
17	Grid 2 (flood gun) and
	grid 4 (writing gun)
18	No connection

Pin	Element
19	No connection
20	Internal connection.
	Do not use
21	No connection
22	Heater (flood gun)
23	Omitted
24	Omitted
25	No connection
26	Internal connection.
	Do not use
27	Cathode (writing gun)
28	Internal connection.
	Do not use
29	No connection
30	Omitted
31	Omitted
32	Grid 1 (flood gun)
33	Cathode (flood gun)
34	No connection
35	Heater (flood gun)

English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

E713B

DIRECT VIEW STORAGE TUBE

Service Type CV9422

The data should be read in conjunction with the Storage Tube Preamble.

INTRODUCTION

The E713B is a direct view storage tube with a useful viewing screen diameter of 4 inches (102mm). It is of ruggedized construction and is designed to provide very bright displays of information ranging from single transients and recurrent waveforms to half tone pictures. The writing gun beam is magnetically deflected. E713B is particularly suitable for the daylight viewing of radar displays and is recommended for airborne and other applications where vibration and low pressure conditions may be encountered.

The tube has two electron guns, one for writing the signal on to the storage surface and the other, the flood gun, for displaying written information on the viewing screen. The writing gun is similar to that in a conventional cathode ray tube, except that it need only be operated for a single trace. In writing, a charge pattern is deposited on the storage surface, which consists of an insulator coating on a metal mesh (the backing electrode). Low velocity electrons from the flood gun approach the storage mesh normally and at constant current density over the useful area. They penetrate the mesh in those areas where a charge pattern has been written, the number doing so being determined by the amount of charge deposited, and are then accelerated to the viewing screen where they produce an image.

Since the flood gun is normally continuously operative, the image on the viewing screen persists without deterioration for about one minute and is visible for periods up to ten minutes. Extended storage periods may be obtained by switching off the flood beam until viewing is required, provided that no writing takes place while the flood gun is inoperative. The image can be completely erased in a fraction of a second by applying a small positive pulse to the backing electrode and controlled persistence can be obtained by varying the duration of shorter repetitive pulses.

GENERAL

Electrical and General

	Writing Gun	Flood Gun	
Cathodes, indirectly heated, oxide coated	one	one	
Heater voltage	6.3	6.3	V
Heater current	0.6	0.6	A
Cathode heating time (minimum)	see note 1	45	s
Inter-electrode capacitances:			
cathode to all other electrodes	4.0	—	pF
grid 1 to all other electrodes	7.0	—	pF
writing gun grid 1 to writing gun cathode*	1.5	—	pF
backing electrode to all other electrodes	—	66	pF
screen to all other electrodes	—	32	pF
Focus method	electrostatic	electrostatic	
Deflection method	magnetic	none	
Phosphor	—	aluminized P20	
Fluorescent colour (see spectral characteristic)		yellow-green	

Mechanical

Overall length	12.187 inches (309.6mm) max
Overall diameter (excluding flexible lead)	5.635 inches (143.1mm) max
Bulb diameter	5.300 inches (134.6mm) max
Useful viewing screen diameter	4.000 inches (101.6mm) min
Net weight	2 pounds (0.9kg) approx
Mounting position (see note 2)	any, except with base up and with the tube axis at an angle less than 20° from vertical
Connections:	
writing gun	flexible leads
flood gun	flexible leads
Bulb cavity caps (five)	B.S.448-CT8 (JEDEC no. J1-21)
Viewing screen connection	flexible lead

* With all other electrodes earthed

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

All voltages are with respect to the flood gun cathode unless otherwise stated

Writing Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Grid 4 voltage			see note 3
Grid 3 voltage (negative value)	—	2000	V
Grid 2 voltage	—	200	V
Grid 1 voltage:			
negative bias*	0	200	V
positive peak*	—	2.0	V
Cathode voltage (negative value)	—	2300	V
Peak heater to cathode voltage:			
heater positive with respect to cathode	—	125	V
heater negative with respect to cathode	—	125	V
Cathode current (peak)	—	1.0	mA
Grid to cathode circuit impedance	—	1.0	MΩ

Flood Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Viewing screen voltage	—	12	kV
Backing electrode voltage (peak) (see note 4)	—	20	V
Grid 4 (collector mesh) voltage	—	300	V
Grid 3A voltage	—	300	V
Grid 3 voltage	—	300	V
Grid 2 voltage (see note 3)	—	150	V
Grid 1 voltage	—	150	V
Peak heater to cathode voltage:			
heater positive with respect to cathode	—	125	V
heater negative with respect to cathode	—	125	V
Cathode current	—	10	mA
Viewing screen dissipation	—	6.0	W
Backing electrode supply impedance	—	5000	Ω
Viewing screen supply impedance (see note 5)	1.0	5.0	MΩ

* With respect to Writing Gun Cathode.

TYPICAL OPERATION

All voltages are with respect to the flood gun cathode unless otherwise stated

WRITING GUN

Operational Conditions

Grid 4 voltage	see note 3	
Grid 3 voltage (usual range for focus)*	400 to 700	V
Grid 2 voltage	0	V
Grid 1 voltage (range for writing beam cut-off)*	−30 to −55	V
Cathode voltage	−1800	V

Typical Performance

Writing beam current (50V modulation) (see note 6)	45	μA
Cathode current (50V modulation) (see note 6)	550	μA

FLOOD GUN

Operational Conditions

Screen voltage	10	kV
Backing electrode d.c. voltage	5.0	V
Erase pulse amplitude for screen cut-off (see notes 7 and 8)	3.9	V
Grid 4 (collector mesh) voltage	225	V
Grid 3A voltage	150	V
Grid 3 voltage (see note 9)	65	V
Grid 2 voltage (see note 3)	70	V
Grid 1 voltage	30	V
Cathode voltage	0	V

Typical Performance

Screen current for full brightness	0.4	mA
Cathode current	3.75	mA
Screen luminance (see note 10)	1800	ft-lamberts
	6170	cd/m^2
Viewing time (see note 11)	20	s min

* With respect to Writing Gun Cathode.

NOTES

1. To prevent the occurrence of transients when switching on or off, the writing gún heater voltage may be applied simultaneously with, or after, the other writing gun voltages, and switched off before these voltages are removed, provided the writing gun is biased to beyond cut-off.
2. Two silicone rubber rings are bonded to the bulb (see outline drawing) and these provide means for positive location of the tube in equipment.
3. Grid 4 (writing gun) is internally connected to grid 2 (flood gun).
4. Except when the faults mentioned under Pulse Erasure, part (c), of the General Instructions on pages 6 and 7 are being corrected.
5. The viewing screen supoly impedance should be less than 5MΩ to prevent excessive changes in screen voltage during erasure.
6. Writing is a charge deposition process and the current required for a given brightness level is proportional to the writing speed and inversely proportional to the number of times the information is written in one place.
7. With manual erasure (approximately 1 second) and the screen voltage simultaneously removed.
8. Maximum screen brightness is obtained when the storage mesh surface has stabilized at approximately zero potential, i.e. flood gun cathode potential. The application of a positive manual erase pulse to the backing electrode produces a corresponding positive increase in the storage mesh surface potential. This surface potential is reduced to near flood gun cathode potential by flood beam electrons. When the erase pulse is removed the surface acquires a negative potential relative to that at full brightness and equal in value to the erase pulse amplitude.
9. To achieve collimation of the flood beam, the voltages applied to the flood gun grids 2, 3, 3A and 4 should be preset to the fixed values given on page 4. The voltage of grid 1 should then be adjusted to just give maximum uniform dislay over the screen. The voltage of grid 3 should be adjusted to give the most uniform erasure when a train of erasing pulses is applied to the backing electrode. Slight readjustment of grid 1 and grid 3A voltages may assist in obtaining the most uniform erasure.
10. The meter used for measuring screen luminance has been corrected to the frequency response of the human eye.

11. Time for background to rise from cut-off to 10% of maximum brightness. An increase in viewing time can be obtained by switching off the flood beam by pulses at a frequency sufficiently high to prevent flicker, the apparent brightness of the display being proportionately reduced.

GENERAL INSTRUCTIONS

Handling

The tube should be transported screen upwards to prevent particles falling on the storage elements. It should be handled with care to avoid damage to the metal seals and the encapsulated screen lead.

Pulse Erasure

(a) The speed of erasure is controlled by the adjustment of the pulse duration in conjunction with the pulse repetition rate, which should be sufficiently high to prevent flicker, and preferably in the range between 100 and 2000 pulses per second. By increasing the pulse duration or the pulse repetition rate, the erasure time may be reduced proportionately. The pulse amplitude also alters the erase rate but primarily determines the final potential to which the storage mesh is driven in the absence of writing. Normally a pulse amplitude two to three times the manual erase value is applied, which gives an approximately uniform rate of erasure for visible signals but tends to suppress small non-integrating signals such as noise. A much lower pulse amplitude must be used if the grey scale is to be preserved with no loss of information.

(b) If it can be conveniently arranged for the screen h.t. to be switched off simultaneously with either manual or pulse train erase then two advantages will ensue:

(i) Contrast during pulse train erase will improve.
(ii) The time taken for erasure will decrease.

(c) The normal erasure procedure may be inadequate or ineffective under the following conditions:

(i) When writing beam electrons have penetrated the surface of the storage insulator and have built up charges within it. Low velocity flood beam electrons cannot neutralize these charges and after the normal erasure procedure has been carried out the original screen image may still be faintly visible as the background illumination increases.

(ii) When parts of the storage mesh surface are driven so positive that the number of secondary electrons produced by the flood beam exceeds those arriving at the surface. This condition is known as runaway charging and can occur when a pulse exceeding 20 volts in amplitude is applied to the backing electrode. It can also occur when an excessively high writing charge is deposited, e.g. with a stationary spot or line and particularly when writing takes place in the absence of flood beam current. Damage may be done to the storage mesh if this fault is not quickly corrected.

Both faults can be corrected by operating a switch to disconnect the backing electrode from its supply and connecting it to the flood gun grid 4 through a protective resistor; this switch must make and break quickly and need be operated once only. The screen should then be at uniform full brightness and normal erasure will prepare the tube for operation. Care should be taken to ensure that this switch cannot be left in the 'on' condition. The above procedure is known as 'clearance'.

Flood Gun

To prevent the occurrence of runaway charging, the flood gun beam must always be operative before the writing gun supplies are switched on.

Writing Gun

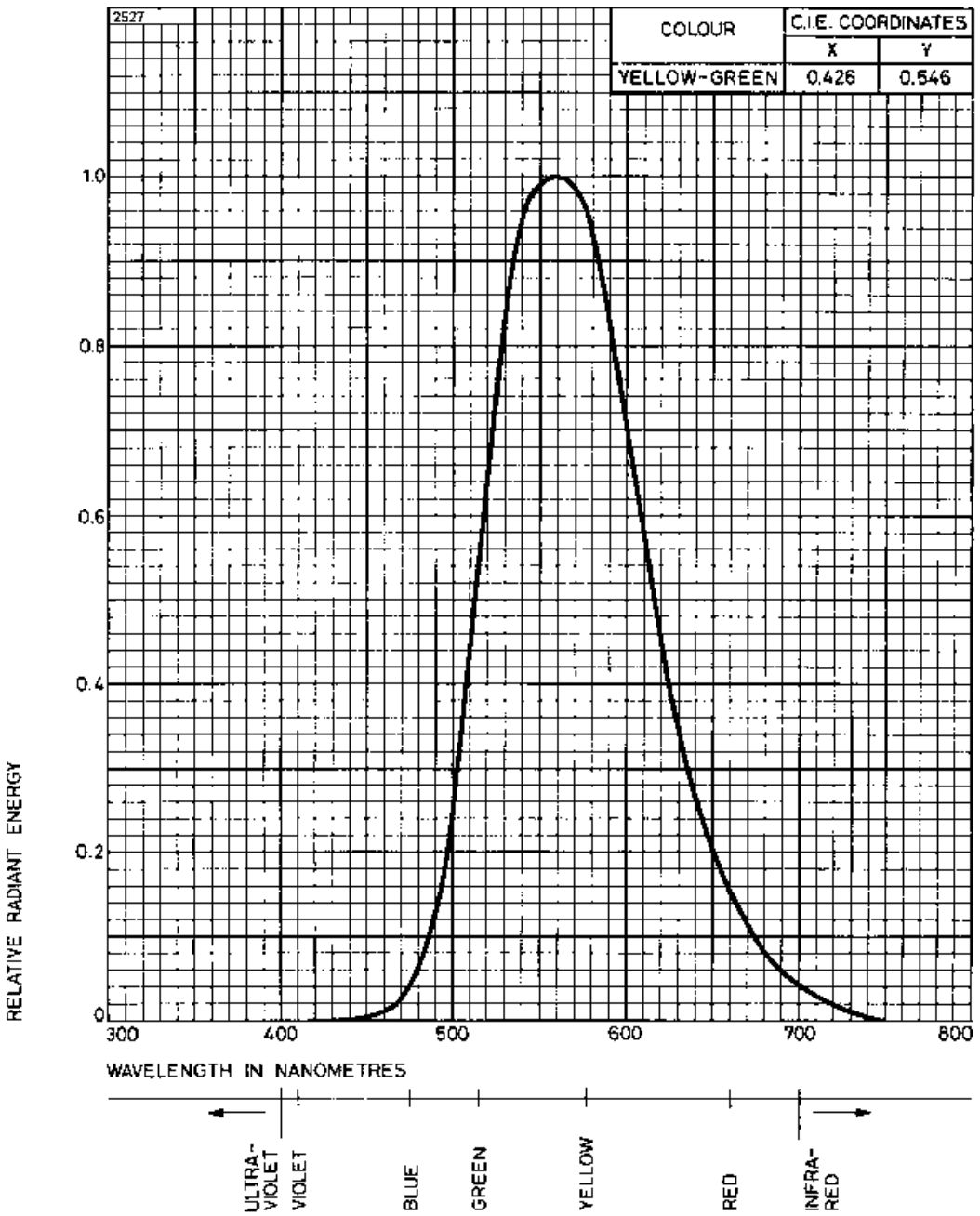
The writing gun cathode is operated at a potential in the region of −1.5 to −2.3kV; consequently the heater supply should be adequately insulated. The cathode supply must be free from ripple to prevent modulation of the writing beam and have good stability to maintain constant modulation depth and focus.

Care should be taken to prevent heavy transient writing beam currents when switching on. The writing beam should be adjusted so that the highlight brightness of the display is not saturated as this will result in a rapid deterioration in resolution.

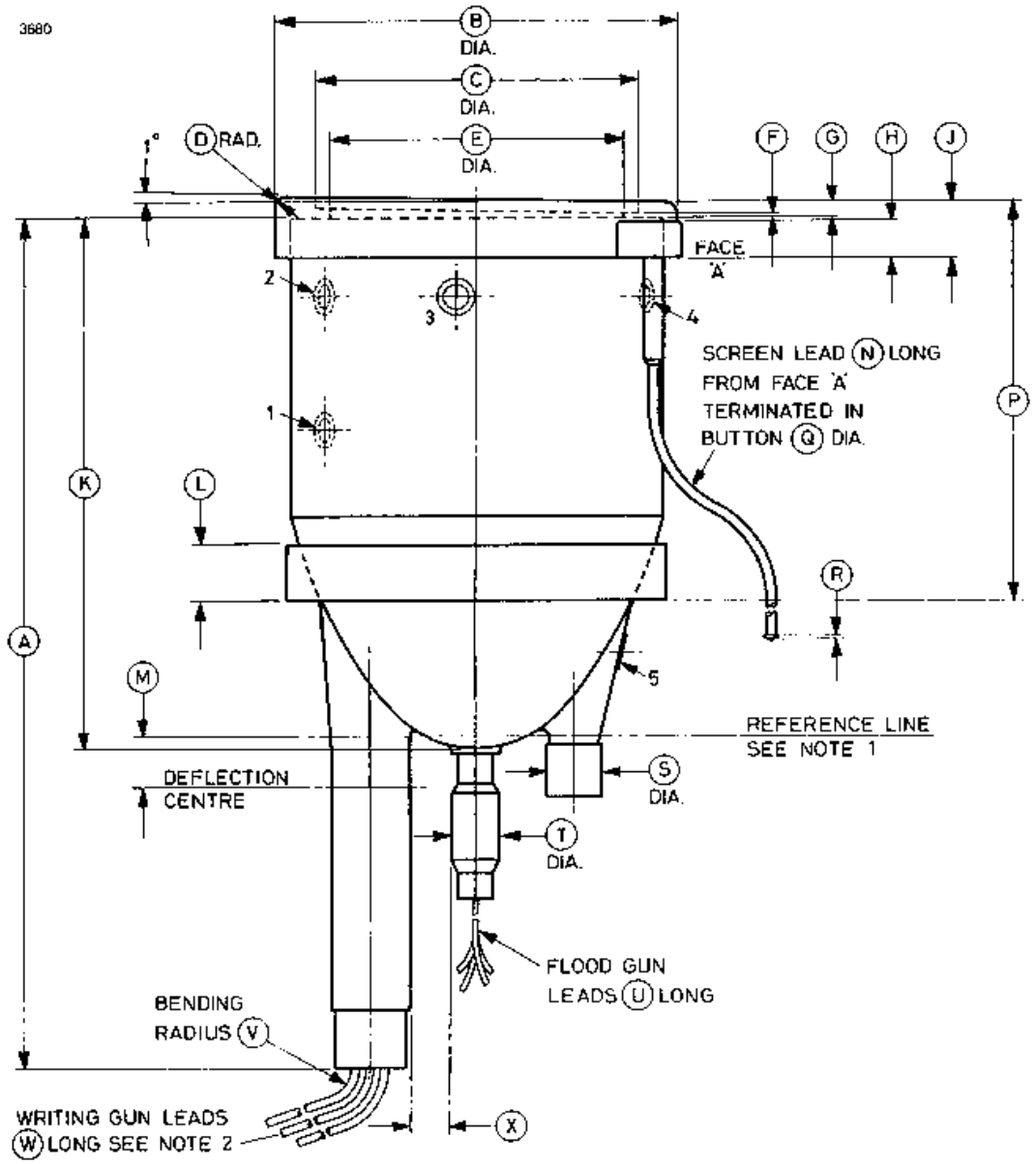
Deflection Supplies

Any failure of the deflection drive that may result in the production of a stationary spot or line may cause runaway charging, even with the flood beam on. Provision should be made for automatically cutting off the writing gun beam in the event of any such failure.

TYPICAL SPECTRAL OUTPUT CHARACTERISTIC FOR P20 PHOSPHOR



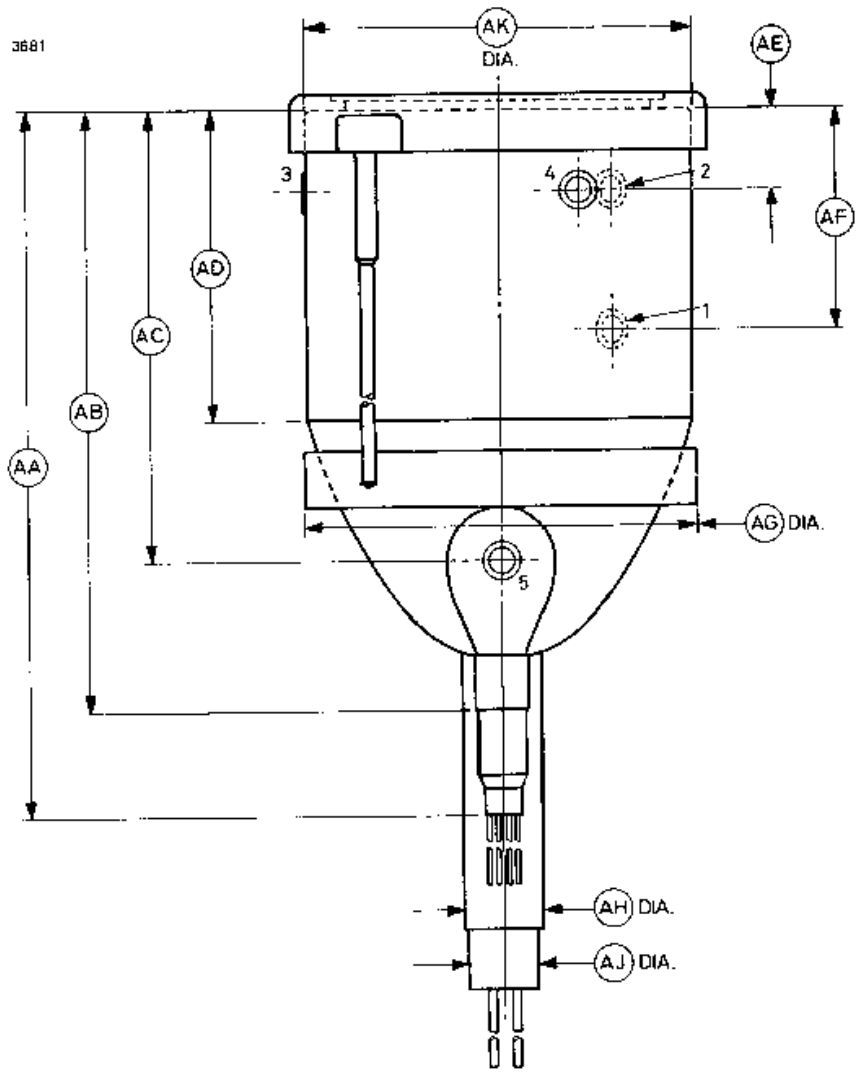
OUTLINE (See page 11 for dimensions)



Outline Notes

1. The reference line is defined by the position of the end of the gauge shown on page 11.
2. The leads to the writing gun are tinned copper wire, 0.50mm^2, stranded 16/0.20mm, silicone rubber insulated to 3.20mm diameter.

OUTLINE

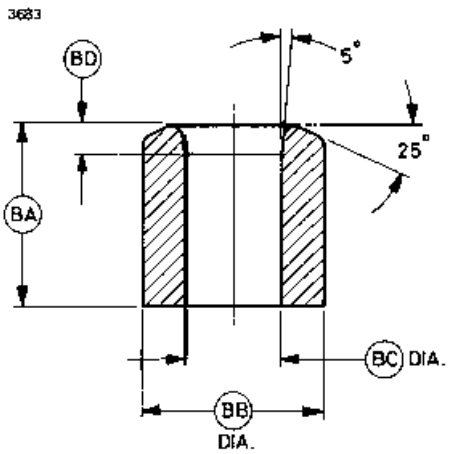


Outline Dimensions

Ref	Inches	Millimetres
A	12.000 max	304.8 max
B	$5.625^{+0.010}_{-0.020}$	$142.9^{+0.25}_{-0.51}$
C	4.525 ± 0.010	114.9 ± 0.25
D	0.187	4.75
E	4.125 ± 0.030	104.8 ± 0.76
F	0.040 ± 0.005	1.02 ± 0.13
G	0.165 ± 0.015	4.19 ± 0.38
H	0.563 max	14.30 max
J	0.800 ± 0.050	20.32 ± 1.27
K	7.500 max	190.5 max
L	0.800 ± 0.050	20.32 ± 1.27
M	0.750	19.05
N	12.125 ± 0.250	308.0 ± 6.35
P	5.625 ± 0.150	142.9 ± 3.8
Q	0.188	4.78
R	0.063	1.60
S	0.750 max	19.05 max
T	0.688 max	17.48 max
U	8.000 min	203.2 min
V	0.250 min	6.35 min
W	6.000 min	152.4 min
X	0.562 min	14.27 min
AA	9.625 max	244.5 max
AB	8.187 max	208.0 max
AC	6.125 ± 0.250	155.6 ± 6.35
AD	4.250 ± 0.250	108.0 ± 6.35
AE	1.125 ± 0.125	28.58 ± 3.18
AF	3.000 ± 0.375	76.20 ± 9.53
AG	$5.300^{+0.010}_{-0.020}$	$134.6^{+0.25}_{-0.51}$
AH	1.055 max	26.80 max
AJ	1.010 ± 0.010	25.65 ± 0.25
AK	5.250	133.4
AN	0.625 max	15.88 max
AP	0.625 max	15.88 max
AQ	1.500 ± 0.063	38.10 ± 1.60
AR	1.375 ± 0.063	34.93 ± 1.60

Millimetre dimensions have been derived from inches.

Reference Line Gauge

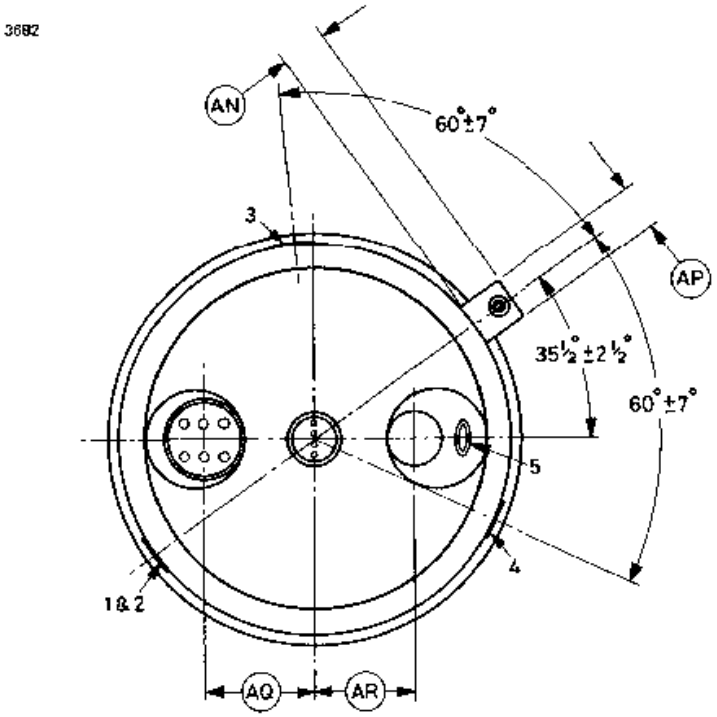


Ref	Inches	Millimetres
BA	2.000 ± 0.010	50.80 ± 0.25
BB	2.000 ± 0.010	50.80 ± 0.25
BC	1.055	26.80
BD	0.312	7.92

Millimetre dimensions have been derived from inches.

OUTLINE (View on base end of tube)

See page 11 for outline dimensions.



Lead Connections, Writing Gun

Lead	Element
Yellow	Cathode
Green	Grid 1
Brown	Heater
Brown	Heater
White	Grid 3
Grey	Grid 2

Lead Connections, Flood Gun

Lead	Element
Yellow	Cathode
Brown	Heater
Brown	Heater
Green	Grid 1

Cavity Cap Connections

Cap	Element
1	Grid 3 (flood gun)
2	Backing electrode
3	Grid 3A (flood gun)
4	Grid 4 (flood gun)
5	Grid 2 (flood gun)

English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

K3007

OSCILLATOR KLYSTRON

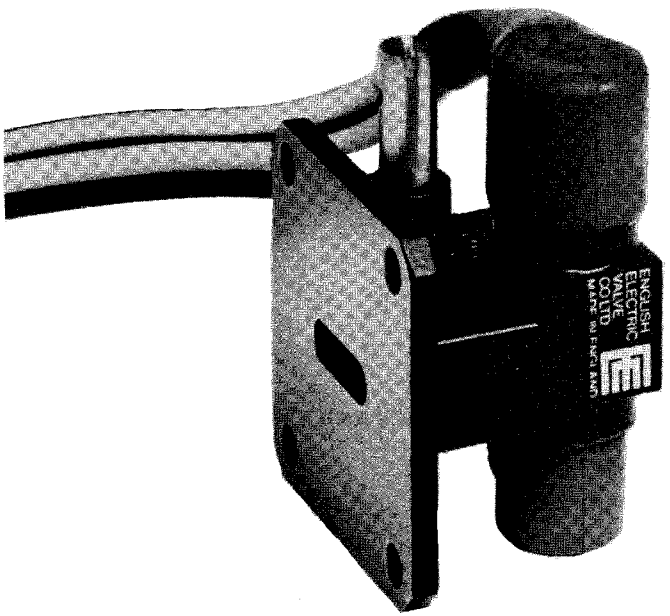
Service Type CV9423

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

ABRIDGED DATA

Rugged reflex klystron for airborne radar.

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



GENERAL

Electrical

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

Mechanical

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

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

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

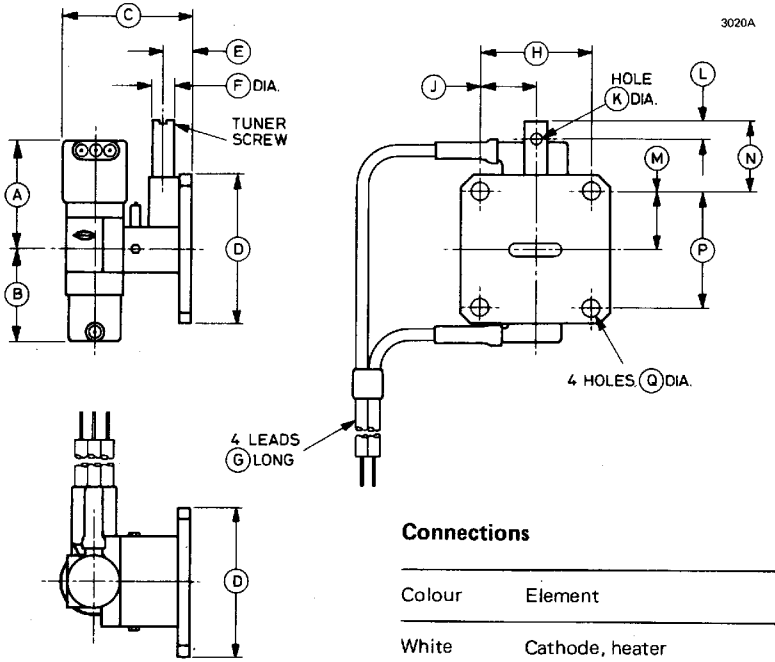
Range of Characteristics

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

NOTES

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

OUTLINE (All dimensions without limits are nominal)



Connections

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

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

Millimetre dimensions have been derived from inches.

K311

OSCILLATOR KLYSTRON

Service Type CV9492

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

ABRIDGED DATA

Low voltage reflex klystron for local oscillator service.

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

GENERAL

Electrical

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

Mechanical

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

Cooling (See note 3) natural

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

Range of Characteristics

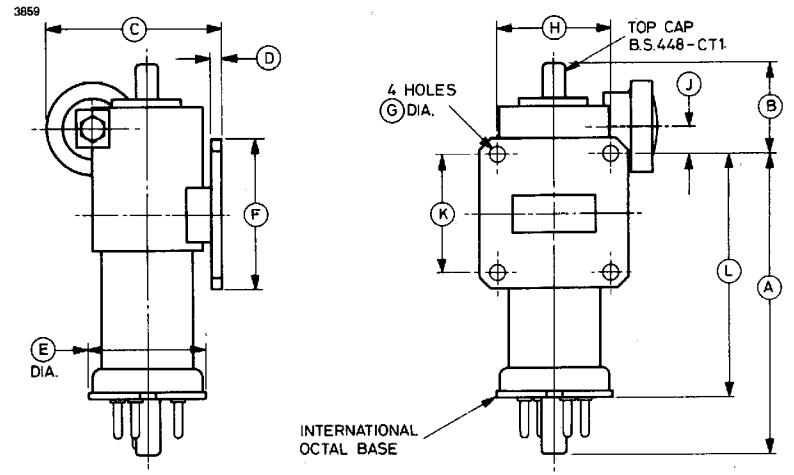
	Min	Typical	Max	
Heater current	0.52	0.58	0.61	A
Resonator current	20	35	44	mA
Reflector voltage	−165	—	−365	V
Output power	30	45	—	mW
Mechanical tuning range	8500	—	9500	MHz
Tuning rate	—	7.0	—	MHz/turn
Electronic tuning range to −3db points	20	30	—	MHz
Reflector modulation sensitivity	—	0.75	—	MHz/V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

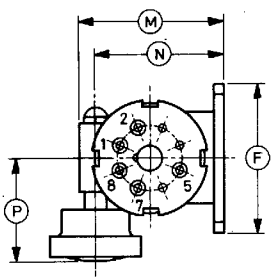
NOTES

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

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

OUTLINE (All dimensions without limits are nominal)





Base Connections

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

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

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

Millimetre dimensions have been derived from inches.

K337

OSCILLATOR KLYSTRON

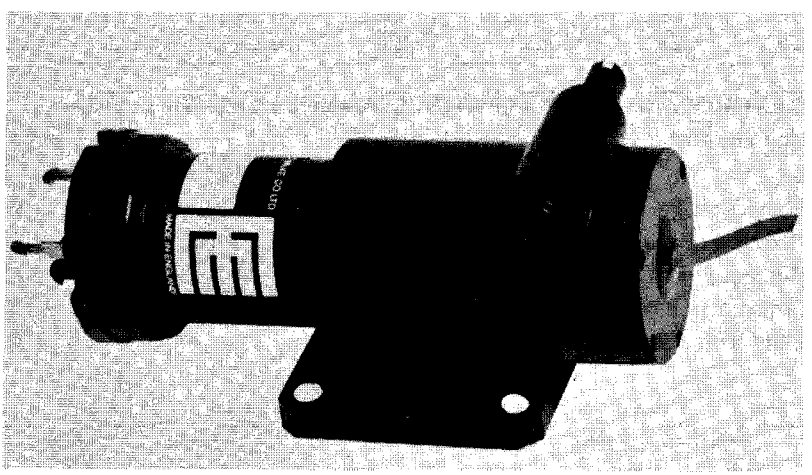
Service Types CV4515, CV5130

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

ABRIDGED DATA

Rugged reflex klystron for local oscillator service.

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



GENERAL

Electrical

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

Mechanical

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

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

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

Range of Characteristics

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

NOTES

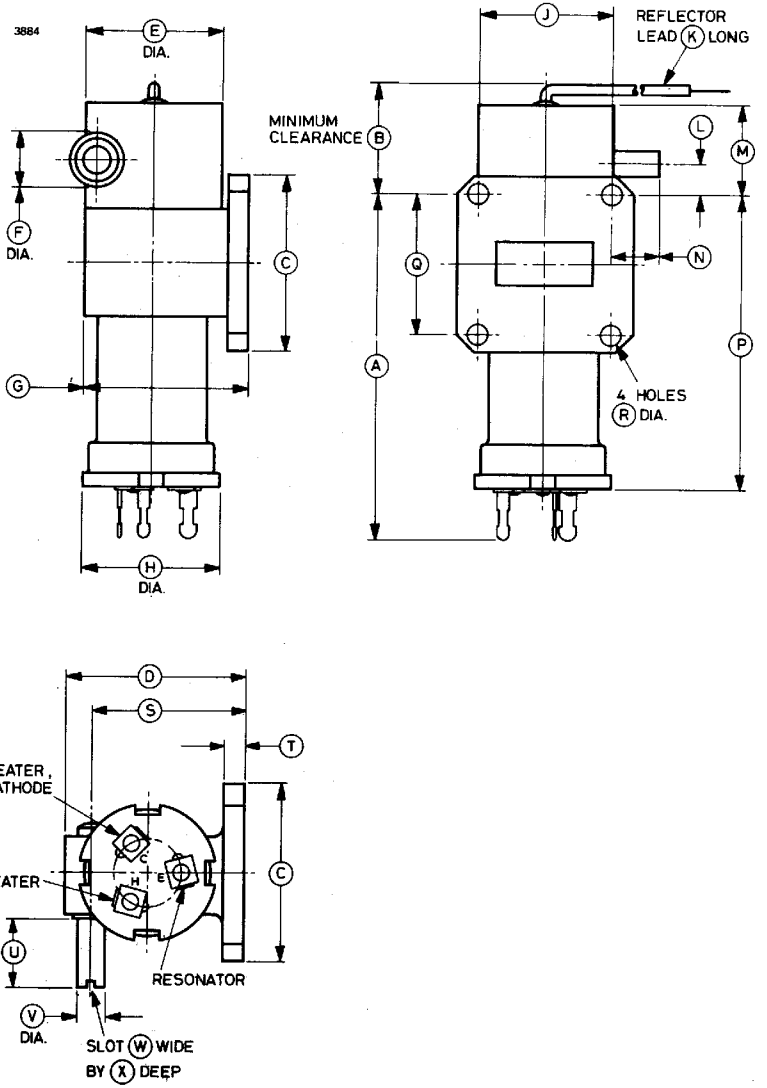
1. Clockwise tuner rotation increases the frequency. The tuner torque is 15oz in (0.1Nm) max. **Warning** No stops are fitted to the tuner and tuning beyond the specified frequency range may damage the klystron.
2. The resonator is normally operated at earth potential and in good thermal contact with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

Outline Dimensions

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

Millimetre dimensions have been derived from inches.

OUTLINE


3884
E
DIA.
F
DIA.
C
G
H
DIA.
MINIMUM
CLEARANCE
B
J
REFLECTOR
LEAD K LONG
L
M
N
Q
A
P
4 HOLES
R DIA.
D
S
T
HEATER,
CATHODE
HEATER
K
C
H
E
A
U
RESONATOR
V
DIA.
SLOT W WIDE
BY X DEEP

K342

OSCILLATOR KLYSTRON

Service Type CV6003

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

ABRIDGED DATA

Rugged reflex klystron for local oscillator service.

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

GENERAL

Electrical

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

Mechanical

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

Cooling (See note 2) natural

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

Range of Characteristics

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

NOTES

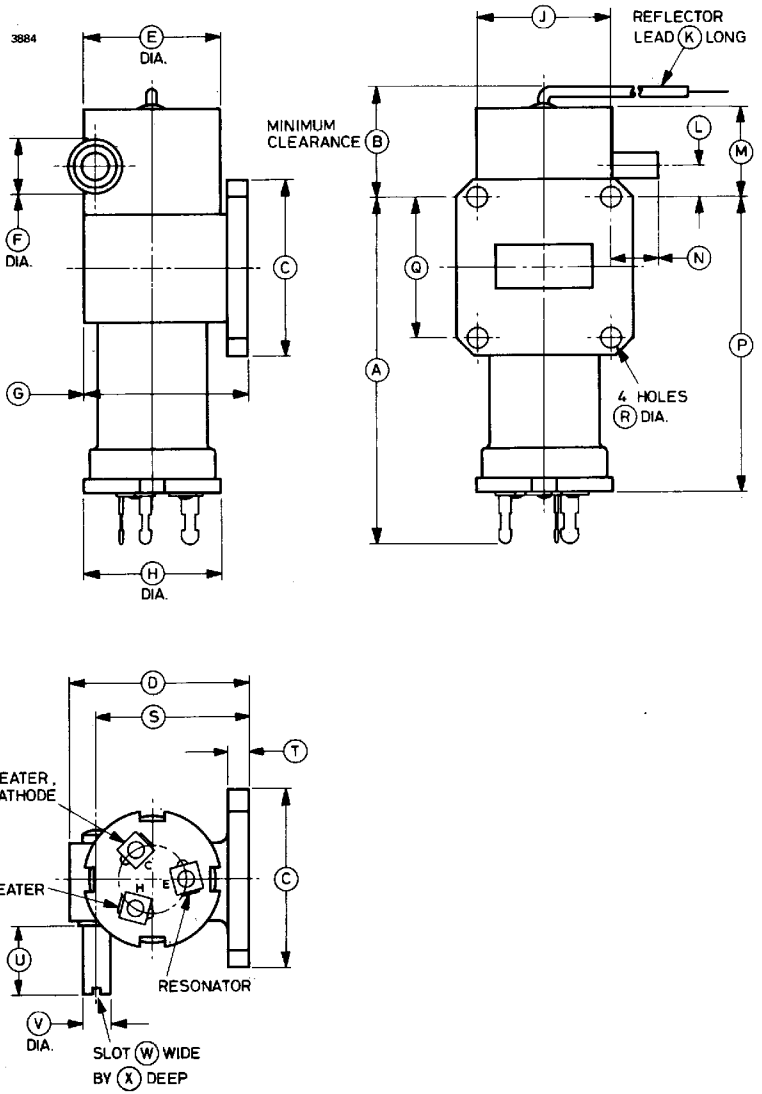
1. Clockwise rotation of the tuner increases the frequency. The tuner torque is 20oz in (0.14Nm) max. **Warning** No stops are fitted to the tuner and tuning beyond the specified frequency range may damage the klystron.
2. The resonator is normally operated at earth potential and in good thermal contact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

Outline Dimensions

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

Millimetre dimensions have been derived from inches.

OUTLINE


3884
E DIA.
F DIA.
C
G
H DIA.
MINIMUM CLEARANCE B
J
REFLECTOR LEAD K LONG
L
M
N
Q
A
P
4 HOLES R DIA.
D
S
T
HEATER, CATHODE
HEATER
U
V DIA.
SLOT W WIDE BY X DEEP
RESONATOR

K350

OSCILLATOR KLYSTRON

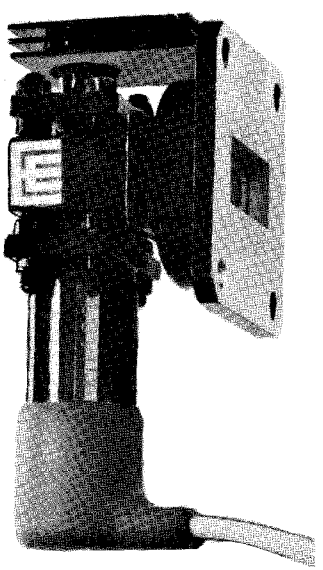
Service Type CV5426

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

ABRIDGED DATA

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

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



GENERAL

Electrical

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

Mechanical

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

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

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

Range of Characteristics

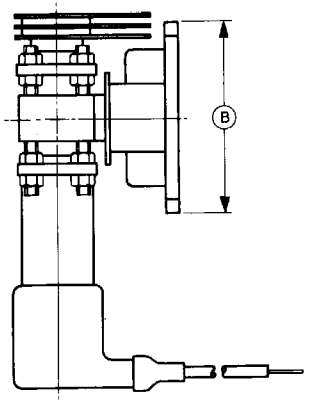
	Min	Typical	Max	
Heater current	1.5	1.6	1.75	A
Frequency	8795	8800	8805	MHz
Beam voltage for mode optimum	680	700	750	V
Beam current	55	70	80	mA
Output power	1.0	1.5	2.5	W
Electronic tuning range to −3db points	10	12	—	MHz
Beam voltage modulation sensitivity	100	200	300	kHz/V
Frequency pulling (see note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

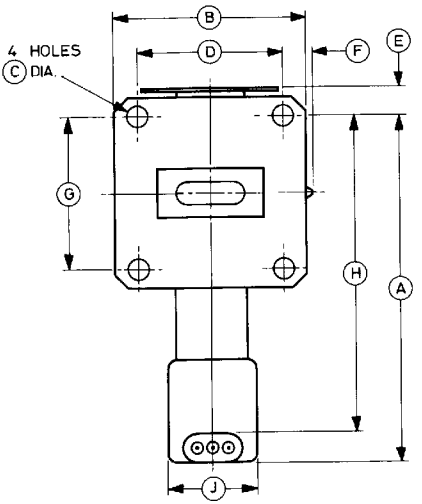
NOTES

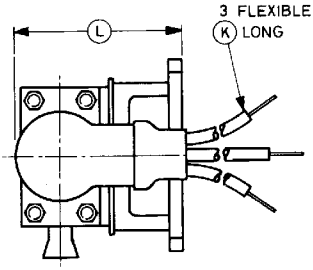
1. Other frequencies can be supplied in the range 8500 to 10 000MHz.
2. Under typical operating conditions, an air flow of 30ft^3/min (0.85m^3/min) directed at the radiator fins is adequate. For best life, the radiator temperature should be kept below 100°C.
3. All voltages except the heater voltage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

OUTLINE

3642A







Lead Connections

Colour	Element
White	Heater, cathode
Yellow	Heater
Green	Cathode

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

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

Millimetre dimensions have been derived from inches.

K391

OSCILLATOR KLYSTRON

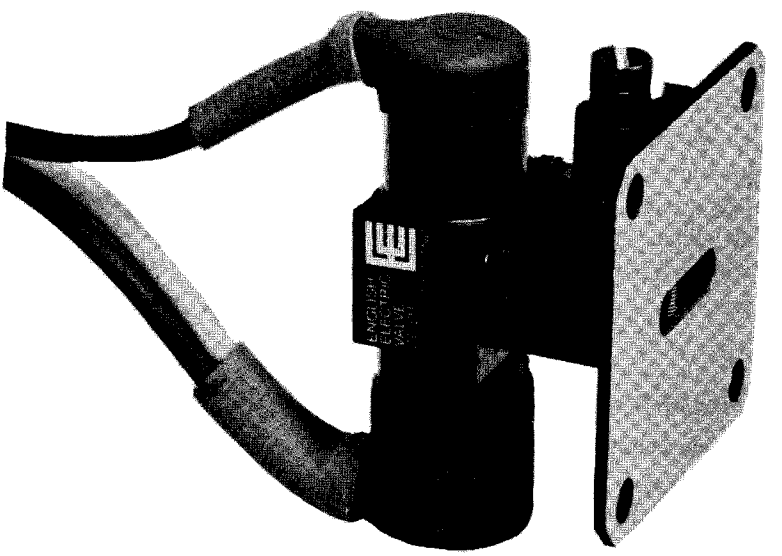
Service Type CV6194

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

ABRIDGED DATA

Rugged, low voltage reflex klystron for airborne service.

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



GENERAL

Electrical

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

Mechanical

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

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

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

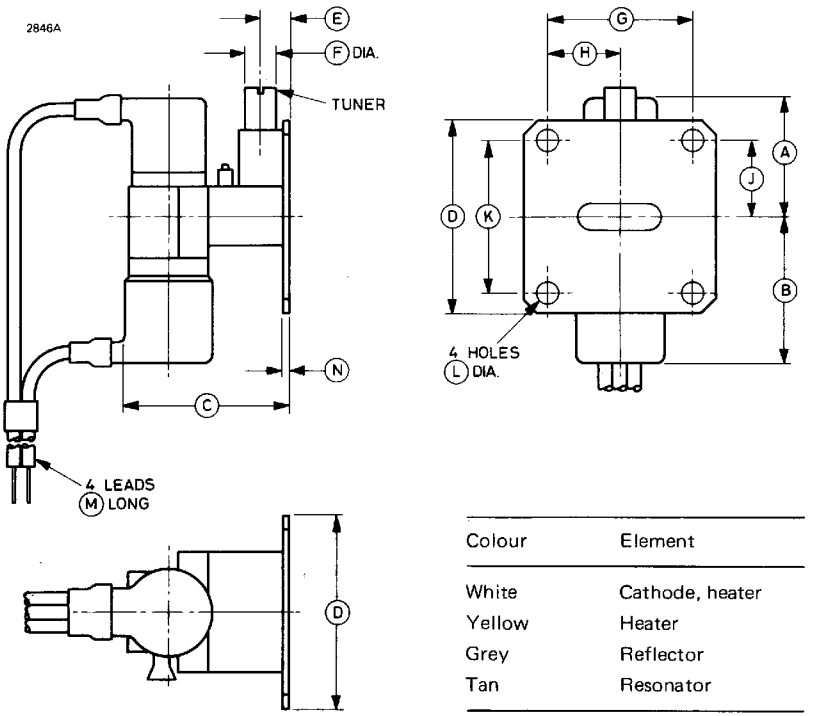
Range of Characteristics

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

NOTES

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

OUTLINE



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

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

Millimetre dimensions have been derived from inches.

K391A

OSCILLATOR KLYSTRON

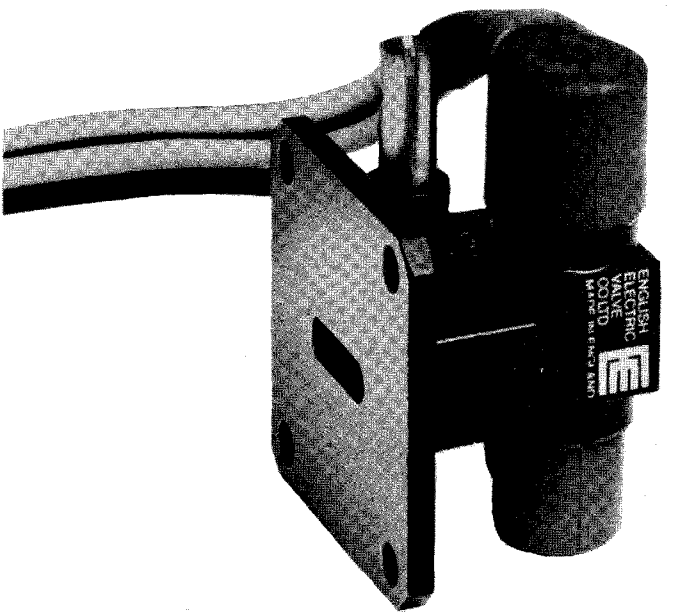
Service Type CV6142

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

ABRIDGED DATA

Rugged reflex klystron for airborne radar and similar applications.

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



GENERAL

Electrical

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

Mechanical

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

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

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

No individual rating to be exceeded.

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

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions

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

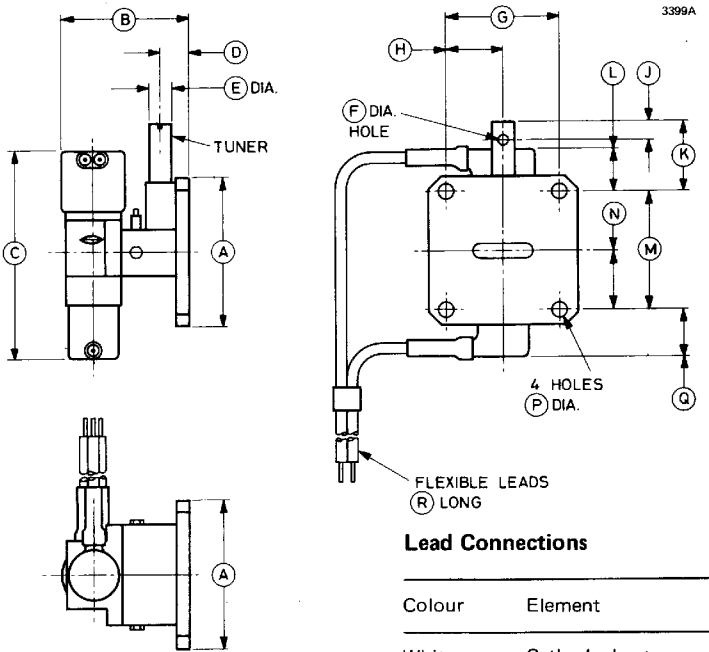
Range of Characteristics

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

NOTES

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

OUTLINE (All dimensions without limits are nominal)



Lead Connections

Colour	Element
White	Cathode, heater
Yellow	Heater
Grey	Reflector

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

Millimetre dimensions have been derived from inches.

M5005

X-BAND MAGNETRON

Service Type CV9424

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	53	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	12.6	V
Heater current at 12.6V	2.2	A
Heater starting current, peak value, not to be exceeded	10	A max
Cathode pre-heating time (minimum)	1.5	min

Mechanical

Overall dimensions	148.4 x 105.1 x 73.66mm max 5.844 x 4.138 x 2.900 inches max
Net weight	1.77kg (3.9 pounds) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling . . . . . forced-air

September 1973

Supersedes September 1971 Issue

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	—	14	V
Heater starting current (peak)	—	10	A
Anode voltage (peak)	11.5	13.5	kV
Anode current (peak)	9.0	12	A
Input power (mean) (see note 2)	—	240	W
Pulse duration	—	5.0	μs
Rate of rise of voltage pulse (see note 4)	40	120	kV/μs
Anode temperature	—	150	°C
V.S.W.R. at the output coupler	—	1.5:1	
Pressurizing of waveguide	—	40	lb/in^2
	—	2.8	kg/cm^2
Altitude (at v.s.w.r. 1.2:1 max)	—	20 000 (360mm Hg min)	ft

TYPICAL OPERATION

Operational Conditions

Heater voltage	7.5	V
Anode current (peak)	12	A
Pulse duration	4.0	μs
Pulse repetition rate	400	p.p.s.

Typical Performance

Anode voltage (peak)	13	kV
Output power (peak)	53	kW
Output power (mean)	85	W

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification

Test Conditions

Heater voltage (for test)	9.3	V
Anode current (mean)	12	mA
Duty cycle	0.001	
Pulse duration (see note 3)	5.0	μs
V.S.W.R. at the output coupler	1.05:1	
Rate of rise of voltage pulse (see notes 4 and 5)	75	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	11.5	13.5	kV
Output power (mean)	40	—	W
Frequency (see note 6)	9345	9405	MHz
Frequency pulling (v.s.w.r. 1.5:1)	—	13	MHz
Stability (see note 7)	—	0.5	%
Frequency pushing	—	0.5	MHz/A
Altitude (v.s.w.r. 1.2:1) (see note 8)	20 000	—	ft
	6.1	—	km
Heater current			see note 9
Temperature coefficient of frequency			see note 10

LIFE TEST

The quality of all production is monitored by the random selection of magnetrons which are then life-tested under test conditions above, but with a v.s.w.r. of 1.5:1 (min) cycled through λg in 30 minutes max. If the magnetron is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the magnetron will not be impaired.

End of Life Criteria (under Test Conditions above)

Output power (mean)	32	W min
Frequency	9345 to 9405	MHz
Stability (see note 7)	2.0	% max

NOTES

1. With no anode input power.

   On stand by the heater voltage must not exceed 12.6 volts. Prior to the application of h.t. the cathode must he heated by applying to the heater 12.6 volts for 1½ minutes. On application of anode power, the heater voltage must be lowered according to the following formula:

   $$V_h = 11.6 - 0.017Pi$$

   where Pi = mean input power in watts.

   The magnetron heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the Magnetron·Preamble.

2. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

3. Tolerance ±10%.

4. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80 per cent amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

5. All magnetrons are also tested functionally with the following pulse conditions:

Rate of rise of voltage pulse	60	kV/μs max
Pulse duration	4.0	μs
Duty cycle	0.0016	
Anode current (mean)	19.2	mA

   Load v.s.w.r. 1.5:1 varied through all phases.

6. With anode temperature of 100°C ± 10°C. Operation at any temperature other than that specified will result in a difference between the operating frequency and that specified under Test Limits.

7. With the magnetron operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency

range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 5 minutes.

8. The altitude test is carried out under the typical operation conditions, that is

Pulse duration	4.0	μs
Duty cycle	0.0016	
Anode current (peak)	12	A

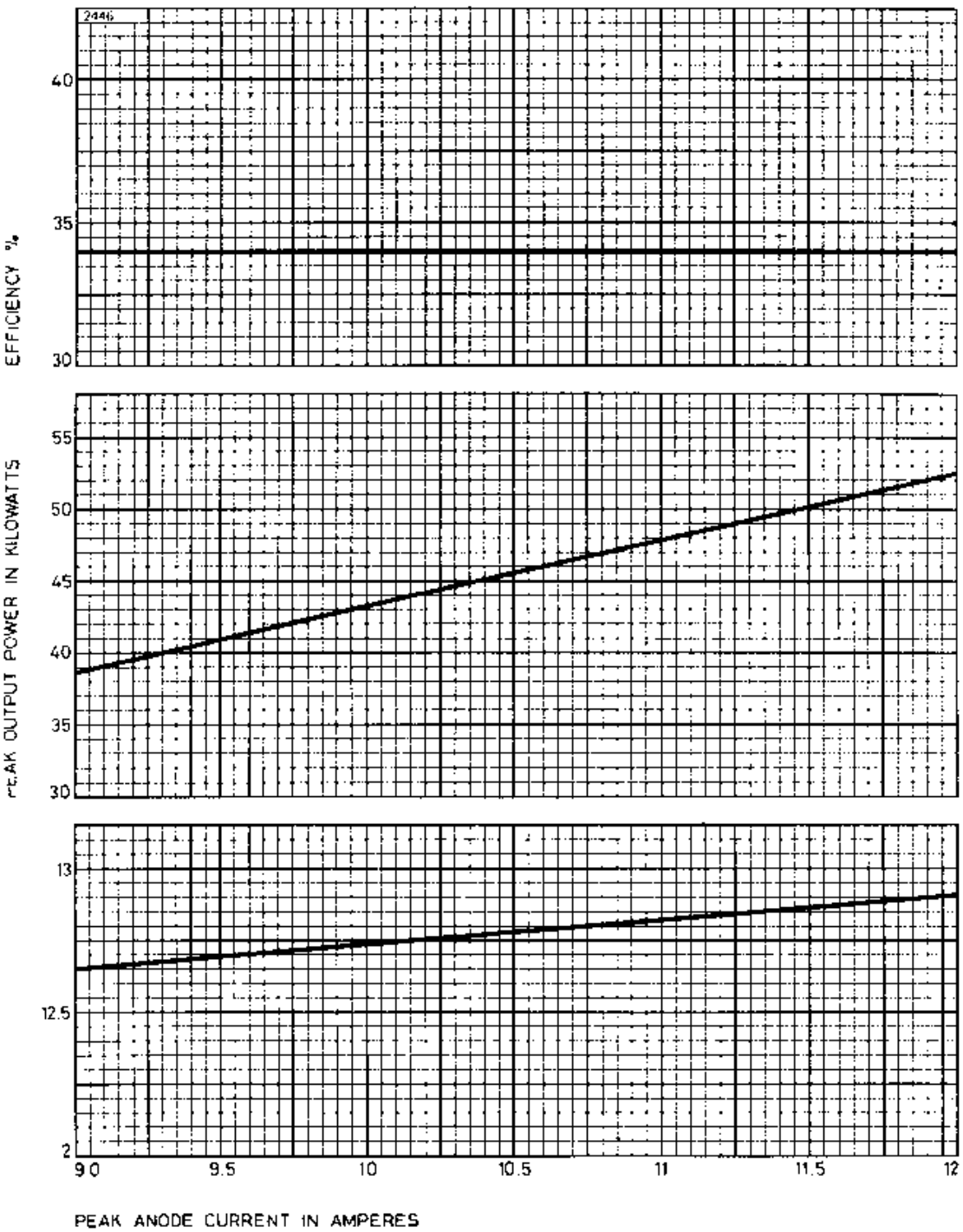
The phase of the mismatch is adjusted to present a voltage maximum at the output flange of the magnetron.

The altitude is computed from pressure readings by means of the I.C.A.O. Standard Atmosphere.

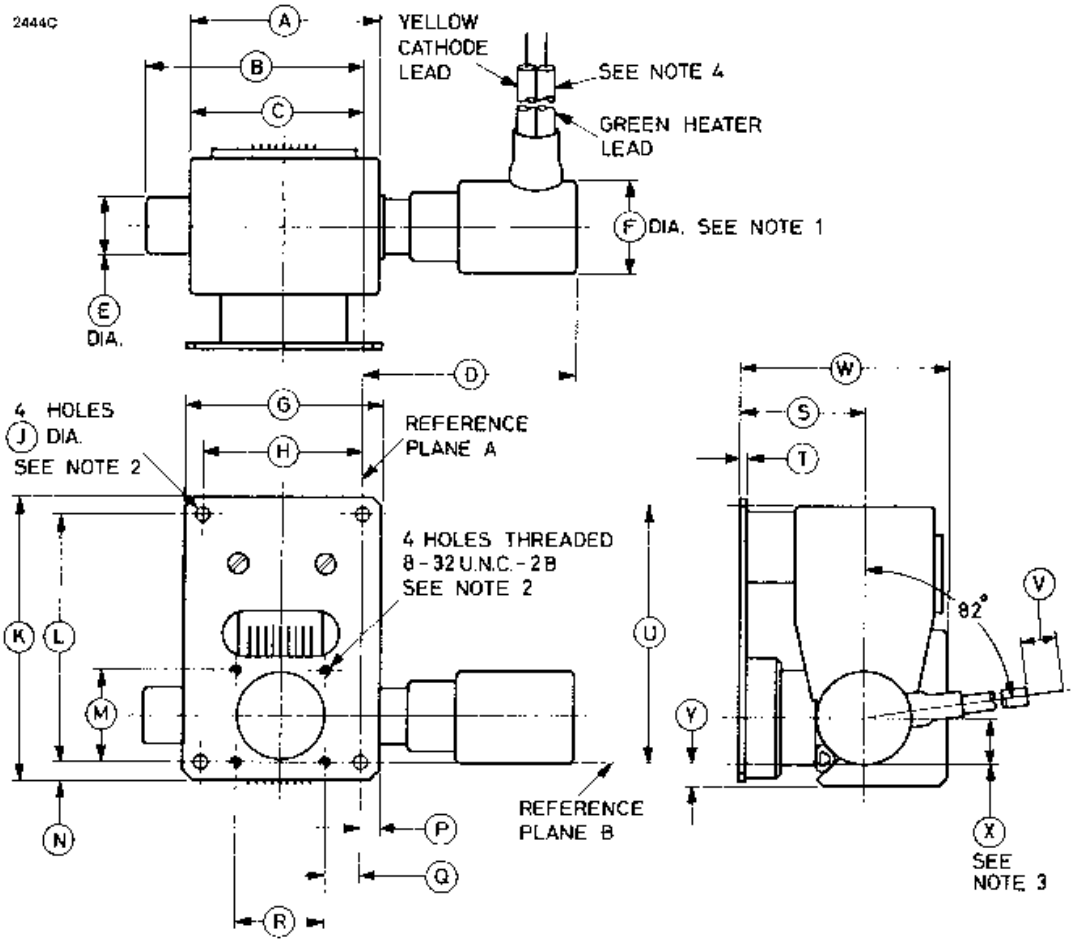
9. Measured with heater voltage of 12.6V and no anode input power, the heater current limits are 2.0A minimum, 2.4A maximum.

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

...E CHART


2446
EFFICIENCY %
40
35
30
PEAK OUTPUT POWER IN KILOWATTS
55
50
45
40
35
30
13
12.5
2
9.0
9.5
10
10.5
11
11.5
12
PEAK ANODE CURRENT IN AMPERES

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.705 max	68.71 max	N	0.250 ± 0.010	6.35 ± 0.25
B	2.944 max	74.78 max	P	0.250 ± 0.010	6.35 ± 0.25
C	2.453 max	62.31 max	Q	0.490	12.45
D	2.900 max	73.66 max	R	1.220	30.99
E	0.787 max	19.99 max	S	1.670 ± 0.125	42.42 ± 3.18
F	1.312 max	33.32 max	T	0.150 max	3.81 max
G	2.705 max	68.71 max	U	3.655 max	92.84 max
H	2.200	55.88	V	0.500 min	12.70 min
J	0.201 ± 0.005	5.11 ± 0.13	W	2.900 max	73.66 max
K	3.905 max	99.19 max	X	0.640	16.26
L	3.400	86.36	Y	0.472 max	11.99 max
M	1.280	32.51			

Millimetre dimensions have been derived from inches.

Outline Notes

1. The cathode sidearm, including silicone rubber encapsulation, will lie within a cylinder of 40mm (1.575 inches) diameter, centred on the axis defined by dimensions S and X.
2. Positional tolerance 0.005 inch (0.13mm) diameter (BS308).
3. Dimension X refers only to the axis of the cathode sidearm.
4. Two leads 30/0.25mm tinned copper wire, silicone rubber covered to 6.35mm (0.250 inch) diameter, of length 242.0mm (9.528 inch) minimum, measured from the centre line of the magnetron.
5. The north seeking pole of the magnet is adjacent to the cathode sidearm.

Lead Connections

Colour	Element
Green	Heater
Yellow	Heater, cathode

English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

M5035

TUNABLE S-BAND MAGNETRON

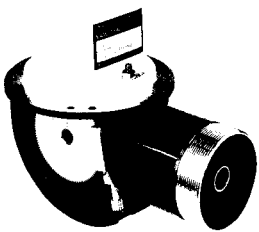
Service Type CV11154

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Mechanically tuned pulse magnetron, similar to 5657.

Tuning range	2900 to 3100 MHz
Typical peak output power	1.0 MW
Magnet	see note 1 on page 5
Output	coaxial line
Coupler	see page 9
Cooling	forced-air



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November 1977

Supersedes March 1974 Issue

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 2)	16	V
Heater current at 16V	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode pre-heating time (minimum) (see note 3)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max	
Net weight	5½ pounds (2.5kg) approx	
Mounting position	any	
Tuning (see note 4)	mechanical	
Tuner revolutions to cover frequency range	120	max

Cooling (see note 5) . . . . . forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 2)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	32.5	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.2	MW
Input power (mean) (see note 6)	–	1.3	kW
Duty cycle	–	0.001	
Pulse duration	–	2.5	μs
Rate of rise of voltage pulse (see note 7)	100	200	kV/μs

Continued on page 3

MAXIMUM AND MINIMUM RATINGS (Continued)

	Min	Max	
Anode temperature (see note 5)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurizing of input and output circuit (see note 8)	–	45	lb/in^2
	–	3.2	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	8.0	8.0	8.0	V
Magnetic field (see note 1)	270	270	270	mT
	2700	2700	2700	gauss
Anode current (peak)	50	70	60	A
Pulse duration	0.5	1.0	2.0	μs
Pulse repetition rate	1500	500	300	p.p.s.

Typical Performance

Anode voltage (peak)	30	30	30	kV
Output power (peak)	700	1000	800	kW
Output power (mean)	525	500	480	W

TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following specification

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
Magnetic field (see note 1)	270 ± 5 2700 ± 50	270 ± 5 2700 ± 50	270 ± 5 2700 ± 50	mT gauss
Heater voltage (for test)	10	10	8.0	V
Anode current (mean)	35	35	38.5	mA
Duty cycle	0.0005	0.0006	0.0006	
Pulse duration (see note 9)	1.0	2.0	1.5	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 8)	200	200	200	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak) (see note 10)	27.5	32.5	—	—	—	—	kV
Output power (mean) (see note 10)	400	—	400	—	440	—	W
Frequency (see notes 11 and 12)	2900	3100	—	—	—	—	MHz
R.F. bandwidth at ¾ power (see note 12)	—	2.5	—	—	—	—	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	—	15	—	—	—	—	MHz
Stability (see notes 10 and 13)	—	0.5	—	—	—	0.5	%
Heater current	see note 14						
Temperature coefficient of frequency	see note 15						

LIFE TEST

The quality of all production is monitored by the random selection of tubes which are then life-tested under Oscillation 1 conditions. If the magnetron is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the tube will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 13)	1	% max

NOTES

1. The magnetron is designed for use with a separate magnet which must conform with the specification given on page 14. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. The recommended magnet, type MA244, is available from English Electric Valve Company Ltd. If an electro-magnet is used, the pole tip dimensions should be as shown on page 15.
2. With no anode input power.

   During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13
400–600	15
less than 400	16

   The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

   The magnetron heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the Magnetron Preamble.

3. It has been verified that the magnetron will operate at ambient temperatures as low as $-55^{\circ}C$. At this temperature the minimum cathode pre-heating time is 3 minutes.

4. Tuning is achieved by rotating a splined shaft which can be fitted to the magnetron in two positions as shown on the outline drawing.

5. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

6. The various parameters are related by the following formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

7. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

8. The mounting plate and the guard pipe are fitted to the magnetron in a manner to permit pressurizing of the input and the output circuit of the magnetron. At the maximum pressure of 45 lb/in^2 (3.2kg/cm^2) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

9. Tolerance $\pm$10%.

10. These tests are carried out with the magnetron tuned to 2900, 3000 and 3100MHz.

11. The magnetron will tune over the indicated frequency range.

12. The r.f. spectrum is checked to ensure that there is no degeneration as the magnetron is tuned through the frequency range. The specification limit for bandwidth applies over the whole of the tuning range.

13. With the magnetron operating into a v.s.w.r. of 1.5:1 phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level within a $\pm$1% frequency range of the normal operating frequency. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 3 minutes of a test interval not to exceed 6 minutes.

14. Measured with heater voltage of 16 V and no anode input power, the heater current limits are 2.8 A minimum, 3.4 A maximum.
15. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07 MHz/°C.

☆ HEALTH AND SAFETY HAZARDS

EEV magnetrons are safe to handle and operate, provided that the relevant precautions stated herein are observed. English Electric Valve Company does not accept responsibility for damage or injury resulting from the use of electronic devices it produces. Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipments incorporating EEV devices and in operating manuals.

High Voltage

Equipment must be designed so that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals must be enclosed and fail-safe interlock switches must be fitted to disconnect the primary power supply and discharge all high voltage capacitors and stored charges in the electronic devices before allowing access. Interlock switches must not be bypassed to allow operation with access doors open.

R.F. Radiation

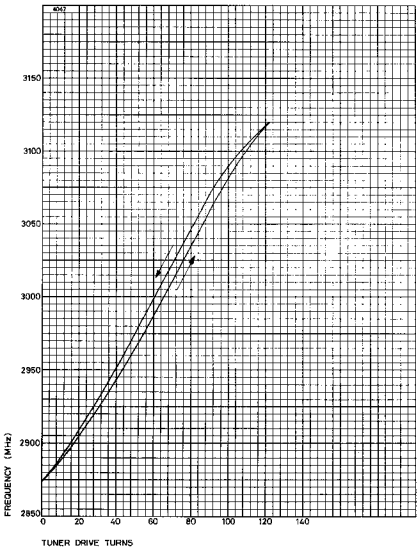
Exposure to r.f. fields can be a hazard even at relatively low frequencies. All r.f. connectors must be correctly fitted before operation so that no leakage of r.f. energy can occur and the r.f. output must be coupled efficiently to the load. It is particularly dangerous to look into open waveguide or coaxial feeders while the device is energized. Screening of the cathode side arm of high power magnetrons may be necessary.

X-Ray Radiation

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

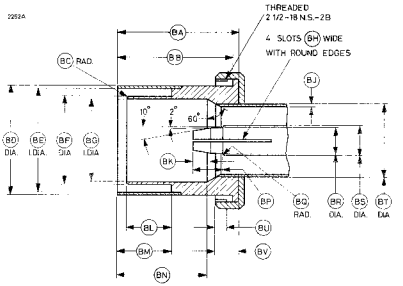
☆ Indicates a change

TYPICAL TUNING CHARACTERISTIC



COUPLER (All dimensions without limits are nominal)

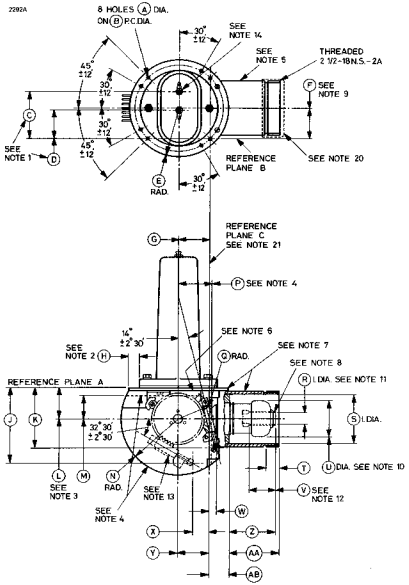
This coupler matches the output of the magnetron to a standard $1^5/_8$-inch coaxial line having an outer conductor of 1.527 inch (38.79mm) internal diameter and an inner conductor of 0.625 inch (15,88mm) diameter.



