AEI

Industrial Valves and Cathode Ray tubes

DATA HANDBOOK

Associated Electrical Industries Ltd
Radio Components Department
155 Charing Cross Road, London, WC2

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(i.e. Valves with an anode dissipation greater than 100W)

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RECTIFIERS AND THYRATRONS

SPECIAL QUALITY VALVES

ELECTRON OPTICAL DEVICES

Photo-cells

Photomultipliers

Cathode-ray tubes

MISCELLANEOUS

October, 1962

Associated Electrical Industries Limited

Radio Components Department

Tel.: GERrard 9797

High Power Valves

(i.e., Valves with an anode dissipation greater than 100 w)

APPLICATION NOTES ON THE USE OF VAPOUR COOLED VALVES

DESIGN CONSIDERATIONS

The limiting value of V_a allows for the use of poorly regulated H.T. supplies or for those with appreciable ripple. In extreme cases of poor regulation or in the presence of large ripple values the maximum design value of V_a may have to be reduced to ensure that the absolute maximum rating is not exceeded during any part of the low frequency cycle or when the H.T. rises off load.

With 3-phase full wave or half wave rectification of normal regulation the typical operating conditions can be used directly.

In analyses care must be taken when using H.T. supplies of large ripple content that allowance is made for the increase in effective voltage, current and power. In the single phase full wave unsmoothed case the increase in power approaches 23% as compared with the product of mean current and voltage.

It is recommended that a resistor of 2·5 ohms for each 1 kV of anode voltage is included between the H.T. source and the valve anode as a surge limiter.

COOLING

The Vapotron system lends itself to four different methods of cooling, each with its own characteristics and advantages.

(*a*) Boiler with convection cooled heat exchangers : This requires a minimum of 0·75 sq. ft. in a horizontal plane for each kilowatt of input power to the boiler. This rating is based on a 30-in. chimney, 30°C. ambient

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APPLICATION NOTES ON THE USE OF VAPOUR COOLED VALVES

air temperature, 70°C. maximum condensate temperature and a recommended design of heat exchanger. This system is attractive where the minimum of moving parts is desirable, where water is at a premium, and where dust-laden atmospheres, or noise, prohibit the use of forced air.

(*b*) Boiler with forced air-cooled heat exchanger :
Proprietary equipments consisting of a heat exchanger and fan are available with adequate steam handling capacity. This arrangement is to be preferred where both space and water are at a premium and noise is no objection.

(*c*) Boiler with water-cooled heat exchanger :
Standard types of water-cooled heat exchanger can be used but their suitability for use with steam should be checked. An efficient heat exchanger of a recommended type will require 0·3 of a litre per minute for each kilowatt of input power to the boiler assuming 20°C. inlet water temperature and 70°C. condensate and outlet water temperature. This system is attractive where water is available and uses the minimum amount possible. Scaling troubles are practically eliminated and the necessity for long lengths of insulating hose disappears. This is probably the most compact arrangement.

(*d*) Boiler Condenser :
This system employs a water-cooled heat exchanger within the boiler, and the same water flow is required as for (*c*). This is a very compact arrangement, but the special anti-electrolytic fittings supplied must be used to overcome the effects of leakage currents through the water.

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APPLICATION NOTES ON THE USE OF VAPOUR COOLED VALVES

SAFETY

The Vapotrons are fitted with three low-temperature soldered pull-out lugs in the supporting rim, which are intended to be connected by an insulating cord to a switch which is actuated should loss of water allow the temperature of the rim to rise above that of the solder melting point. This temperature is low enough to preclude damage to the valve.

Dangerous steam pressures are not possible using the boilers, as the blockage in the steam outlet will only result in the valve being lifted off its seating. This occurs at a pressure of the order of 1–2 lbs per sq. in.

In the boiler condenser system the valve is positively fixed to the seating and a sensitive pressure switch is fitted as well as pull-out lugs, so that in case of cooling water failure and consequent rise in steam pressure, a switch will operate and trip the equipment long before any dangerous pressures can be set up. The pull-out lugs will still operate in the event of loss of water from the boiler condenser.

The foregoing are the essential safety precautions which should be taken with every Vapotron installation, but for convenience others could be added, and it is recommended that water level indicators are used with boilers, though these can take an extremely simple form merely by arranging a sight glass on the vertical portion of the condensate return tube. The boiler condensers have a level indication incorporated in the casing.

Condensed Data on Obsolete Types

Type	Class	V_h (volts	I_h (amps)	I_k(em) (amps)	V_a(max) (kV)	P_a(max) (watts)	μ	f(max) at full rating (Mc/s)	r_a (KΩ)
EHF350	Triode R	22.0	16.0	2.5	4	500	43	60	13.5
EHZ350/1	Triode R	22.0	16.0	2.5	5	750	43	60	13.5
ES15	Triode R	16.5	17.5	3.4	4	700	50	6	12.5
ES207	Triode R	16.5	18.0	1.6	5	800	50	75	8.2
ES250M	Triode R	11.0	4.0	4.0	2	250	15	2	4.0
ES253	Triode R	16.5	16.5	1.2	12	800	50	6	20.0
ES357	Triode R	10.0	10.0		4	350	32	100	5.3
ES450	Triode R	17.0	5.65		7	450	30	1	20.0
ES450X	Triode R	18.0	5.15		5	450	30	1	20.0
ES1500	Triode R	15.5	24.0	1.5	7.5	1,500	45	1	20.0
ES1500A	Triode R	15.5	24.0	1.5	7.5	1,500	45	20	20.0
ES1500A/1	Triode R	15.5	24.0	1.5	7.5	1,500	45	20	20.0
ES1500B	Triode R	17.0	27.5	2	7.5	1,500	37	2	16.0
ES1500B/1	Triode R	17.0	27.5	2	7.5	1,500	37	2	16.0
ES1500C/1	Triode R	14.5	28.0	2	7.5	1,500	35	2	16.0
ESW204	Triode R	11.0	6.5	2	2	250	20	60	9.0
ESW207	Triode W	22.0	52.0	9	15	10,000	20	1.6	3.5
ET30	Triode R	12.5	6.3		5	250	26	20	19.0

Abbreviations : R—Radiation Cooled ; W—Water Cooled.

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Condensed Data on Replacement Types

RADIATION COOLED TRIODES

Type Number	V_f (V)	I_f (A)	$V_{a(max)}$ (kV)	$i_{k(pk)max}$ (A)	$p_{a(max)}$ (W)	f_{max}* (Mc/s)	g_m (mA/V)	μ
EHZ350	22	16	5·0	2·5	750	60	3·2	43
ES204A	11	6·3	3·0	4·0	250	2	3·5	25
ES204X	11	6·3	3·0	4·0	250	2	3·5	38
ES275	17	2·5	2·5	1·25	275	1·5	7·3	16
ES1001	10	18	5·0	6·0	1,000	30	8·0	40
ES1500C	14·5	28	7·5	2·0	1,500	2	2·2	35

RADIATION COOLED TETRODE

ESG250	11·25	8·0	5·0	—	250	—	1·0	100

RADIATION COOLED PENTODE

ESP450	10	13	3·0	—	450	10	6·5	—

FORCED AIR COOLED TRIODES

ESA891	22	60	10	8·5	4,000	1·6	—	8·5
ESA892	22	60	10	8·5	4,000	1·6	7·5	48
ESA2500	8	80	7·5	4·5	2,500	40	5·5	55

WATER COOLED TRIODES

ESW891	22	60	12	8·5	6,000	1·6	—	8·5
ESW892	22	60	13	8·5	10,000	1·6	7·5	48
ESW3000	8·0	80	7·5	4·5	3,000	10	5·5	55

* At full ratings

SELECTION CHART

$P_{a(max)}$ (kW)	f_{max} at full rating (Mc/s)	Cooling			
		Radiation	Forced Air	Water	Vapour
0·275	1·5	V1505			
0·3	1·5	14D13			
0·3	30	ES833			
0·45	10	ESP450			
0·5	60	14D12			
0·65	60			15P12*	
0·75	1·5	14D14			
0·8	60	15D12			
1·0	40	ES1001			
1·3	60		15J12		15V12
3·0	40		16J12 ESA1500	16P12* 16P13*	
4·0	1·6		ESA892		
5·0	40		ESA5000		ESV1500
5·0	50			ESW5000	
10	1·6			ESW892	ESV892
12	40		17J12		
25	40				17V12

* Limited by water connections to 10 Mc/s.

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AEI Radiation Cooled Triode 14D12

GENERAL

The 14D12 is a radiation cooled triode with a graphite anode and a directly heated thoriated tungsten filament. It is intended for use in r.f. heating, modulating and transmitting equipment.

RATINGS*

Filament voltage	V_f	5·0±5%	V
Filament current (approx)	I_f	32·5**	A
Maximum anode voltage	$V_{a(max)}$	6·0	kV
Maximum d.c. grid voltage	$V_{g(max)}$	1000	V
Maximum anode dissipation	$p_{a(max)}$	500†	W
Maximum grid dissipation	$p_{g(max)}$	50	W
Maximum peak cathode current	$i_{k(pk)max}$	3·0	A
Maximum operating frequency	f_{max}	60	Mc/s
Maximum bulb temperature	$T_{bulb(max)}$	250	°C
Maximum seal temperature	$T_{seal(max)}$	200	°C

* Limiting values are absolute maximum values.

** The filament is suitable for direct switching.

† At this dissipation the anode runs bright red at approximately 870°C (Pyrometer reading).

INTER-ELECTRODE CAPACITANCES

Anode/grid	$c_{a\text{-}g}$	6·0	pF
Grid/filament	$c_{g\text{-}f}$	11	pF
Anode/filament	$c_{a\text{-}f}$	0·4	pF

CHARACTERISTICS

Anode voltage	V_a	4·0	kV
Anode current	I_a	120	mA
Mutual conductance	g_m	3·6	mA/V
Amplification factor	μ	22	
Valve anode resistance ($\delta v_a/\delta i_a$)	r_a	6·1	kΩ

Notes

Cooling is by low velocity air blast necessary under all conditions of valve service other than filament dissipation alone.

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TYPICAL OPERATION—At maximum operating conditions.
Class C r.f. power amplifier—unmodulated or frequency modulated.

D.C. anode voltage	V_a	4·0	5·0	6·0	kV
D.C. grid voltage	V_g	280	400	500	V
Peak r.f. drive voltage		570	690	790	V
D.C. anode current	I_a	585	530	500	mA
D.C. grid current	I_g	175	155	145	mA
Driving power		90	100	110	W
Power output	P_{out}	1·8	2·2	2·5	kW

TYPICAL OPERATION—At maximum operating conditions (f_{max} = 60Mc/s)
Class C self oscillator—anode supply d.c. or 3-phase full-wave rectified.

D.C. anode voltage	V_a	4·0	5·0	6·0	kV
D.C. anode current	I_a	585	530	500	mA
D.C. grid current	I_g	175	155	145	mA
Grid resistance	R_g	1·6	2·6	3·4	kΩ
Power input	P_{in}	2·3	2·6	3·0	kW
Power output	P_{out}	1·7	2·0	2·4	kW
Power output at 85% transfer efficiency	P_{out}	1·45	1·75	2·0	kW
Maximum anode dissipation	$P_{a(max)}$	500	500	500	W
Grid dissipation	P_g	45	40	35	W

TYPICAL OPERATION—At maximum operating conditions (f_{max} = 60 Mc/s)
Class C self oscillator—single-phase full-wave rectified, unsmoothed anode supply.

A.C. anode voltage (r.m.s.)	$V_{a(r.m.s.)}$	4·25	kV
Mean anode voltage	$V_{a(av)}$	3·8	kV
D.C. anode current	I_a	405	mA
D.C. grid current	I_g	105	mA
Grid resistance	R_g	2·0	kΩ
Power input	P_{in}	1·9	kW
Power output	P_{out}	1·4	kW
Power output at 85% transfer efficiency	P_{out}	1·2	kW
Maximum anode dissipation	$P_{a(max)}$	500	W
Grid dissipation	P_g	20	W

AEI Radiation Cooled Triode 14D12

TYPICAL OPERATION—At maximum operating conditions ($f_{max} = 60$ Mc/s)
Class C self oscillator—with a.c. anode supply.

A.C. anode voltage (r.m.s.)	$V_{a(r.m.s.)}$	4·25	kV
Mean anode voltage	$V_{a(av)}$	1·9	kV
Mean anode current	$I_{a(av)}$	290	mA
Mean grid current	$I_{g(av)}$	62	mA
Grid resistance	R_g	325	Ω
Power input	P_{in}	1·4	kW
Power output	P_{out}	0·8	kW
Power output at 85% transfer efficiency	P_{out}	0·7	kW
Maximum anode dissipation	$p_{a(max)}$	500	W
Grid dissipation	p_g	15	W

TYPICAL OPERATION—At maximum operating conditions per valve.
Class B1 audio amplification—push pull operation.

Anode voltage	V_a	6·0	kV
A.C. anode current (r.m.s.)	$I_{a(r.m.s.)}$	0·25	A
Power input	P_{in}	1·0	kW
Power output	P_{out}	0·5	kW
Anode dissipation	p_a	0·5	kW
Anode efficiency		50	%
Bias signal	V_g	−220	V
Peak signal voltage	$v_{sig(pk)}$	220	V

MOUNTING POSITION—Vertical, anode upwards.

TOP CAP—Anode.

BASE—Special.

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OPERATING INSTRUCTIONS

Installation

The valve should be mounted vertically with the anode upwards. Connections should always make good electrical contact to prevent overheating pins and seals, particularly by r.f. current.

It is essential that connection be made to both grid pins when running at higher frequencies to reduce current taken by each pin. The valve must be protected against excessive vibration and shock.

Cooling

Forced air blast is recommended for all conditions of valve service except filament dissipation alone.

An air flow of 50 cu. ft./min. directed vertically upwards on to the grid and filament pins is ample.

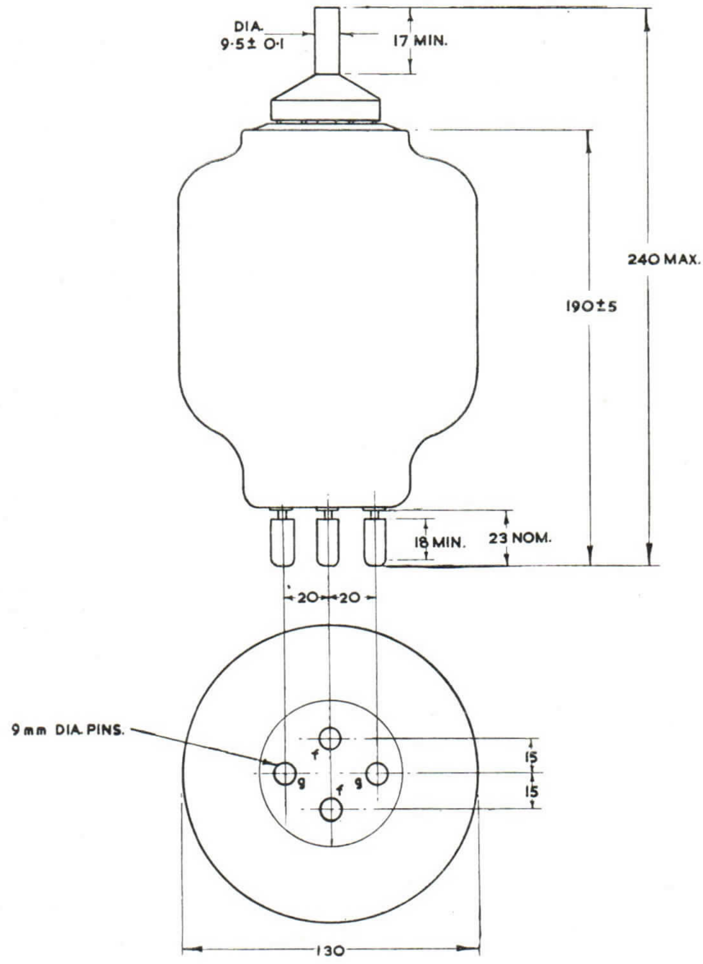
The anode connector should be designed to keep the temperature of the anode seal below the maximum temperature stated.

Operation

The operating data list conditions for maximum output for respective classes of service at the relevant anode voltage. Linear interpolation between anode voltage steps is admissible. As these conditions utilize some or all of the maximum valve ratings, close control of conditions has to be maintained.

In Class C self oscillator service, precautions should be taken against excessive mains voltage variation. Current overload trips should be included in anode and grid circuits as well as an under current trip in the grid circuit.

In industrial r.f. heating it is not usual that all precautions can be taken, and under these conditions some reductions in operating conditions have to be made so that widely fluctuating loads, poor h.t. regulation, and mains variations can be accommodated. Each type of variation brings its own problems and no set rules are practicable.



All dimensions in millimetres.

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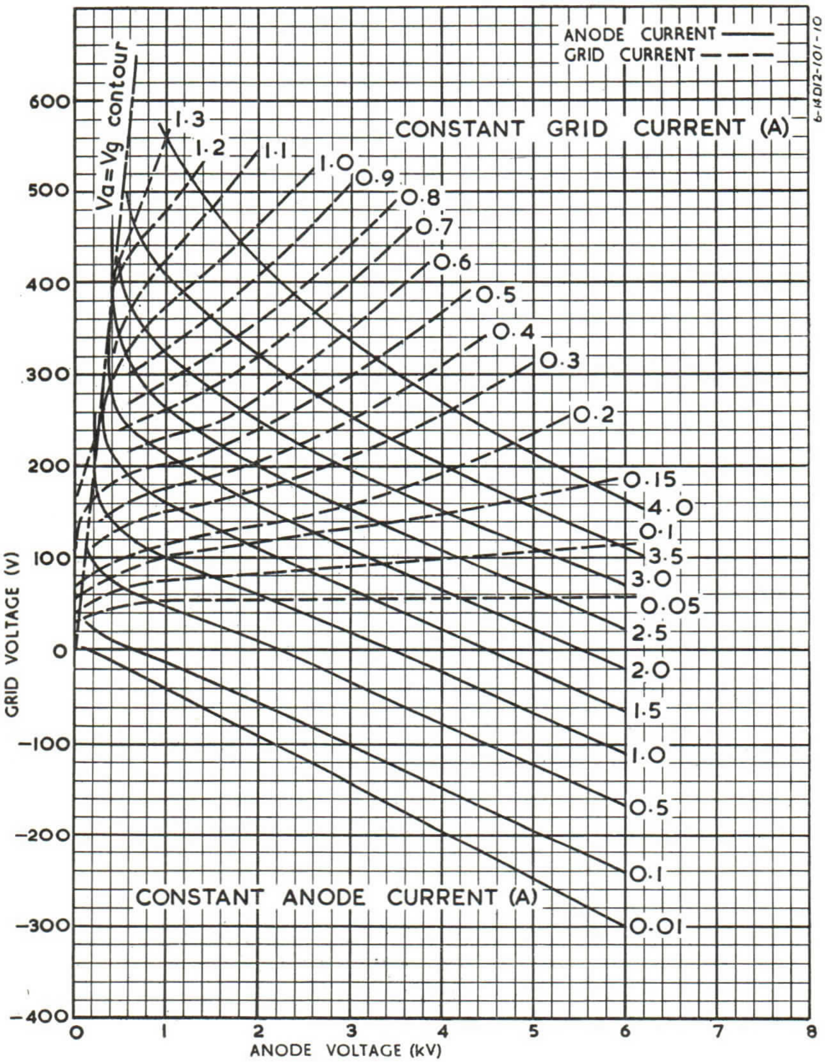
CONSTANT CURRENT CHARACTERISTICS



14D13

RADIATION COOLED TRIODE

GENERAL

The 14D13 is a directly heated Radiation Cooled Triode which is mechanically and electrically identical to the V1505. It has a graphite anode and a thoriated tungsten filament. It is intended for use in Relay and Vibrator Amplifiers, also other low R.F. and A.F. service.

RATING—Absolute Values

Filament Voltage	V_f	14±5%	V
Filament Current	I_f	7·0	A
Maximum Anode Voltage (D.C.)	$V_{a(max)}$	3·0	kV
Maximum Peak Cathode Current	$i_{k(pk)max}$	4·0	A
Maximum Anode Dissipation (continuous)	$P_{a(max)}$	300	W
Maximum Operating Frequency at full ratings	$f_{(max)}$	1·5	Mc/s

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	c_{a-g}	18
Grid/Filament	c_{g-f}	14
Anode/Filament	c_{a-f}	9·0

DIMENSIONS

Maximum Overall Length	345	mm
Maximum Diameter	90	mm
Maximum Seated Height	322	mm

MOUNTING POSITION—Vertical, base down

CHARACTERISTICS

Anode Voltage	V_a	2·0	kV
Anode Current	I_a	150	mA
Mutual Conductance	g_m	8·0	mA/V
Amplification Factor	μ	16	
Valve Anode Resistance	r_a	2·0	kΩ

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14D13

RADIATION COOLED TRIODE

TYPICAL OPERATION—Class AB2, two valves

Values for one valve unless otherwise stated.

Anode Voltage (d.c.) (no signal)	V_a	2·68*	kV
Anode Voltage (d.c.) (maximum signal)	V_a	2·5	kV
Grid Voltage (d.c.) (approx)	V_g	—160	V
Grid Voltage (r.m.s.) (A.F. Sine Wave)	$V_{g(r.m.s.)}$	180	V
Anode Current (d.c.) (no signal)	I_a	100	mA
Anode Current (d.c.) (maximum signal)	I_a	350	mA
Grid Current (d.c.) (maximum signal) (approx)	I_g	25	mA
Grid Current (peak) (approx)	$i_{g(pk)}$	400	mA
Driving Power (maximum signal) (approx)		6·0	W
Maximum Anode Dissipation	$P_{a(max)}$	300	W
Anode/Anode Load (two valves)		10	kΩ
Power Output (maximum signal) (two valves)	Pout	>1·2	kW
Distortion (total at maximum signal) (two valves)	D	<5	%

* Based on 10% h.t. supply regulation.

BASE—Special 4 pin

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15D12

RADIATION COOLED TRIODE

Directly heated

GENERAL

The 15D12 is a directly heated radiation cooled triode. It has a graphite anode, a thoriated tungsten filament and is intended for use in r.f. heating equipment.

RATING

Filament Voltage	V_f	6·3	V
Filament Current	I_f	31—34*	A
Maximum Peak Anode Voltage	$v_{a(pk)max}$	6·0	kV
Maximum Anode Dissipation	$p_{a(max)}$	800**	W
Maximum Grid Dissipation	$p_{g(max)}$	60	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	4·0	A
Maximum Operating Frequency	f_{max}	60	Mc/s
Maximum Seal Temperature	$T_{seal(max)}$	200	°C
Maximum Bulb Temperature	$T_{bulb(max)}$	250	°C

* The filament is suitable for direct switching without additional current limitations and will withstand fluctuations in voltage of $\pm 5\%$.

** At this dissipation the anode runs at approximately 900°C (Optical reading)

All limiting values are Absolute, not Design Centres.

INTER-ELECTRODE CAPACITANCES

Anode/Grid	$c_{a\text{-}g}$	6·5	pF
Grid/Filament	$c_{g\text{-}f}$	13	pF
Anode/Filament	$c_{a\text{-}f}$	0·5	pF

CHARACTERISTICS

Anode Voltage	V_a	4·0	kV
Anode Current	I_a	200	mA
Mutual Conductance	g_m	5·6	mA/V
Amplification Factor	μ	23	
Anode Resistance ($\delta v_a/\delta i_a$)	r_a	4·1	kΩ

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15D12

RADIATION COOLED TRIODE

Directly heated

TYPICAL OPERATION—At maximum operating conditions per valve.

Class B1 audio amplification—push pull operation.

Anode Voltage	V_a	6·0	kV
A.C. Anode Current (r.m.s.)	$I_{a(r.m.s.)}$	0·4	A
Power Input	P_{in}	1·5	kW
Power Output	P_{out}	0·7	kW
Anode Dissipation	p_a	0·8	kW
Anode Efficiency		48	%
Bias Voltage	V_g	−225	V
Peak Signal Voltage	$v_{sig(pk)}$	225	V

TYPICAL OPERATION—At maximum operating conditions.

Class C self oscillator—single phase full wave rectified (no smoothing)

		Mean	R.M.S.	Peak	
Anode Voltage	V_a	3·8	4·25	6·0	kV
Bias Voltage	V_g	−150			V
Positive Grid Voltage	V_{sig}	180			V
Grid Resistor		1·05			kΩ
Anode Current	I_a	625		1700	mA
Grid Current	I_g	140		800	mA
Cathode Current	I_k	2·55	2·8	4·0	A
Anode Dissipation	p_a	800			W
Grid Drive Power		55			W
Grid Dissipation	p_g	25			W
Anode Efficiency		72			%
Power Output (amplifier)	P_{out}	2·1			kW
Power Output (oscillator) at 100% Transfer Efficiency	P_{out}	2·05			kW
Power Output (oscillator) at 85% Transfer Efficiency	P_{out}	1·75			kW

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15D12

RADIATION COOLED TRIODE
Directly heated

TYPICAL OPERATION—At maximum operating conditions.

Class C self oscillator—3-phase full wave rectified or d.c.

		Mean	R.M.S.	Peak	
Anode Voltage	V_a	4·0	5·0	6·0	kV
Bias Voltage	V_g	−260	−340	−500	V
Positive Grid Voltage	V_{sig}	260	260	240	V
Grid Resistor		1·2	1·65	3·35	kΩ
Mean Anode Current	$I_{a(av)}$	815	780	660	mA
Mean Grid Current	$I_{g(av)}$	220	205	150	mA
Peak Cathode Current	$i_{k(pk)}$	4·0	4·0	4·0	A
Peak Anode Current	$i_{a(pk)}$	2·8	2·8	3·0	A
Peak Grid Current	$i_{g(pk)}$	1·2	1·2	1·0	A
Anode Dissipation	Pa	800	800	800	W
Grid Drive Power		105	115	105	W
Grid Dissipation	Pg	50	45	30	W
Anode Efficiency		76	79	80	%
Power Output (amplifier)	Pout	2·5	3·1	3·2	kW
Power Output (oscillator) at 100% Transfer Efficiency	Pout	2·4	3·0	3·1	kW
Power Output (oscillator) at 85% Transfer Efficiency	Pout	2·0	2·5	2·6	kW

TYPICAL OPERATION—At maximum operating conditions.

Class C self oscillator—single phase self rectified.

		Mean	R.M.S.	Peak	
Anode Voltage	V_a	1·9	3·0	6·0	kV
Bias Voltage	V_g	−20			V
Positive Grid Voltage	V_{sig}	120			V
Grid Resistor		195			Ω
Anode Current	I_a	430		900	mA
Grid Current	I_g	100		500	mA
Cathode Current	I_k	1·25	2·0	4·0	A
Anode Dissipation	Pa	800			W
Grid Drive Power		31			W
Grid Dissipation	Pg	29			W
Anode Efficiency		63			%
Power Output (amplifier)	Pout	1·25			kW
Power Output (oscillator) at 100% Transfer Efficiency	Pout	1·2			kW
Power Output (oscillator) at 85% Transfer Efficiency	Pout	1·0			kW

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15D12

RADIATION COOLED TRIODE

Directly heated

DIMENSIONS

Maximum Overall Length	254 mm
Maximum Diameter	152 mm

MOUNTING POSITION—Vertical, anode upwards.

TOP CAP—Anode

BASE—Special

OPERATING INSTRUCTIONS

Installation

The valve should be mounted vertically with the anode upwards. Connections should always make good electrical contact to prevent overheating pins and seals, particularly by r.f. current.

It is essential that connection be made to both grid pins when running at higher frequencies to reduce current taken by each pin. The valve must be protected against excessive vibration and shock.

Cooling

Forced air blast is recommended for all conditions of valve service except filament dissipation alone.

An air flow of 50 cu. ft./min. directed vertically upwards on to the grid and filament pins is ample.

The anode connector should be designed to keep the temperature of the anode seal below the maximum temperature stated.

Operation

The operating data list conditions for maximum output for respective classes of service at the relevant anode voltage. Linear interpolation between anode voltage steps is admissible. As these conditions utilize some or all of the maximum valve ratings, close control of conditions has to be maintained.

In Class C self oscillator service, precautions should be taken against excessive mains voltage variation. Current overload trips should be included in anode and grid circuits as well as an under current trip in the grid circuit.

In industrial r.f. heating it is not usual that all precautions can be taken, and under these conditions some reductions in operating conditions have to be made so that widely fluctuating loads, poor h.t. regulation, and mains variations can be accommodated. Each type of variation brings its own problems and no set rules are practicable.

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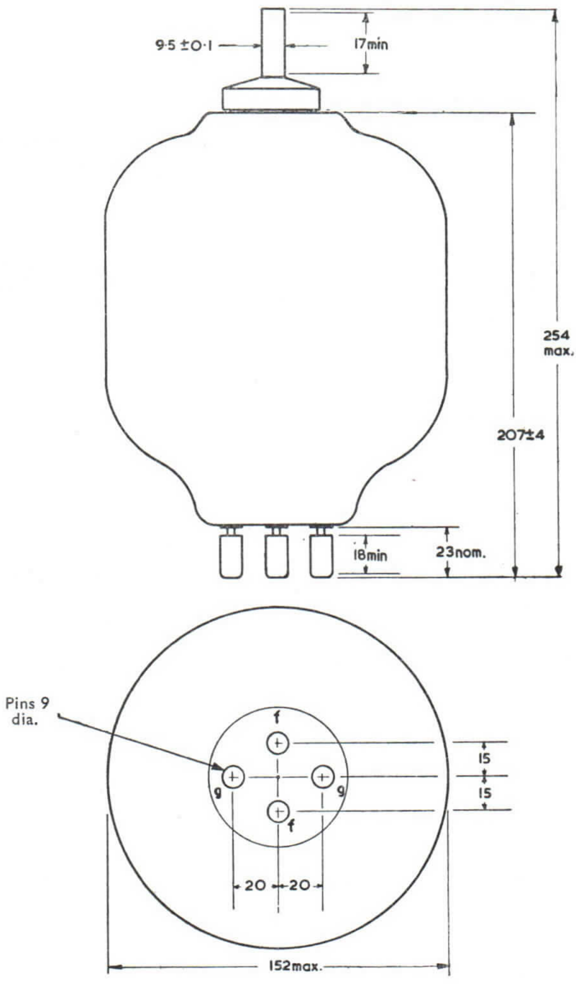
AEI Radiation Cooled Triode 15D12



All dimensions in mm.

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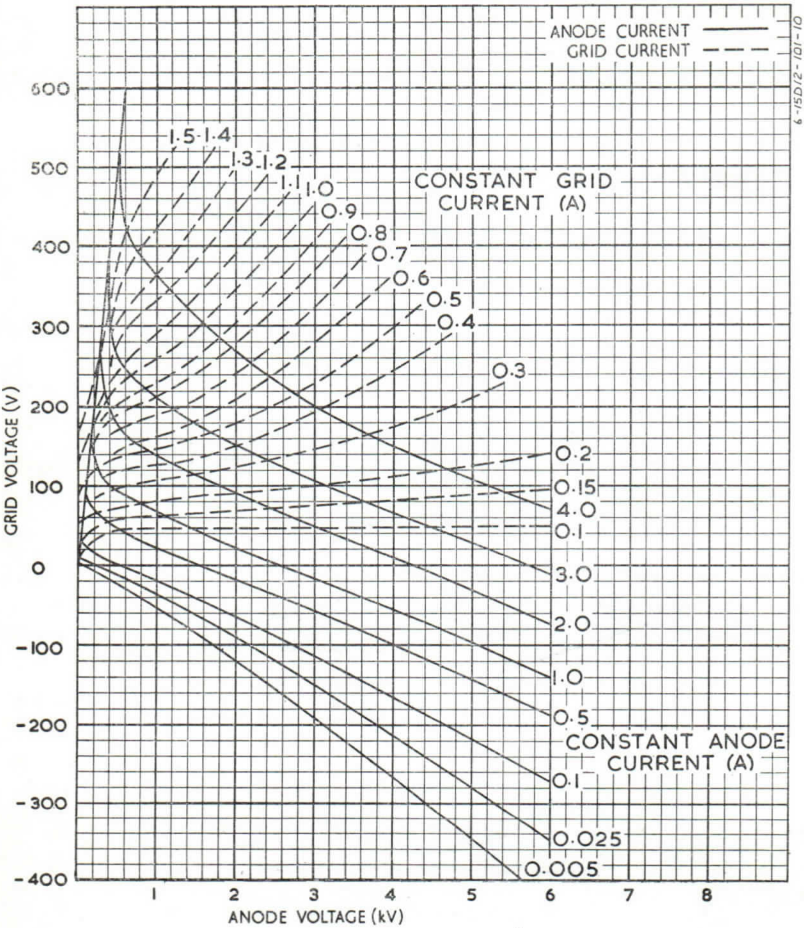
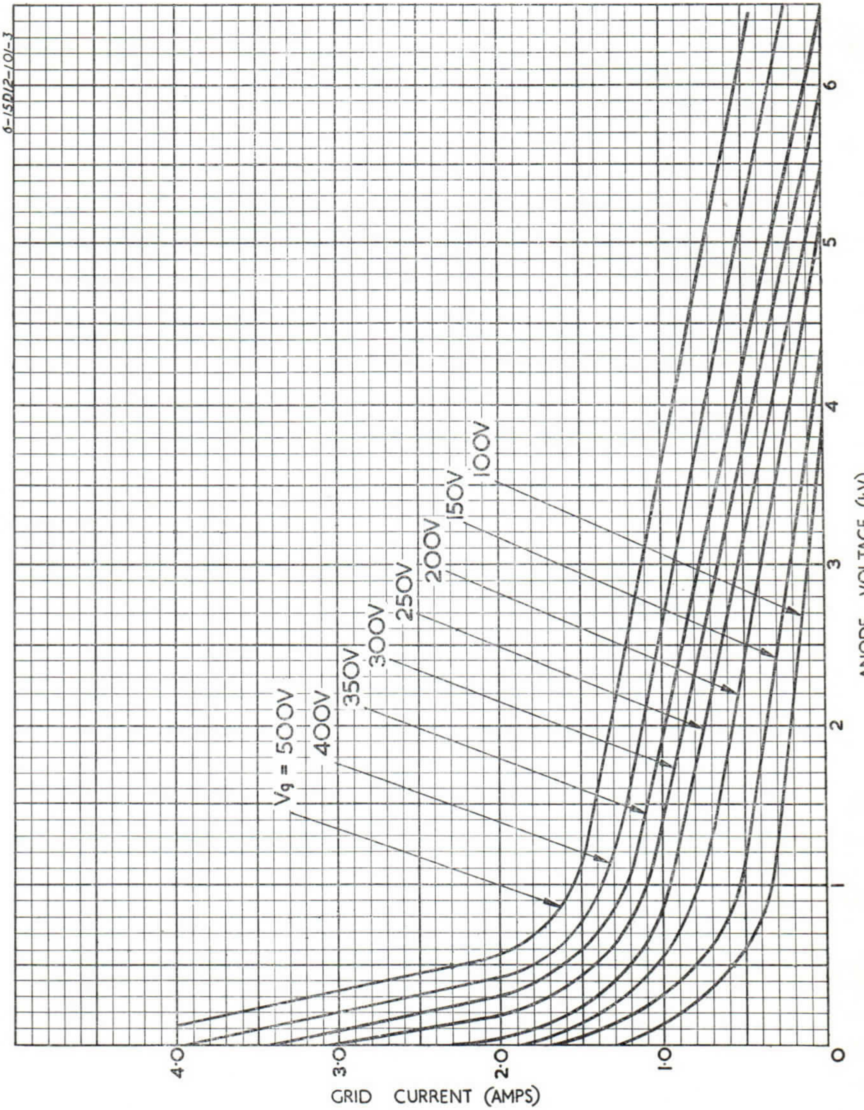
CONSTANT CURRENT CHARACTERISTICS



CHARACTERISTIC CURVES: V_a/I_g



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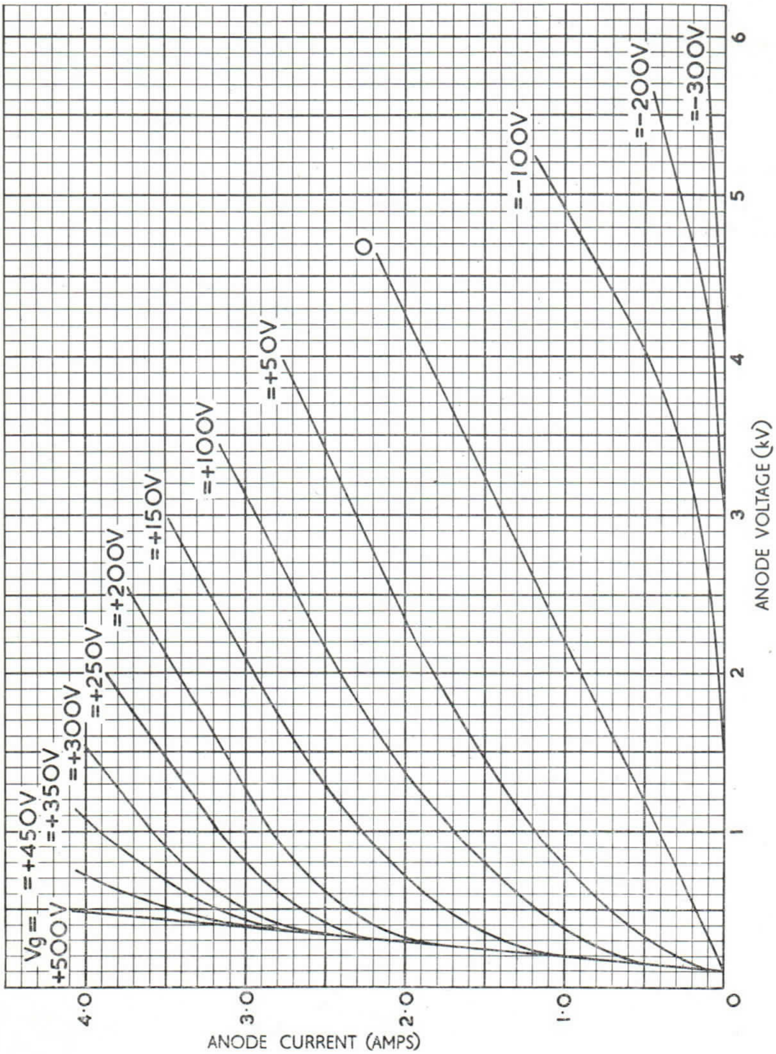
CHARACTERISTIC CURVES: I_a/V_a



15J12
FORCED AIR COOLED TRIODE
Directly heated

TENTATIVE

GENERAL

The 15J12 is a forced air cooled triode which has a directly heated thoriated tungsten filament. It is intended for use in r.f. heating equipment.

RATING

Filament Voltage	V_f	6·3	V
Filament Current	I_f	32·5	A
Maximum Anode Voltage	$V_{a(max)}$	7·0	kV
Maximum Anode Dissipation	$P_{a(max)}$	1·3	kW
Minimum Air Flow for Maximum Anode Dissipation		60	ft^3/min
Maximum Peak Cathode Current	$i_{k(pk)max}$	4·0	A
Maximum Operating Frequency at Full Rating	f_{max}	60	Mc/s

INTER-ELECTRODE CAPACITANCES

Anode/Grid	$c_{a\text{-}g}$	11	pF
Grid/Filament	$c_{g\text{-}f}$	13	pF
Anode/Filament	$c_{a\text{-}f}$	0·6	pF

CHARACTERISTICS

Anode Voltage	V_a	4·0	kV
Anode Current	I_a	190	mA
Mutual Conductance	g_m	5·1	mA/V
Amplification Factor	μ	22	

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15J12
FORCED AIR COOLED TRIODE
Directly heated
TENTATIVE

TYPICAL OPERATION—Maximum operating conditions per valve

Class B1 audio amplifier—push-pull operation

Anode Voltage	V_a	6·0	kV
Anode Current R.M.S.	$I_{a(r.m.s.)}$	0·6	A
Power Input	P_{in}	2·2	kW
Power Output	P_{out}	0·9	kW
Anode Dissipation	Pa	1·3	kW
Anode Efficiency		40	%
Negative Grid Bias Voltage	V_g	−225	V
Peak Signal Voltage	$v_{sig(pk)}$	225	V

TYPICAL OPERATION—Maximum operating conditions

Class C—single phase full wave (no smoothing)

		Mean	R.M.S.	Peak	
Anode Voltage	V_a	3·8	4·25	6·0	kV
Negative Grid Bias Voltage	V_g	−80			V
Positive Grid Voltage	V_{sig}	154			V
Grid Resistance	R_g	0·7			kΩ
Mean Anode Current	$I_{a(av)}$	730			mA
Mean Grid Current	$I_{g(av)}$	120			mA
Peak Cathode Current	$i_{k(pk)}$	2·5	2·8	4·0	A
Peak Anode Current	$i_{a(pk)}$	1·9			A
Peak Grid Current	$i_{g(pk)}$	0·6			A
Anode Dissipation	Pa	1·3			kW
Grid Drive Power		30			W
Grid Dissipation	Pg	20			W
Anode Efficiency		61			%
Power Output (amplifier)	P_{out}	2·1			kW
Power Output (oscillator) at 100% Transfer Efficiency	P_{out}	2·1			kW
Power Output (oscillator) at 85% Transfer Efficiency	P_{out}	1·8			kW

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15J12

FORCED AIR COOLED TRIODE

Directly heated

TENTATIVE

TYPICAL OPERATION—Maximum operating conditions

Class C—3-phase rectified or d.c.

Anode Voltage	V_a	4·0	5·0	6·0	kV
Negative Grid Bias Voltage	V_g	−140	−220	−300	V
Positive Grid Voltage	V_{sig}	270	270	270	V
Grid Resistance	R_g	553	982	1400	Ω
Mean Anode Current	$I_{a(av)}$	1068	993	930	mA
Mean Grid Current	$I_{g(av)}$	253	224	204	mA
Peak Cathode Current	$i_{k(pk)}$	4·0	4·0	4·0	A
Peak Anode Current	$i_{a(pk)}$	3·0	3·0	3·0	A
Peak Grid Current	$i_{g(pk)}$	1·0	1·0	1·0	A
Anode Dissipation	p_a	1·3	1·3	1·3	kW
Grid Drive Power		104	100	108	W
Grid Dissipation	p_g	60	50	48	W
Anode Efficiency		69	73	76	%
Power Output (amplifier)	P_{out}	2·9	3·6	4·2	kW
Power Output (oscillator) at 100% Transfer Efficiency	P_{out}	2·8	3·5	4·1	kW
Power Output (oscillator) at 85% Transfer Efficiency	P_{out}	2·4	3·0	3·5	kW

DIMENSIONS

Maximum Overall Length	200 mm
Maximum Diameter	102 mm

MOUNTING POSITION—Vertical, anode upwards

ANODE—External

BASE—Special

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15J12
FORCED AIR COOLED TRIODE
Directly heated

TENTATIVE

OPERATING INSTRUCTIONS

Installation

The valve should be mounted vertically with anode upwards. Connections should always make good electrical contact to prevent overheating of pins and seals, particularly by r.f. current.

It is essential that connection be made to both grid pins when running at higher frequencies, to reduce current taken by each pin.

The valve must be protected against excessive vibration and shock.

Cooling

A minimum forced air blast of 60 cu.ft/min, directed horizontally at the anode, is required when running this valve.

At higher frequencies, etc. a low velocity air blast directed on to the filament and grid pins is recommended.

Operation

The operating data list conditions for maximum output for respective classes of service at the relevant anode voltage.

Linear interpolation between anode voltage steps is admissible. As these conditions utilize some or all of the maximum valve ratings, close control of conditions has to be maintained. In Class C self oscillator service precautions should be taken against excessive mains voltage variations. Current overload trips should be included in anode and grid circuits as well as an under current trip in the grid circuit.

In industrial r.f. heating it is not usual that all precautions can be taken, and under these conditions some reductions in operating conditions have to be made so that widely fluctuating loads, poor h.t. regulation, and mains variations can be accommodated. Each type of variation brings its own problems and no set rules are practicable.

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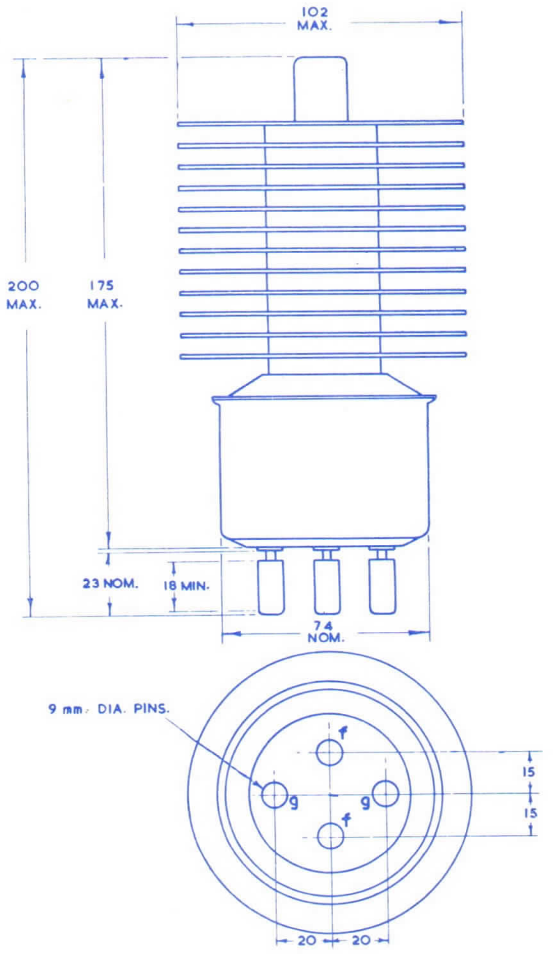
15J12

FORCED AIR COOLED TRIODE

Directly heated

TENTATIVE



All dimensions in mm.

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15P12

WATER COOLED TRIODE

TENTATIVE

GENERAL

The 15P12 is a Water Cooled Triode with a directly heated thoriated tungsten filament. It is intended for use in R.F. heating equipment.

RATING—Absolute Values

Filament Voltage	V_f	5	V
Filament Current	I_f	32·5	A
Maximum Anode Voltage	$V_{a(max)}$	7	kV
Maximum Anode Dissipation	$P_{a(max)}$	650	W
Minimum Water Flow for Maximum Anode Dissipation		1	L/min
Maximum Water Outlet Temperature		55	°C

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	$c_{a\text{-}g1}$	10·5
Grid/Filament	$c_{g1\text{-}f}$	11
Anode/Filament	$c_{a\text{-}f}$	0·5

DIMENSIONS

Maximum Overall Length	180	mm
Maximum Diameter (Glass)	80	mm

MOUNTING POSITION—Vertical, base down.

CHARACTERISTICS

Anode Voltage	V_a	4	kV
Anode Current	I_a	120	mA
Mutual Conductance	g_m	3·3	mA/V
Amplification Factor	μ	21	

ANODE—External

BASE—Special

Associated Electrical Industries Limited
Electronic Components Division
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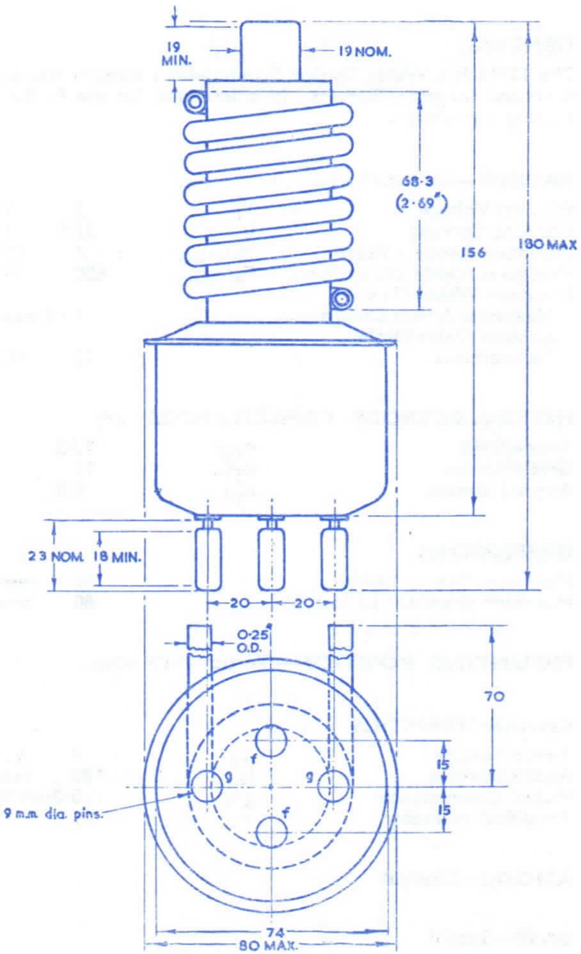
15P12

WATER COOLED TRIODE

TENTATIVE



All dimensions in millimetres unless otherwise shown.

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AEI Water Cooled Triode 15P12

GENERAL

The 15P12 is a water cooled triode with a directly heated thoriated tungsten filament. It is intended for use in r.f. heating equipment.

RATINGS*

Filament voltage	V_f	5·0	V
Filament current	I_f	32·5	A
Maximum anode voltage	$V_{a(max)}$	7·0	kV
Maximum anode dissipation	$p_{a(max)}$	650	W
Minimum water flow for maximum anode dissipation		1	L/min
Maximum water outlet temperature		55	°C
Maximum peak cathode current	$i_{k(pk)max}$	3·0	A
Maximum operating frequency at full ratings	f_{max}	60†	Mc/s

* Limiting values are absolute maximum values.
† Limited by water connections to 10 Mc/s.

INTER-ELECTRODE CAPACITANCES

Anode/grid	$c_{a\text{-}g}$	10·5	pF
Grid/filament	$c_{g\text{-}f}$	11	pF
Anode/filament	$c_{a\text{-}f}$	0·5	pF

CHARACTERISTICS

Anode voltage	V_a	4·0	kV
Anode current	I_a	120	mA
Mutual conductance	g_m	3·3	mA/V
Amplification factor	μ	21	

TYPICAL OPERATION—Maximum operating conditions per valve

Class B1 audio amplification—push-pull operation.

Maximum anode voltage	V_a	6·0	kV
Anode current r.m.s.	$I_{a(r.m.s.)}$	0·3	A
Power input	P_{in}	1·2	kW
Power output	P_{out}	0·6	kW
Anode dissipation	p_a	0·6	kW
Anode efficiency		50	%
Bias voltage	V_g	–220	V
Peak signal voltage	$v_{sig(pk)}$	220	V

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TYPICAL OPERATION—Maximum operating conditions
Class C—3-phase full-wave rectified or d.c.

Anode voltage	V_a	4·0	5·0	6·0	kV
Bias voltage	V_g	–220	–300	–400	V
Positive grid voltage	V_{sig}	280	280	280	V
Grid resistor	R_g	1·75	1·9	3·1	kΩ
Mean anode current	$I_{a(av)}$	620	600	550	mA
Mean grid current	$I_{g(av)}$	130	160	130	mA
Peak cathode current	$i_{k(pk)}$	3·0	3·0	3·0	A
Peak anode current	$i_{a(pk)}$	2·0	2·0	2·0	A
Peak grid current	$i_{g(pk)}$	1·0	1·0	1·0	A
Anode dissipation	p_a	630	640	650	W
Grid drive power		60	85	85	W
Grid dissipation	p_g	28	38	30	W
Anode efficiency		75	78	80	%
Power output (amplifier)	P_{out}	1·8	2·3	2·65	kW
Power output (oscillator) at 100% transfer efficiency	P_{out}	1·7	2·2	2·6	kW
Power output (oscillator) at 85% transfer efficiency	P_{out}	1·5	1·9	2·2	kW

TYPICAL OPERATION—Maximum operating conditions
Class C—single-phase full-wave rectified (no smoothing).

		Mean	R.M.S.	Peak	
Anode voltage	V_a	3·8	4·25	6·0	kV
Bias voltage	V_g	–140			V
Positive grid voltage	V_{sig}	184			V
Grid resistor	R_g	1·6			kΩ
Mean anode current	$I_{a(av)}$	460			mA
Mean grid current	$I_{g(av)}$	89			mA
Peak cathode current	$i_{k(pk)}$	1·9	2·1	3·0	A
Peak anode current	$i_{a(pk)}$!	1·4			A
Peak grid current	$i_{g(pk)}$	0·5			A
Anode dissipation	p_a	650			W
Grid drive power		23			W
Grid dissipation	p_g	7			W
Anode efficiency		70			%
Power output (amplifier)	P_{out}	1·5			kW
Power output (oscillator) at 100% transfer efficiency	P_{out}	1·5			kW
Power output (oscillator) at 85% transfer efficiency	P_{out}	1·3			kW

MOUNTING POSITION—Vertical, anode upwards

ANODE—External

BASE—Special

OPERATING INSTRUCTIONS

Installation

This valve should be mounted vertically with anode upwards. Connections should always make good electrical contact to prevent overheating of pins and seals, particularly by r.f. currents.

It is essential that connection be made to both grid pins when running at high frequencies, to reduce current taken by each pin.

The valve must be protected against excessive vibration and shock.

Cooling

Water cooling is required for all conditions of service including filament dissipation alone.

The minimum water flow for maximum output is 1 litre/min. The hose connecting the water supply to the valve should not be less than 20 ft long, this also applies to the return hose. Lengths shorter than 20 ft. will result in loss of power.

Cold water should be fed into the lower end of the copper spiral and the outlet temperature from the top of the spiral must not exceed 60°C.

A low velocity air blast directed on filament and grid pins is recommended when running at full power at the higher frequencies.

Operation

The operating data, list conditions for maximum output for respective classes of service at the relevant anode voltage.

Linear interpolation between anode voltage steps is admissible. As these conditions utilize some or all of the maximum valve ratings, close control of conditions has to be maintained.

In Class C Self Oscillator service precautions should be taken against excessive mains voltage variation. Current overload trips should be included in anode and grid circuits as well as an under current trip in the grid circuit.

In industrial r.f. heating it is not usual that all precautions can be taken, and under these conditions, some reductions in operating conditions have to be made so that widely fluctuating loads, poor h.t. regulation and mains variations can be accommodated. Each type of variation brings its own problems and no set rules are practicable.

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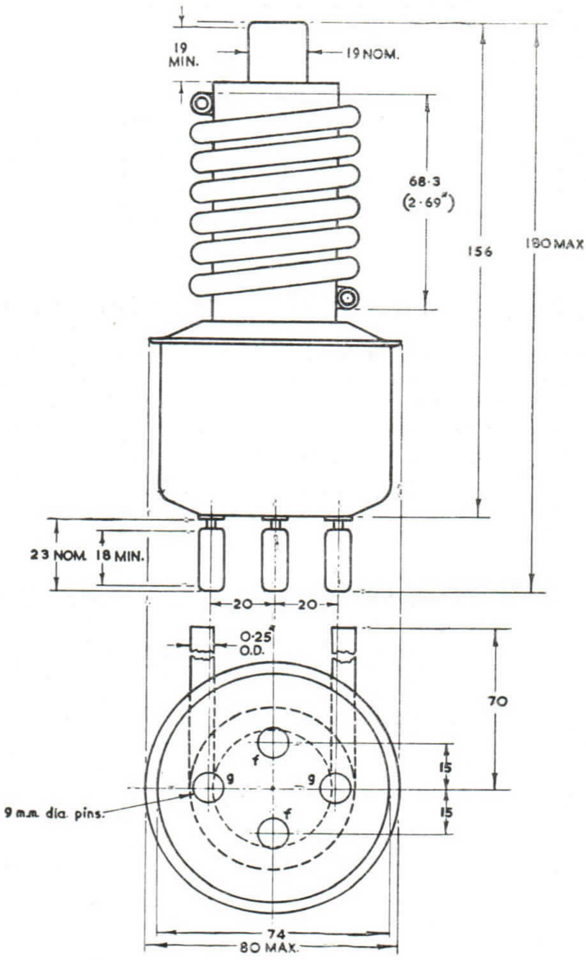
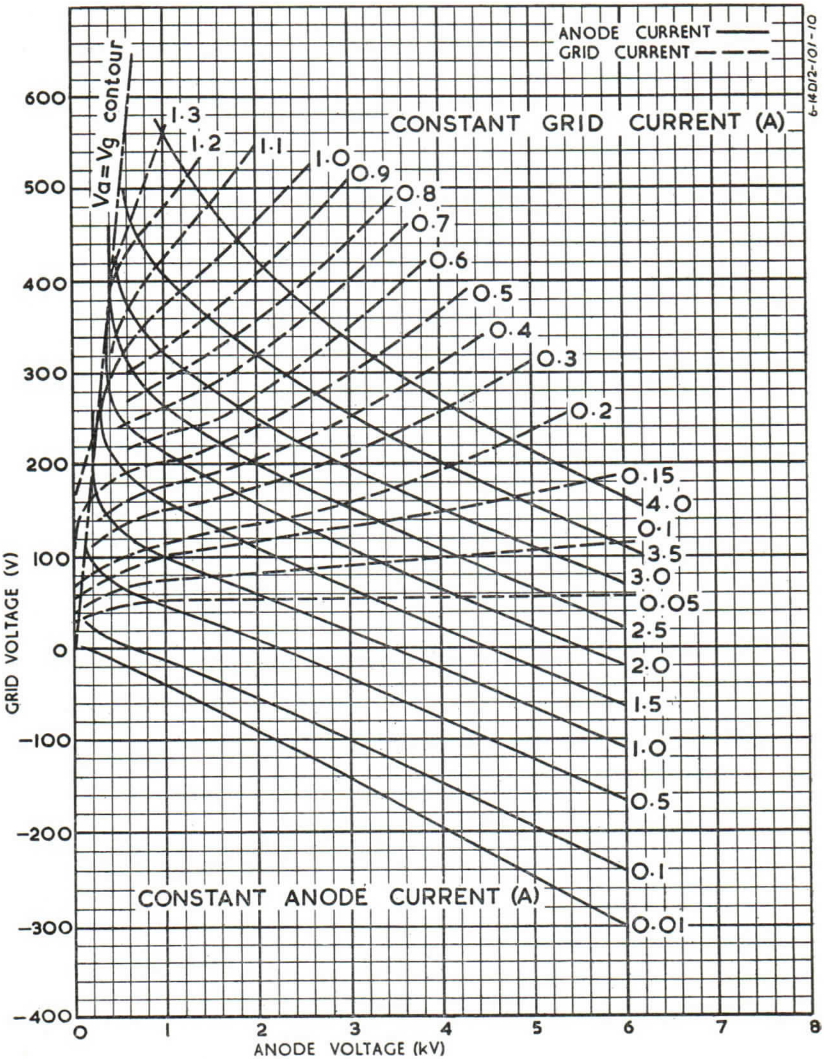


All dimensions in millimetres unless otherwise shown.

CONSTANT CURRENT CHARACTERISTICS



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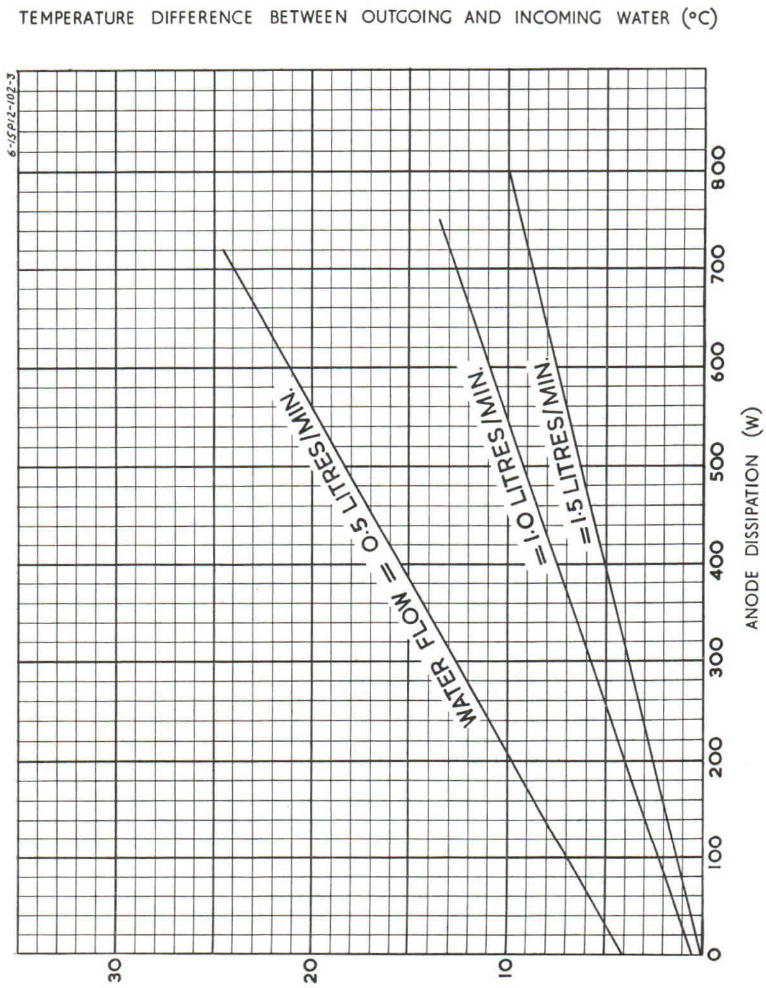
WATER FLOW/DISSIPATION CHART



15V12

VAPOUR COOLED TRIODE

Directly heated

TENTATIVE

GENERAL

The 15V12 is a directly heated vapour cooled triode intended for use in r.f. heating equipment. It has a thoriated tungsten filament and a maximum operating frequency at full ratings of 60 Mc/s.

RATING

Filament Voltage	V_f	6·3	V
Filament Current	I_f	32·5	A
Maximum Anode Voltage	$V_{a(max)}$	7·0	kV
Maximum Anode Dissipation	$p_{a(max)}$	1·3	kW
Maximum Operating Frequency at Full Ratings	f(max)	60	Mc/s

INTER-ELECTRODE CAPACITANCES

Grid/Filament	c_{g-f}	13	pF
Anode/Grid	c_{a-g}	11	pF
Anode/Filament	c_{a-f}	0·6	pF

CHARACTERISTICS

Anode Voltage	V_a	4·0	kV
Anode Current	I_a	190	mA
Mutual Conductance	gm	5·1	mA/V
Amplification Factor	μ	22	

TYPICAL OPERATION—Maximum operating conditions per valve

Class B1 audio amplifier—push pull operation

Anode Voltage	V_a	6·0	kV
Anode Current R.M.S.	$I_{a(r.m.s.)}$	0·6	A
Power Input	P_{in}	2·2	kW
Power Output	P_{out}	0·9	kW
Anode Dissipation	p_a	1·3	kW
Anode Efficiency		40	%
Negative Grid Bias Voltage	V_g	−225	V
Peak Signal Voltage	$v_{sig(pk)}$	225	V

Associated Electrical Industries Limited

Electronic Components Department

Tel: GERrard 9797

15V12

VAPOUR COOLED TRIODE

Directly heated

TENTATIVE

TYPICAL OPERATION—Maximum operating conditions

Class C—single phase full wave (no smoothing)

		Mean	R.M.S.	Peak	
Anode Voltage	V_a	3·8	4·25	6·0	kV
Negative Grid Bias Voltage	V_g	−80			V
Positive Grid Voltage	V_{sig}	154			V
Grid Resistance	R_g	0·7			kΩ
Mean Anode Current	$I_{a(av)}$	730			mA
Mean Grid Current	$I_{g(av)}$	120			mA
Peak Cathode Current	$i_{k(pk)}$	2·5	2·8	4·0	A
Peak Anode Current	$i_{a(pk)}$	1·9			A
Peak Grid Current	$i_{g(pk)}$	0·6			A
Anode Dissipation	P_a	1·3			kW
Grid Drive Power		30			W
Grid Dissipation	P_g	20			W
Anode Efficiency		61			%
Power Output (amplifier)	P_{out}	2·1			kW
Power Output (oscillator) at 100% Transfer Efficiency	P_{out}	2·1			kW
Power Output (oscillator) at 85% Transfer Efficiency	P_{out}	1·8			kW

TYPICAL OPERATION—Maximum operating conditions

Class C—3-phase rectified or d.c.

Anode Voltage	V_a	4·0	5·0	6·0	kV
Negative Grid Bias Voltage	V_g	−140	−220	−300	V
Positive Grid Voltage	V_{sig}	270	270	270	V
Grid Resistance	R_g	553	982	1400	Ω
Mean Anode Current	$I_{a(av)}$	1068	993	930	mA
Mean Grid Current	$I_{g(av)}$	253	224	204	mA
Peak Cathode Current	$i_{k(pk)}$	4·0	4·0	4·0	A
Peak Anode Current	$i_{a(pk)}$	3·0	3·0	3·0	A
Peak Grid Current	$i_{g(pk)}$	1·0	1·0	1·0	A
Anode Dissipation	P_a	1·3	1·3	1·3	kW
Grid Drive Power		104	100	108	W
Grid Dissipation	P_g	60	50	48	W
Anode Efficiency		69	73	76	%
Power Output (amplifier)	P_{out}	2·9	3·6	4·2	kW
Power Output (oscillator) at 100% Transfer Efficiency	P_{out}	2·8	3·5	4·1	kW
Power Output (oscillator) at 85% Transfer Efficiency	P_{out}	2·4	3·0	3·5	kW

Associated Electrical Industries Limited

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15V12

VAPOUR COOLED TRIODE

Directly heated

TENTATIVE

DIMENSIONS

Maximum overall length	200 mm
Maximum diameter	80 mm

MOUNTING POSITION—Vertical, base up

BASE—Special

Operating Instructions

Installation

The valve should be mounted vertically with anode downwards in a specially designed boiler (type LM287). Connections should always make good electrical contact to prevent overheating of pins and seals, particularly by r.f. current.

It is essential that connections be made to both grid pins when running at higher frequencies so as to reduce current taken by each pin.

Cooling

The valve is immersed in water and at the higher frequencies, a low velocity air blast must also be directed on to the filament and grid pins.

Operation

The operating data list conditions for maximum output for respective classes of service at the relevant anode voltage.

Linear interpolation between anode voltage steps is admissible. As these conditions utilize some or all of the maximum valve ratings, close control of conditions has to be maintained. In Class C self oscillator service precautions should be taken against excessive mains voltage variations. Current overload trips should be included in anode and grid circuits as well as an under current trip in the grid circuit.

In industrial r.f. heating it is not usual that all precautions can be taken, and under these conditions some reductions in operating conditions have to be made so that widely fluctuating loads, poor h.t. regulation, and mains variations can be accommodated. Each type of variation brings its own problems and no set rules are practicable.

Associated Electrical Industries Limited
Electronic Components Department
Tel: GERrard 9797

AEI Forced Air Cooled Triode 16J12

TENTATIVE

GENERAL

The 16J12 is a directly heated forced air cooled triode. It has a thoriated tungsten filament and is intended for use in transmitting equipment. The filament is suitable for direct switching.

RATINGS

Filament voltage	V_f	8·0 ± 5%	V
Filament current	I_f	26	A
Maximum d.c. anode voltage	$V_{a(max)}$	7·5	kV
Maximum peak cathode current	$i_{k(pk)max}$	6·0	A
Maximum anode dissipation	$p_{a(max)}$	3·0	kW
Maximum operating frequency	f_{max}	40	Mc/s

MOUNTING POSITION—Vertical, base upwards

CHARACTERISTICS

Anode voltage	V_a	7	kV
Anode current	I_a	400	mA
Mutual conductance	g_m	6·5	mA/V
Amplification factor	μ	55	

ANODE—External

BASE—Special

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Radio Components Department

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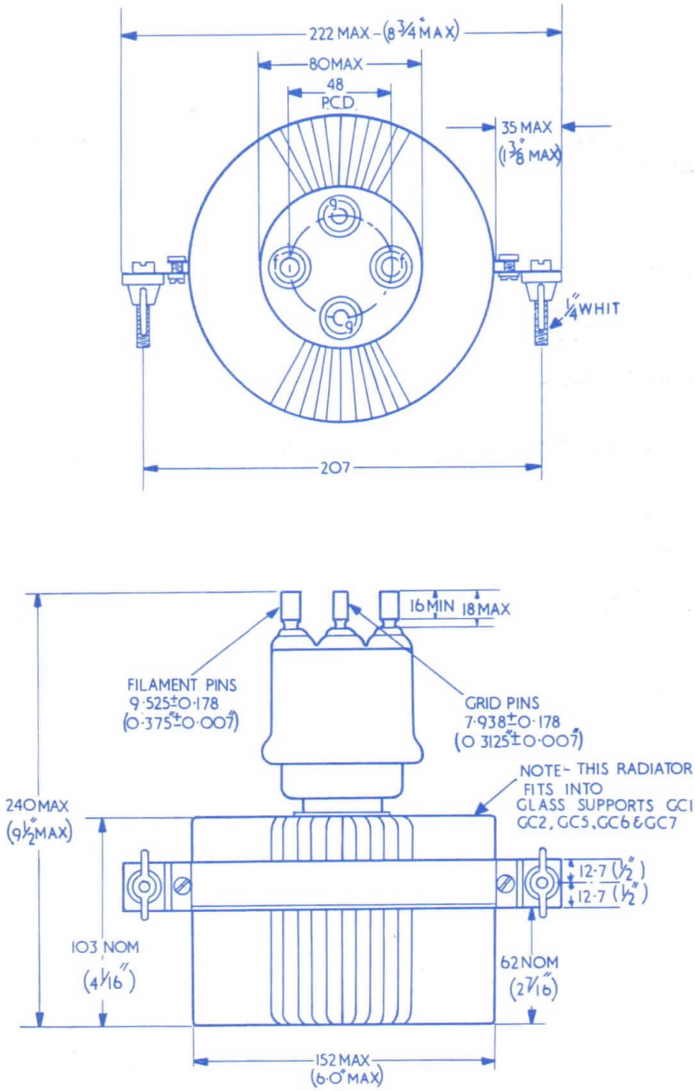

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All dimensions in millimetres unless otherwise shown

16P12

WATER COOLED TRIODE

Directly heated

TENTATIVE

GENERAL

The 16P12 is a directly heated, water cooled triode with integral cooling. It has a thoriated tungsten filament and is intended for use in induction heating equipment. The filament is suitable for direct switching.

RATING

Filament Voltage	V_f	$8{\cdot}0 \pm 5\%$ V
Filament Current	I_f	26·0 A
Maximum d.c. Anode Voltage	$V_{a(max)}$	8·0 kV
Maximum Peak Cathode Current	$i_{k(pk)max}$	6·0 A
Maximum Anode Dissipation	$P_{a(max)}$	3·0 kW
Maximum Operating Frequency		
(Limited by water connections)	$f_{(max)}$	10 Mc/s
(Limited by valve)	$f_{(max)}$	40 Mc/s

INTER-ELECTRODE CAPACITANCES

Anode/Grid	$c_{a\text{-}g}$	11·5 pF
Grid/Filament	$c_{g\text{-}f}$	14·5 pF
Anode/Filament	$c_{a\text{-}f}$	0·8 pF

CHARACTERISTICS

Anode Voltage	V_a	5·0 kV
Anode Current	I_a	400 mA
Mutual Conductance	g_m	7·5 mA/V
Amplification Factor	μ	24

DIMENSIONS

Maximum Overall length	211 mm

MOUNTING POSITION—Vertical, base upwards

ANODE—External

BASE—Special

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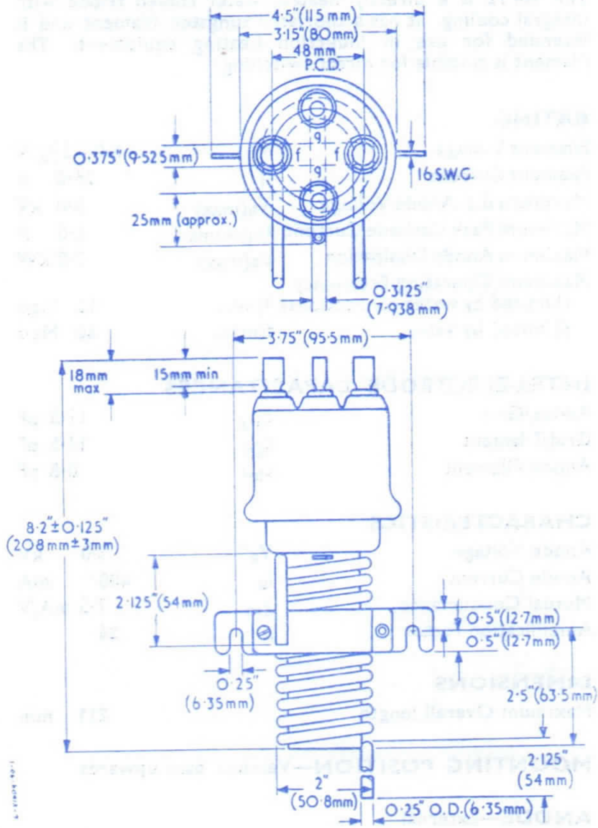
Electronic Components Department
Tel: GERrard 9797

16P12
WATER COOLED TRIODE
Directly heated
TENTATIVE



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Electronic Components Department
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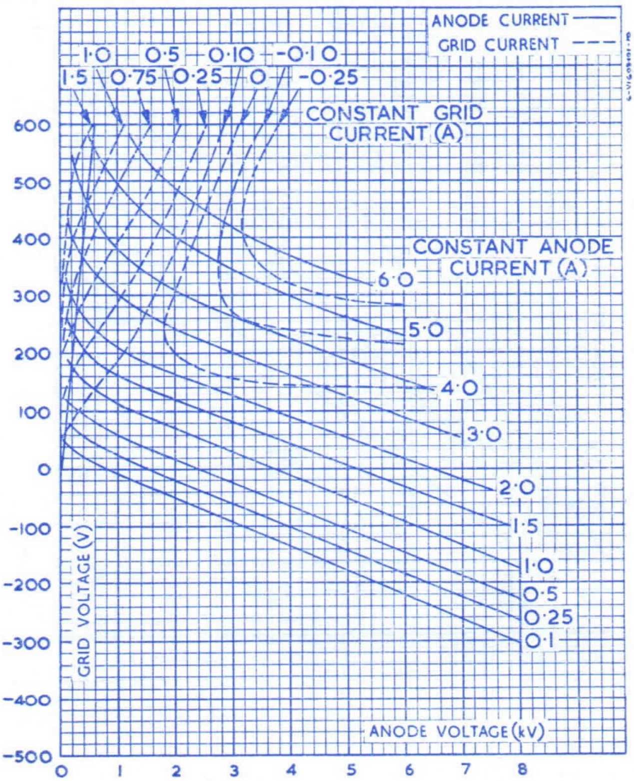
16P12

WATER COOLED TRIODE

Directly heated

TENTATIVE

CHARACTERISTIC CURVES: V_g/V_a
CONSTANT CURRENT CHARACTERISTICS



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Electronic Components Department
Tel: GERrard 9797

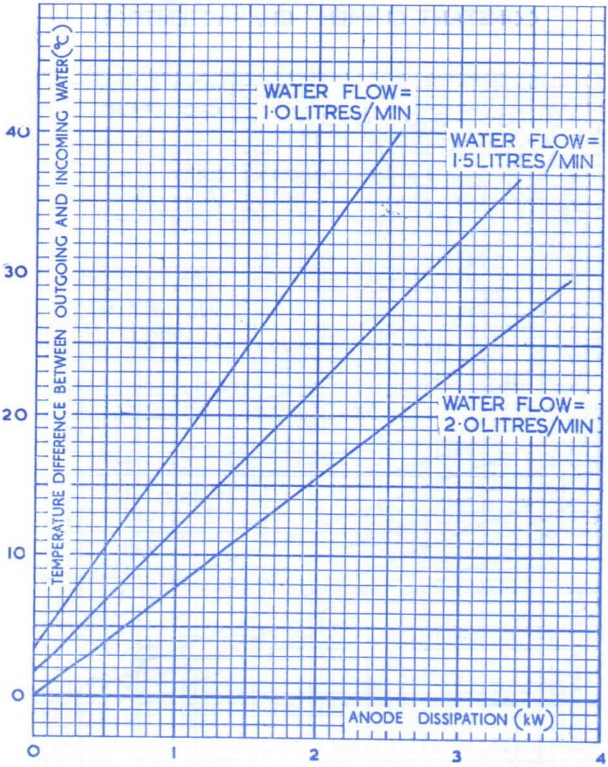
16P12

WATER COOLED TRIODE

Directly heated

TENTATIVE

WATER FLOW/DISSIPATION CHART



Associated Electrical Industries Limited

Electronic Components Department

Tel: GERrard 9797

3R/167E

16P13

WATER COOLED TRIODE

Directly heated

TENTATIVE

GENERAL

The 16P13 is a directly heated Water Cooled Triode with integral cooling and union connectors. It is intended for use as an R.F. Oscillator in eddy current heating apparatus, etc. This valve is the water cooled version of the ESA1500 and is identical to the 16P12 except that it has unions attached to the ends of the water cooling tube. The thoriated tungsten filament is suitable for direct switching.

RATING

Filament Voltage	V_f	8·0±5%	V
Filament Current	I_f	26	A
Maximum Anode Voltage (D.C.)	$V_{a(max)}$	8	kV
Maximum Peak Cathode Current	$I_{k(pk)max}$	6	A
Maximum Anode Dissipation	$P_{a(max)}$	3·0	kW
Maximum Operating Frequency (Limited by water connections)	$f_{(max)}$	10	Mc/s
Maximum Operating Frequency (Limited by valve)	$f_{(max)}$	40	Mc/s

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	$c_{a\text{-}g}$	11·5
Anode/Filament	$c_{a\text{-}f}$	0·8
Grid/Filament	$c_{g\text{-}f}$	14·5

DIMENSIONS

Maximum Overall Length	211	mm

UNION CONNECTORS—to suit ¼" o.d. Tube to BS2051.

MOUNTING POSITION—Vertical with base up.

Associated Electrical Industries Limited

Electronic Components Division

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16P13
WATER COOLED TRIODE
Directly heated
TENTATIVE

CHARACTERISTICS

Anode Voltage	V_a	5	kV
Anode Current	I_a	400	mA
Mutual Conductance	gm	7·5mA/V	
Amplification Factor	μ	24	

ANODE—External.

BASE—Special.

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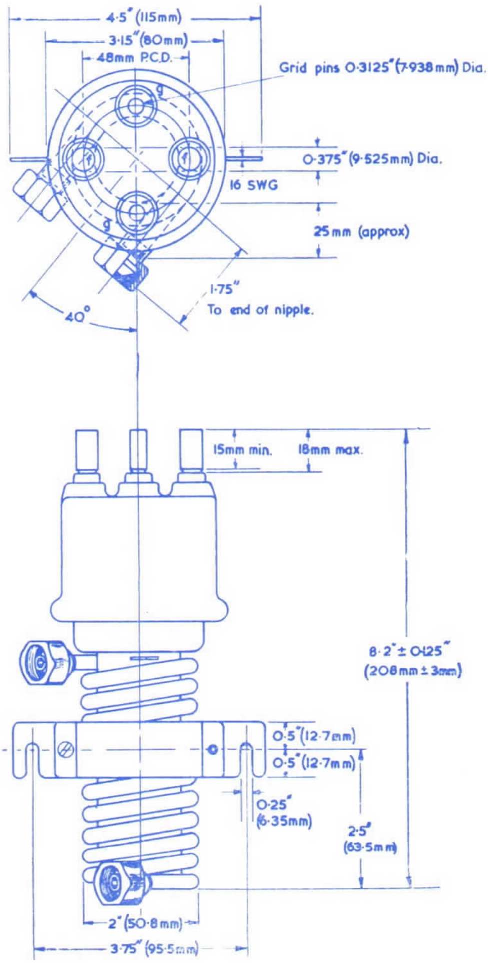
16P13

WATER COOLED TRIODE

Directly heated

TENTATIVE



Associated Electrical Industries Limited

Electronic Components Department

Tel: GERrard 9797

ES833

RADIATION COOLED TRIODE

GENERAL

The ES.833 is a high mu triode particularly suitable for use as an R.F. Power Amplifier, Oscillator or Class B modulator.

The anode and grid connections are brought out at the top and are taken through metal to glass seals to heavy current terminals. As a result of this construction the valve is exceptionally efficient at higher radio frequencies and may be operated under class 'C' CW conditions at a maximum input of 1.8 kW at frequencies up to 30Mcs, with forced air cooling. At reduced input rating it is possible to operate the valve as high as 75Mcs.

RATING

Filament Voltage (volts)	V_f	10.0
Filament Current (amps)	I_f	10.0
Maximum Anode Voltage (volts)	$V_{a(max)}$	• 3,000
Maximum Anode Dissipation (watts)	$W_{a(max)}$	• 300
Amplification Factor	μ	35
Maximum Operating Frequency at Full Rating		$ 30 Mc/s

• The Maximum Anode Voltage may be increased to 4,000v, and the Anode dissipation to 400w providing the valve is forced-air cooled at a rate of 40 cu.ft/min., on top of bulb between anode and grid seals, directed through a 2" nozzle.

$ At higher frequencies the maximum permissible anode voltages and inputs must be reduced.

INTER-ELECTRODE CAPACITANCES

Anode/Grid (μμF)	C_{a-g1}	6.3
Anode/Filament (μμF)	C_{a-f}	8.5
Grid/Filament (μμF)	g_{1-f}	12.3

DIMENSIONS

Maximum Overall Length	8.812 ins : 224 mm
Maximum Diameter	4.594 ins : 116 mm
Approximate Nett Weight (lbs)	1
Approximate Packed Weight (lbs)	3½

MOUNTING POSITION - Vertical

Indicates a change ←

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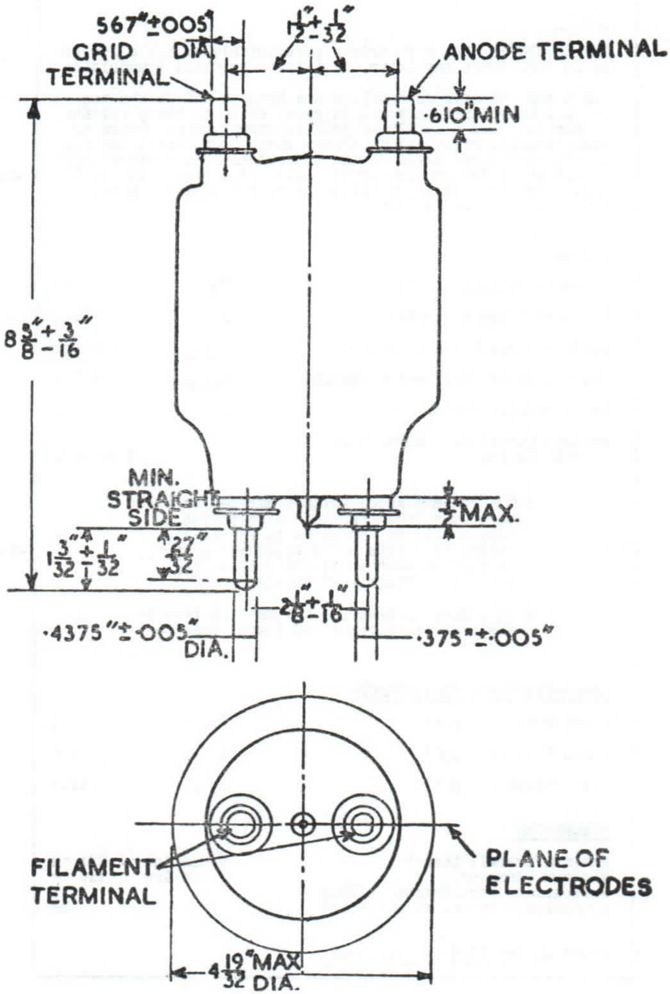
ES833

RADIATION COOLED TRIODE

←



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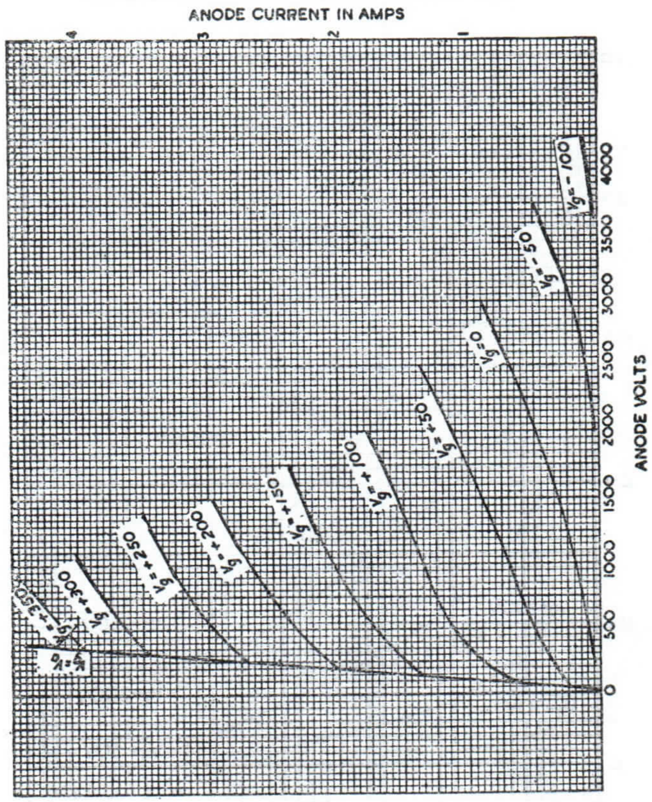
ES833

RADIATION COOLED TRIODE

AVERAGE CHARACTERISTIC CURVES



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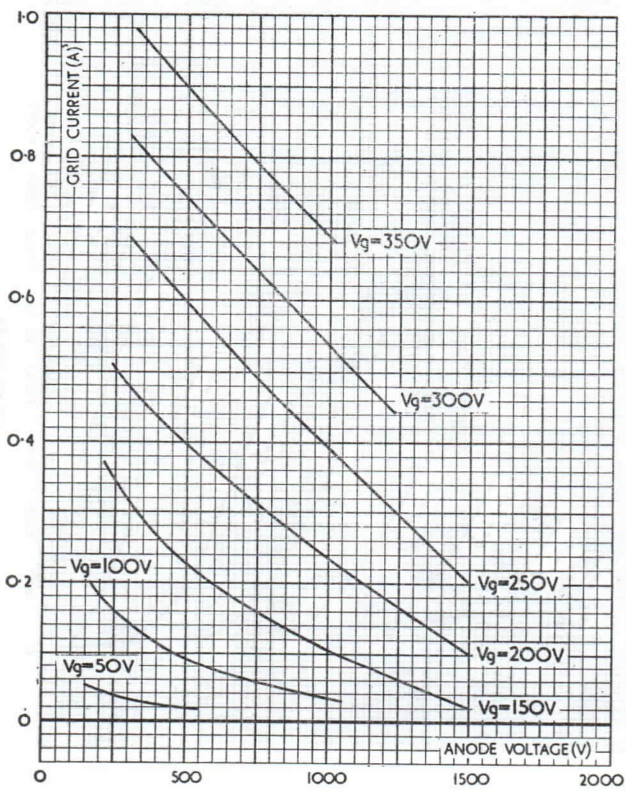
ES833

RADIATION COOLED TRIODE

AVERAGE CHARACTERISTIC CURVES: I_g/V_a



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ESA1002

FORCED AIR COOLED TRIODE

GENERAL

The ESA1002 is a forced air cooled triode having a directly heated thoriated tungsten filament. It has a maximum anode dissipation of 12 kW and a maximum anode voltage rating of 10 kV, the maximum operating frequency at full rating being 40 Mc/s.

