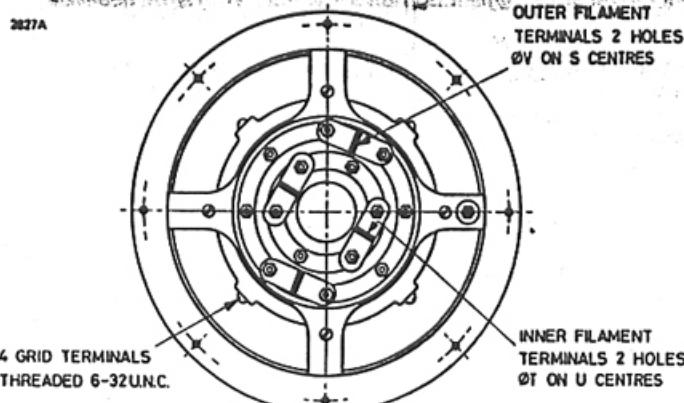


OUTLINE DETAIL OF MA87 (All dimensions without limits are nominal)**View from underside showing terminals**

Dimensions in inches (1.02 mm) with respect to the anode and grid centres
Dimensions in millimetres (0.012 mm) with respect to the filament terminals indicated by the



2027A

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	0.247 ± 0.010	6.27 ± 0.25 *
C	3.910 ± 0.030	99.31 ± 0.76	N	0.707 ± 0.020	17.96 ± 0.52 *
D	3.702 ± 0.030	94.03 ± 0.76	P*	0.902 ± 0.050	22.90 ± 1.27 *
E	3.281 ± 0.030	83.34 ± 0.76	Q*	1.669 ± 0.050	42.40 ± 1.27 *
F	2.031 ± 0.030	51.59 ± 0.76	R*	0.093 ± 0.016	2.35 ± 0.40
G*	0.146	3.70	S	1.662 ± 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	V	0.250 ± 0.015	6.35 ± 0.38

Millimetre dimensions have been derived from inches except where indicated thus:

1.474±0.014
0.147±0.004

1.495±0.011
0.149±0.004

1.495±0.011
0.149±0.004

* Indicates a change.

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.



(If shown 650) Emission Test Report

R.F. POWER

TETROD

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

ABRIDGED DATA

Water and forced-air cooled power tetrode, coaxial metal-ceramic envelope, for audio and r.f. applications.

The tube is recommended for r.f. linear amplifiers, television linear amplifier service, and as a switch tube for pulsed regulator service.

Anode dissipation (class

C telegraphy) 25 kW max

Anode voltage 10 kV max

Frequency for full ratings 110 MHz max

Frequency at reduced ratings 225 MHz max

Output power (class C telegraphy) 36.5 kW

To 5000V



Grid current	Anode current	Anode voltage	Power
0.1	0.2	10	25 kW
0.2	0.4	10	25 kW
0.4	0.8	10	25 kW
0.8	1.6	10	25 kW

GENERAL

Electrical

Filament	Thoriated tungsten	
Filament voltage (see note 1)	6.3	V
Filament current at 6.3 V	152 to 168	A
Grid-screen amplification factor	4.5	
Inter-electrode capacitances:		

	Grounded Filament		Grounded Grid and Screen	
	Min	Max	Min	Max
input	154	167	62	72 pF
output	22	27	23	28 pF
feedback	-	2.0	-	0.3 pF

Mechanical

Overall length	12.690 inches (322.3 mm) max
Overall diameter	4.750 inches (120.7 mm) max
Net weight	13.5 pounds (6.1 kg) approx
Mounting position	vertical, either way up

COOLING

The tube has an integral water jacket and may be operated with the anode up or down. Minimum water cooling requirements are shown in the following table; higher rates of flow should be used where possible. An allowance of 1600 watts for the power dissipated by the filament and grids has been made in the values given.

Anode dissipation (kW)	Water flow		Pressure drop	
	gal/min	l./min	lb/in ²	kg/cm ²
10	2.2	10	3.3	0.23
15	3.0	13.6	5.0	0.35
20	4.0	18.2	8.0	0.56
25	5.0	22.7	11.5	0.82

COOLING (continued)

The water outlet temperature must not exceed 70 °C, and the water inlet pressure must not exceed 50 lb/in² (3.5 kg/cm²). (A) COOLANT MAXIMUM
Anode voltage
Forced-air cooling of the base is also required; the use of air distribution socket MA87 is recommended. A flow of approximately 50 ft³/min through the socket and over the seals will be sufficient.