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

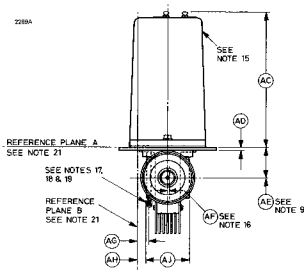
OUTLINE


2292A
8 HOLES (A) DIA. ON (B) P.C.DIA.
.30" ±.12"
SEE NOTE 14
SEE NOTE 5
THREADED 2 1/2-16N.S.-2A
(F) SEE NOTE 9
45° ±12'
30' ±12'
30' ±12'
45° ±12'
(C)
(D)
SEE NOTE 1
(E) RAD.
30' ±12'
REFERENCE PLANE B
SEE NOTE 20
REFERENCE PLANE C SEE NOTE 21
(G)
(P) SEE NOTE 4
SEE NOTE 6
.14" ±.2' 30'
SEE NOTE 2 (H)
(Q) RAD.
SEE NOTE 7
SEE NOTE 8
(R) I.DIA. SEE NOTE 11
REFERENCE PLANE A
(J)
(K)
.32" ±.2' 30'
(S) I.DIA.
(L)
(M)
SEE NOTE 3
(N) RAD.
SEE NOTE 13
SEE NOTE 4
(T)
(U) DIA. SEE NOTE 10
(V) SEE NOTE 12
(W)
(X)
(Z)
(Y)
(AA)
(AB)

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	T	0.593 min	15.06 min
B	4.064 ± 0.006	103.23 ± 0.15	U	1.620 max	41.15 max
C	2.156	54.76	V	1.125 min	28.58 min
D	1.359	34.52	W	0.313	7.95
E	2.281 ± 0.015	57.94 ± 0.38	X	0.756	19.20
F	1.437 ± 0.020	36.50 ± 0.51	Y	1.437	36.50
G	1.437	36.50	Z	2.085 ± 0.025	52.96 ± 0.64
H	0.500 min	12.70 min	AA	2.297 ± 0.010	58.34 ± 0.25
J	3.500	88.90	AB	0.818 ± 0.015	20.78 ± 0.38
K	2.812	71.42	AC	6.313 ± 0.094	160.4 ± 2.4
L	1.440	36.58	AD	0.187	4.75
M	1.063 min	27.00 min	AE	1.440 ± 0.020	36.58 ± 0.51
N	2.656 max	67.46 max	AF	0.025	0.64
P	1.500 min	38.10 min	AG	0.563 ± 0.125	14.30 ± 3.18
Q	1.500 min	38.10 min	AH	0.575 ± 0.050	14.61 ± 1.27
R	0.555 ± 0.005	14.10 ± 0.13	AJ	1.740 max	44.20 max
S	2.321 ± 0.007	58.95 ± 0.18			

Millimetre dimensions have been derived from inches.



Outline Notes

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the magnetron resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inches (54.86mm) diameter circle located as specified for the non-tunable side of the anode.
4. The maximum width specified by dimension AJ applies to the area defined by the broken line and the circumference of the radiator.
5. The magnetron will be painted with black, heat resisting non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe, all surfaces inside guard pipe, tuning gear, stop, and worm shaft assembly.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The magnetron may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe only.
10. The centre line of the maximum diameter will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. Optional location of tuning spline. The magnetron will be supplied with the spline located as specified by the customer.

14. Hexagon locking head banana pin jack, hole 0.169 ± 0.005 inch (4.29 ± 0.13mm) diameter x 0.593 inch (15.06mm) long as per Mil-E-1, latest issue.

15. The common cathode connection is marked with letter C.

16. This dimension shows the relation between a plane passing through the lateral centre of the anode, and a plane passing through the centre of the guard pipe.

17. The tuning mechanism will provide the full range of tuning with a maximum of 4 complete revolutions of the large tuning gear.

18. The spline for adjusting the tuning mechanism is as follows: 12 teeth, 48 d.p., involute form.

19. The clearance between the tuning spline and the guard pipe will be sufficient to allow the use of S.S. White No. 2666X end fitting ($^{13}/_{32}$ inch diameter).

20. Protective guard for shipping purposes.

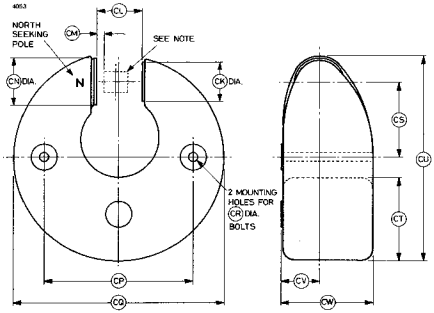
21. Reference plane A is defined as a plane passing along the face of the mounting plate.

    Reference plane B is defined as a plane perpendicular to plane A and passing through the centre of the holes shown.

    Reference plane C is defined as a plane mutually perpendicular to planes A and B and passing through the centre of the hole as shown.

SPECIFICATION OF PERMANENT MAGNET MA244

(All dimensions without limits are nominal)



Ref	Millimetres	Inches	Ref	Millimetres	Inches
CK	41.27	1.625	CR	7.94	0.313
CL	45.72 ± 0.13	1.800 ± 0.005	CS	79.0	3.110
CM	6.86	0.270	CT	90.0 max	3.543 max
CN	50.80	2.000	CU	220.0 max	8.661 max
CP	152.4	6.000	CV	36.58 ± 0.25	1.440 ± 0.010
CQ	220.0 max	8.661 max	CW	100.0 max	3.937 max

Inch dimensions have been derived from millimetres except dimension CM.

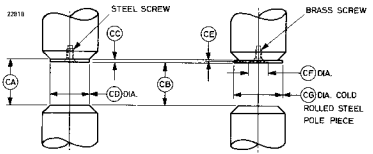
Net weight of MA244 . . . . . 36 pounds (16.5kg) approx

Note The total variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated as shown and coaxially between the poles must not exceed 28mT (280 gauss).

ELECTRO-MAGNET POLE PIECES

Magnet with Single Conventional Pole Piece

Magnet with Distortion Pole Piece



Ref	Inches	Millimetres
CA	1.925 ± 0.005	48.90 ± 0.13
CB	1.800 ± 0.005	45.72 ± 0.13
CC	0.125 ± 0.015	3.18 ± 0.38
CD	1.625 ± 0.015	41.28 ± 0.38
CE	0.031 ± 0.015	0.79 ± 0.38
CF	0.786 ± 0.005	19.96 ± 0.13
CG	2.000 ± 0.015	50.80 ± 0.38

Millimetre dimensions have been derived from inches.

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Chelmsford, Essex, England

Printed in England

M505

X-BAND MAGNETRON

Service Type CV1747

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9360 to 9460	MHz
Typical peak output power	45	kW
Magnet		separate
Output	British X-band waveguide (1.000 x 0.500 inch internal)	
Coupler	A.S.R.E. drawing no. 37820	
Cooling		forced-air

GENERAL

Electrical

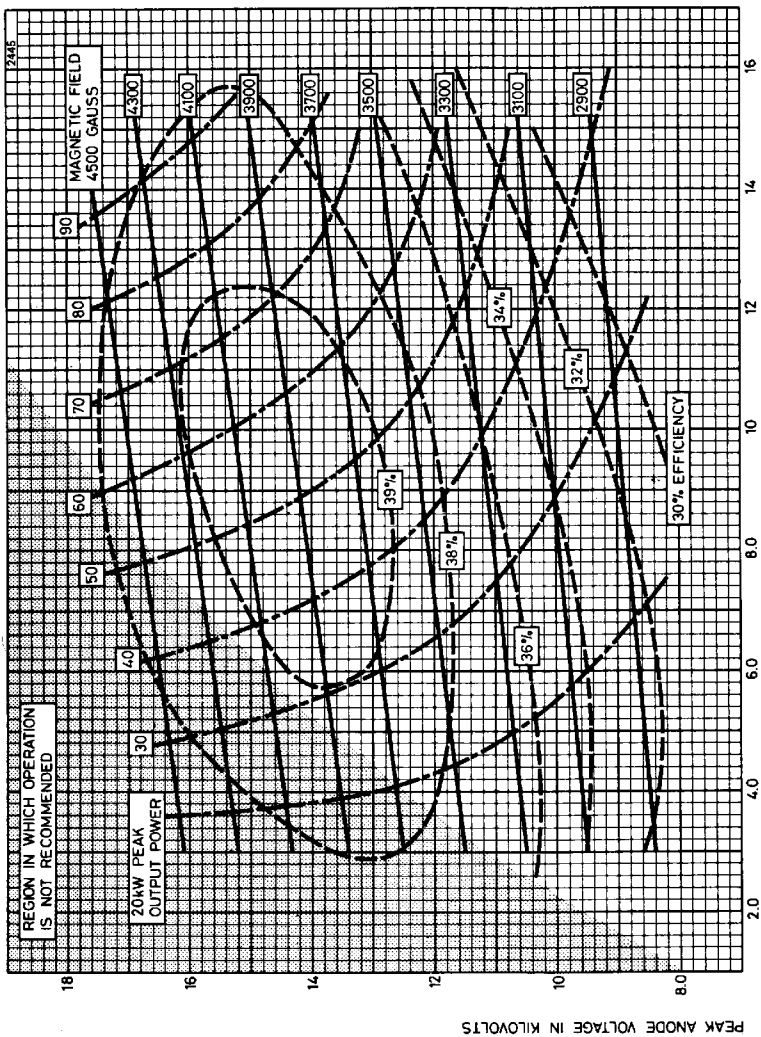
Cathode	indirectly heated	
Heater voltage (see note 1)	3.0	V
Heater current at 3.0V	3.5	A
Cathode heating time (minimum)	90	s

Mechanical

Overall dimensions	8.250 x 3.343 x 3.281 inches max 209.6 x 84.91 x 83.34mm max	
Net weight	1¾ pounds (0.8kg) approx	
Mounting position		any

Cooling . . . . . forced-air

TYPICAL PERFORMANCE CHART



MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	2.7	3.3	V
Anode voltage (peak)	10	16	kV
Anode current (peak)	—	12	A
Input power (peak)	—	150	kW
Input power (mean) (see note 2)	—	150	W
Duty cycle	—	0.001	
Pulse length	—	2.0	μs
Rate of rise of voltage pulse (see note 3)	—	150	kV/μs
Anode temperature (see note 4)	—	140	°C
V.S.W.R. at the output coupler	—	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	1.5	V
Magnetic field (see note 5)	3250	gauss
Anode current (peak)	12	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	11.1	kV
Output power (peak)	45	kW
Output power (mean)	45	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
Magnetic field (see note 5)	3250	3250	3250	gauss
Heater voltage (for test)	1.5	1.5	1.5	V
Anode current (mean)	12	12	12	mA
Duty cycle	0.001	0.001	0.001	
Pulse length (see note 6)	1.0	1.0	2.0	μs
V.S.W.R. at the output coupler	1.05:1	1.5:1	1.5:1	
Rate of rise of voltage pulse (see note 3)	150	150	150	kV/μs

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	10.5	12.5	—	—	—	—	kV
Output power (mean)	35	—	—	—	—	—	W
Frequency (see note 7)	9360	9460	—	—	—	—	MHz
R.F. bandwidth at ¼ power (see note 8)	—	—	—	3.0	—	—	MHz
Frequency pulling	—	—	—	15	—	—	MHz
Frequency pushing (see note 9)	—	5.0	—	—	—	—	MHz
Missing pulse count (see note 10)	—	—	—	0.25	—	—	%
Cold impedance	see note 11						
Mode change	see note 12						
Heater current	see note 13						
Temperature coefficient of frequency	see note 14						

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 3 conditions. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	28	W min
R.F. bandwidth at ¼ power (Oscillation 2)	3.0	MHz max
Frequency	9360 to 9460	MHz

NOTES

1. With no anode input power.

   On the application of anode power, the heater voltage must be reduced in accordance with the following schedule.

Mean input power (W)	Heater voltage (V)
up to 40	3.0
40 to 110	2.0
110 to 150	1.5

   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

3. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

4. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the anode fins.

5. Tolerance $\pm$50 gauss. The north pole of the magnet must be adjacent to the cathode terminal.

6. Tolerance $\pm$10%.

7. At anode temperature 25°C.

8. The maximum bandwidth in MHz is given by 3.0/(pulse length in μs).

9. The mean anode current is varied between 12 and 14mA.

10. The mismatch is varied through all phases during a 30 second period while the count is taken. Missing pulses are expressed as a percentage of the number of input pulses applied during this 30 second period. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 9360 to 9460MHz.

11. When a signal of the same frequency as the valve operating frequency is fed into the valve, a standing wave is produced in the feeder system. The v.s.w.r. is tested to be greater than 6:1 and its phase such that a position of standing wave minimum is 4.5 to 10.5mm from the flange toward the anode.
12. Over the range 8 to 15mA, no pulses shall be missing when viewed with a spectrum analyser, nor double traces of voltage or current observed on the oscilloscope.
13. Measured with heater voltage of 3.0V and no anode input power, the heater current limits are 3.0A minimum, 4.0A maximum.
14. Design test only. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

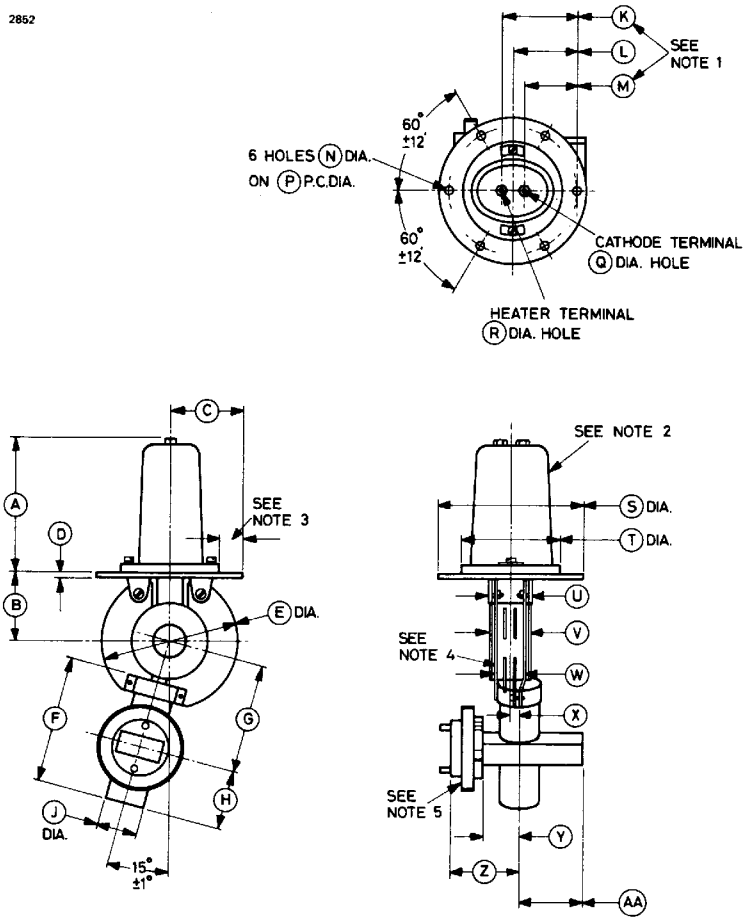
Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.984 ± 0.062	75.79 ± 1.57	P	2.875 ± 0.006	73.03 ± 0.15
B	1.500 ± 0.020	38.10 ± 0.51	Q	0.169 ± 0.004	4.293 ± 0.102
C	1.625	41.28	R	0.125 ± 0.002	3.175 ± 0.051
D	0.125	3.175	S	3.250 ± 0.031	82.55 ± 0.79
E	3.062 max	77.77 max	T	2.218 max	56.34 max
F	2.812 max	71.42 max	U	1.107 max	28.12 max
G	2.437 ± 0.020	61.90 ± 0.51	V	0.974 max	24.74 max
H	1.281 max	32.54 max	W	$0.8070^{+0.0050}_{-0.0045}$	$20.498^{+0.127}_{-0.114}$
J	0.875 ± 0.010	22.23 ± 0.25			
K	1.687	42.85	X	0.219	5.56
L	1.437	36.50	Y	0.830 min	21.08 min
M	1.187	30.15	Z	1.500 ± 0.010	38.10 ± 0.25
N	0.193 ± 0.003	4.902 ± 0.076	AA	1.438 max	36.53 max

Millimetre dimensions have been derived from inches.

OUTLINE

2852



See page 8 for Outline Notes

Outline Notes

1. The centre line will be within 0.023 inch (0.58mm) of the nominal position and the spacing between the pin jacks will be 0.500 ± 0.010 inch (12.70 ± 0.25mm).
2. The common cathode connection is indicated by a letter 'C' on this surface.
3. This surface of the mounting flange will be flat to within 0.010 inch (0.25mm).
4. Position of radiator fin assembly may vary 0.020 inch (0.51mm) from centre line through valve.
5. The face of the flange may deviate 1° from the nominal position relative to the axis of the waveguide.

M513A

X-BAND MAGNETRON

Service Type CV3528

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	9345 to 9405	MHz
Typical peak output power	22	kW
Magnets		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		UG-40B/U (5985-99-083-0051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	5.375 x 5.031 x 4.468 inches max 136.5 x 127.8 x 113.5mm max
Net weight	5 pounds (2.3kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 5) . . . . . natural or forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	—	3.0	A
Anode voltage (peak)	7.0	8.0	kV
Anode current (peak)	5.5	8.5	A
Input power (peak)	—	64	kW
Input power (mean) (see note 3)	—	80	W
Duty cycle	—	0.0025	
Pulse length	—	2.0	μs
Rate of rise of voltage pulse (see note 4)	—	100	kV/μs
Anode temperature (see note 5)	—	120	°C
V.S.W.R. at the output coupler	—	1.5:1	
Ambient pressure for satisfactory operation	500	—	mm Hg
Pressurising of waveguide (see note 6)	—	45	lb/in^2
	—	3.16	kg/cm^2

TYPICAL OPERATION

Operational Conditions

	Condition 1	Condition 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	7.5	7.5	A
Pulse length	1.0	0.1	μs
Pulse repetition rate	500	1000	p.p.s.
Rate of rise of voltage pulse	100	100	kV/μs

Typical Performance

Anode voltage (peak)	7.6	7.6	kV
Output power (peak)	22	22	kW
Output power (mean)	11	2.2	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	6.3	6.3	V
Anode current (mean)	3.75	0.375	mA
Duty cycle	0.0005	0.00005	
Pulse length (see note 7)	1.0	0.05	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 4)	100	100	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	7.0	8.0	7.0	8.0	kV
Output power (mean)	9.0	—	0.75	—	W
Frequency (see note 8)	9345	9405	—	—	MHz
R.F. bandwidth at ¼ power	—	2.5	—	50	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	—	15	—	—	MHz
Stability (see note 9)	—	0.25	—	0.25	%
Cold impedance					see note 10
Heater current					see note 11
Temperature coefficient of frequency					see note 12

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Typical Operation Condition 1. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillations 1 and 2)

	Oscillation 1	Oscillation 2	
Anode voltage (peak)	7.0	7.0	kV min
Output power (mean)	8.0	—	W min
R.F. bandwidth at ¼ power	3.5	—	MHz max
Frequency	9345 to 9405	—	MHz
Stability (see note 9)	2.0	—	% max

NOTES

1. With no anode input power.
   For average pulse input powers greater than 25 watts the heater voltage must be reduced within 3 seconds after the application of h.t. according to the following schedule:

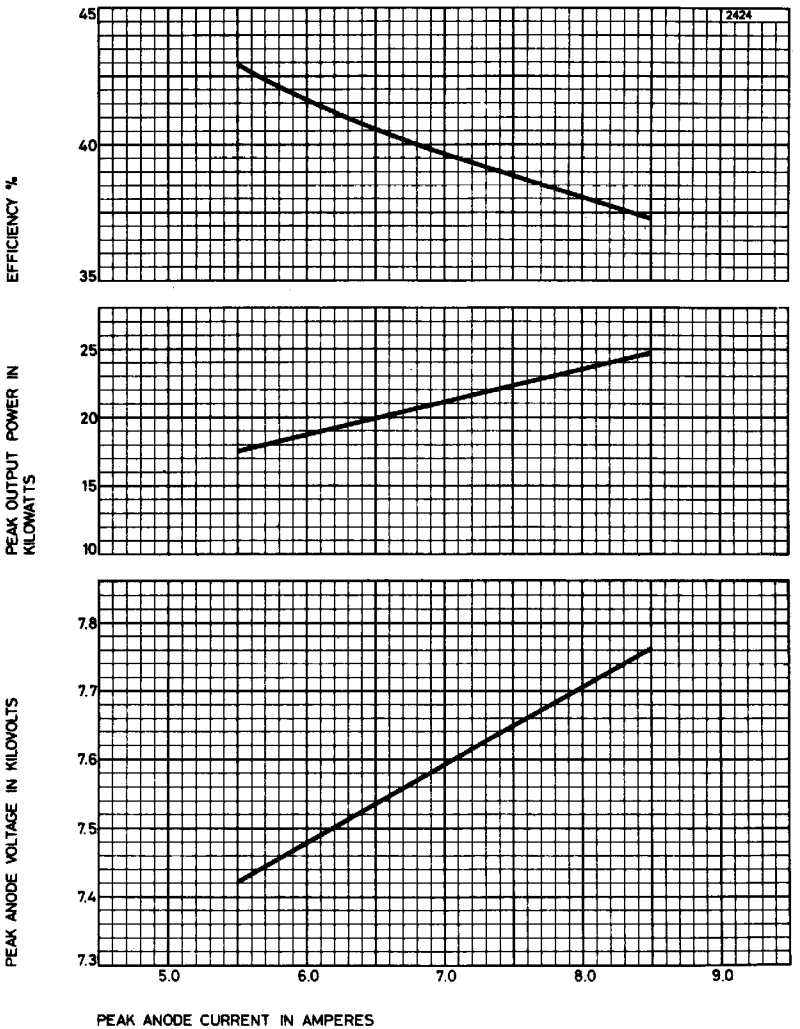
$$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \text{ volts}$$

   where Pi = mean input power in watts.
   The valve heater must be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.
2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.
3. The various parameters are related by the following formula:

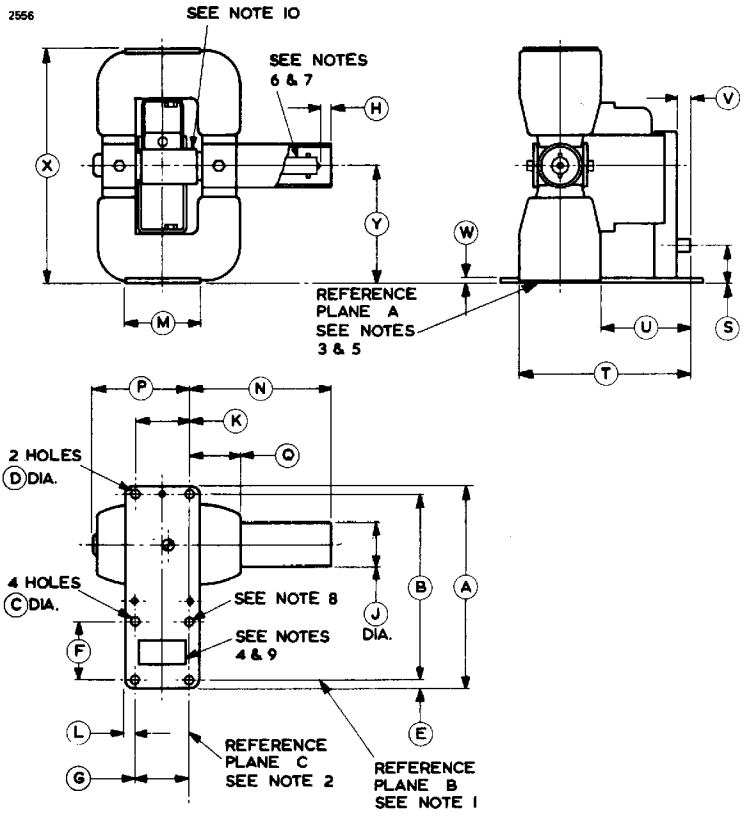
$$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.
4. Defined as steepest tangent to leading edge of voltage pulse above 80% amplitude. Any capacitance in viewing system must not exceed 6.0pF.
5. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.
6. At the maximum pressure of 45 lb/in^2 (3.16kg/cm^2) absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.
7. Tolerance ±10%.
8. Other frequency ranges can be supplied on request.
9. With the valve operating into a v.s.w.r. of 1.15:1. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.
10. For the range 9345 to 9405MHz the impedance of the valve measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1 with a minimum 16.5 to 22.5mm from the output flange towards the anode.
11. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.
12. Design test only. The frequency change with anode temperature change after warm-up will not exceed −0.25MHz/°C.

TYPICAL PERFORMANCE CHART



OUTLINE



Bayonet Cap Connections

Contact	Element
End contact	Heater
Shell	Heater, Cathode

Outline Dimensions

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.468 max	113.5 max	M	1.625 ± 0.016	41.28 ± 0.41
B	4.103 ± 0.004	104.216 ± 0.102	N	3.187 max	80.95 max
C	0.170 ± 0.003	4.318 ± 0.076	P	2.187 max	55.55 max
D	0.175 ± 0.003	4.445 ± 0.076	Q	1.187 max	30.15 max
E	0.172 ± 0.016	4.37 ± 0.41	S	0.875 ± 0.125	22.22 ± 3.18
F	1.280 ± 0.004	32.512 ± 0.102	T	4.000 max	101.6 max
G	1.220 ± 0.004	30.988 ± 0.102	U	1.938 max	49.23 max
H	0.250 max	6.35 max	V	0.375 max	9.53 max
J	1.000 max	25.40 max	W	0.125	3.18
K	1.220 ± 0.004	30.988 ± 0.102	X	5.031 max	127.8 max
L	0.203 ± 0.016	5.16 ± 0.41	Y	2.500 ± 0.050	63.50 ± 1.27

Millimetre dimensions have been derived from inches.

Outline Notes

1. Reference plane B passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane A.
2. Reference plane C intersects plane B at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes A and B.
3. With surface A resting on a flat surface plate, a feeler gauge 0.020 inch (0.51mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
4. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler UG-40B/U (5985-99-083-0051).
5. Surface A and interior surfaces of waveguide will be plated with 10mg/in^2 (1.55mg/cm^2) of gold or 30mg/in^2 (4.65mg/cm^2) of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.

6. The axis of the heater lead protector will be within 5° of a normal to reference plane C.
7. The clearance between the inside surface of the protector and the 0.375 inch (9.53mm) diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52-1952, type BA9s/14) will not be less than 0.125 inch (3.18mm).
8. The centre of this hole will lie within 0.004 inch (0.102mm) of reference plane C.
9. This area is gasketed for pressurising the waveguide output as with coupler UG-40B/U (5985-99-083-0051).
10. The anode temperature is measured at this point.

M5196A
M5196B

X-BAND MAGNETRONS

***Service* Type (M5196B) CV10758**

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetrons differing only in cold impedance and heater/cathode connections. M5196A and M5196B are direct replacements for the M599A and M599B respectively, being mechanically and electrically interchangeable but tested to more stringent electrical specifications. Under most conditions they have a longer operating life.

Frequency range	9415 to 9475	MHz
Typical peak output power	4.0	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler		NATO S.N. 5985-99-083-0051
Cooling		natural

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage	6.3	V
Heater current at 6.3 V	0.5	A
Cathode pre-heating time (minimum) (see note 1)	30	s
Input capacitance	9.0	pF max
Distance of voltage standing wave minimum from output flange towards the anode:		
M5196A	3.0 to 9.0	mm
M5196B	0 to 6.0	mm

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Mechanical

Overall dimensions	5.342 x 3.937 x 1.338 inches max 135.7 x 100.0 x 34.0 mm max
Net weight	1.95 pounds (0.9 kg) approx
Mounting position	any

A minimum clearance of 2 inches (50 mm) must be maintained between the magnet and any magnetic materials.

Cooling	natural

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage	5.7	6.9	V
Anode voltage (peak)	3.2	3.8	kV
Anode current (peak)	2.5	3.5	A
Input power (mean) (see note 2)	–	13	W
Duty cycle	–	0.001	
Pulse duration	0.02	1.0	μs
Rate of rise of voltage pulse (see note 3)	–	70	kV/μs
Anode temperature	–	120	°C
V.S.W.R. at the output coupler	–	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage (for operation)	6.3	V
Anode current (peak)	3.0	A
Pulse duration	0.1	μs
Pulse repetition rate	2000	p.p.s.
Rate of rise of voltage pulse	60	kV/μs

Typical Performance

Anode voltage (peak)	3.6	kV
Output power (peak)	4.0	kW
Output power (mean)	0.8	W

TEST CONDITIONS AND LIMITS

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

Test Conditions

Heater voltage (for test)	6.3	V
Anode current (mean)	3.0	mA
Duty cycle	0.001	
Pulse duration (see note 4)	1.0	μs
V.S.W.R. at the output coupler	<1.15:1	
Rate of rise of voltage pulse (see note 3)	70	kV/μs

Limits

	Min	Max	
Anode voltage (peak)	3.2	3.8	kV
Output power (peak)	3.6	–	kW ☆
Frequency (see note 5)	9415	9475	MHz
R.F. bandwidth at ¼ power (see note 6)	–	2.5	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	–	18	MHz
Frequency pushing	–	2.5	MHz/A
Stability (see notes 6 and 7)	–	0.25	%
Cold impedance			see note 8
Heater current			see note 9
Temperature coefficient of frequency			see note 10

LIFE TEST

The quality of all production is monitored by the random selection of tubes which are then life-tested under Typical Operating Conditions. If the magnetron is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the tube will not be impaired.

End of Life Criteria (under Test Conditions above)

	Min	Max	
Anode voltage (peak)	3.2	3.8	kV
Output power (peak)	2.5	–	kW
Frequency	9415	9475	MHz
R.F. bandwidth at ¼ power (see note 6)	–	3.5	MHz

☆ Indicates a change.

NOTES

1. For ambient temperatures above 0 °C For ambient temperatures between 0 and −55 °C the cathode pre-heating time is 45 seconds minimum.
2. The various parameters are related by the following formula:

$$P_i = i_{apk} \times v_{apk} \times Du$$

where P_i = mean input power in watts

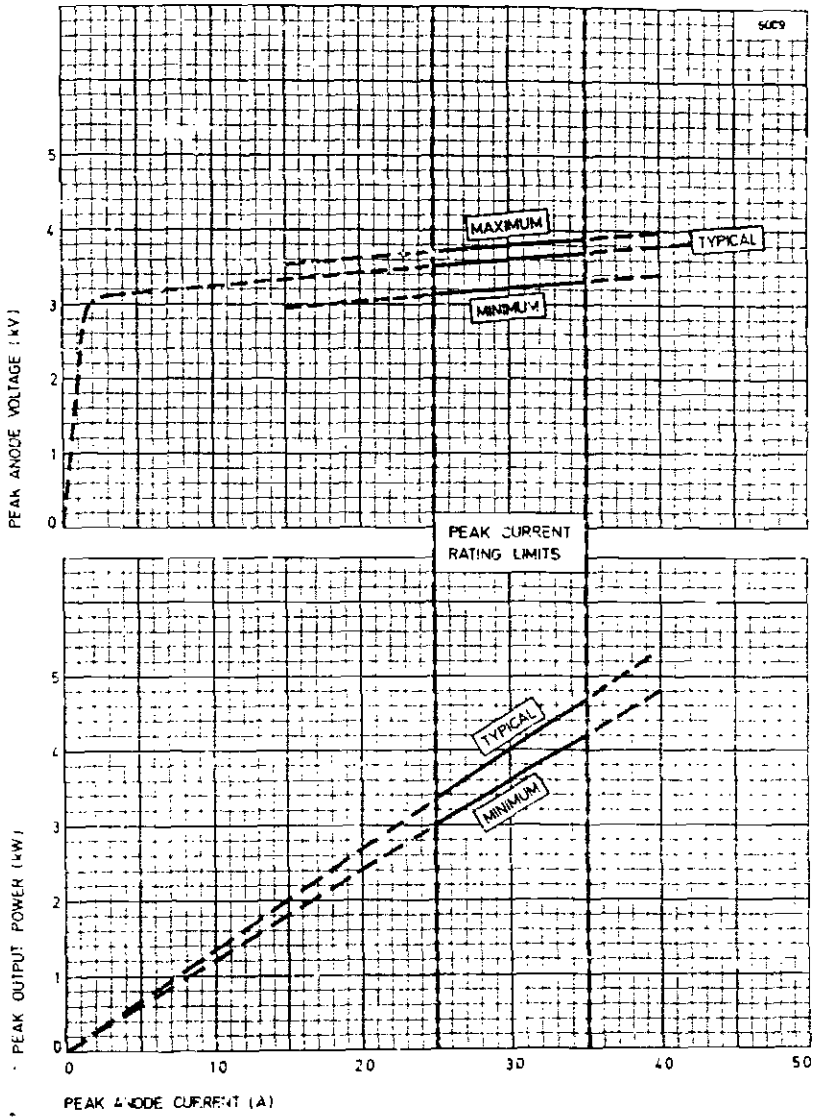
i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle

3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0 pF.
4. Tolerance ± 10%.
5. Other frequency ranges can be supplied on request.
6. With the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over the mean anode current range of 2.5 to 3.5 mA
7. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.
8. The impedance of the magnetron measured at the operating frequency when not oscillating will be such as to give a v.s.w.r. of at least 6:1. The voltage minimum will be 3.0 to 9.0 mm from the output flange of the M5196A and 0 to 6.0 mm from the output flange of the M5196B, towards the anode.
9. The heater current, measured with heater voltage of 6.3 V and no anode input power, will be within the range 0.5 A and 0.6 A.
10. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25 MHz/°C.

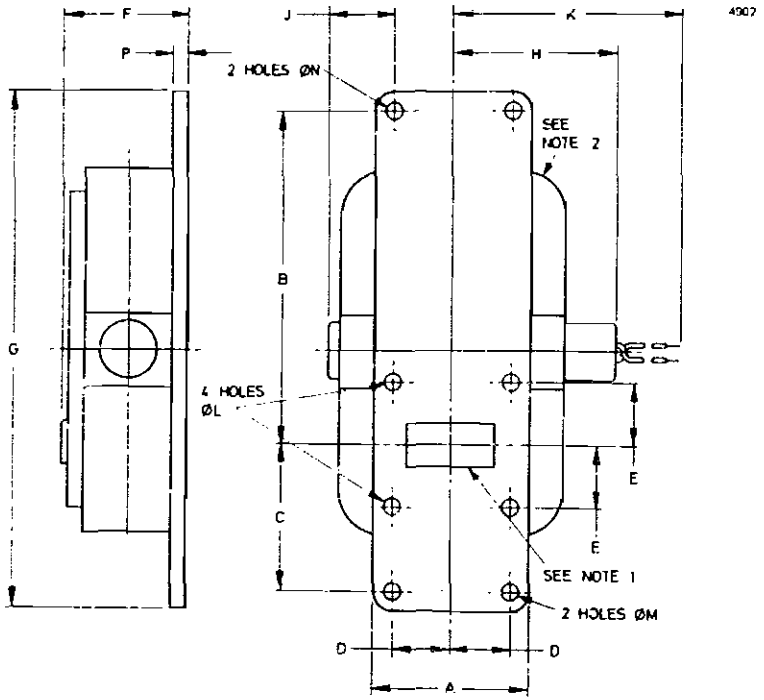
☆ TYPICAL PERFORMANCE CHART



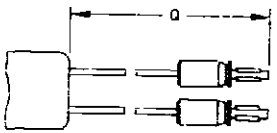
☆ Indicates a change

OUTLINE

M5196B is identical in outline with M5196A but the heater and cathode terminals are fitted with plugs and are dimensioned as shown (see detail drawing below).



Detail of M5196B Heater and Cathode Terminals



Outline Dimensions

Ref	Inches	Millimetres
A	1.625 ± 0.015	41.28 ± 0.38
B	3.463 ± 0.004	87.960 ± 0.102
C	1.521 ± 0.004	38.633 ± 0.102
D	0.610 ± 0.002	15.494 ± 0.051
E	0.640 ± 0.004	16.256 ± 0.102
F	1.338 max	33.99 max
G	5.335 ± 0.007	135.51 ± 0.18
H	2.165 max	54.99 max
J	0.720 max	18.29 max
K	9.625 min	244.5 min
	(M5196A)	(M5196A)
L	0.170 ± 0.003	4.318 ± 0.076
M	0.175 ± 0.003	4.445 ± 0.076
N	0.175 ± 0.003	4.445 ± 0.076
P	0.157 min	3.99 min
Q	8.500 ± 0.500	215.9 ± 12.7
	(M5196B)	(M5196B)

Millimetre dimensions have been derived from inches

Lead Connections

Colour	M5196B Plug*	Element
Red	378/4/Red	Heater
Blue	378A/3/Black	Heater, Cathode

* By Belling Lee

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English Electric Valve Company Limited
Chelmsford, Essex, England
Printed in England

M525

S-BAND MAGNETRON

Service Types CV2362 to CV2368

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range (in seven bands)	2750 to 2855	MHz
Typical peak output power	1.15	MW
Magnet		separate
Output		no. 10 waveguide (2.840 x 1.340 inches internal)
Coupler		see pages 7 and 8
Cooling		water

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	8.5	V
Heater current	9.0	A
Heater starting current, peak value, not to be exceeded	50	A max
Cathode heating time (minimum)	3	minutes

Mechanical

Overall dimensions	17.32 x 6.00 x 6.00 inches max 441 x 153 x 153mm max
Net weight	12 pounds (5.5kg) approx
Mounting position	any

Cooling . . . . . water

The water cooling system is connected to the valve via ¼-inch B.S.P. unions. The water flow must exceed 1 litre/minute with a maximum outlet temperature of 90°C. A 5-foot head of water will be adequate to ensure the flow.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	7.65	9.35	V
Heater starting current (peak)	—	50	A
Anode voltage (peak)	—	40	kV
Anode current (peak)	—	80	A
Input power (peak)	—	3.0	MW
Input power (mean) (see note 2)	—	4.5	kW
Duty cycle	—	0.00125	
Pulse length	—	1.25	μs
Rate of rise of voltage pulse (see note 4)	100	200	kV/μs
Anode temperature	—	90	°C
Cathode terminal temperature	—	150	°C
V.S.W.R. at the output coupler	—	1.5:1	

TYPICAL OPERATION

Operational Conditions

Heater voltage	6.0	V
Magnetic field (see note 5)	1800	gauss
Anode current (peak)	70	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	36	kV
Output power (peak)	1.15	MW
Output power (mean)	1.15	kW

X-RAY WARNING

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 5)	1800	1800	gauss
Heater voltage (for test)	6.0	6.0	V
Anode current (peak)	70	70	A
Duty cycle	0.00125	0.00125	
Pulse length (see note 3)	1.25	1.25	μs
V.S.W.R. at the output coupler	1.1:1	1.5:1	
Rate of rise of voltage pulse	150	150	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	34	38	–	–	kV
Efficiency	40	–	–	–	%
Frequency:					
CV2362	2750	2765	–	–	MHz
CV2363	2765	2780	–	–	MHz
CV2364	2780	2795	–	–	MHz
CV2365	2795	2810	–	–	MHz
CV2366	2810	2825	–	–	MHz
CV2367	2825	2840	–	–	MHz
CV2368	2840	2855	–	–	MHz
R.F. bandwidth at ¼ power	–	–	–	2.5	MHz
Frequency pulling	–	–	–	7.0	MHz
Stability (see note 6)	–	–	–	0.5	%
Heater current					see note 7
Temperature coefficient of frequency					see note 8

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Efficiency	35	% min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 6)	1.0	% max

NOTES

1. With no anode input power.

   During high voltage operation it is essential to operate the heater in accordance with the following schedule.

Mean Input Power (kW)	Heater Voltage (V)
less than 1.0	8.5
1.0 to 2.5	7.0
2.5 to 3.5	6.0
3.5 to 4.5	4.0

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. The various parameters are related by the following formula:

   $P_i = i_{apk} \times v_{apk} \times Du$

   where P_i = mean input power in watts

   i_{apk} = peak anode current in amperes

   v_{apk} = peak anode voltage in volts

   and Du = duty cycle.

3. Tolerance $\pm$ 10%.

4. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

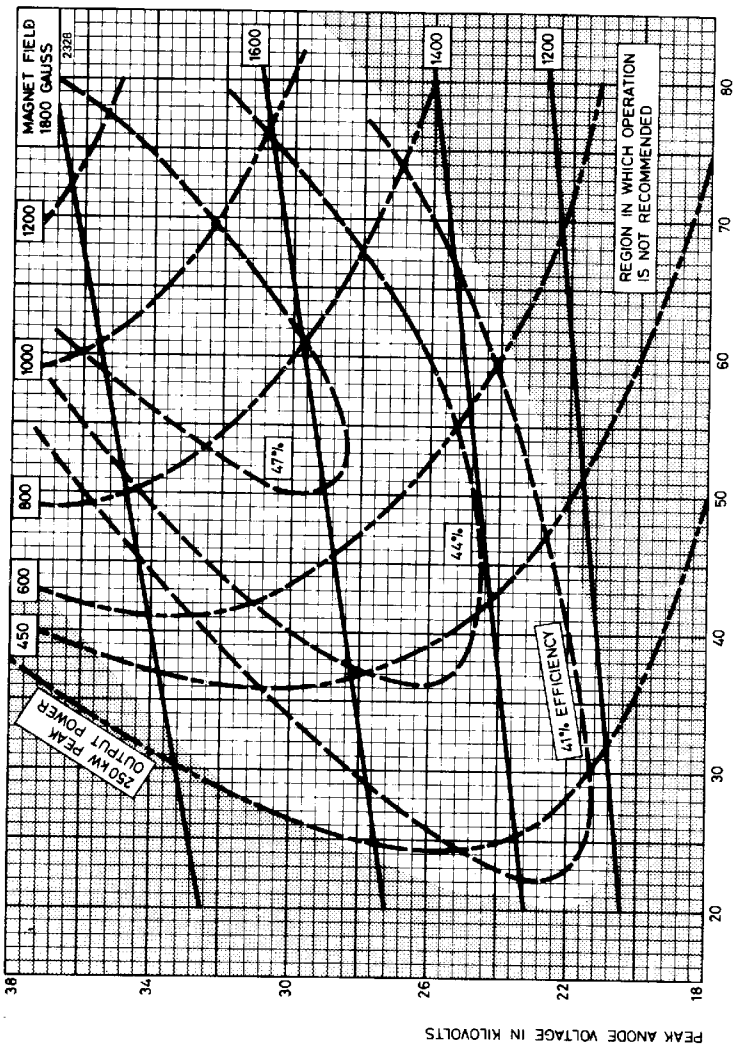
5. The variation of magnetic field within a cylinder 1½ inches (38.10mm) diameter and 1.125 inch (28.58mm) long, situated centrally and co-axially between the poles of the magnet should not exceed 10% overall. The position of the magnet must be adjusted so that the axis of the field is in line with the axis of the anode. The north pole of the magnet must be adjacent to the cathode terminal. The user is invited to consult English Electric Valve Company Ltd. on the choice of magnets.

6. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses over an interval of 60 seconds.

7. Measured with heater voltage of 8.5V and no anode input power, the heater current limits are 8.0A minimum, 10A maximum.

8. Design test only. The maximum frequency change with anode temperature change (after warm-up) is -0.07MHz/°C.

TYPICAL PERFORMANCE CHART

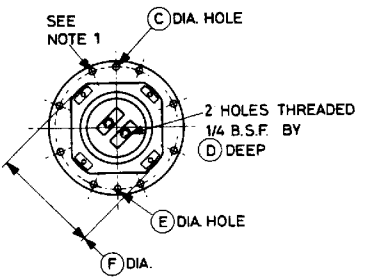


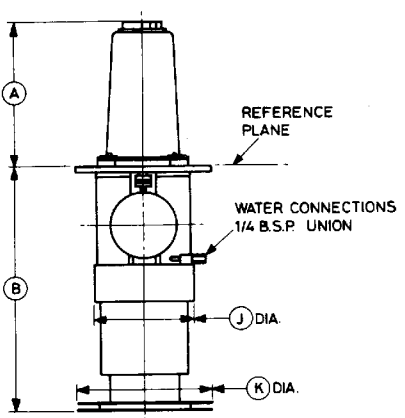
OUTLINE

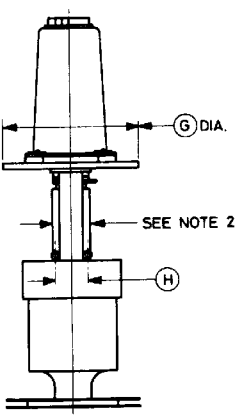
Ref	Inches	Millimetres
A	6.375 ± 0.035	161.93 ± 0.89
B	10.875 ± 0.032	276.23 ± 0.81
C	$0.312^{+0.003}_{-0.000}$	$7.925^{+0.076}_{-0.000}$
D	0.250	6.35
E	$0.250^{+0.003}_{-0.000}$	$6.350^{+0.076}_{-0.000}$
F	4.750 max	120.7 max
G	$6.000^{+0.000}_{-0.010}$	$152.4^{+0.00}_{-0.25}$
H	1.375 ± 0.032	34.93 ± 0.81
J	4.406 ± 0.015	111.9 ± 0.38
K	5.875 ± 0.015	149.23 ± 0.38

Millimetre dimensions have been derived from inches.

2326



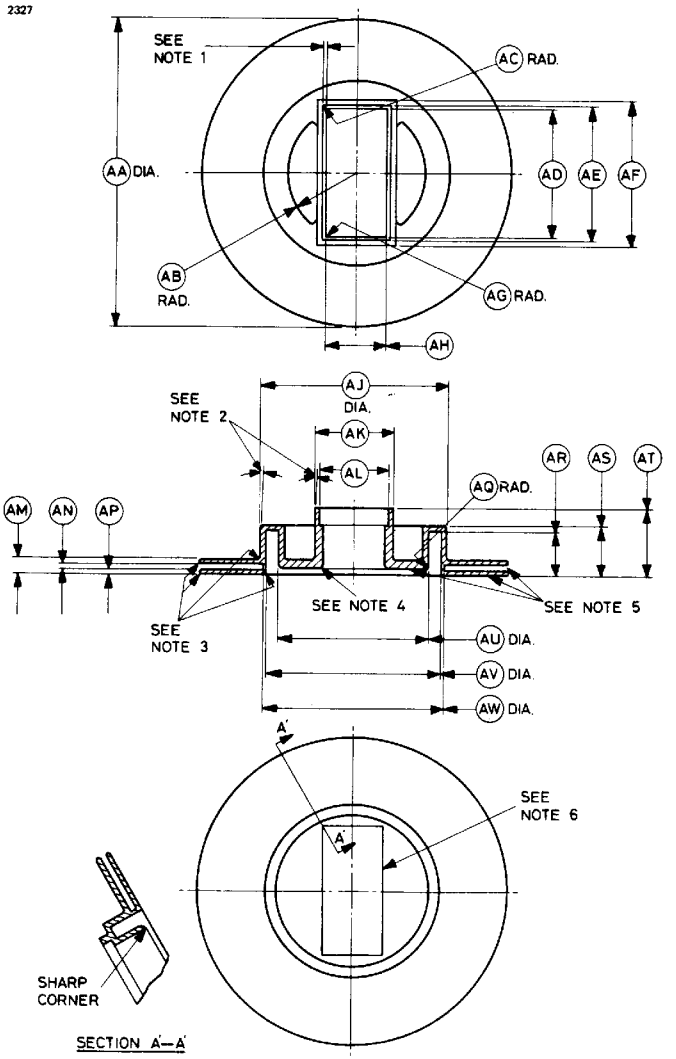




Outline Notes

1. Holes to clear 8 studs 0.250 inch (6.35mm) diameter equally spaced on 5.500 inch (139.7mm) P.C.D. and within 0.005 inch (0.13mm) of nominal position with the valve located by dowel pins 0.307 inch (7.80mm) diameter and 0.245 inch (6.22mm) diameter spaced 5.500 ± 0.002 inch (139.700 ± 0.051mm) apart.
2. The valve is to fit between magnet poles 3.010 inch (76.45mm) diameter and 2.125 inch (53.98mm) apart, located symmetrically with respect to dowel holes in the mounting flange and 2.500 inch (63.5mm) from the reference plane.

COUPLER



See page 8 for dimensions and notes.

Dimensions for Coupler (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
AA	5.875	149.2	AM	0.375	9.53
AB	1.500	38.10	AN	0.125	3.18
AC	0.050 max	1.27 max	AP	0.125	3.18
AD	2.840 ± 0.003	72.136 ± 0.076	AQ	0.090	2.29
AE	$3.005^{+0.005}_{-0.000}$	$76.327^{+0.127}_{-0.000}$	AR	0.980 ± 0.005	24.89 ± 0.13
			AS	1.125	28.58
AF	3.250	82.55	AT	1.500	38.10
AG	0.025 max	0.64 max	AU	3.320 ± 0.005	84.33 ± 0.13
AH	1.340 ± 0.003	34.036 ± 0.076	AV	3.880 ± 0.005	98.55 ± 0.13
AJ	4.125	104.8	AW	4.000	101.6
AK	1.750	44.45			
AL	$1.505^{+0.005}_{-0.000}$	$38.227^{+0.127}_{-0.000}$			

Millimetre dimensions have been derived from inches.

Notes for Coupler

1. These faces parallel to within 25'.
2. Maximum draft angle 2°.
3. Radius on these corners 0.031 inch (0.79mm).
4. On all four sides 0.125 inch (3.2mm) radius at centre fairs to give a sharp corner as shown in section A' - A'; length of fairing not to exceed 0.125 inch (3.2mm).
5. These faces to be flat, smooth, free from machining marks and square with rectangular bore.
6. Rectangular bore to be within 0.003 inch (0.076mm) of nominal position.

M537A

X-BAND MAGNETRON

Service Type CV6108

The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron

Frequency range	8770 to 8830	MHz
Typical peak output power	9.0	kW
Magnet		integral
Output		no. 16 waveguide (0.900 x 0.400 inch internal)
Coupler	UG-40B/U (5985-99-083-0051)	
Cooling		forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3V	0.5	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	5.375 x 4.468 x 3.562 inches max 136.5 x 113.5 x 90.47mm max
Net weight	3¼ pounds (1.5kg) approx
Mounting position	any

A minimum clearance of 2 inches (50mm) must be maintained between the magnet and any magnetic materials.

Cooling (see note 7) . . . . . forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage	5.7	7.0	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	–	6.0	kV
Anode current (peak)	3.5	5.5	A
Input power (peak)	–	33	kW
Input power (mean) (see note 3)	–	82.5	W
Duty cycle (see note 4)	–	0.0025	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (at 4.5A peak anode current) (see note 6)	–	75	kV/μs
Anode temperature (see note 7)	–	140	°C
V.S.W.R. at the output coupler	–	1.5:1	
Altitude	–	10 000	ft
	–	3.05	km

TYPICAL OPERATION

Operational Conditions

Heater voltage	5.4	V
Anode current (peak)	4.5	A
Pulse length	1.0	μs
Pulse repetition rate	1000	p.p.s.

Typical Performance

Anode voltage (peak)	5.5	kV
Output power (peak)	9.0	kW
Output power (mean)	9.0	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Heater voltage (for test)	4.5	6.3	V
Anode current (mean)	9.0	4.5	mA
Duty cycle	0.002	0.001	
Pulse length (see note 5)	1.0	2.0	μs
V.S.W.R. at the output coupler (maximum)	1.05:1	1.05:1	
Rate of rise of voltage pulse (see note 6)	75	75	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	5.3	5.7	—	—	kV
Output power (mean)	16	—	—	—	W
Frequency (see note 8)	8770	8830	—	—	MHz
R.F. bandwidth (see note 9)	—	2.5	—	1.25	MHz
Frequency pulling (see note 10)	—	15	—	—	MHz
Stability (see note 11)	—	0.25	—	0.25	%
Cold impedance					see note 12
Heater current					see note 13
Temperature coefficient of frequency					see note 14

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 2 Test Conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillations 1 and 2)

	Oscillation 1	Oscillation 2	
Output power (mean)	12.5	—	W min
R.F. bandwidth at ¼ power (anode current 7.5mA mean)	3.0	—	MHz max
Frequency: must be within Test Limits above, Oscillation 1			
Stability	—	1.0	% max

NOTES

1. With no anode input power.

   For average pulse input powers greater than 25 watts the heater voltage shall be reduced within 3 seconds after the application of h.t. according to the following schedule:

   $$V_h = 6.3\left[1 - \frac{Pi}{180}\right] \pm 0.6 \text{ volts}$$

   where Pi = mean input power in watts.

   The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. These ratings apply only for equally spaced pulses.

5. Tolerance ±10%.

6. Defined as the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0pF.

7. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

8. With anode temperature 40°C ± 10°C measured at the point indicated on the outline drawing.

9. The bandwidth is measured at ¼ power points. The side lobes will be at least 6db down.

10. Measured with a v.s.w.r. greater than 1.5:1 in all phases of the mis-

match. Frequency pulling is the maximum variation in frequency as the mismatch is varied through all phases.

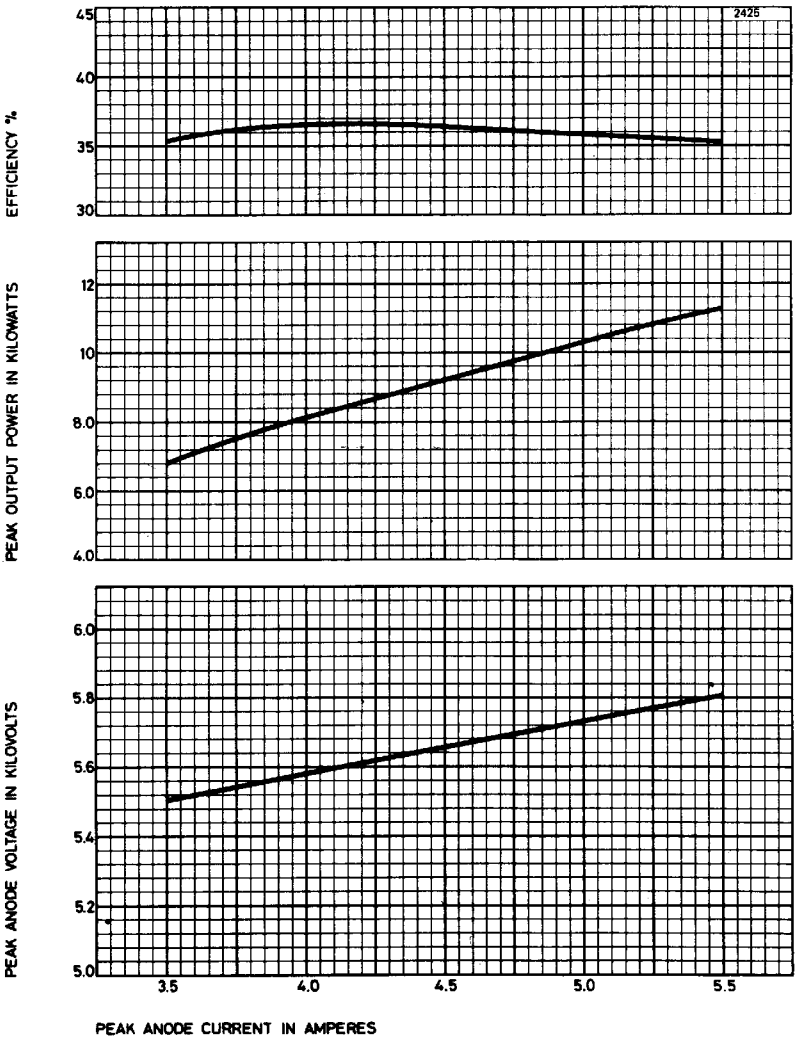
11. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the frequency range 8770 to 8830MHz. Missing pulses are expressed as a percentage of the number of input pulses applied during any consecutive 5 minute interval of a 15 minute test period.

12. When a signal of the same frequency as the magnetron operating frequency is fed into the valve, a standing wave is produced in the feeder system. The v.s.w.r. is tested to be greater than 8:1.

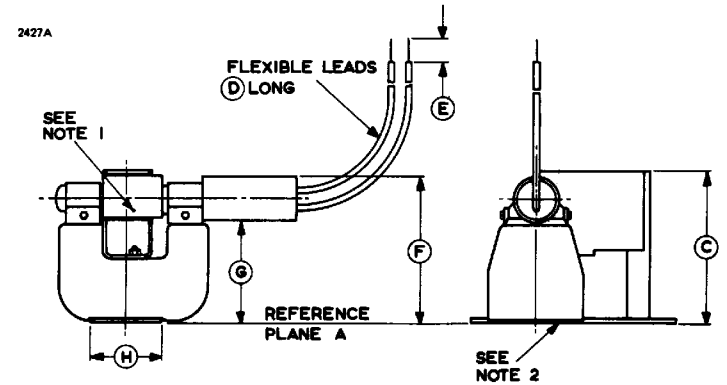
13. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 0.43A minimum, 0.60A maximum.

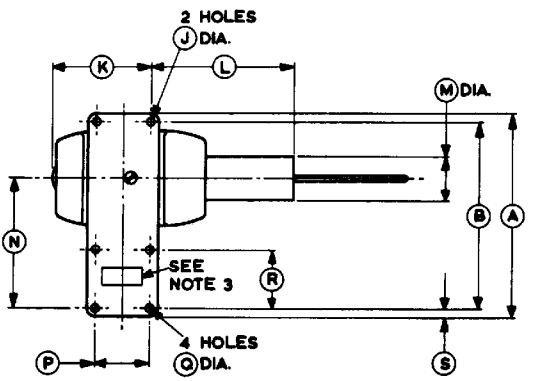
14. Design test only. The maximum frequency change with anode temperature change (after warm-up) is -0.25MHz/$^{\circ}$C.

TYPICAL PERFORMANCE CHART



OUTLINE





Lead Connections

Colour	Element
Yellow	Heater
Green	Heater, Cathode

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	4.468 max	113.5 max
B	4.103 ± 0.004	104.216 ± 0.102
C	3.562 max	90.47 max
D	6.000 min	152.4 min
E	0.500	12.70
F	3.325 max	84.46 max
G	2.225 min	56.52 min
H	1.640 max	41.66 max
J	0.175 ± 0.003	4.445 ± 0.076
K	2.390 max	60.71 max
L	3.187 max	80.95 max
M	1.250 max	31.75 max
N	2.937 ± 0.250	74.60 ± 6.35
P	1.220 ± 0.004	30.988 ± 0.102
Q	0.170 ± 0.003	4.318 ± 0.076
R	1.280 ± 0.004	32.512 ± 0.102
S	0.187 max	4.75 max

Millimetre dimensions have been derived from inches.

Outline Notes

1. Anode temperature to be measured at this point.
2. The flatness of the mounting plate will be such that with the valve resting on a plane surface a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.125 inch (3.18mm) at any point.
3. The position of the waveguide and fixing holes will be such that the magnetron operates into coupler type UG-40B/U (5985-99-083-0051).

M577B M578B

S-BAND MAGNETRONS

Service Type CV10210 (M577B)

ABRIDGED DATA

Fixed frequency pulse magnetrons, replacing types M577, M577A and M578, M578A. Frequency variants of 4J43 and 4J44.

Frequency range:		
M577B	3000 to 3040	MHz
M578B	3060 to 3100	MHz
Typical peak output power	900	kW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	–	15	A
Anode voltage (peak)	–	30	kV
Anode current (peak)	–	70	A
Input power (peak)	–	2.0	MW
Input power (mean) (see note 3)	–	1.2	kW
Duty cycle	–	0.001	
Pulse length (see note 4)	–	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	–	100	°C
Cathode terminal temperature	–	100	°C
V.S.W.R. at the output coupler	–	1.5:1	
Ambient pressure for satisfactory operation	500	–	mm Hg
Pressurising (see note 7):			
input circuit	–	45	lb/in^2
output circuit	–	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	10.5	V
Magnetic field (see note 8)	2700	gauss
Anode current (peak)	70	A
Pulse length	1.0	μs
Pulse repetition rate	500	p.p.s.

Typical Performance

Anode voltage (peak)	28	kV
Output power (peak)	900	kW
Output power (mean)	450	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	—	—	kV
Output power (mean)	400	—	—	—	W
Frequency:					
M577B	3000	3040	—	—	MHz
M578B	3060	3100	—	—	MHz
R.F. bandwidth at ¼ power	—	2.5	—	—	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	—	15	—	—	MHz
Stability (see note 9)	—	0.5	—	0.5	%
Heater current				see note 10	
Temperature coefficient of frequency				see note 11	

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000—1200	8.0
800—1000	10.5
600—800	13.0
400—600	15.0
less than 400	16.0

The above schedule is valid only for pulse repetition rates of 300p.p.s. or higher.

The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

(b) M577B and M578B have hum-free heaters and have been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts

i_{apk} = peak anode current in amperes

v_{apk} = peak anode voltage in volts

and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of 45lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

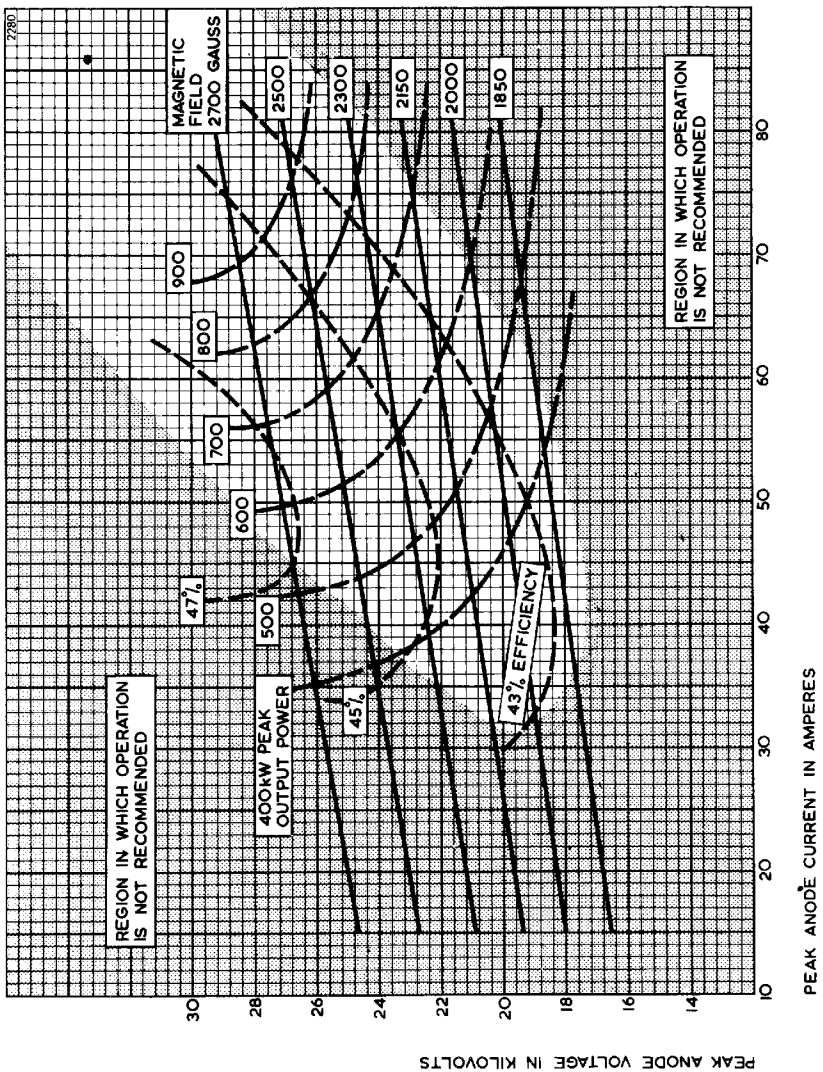
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

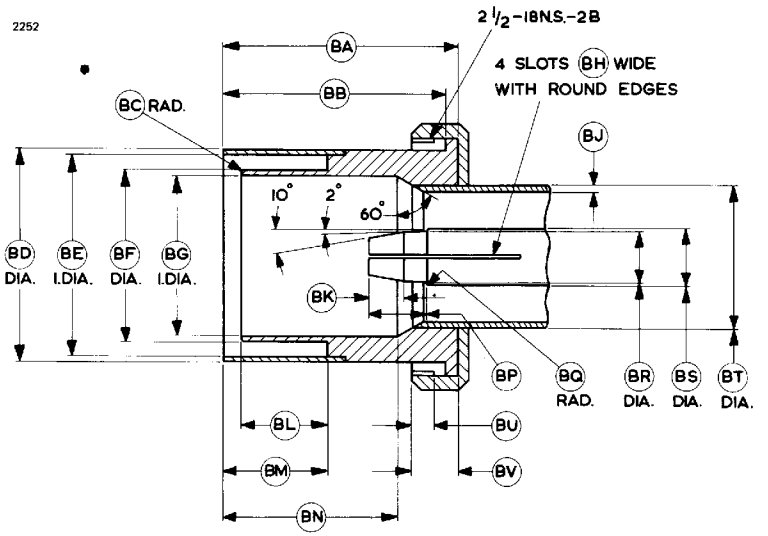
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07MHz/°C.

PERFORMANCE CHART



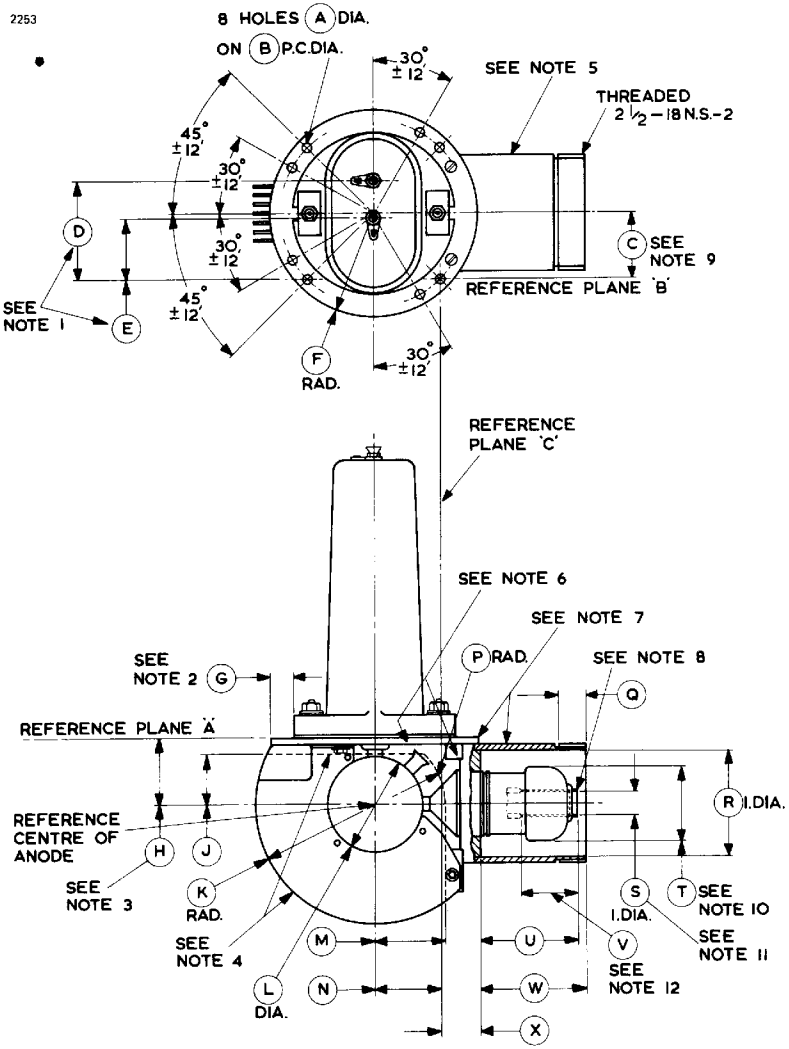
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches

OUTLINE (See page 10 for outline notes)

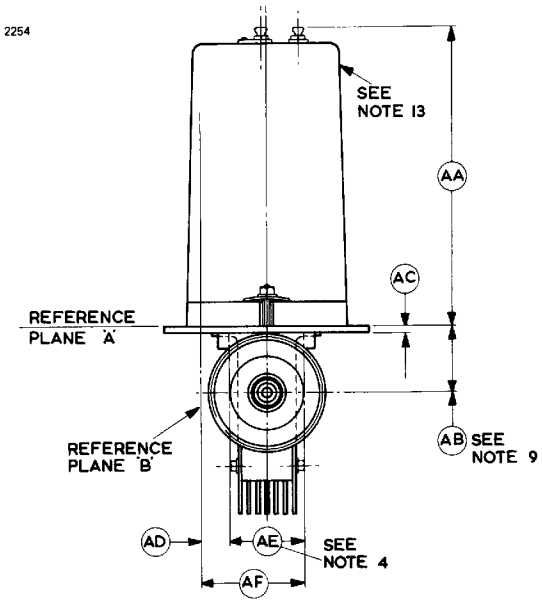


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

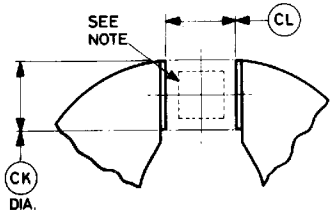
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION

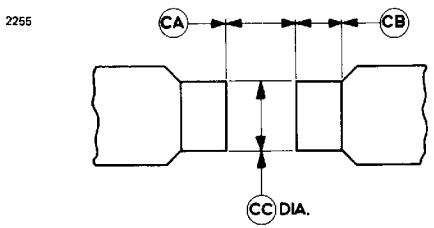


Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES



Ref	Inches	Millimetres
CA	$1.500^{+0.005}_{-0.000}$	$38.10^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

M595B

S-BAND MAGNETRON

Service Type CV8905

ABRIDGED DATA

Fixed frequency pulse magnetron		
Frequency range	2860 to 2900	MHz
Typical peak output power	1.0	MW
Magnet	separate, see note 8 on page 5	
Output	coaxial line; internal diameter of outer conductor 1.527 inches, diameter of inner conductor 0.625 inch	
Coupler	see page 7	
Cooling	forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	16	V
Heater current	3.1	A
Heater starting current, peak value, not to be exceeded	15	A max
Cathode heating time (minimum) (see note 2)	2	min

Mechanical

Overall dimensions	10.523 x 7.233 x 4.624 inches max 267.3 x 183.7 x 117.5mm max
Net weight	6 pounds (2.8kg) approx
Mounting position	any

Cooling forced-air

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Heater voltage (see note 1)	14.4	17.6	V
Heater starting current (peak)	—	15	A
Anode voltage (peak)	—	30	kV
Anode current (peak)	—	70	A
Input power (peak)	—	2.0	MW
Input power (mean) (see note 3)	—	1.2	kW
Duty cycle	—	0.001	
Pulse length (see note 4)	—	2.5	μs
Rate of rise of voltage pulse (see note 5)	100	200	kV/μs
Anode temperature (see note 6)	—	100	°C
Cathode terminal temperature	—	100	°C
V.S.W.R. at the output coupler	—	1.5:1	
Ambient pressure for satisfactory operation	500	—	mm Hg
Pressurising (see note 7):			
input circuit	—	45	lb/in^2
output circuit	—	45	lb/in^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	13	10.5	V
Magnetic field (see note 8)	2150	2700	gauss
Anode current (peak)	56	70	A
Pulse length	1.0	1.0	μs
Pulse repetition rate	500	500	p.p.s.