RATING

Filament Voltage	(volts)	V_f	8·0
Filament Current	(amps)	I_f	124
Maximum Anode Voltage	(kV)	$V_{a(max)}$	10·0
Maximum Anode Dissipation	(kW)	$P_{a(max)}$	12·0
Maximum Cathode Current (Peak)	(amps)	$I_{k(max)pk}$	33·0
Maximum Grid Dissipation	(watts)	$P_{g(max)}$	800
Mutual Conductance	(mA/V)	g_m	35
Amplification Factor		μ	28
Anode Impedance	(ohms)	r_a	800
Maximum Operating Frequency (full rating)	(Mc/s)	$f_{(max)}$	40
Maximum R.F. Power Output	(kW)	P_{out}	35

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	$c_{a\text{-}g1}$	40
Anode/Filament	$c_{a\text{-}f}$	1·3
Grid/Filament	$c_{g1\text{-}f}$	56

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

ESA1002

FORCED AIR COOLED TRIODE

AIRFLOW—400 cu. ft. min.

DIMENSIONS

Maximum Overall Length	(ins)	$13\frac{5}{8}$
Maximum Diameter	(ins)	$7\frac{1}{16}$
Approximate Nett Weight	(lbs)	28
Approximate Packed Weight	(lbs)	84

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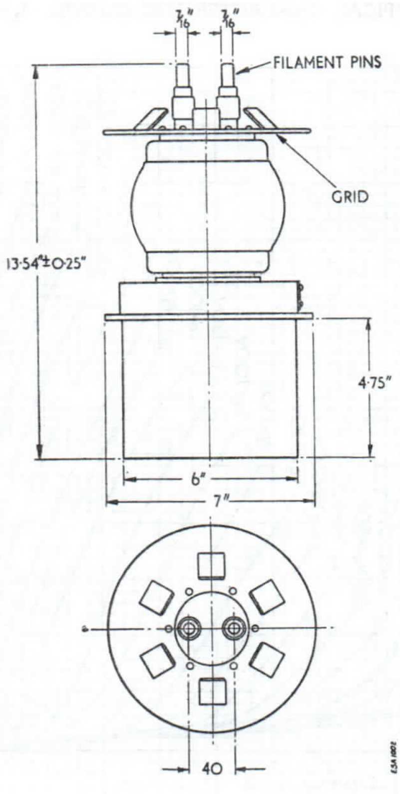
ESA1002

FORCED AIR COOLED TRIODE



All dimensions in mm unless stated otherwise.

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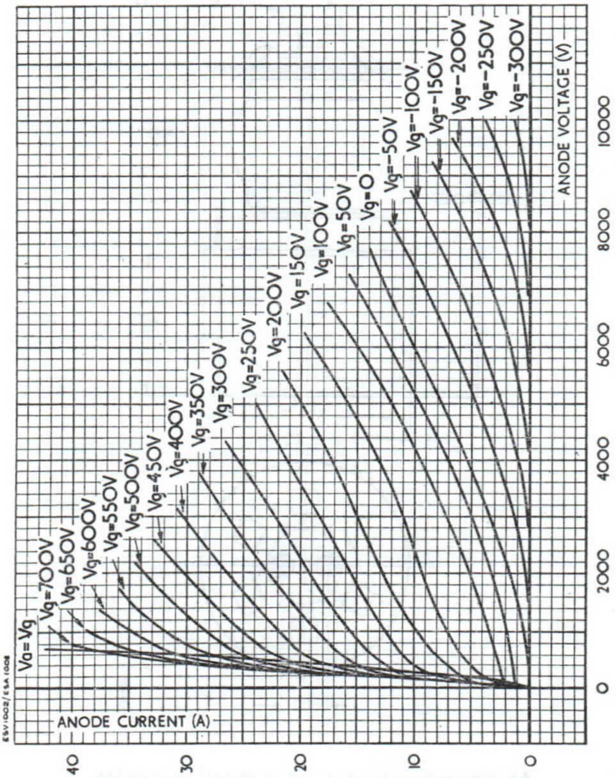
ESA1002

FORCED AIR COOLED TRIODE

TYPICAL CHARACTERISTIC CURVES : I_a/V_a



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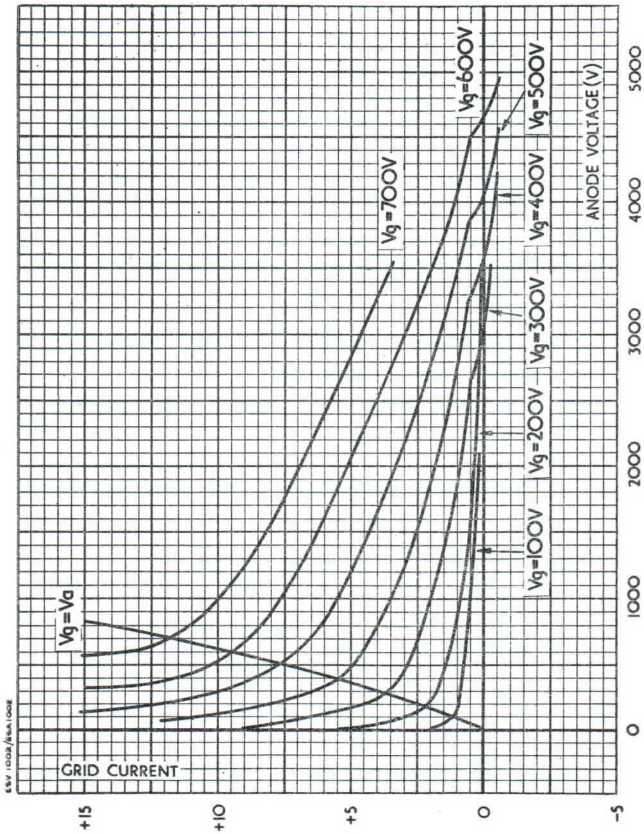
Tel.: GERrard 9797

ESA1002

FORCED AIR COOLED TRIODE

TYPICAL CHARACTERISTIC CURVES : I_g/V_a



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Tel.: GERrard 9797

AEI Forced Air Cooled Triode ESA1500

GENERAL

The ESA1500 is a forced air cooled triode having a directly heated thoriated tungsten filament. It is intended for use in induction and dielectric heating equipment.

RATINGS*

Filament voltage	V_f	8·0	V
Filament current	I_f	26†	A
Maximum anode voltage	$V_{a(max)}$	6·0	kV
Maximum anode dissipation	$p_{a(max)}$	3·0	kW
Maximum peak cathode current	$i_{k(pk)max}$	6·0	A
Maximum operating frequency at maximum ratings	f_{max}	40	Mc/s
Minimum air flow for maximum dissipation		300	ft^3/min

* Limiting values are absolute values.

† The filament is suitable for direct switching without additional current limitation in the circuit.

INTER-ELECTRODE CAPACITANCES

Anode/grid	$c_{a\text{-}g}$	11·5	pF
Anode/filament	$c_{a\text{-}f}$	0·8	pF
Grid/filament	$c_{g\text{-}f}$	14·5	pF

CHARACTERISTICS

Anode voltage	V_a	5·0	kV
Anode current	I_a	400	mA
Anode impedance	r_a	3·2	kΩ
Mutual conductance	g_m	7·5	mA/V
Amplification factor	μ	24	
Perveance		0·56	$mA/V^{\frac{3}{2}}$

COOLING

This is by forced air blast, and should be employed for all conditions of valve service, including filament dissipation only.

It is recommended that a minimum air flow of 300 ft^3/min at maximum power output be used. Direction of flow is through the anode cooler and over the glass bulb.

At the higher frequencies grid connectors should be designed to assist cooling, and both connections should be made to reduce the current taken by each pin.

Care should be taken to ensure all connections to the valve make good electrical contact to avoid overheating pins and seals.

Associated Electrical Industries Limited

Radio Components Department

Tel: GERrard 9797

TYPICAL OPERATION (See " Notes " below)

Anode voltage	V_a	5·0	6·0	kV
Mean anode current	$I_{a(av)}$	1·55	1·5	A
Mean grid current	$I_{g(av)}$	145	135	mA
Bias voltage	V_g	250	350	V
Bias resistor	R_g	1·75	2·6	kΩ
Peak cathode current	$i_{k(pk)}$	6·0	6·0	A
Peak anode current	$i_{a(pk)}$	5·0	5·0	A
Peak grid current	$i_{g(pk)}$	1·0	1·0	A
Anode dissipation	p_a	2·5	2·5	kW
Grid dissipation	p_g	70	65	W
Anode efficiency		69	72	%
Power output (oscillator)	P_{out}	5·3	6·3	kW
Power output at 85% transfer efficiency	P_{out}	4·5	5·35	kW

NOTES

The typical operating conditions given, are for valve service as a class C self oscillator and are calculated assuming a d.c. or three-phase full-wave rectified anode voltage. Where conditions of service make the valve liable to excessive mains variation, poor regulation of supplies, or power supplies with a high peak to mean ratio, care should be taken to see that the limiting values are not exceeded.

It is recommended that a protective resistance of 10Ω/kV be connected between the h.t. supply and the valve anode to avoid damage to the valve in the event of intermittent flash over.

Some cases (e.g., intermittent operation where the duty factor is suitable) allow increased anode dissipation and peak cathode current. Each case should be treated on its merits and more information on this type of duty may be had on request.

MOUNTING POSITION—Vertical, anode down

BASE—Special

ESA5000

FORCED AIR COOLED TRIODE

(Previously EHA.5000)

GENERAL

The ESA5000 is a three electrode valve designed for use as a ← Radio Frequency Amplifier or Oscillator. The anode is fitted with a special radiator and cooling is obtained by forced air. The design minimises lead inductance and this valve is particularly suitable for use in R.F. heating equipments. It is the direct equivalent of the American type 889R.

RATING

Filament Voltage (volts)	V_f	11·0
Filament Current (amps)	I_f	125
Maximum Anode Voltage (volts)	$V_{a(max)}$	8,500
Maximum Filament Emission (amps)	F_{em}	9 ←
Maximum Anode Dissipation (kW)	$W_{a(max)}$	5·0
Mutual Conductance (mA/V)	g_m	* 10
Amplification Factor	μ	* 20
Anode Impedance (ohms)	r_a	*2,000
Maximum Operating Frequency at full rating		† 25 Mc/s

* Taken at $V_a = 5{,}000$v ; $I_a = 1{,}000$mA.

† At higher frequencies the maximum permissible anode voltages and inputs must be reduced.

INTER-ELECTRODE CAPACITANCES

Anode/Grid ($\mu\mu$F)	$c_{a\text{-}g1}$	20·7
Anode/Filament ($\mu\mu$F)	$c_{a\text{-}f}$	2·5
Grid/Filament ($\mu\mu$F)	$g_{1\text{-}f}$	19·5

AIR FLOW (MAIN)

500 cubic feet per minute. In addition, 15 cubic feet per minute should be directed on to the seals.

DIMENSIONS

Maximum Overall Length (mm)	298·5
Maximum Diameter (mm)	192·0
Approximate Nett Weight (lbs)	34·0
Approximate Packed Weight (lbs)	72·0

MOUNTING POSITION—Vertical.

Indicates a change ←

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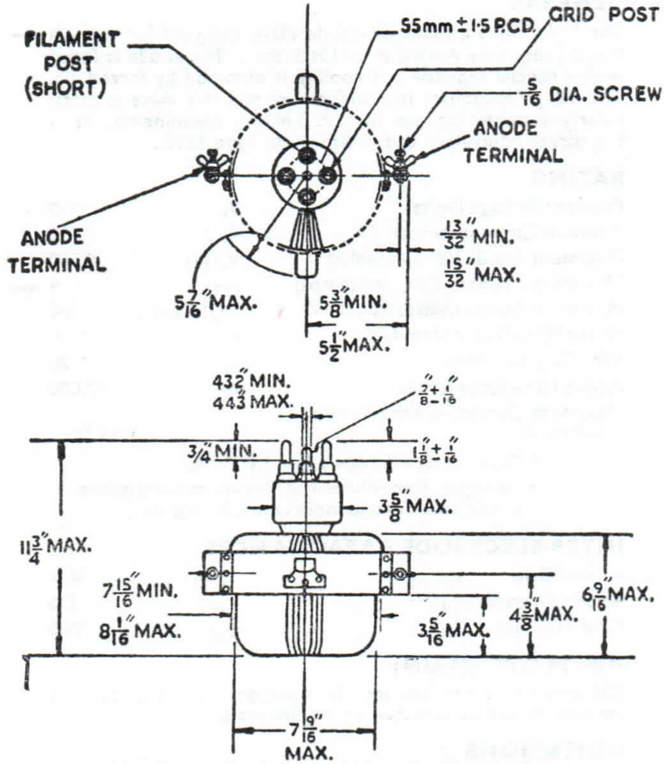
ESA5000

FORCED AIR COOLED TRIODE

(Previously EHA.5000)



LIFTING HANDLES IN LINE WITH FIL. PINS

ALL DIMS IN ins UNLESS STATED OTHERWISE

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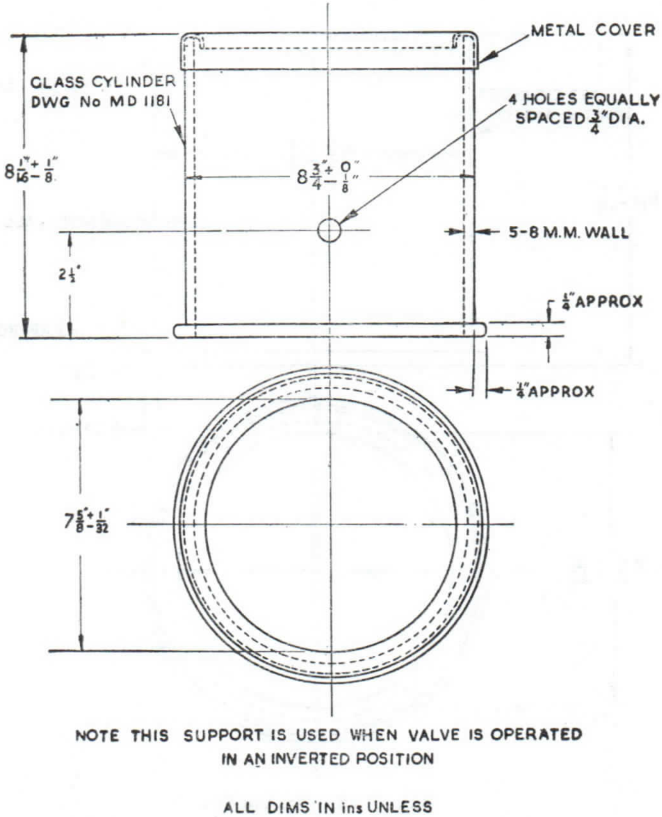
ESA5000
FORCED AIR COOLED TRIODE

SUPPORT TYPE G.C.4.



NOTE THIS SUPPORT IS USED WHEN VALVE IS OPERATED
IN AN INVERTED POSITION

ALL DIMS IN ins UNLESS
STATED OTHERWISE

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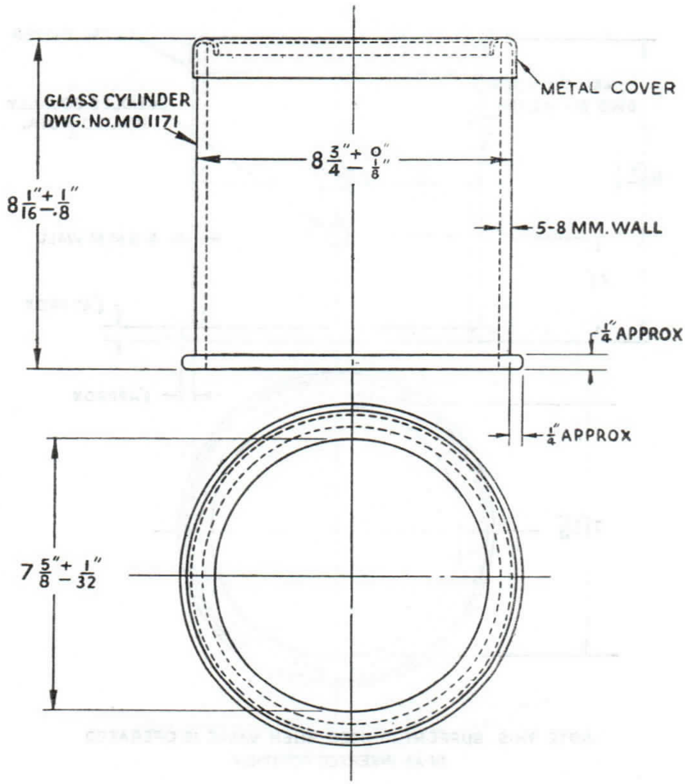
ESA5000

FORCED AIR COOLED TRIODE

SUPPORT TYPE G.C.3.



ALL DIMS. IN ins UNLESS
STATED OTHERWISE

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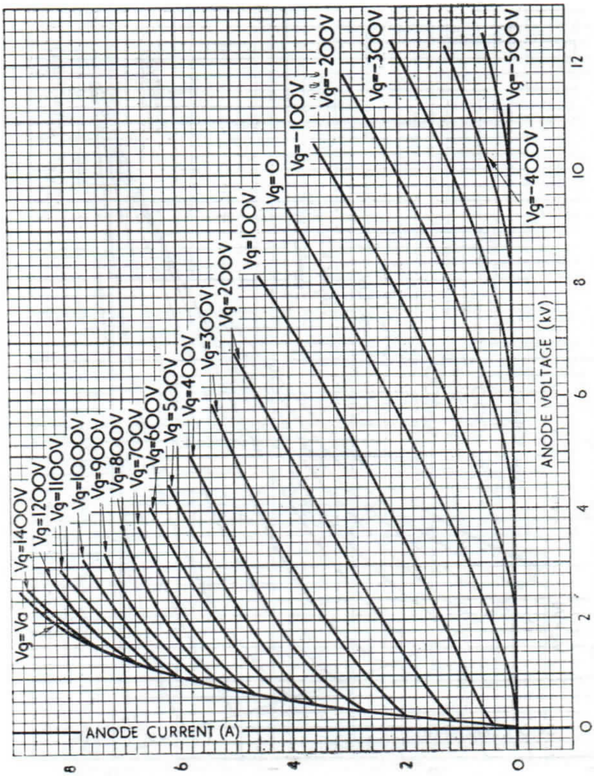
ESA5000

FORCED AIR COOLED TRIODE

(Previously EHA5000)

AVERAGE CHARACTERISTIC CURVES: I_a/V_a

(V_f=11 Volts A.C.)



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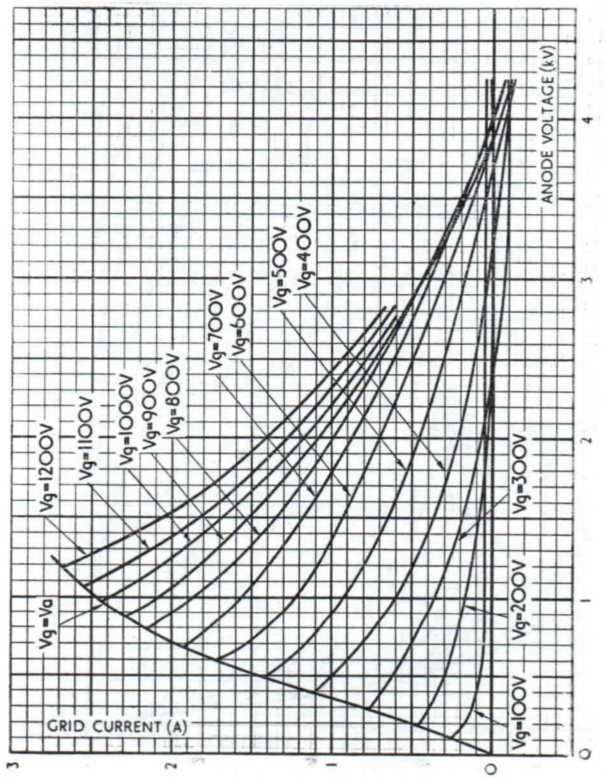
ESA5000

FORCED AIR COOLED TRIODE

(Previously EHA5000)

CHARACTERISTIC CURVES: I_g/V_a

(V_f=11 Volts A.C.)



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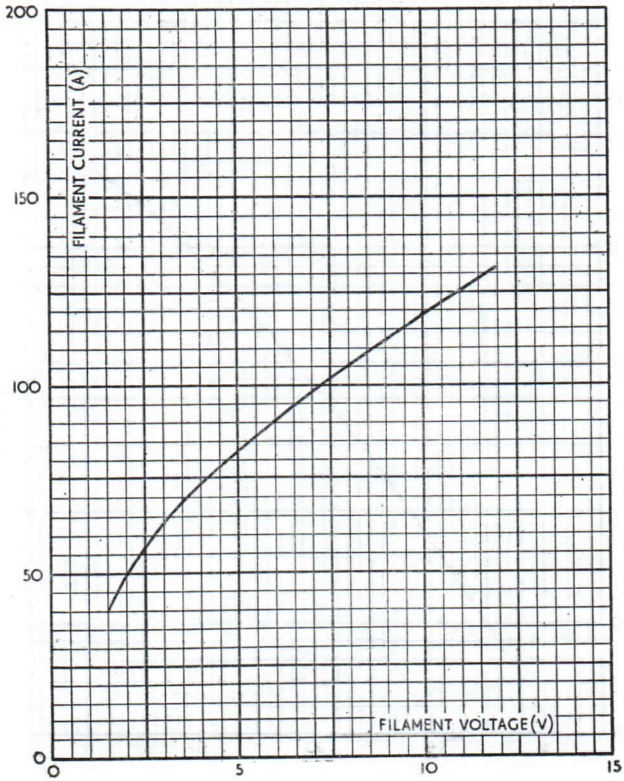
ESA5000

FORCED AIR COOLED TRIODE

(Previously EHA5000)

AVERAGE CHARACTERISTIC CURVE: I_f/V_f

(Cold resistance = 0.0003 Ω)



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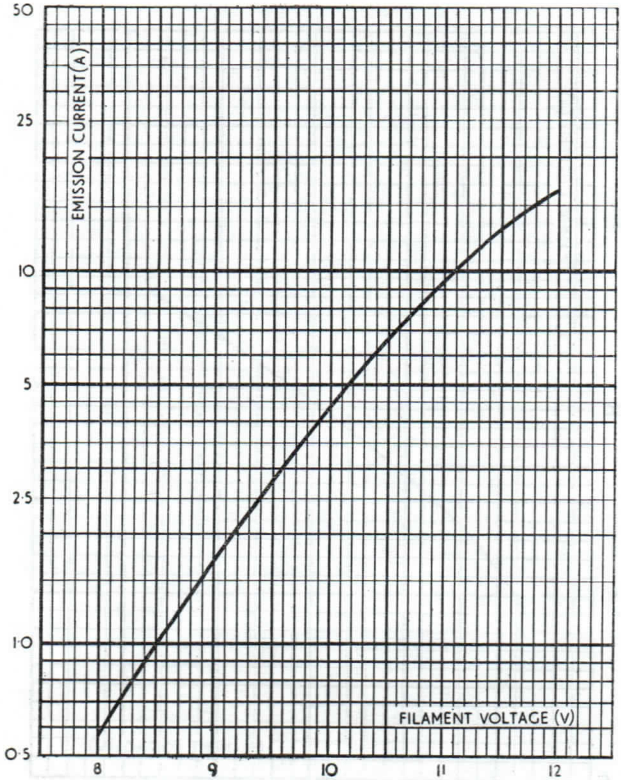
ESA5000

FORCED AIR COOLED TRIODE

(Previously EHA5000)

CHARACTERISTIC CURVE : I_{em}/V_f



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Electronic Components Division

Tel.: GERrard 9797

ESV1002

VAPOUR COOLED TRIODE

GENERAL

The ESV1002 is a Vapour Cooled Triode having a directly heated thoriated tungsten filament. It has a maximum anode dissipation of 25 kW, and a maximum anode voltage rating of 10 kV, the maximum operating frequency at full rating being 10 Mc/s.

RATING

Filament Voltage	(volts)	V_f	8·0
Filament Current	(amps)	I_f	124
Maximum Anode Voltage	(kV)	$V_{a(max)}$	11†
Maximum Grid Bias Voltage	(volts)	V_{g1}	−1200†
Maximum Anode Dissipation	(kW)	$p_{a(max)}$	25†
Maximum Cathode Current	(amps)	$I_{k(max)}$	33†
Maximum Grid Dissipation	(watts)	$p_{g(max)}$	800†
Mutual Conductance	(mA/V)	g_m	35
Amplification Factor		μ	28
Anode Impedance	(ohms)	r_a	800
Maximum Operating Frequency	(Mc/s)	$f_{(max)\ (abs)}$	10*
Maximum R. F. Power Output	(kW)	P_{out}	60

* Limited by the boilers and boiler's condensers. The maximum operating frequency may not be increased by operation at reduced ratings.

† Absolute maximum values which must not be exceeded.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	$c_{a\text{-}g1}$	40
Anode/Filament	$c_{a\text{-}f}$	1·3
Grid/Filament	$c_{g1\text{-}f}$	56

DIMENSIONS

Maximum Overall Length	(ins)	14
Maximum Diameter	(ins)	$6\frac{1}{2}$
Approximate Nett Weight	(lbs)	36
Approximate Packed Weight	(lbs)	92

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

ESV1002

VAPOUR COOLED TRIODE

TYPICAL OPERATION—Class C R.F. Amplifier and Oscillator.

Anode Voltage	(kV)	V_a	6	8	10
Grid Bias Voltage	(volts)	V_{g1}	−300	−400	−450
Grid Positive Voltage (Peak)	(volts)	$V_{g1(pk)}$	+520	+520	+520
Grid Bias Resistor	(ohms)	R_{g1}	254	380	455
Mean Anode Current	(amps)	I_a	7·62	7·2	7·68
Mean Grid Current	(amps)	I_{g1}	1·18*	1·06*	0·99*
Grid Drive r.m.s. Voltage	(volts)	$V_{g1(rms)}$	580	650	685
Peak Cathode Current	(amps)	$I_{k(pk)}$	33	33	33
Anode Dissipation	(kW)	P_a	11·6	12·1	16·4
Grid Drive Power	(watts)	P_{dr}	870*	875*	860*
Grid Dissipation	(watts)	P_{g1}	516*	453*	415*
Anode Efficiency	%	η_a	76·4	78·6	78·6
Anode Output (Amplifier)	(kW)	P_{out}	35	45·4	60·4
Anode Output (Oscillator)	(kW)	P_{out}	29	37·8	50·5
Angle of Anode Current flow	(degrees)	θ_a	163	162	166
Minimum Convection Cooler area	(sq. ft.)		9·8	10·2	13·4
Minimum Water Flow (Water Cooled Types)	(litres/min at 20°C inlet temp.)		4	4·1	5·4

* Approximate values. With lamps as the grid resistor and normal HT regulation, grid dissipation should not rise by more than 25% at ⅓ full load anode current.

See "Application Notes on the use of Vapour Cooled Valves."

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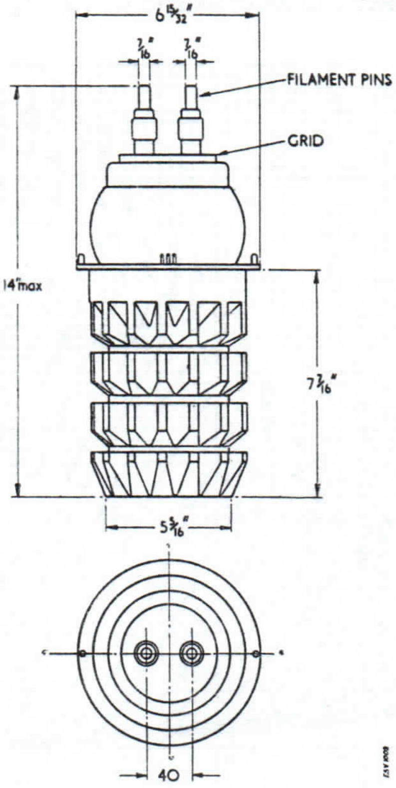
ESV1002

VAPOUR COOLED TRIODE



All dimensions in mm. unless stated otherwise

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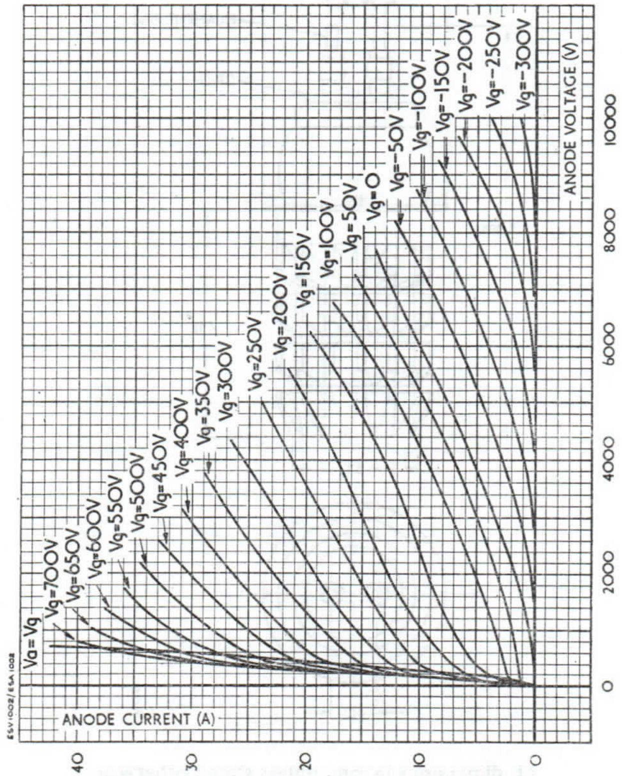
ESV1002

VAPOUR COOLED TRIODE

TYPICAL CHARACTERISTIC CURVES : I_a/V_a



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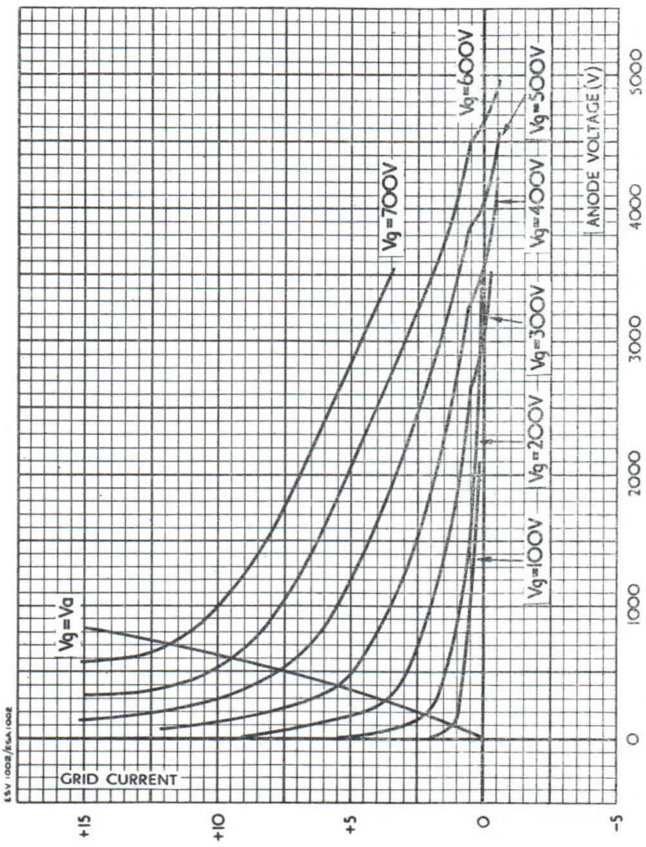
ESV1002

VAPOUR COOLED TRIODE

TYPICAL CHARACTERISTIC CURVES : I_g/V_a



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ESV1500

VAPOUR COOLED TRIODE

GENERAL

The ESV1500 is a Vapour Cooled Triode, having a directly heated thoriated tungsten filament. It has a maximum anode dissipation of 5 kW and a maximum anode voltage rating of 8 kV, the maximum operating frequency at full rating being 10 Mc/s.

RATING

Filament Voltage	(volts)	V_f	8·0
Filament Current	(amps)	I_f	26·0
Maximum Anode Voltage	(kV)	$V_{a(max)}$	8·0
Maximum Anode Dissipation	(kW)	$P_{a(max)}$	5·0
Maximum Filament Emission (Peak)	(amps)	$I_{k(max)pk.}$	8·0
Maximum Grid Dissipation	(watts)	$P_{g(max)}$	150
Mutual Conductance	(mA/V)	g_m	7·5
Amplification Factor		μ	24
Anode Impedance	(ohms)	r_a	3,200
Maximum Operating Frequency (Full Rating)	(Mc/s)	$f_{(max)}$	40
Maximum Operating Frequency (Reduced Rating)	(Mc/s)	$f_{(max)abs.}$	80
Maximum R.F. Power Output	(kW)	P_{out}	8·0

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	c_{a-g}	11
Anode/Filament	c_{a-f}	1
Grid/Filament	c_{g-f}	15

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

ESV1500

VAPOUR COOLED TRIODE

DIMENSIONS

Maximum Overall Length	(ins)	$9\frac{3}{4}$
Maximum Diameter	(ins)	$4\frac{7}{8}$
Approximate Nett Weight	(lbs)	10
Approximate Packed Weight	(lbs)	47

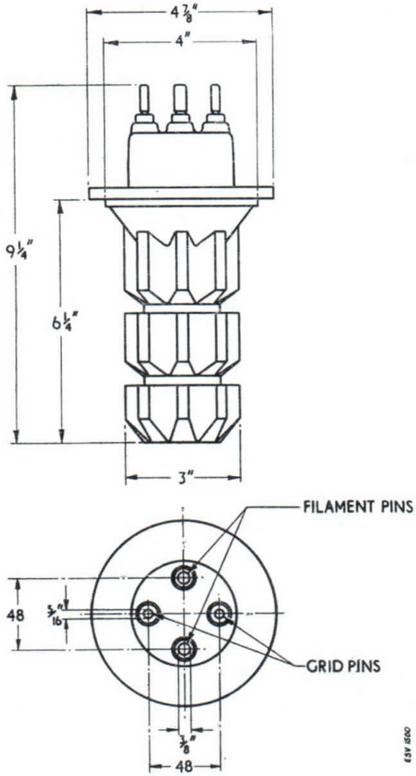
OPERATION

See " Application Notes on the use of Vapour Cooled Valves "

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

ESV1500

VAPOUR COOLED TRIODE



All dimensions in mm unless otherwise stated

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Electronic Components Division
Tel.: GERrard 9797

ESW5000

WATER COOLED TRIODE

(Previously EHW5000) ←

GENERAL

The ESW 5000 is a directly heated three electrode power valve designed for use as a radio - frequency amplifier, oscillator or Class 'B modulator. It is an exact equivalent to the American GL.889. ←

RATING

Filament Voltage (volts)	V_f	11
Filament Current (amps)	I_f	125
Maximum Anode Voltage (volts)	$V_{a(max)}$	8,500
Maximum Filament Emission (amps)	F_{em}	9 ←
Maximum Anode Dissipation (k.W.)	$W_{a(max)}$	5
Mutual Conductance (mA/V)	g_m	10
Amplification Factor	μ	20
Anode Impedance (ohms)	r_a	2,000
Maximum Operating Frequency at full rating		25 Mc/s
R.F. Power Output (kW)	P_{out}	10

INTER-ELECTRODE CAPACITANCES

Anode/Grid	(μμF)	C_{a-g1}	20.7
Anode/Filament	(μμF)	C_{a-f}	2.5
Grid/Filament	(μμF)	C_{g1-f}	19.5

Water Flow (MAIN) 3 - 6 gallons per minute

AIR FLOW 15 cubic feet per minute should be directed on to seals.

DIMENSIONS

Maximum Overall Length	(mm)	267
Maximum Diameter	(mm)	90

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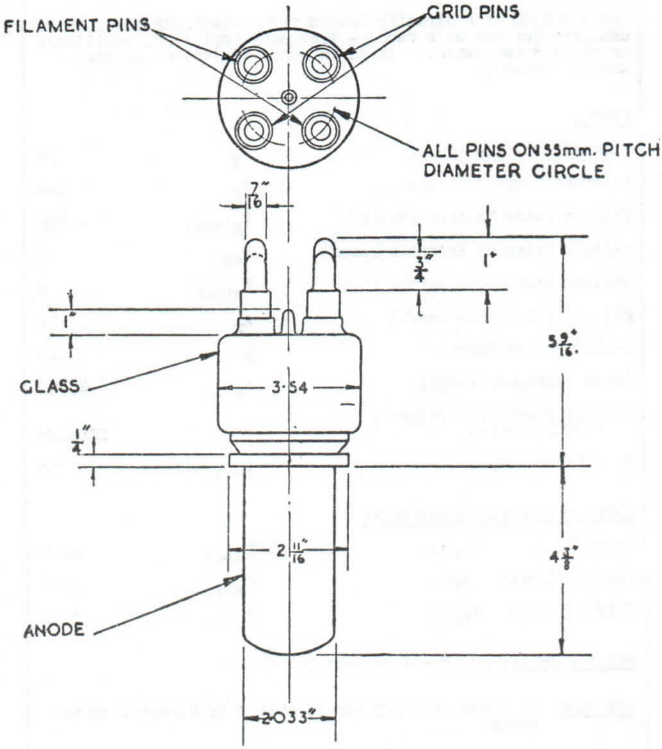
Electronic Components Division

Tel.: GERRARD 9797

ESW5000

WATER COOLED TRIODE

(Previously EHW5000) ←



All dimensions in mm. unless otherwise stated

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Electronic Components Division

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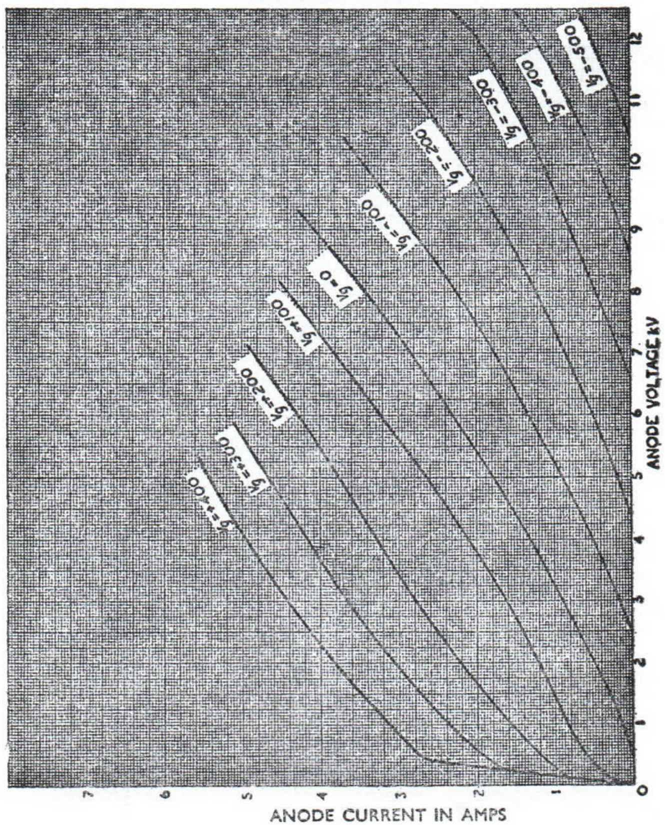
ESW5000

WATER COOLED TRIODE

(Previously EHW5000)

AVERAGE CHARACTERISTIC CURVES



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Electronic Components Division
Tel.: GERRARD 9797

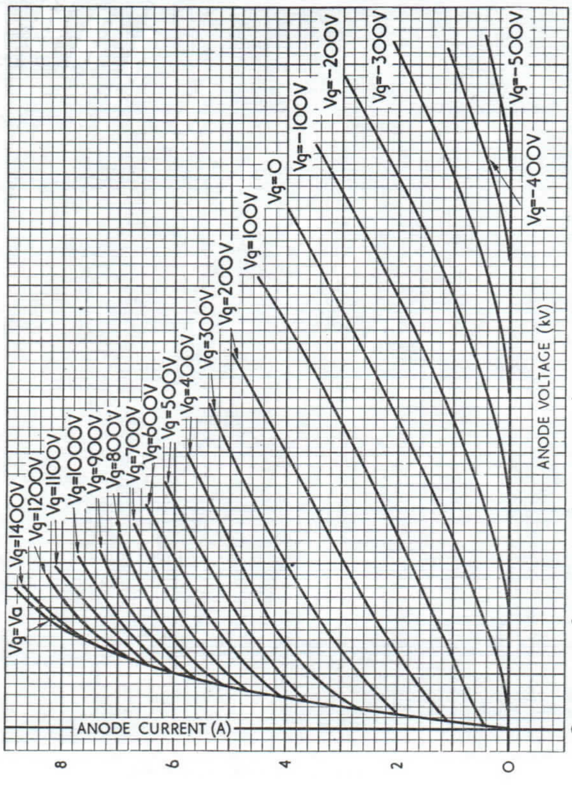
ESW5000

WATER COOLED TRIODE

(Previously EHW5000)

AVERAGE CHARACTERISTIC CURVES: I_a/V_a

($V_f = 11$ Volts A.C.)



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Electronic Components Division

Tel.: GERRARD 9797

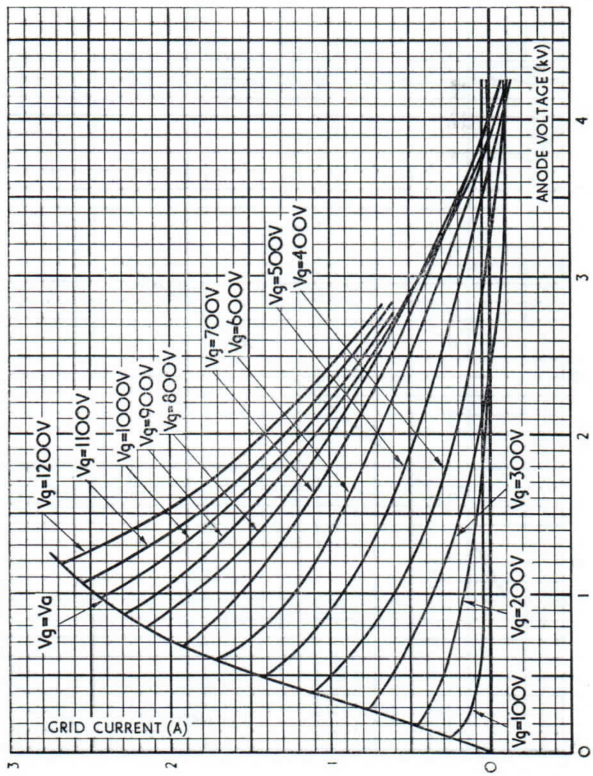
ESW5000

WATER COOLED TRIODE

(Previously EHW5000)

CHARACTERISTIC CURVES: I_g/V_a

($V_f = 11$ Volts A.C.)



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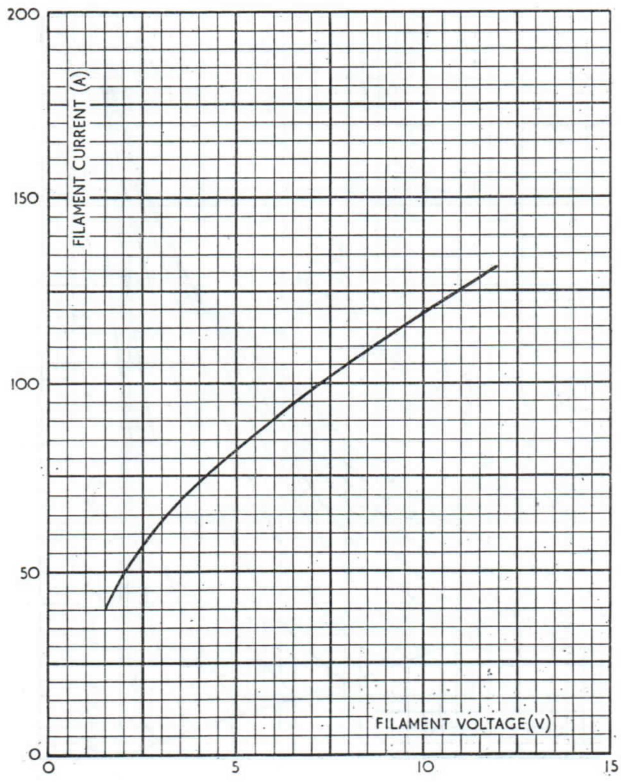
ESW5000

WATER COOLED TRIODE

(Previously EHW5000)

AVERAGE CHARACTERISTIC CURVE: I_f/V_f

(Cold resistance = 0.0003 Ω)



Associated Electrical Industries Limited

Electronic Components Division

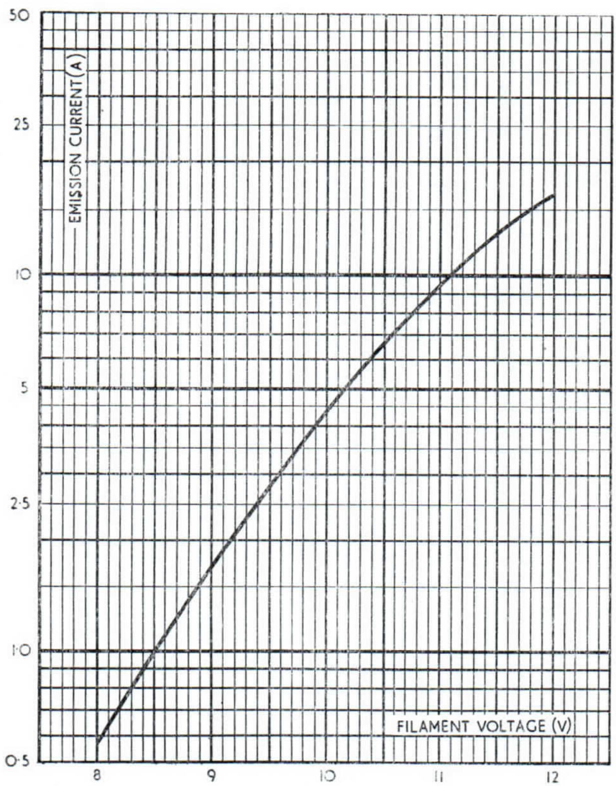
Tel.: GERRARD 9797

ESW5000

WATER COOLED TRIODE

(Previously EHW5000)

CHARACTERISTIC CURVE: I_{em}/V_f



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Electronic Components Division

Tel.: GERRARD 9797

V1505

RADIATION COOLED TRIODE

GENERAL

The V.1505 is a Directly Heated Thoriated Filament Triode suitable for operation as a Power Amplifier or Oscillator at frequencies up to 1.5 Mc/s.

RATING

Filament Voltage (volts)	V_f	14
Filament Current (amps)	I_f	6.5
Maximum Anode Voltage (volts)	V_a	3,000
Maximum Filament Emission (amps)	F_{em}	4
Maximum Anode Dissipation (watts)	W_a	275
Mutual Conductance (ma/V)	g_m	• 8
Amplification Factor	μ	• 16
Anode Impedance (ohms)	r_a	• 2,000
Maximum Operating Frequency at Full Rating		1.5 Mc/s
Audio Power Output	P_{out}	800 watts (2 valves)

• Taken at V_a = 2,000 volts; I_a = 150 m/A

INTER-ELECTRODE CAPACITANCES

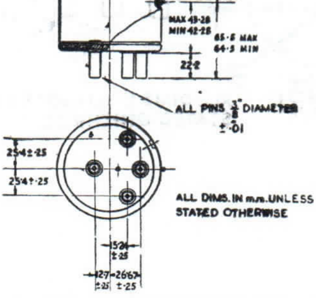
Anode/Grid (μμF)	C_{a-g1}	18
Anode/Filament (μμF)	C_{a-f}	9
Grid/Filament (μμF)	C_{g1-f}	14

DIMENSIONS

Maximum Overall Length (inches)	12.5
Maximum Overall Diameter (inches)	3.54

BASE P1410

V1505 FILAMENT CAP



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Electronic Components Division

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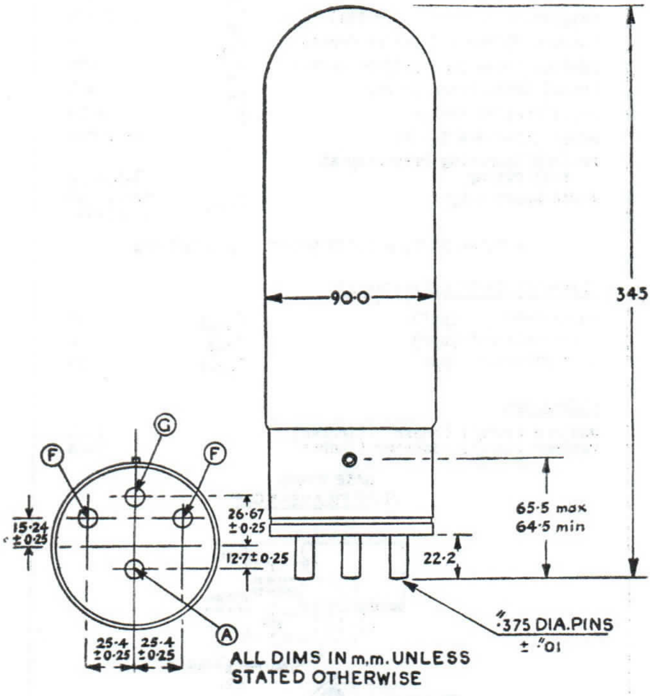
V1505

RADIATION COOLED TRIODE



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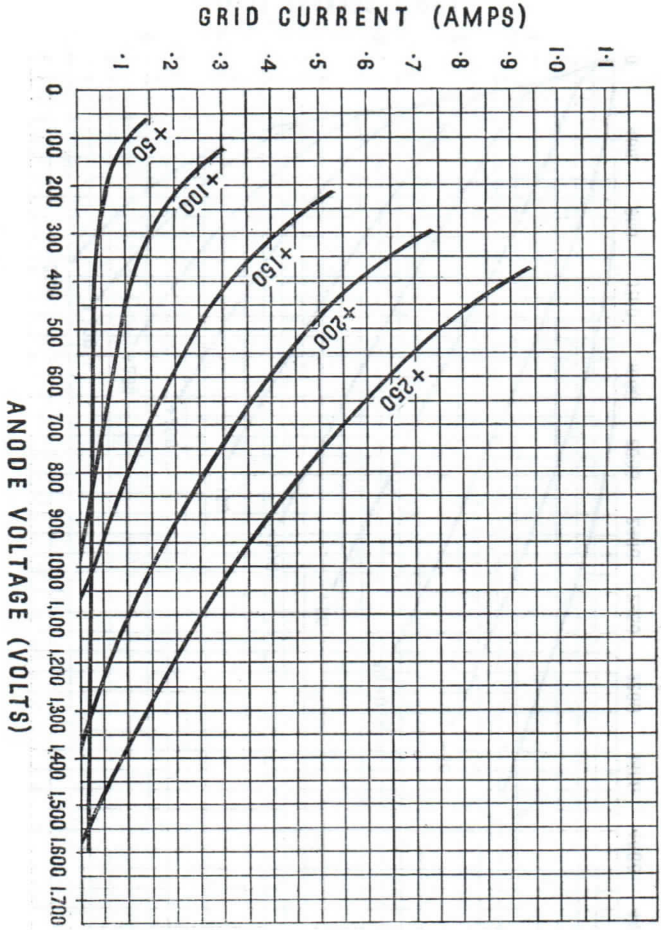
V1505

RADIATION COOLED TRIODE



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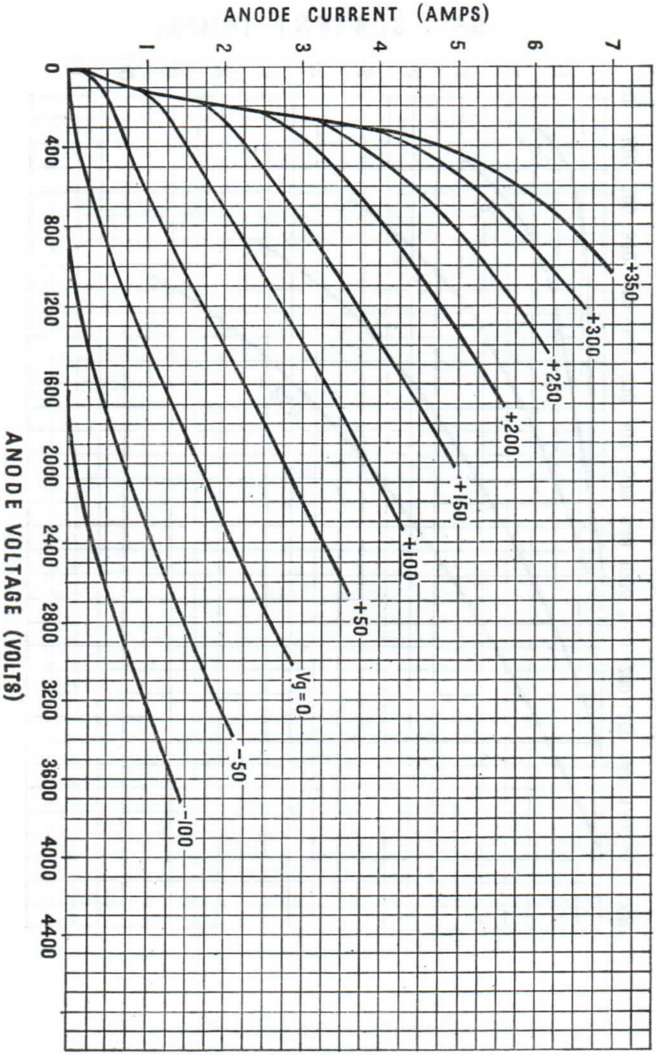
V1505

RADIATION COOLED TRIODE



Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

Low Power Valves

(i.e., Valves with an anode dissipation
less than 100 w)

AEI Low Power Valves

Condensed Data on Replacement Types

Type	Description	V_h or V_f (V)	I_h or I_f (A)	$V_{a(max)}$ (kV)	$V_{g2(max)}$ (V)	$P_{a(max)}$ (W)	g_m (mA/V)	μ
6F32	R.F. Pentode	6·3	0·63	0·25	200	4·5	3·35	—
Base Connections BO7	(1) h (2) k (3) a (4) g_2 (5) g_3 (6) M (7) NP (8) h (TC) g_1							
11E2	Beam Power Amplifier	6·3	0·9	12·5	550	5·0	—	—
Base Connections IO	(1) NP (2) h (3) NP (4) g_2 (5) g_1 (6) NP (7) h (8) k (SC) a							
AC/SP3/RH	H.F. Pentode	4·0	1·0	0·25	250	—	7·5	—
Base Connections B7	(1) M (2) a (3) g_3 (4) h (5) h (6) k (7) g_2 (TC) g_1							
ES75H	Radiation Cooled Triode	10	4·2	1·0	—	75	3·4	11
Base—special								
ESW205	Radiation Cooled Triode	10	6·0	2·0	—	100	5·0	70
Base—special								
ESW501	Radiation Cooled Triode	6·0	4·0	1·5	—	60	1·3	8·0
Base—B4								
V453	A.F. Pentode	4·0	0·65	0·25	150	—	2·0	—
Base Connections BO7	(1) h (2) k (3) a (4) g_2 (5) g_3 (6) M (7) NP (8) h (TC) g_1							

Associated Electrical Industries Limited
Radio Components Department
Tel: GERrard 9797

6F17

MINIATURE PULSE & R.F. BEAM TETRODE

Indirectly heated—for parallel operation

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.3
Maximum Anode Voltage (volts)	$V_{a(max)}$	600
Maximum Screen Voltage (volts)	$V_{g2(max)}$	600
Mutual Conductance (mA/V)	g_m	• 8.3
Maximum Anode Dissipation (watts)	P_a	‡ 3.5
Maximum Screen Dissipation (watts)	P_{g2}	0.7

• Tested under pulse conditions and taken at $V_a = V_{g2} = 250v$; $V_{g1} = -6.25v$; $I_a \simeq 64mA$.

‡ If used in a can at maximum rating the can must be matt black both internally and externally.

INTER-ELECTRODE CAPACITANCES

		‖	¶	[
Anode/Control Grid (µµF)	C_{a-g1}	.03	.033	.05
Anode/Earth (µµF)	C_{out}	6.0	7.1	5.9
Control Grid/Earth (µµF)	C_{in}	6.6	7.6	7.5

‖ Inter-electrode capacitance with holder capacitance balanced out, but with cylindrical screen.

¶ Total capacitance including Benjamin B7G holder type 75/828 and cylindrical screen type 75/832.

[Total capacitance including Benjamin B7G holder type 75/663R without cylindrical screen.

DIMENSIONS

Maximum Overall Length (mm)	54
Maximum Diameter (mm)	19
Maximum Seated Height (mm)	47.5
Approximate Nett Weight (ozs)	1
Approximate Packed Weight (ozs)	2

MOUNTING POSITION - Unrestricted.

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

6F17

MINIATURE PULSE & R. F. BEAM TETRODE

Indirectly heated—for parallel operation

BULB Clear

BASE B7G

Viewed from free end of pins

CONNEXIONS

Pin 1	Control Grid	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Beam Plates	
Pin 7	Screen Grid	g2

Associated Electrical Industries Limited
Electronic Components Division
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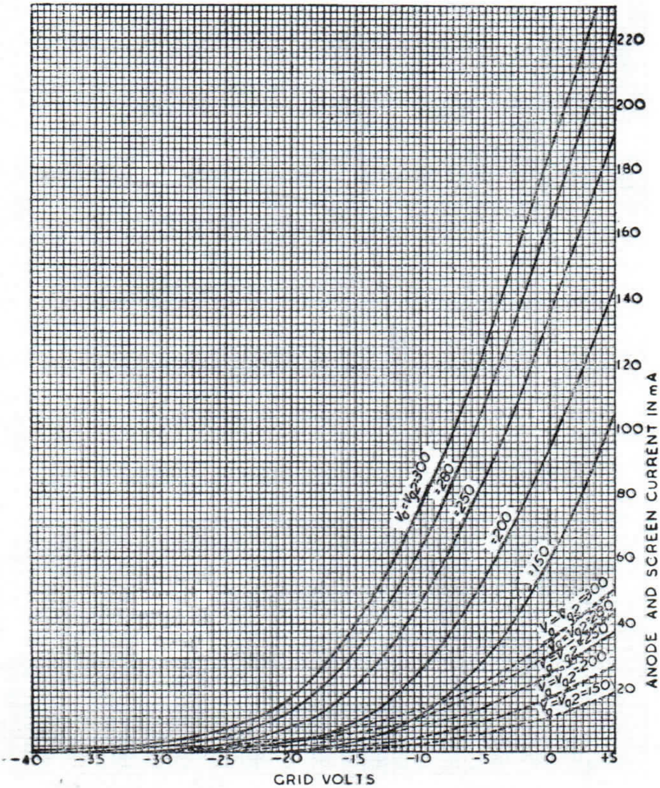
6F17

MINIATURE PULSE & R. F. BEAM TETRODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES

These curves were taken with a short duration pulse having a 400 · 1 off to on period



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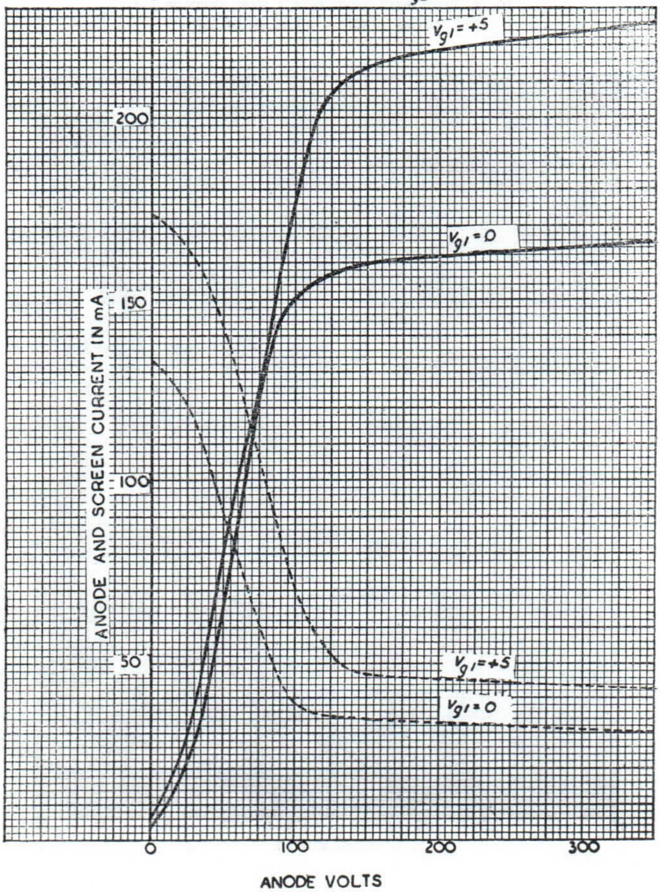
6F17

MINIATURE PULSE & R. F. BEAM TETRODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES

These curves were taken with a short duration pulse having a 400:1 off to on period at V_{g2}=280



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6F21

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

GENERAL

The 6F21 is a miniature based indirectly heated variable mu H.F. Pentode. It is intended for use in H.F. or L.F. Amplifiers having parallel connected heaters.

RATING

Heater Voltage (volts)	V_h	6·3
Heater Current (amps)	I_h	0·2
Maximum Anode Voltage (volts)	$V_{a(max)}$	300
Maximum Screen Voltage (volts)	$V_{g2(max)}$	300
Maximum Anode Voltage (volts)	$V_{a(max)}$	500*
Maximum Screen Voltage (volts)	$V_{g2(max)}$	300*
Mutual Conductance (mA/V)	g_m	2·5††
Inner μ	$\mu_{g1,g2}$	30††
Maximum Potential Heater/Cathode (volts DC)	$V_{h,k(max)}$	150
Maximum Anode Dissipation (watts)	$P_{a(max)}$	3·0
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	0·7

* With 5,000 ohms in series with the anode, and 20,000 ohms in series with the screen, $I_a = 0$.

†† $V_a = 250$ v ; $V_{g2} = 200$ v ; $V_{g1} = -2{\cdot}5$ v.

INTER-ELECTRODE CAPACITANCES (pF)

		§	‡	‡‡
Anode/Earth	c_{out}	7·0	8·1	
Gride 1/Earth	c_{in}	4·7	5·8	
Anode/Grid 1	$c_{a\text{-}g1}$	0·0078	0·0098	0·0083

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

6F21

VARIABLE MU H,F. PENTODE

Indirectly heated—for parallel operation

§ Inter-electrode capacity with holder capacity balanced out.

‡ Total capacity with a Benjamin B7G holder type 75/787R.

‡‡ Total capacity with a Benjamin type 75/787R holder and a perpendicular shield between pins 2, 3 and 6, 7.

"Earth" denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Maximum Overall Length	(mm)	54·5
Maximum Diameter	(mm)	19
Maximum Seated Height	(mm)	47·5
Approximate Nett Weight	(ozs)	¼
Approximate Packed Weight	(ozs)	½

MOUNTING POSITION

Unrestricted.

TYPICAL OPERATION

Anode Voltage (volts)	V_a	250	250
Screen Voltage (volts)	V_{g2}	100	200
Grid Bias (volts)	V_{g1}	−0·5	−2·5
Anode Current (mA)	I_a	4·9	7·8
Screen Current (mA)	I_{g2}	1·25	2·0
Mutual Conductance (mA/V)	g_m	2·5	2·5
Grid Bias for Mutual Conductance of 10 μA/V (volts)			−34
Equivalent Grid Noise Resistance (KΩ)	R_{eq}		7·5
Anode Impedance (MΩ)	r_a		1·2

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

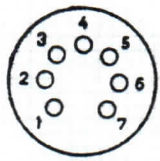
6F21

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

BULB—Clear.

BASE—B7G.



Viewed from free end of pins

CONNECTIONS

Pin 1	Control Grid	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Suppressor Grid and Shield	g3,s
Pin 7	Screen Grid	g2

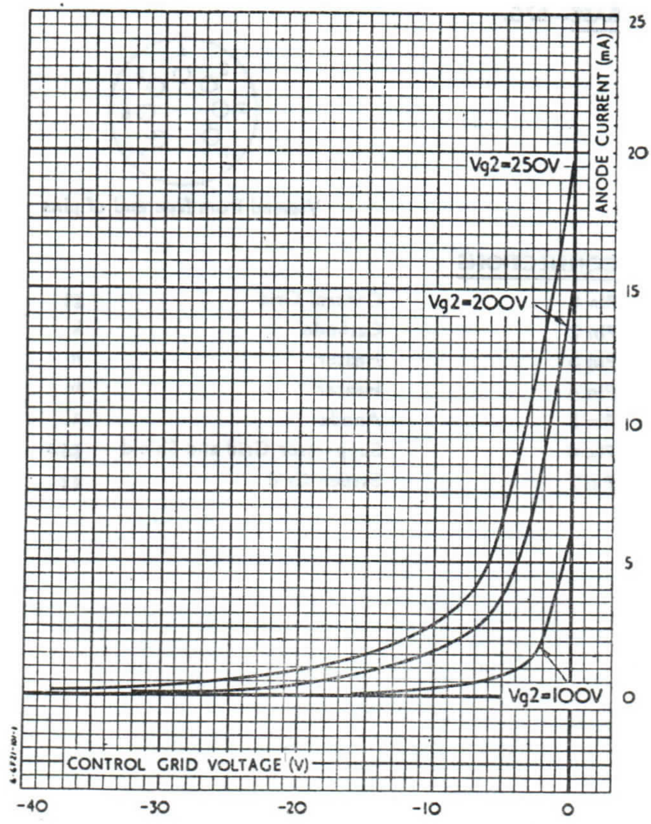
Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

6F21

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES:
I_a/V_{g1} Curves taken at $V_a = 250V$



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6F21

VARIABLE MU H.F. PENTODE

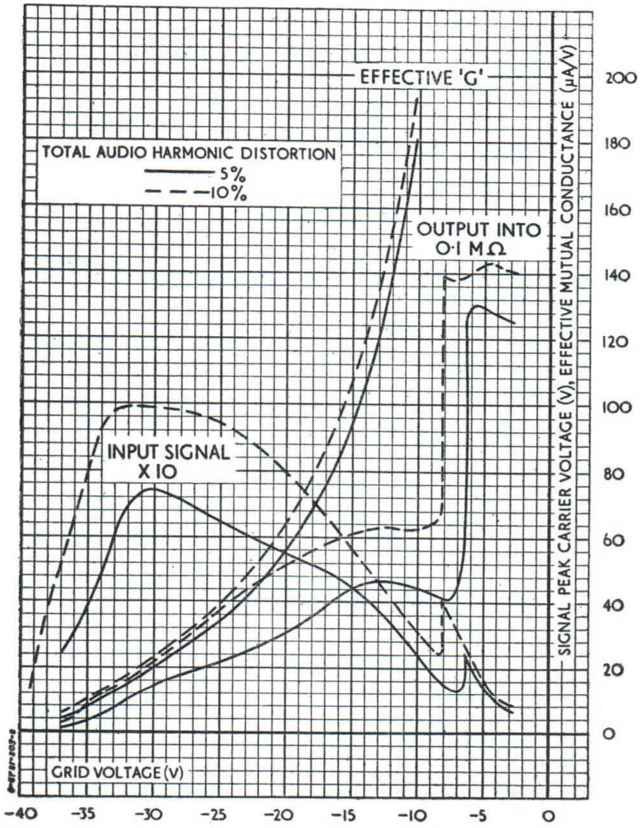
Indirectly heated—for parallel operation.

AVERAGE CHARACTERISTIC CURVES : $V_{sig(pk)}$, gm(eff)/V_g

$V_a = 250V$ $V_{g2} = 200V$ $V_{g3} = 0V$

$f_{sig} = 110kc/s$ Mod. $= 60\%$ $R_L = 0.1M\Omega$

Initially : $V_{g1} = 2.5V$ $I_a = 7.8mA$ $I_{g2} = 2.0mA$



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6F33

SCREENED R.F. PENTODE

Indirectly heated

GENERAL

The 6.F.33 has a short cut-off Suppressor Grid characteristic which makes it particularly suitable for use in Modulator, Variable Reactance and Timing Circuits. A diode has been tied to the suppressor in order to prevent "blocking" when this grid is driven positive. ←

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.35
Maximum Anode Voltage (volts)	$V_{a(max)}$	250
Maximum Screen Voltage (volts)	$V_{g2(max)}$	250
Mutual Conductance (mA/V)	g_m	• 4.35
Inner µ ≠	$\mu_{g1\,g2}$	• 38
Maximum Anode Dissipation (watts)	$p_{a(max)}$	2.5
Maximum Screen Dissipation (watts)	p_{g2}	0.8
Maximum Potential Heater/Cathode (volts DC)	$V_{h-k(max)}$	100

• Taken at $V_a = 200v$; $V_{g2} = 100v$; $V_{g1} = -1.5v$; $V_{g3} = 0v$.

≠ i.e. $\frac{\delta V_{g2}}{\delta V_{g1}}$ with I_a constant.

INTER-ELECTRODE CAPACITANCES

			₯	$	
Anode/Earth	(µµF)	c_{out}	4.5	5.6	←
Anode/Control Grid	(µµF)	c_{a-g1}	0.01	0.012	
Control Grid/Earth	(µµF)	c_{in}	7.3	8.4	←
Suppressor Grid/Earth	(µµF)	c_{g3-E}	10.0	11.1	←

₯ Measured with Benjamin cylindrical screen type 75/832, but holder capacity balanced out.

$ Including capacity of Benjamin B7G holder type 75/833 and screen type 75/832.

DIMENSIONS

Maximum Overall Length	(mm)	54
Maximum Diameter	(mm)	19
Maximum Seated Height	(mm)	48.6
Approximate Nett Weight	(ozs)	¼
Approximate Packed Weight	(ozs)	½

MOUNTING POSITION - Unrestricted.

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

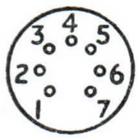
6F33

SCREENED R.F. PENTODE

Indirectly heated

BULB Clear

BASE B.7.G



Viewed from free end of pins

CONNECTIONS

Pin 1	Control Grid	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Suppressor Grid	g3
Pin 7	Screen Grid	g2

Associated Electrical Industries Limited
Electronic Components Division
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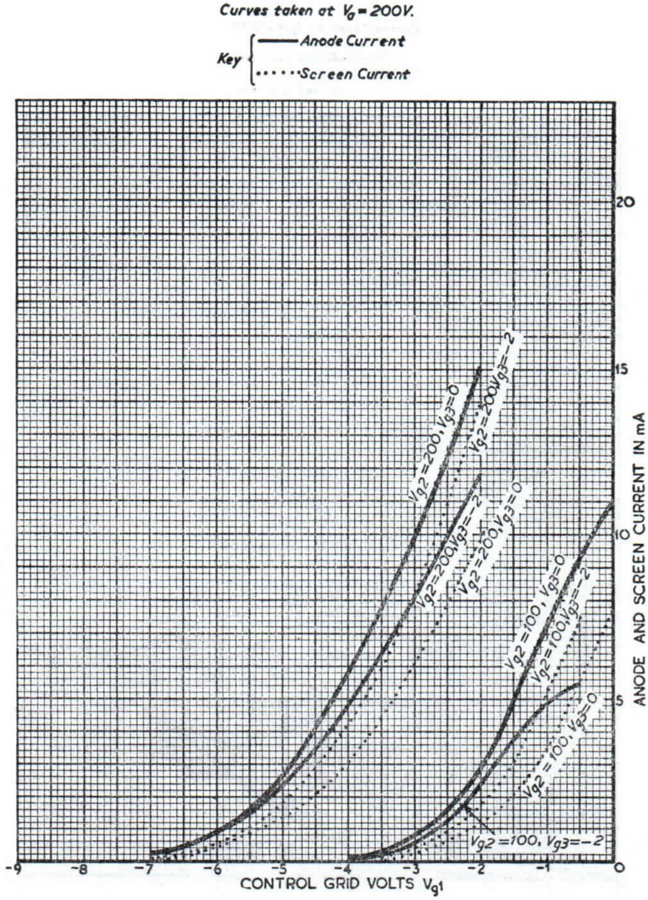
6F33

SCREENED R.F. PENTODE

Indirectly heated

CHARACTERISTIC CURVES OF AVERAGE



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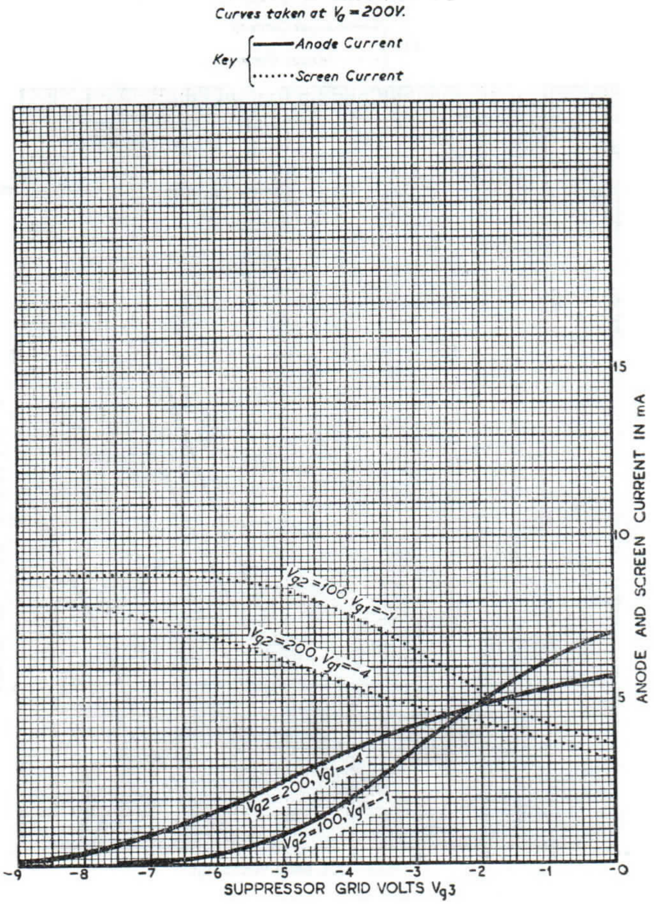
6F33

SCREENED R.F. PENTODE

Indirectly heated

CHARACTERISTIC CURVES OF AVERAGE



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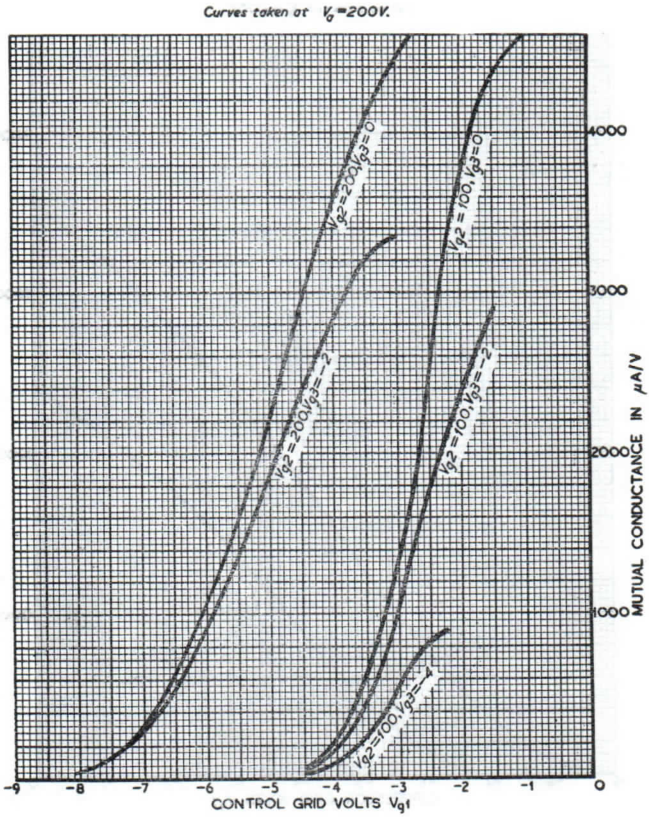
6F33

SCREENED R.F. PENTODE

Indirectly heated

CHARACTERISTIC CURVES OF AVERAGE



Associated Electrical Industries Limited
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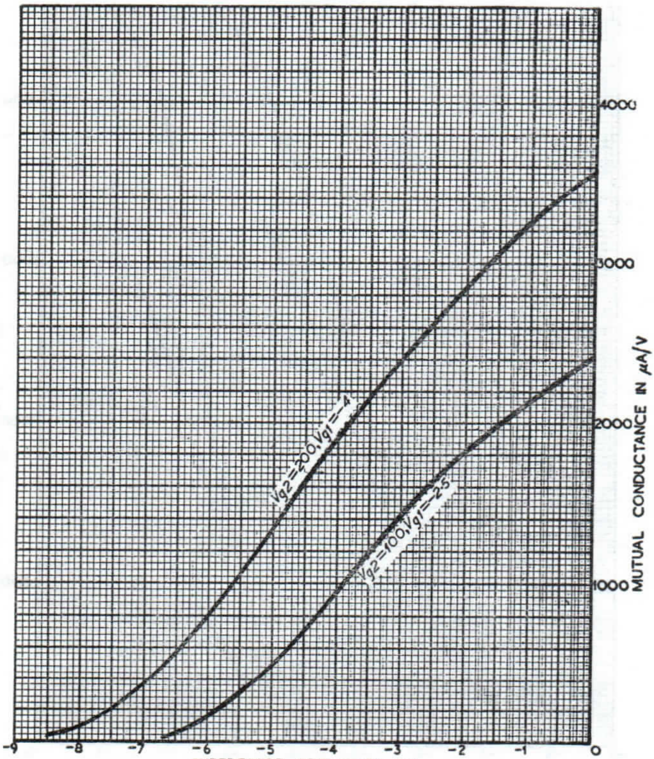
6F33

SCREENED R.F. PENTODE

Indirectly heated

CHARACTERISTIC CURVES OF AVERAGE

Curves taken at $V_a = 200V$



Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

6P17

OUTPUT PENTODE

Indirectly heated—for parallel operation

TENTATIVE

GENERAL

The 6P17 is a miniature based Power Output Pentode having a maximum anode dissipation of 4.75 watts and its Suppressor Grid internally tied to the cathode.

It has a maximum operating frequency at full ratings of 100 Mc/s and is intended for use in equipment powered from AC mains.

RATING

Heater Voltage	(volts)	V_h	6.3
Heater Current	(amps)	I_h	0.2
Maximum Anode Voltage	(volts)	$V_{a\,(max)}$	300
Maximum Screen Voltage	(volts)	$V_{g2(max)}$	275
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	4.75*
Maximum Screen Dissipation	(watts)	$P_{g2(max)}$	0.8
Maximum Heater/Cathode Voltage	(volts)	$V_{h\text{-}k(max)}$	150†
Maximum Grid 1/Grid 2 Voltage (DC)	(volts)	$V_{g1\text{-}g2(max)}$	300
Maximum Grid 1/Cathode Voltage (DC)	(volts)	$V_{g1\text{-}k(max)}$	100
Maximum Mean Grid 1 Current	(mA)	$I_{g1\,(max)}$	3.3
Mutual Conductance	(mA/V)	g_m	2.6‡
Inner Amplification Factor		$\mu_{g1\text{-}g2}$	12‡
Maximum Operation Frequency at full ratings	(Mc/s)	$f_{(max)}$	100

* Valve unscreened with adequate ventilation.

† Cathode positive or negative to heater.

‡ Measured at $V_a = V_{g2} = 250$ V; $I_a = 16$ mA; $V_{g1} = -13.5$V.

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

6P17

OUTPUT PENTODE

Indirectly heated—for parallel operation

TENTATIVE

INTER-ELECTRODE CAPACITANCES (pF)

Grid 1/Earth	c_{in}	4.25
Anode/Earth	c_{out}	6.5
Anode/Grid 1	$c_{a\text{-}g1}$	<0.3

Measured cold with an external screen but with holder capacity balanced out.

" Earth " denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Maximum Overall Length	(mm)	54.5
Maximum Diameter	(mm)	19.0
Maximum Seated Height	(mm)	47.5
Approximate Nett Weight	(ozs)	$\frac{1}{4}$
Approximate Packed Weight	(ozs)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted.

TYPICAL OPERATION—Class A Power Output.

Anode Voltage	(volts)	V_a	250
Screen Voltage	(volts)	V_{g2}	250
Cathode Bias Resistance	(ohms)	R_k	740
Anode Current	(mA)	I_a	16
Screen Current	(mA)	I_{g2}	2.4
Power Output for 10% Total Harmonic Distortion	(watts)	P_{out}	1.4
Anode Load Impedance	(kΩ)	R_a	16
Input Voltage Swing (r.m.s.)	(volts)	V_{in}	5.3

BULB—Clear

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

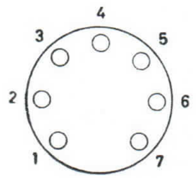
6P17

OUTPUT PENTODE

Indirectly heated—for parallel operation

TENTATIVE

BASE—B7G



Viewed from free end of pins

VALVE HOLDER

Ediswan Clix VH337/7, VH437/7 and VH17/7 series.

CONNECTIONS

Pin 1	Grid 1	g1
Pin 2	Cathode, Grid 3	k,g3
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	No Connection	N.C.
Pin 7	Grid 2	g2

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

11A1

LOW MU TRIODE

Indirectly heated

GENERAL

The 11A1 is a miniature based triode intended for use as a series stabiliser valve. It has a maximum cathode current of 120mA and a maximum anode dissipation of 15 watts. These valves are suitable for operation in parallel.

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.95
Maximum Anode Voltage (volts)	$V_{a(max)}$	300
Maximum Anode Dissipation (watts)	$P_{a(max)}$	15
Maximum Cathode Current (mA)	$I_{k(max)}$	120
Maximum Heater/Cathode Voltage (volts)	$V_{h\text{-}k(max)}$	250
Mutual Conductance (mA/V)	g_m	12*
Amplification Factor	μ	4.5*
Anode Impedance (ohms)	r_a	375*

* Measured at $V_a = 150V$; $I_a = 100mA$

INTER-ELECTRODE CAPACITANCES (pF)†

Anode/Grid	$c_{a\text{-}g}$	9.0
Anode/Cathode	$c_{a\text{-}k}$	4.5
Grid/Cathode	$c_{g\text{-}k}$	8.5

† Measured without external shield

DIMENSIONS

Maximum Overall Length	(mm)	65
Maximum Diameter	(mm)	22
Maximum Seated Height	(mm)	58
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

11A1

LOW MU TRIODE

Indirectly heated

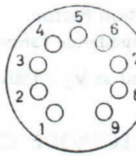
MOUNTING POSITION—Unrestricted

TYPICAL OPERATION—Series Regulator (Two valves in parallel)

Input Voltage (volts)	V_{in}	360
Output Voltage (volts)	V_{out}	210
Output Current (total) (mA)	$I_{out\ (tot)}$	200
Stabilisation for ± 7% input (%)		0.2

Small resistors should be inserted in the anode and cathode leads of each valve for balancing purposes.

BASE—Noval (B9A)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Cathode	k
Pin 3	Internal Connection	IC
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Grid	g
Pin 7	Internal Connection	IC
Pin 8	Internal Connection	IC
Pin 9	Anode	a

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11D12

LOW-MU DOUBLE TRIODE

Indirectly heated

TENTATIVE

GENERAL

The 11D12 is an indirectly heated, low-mu, Power Double Triode with separate cathodes. It is suitable for use in booster scanning circuits, and as a series regulator in DC Power Supply Units.

RATING—Absolute values

Heater Voltage	V_h	6·3	V
Heater Current	I_h	2·5	A
Maximum Anode Supply Voltage	$V_{a(b)max}$	550*	V
Maximum Anode Voltage	$V_{a(max)}$	250*	V
Maximum Peak Inverse Voltage (Booster)		3·0*†	kV
Maximum Negative Control Grid Pulse Voltage (booster)		2·3*†	kV
Maximum Cathode Current	$I_{k(max)}$	125*	mA
Maximum Anode Dissipation	$P_{a(max)}$	13*	W
Maximum Resistance between Grid and Cathode (cathode bias)		1·0*	MΩ
Maximum Resistance between Grid and Cathode (fixed bias)		0·1*‡	MΩ
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	300*§	V
Maximum Bulb Temperature	$T_{Bulb(max)}$	230	°C

* Each Section.

† Booster scanning service. Maximum pulse duration 15% of one cycle with a maximum duration of 15µs.

‡ With fixed bias the anode circuit should contain a protective resistance to provide a minimum drop of 15V D.C. at the normal operating conditions. When two or more sections are used in parallel at dissipations approaching the rated maximum, separate anode and cathode resistors must be used to assist load sharing. When combined fixed and cathode bias is used, the cathode bias portion should have a minimum value of 7·5V D.C. at the normal operating conditions and with grid to cathode resistance of 100kΩ. It is not recommended that fixed bias be used when the valve is used in a booster scanning circuit.

§ Operation is not recommended with a damper pulse between heater and cathode.

Associated Electrical Industries Limited

Electronic Components Division

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11D12

LOW-MU DOUBLE TRIODE

Indirectly heated

TENTATIVE

INTER-ELECTRODE CAPACITANCES (pF)*—Each Section

Anode/Grid	c_{a-g}	7·3
Heater/Cathode	c_{h-k}	9·6
Anode 2/Anode 1	$c_{a''-a'}$	2·7
Grid 2/Grid 1	$c_{g''-g'}$	0·25
Grid 1 or Grid 2/Earth	c_{in}	6·9
Anode 1 or Anode 2/Earth	c_{out}	2·5

* Measured in fully shielded socket without can.

DIMENSIONS

Maximum Overall Length	103 mm
Maximum Base Diameter	43·5 mm
Maximum Seated Height	88·5 mm

MOUNTING POSITION—Unrestricted

CHARACTERISTICS*—Each Section

Anode Supply Voltage	$V_{a(b)}$	135	V
Anode Current	I_a	125	mA
Cathode Bias Resistance	R_k	250	Ω
Mutual Conductance	g_m	7·0	mA/V
Amplification Factor	μ	2·0	
Valve Anode Resistance (approx)	r_a	280	Ω

* Values quoted correspond to operation at the absolute limit of anode current and dissipation.

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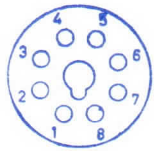
11D12

LOW-MU DOUBLE TRIODE

Indirectly heated

TENTATIVE

BASE—108



Viewed from free end of pins

CONNECTIONS

Pin 1	Grid 1	g′
Pin 2	Anode 1	a′
Pin 3	Cathode 1	k′
Pin 4	Grid 2	g″
Pin 5	Anode 2	a″
Pin 6	Cathode 2	k″
Pin 7	Heater	h
Pin 8	Heater	h

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11E3
BEAM POWER AMPLIFIER
Indirectly heated—for Pulse Amplification

RATING

Heater Voltage (volts)	V_h	4.2
Heater Current (amps)	I_h	2.5
Maximum Anode Voltage as Series Modulator (volts DC)	$V_{a(max)}$	3,500
Maximum Peak Anode Voltage as Break Modulator (volts)	$V_{a(pk)max}$	12,500
Maximum Screen Voltage (volts)	$V_{g2(max)}$	700
Maximum Control Grid Negative Bias (volts-ve)	$V_{g1(max)}$	-700
Maximum Peak Cathode Current (amps)	$I_{k(pk)max}$	† 3.5
Inner µ	μ_{g1-g2}	‡ 9.0
Maximum Anode Dissipation (watts)	$W_{a(max)}$	10.0
Maximum Screen Dissipation as Series Modulator (watts)	$W_{g2(max)Series}$	0.9
Maximum Screen Dissipation as Break Modulator (watts)	$W_{g2(max)Break}$	2.0
Maximum Potential Heater/Cathode (volts DC)	$V_{h-k(max)}$	150

† Taken under Pulse Conditions of approximately 10 micro-seconds duration and 400:1 minimum off-on ratio.

‡ Taken at $V_a = 200$; $V_{g2} = 200$; $I_a = 40$ mA

INTER-ELECTRODE CAPACITANCES

Anode/Earth (µµF)	C_{out}	7.5
Anode/Control Grid (µµF)	C_{a-g1}	0.26
Control Grid/Earth (µµF)	C_{in}	20

"Earth" denotes the remaining earthy potential electrodes and heater joined to cathode.