The cooling water and air flows may be removed simultaneously with the tube power.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

(Class AB1) (See Note 2)

MAXIMUM RATINGS (Absolute values)

Anode voltage	10	kV max
Anode current	6.0	A max
Anode dissipation	25	kW max
Screen voltage	2.0	kV max
Screen dissipation	450	W max
Grid dissipation	200	W max

TYPICAL OPERATING CONDITIONS (Class AB1, two tubes)

Anode voltage	7.5	10	kV
Screen voltage	1.5	1.5	kV
Grid voltage (see note 3)	-350	-370	V
Peak a.f. grid voltage, per tube	330	340	V
Anode current (zero signal)	2 x 1.0	2 x 1.0	A
Anode current (maximum signal)	8.8	8.5	A
Screen current (zero signal)	0	0	A
Screen current (maximum signal)	0.34	0.30	A
Anode dissipation (maximum signal)	12.2	14	kW
Effective load (anode to anode)	1.73	2.52	kΩ
Nominal driving power (maximum signal)	0	0	W
Output power (maximum signal)	41.6	57	kW

RADIO FREQUENCY LINEAR AMPLIFIER

(Bentham) DH1100

(Class AB1) (See note 2)

Maximum ratings for power output up to 100 W. Maximum plate current 6.0 A.

MAXIMUM RATINGS (Absolute values)

Anode voltage	10	kV max
Anode current	6.0	A max
Anode dissipation	25	kW max
Screen voltage	2.0	kV max
Screen dissipation	450	W max
Grid dissipation	200	W max

TYPICAL OPERATING CONDITIONS (Up to 110 MHz)

(Peak envelope or modulation crest conditions)

Anode voltage	7.5	10	kV
Screen voltage	1.5	1.5	kV
Grid voltage (see note 3)	-350	-370	V
Peak r.f. grid voltage	330	340	V
Anode current (zero signal)	1.0	1.0	A
Anode current (single tone)	4.0	4.25	A
Screen current (single tone)	0.17	0.15	A
Anode dissipation	12.2	14	kW
Nominal driving power	0	0	W
Output power (see note 4)	20.8	28.5	kW
Resonant load impedance	865	1260	Ω

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	8.0	kV max
Anode current	4.0	A max
Anode dissipation (see note 5)	16.4	kW max
Screen voltage	1.5	kV max
Screen dissipation	450	W max
Grid dissipation	200	W max

TYPICAL OPERATING CONDITIONS (Up to 110 MHz)

Anode voltage	7.5	10	kV
Screen voltage	750	750	V
Grid voltage	-600	-640	V
Peak a.f. screen voltage (for 100% modulation)	740	710	V
Peak r.f. grid voltage	800	840	V
Anode current	3.75	3.65	A
Screen current	0.45	0.43	A
Grid current	0.18	0.18	A
Anode dissipation	5.1	5.8	kW
Nominal driving power	150	150	W
Output power	17.4	23.5	kW

R.F. POWER AMPLIFIER OR OSCILLATOR

(Class 'C' Telegraphy, key down conditions, one tube)

MAXIMUM RATINGS (Absolute values)

Anode voltage	10	kV max
Anode current	5.0	A max
Anode dissipation	25	kW max
Screen voltage	2.0	kV max
Screen dissipation	450	W max
Grid dissipation	200	W max

TYPICAL OPERATING CONDITIONS (up to 110 MHz)

Anode voltage	7.5	10	kV
Screen voltage	750	750	V
Grid voltage	-510	-550	V
Peak r.f. grid voltage	730	790	V
Anode current	4.65	4.55	A
Screen current	0.59	0.54	A
Grid current	0.30	0.27	A
Anode dissipation	8.1	9.0	kW
Nominal driving power	250	220	W
Output power	26.7	36.5	kW

SWITCH TUBE OR PULSED REGULATOR SERVICE

MAXIMUM RATINGS (Absolute values)

D.C. anode voltage	20	kV max
Peak anode current	60	A max
Anode dissipation (average)	25	kW max
D.C. screen voltage	3.0	kV max
Screen dissipation (average)	450	W max
D.C. grid voltage (negative)	1.5	kV max
Grid dissipation (average)	200	W max
Peak cathode current	80	A max
Pulse duration	see note 6	
Duty factor	see note 6	

NOTES

1. The tube must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed $\pm 5\%$.
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 25 kW anode dissipation at 100% sine wave modulation.
6. The duty factor must be sufficiently low to prevent the tube dissipation ratings from being exceeded. For pulse durations of more than 0.1 s, a reduction in tube dissipation ratings is necessary.