Typical Performance

Anode voltage (peak)	22	28	kV
Output power (peak)	600	1000	kW
Output power (mean)	300	500	W

TEST CONDITIONS AND LIMITS

The valve is tested to comply with the following electrical specification

Test Conditions

	Oscillation 1	Oscillation 2	
Magnetic field (see note 8)	2700	2700	gauss
Heater voltage (for test)	10	10	V
Anode current (mean)	35	45	mA
Duty cycle	0.0005	0.0006	
Pulse length (see note 4)	1.0	2.0	μs
V.S.W.R. at the output coupler	1.15:1	1.15:1	
Rate of rise of voltage pulse (see note 5)	200	200	kV/μs

Limits

	Min	Max	Min	Max	
Anode voltage (peak)	26	30	—	—	kV
Output power (mean)	400	—	—	—	W
Frequency	2860	2900	—	—	MHz
R.F. bandwidth at ¼ power	—	2.5	—	—	MHz
Frequency pulling (v.s.w.r. not less than 1.5:1)	—	15	—	—	MHz
Stability (see note 9)	—	0.5	—	0.5	%
Heater current					see note 10
Temperature coefficient of frequency					see note 11

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under Oscillation 1 conditions above. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 1)

Output power (mean)	320	W min
R.F. bandwidth at ¼ power	2.5	MHz max
Stability (see note 9)	1.0	% max

NOTES

1. (a) With no anode input power.

During high voltage operation it is essential to operate the heater according to the following schedule:

Mean Input Power (W)	Heater Voltage (V)
1000–1200	8.0
800–1000	10.5
600–800	13.0
400–600	15.0
less than 400	16.0

The above schedule is valid only for pulse repetition rates of 300p.p.s. or greater.

The valve heater shall be protected against arcing by the use of a minimum capacitance of 4000pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2μF may be necessary depending on the equipment design. For further details see the preamble to this section.

(b) The M595B has a hum-free heater and has been tested for satisfactory operation with sinusoidal heater supply voltages of frequency 50, 60 and 500Hz. English Electric Valve Company Ltd. should be consulted if other supply frequencies are to be used. Where complete freedom from frequency modulation is essential, the use of a d.c. heater supply is recommended.

2. For ambient temperatures above 0°C. For ambient temperatures between 0 and −55°C the cathode heating time is 3 minutes minimum.

3. The various parameters are related by the following formula:

$$Pi = i_{apk} \times v_{apk} \times Du$$

where Pi = mean input power in watts
i_{apk} = peak anode current in amperes
v_{apk} = peak anode voltage in volts
and Du = duty cycle.

4. Tolerance ±10%.

5. The rate of rise of voltage is the slope of the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. The anode temperature must be kept below the limit specified by means of a suitable flow of air over the cooling fins.

7. The mounting plate and the guard pipe are fitted to the valve in a manner to permit pressurising of the input circuit and the output circuit of the valve. At the maximum pressure of 45lb/in^2 absolute, the leakage will not exceed 0.5 litre (N.T.P.) per minute.

8. The valve is designed for use with a separate magnet which must conform with the specification given at the top of page 11. The axis of the magnetic field must be coincident with the axis of the anode, and the north pole of the magnet must be adjacent to the cathode terminal. A suitable magnet, type MA228, is available.

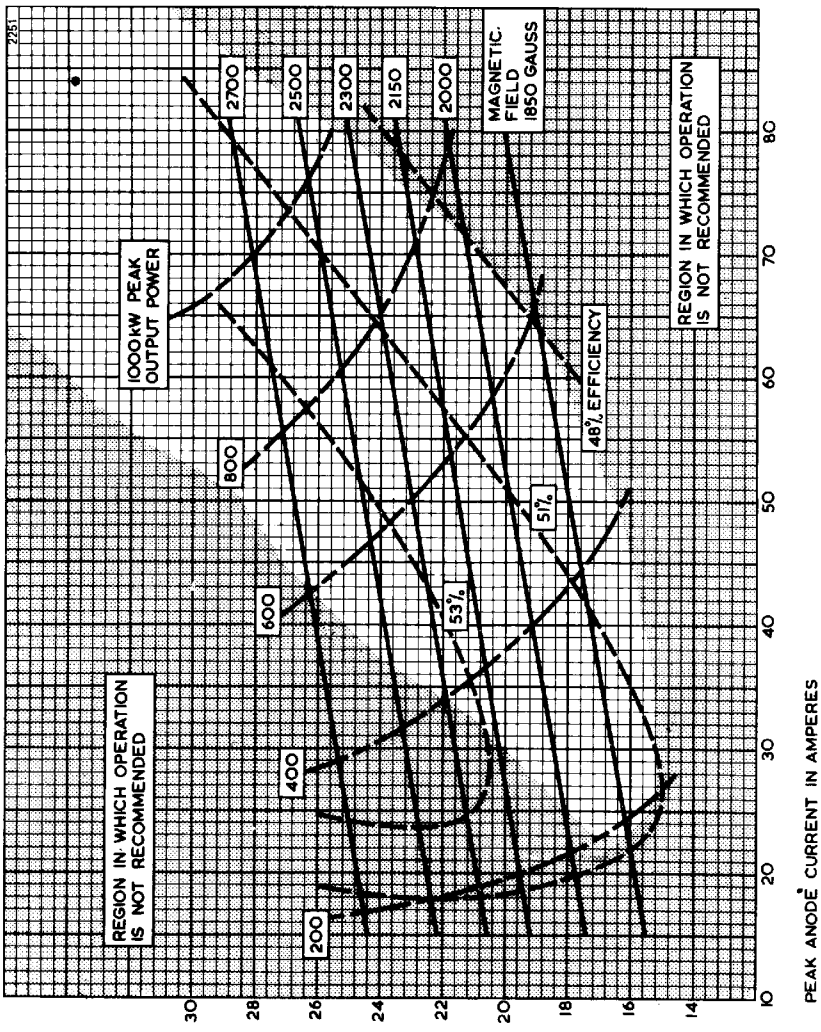
   If an electro-magnet is used, the pole tip dimensions should be as shown on page 11.

9. With the valve operating into a mismatch of v.s.w.r. 1.5:1, phased to give maximum instability. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal energy level in the rated frequency range of the valve. Missing pulses are expressed as a percentage of the number of input pulses applied during the last 30 seconds of a test interval not to exceed 5 minutes.

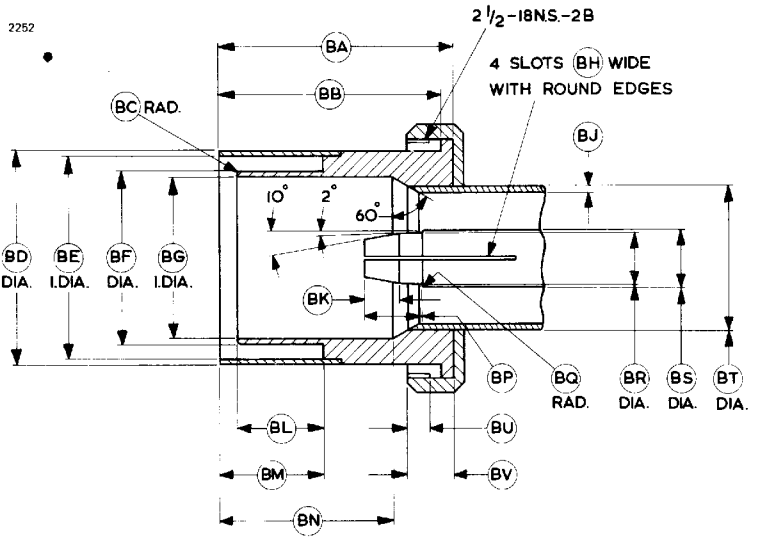
10. Measured with heater voltage of 16V and no anode input power, the heater current limits are 2.8A minimum, 3.4A maximum.

11. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.07MHz/°C.

PERFORMANCE CHART



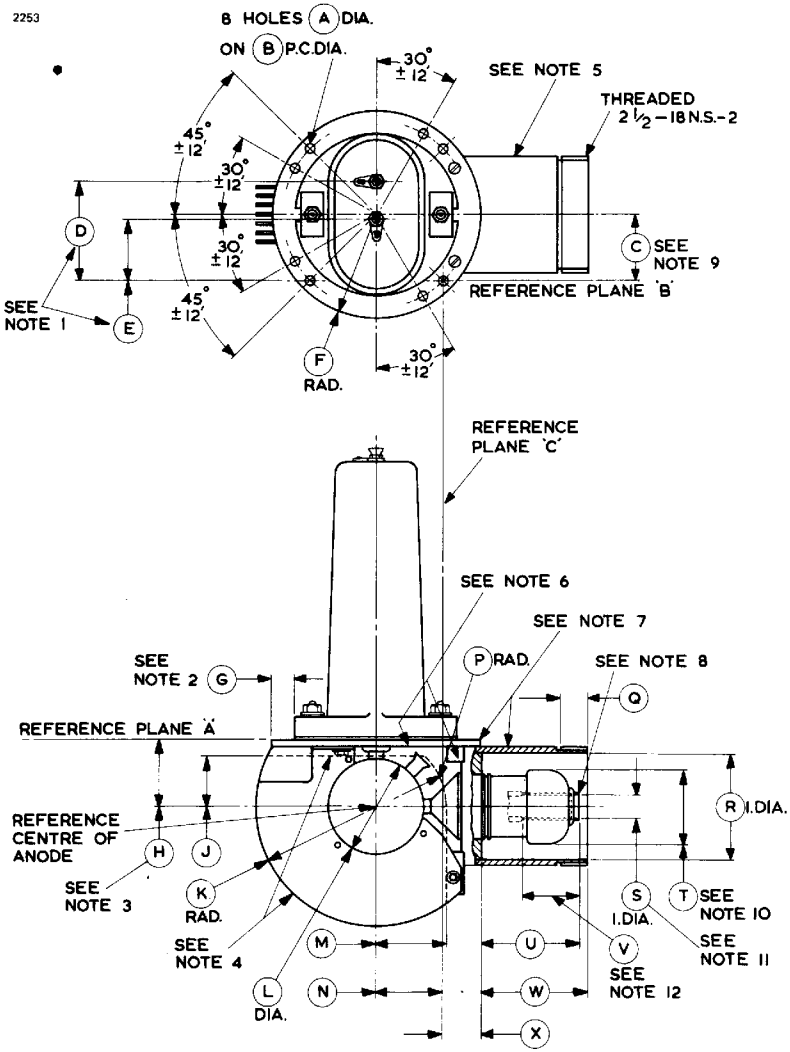
COUPLER



Ref	Inches	Millimetres	Ref	Inches	Millimetres
BA	2.531 ± 0.015	64.29 ± 0.38	BL	0.937 ± 0.003	23.800 ± 0.076
BB	2.402 ± 0.005	61.01 ± 0.13	BM	1.125 ± 0.003	28.575 ± 0.076
BC	0.031 ± 0.015	0.79 ± 0.38	BN	1.875 ± 0.005	47.63 ± 0.13
BD	2.310 ± 0.002	58.674 ± 0.051	BP	0.625 ± 0.015	15.88 ± 0.38
BE	2.185 ± 0.002	55.499 ± 0.051	BQ	0.016 ± 0.015	0.41 ± 0.38
BF	1.875 ± 0.002	47.625 ± 0.051	BR	0.576 ± 0.002	14.630 ± 0.051
BG	1.720 ± 0.002	43.688 ± 0.051	BS	0.625	15.88
BH	0.030	0.76	BT	1.625	41.28
BJ	0.049	1.24	BU	0.250 ± 0.015	6.35 ± 0.38
BK	0.375 ± 0.015	9.53 ± 0.38	BV	0.500 ± 0.015	12.70 ± 0.38

Millimetre dimensions have been derived from inches.

OUTLINE (see page 10 for outline notes)

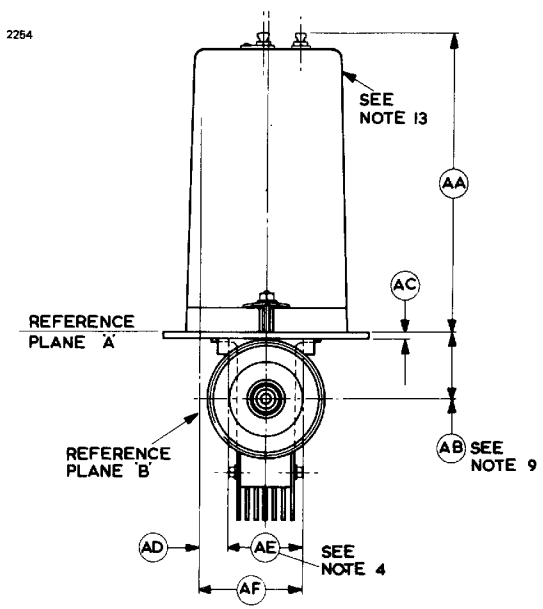


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	0.210 ± 0.005	5.33 ± 0.13	Q	0.593 min	15.06 min
B	2.032 ± 0.003	51.613 ± 0.076	R	2.321 ± 0.007	58.95 ± 0.18
C	1.437 ± 0.020	36.50 ± 0.51	S	0.555 ± 0.005	14.10 ± 0.13
D	2.156	54.76	T	1.620 max	41.15 max
E	1.359	34.52	U	2.085 ± 0.025	52.96 ± 0.64
F	2.281 ± 0.031	57.94 ± 0.79	V	1.125 min	28.58 min
G	0.500 min	12.70 min	W	2.297 ± 0.010	58.34 ± 0.25
H	1.440	36.58	X	0.818 ± 0.015	20.78 ± 0.38
J	1.063 min	27.00 min	AA	6.313 ± 0.094	160.35 ± 2.39
K	2.656 max	67.46 max	AB	1.440 ± 0.020	36.58 ± 0.51
L	2.062	52.37	AC	0.187	4.75
M	1.500 min	38.10 min	AD	0.677 min	17.20 min
N	1.437	36.50	AE	1.490 max	37.85 max
P	1.500 min	38.10 min	AF	2.197 max	55.80 max

Millimetre dimensions have been derived from inches.

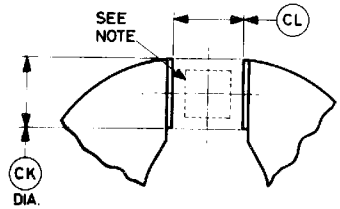
OUTLINE



OUTLINE NOTES

1. The centres of the jack holes will be within a radius of 0.100 inch (2.54mm) of the location specified, but spaced 0.797 ± 0.015 inch (20.24 ± 0.38mm) with respect to each other.
2. With the valve resting on a plane surface, the flatness of this annular area will be such that a feeler gauge 0.015 inch (0.38mm) thick and 0.125 inch (3.18mm) wide will not enter more than 0.250 inch (6.35mm) at any point.
3. The periphery of the anode will lie within a 2.160 inch (54.86mm) diameter circle located as specified.
4. The maximum width specified by dimension 'AE' applies to the area defined by the broken line and the circumference of the radiator.
5. The valve will be painted with black, heat resisting, non-corrosive paint, except for the following paint free areas: top surface of mounting plate, parts above mounting plate, screw threads on guard pipe and all surfaces inside the guard pipe.
6. All joints on the mounting plate and guard pipe will be soldered to provide hermetic seals.
7. The valve may be supported by the mounting plate or guard pipe.
8. There will be no sharp edges on the outside diameter at the end of the inner conductor.
9. Applies to the location of the centre line of the guard pipe.
10. The centre line of the glass portion will be concentric with the centre line of the guard pipe to within 0.040 inch (1.02mm).
11. Applies to the inner conductor insert only. The centre line of the inner conductor insert will be concentric with the centre line of the guard pipe to within 0.025 inch (0.64mm).
12. Applies to the straight portion of the inner conductor wall.
13. The common cathode connection is indicated by letter C.

PERMANENT MAGNET SPECIFICATION



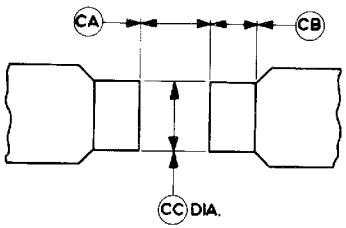
Ref	Inches	Millimetres
CK	1.500	38.10
CL	$1.500^{+0.010}_{-0.000}$	$38.10^{+0.25}_{-0.00}$

Millimetre dimensions have been derived from inches.

Note The variation of magnetic field within a cylinder 1.000 inch (25.4mm) long and 0.900 inch (22.86mm) diameter situated centrally and coaxially between the poles must not exceed ±140 gauss.

ELECTRO-MAGNET POLE PIECES

2255



Ref	Inches	Millimetres
CA	$1.500^{+0.005}_{-0.000}$	$38.10^{+0.13}_{-0.00}$
CB	1.000 min	25.40 min
CC	1.500 ± 0.010	38.10 ± 0.25

Millimetre dimensions have been derived from inches.

N1010A N1010S

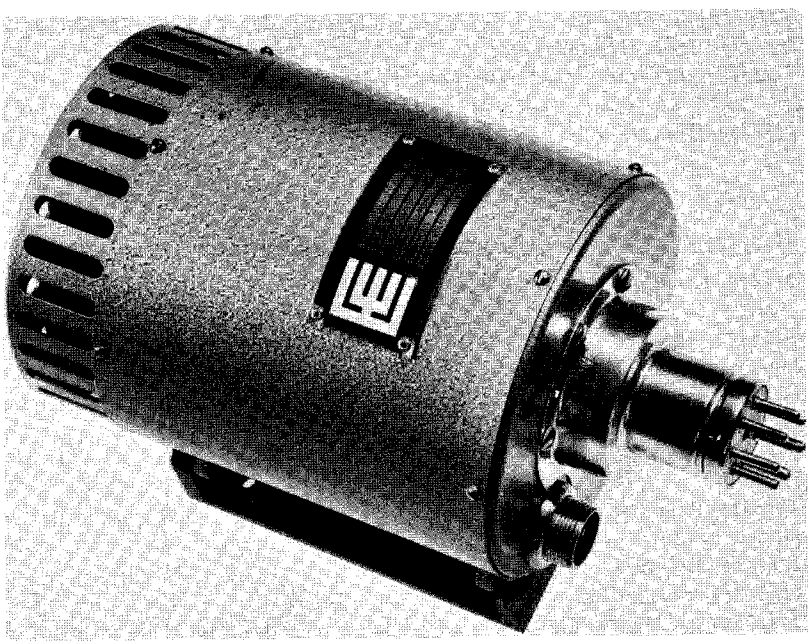
BACKWARD WAVE OSCILLATORS

Service types CV2393 (N1010A), CV6024 (N1010S)

ABRIDGED DATA

O-type backward wave oscillators for wide band microwave receivers and oscillators, suitable for pulse or amplitude modulation.

Frequency range	7.0 to 11.5	GHz
Typical output power over band	40 to 130	mW
Integral focusing:		
N1010A	permanent magnet	
N1010S	solenoid	
Output connector	50Ω type N coaxial	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	2.3	A
Cathode pre-heating time (minimum)	2.0	min
Inter-electrode capacitances:		
cathode to grid, anode and delay line	10	pF
grid to cathode, anode and delay line	15	pF
anode to cathode, grid and delay line	15	pF
delay line to cathode, grid and anode	10	pF
delay line to outer shell	300	pF
Solenoid power supply (N1010S)	24V, 4.5A	d.c.

Mechanical

Overall dimensions	see outline drawings
Net weight	11 pounds (5kg) approx
Mounting position (see note 1)	any
Base	medium 7-pin (JEDEC A7-13)
R.F. output connector	50Ω type N
Solenoid connector (N1010S)	AP208600/CV48992

Tubes are vibration tested to withstand normal service conditions.

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

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

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.8	V
Heater starting current (peak)	—	4.0	A
Grid voltage (see note 4)	0	−250	V
Delay line voltage	250	1700	V
Delay line current (see note 5)	—	40	mA
Delay line dissipation	—	50	W
Anode voltage (see note 6)	—	300	V
Anode current	—	10	mA
Body temperature	—	120	°C
Solenoid voltage (N1010S)	16	24	V
Solenoid current (N1010S)	3.0	7.0	A

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions (See note 3)

Heater voltage	6.3	V
Grid voltage	0	V
Load v.s.w.r.	1.2:1	max

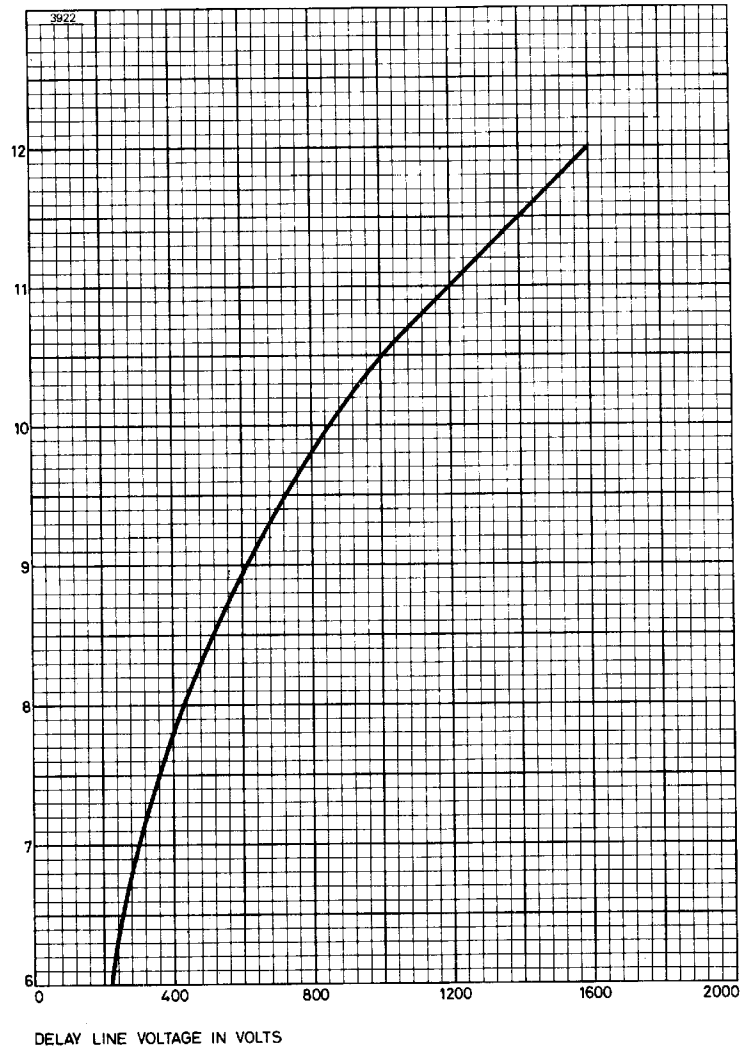
Typical Performance

	Min	Typical	Max	
Heater current	2.0	2.3	2.5	A
Delay line voltage:				
at 7GHz	300	315	350	V
at 9GHz	580	615	700	V
at 11.5GHz	1300	1400	1500	V
Delay line current:				
at 7GHz	—	22	25	mA
at 9GHz	—	25	30	mA
at 11.5GHz	—	33	35	mA
Anode voltage (see note 7)	100	150	200	V
Anode current	—	2.0	10	mA
Solenoid current for N1010S (see note 7)	3.0	4.5	7.0	A
Solenoid voltage	16	23	24	V
Grid cut-off voltage (see note 8)	—	−70	−100	V
Output power:				
at 7GHz	20	40	—	mW
at 9GHz	20	80	—	mW
at 11.5GHz	20	130	—	mW
Frequency pulling (see note 9)	—	6.0	8.0	MHz
Signal to noise ratio (see note 10)	150	155	—	db/Hz

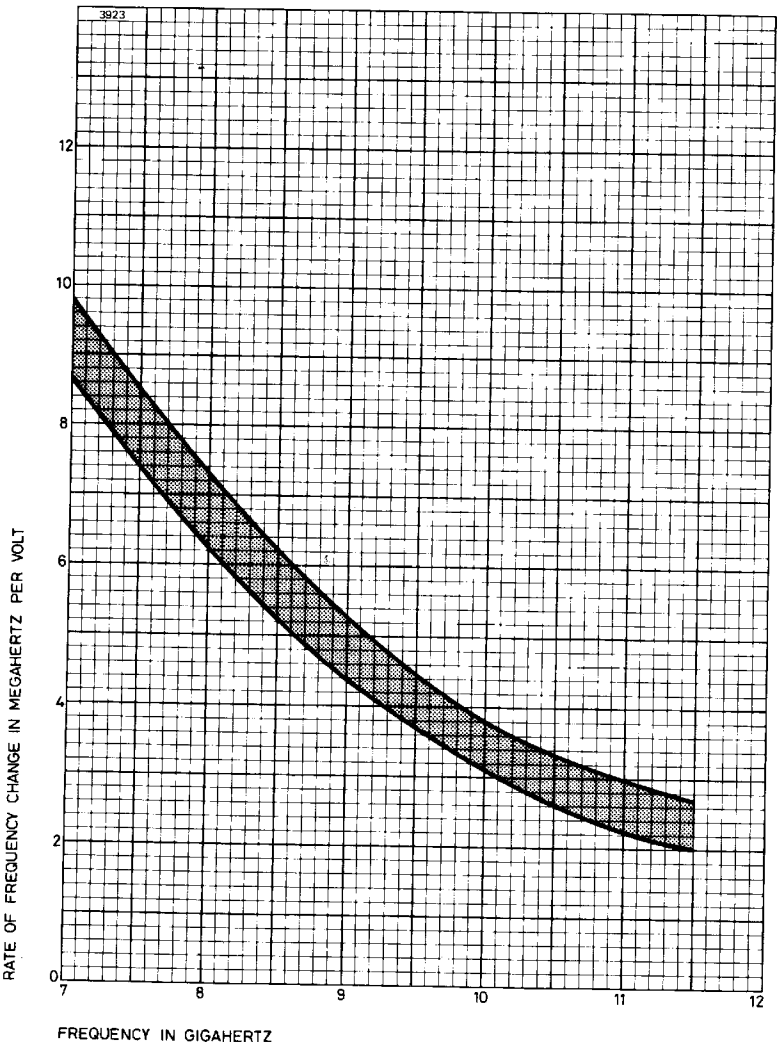
NOTES

1. Any magnetic materials must at all times be kept at least 8 inches (20cm) away from the N1010A, or a permanent loss of performance may result.
2. For the N1010A an airflow of $10ft^3/min$ ($0.28m^3/min$) is required, directed at the radiator; for the N1010S $20ft^3/min$ ($0.57m^3/min$), directed at the radiator and the sides of the solenoid. The pressure drop is less than 1 inch w.g.
3. All voltages except the heater voltage are with respect to cathode.
4. The grid must never become positive with respect to cathode. For normal c.w. operation the grid is connected to cathode.
5. The delay line and collector are internally connected.
6. Anode voltage must never be applied before the delay line voltage.
7. The optimum anode voltage and solenoid current (for N1010S) are marked on each tube.
8. The grid voltage at which oscillation ceases.
9. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
10. Measured as the ratio of the signal to the average noise in a 10MHz bandwidth, centred at least 20MHz from the carrier. For low noise performance the N1010A should be at least 18 inches (460mm) from any magnetic materials. Either the cathode, anode or delay line should be earthed.

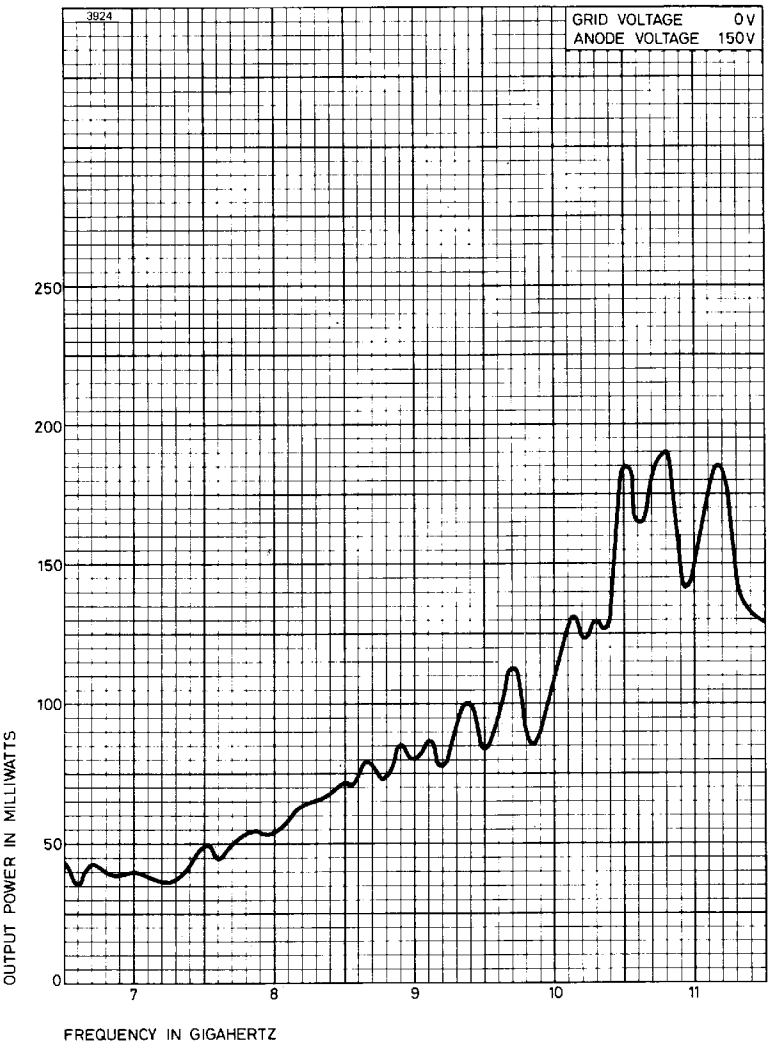
TYPICAL DELAY LINE VOLTAGE CHARACTERISTIC



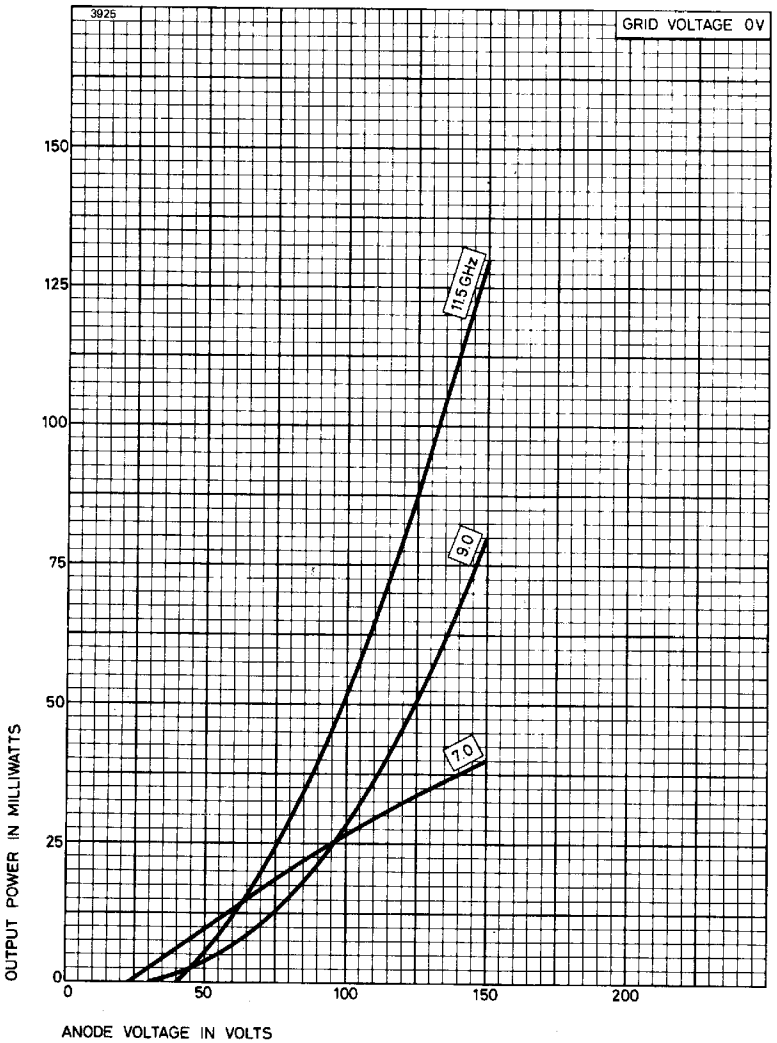
FREQUENCY CHANGE CHARACTERISTIC



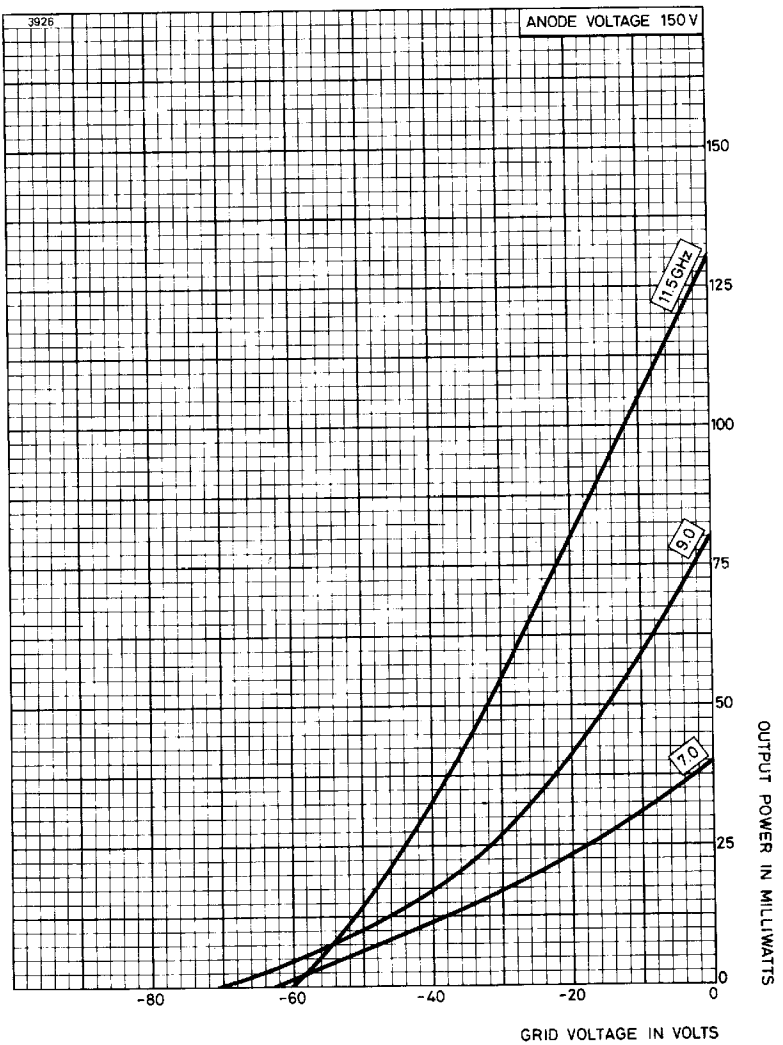
TYPICAL POWER CHARACTERISTIC



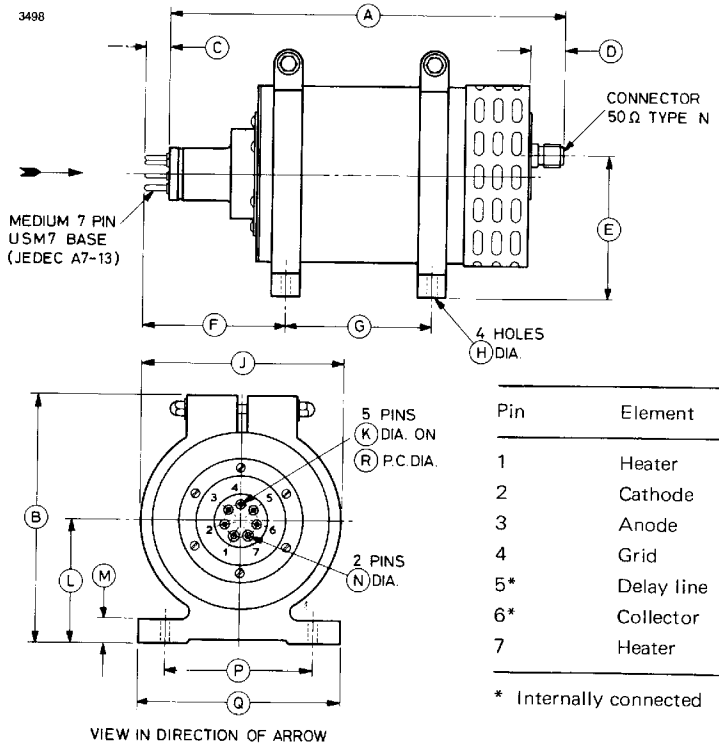
TYPICAL ANODE MODULATION CHARACTERISTICS



TYPICAL GRID MODULATION CHARACTERISTICS



OUTLINE OF N1010A (All dimensions without limits are nominal)



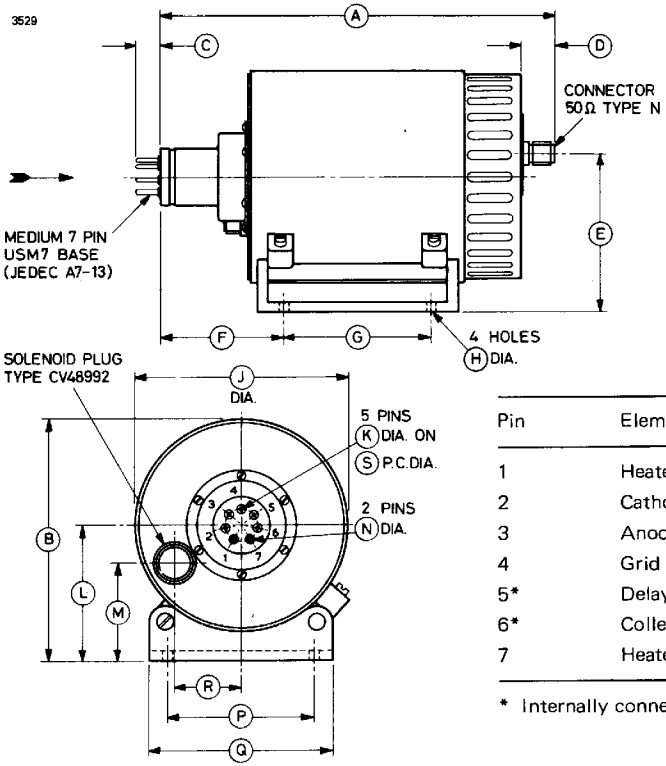
Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4	J	4.961 ± 0.062	126.0 ± 1.6
B	6.000 max	152.4 max	K	0.125 ± 0.003	3.175 ± 0.076
C	0.625 max	15.88 max	L	2.953	75.01
D	0.813	20.65	M	0.400	10.16
E	3.504	89.00	N	0.156 ± 0.003	3.962 ± 0.076
F	3.460 ± 0.375	87.88 ± 9.53	P	3.543 ± 0.010	89.99 ± 0.25
G	3.543 ± 0.010	89.99 ± 0.25	Q	4.961 ± 0.062	126.0 ± 1.6
H	0.217	5.51	R	1.000	25.40

Millimetre dimensions have been derived from inches.

OUTLINE OF N1010S (All dimensions without limits are nominal)



VIEW IN DIRECTION OF ARROW

Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4	K	0.125 ± 0.003	3.175 ± 0.076
B	5.860 ± 0.125	148.8 ± 3.2	L	3.270 ± 0.031	83.06 ± 0.79
C	0.625 max	15.88 max	M	2.343 ± 0.187	59.51 ± 4.75
D	0.813	20.65	N	0.156 ± 0.003	3.962 ± 0.076
E	3.801 ± 0.187	96.55 ± 4.75	P	3.543 ± 0.010	89.99 ± 0.25
F	3.000 ± 0.250	76.20 ± 6.35	Q	4.500 ± 0.031	114.3 ± 0.8
G	3.543 ± 0.010	89.99 ± 0.25	R	1.606 ± 0.187	40.79 ± 4.75
H	0.218	5.54	S	1.000	25.40
J	5.181 ± 0.015	131.6 ± 0.4			

Millimetre dimensions have been derived from inches.

N1034A N1034S

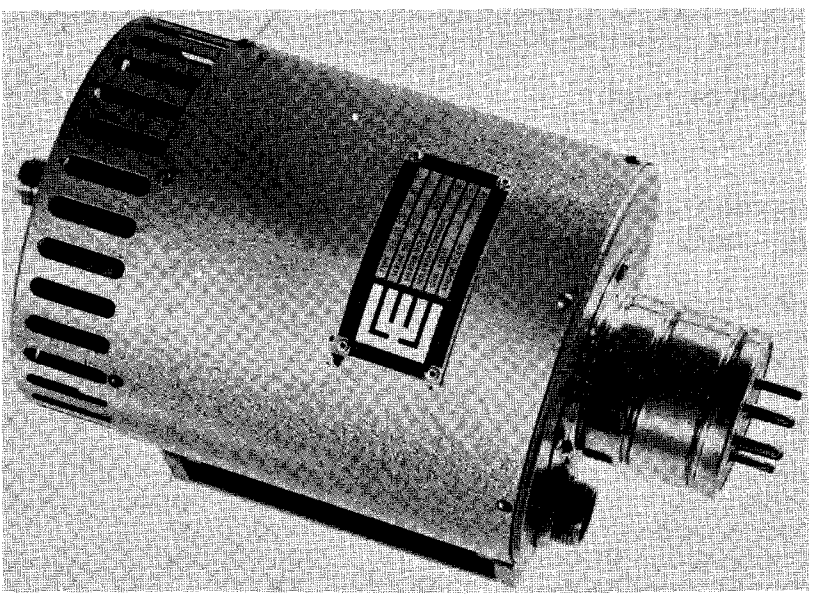
BACKWARD WAVE OSCILLATORS

Service types CV2381 (N1034A), CV6023 (N1034S)

ABRIDGED DATA

O-type backward wave oscillators for wide band microwave receivers and oscillators, suitable for pulse or amplitude modulation.

Frequency range	2.4 to 4.5	GHz
Typical output power over band	90 to 400	mW
Integral focusing:		
N1034A	permanent magnet	
N1034S	solenoid	
Output connector	50Ω type N coaxial	



GENERAL

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	2.4	A
Cathode pre-heating time (minimum)	2.0	min
Inter-electrode capacitances:		
cathode to grid, anode and delay line	10	pF
grid to cathode, anode and delay line	15	pF
anode to cathode, grid and delay line	15	pF
delay line to cathode, grid and anode	10	pF
delay line to outer shell	300	pF
Solenoid power supply (N1034S)	24V, 4A	d.c.

Mechanical

Overall dimensions	see outline drawings
Net weight	11 pounds (5kg) approx
Mounting position (see note 1)	any
Base	B.S.448-B7D (JEDEC A7-17)
R.F. output connector	50Ω type N
Solenoid connector (N1034S)	AP208600/CV48992

Tubes are vibration tested to withstand normal service conditions.

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

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

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.8	V
Heater starting current (peak)	—	4.0	A
Grid voltage (see note 4)	0	−150	V
Delay line voltage	150	1500	V
Delay line current (see note 5)	—	50	mA
Delay line dissipation	—	50	W
Anode voltage (see note 6)	—	200	V
Anode current	—	20	mA
Body temperature	—	120	°C
Solenoid voltage (N1034S)	16	24	V
Solenoid current (N1034S)	3.0	7.0	A

RANGE OF CHARACTERISTICS AND TYPICAL OPERATION

Operating Conditions (See note 3)

Heater voltage	6.3	V
Grid voltage	0	V
Load v.s.w.r.	1.2:1	max

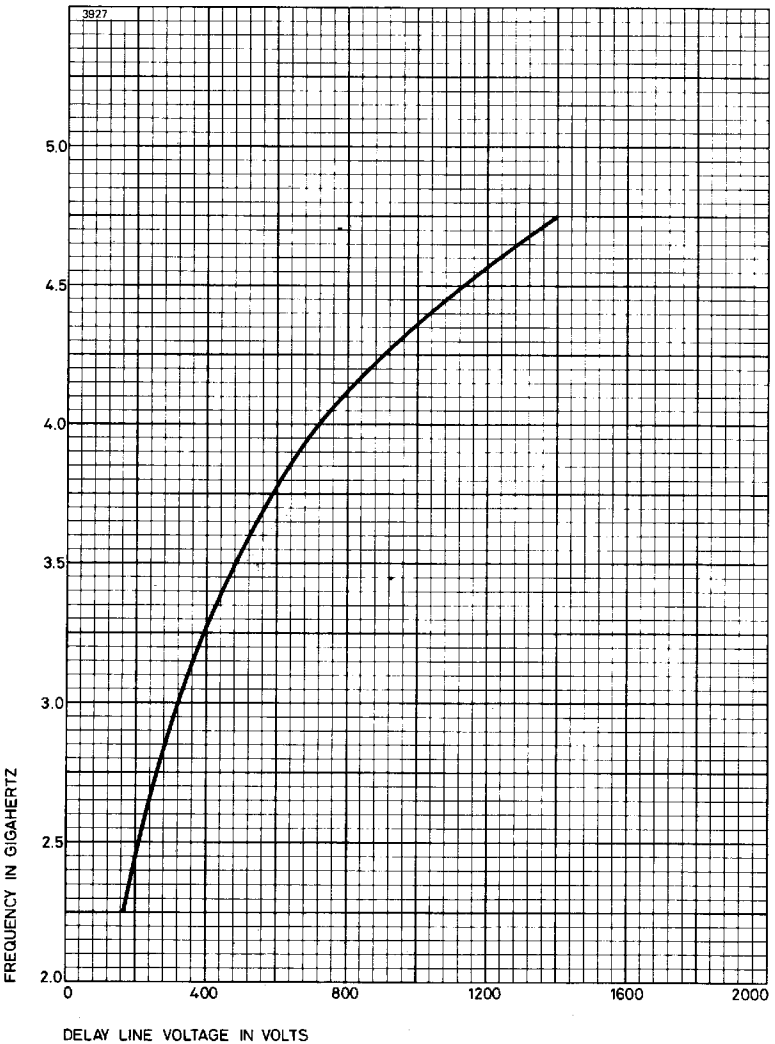
Typical Performance

	Min	Typical	Max	
Heater current	2.1	2.4	2.6	A
Delay line voltage:				
at 2.4GHz	150	190	200	V
at 2.6GHz	180	225	235	V
at 3.4GHz	400	440	460	V
at 4.5GHz	1030	1130	1170	V
Delay line current:				
at 2.4GHz	16	35	40	mA
at 2.6GHz	—	36	—	mA
at 3.4GHz	30	38	50	mA
at 4.5GHz	30	45	50	mA
Anode voltage (see note 7)	100	150	200	V
Anode current	—	3.0	20	mA
Solenoid current for N1034S (see note 7)	3.0	4.0	7.0	A
Solenoid voltage	16	21	24	V
Grid cut-off voltage (see note 8)	—	−50	−100	V
Output power:				
at 2.4GHz	20	90	—	mW
at 2.6GHz	50	160	—	mW
at 3.4GHz	150	340	—	mW
at 4.5GHz	250	400	—	mW
Frequency pulling (see note 9)	—	6.0	7.0	MHz
Signal to noise ratio (see note 10)	150	155	—	db/Hz

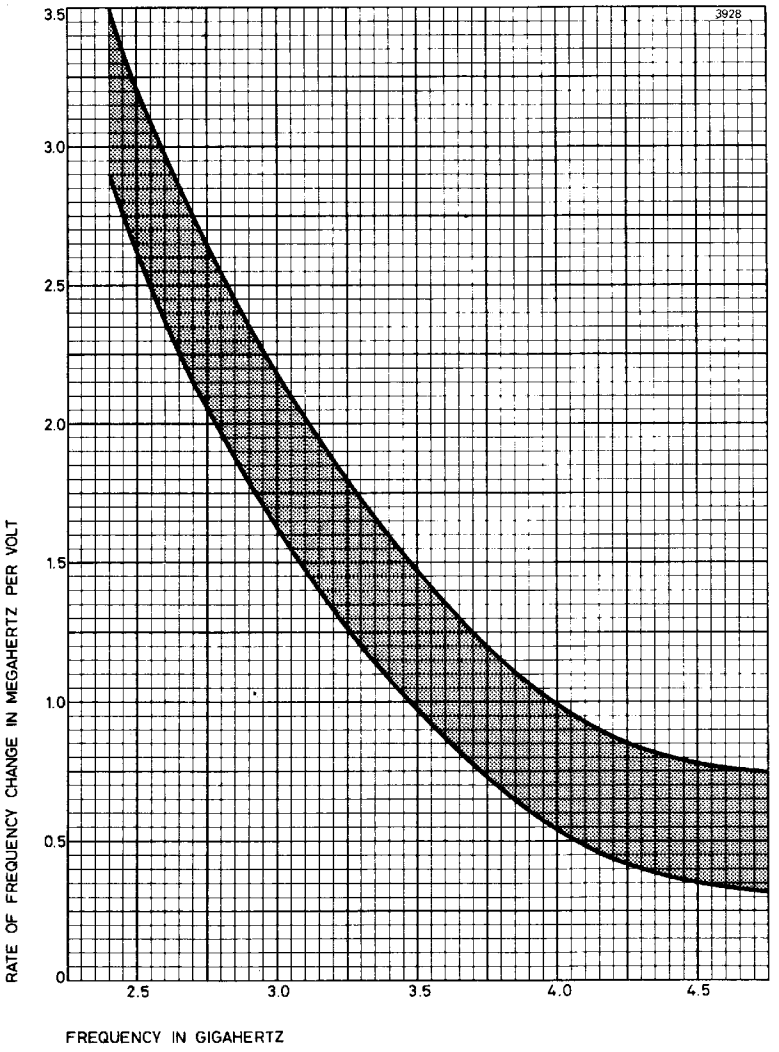
NOTES

1. Any magnetic materials must at all times be kept at least 8 inches (20cm) away from the N1034A, or a permanent loss of performance may result.
2. For the N1034A an airflow of $10ft^3/min$ ($0.28m^3/min$) is required, directed at the radiator; for the N1034S $20ft^3/min$ ($0.57m^3/min$), directed at the radiator and the sides of the solenoid. The pressure drop is less than 1 inch w.g.
3. All voltages except the heater voltage are with respect to cathode.
4. The grid must never become positive with respect to cathode. For normal c.w. operation the grid is connected to cathode.
5. The delay line and collector are internally connected.
6. Anode voltage must never be applied before the delay line voltage.
7. The optimum anode voltage and solenoid current (for N1034S) are marked on each tube.
8. The grid voltage at which oscillation ceases.
9. With a mismatch of v.s.w.r. 1.5:1, varied through all phases.
10. Measured as the ratio of the signal to the average noise in a 10MHz bandwidth, centred at least 20MHz from the carrier. For low noise performance the N1034A should be at least 18 inches (460mm) from any magnetic materials. Either the cathode, anode or delay line should be earthed.

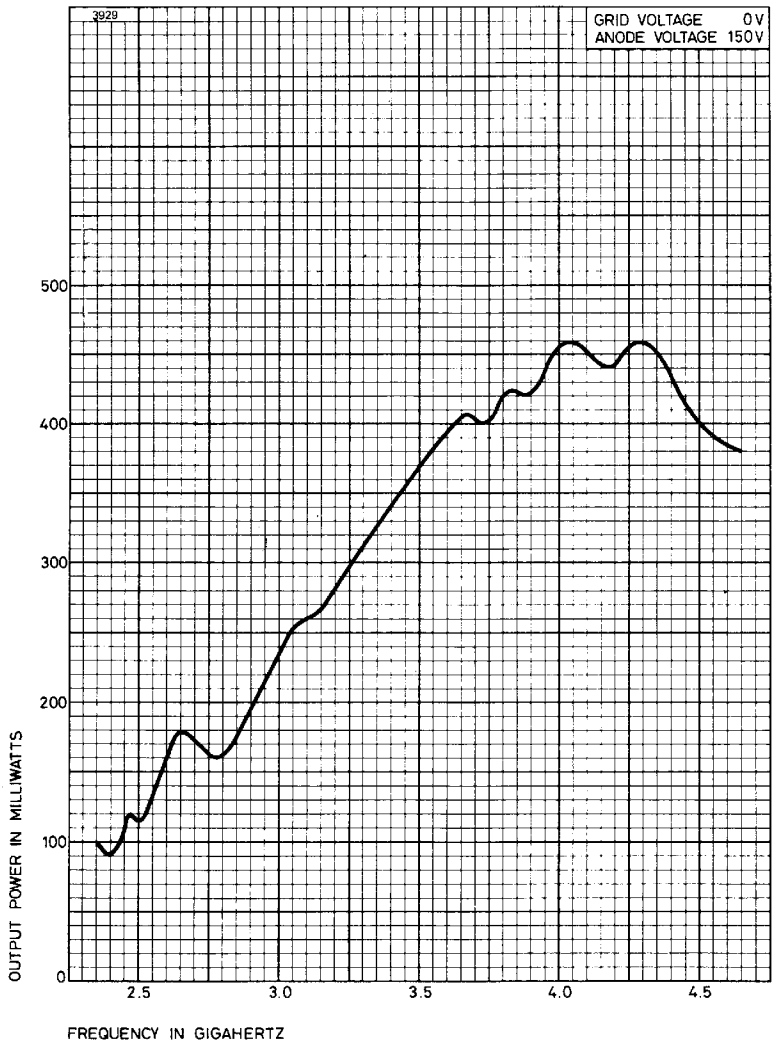
TYPICAL DELAY LINE VOLTAGE CHARACTERISTIC



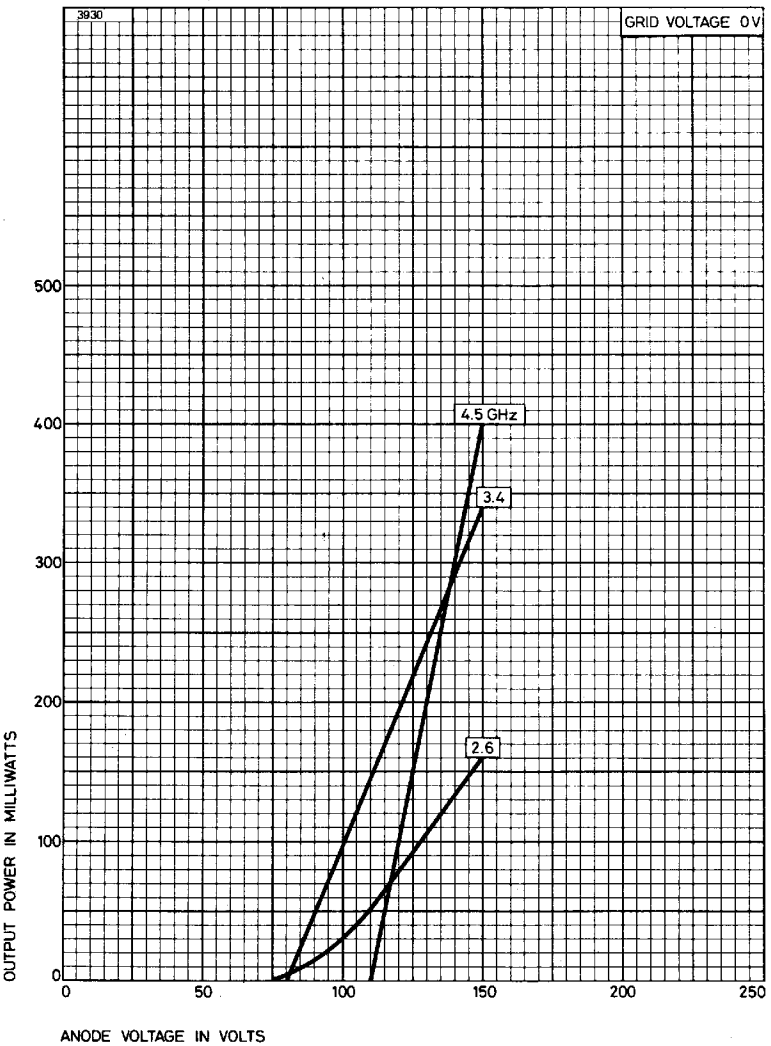
FREQUENCY CHANGE CHARACTERISTIC



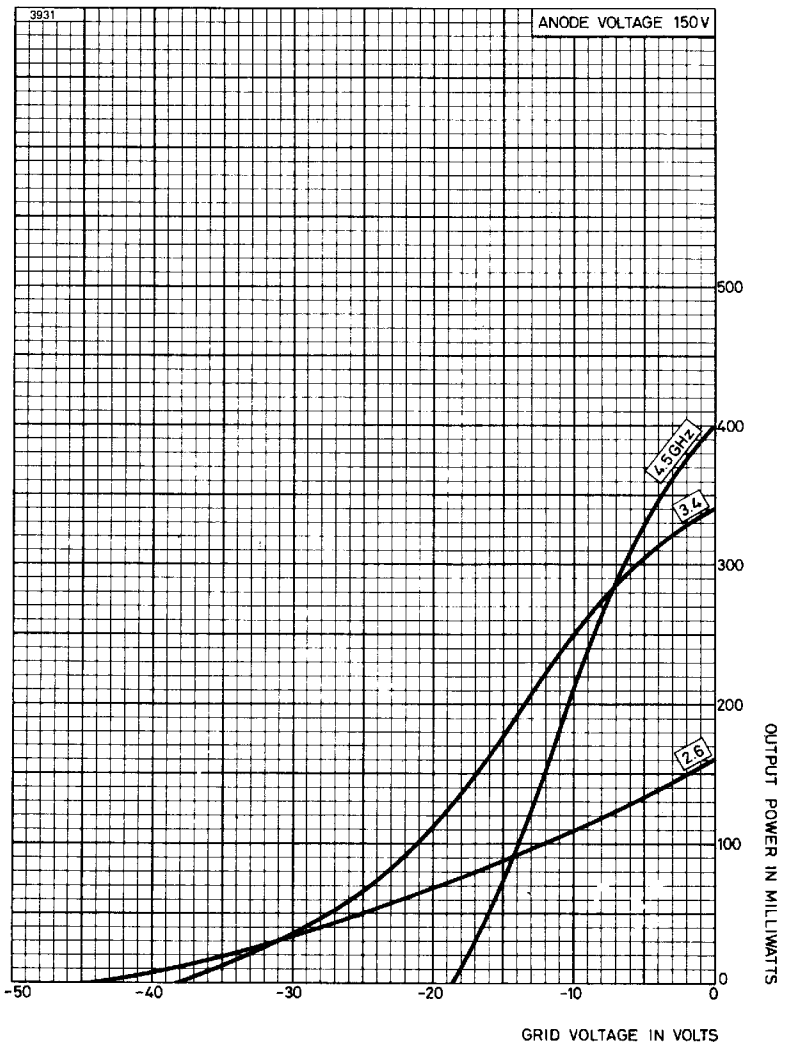
TYPICAL POWER CHARACTERISTIC



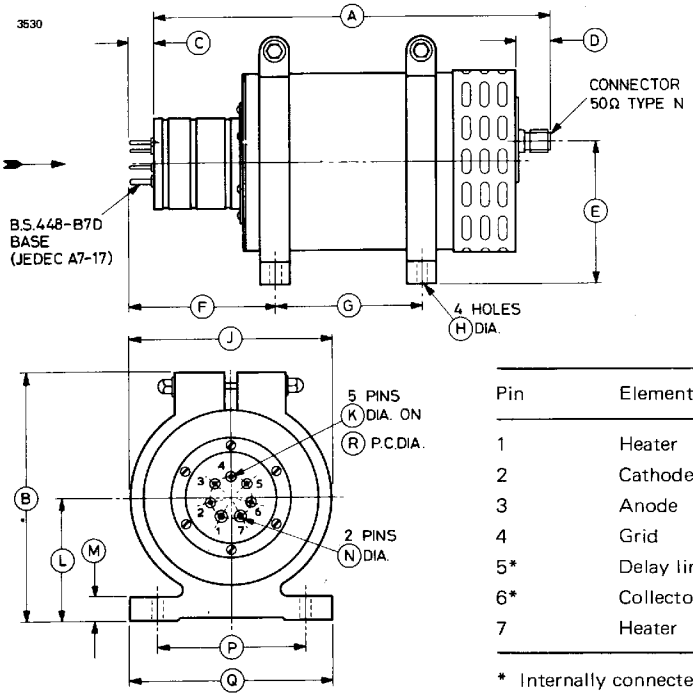
TYPICAL ANODE MODULATION CHARACTERISTICS



TYPICAL GRID MODULATION CHARACTERISTICS



OUTLINE OF N1034A (All dimensions without limits are nominal)



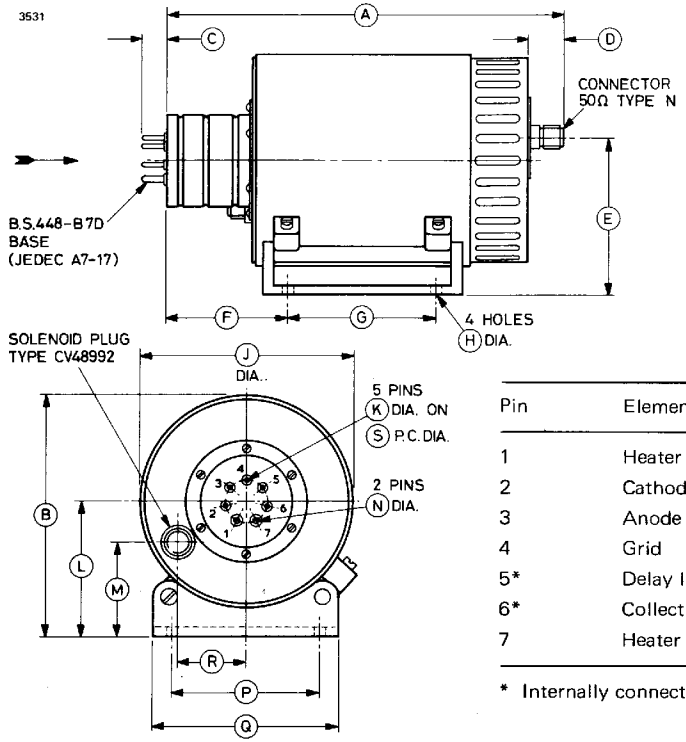
Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4	J	4.961 ± 0.062	126.0 ± 1.6
B	6.000 max	152.4 max	K	0.125 ± 0.003	3.175 ± 0.076
C	0.625 max	15.88 max	L	2.953	75.01
D	0.813	20.65	M	0.400	10.16
E	3.504	89.00	N	0.156 ± 0.003	3.962 ± 0.076
F	3.460 ± 0.375	87.88 ± 9.53	P	3.543 ± 0.010	89.99 ± 0.25
G	3.543 ± 0.010	89.99 ± 0.25	Q	4.961 ± 0.062	126.0 ± 1.6
H	0.217	5.51	R	1.000	25.40

Millimetre dimensions have been derived from inches.

OUTLINE OF N1034S (All dimensions without limits are nominal)



VIEW IN DIRECTION OF ARROW

Pin	Element
1	Heater
2	Cathode
3	Anode
4	Grid
5*	Delay line
6*	Collector
7	Heater

* Internally connected

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.625 ± 0.250	244.5 ± 6.4	K	0.125 ± 0.003	3.175 ± 0.076
B	5.860 ± 0.125	148.8 ± 3.2	L	3.270 ± 0.031	83.06 ± 0.79
C	0.625 max	15.88 max	M	2.343 ± 0.187	59.51 ± 4.75
D	0.813	20.65	N	0.156 ± 0.003	3.962 ± 0.076
E	3.801 ± 0.187	96.55 ± 4.75	P	3.543 ± 0.010	89.99 ± 0.25
F	3.000 ± 0.250	76.20 ± 6.35	Q	4.500 ± 0.031	114.3 ± 0.8
G	3.543 ± 0.010	89.99 ± 0.25	R	1.606 ± 0.187	40.79 ± 4.75
H	0.218	5.54	S	1.000	25.40
J	5.181 ± 0.015	131.6 ± 0.4			

Millimetre dimensions have been derived from inches.

N1047M

LOW NOISE TRAVELLING WAVE TUBE

Service Type CV8908

ABRIDGED DATA

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

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

GENERAL

Electrical

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

Mechanical

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

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

No individual rating to be exceeded

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

TYPICAL OPERATION (at 2.9GHz)

Operational Conditions (see note 2)

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

Continued on page 3

Typical Performance

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

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

Recommended Applied Conditions (see note 2)

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

Range of Characteristics (with recommended applied conditions)

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

NOTES

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

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

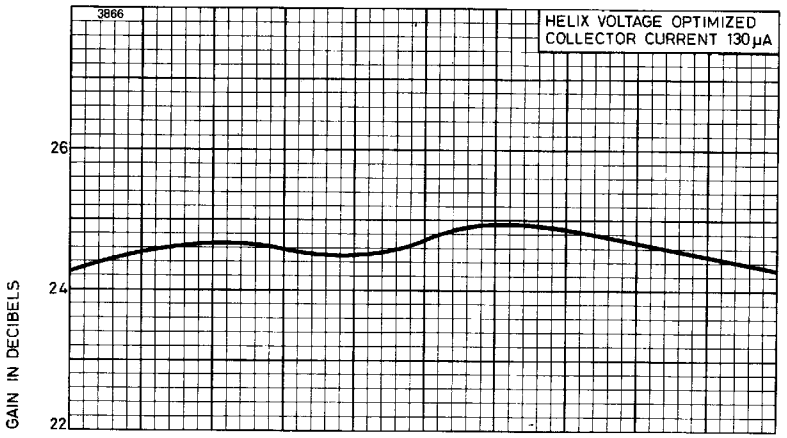
9. Care must be taken to avoid distortion of the magnetic field by metal parts in the vicinity of the tube. Unless otherwise specified, non-magnetic material should be used for such parts.

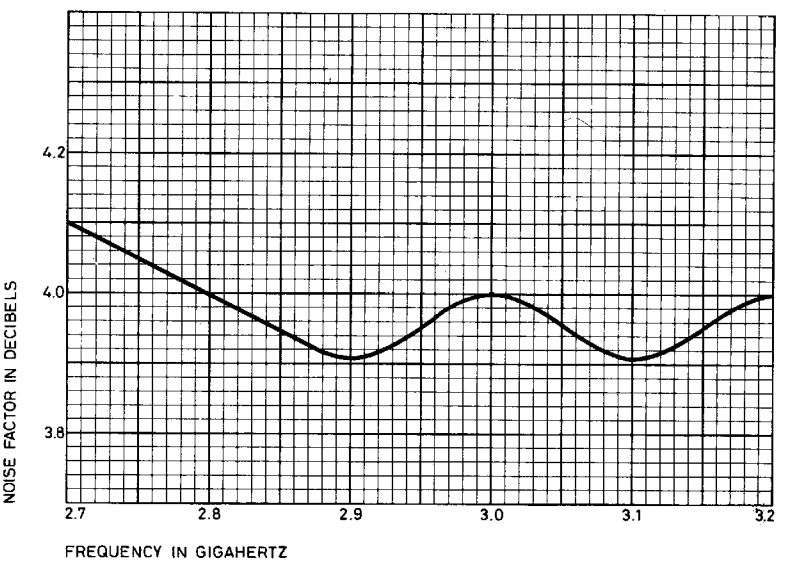
10. Provision must be made for aligning the tube in the solenoid. An adjustment of ±0.100 inch (±2.54mm) about the axis should be sufficient. Care should be taken when winding the solenoid to ensure that the mechanical and magnetic axes are the same. The use of the EEV lightweight solenoid type N4041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

11. Tolerance ±5%.

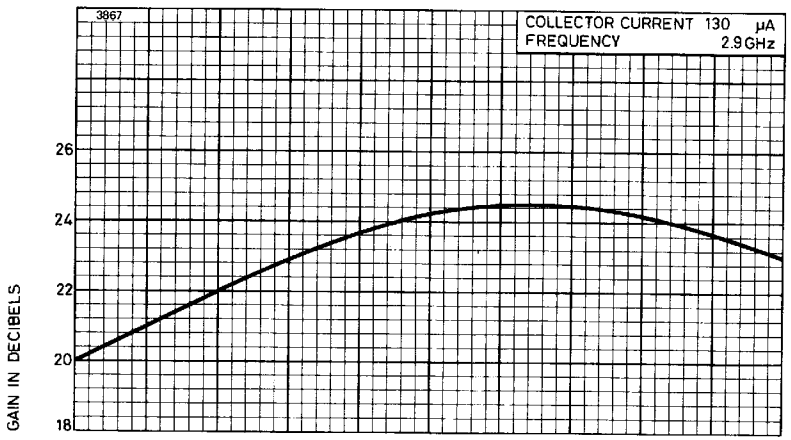
12. The input and output matching transformers are contained within the canister of the tube. They are adjusted during manufacture for optimum performance over the frequency range and further adjustments are neither possible nor necessary.