DIMENSIONS

Maximum Overall Length (mm)	140
Maximum Diameter (mm)	54
Maximum Seated Height (mm)	125
Approximate Nett Weight (ozs)	2½
Approximate Packed Weight (ozs)	7

MOUNTING POSITION Vertical

NOTE

This valve is intended for use as a break or series modulator with a short duration pulse input signal. When the equipment may be subjected to reduced atmospheric pressures the peak voltage between the control grid and Screen grid should not exceed 1,200 volts.

Associated Electrical Industries Limited
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11E3

BEAM POWER AMPLIFIER

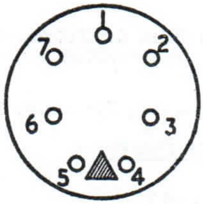
Indirectly heated—for Pulse Amplification

TYPICAL OPERATION		Series Modulator	Break Modulator
Quiescent Anode Voltage (volts)	$V_{a(o)}$	3,500	500
Screen Voltage (volts)	V_{g2}	500	500
Signal Voltage Positive (volts)		50	25
Peak Anode Current (amps)	$I_{a(pk)}$	2	1
Approximate Knee Voltage (volts)		200	
Peak Anode Output Voltage (volts)		3,300	10,000
Approximate Peak Grid Current (amps)	$I_{g1(pk)}$	0.12	0.05

CAP BVA Standard

BULB Clear

BASE British 7 Pin.



Viewed from free end of pins.

CONNEXIONS

Pin 1	Blank	-
Pin 2	Control Grid	g1
Pin 3	Blank	-
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Cathode	k
Pin 7	Screen Grid	g2
Top Cap	Anode	a

Associated Electrical Industries Limited

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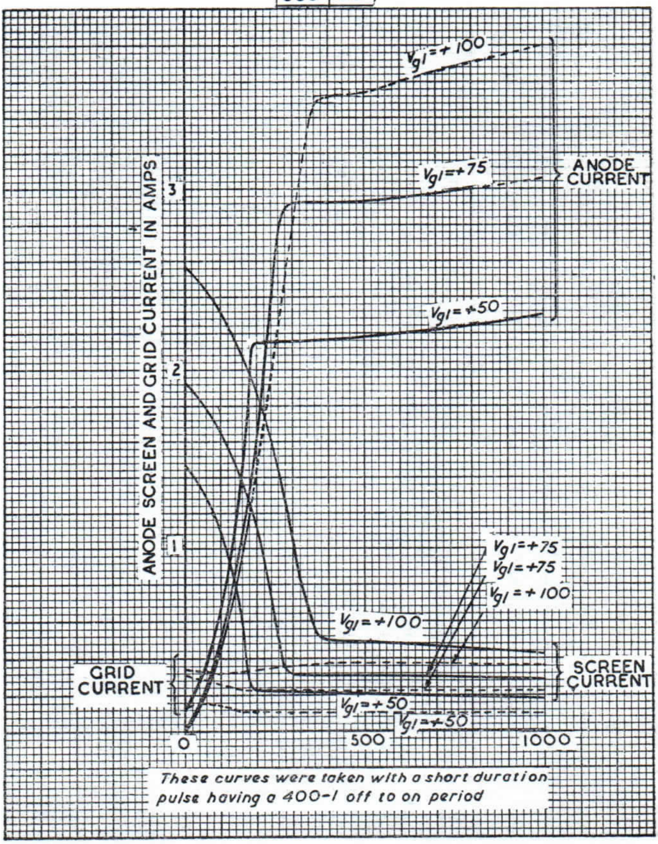
11E3

BEAM POWER AMPLIFIER

Indirectly heated—for Pulse Amplification

AVERAGE CHARACTERISTIC CURVES

V_{g2}	V_h
500	4·2



ANODE VOLTS

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

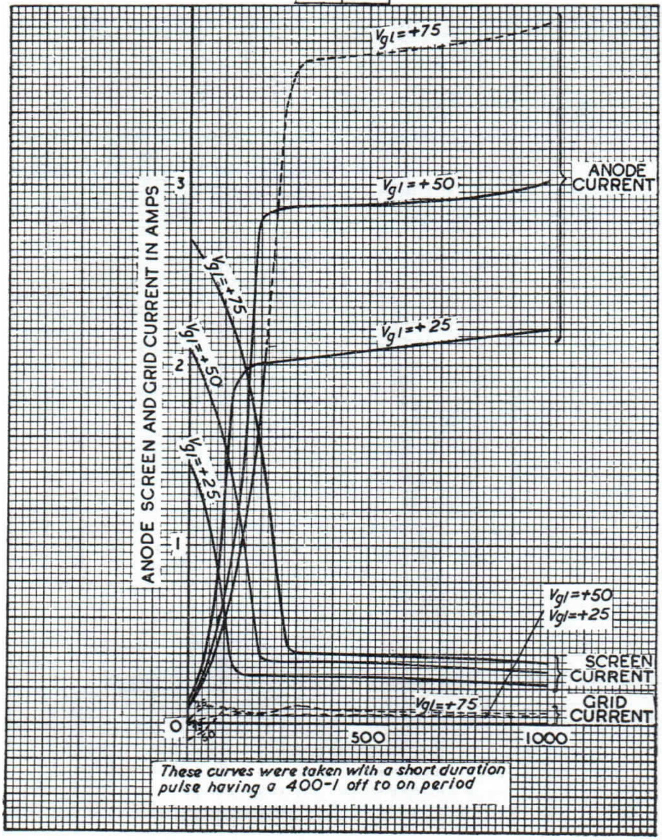
11E3

BEAM POWER AMPLIFIER

Indirectly heated—for Pulse Amplification

AVERAGE CHARACTERISTIC CURVES

V_{g2}	V_h
700	4·2



ANODE VOLTS

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

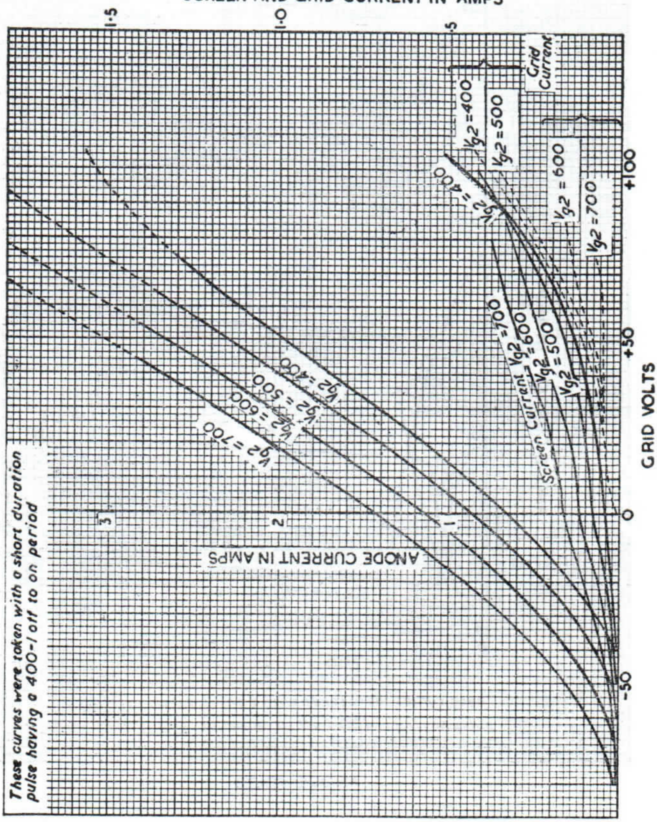
11E3

BEAM POWER AMPLIFIER

Indirectly heated—for Pulse Amplification

AVERAGE CHARACTERISTIC CURVES

V_a	V_h
1000	4·2



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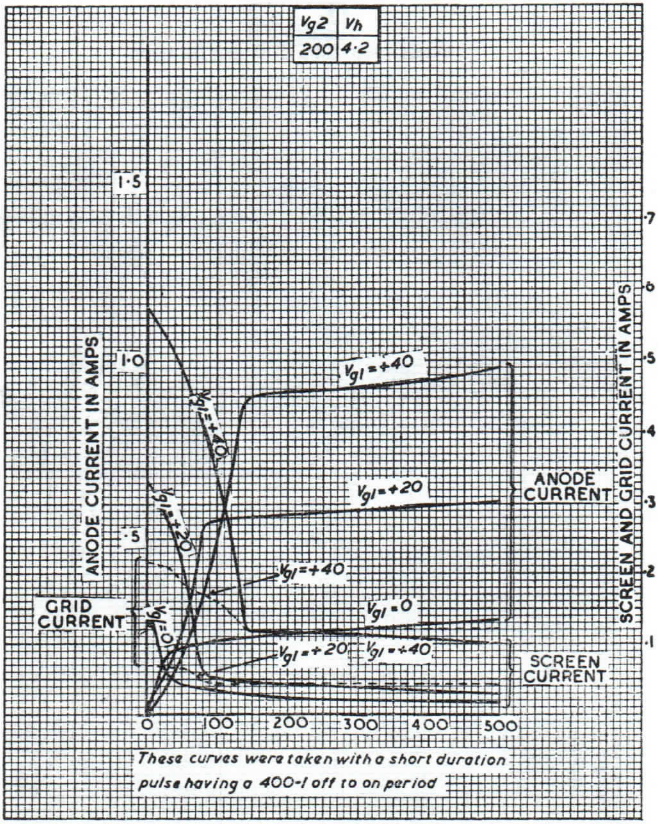
11E3

BEAM POWER AMPLIFIER

Indirectly heated—for Pulse Amplification

AVERAGE CHARACTERISTIC CURVES



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Tel.: GERRARD 9797

11E13

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

GENERAL

The 11E13 is an indirectly heated, miniature based, h.f. double tetrode. It is internally neutralised and is intended for use as a push-pull amplifier at frequencies up to 225 Mc/s.

RATING§

Heater Voltage	V_h	6·3	12·6	V
Heater Current	I_h	0·83	0·42	A
Maximum Operating Frequency	$f_{(max)}$		225	Mc/s
Maximum Permissible Temperature of hottest part of bulb			225	°C
Maximum Permissible Temperature of the base pins			120	°C

§ All limiting values are Absolute, not Design Centres.

RATING—Absolute values

Class "C" r.f. amplifier for c.w. telegraphy or f.m. telephony.

Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	200	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−150	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	5·0*	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	1·0*	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	0·2*	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	225*	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	50*	mA
Maximum Mean Control Grid Current	$I_{g1(av)max}$	3·0*	mA

* Each section.

Associated Electrical Industries Limited
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11E13

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

RATING—Absolute values

Class "C" r.f. amplifier with anode and screen grid modulation (carrier condition for use with modulation factor 1).

Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	200	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−150	V
Maximum Heater/Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Anode Dissipation	$p_{a(max)}$	3·3*	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	0·65*	W
Maximum Control Grid Dissipation	$p_{g1(max)}$	0·2*	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	180*	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	40*	mA
Maximum Mean Control Grid Current	$I_{g1(av)max}$	3·0*	mA

* Each section.

RATING—Absolute values

Frequency Trebler.

Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	200	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−150	V
Maximum Heater/Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Anode Dissipation	$p_{a(max)}$	5·0*	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	1·0*	W
Maximum Control Grid Dissipation	$p_{g1(max)}$	0·2*	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	225*	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	35*	mA
Maximum Mean Control Grid Current	$I_{g1(av)max}$	2·0*	mA

* Each section.

Associated Electrical Industries Limited
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11E13

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

INTER-ELECTRODE CAPACITANCES

Anode/Grid 1 (each section)*	$c_{a\text{-}g1}$	<0·1 pF
Grid 1/All other electrodes (each section)	$c_{g1\text{-}all}$	6·2 pF
Anode/All other electrodes (each section)	$c_{a\text{-}all}$	2·6 pF
Input Capacitance ‡	c_{in}	5·0 pF
Output Capacitance ‡	c_{out}	1·5 pF

* Internally neutralised for push-pull operation.
‡ Two sections in push-pull.

CHARACTERISTICS †‡

Mutual Conductance	g_m	3·3 mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	7·5

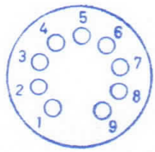
† Each section.
‡ At $I_a = 30$ mA.

DIMENSIONS

Maximum Overall Length	78·5 mm
Maximum Diameter	22·2 mm
Maximum Seated Height	71·5 mm

MOUNTING POSITION—Unrestricted, but when mounted horizontally pins 2 and 7 must be in the same vertical plane.

BASE—Noval (B9A)



Viewed from free end of pins

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11E13

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

CONNECTIONS

Pin 1	Control Grid, Section 1	$g1'$
Pin 2	Cathode, Shield	k,s
Pin 3	Control Grid, Section 2	$g1''$
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Anode, Section 1	a'
Pin 7	Screen Grid	$g2', g2''$
Pin 8	Anode, Section 2	a''
Pin 9	Heater Centre Tap	h_{ct}

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11E15

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

GENERAL

The 11E15 is an internally neutralised h.f. double tetrode. It is intended for use as a push-pull amplifier or frequency trebler at frequencies up to 500 Mc/s.

RATING§

Heater Voltage	V_h	12·6	6·3	V
Heater Current	I_h	0·9	1·8	A
Maximum Operating Frequency	$f_{(max)}$		500	Mc/s
Maximum Permissible Temperature of hottest part of bulb			200	°C
Maximum Permissible Temperature of the base pins			180	°C

§All limiting values are Absolute, not Design Centres.

RATING—Absolute values

As Class "C" r.f. push-pull power amplifier for c.w. telegraphy or f.m. telephony.

Maximum Anode Voltage	$V_{a(max)}$	600*	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−100	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	20†	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	3·5†	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	1·0†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	700†	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	120†	mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1\text{-}k(max)}$	50†	kΩ

Continued

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11E15

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1\text{-}k(max)}$	100†	kΩ
Maximum Mean Control Grid Current	$I_{g1(av)max}$	5·0†	mA

* For natural cooling $V_{a(max)}$=600V up to 150 Mc/s but is limited to 280V at 500 Mc/s. For forced air cooling $V_{a(max)}$=600V up to 280 Mc/s but is limited to 500V at 500 Mc/s.

† Each section.

RATING—Absolute values

Class " B " a.f. power amplifier or modulator.

Maximum Anode Voltage	$V_{a(max)}$	600	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−100	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	20†	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	3·5†	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	1·0†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	450†	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	140†	mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1\text{-}k(max)}$	50†	kΩ
Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1\text{-}k(max)}$	100†	kΩ

† Each section.

Associated Electrical Industries Limited

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11E15

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

RATING—Absolute values

As Class "C" r.f. power amplifier with anode and screen modulation (carrier condition for use with modulation factor 1).

Maximum Anode Voltage	$V_{a(max)}$	600*	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	–175	V
Maximum Heater/Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Anode Dissipation	$p_{a(max)}$	14†	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	2·3†	W
Maximum Control Grid Dissipation	$p_{g1(max)}$	1·0†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	1·0†	A
Maximum Mean Cathode Current	$I_{k(av)max}$	120†	mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1-k(max)}$	50†	kΩ
Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1-k(max)}$	100†	kΩ
Maximum Mean Control Grid Current	$I_{g1(av)max}$	5·0†	mA

* For natural cooling $V_{a(max)}$=600V up to 150 Mc/s but is limited to 280V at 500 Mc/s. For forced air cooling $V_{a(max)}$=600V up to 250 Mc/s but is limited to 480V at 500 Mc/s.

† Each section.

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11E15

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

RATING—Absolute values

Frequency Trebler.

Maximum Anode Voltage	$V_{a(max)}$	750	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−175	V
Maximum Heater/Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	20†	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	3·5†	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	1·0†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	700†	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	100†	mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1-k(max)}$	50†	kΩ
Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1-k(max)}$	100†	kΩ
Maximum Mean Control Grid Current	$I_{g1(av)max}$	5·0†	mA

† Each section

INTER-ELECTRODE CAPACITANCES

Anode/Grid 1*†	c_{a-g1}	0·06	pF
Grid 1/All other electrodes†	c_{g1-all}	10·5	pF
Anode/All other electrodes†	c_{a-all}	3·2	pF
Input Capacitance‡	c_{in}	6·7	pF
Output Capacitance‡	c_{out}	2·1	pF

* Internally neutralised for push pull operation.

† Each section.

‡ 2 sections in push pull.

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11E15

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

CHARACTERISTICS

Mutual Conductance	g_m	4·5†‡ mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	8·0†‡

† Each section.
‡At $V_a = 300V$, $V_{g2} = 250V$, $I_a = 30mA$.

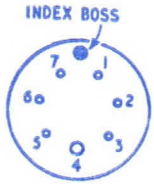
DIMENSIONS

Maximum Overall Length	103 mm
Maximum Diameter	47 mm
Maximum Seated Height	91 mm
Approximate Net Weight	2·3 ozs

MOUNTING POSITION—Unrestricted, but when mounted horizontally anode pins should be in a horizontal plane.

CAPS—Wire 2 mm dia.

BASE—B7A



Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Control Grid, Section 1	g1′
Pin 3	Screen Grid	g2′g2″
Pin 4	Cathode, Beam Plates, Shield	k,bp,s
Pin 5	Heater Centre Tap	h_{ct}
Pin 6	Control Grid, Section 2	g1″
Pin 7	Heater	h
Cap No. 1	Anode, Section 1	a′
Cap No. 2	Anode, Section 2	a″

Associated Electrical Industries Limited
Electronic Components Department
Tel: GERrard 9797

11E16

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

GENERAL

The 11E16 is an internally neutralised h.f. double tetrode. It has a centre tapped heater and is intended for use as a push-pull amplifier or frequency trebler at frequencies up to 600 Mc/s.

RATING§

Heater Voltage	V_h	12·6	6·3	V
Heater Current	I_h	0·65	1·3	A
Maximum Operating Frequency	$f_{(max)}$		600	Mc/s
Maximum Permissible Temperature of hottest part of bulb			200	°C
Maximum Permissible Temperature of the base pins			180	°C

§ All limiting values are Absolute, not Design Centres.

RATING—Absolute values.

Class " C " r.f. push-pull power amplifier for c.w. telegraphy or f.m. telephony.

Maximum Anode Voltage	$V_{a(max)}$	600*	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−75	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	10†	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	1·5†	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	0·5†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	260†	mA

Continued

Associated Electrical Industries Limited
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11E16

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

Maximum Mean Cathode Current	$I_{k(av)max}$	55† mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1-k(max)}$	50† kΩ
Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1-k(max)}$	100† kΩ
Maximum Mean Control Grid Current	$I_{g1(av)max}$	2·5† mA

* For natural cooling $V_{a(max)}$ = 600V up to 150 Mc/s but is limited to 250V at 600 Mc/s. For forced air cooling $V_{a(max)}$ = 600V up to 300Mc/s but is limited to 400V at 600 Mc/s.

† Each section.

RATING—Absolute values.

Class "C" r.f. power amplifier with anode and screen modulation (carrier condition for use with modulation factor 1).

Maximum Anode Voltage	$V_{a(max)}$	600*	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−100	V
Maximum Heater/Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	6·7†	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	1·2†	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	0·5†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	400†	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	50†	mA
Maximum Mean Control Grid Current	$I_{g1(av)max}$	2·5†	mA

* For natural cooling $V_{a(max)}$ = 600V up to 150 Mc/s but is limited to 250V at 600 Mc/s. For forced air cooling $V_{a(max)}$ = 600V up to 250 Mc/s but is limited to 440V at 600 Mc/s.

† Each section.

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11E16

H.F. DOUBLE TETRODE

Indirectly heated

TENTATIVE

RATING—Absolute values.

Frequency Trebler.

Maximum Anode Voltage	$V_{a(max)}$	600	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−200	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	10†	W
Maximum Screen Grid Dissipation	$P_{g2(max}$	1·5†	W
Maximum Control Grid Dissipation	$P_{g1(max)}$	0·5†	W
Maximum Peak Cathode Current	$i_{k(pk)max}$	275†	mA
Maximum Mean Cathode Current	$I_{k(av)max}$	50†	mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1\text{-}k(max)}$	50†	kΩ
Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1\text{-}k(max)}$	100†	kΩ
Maximum Mean Control Grid Current	$I_{g1(av)max}$	2·5†	mA

† Each section.

RATING—Absolute values

Class " B " a.f. power amplifier or modulator.

Maximum Anode Voltage	$V_{a(max)}$	600	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Negative Control Grid Voltage	$V_{g1(max)}$	−75	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Anode Dissipation	$P_{a(max)}$	10†	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	1·5†	W

Continued

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11E16
H.F. DOUBLE TETRODE
Indirectly heated

TENTATIVE

Maximum Control Grid Dissipation	$P_{g1(max)}$	0·5† W
Maximum Peak Cathode Current	$i_{k(pk)max}$	120† mA
Maximum Mean Cathode Current	$I_{k(av)max}$	55† mA
Maximum Control Grid/Cathode Resistance (fixed bias)	$R_{g1\text{-}k(max)}$	50† kΩ
Maximum Control Grid/Cathode Resistance (automatic bias)	$R_{g1\text{-}k(max)}$	100† kΩ

† Each section

INTER-ELECTRODE CAPACITANCES

Anode/Grid 1 *†	$c_{a\text{-}g1}$	0·04 pF
Grid 1/All other electrodes†	$c_{g1\text{-}all}$	7·5 pF
Anode/All other electrodes†	$c_{a\text{-}all}$	2·6 pF
Input Capacitance‡	c_{in}	4·4 pF
Output Capacitance‡	c_{out}	1·6 pF

* Internally neutralised for push-pull operation.

† Each section.

‡ 2 sections in push-pull.

CHARACTERISTICS†‡

Mutual Conductance	g_m	3·0 mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	8·0

† Each section.

‡ At $V_a = 300V$, $V_{g2} = 250V$, $I_a = 20mA$.

DIMENSIONS

Maximum Overall Length	85 mm
Maximum Diameter	47 mm
Maximum Seated Height	73 mm
Approximate Net Weight	2 oz

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11E16

H.F. DOUBLE TETRODE

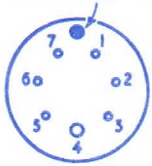
Indirectly heated

TENTATIVE

MOUNTING POSITION—Mobile operation ; vertical, base up or down. Fixed station operation ; vertical, base up or down. Horizontal ; anode pins in horizontal plane.

CAPS—Wire 2mm dia.

BASE—B7A



Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Control Grid, Section 1	$g1'$
Pin 3	Screen Grid	$g2'\ g2''$
Pin 4	Cathode, Beam Plates, Shield	k,bp,s
Pin 5	Heater Centre Tap	h_{ct}
Pin 6	Control Grid, Section 2	$g1''$
Pin 7	Heater	h
Cap No. 1	Anode, Section 1	a'
Cap No. 2	Anode, Section 2	a''

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12E1

BEAM TETRODE

Indirectly heated—for parallel operation

GENERAL

The 12E1 is intended for use as a series or shunt control valve in stabilised power packs.

RATING

Heater Voltage (volts)	V_h	6·3
Heater Current (amps)	I_h	1·6
Maximum Anode Voltage (volts)	$V_{a(max)}$	800
Maximum Screen Voltage (volts)	$V_{g2(max)}$	300
Maximum Control Grid Voltage (volts)	$V_{g1(max)}$	—100
Maximum Voltage between g_1 and g_2 (volts)	$V_{g1-g2(max)}$	400
Mutual Conductance (mA/V)	g_m	14*
Inner μ	$\mu_{g1,g2}$	5·3*
Maximum Anode Dissipation (watts)	$P_{a(max)}$	35
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	5·0
Maximum Cathode Current (mA)	$I_{k(max)}$	300
Maximum Potential Heater/Cathode (volts D.C.)	$V_{h-k(max)}$	300†

* Taken at $V_a = V_{g_2} = 150V$ $I_a = 200mA$.

† Provided the cathode is positive.

All maximum ratings are Absolute values not Design Centres.

INTER-ELECTRODE CAPACITANCES (pF)

Grid/Earth	c_{in}	23·0
Anode/Earth	c_{out}	8·0
Anode/Grid	$c_{a,g1}$	0·85

"Earth" denotes the remaining earthy potential electrodes and heater joined to cathode.

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12E1

BEAM TETRODE

Indirectly heated—for parallel operation

DIMENSIONS

Maximum Overall Length (mm)	146
Maximum Diameter (mm)	54
Maximum Seated Height (mm)	133
Approximate Nett Weight (ozs)	$2\frac{1}{2}$
Approximate Packed Weight (ozs)	7

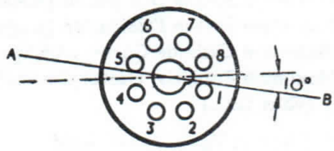
MOUNTING POSITION—Vertical

If run horizontally then the axis AB must be on a horizontal plane.

BULB—Clear

TOP CAP—American miniature (CT 1)

BASE—International Octal (108)



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CONNECTIONS

Pin 1	No connection	NC
Pin 2	Heater	h
Pin 3	No connection	NC
Pin 4	Screen Grid	g_2
Pin 5	Control Grid	g_1
Pin 6	No connection	NC
Pin 7	Heater	h
Pin 8	Cathode	k
Top Cap	Anode	a

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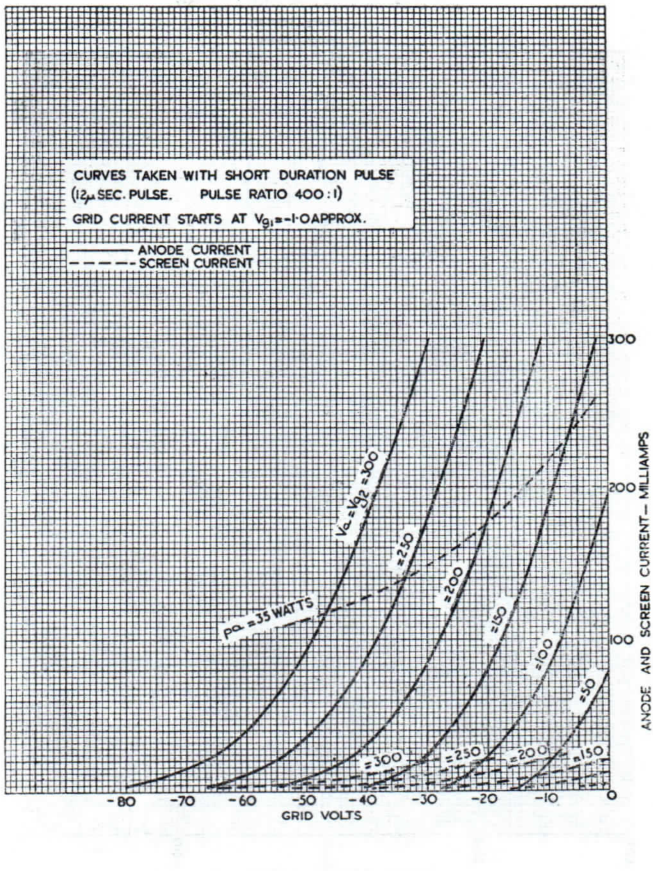
12E1

BEAM TETRODE

Indirectly heated—for parallel operation



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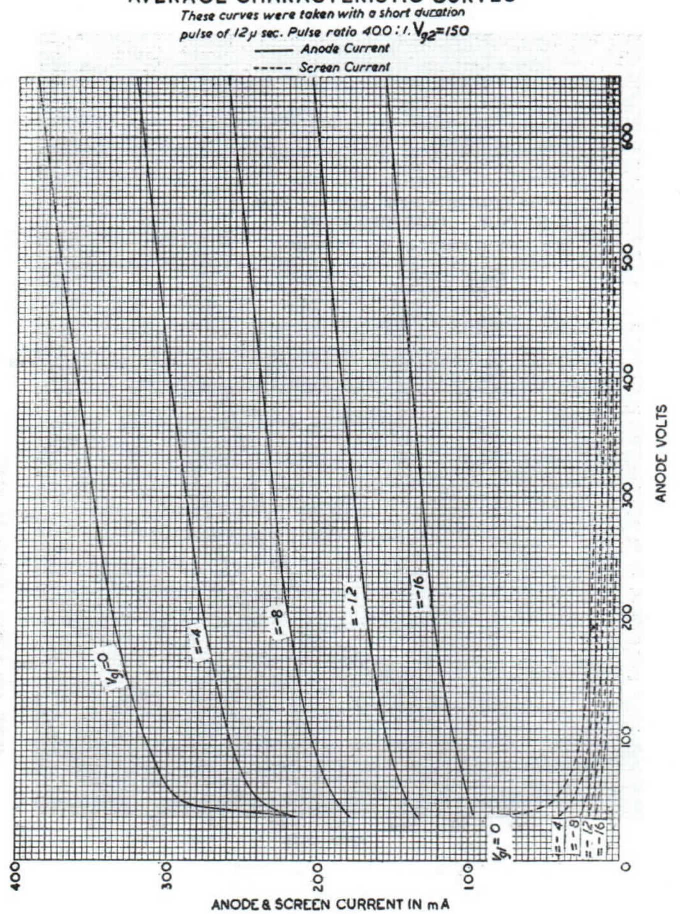
12E1

BEAM TETRODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES



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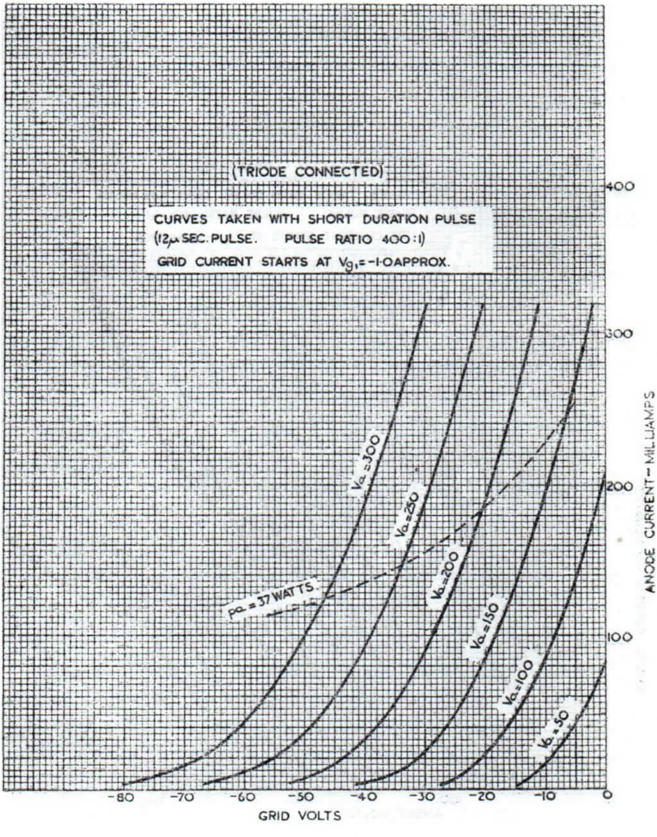
12E1

BEAM TETRODE

Indirectly heated—for parallel operation



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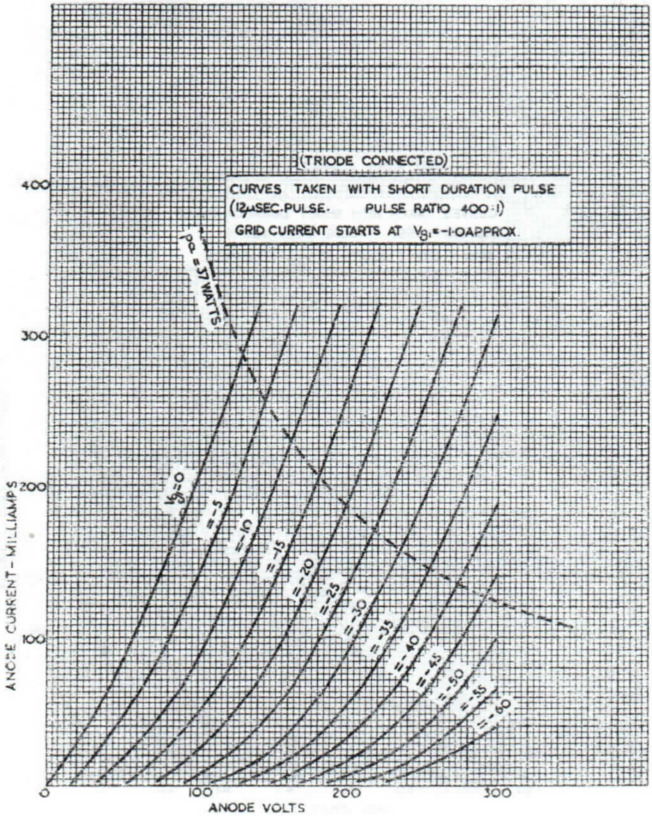
12E1

BEAM TETRODE

Indirectly heated—for parallel operation



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12E12

PULSE MODULATOR TETRODE

TENTATIVE

GENERAL

The 12E12 is a Pulse Modulator Tetrode, having a maximum anode dissipation of 60 watts, and a maximum peak anode current of 15 amps. It has an indirectly heated cathode, and is intended for use in Radar equipment.

RATING

Heater Voltage	(volts)	V_h	26
Heater Current	(amps)	I_h	1.6
Maximum Anode Voltage	(kV)	$V_{a(max)}$	11.0
Maximum Screen Grid Operating Voltage	(kV)	$V_{g2(max)}$	1.25
Maximum Screen Grid Voltage ($I_a = 0$)	(kV)	$V_{g2(max)}$	1.35
Maximum Control Grid Voltage (Negative)	(volts)	$-V_{g1(max)}$	−1,000
Maximum Control Grid Voltage (Positive Peak)	(volts)	$+V_{g1(pk)max.}$	300
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	60
Maximum Screen Dissipation	(watts)	$P_{g2(max)}$	8
Maximum Grid 1 Dissipation	(watts)	Pg1(max)	3
Maximum Peak Anode Current	(amps)	$I_{a(pk)max.}$	15†
Maximum Grid 1 Series Resistance	(kΩ)	Rg1	100
Minimum Screen Grid Series Resistance	(kΩ)	R_{g2}	20*

* The Screen Grid should be decoupled to earth with a condenser.

† For a duty cycle not greater than 0.001. With peak currents in excess of 5 amps the product of peak current in amps and pulse duration in microseconds should not exceed 30.

Rating (Continued Overleaf)

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12E12

PULSE MODULATOR TETRODE

TENTATIVE

The current-time product limit still applies for currents less than 5 amps, the maximum duty cycle then being limited by the anode dissipation.
The valve should not operate for longer than 5 μs in any 100 μs period.
A minimum cathode heating time of three minutes should elapse before any cathode current is drawn.
All Maximum Ratings are Absolute values not Design Centres.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid 1 (max)	$c_{a\text{-}g1}$	2.0
Cathode/Grid 1	$c_{g\text{-}k}$	37
Anode/Cathode	$c_{a\text{-}k}$	7.5

DIMENSIONS

Maximum Overall Length	(mm)	150
Maximum Diameter	(mm)	65
Maximum Seated Height	(mm)	142
Approximate Nett Weight	(ozs)	$5\frac{3}{4}$
Approximate Packed Weight	(ozs)	24

MOUNTING POSITION—Vertical preferred, but if horizontal the grid plane should be vertical.

TYPICAL OPERATION—As Series Modulator.

Anode Voltage Supply	(kV)	$V_{a(b)}$	9.5
Screen Voltage	(kV)	V_{g2}	1.2
Grid No. 1 Bias	(volts)	$-V_{g1}$	—800
Grid No. 1 Pulse	(volts)	$+V_{g1}$	1,020
Anode Current Pulse	(amps)	$I_{a(pk)}$	10
Anode Load	(ohms)	R_a	800
Peak Pulse Power Input	(kW)	$P_{in(pk)}$	100
Peak Pulse Power Output	(kW)	$P_{out(pk)}$	80
Output Voltage	(kV)	V_{out}	8
Pulse Duration	(μ secs)	t_p	2
Pulse Repetition Frequency	(p/s)	P.R.F.	500

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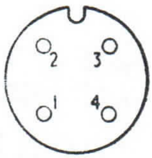
12E12

PULSE MODULATOR TETRODE

TENTATIVE

TOP CAP—CT3

BASE—B4A



Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Screen Grid	g2
Pin 3	Control Grid	g1
Pin 4	Heater, Cathode	h,k
Top Cap	Anode	a

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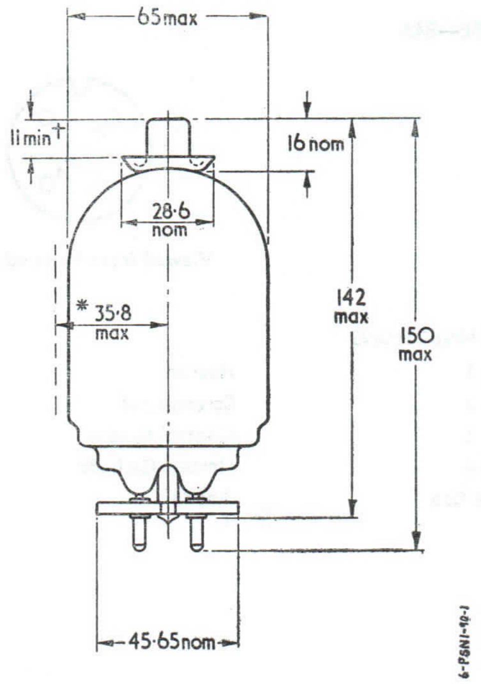
12E12

PULSE MODULATOR TETRODE

TENTATIVE



All Dimensions in mm.

* Eccentricity with respect to centre line of base.

† Straight side of top cap.

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12E13

BEAM TETRODE

Indirectly heated

GENERAL

The 12E13 is a beam tetrode which has a maximum anode dissipation of 35 watts and a maximum cathode current of 175 mA. It is intended for use as a series or parallel regulator valve in stabilised power supply units.

It is also suitable for use as the output stage of an AF amplifier for which two valves will provide up to 100 watts output. Under intermittent conditions, an output of 150 watts is obtainable under Class B conditions.

RATING

Heater Voltage	V_h	6·3	V
Heater Current	I_h	1·6	A
Maximum Anode Voltage	$V_{a(max)}$	600	V
Maximum Screen Voltage	$V_{g2(max)}$	600	V
Maximum Anode+Screen Voltage	$V_{a+g2(max)}$	600*	V
Maximum Anode Dissipation	$P_{a(max)}$	35	W
Maximum Screen Dissipation	$P_{g2(max)}$	6	W
Maximum Anode+Screen Dissipation	$P_{a+g2(max)}$	40*	W
Maximum Cathode Current	$I_{k(max)}$	175	mA
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	150	V
Maximum Grid/Cathode Resistance (cathode bias)		220**	kΩ
Maximum Grid/Cathode Resistance (fixed bias)		100**	kΩ

* Triode connection

** Resistance tolerance ± 20%

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12E13

BEAM TETRODE

Indirectly heated

INTER-ELECTRODE CAPACITANCES

Grid 1/Earth	c_{in}	16 pF
Anode/Earth	c_{out}	12 pF
Anode/Grid 1	c_{a-g1}	1·2 pF

DIMENSIONS

Maximum Overall Length	125 mm
Maximum Seated Height	110 mm
Maximum Diameter	52 mm

MOUNTING POSITION—Unrestricted.

If mounted horizontally, pins 4 and 8 should be in a vertical plane with an inter valve spacing of not less than 4 inches. With two or more valves, vertically mounted, pins 4 and 8 should preferably be in line. Free air circulation should be available and the hottest part of the bulb should not exceed 250°C.

CHARACTERISTICS—Pentode Connection

Anode Voltage	V_a	250 V
Screen Voltage	V_{g2}	250 V
Anode Current	I_a	140 mA
Mutual Conductance	gm	11 mA/V
Anode Impedance	r_a	12 kΩ
Inner Mu	μ_{g1-g2}	8

CHARACTERISTICS—Triode Connection

Anode, Screen Voltage	$V_{a,g2}$	250 V
Anode Current	I_a	160 mA
Mutual Conductance	gm	12 mA/V
Anode Impedance	r_a	670 Ω
Amplification Factor	μ	8

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12E13

BEAM TETRODE

Indirectly heated

TYPICAL OPERATION—Push-Pull Ultra-Linear. Cathode Bias

Supply Voltage	$V_{a(b)}$	500	V
Anode Voltage	V_a	425	V
Screen Voltage	V_{g2}	425	V
Anode+Screen Current (maximum signal)	$I_{a+g2(max\ sig)}$	2×100	mA
Anode+Screen Current (quiescent)	$I_{a+g2(o)}$	2×87	mA
Anode+Screen Dissipation (quiescent)	$P_{a+g2(o)}$	2×40	W
Anode+Screen Dissipation (maximum signal)	$P_{a+g2(max\ sig)}$	2×18	W
Grid Bias Applied (approx.)	V_{g1}	−50	V
Cathode Bias Resistance	R_k	2×525±5%*	Ω
Input Voltage (grid-grid)	$V_{in(g-g)}$	90	V
Anode Load (anode-anode)	$R_{L(a-a)}$	6	kΩ
Output Impedance	z_{out}	4·5	kΩ
Power Output	P_{out}	50	W
Distortion	D	1†	%
Intermodulation		5†	%

* Separate bias resistors are essential.

† Average pair.

TYPICAL OPERATION—Push-Pull Ultra-Linear. Fixed Bias

Supply Voltage	$V_{a(b)}$	560	V
Anode Voltage	V_a	550	V
Screen Voltage	V_{g2}	550	V
Anode+Screen Current (quiescent)	$I_{a+g2(o)}$	2×50	mA
Anode+Screen Current (maximum signal)	$I_{a+g2(max\ sig)}$	2×150	mA

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12E13

BEAM TETRODE

Indirectly heated

Anode+Screen Dissipation (quiescent)	$P_{a+g2(o)}$	2×30	W
Anode+Screen Dissipation (maximum signal)	$P_{a+g2(max)}$	2×33	W
Grid Bias Applied (approx)	V_{g1}	−80*	V
Input Voltage (grid-grid)	$V_{in(g-g)}$	120	V
Anode Load (anode-anode)	$R_{L(a-a)}$	4·5	kΩ
Output Impedance	z_{out}	6·5	kΩ
Power Output	P_{out}	100	W
Distortion	D	3 to 6†	%
Intermodulation		12	%

* A negative bias range of 70±25% is recommended.
† The distortion will vary according to the degree of matching.

TYPICAL OPERATION—Push-Pull Triode Connection

Cathode Bias

Supply Voltage	$V_{a(b)}$	400	485	V
Anode Voltage	V_a	350	425	V
Screen Voltage	V_{g2}	350	425	V
Anode+Screen Current (quiescent)	$I_{a+g2(o)}$	2×67	2×85	mA
Anode+Screen Current (maximum signal)	$I_{a+g2(max)}$	2×72	2×90	mA
Anode+Screen Dissipation (quiescent)	$P_{a+g2(o)}$	2×24	2×40	W
Grid Bias Applied (approx)	V_{g1}	−38	−48	V
Cathode Bias Resistance	R_k	2×525±5%*	2×525±5%*	Ω
Input Voltage (grid-grid)	$V_{in(g-g)}$	60	70	V
Anode Load (anode-anode)	$R_{L(a-a)}$	4	4	kΩ
Output Impedance	z_{out}	2·5	2·5	kΩ
Power Output	P_{out}	15	27	W
Distortion	D	1 to 3†	1 to 3†	%
Intermodulation		6	6	%

* Separate bias resistors are essential.
† The distortion will vary according to the degree of matching

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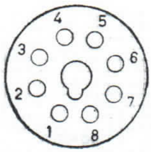
12E13

BEAM TETRODE

Indirectly heated

BASE—International Octal (I08)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Shield	s
Pin 2	Heater	h
Pin 3	Anode	a
Pin 4	Screen Grid	g2
Pin 5	Control Grid	g1
Pin 6	No Pin	NP
Pin 7	Heater	h
Pin 8	Cathode, Beam Plates	k,bp

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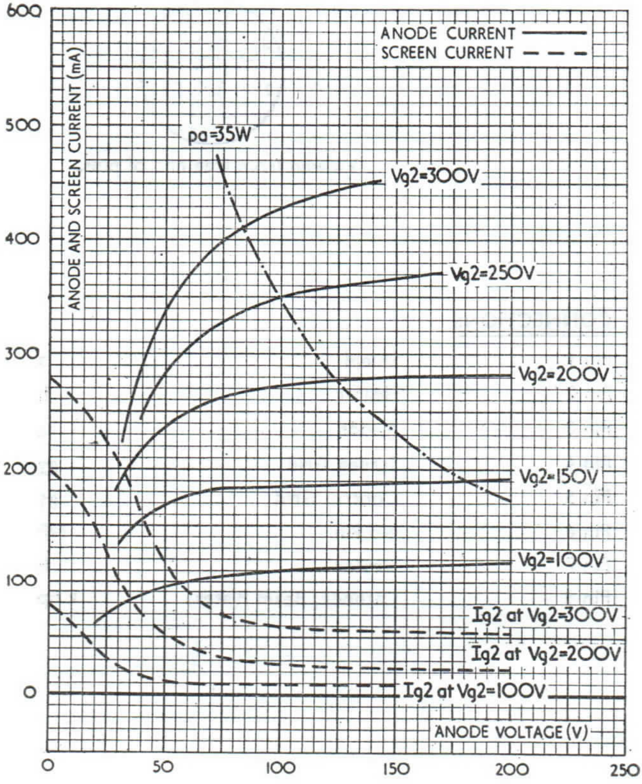
12E13

BEAM TETRODE

Indirectly heated

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$

($V_{g1} = 0V$)



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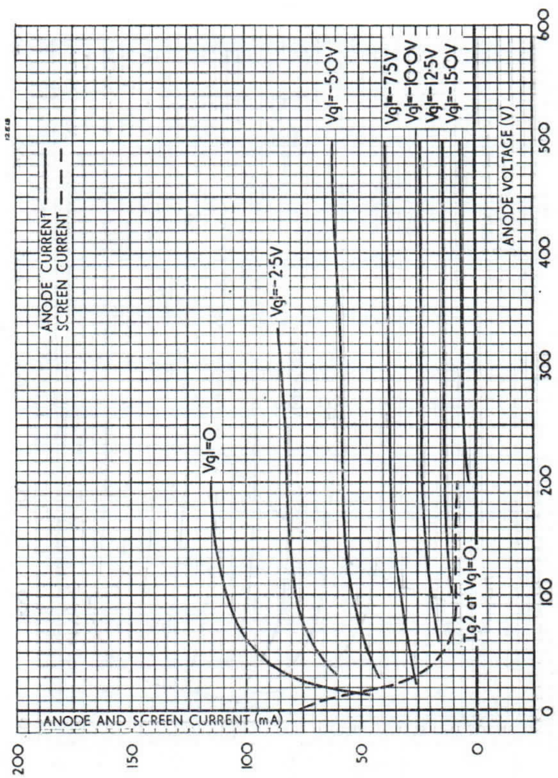
12E13

BEAM TETRODE

Indirectly heated

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$

($V_{g2}=100V$)



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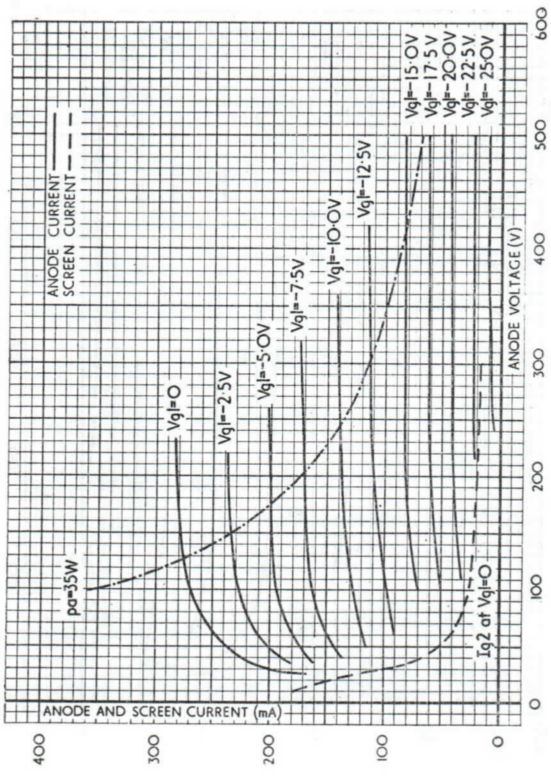
12E13

BEAM TETRODE

Indirectly heated

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$

($V_{g2} = 200V$)



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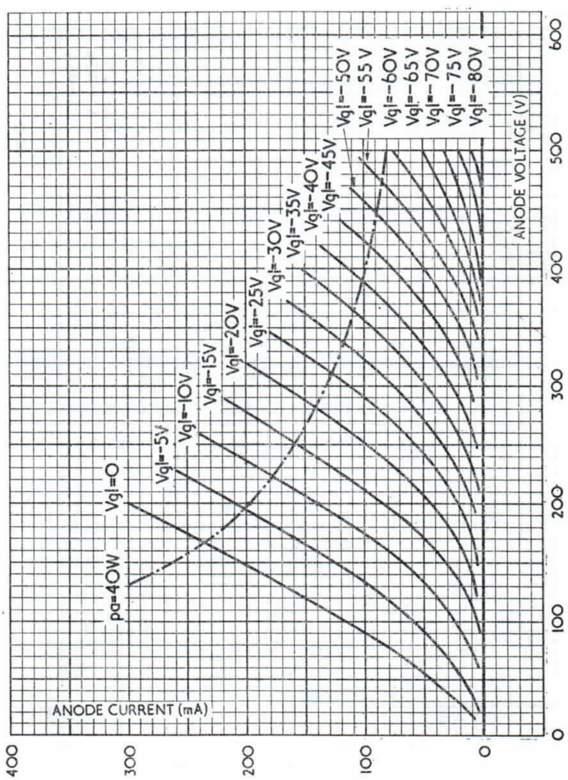
12E13

BEAM TETRODE

Indirectly heated

CHARACTERISTIC CURVES: I_a/V_a

Triode Connection



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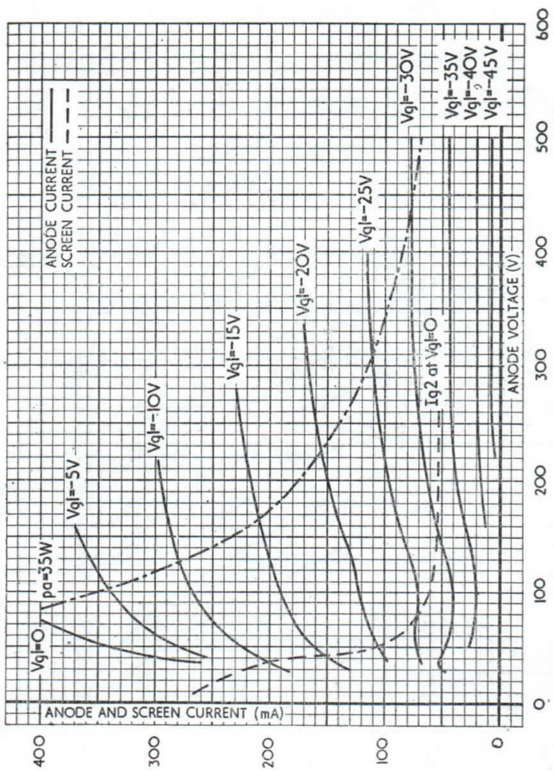
Tel.: GERRARD 9797

I2E13

BEAM TETRODE

Indirectly heated

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$
($V_{g2} = 300V$)



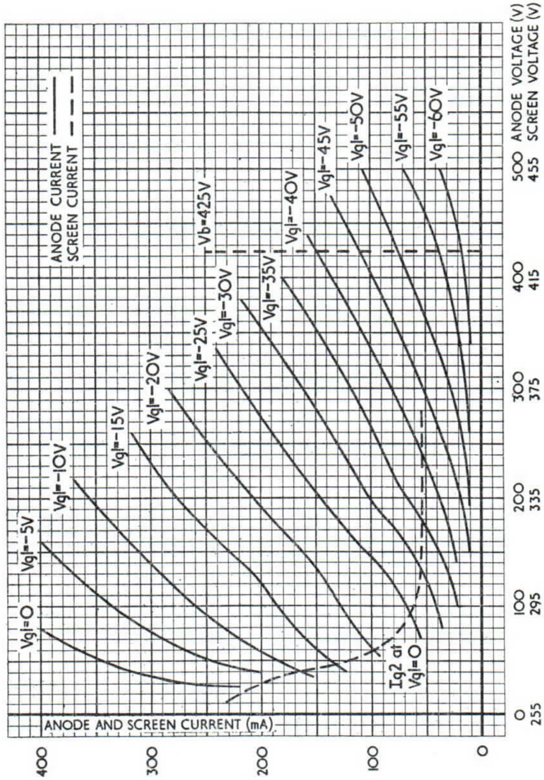
Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

12E13

BEAM TETRODE

Indirectly heated

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a, V_{g2}$
$(V_b = 425V)$
Ultra-Linear Connection — 40% taps*



* Position of the screen grid taps on the output transformer.

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

12E14

BEAM TETRODE

Indirectly heated

TENTATIVE

GENERAL

The 12E14 is an indirectly heated Beam Tetrode with a maximum anode dissipation of 35W. It is suitable for use in stabilised power supply units.

RATING—Absolute Values

Heater Voltage	V_h	6·3	V
Heater Current	I_h	1·6	A
Maximum Anode Voltage	$V_{a(max)}$	800	V
Maximum Screen Voltage	$V_{g2(max)}$	300	V
Maximum Control Grid Voltage	$V_{g1(max)}$	–100	V
Maximum Control Grid/Screen Voltage	$V_{g1\text{-}g2(max)}$	400	V
Maximum Anode Dissipation	$P_{a(max)}$	35	W
Maximum Screen Dissipation	$P_{g2(max)}$	5	W
Maximum Cathode Current	$I_{k(max)}$	300	mA
Maximum Heater/Cathode Voltage d.c. (heater negative)	$V_{h\text{-}k(max)}$	300	V

DIMENSIONS

Maximum Overall Length	106	mm
Maximum Diameter	44	mm
Maximum Seated Height	93	mm

MOUNTING POSITION—Vertical. If run horizontally then axis AB must be on a horizontal plane.

Associated Electrical Industries Limited

Electronic Components Division

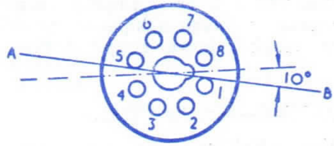
Tel.: GERRARD 9797

12E14

BEAM TETRODE
Indirectly heated

TENTATIVE

BASE—108



Viewed from free end of pins

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Heater	h
Pin 3	Anode	a
Pin 4	Grid 2	g2
Pin 5	Grid 1	g1
Pin 6*	Beam Plates	bp
Pin 7	Heater	h
Pin 8	Cathode	k

* Should be connected to Cathode.

Associated Electrical Industries Limited
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13E1

BEAM TETRODE

Indirectly heated—for D.C. Control Applications

GENERAL

This Low Impedance Beam Tetrode is intended for general D.C. Control applications and has a centre tapped heater. It is suitable for Triode connection and has a maximum anode dissipation of 90 watts.

RATING

Heater Voltage (volts)	V_h	26.0	13.0	
Heater Current (amps)	I_h	1.3	2.6	
Maximum Anode Voltage (volts)	$V_{a(max)}$	800	1500†	←
Maximum Screen Voltage (volts)	$V_{g2(max)}$	300		
Maximum Control Grid Voltage (volts)	$V_{g1(max)}$	—100		
Maximum Anode Dissipation (watts)	$P_{a(max)}$	90		
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	10		
Maximum Anode plus Screen Dissipation (Triode Connection) (watts)	$P_{a+g2(max)}$	95		←
Maximum Control Grid Dissipation (watts)	$P_{g1(max)}$	1		←
Maximum Cathode Current (mA)	$I_{k(max)}$	800	5000†	←
Maximum Heater/Cathode Voltage (volts D.C.) (Heater—ve)	$V_{h\text{-}k(max)}$	300		
Mutual Conductance (Triode Connection) (mA/V)	g_m	35*		
Amplification Factor (Triode Connection)	μ_t	4.5*		
Anode Resistance ($\delta v_a/\delta i_a$) (Triode Connection) (ohms)	$r_{a(t)}$	130*		

* $V_a = 150$ volts $I_a = 500$mA.

All maximum ratings are absolute values not design centres.

† Series pulse rating. For peak currents greater than 2 amps, the product of the peak current and pulse duration in amp-microseconds should not exceed 10. The valve should not operate for longer than 5μs in any 100 μs period. ←

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

AEI

EDISWAN

13E1

BEAM TETRODE

Indirectly heated—for D.C. Control Applications

INTER-ELECTRODE CAPACITANCES (pF)

Control Grid/Earth	c_{in}	56
Anode/Earth	c_{out}	20·4
Anode/Control grid	$c_{a\text{-}g1}$	1·3

DIMENSIONS

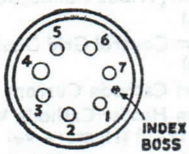
Maximum Overall Length	(mm)	166.0
Maximum Diameter	(mm)	65.0 ←
Maximum Seated Height	(mm)	157.0
Approximate Nett Weight	(ozs)	6.0
Approximate Packed Weight	(ozs)	30.0

MOUNTING POSITION—Vertical

BULB—Clear

BASE—B7A

Viewed from free end of pins.



VALVEHOLDER—Ediswan Clix Cat. No. VH117/701

CONNECTIONS

Pin 1	Heater	h
Pin 2	Heater Centre Tap	h tap
Pin 3	Control Grid	g1
Pin 4	Cathode	k
Pin 5	Screen Grid	g2
Pin 6	Anode	a
Pin 7	Heater	h

Indicates a change ←

Associated Electrical Industries Limited

Electronic Components Division

Tel: GERrard 9797

13E1

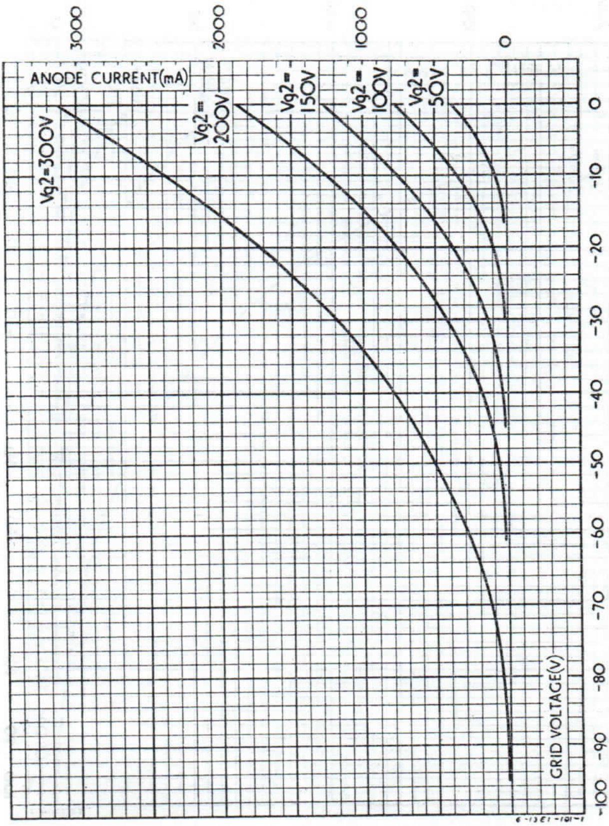
BEAM TETRODE

Indirectly heated—for D.C. Control Applications

AVERAGE CHARACTERISTIC CURVES: I_a/V_{g1}

$V_a = 600V$

Curves taken with short duration pulse



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Electronic Components Division

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13E1

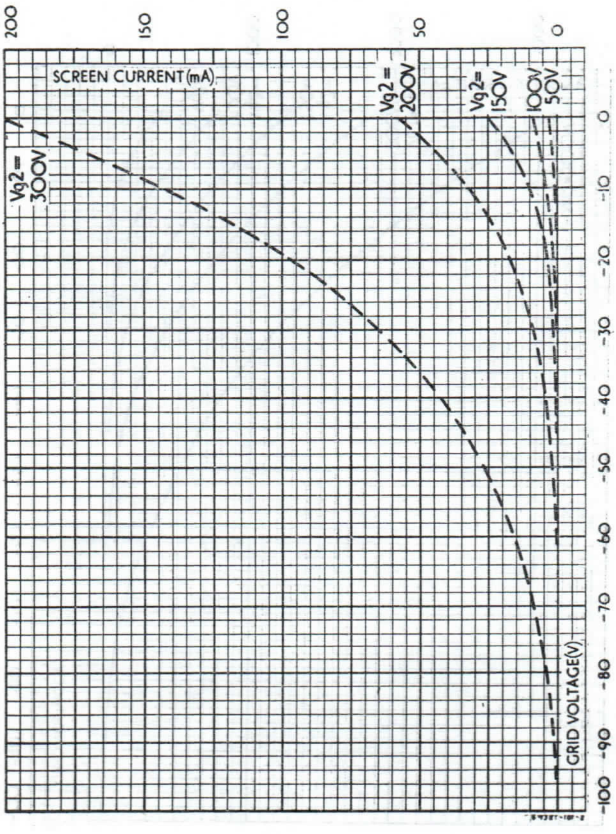
BEAM TETRODE

Indirectly heated—for D.C. Control Applications

AVERAGE CHARACTERISTIC CURVES: I_{g2}/V_{g1}

$V_a = 600V$

Curves taken with short duration pulse



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Electronic Components Division

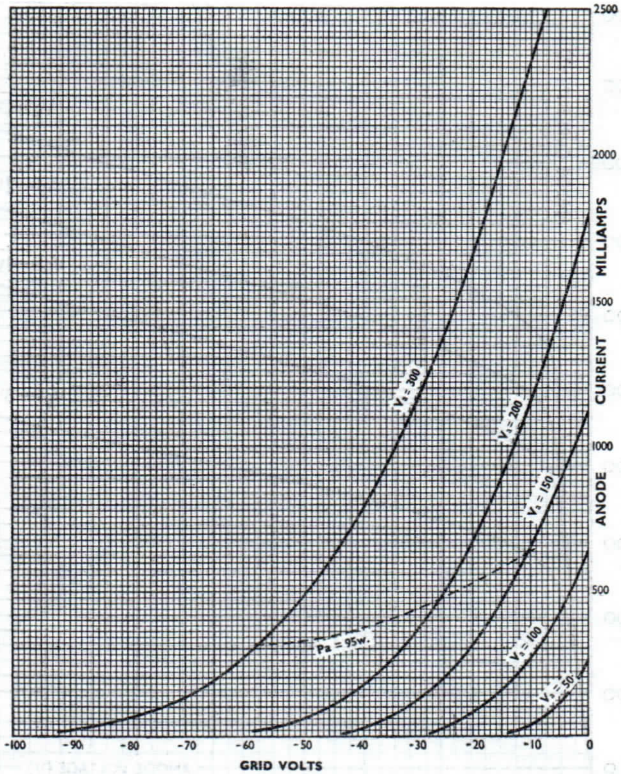
Tel.: GERrard 9797

13E1

BEAM TETRODE

Indirectly heated—for D.C. Control Applications

AVERAGE CHARACTERISTIC CURVES: I_a/V_{g1}
TRIODE CONNECTED
Curves taken with short duration pulse



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Electronic Components Division
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13E1

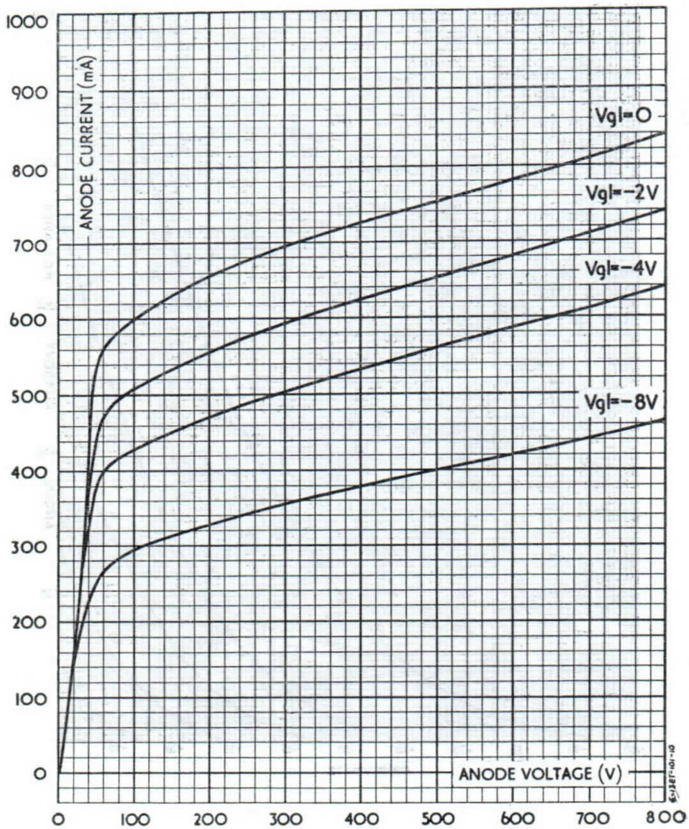
BEAM TETRODE

Indirectly heated—for D.C. Control Applications

AVERAGE CHARACTERISTIC CURVES: I_a/V_a

$V_{g2} = 100V$

Curves taken with short duration pulse



Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

13EI

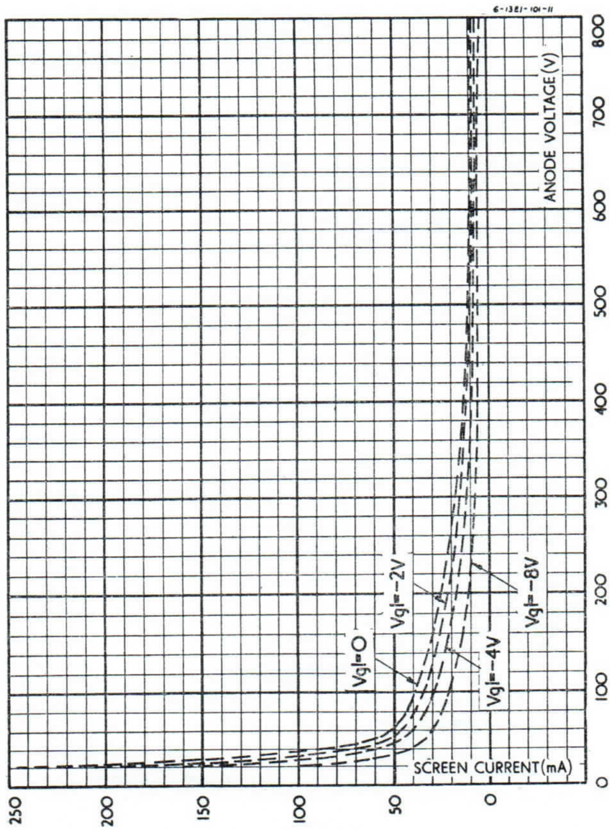
BEAM TETRODE

Indirectly heated—for D.C. Control Applications

AVERAGE CHARACTERISTIC CURVES: I_{g2}/V_a

$V_{g2}=100V$

Curves taken with short duration pulse



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13E12

BEAM TETRODE

TENTATIVE

GENERAL

The 13E12 is an indirectly heated Beam Tetrode having a centre tapped heater. It is suitable for use in stabilised power supply units, servo-mechanisms, etc.

RATING—Absolute Values

Heater Voltage	V_h	26·0	13·0	V
Heater Current	I_h	1·3	2·6	A
Maximum Anode Voltage	$V_{a(max)}$		800	V
Maximum Screen Voltage	$V_{g2(max)}$		300	V
Maximum Control Grid Voltage	$V_{g1(max)}$		−100	V
Maximum Anode Dissipation	$P_{a(max)}$		90	W
Maximum Screen Dissipation	$P_{g2(max)}$		10	W
Maximum Anode + Screen Dissipation (Triode Connected)	$P_{a+g2(max)}$		95	W
Maximum Control Grid Dissipation	$P_{g1(max)}$		1	W
Maximum Cathode Current	$I_{k(max)}$		800	mA
Maximum Heater/Cathode Voltage D.C. (Cathode Positive)	$V_{h\text{-}k(max)}$		300	V

INTER-ELECTRODE CAPACITANCES (pF)

Control Grid/Earth	c_{in}	62·0
Anode/Earth	c_{out}	17·0
Anode/Control Grid	$c_{a\text{-}g1}$	1·0

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

13E12
BEAM TETRODE
TENTATIVE

DIMENSIONS

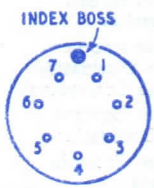
Maximum Overall Length	140 mm
Maximum Diameter	65 mm
Maximum Seated Height	128 mm
Approximate Nett Weight	5 ozs
Approximate Packed Weight	29 ozs

MOUNTING POSITION—Vertical

CHARACTERISTICS—Triode Connected

Anode Voltage	V_a	150	V
Anode Current	I_a	500	mA
Mutual Conductance	g_m	25	mA/V
Amplification Factor	μ	2·8	
Valve Anode Resistance (approx.)	r_a	110	Ω

BASE—B7A



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater	h
Pin 2	Heater Centre Tap	h_{ct}
Pin 3	Control Grid	g1
Pin 4	Cathode	k
Pin 5	Screen Grid	g2
Pin 6	Anode	a
Pin 7	Heater	h

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

ES85

RADIATION COOLED TRIODE

GENERAL

The ES85 is a directly heated Thoriated tungsten filament triode, designed to operate as a Class B amplifier or modulator and as a Class C amplifier or oscillator.

RATING

Filament Voltage (volts)	V_f	10
Filament Current (amps)	I_f	3·25
Maximum Anode Voltage (kV)	$V_{a(max)}$	1·25
Maximum Anode Dissipation (watts)	P_a	85
Mutual Conductance (mA/V)	g_m	3·7
Amplification Factor*	μ	12·7
Anode Impedance (ohms)	r_a	3,450
Maximum Operating Frequency at Full Rating (Mc/s)		6
Maximum Audio Output 2 Valves (watts) (Class B Push-Pull)	P_{out}	310
Distortion at Maximum Output	D_{tot}	3%

* Taken at V_a = 1 kV ; V_g = —55 v.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	c_{ga}	13
Anode/Filament	c_{out}	4
Grid/Filament	c_{in}	6·5

DIMENSIONS

Maximum Overall Length (mm)	204
Maximum Diameter (mm)	57

BASE—Jumbo

NOTE: This valve should be mounted so that its filament is in vertical plane.

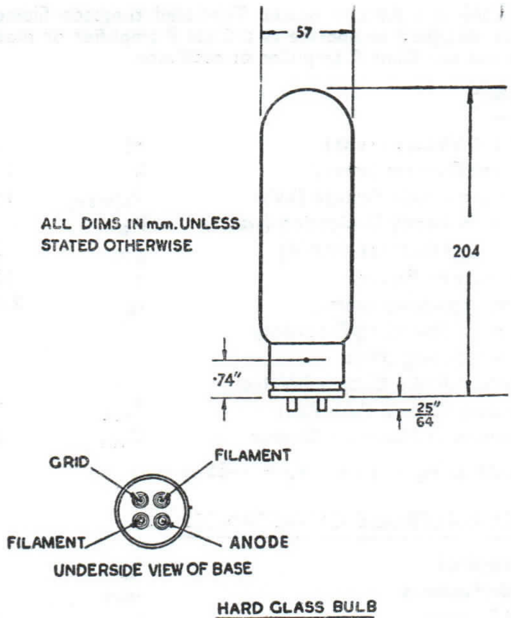
Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

ES85

RADIATION COOLED TRIODE



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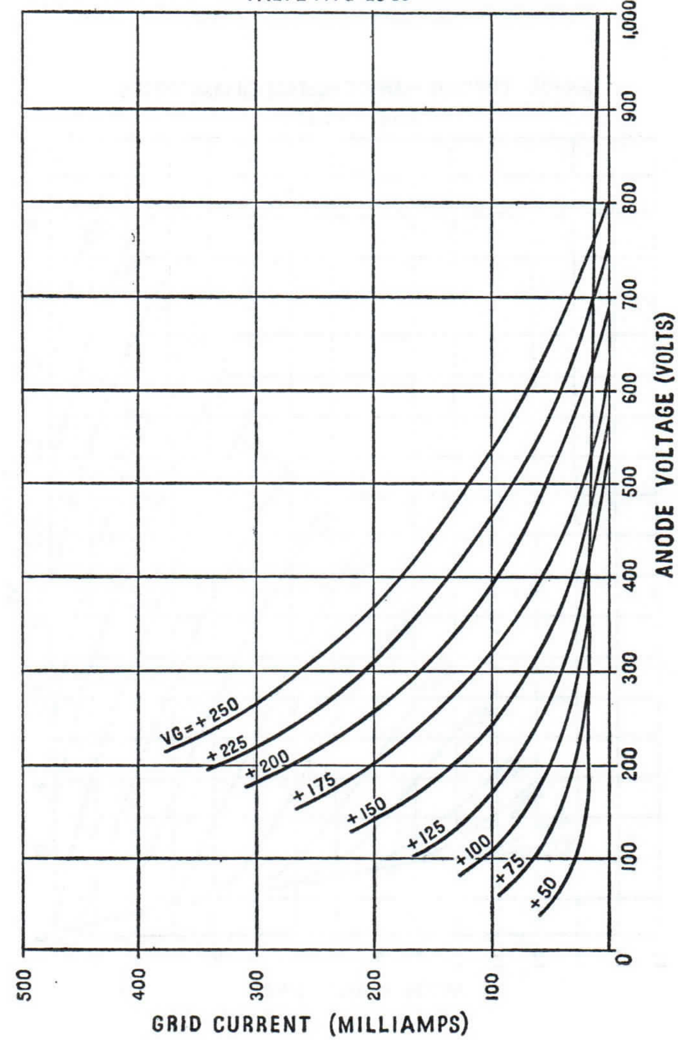
ES85
RADIATION COOLED TRIODE

GRID CURRENT – ANODE VOLTAGE CHARACTERISTIC
VALVE TYPE ES 85



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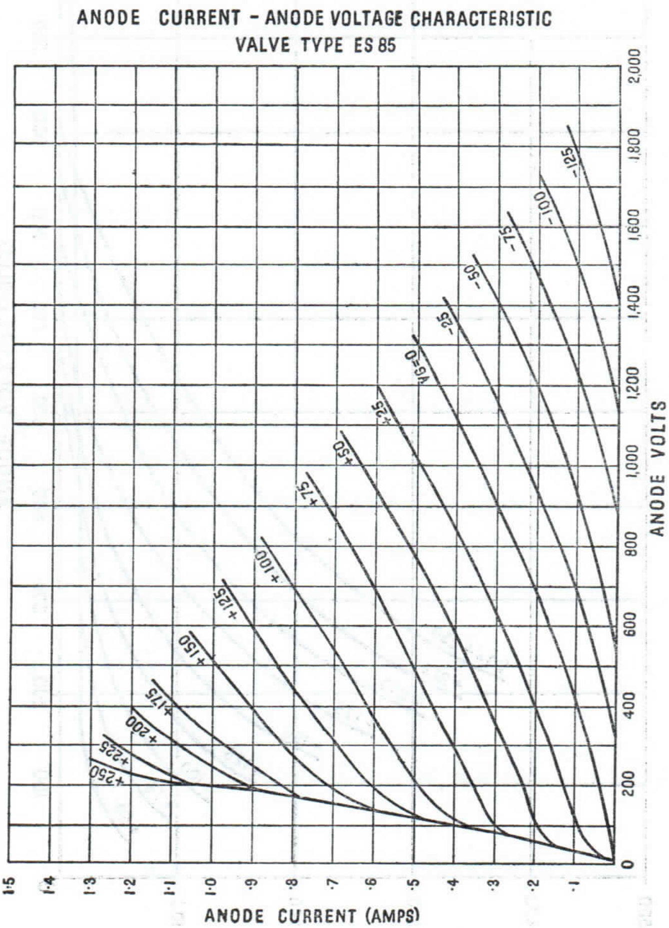
ES85

RADIATION COOLED TRIODE



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ES1101

RADIATION COOLED TRIODE

TENTATIVE

GENERAL

The ES1101 is an indirectly heated power triode intended for use under zero bias conditions in Class B Push Pull Audio Amplifiers. It has a maximum anode dissipation of 40 watts and a maximum power output per pair of valves of 200 watts.

RATING

Heater Voltage (volts)	V_h	7.5
Heater Current (amps)	I_h	1.2
Maximum Anode Voltage (volts)	$V_{a(max)}$	1250
Maximum (Mean) Cathode Current (mA)	$I_{k(av)max}$	200
Maximum Anode Dissipation (watts)	$P_{a(max)}$	40
Mutual Conductance (mA/V)	g_m	3.0*
Amplification Factor	μ	72*
Anode Impedance (kilohms)	r_a	24*

* Measured at $V_a = 1000V$; $I_a = 40mA$

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	c_{a-g}	4.0
Anode/Cathode	c_{a-k}	1.0
Grid/Cathode	c_{g-k}	5.2

DIMENSIONS

Maximum Overall Length	(mm)	156
Maximum Seated Height	(mm)	141
Maximum Diameter	(mm)	52
Approximate Nett Weight	(ozs)	2
Approximate Packed Weight	(ozs)	4

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

ES1101

RADIATION COOLED TRIODE

TENTATIVE

MOUNTING POSITION—Vertical, base downwards

TYPICAL OPERATION—Push Pull Class B Audio Output (Values per valve)

Anode Voltage (volts)	V_a	1000	1250
Anode Current (no signal) (mA)	$I_{a(0)}$	25	20
Anode Current (maximum signal) (mA)	$I_{a(max\ sig)}$	137	120
Grid Bias (volts)	V_g	0	—4.0
Grid Current (Mean) (mA)	$I_{g(av)}$	25	20
Grid Current (Peak) (mA)	$I_{g(pk)}$	50	42
Input Voltage (grid to grid) (peak) (volts)	$V_{in(g-g)}$	200	200
Drive Power (watts)	P_{dr}	2.5	2.2
Anode Dissipation (no signal) (watts)	Pa(0)	12.5	12.5
Anode Dissipation (max signal) (watts)	Pa(max sig)	25	25
Anode Load (anode to anode) (kilohms)	R_{a-a}	10	13
Power output (total) (watts)	P_{out}	175	200
Distortion (%)	D	6	6
Input Impedance (grid to grid) (kilohms)	$Z_{in(g-g)}$	4	4.5
Output Impedance (kilohms)	Z_{out}	15	15

The above conditions apply to speech and music only. For continuous sine wave modulation the anode load should be increased by not less than 20% to avoid excessive dissipation.

Associated Electrical Industries Limited

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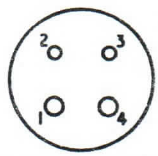
ES1101

RADIATION COOLED TRIODE

TENTATIVE

BASE—UX4



Viewed from free end of pins.

TOP CAP—CT2

CONNECTIONS

Pin 1	Heater	h
Pin 2	Cathode	k
Pin 3	Grid	g
Pin 4	Heater	h
Cap	Anode	a

Associated Electrical Industries Limited

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ES1102

RADIATION COOLED TRIODE

TENTATIVE

GENERAL

The ES1102 is a directly heated power triode intended for use in Class AB_1 or AB_2 Push Pull Amplifiers having a maximum power output of 300 watts per pair of valves. It has a maximum anode dissipation of 100 watts.

RATING

Filament Voltage (volts)	V_f	6·0
Filament Current (amps)	I_f	2·7
Maximum Anode Voltage (volts)	$V_{a(max)}$	1250
Maximum Mean Cathode Current (mA)	$I_{k(av)max}$	250
Maximum Anode Dissipation (watts)	$P_{a(max)}$	100
Mutual Conductance (mA/V)	g_m	3·9*
Amplification Factor	μ	5·5*
Anode Impedance (kilohms)	r_a	1·41*

* Measured at $V_a = 1kV$; $I_a = 100mA$.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid	$c_{a\text{-}g}$	15·7
Anode/Filament	$c_{a\text{-}f}$	10·8
Grid/Filament	$c_{g\text{-}f}$	15·8

DIMENSIONS

Maximum Overall Length	(mm)	192
Maximum Seated Height	(mm)	182
Maximum Diameter	(mm)	65
Approximate Nett Weight	(lbs)	1
Approximate Packed Weight	(lbs)	2

Associated Electrical Industries Limited
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ES1102

RADIATION COOLED TRIODE

TENTATIVE

MOUNTING POSITION—Vertical, base downwards.

TYPICAL OPERATION—Push-Pull. Values per valve.

		Class AB_1		Class AB_2	
Anode Voltage (maximum signal) (kV)	$V_{a(max\,sig)}$	1·0	1·25	1·0	1·25
Anode Current (no signal) (mA)	$I_{a(o)}$	50	50	50	50
Anode Current (maximum Signal) (mA)	$I_{a(max\,sig)}$	165	150	150	182
Anode Dissipation (no signal) (watts)	$P_{a(o)}$	55	70	55	55
Anode Dissipation (maximum signal) (watts)	$P_{a(max\,sig)}$	53	100	50	80
Grid Bias (volts)	V_g	—200	—225	—200	—225
Input Voltage (grid to grid) (peak) (volts)	$V_{in(g\text{-}g)pk}$	400	450	500	560
Grid Current (mA)	I_g	0	0	7·5	10
Anode Load (Anode to Anode) (kilohms)	$R_{a\text{-}a}$	4	8	8	8
Power Output (total)(watts)	P_{out}	125	175	200	300
Distortion (%)		4	5	6	6

The power supply should have an impedance not greater than 400 ohms.

Under Class AB_2 conditions the anode dissipation rises to a maximum at approximately one half of full output.

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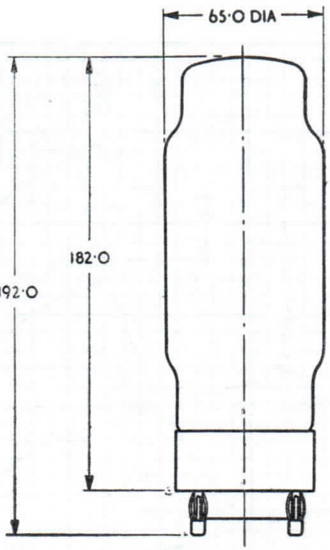
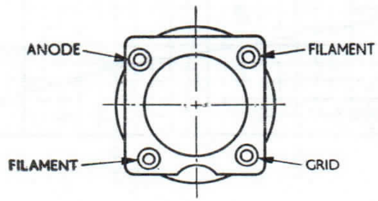
ES1102

RADIATION COOLED TRIODE

TENTATIVE



BASE—L4



All dimensions in mm.

Associated Electrical Industries Limited

Electronic Components Division

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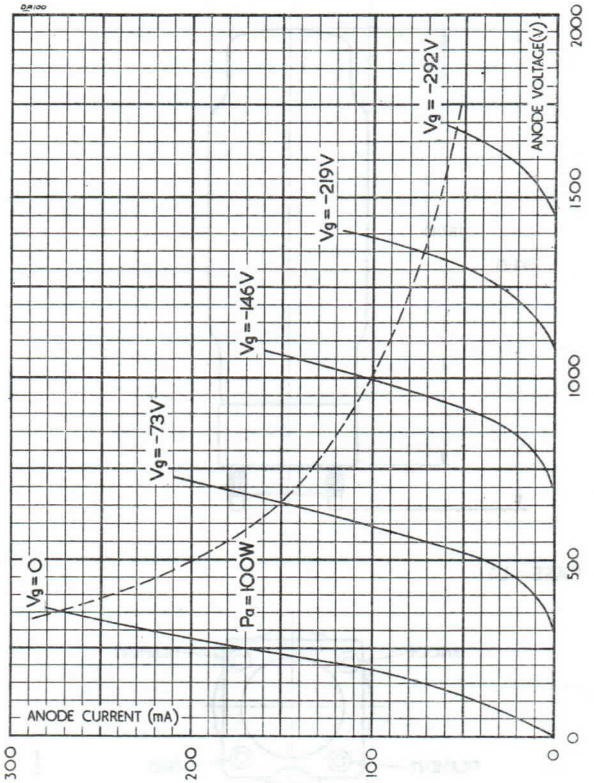
ES1102

RADIATION COOLED TRIODE

TENTATIVE

CHARACTERISTIC CURVES: I_a/V_a



Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

Rectifiers and
Thyratrons

SELECTION CHART
HIGH VOLTAGE RECTIFIERS

HALF-WAVE MERCURY VAPOUR				
	PEAK CATHODE CURRENT (Amps)			
P.I.V. (kV)	1·25	5·0	6·0	7·0
10	ESU76 ESU886 ESU101	ESU150	ESU872 ESU8008	
15			ESU200	ESU575 ESU673

Associated Electrical Industries Limited

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SELECTION CHART
HIGH VOLTAGE RECTIFIERS

HALF-WAVE HIGH VACUUM					
	PEAK CATHODE CURRENT (Amps)				
P.I.V. (kV)	0·18	0·375	0·6	1·0	1·1
6·0	19G6				
6·3		19G3			
15			19H1		
18				19H5	
20	19H4				
40					ESU74
50					ESU77

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

Condensed Data on Obsolete Types

Type	Class	V_h (volts)	I_h (amps)	$I_{k(pk)}$ (amps)	P.I.V. (kV)	Max. Mean I_a(amps)	Cathode Heating Time (secs)	Max. Anode Dissi-pation	Notes
EHT16	Rectifier H.W. M	4.0	15.0	15.0	20	3.0	60		
ESU75	Rectifier H.W. M	2.0	10.0	0.9	7	0.2	15		
ESU206	Rectifier H.W. V	11.5	5.0		10	0.1			
ESU208	Rectifier H.W. V	14.0	6.0		14	0.3			
ESU303	Rectifier H.W. M	4.0	12.5	3.0	10	0.75	60		
ESU400	Rectifier H.W. M	5.0	12.5	6.0	10	1.5	60		
ESU450	Rectifier H.W. V	17.0	6.6	0.4	20				
ESU751	Rectifier H.W. M	2.0	10.0	0.9	5		15		
ESU1500	Rectifier H.W. V	15.5	28.0		30	0.6			
ESU1500AX	Rectifier H.W. V	16.5	15.2		60	0.4			
MR15	Rectifier H.W. Thyratron	4.0	15.0	15.0	20	3.0	60		Control Ratio 300
MR304	Rectifier H.W. Thyratron	4.0	12.5	3.0	14	0.8	60		Control Ratio 400
MU25	Rectifier H.W. M	4.0	28.0	100	0.5	25	300		

Abbreviations : H.W.—Half Wave ; M—Mercury Vapour ; V—Vacuum.

Associated Electrical Industries Limited

Radio Components Department

Tel: GERrard 9797

Condensed Data on Replacement Types

LOW VOLTAGE RECTIFIERS

Type Number	Description	V_f (V)	I_f (A)	V_{out} (V)	I_{out} (A)	Base
68504	Full-wave, tungar	2·3	18	30	5·0	G.E.S.
68506	Half-wave, tungar	2·3	18	75	6·0	G.E.S.
68508	Half-wave, tungar	2·5	25	60	15	G.E.S.
68510	Half-wave, tungar	2·0	12	75	1·5	E.S.
68530	Full-wave, gas discharge	2·0	8·0	30	6·0	Special
68532	Full-wave, gas discharge	2·0	3·5	20	2·0	Special

HALF-WAVE HIGH VACUUM RECTIFIERS

Type Number	V_f or V_h (V)	I_f or I_h (A)	$i_{k(pk)max}$ (A)	P.I.V. (max) (kV)	$I_{k(max)}$ (mA)	$P_{a(max)}$ (W)	Base
19E2	4·0	2·1	12	4·0	—	5·0	108
19G3	4·0	1·4	0·375	6·3	50	—	108
19H1	4·0	2·0	0·6	15	75	—	B4
19H5	4·0	4·0	1·0	18	—	32	G.E.S.
ESU151	4·0	12·0	1·0	75	200	100	G.E.S.
V1901	16·5	15·2	—	60	400	—	E.S.

HALF-WAVE MERCURY VAPOUR RECTIFIERS

Type Number	V_f (V)	I_f (A)	$i_{k(pk)}$ (A)	P.I.V.(max) (kV)	$I_{k(max)}$ (A)	V_{out}* (kV)	I_{out}* (A)	Base
ESU76	2·0	7·5	1·25	10	0·25	3·2	0·5	G.E.S.
ESU150	4·0	7·5	5·0	15	1·0	4·75	2·0	G.E.S.