HEALTH AND SAFETY HAZARDS

EEV electronic devices are safe to handle and operate, provided that the precautions stated are observed. EEV 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 other stored energy before allowing access. Interlock switches must not be bypassed to allow operation with access doors open.

R.F. Radiation

Personnel must not be exposed to excessive r.f. radiation. A properly designed equipment cabinet with good r.f. electrical connection between panels will normally provide sufficient protection.

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.

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 pack. During installation or replacement the tube must not be scratched or damaged in any way likely to reduce the strength of the envelope.

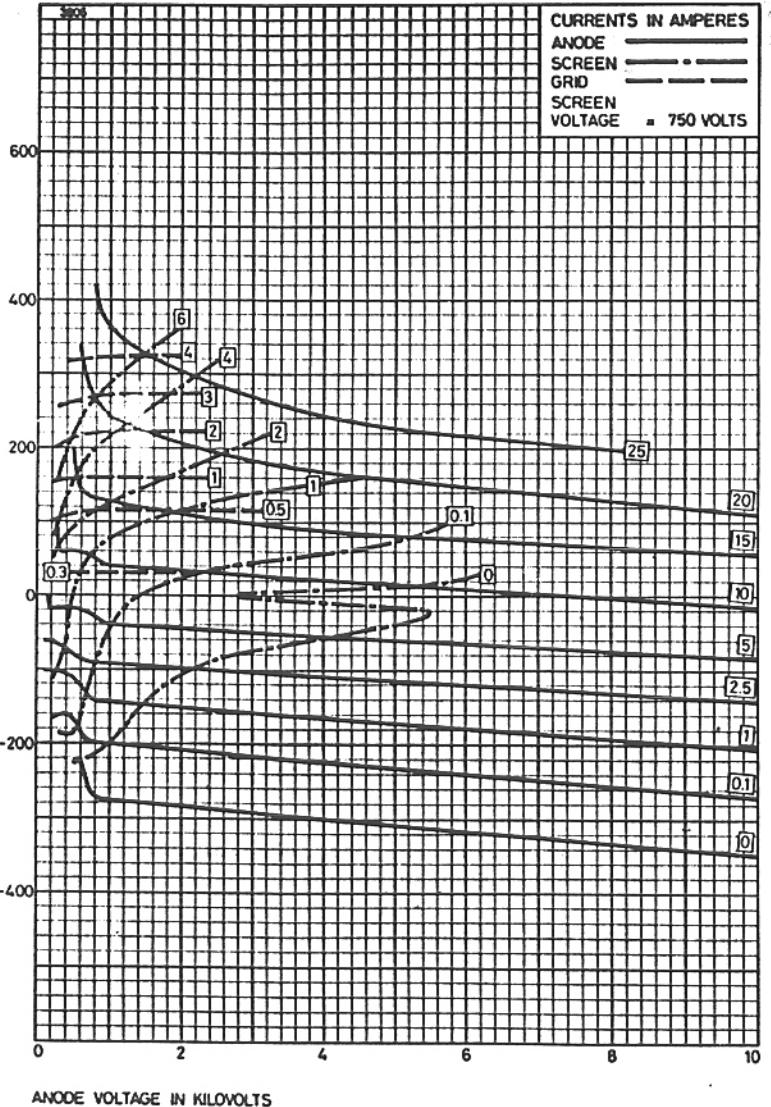
References

1. BS3192. Specification for safety requirements for radio (including television) transmitting apparatus.
2. JEDEC Publication no. 81. Recommended practice on X-radiation detection and measurement for high power tubes.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