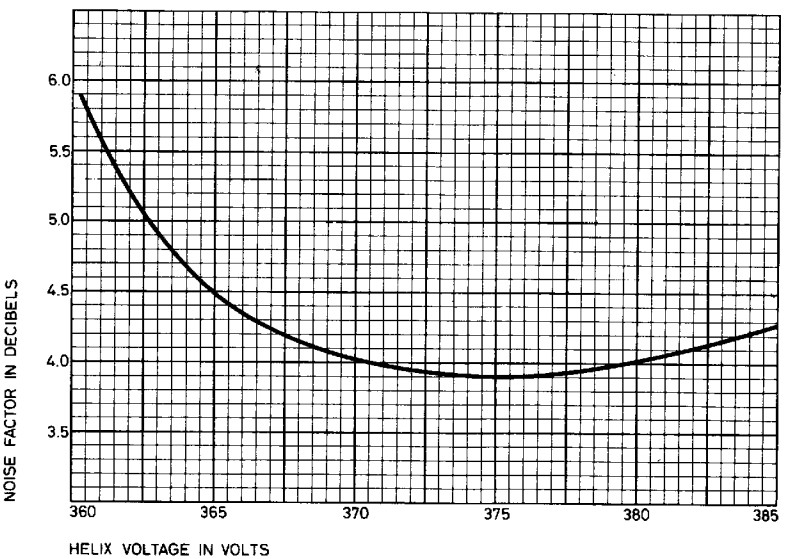
TYPICAL PERFORMANCE CHARACTERISTICS



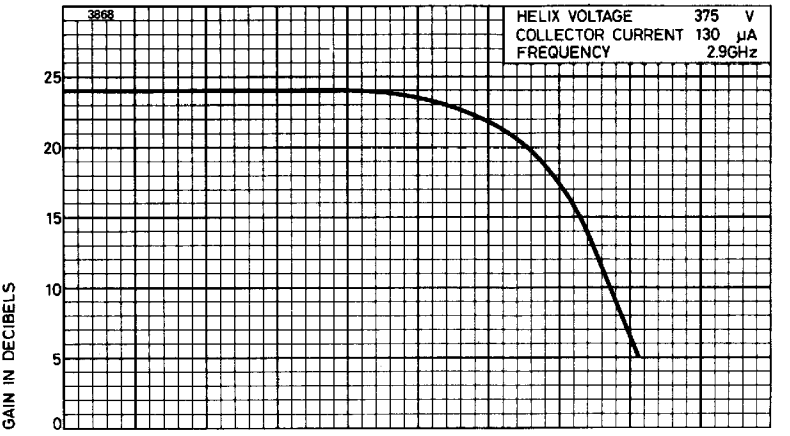


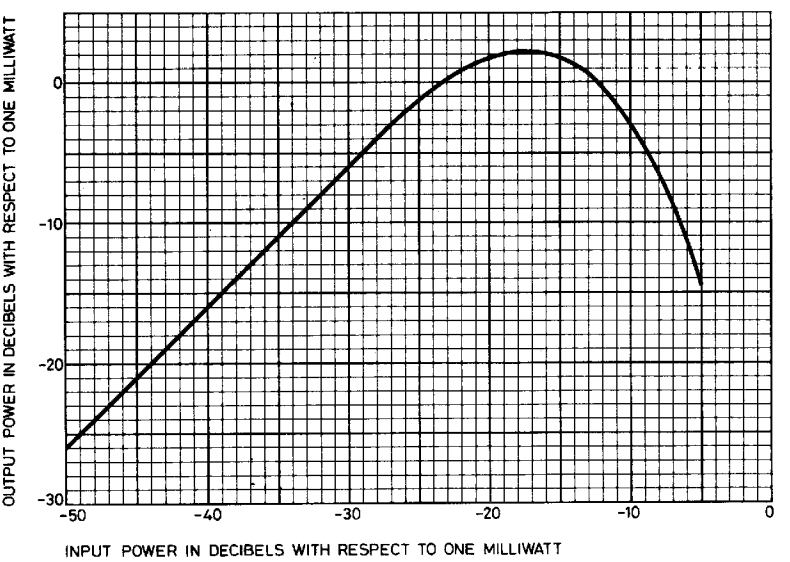
TYPICAL PERFORMANCE CHARACTERISTICS



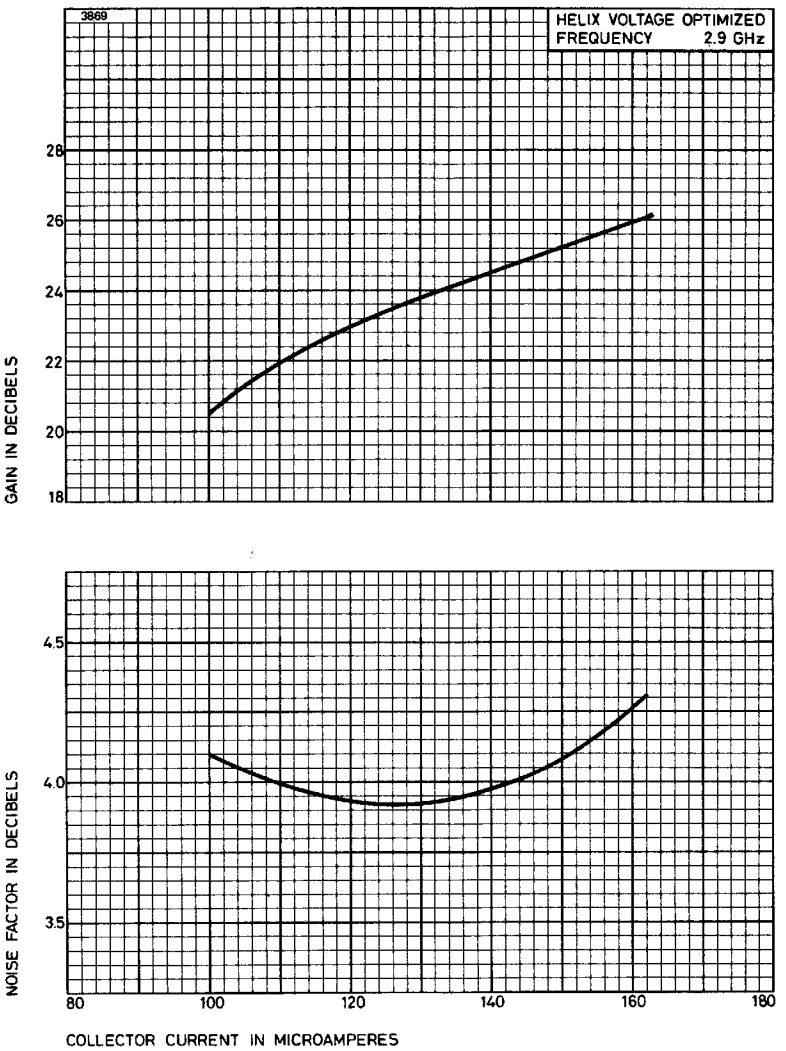


TYPICAL PERFORMANCE CHARACTERISTICS

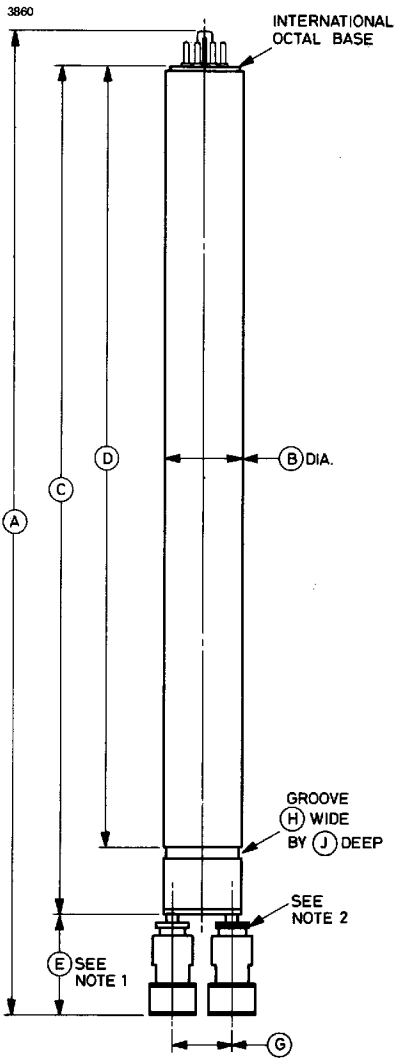




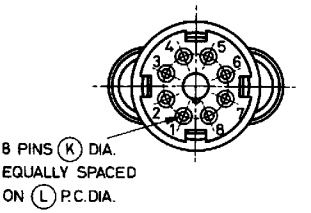
TYPICAL PERFORMANCE CHARACTERISTICS



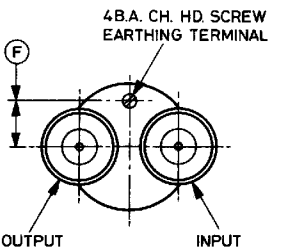
OUTLINE



Enlarged View on Base



Enlarged View on Connectors



Outline Dimensions (All dimensions without limits are nominal)

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

Millimetre dimensions have been derived from inches

Connections

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

Outline Notes

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

P863

RUGGEDISED VIDICON

Service Type CV6243

INTRODUCTION

The P863 is a short, rugged 1-inch vidicon of separate mesh construction with magnetic deflection and focusing, designed for special applications involving severe shock and vibration. This very sensitive vidicon features a separate mesh electrode and a very uniform target layer, resulting in good signal uniformity over a wide range of signal electrode voltages. It has a low power (0.6 watt) heater and differs from the P831 mainly in the mesh connection, which is brought out to a ring contact near the faceplate instead of to the 8-pin base (see outline drawing).

When operated with high voltages on grid 3 and the mesh, higher and more uniform resolution and improved signal uniformity are obtained over a wide range of signal electrode voltage than may be obtained using standard vidicons. Limiting resolutions in the region of 1000 TV lines may be obtained in the centre of the picture when the tube is operated under these conditions, optimum resolution being achieved when the grid 3 voltage is 0.6 to 0.7 of the mesh voltage.

The high sensitivity and low lag properties of the P863 photoconductive surface allow it to be used under lighting conditions encountered in special industrial and military applications. The uniformity of the layer enables uniform dark current and improved uniformity of sensitivity over the scanned area to be obtained provided that suitable associated deflecting and focusing components are used.

GENERAL DATA

Electrical

Cathode	indirectly heated, oxide coated	
Heater voltage	6.3	V
Heater current	95	mA
Inter-electrode capacitance, signal electrode to all other electrodes (average value) (see note 1)	5.0	pF
Spectral response	see spectral sensitivity curve	
Focusing method	magnetic	
Deflection method	magnetic	
Magnetic fields:		
focusing field, at centre of focusing device (see note 2)	37 to 56	gauss
alignment field, adjustable	0 to 4	gauss

Mechanical

Overall length	5.180 inches (131.6mm) max
Overall diameter	1.135 inches (28.9mm) max
Useful size of rectangular image; diagonal, centrally situated	0.63 inches (15.9mm) max
Orientation	The horizontal scan should be parallel to the plane passing through the tube axis and the blank key-pin position. The masking is for orientation only and does not define the proper scanned area.
Net weight	2 ounces (60g) approx
Mounting position (see note 3)	any
Base	small button ditetrar 8-pin (JEDEC no. E8-11)
Mating socket	Type R41-79502 by United Carr Fasteners Ltd. (or equivalent)

Storage

Recommended store temperature	15 to 35	°C

Tubes should be stored in darkness.

WARNING

When operating a tube the following precautions should be observed:

1. Ensure that the temperature of the tube is within its recommended range.
2. Avoid over exposure of stationary pictures, e.g. test patterns, or after-image may result.
3. A surge limiting device must be incorporated if necessary to ensure that the heater current does not exceed 150mA when switching on or at any other time.
4. Ensure that the envelope between the signal electrode and mesh contacts is clean.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating to be exceeded.

	Min	Max	
Heater voltage	5.7	6.9	V
Signal electrode voltage	—	100	V
Grid 4 (mesh) voltage (see note 4)	—	1000	V
Grid 3 (beam focus) voltage (see note 4)	—	1000	V
Grid 2 (accelerator) voltage	—	750	V

Continued on page 3

MAXIMUM AND MINIMUM RATINGS (Absolute values) — continued

	Min	Max	
Grid 1 voltage:			
negative bias value	—	300	V
positive bias value	—	0	V
Blanking voltage, peak to peak (see note 5):			
when applied to grid 1 (negative pulses)	40	—	V
when applied to cathode (positive pulses)	20	—	V
Peak heater to cathode voltage:			
heater negative with respect to cathode	—	125	V
heater positive with respect to cathode	—	10	V
Dark current	—	0.25	μA
Peak signal electrode current (see note 6)	—	0.55	μA
Faceplate temperature	—	71	°C
Peak illumination of faceplate	—	1000	ft-candles
	—	10 760	lux

TYPICAL OPERATION

Operating Conditions (for scanned area of 0.5 x 0.375 inch)

The following values and notes are for general guidance and may vary from tube to tube.

	Low Voltage Operation	High Voltage Operation	
Grid 4 (mesh) voltage (see note 4)	500	750	V
Grid 3 (beam focus) voltage (approx) (see notes 4 and 7)	300	450	V
Grid 2 (accelerator) voltage	300	300	V
Grid 1 voltage for picture cut-off (with no blanking voltage on grid 1)	−45 to −100	−45 to −100	V
Blanking voltage, peak to peak:			
when applied to grid 1 (negative pulses)	75	75	V
when applied to cathode (positive pulses)	20	20	V
Field strength at centre of focusing coil (see notes 2, 7 and 8)	41 ± 4	52 ± 4	gauss
Alignment field, adjustable (see notes 9 and 10)	0 to 4	0 to 4	gauss
Faceplate temperature (see note 11)	30 to 35	30 to 35	°C

Typical Performance	**Low Voltage**	**High Voltage**	
Limiting resolution at centre of picture (approx)	900	1000	TV lines
Amplitude response to a 400 TV line square wave test pattern at centre of picture (approx)	60	70	%
Lag (see note 12)	20		% max
'Gamma' of transfer characteristic for signal output between 0.02 and 0.2μA	0.5 to 0.6		
Visual equivalent signal to noise ratio (see note 13)	300:1		approx

	Condition				
	1*	**2†**	**3‡**	**4⊕**	
Faceplate illumination (highlights) (see note 18)	0.1	0.5	1.0	5.0	ft-candles
Signal output current (peak) (see note 19):					
typical	0.14	0.27	0.20	0.25	μA
minimum	—	—	0.15	—	μA
Approximate range of signal electrode voltage (see note 20)	35–70	30–60	20–40	10–40	V
Dark current (see note 21)	0.2	0.1	0.02	<0.02	μA

* See note 14 † See note 15 ‡ See note 16 ⊕ See note 17

SPECIAL PERFORMANCE

Tubes of this type have been successfully submitted to a type approval programme including the following environmental tests.

1. Thermal shock
2. Rapid depressurisation
3. Tropical exposure
4. Long term storage at elevated temperature (70°C)
5. Mechanical shock
6. Combined temperature, pressure and vibration
7. Random noise vibration

It may be possible, from the results of these tests to predict the probable performance of the tube under various environmental conditions.

If it is proposed to use the tubes under conditions of severe vibration etc., the manufacturer may be able to advise as to the performance to be expected.

SEQUENCE OF CAMERA ADJUSTMENTS

(For Typical Operating Conditions as shown on page 3)

(a) Set the grid 1 voltage for the maximum negative bias for picture cut-off and apply the other voltages given under Typical Operating Conditions.

(b) Check that the deflection circuits are functioning properly and adjust the scanning amplitude controls so that a maximum area of the photoconductive layer will be scanned.

(c) Set the signal electrode voltage to give the signal current specified for the particular condition of operation. The table on page 4 gives an indication of the ranges of signal electrode voltage required for four conditions of operation. For other conditions of operation, reference should be made to the light transfer characteristic and the graph showing the range of signal electrode voltage to produce a given dark current and therefore a given sensitivity. It is preferable, if possible, to adjust the dark current to the specified value for the particular condition of operation; P863 tubes will have substantially identical performances when operated with identical values of dark current.

The magnitude of non-uniformities of dark current, as well as lag, tend to increase with signal electrode voltage; therefore operation at low values of signal electrode voltage helps to minimise these effects.

(d) Decrease grid 1 voltage from its maximum negative value until a signal is produced.

(e) Adjust grid 3 (beam focus) or grid 3 and grid 4 (mesh) voltages, the lens stop and the optical focus alternately to obtain the best focused picture with the peak signal output current specified under Typical Performance.

(f) Adjust the lens aperture and signal electrode voltage to produce the desired output signal. Lag decreases with increase in illumination on the faceplate.

(g) Adjust the alignment field so that the centre of the picture does not move as grid 3 (beam focus) and grid 4 (mesh) voltages are rocked slightly. Adjust grid 1 (beam current) voltage to provide sufficient beam to just discharge the highlights. It is permissible to set the alignment fields slightly off the minimum movement position to maintain signal uniformity.

(h) Adjust the deflection amplitude and position to scan an area 0.500 inch x 0.375 inch. This is facilitated by the use of a perspex mask inscribed with circles 0.500 inch and 0.375 inch diameter, placed in contact and

concentric with the faceplate of the tube. Light is allowed to fall on the photoconductive layer and an image of the rings is obtained on the monitor. No lens is necessary. The scan amplitude and centring controls are adjusted until the diameter of the larger circle is equal to the width of the raster and that of the smaller equal to the height.

(j) Centre the raster in the useful area of the photoconductive layer and check the alignment (step g).

(k) If the picture is faint, even with adequate video gain, open the lens iris more and, if necessary, increase the signal electrode voltage.

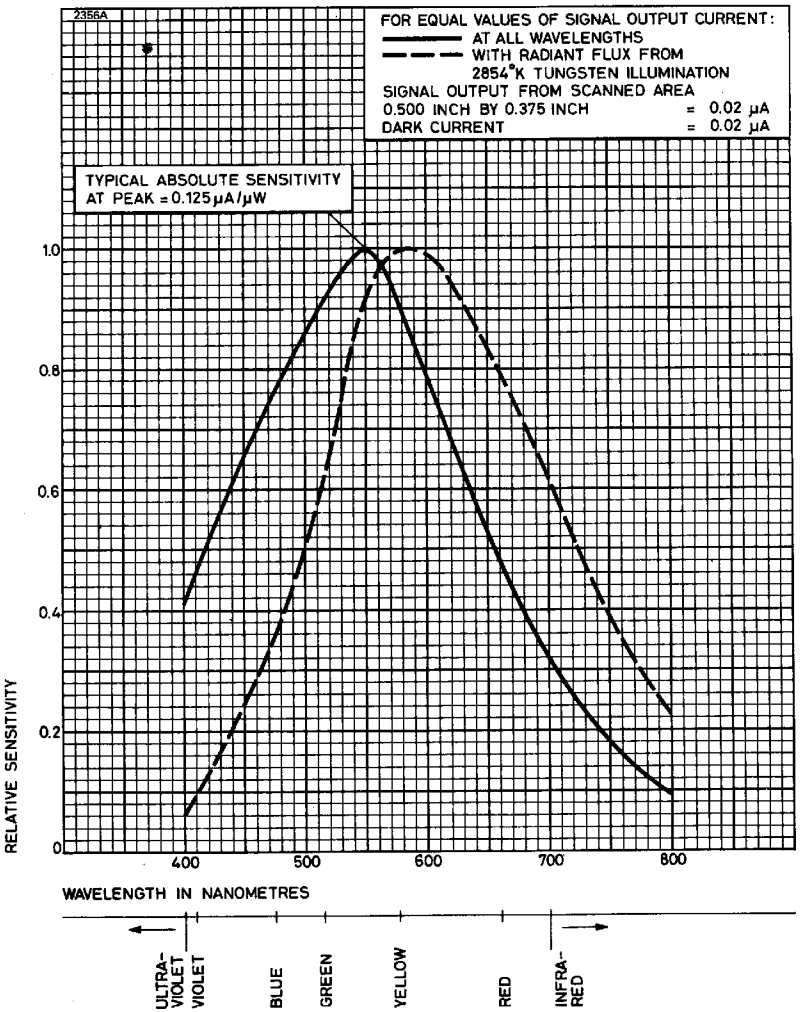
(l) Repeat steps (e) to (g) until optimum picture reproduction is obtained.

NOTES

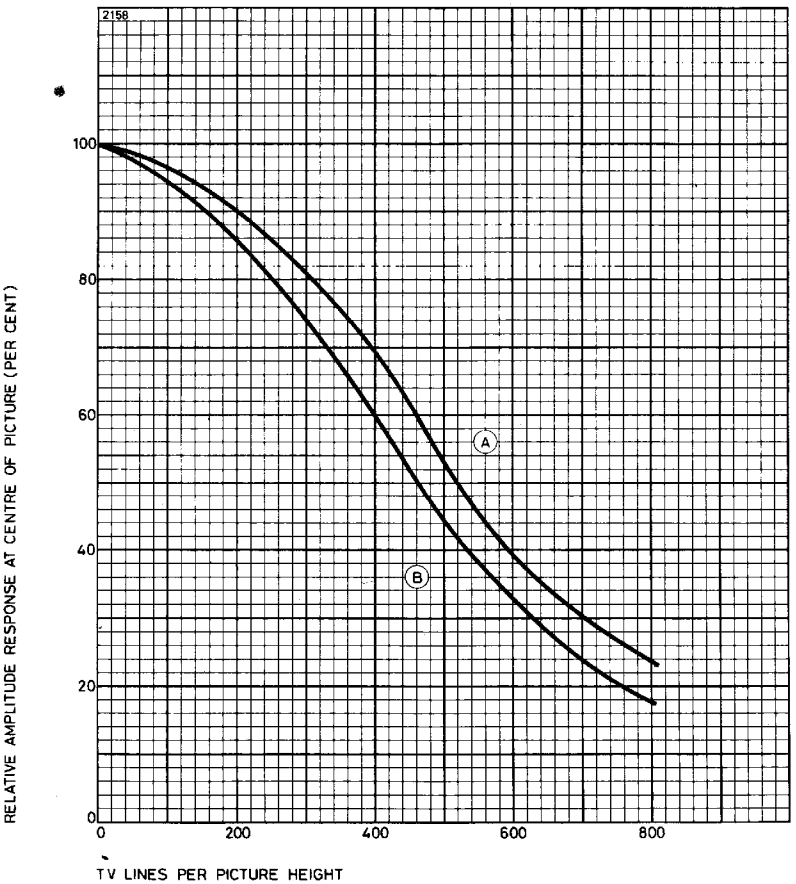
1. This capacitance, which in effect forms the output impedance of the tube, is increased when the tube is mounted in a deflecting yoke and focusing coil assembly. The resistive component of the output impedance is of the order of 100 megohms.
2. The direction of the focusing current should be such that a north pole is attracted to the image end of the focusing coil.
3. When subjected to vibration the tube should not be displaced with respect to the focus, deflection and alignment fields.
4. Grid 3 and grid 4 voltages are adjusted for the best focus. The resolution, uniformity of focus and picture quality decrease with decreasing grid 3 and grid 4 voltage. In general grid 3 should be operated above 250 volts and be approximately 0.6 of grid 4 voltage.
5. The blanking voltage required when applied to the cathode is less than that required when applied to grid 1 as the former reduces the potential difference between the cathode and the scanned side of the target.
6. The video amplifier must be designed to handle signal currents of this magnitude, to avoid picture distortion due to overloading of the amplifier.
7. It may be preferred to adjust beam focus by varying the focus coil current to obtain the field strengths indicated in the Typical Operating Conditions. If the focus coil field strength is fixed, beam focus may be obtained within a $\pm 10\%$ range (approximately) of the grid 3 and grid 4 voltages. The ratio of 0.6 between grid 3 and grid 4 should be maintained as these voltages are varied.
8. Use a deflection yoke, focusing coil and alignment coil which have been approved for operation under specified conditions of shock and vibration.

9. Adjust the current through the alignment coils until the centre of the test pattern does not move as grid 3 and grid 4 voltages or the focus coil current are varied in and out of focus.
10. The alignment coil should be located so that its centre is 3.69 inches from the faceplate of the tube. Its axis should be coincident with the axis of the tube, the deflecting yoke and the focusing coil.
11. Unless the temperature of the faceplate is maintained at a constant value within this range, the dark current and performance will drift from the optimum performance established on initial setting up.
12. Percentage of initial value of signal output current remaining 3 field periods after light is cut off (i.e. 50ms in American standard systems and 60ms in European systems) with a faceplate illumination of 2ft-candles and a total signal current of 0.3μA.
13. Measured with a high gain, low noise, cascode type pre-amplifier having a bandwidth of 5.1MHz and a peak signal output current of 0.35μA. The visual equivalent signal to noise ratio is taken as the ratio of the highlight signal output current to the r.m.s. noise current, multiplied by a factor of 3 (ref. Otto H. Schade, 'Electro-optical Characteristics of Television Systems; Introduction and Part 1 — Characteristics of Vision and Visual Systems', RCA Review, March 1948).
14. Maximum sensitivity operation.
15. Intermediate sensitivity operation.
16. Average sensitivity operation.
17. High light level operation.
18. For example, a scene brightness of approximately 430 ft-lamberts with lens aperture f/4 and a transmission of 75% produces 5 foot candles illumination on the faceplate.
19. The signal output current is the highlight signal electrode current during one frame after the dark current component has been subtracted. Signal currents higher than 0.25μA may be used depending on requirements.
20. The signal electrode voltage for each tube is adjusted to that value which gives the desired operating signal current; the indicated range of signal electrode voltage for each operational condition is given to illustrate the variation normally encountered.
21. The deflecting circuits must provide extremely linear scanning for good black level reproduction under these conditions. Dark current is proportional to the scanning velocity. Any change in scanning velocity produces a black level error in direct proportion to the change in velocity of scanning.

TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



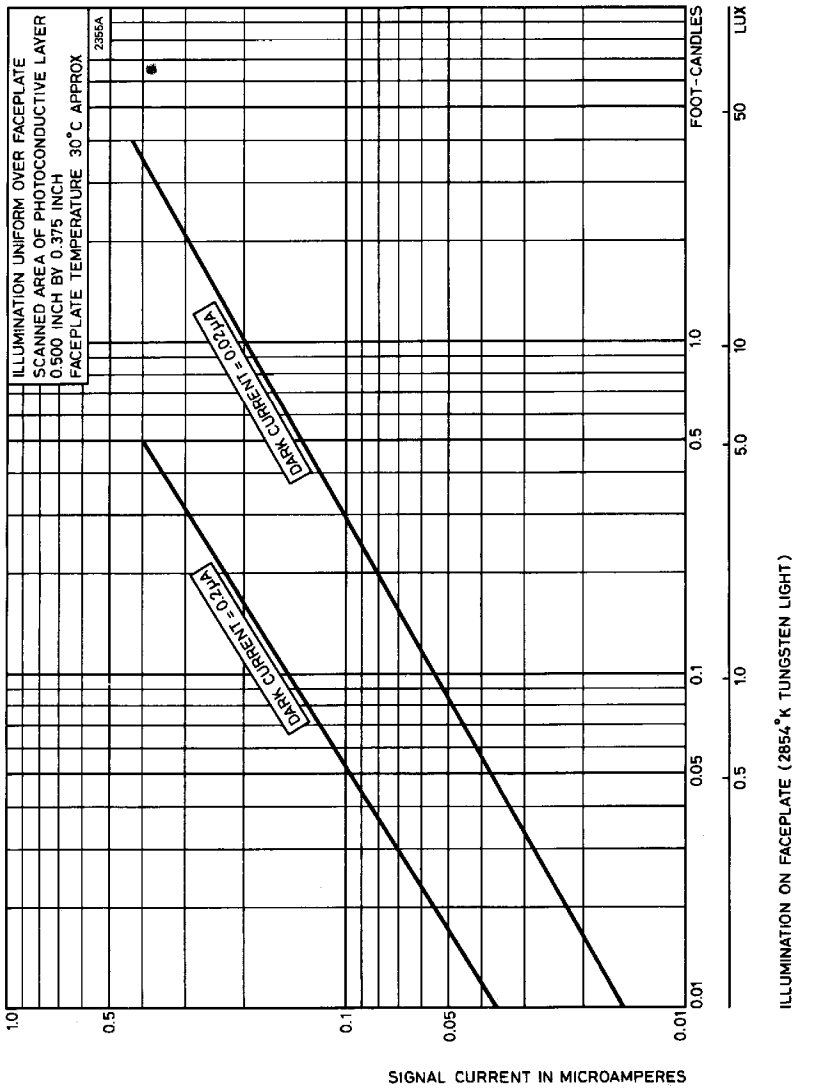
TYPICAL RESOLUTION



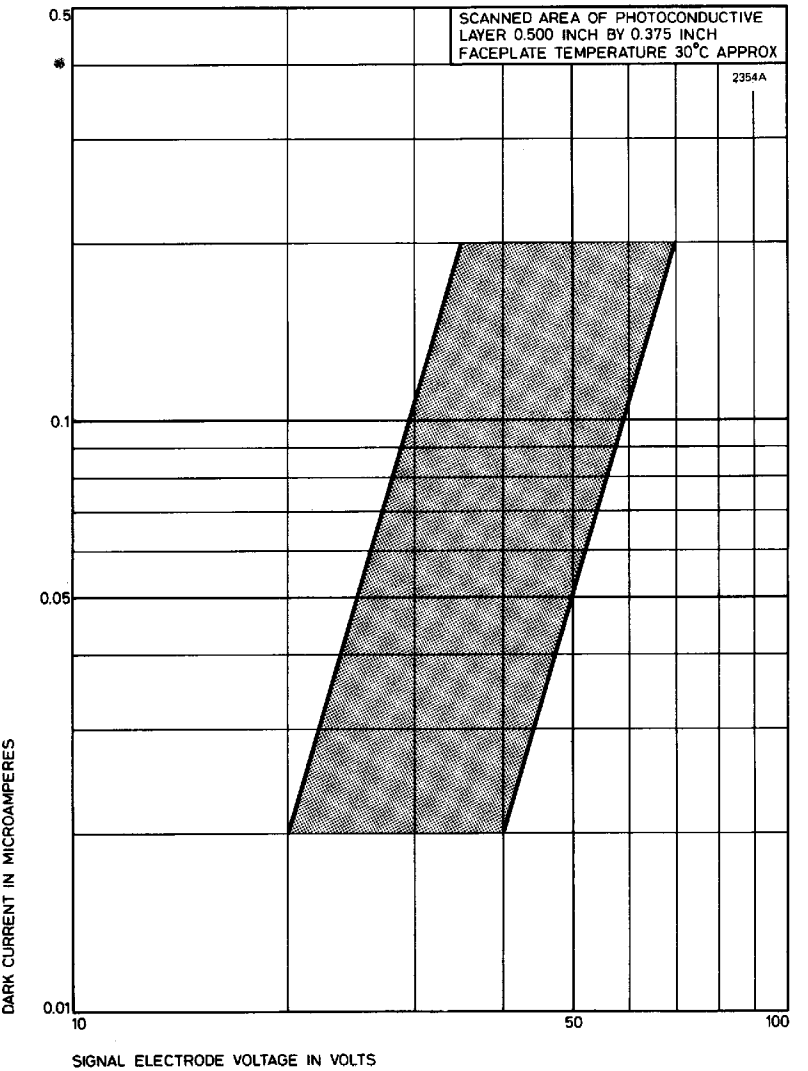
	Curve A	Curve B	
Grid 4 voltage	750	500	V
Grid 3 voltage	450	300	V
Focus field	52	41	gauss
Highlight signal output current	0.35	0.35	μA
Dark current	0.02	0.02	μA
Test pattern	square wave resolution wedge transparency		

Measured on a camera incorporating Cleveland Electronics deflection yoke VY-111-3, focusing coil VF-115-12 and alignment coil VA-118, the channel having a flat response and adequate bandwidth.

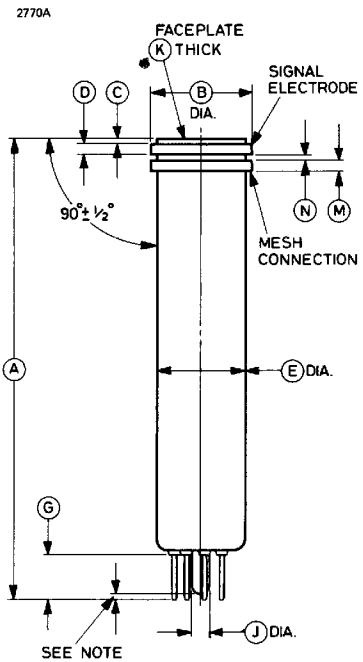
TYPICAL LIGHT TRANSFER CHARACTERISTICS

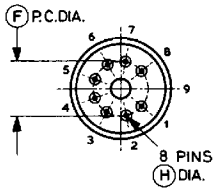


TYPICAL RANGE OF DARK CURRENT



OUTLINE (All dimensions without limits are nominal)





Pin	Element
1	Heater
2	Grid 1
3	No connection
4	Internal connection. Do not use
5	Grid 2
6	Grid 3 (beam focus)
7	Cathode
8	Heater
9	Key pin position, blank

Note The seal-off will not project beyond the pins.

Ref	Inches	Millimetres
A	5.120 ± 0.060	130.0 ± 1.5
B	1.125 ± 0.010	28.58 ± 0.25
C	0.050 max	1.27 max
D	0.125 ± 0.002	3.175 ± 0.051
E	$1.020^{+0.030}_{-0.035}$	$25.91^{+0.76}_{-0.89}$
F	0.600	15.24
G	0.503 max	12.78 max
H	$0.050^{+0.002}_{-0.004}$	$1.270^{+0.051}_{-0.102}$
J	0.265 max	6.73 max
K	0.093 ± 0.005	2.36 ± 0.13
M	0.125 ± 0.002	3.175 ± 0.051
N	0.050	1.27

Millimetre dimensions have been derived from inches.

* P863, page 12

QS1212

VOLTAGE REFERENCE TUBE

Service Types CV4048, CV5285

The data to be read in conjunction with the Voltage Stabilizer Preamble.

DESCRIPTION

The QS1212 is a single gap cold cathode gas-filled voltage reference tube with a B7G base. It is rugged and reliable and is designed to provide a very stable voltage output of 85 volts over long periods. Radioactive material is used to give the same maximum striking voltage in total darkness and normal lighting.

GENERAL DATA

Characteristics

Striking voltage in normal lighting or total darkness	115	V max
Operating voltage at 6.0mA	85 ± 2	V
Cathode current range	1.0 to 10	mA
Regulation:		
over current range of 1.0 to 10mA	4.0	V max
over current range of 5.8 to 6.2mA	0.18	V max
Variation of operating voltage with life (see note):		
during the first 300 hours	0.3	% max
during subsequent 1000 hours	0.2	% max
during any 1000 hour period after the first 1000 hours	0.1	% max
Acceleration (continuous)	2.5	g max
Shock (short duration)	500	g max
Noise (peak to peak) (50 to 5000Hz) over the current range 1.0 to 10mA	5.0	mV max
Voltage jumps over the current range 1.0 to 10mA	100	mV max

Continued on page 2

Characteristics (Continued)

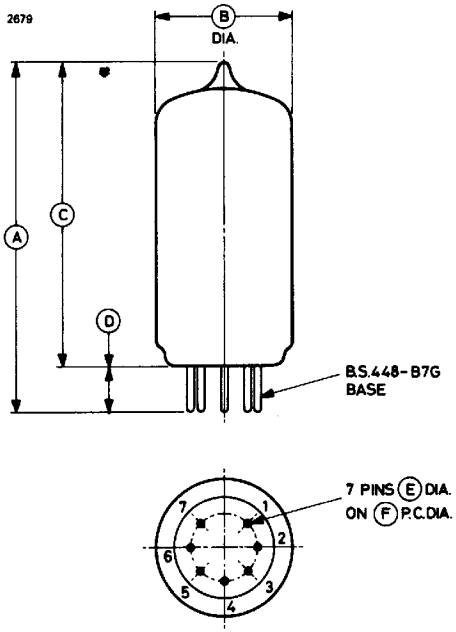
Ambient temperature range	−55 to +90	°C
Temperature coefficient:		
between −55°C and +25°C	−10	mV/°C max
between +25°C and +90°C	−5.0	mV/°C max

Mechanical

Overall length	2.126 inches (54.0mm) max
Seated height	1.874 inches (47.6mm) max
Overall diameter	0.748 inch (19.0mm) max
Mounting position	any
Base	B.S.448-B7G

Note For minimum variation of operating voltage with life the current should be as nearly constant as possible, preferably 6.0mA.

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.126 max	54.0 max
B	0.748 max	19.0 max
C	1.874 max	47.6 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

QS1215

VOLTAGE STABILIZER

Service Type CV5173

The data to be read in conjunction with the Voltage Stabilizer Preamble.

DESCRIPTION

The QS1215 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 90 volts over the current range 1.0 to 40mA. Radio-active material is used in the tube to give the same maximum striking voltage in total darkness and normal room lighting.

GENERAL DATA

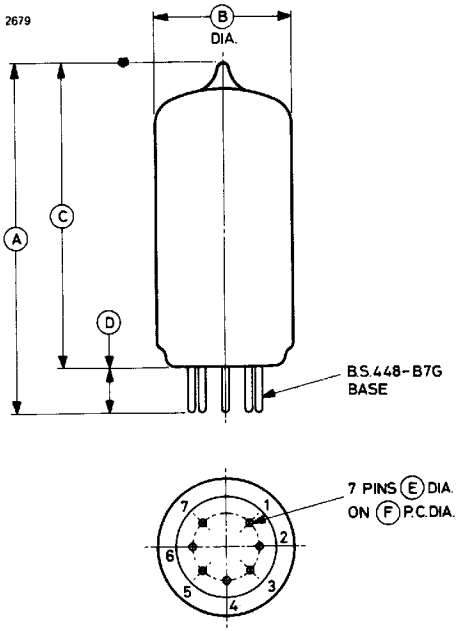
Characteristics

Striking voltage in normal lighting	115	V max
Striking voltage in total darkness	115	V max
Operating voltage at 20mA	90^{+2}_{-4}	V
Cathode current range	1.0 to 40	mA
Regulation over current range	12	V max
Variation of operating voltage with life during 1000 hours at 20mA	±1.0	% max
Ambient temperature range	−55 to +70	°C
Inverse voltage	80	V max
Shunt capacitance	0.1	μF max

Mechanical

Overall length	2.126 inches (54.0mm) max
Seated height	1.874 inches (47.6mm) max
Overall diameter	0.748 inch (19.0mm) max
Mounting position	any
Base	B.S.448-B7G

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A	2.126 max	54.0 max
B	0.748 max	19.0 max
C	1.874 max	47.6 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

QT1257

TOUCH BUTTON TUBE

DESCRIPTION

The QT1257 is a cold cathode tube designed for use as a self-indicating electronic switch; it is actuated by touch.

RATINGS

Minimum anode-cathode d.c. breakdown voltage . . .	325	V
Anode-cathode d.c. maintaining voltage at 10mA	80	V
Maximum continuous cathode current	25	mA
Maximum peak cathode current	100	mA

OPERATION

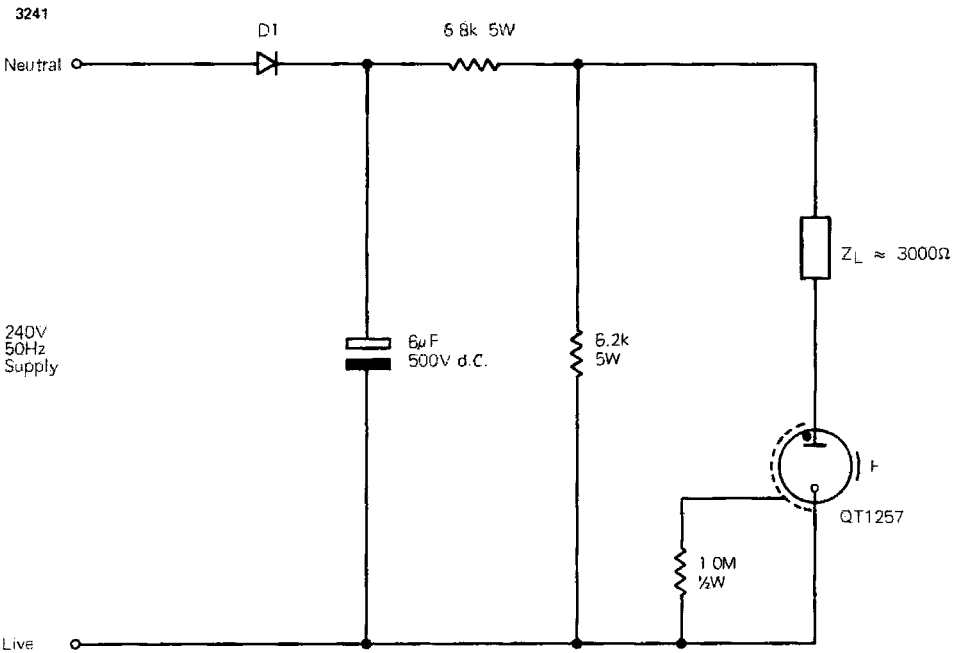
The Electronic Touch Button is a special type of trigger tube which is switched to the conducting state by the touch of a person's finger on an external control electrode which is placed at the end of the tube. After the electrode has been touched, the tube emits a visible glow until the h.t. supply is momentarily interrupted for a time exceeding the tube deionization time. The current flowing through the tube may be used to operate a relay.

A typical application of this tube is its use in the control panel of lifts for selecting the floor at which the passenger wishes to alight. When the tube corresponding to the selected floor is touched, it continues to glow until the lift reaches that floor.

A typical circuit is shown on page 2. The external screening* around the touch tube is connected to the live lead of the mains supply via a 1 megohm resistor. When the external control electrode F is touched by the hand, or is earthed, there is an alternating voltage of 240 volts between this electrode and the tube cathode. The current which flows produces enough ions to ignite the main gap. Even if the tube is touched by a hand covered with a glove, the capacitance between the external electrode and earth normally exceeds 5pF and this is adequate to fire the tube.

* The external screening may be coated with insulating material.

TYPICAL CIRCUIT

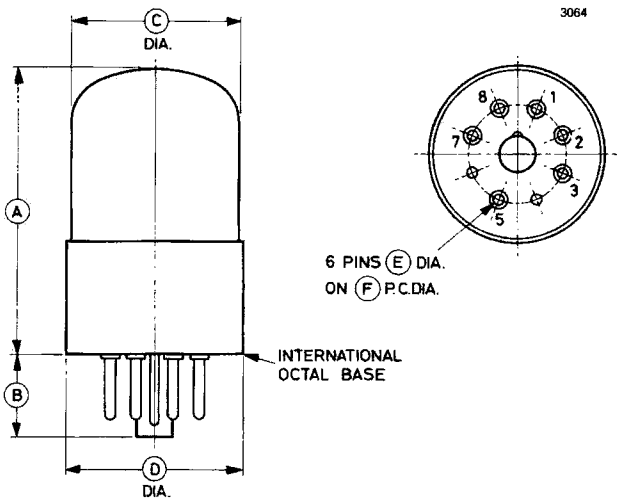


Nominal load current 12–15mA.

D1 Silicon rectifier, such as:–
AEI type SJ803–F

Z_L Relay; suggested types for use as load are:–
Radiospares type 46
STC types 25 or 25HD
Keyswitch types MH2 or MH2P (2500Ω coil)
Potter and Brumfield type KCP11 (10mA coil)

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A*	1.969 max	50.0 max
B	0.560 max	14.22 max
C*	1.181 max	30.0 max
D	1.253 max	31.83 max
E	0.093	2.36
F	0.687	17.45

Millimetre dimensions have been derived from inches except where marked *

Pin	Element
1	No connection
2	Cathode
3	No connection
4	Omitted
5	Anode
6	Omitted
7	No connection
8	No connection

TOUCH BUTTONS - DESCRIPTION OF OPERATION

Touch buttons utilise a three element gas filled tube as the active component.

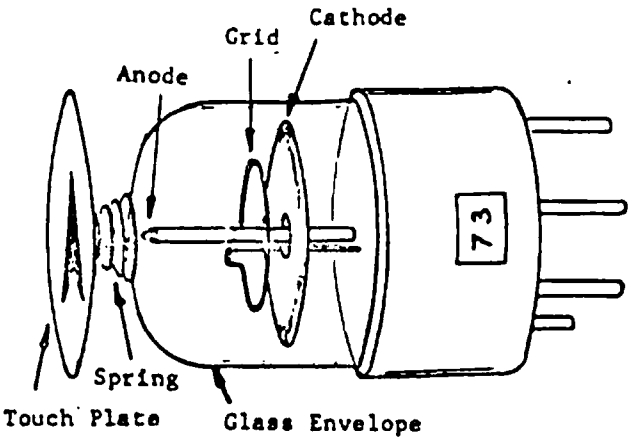


FIG. 1. OTIS TOUCH BUTTON TUBE

These tubes have only two states - conducting or not conducting. When conducting, the voltage drop across the tube is constant over a wide current range, and this voltage is printed on the side of the tube. (Normally 72V - 75V). If a D.C voltage is applied between anode and cathode such that the anode is positive, with respect to the cathode, and if this voltage is gradually increased, a point will be reached where the tube will 'fire' i.e. change from non-conducting to conducting state.

In thepractical touch button circuit, however, the anode voltage is held a little below the normal break-down voltage and the tube is fired by effectively lowering the break-down voltage of the tube to below the applied anode voltage. (see sketch 2).

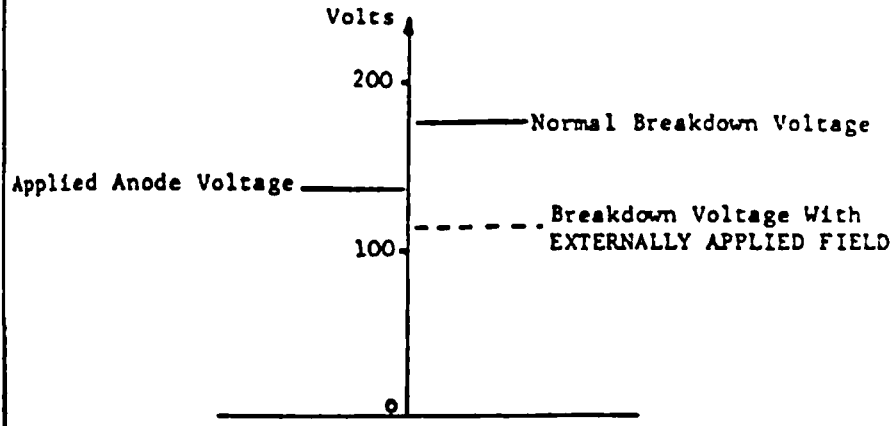


FIG. 2. TUBE FIRES WHEN BREAKDOWN VOLTAGE IS MADE LESS THAN THE ANODE VOLTAGE

The lowering of the break-down voltage is achieved by the application of an A.C. voltage between the cathode and the exterior of the glass envelope. This establishes an alternating field within the tube which excites the gas molecules and makes them more conductive.
The circuit used to apply the A.C. voltage across the tube is unusual in that 'the person touching the touch plate' and 'ground' are used as conductors. (see fig. 3).

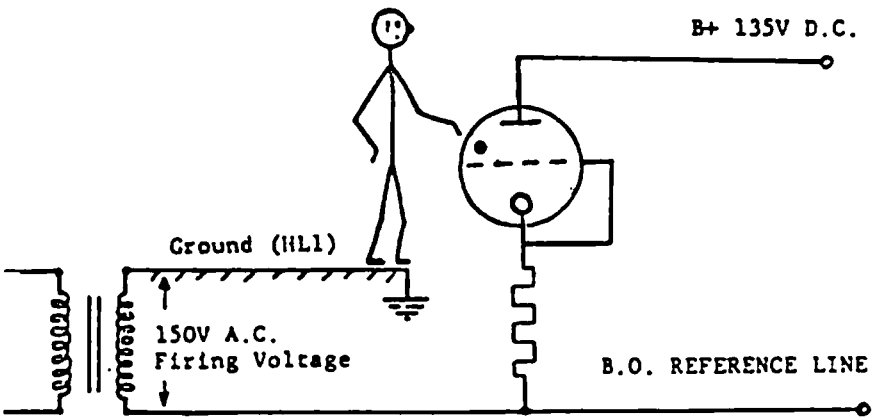


FIG. 3 FIRING OF TOUCH BUTTON

It is apparent that in this 'firing circuit' there are many insulators, e.g. the carpet on the floor, the soles of the persons shoes, the touch button plate and the glass envelope of the tube itself. However, it must be remembered that conductors separated by an insulator form a capacitor, and a capacitor is a conductor in an A.C. circuit. These capacitances in the firing circuit are, of course, very small and provide a very high impedance circuit in which the current is only about 0.01 μA.

Once fired, conduction continues after removal of the firing voltage, and the tube can only be extinguished by lowering the current through it, below a certain critical value.
In practise, this is done by injecting a positive D.C. voltage at the cathode of the tube. This decreases the voltage across the tube to below the normal tube volt drop causing the current in the tube to fall to below the critical value. We will return to this later.

THE SIGNAL VOLTAGE FROM THE TOUCH TUBE

The signal voltage is obtained at the cathode of the tube. Referring to fig. 4, it can be seen that when the tube is not conducting, there will be no volt drop across the cathode resistor and hence no output signal.

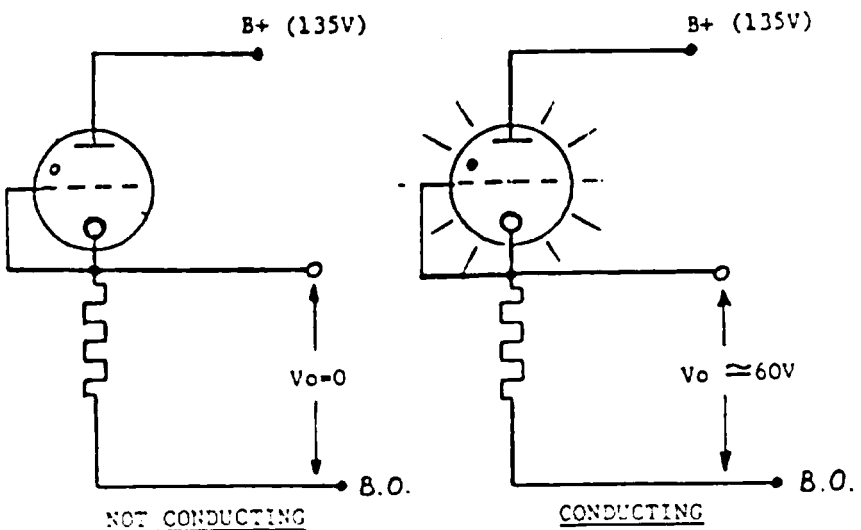


FIG. 4 VOLT DROP ACROSS CATHODE RESISTOR IS USED AS SIGNAL VOLTAGE

When the tube is conducting the current passing through the cathode resistance produces a volt drop across it, and this appears at the cathode as a positive D.C. voltage of about 60 volts. (relative to B.O. line)

CROSS-FIRING

Where two sets of hall or car buttons are used, the two touch tubes for each landing are, in effect, connected in parallel. The circuit is arranged so that when one tube is fired, the other one of the pair automatically fires thus ensuring that both touch plates are illuminated.
In this cross-firing process, the tube grids and anode resistors play an important role.

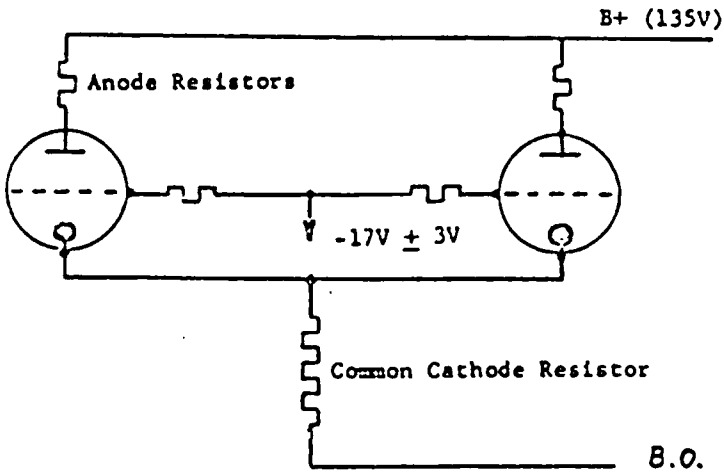


FIG 5 DOUBLE RISER CIRCUIT

When the first tube is fired, a current (double the normal value) flows, through the anode resistor, the tube and the 'shared' cathode resistor. This gives rise to a volt drop across the cathode resistor of about 60V.
Because the cathode of the unfired tube is connected to the top of this resistor, its voltage will rise from 0 to 60v. The voltage between the grid and cathode rises from 17V to 17+60 = 77. This is sufficient to cause 'breakdown' from cathode to grid, and a 'reverse' current is established flowing from cathode to grid. (see fig. 6).

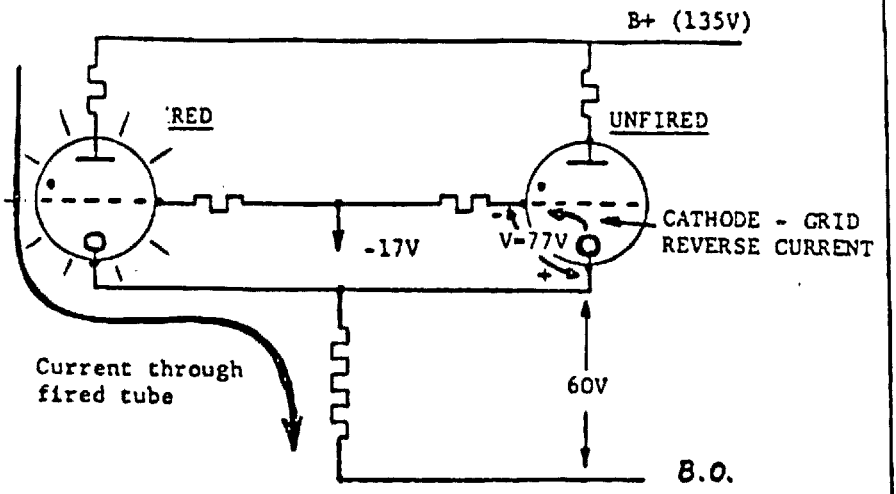


FIG. 6 CATHODE TO GRID BREAK-DOWN

The cathode-grid reverse current in the unfired tube excites the gas molecules, making them more conductive. This lowers the anode to cathode breakdown voltage. To just above the normal tube volt drop.

If the tubes wereconnected directly in parallel, the voltage across the unfired tube would be equal to the normal volt drop across the fired tube, and would not be 'just above' this voltage as required.

By including resistors in series with the anodes, the voltage to the unfired tube is equal to the normal volt drop of the fired tube PLUS the volt drop across the anode resistor of the fired tube. (see fig. 7). For this reason, it is essential that both tubes have the same volt drop as printed on the side of the tube.

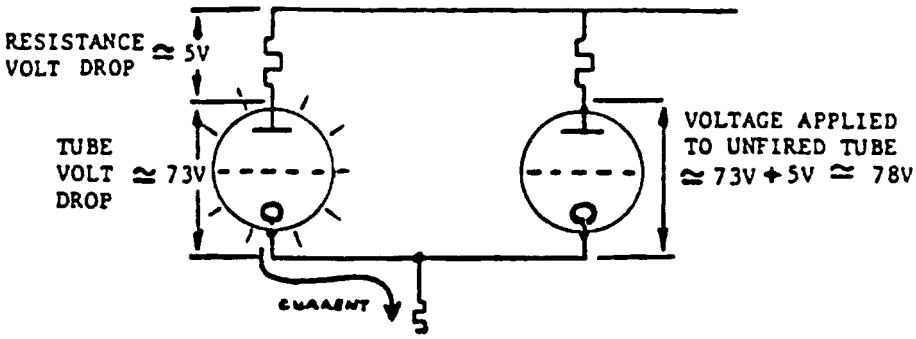


FIG.7 FUNCTION OF ANODE RESISTORS.

TOUCH BUTTONS

DETECTION OF SIGNAL VOLTAGE

The touch button circuit has a relatively high impedance and hence the signal voltage cannot be applied directly to a relay coil. Instead a silicon controlled rectifier (S.C.R.) is used to detect the signal and operate a relay.

A TYPICAL CIRCUIT IS SHOWN IN FIG. 8 BELOW.

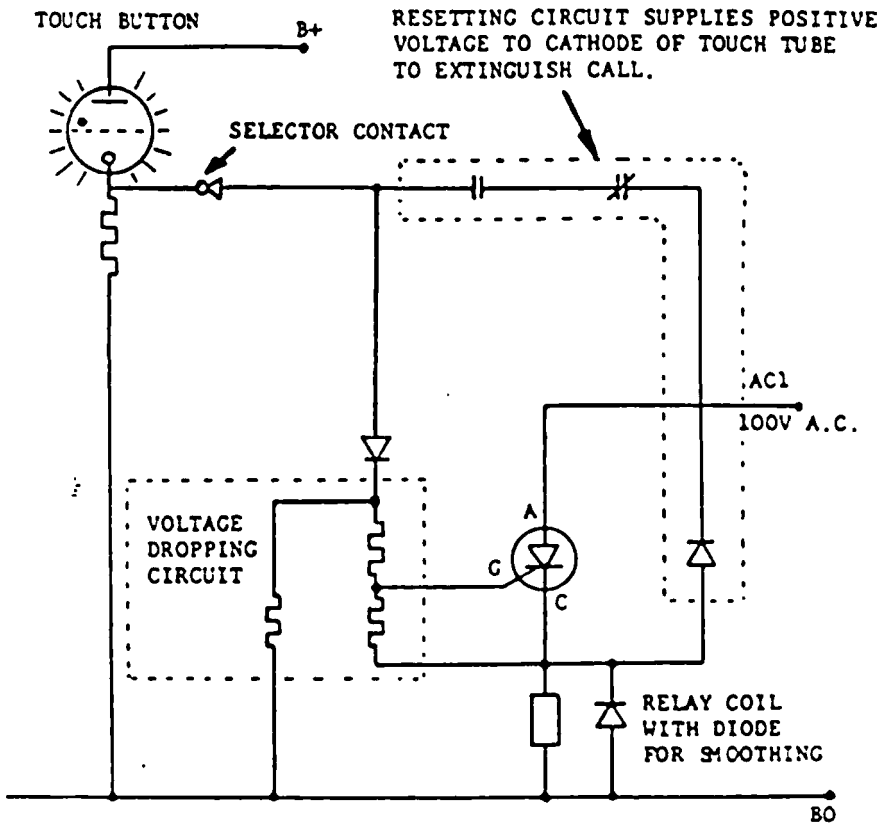


fig. 8 SCR circuit

CATHODE RAY TUBE

T921

Service Type CV464

INTRODUCTION

The T921 is a 9-inch diameter electrostatic focus, magnetic deflection Cathode Ray Tube designed for radar applications. The fluorescent colour of the aluminium backed screen is orange, with an orange afterglow of very long persistence. See Note 1 for alternative screens.

A high proportion of the beam current is delivered to the screen and the tube gives a display of adequate brightness from the short modulation pulses encountered in short range radars.

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (a.c. or d.c.)	4·0 V
Heater Current	1·1 A Max
Screen (*See Notes* 1 *and* 2)	Aluminium Backed
Fluorescent Colour	Orange
Afterglow Colour	Orange
Afterglow Persistence	Very Long
Deflection Angle	58°
Deflection Method	Magnetic
Focusing Method	Electrostatic
Inter-electrode Capacitances:	
Grid to all other electrodes	12 pF Max
Anode 1 to all other electrodes	15 pF Max
Cathode to all other electrodes	12 pF Max

Mechanical

Overall Length	452mm (17·80 inches) Max
Overall Diameter	230mm (9 inches) Max
Neck Diameter	36mm (1·42 inches) Max
Net Weight	5 pounds (2·3 kg) Approx
Base	International Octal (B.S.448/B8–0)
Anode 3 Cap (*See Note* 3)	B.S.448/CT1
Mounting Position	Any

MAXIMUM RATINGS

(Absolute Values)

Anode 3 Voltage	13 kV Max
Anode 2 Voltage	2·15 kV Max
Anode 1 Voltage	2·20 kV Max
Grid Voltage (negative value, never positive)	200 V Max
Peak Heater to Cathode Voltage:	
Heater positive with respect to cathode	125 V Max
Heater negative with respect to cathode	125 V Max

Printed in England

TYPICAL OPERATING CONDITIONS

Anode 3 Voltage	8·0	12	kV
Anode 2 Voltage for focus (*See Note* 4)	1·25	1·95	kV
Anode 1 Voltage (*See Note* 4)	1·35	2·0	kV
Grid Voltage for cut-off	−45 to −100	−70 to −126	V

NOTES

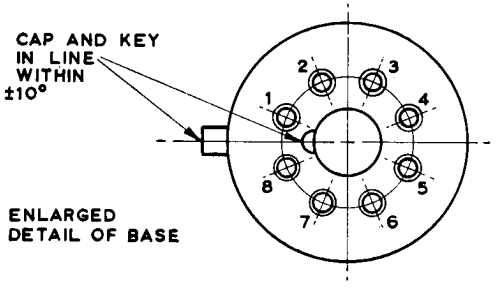
1. The T921 has an E.E.V. Z Screen which satisfies the requirements of the E.V.S. 009 Screen Specification. It can also be manufactured with alternative screens, and customers' enquiries are invited.

2. The fluoride screen is sensitive to burn and should not be operated with slow moving spots.

3. Alternatively, the T921 can be supplied with an anode cavity cap to B.S.448/CT8.

4. Anode 1 must be at least 50 volts positive with respect to anode 2 to prevent secondary electrons reaching the screen. A focus control range of at least ±15% in anode 2 voltage should be provided to facilitate adjustment by passing clearly through focus. To allow for variations in anode 3 voltage, either in design or as the result of mains fluctuations, the anode 2 voltage for focus may be taken as being approximately 16% of the anode 3 voltage.

OUTLINE DETAILS

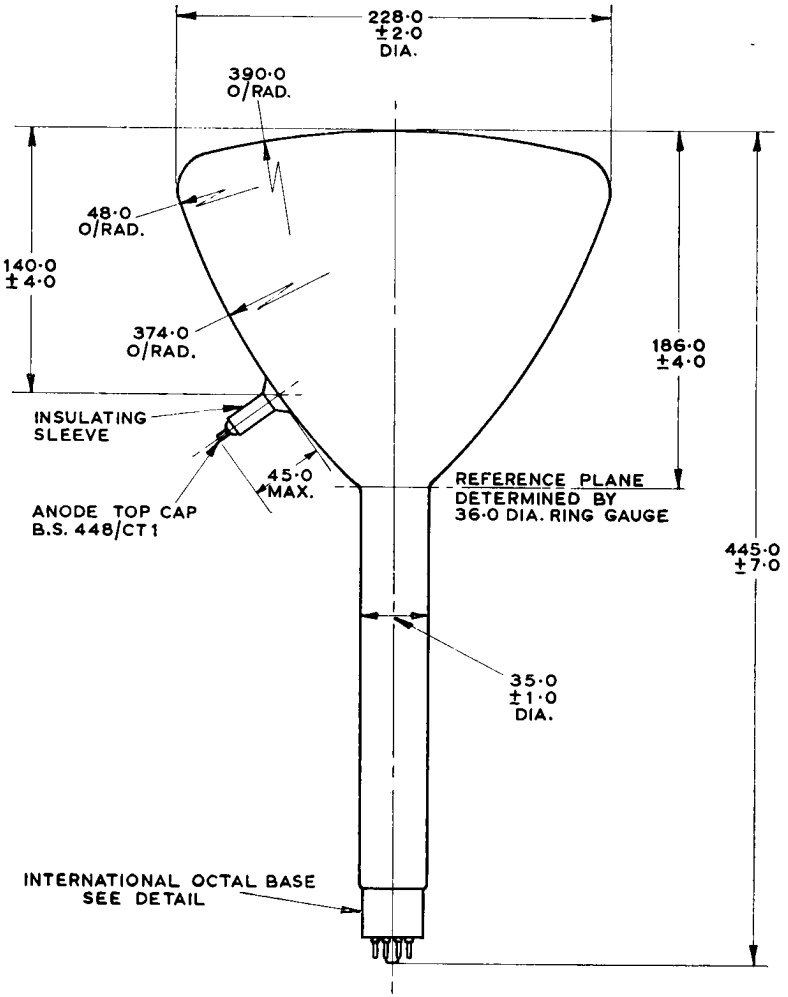


818

PIN	ELEMENT
1	NO CONNECTION
2	ANODE 1
3	ANODE 2
4	NO CONNECTION
5	GRID 1
6	CATHODE
7	HEATER
8	HEATER
CAP	ANODE 3

OUTLINE

816



ALL DIMENSIONS IN MILLIMETRES

CATHODE RAY TUBE

T922

ENGLISH ELECTRIC

Service Type CV2162

INTRODUCTION

The T922 is a 12 inch diameter electrostatic focus, magnetic deflection Cathode Ray Tube designed for radar applications. The fluorescent colour of the aluminium backed screen is orange, with an orange afterglow of very long persistence. See Note 1 for alternative screens.

A high proportion of the beam current is delivered to the screen and the tube gives a display of adequate brightness from the short modulation pulses encountered in short range radars.

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (a.c. or d.c.)	4·0 V
Heater Current	1·1 A Max
Screen (*See Notes* 1 *and* 2):	Aluminium Backed
Fluorescent Colour	Orange
Afterglow Colour	Orange
Afterglow Persistence	Very Long
Deflection Angle	50°
Deflection Method	Magnetic
Focusing Method	Electrostatic
Inter-electrode Capacitances:	
Grid to all other electrodes	12 pF Max
Anode 1 to all other electrodes	15 pF Max
Cathode to all other electrodes	12 pF Max

Mechanical

Overall Length	545mm (21·5 inches) Max
Overall Diameter	307mm (12 inches) Max
Neck Diameter	36mm (1·42 inches) Max
Net Weight	12 pounds (5·5 kg) Approx
Base	International Octal (B.S.448/B8–0)
Anode 3 Cap (*See Note* 3)	B.S 448/CT1
Mounting Position	Any

MAXIMUM RATINGS

(Absolute Values)

Anode 3 Voltage	13 kV Max
Anode 2 Voltage	2·15 kV Max
Anode 1 Voltage	2·20 kV Max
Grid Voltage (negative value, never positive)	200 V Max
Peak Heater to Cathode Voltage:	
Heater positive with respect to cathode	125 V Max
Heater negative with respect to cathode	125 V Max

TYPICAL OPERATING CONDITIONS

Anode 3 Voltage	12	kV
Anode 2 Voltage for focus (*See Note* 4)	1·95	kV
Anode 1 Voltage (*See Note* 4)	2·0	kV
Grid Voltage for cut-off	−70 to −126	V

NOTES

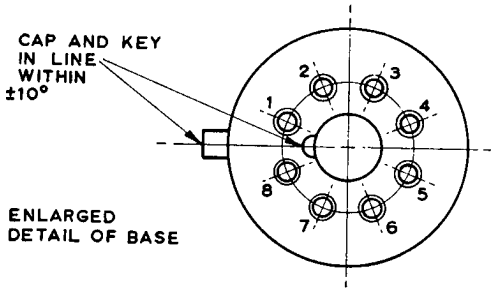
1. The T922 has an E.E.V. Z Screen which satisfies the requirements of the E.V.S. 009 Screen Specification. It can also be manufactured with alternative screens, and customers' enquiries are invited.

2. The fluoride screen is sensitive to burn and should not be operated with slow moving spots.

3. Alternatively, the T922 can be supplied with an anode cavity cap to B.S.448/CT8.

4. Anode 1 must be at least 50 volts positive with respect to anode 2 to prevent secondary electrons reaching the screen. A focus control range of at least ±15% in anode 2 voltage should be provided to facilitate adjustment by passing clearly through focus. To allow for variations in anode 3 voltage, either in design or as the result of mains fluctuations, the anode 2 voltage for focus may be taken as being approximately 16% of the anode 3 voltage.

OUTLINE DETAILS



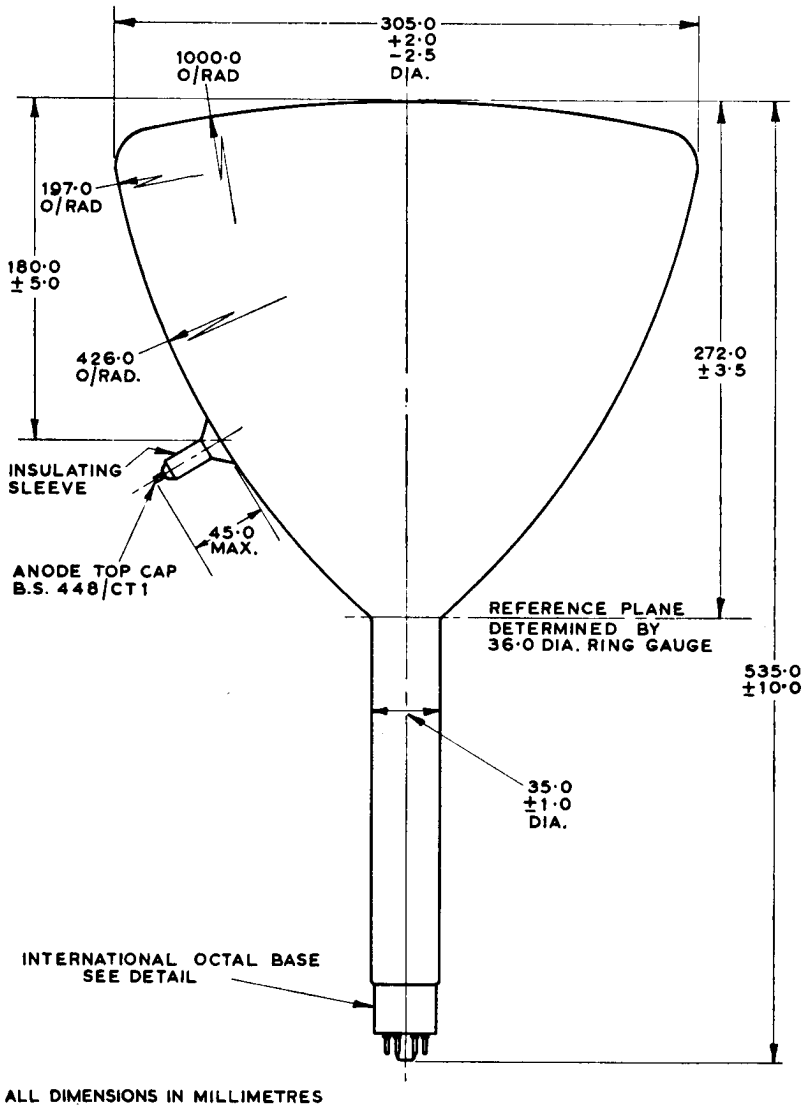
818

PIN	ELEMENT
1	NO CONNECTION
2	ANODE 1
3	ANODE 2
4	NO CONNECTION
5	GRID 1
6	CATHODE
7	HEATER
8	HEATER
CAP	ANODE 3

ENGLISH ELECTRIC

OUTLINE

817



ALL DIMENSIONS IN MILLIMETRES

Printed in England

PROJECTION CATHODE RAY TUBES

T940B T940G T940R T940W

INTRODUCTION

The T940 series comprises four five-inch diameter Projection Cathode Ray Tubes with magnetic focusing and magnetic deflection, designed for applications where high brightness displays of large area are required. The four tubes differ only in their screen properties; the fluorescent colours of the screens are given by the suffix letters B, G, R, and W, denoting blue, green, red and white respectively.

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·66	A Max
Screen	Aluminised	
Screen Fluorescent Colour:		
T940B	Blue	
T940G	Green	
T940R (*See Note* 2)	Red	
T940W	White	
Deflection Method	Magnetic	
Deflection Angle	47	Degrees
Focusing Method	Magnetic	
Raster Dimensions	72 × 96	mm Min
Highlight Brightness (at 4·5mA peak anode current) (*See Note* 3)	6500 18 850	mcd/cm² ft-lamberts
Inter-electrode Capacitances:		
Grid to all other electrodes	10	pF
Cathode to all other electrodes	9·0	pF

Mechanical

Overall Length	17·08 inches	(434mm)	Max
Overall Diameter (excluding anode spigot)	5·34 inches	(135·5mm)	Max
Neck Diameter	1·5 inches	(38mm)	Max
Net Weight	2 pounds	(910g)	Approx
Base (*See Note* 4)			B.S.448-B12A
Anode Connector (Supplied separately. *See Note* 5)			MA151
Mounting Position			*See Note* 6

Cooling

The screen requires forced-air cooling

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CHELMSFORD
ENGLAND

Telephone:
Chelmsford 3491

Printed in England

MINIMUM AND MAXIMUM RATINGS
(Absolute Values)

	Min	*Max*	
Anode Voltage (*See Note* 7)	40	55	kV
Grid Voltage (negative value, never positive) ..	—	250	V
Anode Current (Mean) (*See Notes* 8 *and* 9) ..	—	500	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	500	kΩ
Heater to Cathode Voltage		*See Note* 10	
Magnification	—	40	

TYPICAL OPERATING CONDITIONS

Anode Voltage	50	kV
Anode Current (Peak)	4·5	mA
Anode Current (Mean)	500	μA
Grid Voltage for cut-off	−100 to −170	V
Spark Trap and External Conductive Coating (*See Note* 11)	Earth Potential	
Focus Power	*See Note* 12	
Line Width (*See Note* 13)	0·004	inch

INSULATION OF EXTERNAL COMPONENTS

The deflection and focus yokes should be insulated from the tube neck, and all corners on conducting surfaces should be rounded off. Earthed conductors should be kept away from the vicinity of the high potential end of the tube.