* Maximum output in biphase half-wave using two valves.

XENON RECTIFIERS

Type Number	V_f (V)	I_f (A)	$i_{k(pk)}$ (A)	P.I.V.(max) (kV)	$I_{k(max)}$ (A)	V_{out} (kV)	I_{out} (A)	Base
ESU104	4·0	2·8	1·0 2·0	10 5·0	0·25 0·5	3·2 1·5	0·5 1·0	B4
ESU105	2·0	7·5	1·0 2·0	10 5·0	0·25 0·5	3·2 1·5	0·5 1·0	G.E.S.

High Vacuum Rectifiers

19G6

HIGH VACUUM HALF WAVE RECTIFIER

Indirectly heated—for High Voltage Power Supplies

RATING

Heater Voltage	V_h	4·0 V
Heater Current	I_h	0·5 A
Maximum Peak Inverse Anode Voltage (Wkg)	P.I.Vmax(w)	6·0 kV
Maximum Peak Inverse Anode Voltage (no-load)	P.I.V(max)	7·0 kV
Maximum Anode Voltage (r.m.s.)	$V_{a(rms)max}$	2·5 kV
Maximum Mean Anode Current	$I_{a(av)max}$	30·0 mA
Maximum Peak Anode Current	$I_{a(pk)max}$	180·0 mA
Minimum Surge Limiting Resistance		5,400* Ω
Maximum Reservoir Capacitance	C_{max}	1·0 μF

* This resistance can be obtained in the distributed resistance of the transformer winding.

INTER-ELECTRODE CAPACITANCES (pF)

Anode to all other electrodes	$C_{a\text{-}all}$	2·8

DIMENSIONS

Maximum Overall Length	60 mm
Maximum Diameter	19 mm
Approximate Nett Weight	¼ oz
Approximate Packed Weight	½ oz

MOUNTING POSITION—Unrestricted

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

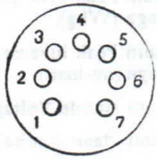
19G6

HIGH VACUUM HALF WAVE RECTIFIER

Indirectly heated—for High Voltage Power Supplies

CAP—CT1

BASE—Miniature Button 7-Pin (B7G.)



Viewed from free end of pins.

BASE CONNECTIONS

Pin 1	IC to Pin 2	IC
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	IC to Pin 2	IC
Pin 6	IC to Pin 2	IC
Pin 7	IC to Pin 2	IC
Cap	Anode	a

NOTES

Cathode and Heater should normally be tied externally. If left free, the heater to cathode voltage must never exceed 10 volts Peak.

The heater must be switched on for 20 seconds before the anode voltage is applied.

All Maximum Ratings are absolute values not design centres.

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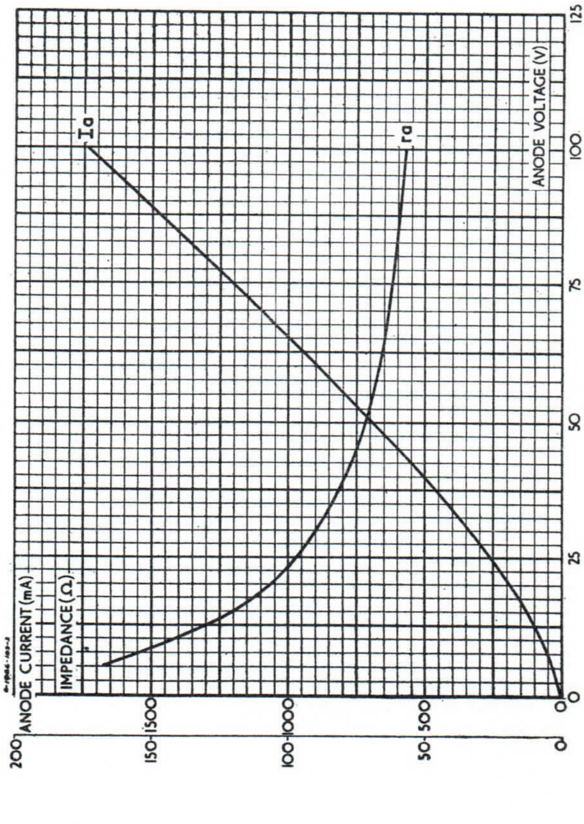
19G6

HIGH VACUUM HALF WAVE RECTIFIER

Indirectly heated—for High Voltage Power Supplies

AVERAGE CHARACTERISTIC CURVES : $I_a, R_a/V_a$



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19H4

HIGH VACUUM DIODE

Indirectly heated—for High Voltage Power Rectification ←

RATING ¶

Heater Voltage (volts)	V_h	2.5	
Heater Current (amps)	I_h	1.7	←
Maximum Mean Anode Current (mA)	$I_{a(av)max.}$	• 30.0	←
Maximum Peak Anode Current (mA)	$I_{a(pk)max.}$	• 180	←
Maximum Peak Inverse Voltage - No Load (KV)	$P.I.V._{o.(max)}$	• 23.0	
Maximum Peak Inverse Voltage - On Load (KV)	$P.I.V._{w.(max)}$	• 20.0	
Maximum Mean Anode Current (mA)		† 5.0	
Maximum Peak Inverse Voltage - No Load or On Load (KV)		† 18.0	
Minimum Surge Limiting Resistance (ohms)	Ω	18,000	←
Maximum Reservoir Condenser (µF)	{50 c/s	0.5	
	{1,600 c/s	0.01	←

• Delayed Switching. The Heater must be switched on for 10 seconds before the Anode Voltage is applied.

† Simultaneous Switching. ←

¶ All Maximum Ratings are absolute values, not design centres.

DIMENSIONS

Maximum Overall Length	(mm)	129
Maximum Diameter	(mm)	40
Maximum Seated Height	(mm)	116
Approximate Nett Weight	(ozs)	2½
Approximate Packed Weight	(ozs)	3½

MOUNTING POSITION - Unrestricted.

Indicates a change ←

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

19H4

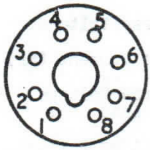
HIGH VACUUM DIODE

Indirectly heated—for High Voltage Power Rectification ←

CAP American Miniature Type

BULB Clear

BASE International Octal (IO8)



Viewed from free end of pins.

CONNEXIONS.

Pin 1	-	-
Pin 2	Heater	h
Pin 3	-	-
Pin 4	-	-
Pin 5	-	-
Pin 6	-	-
Pin 7	Heater/Cathode	h/k ←
Pin 8	-	-
Top Cap	Anode	a

NOTE

All pins with the exception of No. 2 should be connected to pin No. 7 on the holder, and pin No. 7 connected to the reservoir condenser.

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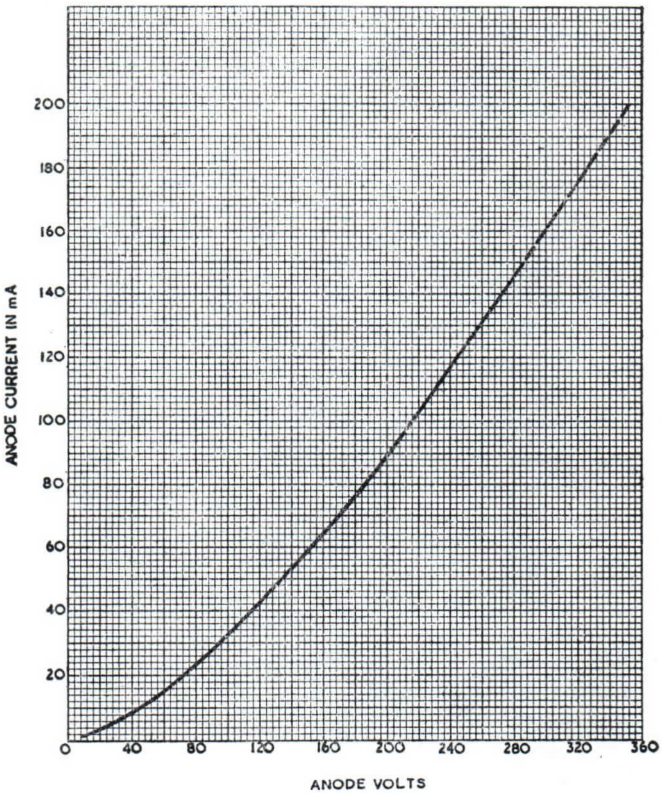
19H4

HIGH VACUUM DIODE

Indirectly heated—for High Voltage Power Rectification

AVERAGE CHARACTERISTIC CURVE



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19H12
HIGH VACUUM DIODE
Directly heated
TENTATIVE

GENERAL

The 19H12 is an Inverse Damping Diode intended for use in radar transmitters to prevent voltage overswings.

RATING

Filament Voltage (volts)	V_h	4·0
Filament Current (amps)	I_h	12·0
Maximum Anode Dissipation (watts)	$P_{a(max)}$	50
Maximum Peak Inverse Voltage (kV)	$PIV_{(max)}$	25
Maximum Peak Pulse Current (Normal) (amps)	$i_{k(pk)max}$	30*
Maximum Peak Pulse Current (Fault) (amps)	$i_{k(fault)max}$	50†
Approximate Pulse Impedance at 30 amps (ohms)	D.C. Resistance	23

* Maximum pulse length 10μs. For mean and r.m.s. currents see rating chart.

† For 1 second maximum. For further details see fault rating chart.

The filament must be switched on for 30 seconds before the anode voltage is applied.

All maximum ratings are Absolute values not Design Centres.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Filament	c_{a-f}	27·8

DIMENSIONS

Maximum Overall Length	(mm)	240
Maximum Diameter	(mm)	120
Approximate Nett Weight	(lb)	$1\frac{3}{4}$
Approximate Packed Weight	(lb)	$6\frac{1}{2}$

MOUNTING POSITION—Unrestricted.

TOP CAPS—CT3

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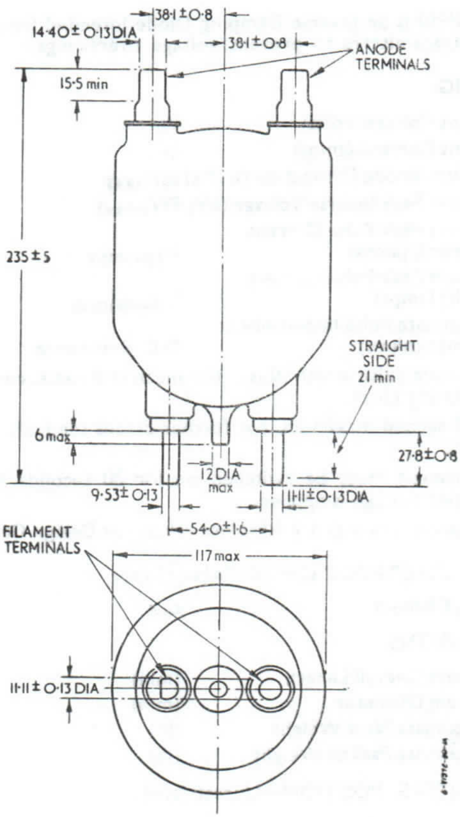
Electronic Components Division

Tel.: GERrard 9797

19H12
HIGH VACUUM DIODE
Directly heated
TENTATIVE



All dimensions in mm.

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19H12

HIGH VACUUM DIODE

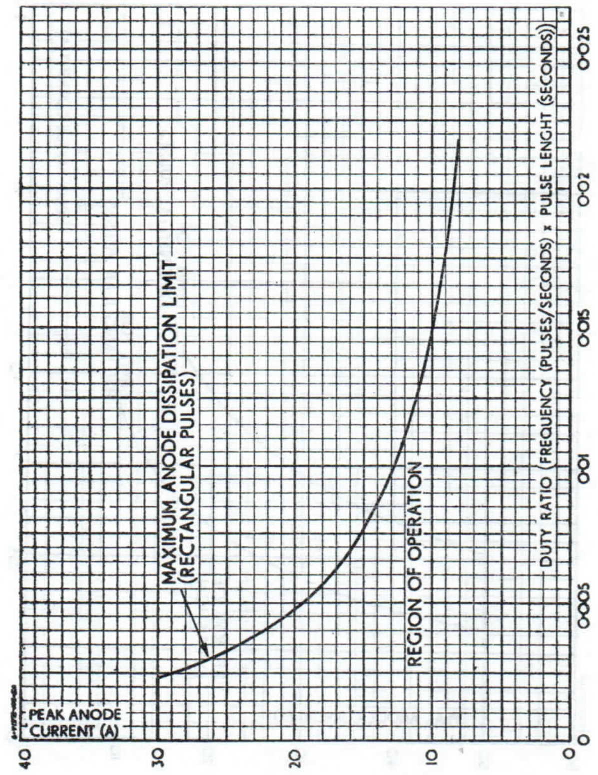
Directly heated

TENTATIVE

RATING CHART: $I_{a(pk)}$/Duty Ratio

Normal Conditions

The Chart gives Absolute Maximum values, not Design Centres



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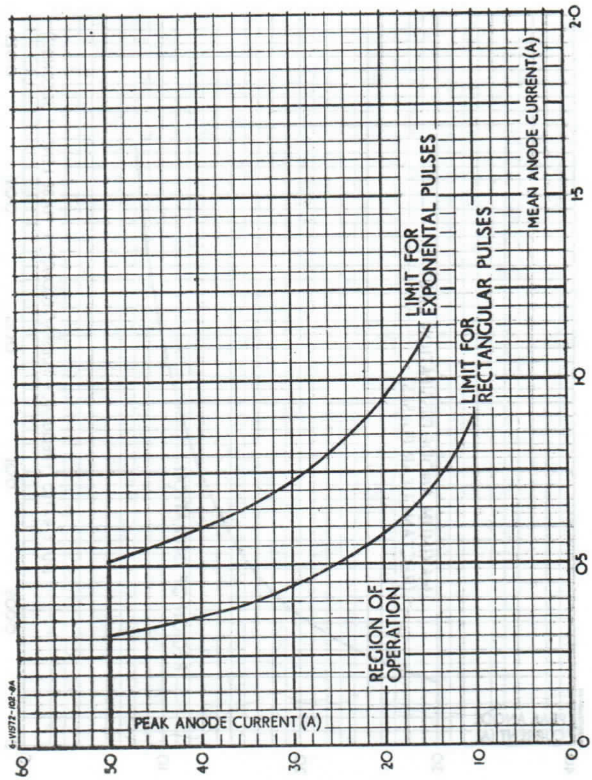
19H12
HIGH VACUUM DIODE
Directly heated
TENTATIVE

RATING CHART: $I_{a(pk)}/I_{a(av)}$
Fault Conditions. Maximum Fault Duration = 1 sec.
The Chart gives Absolute Maximum values, not Design Centres



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19H12

HIGH VACUUM DIODE

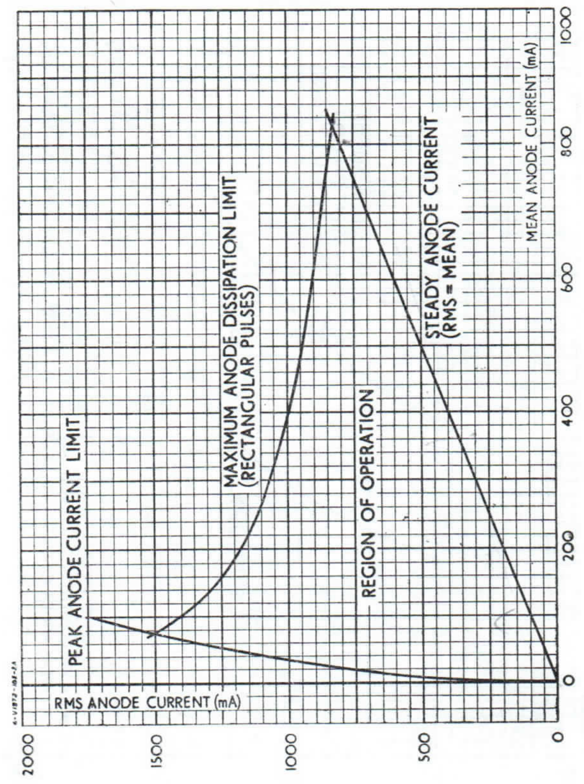
Directly heated

TENTATIVE

RATING CHART

Normal conditions

The Chart gives Absolute Maximum values, not Design Centres



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Electronic Components Division

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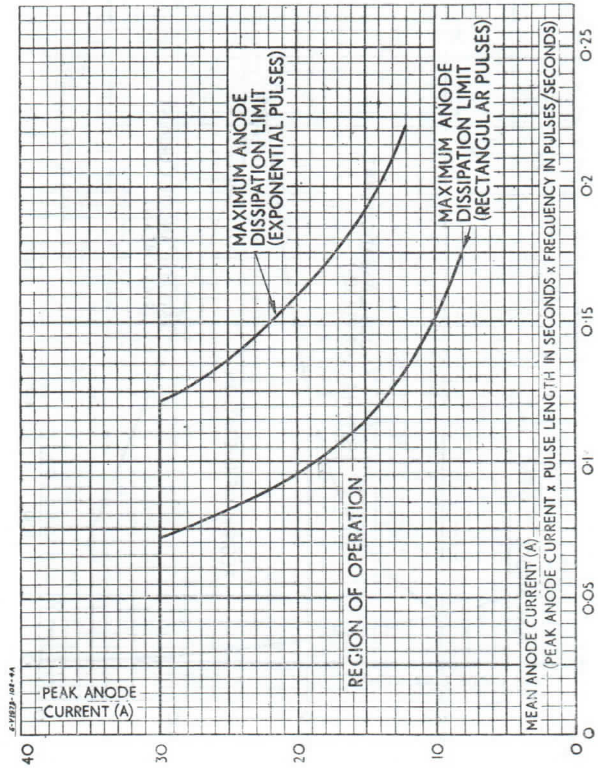
I9HI2
HIGH VACUUM DIODE
Directly heated
TENTATIVE

RATING CHART: $I_{a(pk)}/I_{a(av)}$
Normal Conditions
The Chart gives Absolute Maximum values, not Design Centres



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ESU74

HIGH VACUUM HALF WAVE RECTIFIER

RATING

Filament Voltage (volts)	V_f	4.0
Filament Current (amps)	I_f	11.5
Maximum Peak Inverse Voltage (volts)	P.I.V. (max)	40,000
Maximum Mean Anode Current (mA)	$I_{a(av)max}$	80
Average Maximum Filament Emission (amps)	I_{em}	1.1
Maximum Anode Dissipation (watts)	P_a	50

DIMENSIONS

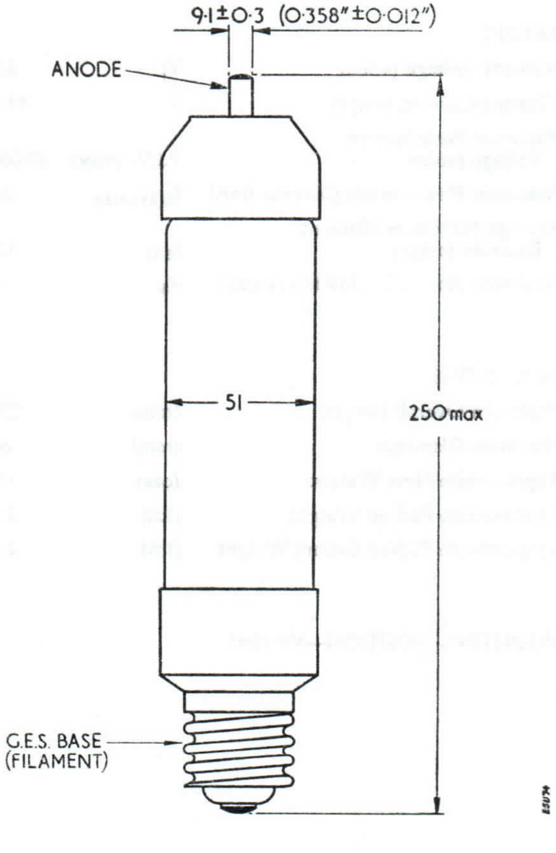
Maximum Overall Length	(mm)	250
Maximum Diameter	(mm)	60
Approximate Nett Weight	(ozs)	7.0
Approximate Packed Weight	(lbs)	2.0
Approximate Packed Export Weight	(lbs)	2.0

MOUNTING POSITION—Vertical.

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

ESU74

HIGH VACUUM HALF WAVE RECTIFIER



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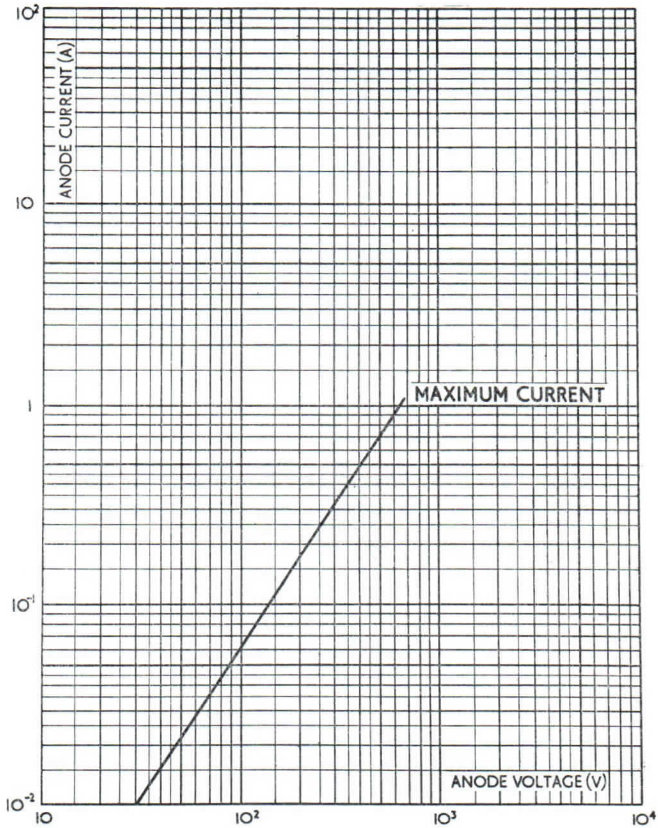
ESU74

HIGH VACUUM HALF WAVE RECTIFIER

TYPICAL CHARACTERISTIC CURVES: I_a/V_a



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ESU77

HALF-WAVE HIGH VACUUM RECTIFIER

GENERAL

The ESU.77 is a directly heated Thoriated Tungsten filament high voltage half-wave rectifier employing a tantalum anode.

RATING

Filament Voltage (volts)	V_f	4
Filament Current (amps)	I_f	12
Maximum Peak Inverse Voltage (kV)	P.I.V.max.	40
Maximum Peak Anode Current for Rectifier and Diode charging conditions (amps)	$I_{a(pk)max.}$	1.1
Maximum Anode Dissipation (watts)	P_a	130
Nominal Internal Resistance at 300 mA (ohms)		600

DIMENSIONS

Maximum Overall Length (mm)	270
Maximum Diameter (mm)	61

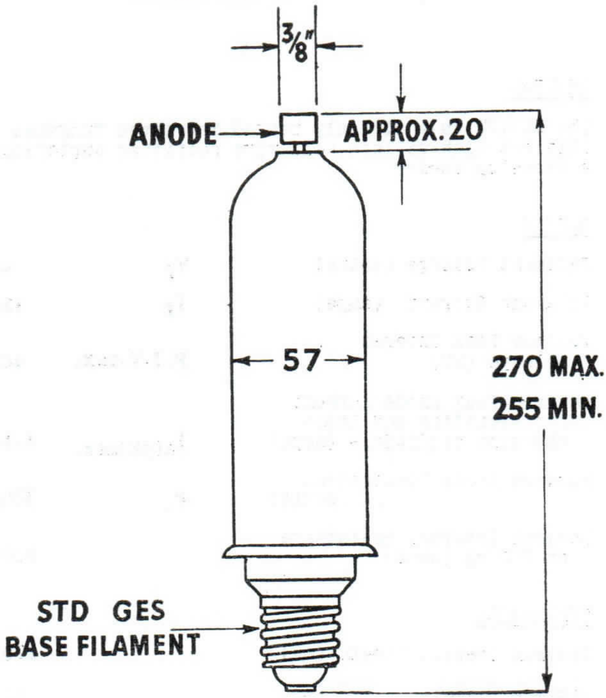
BASE - G.E.S.

MOUNTING POSITION - Vertical

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

ESU77

HALF-WAVE HIGH VACUUM RECTIFIER



HARD GLASS BULB

All dimensions in mm. unless stated otherwise.

Associated Electrical Industries Limited
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Tel.: GERRARD 9797

Gas-filled Rectifiers

ESU101
HALF-WAVE MERCURY VAPOUR RECTIFIER
TENTATIVE

GENERAL

The ESU101 is a directly heated high voltage half-wave mercury vapour rectifier, which has been designed for use in radio relay amplifiers.

RATING

Filament Voltage (volts)	V_f	4·0
Filament Current (amps)	I_f	2·7
Maximum Peak Inverse Voltage (kV)	P.I.V.(max)	10·0
Maximum Peak Anode Current (amps)	$I_{a(pk)max}$	1·25
Maximum Mean Anode Current(amps)	$I_{a(av)max}$	0·25
Voltage Drop (approx) (volts)	Vdrop	16
Condensed Mercury Temperature Range (°C)		20 to 60
Heating Time (seconds)		60

DIMENSIONS

Maximum Overall Length	(mm)	139
Maximum Diameter	(mm)	48
Approximate Nett Weight	(ozs)	2
Approximate Packed Weight	(ozs)	3¼

MOUNTING POSITION Vertical, base downwards.

TYPICAL OPERATION

A Biphase Half Wave Rectifier using two valves can give an output of 500 mA at 3·2 kV.

NOTES

The H.T. supply to the anode should not be switch on until the specified filament heating time has elapsed. When newly installed or after a period of disuse the filament should be run at normal temperature for 15 minutes before the application of the H.T. voltage.

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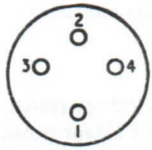
ESU101
HALF-WAVE MERCURY VAPOUR RECTIFIER
TENTATIVE

BULB Clear.

BASE British 4 Pin (B4).



Viewed from free end of pins.

CAP $\frac{11}{16}$ ins. diameter.

VALVEHOLDER EDISWAN CLIX VH300/4, VH42/4.

TOP CAP CONNECTOR EDISWAN CLIX TC434

CONNECTIONS

Pin 1	No Connection	NC
Pin 2	No Connection	NC
Pin 3	Filament	f
Pin 4	Filament	f
Top Cap	Anode	a

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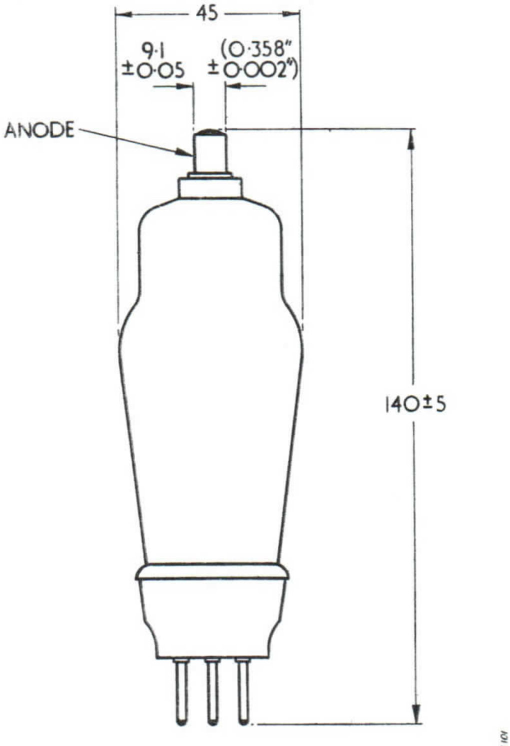
ESU101
HALF-WAVE MERCURY VAPOUR RECTIFIER
TENTATIVE



All Dimensions in mm unless stated otherwise.

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ESU103

HALF-WAVE XENON RECTIFIER

TENTATIVE

GENERAL

The ESU103 is a directly heated half-wave Xenon Rectifier requiring a heating delay time of 10 seconds. Two rectifiers in a Full-wave circuit will give an output of 0.5 amps at 3.2kV or 1.0 amp at 1.6kV. This rectifier may be operated in the ambient temperature range —50°C to +75°C.

RATING

Filament Voltage (volts)	V_f		2.5	
Filament Current (amps)	I_f		5.0	
Maximum Peak Inverse Voltage (kV)	PIV (max)	5.0		10.0
Maximum Peak Anode Current (amps)	$i_{a(pk)max}$	2.0		1.0
Maximum Mean Anode Current (amps)	$I_{a(av)max}$	0.5		0.25
Maximum Voltage Drop (volts)				12.0
Minimum Heating Time (secs)				10
Ambient Temperature Range (°C)				—55 to +75

DIMENSIONS

Maximum Overall Length	(mm)	160
Maximum Seated Height	(mm)	144
Maximum Diameter	(mm)	52
Approximate Nett Weight	(ozs)	4
Approximate Packed Weight	(ozs)	8

MOUNTING POSITION—Unrestricted

Associated Electrical Industries Limited

Electronic Components Division

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ESU103

HALF-WAVE XENON RECTIFIER

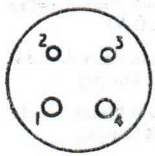
TENTATIVE

TYPICAL OPERATION—Full-wave (2 Valves)

Peak Inverse Voltage Rating (kV)	PIV(max)	5	10
Output Voltage (kV)	V_{out}	1.6	3.2
Output Current (amps)	I_{out}	1.0	0.5

TOP CAP—CT3

BASE—UX4 with Bayonet



Viewed from free end of pins.

VALVE HOLDER—Ediswan Clix VH262/4

TOP CAP CONNECTOR—Ediswan Clix TC433

CONNECTIONS

Pin 1	Filament	f
Pin 2	No Connection	NC
Pin 3	No Connection	NC
Pin 4	Filament, Shield	f,s
Top Cap	Anode	a

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

ESU106

HALF-WAVE MERCURY VAPOUR RECTIFIER

TENTATIVE

GENERAL

THE ESU106 is an indirectly heated half-wave Mercury Vapour Rectifier having a normal cathode heating delay time of five minutes. Two rectifiers in a full wave circuit will give an output of 6 amps at 6.3kV. This rectifier may be operated with condensed mercury temperatures in the range +25°C to +70°C.

RATING

Heater Voltage (volts)	V_h	4.0
Heater Current (amps)	I_h	14.0 to 16.0
Maximum Peak Inverse Voltage (kV)	PIV(max)	20.0†
Maximum Peak Anode Current (amps)	$i_{a(pk)max}$	15.0†
Maximum Mean Anode Current (amps)	$I_{a(av)max}$	3.0†
Maximum Voltage Drop (volts)		15.0
Minimum Cathode Heating Time (at 15°C) (minutes)		5.0*
Condensed Mercury Temperature Range (°C)		+25 to +70
Maximum Surge Cathode Current (0.1 sec max) (amps)	$I_{k(surge)max}$	150

* At free air ambient temperature 10°C heating time is 10 minutes, at 5°C heating time is 20 minutes.

† See " Typical Operation " for temperature derating.

DIMENSIONS

Maximum Overall Length	(mm)	310
Maximum Diameter	(mm)	78
Approximate Nett Weight	(lbs)	1
Approximate Packed Weight	(lbs)	8

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

ESU106

HALF-WAVE MERCURY VAPOUR RECTIFIER

TENTATIVE

MOUNTING POSITION—Vertical, base downwards

TYPICAL OPERATION

A Full Wave Rectifier using 2 valves can deliver an output of 6 amps at 6.3kV.

Condensed Mercury Temperature (°C)		70	65	60	55—25
Maximum Peak Inverse Voltage (kV)	$PIV_{(max)}$	5	10	15	20
Maximum Peak Cathode Current (amps)	$i_{k(pk)max}$	30	20	18	15
Maximum Mean Cathode Current (amps)	$I_{k(av)max}$	7	5	4	3

NOTE

The cathode of this rectifier should be allowed an adequate heating time, preferably longer than the specified absolute minimum but in any circumstances no shorter, before the application of anode voltage.

The condensed mercury temperature, which may be measured with a thermocouple attached to the coolest part of the bulb, should never pass outside the specified limits during operation.

After transportation, or a period of storage, or when first placed in service, an initial cathode heating time of 30 minutes should be allowed to ensure the correct distribution of the mercury within the valve.

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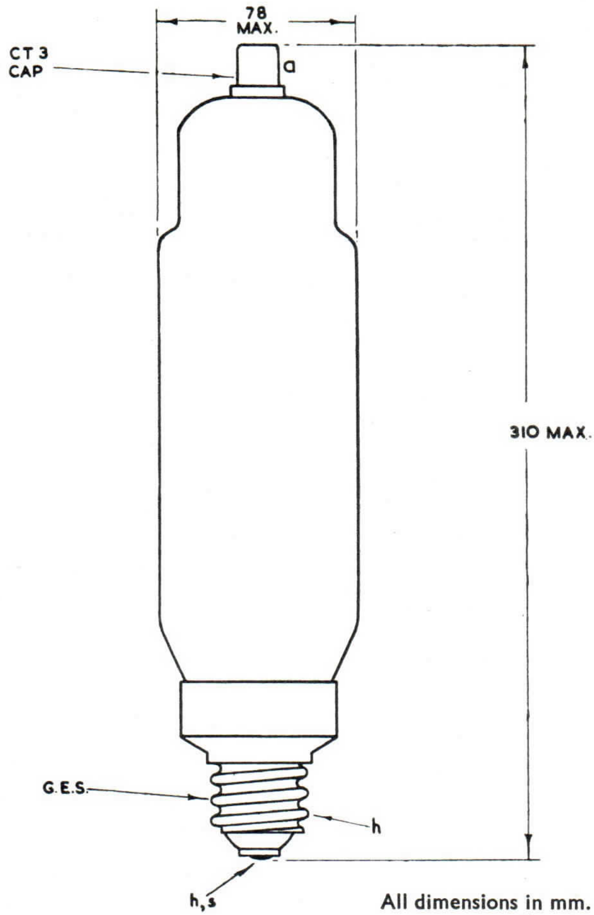


All dimensions in mm.

VALVE HOLDER—AEI 4857

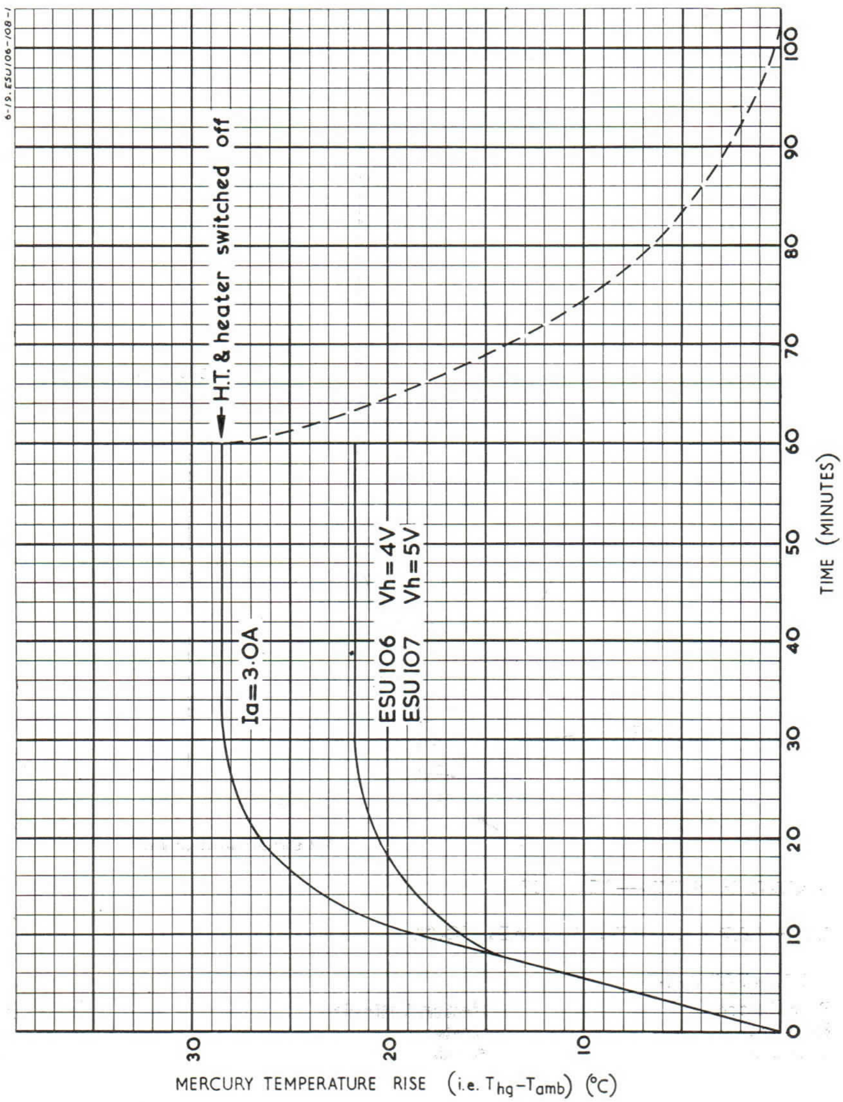
TOP CAP CONNECTOR—AEI TC433

CONNECTIONS

Base Centre	Heater, Cathode	h,k
Base Shell	Heater	h
Top Cap	Anode	a

Associated Electrical Industries Limited
Radio Components Department
Tel: GERrard 9797

CHARACTERISTIC CURVES : T_{Hg}/t



ESU107

HALF-WAVE MERCURY VAPOUR RECTIFIER

GENERAL

The ESU107 is an indirectly heated half-wave mercury vapour rectifier having a minimum cathode heating delay time of three minutes. Two rectifiers in a full wave circuit will give an output of 6·0A at 6·3kV. This rectifier may be operated with condensed mercury temperatures in the range +25° to +70°C.

RATING

Heater voltage	V_h				5·0	V
Heater current	I_h				12	A
Maximum peak inverse voltage	P.I.V.(max)				20	kV
Maximum operating frequency	f_{max}				150	c/s
Minimum pre-heat time					3	min
Maximum output voltage in biphase half-wave using two valves	$V_{(out)max}$				6·3	kV
Maximum output current in biphase half-wave using two valves	$I_{(out)max}$				6·0	A
Maximum voltage drop across valve					15	V
Maximum surge cathode current (0·1 sec max)	$I_{k(surge)max}$				150	A
Maximum peak inverse voltage	P.I.V.(max)	20	15	10	5·0	kV
Condensed mercury temperature limits		25-55	25-60	25-65	25-70	°C
Peak cathode current	$i_{k(pk)}$	15	18	20	25	A
Maximum average cathode current (maximum average time 10 sec)	$I_{k(av)max}$	3·0	4·0	5·0	6·0	A

DIMENSIONS

Maximum overall length	305	mm
Maximum diameter	78	mm
Maximum seated height	285	mm
Approximate net weight	1	lb
Approximate packed weight	8	lb

Associated Electrical Industries Limited

Electronic Components Department

Tel: GERrard 9797

ESU107

HALF-WAVE MERCURY VAPOUR RECTIFIER

MOUNTING POSITION—Vertical, base downwards.

NOTES

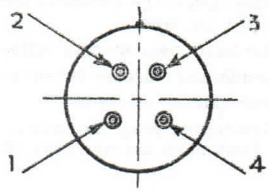
The cathode of this rectifier should be allowed an adequate heating time, preferably longer than the specified absolute minimum, but in any circumstances no shorter, before the application of anode voltage.

The condensed mercury temperature, which may be measured with a thermocouple attached to the coolest part of the bulb, should never pass outside the specified limits during operation.

After transportation, or a period of storage, or when first placed in service, an initial cathode heating time of 30 minutes should be allowed to ensure the correct distribution of the mercury within the valve.

TOP CAP—CT3

BASE—B4D



Viewed from free end of pins.

CONNECTIONS

Pin 1	No Connection	NC
Pin 2	Heater, Cathode	h,k
Pin 3	Heater	h
Pin 4	No Connection	NC
Top Cap	Anode	a

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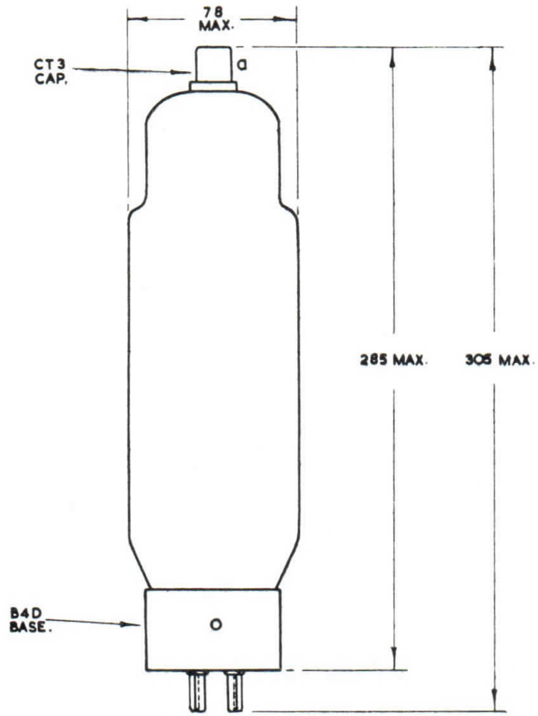

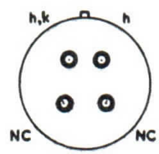

VIEW OF FREE END.

All dimensions in mm.

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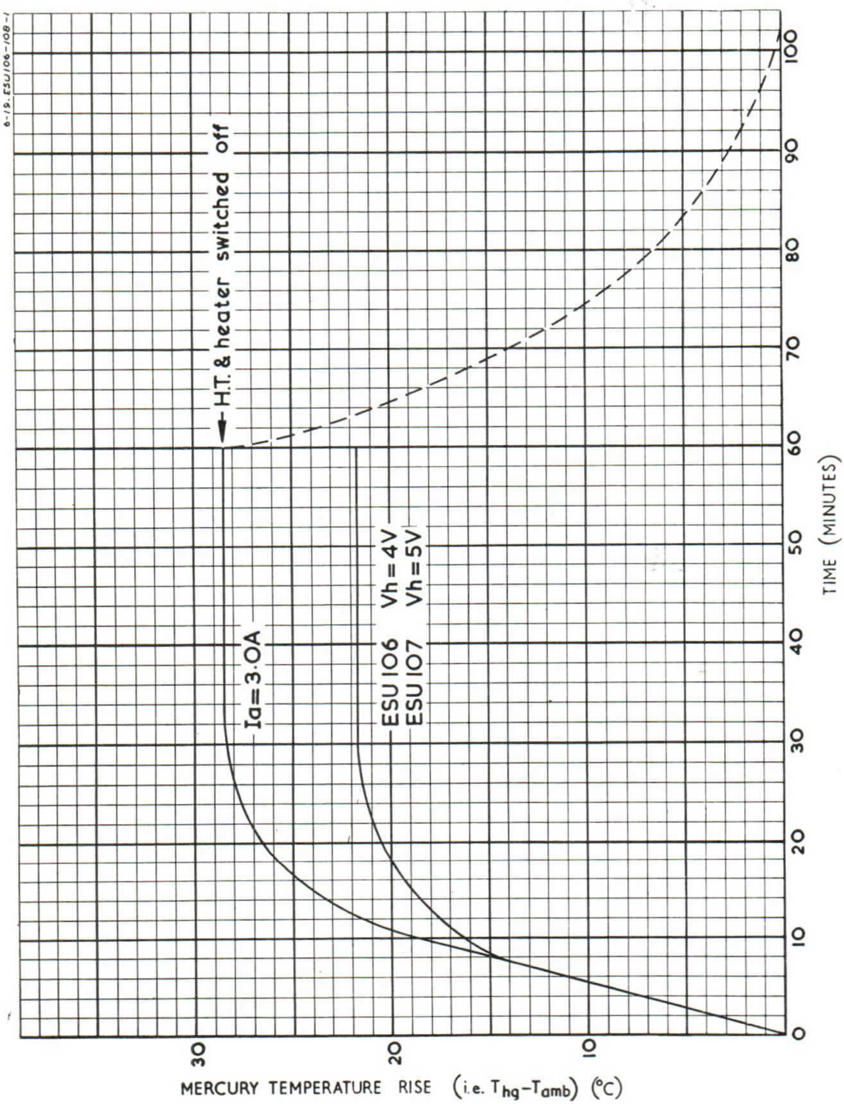
CHARACTERISTIC CURVES: T_{Hg}/t



ESU111

HALF WAVE MERCURY VAPOUR RECTIFIER ←

GENERAL

The ESU111 is an indirectly heated half wave Mercury Vapour Rectifier having a cathode heating delay time of 3 minutes. Two rectifiers in a full wave circuit will give an output of 6 amps at 6.3kV. This rectifier may be operated with condensed mercury temperatures in the range +25°C to +70°C.

RATING

Heater Voltage (volts)	V_h	5·0
Heater Current (amps)	I_h	12·0 ←
Maximum Peak Inverse Voltage (kV)	PIVmax	20·0*
Maximum Peak Anode Current (amps)	$i_{a(pk)max}$	15·0*
Maximum Mean Anode Current (amps)	$i_{a(av)max}$	3·0*
Maximum Voltage Drop (volts)		15·0
Minimum Heating Time (mins)		3 ←
Condensed Mercury Temperature Range		+25 to +70°C

* See " Typical Operation " for temperature derating.

DIMENSIONS

Maximum Overall Length	(mm)	337 ←
Maximum Seated Height	(mm)	310 ←
Maximum Diameter	(mm)	78
Approximate Nett Weight	(lbs)	1
Approximate Packed Weight	(lbs)	8½

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ESU111

HALF WAVE MERCURY VAPOUR RECTIFIER

MOUNTING POSITION—Vertical, base downwards

TYPICAL OPERATION

A full wave Rectifier using 2 valves can deliver an output of 6.0. amps at 6.3kV.

Condensed Mercury Temperature (°C)		70 to 25	65 to 25	60 to 25	55 to 25
Maximum Peak Inverse Voltage (kV)	PIV(max)	5	10	15	20
Maximum Peak Cathode Current (amps)	$I_{k(pk)max}$	25	20	18	15
Maximum Mean Cathode Current (amps)	$I_{k(av)max}$	6	5	4	3

NOTES.—

The cathode of this rectifier should be allowed an adequate heating time, preferably longer than the specified absolute minimum but in any circumstances no shorter, before the application of anode voltage.

The condensed mercury temperature, which may be measured with a thermocouple attached to the coolest part of the bulb, should never pass outside the specified limits during operation.

After transportation, or a period of storage, or when first placed in service, an initial cathode heating time of 30 minutes should be allowed to ensure the correct distribution of the mercury within the valve.

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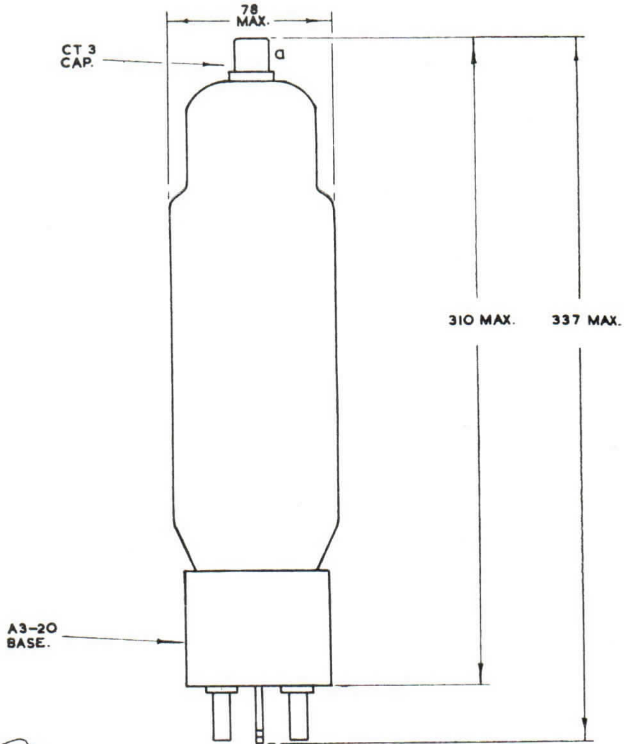
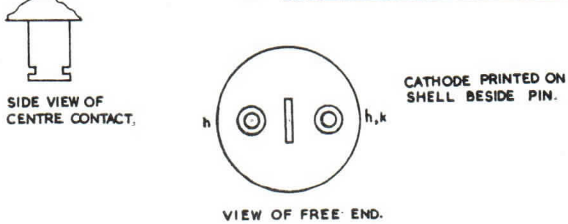
ESU111

HALF-WAVE MERCURY VAPOUR RECTIFIER





All dimensions in mm.

BASE—RMA A3-20

TOP CAP CONNECTOR—AEI TC433

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ESU115

HALF-WAVE MERCURY VAPOUR RECTIFIER

GENERAL

The ESU115 is a directly heated high voltage half-wave mercury vapour rectifier, which has been designed for use in radio relay amplifiers.

RATING

Filament Voltage (volts)	V_f	4·0
Filament Current (amps)	I_f	2·7
Maximum Peak Inverse Voltage (kV)	P.I.V.(max)	6·5
Maximum Peak Anode Current (amps)	$I_{a(pk)max}$	1·25
Maximum Mean Anode Current(amps)	$I_{a(av)max}$	0·25
Voltage Drop (approx) (volts)	V_{drop}	16
Condensed Mercury Temperature Range (°C)		20 to 60
Heating Time (seconds)		60

DIMENSIONS

Maximum Overall Length	(mm)	139
Maximum Diameter	(mm)	48
Approximate Nett Weight	(ozs)	3
Approximate Packed Weight	(ozs)	3¼

MOUNTING POSITION—Vertical, base downwards.

TYPICAL OPERATION

A Biphase Half Wave Rectifier using two valves can give an output of 500 mA at 2·0 kV.

NOTES

The H.T. supply to the anode should not be switched on until the specified filament heating time has elapsed. When newly installed or after a period of disuse the filament should be run at normal temperature for 15 minutes before the application of the H.T. voltage.

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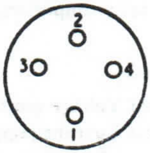
ESU115

HALF-WAVE MERCURY VAPOUR RECTIFIER

BULB—Clear.

BASE—British 4 Pin (B4).



Viewed from free end of pins.

CAP—CT2.

VALVEHOLDER—EDISWAN CLIX VH300/4, VH42/4.

TOP CAP CONNECTOR—EDISWAN CLIX TC430.

CONNECTIONS

Pin 1	No Connection	NC
Pin 2	No Connection	NC
Pin 3	Filament	f
Pin 4	Filament	f
Top Cap	Anode	a

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ESU200

HALF WAVE MERCURY VAPOUR RECTIFIER

GENERAL

The ESU200 is a directly heated oxide coated filament High Voltage Half Wave Mercury Vapour Rectifier.
When first placed into operation it is essential that the filament is run at its rated value for 15 minutes without any anode voltage being applied.

RATING

Filament Voltage (volts)	V_f	4·0
Filament Current (amps)	I_f	11·0
Maximum Peak Inverse Anode Voltage (kV)	PIV (max)	**15
Maximum Peak Anode Current (amps)	$I_{a(pk)(max)}$	**5·0
Maximum Average Anode Current (amps)	$I_{a(av)(max)}$	1·25
Voltage Drop (volts) approx.		12
Ambient Temperature Range		20°-60° C
Cathode Heating Delay Time (secs)	t	60

DIMENSIONS

Maximum Overall Length	(mm)	270
Maximum Diameter	(mm)	57
Approximate Nett Weight	(ozs)	8
Approximate Packed weight	(lbs)	1½
Approximate Packed Export Weight	(lbs)	1¾

MOUNTING POSITION—Vertical

TOP CAP—Anode (C.T.9)

BASE G.E.S.—Filament

**Note :—Maximum ratings cannot necessarily be used simultaneously. Normally if either the maximum P.I.V. or maximum mean current are to be used, the other factor has to be reduced appreciably.

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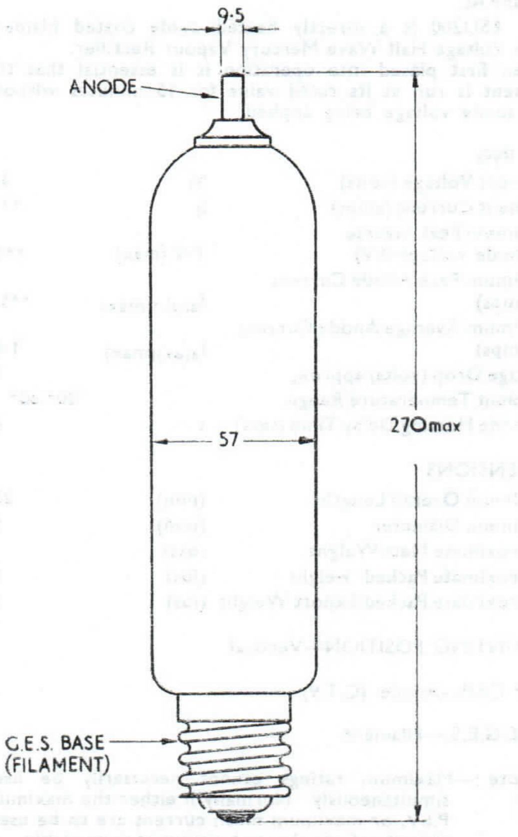
ESU200

HALF WAVE MERCURY VAPOUR RECTIFIER



All dimensions in m.m.

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ESU575

HALF WAVE MERCURY VAPOUR RECTIFIER

Directly heated

RATING

Filament Voltage (volts)	V_f	5·0
Filament Current (amps)	I_f	10·0 ←
Maximum Peak Anode Current (amps)	$I_{a(pk)max.}$	7·0 ←
Maximum Mean Anode Current (amps)	$I_{a(av)max.}$	1·75 ←
Maximum Peak Inverse Voltage (volts)	P.I.V.(max)	15,000
Approximate Voltage Drop (volts)	V_{ir}	10·0
Filament Heating Time (secs)		60
Condensed Mercury Temp. (°C)		20–60

DIMENSIONS

Maximum Overall Length (mm)		275 ←
Maximum Diameter (mm)		78
Approximate Nett Weight	(ozs)	10½
Approximate Packed Weight	(lbs)	4
Approximate Packed Export Weight	(lbs)	4½

MOUNTING POSITION—Vertical.

BASE—Jumbo.

SPECIAL NOTE. When the rectifier is first placed into service, the filament should be operated at Normal Voltage for 15 minutes without the anode voltage. This will enable the mercury to be correctly distributed.

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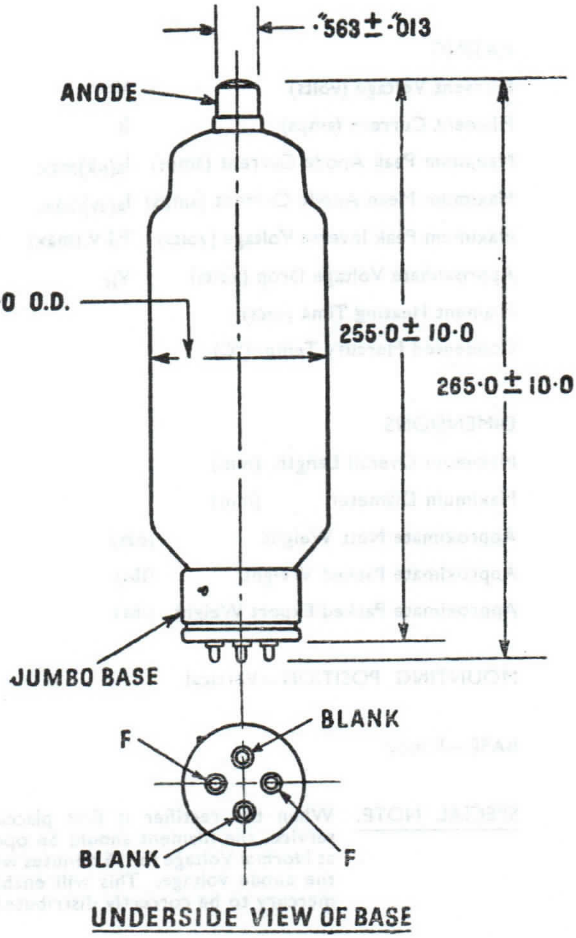
ESU575

HALF WAVE MERCURY VAPOUR RECTIFIER

Directly heated



ALL DIMENSIONS IN M.M. UNLESS OTHERWISE STATED

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ESU673

HALF WAVE MERCURY VAPOUR RECTIFIER

Directly heated

RATING

Filament Voltage (volts)	V_f	5·0
Filament Current (amps)	I_f	10·0
Maximum Peak Anode Current (amps)	$I_{a(pk)max.}$	7·0
Maximum Mean Anode Current (amps)	$I_{a(av)max.}$	1·75
Maximum Peak Inverse Voltage (kV)	P.I.V.(max)	15
Approximate Voltage Drop (volts)	V_{ir}	10·0
Cathode Heating Time (secs)		60
Condensed Mercury Temperature (°C)		20–60

DIMENSIONS

Maximum Overall Length	(mm)	282
Maximum Diameter	(mm)	78
Approximate Nett Weight	(ozs)	10½
Approximate Packed Weight	(lbs)	4
Approximate Packed Export Weight	(lbs)	4½

MOUNTING POSITION—Vertical.

BASE—Super Jumbo—Filament.

TOP CAP—Anode.

SPECIAL NOTE

When the rectifier is first placed into service, the filament should be operated at Normal Voltage for 15 minutes without the anode voltage. This will enable the mercury to be correctly distributed.

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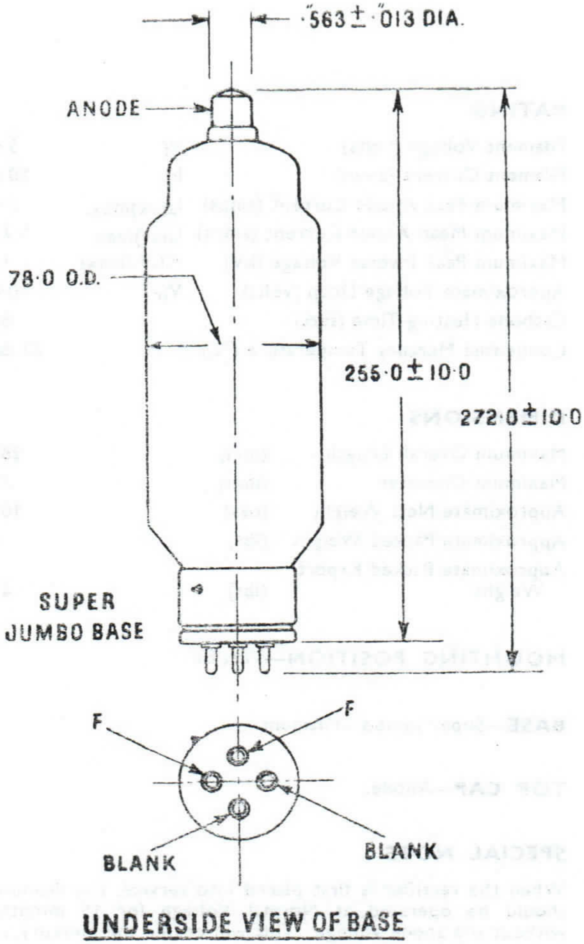
ESU673

HALF WAVE MERCURY VAPOUR RECTIFIER
Directly heated



UNDERSIDE VIEW OF BASE

ALL DIMENSIONS IN M.M UNLESS OTHERWISE STATED

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ESU866

HALF WAVE MERCURY VAPOUR RECTIFIER

RATING

Filament Voltage (volts)	V_f	2.5
Filament Current (amps)	I_f	5.0
Maximum Peak Anode Current (amps)	$I_{a(pk)}$	1.0
Maximum Peak Inverse Voltage (volts)	P.I.V (max)	10,000
Maximum Mean Anode Current (amps)	$I_{a(av)max}$	0.25
Approximate Voltage Drop (volts)	V_{ir}	15
Cathode Delay Time (secs)	t	60
Ambient Temperature (C^o)		20-60

DIMENSIONS

Maximum Overall Length (mm)	170
Maximum Diameter (mm)	66
Approximate Nett weight (ozs)	3
Approximate Packed Weight (lbs)	1½
Approximate Packed Export Weight	2

MOUNTING POSITION Vertical

BASE

U.X. 4 pin. This valve can also be supplied fitted with an E.S. base, in which case it is known as the ESU.866/ES.

TOP CAP Anode

SPECIAL NOTE

When first placed into operation it is essential that the filament is run at the rated value for 15 minutes without any anode voltage being applied.

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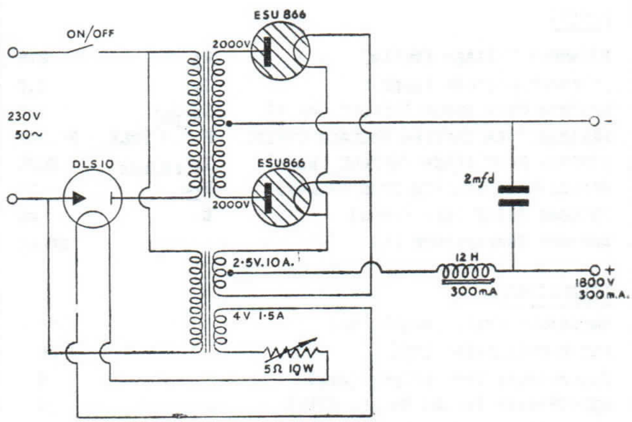
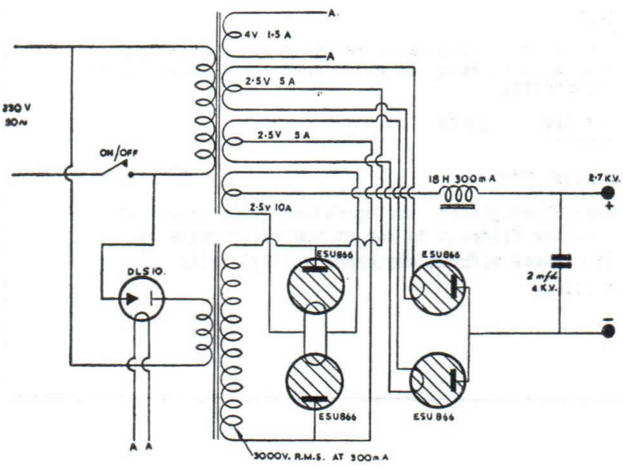
ESU866

HALF WAVE MERCURY VAPOUR RECTIFIER

FULL WAVE CIRCUIT TO SUPPLY 1·8 KV AT 300 mA.



BRIDGE RECTIFIER CIRCUIT TO SUPPLY 2·7 K.V. AT 300 m.A.



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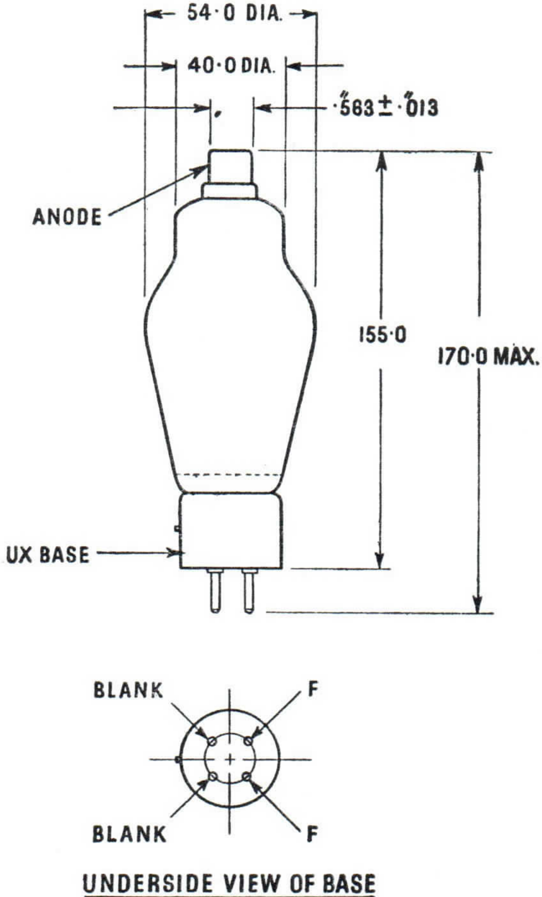
ESU866

HALF WAVE MERCURY VAPOUR RECTIFIER



ALL DIMENSIONS IN M.M. UNLESS OTHERWISE STATED

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

ESU872

HALF WAVE MERCURY VAPOUR RECTIFIER

GENERAL

This directly heated rectifier is designed to withstand high peak inverse voltages and to conduct at relatively low applied voltages.

RATING

Filament Voltages (volts)	V_f	5.0
Filament Current (amps)	I_f	7.5
Maximum Peak Inverse Anode Voltage (KV)	P.I.V.	10
Peak Anode Current (amps)	$I_{a(pk)}$	5
Maximum Mean Anode Current (amps)	$I_{a(mean)}$	1.25
Condensed Mercury Temperature (°C)		20-60
Cathode Heating Delay Time (secs)		60
Voltage Drop (volts)		15

DIMENSIONS

Maximum Overall Length	(inches)	8½
Maximum Diameter	(inches)	2.5/16

BASE Jumbo - filament

TOP CAP - Anode

APPLICATION

When a mercury vapour rectifier is first placed in service, its filament should be operated at normal voltage for approximately 15 minutes without anode voltage in order to distribute the mercury properly. This procedure need not be repeated unless, during subsequent handling, the mercury is spattered on to the filament and anode.

Mount the rectifier vertically in a well-ventilated position as the bulb becomes hot during continuous operation. To avoid the possibility of flash-back on reverse voltage, the temperature of the rectifier bulb at the point where the mercury vapour condenses should not be allowed to exceed 60°C. Where there is a possibility of the air temperature rising considerably, an air draught cooling should be used.

Unless the valve is operated on very light loads, the filament must be allowed to attain its full operating temparature before the anode voltage is applied, and the Cathode Delay Time should elapse before the anode supply is switched on. A delay switch is recommended for full load operation (see DLS range of swich The filament supply should not be switched off before the H.T. supply.

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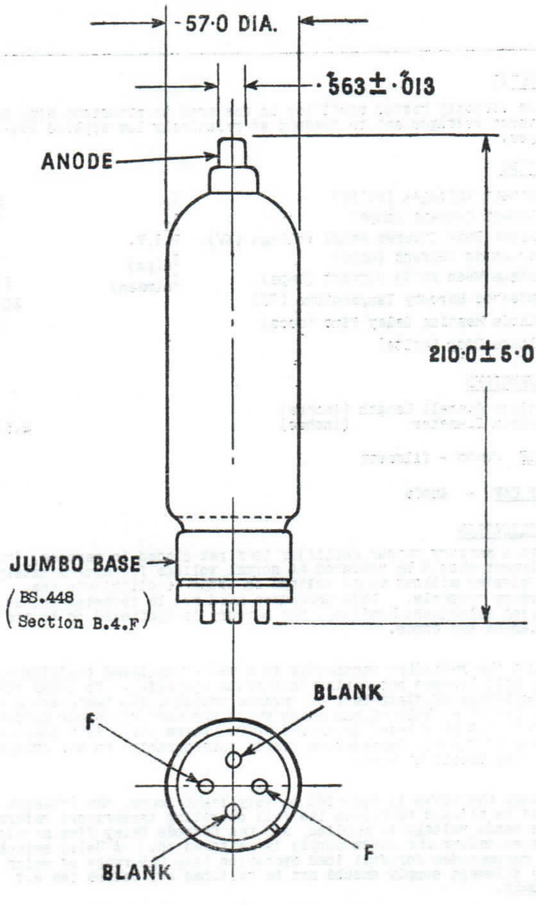
ESU872

HALF WAVE MERCURY VAPOUR RECTIFIER



UNDERSIDE VIEW OF BASE

ALL DIMENSIONS IN M.M. UNLESS OTHERWISE STATED

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

ESU8008

HALF WAVE MERCURY VAPOUR RECTIFIER

GENERAL

This directly heated rectifier is designed to withstand high peak inverse voltages and to conduct at relatively low applied voltages.

RATING

Filament Voltages (volts)	V_f	5.0
Filament Current (amps)	I_f	7.5
Maximum Peak Inverse Anode Voltage (KV)	P.I.V.	10
Maximum Peak Anode Current (amps)	$I_{a(pk)}$	5
Maximum Mean Anode Current (amps)	$I_{a(mean)}$	1.25
Condensed Mercury Temperature (°C)		20-60
Cathode Heating Time (secs)		60
Approximate Voltage Drop (volts)		10

DIMENSIONS

Maximum Overall Length (inches)	8½
Maximum Diameter (inches)	2.5/16

BASE Super Jumbo - filament

TOP CAP - Anode

APPLICATION

When a mercury vapour rectifier is first placed in service, its filament should be operated at normal voltage for approximately 15 minutes without anode voltage in order to distribute the mercury properly. This procedure need not be repeated unless, during subsequent handling, the mercury is spattered on to the filament and anode.

Mount the rectifier vertically in a well-ventilated position as the bulb becomes hot during continuous operation. To avoid the possibility of flash-back on reverse voltage, the temperature of the rectifier bulb at the point where the mercury vapour condenses should not be allowed to exceed 60°C. Where there is a possibility of the air temperature rising considerably, an air draught cooling should be used.

Unless the valve is operated on very light loads, the filament must be allowed to attain its full operating temperature before the anode voltage is applied, and the Cathode Delay Time should elapse before the anode supply is switched on. A delay switch is recommended for full load operation (see DLS range of switches). The filament supply should not be switched off before the H.T. supply.

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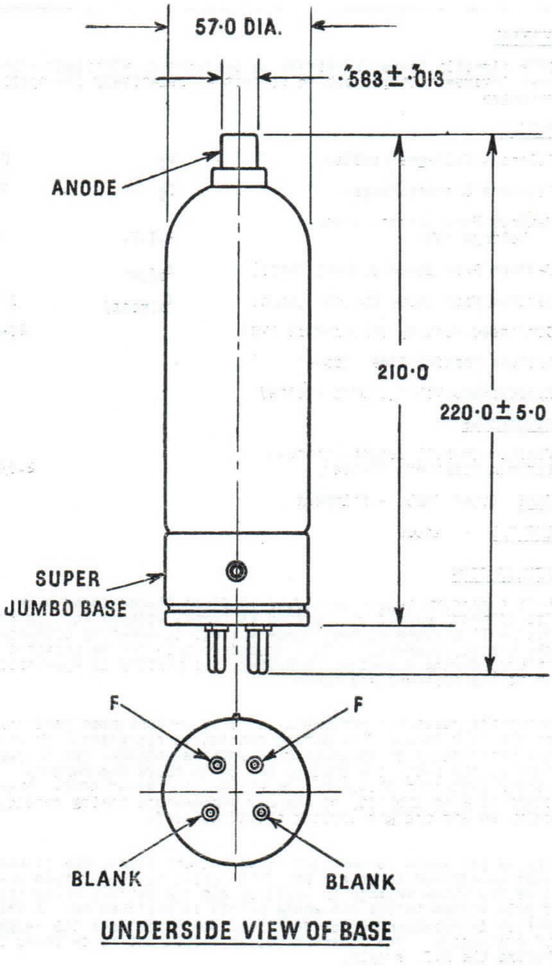
ESU8008

HALF WAVE MERCURY VAPOUR RECTIFIER



ALL DIMENSIONS IN M.M. UNLESS OTHERWISE STATED

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

Thyratrons

20A2

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	1.0
Approximate Voltage drop (volts)		9.0
Max. Peak Forward Anode Voltage	$V_{a(max)}$	600
Max. Peak Inverse Anode Voltage	P.I.V.(max)	1300
Max. Shield Grid Voltage (volts)	$V_{g2(max)}$	-100
Max. Control Grid Voltage (volts)	$V_{g1(max)}$	-100
Max. Peak Cathode Current (mA)	$I_{k(pk)max}$	1250
Max. Mean Cathode Current (mA)	$I_{k(av)max}$	250
Control Grid Series Resistance (megohms)		.01 to 1.0

NOTE

Cathode and heater should normally be tied externally. If left free, the heater to cathode voltage must never exceed 25 volts peak. The heater must be switched on for 15 seconds before anode voltage is applied.

All maximum ratings are absolute values, not design centres.

DIMENSIONS

Maximum Overall Length (mm)	110
Maximum Diameter (mm)	40
Maximum Seated Height (mm)	97
Approximate Nett Weight (ozs)	1½
Approximate Packed Weight (ozs)	2

MOUNTING POSITION - Unrestricted.

Associated Electrical Industries Limited
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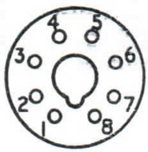
20A2

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

BULB Clear

BASE International Octal (IO8)



Viewed from free end of pins.

CONNEXIONS

Pin 1	No connection	NC
Pin 2	Heater	h
Pin 3	Anode	a
Pin 4	No connection	NC
Pin 5	Control Grid	g1
Pin 6	Shield Grid	g2
Pin 7	Heater	h
Pin 8	Cathode	k

Associated Electrical Industries Limited

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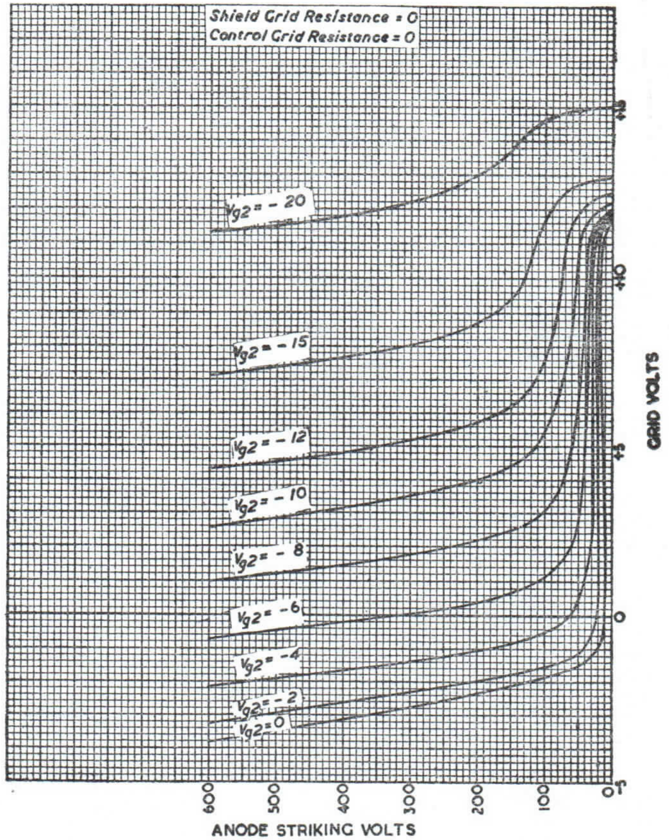
20A2

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

AVERAGE CHARACTERISTIC CURVES



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20A3

THYRATRON GAS TETRODE

Indirectly heated—for use as Gas Relay

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.6
Arc Voltage Drop (volts)		8
Maximum Forward Anode Volts	V_a	650
Maximum Peak Inverse Anode Voltage (volts)	P.I.V.(max)	1300
Maximum Shield Grid Voltage (volts)	V_{g2}(max)	-100
Maximum Control Grid Volts	V_{g1}(max)	-100
Maximum Peak Cathode Current (mA)	I_k(pk)max	500
Maximum Average Cathode Current (mA)	I_k(av)max	100
Control Grid Circuit Res. (Megohms)	R_{g1}	0.01-10.0
Control Ratio G1		250 *
Control Ratio G2		1000 †

* $V_{g2} = 0$ $R_{g1} = 0$

† $V_{g1} = 0$ $R_{g1} = 0$ $R_{g2} = 0$

IMPORTANT

i) Heater to cathode voltage must never exceed 25 volts peak.

ii) The heater must be switched on for 10.sec min before anode voltage is applied.

iii) All maximum ratings are absolute values, not design centres.

DIMENSIONS

Overall Length Maximum (mm)	54
Maximum Diameter (mm)	19
Maximum Seated Height (mm)	47.5
Approximate Nett Weight (ozs)	¼
Approximate Packed Weight (ozs)	½

MOUNTING POSITION - Unrestricted.

Associated Electrical Industries Limited

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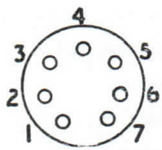
20A3

THYRATRON GAS TETRODE

Indirectly heated—for use as Gas Relay

BASE - Miniature Button 7, pin B7G.



Viewed from free end of pins.

CONNEXIONS

Pin 1	Grid 1	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Grid 2	g2
Pin 6	Anode	a
Pin 7	Grid 2	g2

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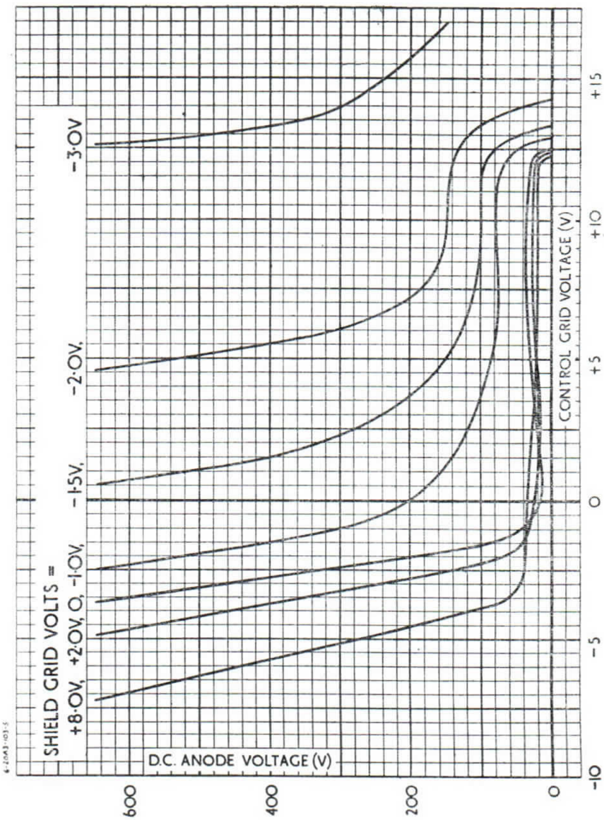
20A3

THYRATRON GAS TETRODE

Indirectly heated—for use as Gas Relay

AVERAGE CHARACTERISTIC CURVES: V_a/V_g

$R_{g1}=0$ $R_{g2}=0$



Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

21A1

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

GENERAL

The 21A1 is a Gas Filled Tetrode intended for use as a Half Wave Grid Controlled Rectifier at altitudes up to 55,000 feet.

RATING

Heater Voltage (volts)	V_h	6·3
Heater Current (amps)	I_h	0·95
Arc Voltage Drop (volts)		9·0
Maximum Peak Forward Anode Voltage (volts)	V_a (max)	600*
Maximum Peak Inverse Anode Voltage (volts)	PIV (max)	1,300*‡
Maximum Shield Grid Voltage (Before Anode Conduction) (volts)	V_{g2} (max)	—100‖
Maximum Control Grid Voltage (Before Anode Conduction) (volts)	V_{g1} (max)	—100‖
Maximum Peak Cathode Current (mA)	$I_{k(pk)}$ max	1,250
Maximum Mean Cathode Current (mA)	$I_{k(av)}$ max	250†
Maximum Mean Positive Control Grid Current (mA)	$I_{g1(av)}$ max	5†§
Control Grid Series Resistance (megohms)	R_{g1}	0·01 to 10
Maximum Peak Heater to Cathode Voltage (Heater Positive) (volts)	$V_{h-k(max)}$	25
Maximum Peak Heater to Cathode Voltage (Heater Negative) (volts)	$V_{h-k(max)}$	100
Ambient Temperature Range (C°)		—50 to +90

NOTES—See overleaf

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

21A1

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

NOTES

The heater must be switched on for 15 seconds minimum before the application of anode voltage.

* Maximum ratings are Absolute Values not Design Centres and apply at air pressure corresponding to an altitude of 55,000 feet and up to a maximum supply frequency of 1·6kc/s.

‡ Under transient switching conditions and note (*) the Maximum Surge Peak Inverse Voltage is 2000V.

‖ Maximum Negative Voltage during Conduction is 10V.

† Maximum averaging time, 15 seconds.

§ Currents of this order may not be drawn when the anode is more negative than —10 volts.

DIMENSIONS

Maximum Overall Length	(mm)	85
Maximum Diameter	(mm)	33
Maximum Seated Height	(mm)	71
Approximate Nett Weight	(ozs)	$1\frac{1}{4}$
Approximate Packed Weight	(ozs)	2

MOUNTING POSITION—Unrestricted

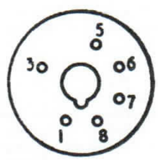
Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

21A1

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

BASE—International Octal (6 Pin)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater	h
Pin 2	No Pin	NP
Pin 3	Anode	a
Pin 4	No Pin	NP
Pin 5	Control Grid	g1
Pin 6	Shield Grid	g2
Pin 7	Heater	h
Pin 8	Cathode	k

Associated Electrical Industries Limited

Electronic Components Division

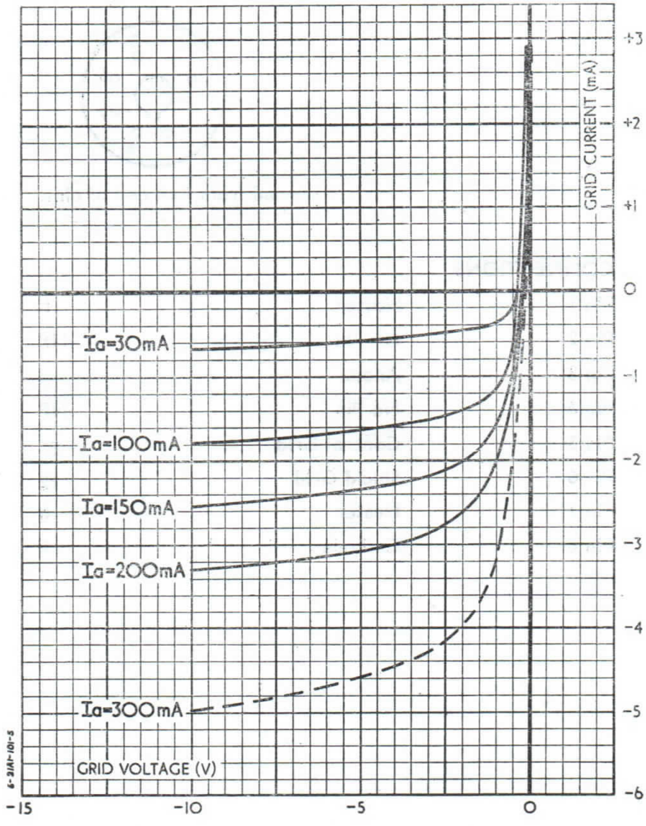
Tel.: GERrard 9797

21A1

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

AVERAGE CHARACTERISTIC CURVES : I_{g1}/V_{g1}



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Electronic Components Division
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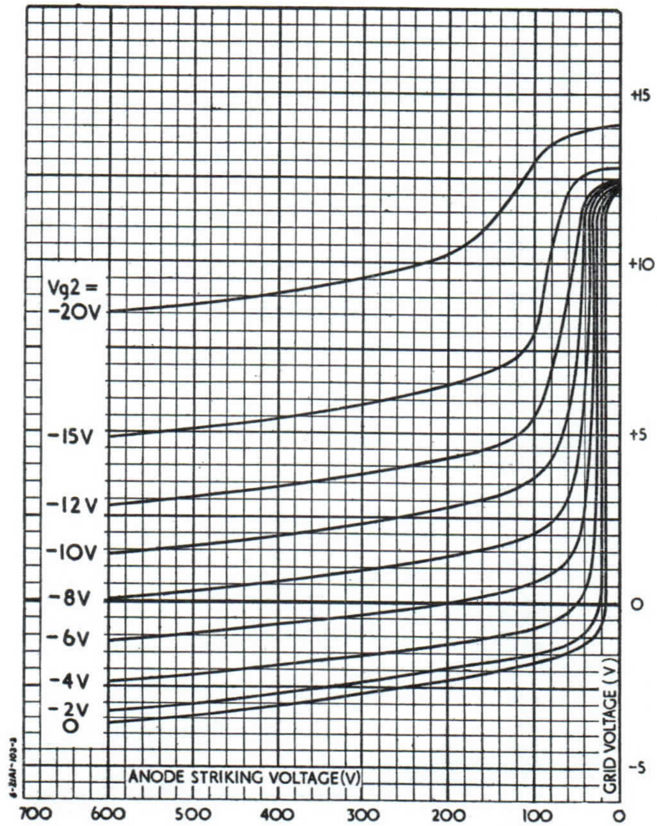
21A1

GAS FILLED TETRODE

Indirectly heated—for use as a Grid Controlled Rectifier

AVERAGE CHARACTERISTIC CURVES : $V_{a(ign)}/V_{g1}$
$R_{g1}=0\Omega \quad R_{g2}=0\Omega$



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AEI Inert Gas Filled Thyratron 21B12

GENERAL

The 21B12 is an inert gas filled thyratron suitable for welding or motor control. It has a directly heated oxide coated cathode.

RATINGS

Filament voltage	V_f	2·5	V
Filament current	I_f	9·0	A
Maximum peak forward anode voltage		1·0	kV
Maximum peak inverse anode voltage	$P.I.V._{max}$	1·25	kV
Maximum mean cathode current	$I_{k(av)max}$	2·5	A
Maximum peak cathode current	$i_{k(pk)max}$	30	A
Maximum surge cathode current (max duration 0·1 sec)		300*	A
Maximum negative grid voltage before conduction	$V_{g(max)}$	−300	V
Maximum negative grid voltage after conduction	$V_{g(max)}$	−10	V
Control ratio		200 : 1	
Maximum striking voltage for conduction		70	V
Voltage drop		12	V
Maximum grid resistance range		10—100†	kΩ
Ionisation time	t_i	10	μs
Deionisation time	t_d	1000	μs
Commutation factor (V/μs × A/μs)		0·7	
Ambient temperature range		−55 to +75	°C

* Recommended anode fuse = 6A. Maximum anode fuse = 10A.
† Recommended value = 33kΩ.

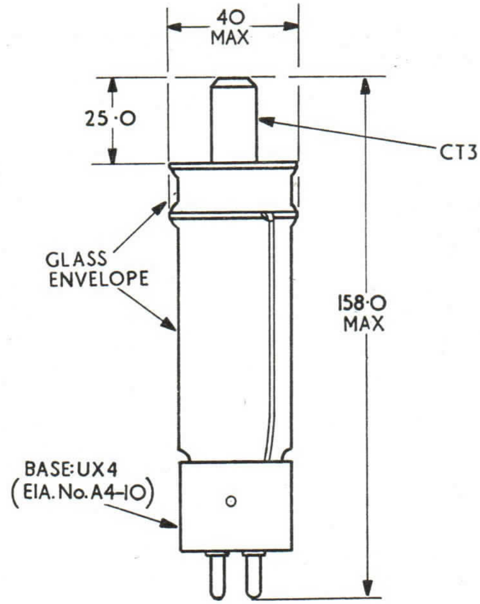
INTER-ELECTRODE CAPACITANCES

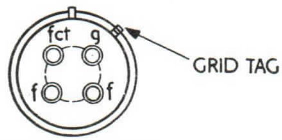
Anode/grid	c_{a-g}	3·8	pF
Anode/filament	c_{a-f}	0·15	pF
Grid/filament	c_{g-f}	2·5	pF

MOUNTING POSITION—Unrestricted

Associated Electrical Industries Limited
Radio Components Department
Tel : GERrard 9797

Inert Gas Filled Thyratron





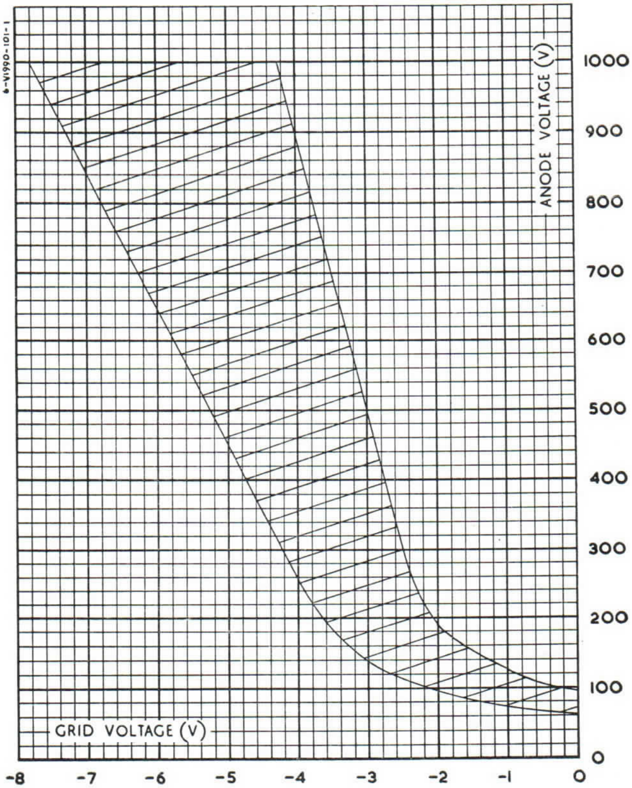
TOP CAP-ANODE

VIEW OF FREE END.