NETHERLANDS AND GERMANY
EEA

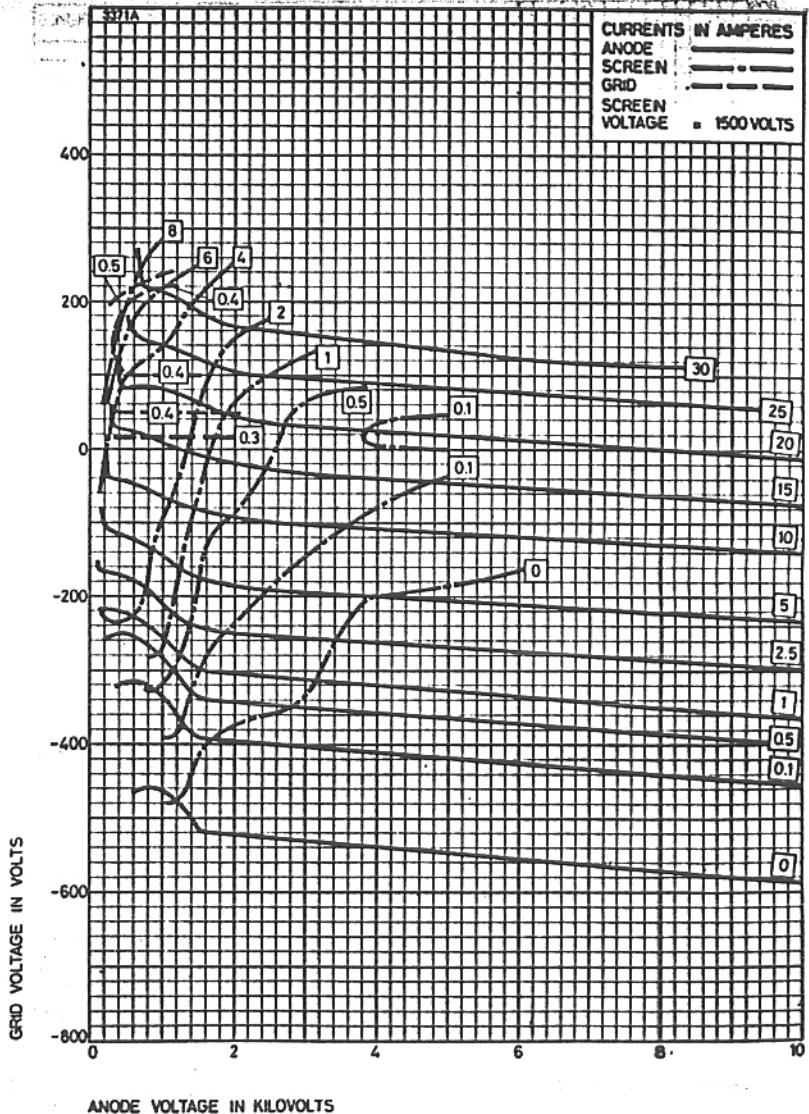
AMERICAN ELECTRO-OPTICAL COMPANY, INC., NEW YORK, N.Y.