X-RAY WARNING

THE VOLTAGE AT WHICH THE TUBE OPERATES INVOLVES AN X-RAY HAZARD. The sheet steel casing of a typical projector in conjunction with the shielding provided by the optical and electrical components normally gives adequate protection but individual designs should be checked by measurement.

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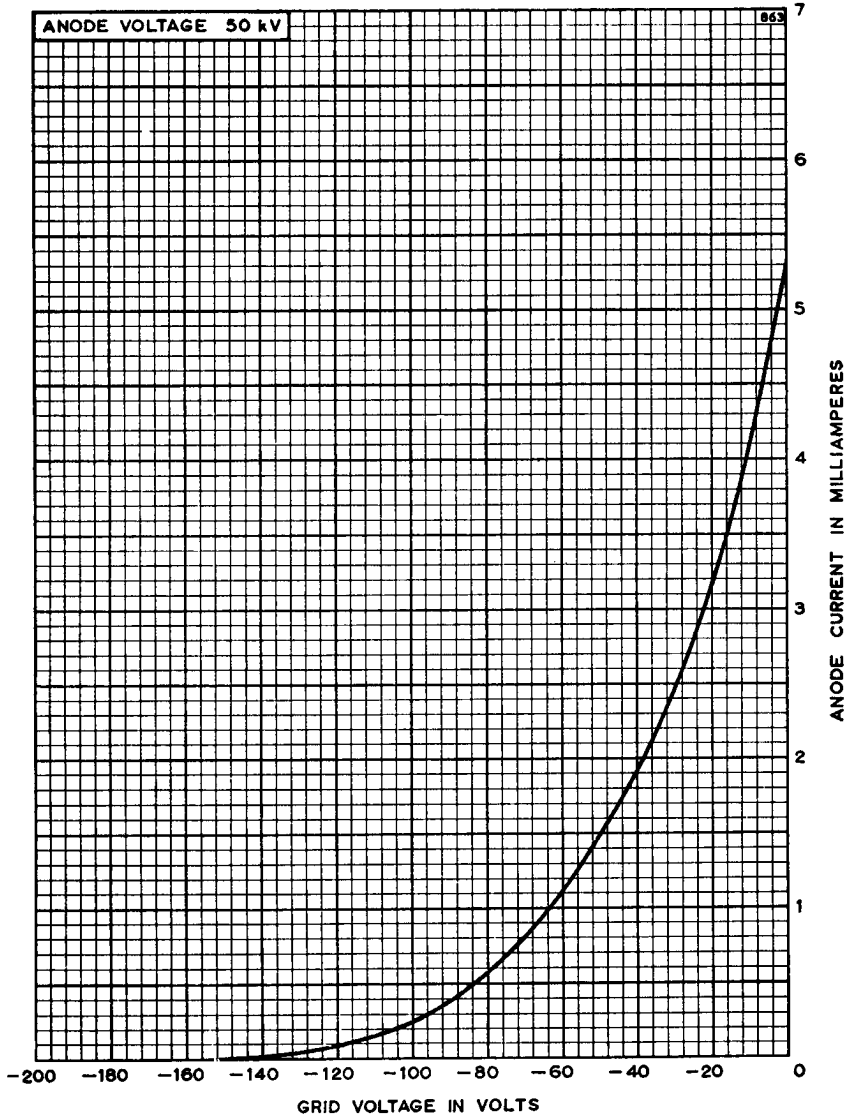
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NOTES

1. The heater is suitable for parallel operation only.
2. The actual screen colour of the T940R is orange but gives red primary colour when used in conjunction with a Wratten 25 filter.
3. This highlight brightness relates to T940W.
4. The socket should not be rigidly mounted but should have flexible leads and be able to move freely. The bottom circumference of the base shell will fall within a circle having a diameter of 50mm which is centred on the perpendicular from the centre of the face plate.
5. It is recommended that the connection to the anode be made with connector type MA151, available from English Electric Valve Company Ltd. See page 7 for details.
6. The tube may be mounted in any position except with the screen downwards and the axis of the tube making an angle of less than 50° with the vertical.
7. A 50kΩ resistor should be included in the anode lead in order to avoid damage to the tube by a momentary internal arc. Before removing the tube from an equipment the screen and cone should be discharged.
8. For normal television pictures. Stationary patterns, with high peak currents concentrated in one area of the tube face and the remaining area dark, impose harmful thermal stresses on the faceplate and must be avoided.
9. Means must be provided for the instantaneous removal of beam current in the event of a failure of either one or both of the time bases. Unless such a safety device is incorporated, a failure of this type will result in the immediate destruction of the screen of the tube.
10. The heater should preferably be connected to the cathode. Applications necessitating the application of a potential between the heater and cathode are subject to engineering approval.
11. The spark trap and external conductive coating should be connected by a low impedance path to the h.t. supply return. The purpose is to isolate from the grid and its associated circuits any occasional, non-destructive, discharges which sometimes occur when starting after prolonged shut down.
12. The focus power required is equivalent to approximately 1300 ampere-turns in a shrouded focus coil with ¼-inch gap. The precise value depends on the gap position.
13. At 500μA anode current with a shrinking raster.

GRID VOLTAGE CHARACTERISTIC



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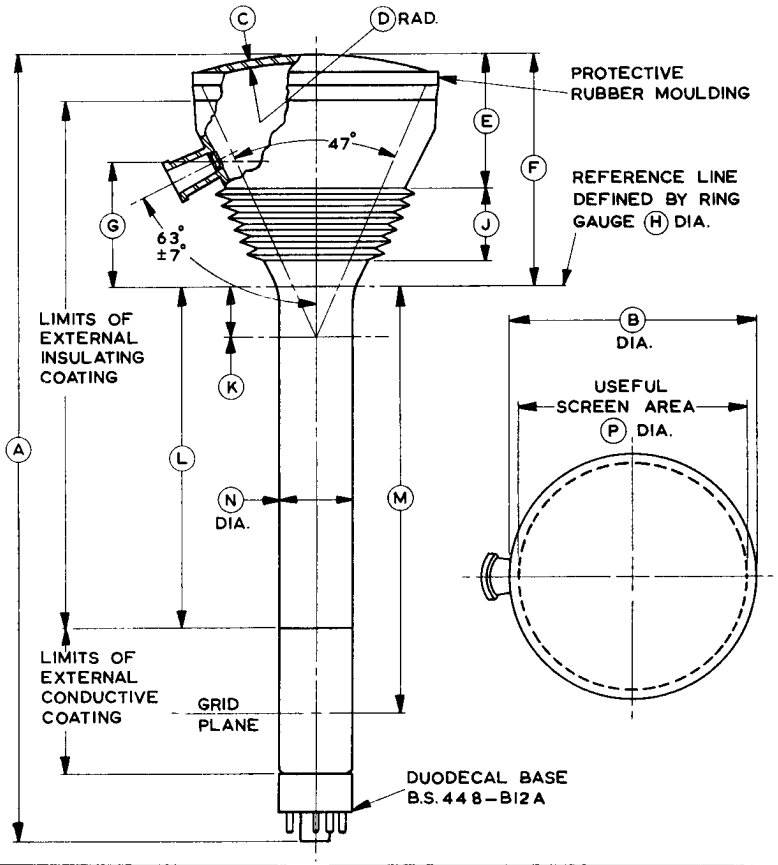
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1261A

OUTLINE



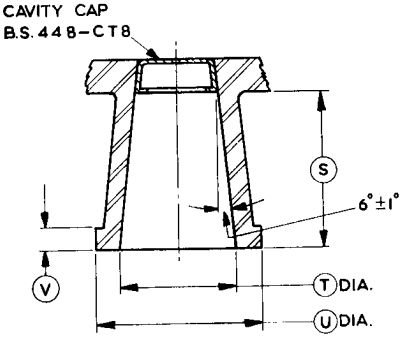
Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	16·693 ± 0·394	424·0 ± 10·0	J	1·496 ± 0·039	38·0 ± 1·0
B	5·275 ± 0·059	134·0 ± 1·5	K	1·083 Max	27·5 Max
C	0·118	3·0	L	7·480 $^{+0\cdot000}_{-0\cdot197}$	190·0 $^{+0\cdot0}_{-5\cdot0}$
D	8·150 ± 0·039	207·0 ± 1·0	M	9·114 ± 0·157	231·5 ± 4·0
E	2·795 ± 0·059	71·0 ± 1·5	N	1·437 ± 0·059	36·5 ± 1·5
F	4·862 ± 0·118	123·5 ± 3·0	P	4·725 Min	120·0 Min
G	2·736 ± 0·157	69·5 ± 4·0			
H	1·500	38·1			

Inch dimensions have been derived from millimetres.

ENGLISH ELECTRIC

ANODE SPIGOT DETAILS

677B

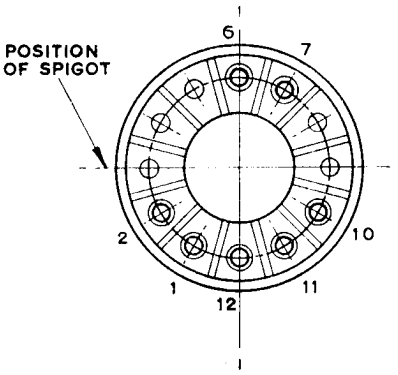


Ref.	Inches	Millimetres
S	0·925±0·098	23·5±2·5
T	0·717±0·020	18·2±0·5
U	0·984±0·016	25·0±0·4
V	0·118 Max	3·0 Max

Inch dimensions have been derived from millimetres.

BASE CONNECTIONS

678

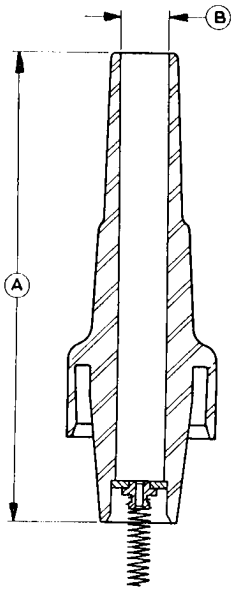


PIN	ELEMENT
1	HEATER
2	GRID
3	OMITTED
4	OMITTED
5	OMITTED
6	NO CONNECTION
7	NO CONNECTION
8	OMITTED
9	OMITTED
10	SPARK TRAP
11	CATHODE
12	HEATER
CAP	ANODE

Printed in England

ANODE CONNECTOR MA151

1284



Ref.	Inches	Millimetres
A	3·268	83·0
B	0·330 ± 0·005	8·38 ± 0·13

Printed in England

ENGLISH ELECTRIC

ABRIDGED DATA

12-inch Diameter Radar Tubes. Two sets of scan coils may be fitted for display of alpha-numeric characters in processed radar systems. The scan angle permits the use of valve or transistor scan amplifiers.

Neck Diameter	1·378 inches (35mm)	
Deflection Angle	50	Degrees
Deflection Method		Magnetic
Focus Method (*See Note* 1)		Magnetic
E.H.T. Voltage	15	kV

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 2)	6·3	V
Heater Current	0·3±10%	A
Faceplate		Clear
Screen (*See Note* 3)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	8·0	pF
Cathode to all other electrodes, less than	8·0	pF

Mechanical

Overall Length	25·591 inches	(650mm)	Max
Overall Diameter	12·087 inches	(307mm)	Max
Neck Diameter	1·398 inches	(35·5mm)	Max
Net Weight	12 pounds	(5·4kg)	Approx
Base			B.S.448–B12A
Anode 2 Cavity Cap			B.S.448–CT8
Mounting Position			*See Note* 4

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 Voltage	9·0	15·5	kV
Anode 1 Voltage	250	600	V
Grid Voltage, negative value (*See Note* 5) ..	—	250	V
Cathode Current (Mean)	—	300	μA
Heater to Cathode Voltage (*See Note* 6):			
Cathode negative	—	150	V
Cathode positive	—	200	V
Peak Heater to Cathode Voltage:			
Cathode positive (*See Note* 7)	—	410	V
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Heater to Cathode Resistance		*See Note* 8	

TYPICAL OPERATING CONDITIONS

Anode 2 Voltage	15	kV
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −90	V
Grid Drive for 50μA beam current	20 to 30	V

OPTIMUM BEAM FOCUSING

In order to obtain maximum brightness and minimum spot size, it is necessary to carry out the following procedure.

(*a*) Stray magnetic fields should be minimised in the region of the gun structure by fitting a tubular mumetal shield over the neck.

(*b*) The beam may be centred in the defining aperture by means of a small magnetic field located in the region of the grid and adjusted to give maximum brightness.

(*c*) The magnetic axis of the focus coil should be aligned with the axis of the electron beam. This may be done either by adjusting the position of the focus coil (See Method 1), or by fitting additional deflection coils to adjust the position of the beam (See Method 2). In each case a.c. focusing (see page 3) may be used to identify the optimum alignment condition.

Method 1

Adjustment of the focus coil position

The mounting of the focus coil should be such that the coil can be moved in any direction, i.e. vertically, horizontally and tilted about either the vertical or horizontal axis. An a.c. current is passed through the focus coil and the position of the coil is adjusted until the optimum alignment is reached. (*See note* below*).

Method 2

Electromagnetic deflection of the beam

Two sets of alignment coils are fitted on the tube neck, between the beam defining aperture and the focus coil (*See diagram, page* 8). Each set of coils is capable of deflecting the beam slightly in both X and Y directions. The currents in the alignment coils are adjusted to give correct alignment of the beam. (*See note* below*).

**A.C. Focusing*

An alternating current is passed through the focus coil such that the positive and negative excursions of the current each produce a focused spot. Provided there is no current through the main deflection coils, the picture on the tube faceplate will consist of a defocused area and two focused spots. The optimum focusing condition is obtained when the two focused spots coincide at the centre of the defocused spot.

NOTES

1. The focus coil should be positioned so that the focusing field is entirely on the screen side of the beam defining aperture. When using a focus coil having a short air gap, the centre of the air gap should be approximately 220mm from the reference plane.
2. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $9{\cdot}5V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.
3. Tubes in the T953 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T953S	S*	—	Yellowish-orange	Long
T953Y	Y*	P33	Orange	Long
T953Z	Z*	P26	Orange	Very Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

4. The tube may be mounted in any position except vertically with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

5. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to + 1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

6. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$

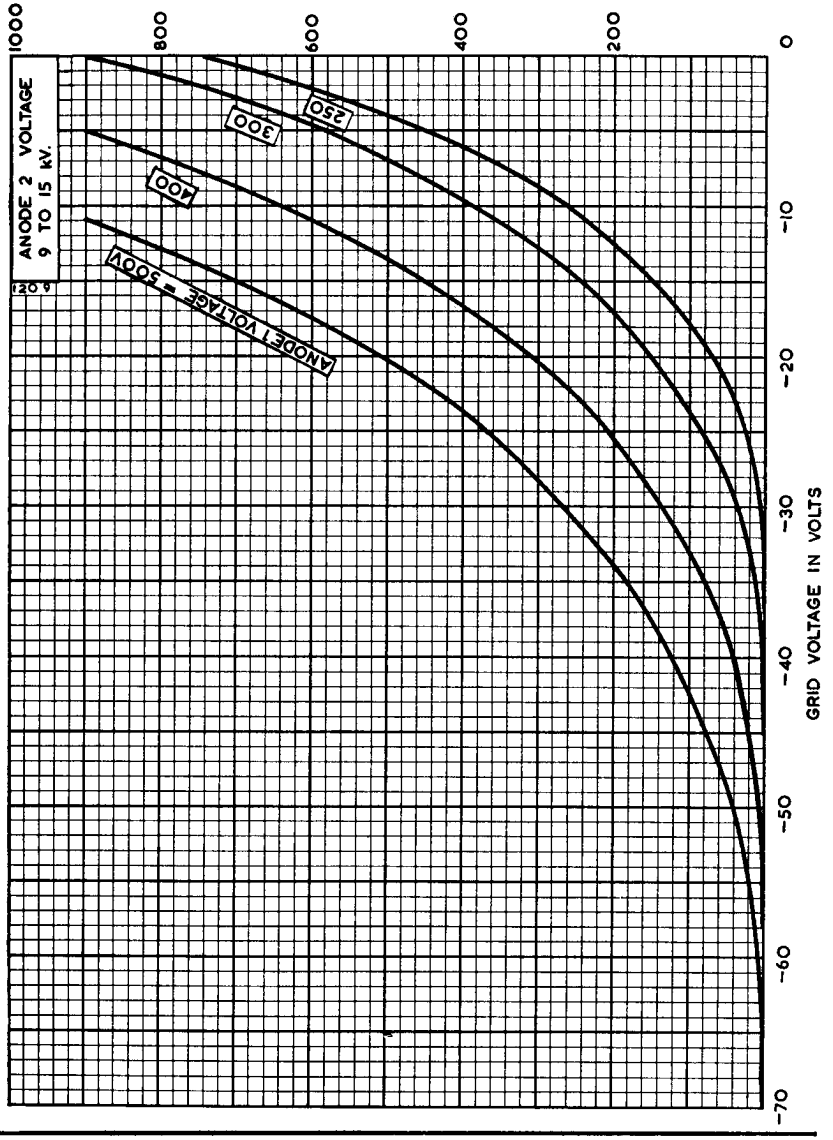
7. During a warming-up period not exceeding 45 seconds.

8. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

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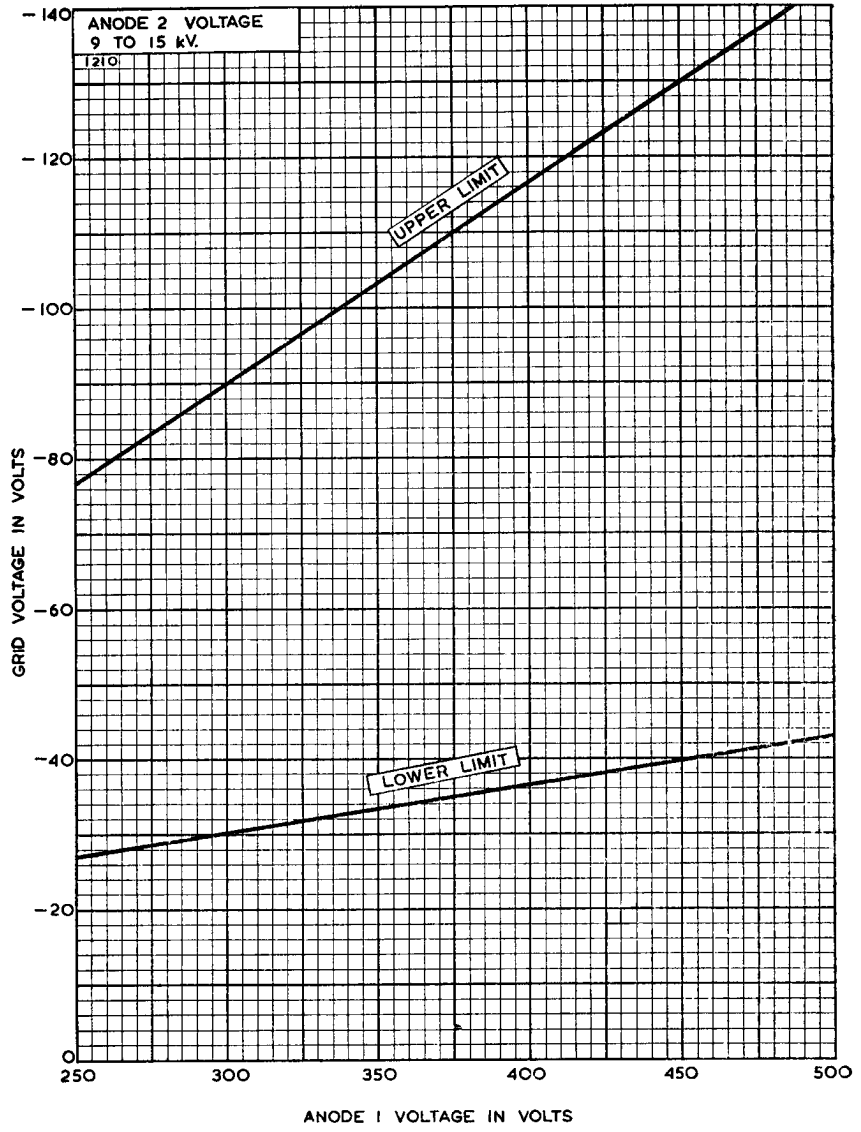
GRID VOLTAGE CHARACTERISTICS

ANODE 2 CURRENT IN MICROAMPERES



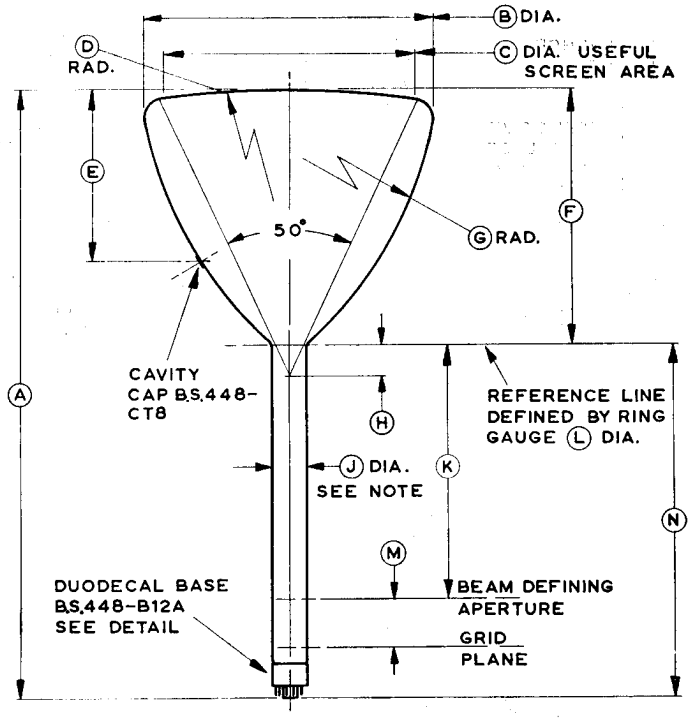
ENGLISH ELECTRIC

GRID VOLTAGE CUT-OFF LIMITS



OUTLINE

1211



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	25·32 ± 0·28	643·0 ± 7·0	H	1·260 Max	32·0 Max
B	12·008 $^{+0·079}_{-0·098}$	305·0 $^{+2·0}_{-2·5}$	J	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$
C	10·43 Min	265·0 Min	K	10·630	270
D	39·37	1000·0	L	1·417	36·00
E	7·087 ± 0·197	180·0 ± 5·0	M	1·969	50·00
F	10·71 ± 0·14	272·0 ± 3·5	N	14·606	371
G	16·77	426·0			

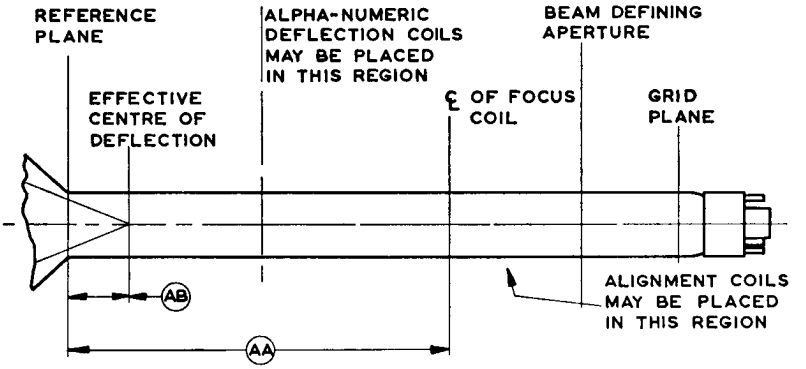
Inch dimensions have been derived from millimetres.

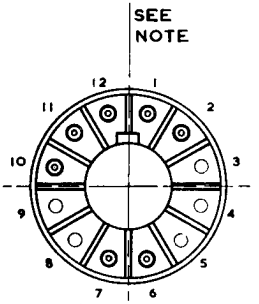
Note A ring gauge 1·417 inches (36·0mm) diameter by 3·937 inches (100mm) long will pass over base and neck to reference plane.

ENGLISH ELECTRIC

1203

OUTLINE DETAILS





Ref.	Inches	Millimetres
AA	8·661	220·0
AB	1·260 Max	32·00 Max

Inch dimensions have been derived from millimetres.

Note The anode cavity cap will be in line with the base key to within 15°.

Pin	Element	Pin	Element
1	Heater	8	Omitted
2	Grid	9	Omitted
3	Omitted	10	Anode 1
4	Omitted	11	Cathode
5	Omitted	12	Heater
6	Internal Connection	CAP	Anode 2
7	Internal Connection		

Printed in England

ENGLISH ELECTRIC

ABRIDGED DATA

8½-Inch Diagonal, Rectangular Display Tubes for monitor and radar applications. They feature long necks, enabling two sets of scan coils to be fitted for display of alpha-numeric characters in computer read-out or radar systems. The narrow scan angle permits the use of valve or transistor scan amplifiers.

Focus Method (*See Note* 3)	Magnetic	
Deflection Method	Magnetic	
Deflection Angle	40	Degrees
E.H.T. Voltage	15	kV

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3 ± 10%	A
Screen (*See Note* 2)	Aluminised	
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	8·0	pF
Cathode to all other electrodes, less than	8·0	pF
Final anode to external coating* (this capacitance may be used for E.H.T. smoothing)	750 pF	Approx

Mechanical

Overall Length	22·25 inches (565 mm)	Max
Faceplate Diagonal	8·510 inches (216 mm)	Max
Neck Diameter	1·40 inches (35·5 mm)	Max
Net Weight	4·6 pounds (2·1 kg)	Approx
Base	B.S.448-B12A	
Anode 2 Cavity Cap	B.S.448-CT8	
Mounting Position	*See Note* 4	

*Versions are available without the external coating, but otherwise identical (T969 series).

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 Voltage	9·0	16·5	kV
Anode 1 Voltage	250	600	V
Grid Voltage, negative value (*See Note* 5)	0	250	V
Heater to Cathode Voltage:			
Cathode negative	—	150	V
Cathode positive (*See Note* 6)	—	200	V
Peak Heater to Cathode Voltage:			
Cathode positive (*See Note* 7)	—	410	V
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Heater to Cathode Resistance	—	*See Note* 8	
Anode 1 Supply Source Impedance	—	1·5	MΩ

TYPICAL OPERATING CONDITIONS

Anode 2 Voltage	15	kV
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −90	V
Grid Drive for 50μA beam current	20 to 30	V

BEAM CENTRING

In order to obtain maximum brightness and the best focus spot size, stray magnetic fields must be minimised over the length of the gun structure. This may be achieved by using a tubular mumetal shield over the neck.

Where optimum performance is required, a small magnet should be used for centring the beam in the defining aperture. (Elac type BC11 is suitable). The magnet should be located in the region of the grid and its position and strength adjusted to give maximum brightness.

X-RAY WARNING

X-Rays are produced when types in the T954 series are operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tubes are adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the tubes.

Printed in England

NOTES

1. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $9{\cdot}5V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

2. Tubes in the T954 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T954S	S*	—	Yellowish-orange	Long
T954T	T	—	Yellow-orange	Medium
T954Y	Y*	P33	Orange	Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

3. The focus coil should be positioned so that the focusing field is entirely on the screen side of the beam defining aperture. When using a focus coil having a short air gap, the centre of the air gap should be approximately 2·75 inches (70mm) from the grid plane.

4. The tube may be mounted in any position except vertically with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

5. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the periods immediately after switching the equipment on or off, when it may be allowed to rise to + 1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

6. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$

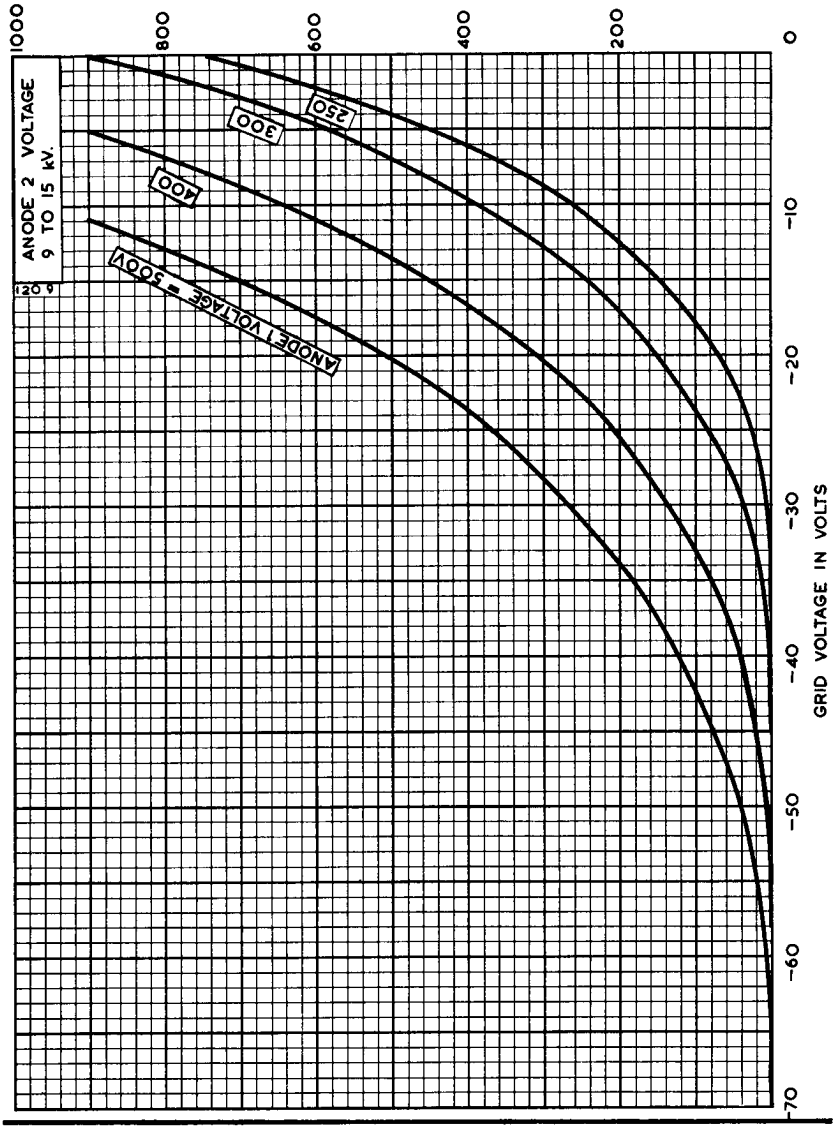
7. During a warming-up period not exceeding 45 seconds.

8. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

ENGLISH ELECTRIC

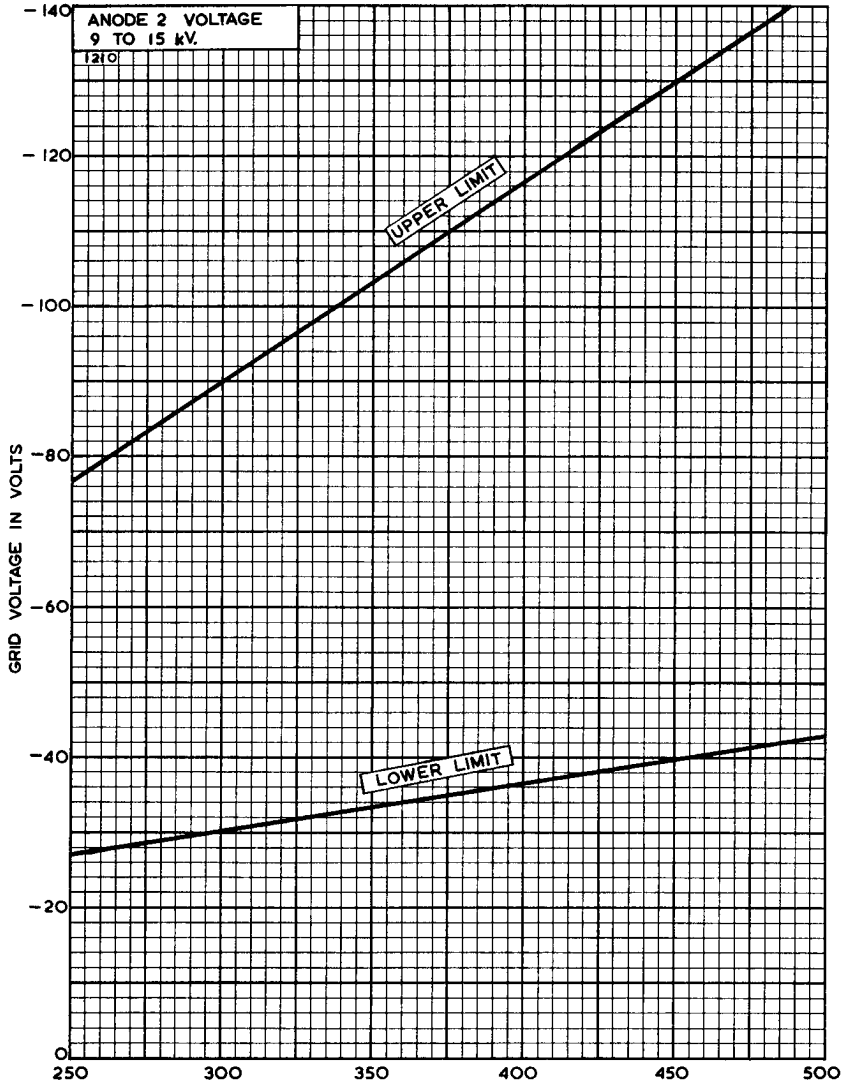
GRID VOLTAGE CHARACTERISTICS

ANODE 2 CURRENT IN MICROAMPERES



ENGLISH ELECTRIC

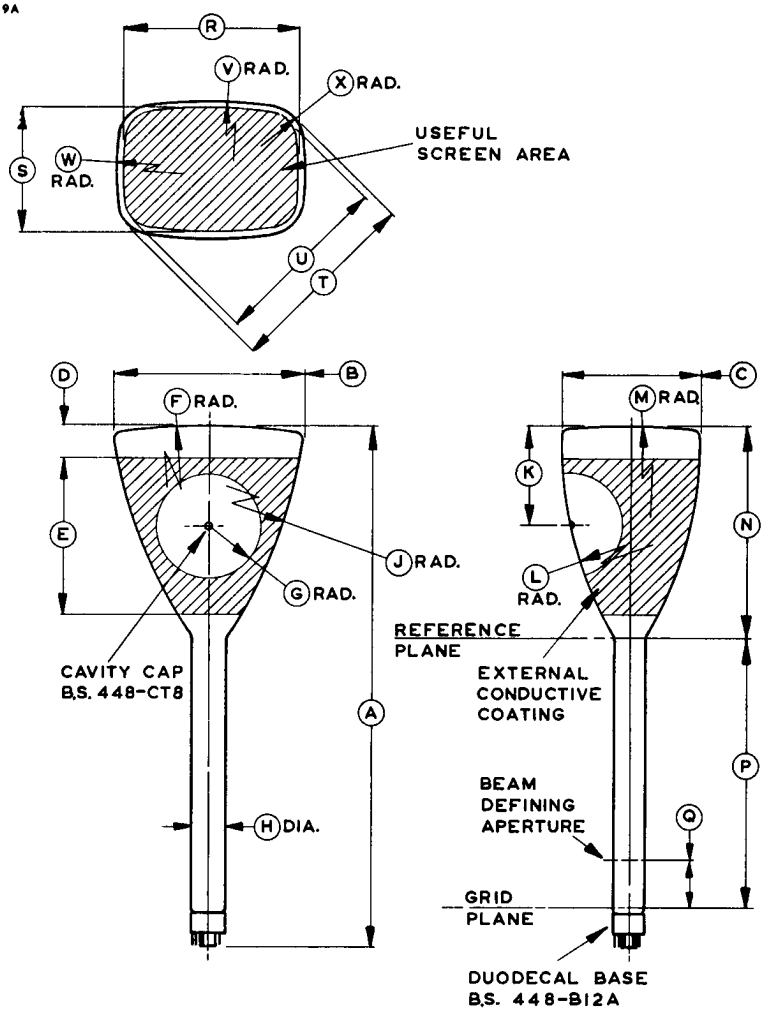
GRID VOLTAGE CUT-OFF LIMITS



ENGLISH ELECTRIC

OUTLINE

1119A



Note—A ring gauge 1·417 inches (36·0mm) diameter by 3·937 inches (100mm) long will pass over base and neck to reference plane.

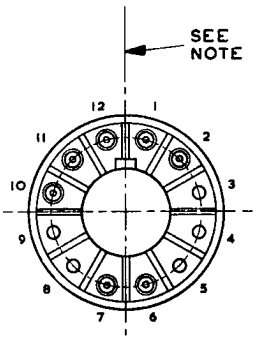
OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	21·970 ± 0·276	558·0 ± 7·0	M	27·00	686·0
B	7·874 ± 0·059	200·0 ± 1·5	N	8·661 ± 0·118	220·0 ± 3·0
C	6·063 ± 0·059	154·0 ± 1·5	P	11·22	285·0
D	1·299	33·0	Q	1·968 ± 0·197	50·0 ± 5·0
E	6·693	170·0	R	7·283	185·0
F	27·00	686·0	S	5·433	138·0
G	2·165	55·0	T	8·445	214·5
H	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$	U	7·677	195·0
J	19·69	500·0	V	18·504	470·0
K	3·937 ± 0·197	100·0 ± 5·0	W	12·244	311·0
L	15·75	400·0	X	1·496	38·0

Inch dimensions have been derived from millimetres.

OUTLINE DETAIL

1198A



Pin	Element
1	Heater
2	Grid
3	No Pin
4	No Pin
5	No Pin
6	No Connection
7	No Connection
8	No Pin
9	No Pin
10	Anode 1
11	Cathode
12	Heater
Cavity Cap	Anode 2

Note—The anode cavity cap will be in line with the base key to within 10°.

INTRODUCTION

The T957Y and T957Z are 12-inch diameter Cathode Ray Tubes with electrostatic focus and magnetic deflection, designed for radar applications. They have spot sizes at least 40% smaller than those of T939Y and T939Z at the same beam currents, and are direct replacements for these types.

The fluorescent colour of the aluminised screen is orange with an orange afterglow; T957Y has an afterglow of long persistence and that of the T957Z is very long. See Note 1 for other screens.

The tubes give a display of adequate brightness from the short modulation pulses encountered in short range radars.

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 2)	6·3	V
Heater Current	0·3	A
Screen (*See Notes* 1 *and* 3)		Aluminised
Fluorescent Colour		Orange
Afterglow Colour		Orange
Afterglow Persistence:		
T957Y		Long
T957Z		Very Long
Deflection Method		Magnetic
Deflection Angle	50	Degrees
Focusing Method	Low Voltage Electrostatic	
Inter-electrode Capacitances:		
Grid to all other electrodes	8·0	pF Max
Cathode to all other electrodes	8·0	pF Max
Anode 2 + anode 4 to external conductive coating	1200	pF Approx

Mechanical

Overall Length	19·450 inches	(494 mm)	Max
Overall Diameter	12·087 inches	(307 mm)	Max
Neck Diameter	1·398 inches	(35·5 mm)	Max
Net Weight	12 pounds	(5·5 kg)	Approx
Base			B.S.448/B12A
Anode 2 and Anode 4 Connection			B.S.448/CT8 Cavity Cap
Mounting Position	Any, except vertical with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.		

Printed in England

MINIMUM AND MAXIMUM RATINGS

(Absolute Values. *See Note* 4)

	Min	*Max*	
Anode 2 and Anode 4 Voltage	8·0	18	kV
Anode 3 Voltage:			
Positive value	—	500	V
Negative value	—	500	V
Anode 1 Voltage	200	500	V
Grid Voltage (negative value)	1·0	200	V
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Grid to Cathode Resistance	—	1·5	MΩ
Heater to Cathode Voltage:			
Heater positive with respect to cathode	—	150	V
Heater negative with respect to cathode	—	150	V
Heater to Cathode Resistance		*See Note* 5	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	12	kV
Anode 3 Voltage (*See Note* 6)	−200 to +200	V
Anode 1 Voltage	300	V
Anode 3 Current	−15 to +15	μA
Grid Voltage for cut-off	−30 to −70	V

NOTES

1. The T957 is supplied with either an E.E.V. Y Screen with long persistence (T957Y) or an E.E.V. Z Screen with very long persistence (T957Z); the screens satisfy the requirements of E.V.S.008 and 009 Screen Specifications respectively. It can also be manufactured with other screens, and customers' enquiries are invited.
2. The heater is suitable for either series or parallel operation.
3. The fluoride screen is sensitive to burn and should not be operated with slow moving spots.
4. All voltages are with respect to the cathode.

Printed in England

5. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1·0MΩ.

6. An acceptable focus quality is obtained with an anode 3 voltage range of −200 to +200V. If it is required to pass through the point of focus a voltage range of at least −300 to +300V will be required.

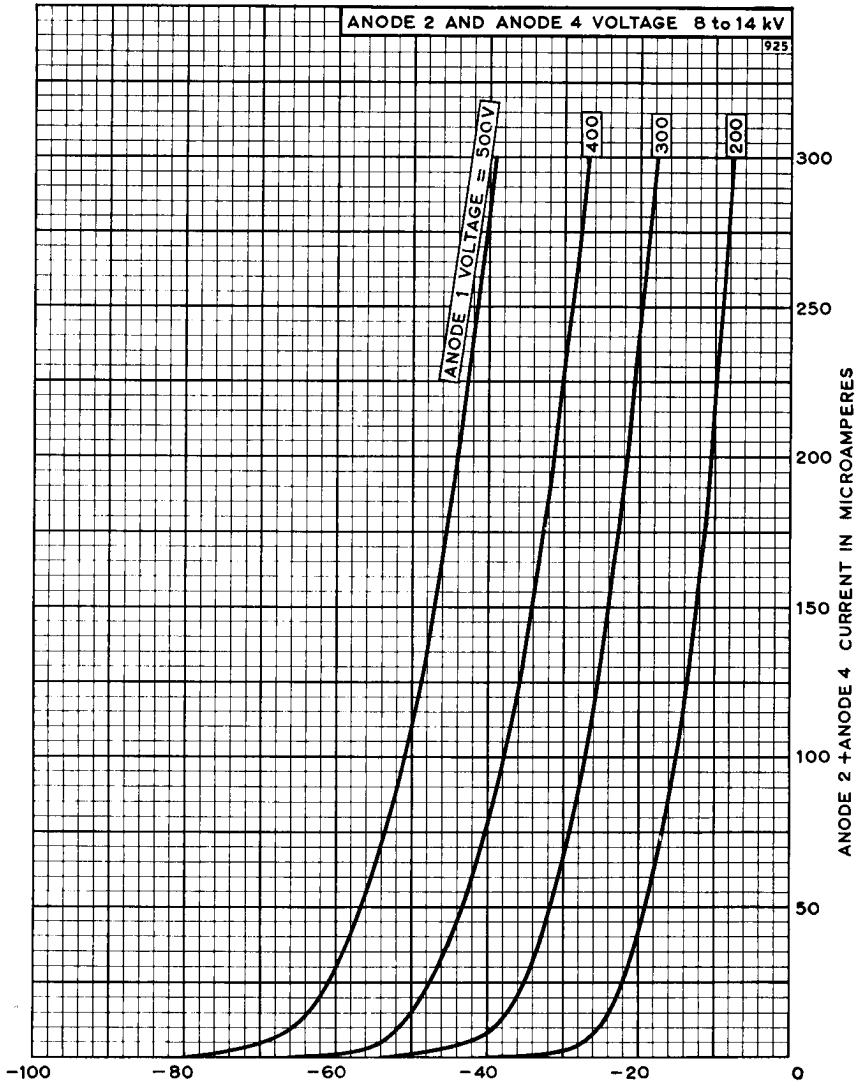
X-RAY WARNING

X-rays are produced when types T957Y and T957Z are operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tube 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.

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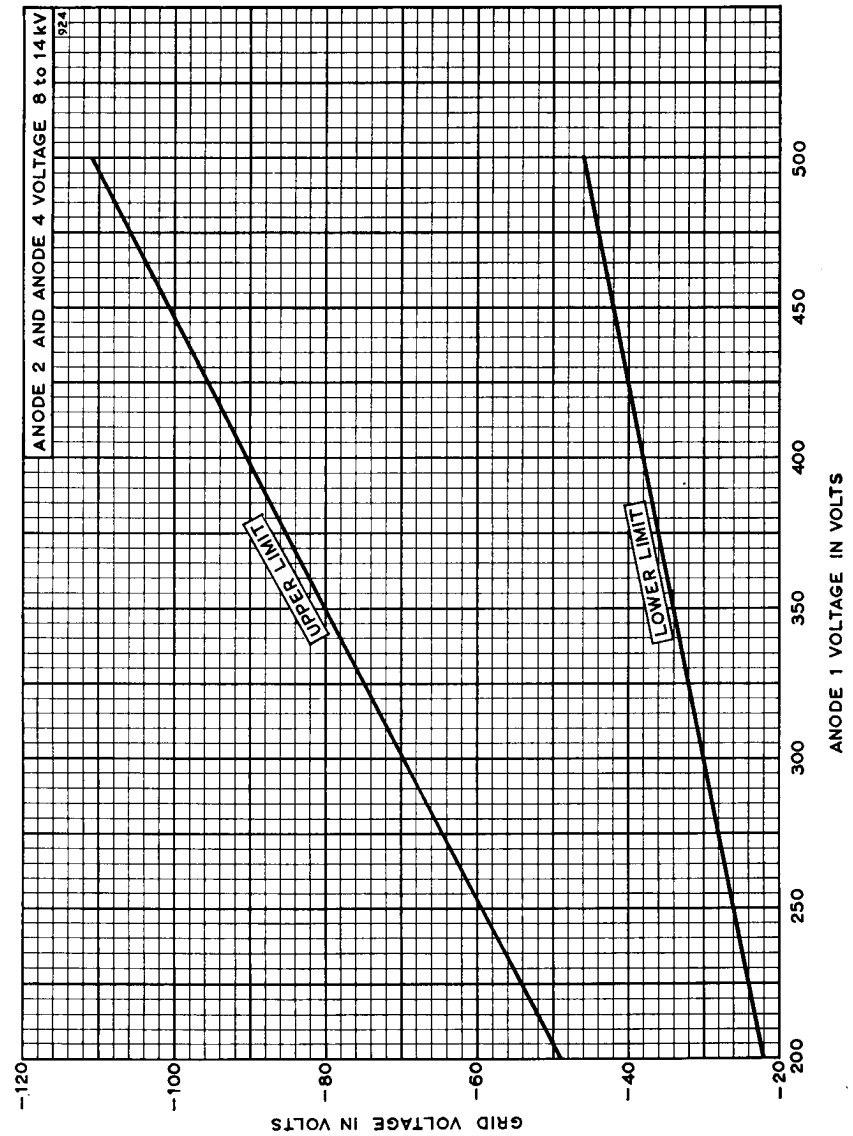
GRID VOLTAGE CHARACTERISTICS



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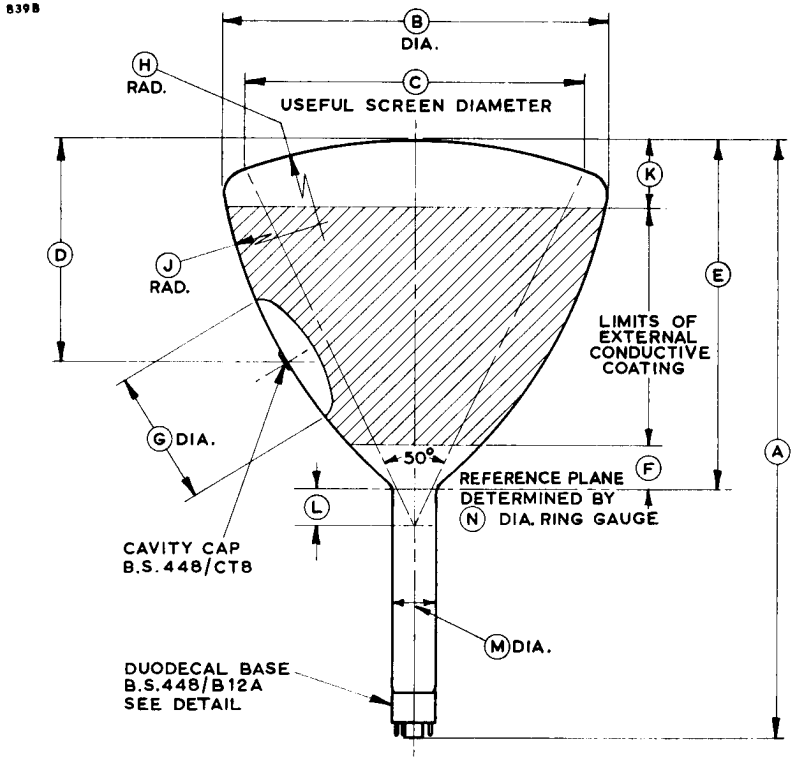
ENGLISH ELECTRIC

GRID CUT-OFF VOLTAGE LIMITS



ENGLISH ELECTRIC

OUTLINE

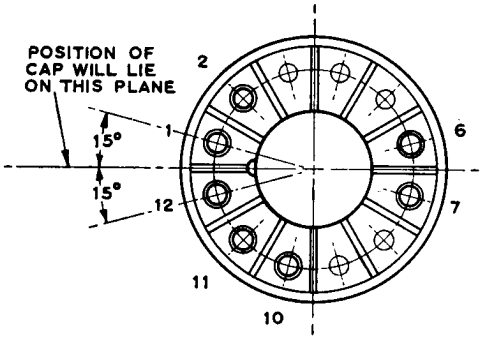


Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	$19{\cdot}134^{+0{\cdot}315}_{-0{\cdot}275}$	$486{\cdot}0^{+8{\cdot}0}_{-7{\cdot}0}$	G	$4{\cdot}331 \pm 0{\cdot}394$	$110{\cdot}0 \pm 10{\cdot}0$
B	$12{\cdot}008^{+0{\cdot}079}_{-0{\cdot}098}$	$305{\cdot}0^{+2{\cdot}0}_{-2{\cdot}5}$	H	39·370	1000·0
C	10·433	265·0	J	16·772	426·0
D	$7{\cdot}087 \pm 0{\cdot}197$	$180{\cdot}0 \pm 5{\cdot}0$	K	1·968	50·0
E	$10{\cdot}709 \pm 0{\cdot}138$	$272{\cdot}0 \pm 3{\cdot}5$	L	1·260	32·0
F	1·417	36·0	M	1·339 to 1·398	34·0 to 35·5
			N	1·417	36·0

Inch dimensions have been derived from millimetres.

Printed in England

OUTLINE DETAILS



840

PIN	ELEMENT
1	HEATER
2	GRID
3	OMITTED
4	OMITTED
5	OMITTED
6	ANODE 3
7	INTERNAL CONNECTION
8	OMITTED
9	OMITTED
10	ANODE 1
11	CATHODE
12	HEATER
CAP	ANODE 2 & ANODE 4

Printed in England

RADAR TUBE

T958Z

ENGLISH ELECTRIC

ABRIDGED DATA

16-inch diameter radar tube.

Neck Diameter	1·378 inches (35mm)
Deflection Angle	50 Degrees
Deflection Method	Magnetic
Focus Method	Electrostatic
E.H.T. Voltage	12 kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (*See Note* 1)	6·3 V
Heater Current	0·3 A
Screen (*See Notes* 2 *and* 3)	Aluminised
Fluorescent Colour	Orange
Persistence	Very Long
Inter-electrode Capacitances:	
Grid to all other electrodes	8·0 pF Max
Cathode to all other electrodes	8·0 pF Max
Anode 2+Anode 4 to external conductive coating	1200 pF Approx

Mechanical

Overall Length	24·02 inches (610 mm) Max
Overall Diameter	16·14 inches (410 mm) Max
Neck Diameter	1·398 inches (35·5 mm) Max
Net Weight	24 pounds (11 kg) Approx
Base	B.S.448–B12A
Anode 2 and Anode 4 Connection	B.S.448–CT8 Cavity Cap
Mounting Position	Any, except vertical with the screen downwards and the axis of the tube making an angle of less than 20° with the vertical.

MAXIMUM AND MINIMUM RATINGS

(Absolute Values. *See Note* 4)

	Min	*Max*	
Anode 2 and Anode 4 Voltage	8·0	18	kV
Anode 3 Voltage:			
Positive value	—	500	V
Negative value	—	500	V
Anode 1 Voltage	200	500	V
Grid Voltage (negative value)	1·0	200	V
Grid to Cathode Impedance (at 50Hz) ..	—	0·5	MΩ
Grid to Cathode Resistance	—	1·5	MΩ
Heater to Cathode Voltage:			
Heater positive with respect to cathode ..	—	150	V
Heater negative with respect to cathode ..	—	150	V
Heater to Cathode Resistance		*See Note* 5	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	12	kV
Anode 3 Voltage (*See Note* 6)	−200 to +200	V
Anode 1 Voltage	300	V
Anode 3 Current	−15 to +15	μA
Grid Voltage for cut-off	−30 to −70	V

NOTES

1. The heater is suitable for either series or parallel operation.
2. The T958 is supplied with an EEV Z Screen which has very long persistence and satisfies the requirements of E.V.S. 009 screen specification. It can also be manufactured with other screens, and customers' enquiries are invited.
3. The fluoride screen is sensitive to burn and should not be operated with slow moving spots.

4. All voltages are with respect to the cathode.

5. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50Hz must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1·0MΩ.

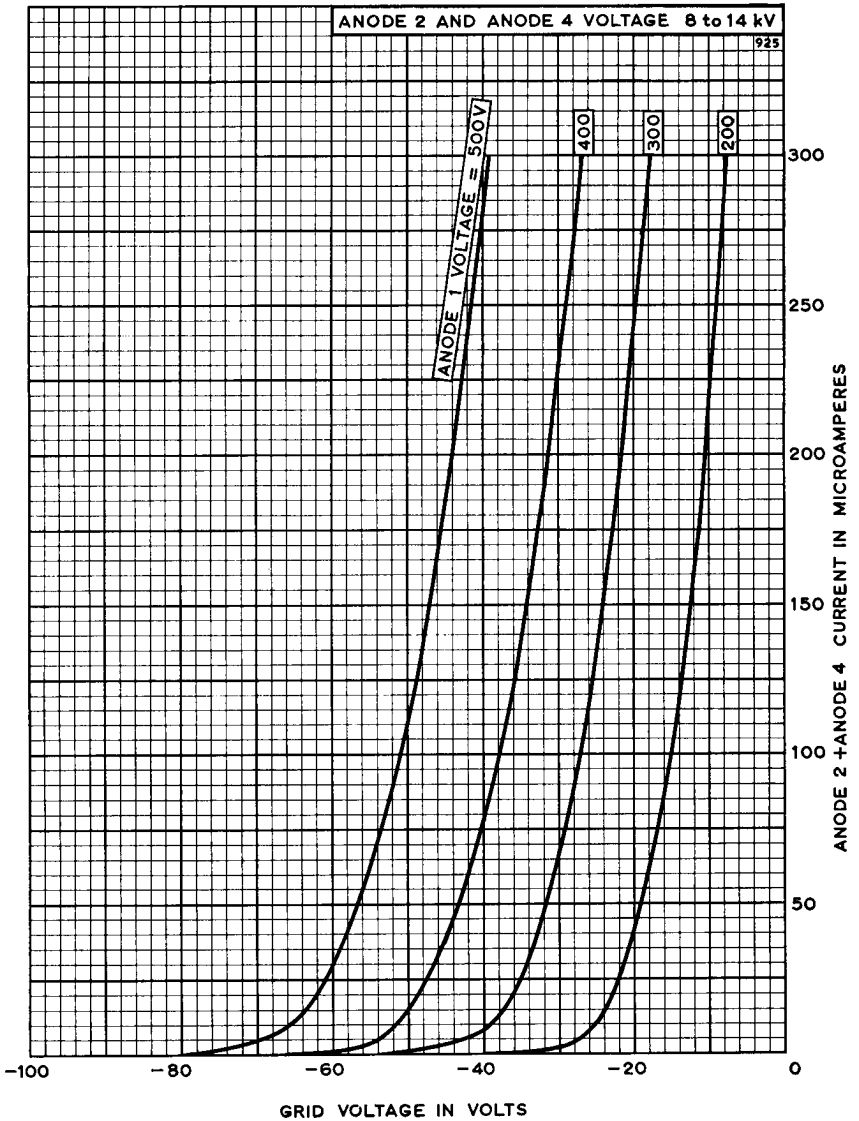
6. An acceptable focus quality is obtained with an anode 3 voltage range of −200 to +200V. If it is required to pass through the point of focus a voltage range of at least −300 to +300V will be required.

X-RAY WARNING

X-rays are produced when T958Z is operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tube 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.

ENGLISH ELECTRIC

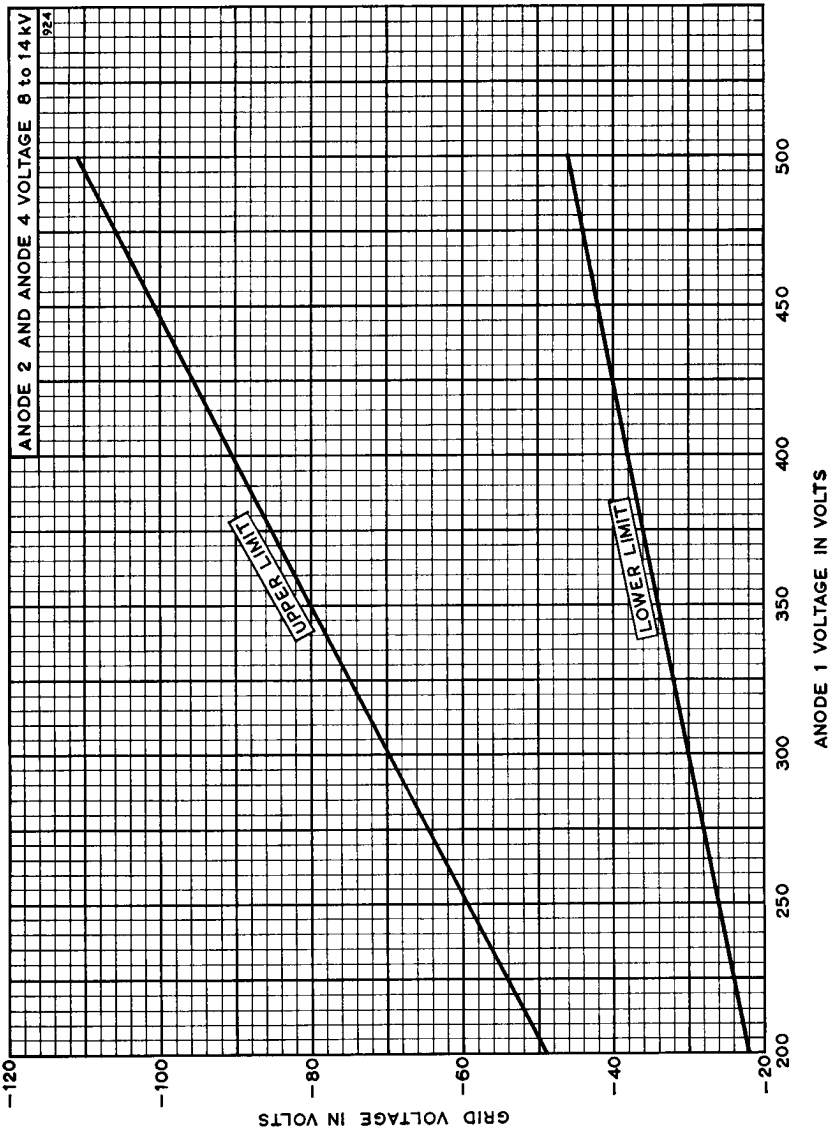
GRID VOLTAGE CHARACTERISTICS



Printed in England

ENGLISH ELECTRIC

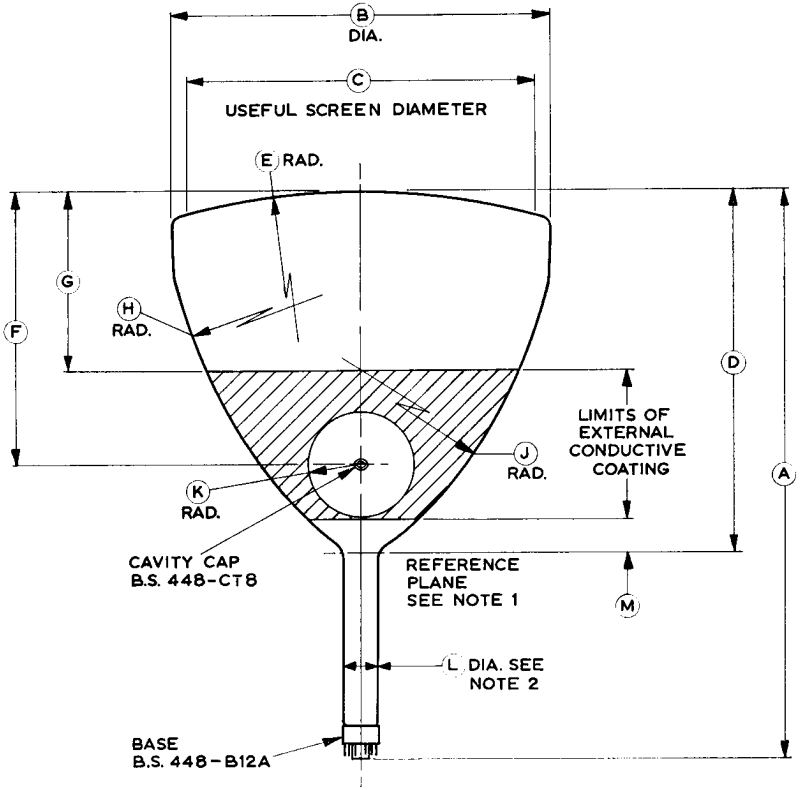
GRID CUT-OFF VOLTAGE LIMITS



Printed in England

OUTLINE

1135



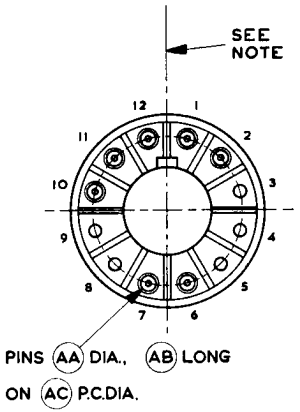
Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	23·622 ± 0·394	600 ± 10·0	H	23·504	597·0
B	15·984 ± 0·157	406·0 ± 4·0	J	16·732	425·0
C	14·685 Min	373·0 Min	K	2·165 ± 0·197	55·0 ± 5·0
D	14·961 ± 0·157	380·0 ± 4·0	L	1·378 $^{+0·020}_{-0·040}$	35·0 $^{+0·5}_{-1·0}$
E	27·560	700·0	M	1·417 ± 0·236	36·0 ± 6·0
F	11·417 ± 0·394	290·0 ± 10·0			
G	7·480 ± 0·394	190·0 ± 10·0			

Inch dimensions have been derived from millimetres.

ENGLISH ELECTRIC

OUTLINE DETAILS

11988



Pin	Element
1	Heater
2	Grid
3	No Pin
4	No Pin
5	No Pin
6	Anode 3
7	Internal Connection
8	No Pin
9	No Pin
10	Anode 1
11	Cathode
12	Heater
Cavity Cap	Anode 2 & Anode 4

Ref.	Inches	Millimetres
AA	0·098 ± 0·003	2·362 ± 0·076
AB	0·410 Max	10·41 Max
AC	1·063	27·00

Millimetre dimensions have been derived from inches.

Note The anode cavity cap will be in line with the base key to within 15°.

OUTLINE NOTES

1. Reference plane determined by 36·0mm diameter ring gauge.
2. A ring gauge 36·0mm diameter by 100mm long will pass over base and neck to reference plane.

MONITOR TUBE

T960W

ABRIDGED DATA

Television Camera Viewfinder or Picture Monitor tube with 7-inch diagonal flat faceplate and high light output screen.

Deflection Angle	65	Degrees
Deflection Method		Magnetic
Focus Method		Electrostatic
E.H.T. Voltage	14	kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	11·5	V
Heater Current	0·15 ± 10%	A
Faceplate	Flat, clear glass	
Screen	Aluminised	
Fluorescent Colour	White	
Persistence	Short	
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	10	pF
Cathode to all other electrodes, less than	8·0	pF
Final Anode to external conductive coating	350	pF Approx

Mechanical

Overall Length	9·291 inches	(236 mm)	Max
Faceplate Diagonal	6·929 inches	(176 mm)	Max
Neck Diameter	1·157 inches	(29·4 mm)	Max
Net Weight	2 pounds	(0·9 kg)	Approx
Base (*See Note* 2)			B8H
Final Anode Connection			B.S.448–CT8
Mounting Position			*See Note* 3

Printed in England

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 and Anode 4 Voltage	10	16	kV
Anode 3 Voltage:			
positive value	—	800	V
negative value	—	500	V
Anode 1 Voltage	250	500	V
Anode 1 Supply Source Impedance	—	1·5	MΩ
Grid Voltage, negative value (*See Note* 4)	0	200	V
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Cathode Current (Mean)	—	150	μA
Heater to Cathode Voltage (*See Note* 5)	—	200	V
Peak Heater to Cathode Voltage:			
Cathode positive (*See Note* 6)	—	400	V
Heater to Cathode Resistance			*See Note* 7

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	14	kV
Anode 3 Voltage (*See Note* 8)	0 to +400	V
Anode 3 Current	−15 to +15	μA
Anode 1 Voltage	400	V
Grid Voltage for cut-off	−30 to −80	V
Resolution		*See Note* 9

BEAM CENTRING

In order to obtain maximum brightness and the best focus spot size, stray magnetic fields must be minimised over the length of the gun structure. This may be achieved by using a tubular mumetal shield over the neck.

Where optimum performance is required, a small magnet should be used for centring the beam in the defining aperture. The magnet should be located in the region of the grid and its position and strength adjusted to give maximum brightness.

→Indicates a change

NOTES

1. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $16V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

2. The tube should not be supported by the base alone and under no circumstances should the socket be used for support purposes.

3. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.

4. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

5. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$

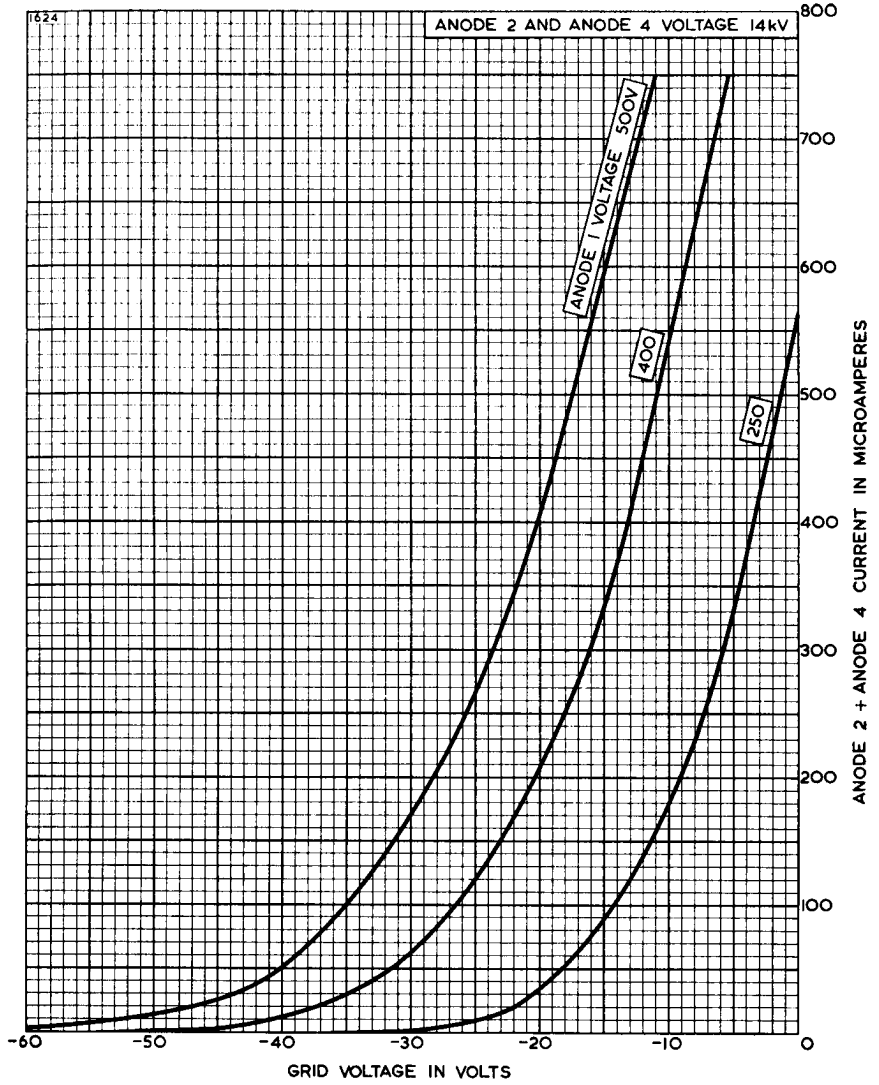
6. During a warming-up period not exceeding 45 seconds.

7. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

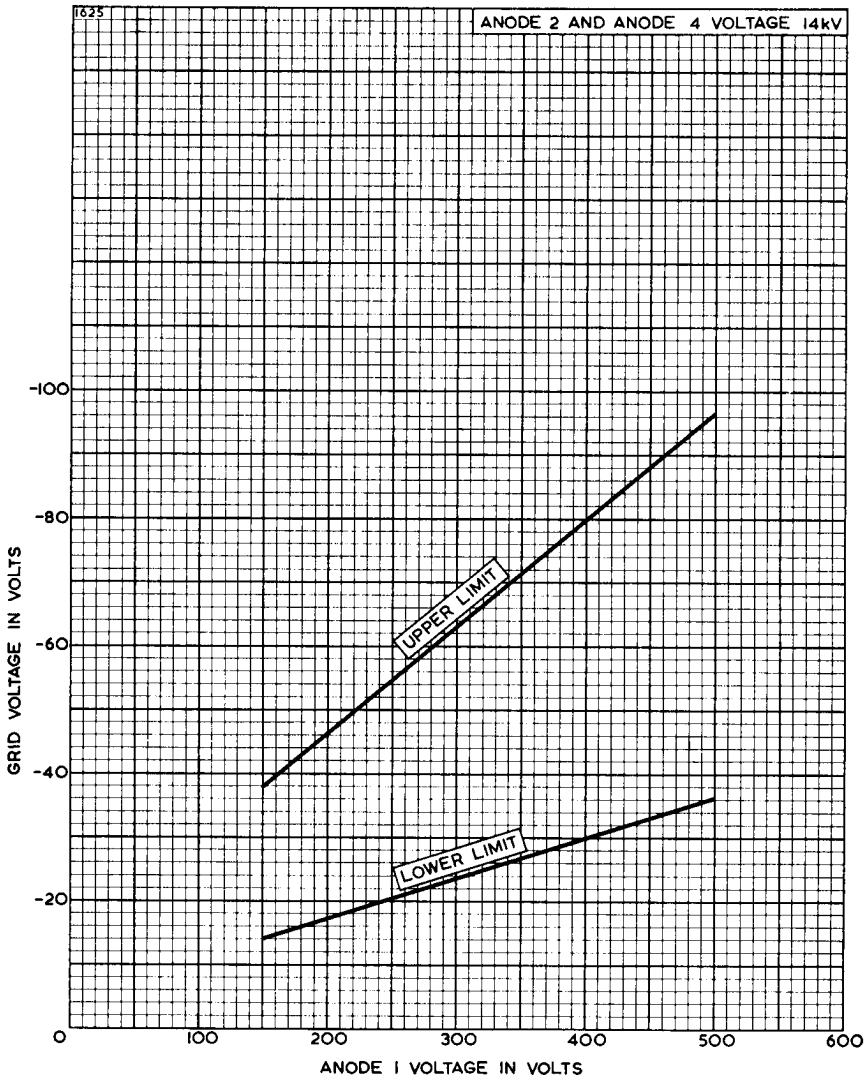
8. An acceptable focus quality will be obtained with an anode 3 voltage range of 0 to +400V. If it is required to pass through the point of focus a voltage range of at least −100 to +500V will be required.

9. The resolution at the centre of the screen (measured at an anode 2 and anode 4 voltage of 14kV and anode 1 voltage of 400V) is equal to or better than 625 lines. The tube will resolve a minimum of 625 lines based on a picture height of 99mm and measured at a brightness of 200ft-lamberts with the anode 3 voltage adjusted to give the smallest and roundest spot.

GRID VOLTAGE CHARACTERISTICS

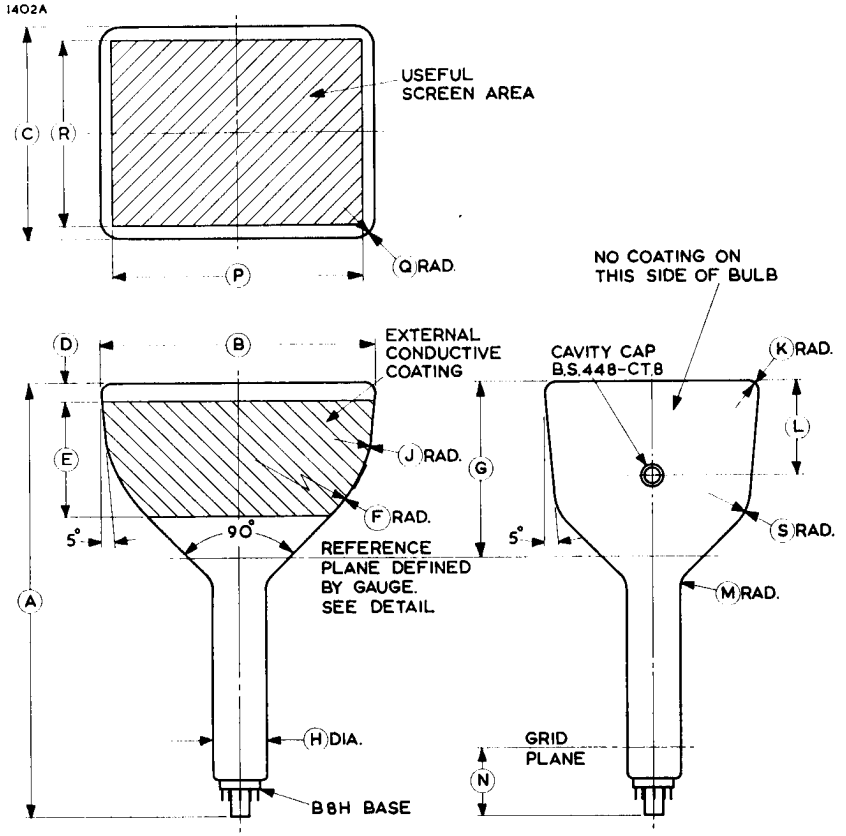


GRID CUT-OFF VOLTAGE LIMITS



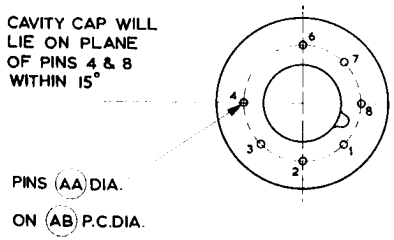
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OUTLINE



OUTLINE DETAILS

1407



Pin	Connection
1	Heater
2	Internal Connection
3	Anode 1
4	Anode 3
5	No Pin
6	Grid
7	Cathode
8	Heater
Cap	Anode 2 & Anode 4

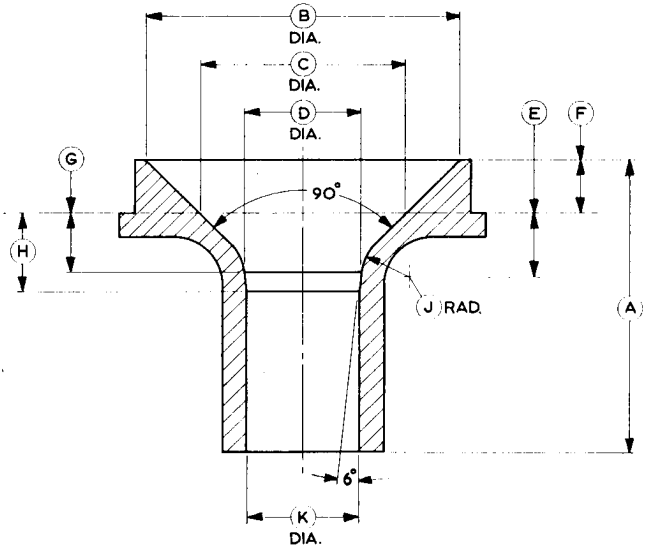
OUTLINE DIMENSIONS

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	9·055 ± 0·236	230·0 ± 6·0	L	1·969 ± 0·236	50·0 ± 6·0
B	5·709 ± 0·118	145·0 ± 3·0	M	0·394	10·0
C	4·409 ± 0·118	112·0 ± 3·0	N	1·417	36·0
D	0·394 ± 0·118	10·0 ± 3·0	P	5·197 Min	132·0 Min
E	2·402 ± 0·118	61·0 ± 3·0	Q	0·394	10·0
F	3·150	80·0	R	3·898 Min	99·0 Min
G	3·661 ± 0·157	93·0 ± 4·0	S	0·984	25·0
H	1·126 ± 0·031	28·6 ± 0·8	AA*	0·040	1·02
J	1·024	26·0	AB*	0·600	15·24
K	0·236	6·0			

Inch dimensions have been derived from millimetres except where indicated thus*.

REFERENCE LINE GAUGE

1406



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	3·063 ± 0·016	77·80 ± 0·40	G	0·613 ± 0·004	15·57 ± 0·10
B	3·248 ± 0·004	82·50 ± 0·10	H	0·815 ± 0·004	20·70 ± 0·10
C	2·122 ± 0·002	53·90 ± 0·05	J	0·500 ± 0·004	12·70 ± 0·10
D	1·211 ± 0·003	30·75 ± 0·07	K	$1{\cdot}168^{+0{\cdot}003}_{-0{\cdot}000}$	$29{\cdot}67^{+0{\cdot}07}_{-0{\cdot}00}$
E	0·665 ± 0·004	16·90 ± 0·10			
F	0·563 ± 0·004	14·30 ± 0·10			

Inch dimensions have been derived from millimetres.

Service Type CV6113 (T963D)

ABRIDGED DATA

12-inch diameter radar tubes for use with valve or transistor scan amplifiers. Two sets of scan coils may be fitted for alpha-numeric character display in processed radar and computer read-out systems. The T963D or Y will give flicker-free images at low repetition frequencies for computer read-out; T963Y is more suitable for very low repetition frequencies.

These tubes offer higher resolution and mechanical accuracy than the T953 series, which have a similar outline.

Neck Diameter	1·378 inches	(35 mm)
Deflection Angle	50	Degrees
Deflection Method		Magnetic
Focus Method (*See Note* 1)		Magnetic
E.H.T. Voltage	15	kV

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (*See Note* 2)	6·3 V
Heater Current	0·3 ± 10% A
Faceplate	Clear
Screen (*See Note* 3)	Aluminised
Inter-electrode Capacitances:	
Grid to all other electrodes, less than	12 pF
Cathode to all other electrodes, less than	12 pF

Mechanical

Overall Length	25·197 inches (640mm)	Max
Overall Diameter	12·087 inches (307mm)	Max
Useful Screen Diameter	9·843 inches (250mm)	Min
Maximum Neck Diameter	Determined by neck gauge page 9	
Net Weight	12 pounds (5·4kg) Approx	
Base	B.S.448–B12A	
Final Anode Connection	Cavity Cap B.S.448–CT8	
Mounting Position	*See Note* 4	

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)
(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 Voltage	9·0	15·5	kV
Anode 1 Voltage	250	600	V
Grid Voltage, negative value (*See Note* 5)	0	250	V
Heater to Cathode Voltage (*See Note* 6):			
Cathode negative	—	150	V
Cathode positive	—	200	V
Peak Heater to Cathode Voltage:			
Cathode positive (*See Note* 7)	—	410	V
Cathode Current (Mean)	—	150	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Heater to Cathode Resistance		*See Note* 8	

TYPICAL OPERATING CONDITIONS

Anode 2 Voltage	15	kV
Anode 1 Voltage	300	V
Focus Coil (*See Note* 1)	540	Ampere-turns
Grid Voltage for cut-off	−60 to −150	V
Grid Drive for 50μA beam current	20 to 40	V
Line Width (*See Note* 9)	0·2	mm
Astigmatism (*See Note* 10)	20	% Max

OPTIMUM BEAM FOCUSING

In order to obtain maximum brightness and minimum spot size, it is necessary to carry out the following procedure.

(*a*) Stray magnetic fields should be minimised in the region of the gun structure by fitting a tubular mumetal shield over the neck.

(*b*) The beam may be centred in the defining aperture by a small magnet, located in the region of the grid and adjusted to give maximum brightness.

(*c*) The magnetic axis of the focus coil should be aligned with the electron beam. This may be done either by adjusting the position of the focus coil (See Method 1), or by fitting additional deflection coils to adjust the position of the beam (See Method 2). In each case a.c. focusing (*See page* 3) may be used to identify the optimum alignment condition.

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Method 1

Adjustment of the focus coil position

The mounting of the focus coil should be such that the coil can be moved in any direction, i.e., vertically, horizontally and tilted about either the vertical or horizontal axis. An a.c. current is passed through the focus coil and the position of the coil is adjusted until the optimum alignment is reached. (*See A.C. Focusing note * below*).

Method 2

Electromagnetic deflection of the beam

Two sets of alignment coils are fitted on the tube neck, between the beam defining aperture and the focus coil (*See diagram, page* 8). Each set of coils is capable of deflecting the beam slightly in both X and Y directions. The currents in the alignment coils are adjusted to give correct alignment of the beam. (*See A.C. Focusing note * below*).

**A.C. Focusing*

An alternating current is passed through the focus coil such that the positive and negative excursions of the current each produce a focused spot. Provided there is no current through the main deflection coils, the picture on the tube faceplate will consist of a defocused area and two focused spots. The optimum focusing condition is obtained when the two focused spots coincide at the centre of the defocused spot.

NOTES

1. The focus coil should be positioned so that the focusing field is entirely on the screen side of the beam defining aperture. When using a focus coil having a short air gap, the centre of the air gap should be approximately 220mm from the reference plane.
2. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $9{\cdot}5V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.
3. Tubes in the T963 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T963D	D*	E.V.S.007	Yellow-orange	Long
T963Y	Y*	P33	Orange	Long
T963Z	Z*	P26	Orange	Very Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow-moving spots.

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

4. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.

5. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to + 1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

6. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$

7. During a warming-up period not exceeding 45 seconds.

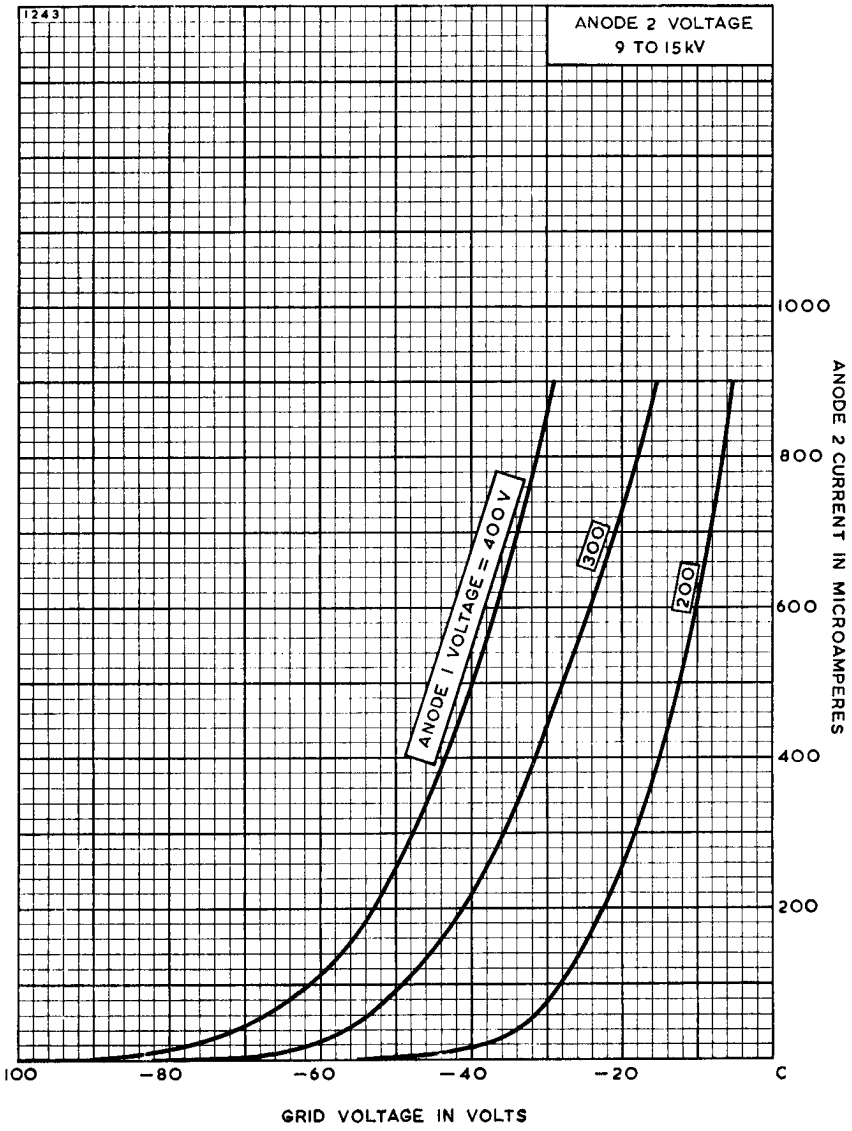
8. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

9. Measured under the following conditions:
   Pulsed line 250mm long
   Pulse length 100μsec
   Pulse repetition rate 50p.p.s.
   Beam current 50μA (peak)
   Modulation pulses and deflection waveform synchronised
   Line width measured with a microscope as in K1001/5.A.5.7.2.2.

10. Measured under the following conditions:
    Undeflected, focused, pulsed spot
    Pulse length 0·1μsec
    Pulse repetition rate 50p.p.s.
    Beam current 50μA (peak).

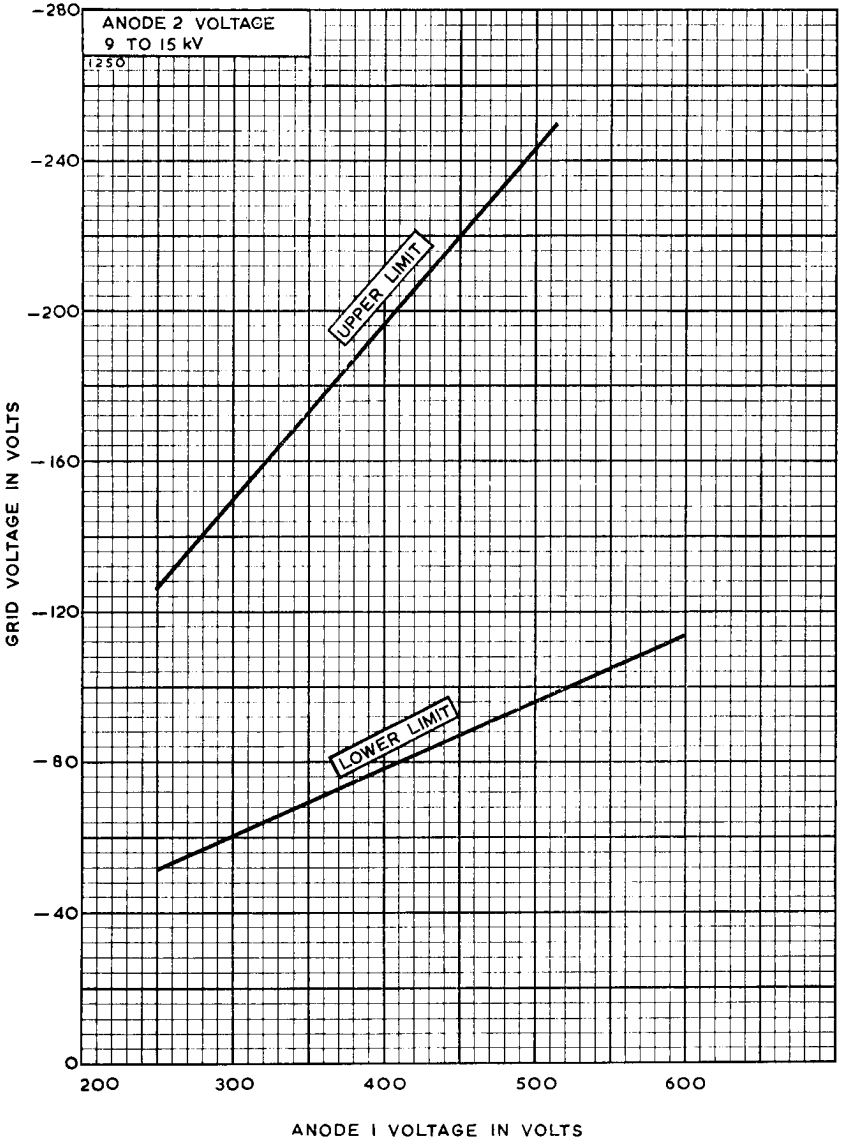
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GRID VOLTAGE CHARACTERISTICS



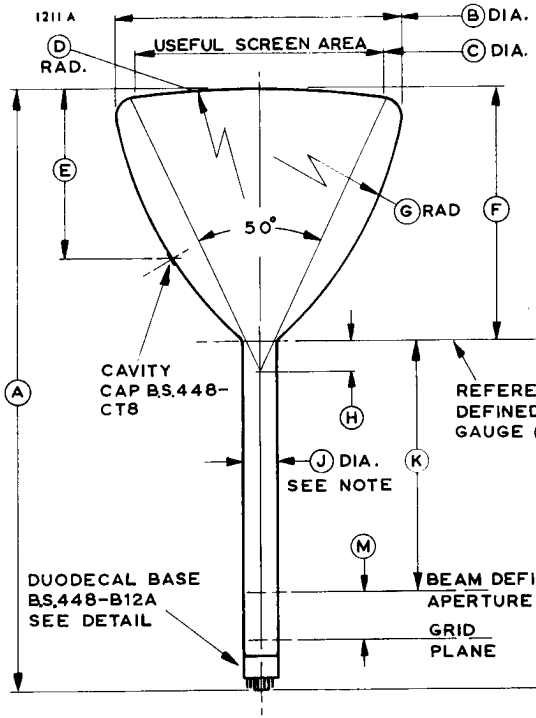
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GRID VOLTAGE CUT-OFF LIMITS



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OUTLINE



Bulb Ring Gauges

Ring Gauge Diameter (mm)	Distance from centre of Tube Face (mm)
280	93 ± 10
230	150 ± 9
180	191 ± 8
130	222 ± 7
80	249 ± 6

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	25·000 ± 0·197	635·0 ± 5·0	H	1·260 Max	32·0 Max
B	12·008 ± 0·079	305·0 ± 2·0	J	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$
C	9·843 Min	250·0 Min	K	10·787	274·0
D	39·370 ± 3·937	1000 ± 100	L	1·417	36·0
E	7·087 ± 0·197	180·0 ± 5·0	M	1·772	45·0
F	10·709 ± 0·138	272·0 ± 3·5	N	14·291	363
G	16·772	426·0			

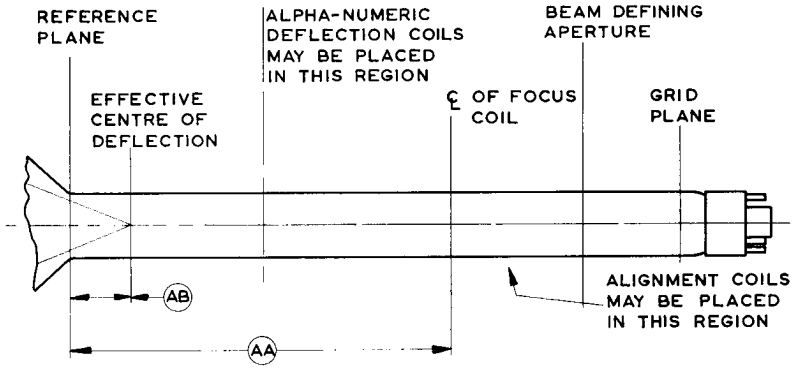
Inch dimensions have been derived from millimetres.

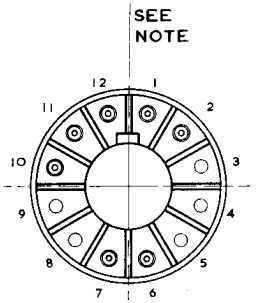
NOTE The mean axis of the neck will pass within 2mm from the geometric centre of the tube face and within 1° of a normal to a plane tangential to the geometric centre of the tube face. The tangential plane is determined by a 3 point spherometer gauge concentric with the tube face.

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OUTLINE DETAILS

1203





Ref.	Inches	Millimetres
AA	8·661	220
AB	1·260 Max	32·0 Max

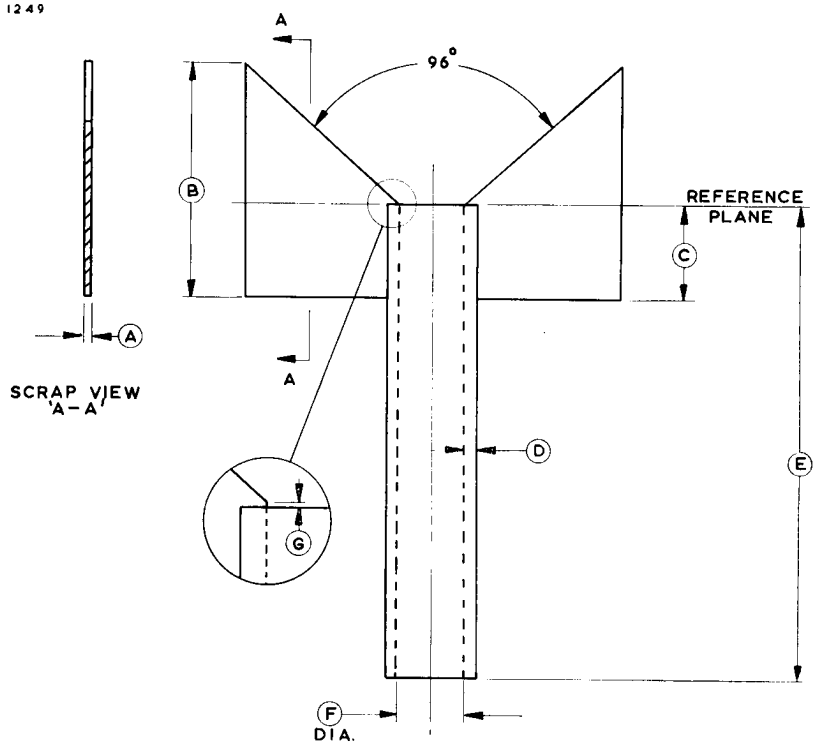
Inch dimensions have been derived from millimetres.

Note. The anode cavity cap will be in line with the base key to within 15°.

Pin	Element	Pin	Element
1	Heater	8	No Pin
2	Grid	9	No Pin
3	No Pin	10	Anode 1
4	No Pin	11	Cathode
5	No Pin	12	Heater
6	No Connection	Cavity	
7	No Connection	Cap	Anode 2

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NECK GAUGE



The gauge shown above will pass freely over base and neck to the reference line, and when rotated through 360° the blades of the gauge will contact the flared neck at the reference line only.

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	0·125	3·18	E	9·843 ± 0·039	250·0 ± 1·0
B	4·921 ± 0·039	125·0 ± 1·0	F	1·417 $^{+0·003}_{-0·000}$	36·00 $^{+0·08}_{-0·00}$
C	1·969 ± 0·039	50·0 ± 1·0	G	0·C00 $^{+0·002}_{-0·000}$	0·00 $^{+0·05}_{-0·00}$
D	0·252 ± 0·012	6·4 ± 0·3			

Inch dimensions have been derived from millimetres except dimension A.

ABRIDGED DATA

8½-inch Diameter Radar Tubes intended primarily for marine radar P.P.I. displays. The narrow scan angle permits the use of valve or transistor scan amplifiers.

Neck Diameter	1·378 inches (35 mm)	
Deflection Angle	41	Degrees
Deflection Method		Magnetic
Focus Method		Electrostatic
E.H.T. Voltage	16	kV

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3 ± 10%	A
Screen (*See Note* 2)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	8·0	pF
Cathode to all other electrodes, less than	8·0	pF
Anode 2 + Anode 4 to external conductive coating (*See Note* 3)	1000	pF

Mechanical

Overall Length	18·110 inches (460 mm)	Max
Overall Diameter	8·524 inches (216·5 mm)	Max
Useful Screen Diameter	7·756 inches (197 mm)	Min
Neck Diameter	1·400 inches (35·5 mm)	Max
Net Weight	5¾ pounds (2·6 kg)	Approx
Base (*See Note* 4)		B8H
Anode 2 and Anode 4 Connection	B.S.448-CT8 Cavity Cap	
Mounting Position (*See Note* 4)		Any

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MAXIMUM AND MINIMUM RATINGS

(Absolute Values. *See Note* 5)

	Min	*Max*	
Anode 2 and Anode 4 Voltage (*See Note* 6) ..	8·0	18	kV
Anode 3 Voltage:			
Positive value	—	1·0	kV
Negative value	—	0·5	kV
Anode 1 Voltage	0·2	0·8	kV
Grid Voltage (negative value)	1·0	200	V
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Grid to Cathode Resistance	—	1·5	MΩ
Heater to Cathode Voltage:			
Heater positive with respect to cathode			
D.C.	—	150	V
Peak	—	250	V
Heater negative with respect to cathode			
D.C.	—	150	V
Peak	—	300	V
Heater to Cathode Resistance		*See Note* 7	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	.. 12 to 16	kV
Anode 3 Voltage	.. 0 to 400	V
Anode 1 Voltage	.. 600	V
Anode 3 Current	−15 to +15	μA
Anode 1 Current (positive or negative)	.. 15	μA
Grid Voltage for visual cut-off	−32 to −48	V
Cathode Voltage for visual cut-off (*See Note* 8) ..	.. 30 to 45	V

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NOTES

1. The heater is suitable for either series or parallel operation. In series operation, the surge heater voltage when switching on must not exceed 9·5$V_{r.m.s.}$ and a current limiting device may be required in the circuit to reduce the surge voltage below this value.
2. Tubes in the T964 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T964Y	Y*	P33	Orange	Long
T964Z	Z*	P26	Orange	Very Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

*This is fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

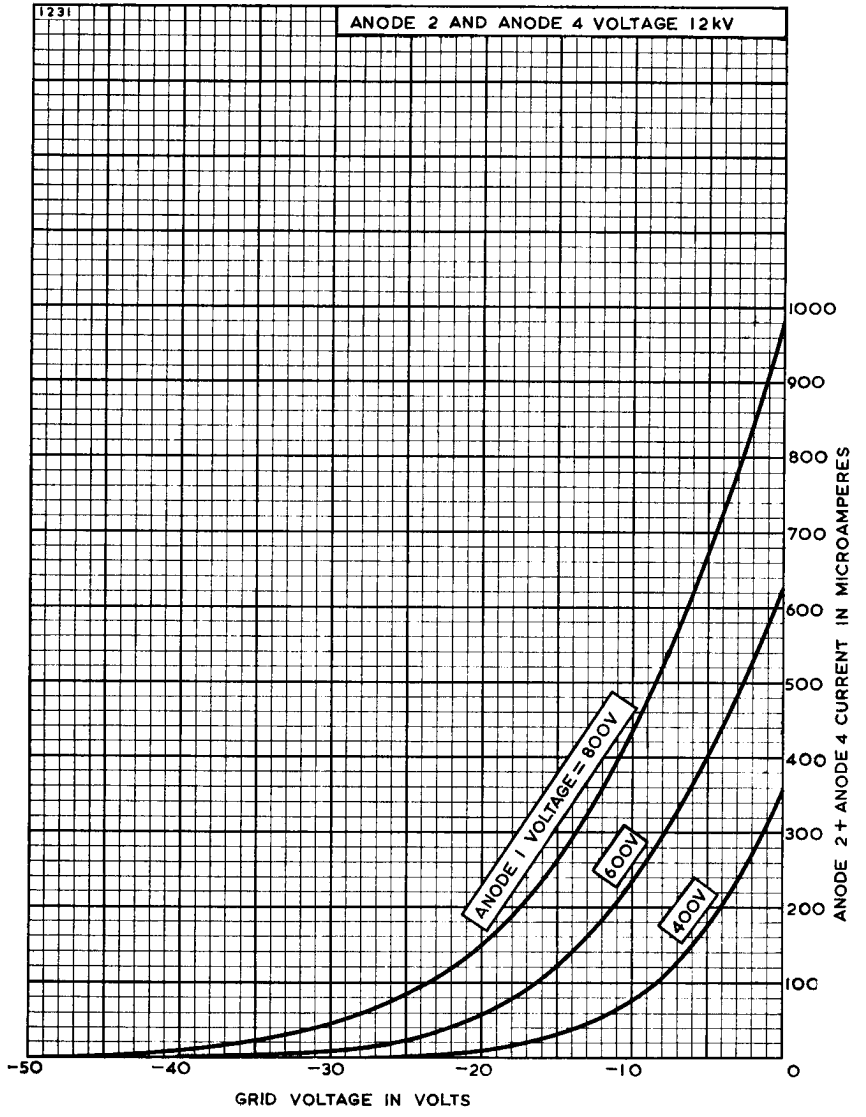
3. The capacitance of anode 2 and anode 4 to the external conductive coating may be used to provide smoothing for the e.h.t. supply.
4. The tube should not be supported by the base alone and under no circumstances should the socket be used for support purposes.
5. All voltages are with respect to cathode except where otherwise specified.
6. The associated equipment should be adequately protected against damage caused by possible high voltage flashovers inside the tube.
7. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.
8. For cathode modulation, all voltages are with respect to the grid.

X-RAY WARNING

X-rays are produced when the T964 is operated above 16kV (absolute value). These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

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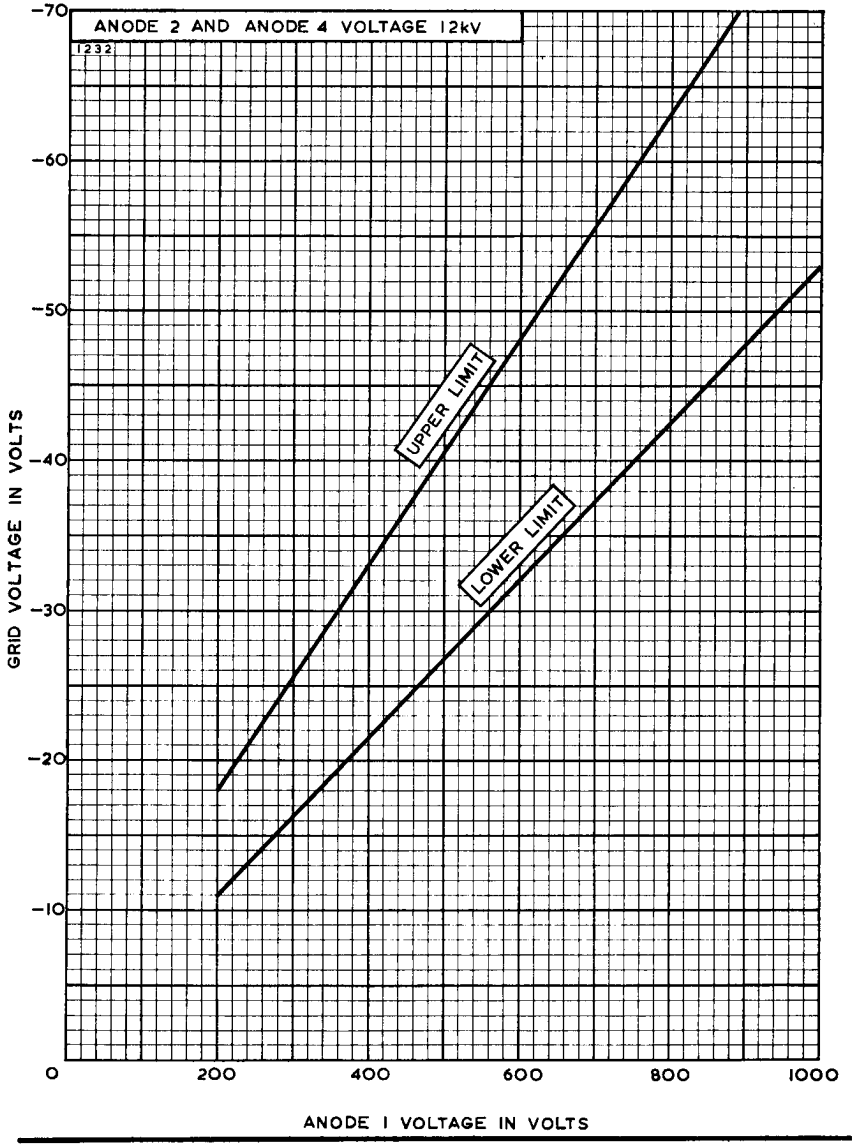
GRID VOLTAGE CHARACTERISTICS



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GRID CUT-OFF VOLTAGE LIMITS



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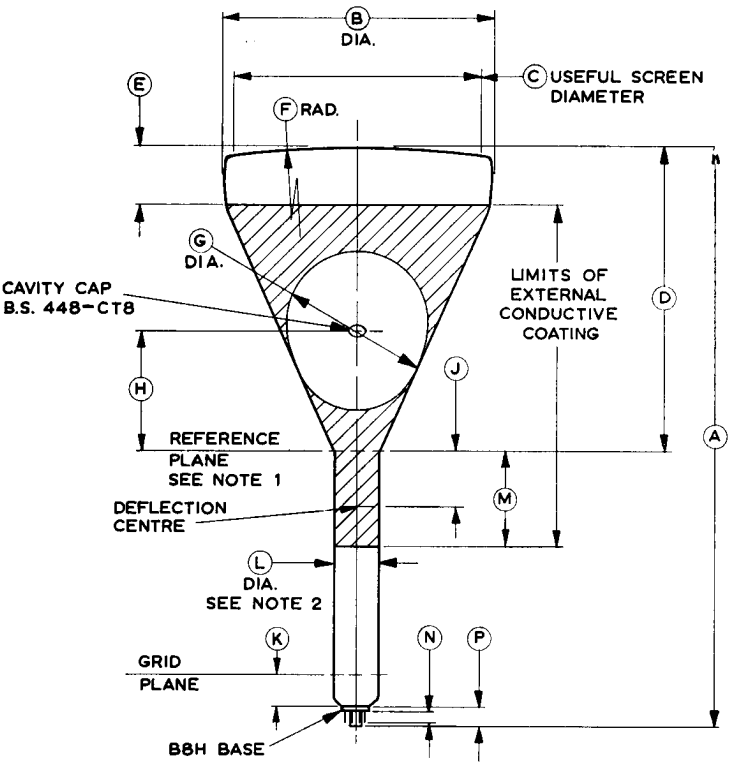
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OUTLINE

1140A



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	18·110 Max	460·0 Max	J	1·240 Max	31·5 Max
B	8·425 ± 0·098	214·0 ± 2·5	K	0·984	25·0
C	7·756 Min	197·0 Min	L	1·378 +0·020 −0·039	35·0 +0·5 −1·0
D	9·449 ± 0·157	240·0 ± 4·0	M	2·953 ± 0·197	75·0 ± 5·0
E	1·772 ± 0·197	45·0 ± 5·0	N	0·333 Max	8·46 Max
F	33·460	850·0	P	0·630	16·0
G	4·331 ± 0·394	110·0 ± 10·0			
H	3·780 ± 0·157	96·0 ± 4·0			

Inch dimensions have been derived from millimetres.

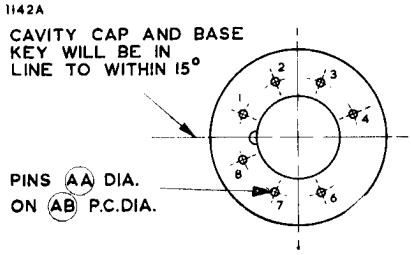
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OUTLINE DETAILS



Ref.	Inches	Millimetres
AA	0·040	1·02
AB	0·600	15·24

Millimetre dimensions have been derived from inches.

Pin	Element
1	Heater
2	Internal Connection
3	Anode 1
4	Anode 3
5	No Pin
6	Grid
7	Cathode
8	Heater
Cavity Cap	Anode 2 and Anode 4

OUTLINE NOTES

1. The Reference Plane is determined by the position where 36·0mm internal diameter ring gauge rests.
2. A ring gauge 36·0mm internal diameter × 100·0mm long will pass over the neck and base to the reference plane.

ABRIDGED DATA

12-inch Diameter Radar Tubes intended primarily for marine radar P.P.I. displays. The narrow scan angle permits the use of valve or transistor scan amplifiers.

Neck Diameter	1·378 inches (35mm)
Deflection Angle	40 Degrees
Deflection Method	Magnetic
Focus Method	Electrostatic
E.H.T. Voltage	16 kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (*See Note* 1)	6·3 V
Heater Current	0·3±10% A
Screen (*See Note* 2)	Aluminised
Inter-electrode Capacitances:	
Grid to all other electrodes, less than	8·0 pF
Cathode to all other electrodes, less than	8·0 pF
Anode 2 and Anode 4 to external conductive coating (*See Note* 3)	1500 pF

Mechanical

Overall Length	22·560 inches (573 mm) Max
Overall Diameter	12·090 inches (307 mm) Max
Useful Screen Diameter	10·430 inches (265 mm) Min
Neck Diameter	1·400 inches (35·5 mm) Max
Net Weight	13½ pounds (6·2 kg) Approx
Base (*See Note* 4)	B8H
Anode 2 and Anode 4 Connection	B.S.448–CT8 Cavity Cap
Mounting Position (*See Note* 4)	Any

MAXIMUM AND MINIMUM RATINGS

(Absolute Values. *See Note* 5)

	Min	*Max*	
Anode 2 and Anode 4 Voltage (*See Note* 6) ..	8·0	17	kV
Anode 3 Voltage:			
Positive value	—	1·0	kV
Negative value	—	0·5	kV
Anode 1 Voltage	0·2	0·8	kV
Grid Voltage (negative value)	1·0	200	V
Grid to Cathode Impedance (at 50Hz) ..	—	0·5	MΩ
Grid to Cathode Resistance	—	1·5	MΩ
Heater to Cathode Voltage:			
Heater positive with respect to cathode			
D.C.	—	150	V
Peak	—	250	V
Heater negative with respect to cathode			
D.C.	—	150	V
Peak	—	300	V
Heater to Cathode Resistance		.. *See Note* 7	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	12 to 16	kV
Anode 3 Voltage	.. −75 to +325	V
Anode 3 Current (positive or negative)	15	μA
Anode 1 Voltage	550	V
Anode 1 Current (positive or negative)	15	μA
Grid Voltage for visual cut-off	−38 to −62	V
Cathode Voltage for visual cut-off (*See Note* 8) ..	36 to 58	V

NOTES

1. The heater is suitable for either series or parallel operation. In series operation, the surge heater voltage when switching on must not exceed $9{\cdot}5V_{r.m.s.}$ and a current limiting device may be required in the circuit to reduce the surge voltage below this value.

2. Tubes in the T965 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T965Y	Y*	P33	Orange	Long
T965Z	Z*	P26	Orange	Very Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

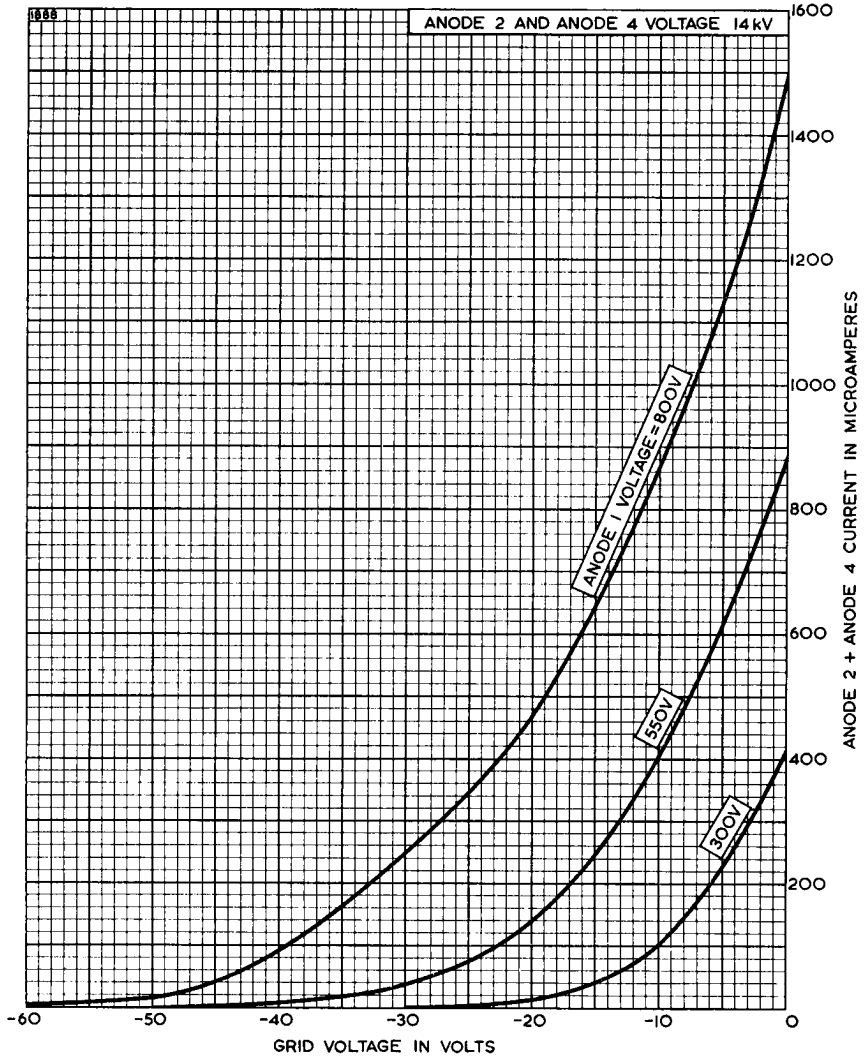
3. The capacitance of anode 2 and anode 4 to the external conductive coating may be used to provide smoothing for the e.h.t. supply.
4. The tube should not be supported by the base alone and under no circumstances should the socket be used for support purposes.
5. All voltages are with respect to cathode except where otherwise specified.
6. The associated equipment should be adequately protected against damage caused by possible high voltage flashovers inside the tube.
7. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50Hz must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1·0MΩ.
8. For cathode modulation, all voltages are with respect to the grid.

X-RAY WARNING

X-rays are produced when the T965 is operated above 16kV (absolute value). These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

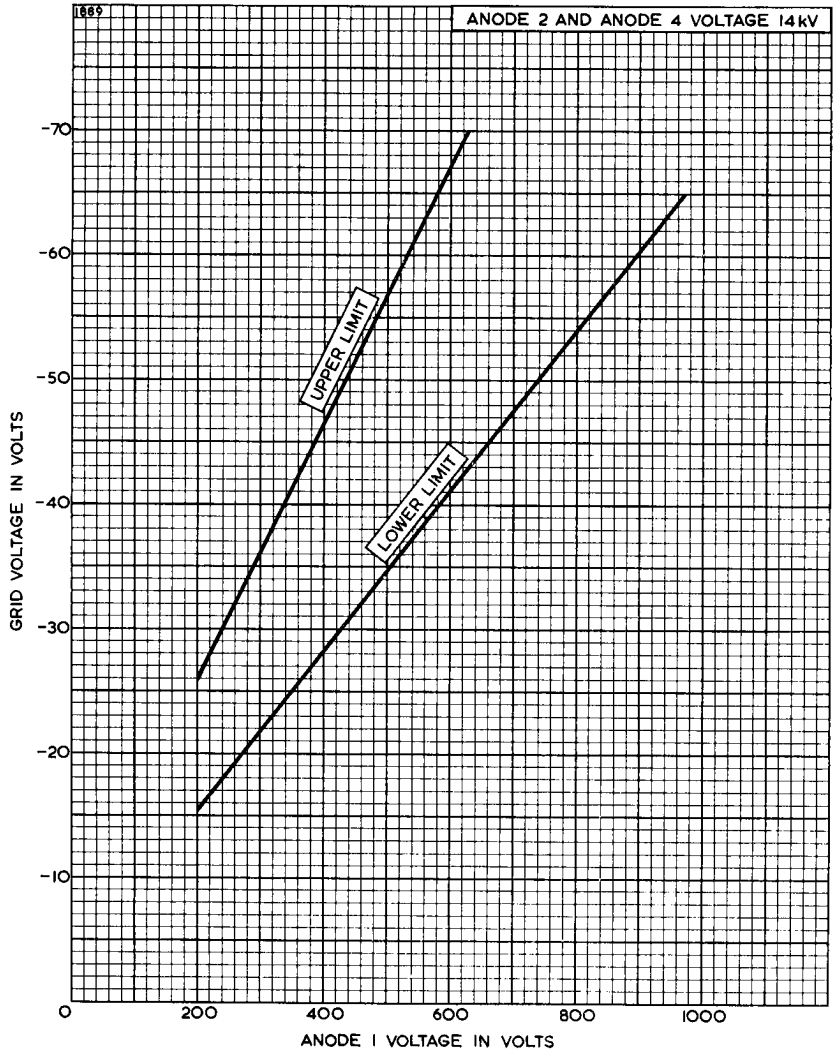
ENGLISH ELECTRIC

GRID VOLTAGE CHARACTERISTICS



ENGLISH ELECTRIC

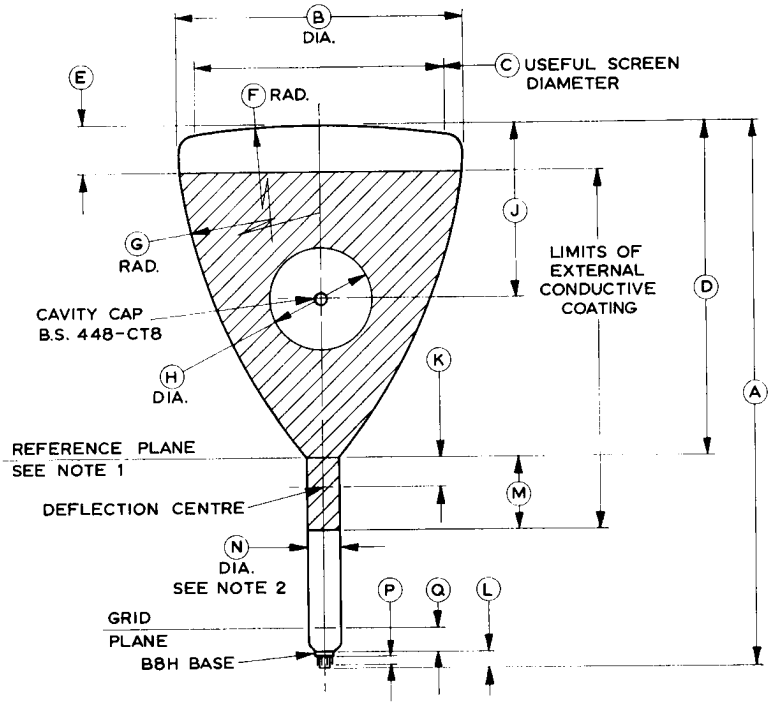
GRID CUT-OFF VOLTAGE LIMITS



ENGLISH ELECTRIC

OUTLINE

1141A

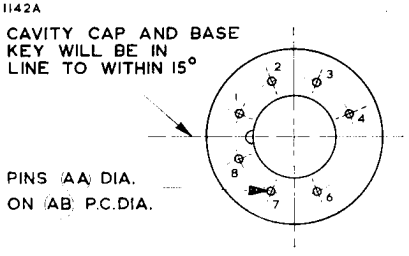


Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	22·560 Max	573·0 Max	J	7·244 ± 0·118	184·0 ± 3·0
B	12·010 $^{+0·080}_{-0·100}$	305·0 $^{+2·0}_{-2·5}$	K	1·240 Max	31·5 Max
C	10·430 Min	265·0 Min	L	0·630	16·0
D	13·900 ± 0·180	353·0 ± 4·5	M	3·543 ± 0·197	90·0 ± 5·0
E	1·969	50·0	N	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$
F	39·370	1000	P	0·333 Max	8·46 Max
G	23·620	600·0	Q	0·984	25·0
H	4·331 ± 0·394	110·0 ± 10·0			

Inch dimensions have been derived from millimetres.

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OUTLINE DETAILS



Ref.	Inches	Millimetres
AA	0·040	1·02
AB	0·600	15·24

Millimetre dimensions have been derived from inches.

Pin	Element
1	Heater
2	Internal Connection
3	Anode 1
4	Anode 3
5	No Pin
6	Grid
7	Cathode
8	Heater
Cavity Cap	Anode 2 and Anode 4

OUTLINE NOTES

1. The Reference Plane is determined by the position where 36·0mm internal diameter ring gauge rests.
2. A ring gauge 36·0mm internal diameter × 100·0mm long will pass over the neck and base to the reference plane.

Printed in England

ABRIDGED DATA

7-inch diameter tubes with triode guns and optical quality flat faceplates. Designed for use in flying spot scanner applications.

Neck Diameter	1·378 inches	(35 mm)
Deflection Angle (to scan nominal diameter of 165mm)	42	Degrees
Deflection Method		Magnetic
Focus Method (*See Note* 1)		Magnetic
E.H.T. Voltage	25	kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	4·0	V
Heater Current	550±10%	mA
Faceplate		Clear
Screen (*See Note* 2)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	9·0	pF
Cathode to all other electrodes, less than	9·0	pF
Final Anode to external conductive coating	1500	pF Approx

Mechanical

Overall Length	21·339 inches	(542 mm)	Max
Overall Diameter	7·441 inches	(189 mm)	Max
Normality of Faceplate to Neck Axis			90°±30′
Faceplate Thickness	0·354±0·039 inch	(9·0±1·0mm)	
Nominal Screen Diameter	6·496 inches	(165mm)	
Useful Screen Areas			*See Note* 3
Neck Diameter	1·398 inches	(35·5 mm)	Max
Net Weight	4·5 pounds	(2·1 kg)	Approx
Base			B.S.448–B8O
Final Anode Connection			B.S.448–CT8
Mounting Position			*See Note* 4

Cooling

The faceplate may require forced-air cooling when the tube is used at high ratings.

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 1 Voltage	20	35	kV
Grid Voltage, negative value (*See Note* 5)	—	250	V
Heater to Cathode Voltage (*See Note* 6):			
Cathode negative	—	150	V
Cathode positive	—	200	V
Peak Heater to Cathode Voltage:			
Cathode positive (*See Note* 7)	—	410	V
Cathode Current (Mean) (*See Note* 8)	—	330	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Heater to Cathode Resistance		*See Note* 9	

TYPICAL OPERATING CONDITIONS

Anode Voltage	25	kV
Spark Trap and External Conductive Coating (*See Note* 10)	Earth Potential	
Grid Voltage for cut-off	−75 to −125	V
Grid Drive for 100μA beam current	25 to 41	V
Focus Power	*See Note* 11	
Line Width (*See Note* 12):		
by shrinking raster method	0·14	mm
by measuring microscope method	0·17	mm

OPTIMUM BEAM FOCUSING

In order to obtain minimum spot size, the magnetic axis of the focus coil should be aligned with the electron beam. This may be done either by adjusting the position of the focus coil (*See Method* 1), or by fitting additional deflection coils to adjust the position of the beam (*See Method* 2). In each case a.c. focusing (*See page* 3) may be used to identify the optimum alignment condition.

Method 1

Adjustment of the focus coil position

The mounting of the focus coil should be such that the coil can be moved in any direction, i.e. vertically, horizontally and tilted about either the vertical or horizontal axis. An a.c. current is passed through the focus coil and the position of the coil is adjusted until the optimum alignment is reached. (*See* * *A.C. Focusing.*)

Printed in England

Method 2

Electromagnetic deflection of the beam

Two sets of alignment coils are fitted on the tube neck, between the cathode and the focus coil. Each set of coils is capable of deflecting the beam slightly in both X and Y directions. The currents in the alignment coils are adjusted to give correct alignment of the beam. (*See* * *A.C. Focusing.*)

**A.C. Focusing*

An alternating current is passed through the focus coil such that the positive and negative excursions of the current each produce a focused spot. Provided there is no current through the main deflection coils, the picture on the tube faceplate will consist of a defocused area and two focused spots. The optimum focusing condition is obtained when the two focused spots coincide at the centre of the defocused spot.

Change of Screen Characteristics During Life

During the first 5 hours of operation the afterglow persistence decreases and this is accompanied by a decrease in light output due to the phosphor ageing. The raster should be overscanned during initial setting up and ageing, to avoid a variation in light output across the final raster.

X-RAY WARNING

X-Rays are produced when tubes in the T966 series are operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tubes are adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the tubes.

NOTES

1. The centre of the air gap of the focus coil should be approximately 110mm from the reference plane.
2. Tubes in the T966 series have screens with the following characteristics

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T966A	A	P24	Green	1μsec to 10% approx.
T966C	C	P16	Bluish-purple	0·1μsec to 10% approx.

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3. The useful screen area is defined by the optical quality requirements of the screen; several sizes are available as follows:

Raster Size	Orientation	Scanning Standard	Code
102×76mm	0±15°	405 625	4/4 4/6
94×70mm	0±15°	405 625	5/4 5/6
105×40mm	45±15°	405 625	6/4 6/6

The orientation of the raster is referred to a plane containing the anode contact and the tube axis. It is defined by the angle between this plane and the plane containing the mid points of the longer sides of the raster and the tube axis. This angle is measured in an anti-clockwise direction from the plane of the anode contact, viewed from the screen end.

Other quality areas can be supplied to special order.

The code reference is added to the tube type number in order to identify a particular variant, e.g. T966A–6/4.

4. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 50° with the vertical.

5. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

6. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$ The heater should preferably be connected to the cathode.

7. During a warming-up period not exceeding 45 seconds.

8. Means must be provided for the instantaneous removal of beam current in the event of a failure of either or both time bases. Unless such a safety device is incorporated, a failure of this type will result in the immediate destruction of the screen of the tube.

9. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

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10. The spark trap and external conductive coating should be connected by a low impedance path to the h.t. supply return. The purpose of this is to isolate from the grid and its associated circuits any occasional, non-destructive discharges which sometimes occur when starting after prolonged shutdown.

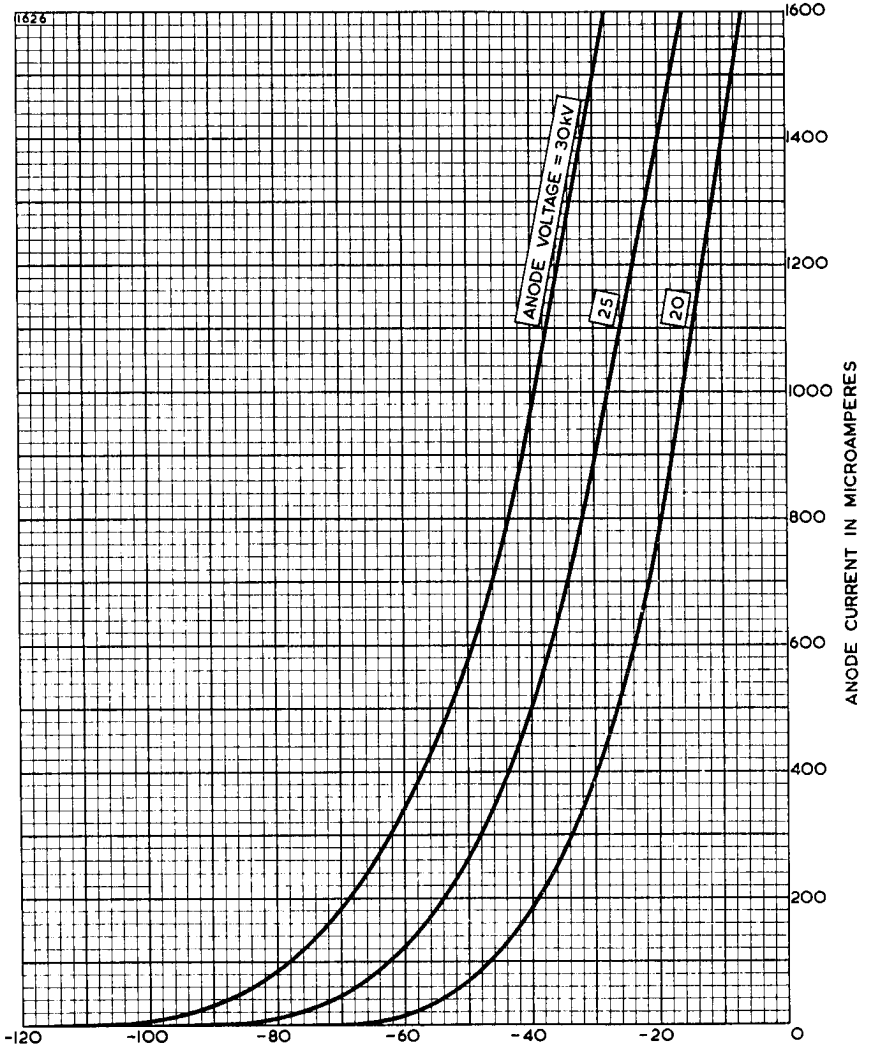
11. The focus power required is equivalent to approximately 800 ampere-turns using a long gap focus coil.

12. Measured under the following conditions:
    Pulsed line 100mm long
    Pulse length 100μsec
    Pulse repetition rate 50p.p.s.
    Beam current 100μA peak.

    The method used for line width measurement with a microscope is as in K1001.

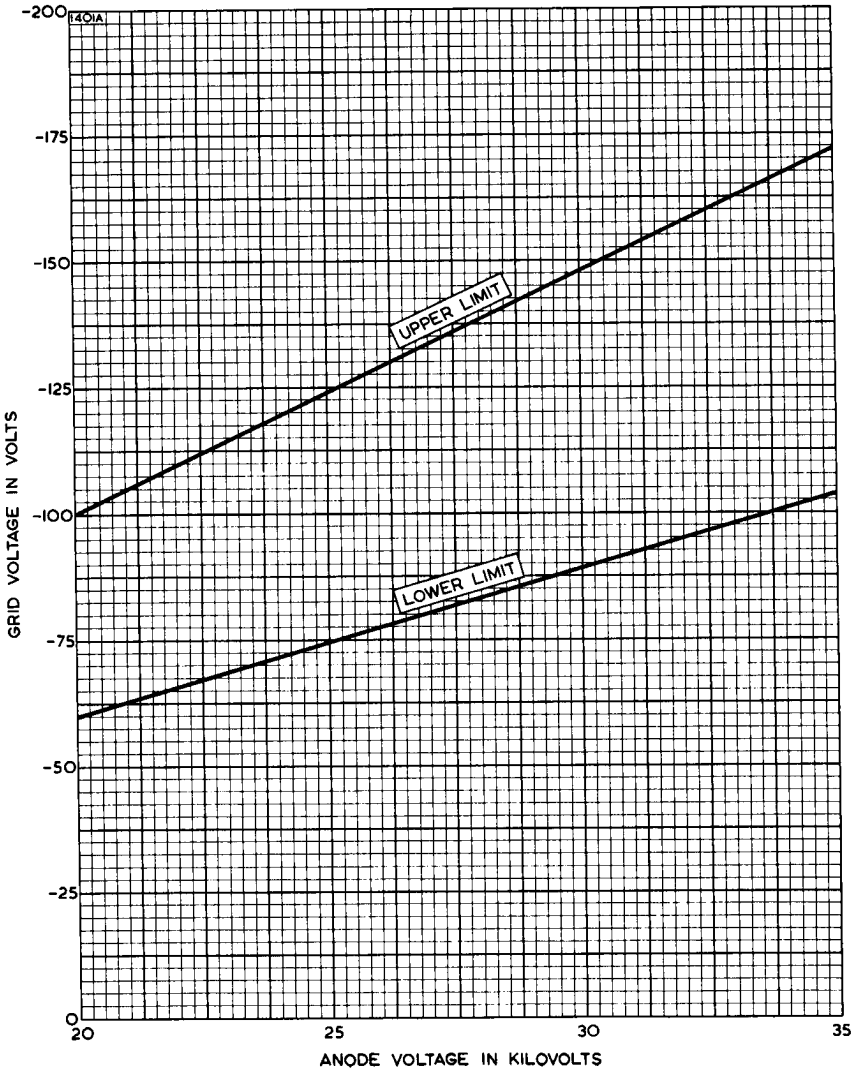
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GRID VOLTAGE CHARACTERISTICS

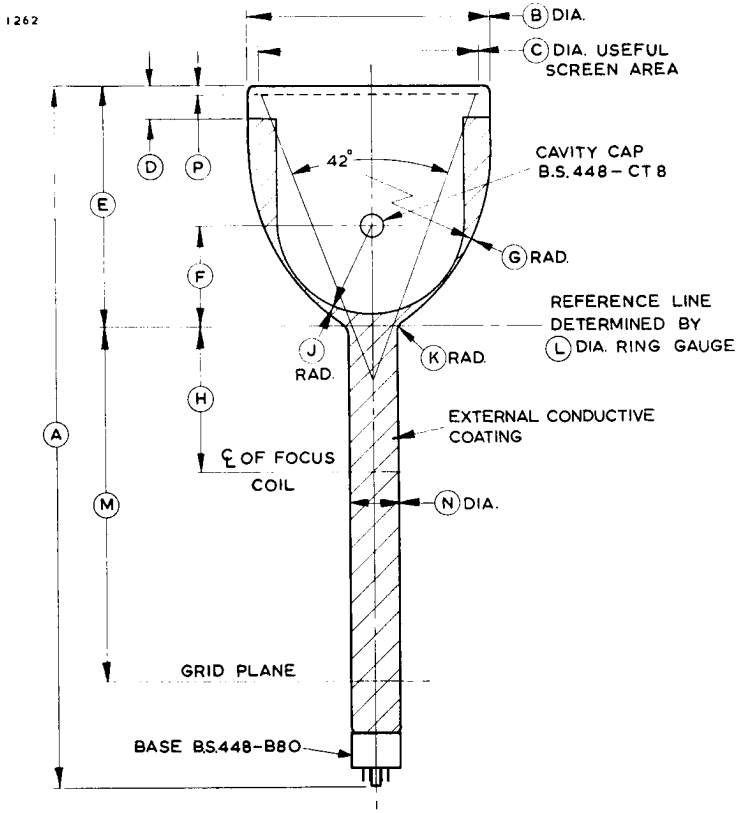


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GRID VOLTAGE CUT-OFF LIMITS



OUTLINE

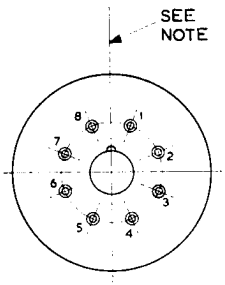


Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	20·945 ± 0·394	532·0 ± 10·0	J	3·346	85·0
B	7·284 ± 0·157	185·0 ± 4·0	K	0·354	9·00
C	6·496	165·0	L	1·417	36·0
D	0·984 ± 0·394	25·0 ± 10·0	M	10·669	271·0
E	7·165 ± 0·157	182·0 ± 4·0	N	$1{\cdot}378^{+0{\cdot}020}_{-0{\cdot}039}$	$35{\cdot}0^{+0{\cdot}5}_{-1{\cdot}0}$
F	2·992 ± 0·157	76·0 ± 4·0	P	0·354 ± 0·039	9·00 ± 1·00
G	6·299	160·0			
H	4·331	110·0			

Inch dimensions have been derived from millimetres.

OUTLINE DETAIL

1629



Pin	Element
1	Spark Trap and External Conductive Coating
2	Heater
3	No Connection
4	No Connection
5	Grid
6	No Connection
7	Heater
8	Cathode
Cap	Anode

Note. The base key will be in line with the Cavity Cap to within $\pm 15°$.

Printed in England

ABRIDGED DATA

16-inch diameter radar tubes for use with valve or transistor scan amplifiers. Two sets of scan coils may be fitted for alpha-numeric character display.

Neck Diameter	1·378 inches (35mm)	
Deflection Angle	50	Degrees
Deflection Method		Magnetic
Focus Method (*See Note* 1)		Magnetic
E.H.T. Voltage	15	kV

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 2)	6·3	V
Heater Current	0·3 ± 10%	A
Faceplate		Clear
Screen (*See Note* 3)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	12	pF
Cathode to all other electrodes, less than	12	pF

Mechanical

Overall Length	29·646 inches	(753 mm)	Max←
Overall Diameter	16·142 inches	(410 mm)	Max
Useful Screen Diameter	14·567 inches	(370 mm)	Min
Neck Diameter (*See Page* 9)	1·398 inches	(35·5 mm)	Max
Net Weight	24 pounds	(11 kg)	Approx
Base			B.S.448–B12A
Final Anode Connection			Cavity Cap B.S.448–CT8
Mounting Position			*See Note* 4

← Indicates a change

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 Voltage	9·0	15·5	kV
Anode 1 Voltage	250	600	V
Grid Voltage, negative value (*See Note* 5) ..	0	250	V
Heater to Cathode Voltage (*See Note* 6):			
Cathode negative	—	150	V
Cathode positive	—	200	V
Peak Heater to Cathode Voltage:			
Cathode positive (*See Note* 7)	—	410	V
Cathode Current (Mean)	—	150	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Heater to Cathode Resistance		*See Note* 8	

TYPICAL OPERATING CONDITIONS

Anode 2 Voltage	15	kV
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −70	V
Grid Drive for 100μA beam current ..	20 to 35	V
Line Width (*See Note* 9)	0·35	mm
Astigmatism (*See Note* 10)	20	% Max

OPTIMUM BEAM FOCUSING

In order to obtain maximum brightness and minimum spot size, it is necessary to carry out the following procedure.

(*a*) Stray magnetic fields should be minimised in the region of the gun structure by fitting a tubular mumetal shield over the neck.

(*b*) The beam may be centred in the defining aperture by a small magnet, located in the region of the grid and adjusted to give maximum brightness.

(*c*) The magnetic axis of the focus coil should be aligned with the electron beam. This may be done either by adjusting the position of the focus coil (*See Method* 1), or by fitting additional deflection coils to adjust the position of the beam (*See Method* 2). In each case a.c. focusing (*See Page* 3) may be used to identify the optimum alignment condition.

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Method 1

Adjustment of the focus coil position

The mounting of the focus coil should be such that the coil can be moved in any direction, i.e. vertically, horizontally and tilted about either the vertical or horizontal axis. An a.c. current is passed through the focus coil and the position of the coil is adjusted until the optimum alignment is reached. (*See Note * below*).

Method 2

Electromagnetic deflection of the beam

Two sets of alignment coils are fitted on the tube neck, between the beam defining aperture and the focus coil (*See Diagram, Page* 8). Each set of coils is capable of deflecting the beam slightly in both X and Y directions. The currents in the alignment coils are adjusted to give correct alignment of the beam. (*See Note * below*).

**A.C. Focusing*

An alternating current is passed through the focus coil such that the positive and negative excursions of the current each produce a focused spot. Provided there is no current through the main deflection coils, the picture on the tube faceplate will consist of a defocused area and two focused spots. The optimum focusing condition is obtained when the two focused spots coincide at the centre of the defocused spot.

NOTES

1. The focus coil should be positioned so that the focusing field is entirely on the screen side of the beam defining aperture. When using a focus coil having a short air gap, the centre of the air gap should be approximately 170mm from the reference plane.
2. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $9{\cdot}5V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.
3. Tubes in the T970 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T970D	D*	E.V.S.007	Yellow-orange	Long
T970Y	Y*	P33	Orange	Long
T970Z	Z*	P26	Orange	Very Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

The tube can be manufactured with alternative screens, and customers'

enquiries are invited.

4. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.

5. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off, when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

6. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$

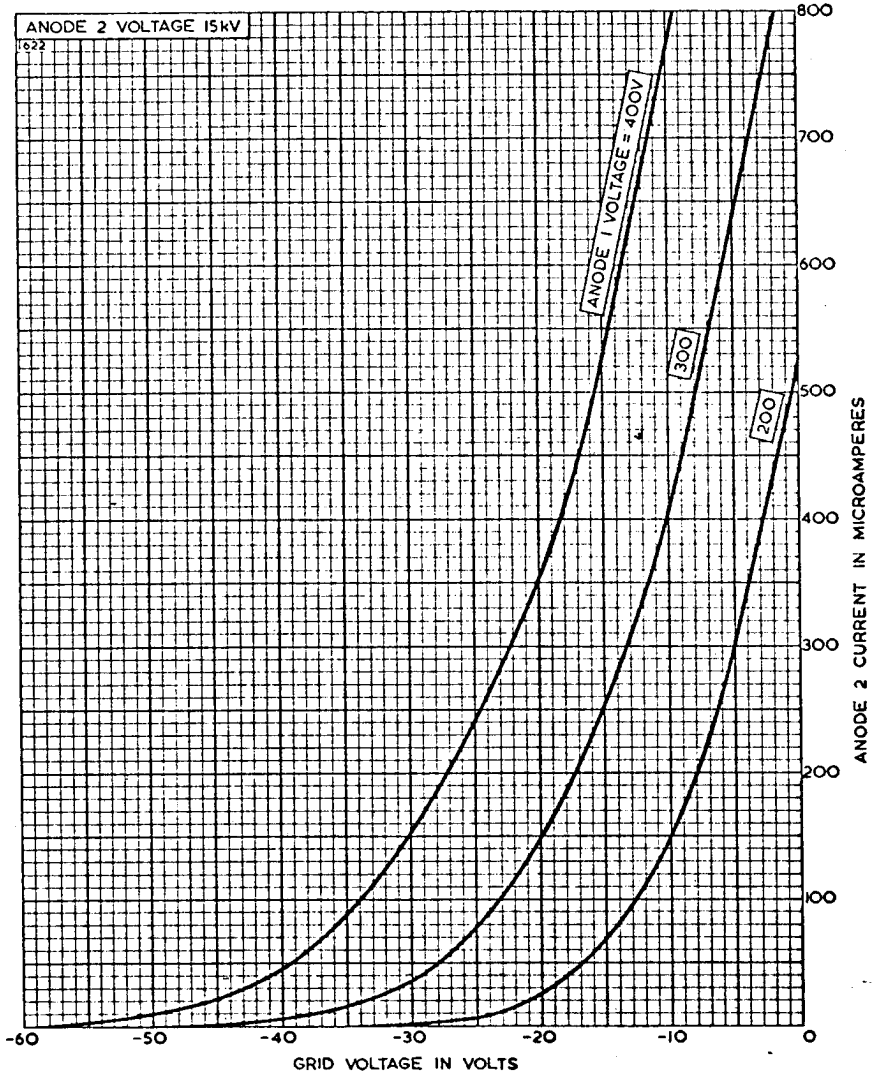
7. During a warming-up period not exceeding 45 seconds.

8. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

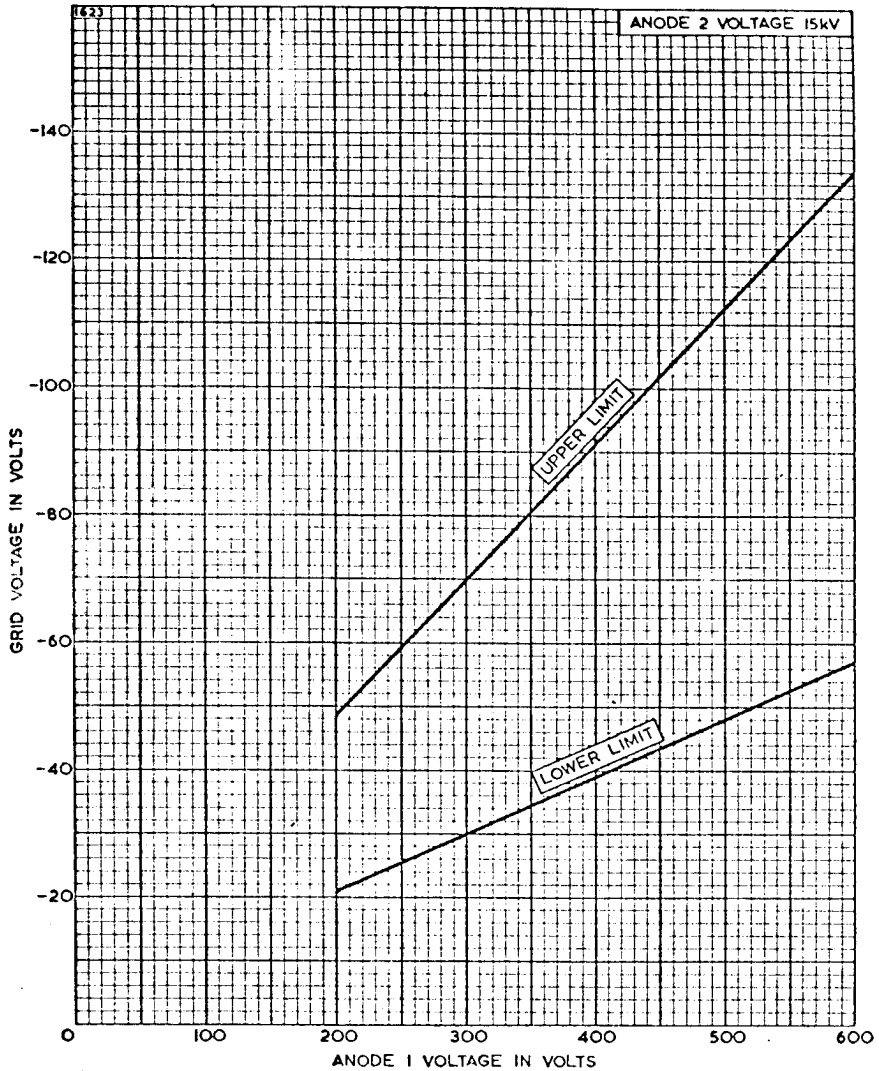
9. Measured under the following conditions:
   Pulsed line 370mm long
   Pulse length 100μsec
   Pulse repetition rate 50p.p.s.
   Beam current 100μA (peak)
   Modulation pulses and deflection waveform synchronised
   Line width measured with a microscope as in K1001/5.A.5.7.2.2.

10. Measured under the following conditions:
    Undeflected, focused, pulsed spot
    Pulse length 0·1μsec
    Pulse repetition rate 50p.p.s.
    Beam current 100μA (peak).

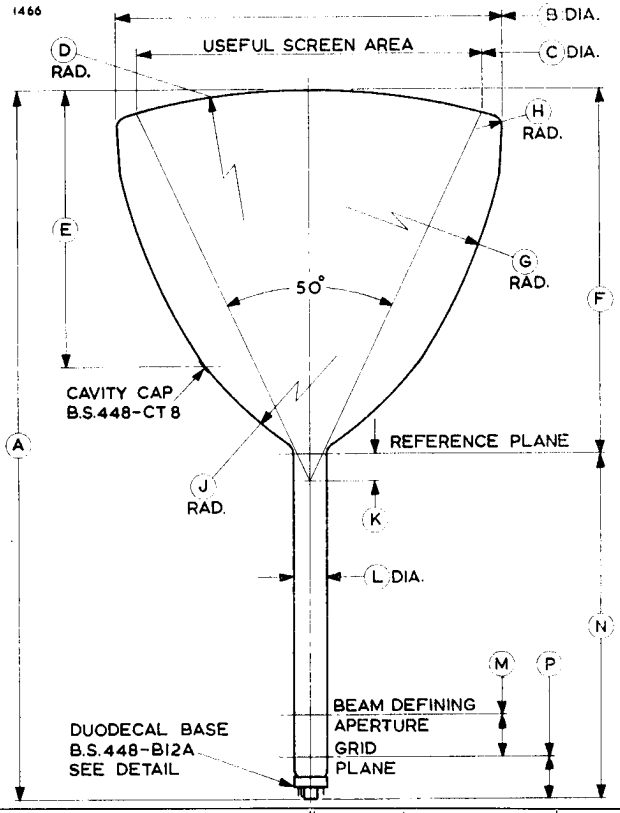
GRID VOLTAGE CHARACTERISTICS



GRID VOLTAGE CUT-OFF LIMITS



OUTLINE



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	29·252 ± 0·394	743·0 ± 10·0	J	16·732	425·0 ←
B	15·984 ± 0·157	406·0 ± 4·0	K	1·260 Max	32·0 Max
C	14·567 Min	370·0 Min	L	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$
D	27·560	700·0	M	1·772	45·0
E	11·417 ± 0·394	290·0 ± 10·0	N	14·291 ± 0·236	363·0 ± 6·0 ←
F	14·961 ± 0·157	380·0 ± 4·0	P	1·732	44·0
G	23·504	597·0			
H	0·472	12·0			

Inch dimensions have been derived from millimetres.

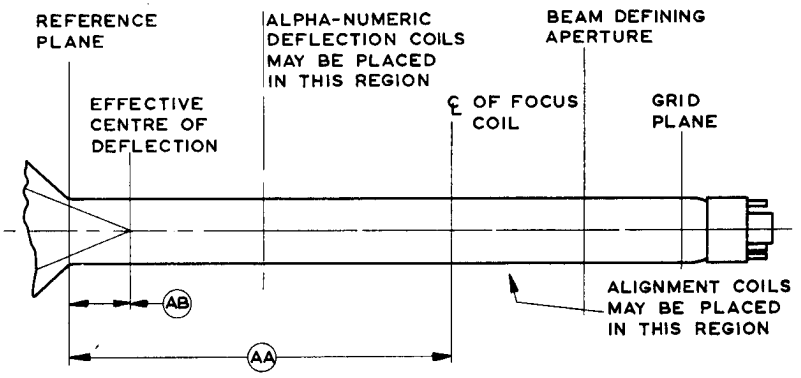
Note The mean axis of the neck will pass within 3mm of the geometric centre of the tube face and within 1° of a normal to a plane tangential to the geometric centre of the tube face.

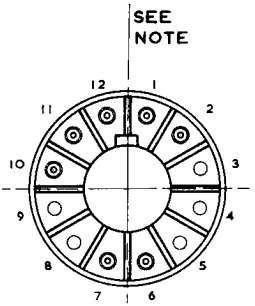
← Indicates a change

ENGLISH ELECTRIC

OUTLINE DETAILS

1203





Ref.	Inches	Millimetres
AA	6·693	170
AB	1·260 Max	32·0 Max

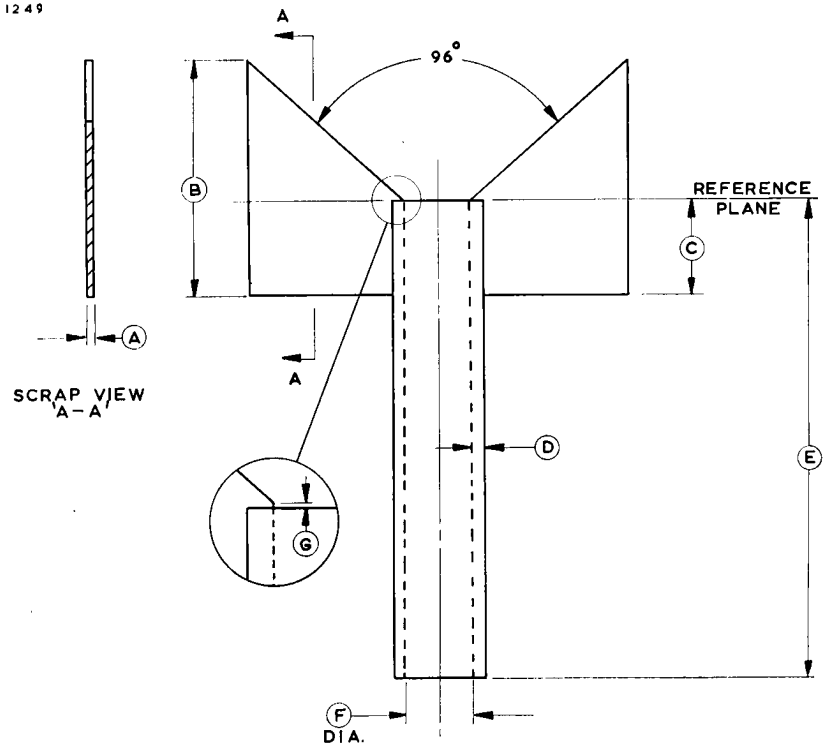
Inch dimensions have been derived from millimetres.

Note The anode cavity cap will be in line with the base key to within 15°.

Pin	Element	Pin	Element
1	Heater	8	No Pin
2	Grid	9	No Pin
3	No Pin	10	Anode 1
4	No Pin	11	Cathode
5	No Pin	12	Heater
6	No Connection	Cavity	
7	No Connection	Cap	Anode 2

Printed in England

NECK GAUGE



The gauge shown above will pass freely over base and neck to the reference line, and when rotated through 360° the blades of the gauge will contact the flared neck at the reference line only.

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	0·125	3·18	F	$1{\cdot}417^{+0{\cdot}003}_{-0{\cdot}000}$	$36{\cdot}0^{+0{\cdot}08}_{-0{\cdot}00}$
B	$4{\cdot}921 \pm 0{\cdot}039$	$125{\cdot}0 \pm 1{\cdot}0$			
C	$1{\cdot}969 \pm 0{\cdot}039$	$50{\cdot}0 \pm 1{\cdot}0$	G	$0{\cdot}000^{+0{\cdot}002}_{-0{\cdot}000}$	$0{\cdot}00^{+0{\cdot}05}_{-0{\cdot}00}$
D	$0{\cdot}252 \pm 0{\cdot}012$	$6{\cdot}4 \pm 0{\cdot}3$			
E	$9{\cdot}843 \pm 0{\cdot}039$	$250{\cdot}0 \pm 1{\cdot}0$			

Inch dimensions have been derived from millimetres except dimension A.

Printed in England

ABRIDGED DATA

12-inch Diameter Radar Tubes intended primarily for marine radar P.P.I. displays. The narrow scan angle permits the use of valve or transistor scan amplifiers.

Neck Diameter	1·378	inches (35 mm)
Deflection Angle	40	Degrees
Deflection Method		Magnetic
Focus Method		Electrostatic
E.H.T. Voltage	16	kV

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3±10%	A
Screen (*See Note* 2)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	8·0	pF
Cathode to all other electrodes, less than	8·0	pF
Anode 2 and Anode 4 to external conductive coating (*See Note* 3)	1500	pF

Mechanical

Overall Length	22·560 inches	(573 mm)	Max
Overall Diameter	12·090 inches	(307 mm)	Max
Useful Screen Diameter	10·430 inches	(265 mm)	Min
Neck Diameter	1·400 inches	(35·5 mm)	Max
Net Weight	13½ pounds	(6·2 kg)	Approx
Base (*See Note* 4)			B8H
Anode 2 and Anode 4 Connection			B.S.448–CT8 Cavity Cap
Mounting Position (*See Note* 4)			Any

ENGLISH ELECTRIC

MAXIMUM AND MINIMUM RATINGS

(Absolute Values. *See Note* 5)

	Min	*Max*	
Anode 2 and Anode 4 Voltage (*See Note* 6) ..	8·0	18	kV
Anode 3 Voltage:			
Positive value	—	1·0	kV
Negative value	—	0·5	kV
Anode 1 Voltage	0·2	0·8	kV
Grid Voltage (negative value)	1·0	200	V
Grid to Cathode Impedance (at 50c/s)	—	0·5	MΩ
Grid to Cathode Resistance	—	1·5	MΩ
Heater to Cathode Voltage:			
Heater positive with respect to cathode			
D.C.	—	150	V
Peak	—	250	V
Heater negative with respect to cathode			
D.C.	—	150	V
Peak	—	300	V
Heater to Cathode Resistance		*See Note* 7	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	12 to 16	kV
Anode 3 Voltage	−200 to +200	V
Anode 3 Current (positive or negative)	15	μA
Anode 1 Voltage	600	V
Anode 1 Current (positive or negative)	15	μA
Grid Voltage for visual cut-off	−40 to −85	V
Cathode Voltage for visual cut-off (*See Note* 8) ..	43 to 82	V

NOTES

1. The heater is suitable for either series or parallel operation. In series operation, the surge heater voltage when switching on must not exceed $9{\cdot}5V_{r.m.s.}$ and a current limiting device may be required in the circuit to reduce the surge voltage below this value.

2. Tubes in the T974 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T974Y	Y*	P33	Orange	Long
T974Z	Z*	P26	Orange	Very Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

3. The capacitance of anode 2 and anode 4 to the external conductive coating may be used to provide smoothing for the e.h.t. supply.

4. The tube should not be supported by the base alone and under no circumstances should the socket be used for support purposes.

5. All voltages are with respect to cathode except where otherwise specified.

6. The associated equipment should be adequately protected against damage caused by possible high voltage flashovers inside the tube.

7. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50c/s must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

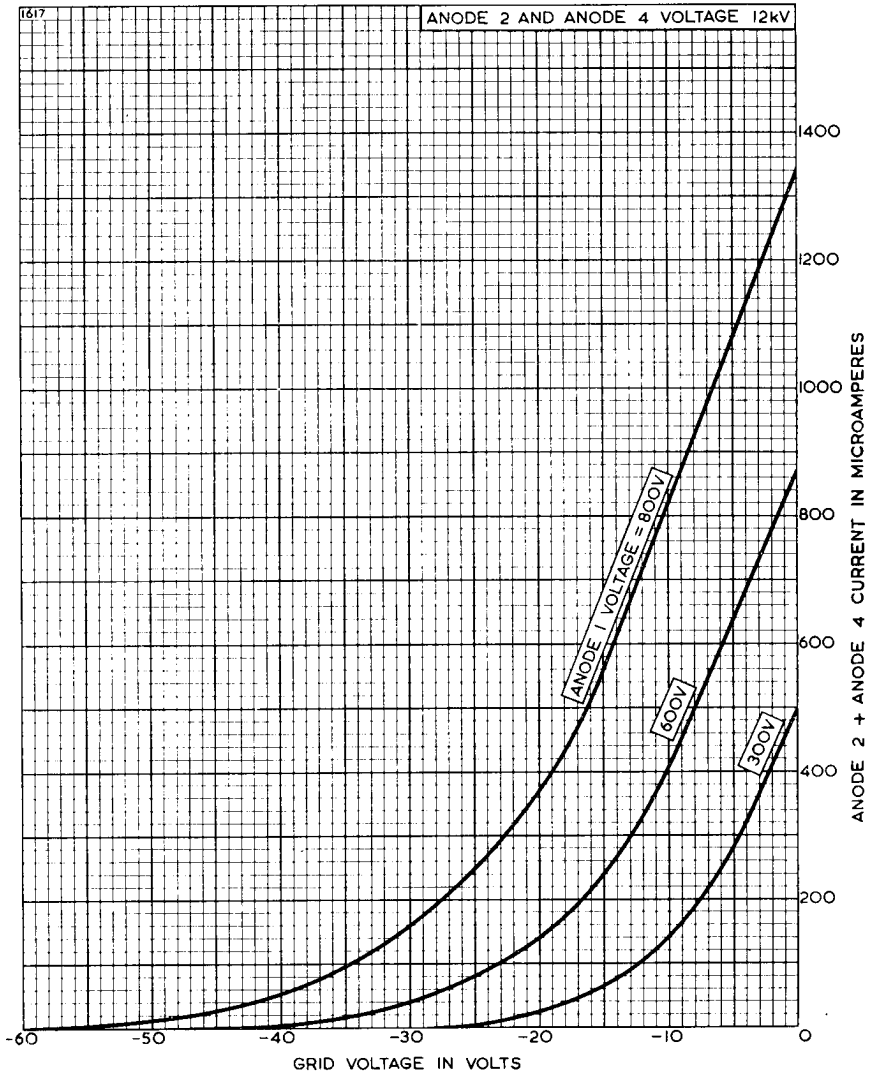
8. For cathode modulation, all voltages are with respect to the grid.

X-RAY WARNING

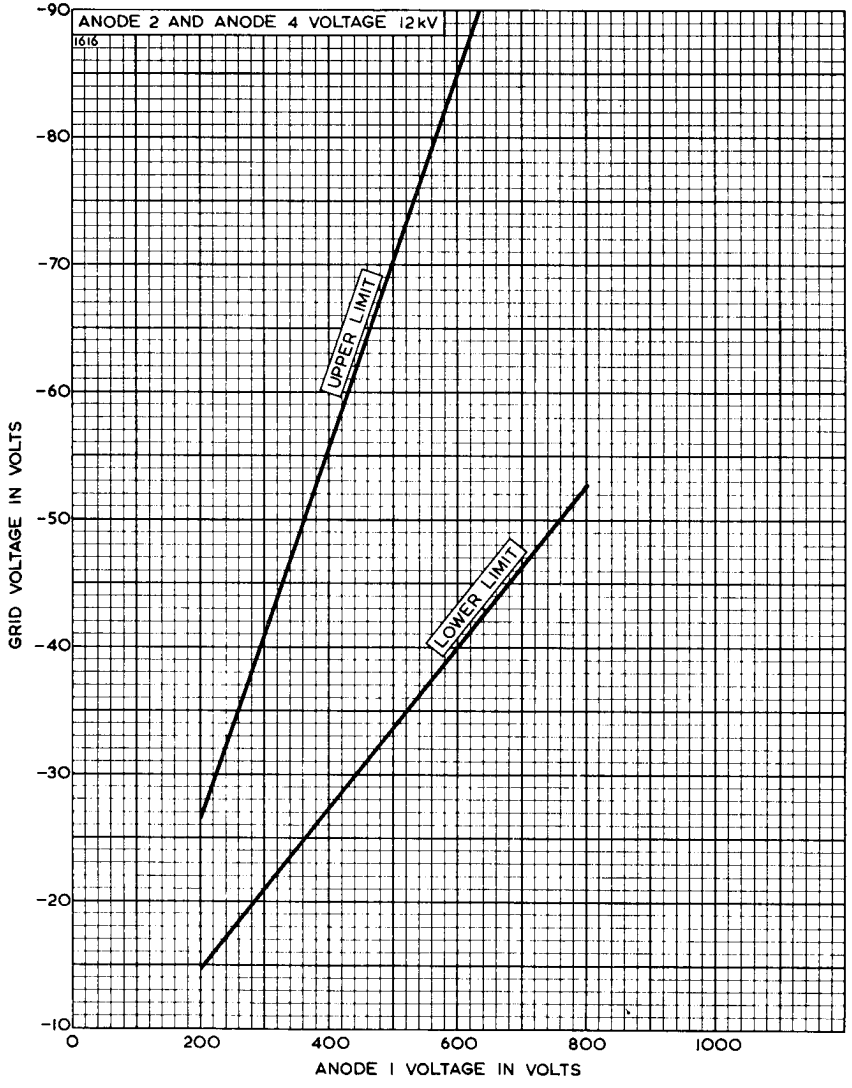
X-rays are produced when the T974 is operated above 16kV (absolute value). These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

ENGLISH ELECTRIC

GRID VOLTAGE CHARACTERISTICS

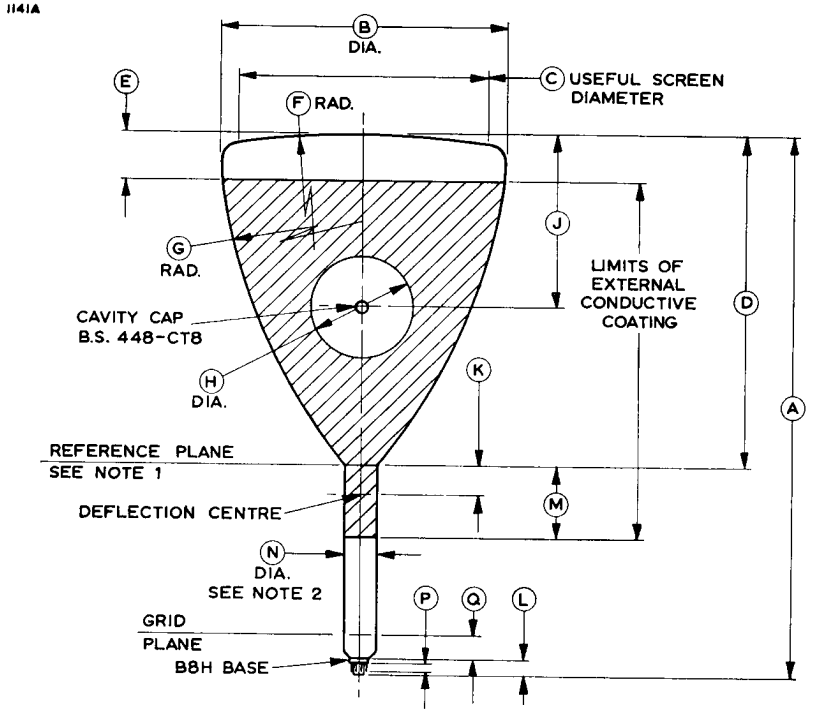


GRID CUT-OFF VOLTAGE LIMITS



ENGLISH ELECTRIC

OUTLINE



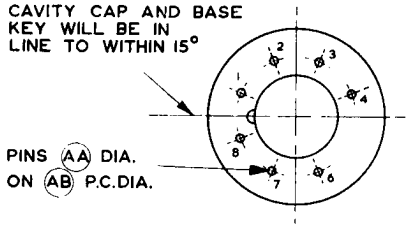
Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	22·560 Max	573·0 Max	J	$7{\cdot}244 \pm 0{\cdot}118$	$184{\cdot}0 \pm 3{\cdot}0$
B	$12{\cdot}010^{+0{\cdot}080}_{-0{\cdot}100}$	$305{\cdot}0^{+2{\cdot}0}_{-2{\cdot}5}$	K	1·240 Max	31·5 Max
C	10·430 Min	265·0 Min	L	0·630	16·0
D	$13{\cdot}900 \pm 0{\cdot}180$	$353{\cdot}0 \pm 4{\cdot}5$	M	$2{\cdot}953 \pm 0{\cdot}197$	$75{\cdot}0 \pm 5{\cdot}0$
E	1·969	50·0	N	$1{\cdot}378^{+0{\cdot}020}_{-0{\cdot}039}$	$35{\cdot}0^{+0{\cdot}5}_{-1{\cdot}0}$
F	39·370	1000	P	0·333 Max	8·46 Max
G	23·620	600·0	Q	0·984	25·0
H	$4{\cdot}331 \pm 0{\cdot}394$	$110{\cdot}0 \pm 10{\cdot}0$			

Inch dimensions have been derived from millimetres.

ENGLISH ELECTRIC

OUTLINE DETAILS

1142A



Ref.	Inches	Millimetres
AA	0·040	1·02
AB	0·600	15·24

Millimetre dimensions have been derived from inches.

Pin	Element
1	Heater
2	Internal Connection
3	Anode 1
4	Anode 3
5	No Pin
6	Grid
7	Cathode
8	Heater
Cavity Cap	Anode 2 and Anode 4

OUTLINE NOTES

1. The Reference Plane is determined by the position where 36·0mm internal diameter ring gauge rests.
2. A ring gauge 36·0mm internal diameter × 100·0mm long will pass over the neck and base to the reference plane.
3. The projected neck axis will pass within 3·5mm (0·138 inch) of the geometric centre of the tube face. The neck axis will make an angle of less than 1° 30′ with the normal to the tangential plane at the centre of the face.

Printed in England

ENGLISH ELECTRIC

ABRIDGED DATA

21-inch diagonal, rectangular display tubes for monitor and radar applications. They feature long necks, enabling two sets of scan coils to be fitted for display of alpha-numeric characters in computer read-out or radar systems. The T975D gives a flicker free display at low repetition frequencies for computer read-out.

Neck Diameter	1·437 inches (36·5mm)
Deflection Angle	90 Degrees
Deflection Method	Magnetic
Focus Method	Electrostatic
E.H.T. Voltage	15 kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (*See Note* 1)	6·3 V
Heater Current	0·3±10% A
Faceplate	Tinted
Screen (*See Note* 2)	Aluminised
Inter-electrode Capacitances:	
Grid to all other electrodes, less than	8·0 pF
Cathode to all other electrodes, less than	8·0 pF

Mechanical

Overall Length	26·260 inches	(667 mm)	Max
Faceplate Diagonal	21·500 inches	(546 mm)	Max
Neck Diameter	1·496 inches	(38 mm)	Max
Net Weight	25·5 pounds	(11·6 kg)	Approx
Base			B.S.448–B12A
Final Anode Connection			Cavity Cap B.S.448–CT8
Mounting Position			*See Note* 3

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 and Anode 4 Voltage	8·0	18	kV
Anode 3 Voltage:			
positive	—	1000	V
negative	—	500	V
Anode 1 Voltage	200	600	V
Grid Voltage, negative value (*See Note* 4) ..	1·0	200	V
Heater to Cathode Voltage (*See Note* 5):			
Cathode negative	—	150	V
Cathode positive	—	200	V
Peak Heater to Cathode Voltage, Cathode positive (*See Note* 6)	—	410	V
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50Hz) ..	—	0·5	MΩ
Heater to Cathode Resistance		*See Note* 7	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	15	kV
Anode 3 Voltage (*See Note* 8)	−200 to +200	V
Anode 3 Current	−15 to +15	μA
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −70	V

X-RAY WARNING

X-Rays are produced when types in the T975 series are operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tubes are adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the tubes.

Printed in England

NOTES

1. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed 9·5$V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

2. Tubes in the T975 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T975D	D*	E.V.S.007	Yellow-orange	Long
T975S	S*	—	Yellow-orange	Long
T975Y	Y*	P33	Orange	Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots. The tube can be manufactured with alternative screens, and customers' enquiries are invited.

3. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.

4. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

5. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than 20$V_{r.m.s.}$

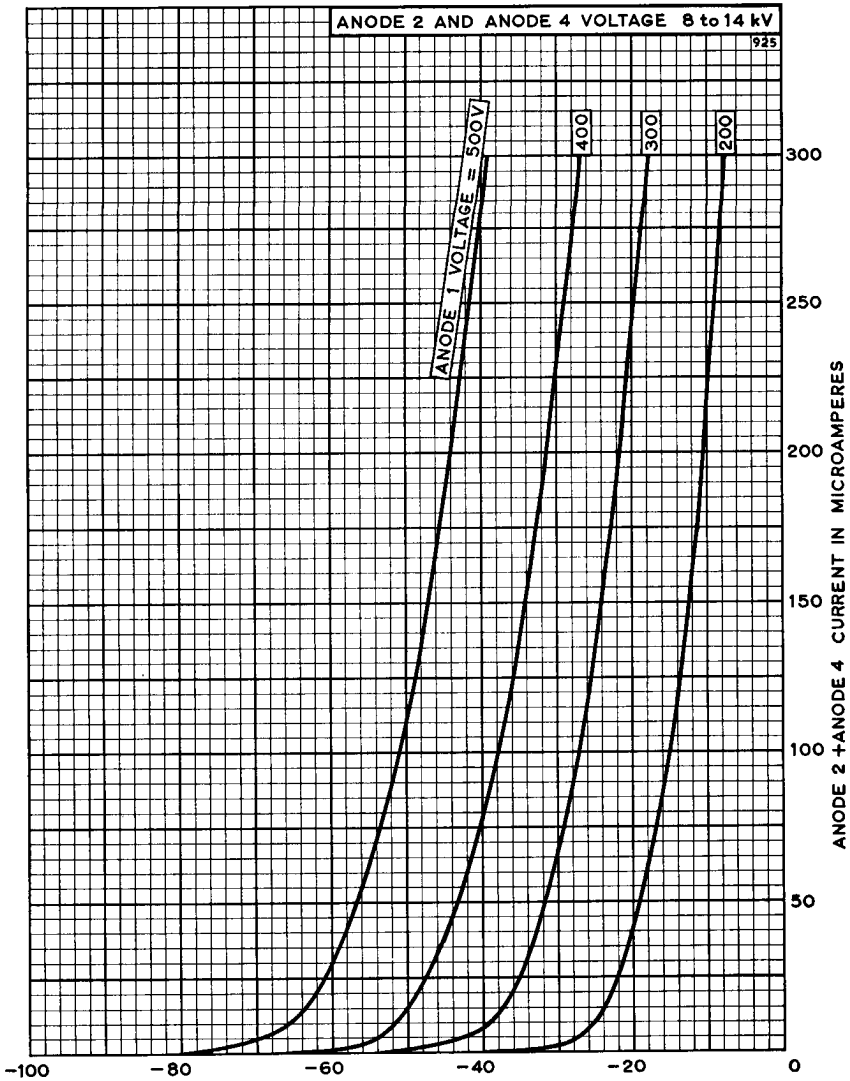
6. During a warming-up period not exceeding 45 seconds.

7. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50Hz must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

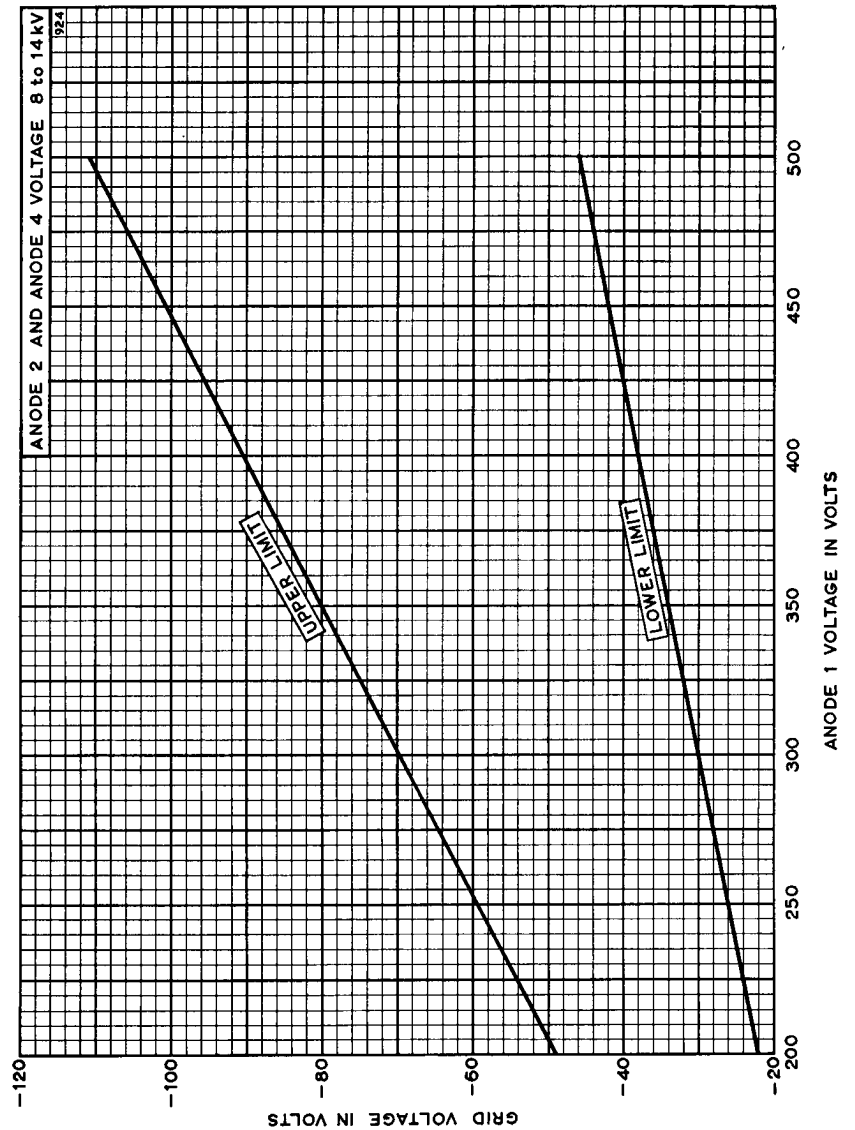
8. An acceptable focus quality will be obtained with an anode 3 voltage range of −200 to +200V. If it is required to pass through the point of focus a voltage range of at least −300 to +300V will be required.

ENGLISH ELECTRIC

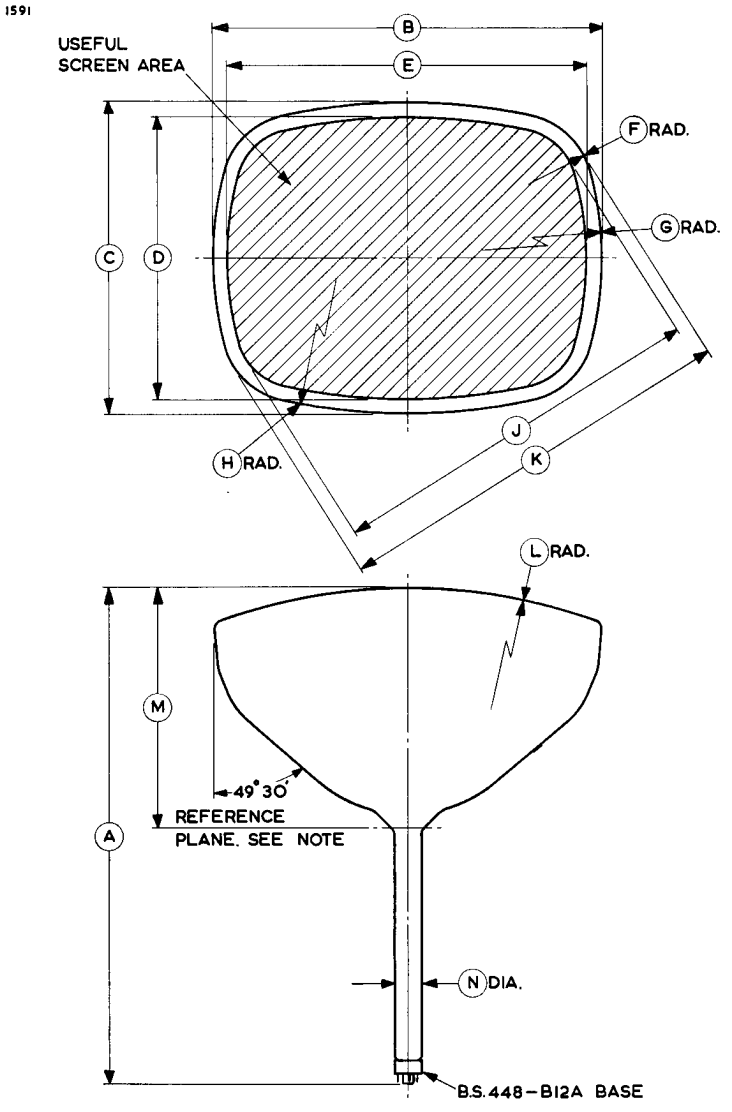
GRID VOLTAGE CHARACTERISTICS



GRID CUT-OFF VOLTAGE LIMITS



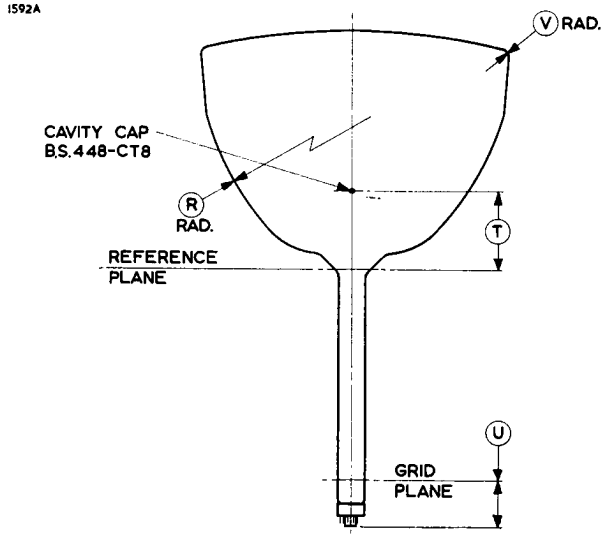
OUTLINE



Note Reference plane determined by gauge JEDEC G116 (*See page* 9)

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OUTLINE

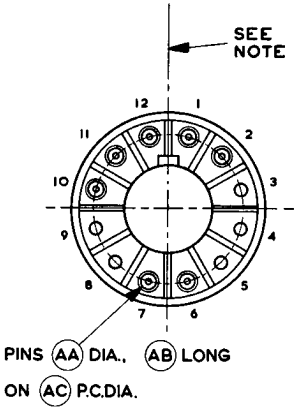


Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	25·945±0·315	659·0±8·0	K	21·375±0·125	542·9±3·2
B	20·236±0·138	514·0±3·5	L	32·992	838·0
C	16·378±0·138	416·0±3·5	M	12·500±0·197	317·5±5·0
D	14·764 Min	375·0 Min	N	1·437±0·059	36·5±1·5
E	18·898 Min	480·0 Min	R	15·000	381·0
F	4·016	102·0	T	4·134±0·256	105·0±6·5
G	17·677	449·0	U	1·969 Nom	50·0 Nom
H	30·787	782·0	V	0·433	11·0
J	19·843 Min	504·0 Min			

Inch dimensions have been derived from millimetres except dimension K

OUTLINE DETAILS

1198B



Pin	Element
1	Heater
2	Grid
3	No Pin
4	No Pin
5	No Pin
6	Anode 3
7	No Connection
8	No Pin
9	No Pin
10	Anode 1
11	Cathode
12	Heater
Cavity Cap	Anode 2 & Anode 4

Ref.	Inches	Millimetres
AA	0·098 ± 0·003	2·362 ± 0·076
AB	0·410 Max	10·41 Max
AC	1·063	27·00

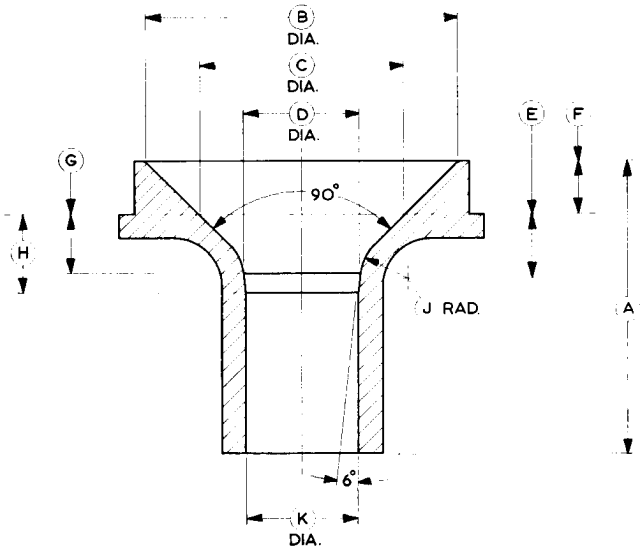
Millimetre dimensions have been derived from inches.

Note The anode cavity cap will be in line with the base key to within 15°

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REFERENCE LINE GAUGE

1406



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	3·062	77·77	F	0·562 ± 0·001	14·275 ± 0·025
B	3·244 ± 0·001	82·398 ± 0·025	G	0·448	11·38
C	2·120 ± 0·002	53·848 ± 0·051	H	0·650	16·51
D	1·542 ± 0·003	39·167 ± 0·076	J	0·500	12·70
E	0·500 ± 0·001	12·700 ± 0·025	K	$1{\cdot}500^{+0{\cdot}003}_{-0{\cdot}000}$	$38{\cdot}10^{+0{\cdot}076}_{-0{\cdot}000}$

Millimetre dimensions have been derived from inches.

CV Equivalents:
CV6130 (T977D)
CV6172 (T977Z)

ABRIDGED DATA

12-inch diameter radar tubes for use with valve or transistor scan amplifiers; improved resolution versions of type T924Z (CV429).

The T977D will give flicker-free images at low repetition frequencies for computer read-out.

Neck Diameter	1·378 inches	(35·0 mm)
Deflection Angle	50	Degrees
Deflection Method		Magnetic
Focus Method (*See Note* 1)		Magnetic
E.H.T. Voltage	15	kV

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 2)	6·3	V
Heater Current	0·3±10%	A
Faceplate		Clear
Screen (*See Note* 3)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	12	pF
Cathode to all other electrodes, less than	12	pF

Mechanical

Overall Length	20·472 inches	(520 mm)	Max
Overall Diameter	12·087 inches	(307 mm)	Max
Useful Screen Diameter	9·843 inches	(250 mm)	Min
Neck Diameter	1·398 inches	(35·5 mm)	Max
Net Weight	12 pounds	(5·4 kg)	Approx
Base			B.S.448–B12A
Final Anode Connection (*See Note* 4)			Cavity Cap B.S.448–CT8
Mounting Position			*See Note* 5

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

(All voltages with respect to cathode)

	Min	*Max*	
Anode 2 Voltage	9·0	15·5	kV
Anode 1 Voltage	250	600	V
Grid Voltage, negative value (*See Note* 6)	0	250	V
Heater to Cathode Voltage (*See Note* 7):			
Cathode negative	—	150	V
Cathode positive	—	200	V
Peak Heater to Cathode Voltage, Cathode positive (*See Note* 8)	—	410	V
Cathode Current (Mean)	—	150	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50Hz)	—	0·5	MΩ
Heater to Cathode Resistance		*See Note* 9	

TYPICAL OPERATING CONDITIONS

Anode 2 Voltage	15	kV
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −90	V
Grid Drive for 50μA beam current	10 to 30	V
Line Width (*See Note* 10)	0·25	mm Max

OPTIMUM BEAM FOCUSING

In order to obtain maximum brightness and minimum spot size, it is necessary to carry out the following procedure.

(*a*) Stray magnetic fields should be minimised in the region of the gun structure by fitting a tubular mumetal shield over the neck.

(*b*) The beam may be centred in the defining aperture by a small magnet, located in the region of the grid and adjusted to give maximum brightness. A suitable magnet is Elac type BC11.

(*c*) The magnetic axis of the focus coil should be aligned with the electron beam. This may be done either by adjusting the position of the focus coil (*See Method* 1), or by fitting additional deflection coils to adjust the position of the beam (*See Method* 2). In each case a.c. focusing (*See Page* 3) may be used to identify the optimum alignment condition.

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Method 1

Adjustment of the focus coil position

The mounting of the focus coil should be such that the coil can be moved in any direction, i.e., vertically, horizontally and tilted about either the vertical or horizontal axis. An a.c. current is passed through the focus coil and the position of the coil is adjusted until the optimum alignment is reached. (*See A.C. Focusing* below.*)

Method 2

Electromagnetic deflection of the beam

Two sets of alignment coils are fitted on the tube neck, between the beam defining aperture and the focus coil (*see diagram, page* 8). Each set of coils is capable of deflecting the beam slightly in both X and Y directions. The currents in the alignment coils are adjusted to give correct alignment of the beam. (*See A.C. Focusing* below.*)

**A.C. Focusing*

An alternating current is passed through the focus coil such that the positive and negative excursions of the current each produce a focused spot. Provided there is no current through the main deflection coils, the picture on the tube faceplate will consist of a defocused area and two focused spots. The optimum focusing condition is obtained when the two focused spots coincide at the centre of the defocused spot.

NOTES

1. The focus coil should be positioned so that the focusing field is entirely on the screen side of the beam defining aperture. When using a focus coil having a short air gap, the centre of the air gap should be approximately 120mm from the reference plane.
2. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $9{\cdot}5V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.
3. Tubes in the T977 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T977D	D*	E.V.S.007	Yellow-Orange	Long
T977Y	Y*	P33	Orange	Long
T977Z	Z*	P26	Orange	Very Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots. The tube can be manufactured with alternative screens, and customers' enquiries are invited.

ENGLISH ELECTRIC

4. When supplied as a CV6130 equivalent, an adaptor is fitted to convert the final anode connection to B.S.448–CT2.

5. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.

6. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.

7. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$

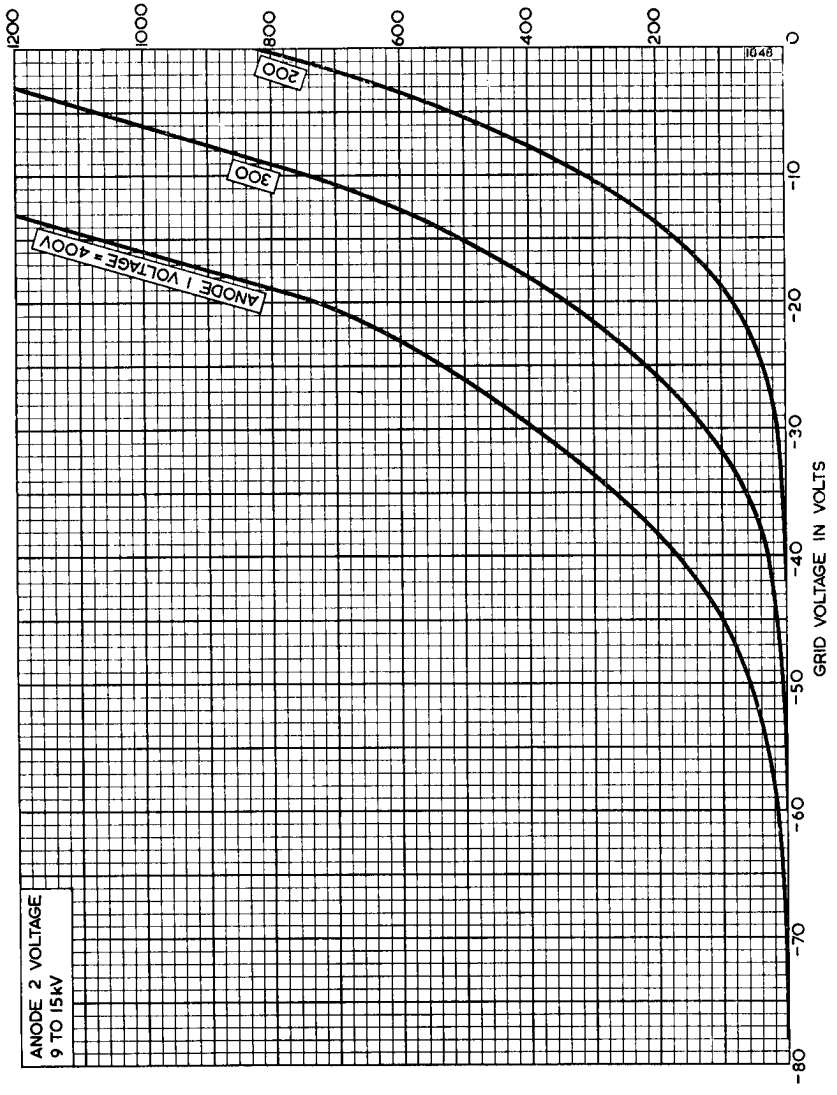
8. During a warming-up period not exceeding 45 seconds.

9. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50Hz must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.

10. Measured under the following conditions:
    Pulsed line 250mm long
    Pulse length 100μs
    Pulse repetition rate 50p.p.s.
    Beam current 50μA (peak)
    Modulation pulses and deflection waveform synchronised
    Line width measured with a microscope as in K1001/5.A.5.7.2.2.

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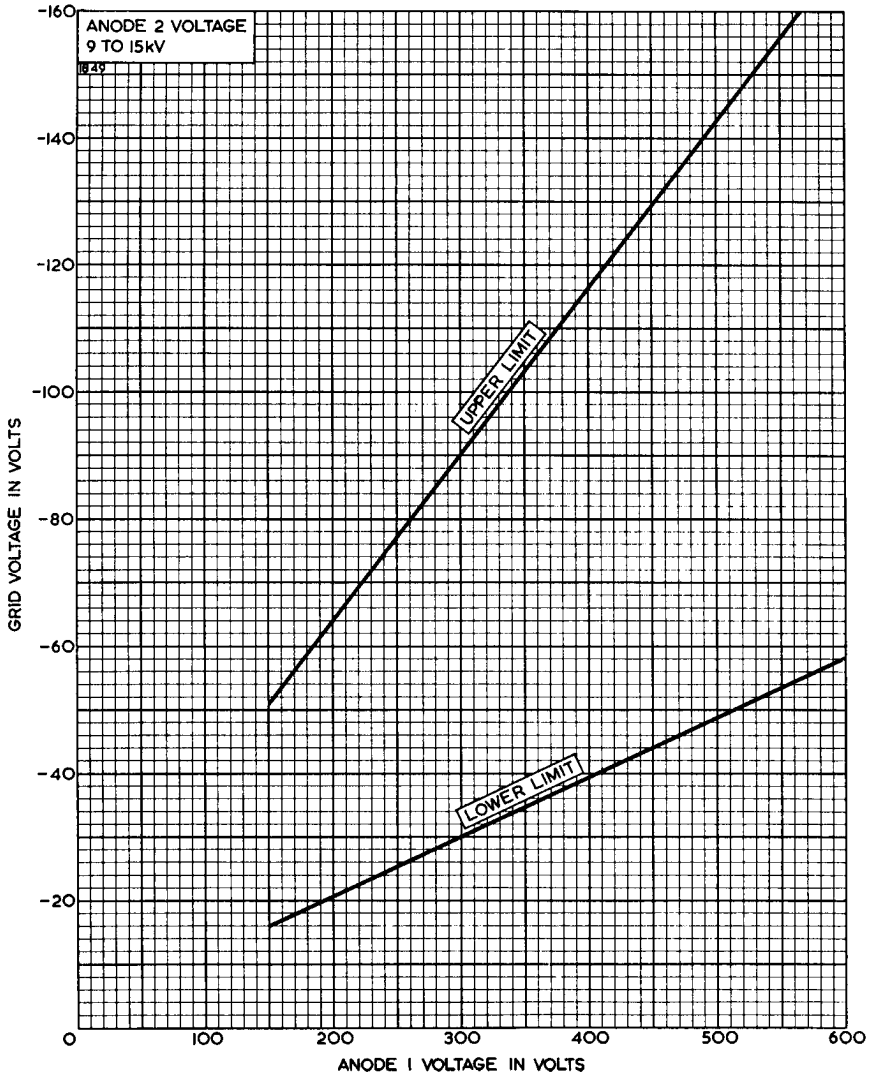
GRID VOLTAGE CHARACTERISTICS



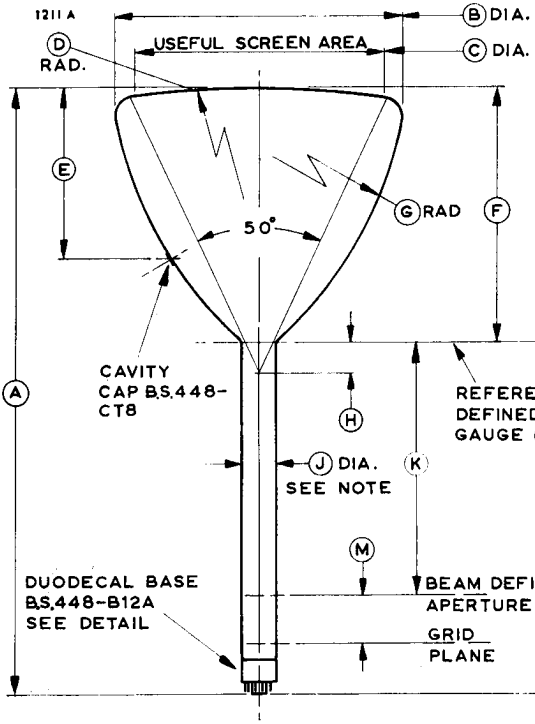
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ENGLISH ELECTRIC

GRID VOLTAGE CUT-OFF LIMITS



OUTLINE



Bulb Ring Gauges

Ring Gauge Diameter (mm)	Distance from centre of Tube Face (mm)
280	93 ± 10
230	150 ± 9
180	191 ± 8
130	222 ± 7
80	249 ± 6

Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	20·197 ± 0·276	513·0 ± 7·0	H	1·260 Max	32·0 Max
B	12·008 $^{+0·079}_{-0·098}$	305·0 $^{+2·0}_{-2·5}$	J	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$
C	9·843 Min	250·0 Min	K	5·787	147
D	39·370 ± 3·937	1000 ± 100	L	1·417	36·0
E	7·087 ± 0·236	180·0 ± 6·0	M	1·969	50
F	10·709 ± 0·138	272·0 ± 3·5	N	9·488	241
G	16·772	426·0			

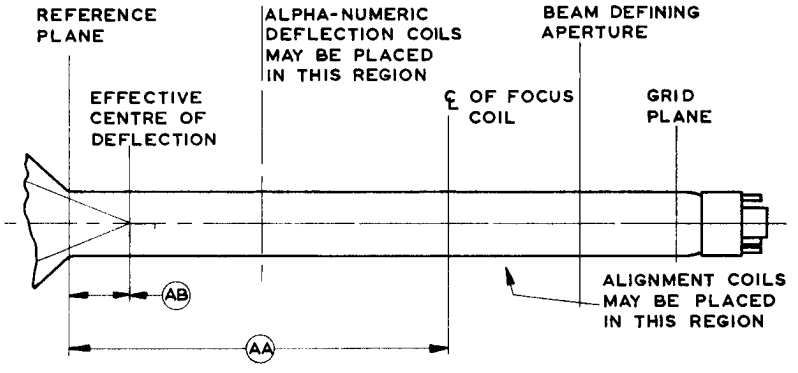
Inch dimensions have been derived from millimetres.

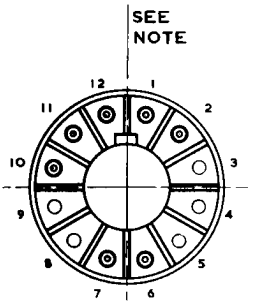
Note A ring gauge 36·1mm diameter by 100mm long will pass over base and neck to reference plane.

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OUTLINE DETAILS

1203





Ref.	Inches	Millimetres
AA	4·724	120
AB	1·260 Max	32·0 Max

Inch dimensions have been derived from millimetres.

Note The anode cavity cap will be in line with the base key to within 15°.

Pin	Element	Pin	Element
1	Heater	8	No Pin
2	Grid	9	No Pin
3	No Pin	10	Anode 1
4	No Pin	11	Cathode
5	No Pin	12	Heater
6	No Connection	Cavity	
7	No Connection	Cap	Anode 2

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OSCILLOSCOPE TUBES

T979H T979N T979X

INTRODUCTION

The T979H, T979N and T979X are 5-inch diameter cathode ray tubes for wide band, high speed oscilloscope applications. They are identical except for their screen characteristics.

The incorporation of a post deflection accelerator mesh and an internal spiral coating, together with an improved gun design, gives the tubes the following features:

(1) Deflection sensitivities in the X and Y directions of 9V/cm and 3V/cm respectively, making them particularly suitable for use with deflection circuits employing transistors.

(2) A large useful screen area, permitting the use of either 6 × 10cm or 8 × 8cm displays.

(3) Excellent brightness, giving a visible trace at writing speeds up to 1–3nsec/cm, and with negligible distortion introduced in the post deflection accelerator (P.D.A.) system. The small amounts of barrel or pin cushion distortion, linearity distortion and astigmatism present can be eliminated by adjustment of electrode potentials.

(4) Good sensibility due to the small spot size.

(5) Variations of deflection sensitivities with variations in P.D.A. voltage are considerably reduced.

(6) Minimum deflector plate inductance and inter-plate capacitance, due to the deflector plate connections being made via short pins sealed into the side of the bulb.

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (*See Note* 1)	6·3 V
Heater Current	0·3 ± 10% A
Faceplate	Flat, Clear Glass
Screen (*See Note* 2)	Aluminised
Deflection Method	Electrostatic
Focus Method	Electrostatic
Linearity of Scan (*See Note* 3)	2 %
Raster Distortion (*See Note* 4)	±1 %
Orthogonality	90 ± 1 Degrees

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Minimum useful scan

Y1 to Y2 (*See Note* 5)	8·0	cm
X1 to X2 (*See Note* 5)	10	cm

Undeflected Spot Position (to geometric centre of faceplate)

Y Orientation	±0·6	cm
X Orientation	±1·0	cm

Helix Resistance

Anode 5 to Interplate Shield	200	MΩ Min
→	1000	MΩ Max

Inter-electrode Capacitances

(With all other electrodes not mentioned, and those marked *, earthed)

Grid to all other electrodes	6·1 pF Nom
Cathode to all other electrodes	5·7 pF Nom
X1 Electrode to all other electrodes except X2*	3·5 pF Nom
X2 Electrode to all other electrodes except X1*	3·5 pF Nom
Y1 Electrode to all other electrodes except Y2*	2·9 pF Nom
Y2 Electrode to all other electrodes except Y1*	2·9 pF Nom
X1 to X2 Electrode	3·1 pF Nom
Y1 to Y2 Electrode	1·7 pF Nom
X1+X2 Electrodes to Y1+Y2 electrodes	< 0·1 pF
X1+X2+Y1+Y2 Electrodes to cathode	< 0·1 pF
X1+X2+Y1+Y2 Electrodes to grid	< 0·1 pF

Mechanical

Overall Length	20·71 inches (526 mm)	Max
→ Overall Diameter (excluding cap)	5·37 inches (136·5 mm)	Max
Seated Height	21·260±0·236 inches (504±6 mm)	
Neck Diameter (excluding pins)	2·28 inches (58 mm)	Max
Useful Screen Area	2·36 by 3·94 or 3·15 by 3·15 inches 6·0 by 10 or 8·0 by 8·0 cm	Min Min
Net Weight	3 pounds (1·4 kg)	Approx
Base		B.S.448–B12F
Anode 5 Cavity Cap		B.S.448–CT8
Mounting Position (*See Note* 6)		Any

→ Indicates a change

MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

(All voltages are with respect to cathode except where otherwise stated)

	Min	*Max*	
Anode 5 (Screen) Voltage (*See Note* 7) ..	6·0	15*	kV
Anode 4 Voltage	1·0	3·3	kV
Anode 3 and Anode 1 Voltage	1·0	3·3	kV
Anode 2 Voltage	0	1·5	kV
Grid Bias Voltage (negative value)	0	200	V
Grid Voltage (positive peak value)	—	2·0	V
Cathode Current (intermittent mean)	—	0·3	mA
Y Plate Shield Voltage	—	3·3	kV
Interplate Shield Voltage	—	3·3	kV
Mesh Shield Voltage	—	3·3	kV
Mesh Voltage (negative with respect to mesh shield voltage)	10	20	V
Deflection Voltage on X or Y electrodes (Peak)	—	500	V
Heater to Cathode Voltage (Peak):			
Cathode positive	—	200	V
Cathode negative	—	125	V
Screen Dissipation (average)	—	5·0	mW/sq.cm
X1 or X2 to Anodes 3 and 1 Impedance ..	—	2·0	MΩ
Y1 or Y2 to Anodes 3 and 1 Impedance ..	—	1·0	MΩ
Grid to Cathode Impedance	—	1·0	MΩ
Anode 4 to Anodes 3 and 1 Impedance ..			*See Note* 8

*With respect to anode 3 and anode 1 voltage.

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TYPICAL OPERATING CONDITIONS

Anode 5 (Screen) Voltage	12	12	12	kV
Mesh Voltage (with respect to mesh shield)	−15	−15	−15	V
Anode 4 Voltage (adjusted for minimum astigmatism) (*See Note* 9) ..	1·0	1·5	3·0	kV
Anode 3 and Anode 1 Voltage	1·0	1·5	3·0	kV
Anode 2 Voltage (for focus)	165 to 335	250 to 500	500 to 1000	V
Grid Voltage (for spot cut-off	−30 to −57	−45 to −85	−90 to −170	V
Y Plate Shield Voltage (*See Note* 10)..	1·0	1·5	3·0	kV
Interplate Shield Voltage (*See Note* 11)	1·0	1·5	3·0	kV
Mesh Shield Voltage (*See Note* 12)..	1·0	1·5	3·0	kV
Mesh Current	(*See Note* 13)	(*See Note* 13)	(*See Note* 13)	
Anode 3 and Anode 1 Current	(*See Note* 14)	(*See Note* 14)	(*See Note* 14)	
Anode 2 Current	±15	±15	±15	μA
Cathode Current	(*See Note* 14)	(*See Note* 14)	(*See Note* 14)	
Deflection Factor (*See Note* 15):				
Mean Potential of X and Y plates	1·0	1·5	3·0	kV
X1 and X2 Electrodes:				
Mean	6·1	9·0	17·5	V/cm
Limits	5·3 to 6·8	8·0 to 10	15·5 to 19·5	V/cm
Y1 and Y2 Electrodes:				
Mean	2·0	3·0	6·2	V/cm
Limits	1·6 to 2·3	2·5 to 3·5	5·2 to 7·2	V/cm
Correction Potential Ranges				
Mesh (with respect to mesh shield) (*See Note* 16)	−12 to −18	−12 to −18	−12 to −18	V
Anode 4 (astigmatism) (*See Notes* 9 *and* 16)	±40	±40	±40	V
Y Plate Shield (*See Notes* 10 *and* 16)	±20	±20	±20	V
Interplate Shield (*See Notes* 11 *and* 16) ..	±60	±40	±20	V
Line Width (*See Note* 17)..	0·6	0·5	0·3	mm

ASSOCIATED COMPONENTS

The following components can be obtained from the suppliers listed; there may possibly be alternative sources:—

(1)	B.S.448-B12F socket	Catalogue No. 77/842	Carr Fastener Co. Ltd. Stapleford, Notts.
(2)	B.S.448-CT8 Cavity Cap Connector	Catalogue No. 77/699	Carr Fastener Co. Ltd. Stapleford, Notts.
(3)	Side Pin Connectors	Miniature wander socket type WS1 (colours: red, black or blue)	A.E.I. Clix, Radio & Electronics Components Division, Barton Hill, Bristol.
(4)	Magnetic Shield to suit T979 series (*See page* 11)		Magnetic Shields Ltd., Headcorn Road, Staplehurst, Tonbridge, Kent.

NOTES

1. The heater is suitable for parallel operation only.

2. The T979 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent and Afterglow Colour	Persistence
T979H	H	P31	Blue-Green	Medium Short
T979N	N	P2	Yellowish-Green	Medium
T979X	X	P7	Blue with Yellowish-Green Afterglow	Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

3. The deflection factor for a deflection of 75% of the useful scan will not differ from that for a deflection of 25% by more than 2%.

4. The edges of a 6 × 10cm raster will fall between two concentric rectangles 101 × 60·6mm and 99 × 59·4mm.

5. The tube can be used for either 6 × 10cm or 8 × 8cm displays.

6. The tube should be supported near the screen and also on the parallel neck near the base; it should not be supported by the base only. The socket should not be mounted rigidly, but should have flexible leads and be able to move freely. To avoid the need for excessive magnetic shielding the tube should be mounted as far away as possible from transformers, chokes and other sources of stray field.

7. Anode 5 may be operated at a voltage lower than the minimum specified but the light output will then be limited by the screen aluminising.

8. When high beam currents are used, anode 4 collects current and the anode 4 to anodes 3 and 1 impedance should be kept as low as possible to avoid defocusing.

9. Adjustment of the anode 4 voltage about the mean Y plate potential is used to correct astigmatism introduced in the deflection system. The range of voltage required is of the order of ± 40V.

10. The Y plate shields should be operated about the mean potential of the Y1 and Y2 electrodes. Variation of the potential about this value controls the edge effects of the Y deflection electrode field and provides a fine adjustment of the deflection linearity in the Y direction.

11. Variation of the interplate shield voltage about the mean potential of the deflection electrodes provides correction for barrel and pin cushion distortion. When the mean potentials of the X and Y deflection electrodes are equal, a range of ± 40V maximum is required (with anode 3 and anode 1 voltage of 1·5kV); the range is slightly wider when the mean potentials are not equal.

12. The mesh shield should be operated at approximately the mean X plate potential.

13. At peak beam current, the mesh current will be of the order of 5μA.

→14. Under normal operating conditions, the peak anode 3 and anode 1 current and the peak cathode current can exceed 0·5mA. Under low duty cycle conditions such as viewing transients however, the peak cathode current may reach 2·0mA and the regulation of the power supplies to the anode 3 and anode 1 circuit and the cathode circuit should be adequate for such variations.

→Indicates a change

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15. The X electrodes and Y electrodes are designed primarily for symmetrical operation. Some degradation of focus and trace geometry will result if the tube is operated under asymmetric conditions.

16. These figures apply when the mean potentials of the X and Y electrodes and anode 3 are equal. When the mean deflection electrode potentials differ from the anode 3 voltage, a slightly wider range will be required.

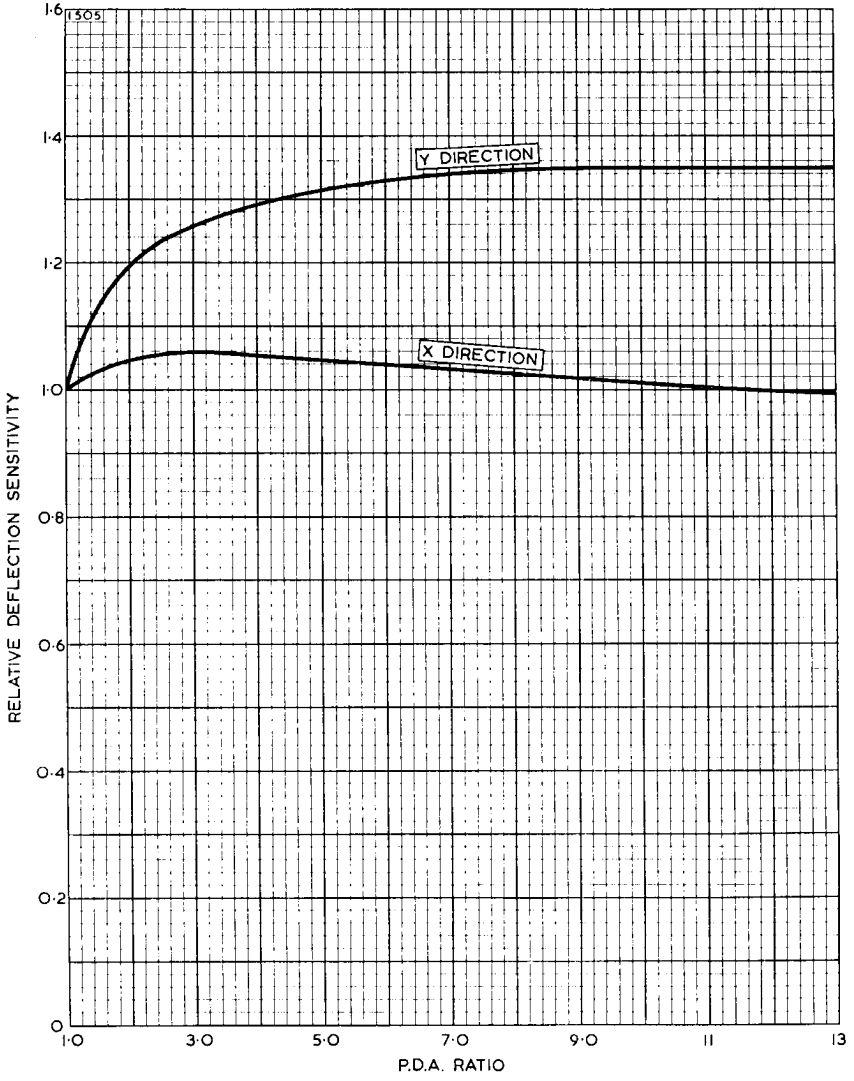
17. Measured under the following conditions:

Anode 4 Voltage		Optimised
Anode 2 Voltage		Optimised
Grid Drive	25	V
Raster Size	5×5	cm
Vertical Lines	200	
Frame Repetition	50	c/s
Spot Velocity	500	m/sec

The line width measured with a microscope as in K1001. Compared with the shrinking raster method, this method is more accurate but pessimistic. Thus it must be remembered that the equivalent line width measured by the shrinking raster method will be considerably less than the value stated when comparison is made with data given in these terms.