6–21B12-90-1

All dimensions in millimetres

CHARACTERISTIC CURVES : V_a/V_g



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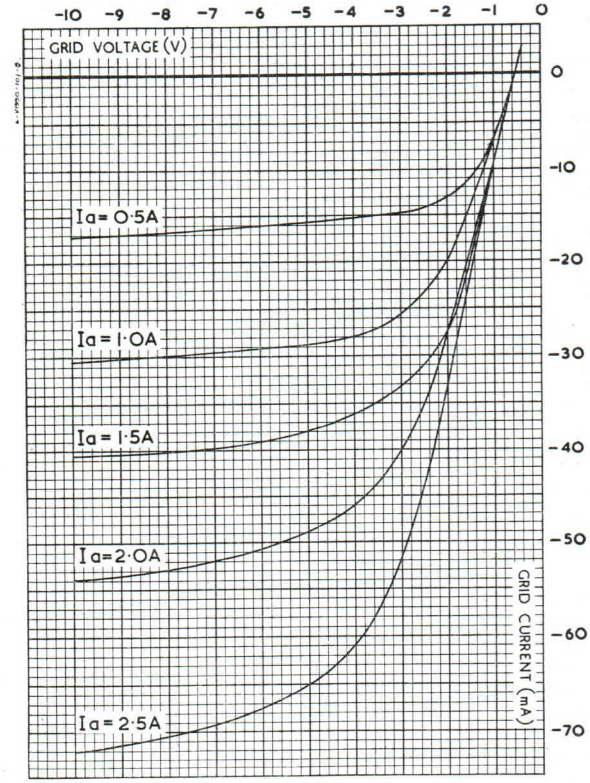
CHARACTERISTIC CURVES : I_g/V_g



21B13

INERT GAS FILLED THYRATRON

TENTATIVE

GENERAL

The 21B13 is a xenon filled thyratron suitable for welding, motor control and other power applications. It has an indirectly heated oxide-coated cathode.

RATING

Heater voltage	V_h	5·0	V
Heater current	I_h	21	A
Maximum peak forward anode voltage		1·2	kV
Maximum peak inverse anode voltage	P.I.V.(max)	1·2	kV
Maximum mean cathode current (max averaging time 15 sec)	$I_{k(av)max}$	10*	A
Maximum peak cathode current	$i_{k(pk)max}$	100	A
Maximum surge cathode current (max duration 0·1 sec)		2000	A
Maximum anode voltage drop		18	V
Maximum anode voltage for conduction		70	V
Maximum negative grid voltage before conduction		–200	V
Maximum negative grid voltage after conduction		–10	V
Maximum grid resistance	$R_{g(max)}$	50	kΩ
Recommended minimum grid resistance	$R_{g(min)}$	10	kΩ
Minimum pre-heat time		120	s
Ambient temperature range		–55 to +75°C	

* The anode structure must be left free, to ensure adequate cooling by free convection.

INTER-ELECTRODE CAPACITANCES

Anode/grid	c_{a-g}	8·8	pF
Anode/cathode	c_{a-k}	0·15	pF
Grid/cathode	c_{g-k}	13·4	pF

CHARACTERISTICS

Approximate ionization time	10	μs
Approximate recovery time (V_g=–200V)	50	μs
Approximate recovery time (V_g=–10V)	500	μs
Critical grid current (at V_a=1kV)	<20	μA
Control ratio	200 : 1	

Associated Electrical Industries Limited
Electronic Components Division
Tel: GERrard 9797

21B13

INERT GAS FILLED THYRATRON

TENTATIVE

MOUNTING POSITION—Vertical, base down

DIMENSIONS

Maximum overall length	230 mm
Maximum diameter over bulb	70 mm
Maximum diameter over connectors	115 mm

CAP—$\frac{9}{16}''$ diameter

BASE—Special

CONNECTIONS

Anode—Cap
Grid—Flexible lead from body of valve
Heater—Copper strip on base with 2BA slot
Heater and Cathode—Copper strip on base with 0BA clearing hole

Associated Electrical Industries Limited
Electronic Components Division
Tel: GERrard 9797

AEI Mercury Vapour Thyratron 21N12

GENERAL

The 21N12 is a convection cooled mercury vapour thyratron. It has an indirectly heated oxide coated cathode and is intended for use in power supplies and welding equipment, etc.

RATINGS—Absolute values

Heater voltage	V_h	$5{\cdot}0 \pm 5\%$	V
†Heater current (nominal)	I_h	5·0	A
Maximum peak forward anode voltage		10	kV
Maximum peak inverse anode voltage	$P.I.V._{max}$	10	kV
Maximum surge peak inverse voltage		20	kV
Maximum anode voltage drop		18	V
Maximum mean cathode current (max averaging 15 sec)	$I_{k(av)max}$	3·0	A
Maximum peak cathode current	$i_{k(pk)max}$	25	A
Maximum surge cathode current (0·1 sec)		250	A
Maximum grid resistance	$R_{g(max)}$	100	kΩ
Maximum supply frequency		150	c/s
Condensed mercury temperature limits	T_{Hg}	35 to 70	°C

† The heater must be switched on for a minimum of three minutes before the anode voltage is applied.

MOUNTING POSITION—Vertical, base down.

CHARACTERISTICS

Critical grid current (at $V_a = 6$kV)		<10	μA
Control ratio (nominal)		200 : 1	
Ionisation time (approx)	t_i	10	μs
De-ionisation time (approx)	t_d	1,000	μs

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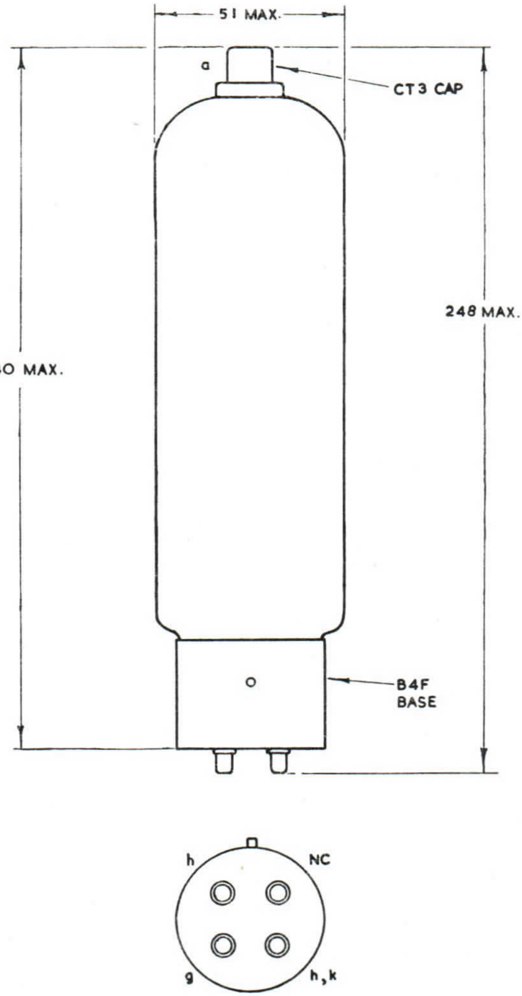
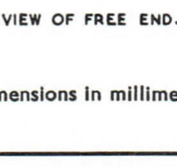
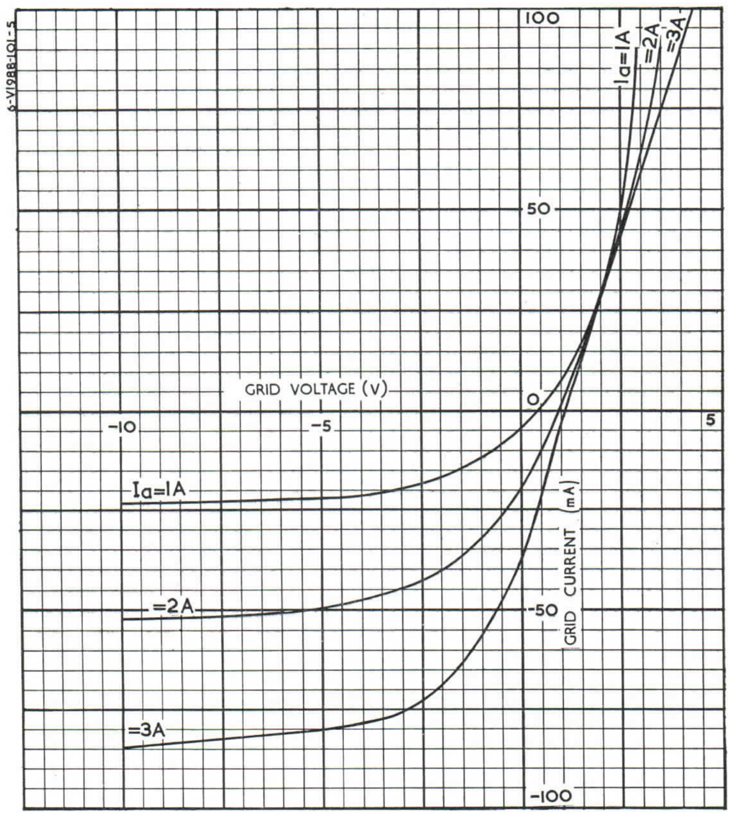




VIEW OF FREE END.

All dimensions in millimetres.

CHARACTERISTIC CURVES: I_g/V_g



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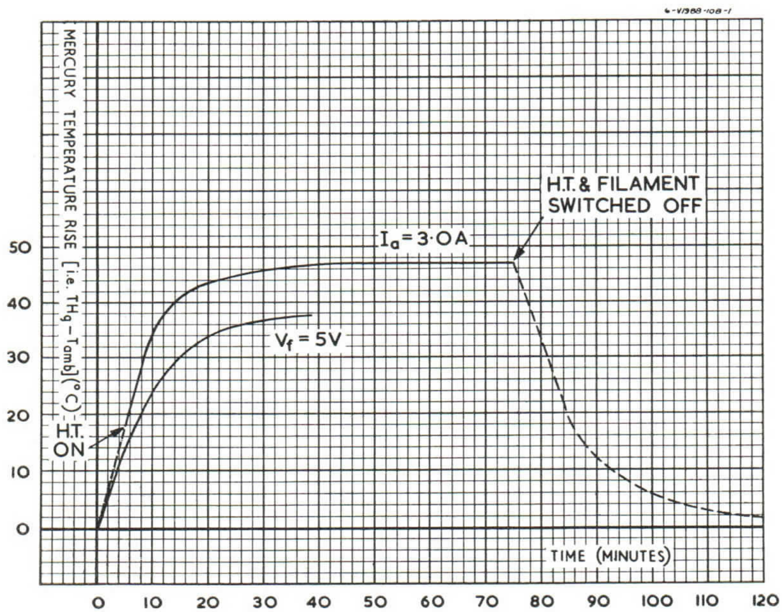
CHARACTERISTIC CURVES: T_{Hg}/t



AEI Mercury Vapour Thyratron 21N13

GENERAL

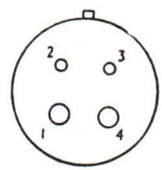
The 21N13 is a mercury vapour thyratron suitable for welding and motor control. It has an indirectly heated oxide coated cathode.

RATINGS

Heater voltage	V_h	5·0	V
Heater current	I_h	5·0	A
Maximum peak forward anode voltage		1·5	kV
Maximum peak inverse anode voltage	$P.I.V._{max}$	1·25	kV
Maximum negative grid voltage before conduction	$V_{g(max)}$	–500	V
Maximum negative grid voltage during conduction	$V_{g(max)}$	–10	V
Maximum mean cathode current (max averaging time 15 sec)	$I_{k(av)max}$	3·0	A
Maximum peak cathode current (25c/s and above)	$i_{k(pk)max}$	20	A
Maximum surge cathode current (fault protection max duration 0·1 sec)		200	A
Critical grid current (at $V_a = 1{\cdot}0$kV)		<10	μA
Maximum power supply frequency		150	c/s
Condensed mercury temperature limits	T_{Hg}	40 to 70°C	
Control ratio		150 : 1	
De-ionisation time (approx)	t_d	1000	μs
Ionisation time (approx)	t_i	10	μs
Anode voltage drop		16	V
Maximum grid resistance	$R_{g(max)}$	100	kΩ
Recommended minimum grid resistance	$R_{g(min)}$	10	kΩ

MOUNTING POSITION—Vertical, base down

BASE—UX4 (E.I.A. No. A4-10)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater	h
Pin 2	Heater, Cathode	h,k
Pin 3	Grid	g
Pin 4	Heater, Cathode	h,k
Cap	Anode	a

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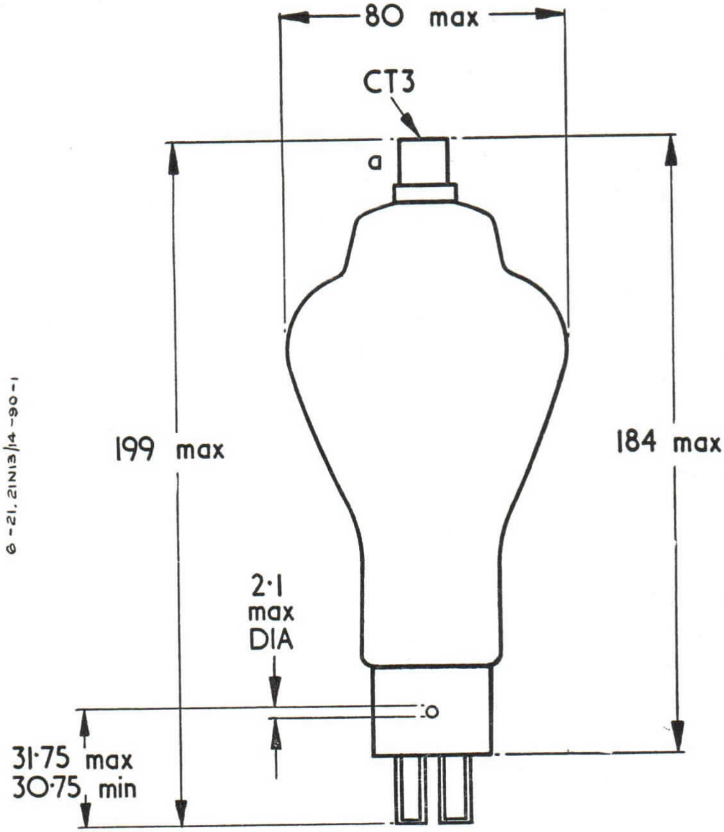
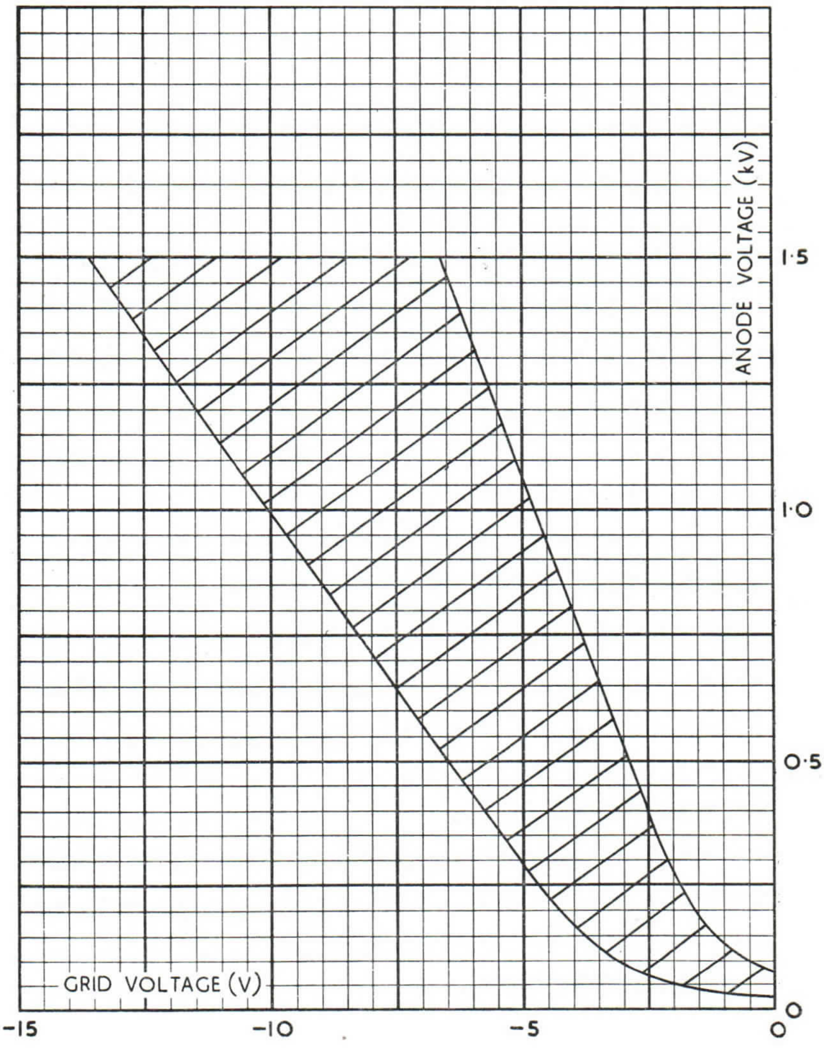


All dimensions in mm.

CHARACTERISTIC CURVES: V_a/V_g



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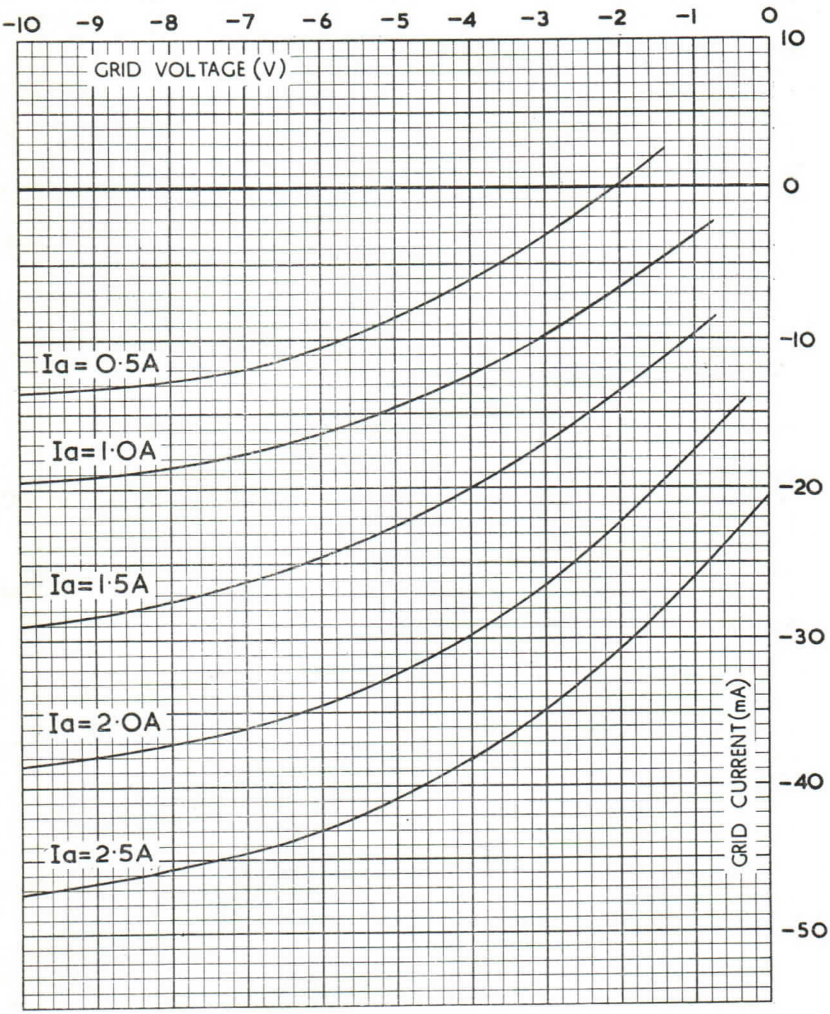
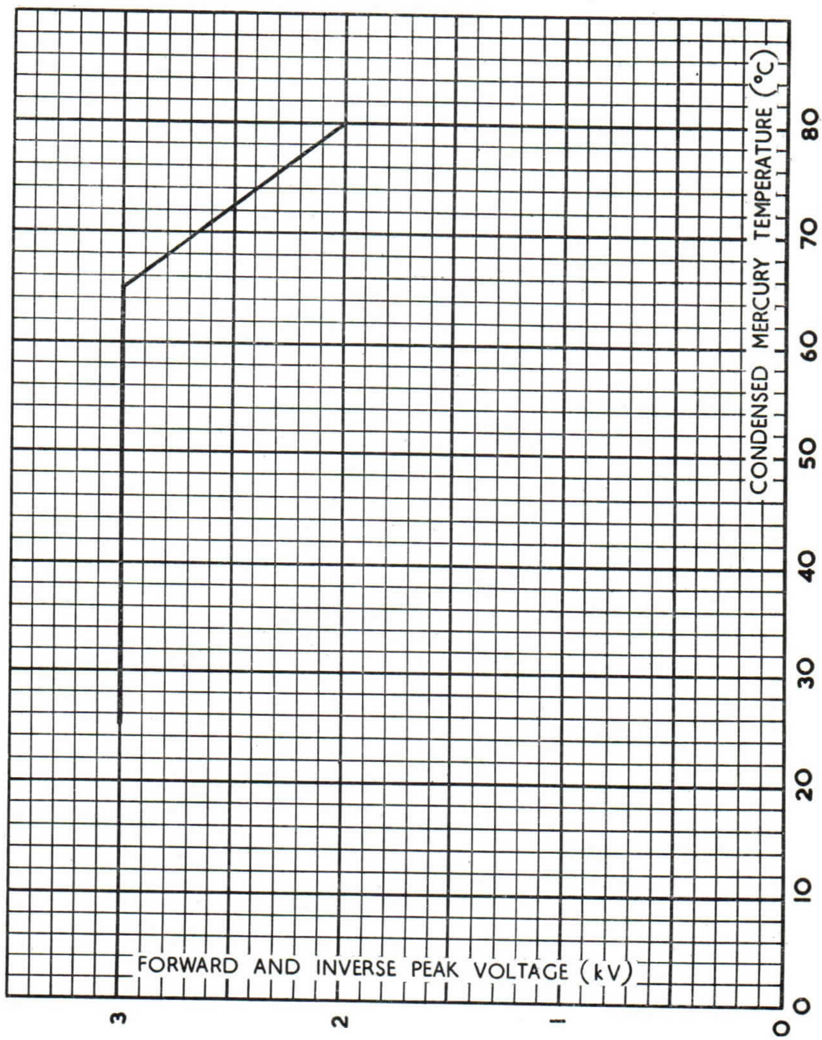
CHARACTERISTIC CURVES : I_g/V_g



RATING CURVE: Forward Voltage, P.I.V./T_{Hg} (Fault Conditions).



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AEI Mercury Vapour Thyratron 21N14

GENERAL

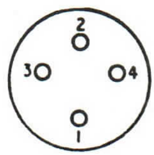
The 21N14 is a mercury vapour thyratron suitable for welding and motor control. It has an indirectly heated oxide-coated cathode.

RATINGS

Heater voltage	V_h	5·0	V
Heater current	I_h	5·0	A
Maximum peak forward anode voltage		1·5	kV
Maximum peak inverse anode voltage	P.I.V. $_{max}$	1·25	kV
Maximum negative grid voltage before conduction	$V_{g(max)}$	−500	V
Maximum negative grid voltage during conduction	$V_{g(max)}$	−10	V
Maximum mean cathode current (max averaging 15 sec)	$I_{k(av)max}$	3·0	A
Maximum peak cathode current (25c/s and above)	$i_{k(pk)max}$	20	A
Maximum surge cathode current (Fault protection max duration 0·1 sec)		200	A
Maximum critical grid current (at $V_a = 1{\cdot}0$kV)		<10	μA
Maximum power supply frequency		150	c/s
Condensed mercury temperature limits	T_{Hg}	40 to 75°C	
Control ratio		150 : 1	
De-ionisation time (approx)	t_d	1,000	μs
Ionisation time (approx)	t_i	10	μs
Anode voltage drop		16	V
Maximum grid resistance	$R_{g(max)}$	100	kΩ
Recommended minimum grid resistance	$R_{g(min)}$	10	kΩ

MOUNTING POSITION—Vertical, Base down

BASE—B4



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater, Cathode	h,k
Pin 2	Grid	g
Pin 3	Heater, Cathode	h,k
Pin 4	Heater	h
Cap	Anode	a

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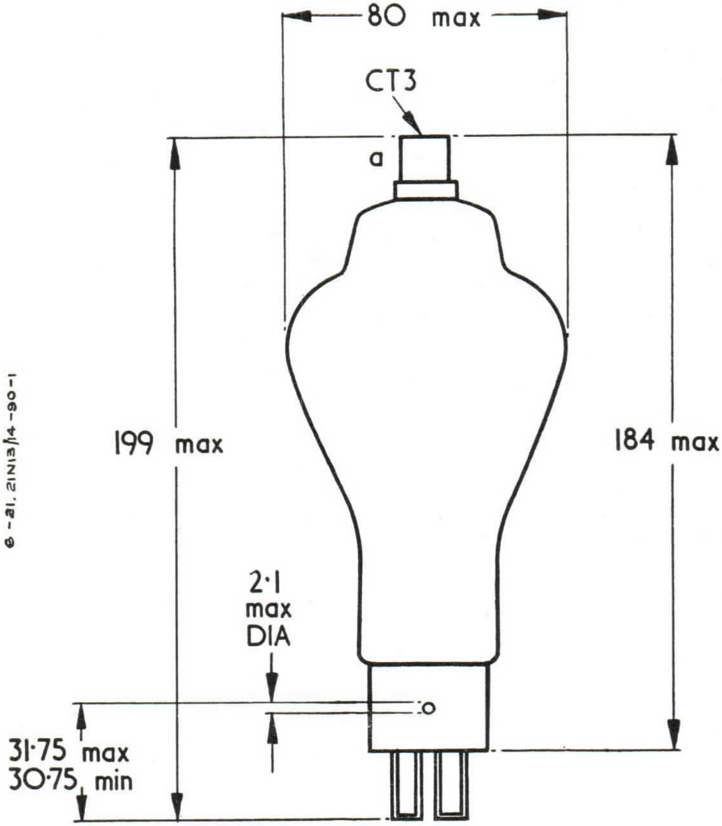
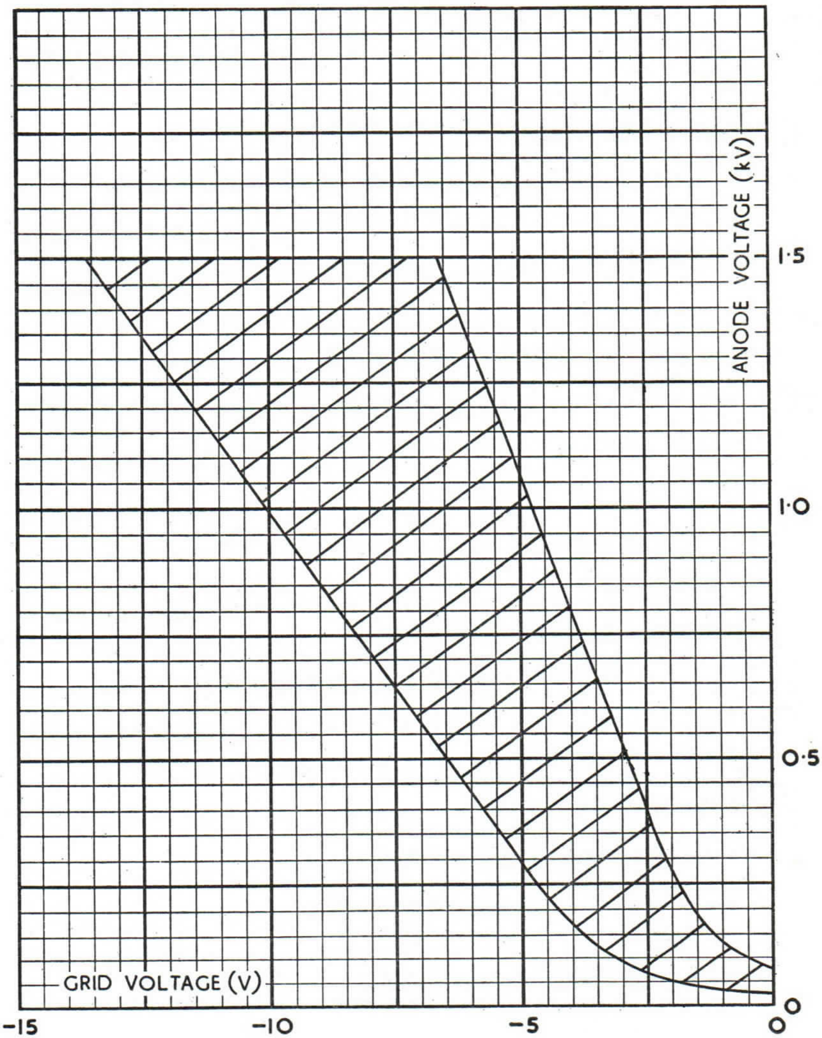


All dimensions in mm.

CHARACTERISTIC CURVES : V_a/V_g



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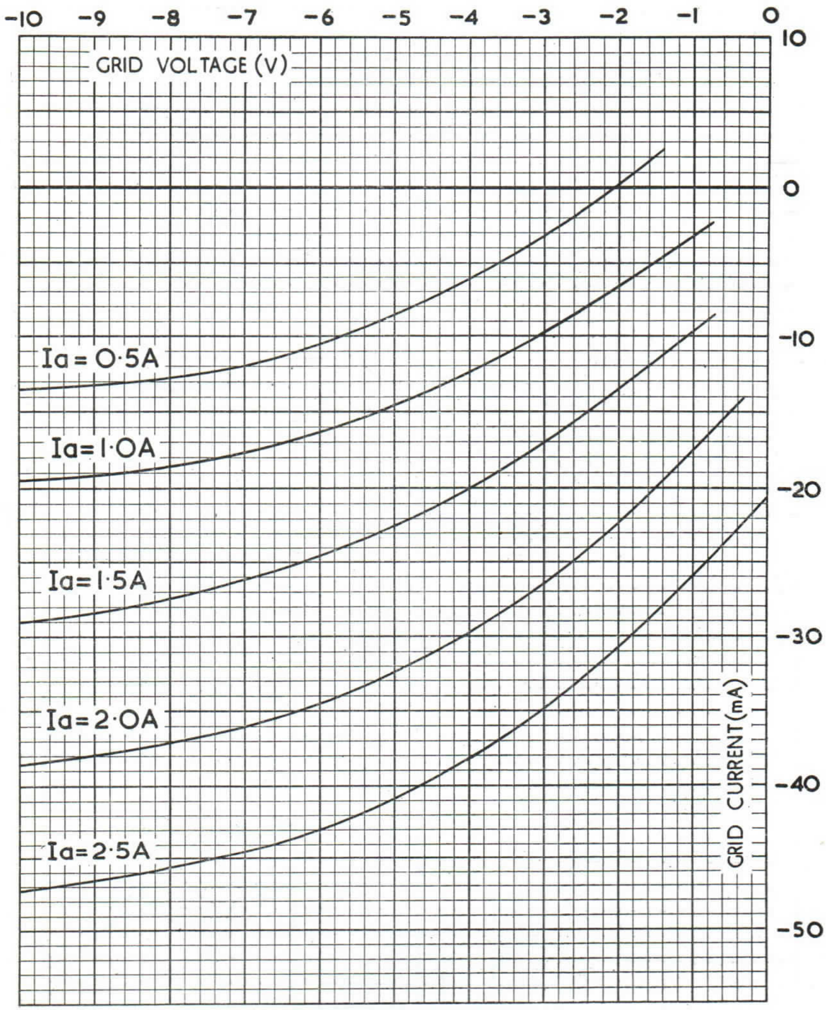
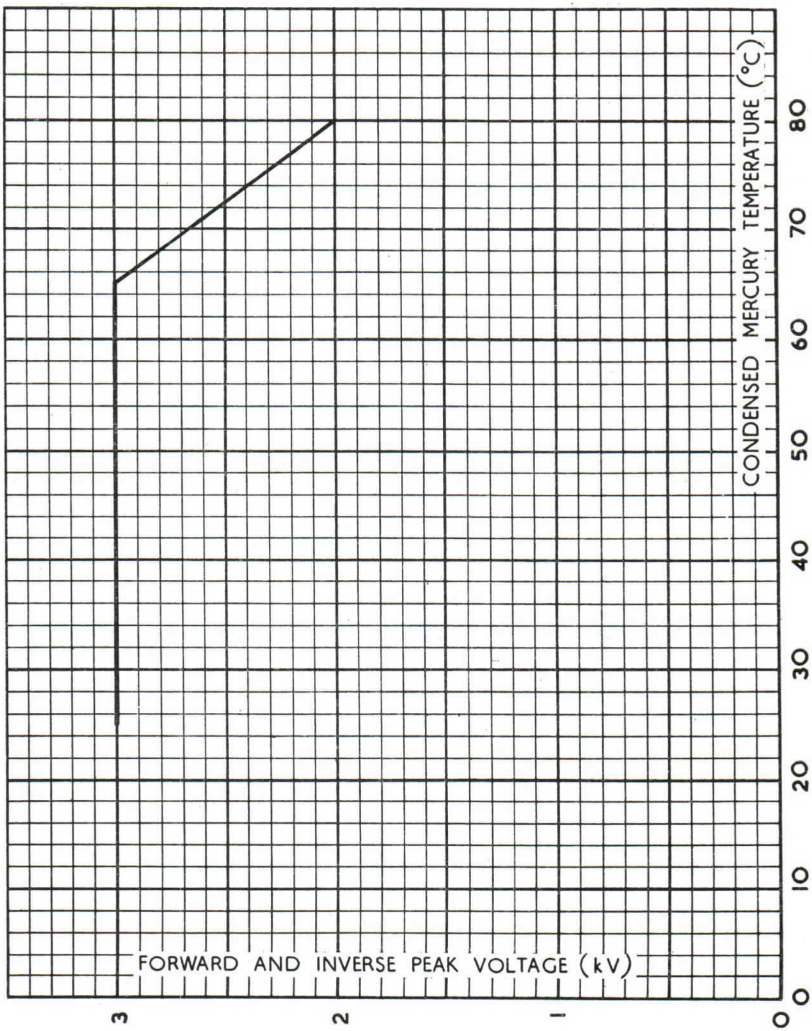
CHARACTERISTIC CURVES : I_g/V_g



RATING CURVE : Forward Voltage, P.I.V./T_{Hg} (Fault Conditions)



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21N15

MERCURY VAPOUR THYRATRON

Indirectly heated

GENERAL

The 21N15 is a Mercury Vapour Thyratron suitable for welding and motor control. It has an indirectly heated oxide coated cathode.

RATING

Heater Voltage	V_h	5·0	V
Heater Current	I_h	5·0	A
Maximum Peak Forward Anode Voltage		1·5	kV
Maximum Peak Inverse Anode Voltage	P.I.V.(max)	1·25	kV
Maximum Negative Grid Voltage (before Conduction)		500	V
Maximum Negative Grid Voltage (during Conduction)		10	V
Maximum Mean Cathode Current (maximum averaging 15 seconds)	$I_{k(av)max}$	3·0	A
Maximum Peak Cathode Current (25c/s and above)	$I_{k(pk)max}$	20	
Maximum Surge Cathode Current (Fault protection maximum duration 0·1 seconds)		200	A
Maximum Critical Grid Current (at $V_a = 1·0kV$)		<10	μA
Maximum Power Supply Frequency		150	c/s
Condensed Mercury Temperature Limits	T_{Hg}	40 to 75	°C
Control Ratio		150:1	
De-ionisation Time (approx)		1,000	μs
Ionisation Time (approx)		10	μs
Anode Voltage Drop		16	V
Maximum Grid Resistance	$R_{g(max)}$	100	kΩ
Recommended Minimum Grid Resistance	$R_{g(min)}$	10	kΩ

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

21N15

MERCURY VAPOUR THYRATRON

Indirectly heated

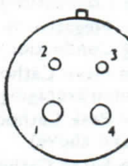
DIMENSIONS

Maximum Overall Length	199 mm
Maximum Diameter	57 mm
Maximum Seated Height	184 mm

MOUNTING POSITION—Vertical, Base down

CAP—CT3

BASE—UX4 (E.I.A. No. A4-10)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater	h
Pin 2	Heater, Cathode	h, k
Pin 3	Grid	g
Pin 4	Heater, Cathode	h, k
Cap	Anode	a

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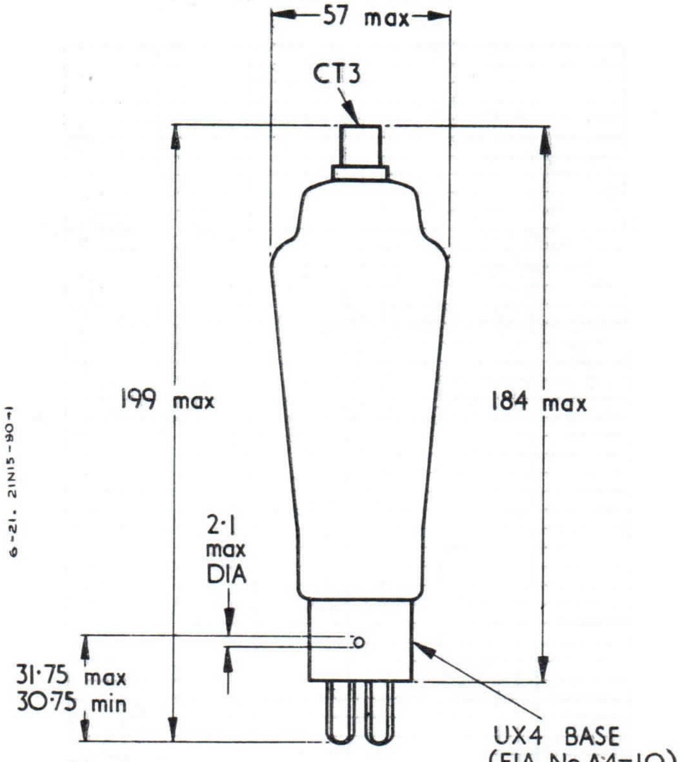
21N15
MERCURY VAPOUR THYRATRON
Indirectly heated



All dimensions in mm.

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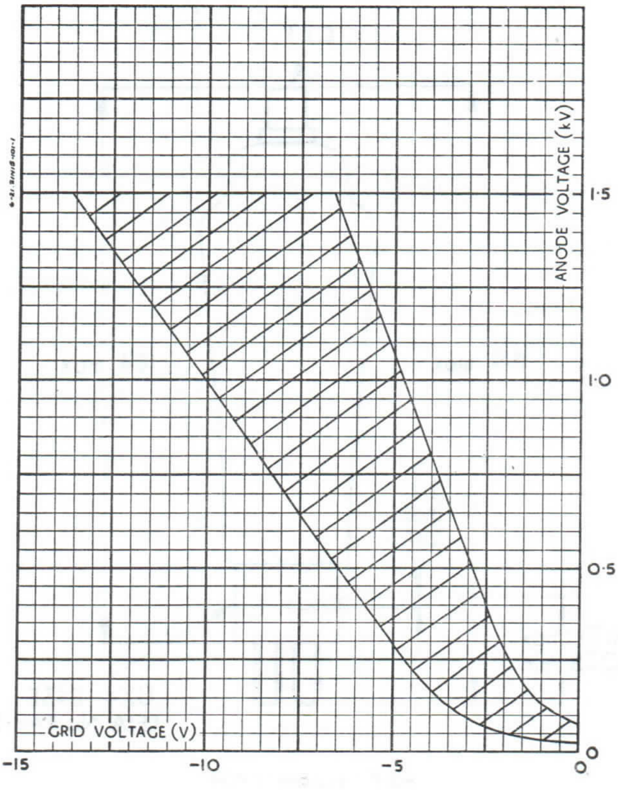
Electronic Components Division
Tel.: GERRARD 9797

21N15

MERCURY VAPOUR THYRATRON

Indirectly heated

CHARACTERISTIC CURVES: V_a/V_g



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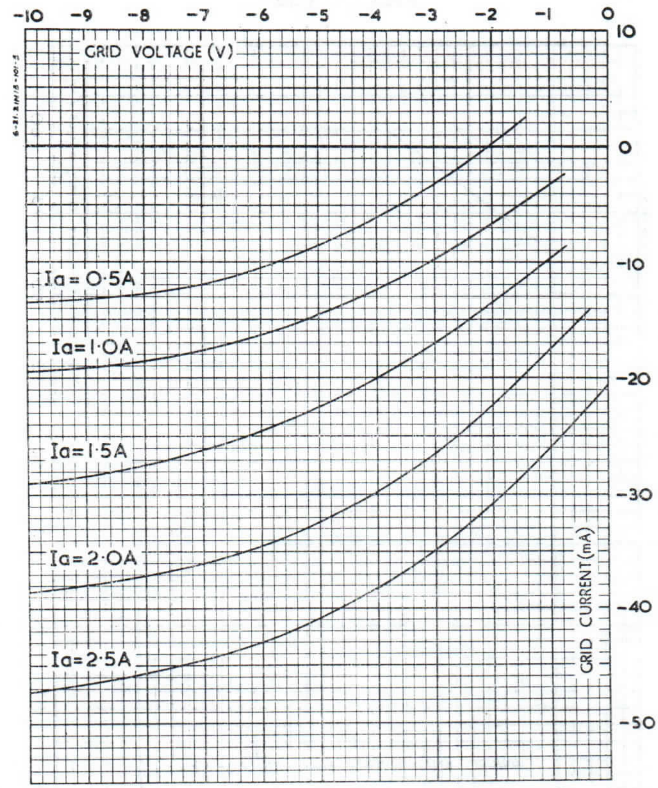
21N15

MERCURY VAPOUR THYRATRON

Indirectly heated

CHARACTERISTIC CURVES: I_g/V_g



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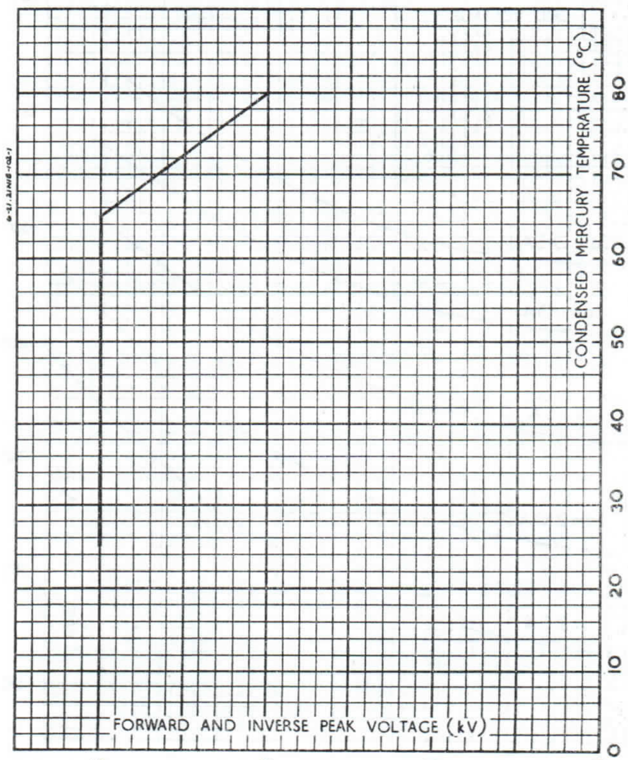
21N15

MERCURY VAPOUR THYRATRON

Indirectly heated

RATING CURVE: Forward Voltage, P.I.V./T_{Hg}

Fault Conditions



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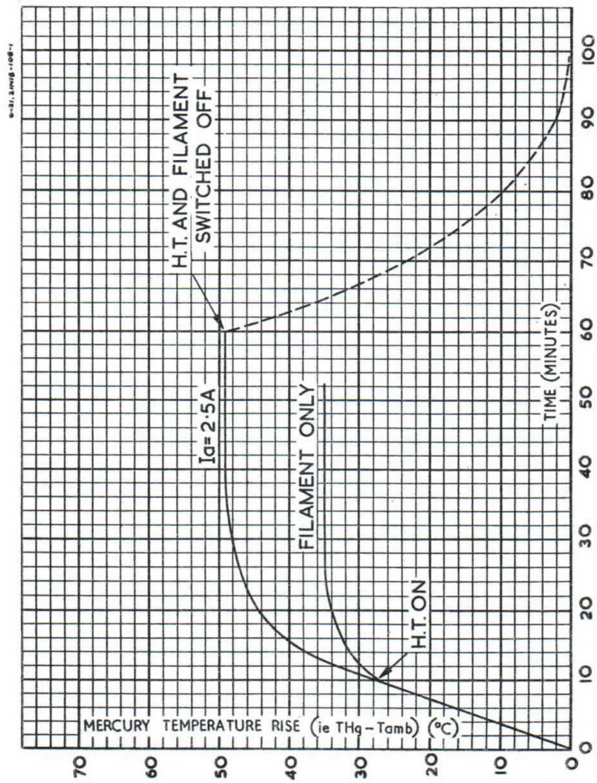
21N15

MERCURY VAPOUR THYRATRON

Indirectly heated

CHARACTERISTIC CURVES: T_{Hg}/t



Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERRARD 9797

Special Quality
Valves

S2P20

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

GENERAL

The S2P20 can withstand continuous vibration at an acceleration of 2·5g. and a short duration shock of 500g. Further interesting design features are as follows:

Miniature construction for Portable equipment.
For use as an R.F. Power Amplifier up to 100Mc/s
R.F. Power, Single ended ... ... $>$2·4W
R.F. Power, Parallel or Push Pull ... ... $>$4·8W
Designed to operate with a low H.T. Voltage of 150V.
Centre tapped Filament for Series or Parallel operation.

RATING—Absolute Values.

		Series	Parallel	
Filament Voltage	V_f	5·0	2·5	V
Filament Current	I_f	0·23	0·46	A
Maximum Anode Dissipation	$P_{a(max)}$	5		W
Maximum Screen Dissipation	$P_{g2(max)}$	2		W
Maximum Anode Voltage	$V_{a(max)}$	150		V
Maximum Screen Voltage	$V_{g2(max)}$	150		V
Maximum Operating Frequency	$f_{(max)}$	100		Mc/s
Maximum Shock (short duration)	(g)	500		
Maximum Acceleration (continuous operation)	(g)	2·5		

INTER-ELECTRODE CAPACITANCES (pF)†

Anode/Grid 1	$c_{a\text{-}g1}$	$<$0.17
Grid 1/Earth	c_{in}	8·5
Anode/Earth	c_{out}	6·6

† Measured with fully shielded socket, without can and skirt.

DIMENSIONS

Maximum Overall Length	67·5mm
Maximum Diameter	22·2mm
Maximum Seated Height	60·5mm

MOUNTING POSITION—Unrestricted.

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

S2P20

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

LIMITS OF CHARACTERISTICS

The test limits are for guidance in equipment design. The quality is controlled statistically to ensure that only a small percentage are outside these limits. The quality control levels are related to the importance of the characteristic being tested.

TEST	CONDITIONS $V_{f(dc)}$ (V)	V_a* (V)	V_{g2}* (V)	V_{g1}* (V)	V_{bp}* (V)	LIFE PERIOD	LIMITS MIN.	LIMITS MAX.	UNITS
Filament Current	5	·	·	·	·	Initial	0·21	0·25	A
Anode Current	5	150	150	−10	0	Initial	21	35	mA
Screen Current	5	150	150	−10	0	Initial	·	4	mA
Mutual Conductance	5	150	150	−10	0	Initial	3·2	5·4	mA/V
Grid No. 1 Cut-off Voltage ($I_a = 2mA$)	5	150	150	·	0	Initial	·	−25	V
Peak Anode Current († $V_{a(b)} = 120V$, $R_L = 320\Omega$, $V_{sig} = 20V_{rms}$, $R_{g1} = 22K\Omega$)	5	·	120	·	0	Initial	110	·	mA
						250 hrs.	100	·	mA
Change in Peak Anode Current	4·5	·	120	·	0	Initial	·	25	mA
Change in Peak Anode Current	5	·	120	·	0	Initial to 1 hr.	·	20	%
Reverse Grid Current	5	150	150	−10	0	Initial	·	2	μA
						250 hrs.	·	4	μA

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SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

LIMITS OF CHARACTERISTICS, cont.

Interelectrode Leakage Resistance									
V_{g1} to all = −100V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
V_{g2} to all = −300V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
V_a to all = −300V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
V_{bp} to all = −300V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
Vibration Noise Output Voltage‡ $V_{a(b)}$ = 150V, R_L = 2KΩ	5	·	150	−10	0	Initial	·	500	mV_{rms}
Life Test Conditions									
Adjust Grid No. 1 Voltage to give I_a = 33mA	5 (rms)	150	150	·	0				
Capacitances measured in fully shielded socket, without can and skirt.	Electrodes g1 to E						6·5	10·5	pF
	a to E						5·6	7·6	pF
	a to g1						·	0·17	pF

* Voltages measured with respect to filament negative (pin 4).

† All power supplies shall have negligible impedance to operating frequency. Grid signal impedance shall be less than 5 ohms ; voltage sinusoidal.

‡ Preheat for 15 minutes before test at Anode Current test conditions.

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SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

SPECIAL TESTS

Glass Envelope Strain Test

A statistical sample is tested to control glass quality. No voltages are applied to the electrodes.
The valves are completely immersed in boiling water at a temperature between 97°C and 100°C for 15 seconds and then immediately plunged into ice cold water for 5 seconds. The valves are then examined for glass cracks.

Base Strain Test

A statistical sample is tested to control base strain. No voltages are applied to the electrodes.
The pins of the valves are forced over a specified cone, valves and cones are then completely submerged in boiling water at a temperature between 97°C and 100°C for 10 seconds. The valves and cones are allowed to cool to room temperature on a wooden support before examining for glass cracks.

Fatigue Test

A statistical sample is tested to control heater failures and other mechanical defects. The heaters are successively run at 5V r.m.s. for one minute and switched off for 3 minutes, no other voltages applied.
The valves are rigidly mounted on a vibrating machine and vibrated for at least 100 hours, for not less than 30 hours in each of three mutually perpendicular planes at a frequency of 170 c/s with a minimum peak acceleration of 5g.

Shock Test

A statistical sample is tested to control mechanical defects likely to be caused by shock. No voltages are applied to the electrodes.
The valves are subjected to five blows of approximately 500g acceleration in each of four directions.

Holding Period—Inoperatives Control

After completing the test specification the valves are held for at least 28 days and are then retested to ensure that there has been no deterioration on storage.

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S2P20

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

CHARACTERISTICS

Filament Voltage	V_f	5	V
Anode Voltage	V_a	150	V
Screen Voltage	V_{g2}	150	V
Control Grid Voltage	V_{g1}	−10	V
Beam Plates Voltage	V_{bp}	0	V
Anode Current	I_a	28	mA
Screen Current	I_{g2}	2	mA
Mutual Conductance	g_m	4·3	mA/V

TYPICAL OPERATION—Class "C" Power Amplifier (at 70 Mc/s)

Anode Voltage	V_a	150	V
Screen Supply Voltage	$V_{g2(b)}$	150	V
Screen Feed Resistor	R_{g2}	3·9	kΩ
Anode Current	I_a	40	mA
Control Grid Current	I_{g1}	1	mA
Control Grid Voltage	V_{g1}	−22	V
Grid Bias Resistor	R_{g1}	22	kΩ
R.F. Power Output (min)	P_{out}	2·4	W

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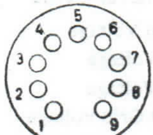
SPECIAL QUALITY BEAM TETRODE
Directly heated—for battery operation

BASE—B9A



Viewed from free end of Pins.

CONNECTIONS

Pin 1	Anode	a
Pin 2	No Connection	NC
Pin 3	Beam Plates	bp
Pin 4	Filament	f
Pin 5	Filament	f+
Pin 6	Grid 2	g2
Pin 7	Grid 1	gl
Pin 8	Beam Plates	bp
Pin 9	Filament Centre Tap	f_{ct}

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S2P21

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

TENTATIVE

GENERAL

The S2P21 can withstand continuous vibration at an acceleration of 2·5g and a short duration shock of 500g. Further interesting design features are as follows :

Miniature construction for portable equipment.

For use as an r.f. power amplifier up to	200 Mc/s
R.F. power, single ended	2·9 W
R.F. power, parallel or push pull	5·8 W

Designed to operate with a low h.t. voltage of 150V.

Centre tapped filament for series or parallel operation.

RATING—Absolute values

Filament voltage	V_f	2·5	5·0	V
Filament current	I_f	0·46	0·23	A
Maximum anode dissipation	$P_{a(max)}$		5·0	W
Maximum screen dissipation	$P_{g2(max)}$		2·0	W
Maximum anode voltage	$V_{a(max)}$		150	V
Maximum screen voltage	$V_{g2(max)}$		150	V
Maximum operating frequency	f_{max}		200	Mc/s
Maximum shock (short duration)			500	g
Maximum acceleration (continuous operation)			2·5	g

INTER-ELECTRODE CAPACITANCES*

Anode/Grid 1	$c_{a\text{-}g1}$	<0·13	pF
Grid 1/Earth	c_{in}	9·0	pF
Anode/Earth	c_{out}	4·5	pF

* Measured in fully-shielded socket, without can and skirt.

CHARACTERISTICS

Filament voltage	V_f	5·0	V
Anode voltage	V_a	150	V
Screen voltage	V_{g2}	150	V
Control grid voltage	V_{g1}	−10	V
Beam plates voltage	V_{bp}	0	V
Anode current	I_a	28	mA
Screen current	I_{g2}	2·0	mA
Mutual conductance	g_m	4·3	mA/V

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AEI

EDISWAN

S2P21

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

TENTATIVE

LIMITS OF CHARACTERISTICS

The test limits are for guidance in equipment design. The quality is controlled statistically to ensure that only a small percentage are outside these limits. The quality control levels are related to the importance of the characteristic being tested.

TEST	CONDITIONS $V_{f(dc)}$ (V)	V_a* (V)	V_{g2}* (V)	V_{g1}* (V)	V_{bp}* (V)	LIFE PERIOD	LIMITS MIN.	MAX.	UNITS
Filament current	5	·	·	·	·	Initial	0·21	0·25	A
Anode current	5	150	150	−10	0	Initial	21	35	mA
Screen current	5	150	150	−10	0	Initial	·	4	mA
Mutual conductance	5	150	150	−10	0	Initial	3·2	5·4	mA/V
Grid No. 1 cut-off voltage (I_a=2mA)	5	150	150	·	0	Initial	·	−25	V
Peak anode current († $V_{a(b)}$=120V, R_L=320Ω, V_{sig}=20V_{rms}, R_{g1}=22KΩ)	5	·	120	·	0	Initial	110	·	mA
						250 hrs.	100	·	mA
Change in peak anode current	4·5	·	120	·	0	Initial	·	25	mA
Change in peak anode current	5	·	120	·	0	Initial to 1 hr.	·	20	%
Reverse grid current	5	150	150	−10	0	Initial	·	2	μA
						250 hrs.	·	4	μA
Inter-electrode leakage resistance									
V_{g1} to all= −100V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
V_{g2} to all= −300V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
V_a to all= −300V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
V_{bp} to all= −300V	0	·	·	·	·	Initial	·	100	MΩ
						250 hrs.	·	50	MΩ
Vibration noise output voltage‡ $V_{a(b)}$=150V, R_L=2KΩ	5	·	150	−10	0	Initial	·	500	mV_{rms}
Life Test Conditions									
Adjust grid No. 1 voltage to give I_a=33mA	5 (rms)	150	150	·	0				
Capacitances measured in fully shielded socket, without can and skirt	Electrodes g1 to E						6·5	10·5	pF
	a to E						5·6	7·6	pF
	a to g1						·	0·17	pF

* Voltages measured with respect to filament negative (pin 4).

† All power supplies shall have negligible impedance to operating frequency. Grid signal Impedance shall be less than 5 ohms ; voltage sinusoidal.

‡ Preheat for 15 minutes before test at anode current test conditions.

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S2P21

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

TENTATIVE

SPECIAL TESTS

Glass Envelope Strain Test

A statistical sample is tested to control glass quality. No voltages are applied to the electrodes.

The valves are completely immersed in boiling water at a temperature between 97°C and 100°C for 15 seconds and then immediately plunged into ice cold water for 5 seconds. The valves are then examined for glass cracks.

Base Strain Test

A statistical sample is tested to control base strain. No voltages are applied to the electrodes.

The pins of the valves are forced over a specified cone, valves and cones are then completely submerged in boiling water at a temperature between 97°C and 100°C for 10 seconds. The valves and cones are allowed to cool to room temperature on a wooden support before examining for glass cracks.

Fatigue Test

A statistical sample is tested to control heater failures and other mechanical defects. The heaters are successively run at 5V r.m.s. for one minute and switched off for 3 minutes, no other voltages applied.

The valves are rigidly mounted on a vibrating machine and vibrated for at least 100 hours, for not less than 30 hours in each of three mutually perpendicular planes at a frequency of 170 c/s with a minimum peak acceleration of 5g.

Shock Test

A statistical sample is tested to control mechanical defects likely to be caused by shock. No voltages are applied to the electrodes.

The valves are subjected to five blows of approximately 500g acceleration in each of four directions.

Holding Period—Inoperatives Control

After completing the test specification the valves are held for at least 28 days and are then retested to ensure that there has been no deterioration on storage.

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S2P21

SPECIAL QUALITY BEAM TETRODE

Directly heated—for battery operation

TENTATIVE

TYPICAL OPERATION—Class C power amplifier at 70 Mc/s.

Anode voltage	V_a	150	V
Screen supply voltage	$V_{g2(b)}$	150	V
Screen feed resistor	R_{g2}	5·0	kΩ
Anode current (approx)	I_a	40	mA
Control grid current	I_{g1}	0·7	mA
Control grid voltage	V_{g1}	−15·4	V
Grid bias resistor	R_{g1}	22	kΩ
R.F. power in load (average)	P_L	2·9	W

TYPICAL OPERATION—Class C power amplifier at 200 Mc/s

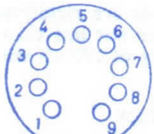
Anode voltage	V_a	150	V
Screen supply voltage	$V_{g2(b)}$	150	V
Screen feed resistor	R_{g2}	17	kΩ
Anode current (approx)	I_a	40	mA
Control grid current	I_{g1}	1·0	mA
Control grid voltage	V_{g1}	−22	V
Grid bias resistor	R_{g1}	22	kΩ
R.F. power in load (average)	P_L	1·9	W

DIMENSIONS

Maximum overall length	67·5	mm
Maximum diameter	22·2	mm
Maximum seated height	60·5	mm

MOUNTING POSITION—Unrestricted.

BASE—Noval (B9A)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Anode	a
Pin 2	Anode	a
Pin 3	Anode	a
Pin 4	Filament	f
Pin 5	Filament	f+
Pin 6	Grid 2	g2
Pin 7	Grid 1	g1
Pin 8	Beam Plates	bp
Pin 9	Filament Centre Tap	fct

Associated Electrical Industries Limited
Electronic Components Department
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S6F12

SPECIAL QUALITY H.F. PENTODE

Indirectly heated—for parallel operation

TENTATIVE

GENERAL

The S6F12 is a Special Quality H.F. Pentode having characteristics similar to the 6F12, and is intended for use in AC or DC powered equipment having parallel connected heater chains. A special shock resistant construction is employed which gives increased reliability and life expectancy.

Quality tests are performed on electrical characteristics, vibration noise, base strain, glass strain, electrode resonance, vibration fatigue, shock resistance, heater cycling, stability and life.

The characteristic curves of the S6F12 are similar to those of the 6F12.

RATING

Heater Voltage	(volts)	V_h	6.3
Heater Current	(amps)	I_h	0.3
Maximum Anode Voltage	(volts)	$V_{a(max)}$	300
Maximum Screen Voltage	(volts)	$V_{g2(max)}$	300
Maximum Anode Dissipation	(watts)	$p_{a(max)}$	3.0
Maximum Screen Dissipation	(watts)	$p_{g2(max)}$	0.9
Maximum Heater to Cathode Voltage	(volts DC)	$V_{h\text{-}k(max)}$	150
Maximum Grid 1 to Cathode Resistance (cathode bias)	(MΩ)	$R_{g1\text{-}k(max)}$	0.5*
Mutual Conductance	(mA/V)	g_m	7.5**
Inner Mu		$\mu_{g1\text{-}g2}$	75**
Maximum Shock (short duration)	(g)		500
Maximum Acceleration (continuous operation)	(g)		2.5
Maximum Bulb Temperature	(°C)		200

* Maximum value for fixed bias operation = 100kΩ.

** $V_a = V_{g2} = 250$ v ; $I_a = 10$ mA ; $I_{g2} = 2.5$ mA ; $V_{g1} = -2$v.

All maximum ratings are Absolute Values not Design Centres.

Associated Electrical Industries Limited

Electronic Components Division

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S6F12

SPECIAL QUALITY H.F. PENTODE

Indirectly heated—for parallel operation

TENTATIVE

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid 1	$c_{a\text{-}g1}$	0.008†
Anode-Earth	c_{out}	3.25††
Grid 1/Earth	c_{in}	7.6 ††

† Total capacity including a Benjamin B7G holder type 75/833 and cylindrical screen can 75/832.

†† Inter-electrode capacity with holder capacity balanced out but with cylindrical screen can.

" Earth " denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Maximum Overall Length	(mm)	54.5
Maximum Diameter	(mm)	19
Maximum Seated Height	(mm)	47.5
Approximate Nett Weight	(ozs)	¼
Approximate Packed Weight	(ozs.)	½

MOUNTING POSITION—Unrestricted.

TYPICAL OPERATION

Anode Voltage	(volts)	V_a	250
Screen Voltage	(volts)	V_{g2}	250
Grid Bias Voltage	(volts)	V_{g1}	−2
Anode Current	(mA)	I_a	10
Screen Current	(mA)	I_{g2}	2.5

BULB—Clear.

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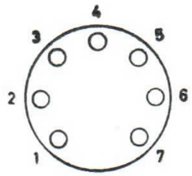
S6F12

SPECIAL QUALITY H.F. PENTODE

Indirectly heated—for parallel operation

TENTATIVE

BASE—B7G



Viewed from free end of pins.

CONNECTIONS

Pin 1	Control Grid	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Suppressor Grid	g3
Pin 7	Screen Grid	g2

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S6F17

SPECIAL QUALITY PULSE AND R.F. TETRODE

Indirectly heated — for parallel operation

TENTATIVE

GENERAL

The S6F17 is a Special Quality Beam Tetrode intended for pulse and R.F. amplification, and has characteristics similar to the 6F17. It is intended for use in AC or DC powered equipment having parallel connected heater chains. A special shock resistant construction is employed which gives increased reliability and life expectancy.

Quality tests are performed on electrical characteristics, vibration noise, base strain, glass strain, electrode resonance, vibration fatigue, shock resistance, heater cycling, stability and life.

RATING

Heater Voltage	(volts)	V_h	6.3
Heater Current	(amps)	I_h	0.3
Maximum Anode Voltage	(volts)	$V_{a(max)}$	600
Maximum Screen Voltage	(volts)	$V_{g2(max)}$	600
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	3.5
Maximum Screen Dissipation	(watts)	$P_{g2(max)}$	0.7
Maximum Heater-Cathode Voltage	(volts)	$V_{h-k(max)}$	100
Mutual Conductance	(mA/V)	g_m	8.3*
Maximum Bulb Temperature	(°C)		165‡
Maximum Shock (Impact)	(g)		500
Maximum Acceleration (Continuous)	(g)		2.5

* $V_a = V_{g2} = 250$ v ; $I_a = 64$ mA ; $V_{g1} = -6.25$ v. Pulse conditions.

‡ Reliability will be seriously impaired if the maximum bulb temperature is exceeded.

All maximum ratings are Absolute Values not Design Centres.

Associated Electrical Industries Limited

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S6F17

SPECIAL QUALITY PULSE AND R.F. TETRODE

Indirectly heated—for parallel operation

TENTATIVE

NOTE

The life expectancy may be reduced if conditions other than those used for life test are imposed on the valve and will be reduced appreciably if maximum ratings are exceeded. Life test values are : $V_a = 250$ v ; $V_{g2} = 200$ v ; $V_{h-k} = 100$ v ; $R_{g1} = 500$ kilohms ; $R_k = 1$ kilohm. Reliability and performance will be adversely affected if heater voltage ratings are exceeded, life and reliability being directly related to the degree with which the heater voltage is maintained at its centre rated value.

INTER-ELECTRODE CAPACITANCES (pF)

Grid 1/Earth	c_{in}	6.2
Anode/Earth	c_{out}	5.2
Grid 1/Anode	c_{a-g1}	0.03

Capacitances measured with screen can but with holder capacity balanced out.

" Earth " denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Maximum Overall Length	(mm)	54.5
Maximum Diameter	(mm)	19.0
Maximum Seated Height	(mm)	47.5
Approximate Nett Weight	(ozs)	$\frac{1}{4}$
Approximate Packed Weight	(ozs.)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted

BULB—Clear

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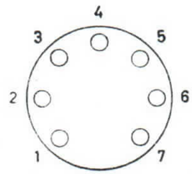
S6F17

SPECIAL QUALITY PULSE AND R.F. TETRODE

Indirectly heated — for parallel operation

TENTATIVE

BASE—B7G.



Viewed from free end of pins.

CONNECTIONS

Pin 1	Grid 1	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Beam Plates	bp
Pin 7	Grid 2	g2

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S6F17F

SPECIAL QUALITY PULSE BEAM TETRODE

Indirectly heated

GENERAL

The S6F17F is an indirectly heated, special quality, pulse beam tetrode with flying leads, for use in pulse and r.f. amplifiers where dependable performance is required under shock and vibration conditions.

A special shock resistant construction is employed which gives increased reliability and life expectancy.

Quality tests are performed on electrical characteristics, vibration noise, lead fragility, glass strain, electrode resonance, vibration fatigue, shock resistance, heater cycling, stability and life.

RATING‡

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A
Maximum Anode Voltage	$V_{a(max)}$	600	V
Maximum Screen Voltage	$V_{g2(max)}$	600	V
Mutual Conductance	g_m	8·3*	mA/V
Maximum Anode Dissipation	$P_{a(max)}$	3·5†	W
Maximum Screen Dissipation	$P_{g2(max)}$	0·7	W
Maximum Heater/Cathode Voltage d.c.	$V_{h\text{-}k(max)}$	100	V
Maximum Bulb Temperature	$T_{bulb(max)}$	165	°C
Maximum Shock (short duration)		500	g
Maximum Acceleration (continuous operation)		2·5	g

* $V_a = V_{g2} = 250V$, $V_{g1} = -6{\cdot}25V$. Tested under pulse conditions.

† If used in a can at maximum rating, the can must be matt black both internally and externally.

‡ All limiting values are Absolute Values, not Design Centres.

Associated Electrical Industries Limited

Electronic Components Division

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S6F17F

SPECIAL QUALITY PULSE BEAM TETRODE

Indirectly heated

LIMITS OF CHARACTERISTICS

The test limits are for guidance in equipment design. The quality is controlled statistically to ensure that only a small percentage are outside these limits. The quality control levels are related to the importance of the characteristic being tested.

Test	Conditions V_h (V)	V_a (V)	V_{g2} (V)	I_a (mA)	Life Period	Limits Min.	Max.	Units
Heater Current	6·3	.	.	.	Initial	0·27	0·33	A
					500 hrs.	0·27	0·33	A
					1,000 hrs.	0·27	0·33	A
Negative Grid Voltage	6·3	200	200	17	Initial	8·4	15·8	V
					500 hrs.	7·4	15·8	V
					1,000 hrs.	6·6	15·8	V
Screen Current	6·3	200	200	17	Initial	2·05	5·1	mA
Mutual Conductance	6·3	200	200	17	Initial	2·6	5·0	mA/V
Pulse Anode Current	6·3	300	300	.	Initial	133	.	mA
$V_{g1} = -100V$, Pulse Amp. $= +100V$					500 hrs.	100	.	mA
$tp = 10 - 15 \mu s$, Duty cycle ·0025					1,000 hrs.	90	.	mA
Change in Pulse Anode Current	6·3	300	300	.	Initial to 1 hr.	.	20	%
Inner Amplification Factor V_{g1} (sig.) $= +2V$	6·3	200	200	17	Initial	7·5	12·5	
Anode Current Cut-off	6·3	200	200	0·1	Initial	.	38	V
Reverse Grid Current $R_{g1} = 500\ k\Omega$ (max)	6·3	200	200	17	Initial	.	0·75	μA
					500 hrs.	.	1·0	μA
					1,000 hrs.	.	1·5	μA

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S6F17F

SPECIAL QUALITY PULSE BEAM TETRODE

Indirectly heated

LIMITS OF CHARACTERISTICS—*Cont.*

Test	Conditions V_h (V)	V_a (V)	V_{g2} (V)	I_a (mA)	Life Period	Limits Min.	Max.	Units
Reverse Grid Current $R_{g1}=500\,k\Omega$, $V_{g1}=-38V$	7·0	200	200	.	Initial	.	−1·5	μA
Heater/Cathode Leakage Current $V_{h\text{-}k}=\pm100V$	6·3	.	.	.	Initial	.	10	μA
					500 hrs.	.	10	μA
					1,000 hrs.	.	10	μA
Inter-electrode Leakage Resistance V_{g1} to all $=-100V$	6·3	.	.	.	Initial	100	.	MΩ
					500 hrs.	50	.	MΩ
V_{g2} to all $=-300V$	6·3	.	.	.	Initial	100	.	MΩ
					500 hrs.	50	.	MΩ
V_a to all $=-300V$	6·3	.	.	.	Initial	100	.	MΩ
					500 hrs.	50	.	MΩ
Vibration Noise Output Voltage $V_{a(b)}=250V$, $V_{g1}=-17V$, $R_L=2k\,\Omega$	6·3	.	250	.	Initial	.	60	mV(p-p)
Life Test Conditions $R_{g1}=500k\,\Omega$, $V_{h\text{-}k}=100V$, $R_k=1k\Omega$	6·3	250	200	.				
Capacitances measured in fully shielded socket but with holder capacity balanced out.	Electrodes		g1 to E			5·2	7·1	pF
			a to E			4·4	6·1	pF
			a to g1			.	0·05	pF

Associated Electrical Industries Limited
Electronic Components Division
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S6F17F

SPECIAL QUALITY PULSE BEAM TETRODE

Indirectly heated

INTER-ELECTRODE CAPACITANCES **

Anode/Grid 1	$c_{a\text{-}g1}$	0·03 pF
Grid 1/Earth	c_{in}	6·2 pF
Anode/Earth	c_{out}	5·2 pF

** Measured with cylindrical screen but with holder capacity balanced out.

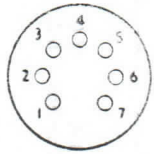
"Earth" denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Minimum Lead Length	38 mm
Maximum Diameter	19 mm
Maximum Seated Height	47·5 mm

MOUNTING POSITION—Unrestricted.

BASE—B7G/F



Viewed from free end.

CONNECTIONS

Pin 1	Grid 1	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Beam Plates	bp
Pin 7	Grid 2	g2

Associated Electrical Industries Limited

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S6F17F

SPECIAL QUALITY PULSE BEAM TETRODE

SPECIAL TESTS

Glass Envelope Strain Test

A statistical sample is tested to control glass quality. No voltages are applied to the electrodes.
The valves are completely immersed in boiling water at a temperature between 97°C and 100°C for 15 seconds and then immediately plunged into ice cold water for 5 seconds. The valves are then examined for glass cracks.

Base Strain Test

A Lead Fragility Test is carried out in place of the Base Strain Test.

Fatigue Test

A statistical sample is tested to control heater failures and other mechanical defects. The heaters are successively run at 6·9V for one minute and switched off for three minutes, no other voltages applied. The valves are rigidly mounted on a vibrating machine and vibrated for at least 100 hours, for not less than 30 hours in each of three mutually perpendicular planes at a frequency of 170 c/s with a minimum peak acceleration of 5g.

Shock Test

A statistical sample is tested to control mechanical defects likely to be caused by shock. No voltages are applied to the electrodes. The valves are subjected to five blows of approximately 500g acceleration in each of four directions.

Holding Period—Inoperatives Control

After completing the test specification the valves are held for at least 28 days and are then retested to ensure that there has been no deterioration on storage.

Associated Electrical Industries Limited
Electronic Components Division
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S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirectly heated

TENTATIVE

GENERAL

The S6F33 is a Special Quality screened H.F. Pentode having a short cut off suppressor grid characteristic and is intended for use where dependable performance is required under conditions of shock and vibration. It is suitable for modulation, gating, and variable reactance applications, where only a small input is available. A diode has been tied to the suppressor grid to prevent blocking when this grid is under positive drive conditions.

RATING—Absolute Values

Heater Voltage (volts)	V_h	6·3
Heater Current (amps)	I_h	0·35
Maximum Anode Dissipation (watts)	$p_{a(max)}$	3·0
Maximum Screen Dissipation (watts)	$p_{g2(max)}$	1·5
Maximum Anode Voltage (volts)	$V_{a(max)}$	300
Maximum Anode Voltage ($I_a=0$) (volts)	$V_{a(b)max}$	550
Maximum Screen Voltage (volts)	$V_{g2(max)}$	300
Maximum Screen Voltage ($I_{g2}=0$) (volts)	$V_{g2(b)max}$	400
Maximum Heater/Cathode Voltage (volts)	$V_{h\text{-}k(max)}$	±150
Maximum Bulb Temperature (°C)		200
Maximum Shock (Short Duration) (g)		500
Maximum Acceleration (Continuous Operation) (g)		2·5

INTER-ELECTRODE CAPACITANCES (pF)

(Measured with a close fitting metal shield)

Control Grid/Earth	$c_{g1\text{-}E}$	7·55
Anode/Earth	$c_{a\text{-}E}$	4·55
Anode/Control Grid	$c_{a\text{-}g1}$	<0·015

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirecty heated

TENTATIVE

DIMENSIONS

Maximum Overall Length	(mm)	54·5
Maximum Diameter	(mm)	19
Maximum Seated Height	(mm)	47·5
Approximate Nett Weight	(ozs)	$\frac{1}{4}$
Approximate Packed Weight	(ozs)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted

TEST CONDITIONS

Anode Voltage (volts)	V_a	200
Grid 2 Voltage (volts)	V_{g2}	200
Grid 3 Voltage (volts)	V_{g3}	0
Cathode Bias Resistance (ohms)	R_k	287
Anode Current (mA)	I_a	7·1
Grid 2 Current (mA)	I_{g2}	4·35
Mutual Conductance (mA/V)	g_m	4·05
Anode Impedance (Megohms)	r_a	0·1
Inner Mu	$\mu_{g1\text{-}g2}$	42

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S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirectly heated

TENTATIVE

LIMITS OF CHARACTERISTICS

The test limits are for guidance in equipment design. The quality is controlled statistically to ensure that only a small percentage are outside these limits. The quality control levels are related to the importance of the characteristic being tested.

Test	Conditions V_h (V)	V_{a-E} (V)	V_{g2-E} (V)	V_{g3}* (V)	R_k (Ω)	Life Period	Limits Min.	Max.	Units
Heater Current	6·3	.	.	.	.	Initial	0·32	0·38	A
						500 hrs.	0·32	0·38	A
Anode Current	6·3	200	200	0	287	Initial	5·6	8·6	mA
						500 hrs.	5·05	8·6	mA
						1,000 hrs.	4·6	8·6	mA
Screen Current	6·3	200	200	0	287	Initial	2·7	6·0	mA
Mutual Conductance	6·3	200	200	0	287	Initial	3·15	5·4	mA/V
						500 hrs.	2·7	5·4	mA/V
						1,000 hrs.	2·5	5·4	mA/V
Change of Mutual Conductance (1 hour life)	6·3	200	200	0	287	Initial to 1 hr.	.	10	%
Change of Mutual Conductance (c.f. gm at V_h = 6·3 V. Preheat valves for 5 mins.)	5·7	200	200	0	287	Initial	.	15	%
Average Change of Mutual Conductance	6·3	200	200	0	287	Initial to 500 hrs.	.	15	%

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirectly heated

TENTATIVE

LIMITS OF CHARACTERISTICS—*Cont.*

Test	Conditions V_h (V)	$V_{a\text{-}E}$ (V)	$V_{g2\text{-}E}$ (V)	V_{g3}* (V)	R_k (Ω)	Life Period	Limits Min.	Limits Max	Units
Inner Amplification Factor (I_k = 12mA, δV_{g1} = 1V)	6·3	200	200	0	287	Initial	34	50	
Grid No. 1 Cut-off (I_a = 0·1mA)	6·3	200	200	0	.	Initial	.	11	V
Grid No. 3 Cut-off (With V_{g3}=0 vary V_{g1} to give I_k=10mA then adjust V_{g3} for I_a = 0·1mA)	6·3	200	100	.	.	Initial	5	11·5	V
Grid No. 3 Current (V_{g1}=—30V)	6·3	200	200	20	.	Initial	1	.	mA
Reverse Grid No. 1 Current (R_{g1} = 0·5 MΩ (max))	6·3	200	200	0	287	Initial	.	0·5	μA
						500 hrs.	.	1·0	μA
						1,000 hrs.	.	1·0	μA
Reverse Grid No. 1 Current**	6·9	300	300	0	560	Initial	.	1·0	μA
Heater/Cathode Leakage Current ($V_{h\text{-}k}$=100V. Cathode positive and negative successively)	6·3	.	.	.	.	Initial	.	20	μA
						500 hrs.	.	40	μA
						1,000 hrs.	.	40	μA
Inter-Electrode Leakage Resistance V_{g1} to all = —100V	6·3	.	.	.	.	Initial	100	.	MΩ
						500 hrs.	50	.	MΩ
						1,000 hrs.	30	.	MΩ
V_{g2} to all = —300V	6·3	.	.	.	.	Initial	100	.	MΩ
						500 hrs.	50	.	MΩ
						1,000 hrs.	30	.	MΩ

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S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirectly heated

TENTATIVE

LIMITS OF CHARACTERISTICS—*Cont.*

Test	Conditions V_h (V)	$V_{a\text{-}E}$ (V)	$V_{g2\text{-}E}$ (V)	V_{g3}* (V)	R_k (Ω)	Life Period	Limits Min.	Max.	Units
V_{g3} to all = —300V	6·3	.	.	.	.	Initial	100	.	MΩ
						500 hrs.	50	.	MΩ
						1,000 hrs.	30	.	MΩ
V_a to all = —300V	6·3	.	.	.	.	Initial	100	.	MΩ
						500 hrs.	50	.	MΩ
						1000 hrs.	30	.	MΩ
Vibration Noise Output Voltage † ($V_{a(b)}$ = 250V, V_{gl} = —4·5V, R_L = 2KΩ at 50c/s and 2 g min. peak acceleration)	6·3	.	250	0	.	Initial	.	15	mV (r.m.s.)
Life Test Conditions	6·3	250	200	0	150				
Capacitances †† Electrodes									
g1 to E							6·5	8·6	pF
a to E							3·9	5·2	pF
a to g1							.	0·015	pF

* A zero indicates that grid 3 and cathode are joined.

** Preheat valve for 5 minutes under test conditions, after a further 5 minutes the grid 1 current must not be rising or out of limits.

† Valve mounted so that the direction of vibration is parallel to the minor axis of the electrode mounting structure.
Test of sufficient duration to obtain a steady reading of noise output.

†† Inter Electode capacity on 1 Mc/s bridge with valve mounted in a fully shielded socket and in a cylindrical screening can.

Associated Electrical Industries Limited
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S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirectly heated

TENTATIVE

GLASS ENVELOPE STRAIN TEST

A statistical sample is tested to control glass quality. No voltages are applied to the electrodes.
The valves are completely immersed in boiling water at a temperature between 97°C and 100°C for 15 seconds and then immediately plunged into ice cold water for 5 seconds. The valves are then examined for glass cracks.

BASE STRAIN TEST

A statistical sample is tested to control base strain. No voltages are applied to the electrodes.
The pins of the valves are forced over a specified cone, valves and cones are then completely submerged in boiling water at a temperature between 97°C and 100°C for 10 seconds. The valves and cones are allowed to cool to room temperature on a wooden support before examining for glass cracks.

FATIGUE TESTS

A statistical sample is tested to control heater failures and other mechanical defects. The heaters are successively run at 6·9V for 1 minute and switched off for 3 minutes, no other voltages applied.
The valves are rigidly mounted on a vibrating machine and vibrated for at least 100 hours, for not less than 30 hours in in each of 3 mutually perpendicular planes at a frequency of 170 c/s with a minimum peak acceleration of 5g.

SHOCK TEST

A statistical sample is tested to control mechanical defects likely to be caused by shock. No voltages are applied to the electrodes.
The valves are subjected to 5 blows of approximately 500g acceleration in each of 4 directions.

HOLDING PERIOD—Inoperatives Control

After completing the test specification the valves are held for at least 28 days and then retested to ensure that there has been no deterioration on storage.

Associated Electrical Industries Limited

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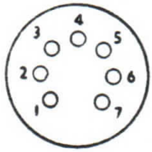
S6F33

SPECIAL QUALITY DUAL CONTROL PENTODE

Indirectly heated

TENTATIVE

BASE—B7G



Viewed from free end of pins.

CONNECTIONS

Pin 1	Grid 1	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Grid 3, Diode Anode	g3,ad
Pin 7	Grid 2	g2

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

S11E12

SPECIAL QUALITY BEAM TETRODE

Indirectly heated—for parallel operation

TENTATIVE

GENERAL

The S11E12 is a Special Quality Beam Tetrode intended for use as a series or shunt control valve in stabilised power supply units, and has similar characteristics (within ratings) to the 12E1. It is indirectly heated and should be parallel connected to the supply. A special shock resistant contruction is employed which gives increased reliability and life expectancy.

Quality tests are performed on electrical characteristics, vibration noise, base strain, glass strain, electrode resonance, vibration fatigue, shock resistance, heater cycling, stability and life.

RATING

Heater Voltage	(volts)	V_h	6.3
Heater Current	(amps)	I_h	1.6
Maximum Anode Voltage	(volts)	$V_{a(max)}$	800
Maximum Screen Voltage	(volts)	$V_{g2(max)}$	300
Maximum Control Grid Voltage	(volts)	$V_{g1(max)}$	—100
Maximum Voltage between Grids 1 and 2	(volts)	$V_{g1-g2(max)}$	400
Mutual Conductance	(mA/V)	g_m	13.5*
Inner Mu		μ_{g1-g2}	5.5*
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	28
Maximum Screen Dissipation	(watts)	$P_{g2(max)}$	5
Maximum Cathode Current	(mA)	$I_{k(max)}$	300
Maximum Heater to Cathode Voltage (DC heater negative)	(volts)	$V_{h-k(max)}$	350
Maximum Heater to Cathode Voltage (DC heater positive)	(volts)	$V_{h-k(max)}$	150
Maximum Resistance Grid 1 to Cathode—Fixed Bias	(ohms)	$R_{g1-k(max)}$	100,000
Maximum Resistance Grid 1 to Cathode—Cathode Follower	(MΩ)	$R_{g1-k(max)}$	1

Associated Electrical Industries Limited
Electronic Components Division
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S11E12

SPECIAL QUALITY BEAM TETRODE

Indirectly heated—for parallel operation

TENTATIVE

Maximum Acceleration (continuous operation)	(g)		2
Maximum Shock (short duration)	(g)		500
Maximum Peak Anode Voltage (Scanning Operation)	(volts)	$V_{a(pk)max}$	1,500†

* Measured at Va = Vg2 = 150 v ; Ia = 200 mA ; Ig2 = 12 mA ; Vg1 = —8.5 v.

† For duty cycle of 1/25 and maximum pulse duration 200 μ seconds.

All maximum ratings are Absolute Values not Design Centres.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid 1	c_{a-g1}	1.8
Grid 1/Earth	c_{in}	19.5
Anode/Earth	c_{out}	16.5

" Earth " denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Maximum Overall Length	(mm)	98
Maximum Diameter	(mm)	44
Maximum Seated Height	(mm)	83
Approximate Nett Weight	(ozs)	$2\frac{1}{2}$
Approximate Packed Weight	(ozs)	$5\frac{1}{4}$

MOUNTING POSITION—Vertical. If run horizontally then it is recommended that the axis AB be on a horizontal plane.

BULB—Clear.

Associated Electrical Industries Limited

Electronic Components Division

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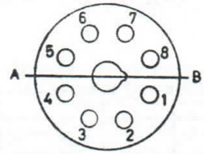
S11E12

SPECIAL QUALITY BEAM TETRODE

Indirectly heated—for parallel operation

TENTATIVE

BASE—International Octal.



Viewed from free end of pins

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Heater	h
Pin 3	Anode	a
Pin 4	Grid 2	g2
Pin 5	Grid 1	g1
Pin 6	Beam Plates	bp
Pin 7	Heater	h
Pin 8	Cathode	k

Note.—Pins 6 and 8 should be connected together at the valve holder.

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S11E12

SPECIAL QUALITY BEAM TETRODE

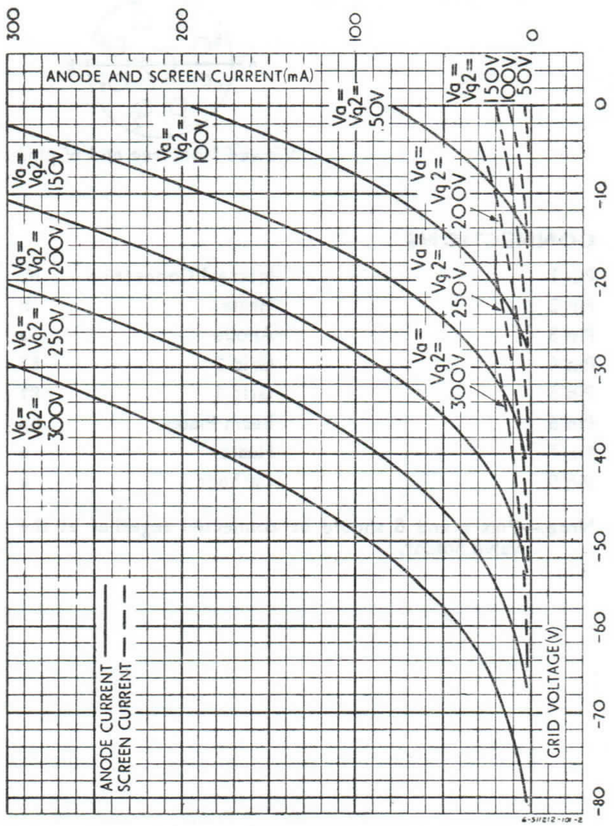
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES: I_a, I_{g2}/V_{g1}

Curves taken with short duration pulse

Pulse Length = 12μsec. Pulse Ratio = 400 : 1

Grid Current starts at V_{g1} = −1·0V (approx.)