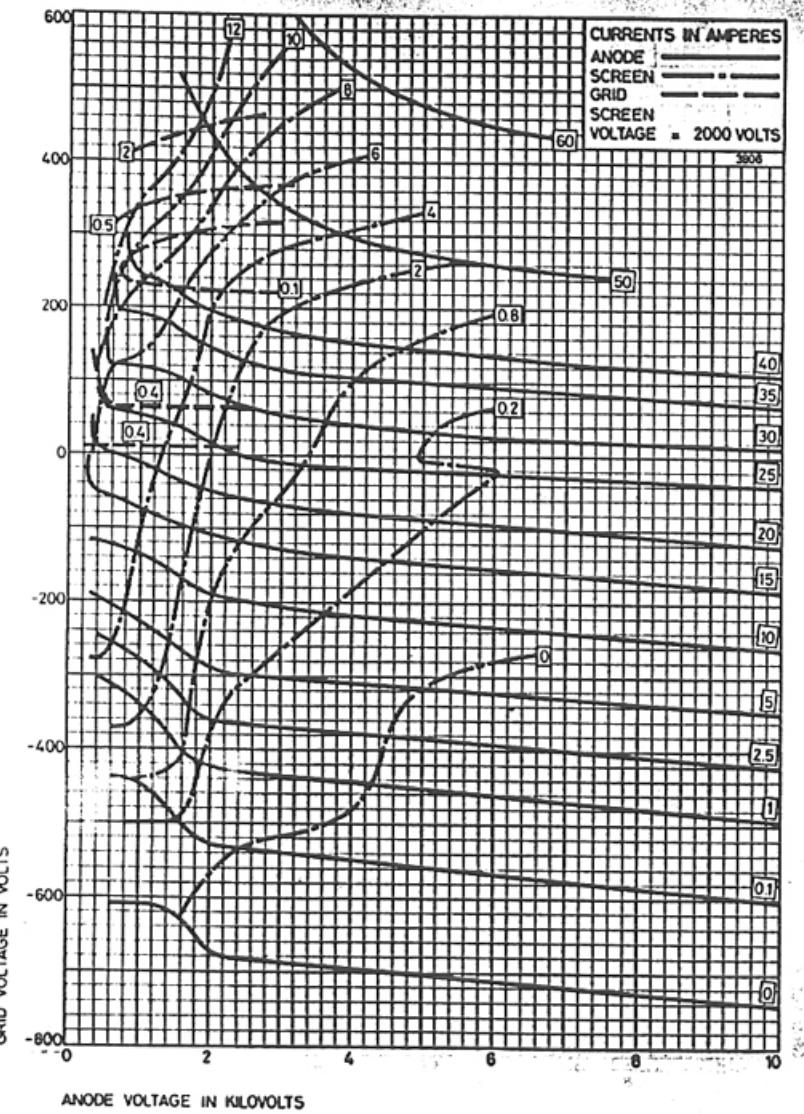
TYPICAL CONSTANT CURRENT CHARACTERISTICS

NETHERLANDS AND GERMANY
EEA

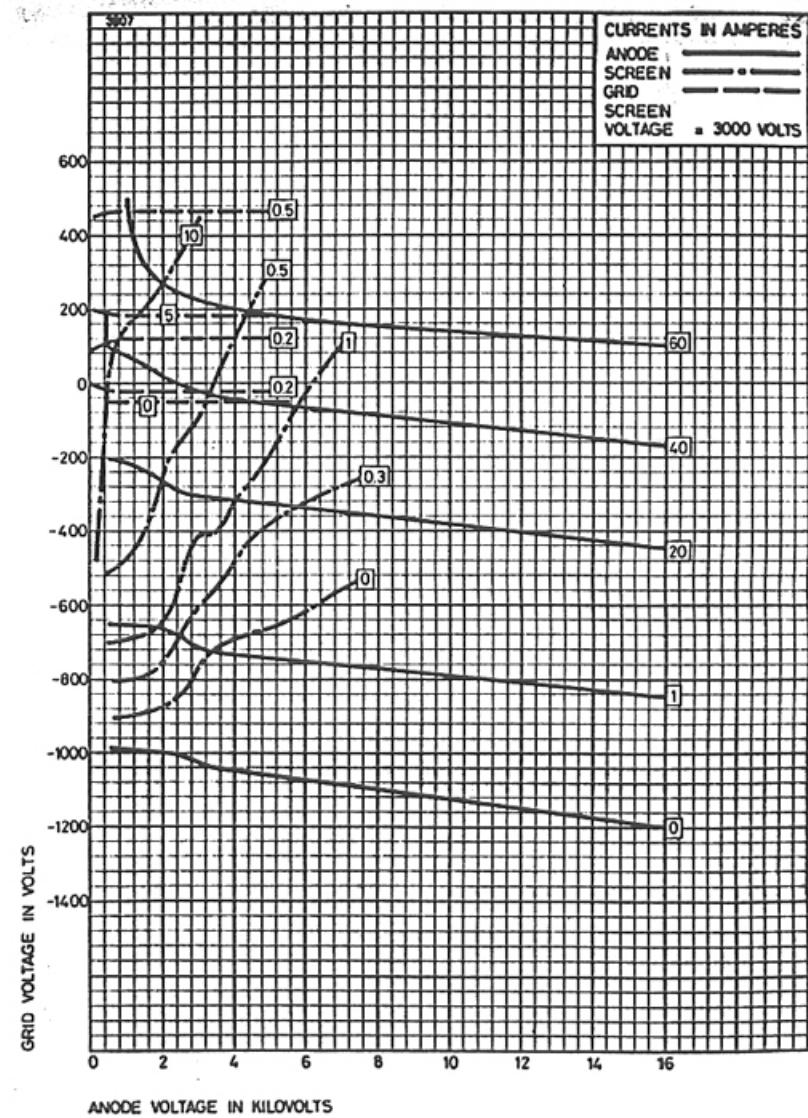
AMERICAN ELECTRO-OPTICAL COMPANY, INC., NEW YORK, N.Y.