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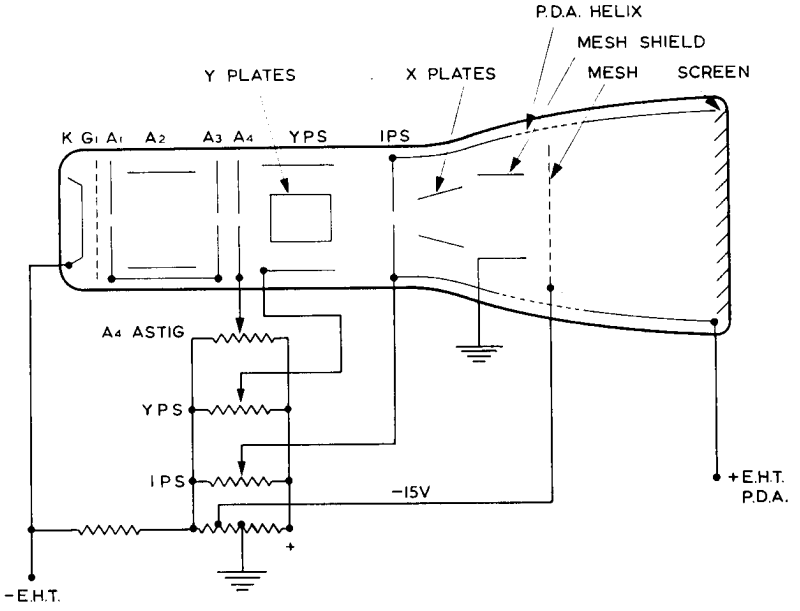
P.D.A. RATIO CHARACTERISTIC



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SCHEMATIC DIAGRAM

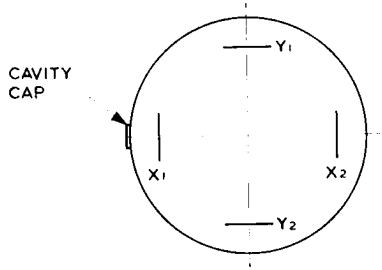
1483



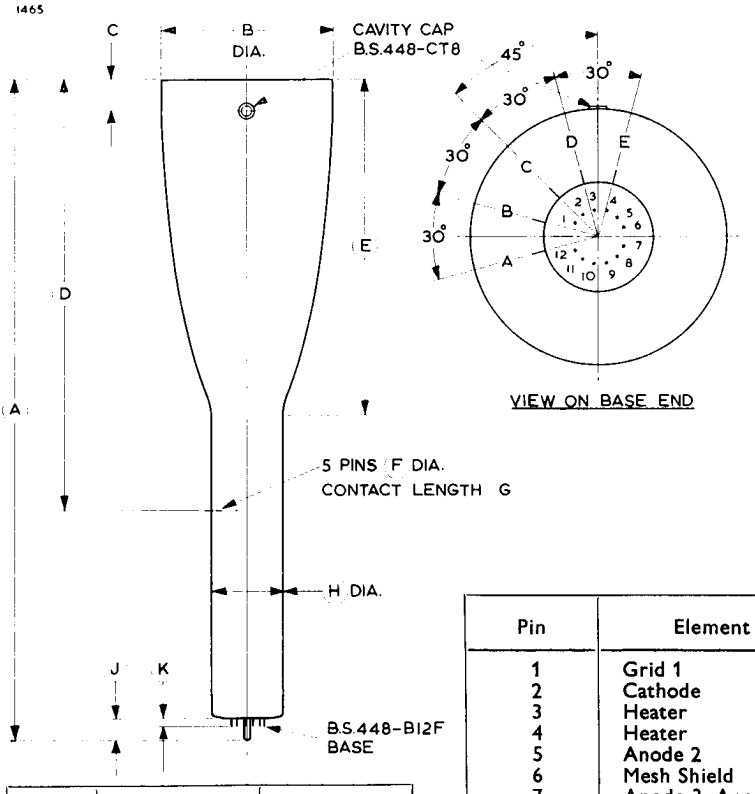
ORIENTATION OF DEFLECTION PLATES

(view on screen end of tube)

1482



OUTLINE



Ref.	Inches	Millimetres
A	20·71 Max	526·0 Max
→ B	5·374 Max	136·5 Max
→ C	1·575 ± 0·118	40·0 ± 3·0
D	13·425 ± 0·197	341·0 ± 5·0
E	10·512 ± 0·394	267 ± 10·0
F	0·039	1·00
G	0·236 ± 0·039	6·0 ± 1·0
H	2·283 Max	58·0 Max
J	0·709 Max	18·0 Max
K	0·248 Max	6·3 Max

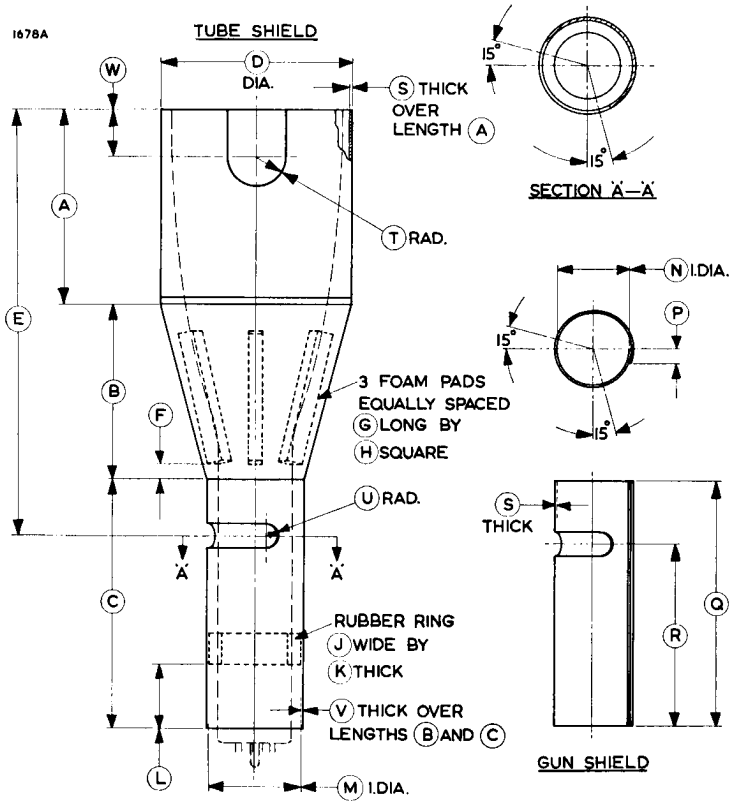
Inch dimensions have been derived from millimetres.

→Indicates a change

Pin	Element
1	Grid 1
2	Cathode
3	Heater
4	Heater
5	Anode 2
6	Mesh Shield
7	Anode 3, Anode 1
8	Anode 4
9	Mesh
10	Y Plate Shield
11	No Connection
12	No Connection
A	X2 Electrode
B	X1 Electrode
C	Interplate Shield
D	Y1 Electrode
E	Y2 Electrode
Cavity Cap	Anode 5 (Screen)

The overall bulb diameter 'B' does not include the cavity cap.

OUTLINE FOR MUMETAL SHIELDS



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	6·125	155·6	L	2·000	50·80
B	5·437	138·1	M	3·094	78·59
C	7·875	200·0	N	2·125	53·98
D	$5{\cdot}437^{+0{\cdot}031}_{-0{\cdot}000}$	$138{\cdot}1^{+0{\cdot}79}_{-0{\cdot}00}$	P	0·500 Approx	12·70 Approx
E	13·437	341·3	Q	7·750	196·9
F	0·500	12·70	R	5·750	146·1
G	4·000	101·6	S	0·015	0·38
H	0·500	12·70	T	1·000	25·40
J	1·000	25·40	U	0·375	9·53
K	0·437	11·10	V	0·036	0·91
			W	1·562	39·67

Millimetre dimensions have been derived from inches.

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OSCILLOSCOPE TUBES

T980H T980N T980X

INTRODUCTION

The T980H, T980N and T980X are 5-inch diameter cathode ray tubes for wide band, high speed oscilloscope applications. They are identical except for their screen characteristics and similar to the T979 series but are fitted with anode modulator electrodes.

The incorporation of a post deflection accelerator mesh and an internal spiral coating, together with an improved gun design, gives the tubes the following features:

(1) Deflection sensitivities in the X and Y directions of 9V/cm and 3V/cm respectively, making them particularly suitable for use with deflection circuits employing transistors.

(2) A large useful screen area, permitting the use of either 6 × 10cm or 8 × 8cm displays.

(3) Excellent brightness, giving a visible trace at writing speeds up to 1–3nsec/cm, and with negligible distortion introduced in the post deflection accelerator (P.D.A.) system. The small amounts of barrel or pin cushion distortion, linearity distortion and astigmatism present can be eliminated by adjustment of electrode potentials.

(4) Anode modulation plates give zero spot movement under normal operating conditions, but if only beam blanking is required, and spot movement can be tolerated, then modulation can be accomplished at a lower voltage.

(5) Good sensibility due to the small spot size.

(6) Variations of deflection sensitivities with variations in P.D.A. voltage are considerably reduced.

(7) Minimum deflector plate inductance and inter-plate capacitance, due to the deflector plate connections being made via short pins sealed into the side of the bulb.

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3 ± 10%	A
Faceplate	Flat, Clear Glass	
Screen (*See Note* 2)	Aluminised	
Deflection Method	Electrostatic	
Focus Method	Electrostatic	
Anode Modulation (*See Note* 3)	Electrostatic	
Linearity of Scan (*See Note* 4)	2	%
Raster Distortion (*See Note* 5)	±1	%
Orthogonality	90 + 1	Degrees

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Minimum useful scan

Y1 to Y2 (*See Note* 6)	8·0	cm
X1 to X2 (*See Note* 6)	10	cm

Undeflected Spot Position (to geometric centre of faceplate)

Y Orientation	±0·6	cm
X Orientation	±1·0	cm

Helix Resistance

Anode 5 to Interplate Shield	200	MΩ Min
→	1000	MΩ Max

Inter-Electrode Capacitances

(With all other electrodes not mentioned, and those marked*, earthed)

Grid to all other electrodes	6·1 pF Nom
Cathode to all other electrodes	5·7 pF Nom
Anode Modulator to all other electrodes	6·5 pF Nom
Anode Modulation Corrector to all other electrodes	8·8 pF Nom
Anode Modulator + Corrector to all other electrodes	11·4 pF Nom
Anode Modulator to anode modulation corrector	1·2 pF Nom
X1 Electrode to all other electrodes except X2*	3·5 pF Nom
X2 Electrode to all other electrodes except X1*	3·5 pF Nom
Y1 Electrode to all other electrodes except Y2*	2·9 pF Nom
Y2 Electrode to all other electrodes except Y1*	2·9 pF Nom
X1 to X2 Electrode	3·1 pF Nom
Y1 to Y2 Electrode	1·7 pF Nom
X1+X2 Electrodes to Y1+Y2 electrodes	<0·1 pF
X1+X2+Y1+Y2 Electrodes to cathode	<0·1 pF
X1+X2+Y1+Y2 Electrodes to grid	<0·1 pF

Mechanical

Overall Length	20·71 inches (526 mm)	Max
→ Overall Diameter (excluding cap)	5·37 inches (136·5 mm)	Max
Seated Height	21·260±0·236 inches (504±6 mm)	
Neck Diameter (excluding pins)	2·28 inches (58 mm)	Max
Useful Screen Area	2·36 by 3·94 or 3·15 by 3·15 inches	Min
	6·0 by 10 or 8·0 by 8·0cm	Min
Net Weight	3 pounds (1·4 kg)	Approx
Base		B.S.448–B12F
Anode 5 Cavity Cap		B.S.448–CT8
Mounting Position (*See Note* 7)		Any

→ Indicates a change

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

(All voltages are with respect to cathode except where otherwise stated)

	Min	*Max*	
Anode 5 Voltage (*See Note* 8)	6·0	15*	kV
Anode 4 Voltage	1·0	3·3	kV
Anode 3 and Anode 1 Voltage	1·0	3·3	kV
Anode 2 Voltage	0	1·5	kV
Anode Modulator Voltage	−300*	+300*	V
Anode Modulation Corrector Voltage	−300*	+300*	V
Anode Modulator to Anodes 3 and 1 Impedance	—	25	kΩ
Anode Modulation Corrector to Anodes 3 and 1 Impedance	—	25	kΩ
Grid Bias Voltage (negative value)	0	200	V
Grid Voltage (positive peak value)	—	2·0	V
Cathode Current (Intermittent Mean)	—	0·3	mA
Y Plate Shield Voltage	—	3·3	kV
Interplate Shield Voltage	—	3·3	kV
Mesh Shield Voltage	—	3·3	kV
Mesh Voltage (negative with respect to mesh shield voltage)	10	20	V
Deflection Voltage on X or Y electrodes (Peak)	—	500	V
Heater to Cathode Voltage (Peak):			
Cathode positive	—	200	V
Cathode negative	—	125	V
Screen Dissipation (average)	—	5·0	mW/sq.cm
X1 or X2 to Anodes 3 and 1 Impedance	—	2·0	MΩ
Y1 or Y2 to Anodes 3 and 1 Impedance	—	1·0	MΩ
Grid to Cathode Impedance	—	1·0	MΩ
Anode 4 to Anodes 3 and 1 Impedance			(*See Note* 9)

*With respect to anode 3 and anode 1 voltage.

TYPICAL OPERATING CONDITIONS

Anode 5 (Screen) Voltage ..	12	12	12	kV
Mesh Voltage (with respect to mesh shield)	−15	−15	−15	V
Anode 4 Voltage (adjusted for minimum astigmatism) (*See Note* 10)	1·0	1·5	3·0	kV
Anode 3 and Anode 1 Voltage ..	1·0	1·5	3·0	kV
Anode 2 Voltage (for focus) ..	165 to 335	250 to 500	500 to 1000	V
Grid Voltage (for spot cut-off) ..	−30 to −57	−45 to −85	−90 to −170	V
Y Plate Shield Voltage (*See Note* 11)	1·0	1·5	3·0	kV
Interplate Shield Voltage (*See Note* 12)	1·0	1·5	3·0	kV
Mesh Shield Voltage (*See Note* 13)	1·0	1·5	3·0	kV
Anode Modulation; minimum spot movement; (30V grid drive) (*See Note* 3*a*):				
Anode Modulator Voltage*† ..	0	0	0	V
Anode Modulator Voltage*§ ..	−16	−24·2	−48·4	V
Anode Modulation Corrector Voltage*†	0	0	0	V
Anode Modulation Corrector Voltage*§	−18·3	−27·5	−55	V
Anode Modulator + Anode Modulation Corrector Current	(*See Note* 14)	(*See Note* 14)	(*See Note* 14)	
Anode Modulation for maximum sensitivity (30V grid drive) (*See Note* 3*b*):				
Anode Modulator Voltage*†	0	0	0	V
Anode Modulator Voltage*§	−8·6	−13	−26	V
Anode Modulator Current ..	(*See Note* 14)	(*See Note* 14)	(*See Note* 14)	
Mesh Current	(*See Note* 15)	(*See Note* 15)	(*See Note* 15)	
Anode 3 and Anode 1 Current ..	(*See Note* 16)	(*See Note* 16)	(*See Note* 16)	
Anode 2 Current	±15	±15	±15	μA
Cathode Current	(*See Note* 16)	(*See Note* 16)	(*See Note* 16)	
Deflection Factor (*See Note* 17):				
Mean Potential of X and Y plates	1·0	1·5	3·0	kV
X1 and X2 Electrodes:				
Mean	6·1	9·0	17·5	V/cm
Limits	5·3 to 6·8	8·0 to 10	15·5 to 19·5	V/cm
Y1 and Y2 Electrodes:				
Mean	2·0	3·0	6·2	V/cm
Limits	1·6 to 2·3	2·5 to 3·5	5·2 to 7·2	V/cm

†Zero modulation, i.e. full beam current. §For extinction of stationary spot.
*With respect to anode 3 and anode 1 voltage.

ENGLISH ELECTRIC VALVE CO. LTD.

CHELMSFORD
ENGLAND

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Correction Potential Ranges

Mesh (with respect to mesh shield) (*See Note* 18) ..	−12 to −18	−12 to −18	−12 to −18	V
Anode 4 (astigmatism) (*See Notes* 10 *and* 18)	±40	±40	±40	V
Y Plate Shield (*See Notes* 11 *and* 18)	±20	±20	±20	V
Interplate Shield (*See Notes* 12 *and* 18)	±60	±40	±20	V
Line Width (*See Note* 19) ..	0·6	0·5	0·3	mm

ASSOCIATED COMPONENTS

The following components can be obtained from the suppliers listed; there may possibly be alternative sources:

(1) B.S.448–B12F socket	Catalogue No. 77/842	Carr Fastener Co. Ltd., Stapleford, Notts.
(2) B.S.448–CT8 Cavity Cap Connector	Catalogue No. 77/699	Carr Fastener Co. Ltd., Stapleford, Notts.
(3) Side Pin Connectors	Miniature wander socket type WS1 (colours red, black or blue).	A.E.I. Clix, Radio and Electronics Components Division, Barton Hill, Bristol.
(4) Magnetic Shield to suit T980 series (*See page* 12)		Magnetic Shields Ltd., Headcorn Road, Staplehurst, Tonbridge, Kent.

NOTES

1. The heater is suitable for parallel operation only.
2. The T980 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent and Afterglow Colour	Persistence
T980H	H	P31	Blue-Green	Medium-Short
T980N	N	P2	Yellowish-Green	Medium
T980X	X	P7	Blue with Yellowish-Green Afterglow	Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

3. (*a*) **Minimum Spot Movement Operation** (Patent applied for). In applications where spot movement caused by anode modulation is undesirable, the modulation electrodes can be operated as follows. The anode modulation corrector requires up to 20% more modulation voltage than the anode modulator to achieve minimum spot movement. The modulating signal is therefore connected directly to the anode modulation corrector and a proportion of the signal (adjusted for minimum spot movement) is fed to the anode modulator. The maximum signal required to cut off the beam in this case is 22V per kV of anode 1 voltage. By this method, zero spot movement can be obtained for a given value of grid drive, and at other values of grid drive the spot movement will be very small (less than one spot diameter). If a slightly greater spot movement can be tolerated, the anode modulator and anode modulation corrector may be connected together.
   (*b*) **Maximum Sensitivity Operation** In applications where spot movement is acceptable, the modulating signal is applied to the anode modulator and the anode modulation corrector is connected to Anode 1. The maximum signal required to cut off the beam in this case is 15V per kV of anode 1 voltage and the spot movement is approximately 7mm.
   N.B. The anode modulation electrodes cannot be used with positive signals to obtain beam brightening.
4. The deflection factor for a deflection of 75% of the useful scan will not differ from that for a deflection of 25% by more than 2%.
5. The edges of a 6 × 10cm raster will fall between two concentric rectangles 101 × 60·6mm and 99 × 59·4mm.
6. The tube can be used for either 6 × 10cm or 8 × 8cm displays.
7. The tube should be supported near the screen and also on the parallel neck near the base; it should not be supported by the base only. The socket should not be mounted rigidly, but should have flexible leads and be able to move freely. To avoid the need for excessive magnetic shielding the tube should be mounted as far away as possible from transformers, chokes and other sources of stray field.
8. Anode 5 may be operated at a voltage lower than the minimum specified but the light output will then be limited by the screen aluminising.
9. When high beam currents are used, anode 4 collects current and the anode 4 to anodes 3 and 1 impedance should be kept as low as possible to avoid defocusing.
10. Adjustment of the anode 4 voltage about the mean Y plate potential is used to correct astigmatism introduced in the deflection system. The range of voltage required is of the order of ±40V.
11. The Y plate shields should be operated about the mean potential of the Y1 and Y2 electrodes. Variation of the potential about this value controls the edge effects of the Y deflection electrode field and provides a fine adjustment of the deflection linearity in the Y direction.

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12. Variation of the interplate shield voltage about the mean potential of the deflector electrodes provides correction for barrel and pin cushion distortion. When the mean potentials of the X and Y deflection electrodes are equal, a range of ±40V maximum is required (with anode 3 and anode 1 voltage of 1·5kV); the range is slightly wider when the mean potentials are not equal.

13. The mesh shield should be operated at approximately the mean X plate potential.

14. The total current will be approximately 50% of the anode 3 and anode 1 current and will be of the opposite direction.

15. At peak beam current, the mesh current will be of the order of 5μA.

16. When anode modulation is used as the sole means of modulating the beam, ← the cathode current must never exceed 0·3mA. Where cathode modulation or grid modulation is used in addition to anode modulation, or cathode and grid modulation are used without anode modulation, the peak anode 1 and 3 current, and the peak cathode current can exceed 0·5mA, and under low duty cycle conditions, such as viewing transients, may reach 2·0mA. Under these conditions the regulation of the power supplies to the anode 1 and anode 3 circuit and cathode circuit should be adequate for such variation.

17. The X electrodes and Y electrodes are designed primarily for symmetrical operation. Some degradation of focus and trace geometry will result if the tube is operated under asymmetric conditions.

18. These figures apply when the mean potentials of the X and Y electrodes and anode 3 are equal. When the mean deflection electrode potentials differ from the anode 3 voltage, a slightly wider range will be required.

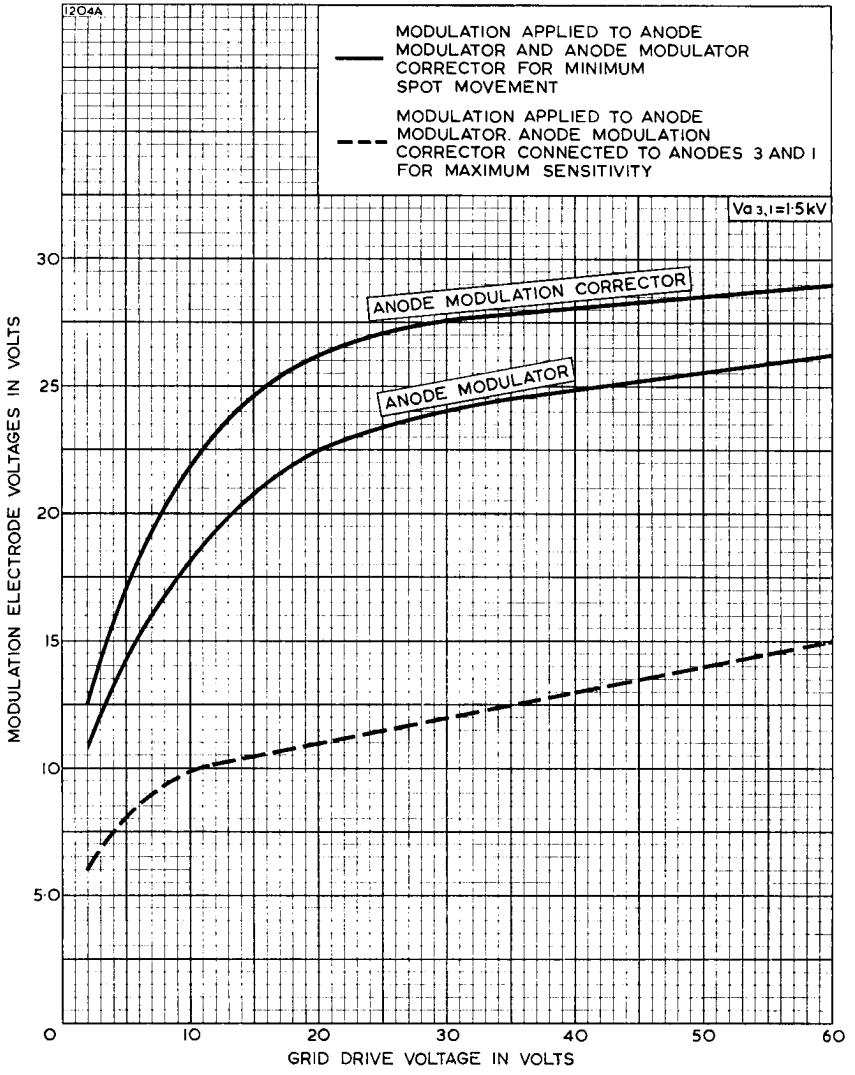
19. Measured under the following conditions:

Anode 4 Voltage	Optimised	
Anode 2 Voltage	Optimised	
Grid Drive	25	V
Raster Size	5×5	cm
Vertical Lines	200	
Frame Repetition	50	c/s
Spot Velocity	500	m/sec

The line width measured with a microscope as in K1001. Compared with the shrinking raster method, this method is more accurate but pessimistic. Thus it must be remembered that the equivalent line width measured by the shrinking raster method will be considerably less than the value stated when comparison is made with data given in these terms.

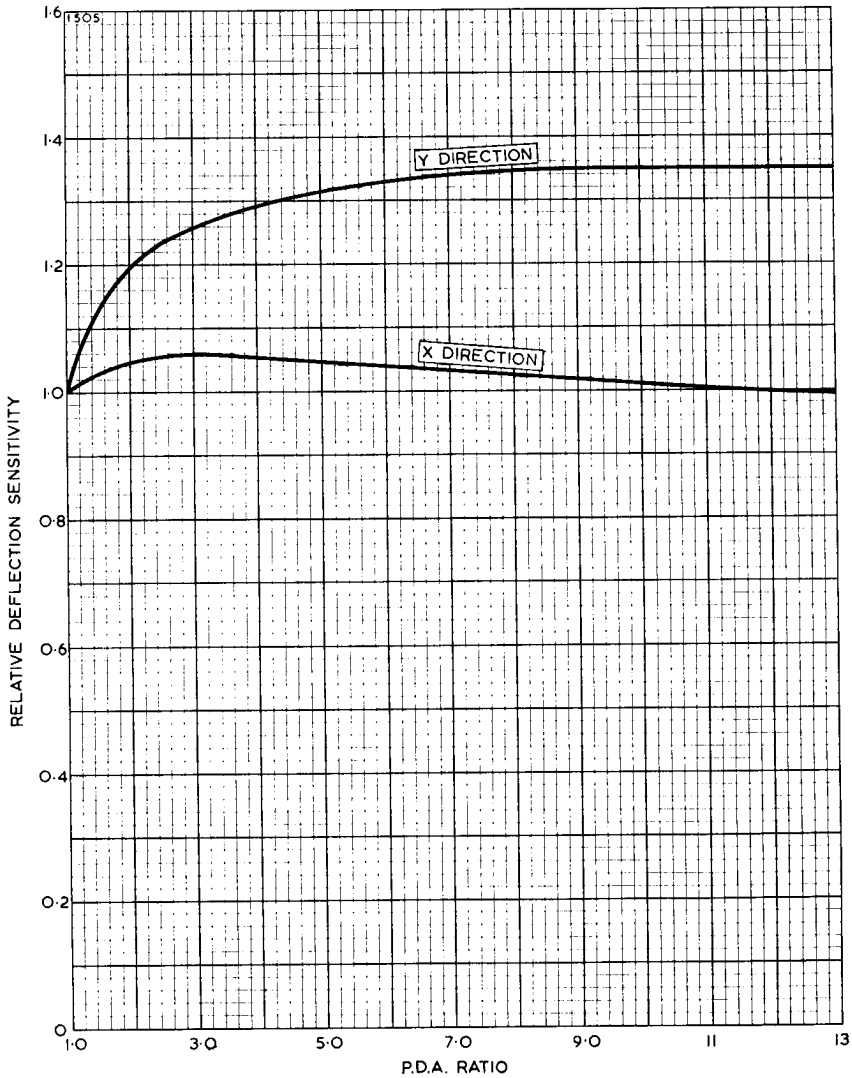
← Indicates a change

MODULATION VOLTAGE CHARACTERISTICS



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P.D.A. RATIO CHARACTERISTIC

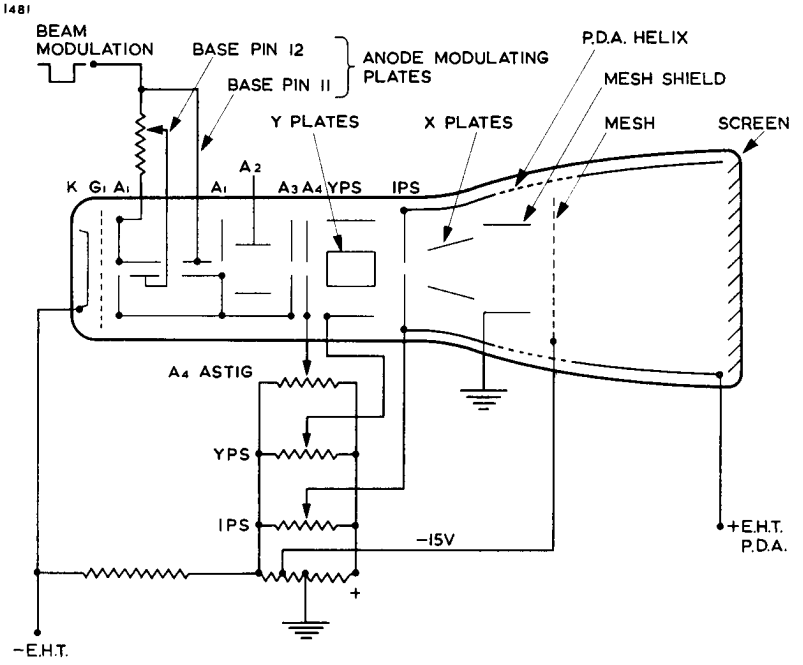


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ENGLISH ELECTRIC

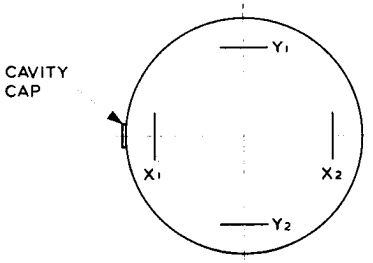
SCHEMATIC DIAGRAM

1481

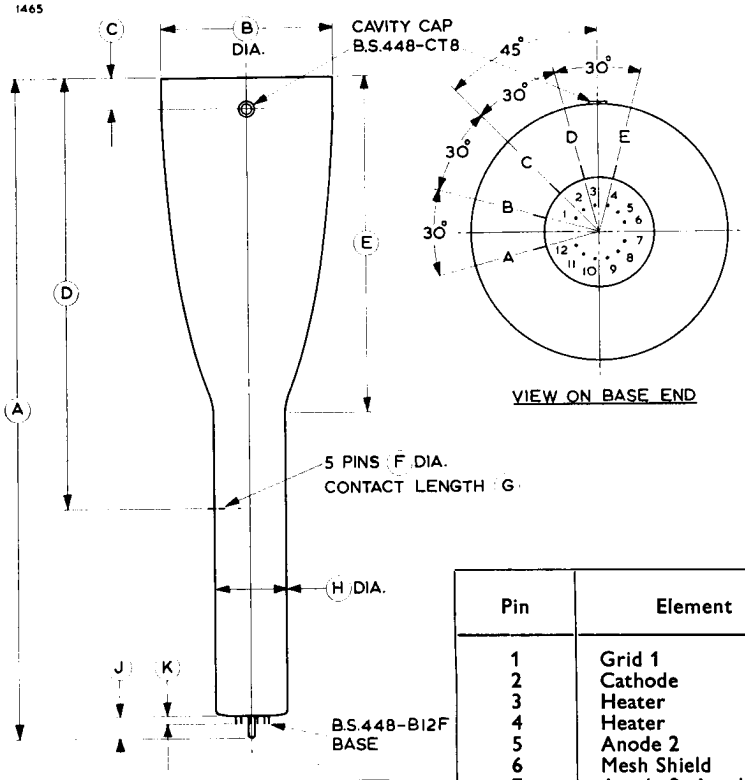


ORIENTATION OF DEFLECTION PLATES
(view on screen end of tube)

1482



OUTLINE



Ref.	Inches	Millimetres
A	20·71 Max	526·0 Max
→ B	5·374 Max	136·5 Max
→ C	1·575 ± 0·118	40·0 ± 3·0
D	13·425 ± 0·197	341·0 ± 5·0
E	10·512 ± 0·394	267·0 ± 10·0
F	0·039	1·00
G	0·236 ± 0·039	6·0 ± 1·0
H	2·283 Max	58·0 Max
J	0·709 Max	18·0 Max
K	0·248 Max	6·3 Max

Inch dimensions have been derived from millimetres.

→ Indicates a change

Pin	Element
1	Grid 1
2	Cathode
3	Heater
4	Heater
5	Anode 2
6	Mesh Shield
7	Anode 3, Anode 1
8	Anode 4
9	Mesh
10	Y Plate Shield
11	Anode Modulation Corrector
12	Anode Modulator
A	X2 Electrode
B	X1 Electrode
C	Interplate Shield
D	Y1 Electrode
E	Y2 Electrode
Cavity Cap	Anode 5 (Screen)

The overall bulb diameter 'B' does not include the cavity cap.

ENGLISH ELECTRIC

ABRIDGED DATA

12-inch diameter, high resolution radar tubes.

Neck Diameter	1·378 inches	(35 mm)
Deflection Angle	50	Degrees
Deflection Method		Magnetic
Focus Method		Electrostatic
E.H.T. Voltage	15	kV

GENERAL

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3	A
Faceplate		Clear
Screen (*See Note* 2)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	12·0	pF
Cathode to all other electrodes, less than	12·0	pF

Mechanical

Overall Length	19·449 inches	(494 mm)	Max
Overall Diameter	12·087 inches	(307 mm)	Max
Useful Screen Diameter	10·433 inches	(265 mm)	Min
Neck Diameter	1·398 inches	(35·5 mm)	Max
Net Weight	12 pounds	(5·5 kg)	Approx
Base			B.S.448–B12A
Final Anode Connection			B.S.448–CT8 Cavity Cap
Mounting Position			*See Note* 3

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

(All voltages with respect to cathode except where otherwise stated)

	Min	*Max*	
Anode 2 and Anode 4 Voltage	8·0	18	kV
Anode 3 Voltage:			
Positive value	—	700	V
Negative value	—	500	V
Anode 1 Voltage	200	500	V
Grid Voltage, negative value (*See Note* 4)	1·0	200	V
Heater to Cathode Voltage (*See Note* 5)	—	150	V
Cathode Current (Mean)	—	150	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50Hz)	—	0·5	MΩ

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	15	kV
Anode 3 Voltage (*See Note* 6)	0 to +400	V
Anode 3 Current	−15 to +15	μA
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −70	V
Grid Drive for 50μA beam current	10 to 30	V
Spot Size at 50μA beam current	0·45	mm

BEAM CENTRING

In order to obtain maximum brightness and the best focused spot size, stray magnetic fields must be minimised over the length of the gun structure. This may be achieved by using a tubular mumetal shield over the neck.

Where optimum performance is required, a small magnet should be used for centring the beam in the defining aperture. (Elac type BC11 is suitable.) The magnet should be located in the region of the grid and its position and strength adjusted to give maximum brightness.

X-RAY WARNING

X-Rays are produced when types in the T982 series are operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tubes are adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect on the design of the tubes.

NOTES

1. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed 9·5V r.m.s. when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.
2. Tubes in the T982 series have screens with the following characteristics.

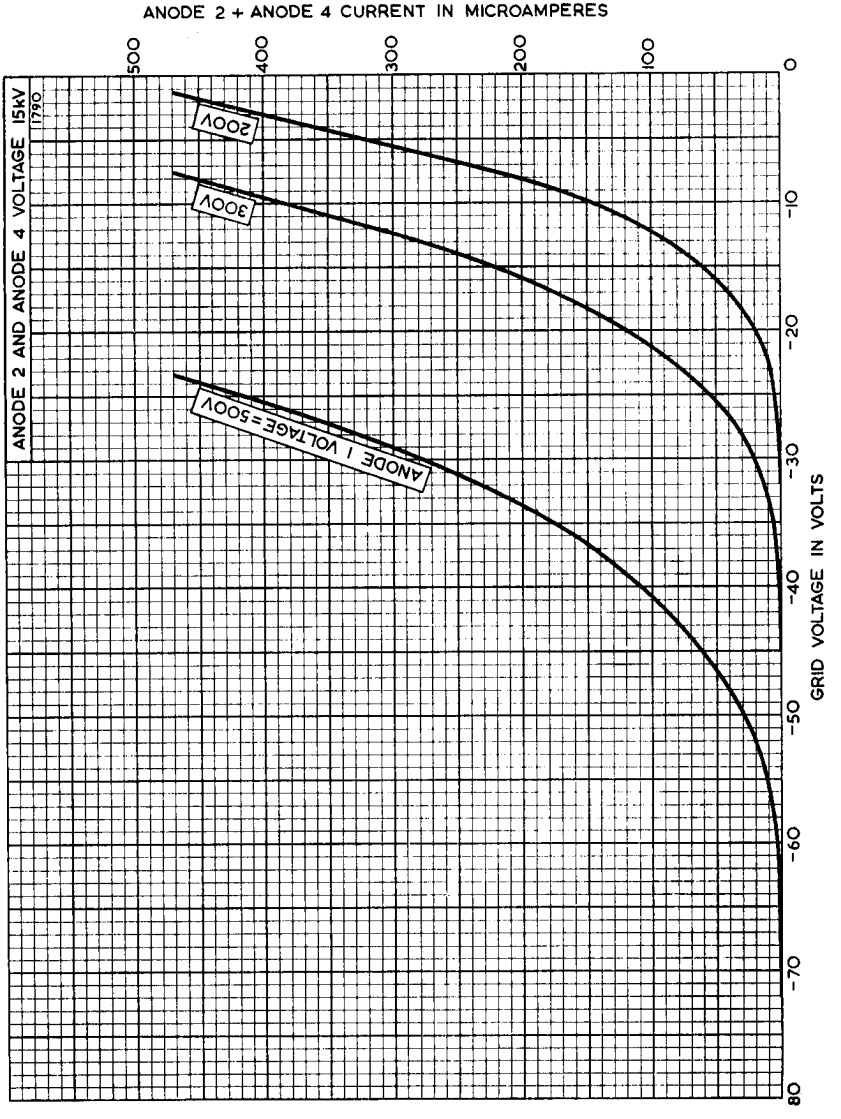
Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T982D	D*	E.V.S.007	Yellow-orange	Long
T982Y	Y*	P33	Orange	Long
T982Z	Z*	P26	Orange	Very Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots. The tube can be manufactured with alternative screens, and customers' enquiries are invited.

3. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.
4. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.
5. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than 20V r.m.s.
6. An acceptable focus quality will be obtained with an anode 3 voltage range of 0 to +400V. If it is required to pass through the point of focus a voltage range of at least −100 to +500V will be required.

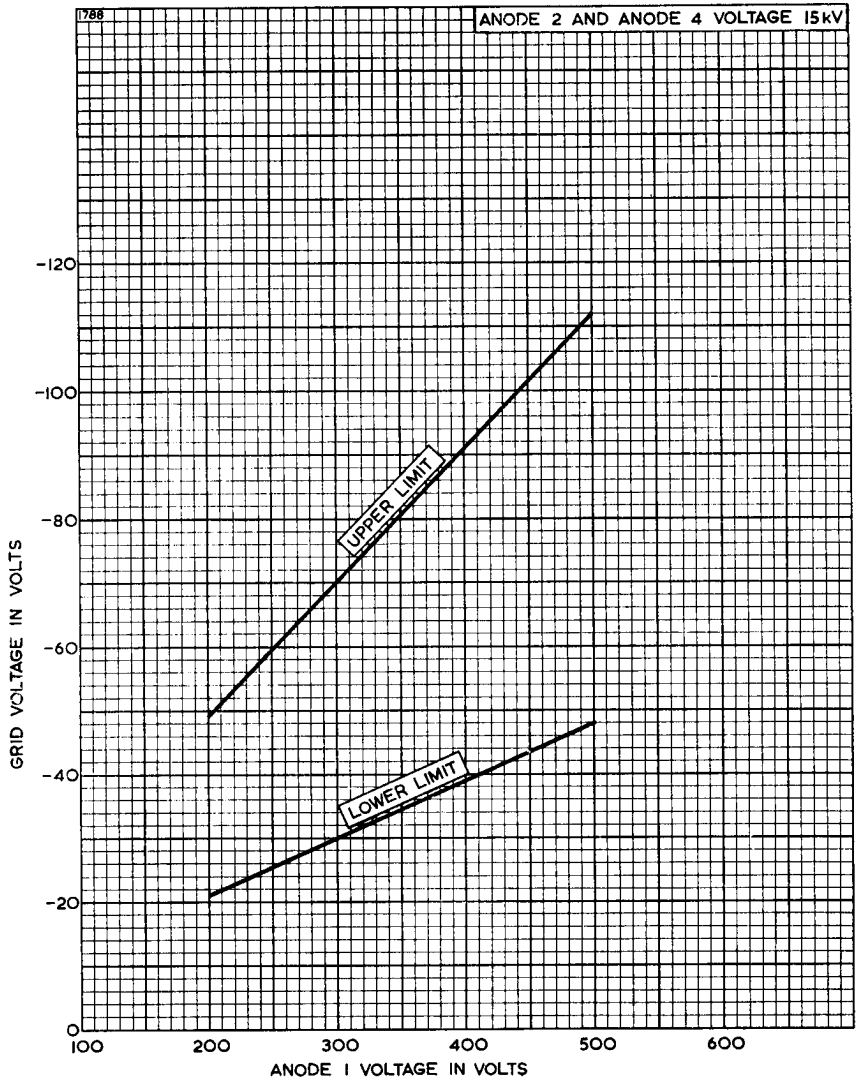
ENGLISH ELECTRIC

GRID VOLTAGE CHARACTERISTICS



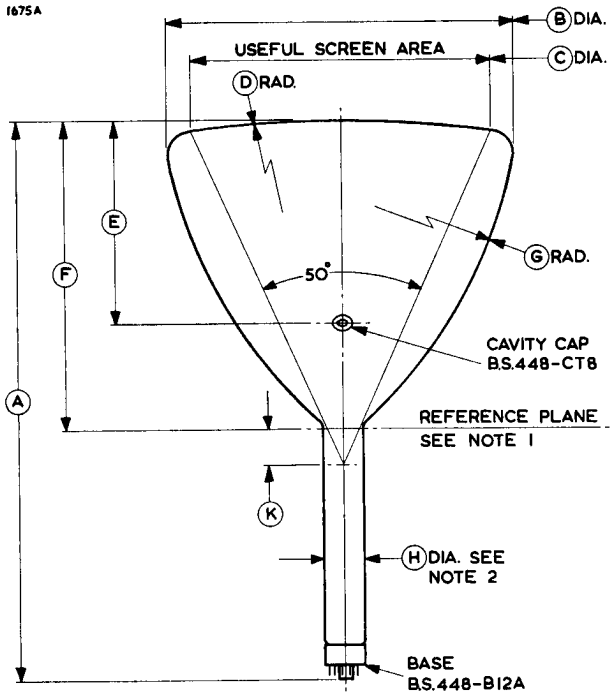
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GRID VOLTAGE CUT-OFF LIMITS



ENGLISH ELECTRIC

OUTLINE



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	$19{\cdot}134^{+0{\cdot}315}_{-0{\cdot}276}$	$486{\cdot}0^{+8{\cdot}0}_{-7{\cdot}0}$	E	$7{\cdot}087 \pm 0{\cdot}020$	$180{\cdot}0 \pm 5{\cdot}0$
B	$12{\cdot}008^{+0{\cdot}079}_{-0{\cdot}098}$	$305{\cdot}0^{+2{\cdot}0}_{-2{\cdot}5}$	F	$10{\cdot}709 \pm 0{\cdot}138$	$272{\cdot}0 \pm 3{\cdot}5$
C	10·433	265·0	G	16·772	426·0
D	39·370	1000·0	H	$1{\cdot}368 \pm 0{\cdot}030$	$34{\cdot}75 \pm 0{\cdot}75$
			K	1·260	32·0

Inch dimensions have been derived from millimetres.

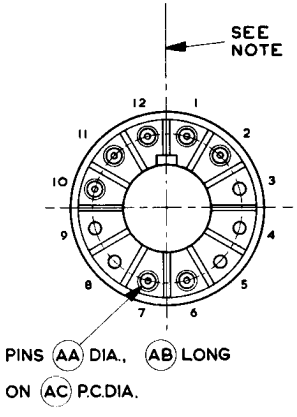
NOTES

1. Reference plane determined by 36·0mm diameter ring gauge.
2. A ring gauge 36·0mm diameter by 100mm long will pass over base and neck to reference plane.

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OUTLINE DETAILS

1198B



Pin	Element
1	Heater
2	Grid
3	No Pin
4	No Pin
5	No Pin
6	Anode 3
7	Internal Connection
8	No Pin
9	No Pin
10	Anode 1
11	Cathode
12	Heater
Cavity Cap	Anode 2 & Anode 4

Ref.	Inches	Millimetres
AA	0·093 ± 0·003	2·362 ± 0·076
AB	0·410 Max	10·41 Max
AC	1·063	27·00

Millimetre dimensions have been derived from inches.

Note: The anode cavity cap will be in line with the base key to within 15°.

RADAR TUBE

T983Z

ABRIDGED DATA

16-inch diameter, high resolution radar tube.

Neck Diameter	1·378 inches (35mm)
Deflection Angle	50 Degrees
Deflection Method	Magnetic
Focus Method	Electrostatic
E.H.T. Voltage	15 kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated
Heater Voltage (*See Note* 1)	6·3 V
Heater Current	0·3 A
Faceplate	Clear
Screen (*See Note* 2)	Aluminised
Fluorescent Colour	Orange
Persistence	Very Long
Inter-electrode Capacitances:	
Grid to all other electrodes, less than	12 pF
Cathode to all other electrodes, less than	12 pF

Mechanical

Overall Length	24·016 inches	(610 mm)	Max
Overall Diameter	16·142 inches	(410 mm)	Max
Useful Screen Diameter	14·685 inches	(373 mm)	Min
Neck Diameter	1·398 inches	(35·5 mm)	Max
Net Weight	24 pounds	(11 kg)	Approx
Base	B.S.448–B12A		
Final Anode Connection	Cavity Cap B.S.448—CT8		
Mounting Position	*See Note* 3		

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MAXIMUM AND MINIMUM RATINGS

(Absolute Values)

(All voltages with respect to cathode except where otherwise stated)

	Min	*Max*	
Anode 2 and Anode 4 Voltage	8·0	18	kV
Anode 3 Voltage:			
positive	—	700	V
negative	—	500	V
Anode 1 Voltage	200	500	V
Grid Voltage, negative value (*See Note* 4)	1·0	200	V
Heater to Cathode Voltage (*See Note* 5)	—	150	V
Cathode Current (Mean)	—	150	μA
Grid to Cathode Resistance	—	1·5	MΩ
Grid to Cathode Impedance (at 50Hz)	—	0·5	MΩ

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	15	kV
Anode 3 Voltage (*See Note* 6)	0 to +400	V
Anode 3 Current	−15 to +15	μA
Anode 1 Voltage	300	V
Grid Voltage for cut-off	−30 to −70	V
Spot Size at 50μA beam current	0·55	mm

BEAM CENTRING

In order to obtain maximum brightness and the best focused spot size, stray magnetic fields must be minimised over the length of the gun structure. This may be achieved by using a tubular mumetal shield over the neck.

Where optimum performance is required, a small magnet should be used for centring the beam in the defining aperture. (Elac type BC11 is suitable.) The magnet should be located in the region of the grid and its position and strength adjusted to give maximum brightness.

X-RAY WARNING

X-Rays are produced when the T983Z is operated with anode voltages above 16kV (absolute value). These rays can constitute a health hazard unless the tube 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.

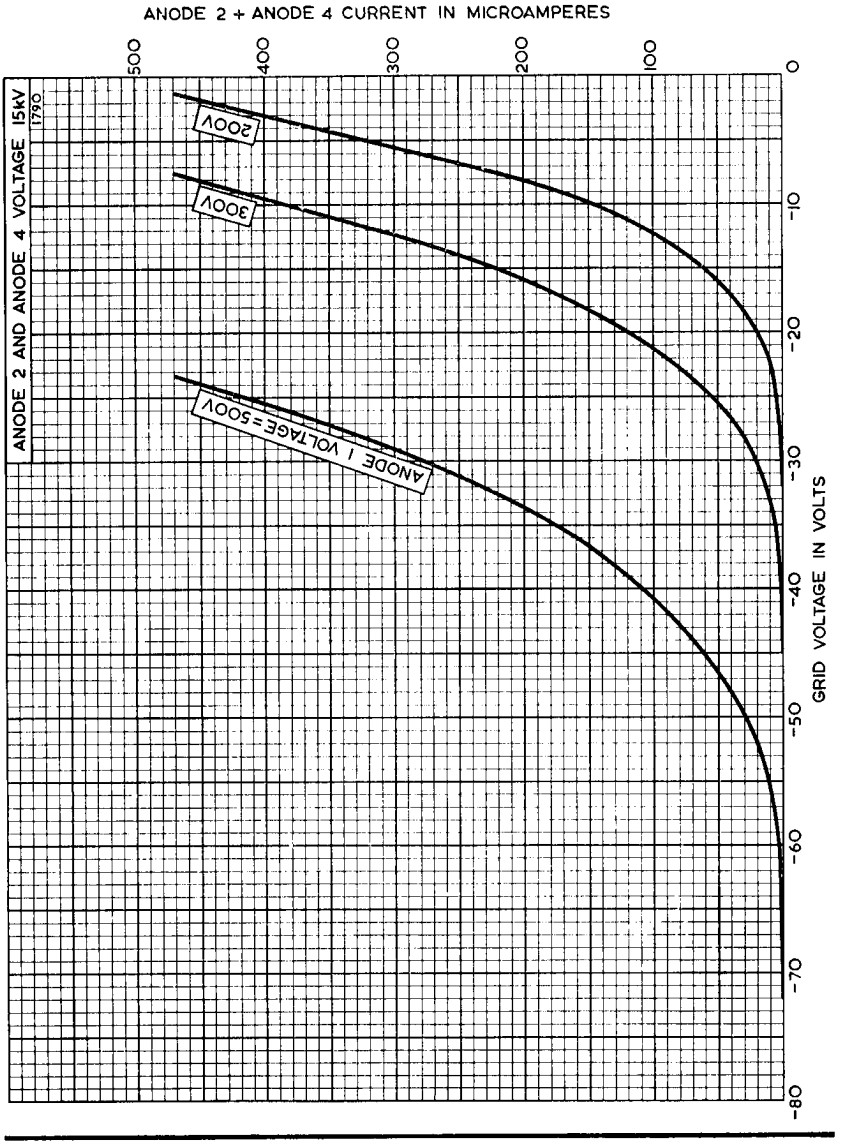
NOTES

1. The heater is suitable for series or parallel operation. In series operation the surge heater voltage must not exceed $9{\cdot}5V_{r.m.s.}$ when the supply is switched on and a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.
2. The T983Z is supplied with an EEV Z screen which has very long persistence and satisfies the requirements of E.V.S.009 screen specification. This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots.

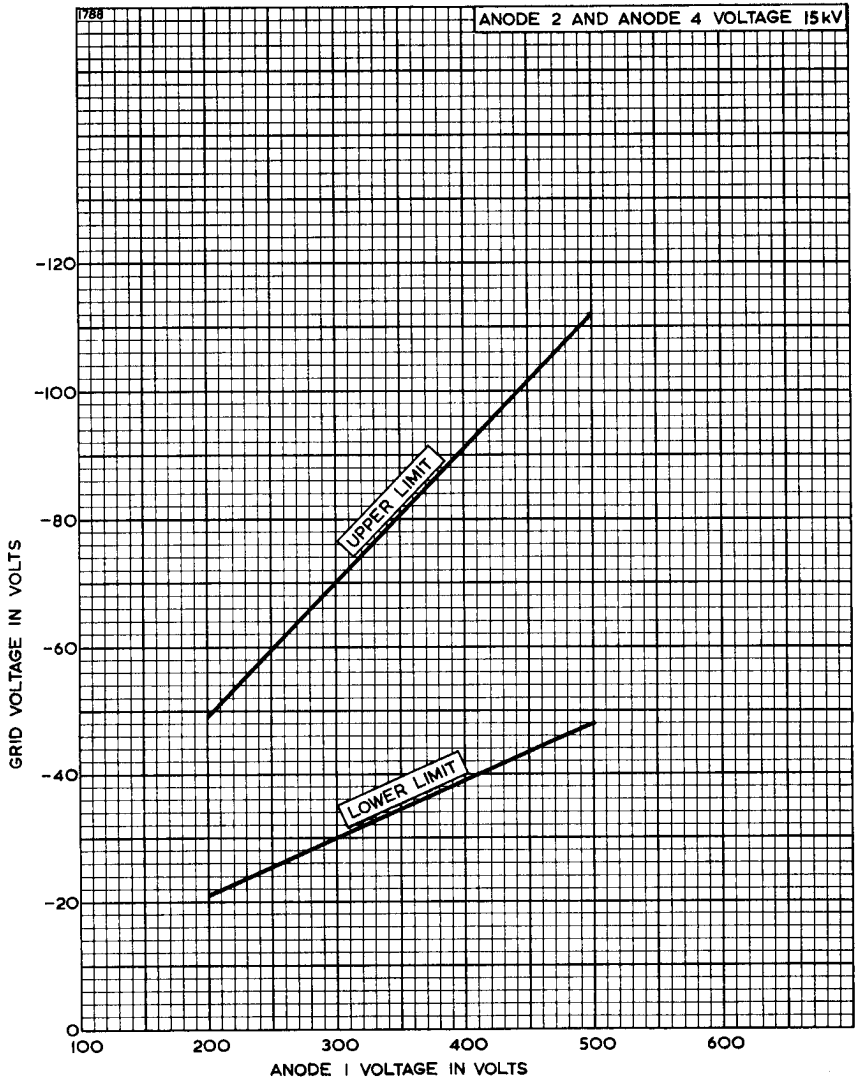
   The tube can be manufactured with alternative screens, and customers' enquiries are invited.
3. The tube may be mounted in any position except with the screen down and the axis of the tube making an angle of less than 20° with the vertical.
4. The d.c. value of grid bias must not be allowed to become positive with respect to the cathode except during the period immediately after switching the equipment on or off when it may be allowed to rise to +1V. The maximum positive grid excursion may reach 2V and at this voltage the grid current may be expected to be approximately 2mA.
5. To avoid excessive hum, the a.c. component of the heater to cathode voltage should be as low as possible, preferably less than $20V_{r.m.s.}$
6. An acceptable focus quality will be obtained with an anode 3 voltage range of 0 to +400V. If it is required to pass through the point of focus a voltage range of at least −100 to +500V will be required.

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GRID VOLTAGE CHARACTERISTICS



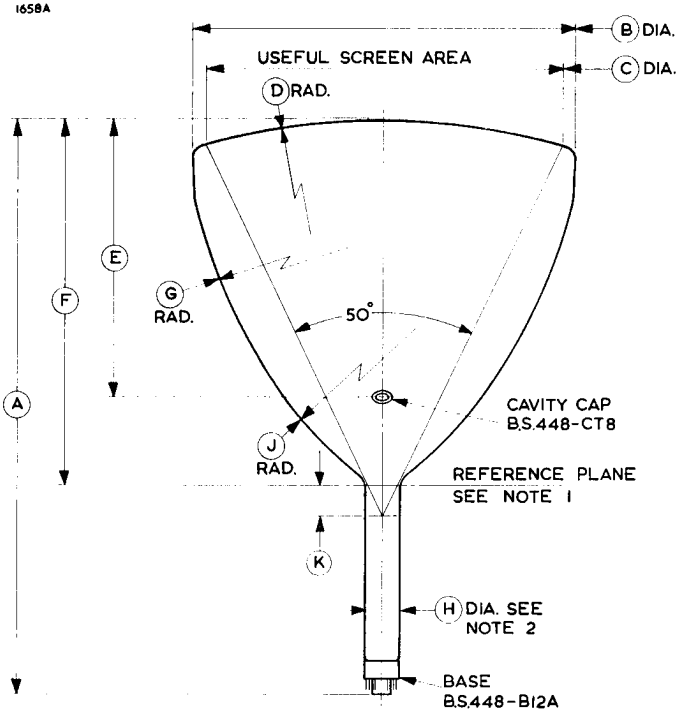
GRID VOLTAGE CUT-OFF LIMITS



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ENGLISH ELECTRIC

OUTLINE



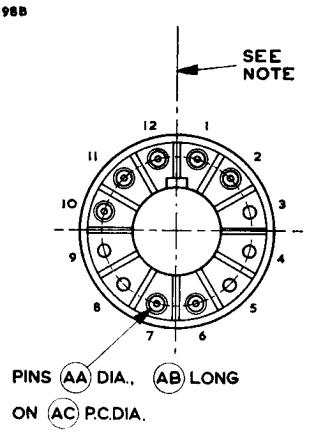
Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	23·622 ± 0·394	600·0 ± 10·0	G	23·504	597·0
B	15·984 ± 0·157	406·0 ± 4·0	H	$1{\cdot}378^{+0{\cdot}020}_{-0{\cdot}039}$	$35{\cdot}00^{+0{\cdot}5}_{-1{\cdot}0}$
C	14·685 Min	373·0 Min	J	16·732	425·0
D	27·559	700·0	K	1·260	32·0
E	11·417 ± 0·394	290·0 ± 10·0			
F	14·961 ± 0·197	380·0 ± 5·0			

Inch dimensions have been derived from millimetres.

NOTES

1. Reference plane determined by 36·0mm diameter ring gauge.
2. A ring gauge 36·0mm diameter by 100mm long will pass over base and neck to reference plane.

OUTLINE DETAILS



Pin	Element
1	Heater
2	Grid
3	No Pin
4	No Pin
5	No Pin
6	Anode 3
7	Internal Connection
8	No Pin
9	No Pin
10	Anode 1
11	Cathode
12	Heater
Cavity Cap	Anode 2 & Anode 4

Ref.	Inches	Millimetres
AA	0·098 ± 0·003	2·362 ± 0·076
AB	0·410 Max	10·41 Max
AC	1·063	27·00

Millimetre dimensions have been derived from inches.

Note: The anode cavity cap will be in line with the base key to within 15°.

ENGLISH ELECTRIC

ABRIDGED DATA

12-inch diameter high brightness Radar Tubes intended primarily for marine radar P.P.I. displays. The narrow scan angle permits the use of valve or transistor scan amplifiers. They are electrically and mechanically interchangeable with T974Y and T974Z, but give a display more than twice as bright when operated under the same conditions.

Neck Diameter	1·378 inches	(35mm)
Deflection Angle	40	Degrees
Deflection Method		Magnetic
Focus Method		Electrostatic
E.H.T. Voltage	16	kV

GENERAL

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3±10%	A
Screen (*See Note* 2)		Aluminised
Inter-electrode Capacitances:		
Grid to all other electrodes, less than	8·0	pF
Cathode to all other electrodes, less than	8·0	pF
Anode 2 and Anode 4 to external conductive coating (*See Note* 3)	1500	pF

Mechanical

Overall Length	22·560 inches	(573 mm)	Max
Overall Diameter	12·090 inches	(307 mm)	Max
Useful Screen Diameter	10·430 inches	(265 mm)	Min
Neck Diameter	1·400 inches	(35·5 mm)	Max
Net Weight	13½ pounds	(6·2 kg)	Approx
Base (*See Note* 4)			B8H
Anode 2 and Anode 4 Connection			B.S.448–CT8 Cavity Cap
Mounting Position (*See Note* 4)			Any

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MAXIMUM AND MINIMUM RATINGS

(Absolute Values. *See Note* 5)

	Min	*Max*	
Anode 2 and Anode 4 Voltage (*See Note* 6) ..	8·0	18	kV
Anode 3 Voltage:			
Positive value	—	1·0	kV
Negative value	—	0·5	kV
Anode 1 Voltage	0·2	0·8	kV
Grid Voltage (negative value)	1·0	200	V
Grid to Cathode Impedance (at 50Hz) ..	—	0·5	MΩ
Grid to Cathode Resistance	—	1·5	MΩ
Heater to Cathode Voltage:			
Heater positive with respect to cathode			
D.C.	—	150	V
Peak	—	250	V
Heater negative with respect to cathode			
D.C.	—	150	V
Peak	—	300	V
Heater to Cathode Resistance		*See Note* 7	

TYPICAL OPERATING CONDITIONS

Anode 2 and Anode 4 Voltage	12 to 16	kV
Anode 3 Voltage	−100 to +300	V
Anode 3 Current (positive or negative)	15	μA
Anode 1 Voltage	600	V
Anode 1 Current (positive or negative)	15	μA
Grid Voltage for visual cut-off	−40 to −85	V
Cathode Voltage for visual cut-off (*See Note* 8) ..	43 to 82	V

NOTES

1. The heater is suitable for either series or parallel operation. In series operation, the surge heater voltage when switching on must not exceed $9{\cdot}5V_{r.m.s.}$ and a current limiting device may be required in the circuit to reduce the surge voltage below this value.

2. Tubes in the T986 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent Colour	Persistence
T986D	D*	E.V.S.007	Yellow-orange	Long
T986Y	Y*	P33	Orange	Long
T986Z	Z*	P26	Orange	Very Long

*This is a fluoride screen which is sensitive to burn and should not be operated with slow moving spots. The tube can be manufactured with alternative screens, and customers' enquiries are invited.

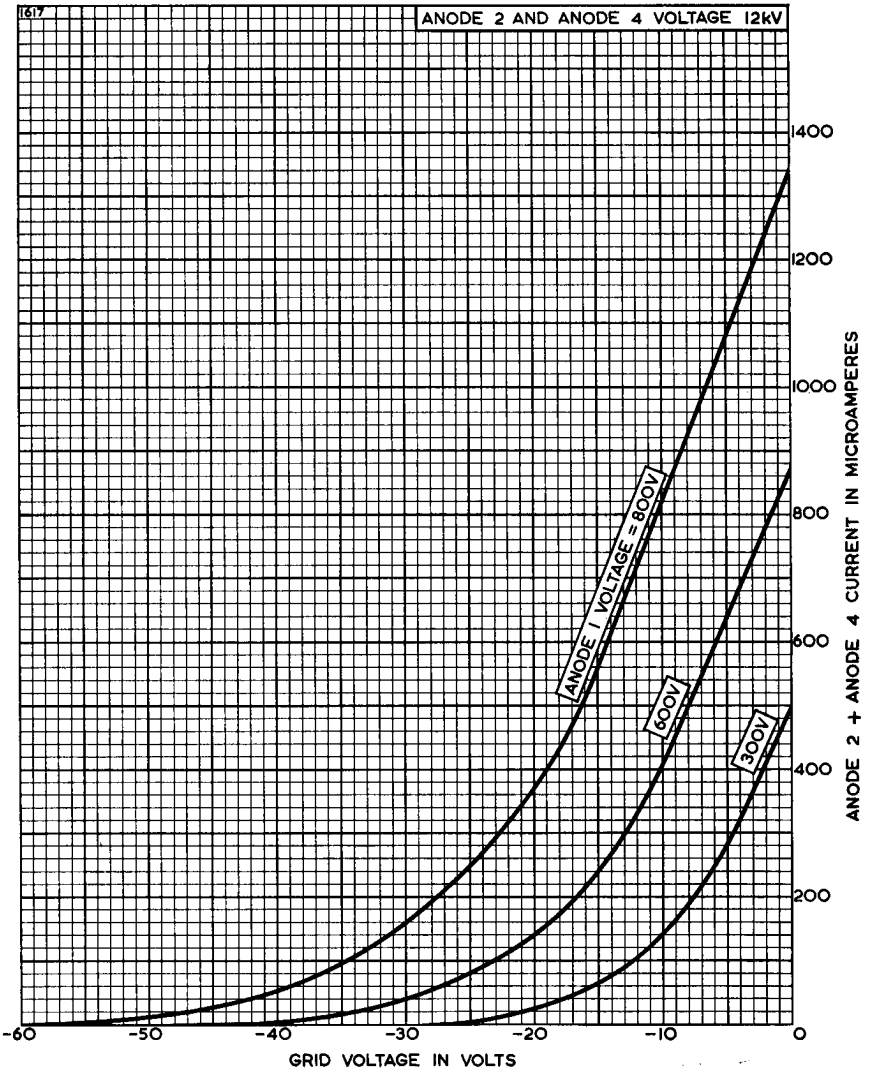
3. The capacitance of anode 2 and anode 4 to the external conductive coating may be used to provide smoothing for the e.h.t. supply.
4. The tube should not be supported by the base alone and under no circumstances should the socket be used for support purposes.
5. All voltages are with respect to cathode except where otherwise specified.
6. The associated equipment should be adequately protected against damage caused by possible high voltage flashovers inside the tube.
7. When the heater is in a series chain or earthed, the impedance between the cathode and earth at 50Hz must not exceed 100kΩ. When the heater is supplied from a separate transformer, the heater to cathode resistance must not exceed 1MΩ.
8. For cathode modulation, all voltages are with respect to the grid.

X-RAY WARNING

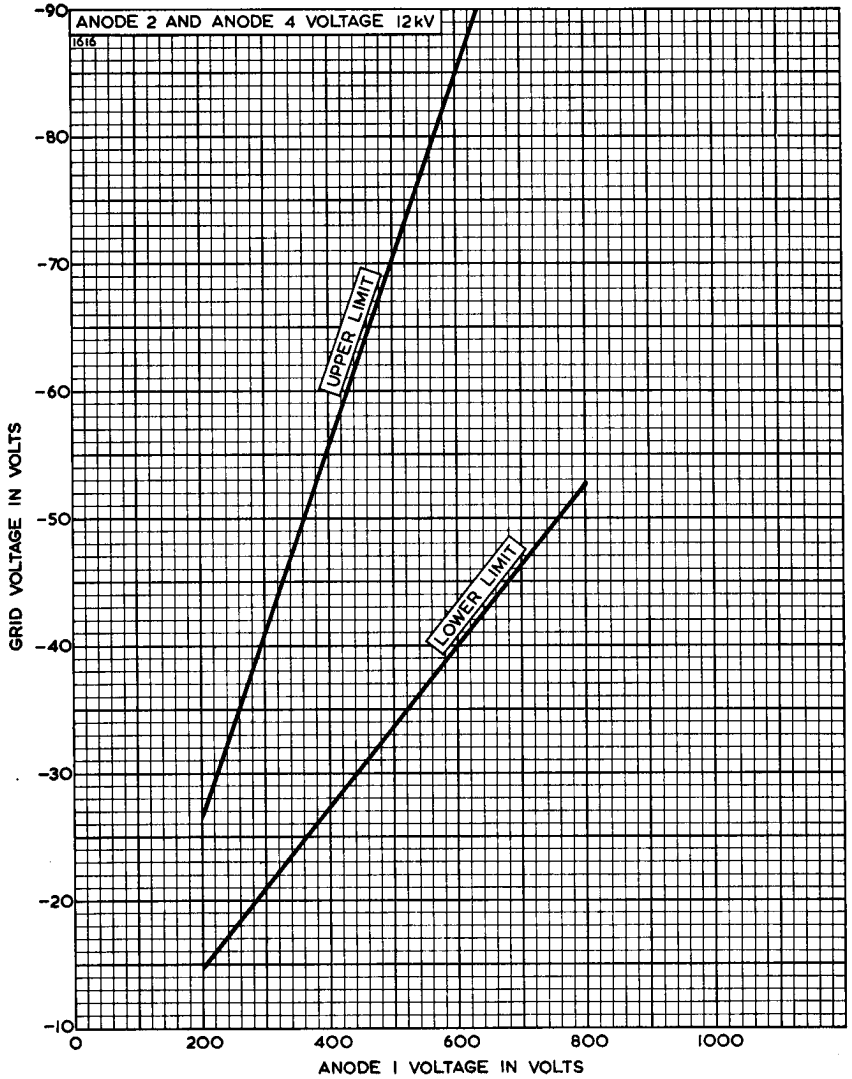
X-rays are produced when the T986 is operated above 16kV (absolute value). These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

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GRID VOLTAGE CHARACTERISTICS



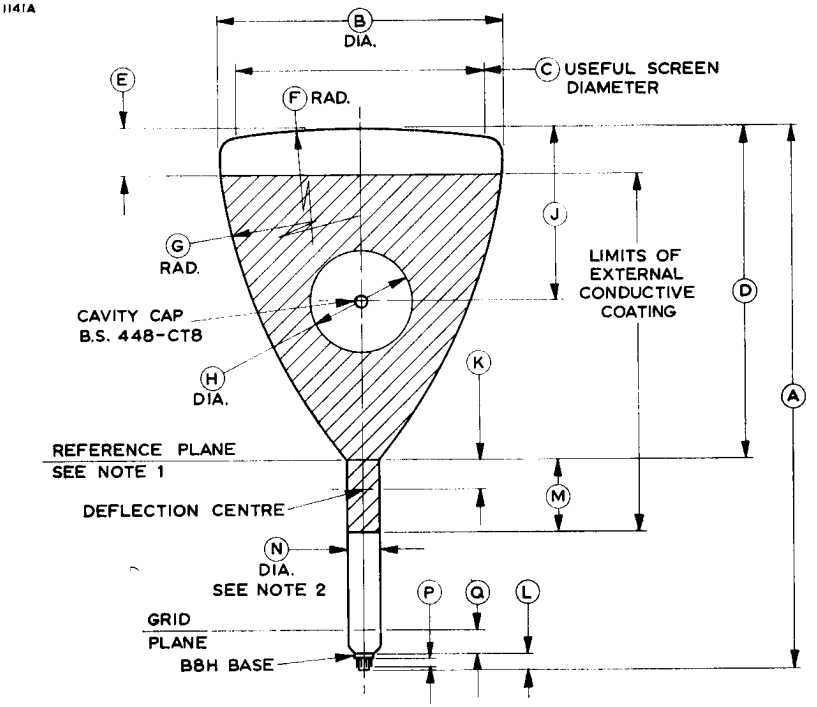
GRID VOLTAGE CUT-OFF LIMITS



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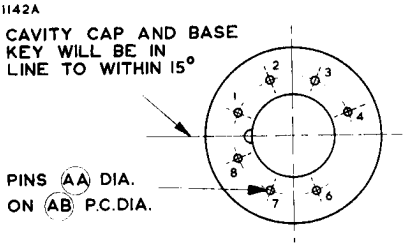
OUTLINE



Ref.	Inches	Millimetres	Ref.	Inches	Millimetres
A	22·560 Max	573·0 Max	J	7·244 ± 0·118	184·0 ± 3·0
B	12·010 $^{+0·080}_{-0·100}$	305·0 $^{+2·0}_{-2·5}$	K	1·240 Max	31·5 Max
C	10·430 Min	265·0 Min	L	0·630	16·0
D	13·900 ± 0·180	353·0 ± 4·5	M	2·953 ± 0·197	75·0 ± 5·0
E	1·969	50·0	N	1·378 $^{+0·020}_{-0·039}$	35·0 $^{+0·5}_{-1·0}$
F	39·370	1000	P	0·333 Max	8·46 Max
G	23·620	600·0	Q	0·984	25·0
H	4·331 ± 0·394	110·0 ± 10·0			

Inch dimensions have been derived from millimetres.

OUTLINE DETAILS



Pin	Element
1	Heater
2	Internal Connection
3	Anode 1
4	Anode 3
5	No Pin
6	Grid
7	Cathode
8	Heater
Cavity Cap	Anode 2 & Anode 4

Ref.	Inches	Millimetres
AA	0·040	1·02
AB	0·600	15·24

Millimetre dimensions have been derived from inches.

OUTLINE NOTES

1. The Reference Plane is determined by the position where 36·0mm internal diameter ring gauge rests.
2. A ring gauge 36·0mm internal diameter × 100·0mm long will pass over the neck and base to the reference plane.
3. The projected neck axis will pass within 3·5mm (0·138 inch) of the geometric centre of the tube face. The neck axis will make an angle of less than 1° 30′ with the normal to the tangential plane at the centre of the faceplate.

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