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S11E12

SPECIAL QUALITY BEAM TETRODE

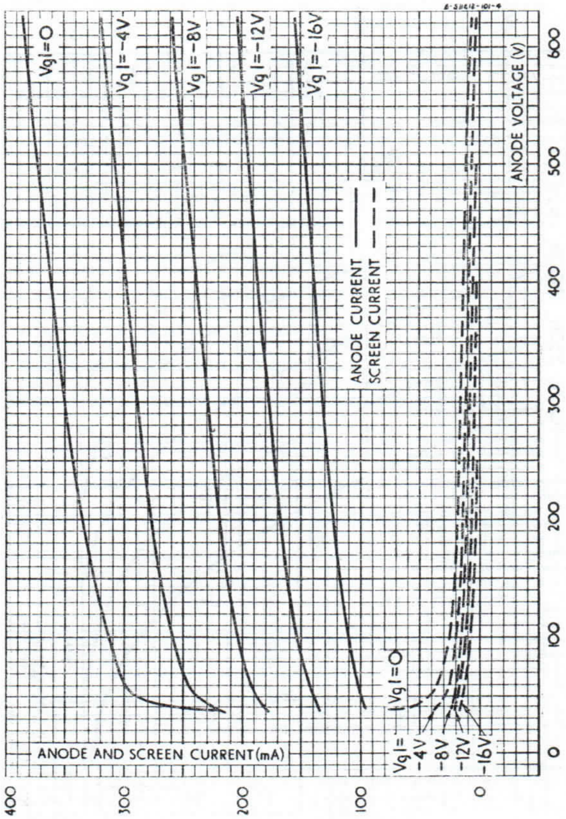
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES: I_a, I_{g2}/V_a

$V_{g2} = 150V$

Curves taken with short duration pulse

Pulse Length = 12μsec. Pulse Ratio = 400 : 1



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S11E12

SPECIAL QUALITY BEAM TETRODE

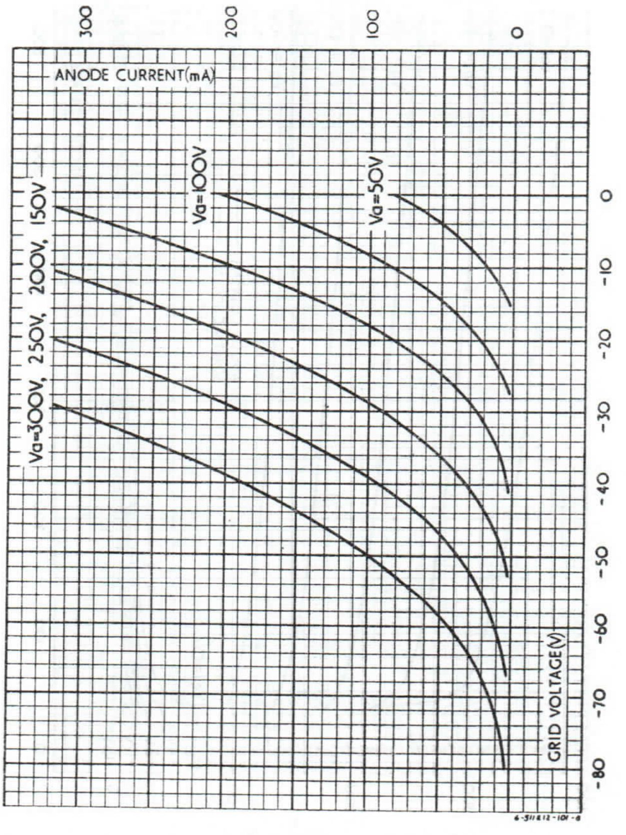
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES: I_a/V_g
TRIODE CONNECTED

Curves taken with short duration pulse

Pulse Length $= 12\mu$sec. Pulse Ratio $= 400:1$

Grid Current starts at $V_{g1} = -1{\cdot}0$V (approx.)



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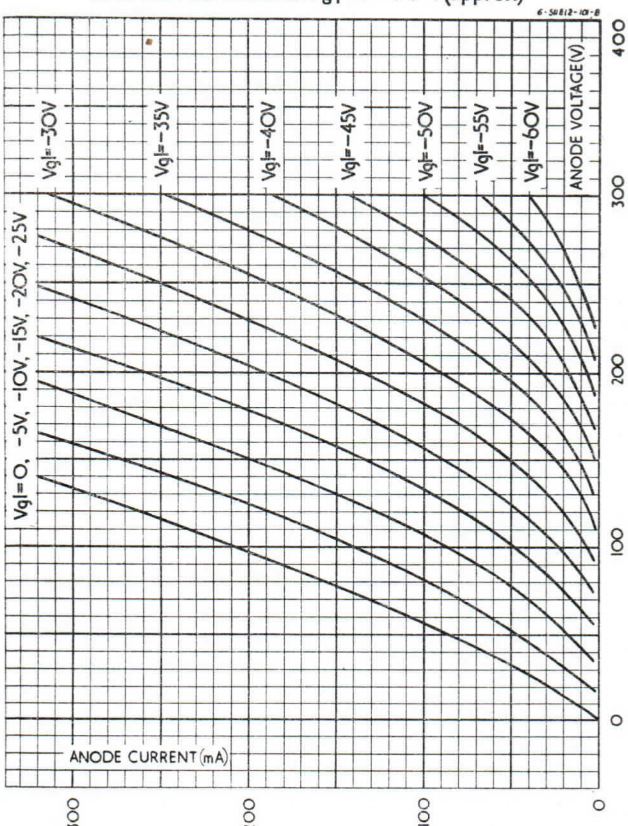
S11E12

SPECIAL QUALITY BEAM TETRODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES: I_a/V_a
TRIODE CONNECTED
Curves taken with short duration pulse
Pulse Length = 12μ sec. Pulse Ratio = 400 : 1
Grid Current starts at $V_{g1} = -1{\cdot}0$ V(approx)



Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

S19G6F

SPECIAL QUALITY HALF-WAVE RECTIFIER

Indirectly heated

GENERAL

The S19G6F is a special quality, indirectly heated, high vacuum half-wave rectifier with flying leads. It is intended for use in high voltage power supplies. A special shock resistant construction is employed which gives increased reliability and life expectancy. Quality tests are performed on electrical characteristics, vibration noise, lead fragility, glass strain, electrode resonance, vibration fatigue, shock resistance, heater cycling, stability, and life.

RATING‡

Heater Voltage	V_h	4·0	V
Heater Current	I_h	0·5	A
Maximum r.m.s. Anode Voltage	$V_{a(r.m.s.)max}$	2·0	kV
Maximum Working Peak Inverse Voltage		5·0	kV
Maximum No Load Peak Inverse Voltage		6·0	kV
Maximum Mean Anode Current	$I_{a(av)max}$	30	mA
Maximum Peak Heater/Cathode Voltage	$v_{h\text{-}k(pk)max}$	10*	V
Maximum Peak Anode Current	$i_{a(pk)max}$	180	mA
Maximum Reservoir Capacitor (50 c/s)	$C_{(max)}$	1·1	μF
Minimum Surge Limiting Resistance	$R_{(lim)min}$	4,500†	Ω
Minimum H.T. Switching Delay for Full Rating	$t_{sd(min)}$	20	s
Maximum Shock (short duration)		500	g
Maximum Acceleration (continuous operation)		2·5	g

* Cathode and heater should normally be tied, externally.

† This resistance can be obtained in the distributed resistance of the transformer winding.

‡ All limiting values are Absolute Values, not Design Centres.

Associated Electrical Industries Limited

Electronic Components Division

Tel: GERrard 9797

AEI

EDISWAN

S19G6F

SPECIAL QUALITY HALF-WAVE RECTIFIER

Indirectly heated

LIMITS OF CHARACTERISTICS

The test limits are for guidance in equipment design. The quality is controlled statistically to ensure that only a small percentage are outside these limits. The quality control levels are related to the importance of the characteristic being tested.

Test	Conditions V_h (V)	V_a (V)	$V_{h\text{-}k}$ (V)	C (μF)	Life Period	Limits Min.	Max.	Units
Heater Current	4	·	·	·	Initial	0·45	0·55	A
					500 hrs.	0·45	0·55	A
Anode Current	4	55	·	·	Initial	50	·	mA
					500 hrs.	48	·	mA
Change in Anode Current	4	55	·	·	Initial to 1 hr.	·	10	%
Heater/Cathode Leakage Current	4	·	10	·	Initial	·	10	μA
Voltage Breakdown, tested in half-wave rectifier circuit. $R_{lim}=4{\cdot}5k\Omega$, $R_L=68k\Omega$, $I_a=30mA$ approximately.	4	2kV rms	·	1	Initial	·	·	
Load conditions maintained for 10 seconds then supply voltage switched on and off three times at five second intervals. There must be no persistent sparking, blue glow or other abnormal manifestations.								
Life Test Conditions								
Tested in half-wave rectifier circuit. $R_{lim}=4{\cdot}5k\Omega$, $R_L=68k\Omega$, $I_a=30mA$ approx.	4	2kV rms	·	1				

Associated Electrical Industries Limited

Electronic Components Division

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S19G6F

SPECIAL QUALITY HALF-WAVE RECTIFIER

Indirectly heated

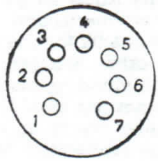
DIMENSIONS

Maximum Seated Height	54 mm
Maximum Diameter	19 mm
Minimum Lead Length	38 mm

MOUNTING POSITION—Unrestricted

CAP—CT1 and flying lead.

BASE—B7G/F



Viewed from free end.

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Internal Connection	IC
Pin 6	Internal Connection	IC
Pin 7	Internal Connection	IC
Top Cap	Anode	a

Associated Electrical Industries Limited
Electronic Components Division
Tel: GERrard 9797

S19G6F

SPECIAL QUALITY HALF-WAVE RECTIFIER

Indirectly heated

Glass Envelope Strain Test

A statistical sample is tested to control glass quality. No voltages are applied to the electrodes.
The valves are completely immersed in boiling water at a temperature between 97°C and 100°C for 15 seconds and then immediately plunged into ice cold water for 5 seconds. The valves are then examined for glass cracks.

Base Strain Test

A Lead Fragility Test is carried out in place of the Base Strain Test.

Fatigue Test

A statistical sample is tested to control heater failures and other mechanical defects. The heaters are successively run at 4·0V for one minute and switched off for three minutes, no other voltages applied. The valves are rigidly mounted on a vibrating machine and vibrated for at least 100 hours, for not less than 30 hours in each of three mutually perpendicular planes at a frequency of 170 c/s with a minimum peak acceleration of 5g.

Shock Test

A statistical sample is tested to control mechanical defects likely to be caused by shock. No voltages are applied to the electrodes. The valves are subjected to five blows of approximately 500g acceleration in each of four directions.

Holding Period—Inoperatives Control

After completing the test specification the valves are held for at least 28 days and then retested to ensure that there has been no deterioration on storage.

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Electron Optical
Devices

Photo-Cells

AEI Photo-cell 27A12

GENERAL

The 27A12 is a vacuum Photo-Cell with a caesium antimony cathode surface, having maximum sensitivity in the blue region of the spectrum. It has a high sensitivity to daylight, but negligible infra-red response. It may be used for sound reproduction, counting applications, etc.

RATINGS—Absolute values

Maximum working voltage		100	V
Maximum mean cathode current (max averaging time 30 sec)	$I_{k(av)max}$	5·0	μA
Maximum ambient temperature	$T_{amb(max)}$	70	°C

INTER-ELECTRODE CAPACITANCE

Anode/cathode	$c_{a\text{-}k}$	0·7	pF

CHARACTERISTICS

Average overall sensitivity (approx)		45*	μA/L
Maximum dark current	$I_{dark(max)}$	0·005†	μA
Minimum insulation resistance between electrodes		20,000	MΩ

* Measured at 0·04 lumens with a lamp colour temperature of 2700°K and a cell series resistance of 1·0MΩ. Anode voltage = 100V.

† Measured at 100V and 1·0MΩ series resistance, zero illumination.

DIMENSIONS

Maximum overall length	54·5 mm
Maximum seated height	47·5 mm
Light centre from seat	23 mm
Maximum diameter	19 mm
Approximate cathode width	18 mm
Approximate cathode length	32 mm

MOUNTING POSITION—Unrestricted

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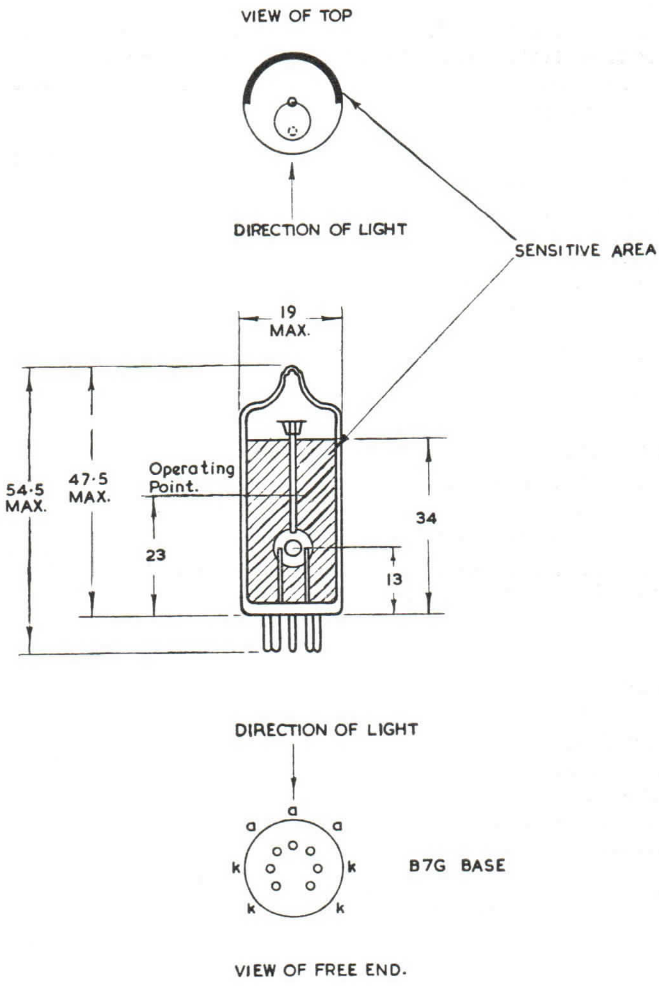
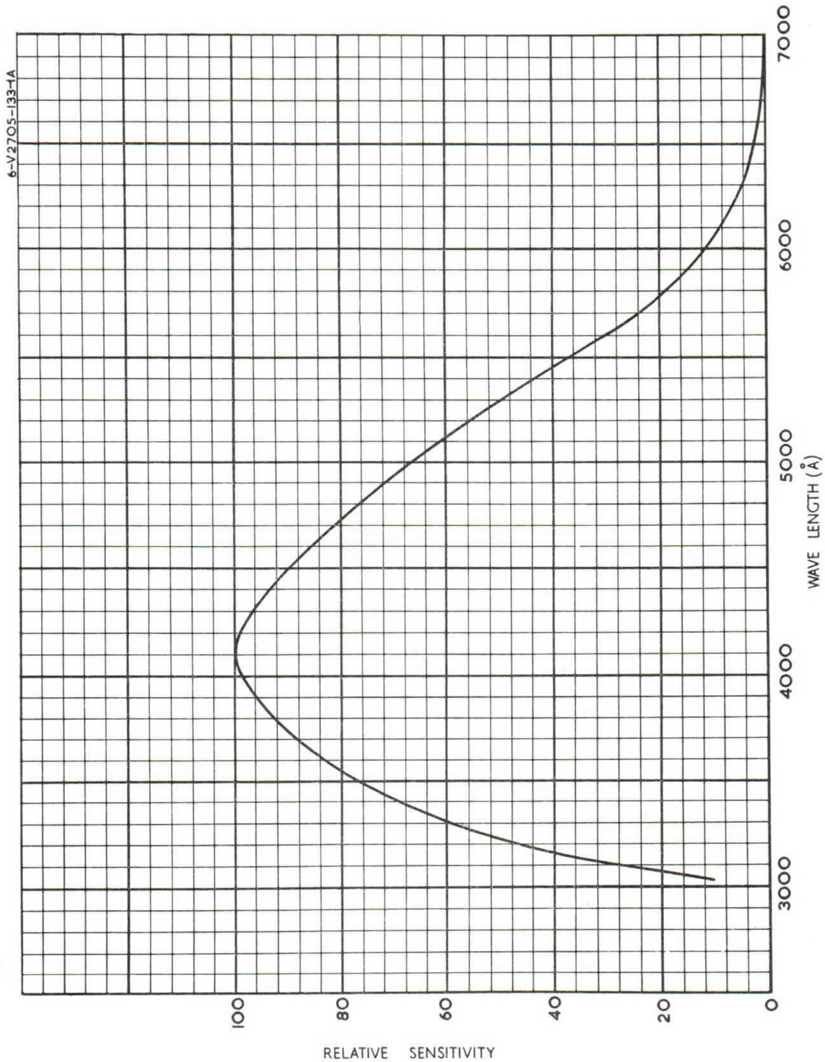


All dimensions in mm.

The cathode connection should be made to pins 1, 2, 6 and 7 connected together and the anode connection to pins 3, 4 and 5 connected together.

AEI Photo-cell **27A12**

SPECTRAL RESPONSE OF ANTIMONY CAESIUM PHOTO-CATHODE



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27C12

PHOTO-CELL

TENTATIVE

GENERAL

The 27C12 is a vacuum Photo-Cell with a caesium-oxygen-silver cathode surface, having maximum sensitivity in the near infra-red region of the spectrum. It is highly sensitive to incandescent light sources and may be used for machine control, counting applications, etc.

RATING—Absolute values

Maximum working voltage		250	V
Maximum mean cathode current (max averaging time 30 sec)	$I_{k(av)max}$	10	μA
Maximum ambient temperature	$T_{amb(max)}$	100	°C

INTER-ELECTRODE CAPACITANCE

Anode/Cathode	c_{a-k}	1·1	pF

CHARACTERISTICS

Average overall sensitivity (approx)		20*	μA/L
Maximum dark current	$I_{dark(max)}$	0·05†	μA
Minimum insulation resistance between electrodes		2000	MΩ
Recommended working voltage		50	V

* Measured at 0·1 lumens with a lamp colour temperature of 2700°K and a cell series resistance of 1·0MΩ. Anode voltage=50V.

† Measured at 100V and 1·0MΩ series resistance, zero illumination.

DIMENSIONS

Maximum overall length	54·5	mm
Maximum seated height	47·5	mm
Light centre from seat	19·5	mm
Maximum diameter	19	mm
Minimum cathode width	11·5	mm
Minimum cathode length	22	
Minimum projected cathode area	2·6	sq.cm

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27C12

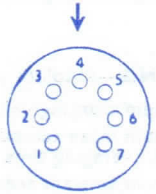
PHOTO-CELL

TENTATIVE

MOUNTING POSITION—Unrestricted

BASE—B7G

Direction of light



Viewed from free end of pins

CONNECTIONS ‡

Pin 1	Cathode	k
Pin 2	Cathode	k
Pin 3	Anode	a
Pin 4	Anode	a
Pin 5	Anode	a
Pin 6	Cathode	k
Pin 7	Cathode	k

‡ The cathode connection should be made to pins 1, 2, 6 and 7 connected together and the anode connection to pins 3, 4 and 5 connected together.

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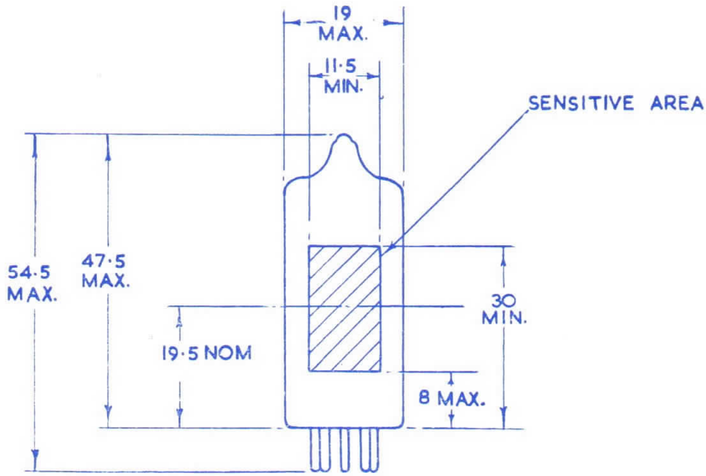
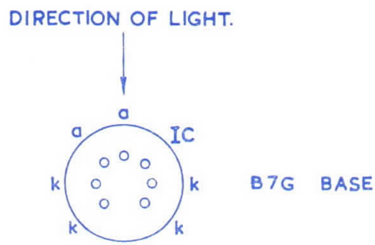
27C12

PHOTO-CELL

TENTATIVE



All dimensions in mm.



VIEW OF FREE END.

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27J12

PHOTO-CELL

TENTATIVE

GENERAL

The 27J12 is a gas-filled Photo-Cell with a caesium-oxygen-silver cathode surface, having maximum sensitivity in the red region of the spectrum. It may be used for actuating electro-mechanical devices.

RATING—Absolute values

Maximum working voltage		90	V
Maximum mean cathode current (max averaging time 30 sec)	$I_{k(av)max}$	2·5	μA
Maximum peak cathode current	$i_{k(pk)max}$	8·0	μA
Maximum peak cathode current density		15	μA/cm²

INTER-ELECTRODE CAPACITANCE

Anode/cathode	c_{a-k}	1·1	pF

CHARACTERISTICS

Average overall sensitivity (approx)		125*	μA/L
Average primary sensitivity (approx)		20†	μA/L
Maximum gas amplification factor	$A_{g(max)}$	10**	
Maximum dark current	$I_{dark(max)}$	0·1‡	μA
Minimum insulation resistance between electrodes		2000	MΩ

* Measured at 0·02 lumens with a lamp colour temperature of 2700°K and a cell series resistance of 1·0MΩ. Anode voltage=90V.

** Gas amplification factor is a ratio of current at 90V to current at 25V under the conditions of note*.

† The primary sensitivity is measured at an anode voltage of 25V, at which ionization has not taken place.

‡ Measured at 90V and 1·0MΩ series resistance, zero illumination.

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27J12

PHOTO-CELL

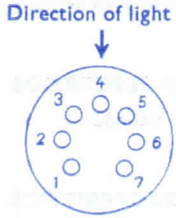
TENTATIVE

DIMENSIONS

Maximum overall length	54·5	mm
Maximum seated height	47·5	mm
Light centre from seat	19·5	mm
Maximum diameter	19	mm
Minimum cathode width	11·5	mm
Minimum cathode length	20·5	mm
Minimum projected cathode area	2·3	sq.cm

MOUNTING POSITION—Unrestricted

BASE—B7G



Viewed from free end of pins

CONNECTIONS§

Pin 1	Cathode	k
Pin 2	Cathode	k
Pin 3	Anode	a
Pin 4	Anode	a
Pin 5	Anode	a
Pin 6	Cathode	k
Pin 7	Cathode	k

§ The cathode connection should be made to pins 1,2,6 and 7 connected together and the anode connection to pins 3,4 and 5 connected together.

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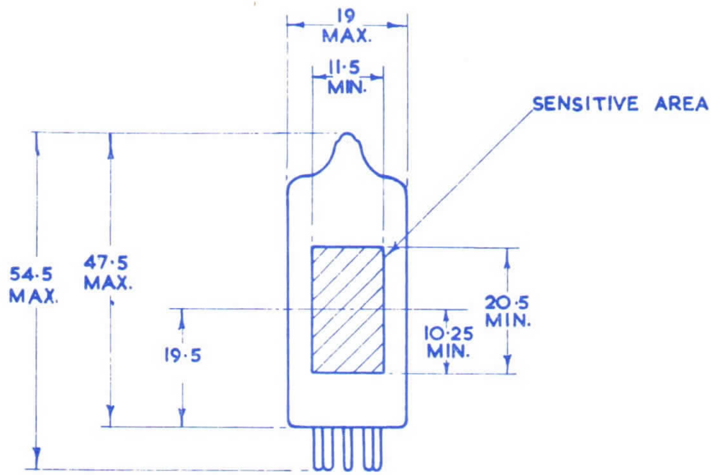
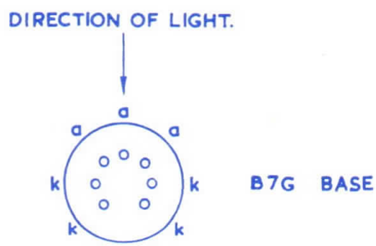
27J12

PHOTO-CELL

TENTATIVE



All dimensions in mm.



VIEW OF FREE END.

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PE50

PHOTO-CELL

GENERAL

The PE50 is a miniature gas-filled photo-cell with a Caesium-Oxygen-Silver cathode surface, having maximum sensitivity in the red and infra-red region of the spectrum. The bulb is blackened except for a window 21 × 11.6 mm opposite the cathode.

RATING—Absolute Values

Approximate Overall Sensitivity (av)	120*	μA/L
Approximate Primary Sensitivity (av)	20**	μA/L
Maximum Gas Amplification Factor	10†	
Maximum Working Voltage	90	V
Maximum Average Cathode Current	2·5	μA
Maximum Averaging Time	30	S
Maximum Peak Cathode Current	8·0	μA
Maximum Peak Cathode Current Density	15	μA/cm²
Maximum Dark Current	0·1‡	μA
Minimum Insulation resistance between electrodes	1,000	MΩ

NOTES

* Measured at 0·02 lumens with lamp colour temperature 2700°K and a cell series resistance of 1·0 MΩ. Anode Voltage = 90 volts.

† Gas Amplification Factor is the ratio of current at 90 volts to current at 25 volts under the conditions mentioned above.

‡ Measured at 90 volts with 1·0 MΩ series resistance, zero illumination.

** The Primary sensitivity is measured at an anode voltage of 25 volts at which ionisation has not taken place.

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PE50

PHOTO-CELL

INTER-ELECTRODE CAPACITANCE (pF)

Anode/Cathode	$c_{a\text{-}k}$	3·0

DIMENSIONS

Maximum Overall Length	69·0 mm
Maximum Seated Height	60·5 mm
Light Centre from Seat (nominal)	42·5 mm
Maximum Bulb Diameter	16·25 mm
Maximum Base Diameter	16·15 mm
Cathode Length (nominal)	21·0 mm
Effective Cathode Width	11·6 mm
Window Area	2·4 cm^2
Projected Cathode Area	2·4 cm^2
Approximate Nett Weight	1 oz
Approximate Packed Weight	4¾ oz

MOUNTING POSITION—Unrestricted.

BASE—Miniature 4 Pin (B4B)

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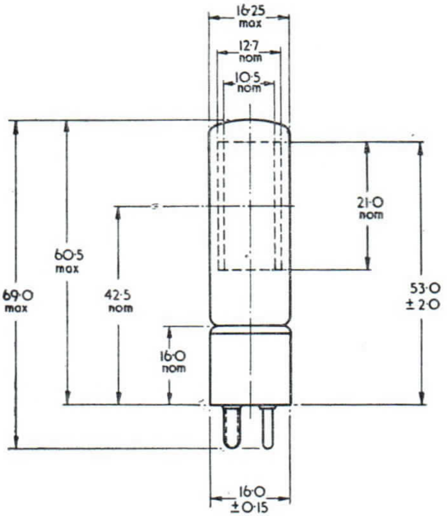
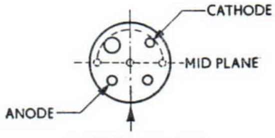
PE50

PHOTO-CELL



BLANK PINS NOT CONNECTED



Viewed from free end of pins.

All Dimensions in mm.

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PE51

PHOTO ELECTRIC CELL

GENERAL

The Mazda PE.51 is a Gas Filled Photo Electric Cell with a Caesium-Oxygen-Silver Cathode surface, having maximum sensitivity in the red and infra-red region of the spectrum.

RATING

Average Overall Sensitivity (μA/lumen)	100+
Average Primary Sensitivity (μA/lumen)	20*
Maximum Gas Amplification Factor	8.0$
Maximum Working Voltage (volts)	90
Maximum Average Cathode Current (μA)	5.0&
Maximum Peak Cathode Current (μA)	15
Maximum Peak Cathode Current Density (μA/sq cm)	15
Maximum Dark Current (μA)	0.1=
Minimum Insulation resistance between electrodes (MΩ)	1,000

NOTES

+ Measured at 0.05 lumens with lamp colour temperature 2700°K and a cell series resistance of 0.5.MΩ Anode Voltage - 90 volts

$ Gas Amplication Factor is ratio of current at 90 volts to current at 25 volts under the conditions mentioned above.

= Measured at 90 volts with 0.5.MΩ series resistance: zero illumination.

* The Primary sensitivity is measured at an anode voltage of 25 volts at which ionisation has not taken place.

& Average over a period not greater than 30 secs.

All Maximum Ratings are Absolute values not Design Centres.

INTER-ELECTRODE CAPACITANCE

Anode to Cathode (μμF)	1.9

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PE51

PHOTO ELECTRIC CELL

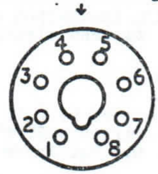
DIMENSIONS

Max. Overall Length (mm)	78.0
Max. Seated Height (mm)	63.5
Light Centre from Seat (mm) (nominal)	41.0 ± 2.5
Max. Bulb Diameter (mm)	28.5
Max. Base Diameter (mm)	32.0
Cathode Length (mm)	22.0
Effective Cathode Width (mm)	21.5
Projected Cathode Area (sq.cm)	4.7
Approximate Nett Weight (oz)	1
Approximate packed weight (oz)	$4\frac{3}{4}$

MOUNTING POSITION - Unrestricted

BASE Mazda Octal (B08)

Direction of Light



Viewed from free end of pins

CONNECTIONS

Pin 1	Cathode	k
Pin 2	+Internal Connection	i.c.
Pin 3	-	-
Pin 4	-	-
Pin 5	Anode	a
Pin 6	-	-
Pin 7	-	-
Pin 8	-	-

+ In use Pin 2 should be left free.

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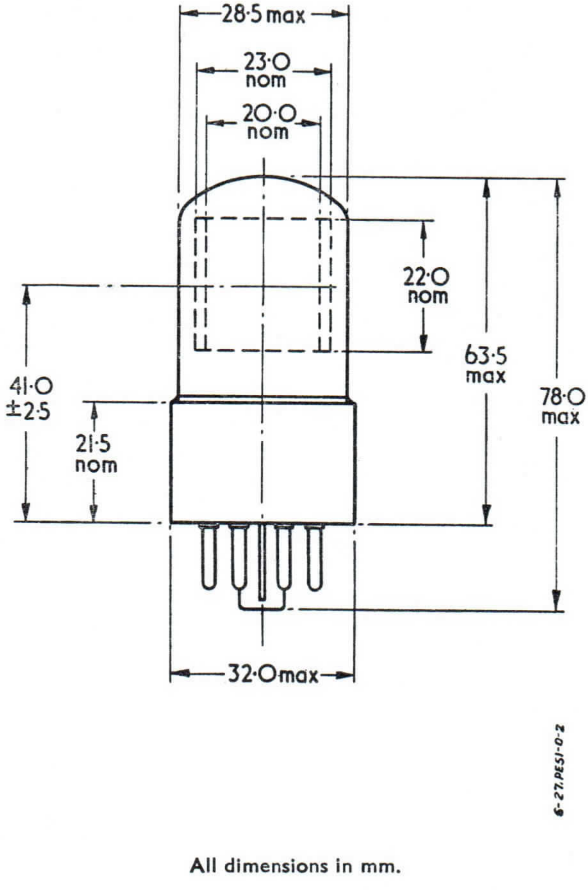
PE51

PHOTO ELECTRIC CELL



All dimensions in mm.

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PE52

PHOTO-ELECTRIC CELL

GENERAL

The Mazda PE.52 is a vacuum Photo-Electric Cell with a Caesium-Oxygen-Silver Cathode Surface, having maximum sensitivity in the red and infra-red region of the spectrum.

RATING

Approximate Sensitivity (µA/lumen)	20 +
Max. Working Voltage (volts)	250
Max. Dark Current (µA)	0.1=
Max. Average Cathode current (µA)	8 •
Maximum Peak Cathode Current (µA)	25
Max. Peak Cathode Current Density (µA/sq.cm)	15
Min. Insulation resistance between electrodes (MΩ)	1800

NOTES

+ Measured at 0.05 lumen with 90 volts applied, and a 0.5 MΩ series resistance: Lamp at colour temperature 2700°K.

= Measured at 90 volts, with 0.5 MΩ series resistance: zero illumination.

• Averaged over a period not greater than 30 secs.

All Maximum Ratings are absolute values not Design Centres.

INTER-ELECTRODE CAPACITANCE

Anode to Cathode (µµF)	1.9

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PE52

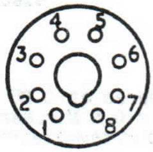
PHOTO-ELECTRIC CELL

DIMENSIONS

Maximum Overall Length (mm)	78.0
Maximum Seated Height (mm)	63.5
Light Centre from Seat (mm)	41.0 ± 2.5
Maximum Bulb Diameter (mm)	28.5
Maximum Base Diameter (mm)	32.0
Cathode Length (mm)	22.0
Effective Cathode Width (mm)	21.5
Projected Cathode Area (Sq.cm)	4.7
Approximate Nett Weight (oz)	1
Approximate packed weight (oz)	$4\frac{5}{8}$

MOUNTING POSITION - Unrestricted

BASE - Mazda Octal (B.O.8) Direction of light ↓



Viewed from free end of pins

CONNECTIONS

Pin 1	Cathode	k
Pin 2	$ Internal Connection	i.c
Pin 3	-	-
Pin 4	-	-
Pin 5	Anode	a
Pin 6	-	-
Pin 7	-	-
Pin 8	-	-

$ In use Pin 2 should be left free

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PE54

PHOTO ELECTRIC CELL

GENERAL

The Mazda PE54 is a Gas Filled Photo Electric Cell with a rectangular wire anode and a Caesium Antimony Cathode surface, having maximum sensitivity in the blue region of the spectrum.

RATING

Average Overall Sensitivity (approx) μA/Lumen	90*
Average Primary Sensitivity (approx) (μA/Lumen)	30$
Maximum Gas Amplification Factor	6‡
Maximum Working Voltage (volts)	90
Maximum Average Cathode Current (μA)	6§
Maximum Peak Cathode Current (μA)	20
Maximum Peak Cathode Current Density (μA/sq.cm)	15
Maximum Dark Current (μA)	0.1†
Minimum Insulation Resistance between Electrodes (Megohms)	1,000

NOTES

* Measured at 0.085 lumens with lamp at colour temperature 2,700 K and a cell series resistance of 1 Megohm.

$ The Primary Sensitivity is measured at an anode voltage of 25, at which ionisation has not taken place.

‡ Gas Amplification factor is a ratio of current at 90 volts to current at 25 volts under conditions of the overall sensitivity measurement.

§ Averaged over a period not greater than 30 seconds.

† Measured at 90 volts and 1 Megohm series resistance, zero illumination.

All Maximum Ratings are absolute values, not design centres.

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PE54

PHOTO ELECTRIC CELL

INTER-ELECTRODE CAPACITANCES (pF)

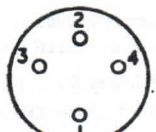
Anode to Cathode	1.6

DIMENSIONS

Maximum Overall Length (mm)	98.0
Maximum Seated Height (mm)	83.0
Light Centre from Seat (mm)	51–57
Maximum Bulb Diameter (mm)	26.5
Maximum Base Diameter (mm)	30.5
Cathode Length (nominal) (mm)	35.0
Effective Cathode Width (mm)	18.0
Projected Cathode Area (sqcm.)	6.3
Approximate Nett Weight (ozs)	$1\frac{1}{4}$
Approximate Packed Weight (ozs)	$2\frac{1}{2}$

MOUNTING POSITION—Unrestricted

BASE—British 4 Pin.



Viewed from free end of pins
Direction of light

CONNECTIONS

Pin 1	Anode	a
Pin 2	Cathode	k
Pin 3	No Pin	NP
Pin 4	No Pin	NP

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PE55

PHOTO ELECTRIC CELL

GENERAL

The Ediswan PE55 is a Gas Filled Photo Electric Cell with a rectangular wire anode and Caesium-Oxygen-Silver Cathode Surface having Maximum sensitivity in the red and infra-red regions of the spectrum.

RATING

Average Overall Sensitivity (approx) (μA/Lumen)		90‡
Average Primary Sensitivity (μA/lumen)		20*
Maximum Gas Amplification Factor	$A_{g(max)}$	9$
Maximum Working Voltage (volts)		90
Maximum Average Cathode Current (μA)	$I_{k(av)max}$	6†
Maximum Peak Cathode Current (μA)	$I_{k(pk)max}$	20
Maximum Peak Cathode Current Density (μA/sq.cm)		15
Maximum Dark Current (μA)	$I_{dark(max)}$	0.1 §
Minimum Insulation Resistance between electrodes (megohms)		10^6

NOTES

‡ Measured at 0.085 lumens with lamp at colour temperature 2,700° K and a cell series resistance of 1 Megohm.

$ Gas Amplification factor is a ratio of current at 90 volts to current at 25 volts under the above conditions.

§ Measured at 90 volts and 1 Megohm series resistance; zero illumination.

* The Primary Sensitivity is measured at an anode voltage of 25, at which ionisation has not taken place.

† Averaged over a period not greater than 30 seconds.

All Maximum Ratings are absolute values, not Design Centres.

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PE55

PHOTO ELECTRIC CELL

INTERELECTRODE CAPACITANCE (pF)

Anode to Cathode	$c_{a\text{-}k}$	3.1

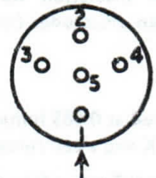
DIMENSIONS

Maximum Overall Length	(mm)	109
Maximum Seated Height	(mm)	94
Light Centre from Seat	(mm)	60+3
Maximum Bulb Diameter	(mm)	26.5
Maximum Base Diameter	(mm)	30.5
Cathode Length	(mm)	35
Cathode Width	(mm)	18
Projected Cathode Area	(sq.cm)	6.3
Approximate Nett Weight	(ozs)	1¼
Approximate Packed Weight	(ozs)	2½

MOUNTING POSITION—Unrestricted

BASE—British 4 Pin.

Viewed from free end of pins



Direction of light

CAP—CT1

VALVE HOLDER—Ediswan Clix VH42/4

CONNECTIONS

Pin 1	Anode	a
Pin 2	No Connection	NC
Pin 3	No Connection	NC
Pin 4	No Connection	NC
Top Cap	Cathode	k

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Photomultipliers

PHOTOMULTIPLIERS

1. GENERAL NOTES

A photomultiplier is a device containing a photo-sensitive cathode, a number of secondary cathodes with good secondary emission characteristics, and an anode. When light or similar radiation falls on the cathode, electrons are emitted, and these are accelerated by a suitable electric field to strike the first secondary cathode and produce a larger number of secondary electrons. This amplification is repeated at successive secondary cathodes and the current finally arriving at the anode is very many times larger than that leaving the cathode.

AEI photomultipliers use an antimony-caesium layer for the sensitive photosurface and also for the secondary emitting surfaces. This layer is sensitive in the visible and ultra-violet range of the spectrum. The electrodes are arranged in a compact manner and the focusing of the electron streams is accomplished by the electrostatic fields between the electrodes. (Secondary cathodes are sometimes known as dynodes.)

2. CONDITIONS OF USE

To obtain optimum amplification the voltage between the cathode and the first secondary cathode, and between all consecutively numbered pairs of secondary cathodes should be equal. This is most conveniently carried out by connecting a chain of equal valued resistors across a suitable power supply unit the junction of each pair of resistors being connected to the appropriate electrode. The current flowing through the resistor chain should preferably be at least 15 times the maximum current to be drawn from the photomultiplier.

The anode current can be read from a suitable meter in the anode circuit or the voltage developed across an anode load resistor can be amplified using a conventional electronic circuit.

It should be noted that a particularly stable power supply should be used for a photomultiplier, since for a given cathode illumination the output current varies very rapidly with changes in voltage : a change of 1% in power supply voltage produces a change of about 6·5% in anode current. A suitable supply unit specially designed for use with photomultipliers is the AEI R1184.

3. PRECAUTIONS

Provisions should be made to vary the supply voltage and/or the intensity of illumination over a wide range because of variations in characteristics between valves, see Para 4.

Continued

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PHOTOMULTIPLIERS

Precautions—*continued*

It is advisable to enclose these valves in an enclosure which is lightproof except for access to the cathode window area.

To obtain long life, stability and to keep dark current (i.e. the current that flows in the absence of any illumination) to a minimum, it may be advisable to run photomultipliers well below their maximum ratings.

These valves should never be exposed to bright light while potentials are being applied to the electrodes. Even when no potentials are applied, such exposure can cause a subsequent period of instability. It is therefore recommended that after any exposure to bright light a period of about 30 minutes under normal working conditions is allowed for the multiplier to become stable before starting to use it.

In some circumstances it may be found necessary to shield photomultipliers from strong electrostatic or magnetic fields.

4. CHARACTERISTICS

(a) Cathode Sensitivity

The cathode sensitivity of a photomultiplier is usually measured by applying a voltage of 30 to 100 volts between the cathode and all the other electrodes connected together. The value of the sensitivity is practically independent of voltage over this range.

The antimony-caesium photo-cathode has its maximum sensitivity at the blue end of the spectrum and it is not very sensitive to red light. The spectral response curves are shown for the individual types, they vary with the transmission characteristics of the envelope.

While the sensitivity does not vary greatly over the surface of the cathode, the anode current produced by one electron emitted from a point on the cathode varies very considerably with the position of this point. This means, of course, that when the cathode is illuminated by a beam of light of small cross-section, the overall sensitivity of the tube will vary very much with the location of the illuminating beam. If the distance along the cathode is measured from the end nearer the base, then the relative anode current is 20%, 90%, 100%, 90% and 20% at approximate distances of 2, 7, 12·5, 18 and 23 mm respectively and the corresponding figures across the cathode are 3, 4, 5·5, 7 and 8·5 mm. In measuring across the cathode from left to right it is assumed the grid is towards the observer with the base down and the cathode width is projected normal to the plane of the grid ; measurements are made from the inside edge of the grid support wire.

Continued

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PHOTOMULTIPLIERS

Characteristics—*continued*

(b) Anode Sensitivity

The average sensitivity figures quoted are very approximate. In the case of a photomultiplier with n stages and a given value of cathode photo-sensitivity, the anode sensitivity will vary as the nth power of the secondary emission coefficient of the secondary cathodes. Thus small changes in this coefficient will produce large changes in the sensitivity.

(c) Transit Time

The transit time of a photomultiplier is the time that elapses between the arrival of a pulse of light at the cathode and the arrival of a pulse of electrons at the anode. The spread in transit times is the increase in width of the output pulse over that of the pulse of light.

In this compact type of construction the transit time and the spread of transit times are very small. The response of the photomultiplier at frequencies of tens of megacycles per second is very little different from the static response.

(d) Signal to Noise Ratio

When ever a current flows in a photomultiplier it always contains a noise component. This mainly originates from the fact that the photo-electric emission from the cathode is not a continuous stream but consists of electrons whose emission varies in a random manner. At very low currents, the anode current, when examined by means of a C.R.O., can be seen to consist of individual pulses of varying amplitude ; each pulse corresponding to the emission of an electron from the cathode. The variations in amplitude are caused by random variations in the multiplication factor at the individual secondary cathodes. This effect augments the original noise.

As mentioned overleaf, photomultipliers give a good signal to noise ratio compared with a photo-cell and amplifier for low levels of illumination. The value of the signal to noise ratio does not vary over a very wide range as the supply voltage is varied but it is preferable to work below the maximum rating for best performance in this respect : (If the overall voltage is reduced to a very low value (say below 20V per stage) the signal to noise ratio will rise due to poor efficiency of collection of electrons from the cathode.)

At very low light levels, the dark current becomes the limiting factor. It is possible to reduce the dark current very considerably by maintaining the photomultiplier at a low temperature e.g. partially surrounding it by solid carbon dioxide. This has the effect of reducing thermionic emission from the cathode and also reducing leakage current through semiconducting films on the insulators. Precautions must be taken to avoid electrical leakage due to moisture condensation.

Continued

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PHOTOMULTIPLIERS

5. APPLICATIONS

The main use of photomultipliers is for the detection and measurement of very low intensities of illumination. The main advantages of a photomultiplier over a simple photo-cell are :—

(i) The high signal to noise ratio for small light levels.

(ii) The high internal amplification.

A photomultiplier is usually preferred to a photo-cell and amplifier because of the ease with which high frequency and pulse outputs are obtained.

For these reasons photomultipliers are often used in scintillation counting of alpha and gamma rays in conjunction with a suitable phosphor.

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27MI

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

RATING

Maximum Supply Voltage Secondary Cathode K.10 to Cathode K.1 (D.C. or Peak A.C.) (Volts)	950
Maximum Potential Anode/Secondary Cathode K.10 (Volts)	150
Maximum Anode Current (mA)	1.0
Cathode kl sensitivity (μA/lumen) (Vkl = 0, all secondary cathodes joined at 100 volts)	† 20 ←

† The sensitivity is on the basis of a lamp colour temperature of 2700°K and a light area of 5mm. x 20mm.

Note: It is recommended that the bleeder current in the potentiometer providing the secondary cathode voltages should be of the order of 10 times the maximum working current output of the tube.

GENERAL

The 27.M.1 is a high vacuum photo-cell with high response in the visible region. The photo electric current produced at the Cathode is multiplied many times by secondary emission occuring at successive cathodes within the valve.

It is capable of multiplying very small currents produced under weak illumination by an average value of one million times, when operated at 100 volts per stage.

The resultant output current is a linear function of the exciting illumination, under normal operating conditions. Since secondary emission occurs simultaneously, the frequency response is flat up to the frequencies at which transit time becomes a limiting factor.

Because of its great sensitivity, low noise level low dark current and freedom from distortion the 27.M.1 may be used for light operated relays, for film scanning, fascimile transmission and in scientific research involving low light levels; and in many applications its small size is an advantage.

It should be appreciated that with photo-electric multipliers, large variations in overall sensitivity may be present between individual valves.

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27MI

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

TYPICAL OPERATION

Voltage between anode and secondary cathode k10 (volts)		50
Voltage difference per stage (volts)		100
Anode dark current (max)(µA)	¶	0.25
Luminous sensitivity (amps/lumen)	‡	20
Current amplification	§‡	10^6

‡ The sensitivity is on the basis of a lamp colour temperature of 2700°K and a light area of 5mm x 20mm.

§ Ratio of anode sensitivity/cathode sensitivity.

¶ With 100 volts between anode and secondary cathode k10.

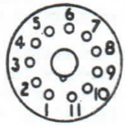
INTER-ELECTRODE CAPACITANCES.

Anode to all other electrodes (µµF)	6.7
Anode to cathode k10 (µµf)	4.1

DIMENSIONS.

Maximum Overall Length	(mm)	94.0
Maximum Bulb diameter	(mm)	28.5
Maximum Base diameter	(mm)	33.4
Light centre from seat	(mm)	49.2 ± 2.4
Cathode Length	(mm)	24
Cathode Width	(mm)	8

BASING. - Special 11 pin Sub Magnal



CONNECTIONS.

Pin 1	Cathode 2
Pin 2	Cathode 3
Pin 3	Cathode 4
Pin 4	Cathode 5
Pin 5	Cathode 6
Pin 6	Cathode 7
Pin 7	Cathode 8
Pin 8	Cathode 9
Pin 9	Cathode 10
Pin 10	Anode
Pin 11	Cathode 1

Direction of light.

Viewed from free end of pins.

Note: Pin 1 is taken as the first pin to the left of the keyway. Similarly pin 11 which is connected to the photo emitting cathode k1 is taken as the first pin to the right of the keyway.

Indicates a change ←

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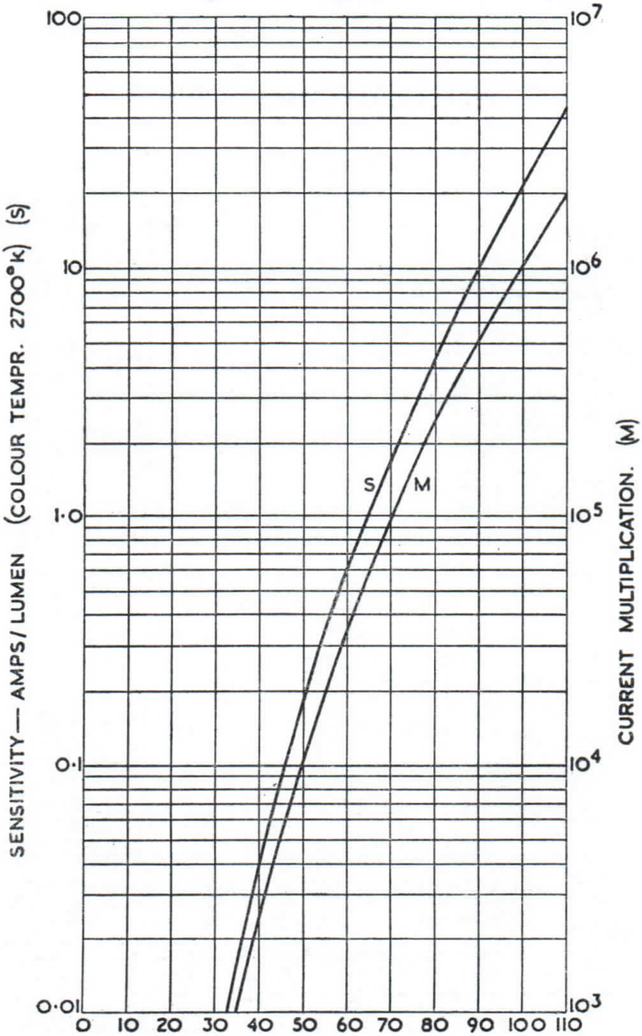
27MI

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

AVERAGE CHARACTERISTIC CURVES (D.C. Operation)



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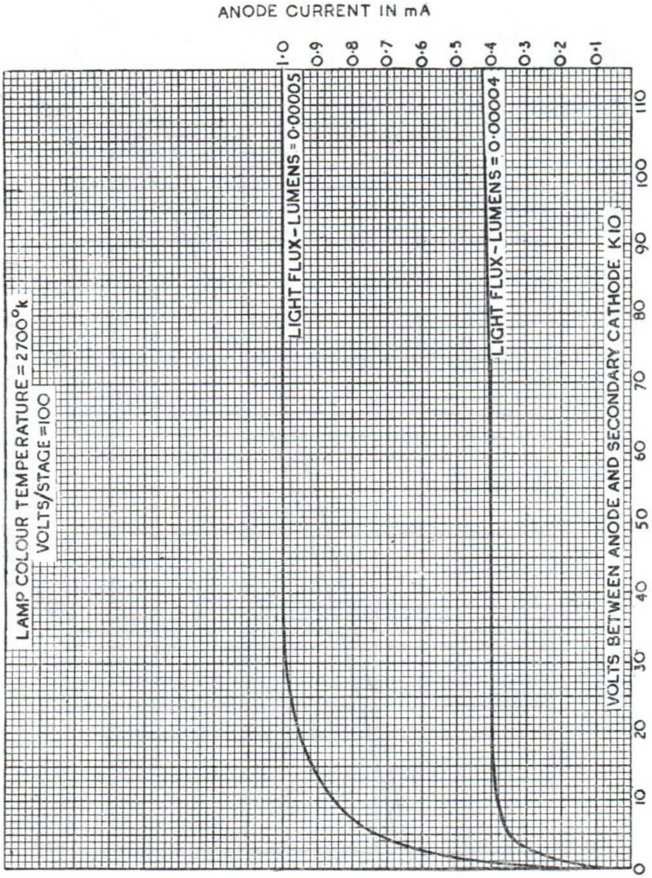
27MI

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

AVERAGE CHARACTERISTIC CURVES



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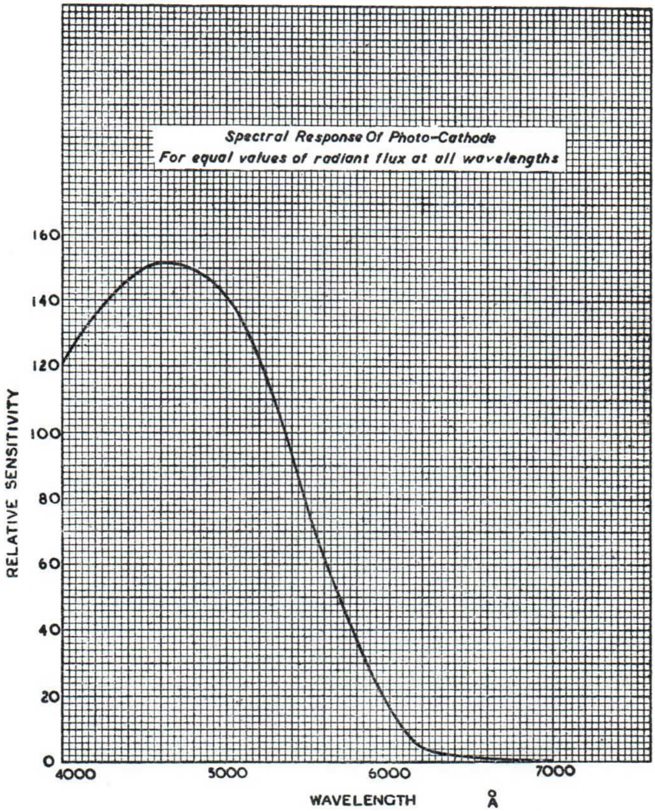
27M1

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

AVERAGE CHARACTERISTIC CURVES



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27M2

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

GENERAL

The 27.M.2 is a high vacuum photo-cell with high response in the visible region. The photo electric current produced at the Cathode is multiplied many times by secondary emission occuring at successive cathodes within the valve.

It is capable of multiplying very small currents produced under weak illumination by an average value of 250,000 times, when operated at 80 volts per stage.

The resultant output current is a linear function of the exciting illumination, under normal operating conditions. Since secondary emission occurs simultaneously, the frequency response is flat up to the frequencies at which transit time becomes a limiting factor.

Because of its sensitivity, low noise level, low dark current and freedom from distortion the 27.M.2 may be used for light operated relays and in experiments involving low light levels: and in many applications where its small size is an advantage.

It should be appreciated that with photo-electric multipliers large variations in overall sensitivity may be present between individual valves

RATING

Maximum Anode Supply Voltage (volts)	• 900
Maximum Potential Anode/Secondary cathode k10 (volts)	100
Maximum Anode Current (mA)	1.0
Cathode k1 sensitivity (µA lumen)	‡ 10

• With respect to cathode.

‡ The sensitivity is on the basis of a lamp colour temperature of 2700° K and a light area of 4mm x 20mm. Vk1 = 0, all secondary cathodes joined at 100 Volts.

NOTES

(1) It is recommended that the bleeder current in the potentiometer providing the secondary cathode voltages should be of the order of 10 times the maximum working current output of the tube.

(2) The 27.M.2 is similar to the 27.M.1 except for the wider tolerance on the anode dark current which necessitates a lower anode supply voltage.

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27M2

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

TYPICAL OPERATION

Voltage between anode and secondary cathode k10 (volts)	50
Voltage Difference per stage (volts)	80
Anode dark current (max) (µA)	• 0.25
Luminous sensitivity (amps/lumen)	‡ 2
Current amplification	† ‡ 250×10^3

• With 80 volts between anode and secondary cathode K10.

† Ratio of anode sensitivity/cathode sensitivity.

‡ The sensitivity is on the basis of a lamp colour temperature of 2700°K and a light area of 4.0mm x 20mm.

NOTE

By joining together Pins 8, 9 and 10 the cell may be used as a 7 stage multiplier. Volts per stage not to exceed 80 volts

By joining together pins 6, 7, 8, 9 and 10 the cell may be used as a 5 stage multiplier. Volts per stage not to exceed 80 volts.

INTER-ELECTRODE CAPACITANCES

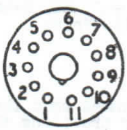
Anode to all other electrodes (µµF)	6.7
Anode to cathode k10 (µµF)	4.1

DIMENSIONS

Maximum Overall length (mm)	94.0
Maximum Seated Height (mm)	80.0
Maximum Bulb Diameter (mm)	28.5
Maximum Base Diameter (mm)	33.4
Light centre from seat (mm)	49.2±2.4
Cathode Length (mm)	24
Cathode Width (mm)	8

BASING Special 11 pin Sub Magnal

Pin 1	Cathode	2
Pin 2	Cathode	3
Pin 3	Cathode	4
Pin 4	Cathode	5
Pin 5	Cathode	6
Pin 6	Cathode	7
Pin 7	Cathode	8
Pin 8	Cathode	9
Pin 9	Cathode	10
Pin 10	Anode	
Pin 11	Cathode	1



Viewed from free end of pins.

NOTE: Pin 1 is taken as the first pin to the left of the keyway. Similarly pin 11 which is connected to the photo emitting cathode k1 is taken as the first pin to the right of the keyway.

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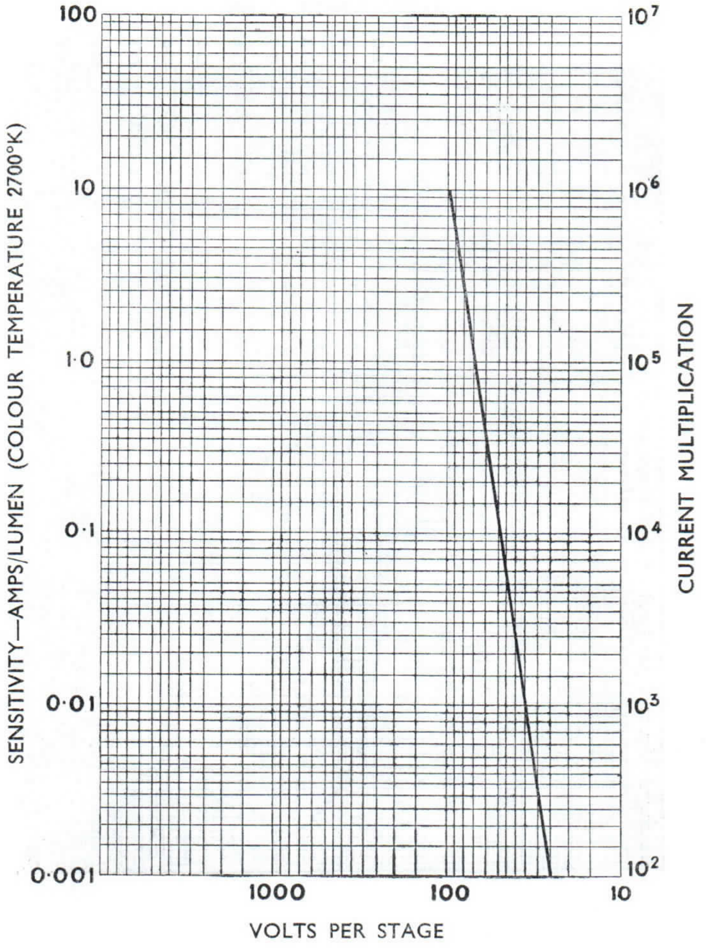
27M2

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

TENTATIVE CHARACTERISTIC CURVES

D.C. OPERATION



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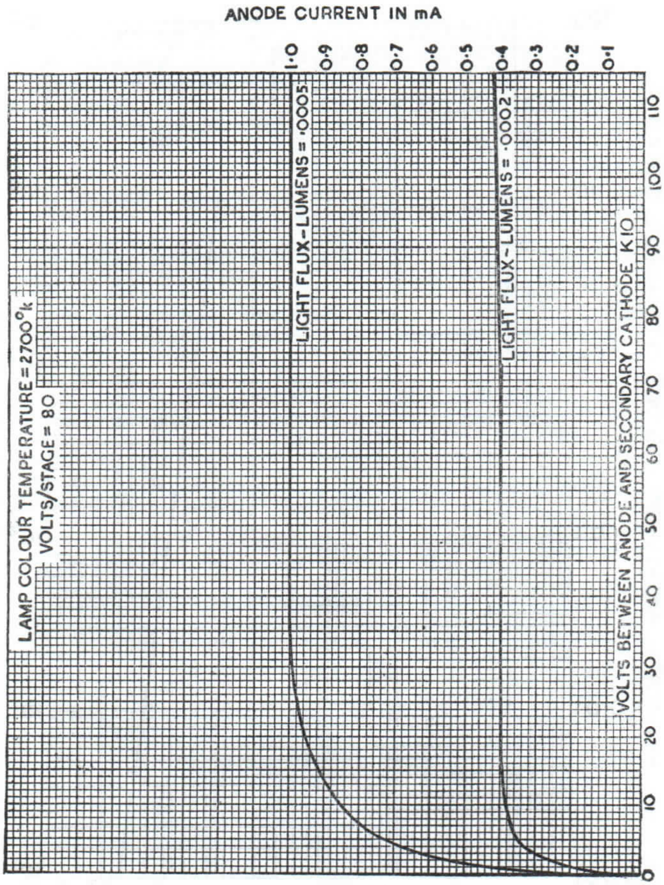
27M2

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

TENTATIVE CHARACTERISTIC CURVES



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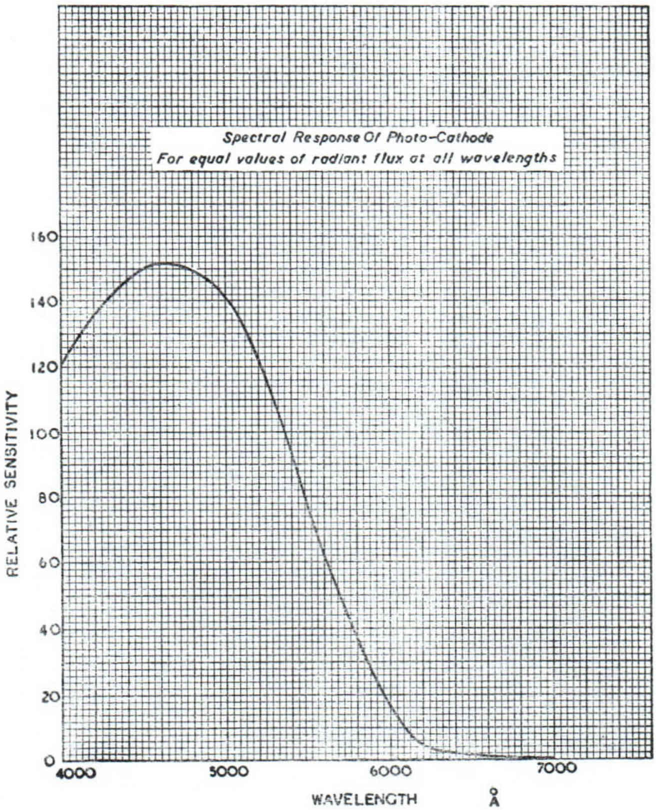
27M2

NINE STAGE PHOTO-ELECTRIC MULTIPLIER



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27M3

NINE STAGE PHOTO-ELECTRIC MULTIPLIER
(U.V. SENSITIVE)

RATING.

Maximum Supply voltage Secondary K10 to Cathode K1, (DC or Peak AC) volts	950
Maximum Potential Anode/Secondary cathode k10 (volts)	150
Maximum Anode Current (mA)	.1
Cathode k1 sensitivity (µA/lumen) (Vk1 = 0, all secondary cathodes joined at 100 volts)	• 10

• The Sensitivity is on the basis of a lamp colour temperature of 2700°K and a light area of 4mm x 20mm.

Note: It is recommended that the bleeder current in the potentiometer providing the secondary cathode voltages should be of the order of 15 times the maximum working current output of the tube.

GENERAL.

The 27M3 is a high vacuum photo-cell with high response in the visible and ultra-violet region. The photo electric current produced at the Cathode is multiplied many times by secondary emission occuring at successive cathodes within the valve.

It is capable of multiplying very small currents produced under weak illumination by an average value of one million times, when operated at 100 volts per stage.

The resultant output current is a linear function of the exciting illumination, under normal operating conditions. Since secondary emission occurs simultaneously, the frequency response is flat up to the frequencies at which transit time becomes a limiting factor.

Because of its great sensitivity, low noise level, low dark current and freedom from distortion the 27M3 may be used for light operated relays, for film scanning, facsimile transmission and in scientific research involving low light levels: and in many applications its small size is an advantage.

It should be appreciated that with photo-electric multipliers, large variations in overall sensitivity may be present between individual valves.

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27M3

NINE STAGE PHOTO-ELECTRIC MULTIPLIER
(U.V. SENSITIVE)

TYPICAL OPERATION.

Voltage between anode and secondary cathode K10 (volts)		50
Voltage difference per stage (volts)		100
Anode dark current (max) (μA)	¶	0.25
Luminous sensitivity (amps/lumen)	†	10
Current amplification.	§	10^6

† The sensitivity is on the basis of a lamp colour temperature of 2700 °K and a light area of 4mm x 20mm.

§ Ratio of anode sensitivity/cathode sensitivity.

¶ With 100 volts between anode and secondary cathode k10.

Note: By joining together pins 8,9 and 10, the cell may be used as a 7 stage multiplier. Volts per stage not to exceed 100 volts.

By joining together pins 6, 7, 8, 9, and 10 the cell may be used as a 5 stage multiplier. Volts per stage not to exceed 100 volts.

INTER-ELECTRODE CAPACITANCES.

Anode to all other electrodes (μμF)	6.7
Anode to cathode k10 (μμF)	4.1

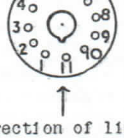
DIMENSIONS.

Maximum Overall Length	(mm)	99.0
Maximum Bulb diameter	(mm)	28.5
Maximum Base diameter	(mm)	33.4
Light centre from seat	(mm)	49.2±2.4
Cathode Length	(mm)	24
Cathode Width	(mm)	8

BASING - Special 11 pin Sub Magnal.

CONNECTIONS.

Pin.	
1.	Cathode 2
2.	Cathode 3
3.	Cathode 4
4.	Cathode 5
5.	Cathode 6
6.	Cathode 7
7.	Cathode 8
8.	Cathode 9
9.	Cathode 10
10	Anode
11	Cathode 1



Direction of light.

Viewed from free end of pins.

Note: Pin 1 is taken as the first pin to the left of the keyway. Similarly pin 11. which is connected to the photo omitting cathode k1 is taken as the first pin to the right of the keyway.

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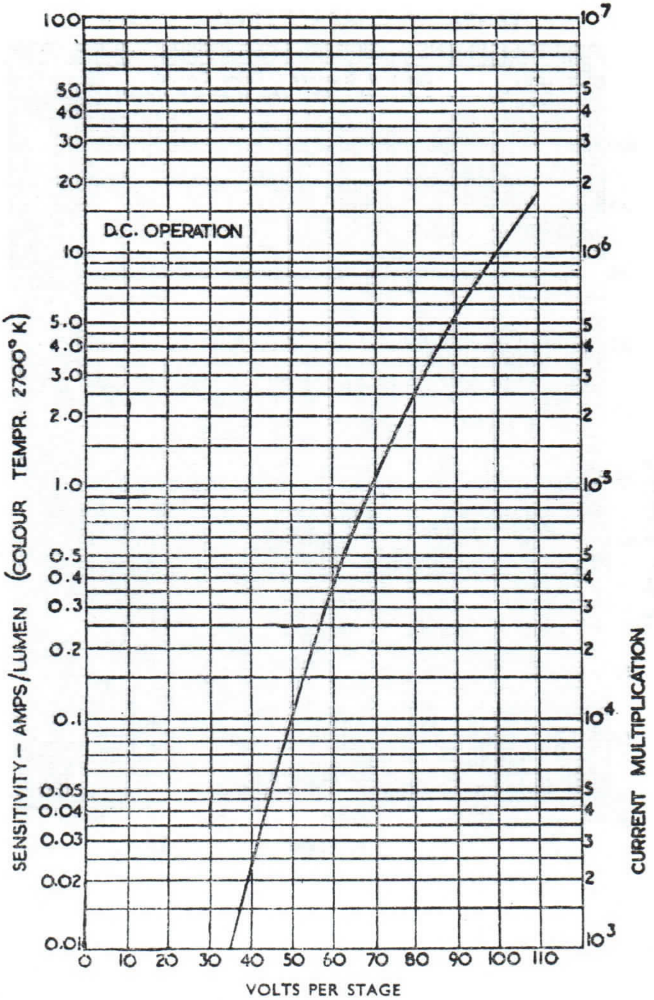
27M3

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

CHARACTERISTIC CURVE (D.C. OPERATION)



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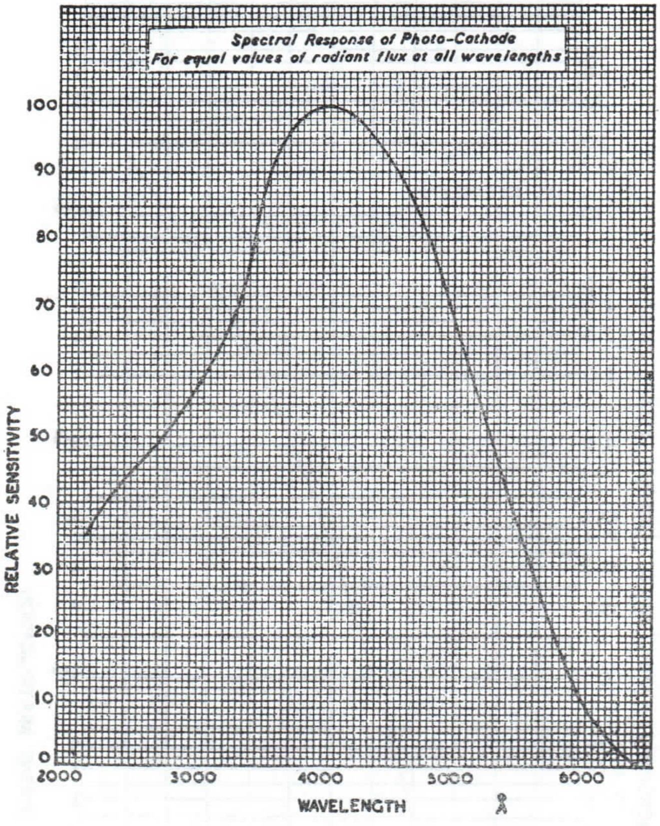
27M3

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

TENTATIVE CHARACTERISTIC CURVE



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27M12

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

GENERAL

The 27M12 is a nine stage photo multiplier cell for use in aircraft, being especially resistant to shock and vibration. It has a blue sensitive caesium antimony coated cathode and is fitted with flying leads.

RATING

Maximum Dynode k10 to Cathode Voltage (DC or Pk AC)	(volts)	$V_{k10-k1(max)}$	585
Maximum Anode to Dynode k10 Voltage	(volts)	$V_{a-k10(max)}$	65
Maximum Anode Current	(mA)	$I_{a(max)}$	1.0
Average Cathode Sensitivity	(μA/lumen)	$S_{k1(av)}$	20*
Maximum Ambient Working Temperature	(°C)		70

* $V_{k1} = 0$, all Dynodes joined at 100 volts. Colour temperature of lamp 2,700°K.

DIMENSIONS

Maximum Overall Length	(mm)	77
Nominal Seated Height	(mm)	63
Light Centre from Top (nominal)	(mm)	27.8
Maximum Bulb Diameter	(mm)	29.5
Cathode Length	(mm)	24
Cathode Width	(mm)	8
Approximate Nett Weight	(ozs)	$1\frac{1}{2}$
Approximate Packed Weight	(ozs)	4

Associated Electrical Industries Limited
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27M12

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

MOUNTING POSITION Unrestricted

TYPICAL OPERATION

Anode to Dynode k10 Voltage	(volts)	$V_{a\text{-}k10}$	65
Voltage per stage	(volts)		65
Anode Dark Current from Dynode k10(max)	(μA)		0.1**
Luminous Sensitivity from Dynode k10	(A/lumen)		0.4‡
Average Current Amplification			20,000‡‡

**With Anode to Dynode k10 and Dynode to Dynode Voltages 100 volts per stage.

‡ Measured with a lamp colour temperature 2,700° K and a light area of 5 x 20 mm.

‡‡ Ratio of k10 sensitivity to cathode sensitivity.

NOTES.—The bleed current in the potentiometer chain should be at least ten times the maximum output current.

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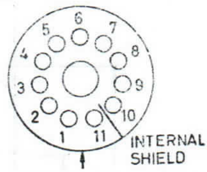
27M12

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

BASE—Flying Leads.



Direction of Light
Viewed from free end

CONNECTIONS

Pin 1	Secondary Cathode 2	k2
Pin 2	Secondary Cathode 3	k3
Pin 3	Secondary Cathode 4	k4
Pin 4	Secondary Cathode 5	k5
Pin 5	Secondary Cathode 6	k6
Pin 6	Secondary Cathode 7	k7
Pin 7	Secondary Cathode 8	k8
Pin 8	Secondary Cathode 9	k9
Pin 9	Secondary Cathode 10	k10
Pin 10	Anode	a
Pin 11	Photo cathode, Shield	k1,s

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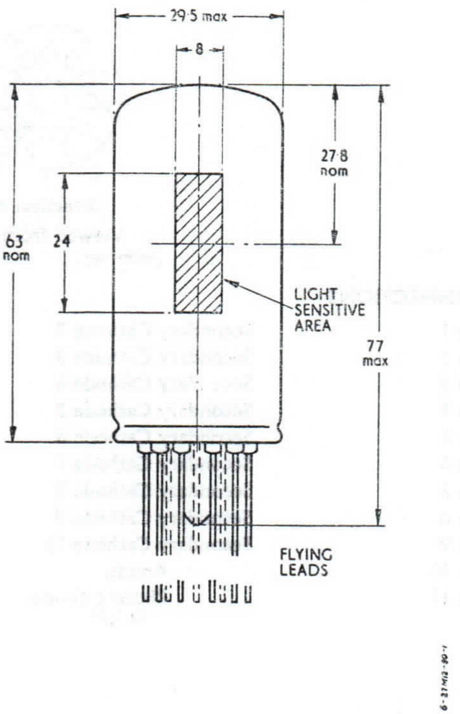
27M12

NINE STAGE PHOTO-ELECTRIC MULTIPLIER



Leads on 17.2 mm P.C.D.

All dimensions in mm.

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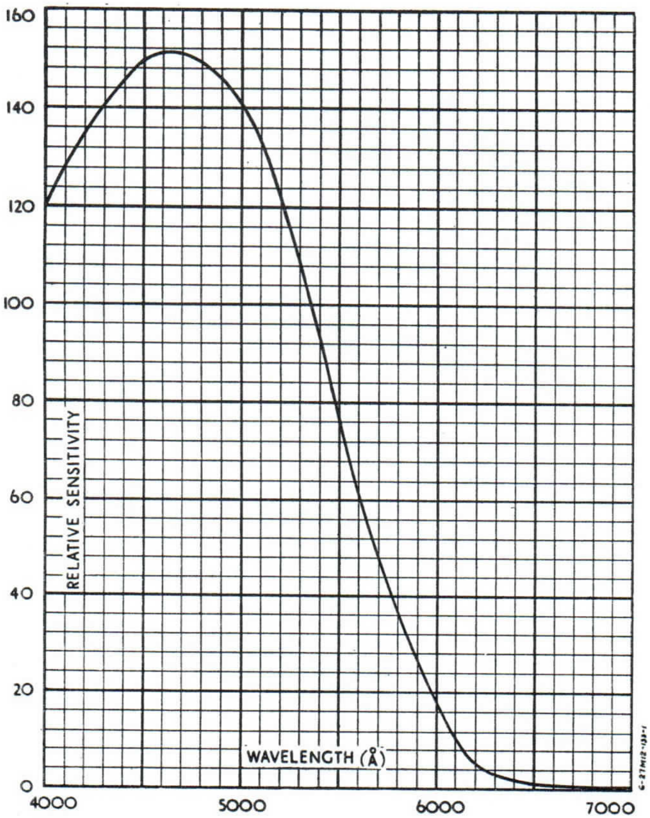
27M12

NINE STAGE PHOTO-ELECTRIC MULTIPLIER

AVERAGE CHARACTERISTIC CURVE : S/λ

For equal values of radiant flux at all wavelengths.



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27M12A

NINE STAGE PHOTOMULTIPLIER

GENERAL

The 27M12A is an improved version of the 27M12, having improved vibration performance. It is a nine stage photomultiplier for use in Aircraft, being especially resistant to shock and vibration. It has a blue sensitive caesium antimony coated cathode and is fitted with flying leads.

RATING(T_{amb} = 70°C) max.

Maximum Dynode k10/Cathode Voltage (DC or peak AC)	$V_{k10\text{-}k1(max)}$	585	V
Maximum Anode/Dynode k10 Voltage	$V_{a\text{-}k10(max)}$	65	V
Maximum Anode Current	$I_{a(max)}$	1·0	mA
Average Cathode Sensitivity	$S_{k1(av)}$	20*	μA/L

* V_{k1} = 0, all dynodes joined at 100 volts. Colour temperature of tungsten lamp = 2,700°K.

DIMENSIONS

Maximum Overall Length (excluding leads)	77	mm
Nominal Seated Height	63	mm
Light Centre from Top (nominal)	27·8	mm
Maximum Bulb Diameter	29·5	mm
Cathode Length	24	mm
Cathode Width	8	mm
Approximate Nett Weight	$1\frac{1}{2}$	ozs
Approximate Packed Weight	4	ozs

MOUNTING POSITION—Unrestricted

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Tel.: GERrard 9797

AEI

27M12A

NINE STAGE PHOTOMULTIPLIER

TYPICAL OPERATION

Anode/Dynode k10 Voltage	$V_{a\text{-}k10}$	65	V
Voltage per stage		65	V
Anode Dark Current from Dynode k10 (max)	$I_{a(dark)max}$	0·1**	μA
Luminous Sensitivity from Dynode k10		0·4‡	A/L
Average Current Amplification		20,000†	
Luminous Sensitivity from Anode		0·6‡	A/L
Average Current Amplification		30,000††	

** With Anode/Dynode k10 and Dynode/Dynode voltages 100 volts per stage.

‡ Measured with a tungsten lamp colour temperature of 2,700°K and a light area of 5 × 20mm.

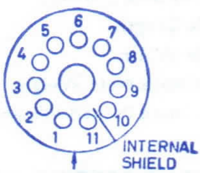
† Ratio of k10 sensitivity to Cathode sensitivity.

†† Ratio of anode sensitivity to Cathode sensitivity.

NOTES

The bleed current in the potentiometer chain should be at least ten times the maximum output current.

BASE—Flying Leads



DIRECTION OF LIGHT

Viewed from free end.

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27M12A

NINE STAGE PHOTOMULTIPLIER

CONNECTIONS

Pin 1	Secondary Cathode 2	k2
Pin 2	Secondary Cathode 3	k3
Pin 3	Secondary Cathode 4	k4
Pin 4	Secondary Cathode 5	k5
Pin 5	Secondary Cathode 6	k6
Pin 6	Secondary Cathode 7	k7
Pin 7	Secondary Cathode 8	k8
Pin 8	Secondary Cathode 9	k9
Pin 9	Secondary Cathode 10	k10
Pin 10	Anode	a
Pin 11	Photo Cathode, Shield	k1,s

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27M13

SEVEN STAGE PHOTO-MULTIPLIER

←

GENERAL

The 27M13 is a seven stage Photo-multiplier having a blue sensitive cathode and twin anodes. Its sensitivity in typical operation is 2.5 amps/lumen. The cathode surface is of Caesium Antimony. ←

RATING

Supply Voltage, Secondary Cathode k8 to photo-cathode k1 (DC or Peak AC) (max)	(volts)	$V_{k8\text{-}k1(max)}$	900
Supply Voltage, Anodes to Secondary Cathode k8 (max)	(volts)	$V_{a\text{-}k8(max)}$	125
Maximum Anode Current	(mA)	$I_{a(max)}$	1·0
Photo Cathode Sensitivity (average)	(μA/lumen)	$S_{k1(av)}$	20·0* ←

* All secondary cathodes and anodes joined, and at a potential of 100 volts to photo-cathode, measured with a light area 5·0 mm × 20 mm and a tungsten filament lamp having a colour temperature of 2,700°K.

All Maximum ratings are Absolute values, not Design Centres.

DIMENSIONS

Maximum Overall Length	(mm)	94
Maximum Seated Height	(mm)	80
Light Centre to Seat	(mm)	49·2 ± 2·4
Maximum Bulb Diameter	(mm)	29·5
Maximum Base Diameter	(mm)	33·4
Cathode Length	(mm)	24
Cathode Width	(mm)	8
Approximate Nett Weight	(ozs)	1¾
Approximate Packed Weight	(ozs)	4¾

MOUNTING POSITION—Unrestricted

Indicates a change ←

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27M13

SEVEN STAGE PHOTO-MULTIPLIER

←

TYPICAL OPERATION

Voltage between Anodes and Secondary Cathode k8	(volts)	V_{a-k8}	50
Voltage per Stage	(volts)	V_{stage}	125
Maximum Anode Dark Current (per Anode)	(μA)		0·25*
Luminous Sensitivity (per Anode)	(A/lumen)		2·5† ←
Average Current Amplification (per Anode)			125,000‡† ←

* With 125 volts between Anode and Secondary Cathode k8

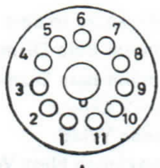
† With a colour temperature of 2,700°K and a light area of 5·0 mm × 20 mm.

‡ Ratio of anode to photo-cathode sensitivities.

NOTE.—The Secondary Cathode voltage potentiometer should have a bleed current of at least ten times the maximum output current.

BASE—B11A (11 pin sub-Magnal)

Viewed from free end of pins



Direction of Light

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27M13

SEVEN STAGE PHOTO-MULTIPLIER

←

CONNECTIONS

Pin 1	Secondary Cathode 2	k2	
Pin 2	Secondary Cathode 3	k3	
Pin 3	Secondary Cathode 4	k4	
Pin 4	Secondary Cathode 5	k5	
Pin 5	Secondary Cathode 6	k6	
Pin 6	Secondary Cathode 7	k7	
Pin 7	Secondary Cathode 8	k8	
Pin 8	Anode 1	a1	
Pin 9	Anode 2	a2	
Pin 10	Internal Connection	IC	←
Pin 11	Photo-cathode	k1	

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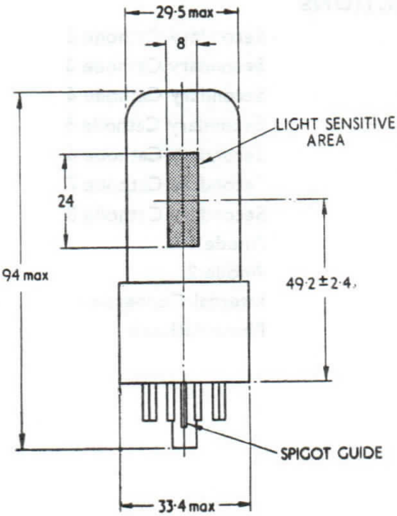
SEVEN STAGE PHOTO-MULTIPLIER



All dimensions in mm.

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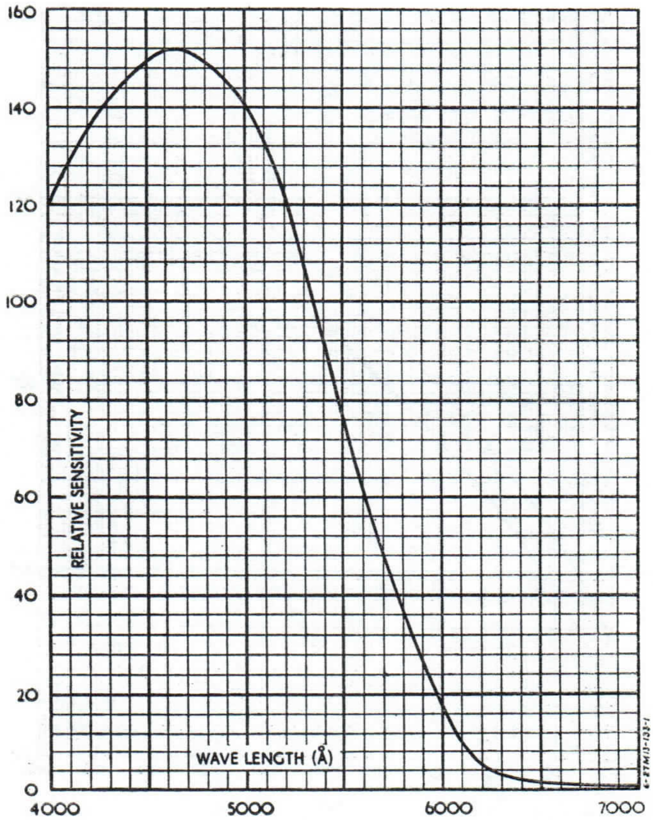
27M13

SEVEN STAGE PHOTO-MULTIPLIER

AVERAGE CHARACTERISTIC CURVE: S/λ

Spectral Response of Photo-Cathode for equal values of Radiant Flux at all Wavelengths.



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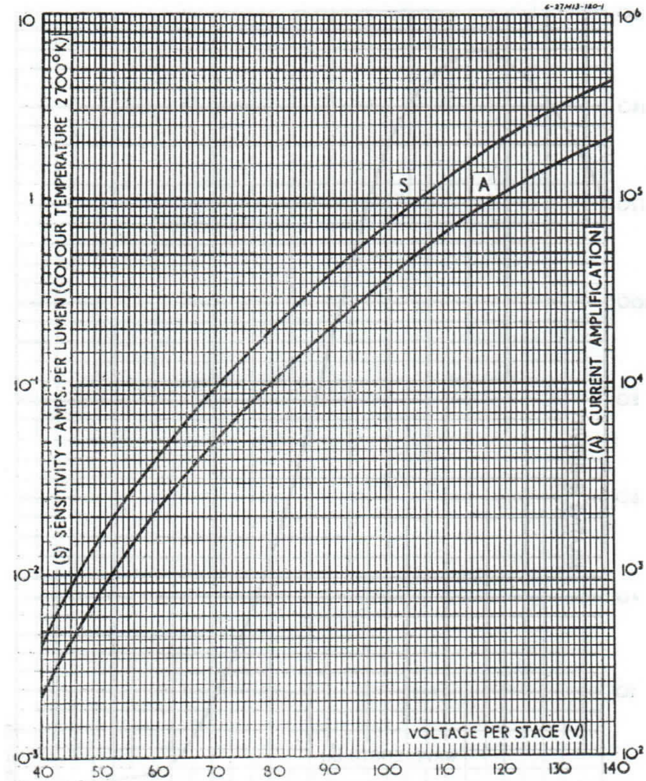
27M13

SEVEN STAGE PHOTO-MULTIPLIER

CHARACTERISTIC CURVES (D.C. OPERATION)

Sensitivity and current amplification for each anode



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Cathode Ray Tubes

AEI Details of Cathode-ray Tube Phosphors

Phosphor Number	Persistence* *(Approx)* 1 Foot Lambert to 1%	Kelly Chart Colour		Typical use
		Fluorescence	Phosphorescence	
T1	60ms	Yellowish Green	Yellowish Green	General oscillography and photography
T2	5 to 50s	Green	Green	Visual and photography
T3	50μs†	Purplish Blue	Purplish Blue	Oscillography and photography
T4	—	—	—	Television
T5	10μs	Green	Green	Flying spot scanning
T6	50s‡	Varies blue to white	Yellowish Green	Radar and oscillography
T7	100 to 300s	Orange	Orange	Radar display
T8	2 to 10s	Yellow	Yellow	General oscillography
T9	100s	Orange	Orange	Large screen oscillography
T10	—	Yellow Green	Yellow Green	Visual and photography
T11	30ms	Orange	Orange	Anti Flicker display
T12	100ms	Orange	Orange	Anti Flicker display

* Persistence is defined as the time taken from the cessation of continuous excitation for the luminance to decay from 1 Foot Lambert to approximately 1% of that value.