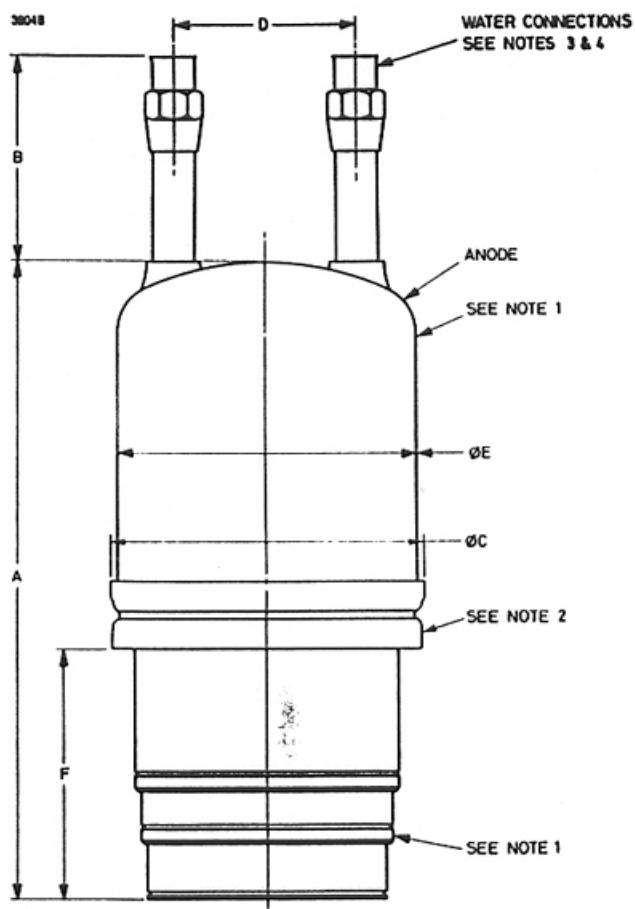
TYPICAL CONSTANT CURRENT CHARACTERISTICS



TYPICAL CONSTANT CURRENT CHARACTERISTICS



OUTLINE (See page 14 for Outline Notes)

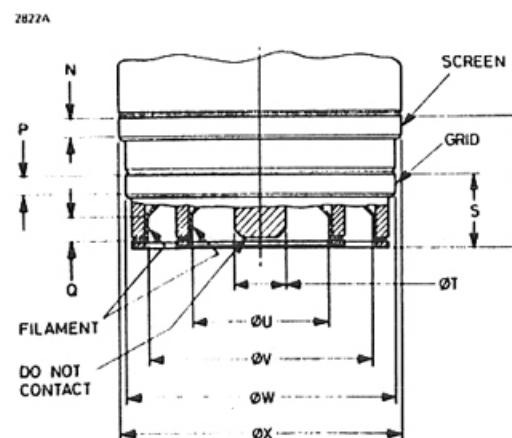


OUTLINE DIMENSIONS

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.315 ± 0.250	236.6 ± 6.4	Q	0.188 min	4.78 min
B	3.000 ± 0.125	76.20 ± 3.18	R	1.795 ± 0.031	45.59 ± 0.79
C	4.750 max	120.7 max	S	1.018 ± 0.032	25.86 ± 0.81
D	2.750 ± 0.125	69.85 ± 3.18	T	0.740 ± 0.020	18.80 ± 0.51
E	4.540 ± 0.030	115.3 ± 0.8	U	1.916 ± 0.020	48.67 ± 0.51
F	3.189 ± 0.118	81.0 ± 3.0 *	V	3.153 ± 0.020	80.09 ± 0.51
N	0.188 min	4.78 min	W	3.812 ± 0.020	96.82 ± 0.51
P	0.188 min	4.78 min	X	4.000 ± 0.020	101.6 ± 0.5

Millimetre dimensions have been derived from inches.

Outline Detail



* Indicates a change.

Outline Notes

- The eccentricity of the screen and filament contact surfaces will not exceed 0.040 inch (1.02 mm) with respect to the anode and grid contact surfaces when the tube is rotated on rollers at the points indicated by the arrows.
- This surface must not be used as an electrical contact and it must not be clamped in any way.
- Water connection 15 mm external diameter copper tubing with $\frac{5}{8}$ -inch short flare fitting nuts threaded $\frac{7}{8}$ -14 U.N.F.-2B. An accessory type MA438, comprising a $\frac{7}{8}$ -14 U.N.F.-2B water coupling with copper tube, is available. Two MA438 are required per 4CW25,000A.
- The water connections must be made as follows, depending on the mounting position.

	Anode down	Anode up
Inlet	1	2
Outlet	2	1

OUTLINE OF AIR DISTRIBUTION SOCKET MA87