† Time to 10%.

‡ Yellow component.

Most AEI cathode-ray tubes can be supplied with any one of the screen phosphors described above but it should be noted that, for various reasons, not all tubes are available with all phosphors listed. Information on specific cases is available on request. Certain tubes with phosphors other than those listed can be supplied to special order. When ordering, the type of screen phosphor required should be indicated by adding the appropriate suffix to the number of the cathode-ray tube, e.g. 31E12/T6.

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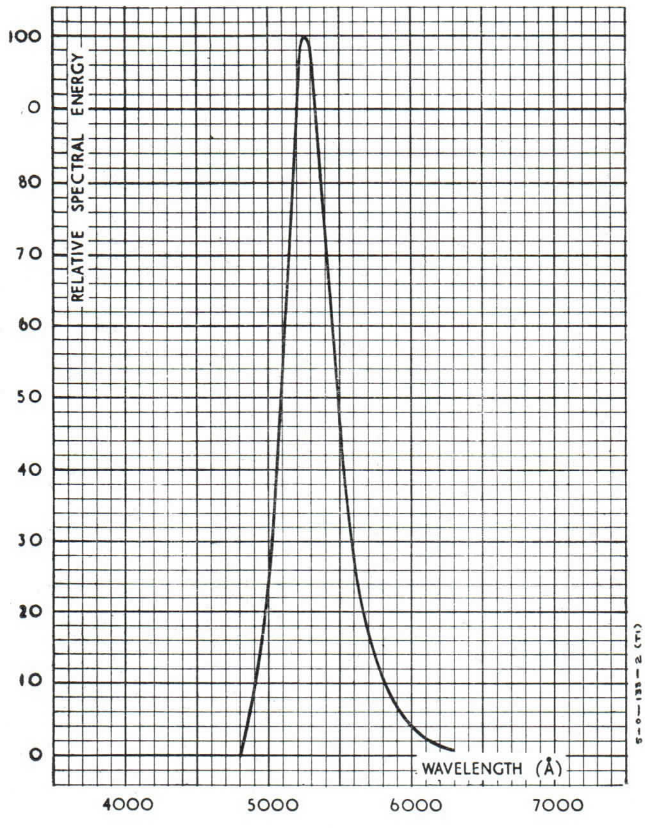
RELATIVE SPECTRAL ENERGY DISTRIBUTION
OF TYPICAL CRT SCREEN



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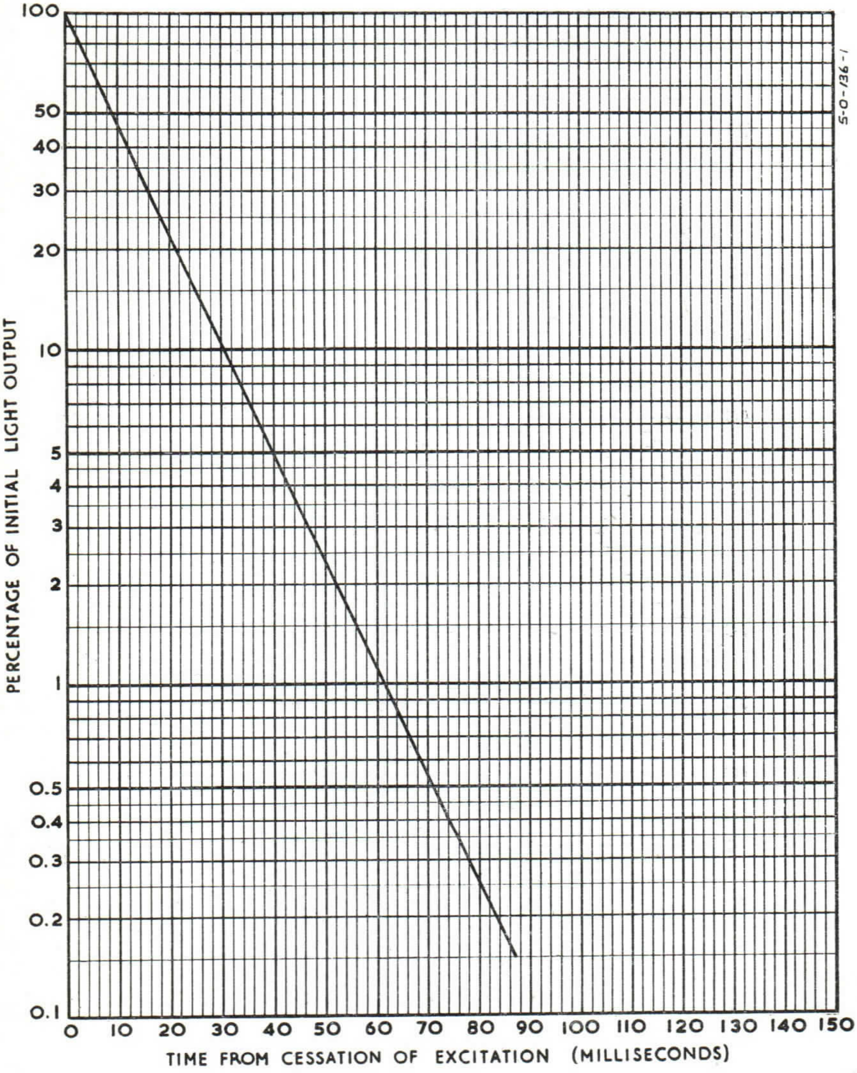
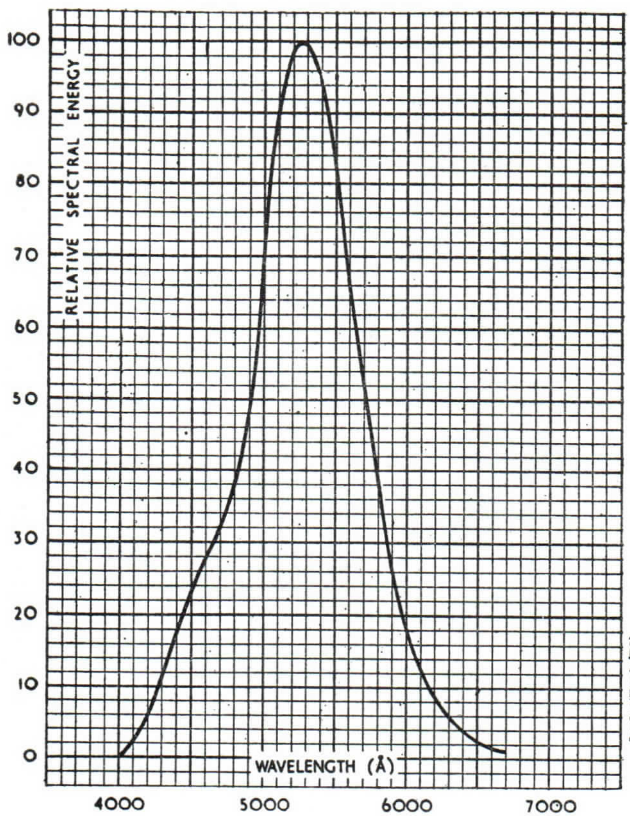
PERSISTENCE CHARACTERISTICS of typical CRT screen

(Characteristics are substantially independent of operating conditions.)



RELATIVE SPECTRAL ENERGY DISTRIBUTION
OF TYPICAL CRT SCREEN



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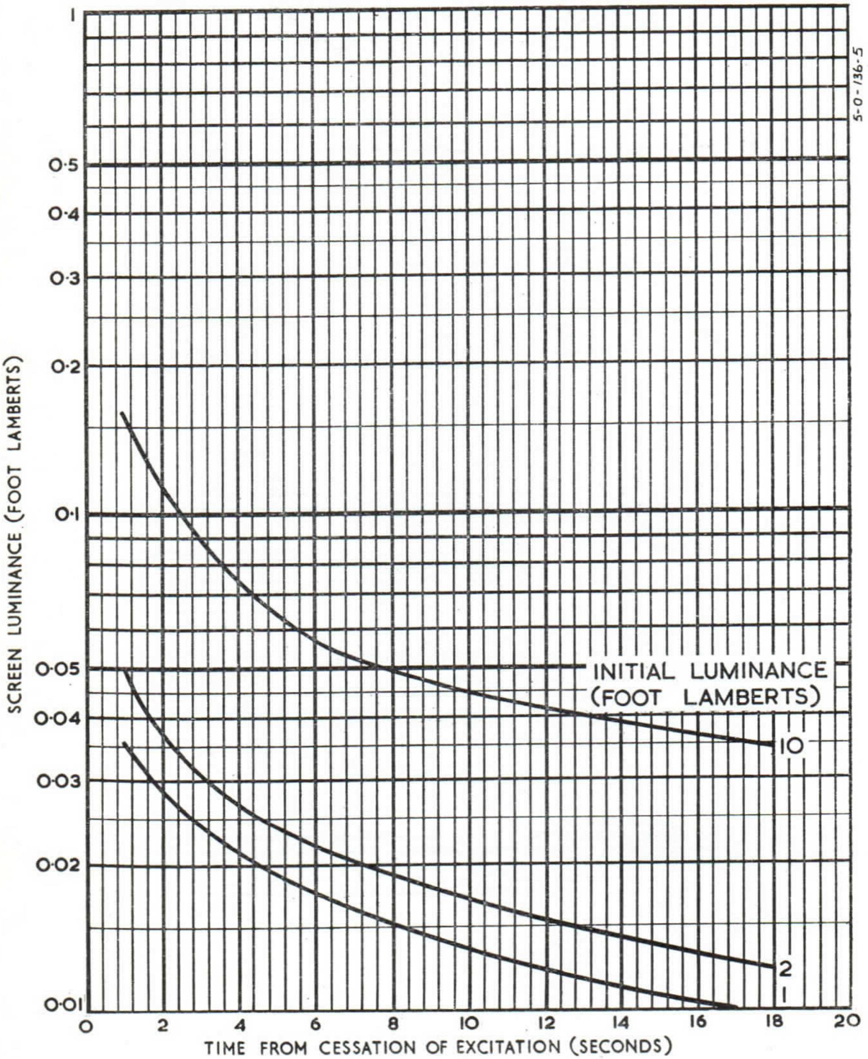
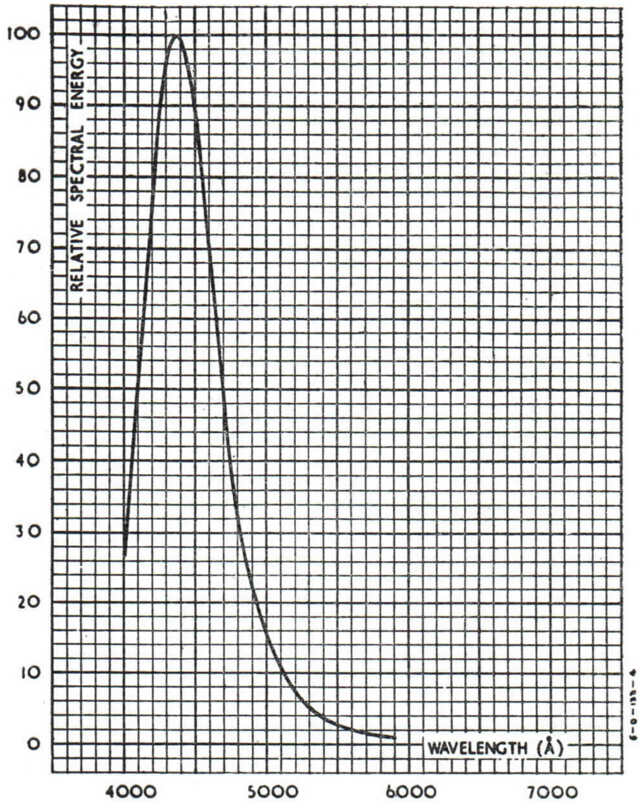
PERSISTENCE CHARACTERISTICS of typical CRT screen.
Excitation—Continuous, focused, 405 line, interlaced raster, 100 mm × 100 mm
Final Anode Voltage—5 kV.



RELATIVE SPECTRAL ENERGY DISTRIBUTION
OF TYPICAL CRT SCREEN



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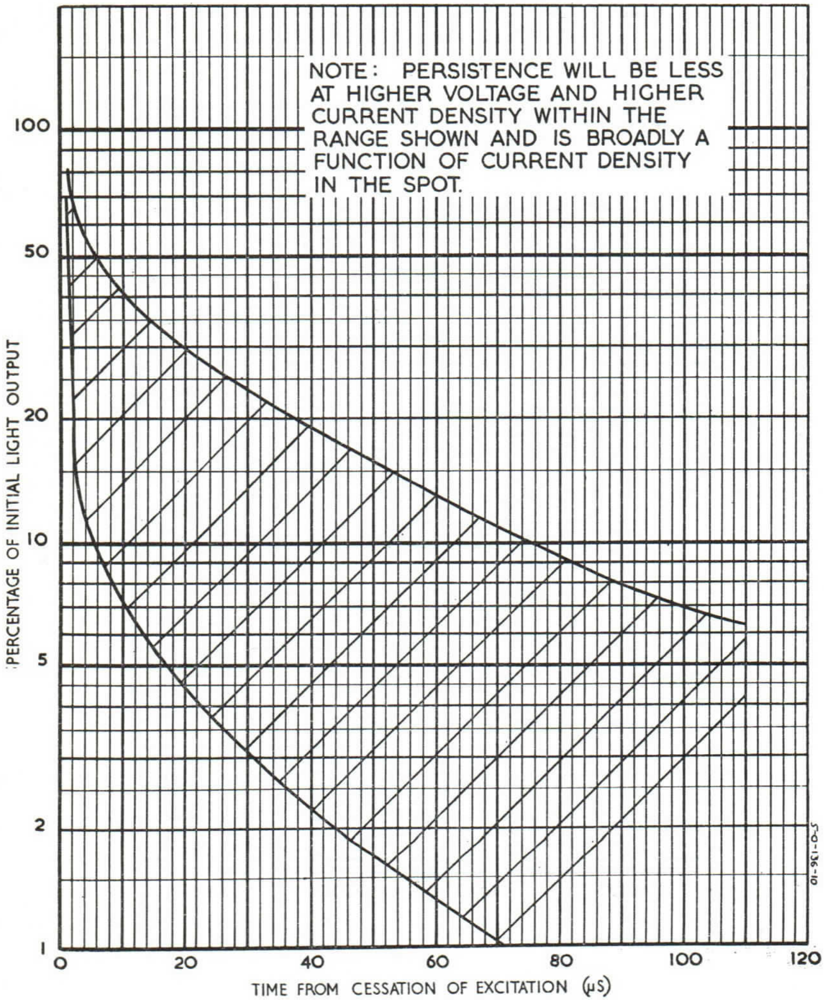
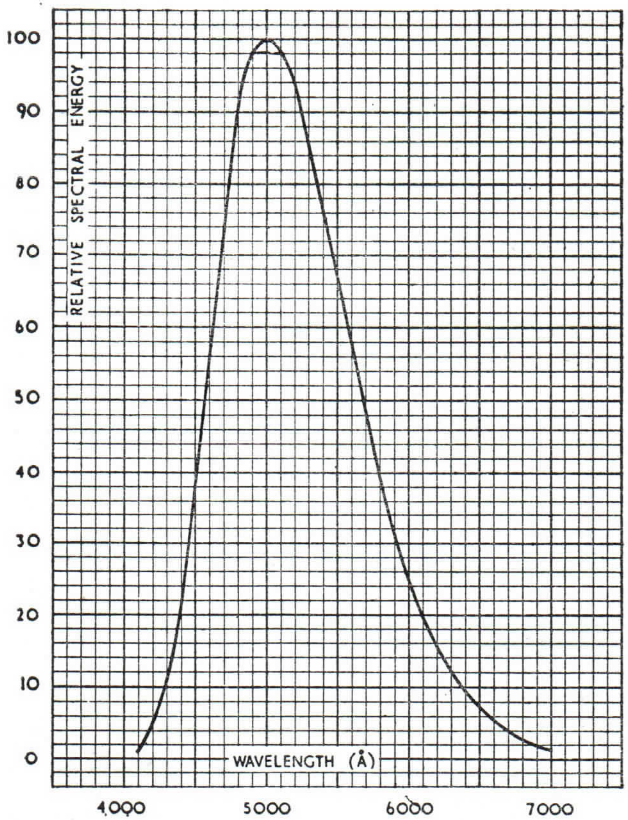
PERSISTENCE CHARACTERISTICS (Range) of typical CRT screen.



RELATIVE SPECTRAL ENERGY DISTRIBUTION OF TYPICAL CRT SCREEN



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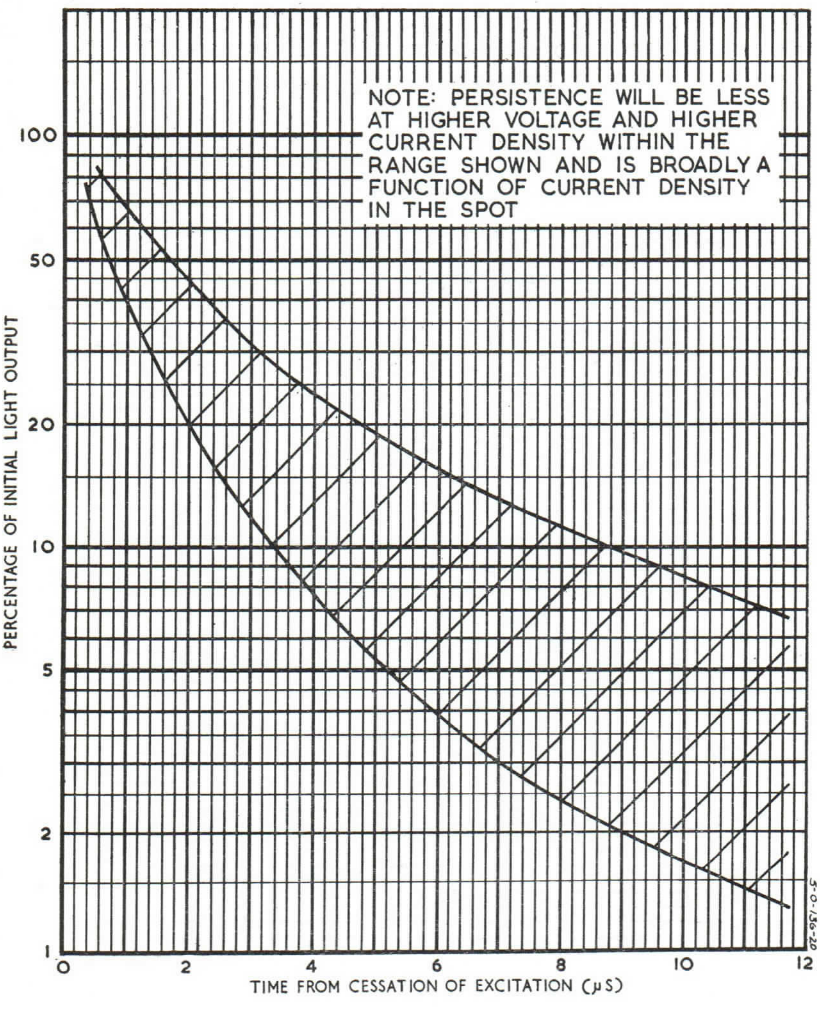
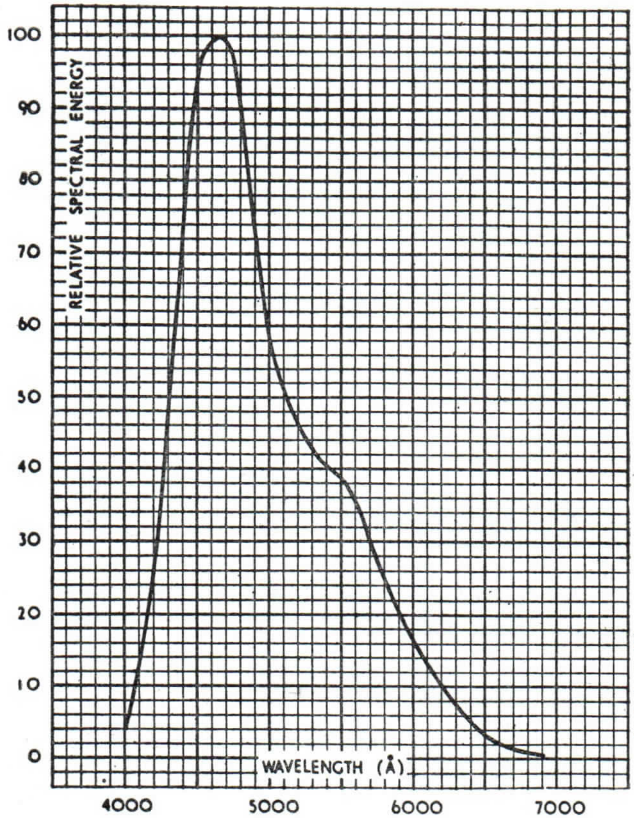
PERSISTENCE CHARACTERISTICS (Range) of typical CRT screen.



RELATIVE SPECTRAL ENERGY DISTRIBUTION
OF TYPICAL CRT SCREEN



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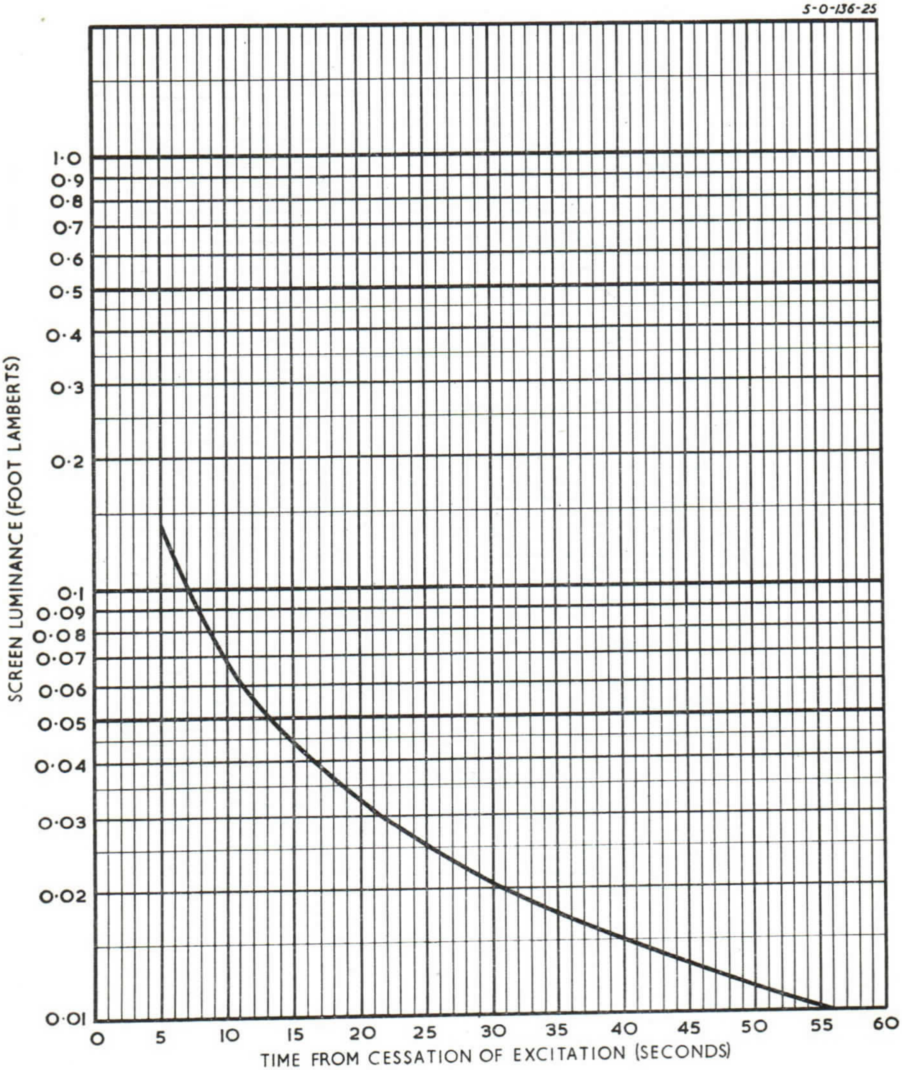
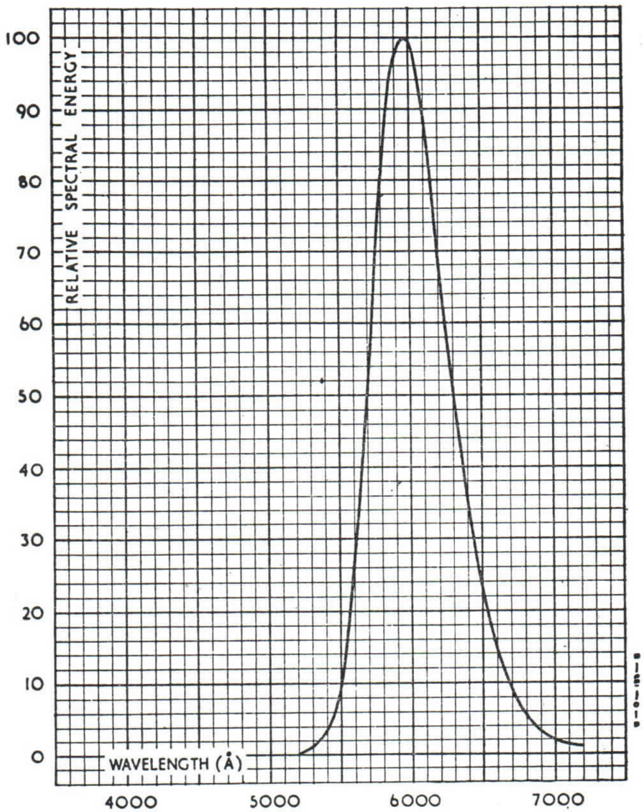
PERSISTENCE CHARACTERISTICS (of yellow component).
Excitation—Continuous, focused, 405 line, interlaced raster, 150 mm × 150 mm
Final Anode Voltage—10 kV.
Initial Luminance—1 Foot Lambert (yellow component).



RELATIVE SPECTRAL ENERGY DISTRIBUTION
OF TYPICAL CRT SCREEN



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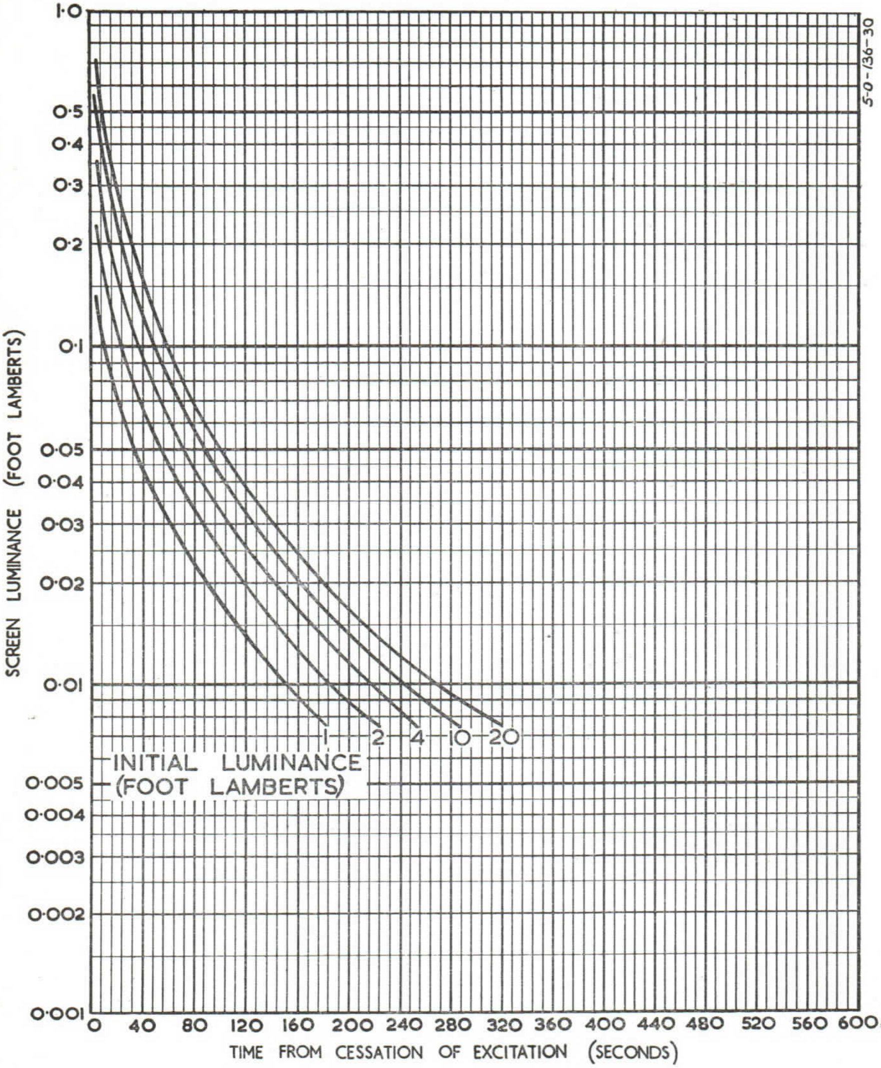
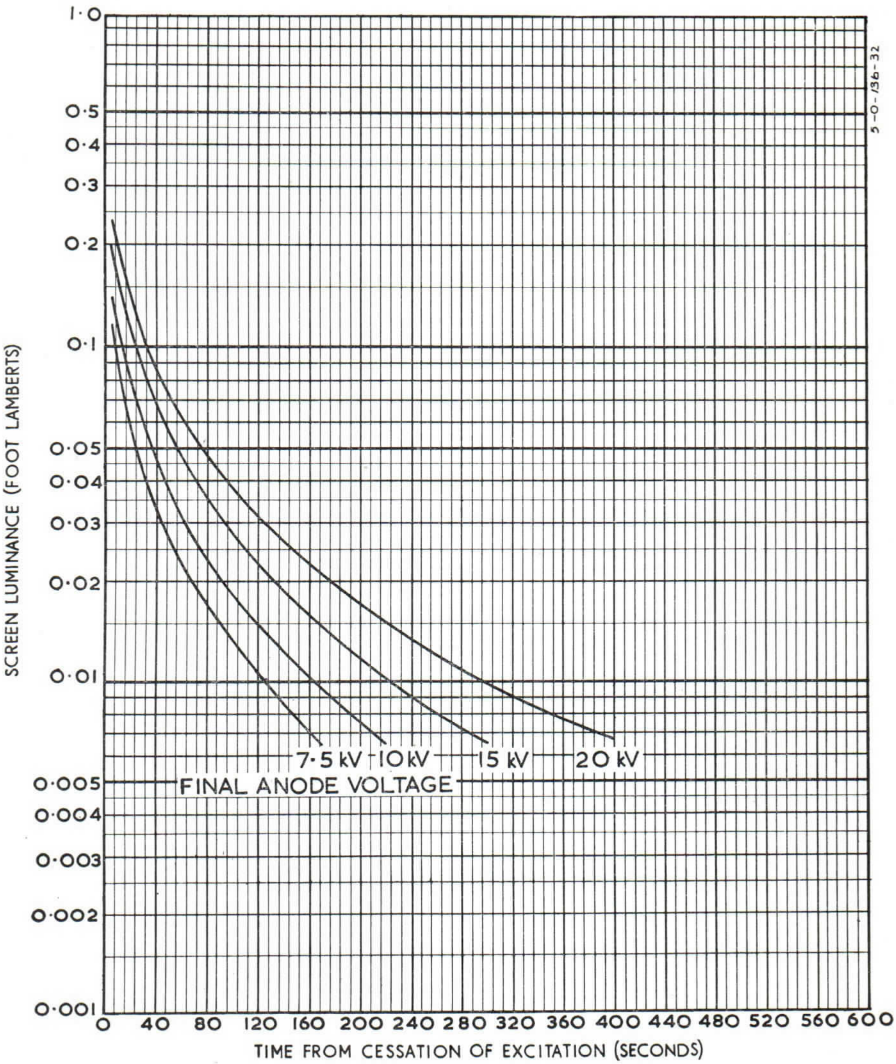
PERSISTENCE CHARACTERISTICS of typical aluminised CRT screen.
Excitation—Continuous, focused, 405 line, interlaced raster, 150 mm × 150 mm
Final Anode Voltage—10 kV
Note—This screen is liable to burn if a stationary or slow-moving spot is used even with low values of mean current.



PERSISTENCE CHARACTERISTICS of typical aluminised CRT screen.
Excitation—Continuous, focused, 405 line, interlaced raster, 150 mm × 150 mm
Initial Luminance—1 Foot Lambert.
Note—This screen is liable to burn if a stationary or slow-moving spot is used even with low values of mean current.



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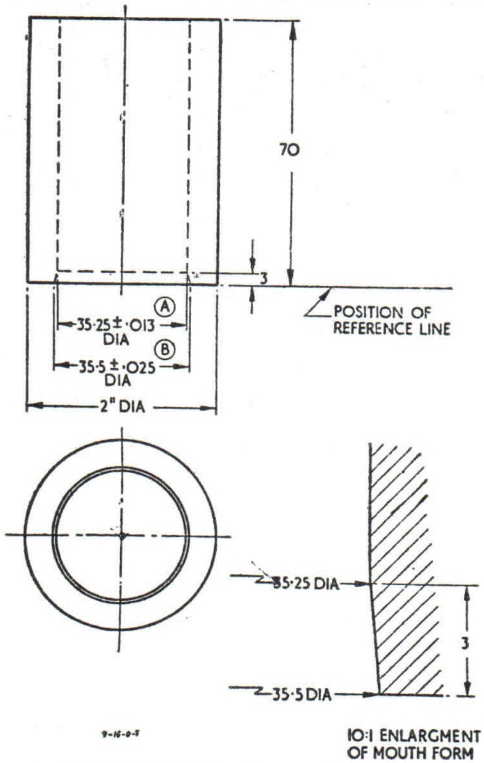
Reference Line Gauge No. 6

For C.R. Tubes having a Nominal Neck Diameter of 34·5 mm.



All dimensions in mm. unless otherwise stated.

NOTE 1—Deflector Yoke Design

The internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

NOTE 2—Tolerances

The tolerances shown are initial manufacturing limits. The figures given below are the maximum allowable limits for wear :

(A) + 0·059 (B) + 0·075

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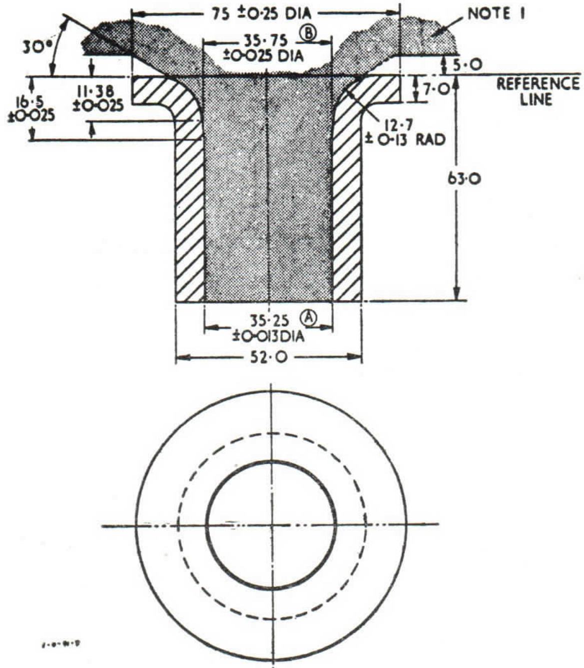
Reference Line Gauge No. 7

For C.R. Tubes having a Nominal Neck Diameter of 34·5 mm.
Deflection Angle 67·5° approx. (Picture Diagonal).



All dimensions in mm. unless otherwise stated.

NOTE 1—Deflector Yoke Design

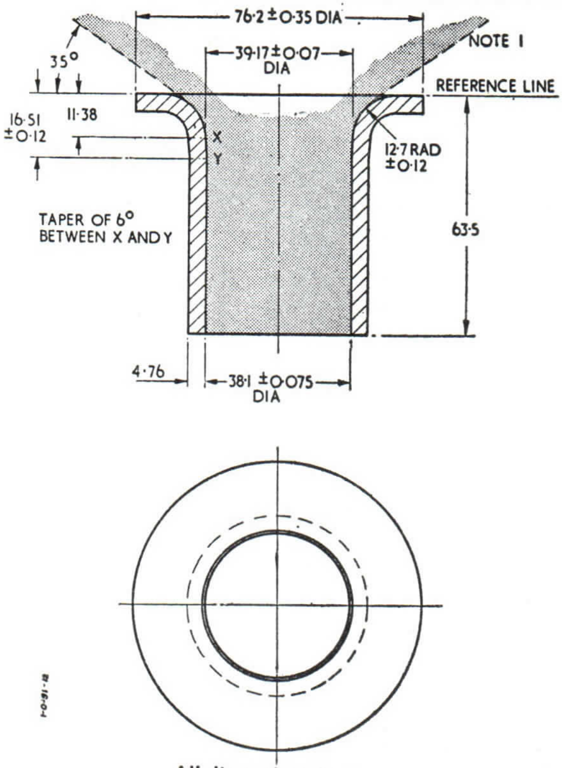
The inner surface of the yoke must not extend into the shaded region and the internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

NOTE 2—Tolerances

The tolerances shown are initial manufacturing limits.
The figures given below are the maximum allowable limits for wear :

(A) + 0·059 (B) + 0.075

For C.R. Tubes having a Nominal Neck Diameter of 36·5mm.



All dimensions in mm.

NOTE 1—Deflector Yoke Design

The inner surface of the yoke must not extend into the shaded region and the internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

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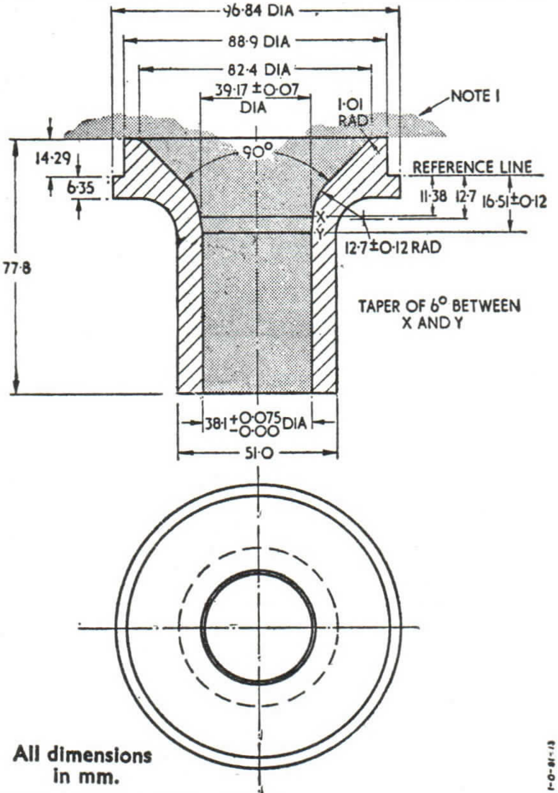
For C.R. Tubes having a Nominal Neck Diameter of 36·5 mm



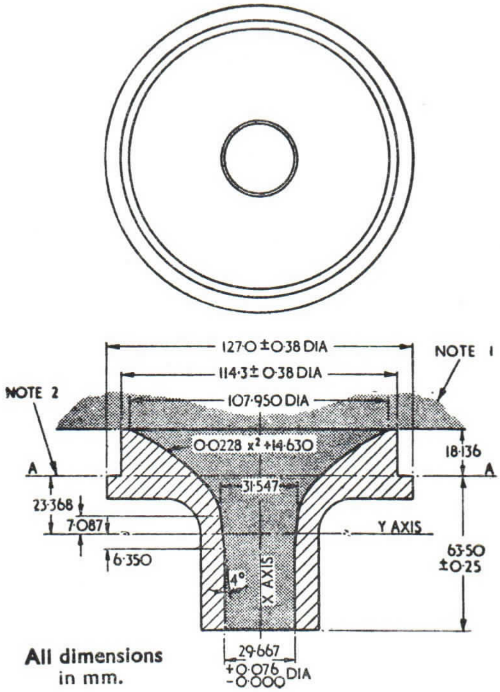
All dimensions in mm.

NOTE 1—Deflector Yoke Design

The inner surface of the yoke must not extend into the shaded region and the internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

AEI Reference Line Gauge No. 16

For C.R. Tubes having a nominal Neck Diameter of 28.5 mm.
Deflection Angle 110° approx. (Picture Diagonal)



NOTE 1.—Deflector Yoke Design.
The inner surface of the yoke must not extend into the shaded region and the internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

NOTE 2.—Reference Line.
The Reference Line is determined by the plane "A-A" when the gauge is seated against the funnel.

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30B1

CATHODE RAY TUBE—ALL ELECTROSTATIC 3½" Dia.

Indirectly heated high grade precision measurement cathode ray tube with a polished flat face

RATING

Heater Voltage (volts)	V_h	4.0
Heater Current (amps)	I_h	0.72
Maximum 1st Anode Voltage (volts)	$V_{a1(max)}$	2,500
Maximum 2nd Anode Voltage (volts)	$V_{a2(max)}$	1,000
Maximum 3rd Anode Voltage (volts)	$V_{a3(max)}$	6,000
Average Sensitivity of "X" Plates (mm/V)		* 420/V
Average Sensitivity of "Y" Plates (mm/V)		* 840/V

Where "V" denotes the voltage on the 3rd Anode and bulb coating.

INTER-ELECTRODE CAPACITANCES

X1 Deflecting Plate/All other electrodes	(µµF)	$C_{x1,all}$	15.0
X2 Deflecting Plate/All other electrodes	(µµF)	$C_{x2,all}$	15.0
Y1 Deflecting Plate/All other electrodes	(µµF)	$C_{y1,all}$	14.5
Y2 Deflecting Plate/All other electrodes	(µµF)	$C_{y2,all}$	14.5
X1 Deflecting Plate/Y1 Deflecting Plate	(µµF)	$C_{x1,y1}$	1.5
X1 Deflecting Plate/Y2 Deflecting Plate	(µµF)	$C_{x1,y2}$	1.0
X2 Deflecting Plate/Y1 Deflecting Plate	(µµF)	$C_{x2,y1}$	1.0
X2 Deflecting Plate/Y2 Deflecting Plate	(µµF)	$C_{x2,y2}$	1.25
Control Grid (Wehnelt)/All other electrodes	(uuF)	$C_{g,all}$	9.5

DIMENSIONS

Maximum Overall Length (mm)	340
Maximum Diameter (mm)	90
Nominal Screen Diameter (inches)	3½
Approximate Nett Weight (ozs)	21
Approximate Packed Weight (lbs)	10¾

NOTES

For general measurement work the 30.B.1/P1 is recommended. This has a screen with a medium persistence green phosphor. For special applications, however, the tube may be supplied with any of the standard phosphors described on the Introductory Page to this section.

Final Anode and Bulb coating are brought out separately in order to enable a finer spot or a higher writing speed to be obtained by increasing the Final Anode voltage above the limit set for the 1st Anode Voltage.

In use the 3rd Anode and bulb coating are normally joined.

All maximum ratings are absolute values not design centres.

30B1

CATHODE RAY TUBE—ALL ELECTROSTATIC $3\frac{1}{2}''$ Dia.

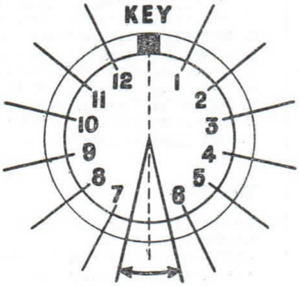
Indirectly heated high grade precision measurement cathode ray tube with a polished flat face

TYPICAL OPERATION

3rd Anode Voltage (volts)	V_{a3}	2,000	3,000	5,000	←
2nd Anode Voltage - approximate, for focus (volts)	V_{a2}	360	540	900	←
1st Anode Voltage (volts)	V_{a1}	2,000	2,000	2,000	←
Average Bias on Control Grid for Cut-off of Beam Current (volts)	V_g	- 60	-60	-60	←
Average Working Bias for 20μA Beam (volts)		- 47	-47	-47	←
Approximate Sensitivity of "X" Plates (mm/V)		0.21	0.14	0.084	←
Approximate Sensitivity of "Y" Plates (mm/V)		0.42	0.28	0.168	←

BASE 12 Contact Key Base (BS.448)

VIEW OF FREE END



PERMISSIBLE ANGULAR VARIATION OF MOUNTS ± 10°

CONNEXIONS

Pin 1	Control Grid	g
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode 1	a1
Pin 6	Anode 2	a2
Pin 7	Internal Coating	m
Pin 8	Deflecting Plate Y2	y2
Pin 9	Deflecting Plate X2	x2
Pin 10	Anode 3	a3
Pin 11	Deflecting Plate X1	x1
Pin 12	Deflecting Plate Y1	y1

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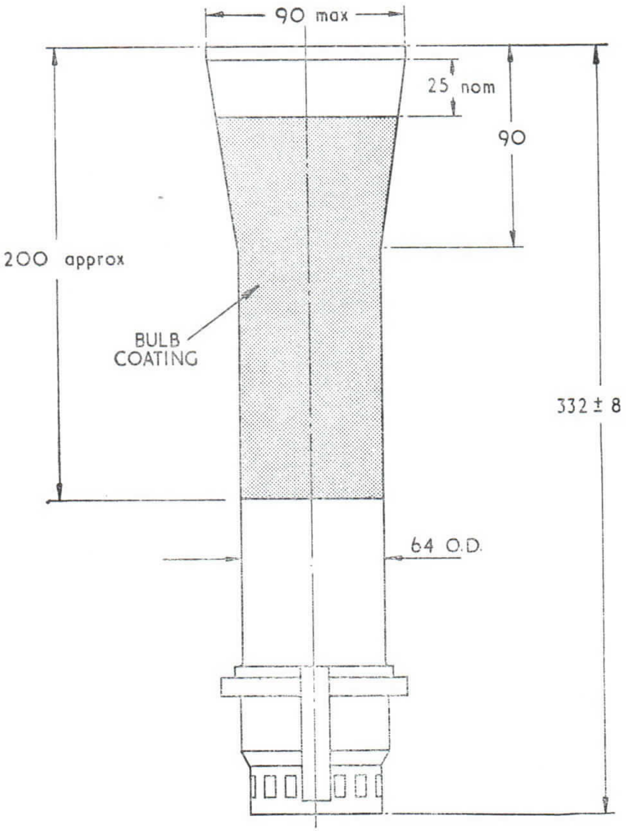
30B1

CATHODE RAY TUBE—ALL ELECTROSTATIC $3\frac{1}{2}''$ Dia.
Indirectly heated high grade precision measurement cathode ray tube with a polished flat face



All dimensions in mm.

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30C2

$5\frac{1}{2}''$ MEASUREMENT CATHODE RAY TUBE ELECTROSTATIC FOCUS AND DEFLECTION

GENERAL

The 30C2 is a precision Measurement Cathode Ray Tube having a $5\frac{1}{2}''$ diameter polished flat face.

RATING

Heater Voltage (volts)	V_h	4.0
Heater Current (amps)	I_h	0.72
Maximum 1st Anode Voltage (volts)	$V_{a1(max)}$	2,500
Maximum 2nd Anode Voltage (volts)	$V_{a2(max)}$	1,000
Maximum 3rd Anode Voltage (volts)	$V_{a3(max)}$	6,000
Average Sensitivity of " X " Plates (mm/V)		600/V*
Average Sensitivity of " Y " Plates (mm/V)		1100/V*

* Where " V " denotes the voltage on the 3rd Anode and bulb coating.

INTER-ELECTRODE CAPACITANCES (pF)

X1 Plate/All other electrodes	$c_{x1\text{-}all}$	15.0
X2 Plate/All other electrodes	$c_{x2\text{-}all}$	15.0
Y1 Plate/All other electrodes	$c_{y1\text{-}all}$	14.5
Y2 Plate/All other electrodes	$c_{y2\text{-}all}$	14.5
X1 Plate/Y1 Plate	$c_{x1\text{-}y1}$	1.5
X1 Plate/Y2 Plate	$c_{x1\text{-}y2}$	1.0
X2 Plate/Y1 Plate	$c_{x2\text{-}y1}$	1.0
X2 Plate/Y2 Plate	$c_{x2\text{-}y2}$	1.25
Grid/All other electrodes	$c_{g\text{-}all}$	9.5

DIMENSIONS

Maximum Overall Length	(mm)	430
Maximum Diameter	(mm)	142
Nominal Screen Diameter	(ins)	$5\frac{1}{2}$
Approximate Nett Weight	(ozs)	30
Approximate Packed Weight	(lbs)	$11\frac{1}{4}$

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30C2

5½″ MEASUREMENT CATHODE RAY TUBE ELECTROSTATIC FOCUS AND DEFLECTION

NOTES

For general measurement work the 30C2/T1 is recommended. This has a screen with a medium persistence green phosphor. For special applications, however, the tube may be supplied with any of the standard phosphors described on the Introductory Page to this Section, except T7.

The Final Anode and the Bulb coating are brought out separately from the First Anode in order that a finer spot or a high writing speed may be obtained by increasing the Final Anode Voltage above the limit set for the First Anode Voltage.

In use the Third Anode and Bulb coating are normally joined.

All Maximum Ratings are Absolute Values, not Design Centres.

TYPICAL OPERATION

3rd Anode Voltage (volts)	V_{a3}	2,000	5,000
2nd Anode Voltage for focus (approx.) (volts)	V_{a2}	440	800
1st Anode Voltage (volts)	V_{a1}	2,000	2,000
Average Bias on Control Grid for Cut-off of Beam Current (volts)	V_g	—60	—60
Average Working Bias for 20μA Beam (volts)		—33	—33
Approximate Sensitivity of "X" Plates (mm/V)		0.30	0.12
Approximate Sensitivity of "Y" Plates (mm/V)		0.57	0.23

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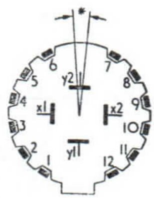
30C2

5½" MEASUREMENT CATHODE RAY TUBE
ELECTROSTATIC FOCUS AND DEFLECTION

BASE—B12D

* Permissible angular variation of mounts ±10°



View from free end of base.

CONNECTIONS

Pin 1	Control Grid	g
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode 1	a1
Pin 6	Anode 2	a2
Pin 7	Internal Coating	m
Pin 8	Deflecting Plate Y2	y2
Pin 9	Deflecting Plate X2	x2
Pin 10	Anode 3	a3
Pin 11	Deflecting Plate X1	x1
Pin 12	Deflecting Plate Y1	y1

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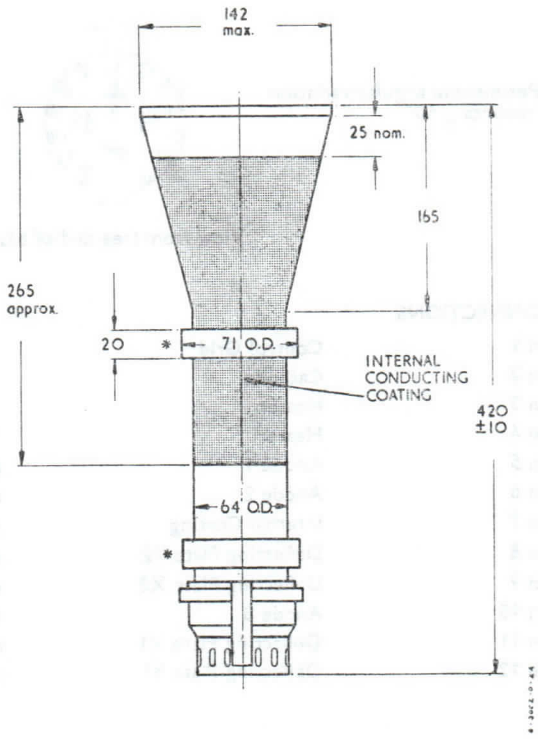
30C2

5½" MEASUREMENT CATHODE RAY TUBE
ELECTROSTATIC FOCUS AND DEFLECTION



All Dimensions in mm.

* Two movable Bakelite bands are fitted to support a Mu-Metal shield.

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30C3

$5\frac{1}{2}''$ MEASUREMENT CATHODE RAY TUBE ELECTROSTATIC FOCUS AND DEFLECTION

GENERAL

The 30C3 is a precision Measurement Cathode Ray Tube having a $5\frac{1}{2}''$ diameter polished glass face. The Deflector Plates are connected through side arms to achieve low values of lead inductance and capacitance.

RATING

Heater Voltage (volts)	V_h	4.0
Heater Current (amps)	I_h	0.72
Maximum 1st Anode Voltage (volts)	$V_{a1(max)}$	2,500
Maximum 2nd Anode Voltage (volts)	$V_{a2(max)}$	1,000
Maximum 3rd Anode Voltage (volts)	$V_{a3(max)}$	6,000
Average Sensitivity of " X " Plates (mm/V)		600/V†
Average Sensitivity of " Y " Plates (mm/V)		1,100/V†

† Where " V " denotes the voltage on the 3rd Anode and Bulb Coating.

INTER-ELECTRODE CAPACITANCES (pF)

X1 Plate/All other electrodes	$c_{x1\text{-}all}$	6.0
X2 Plate/All other electrodes	$c_{x2\text{-}all}$	6.0
Y1 Plate/All other electrodes	$c_{y1\text{-}all}$	8.6
Y2 Plate/All other electrodes	$c_{y2\text{-}all}$	8.6
X1 Plate/Y1 Plate	$c_{x1\text{-}y1}$	0.25
X1 Plate/Y2 Plate	$c_{x1\text{-}y2}$	0.25
X2 Plate/Y1 Plate	$c_{x2\text{-}y1}$	0.25
X2 Plate/Y2 Plate	$c_{x2\text{-}y2}$	0.25
Grid/All other electrodes	$c_{g\text{-}all}$	8.2
X1 Plate/X2 Plate	$c_{x1\text{-}x2}$	2.5
Y1 Plate/Y2 Plate	$c_{y1\text{-}y2}$	3.2

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

30C3

$5\frac{1}{2}''$ MEASUREMENT CATHODE RAY TUBE ELECTROSTATIC FOCUS AND DEFLECTION

DIMENSIONS

Maximum Overall Length	(mm)	430
Maximum Diameter	(mm)	142
Nominal Screen Diameter	(ins)	$5\frac{1}{2}$
Approximate Nett Weight	(ozs)	30
Approximate Packed Weight	(lbs)	$11\frac{1}{4}$

NOTES

The connections to the deflector plates are brought out to side contacts on the neck of the tube in order to reduce the inductance and capacitance of the leads, and the coupling between the X and Y plates. It is intended, particularly, for H.F. and pulse measurements.

For general measurement work the 30C3/T1 is recommended. This has a screen with a medium persistence green phosphor. For special applications, however, the tube may be supplied with any of the standard phosphors described on the Introductory Page to this section, except T7.

The Final Anode and the Bulb coating are brought out separately in order that a finer spot or a higher writing speed may be obtained by increasing the Final Anode voltage above the limit set for the First Anode Voltage.

In use the Third Anode and Bulb coating are normally joined.

All Maximum Ratings are Absolute Values not Design Centres.

TYPICAL OPERATION

3rd Anode Voltage (volts)	V_{a3}	2,000	6,000
2nd Anode Voltage for focus (approx.) (volts)	V_{a2}	440	960
1st Anode Voltage (volts)	V_{a1}	2,000	2,000
Average Bias on Control Grid for Cut-off of Beam Current (volts)	V_g	—60	—60
Average Working Bias for 20μA Beam (volts)		—33	—33
Approximate Sensitivity of " X " Plates (mm/V)		0.30	0.1
Approximate Sensitivity of " Y " Plates (mm/V)		0.57	0.19

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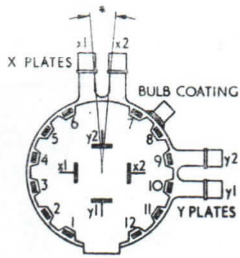
30C3

$5\frac{1}{2}''$ MEASUREMENT CATHODE RAY TUBE ELECTROSTATIC FOCUS AND DEFLECTION

CAPS—CT2

BASE—B12D

*Permissible angular variation of mounts $\pm 10°$



Viewed from free end of base.

CONNECTIONS

Pin 1	Control Grid	g
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode 1	a1
Pin 6	Anode 2	a2
Pin 7	No Connection	NC
Pin 8	No Connection	NC
Pin 9	No Connection	NC
Pin 10	Anode 3	a3
Pin 11	No Connection	NC
Pin 12	No Connection	NC

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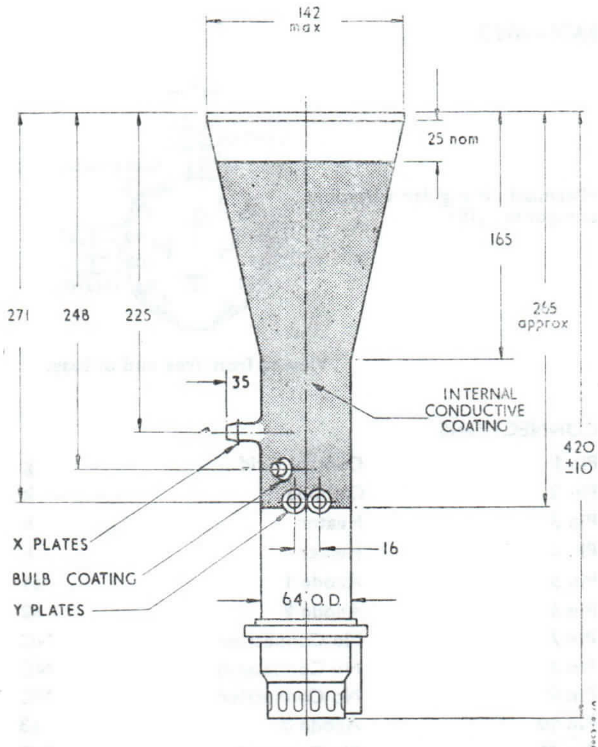
30C3

5½" MEASUREMENT CATHODE RAY TUBE
ELECTROSTATIC FOCUS AND DEFLECTION



All Dimensions in mm.

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30C9

CATHODE RAY TUBE—ALL ELECTROSTATIC 7" Dia.

Indirectly heated—for measurements

RATING

Heater Voltage (volts)	V_h	4.0
Heater Current (amps)	I_h	0.72
Maximum 1st Anode Voltage (volts)	$V_{a1(max)}$	500
Maximum 2nd Anode Voltage (volts)	$V_{a2(max)}$	1,000
Maximum 3rd Anode Voltage (volts)	$V_{a3(max)}$	4,000
Average Sensitivity of "X" plates (mm/V)		*520/V
Average Sensitivity of "Y" plates (mm/V)		*520/V

* Where "V" denotes the voltage on the 3rd Anode.

All Maximum Ratings are Absolute values not Design Centres.

INTER-ELECTRODE CAPACITANCES

X1 Deflecting Plate/all other electrodes (μμF)	$C_{x1,all}$	14.6
X2 Deflecting Plate/all other electrodes (μμF)	$C_{x2,all}$	14.0
Y1 Deflecting Plate/all other electrodes (μμF)	$C_{y1,all}$	14.9
Y2 Deflecting Plate/all other electrodes (μμF)	$C_{y2,all}$	13.8
X1 Deflecting Plate/X2 Deflecting Plate (μμF)	$C_{x1,x2}$	4.5
Y1 Deflecting Plate/Y2 Deflecting Plate (μμF)	$C_{y1,y2}$	4.4
X1+X2 Deflecting Plates/Y1+Y2 Deflecting Plates (μμF)	$C_{(X1+X2)(Y1+Y2)}$	2.7
Control Grid (Wehnelt)/All other electrodes (μμF)	$C_{g,all}$	8.6

DIMENSIONS

Maximum Overall Length (mm)	495
Maximum Diameter (mm)	175
Nominal Screen Diameter (inches)	7
Approximate Nett Weight (lbs)	$2\frac{1}{4}$
Approximate Packed Weight (lbs)	$11\frac{3}{4}$

NOTES

The 30.C.9 is a precision contructed instrument for applications where the accuracy of the gun contruct-tion employed in compass tubes is required without the provision of scales.

The gun system is capable of providing the high beam currents when pulse modulation of the grid is required.

For general measurement work the 30.C.9/P1 is recommended. This has a screen with a medium persist-ence green phosphor. For special applications, however, the tube may be supplied with any of the standard phosphors described on the introductory page in this section.

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30C9

CATHODE RAY TUBE—ALL ELECTROSTATIC 7″ Dia.

Indirectly heated—for measurements

TYPICAL OPERATION

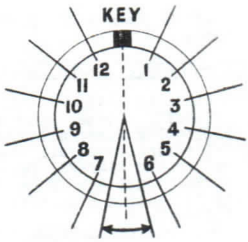
3rd Anode Voltage (volts)	V_{a3}	2,200
2nd Anode Voltage-approximate for focus (volts) †	V_{a2}	440
1st Anode Voltage (volts)	V_{a1}	450
Negative Bias on Control Grid for cut-off of Beam Current (volts)	V_g	30-90

† The voltage required on the 2nd Anode for focus decreases with an increase of beam current and the above figure gives the voltage required at low current.

BASE 12 contact Key Base

(BS.448)

VIEW OF FREE END



PERMISSIBLE ANGULAR VARIATION OF MOUNTS ± 10°

CONNECTIONS

Pin 1	Control Grid	g
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode 1	a1
Pin 6	Anode 2	a2
Pin 7	-	-
Pin 8	Deflecting Plate Y2	Y2
Pin 9	Deflecting Plate Y1	Y1
Pin 10	Anode 3	a3
Pin 11	Deflecting Plate X1	X1
Pin 12	Deflecting Plate X2	X2

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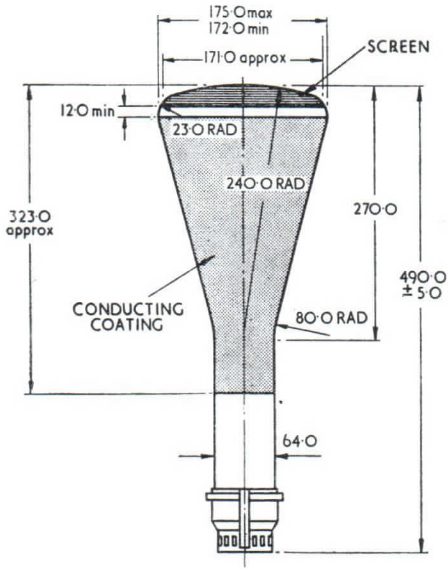
30C9

CATHODE RAY TUBE—ALL ELECTROSTATIC 7" Dia.

Indirectly heated—for measurements



All dimensions in mm.

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30E6

CATHODE RAY TUBE–ALL ELECTROSTATIC 12″ Dia.

For measurement purposes

RATING

Heater Voltage (volts)	Vh	4.0
Heater Current (amps)	Ih	0.72
Maximum 1st Anode Voltage (volts)	Va1 (max)	500
Maximum 2nd Anode Voltage (volts)	Va2(max)	1,400
Maximum 3rd Anode Voltage (volts)	Va3(max)	6,000
Average Sensitivity of " X " Plates (mm/V)		*900/V
Average Sensitivity of " Y " Plates (mm/V)		*900/V

* Where " V " denotes the voltage on the 3rd Anode.

DIMENSIONS

Maximum Overall Length	(mm)	640
Maximum Diameter	(mm)	312
Maximum Neck Diameter	(mm)	65
Nominal Screen Diameter	(inches)	12
Approximate Nett Weight	(lbs)	$7\frac{1}{2}$
Approximate Packed Weight	(lbs)	40

NOTES

For general measurement work the 30E6/T1 is recommended. This has a screen with a medium persistence green phosphor. For special applications, however, the tube may be supplied with any of the standard phosphors described in the Introductory page to this Section except T7.

All Maximum Ratings are Absolute values not Design Centres.

Associated Electrical Industries Limited
Electronic Components Division
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30E6

CATHODE RAY TUBE–ALL ELECTROSTATIC 12" Dia.

For measurement purposes

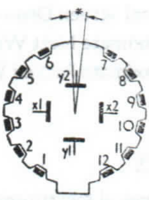
TYPICAL OPERATION

3rd Anode Voltage (volts)	V_{a3}	5,000	6,000
*2nd Anode Voltage—approximate for focus (volts)	V_{a2}	1,000	1,200
1st Anode Voltage (volts)	V_{a1}	400	450
Negative Bias on Control Grid for Cut-off beam Current (volts)	V_g	30-60	34-64

* The voltage required on the 2nd Anode for focus decreases with an increase of beam current and the above figure gives the voltage required at low currents.

BASE—B12D

* Permissible angular variation of mounts ±10°



View from free end of base.

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30E6

CATHODE RAY TUBE–ALL ELECTROSTATIC 12" Dia.

For measurement purposes

CONNECTIONS

Pin 1	Control Grid	g
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode 1	a1
Pin 6	Anode 2	a2
Pin 7	No Connection	NC ←
Pin 8	Deflecting Plate Y2	y2
Pin 9	Deflecting Plate X2	x2
Pin 10	Anode 3, Internal Coating	a3,m
Pin 11	Deflecting Plate X2	x1
Pin 12	Deflecting Plate Y1	y1

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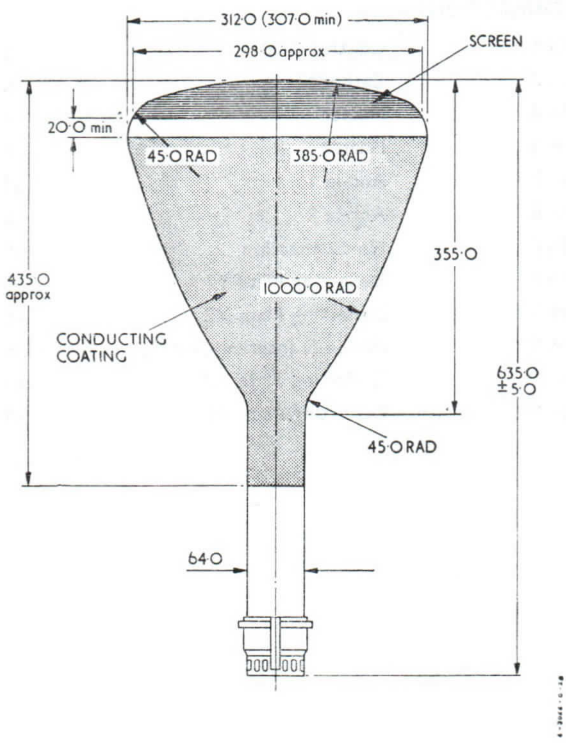
30E6

CATHODE RAY TUBE–ALL ELECTROSTATIC 12″ Dia.

For measurement purposes



All Dimensions in mm.

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30E11

CATHODE RAY TUBE—LONG AFTERGLOW
12 inch Diameter
Indirectly heated—for Marine Radar

GENERAL

The 30E11 is a 12″ aluminised cathode ray tube, having a special long-afterglow screen, suitable for P.P.I. display. A double layer type screen is employed which gives a blue flash with a yellow afterglow. The focusing is electrostatic and the deflection magnetic.

RATING

Heater Voltage (volts)	V_h	4·0
Heater Current (amps)	I_h	0·75
Maximum 1st Anode Voltage (volts)	$V_{a1(max)}$	1,700
Maximum 2nd Anode Voltage (volts)	$V_{a2(max)}$	1,700
Maximum 3rd Anode Voltage (volts)	$V_{a3(max)}$	*10,000

* The maximum rating of 10kV is a design centre rating. The absolute maximum of 12,000 volts must not be exceeded.

NOTE. The 1st Anode must always be at least 50 volts positive with respect to the 2nd Anode.

DIMENSIONS

Maximum Overall Length (mm)	540
Maximum Bulb Diameter (mm)	312
Maximum Neck Diameter (mm)	35
Minimum Neck Diameter (mm)	33·5
Screen Face to 35.5 m/r dia. Swing Gauge (mm)	284 ± 3
Nominal Screen Diameter (ins.)	12
Approximate Nett Weight (lbs)	6
Approximate Packed Weight (lbs)	35

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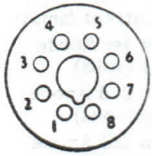
30E11

CATHODE RAY TUBE—LONG AFTERGLOW
12 inch Diameter
Indirectly heated—for Marine Radar

TYPICAL OPERATION

3rd Anode Voltage (volts)	10,000
2nd Anode Voltage (Focusing) volts (approx)	1,500
1st Anode Voltage (volts)	1,550
Average Negative Bias on Control Grid for cut-off of Beam Current (volts)	80

BASE—International Octal (108)



Viewed from free end of pins

CAP—CT2

VALVE HOLDER—Ediswan Clix VH 232/8, VH 238/8.

CONNECTIONS

Pin 1	No Internal Connection	NC
Pin 2	Anode 1	a1
Pin 3	Anode 2	a2
Pin 4	No Internal Connection	NC
Pin 5	Grid	g
Pin 6	Cathode	k
Pin 7	Heater	h
Pin 8	Heater	h
CAP	Anode 3	a3

Associated Electrical Industries Limited
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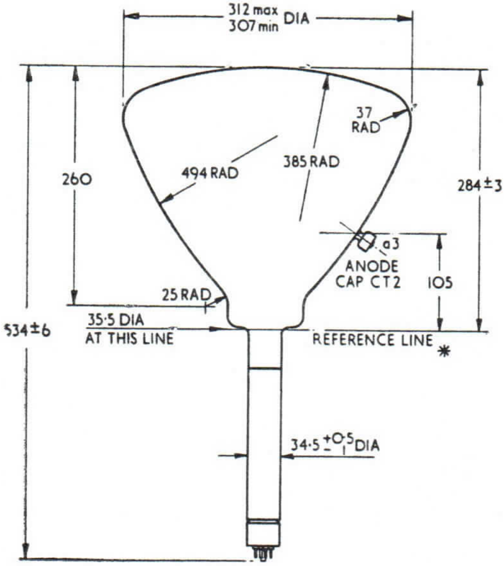
30E11

CATHODE RAY TUBE—LONG AFTERGLOW
12 inch Diameter
Indirectly heated—for Marine Radar



All dimensions in mm.

Anode Cap in line with keyway on base.

* Determined by Reference Line Gauge No. 6. See Section 3.

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

31B81

CATHODE RAY TUBE—ALL ELECTROSTATIC 3½" DIA.
Post Deflection Acceleration
For High Precision Instruments

GENERAL

The 31B81 is a flat screen Cathode Ray Tube with post-deflection acceleration. It is suitable for high precision instruments.

RATING

Heater Voltage	V_h	6·3 V
Heater Current	I_h	0·5 A
Maximum Final Anode Voltage	$V_{a4(max)}$	8 kV
Minimum Final Anode Voltage	$V_{a4(min)}$	2 kV
Maximum Third Anode Voltage	$V_{a3(max)}$	4 kV
Minimum Third Anode Voltage	$V_{a3(min)}$	1 kV
Maximum Second Anode Voltage	$V_{a2(max)}$	2 kV
Maximum First Anode Voltage	$V_{a1(max)}$	2·5kV
Minimum First Anode Voltage	$V_{a1(min)}$	1 kV
Maximum Negative Grid Voltage	$V_{g(max)}$	−200 V
Minimum Negative Grid Voltage (cathode hot)	$V_{g(min)}$	0* V
Maximum Positive Grid Voltage (cathode cold)	$V_{g(max)}$	200 V
Maximum X1 Plate/X2 Plate Voltage	$V_{x1\text{-}x2(max)}$	1 kV
Maximum Y1 Plate/Y2 Plate Voltage	$V_{y1\text{-}y2(max)}$	1 kV
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	150 V
Maximum X Plate/Third Anode Resistance	$R_{x\text{-}a3(max)}$	5 MΩ
Maximum Y Plate/Third Anode Resistance	$R_{y\text{-}a3(max)}$	5 MΩ
Maximum Grid/Cathode Resistance	$R_{g\text{-}k(max)}$	2 MΩ
Minimum Heater/Cathode Resistance	$r_{h\text{-}k(min)}$	2†MΩ
Minimum Grid/Cathode Resistance	$r_{g\text{-}k(min)}$	10 MΩ

* The Grid must not become positive with respect to cathode.

† Heater 100V negative to cathode.

Associated Electrical Industries Limited

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31B81

CATHODE RAY TUBE—ALL ELECTROSTATIC $3\frac{1}{2}''$ DIA.
Post Deflection Acceleration
For High Precision Instruments

INTER-ELECTRODE CAPACITANCES (pF)

Cathode/All other electrodes	$c_{k\text{-all}}$	8
Grid/All other electrodes	$c_{g\text{-all}}$	17
X1 Deflecting Plate/X2 Deflecting Plate	$c_{x1\text{-}x2}$	2·5
Y1 Deflecting Plate/Y2 Deflecting Plate	$c_{y1\text{-}y2}$	3
X1 Deflecting Plate/All other electrodes except X2	$c_{x1\text{-all, less }x2}$	8
X2 Deflecting Plate/All other electrodes except X1	$c_{x2\text{-all, less }x1}$	8
Y1 Deflecting Plate/All other electrodes except Y2	$c_{y1\text{-all, less }y2}$	7·5
Y2 Deflecting Plate/All other electrodes except Y1	$c_{y2\text{-all, less }y1}$	7·5
Y1 Deflecting Plate/X1 or X2 Deflecting Plate (approx.)	$c_{y1\text{-}x1\text{ or }x2}$	0·1
Y2 Deflecting Plate/X1 or X2 Deflecting Plate (approx.)	$c_{y2\text{-}x1\text{ or }x2}$	0·2

CHARACTERISTICS

Second Anode Voltage (focus anode)	V_{a2}	350	V
Grid Bias Voltage for cut off at			
$V_{a1}=1\text{kV}$	V_g	−35	V
$V_{a1}=2\text{kV}$	V_g	−70	V
$V_{a1}=2{\cdot}5\text{kV}$	V_g	−87	V
X Plate Sensitivity ($V_{a4}=V_{a3}$)	S_x	$\frac{800}{V_{a3}}$	mm/V
Y Plate Sensitivity ($V_{a4}=V_{a3}$)	S_y	$\frac{520}{V_{a3}}$	mm/V
X Plate Sensitivity ($V_{a4}=2V_{a3}$)	S_x	$\frac{620}{V_{a3}}$	mm/V
Y Plate Sensitivity ($V_{a4}=2V_{a3}$)	S_y	$\frac{400}{V_{a3}}$	mm/V
Grid Voltage (Drive) at $I_{a4}=25\mu\text{A}$, $V_{a1}=2\text{kV}$	V_g	<32	V

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31B81

CATHODE RAY TUBE—ALL ELECTROSTATIC $3\frac{1}{2}$" DIA.
Post Deflection Acceleration
For High Precision Instruments

The undeflected spot will fall within a circle of 5 mm radius from the centre of the tube face.

The Plate sensitivity for a deflection of less than 75% of the useful scan will not differ from that for 25% by more than 2%.

The edges of a raster with mean dimensions which are 75% of the useful scan will not deviate from the mean rectangle by more than $2\frac{1}{2}$%.

The minimum useful screen area is a circle of 3·7 cm radius.

Orthogonality of deflection axes is $\pm 1\%$.

DEFLECTION DISTORTION

In any Cathode Ray Tube using a simple post-deflection accelerator, the application of the accelerating potential results in deflection distortion, which becomes more pronounced as the ratio of V_{a4}/V_{a3} is increased.

It is recommended that for work involving the measurement of relative deflection amplitudes directly on the tube face this ratio should not exceed 2 : 1.

ORIENTATION

Looking at the screen with the spigot key upward, a positive potential applied to X1 will deflect the spot to the left and a positive potential applied to Y1 will deflect the spot upward.

MAGNETIC SHIELDING

The magnetic shield should be of high permeability material, of a thickness determined by the magnetic field at the tube position. The shield should be earthed. To obtain optimum results equipment containing Cathode Ray Tubes should always be designed to minimise the magnetic field around the tubes, as magnetic shielding can never be completely effective. In addition to the more obvious deflection effects of alternating fields, steady magnetic fields from smoothing chokes, magnetised steel components, etc., can produce spot distortion or low gun efficiency.

Associated Electrical Industries Limited
Electronic Components Division
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31B81

CATHODE RAY TUBE—ALL ELECTROSTATIC $3\frac{1}{2}$" DIA.

Post Deflection Acceleration

For High Precision Instruments

DIMENSIONS

Maximum Overall Length	360mm
Maximum Screen Diameter	92mm
Maximum Neck Diameter	52mm

MOUNTING

The tube should not be supported by the base alone, but should preferably be held in a rubber-lined clamping ring at the screen end together with a similar clamp round the magnetic screen close to the base.

The socket should have sufficient freedom of movement to accommodate the tube overall length tolerance and a small amount of lateral float to ensure good pin contact without straining the base.

SCREEN PHOSPHORS

Type	*Colour*	*Persistence*	*Application*
T1	Green	Medium	Visual
T3	Blue Actinic	Short	Photographic
T4	White	Medium Short	Visual/ Photographic
T6	Yellow Afterglow	Long	Visual
T7	Orange Afterglow	Very Long	Visual

TYPICAL OPERATION

Final Anode Voltage	V_{a4}	4 kV
Third Anode Voltage	V_{a3}	2 kV
Second Anode Voltage	V_{a2}	350 V
First Anode Voltage	V_{a1}	2 kV
Grid Voltage	V_g	–60 V
Third Anode Current	I_{a3}	1 μA
Final Anode Current (=I screen)	I_{a4}	2 μA

The Line width at $I_{screen} = 0{\cdot}5\mu A$ is 0·3mm measured on a circle 50mm diameter.

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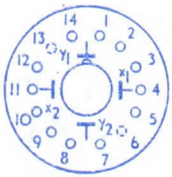
31B81

Cathode Ray Tube—All Electrostatic $3\frac{1}{2}''$ Dia.

Post Deflection Acceleration
For High Precision Instruments

SIDE CONTACT—CT8

BASE—B14A (Diheptal)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater	h
Pin 2	Cathode	k
Pin 3	Grid	g
Pin 4	First Anode	a1
Pin 5	Second Anode	a2
Pin 6	No pin	NP
Pin 7	Deflector Plate Y1	Y1
Pin 8	Deflector Plate Y2	Y2
Pin 9	Third Anode	a3
Pin 10	Deflector Plate X2	x2
Pin 11	Deflector Plate X1	x1
Pin 12	No Connection	NC
Pin 13	No Pin	NP
Pin 14	Heater	h
Cap	Final Anode	a4

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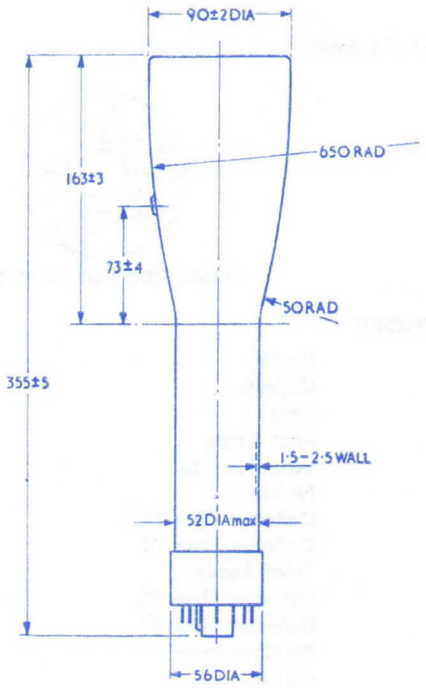
31B81

CATHODE RAY TUBE—ALL ELECTROSTATIC $3\frac{1}{2}''$ DIA.

Post Deflection Acceleration

For High Precision Instruments



All Dimensions in mm.

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

31B82

CATHODE RAY TUBE—ALL ELECTROSTATIC 5″ DIA.
Helical Post Deflection Acceleration
For High Performance Oscillography

GENERAL

The 31B82 is a precision Cathode Ray Tube designed for high performance oscillography. It has high deflection sensitivity and a helical post-deflection accelerator which allows the application of high p.d.a. ratios. The screen is aluminised and the deflector plates are brought out to side arms.

RATING

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·6	A
Maximum Final Anode Voltage	$V_{a4(max)}$	12	kV
Maximum Second Anode Voltage	$V_{a2(max)}$	800	V
Maximum First and Third Anode Voltage	$V_{a1,a3(max)}$	2	kV
Maximum Negative Grid Voltage	$V_{g(max)}$	−200	V
Maximum Positive Grid Voltage	$V_{g(max)}$	0*	V
Maximum Third Anode Peak Voltage to X or Y plates	$V_{a3(pk)max}$	500	V
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	180	V
Maximum Isolating Shield Voltage	$V_{is(max)}$	2·1kV	
Maximum Deflector Plate Shield Voltage	$V_{def(max)}$	2·1kV	

* The grid must not become positive with respect to cathode.

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31B82

CATHODE RAY TUBE—ALL ELECTROSTATIC 5" DIA.
Helical Post Deflection Acceleration
For High Performance Oscillography

INTER-ELECTRODE CAPACITANCES (pF)†

Cathode/All other electrodes	$c_{k\text{-}all}$	4·6
Grid/All other electrodes	$c_{g\text{-}all}$	6·4
X1 Deflecting Plate/X2 Deflecting Plate	$c_{x1\text{-}x2}$	1·9
Y1 Deflecting Plate/Y2 Deflecting Plate	$c_{y1\text{-}y2}$	1·5
X1 Deflecting Plate/All other electrodes	$c_{x1\text{-}all}$	3·5
X2 Deflecting Plate/All other electrodes	$c_{x2\text{-}all}$	3·5
Y1 Deflecting Plate/All other electrodes	$c_{y1\text{-}all}$	2·8
Y2 Deflecting Plate/All other electrodes	$c_{y2\text{-}all}$	2·8

† With holder balanced out.

POST DEFLECTION ACCELERATOR—Helical

Resistance	R_{pda}	200–600	MΩ

ORIENTATION

Looking at the screen with the p.d.a. contact to the left, a positive potential applied to X1 will deflect the spot to the left and a positive potential applied to Y1 will deflect the spot upward.

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERrard 9797

31B82

CATHODE RAY TUBE—ALL ELECTROSTATIC 5″ DIA.

Helical Post Deflection Acceleration
For High Performance Oscillography

DIMENSIONS

Maximum Overall Length	469 mm
Maximum Screen Diameter	135·4 mm
Maximum Neck Diameter	52·55mm

MOUNTING

The tube should not be supported by the base alone, but should preferably be held in a rubber-lined clamping ring at the screen end together with a similar clamp round the magnetic screen close to the base.
The socket should have sufficient freedom of movement to accommodate the tube overall length tolerance and a small amount of lateral float to ensure good pin contact without straining the base.

SCREEN PHOSPHORS

Type	*Colour*	*Persistence*	*Application*
T1	Green	Medium	Visual
T3	Blue Actinic	Short	Photographic
T4	White	Medium Short	Visual/ Photographic
T6	Yellow Afterglow	Long	Visual
T7	Orange Afterglow	Very Long	Visual
T8	Yellow Afterglow	Medium Long	Visual

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31B82

CATHODE RAY TUBE—ALL ELECTROSTATIC 5" DIA.
Helical Post Deflection Acceleration
For High Performance Oscillography

TYPICAL OPERATION

Final Anode Voltage	V_{a4}	10 kV
Second Anode Voltage	V_{a2}	180 to 590 V
First and Third Anode Voltage	$V_{a1,a3}$	1·67kV
Grid Bias Voltage for cut-off	V_g	–50 to –80 V
Isolation Shield Voltage	V_{is}	1·57 to 1·7*kV
Deflector Plate Shield Voltage	V_{def}	1·57 to 1·7‡kV

* The inner end of the helix and the isolation shield are connected together inside the tube. With the correct potential on these electrodes, barrel and pin-cushion effects are minimised.

‡ Adjustment of the deflection plate shield potential controls the linearity of the Y deflection by variation of the edge effect of the Y deflection plates.

For many purposes the deflection plate shield (pin 12) may be connected externally to the isolation shield.

DEFLECTION CHARACTERISTICS—Under above conditions

Sensitivity of X Plates	S_x	$\frac{560}{V_{a3}}$ mm/V
Sensitivity of Y Plates	S_y	$\frac{2800}{V_{a3}}$ mm/V
Useful X Plate Scan		10 cm
Useful Y Plate Scan		4 cm

The undeflected spot will fall within a circle of 5 mm radius from the centre of the tube face.

Orthogonality of deflection axes : $\pm 1\%$

The edges of a raster the size of the useful scan will not deviate from the mean rectangle by more than 1·5%.

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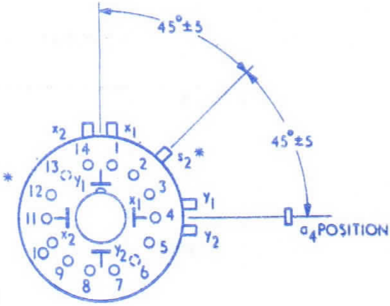
31B82

CATHODE RAY TUBE—ALL ELECTROSTATIC 5″ DIA.

Helical Post Deflection Acceleration
For High Performance Oscillography

SIDE CONTACT—CT8

BASE—B14A (Diheptal)



Viewed from free end of pins.

CONNECTIONS

Pin 1	Heater	h
Pin 2	Cathode	k
Pin 3	Grid	g
Pin 4	No Connection	NC
Pin 5	Second Anode	a2
Pin 6	No Pin	NP
Pin 7	No Connection	NC
Pin 8	No Connection	NC
Pin 9	First and Third Anode	a1, a3
Pin 10	No Connection	NC
Pin 11	No Connection	NC
Pin 12*	Deflector Plate Shield	S1
Pin 13	No Pin	NP
Pin 14	Heater	h
Cap	Final Anode	a4
*	Isolation Shield	S2

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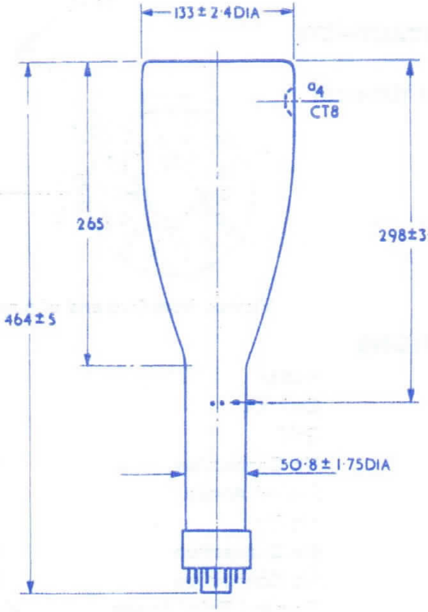
CATHODE RAY TUBE—ALL ELECTROSTATIC 5″ DIA.

Helical Post Deflection Acceleration
For High Performance Oscillography



All Dimensions in mm.

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AEI **Cathode-ray Tube** **31C12**

GENERAL

The 31C12 is an electrostatically focused and magnetically deflected cathode-ray tube intended for use in Radio DF Compass equipment. The tube is aluminised, has a 6″ diameter flat face, and is available with a " T2 " screen which gives a blue-green trace of long persistence.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·6	A
Maximum first and third anode voltage	$V_{a1,a3(max)}$	14*	kV
Minimum first and third anode voltage	$V_{a1,a3(min)}$	10	kV
Maximum second anode voltage	$V_{a2(max)}$	±700	V
Maximum heater/cathode voltage, d.c. (heater negative)	$V_{h-k(max)}$	180	V
Maximum peak heater/cathode voltage, d.c. (heater negative)	$v_{h-k(pk)max}$	400†‡	V

* 14kV is a design centre rating, the absolute rating of 15·5kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding 1 minute.

INTER-ELECTRODE CAPACITANCES

Grid/All other electrodes	c_{g-all}	5·5	pF
Cathode/All other electrodes	c_{k-all}	6·0	pF

These capacitances include an AEI duodecal holder type CRT92/7.

TYPICAL OPERATION

First and third anode voltage	$V_{a1,a3}$	12	kV
Second anode voltage for focus (range)	V_{a2}	—100 to +300	V
Grid bias voltage for cut-off of raster	V_g	-30 to -72	V
Maximum peak to peak modulating voltage for modulation of limit cathode-ray tube up to 50μA		25	V

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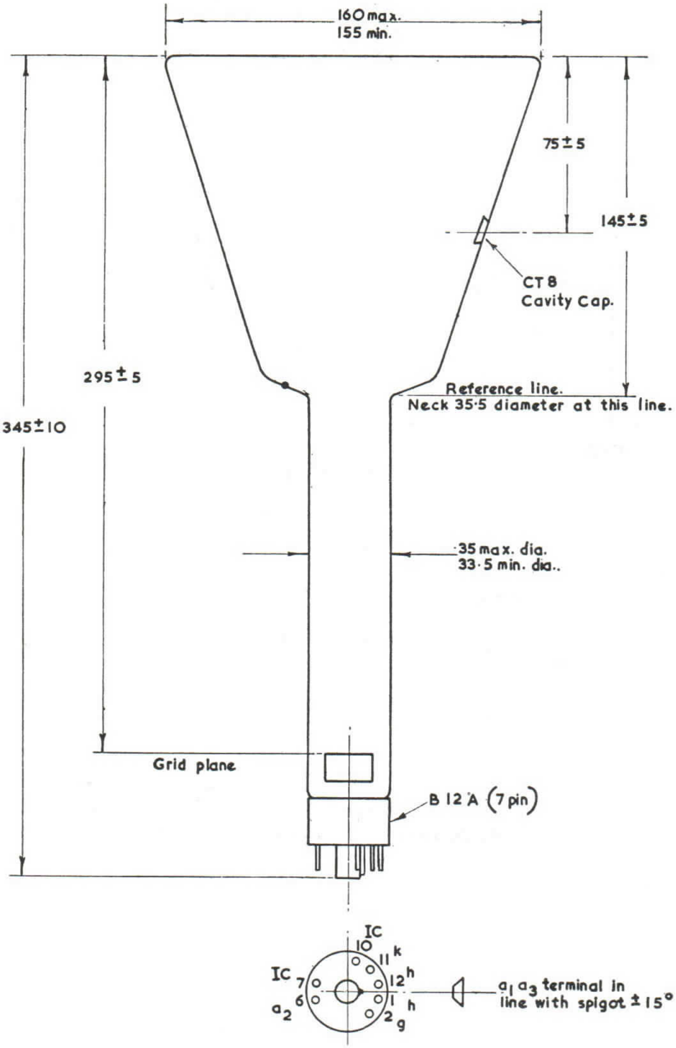

All dimensions in millimetres.
Not to be scaled.

31C13

CATHODE RAY TUBE

Indirectly heated—for Radio DF Compass

TENTATIVE

GENERAL

The 31C13 is a magnetically focused and deflected cathode ray tube. The tube is aluminised, has a 6″ diameter flat face, and is available with a "T1" screen which gives a green trace of medium persistence. It has an internal compass scale graduated with octantal correction and its face is treated to reduce specular reflection.

RATING

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·6	A
Maximum Anode Voltage	$V_{a(max)}$	10*	kV
Minimum Anode Voltage	$V_{a(min)}$	7·5	kV
Maximum Heater/Cathode Voltage d.c. (heater negative)	$V_{h-k(max)}$	150	V

* 10kV is a design centre rating. The absolute rating of 12·5kV maximum must not be exceeded.

INTER-ELECTRODE CAPACITANCES

Grid/All other electrodes	c_{g-all}	4·7	pF
Cathode/All other electrodes	c_{k-all}	5·3	pF

These capacitances include an Ediswan Clix wafer type duodecal holder.

TYPICAL OPERATION

Anode Voltage	V_a	9·5	kV
Grid Bias Voltage for cut-off of 140 mm focused line	V_g	−43 to −93	V
Average Peak to Peak Modulating Voltage for Modulation up to 150 μA		30	V
Maximum Peak to Peak Modulating Voltage for Modulation of limit Cathode Ray Tube up to 150 μA		35	V

A resistance should be inserted in the anode circuit in order to limit the discharge current to 100 mA(max), in the event of a flash-over inside the tube.

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31C13

CATHODE RAY TUBE

Indirectly heated—for Radio DF Compass

TENTATIVE

DIMENSIONS

Maximum Overall Length	458	mm
Maximum Face Diameter	160	mm
Maximum Neck Diameter	35	mm
Approximate Nett Weight	$2\frac{1}{4}$	lbs
Approximate Packed Weight	$16\frac{1}{4}$	lbs

CAP—Cavity CT8

BASE—B12A (5 Pin)

Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	No Pin	NP
Pin 7	No Pin	NP
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	No Connection	NC
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Anode	a

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

31C14

CATHODE RAY TUBE

Indirectly heated—for Radio D.F. Compass

GENERAL

The 31C14 is a magnetically focused and deflected cathode ray tube. The tube is aluminised, has a 6″ diameter flat face, and is available with a screen type T1 which gives a green trace of medium persistence. It has an internal compass scale uniformly graduated and its face is treated to reduce specular reflection.

RATING

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·6	A
Maximum Anode Voltage	$V_{a(max)}$	10*	kV
Minimum Anode Voltage	$V_{a(min)}$	7·5	kV
Maximum Heater/Cathode Voltage d.c. (heater negative)	$V_{h\text{-}k(max)}$	150	V

* 10 kV is a design centre rating. The absolute rating of 12·5 kV maximum must not be exceeded.

INTER-ELECTRODE CAPACITANCES

Grid/All other electrodes	$c_{g\text{-}all}$	4·7	pF
Cathode/All other electrodes	$c_{k\text{-}all}$	5·3	pF

These capacitances include an AEI wafer-type duodecal holder.

TYPICAL OPERATION

Anode Voltage	V_a	9·5	kV
Grid Bias Voltage for cut-off of 140mm focused line	V_g	−43 to −93	V
Average Peak to Peak Modulating Voltage for Modulation up to 150μA		30	V
Maximum Peak to Peak Modulating Voltage for Modulation of limit Cathode Ray Tube up to 150μA		35	V

A resistance should be inserted in the anode circuit in order to limit the discharge current to 100mA (max), in the event of a flash-over inside the tube.

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31C14

CATHODE RAY TUBE

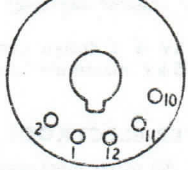
Indirectly heated—for Radio D.F. Compass

DIMENSIONS

Maximum Overall Length	458 mm
Maximum Face Diameter	160 mm
Maximum Neck Diameter	35 mm
Approximate Net Weight	$2\frac{1}{4}$ lb.
Approximate Packed Weight	$16\frac{1}{4}$ lb.

CAP—Cavity (CT8)

BASE—B12A (5 Pin)



Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	No Pin	NP
Pin 7	No Pin	NP
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	No Connection	NC
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Anode	a

Associated Electrical Industries Limited
Electronic Components Department
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31C81

CATHODE RAY TUBE–ALL ELECTROSTATIC 6″ DIA.
Post Deflection Acceleration
For High Precision Instruments

GENERAL

The 31C81 is a flat screen Cathode Ray Tube with post-deflection acceleration. It is suitable for high precision instruments.

RATING

Heater Voltage	V_h	6·3	V
Heater Current (approx)	I_h	0·5	A
Maximum Final Anode Voltage	$V_{a4(max)}$	8	kV
Minimum Final Anode Voltage	$V_{a4(min)}$	2	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	4	kV
Minimum Third Anode Voltage	$V_{a3(min)}$	1	kV
Maximum Second Anode Voltage	$V_{a2(max)}$	2	kV
Maximum First Anode Voltage	$V_{a1(max)}$	2·5	kV
Minimum First Anode Voltage	$V_{a1(min)}$	1	kV
Maximum Negative Grid Voltage	$V_{g(max)}$	−200	V
Minimum Negative Grid Voltage (Cathode Hot)	$V_{g(min)}$	0*	V
Maximum Positive Grid Voltage (Cathode Cold)	$V_{g(max)}$	200	V
Maximum X1 Plate/X2 Plate Voltage	$V_{x1\text{-}x2(max)}$	1	kV
Maximum Y1 Plate/Y2 Plate Voltage	$V_{y1\text{-}y2(max)}$	1	kV
Maximum Heater/Cathode Voltage	$V_{h\text{-}k(max)}$	150	V
Maximum X Plate/Third Anode Resistance	$R_{x\text{-}a3(max)}$	5	MΩ
Maximum Y Plate/Third Anode Resistance	$R_{y\text{-}a3(max)}$	5	MΩ
Maximum Grid/Cathode Resistance	$R_{g\text{-}k(max)}$	2	MΩ
Minimum Heater/Cathode Resistance	$r_{h\text{-}k(min)}$	2†	MΩ
Minimum Grid/Cathode Resistance	$r_{g\text{-}k(min)}$	10	MΩ

* The Grid must not become positive with respect to cathode.

† Heater 100V Negative with respect to cathode.

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Electronic Components Division
Tel.: GERrard 9797

31C81

CATHODE RAY TUBE—ALL ELECTROSTATIC 6" DIA.
Post Deflection Acceleration
For High Precision Instruments

INTER-ELECTRODE CAPACITANCES (pF)

Cathode/All other electrodes	$c_{k\text{-all}}$	8
Grid/All other electrodes	$c_{g\text{-all}}$	17
X1 Deflecting Plate/X2 Deflecting Plate	$c_{x1\text{-}x2}$	2·5
Y1 Deflecting Plate/Y2 Deflecting Plate	$c_{y1\text{-}y2}$	3
X1 Deflecting Plate/All other electrodes except X2	$c_{x1\text{-all,less }X2}$	8
X2 Deflecting Plate/All other electrodes except X1	$c_{x2\text{-all,less }X1}$	8
Y1 Deflecting Plate/All other electrodes except Y2	$c_{y1\text{-all,less }Y2}$	7·5
Y2 Deflecting Plate/All other electrodes except Y1	$c_{y2\text{-all,less }Y1}$	7·5
Y1 Deflecting Plate/X1 or X2 Deflecting Plate (approx.)	$c_{y1\text{-}xl\text{ or }x2}$	0·1
Y2 Deflecting Plate/X1 or X2 Deflecting Plate (approx.)	$c_{y2\text{-}xl\text{ or }x2}$	0·2

DEFLECTION DISTORTION

In any Cathode Ray Tube using a simple post-deflection accelerator, the application of the accelerating potential results in deflection distortion, which becomes more pronounced as the ratio of the V_{a4}/V_{a3} is increased. It is recommended that for work involving the measurement of relative deflection amplitudes directly on the tube face this ratio should not exceed 2 : 1.

ORIENTATION

Looking at the screen with the spigot key upward, a positive potential applied to X1 will deflect the spot to the left and a positive potential applied to Y1 will deflect the spot upward.

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31C81

CATHODE RAY TUBE–ALL ELECTROSTATIC 6″ DIA.
Post Deflection Acceleration
For High Precision Instruments

MAGNETIC SHIELDING

The magnetic shield should be of high permeability material, of a thickness determined by the magnetic field at the tube position. The shield should be earthed. To obtain optimum results, equipment containing Cathode Ray Tubes should always be designed to minimise the magnetic field around the tubes, as magnetic shielding can never be completely effective. In addition to the more obvious deflection effects of alternating fields, steady magnetic fields from smoothing chokes, magnetised steel components, etc., can produce spot distortion or low gun efficiency.

DIMENSIONS

Maximum Overall Length	500mm
Maximum Screen Diameter	163mm
Maximum Neck Diameter	52mm

MOUNTING

The tube should not be supported by the base alone, but should preferably be held in a rubber-lined clamping ring at the screen end together with a similar clamp round the magnetic screen close to the base. The socket should have sufficient freedom of movement to accommodate the tube overall length tolerance and a small amount of lateral float to ensure good pin contact without straining the base.

SCREEN PHOSPHORS

Type	*Colour*	*Persistence*	*Application*
T1	Green	Medium	Visual
T3	Blue Actinic	Short	Photographic
T4	White	Medium Short	Visual/ Photographic
T6	Yellow Afterglow	Long	Visual
T7	Orange Afterglow	Very Long	Visual

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31C81

CATHODE RAY TUBE–ALL ELECTROSTATIC 6" DIA.
Post Deflection Acceleration
For High Precision Instruments

TYPICAL OPERATION

Final Anode Voltage	V_{a4}	4 kV
Third Anode Voltage	V_{a3}	2 kV
Second Anode Voltage	V_{a2}	350 V
First Anode Voltage	V_{a1}	2 kV
Grid Voltage	V_g	−60 V
Third Anode Current	I_{a3}	1 μA
Final Anode Current (=Screen Current)	I_{a4}	2 μA

The line width at $I_{screen} = 0{\cdot}5\mu A$ is 0·5 mm. measured on a circle of 50 mm. diameter.

CHARACTERISTICS

Second Anode Voltage (focus anode)	V_{a2}	350	V
Grid Bias Voltage for cut-off			
at $V_{a1} = 1kV$	V_g	−35	V
$V_{a1} = 2kV$	V_g	−70	V
$V_{a1} = 2{\cdot}5kV$	V_g	−87	V
X Plate Sensitivity ($V_{a4} = V_{a3}$)	S_x	$\frac{1170}{V_{a3}}$	mm/V
Y Plate Sensitivity ($V_{a4} = V_{a3}$)	S_y	$\frac{860}{V_{a3}}$	mm/V
X Plate Sensitivity ($V_{a4} = 2V_{a3}$)	S_x	$\frac{940}{V_{a3}}$	mm/V
Y Plate Sensitivity ($V_{a4} = 2V_{a3}$)	S_y	$\frac{710}{V_{a3}}$	mm/V
Grid Voltage (drive) at $I_{a4} = 25\mu A$, $V_{a1} = 2kV$	V_g	<32	V

The Plate sensitivity for a deflection of less than 75% of the useful scan will not differ from that for 25% by more than 2%.

The undeflected spot will fall within a circle of 7 mm radius from the centre of the tube face.

The minimum useful screen area is a circle of 7 cm radius.

Orthogonality of deflection axes is ± 1°.

The edges of a raster with mean dimensions which are 75% of the useful scan will not deviate from the mean rectangle by more than 2½%.

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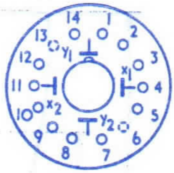
31C81

CATHODE RAY TUBE–ALL ELECTROSTATIC 6" DIA.
Post Deflection Acceleration
For High Precision Instruments

SIDE CONTACT—CT8

BASE—B14A (Diheptal)



Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Cathode	k
Pin 3	Grid	g
Pin 4	First Anode	a1
Pin 5	Second Anode	a2
Pin 6	No Pin	NP
Pin 7	Deflector Plate Y1	Y1
Pin 8	Deflector Plate Y2	Y2
Pin 9	Third Anode	a3
Pin 10	Deflector Plate X2	X2
Pin 11	Deflector Plate X1	X1
Pin 12	No Connection	NC
Pin 13	No Pin	NP
Pin 14	Heater	h
Cap	Final Anode	a4

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CATHODE RAY TUBE–ALL ELECTROSTATIC 6" DIA.

Post Deflection Acceleration
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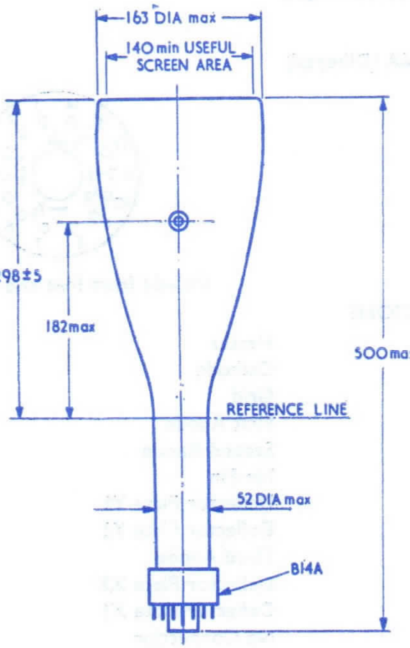

All Dimensions in mm.

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AEI Cathode-ray Tube 31D12

GENERAL

The 31D12 is an $8\frac{1}{2}''$ diagonal rectangular tube with 90° magnetic deflection and low voltage electrostatic focusing. It is suitable for use in industrial monitoring equipment.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·3*	A
Maximum second and fourth anode voltage	$V_{a2,a4(max)}$	15**	kV
Minimum second and fourth anode voltage	$V_{a2,a4(min)}$	8·0	kV
Maximum third anode voltage	$V_{a3(max)}$	±700	V
Maximum first anode voltage	$V_{a1(max)}$	400	V
Maximum heater/cathode voltage, d.c. (heater negative)	$V_{h\text{-}k(max)}$	200	V
Maximum peak heater/cathode voltage, d.c. (heater negative)	$v_{h\text{-}k(pk)max}$	400†‡	V

* The cathode-ray tube heater should always be connected at the chassis end if used in a series heater chain.

** 15kV is a design centre rating, the absolute rating of 18kV must not be exceeded.

† Absolute rating.

‡ During a warming up period not exceeding one minute.

INTER-ELECTRODE CAPACITANCES

Grid/all other electrodes	$c_{g\text{-}all}$	7·0§	pF
Cathode/all other electrodes	$c_{k\text{-}all}$	3·0§	pF
Anode 2 and anode 4/external conductive coating (approx.)	$c_{a2,a4\text{-}M}$	400	pF

§ Inter-electrode capacitances with holder capacitance balanced out.

TYPICAL OPERATION

Second and fourth anode voltage	$V_{a2,a4}$	12	kV
First anode voltage	V_{a1}	300	V
Third anode voltage for focus (range)	V_{a3}	±200	V
Grid bias voltage for cut-off of raster	V_g	–30 to –72	V
Average peak to peak modulating voltage for modulation up to 150μA		24	V

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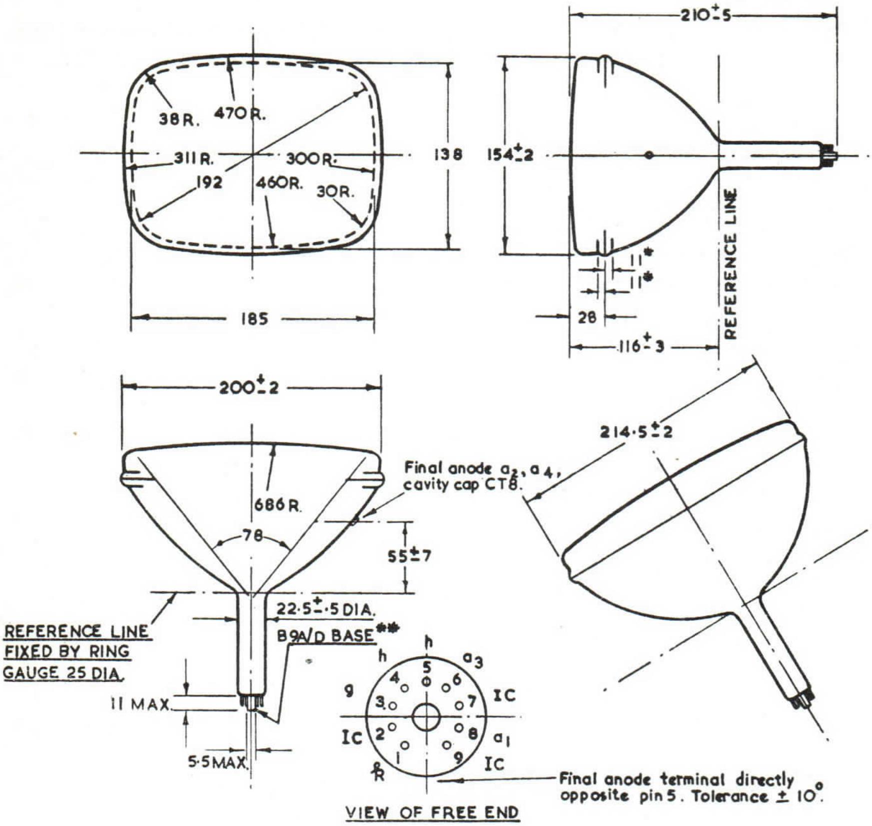

All dimensions in millimetres.
Not to be scaled.

Notes

* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

** The socket for the B9A/D button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base.

GENERAL

The 31D13 is an $8\frac{1}{2}''$ diagonal rectangular tube with 90° magnetic deflection and low voltage electrostatic focusing. It is intended for use in television studio monitoring equipment.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·3*	A
Maximum second and fourth anode voltage	$V_{a2,a4(max)}$	16**	kV
Minimum second and fourth anode voltage	$V_{a2,a4(min)}$	8·0	kV
Maximum third anode voltage	$V_{a3(max)}$	±500	V
Maximum first anode voltage	$V_{a1(max)}$	500	V
Maximum heater/cathode voltage, heater negative (d.c.)	$V_{h\text{-}k(max)}$	200	V
Maximum peak heater/cathode voltage, heater negative (d.c.)	$v_{h\text{-}k(pk)max}$	400†‡	V

* The cathode-ray tube heater should always be connected at the chassis end in a series heater chain.

** 16kV is a design centre rating, the absolute rating of 18kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding one minute.

INTER-ELECTRODE CAPACITANCES§

Grid/All other electrodes	$c_{g\text{-}all}$	9·0	pF
Cathode/All other electrodes	$c_{k\text{-}all}$	7·0	pF

§ These capacitances include an AEI duodecal holder type CRT92/7.

TYPICAL OPERATION

Second and fourth anode voltage	$V_{a2,a4}$	12	kV
First anode voltage	V_{a1}	300	V
Third anode voltage for focus (range)	V_{a3}	−300 to +300	V
Grid bias for cut-off of raster	V_g	−30 to −72	V
Average peak to peak modulating voltage for modulation up to 150μA		24	V

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Radio Components Department

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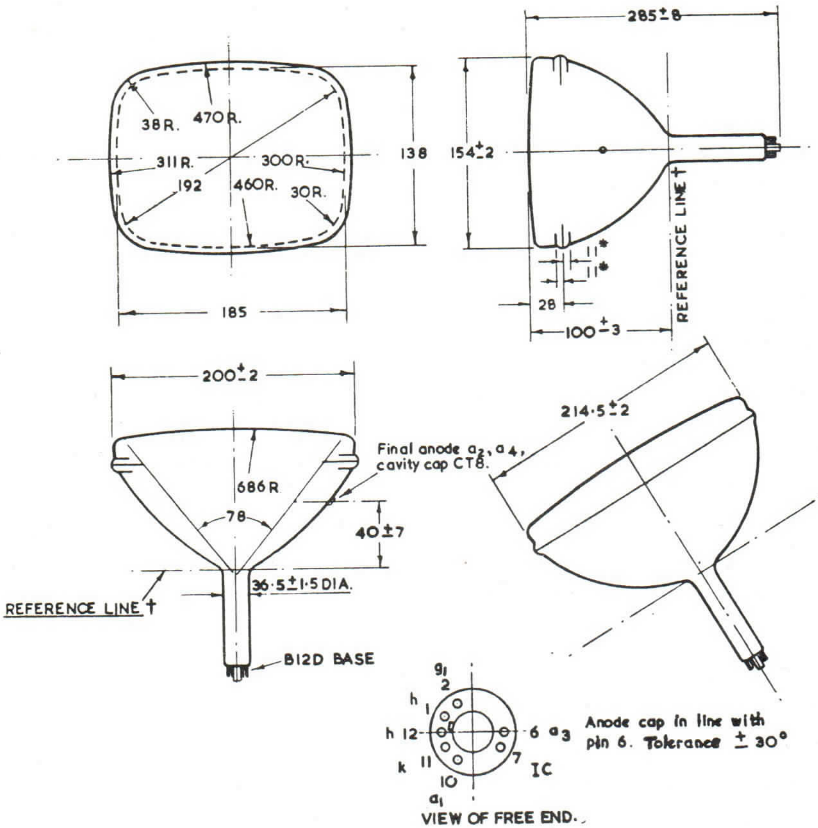

All dimensions in millimetres.
Not to be scaled.

Notes

* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

† Determined by Reference Gauge No. 13.

AEI Cathode-ray Tube 31D15

GENERAL

The 31D15 is an $8\frac{1}{2}''$ diagonal rectangular tube with 90° magnetic deflection and low voltage electrostatic focusing. It is intended for use in industrial monitoring equipment.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·3*	A
Maximum second and fourth anode voltage	$V_{a2,a4(max)}$	15**	kV
Minimum second and fourth anode voltage	$V_{a2,a4(min)}$	8·0	kV
Maximum third anode voltage	$V_{a3(max)}$	±700	V
Maximum first anode voltage	$V_{a1(max)}$	500	V
Maximum heater/cathode voltage, heater negative (d.c.)	$V_{h\text{-}k(max)}$	200	V
Maximum peak heater/cathode voltage, heater negative (d.c.)	$v_{h\text{-}k(pk)max}$	400†‡	V

* The cathode-ray tube heater should always be connected at the chassis end if used in a series heater chain.

** 15kV is a design centre rating, the absolute rating of 18kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding one minute.

INTER-ELECTRODE CAPACITANCES

		§	§§	
Grid/All other electrodes	$c_{g\text{-}all}$	7·0	8·5	pF
Cathode/All other electrodes	$c_{k\text{-}all}$	3·0	3·5	pF
Anode 2 and Anode 4/External conductive coating (approx)	$c_{a2,a4\text{-}M}$	400		pF

§ Inter-electrode capacitances with holder capacitance balanced out.

§§ Inter-electrode capacitances including an AEI B8H holder VH68/81 (8-pin).

TYPICAL OPERATION

Second and fourth anode voltage	$V_{a2,a4}$	12	kV
First anode voltage	V_{a1}	400	V
Third anode voltage for focus (range)	V_{a3}	±200	V
Grid bias for cut-off of raster	V_g	−30 to −72	V
Average peak/peak modulating voltage for modulation up to 150μA		24	V

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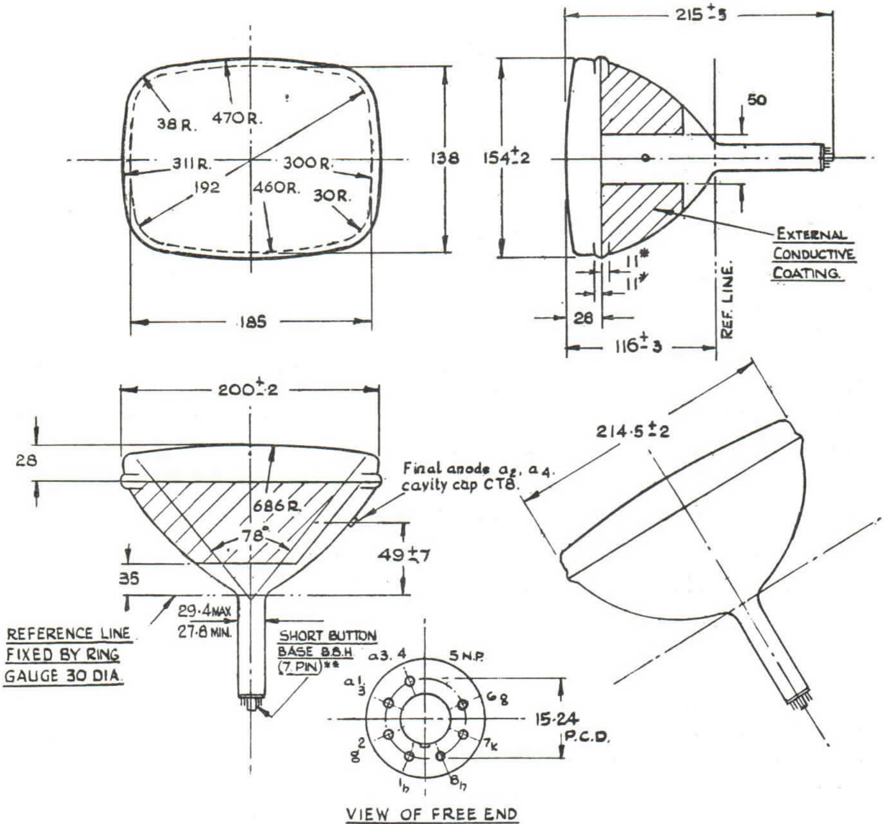

All dimensions in millimetres.

Not to be scaled.

Notes

* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

** The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base.

31E12

12" RADAR CATHODE RAY TUBE

Electrostatic Focus—Magnetic Deflection

GENERAL

The 31E12 is a 12″ aluminised cathode ray tube having a long afterglow T6 or T7 aluminised screen suitable for radar PPI display. The tube has a substantially flat face.

RATING

Heater Voltage (volts)	V_h	6·3
Heater Current (amps)	I_h	0·6
Maximum Final Anode Voltage (kV)	$V_{a2+4(max)}$	12*
Minimum Final Anode Voltage (kV)	$V_{a2+4(min)}$	8
Maximum First Anode Voltage (volts)	$V_{a1(max)}$	400
Maximum Heater/Cathode Voltage (Heater Negative) (D.C.) (volts)	$V_{h\text{-}k(max)}$	150

* The maximum rating of 12kV is a Design Centre Rating. The Absolute Maximum of 14kV must not be exceeded.

INTER-ELECTRODE CAPACITANCES (pF)

Grid/Earth	$c_{g\text{-}E}$	9
Cathode/Earth	$c_{k\text{-}E}$	7
Second and Fourth Anode/External Conductive Coating	$c_{a2+4\text{-}M}$	1500

These Capacities include an Ediswan Clix holder CRT 92/7.

DIMENSIONS

Maximum Overall Length	(mm)	485
Maximum Diameter	(mm)	307
Maximum Neck Diameter	(mm)	35·5
Approximate Nett Weight	(lbs)	11¾
Approximate Packed Weight	(lbs)	23¼

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Electronic Components Division

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AEI

31E12

12" RADAR CATHODE RAY TUBE

Electrostatic Focus—Magnetic Deflection

TYPICAL OPERATION

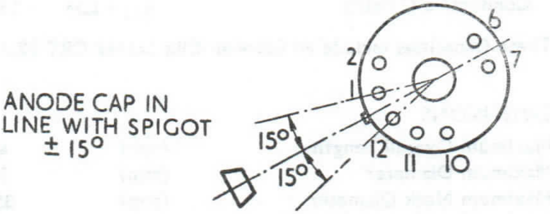
Final Anode Voltage (kV)	V_{a2+4}	12
First Anode Voltage (volts)	V_{a1}	300
Third Anode Voltage for focus (mean) (volts)	V_{a3}	0
Grid Bias for cut-off of 250mm focussed line (volts)	V_g	33—77
Average peak to peak modulating voltage for modulation up to 150 μA*		24
Persistence T6 Screen (secs)		50†
Persistence T7 Screen (secs)		175†

† Persistence is defined as the time taken from the cessation of continuous excitation for the luminance to decay from 1 Foot-Lambert to approximately 1% of that value.

* The T7 screen is liable to burn if a stationary or slowly moving spot is used even with low values of mean current.

The 31E12 is available with either a T6 Long Yellow Afterglow Screen or a T7 Very Long Orange Afterglow Screen.

BASE—Duodecal (B12A)



Viewed from free end of pins.

CAP—Cavity (CT8)

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31E12

12" RADAR CATHODE RAY TUBE

Electrostatic Focus—Magnetic Deflection

CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	Third Anode	a3
Pin 7	Internal Connection	IC
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	First Anode	a1
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Second and Fourth Anode	a_{2+4}

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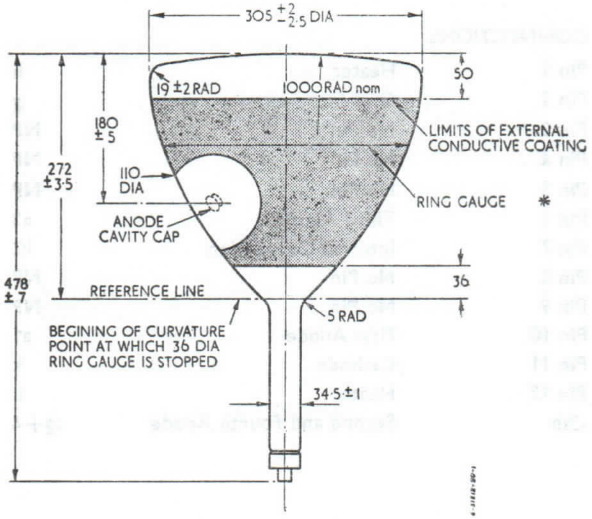
31E12

12" RADAR CATHODE RAY TUBE

Electrostatic Focus—Magnetic Deflection



* Ring Gauge (mm)	Distance from centre of Screen (mm)
280	93 ± 10
230	150 ± 9
180	191 ± 8
130	222 ± 7
80	249 ± 6
36	272 ± 3.5

All dimensions in mm

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GENERAL

The 31E13 is a magnetically focused and deflected cathode-ray tube primarily designed for PPI applications. This aluminised tube has a 12″ diameter flat face and is available with a T6 or T7 screen. It has a straight tetrode gun, and conforms to the British Service specification CV429.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·6	A
Maximum second anode voltage	$V_{a2(max)}$	15·5*	kV
Minimum second anode voltage	$V_{a2(min)}$	9·0	kV
Maximum first anode voltage	$V_{a1(max)}$	600*	V
Maximum heater/cathode voltage, heater negative (d.c.)	$V_{h\text{-}k(max)}$	150	V

* The maximum ratings are absolute maximum values.

INTER-ELECTRODE CAPACITANCES**

Grid/Earth	$c_{g\text{-}E}$	<8·0	pF
Cathode/Earth	$c_{k\text{-}E}$	<8·0	pF

** With holder capacity balanced out.

TYPICAL OPERATION

Second anode voltage	V_{a2}	15	kV
First anode voltage	V_{a1}	300	V
Grid bias for cut-off	V_g	−60 to −90	V
Average peak/peak modulating voltage for modulation up to 50 μA		24	V
Deviation of unfocused and undeflected spot from centre of screen		<15	mm
Maximum unfocused spot diameter for 50 μA beam current		15	mm
Maximum line width for 50μA beam current		0·5†	mm
Persistence of T6 screen (long yellow afterglow)		50‡	s
Persistence of T7 screen (very long orange afterglow)		200‡§	s

† 100μs pulse at 100 p/s. 100μs line scan 250 mm long.

‡ Persistence is defined as the time taken from the cessation of continuous excitation for the luminance to decay from 1 foot lambert to approximately 1% of that value.

§ The T7 screen is liable to burn even at low values of beam current if operated with stationary or slow moving spot.

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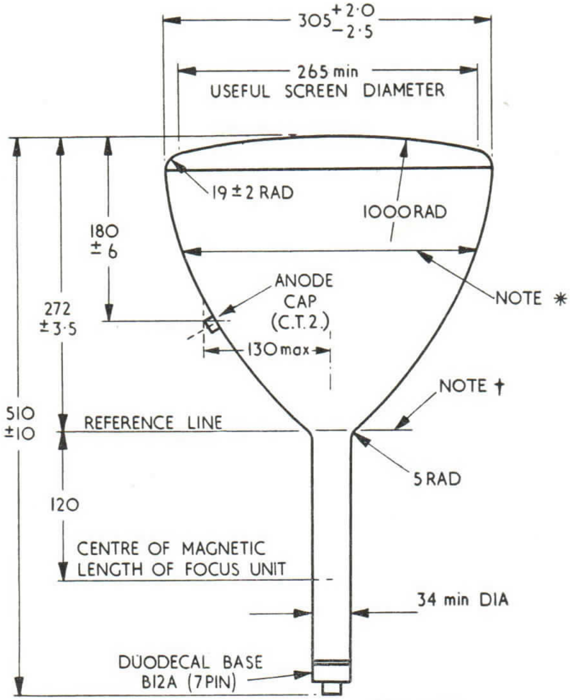
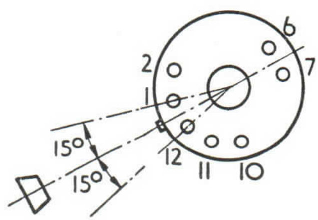


All dimensions in millimetres.

† Beginning of curvature point at which 36·1 dia. ring gauge is stopped.

* Ring Gauge (mm)	Distance from centre of Screen (mm)
280	93 ± 10
230	150 ± 9
180	191 ± 8
130	222 ± 7
80	249 ± 6
36·1	272 ± 3·5



CONNECTIONS

Pin 1	Heater (h)	Pin 10	First anode (a1)
Pin 2	Grid (g)	Pin 11	Cathode (k)
Pin 6	Internal Connection (IC)	Pin 12	Heater (h)
Pin 7	Internal Connection (IC)	Cap	Second anode (a2)

Anode cap in line with spigot ±15°

AEI Cathode-ray Tube 31E14

GENERAL

The 31E14 is a 14″ diagonal rectangular tube with 70° magnetic deflection and low voltage electrostatic focusing. It is intended for use in television studio monitoring equipment.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·3*	A
Maximum second and fourth anode voltage	$V_{a2,a4(max)}$	16**	kV
Minimum second and fourth anode voltage	$V_{a2,a4(min)}$	10	kV
Maximum third anode voltage	$V_{a3(max)}$	±500	V
Maximum first anode voltage	$V_{a1(max)}$	500	V
Maximum heater/cathode voltage, d.c. (heater negative)	$V_{h\text{-}k(max)}$	180	V
Maximum peak heater/cathode voltage, d.c. (heater negative)	$v_{h\text{-}k(pk)max}$	400†‡	V

* The cathode-ray tube heater should always be connected at the chassis end in a series heater chain.
** 16kV is a design centre rating, the absolute rating of 20kV must not be exceeded.
† Absolute rating.
‡ During a warming-up period not exceeding one minute.

INTER-ELECTRODE CAPACITANCES§

Grid/All other electrodes	$c_{g\text{-}all}$	9·0	pF
Cathode/All other electrodes	$c_{k\text{-}all}$	7·0	pF
Anode 2 and Anode 4/External conductive coating (approx)	$c_{a2,a4\text{-}M}$	1,300	pF

§ These capacitances include an AEI duodecal holder type CRT92/7.

TYPICAL OPERATION

Second and fourth anode voltage	$V_{a2,a4}$	12	kV
First anode voltage	V_{a1}	300	V
Third anode voltage for focus (range)	V_{a3}	−300 to +300	V
Grid bias voltage for cut-off of raster	V_g	−30 to −72	V
Average peak to peak modulating voltage for modulation up to 150μA		24	V

Note

If this tube is operated at voltages in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0·5 milliroentegens per hour, the window will normally provide adequate protection.

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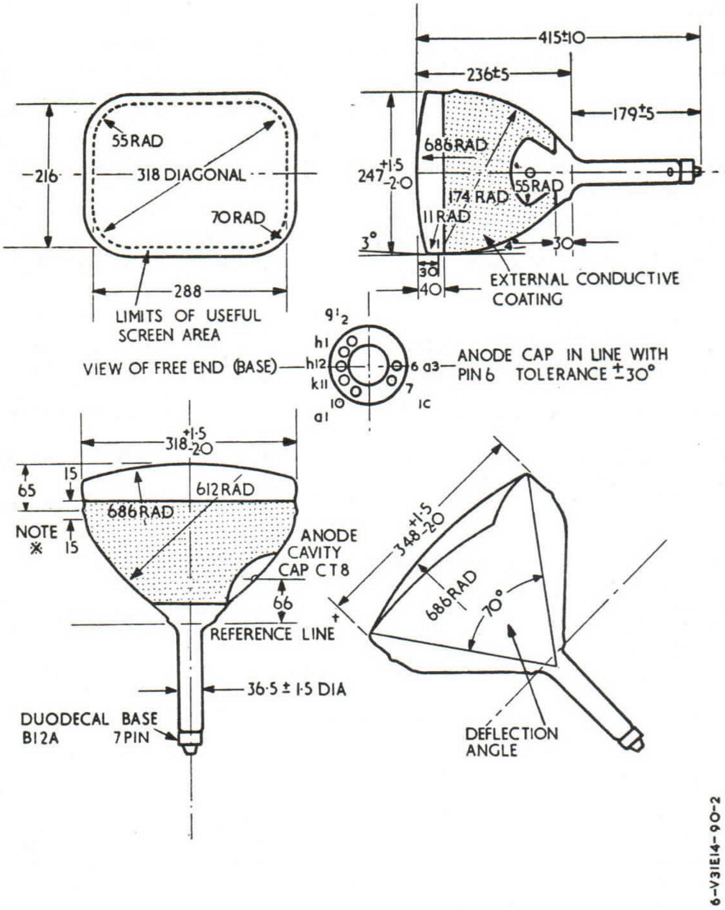

All dimensions in millimetres.
Not to be scaled.

Notes

* During the face sealing operation the glass in this area (total 30 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

† Determined by reference gauge No. 12.

AEI Cathode-ray Tube 31F12

GENERAL

The 31F12 is an electrostatically focused and magnetically deflected cathode ray tube intended for use in large screen oscilloscopes. It has a 17″ diagonal and a deflection angle of 70°. The grey glass face of the aluminised tube is rectangular and has a total light transmission at the centre of approximately 72%. A screen type T9 is employed which has a long orange afterglow.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·6	A
Maximum second and fourth anode voltage	$V_{a2,a4(max)}$	16*	kV
Minimum second and fourth anode voltage	$V_{a2,a4(min)}$	12	kV
Maximum third anode voltage	$V_{a3(max)}$	±700	V
Maximum first anode voltage	$V_{a1(max)}$	400	V
Maximum heater/cathode voltage, (d.c.) heater negative	$V_{h\text{-}k(max)}$	180	V
Maximum peak heater/cathode voltage, (d.c.) heater negative	$v_{h\text{-}k(pk)max}$	400†‡	V

* 16kV is a design centre rating, the absolute rating of 17·6kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding 1 minute.

INTER-ELECTRODE CAPACITANCES

Grid/All other electrodes	$c_{g\text{-}all}$	9·0	pF
Cathode/All other electrodes	$c_{k\text{-}all}$	6·5	pF

These capacitances include an AEI duodecal holder type CRT92/7.

TYPICAL OPERATION

Second and fourth anode voltage	$V_{a2,a4}$	14—15	kV
First anode voltage	V_{a1}	300	V
Third anode voltage for focus (range)	V_{a3}	−100 to +300	V
Grid bias voltage for cut-off of raster	V_g	−30 to −72	V
Average peak to peak modulating voltage for modulation up to 150μA		24	V
Centring magnet flux density		0—10	G
Maximum distance of centre of centring field from reference line		56	mm
Persistence of T9 screen		100§	s

§ Persistence is defined as the time taken, from the cessation of continuous excitation, for the luminance to decay from 1 Foot Lambert to approximately 1% of that value.

Note

The T9 screen is liable to burn, even at low values of beam current, if operated with stationary or slow moving spot.

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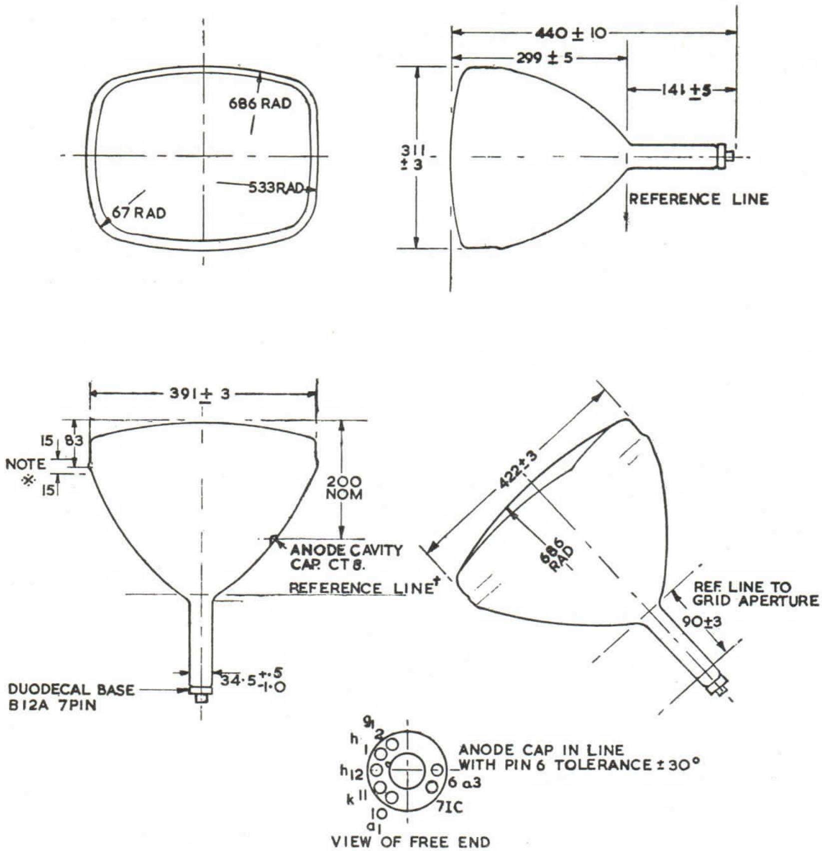


All dimensions in millimetres.
Not to be scaled.

Notes

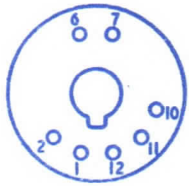
* During the face sealing operation the glass in this area (total 30mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

† Determined by Reference Gauge No. 7.

31G12
CATHODE RAY TUBE
Indirectly heated—for large screen Oscilloscopes

TENTATIVE

BASE—B12A(7 Pin)



Viewed from free end of pins

CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	Third Anode	a_3
Pin 7	Internal Connection	IC
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	First Anode	a_1
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Second and Fourth Anode	a_2,a_4

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AEI Cathode-ray Tube 31G12

GENERAL

The 31G12 is an electrostatically focused and magnetically deflected cathode-ray tube intended for use in large screen oscilloscopes. It has a 21″ diagonal and a deflection angle of 90°. The grey glass face of the aluminised tube is rectangular and has a total light transmission at the centre of approximately 72%. A screen type T9 is employed which has a long orange afterglow.

RATINGS

Heater voltage	V_h	6·3	V
Heater current	I_h	0·6	A
Maximum second and fourth anode voltage	$V_{a2,a4(max)}$	16*	kV
Minimum second and fourth anode voltage	$V_{a2,a4(min)}$	12	kV
Maximum third anode voltage	$V_{a3(max)}$	±700	V
Maximum first anode voltage	$V_{a1(max)}$	400	V
Maximum heater/cathode voltage, d.c. (heater negative)	$V_{h\text{-}k(max)}$	180	V
Maximum peak heater/cathode voltage, d.c. (heater negative)	$v_{h\text{-}k(pk)max}$	400†‡	V

* 16kV is a design centre rating, the absolute rating of 17·6kV must not be exceeded.
† Absolute rating.
‡ During a warming-up period not exceeding one minute.

INTER-ELECTRODE CAPACITANCES

Grid/All other electrodes	$c_{g\text{-}all}$	9·0	pF
Cathode/All other electrodes	$c_{k\text{-}all}$	6·5	pF

These capacitances include an AEI duodecal holder type CRT92/7.

TYPICAL OPERATION

Second and fourth anode voltage	$V_{a2,a4}$	14—15	kV
First anode voltage	V_{a1}	300	V
Third anode voltage for focus (mean)	V_{a3}	+100	V
Grid bias voltage for cut-off of raster	V_g	–30 to –72	V
Average peak to peak modulating voltage for modulation up to 150μA		24	V
Centring magnet flux density		0—10	G
Maximum distance of centre of centring field from reference line		56	mm
Persistence of T9 screen		100§	s

§ Persistence is defined as the time taken from the cessation of continuous excitation for the luminance to decay from 1 Foot Lambert to approximately 1% of that value.

Note

The T9 screen is liable to burn, even at low values of beam current, if operated with a stationary or slow-moving spot.

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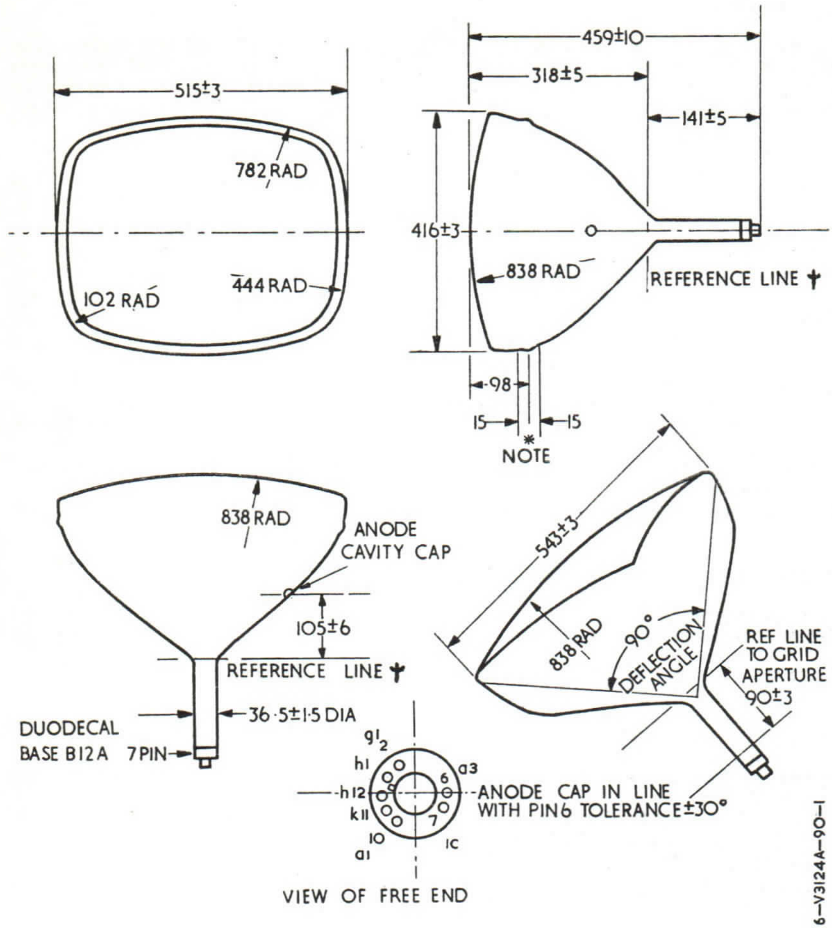

All dimensions in millimetres.

Notes

* During the face sealing operation the glass in this area (total 30 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

† Determined by reference line gauge No. 13.

Miscellaneous

APPLICATION NOTES
ON
VACUUM THERMAL DELAY SWITCHES

Vacuum Thermal Delay Switches find application in the delayed automatic switching required to protect certain types of thermionic valves or circuit elements, and may also be used for sequential switching operations not requiring precise timing.

The closing delay time after applying heater voltage lies between 30 and 90 seconds. In some cases the delay may be increased to a maximum of 180 seconds by a reduction of the heater voltage, achieved with resistor fitted preferably in the primary of the heater transformer. This is not, however, recommended, since it results in slower contact movement with reduced contact throw and pressure. The consequence of these effects is greater sensitivity to ambient temperature change and vibration, with a greater liability to intermittency at the moment of contact. Similarly the delay may be reduced by increase of the heater voltage provided that the increased emission from the heater produces no ill-effects. However, it should be noted that increases of more than 50 per cent. above the normal heater voltage rating will result in a significant reduction in life expectancy.

Where reactive circuits are switched or the contact current may exceed the rated maximum, and where the maximum switching delay time must be maintained under all conditions a secondary relay system should be operated by the thermal delay switch. This relay should be of the self-holding type and should when operated simultaneously break the switch heater supply and switch the main circuit.

The non-compensated switches will not be affected greatly by reasonable changes in ambient temperature but when consistent operation is required in the temperature range —40°C. to +85°C., a temperature compensated switch should be selected. This latter type of switch is unsuited to variation of the closing time by alteration of the heater voltage.

The heater should be neutral or positive with respect to the Moving Contact. Where the heater must be negative or where an A.C. voltage exists, the switch duty should be as low as possible since danger of ionic discharge increases with heater-contact voltage and contact current under these conditions.

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DLS10

VACUUM THERMAL DELAY SWITCH

GENERAL

The DLS10 is a Vacuum Thermal Delay Switch with an AC switch rating of 6 amps at 250 volts, or 200 mA at 1,000 volts. It has a heater rating of 1·5 amps at 4 volts, and switch closure delay times of from 30 to 90 seconds, the switch being open when cold.

RATING

Heater Voltage	(volts)	V_h	4·0
Heater Current	(amps)	I_h	1·5
Minimum Delay Time	(secs)	$t_{sd(min)}$	30
Maximum Delay Time	(secs)	$t_{sd(max)}$	90
Maximum Switch Current at 250 volts r.m.s. (AC)	(amps)	$I_{(rms)max}$	6
Maximum Switch Current at 1 kV r.m.s. (AC)	(mA)	$I_{(rms)max}$	200

DIMENSIONS

Maximum Overall Length	(mm)	150 ←
Maximum Seated Height	(mm)	120
Maximum Diameter	(mm)	45
Approximate Nett Weight	(ozs)	1½
Approximate Packed Weight	(ozs)	2½

MOUNTING POSITION—Unrestricted ←

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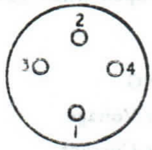
DLS10

VACUUM THERMAL DELAY SWITCH

OPERATION

See "Application notes on Vacuum Thermal Delay Switches"

BASE—British 4 pin (B4)



Viewed from free end of pins

VALVE HOLDER—Ediswan Clix VH42/4, VH300/4

CONNECTIONS

Pin 1	Fixed Contact	cf
Pin 2	Moving Contact	cm
Pin 3	Heater	h
Pin 4	Heater	h

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DLS15 & DLS16
VACUUM THERMAL DELAY SWITCHES

GENERAL

The DLS.15 and DLS.16 are designed for similar applications as the DLS.10 but are intended to fill the demand for a delay switch of reduced dimensions.

RATING

		DLS.15	DLS.16
Filament Voltage (volts)	V_f	4	6.3
Filament Current (amps)	I_f	.75	.48
Delay Time (secs)		min. 30 - max. 90	
Maximum Mean Current (Low Voltage Rating)	I_{pk}	5 amps @ 240 v.	
Maximum Mean Current (High Voltage Rating)	I_{pk}	100 m/a @ 1,000 v.	

DIMENSIONS

		DLS.15	DLS.16
Maximum Overall Length	(mm)	60 N.I.P. *	
Maximum Diameter	(mm)	32	
Maximum Height	(mm)	60	65

* Not Including Pins

MOUNTING POSITION - Unrestricted.

BASE

DLS.15 B.V.A. 4 pin	DLS.16 International Octal Base
Pin 1 - Fixed Contact	Pin 1 - -
Pin 2 - Moving Contact	Pin 2 - Filament
Pin 3 - Filament	Pin 3 - -
Pin 4 - Filament	Pin 4 - Moving Contact
	Pin 5 - -
	Pin 6 - Fixed Contact
	Pin 7 - -
	Pin 8 - Filament

IMPORTANT NOTE

To prevent any potential difference existing between the moving contact and heater, the two should be tied externally.

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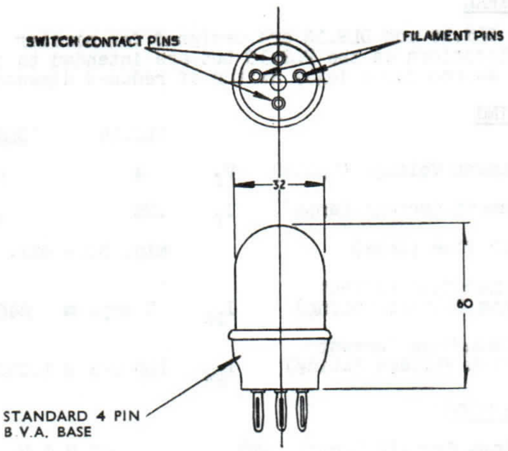
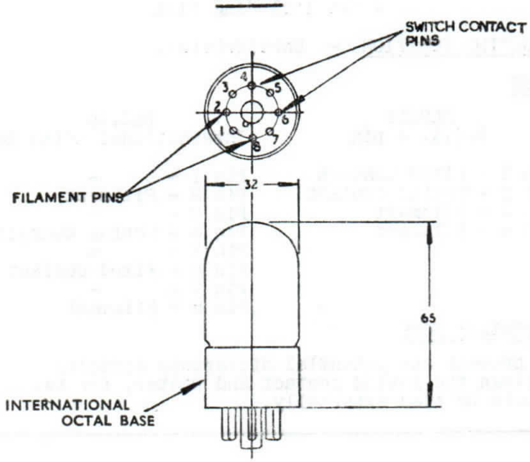
DLS15 & DLS16
VACUUM THERMAL DELAY SWITCHES

DLS.15



DLS.16



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DLS19

VACUUM THERMAL DELAY SWITCH

GENERAL

The DLS19 is a miniature-based Vacuum Thermal Delay Switch with an AC switch rating of 2 amps at 250 volts, or 100 mA at 500 volts. It has a heater rating of 0·5 amps at 6·3 volts, and switch closure delay times of from 35 to 70 seconds, the switch being open when cold. It is compensated to maintain a constant closure delay time in the ambient temperature range $-40°C$ to $+85°C$.

RATING

Heater Voltage	(volts)	V_h	6·3
Heater Current	(amps)	I_h	0·5
Minimum Delay Time	(secs)	$t_{sd(min)}$	35
Maximum Delay Time	(secs)	$t_{sd(max)}$	70
Maximum Switch Current at 250 volts r.m.s. (AC)	(amps)	$I_{(rms)max}$	2
Maximum Switch Current at 500 volts r.m.s. (AC)	(mA)	$I_{(rms)max}$	100
Maximum Switch Current at 250 volts (DC)	(amps)	$I_{(DC)max}$	1
Maximum Heater to Contact Voltage	(volts)	V_{h-c}	200

DIMENSIONS

Maximum Overall Length	(mm)	54
Maximum Seated Height	(mm)	48
Maximum Diameter	(mm)	19
Approximate Nett Weight	(ozs)	$\frac{1}{4}$
Approximate Packed Weight	(ozs)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

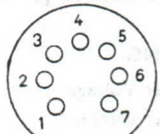
DLS19

VACUUM THERMAL DELAY SWITCH

OPERATION

See "Application notes on Vacuum Thermal Delay Switches"

BASE—B7G



Viewed from free end of pins

VALVE HOLDER—Ediswan Clix VH337/701 and VH437/701 series

CONNECTIONS

Pin 1	Heater	h
Pin 2	No Connection	NC
Pin 3	Moving Contact	cm
Pin 4	Fixed Contact	cf
Pin 5	No Connection	NC
Pin 6	No Connection	NC
Pin 7	Heater	h

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Electronic Components Division

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DLS23

VACUUM THERMAL DELAY SWITCH

GENERAL

The DLS23 is a Vacuum Thermal Delay Switch with an AC switch rating of 5 amps at 240 volts, or 100 mA at 1,000 volts. It has a heater rating of 1 amp at 2.5 volts and a switch closure delay time of from 30 to 90 seconds, the switch being open when cold.

RATING

Heater Voltage	(volts)	V_h	2.5
Heater Current	(amps)	I_h	1.0
Minimum Delay Time	(secs)	$t_{sd(min)}$	30
Maximum Delay Time	(secs)	$t_{sd(max)}$	90
Maximum Switch Current at 240 volts r.m.s. (AC)	(amps)	$I_{(rms)max}$	5
Maximum Switch Current at 1 kV r.m.s. (AC)	(mA)	$I_{(rms)max}$	100

DIMENSIONS

Maximum Overall Length	(mm)	65
Maximum Seated Height	(mm)	60
Maximum Diameter	(mm)	32
Approximate Nett Weight	(ozs)	1
Approximate Packed Weight	(ozs)	$2\frac{1}{2}$

MOUNTING POSITION—Unrestricted

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

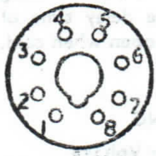
DLS23

VACUUM THERMAL DELAY SWITCH

OPERATION

See "Application Notes on Vacuum Thermal Delay Switches"

BASE—International Octal



Viewed from free end of pins

VALVE HOLDER

Ediswan Clix VH330/8, VH238/8, VH248/8

CONNECTIONS

Pin 1	No Connection	NC
Pin 2	Heater	h
Pin 3	Heater	h
Pin 4	No Connection	NC
Pin 5	Fixed Contact	cf
Pin 6	No Connection	NC
Pin 7	Moving Contact	cm
Pin 8	No Connection	NC

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DLS24

VACUUM THERMAL DELAY SWITCH

REVERSE ACTION

GENERAL

The DLS24 is a Miniature based Reverse Action Vacuum Thermal Delay Switch having AC switch ratings of 1 amp at 240 volts or 200 mA at 500 volts. It has a heater rating of 0.5 amps at 6.3 volts and a switch opening delay time of from 30 to 90 seconds, the switch being closed when cold. It is compensated to maintain a constant opening delay time in the ambient temperature range —40°C to +85°C.

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.5
Minimum Delay Time (secs)	$t_{sd(min)}$	30
Maximum Delay Time (secs)	$t_{sd(max)}$	90
Maximum Switch Current at 240 volts (r.m.s.) (AC) (amps)	$I_{(r.m.s.)}$ max	1.0
Maximum Switch Current at 500 volts (r.m.s.) (AC) (mA)	$I_{(r.m.s.)}$ max	200
Maximum Heater to Contact Voltage (volts)	V_{h-c}	200
Heater Resistance (cold) (ohms)	r_h (min)	1.3

DIMENSIONS

Maximum Overall Length	(mm)	54
Maximum Seated Height	(mm)	48
Maximum Diameter	(mm)	19
Approximate Nett Weight	(ozs)	$\frac{1}{4}$
Approximate Packed Weight	(ozs)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted

OPERATION

See 'Application notes on Vacuum Thermal Delay Switches.'

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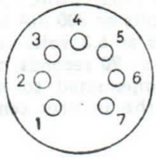
DLS24

VACUUM THERMAL DELAY SWITCH

REVERSE ACTION

BASE—B7G



Viewed from free end of pins

VALVE HOLDER—Ediswan Clix VH337/702 and VH437/702 series.

CONNECTIONS

Pin 1	Heater	h
Pin 2	No Connection	NC
Pin 3	Moving Contact	cm
Pin 4	Fixed Contact	cf
Pin 5	No Connection	NC
Pin 6	No Connection	NC
Pin 7	Heater	h

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Electronic Components Division
Tel.: GERrard 9797

24T12

VACUUM THERMAL DELAY SWITCH
REVERSE ACTION
TENTATIVE

GENERAL

The 24T12 is a Vacuum Thermal Delay Switch with an a.c. switch rating of 1 amp at 240 volts. It has a filament rating of 0·5 amps at 6·3 volts and switch closure delay times of from 15 to 45 seconds, the switch being closed when cold.

RATING

Filament Voltage	V_f	6·3	V
Filament Current	I_f	0·5	A
Maximum Switch Current at 240 volts r.m.s. (A.C.)	$I_{(rms)max}$	1·0	A
Maximum Switch Voltage at 200 mA	$V_{(rms)max}$	500	V
Minimum Switch Closing Time	$t_{sd(min)}$	15	s
Maximum Switch Closing Time	$t_{sd(max)}$	45	s

DIMENSIONS

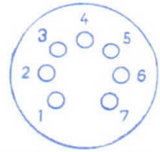
Maximum Overall Length	54·5 mm
Maximum Diameter	19·0 mm
Maximum Seated Height	47·5 mm

MOUNTING POSITION—Unrestricted

OPERATION

See " Application notes on Vacuum Thermal Delay Switches ".

BASE—B7G



Viewed from free end of pins

Associated Electrical Industries Limited

Electronic Components Division

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AEI

EDISWAN

24T12

VACUUM THERMAL DELAY SWITCH
REVERSE ACTION
TENTATIVE

CONNECTIONS

Pin 1	Heater	h
Pin 2	No Connection	NC
Pin 3	Moving Contact	cm
Pin 4	Fixed Contact	cf
Pin 5	No Connection	NC
Pin 6	No Connection	NC
Pin 7	Heater	h

Associated Electrical Industries Limited
Electronic Components Division
Tel.: GERRARD 9797

DRG36/2

TELEPHONE LINE PROTECTOR

GENERAL

The DRG36/2 is a Neon/Helium filled Telephone Line Protector. It is intended for use in discharging limited surges on a pair of Telephone lines, and is especially suitable for use with underground lines.

RATING

Minimum Striking Voltage (volts r.m.s.)	$V_{ign(min)}$	130
Maximum Glow to Arc Transition Voltage Line resistance 60 ohms (volts r.m.s.)		250
Maximum Glow to Arc Transition Current per line (amps)		1·0
Maximum Current per line (amps)	$i_{sur(max)}$	7·5
Maximum Charge passed at Maximum Current through both lines simultaneously (coulombs)		150
Breakdown Delay at 3000 volts (Statistical Max) (Micro Seconds)		5*

* To ensure regularity of striking, each tube contains a radio-active source for ionising purposes.

DIMENSIONS

Maximum Overall Length	(mm)	158
Maximum Diameter	(mm)	35
Maximum Seated Height	(mm)	133
Approximate Nett Weight	(ozs)	2½
Approximate Packed Weight	(ozs)	3½

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Electronic Components Division
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DRG36/2

TELEPHONE LINE PROTECTOR

MOUNTING POSITION—Unrestricted.

TYPICAL OPERATION

One protector is installed at each end of a telephone loop. The two line electrodes are connected across the pair of lines and the single electrode is earthed in the most suitable way depending on the terrain. At normal carrier plus signal voltages the tube is inert and imposes no load upon the line.

A surge of voltage from an external source (e.g. parallel power lines, electric storms, etc.) induced on the telephone lines causes the device to strike within microseconds thus providing a low impedance path to earth until the surge is cleared. Clearance of both lines is simultaneous since each is connected to the same tube. After clearing a surge the tube again becomes inert until another surge is induced.

Small surges are discharged through a red neon glow discharge carrying up to 0·5 amp.

Larger surges cause the tungsten arc to strike and currents of 0·5A to 15A are borne without damage. Larger surges giving currents greater than 15 Amps will be cleared but, if prolonged, may damage or destroy the tube.

Limiting impedance (provided the earthing is efficient) is that of the telephone line between the point where the surge strikes and the Telephone Line Protector (i.e. 300 ohms maximum for a typical loop).

When used on overhead lines the tube may be placed in parallel with a spark gap which will discharge the very heavy surges due to lightning strokes preserving the tube for the clearing of more limited surges.

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Tel.: GERrard 9797

DRG36/2

TELEPHONE LINE PROTECTOR

TOP CAP—Thumb Screw Terminal 2BA.

BASE—Edison Screw.

CONNECTIONS

Screw Centre	Line Electrode 1
Screw Thread	Line Electrode 2
Top Cap	Earth Electrode

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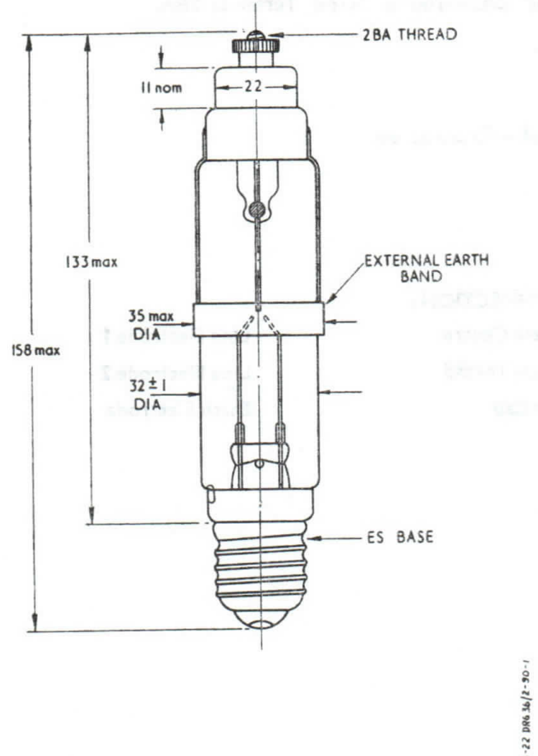
DRG36/2

TELEPHONE LINE PROTECTOR



All dimensions in m.m.

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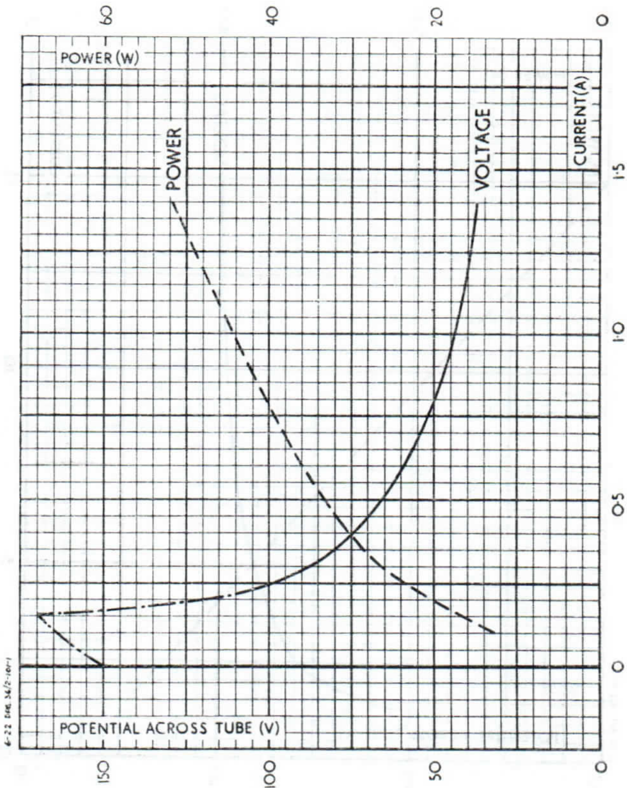
DRG36/2

TELEPHONE LINE PROTECTOR

AVERAGE CHARACTERISTIC CURVES : V,P/I



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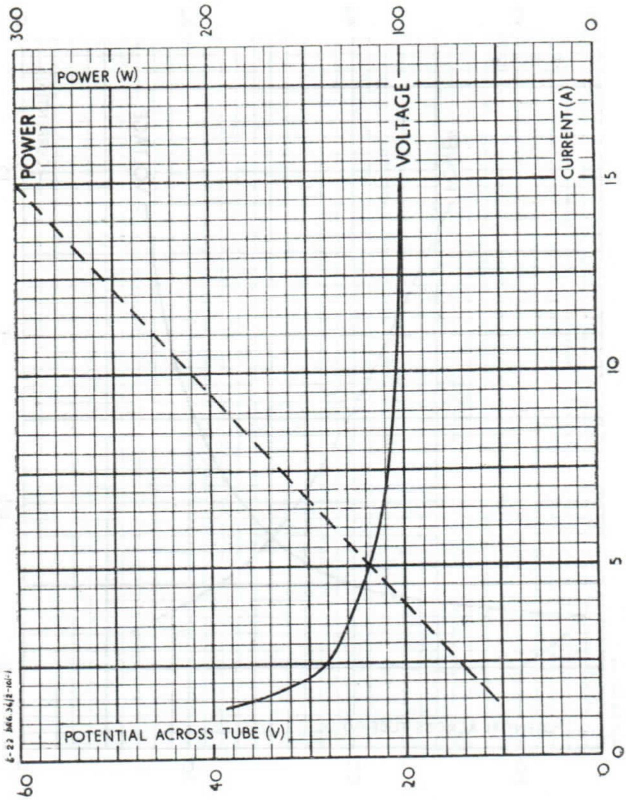
DRG36/2

TELEPHONE LINE PROTECTOR

AVERAGE CHARACTERISTIC CURVES: V,P/I



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6H1

HEXODE

Indirectly heated—for parallel operation

←

GENERAL

The 6H1 is a miniature based hexode intended for use as a frequency changer with a separate triode oscillator, and will operate up to a frequency of 20 Mc/s. It is also suitable for use as a gated amplifier, and may be used in equipment having AC or DC powered parallel connected heater chains.

RATING

Heater Voltage	(volts)	V_h	6·3
Heater Current	(amps)	I_h	0·2
Maximum Anode Voltage	(volts)	$V_{a(b)max}$	550†
Maximum Operating Anode Voltage	(volts)	$V_{a(max)}$	300
Maximum Screen Voltage	(volts)	$V_{g2,4(b)max}$	400†
Maximum Operating Screen Voltage	(volts)	$V_{g2,4(max)}$	300
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	1·0
Maximum Screen Dissipation	(watts)	$P_{g2+4(max)}$	0·7
Mutual Conductance	(mA/V)	g_m	2·1*

* Measured at $V_a = 250$ V ; $V_{g2+g4} = 100$ V ; $V_{g1} = -1{\cdot}8$V.

† $I_a = 0$.

All Maximum Values quoted are absolute.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Grid 1	$c_{a\text{-}g1}$	0·06
Anode/Earth	$c_{a\text{-}E}$	9·25
Grid 1/Earth	$c_{g1\text{-}E}$	4·3
Grid 3/All	$c_{g3\text{-}all}$	4·9

" Earth " denotes all earth potential electrodes, shields and heater connected to the cathode.

These capacities are measured cold with a metal screening can fitted to the valve.

Associated Electrical Industries Limited

Electronic Components Division

Tel.: GERrard 9797

6H1
HEXODE
Indirectly heated—for parallel operation

←

DIMENSIONS

Maximum Overall Length	(mm)	54·5 ←
Maximum Diameter	(mm)	19·0
Maximum Seated Height	(mm)	47·5 ←
Approximate Nett Weight	(ozs)	$\frac{1}{4}$
Approximate Packed Weight	(ozs)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted.

TYPICAL OPERATION—Frequency Changer

Anode Voltage	(volts)	V_a	250
Screen Voltage	(volts)	V_{g2+4}	100
Grid 1 Bias Voltage	(volts)	V_{g1}	−2·2 ←
Anode Current (approx)	(mA)	I_a	2·3* ←
Screen Current (approx)	(mA)	I_{g2+4}	2·7* ←
Conversion Conductance	(μA/V)	g_c	560† ←
Valve Anode Resistance ($\delta v_a/\delta i_a$)	(MΩ)	r_a	1·0 ←
Peak Heterodyne Voltage	(volts)	$V_{het(pk)}$	12 ←
Grid 3 Resistor	(kΩ)	R_{g3}	47*

* Grid 3 connected in parallel with the grid of the oscillator valve and biased by grid current through the Grid 3 resistor.

† Measured with an anode circuit of low dynamic impedance.

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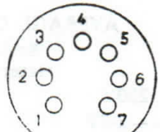
6H1

HEXODE

Indirectly heated—for parallel operation

BASE—B7G



Viewed from free end of pins

VALVE HOLDER—Ediswan Clix VH337/7, VH437/7 and VH17/7 series.

CONNECTIONS

Pin 1	Grid 1	g1
Pin 2	Cathode	k
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Anode	a
Pin 6	Grid 3	g3
Pin 7	Grid 2 and Grid 4	g2+g4

Associated Electrical Industries Limited

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6H1

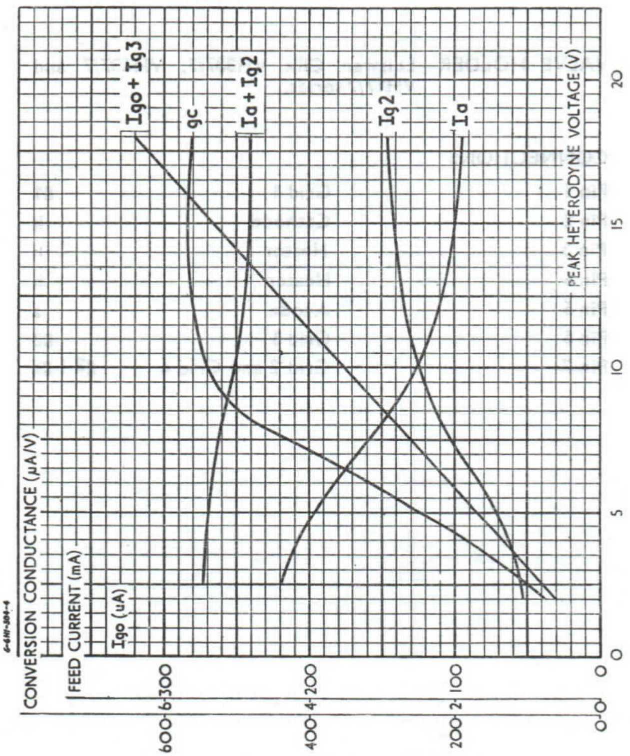
HEXODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES:
$g_c, I_a, I_{g2}, I_{g3}, I_{g0}/V_{het(pk)}$
Heterodyne injected into g3

$V_a = 250V$ $V_{g2} = 100V$ $V_{g3} =$ Self Bias
$V_{g1} = -2{\cdot}2V$ $Z_L = 49k\Omega$ $R_{g3} = 47k\Omega$

Note: g3 is connected in parallel with the grid of an external oscillator and is biased by grid current.



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22M1

GLOW MODULATOR

GENERAL

The 22M1 is a Glow Modulator with a cold cathode. It is intended for use as a modulated light source in facsimile equipment.

RATING

Maximum Striking Voltage		225	V
Maximum Peak Current	$I_{pk(max)}$	75	mA
Maximum Mean Current	$I_{av(max)}$	35	mA
Maximum Voltage Drop at 30mA		150	V

DIMENSIONS

Maximum Overall Length	78	mm
Maximum Diameter (base)	34	mm
Maximum Seated Height	64	mm

MOUNTING POSITION—Unrestricted

CHARACTERISTICS

Approximate light output at 30mA	0·13 cd
Luminance	60 cd/sq. in.
Average diameter of light area on screen normal to valve axis and 20mm from end of bulb	25 mm
Diameter of light source (approx.)	1·3 mm

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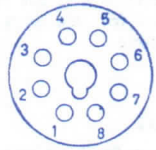
22M1

GLOW MODULATOR

BASE—International Octal (I02)



Viewed from free end of pins.

CONNECTIONS

Pin 1	No Pin	NP
Pin 2	No Pin	NP
Pin 3	Cathode	k
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	No Pin	NP
Pin 7	Anode	a
Pin 8	No Pin	NP

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29CI

HIGH VACUUM CONTROL DIODE

Directly heated tungsten filament—for use as the controlling element in stabiliser circuits

RATING

Approximate Filament Voltage (volts)	V_f	4.0
Approximate Filament Current (amps)	I_f	0.8
Maximum Anode Current (mA)	$I_{a(max)}$	3.0
Maximum Anode Voltage (volts)	$V_{a(max)}$	100

DIMENSIONS

Maximum Overall Length (mm)	80
Maximum Diameter (mm)	32
Maximum Seated Height (mm)	67
Approximate Nett Weight (ozs)	1¼
Approximate Packed Weight (ozs)	2¼

MOUNTING POSITION - Unrestricted.

Associated Electrical Industries Limited
Electronic Components Division
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29C1

HIGH VACUUM CONTROL DIODE

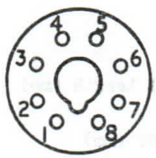
Directly heated tungsten filament—for use as the controlling element in stabiliser circuits

TYPICAL OPERATION

Saturated Anode Current (mA)	I_a	2.0
Minimum Anode Voltage (volts)	$V_{a(min)}$	20
Approximate Filament voltage (volts)	V_f	4.0
Approximate Filament current (amps)	I_f	0.8

BULB Clear

BASE International Octal (IO8)



Viewed from free end of pins.

CONNEXIONS

Pins 1, 2, 4	Filament	f
Pin 3	Blank	-
Pin 5	Anode	a
Pins 6, 7, 8	Filament	f

Associated Electrical Industries Limited

Electronic Components Division

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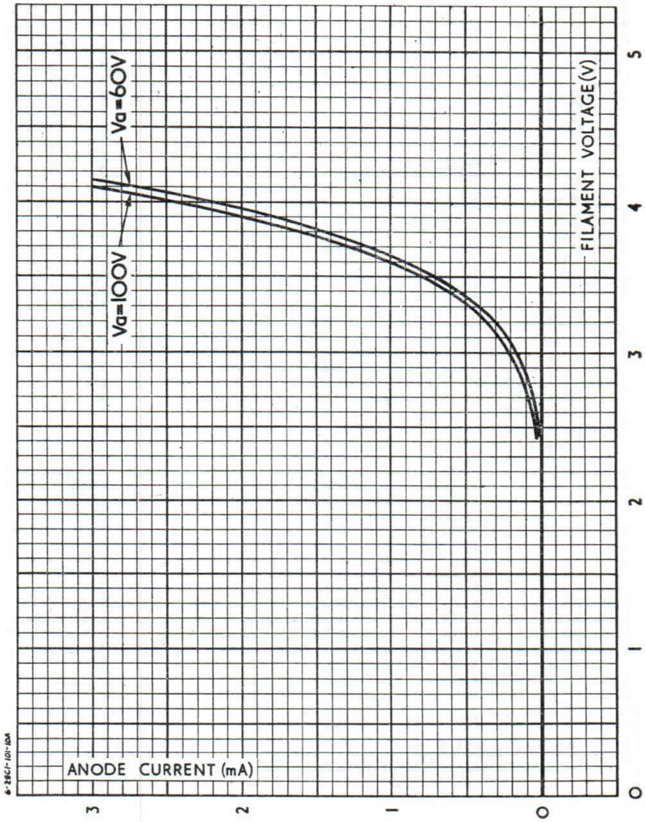
29CI

HIGH VACUUM CONTROL DIODE

Directly heated tungsten filament—for use as the controlling element in stabiliser circuits

AVERAGE CHARACTERISTIC CURVES: I_a/V_f



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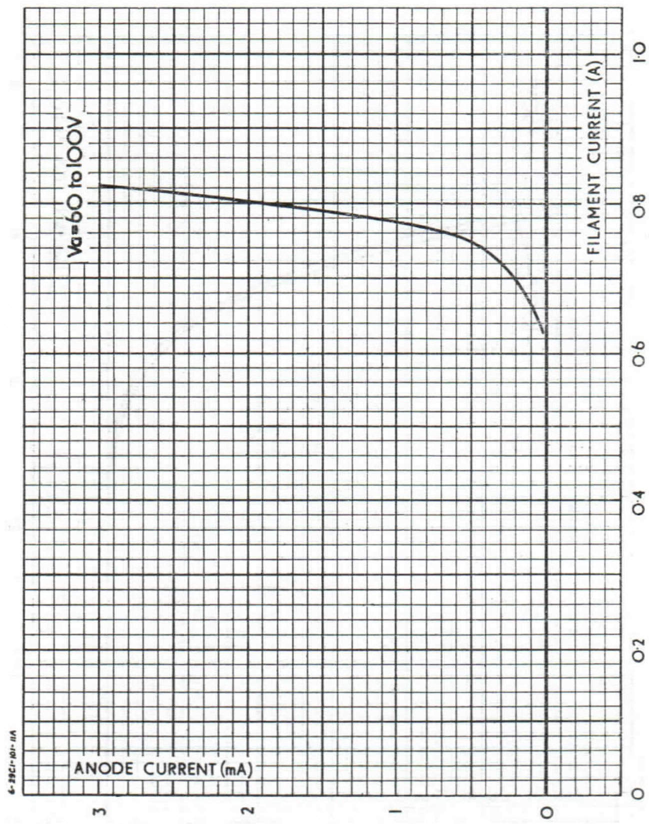
29C1

HIGH VACUUM CONTROL DIODE

Directly heated tungsten filament—for use as the controlling element in stabiliser circuits

AVERAGE CHARACTERISTIC CURVES: I_a/I



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CONDENSED DATA ON OBSOLETE TYPES

BARRETTERS

Type	Volts	Current (A)	Base	Overall Length mm	Max. Dia. mm	Remarks
BU.10	50–80	0.117–0.143	4 Pin	105 N.I.P.	58	
BU.29/4	2.5–6.0	0.27 –0.30	IO			
BU.30/2	1–3	0.27 –0.33	ES	85	32	
BU.30/4	2.5–6	0.27 –0.33	ES	100	32	
BU.30/6	3–9	0.27 –0.33	ES	90	30	
BU.30/6A	3–9	0.27 –0.33	IO	90	30	
BU.30/8	4–12	0.27 –0.33	ES	100	32	
BU.30/10	6–14	0.27 –0.33	ES	115	32	
BU.30/12	6–18	0.27 –0.33	ES	100	32	
BU.30/50	25–75	0.27 –0.33	ES	120	38	
BU.30/50A	25–75	0.27 –0.33	4 Pin	120	38	
BU.30/50B	25–75	0.27 –0.33	3 Pin	120	38	
BU.30/110	85–170	0.27 –0.33	ES	240	46	
BU.35/14	10–18	0.315–0.385	ES	115	38	
BU.35/80	40–120	0.315–0.385	ES	145	58	
BU.40/8	4–12	0.36 –0.44	ES	125	32	
BU.43/30	15–45	0.387–0.473	ES	105	32	
BU.47/6	3–9	0.323–0.517	ES	100	32	
BU.50/8	4–12	0.45 –0.55	ES	125	32	
BU.50/24	12–36	0.45 –0.55	3 Pin	95 N.I.P.	32	Centre-tapped
BU.50/40	25–50	0.45 –0.55	ES	120	32	
BU.60/120	80–150	0.55 –0.65	ES	170	64	
BU.63/30	15–45	0.567–0.693	4 Pin	110 N.I.P.	53	
BU.65/10	6–14	0.585–0.715	ES	107	32	
BU.65/14	9–20	0.585–0.715	ES	105	32	
BU.70/8	4–12	0.63 –0.77	3 Pin	75 N.I.P.	32	Centre-tapped
BU.70/12	8–16	0.63 –0.77	3 Pin	80 N.I.P.	32	Centre-tapped
BU.70/16	10–21	0.63 –0.77	3 Pin	80 N.I.P.	32	Centre-tapped
BU.70/22	16–38	0.63 –0.77	3 Pin	90 N.I.P.	38	Centre-tapped
BU.70/28	16–38	0.63 –0.77	3 Pin	100 N.I.P.	32	Centre-tapped
BU.70/35	20–45	0.63 –0.77	3 Pin	100 N.I.P.	38	Centre-tapped
BU.78/10	8–14	0.72 –0.9	B4	75 N.I.P.	32	Centre-tapped
BU.78/10X	5–15	0.78 ± 5%	4 Pin	90 N.I.P.	38	Centre-tapped
BU.80/21	12–30	0.72 –0.88	ES	135	38	
BU.85/5	4–8	0.765–0.935	ES	105	32	

Associated Electrical Industries Limited
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CONDENSED DATA ON OBSOLETE TYPES

BARRETTERS

Type	Volts	Current (A)	Base	Overall Length mm	Max. Dia. mm	Remarks
BU.85/8	4–12	0.765–0.935	ES	125	32	
BU.90/100	50–150	0.810–0.990	ES	320	64	
BU.100/06	0.4–0.8	0.9 –1.1	MES	45	26	
BU.100/3	1.5–4.5	0.9 –1.1	ES	100	32	
BU.100/4	2–6	0.9 –1.1	ES	110	32	
BU.100/6	3–9	0.9 –1.1	ES	90	32	
BU.100/8	4–12	0.9 –1.1	ES	96	32	
BU.100/10	5–15	0.9 –1.1	ES	115	32	
BU.100/11	6–16	0.9 –1.1	ES	122	32	
BU.100/14	7–20	0.9 –1.1	ES	125	38	
BU.100/14A	7–20	0.9 –1.1	3 Pin	120 N.I.P.	38	
BU.100/20	15–30	0.9 –1.1	ES	100	38	
BU.115/22	11–31	1.03 –1.26	3 Pin	105 N.I.P.	38	Centre-tapped
BU.130/7	4–10	1.17 –1.43	ES	115	32	
BU.133/110	60–160	1.2 –1.46	ES	315	64	
BU.140/28	18–35	1.26 –1.54	4 Pin	115 N.I.P.	64	
BU.150/160	80–240	1.275–1.725	ES	320	90	
BU.170/28	15–40	1.53 –1.87	3 Pin	110 N.I.P.	38	Centre-tapped
BU.180/5	3–7	1.62 –1.98	MO	75 N.I.P.	32	
BU.190/24	15–34	1.71 –2.09	3 Pin	120	38	Centre-tapped
BU.200/7	4–10	1.8 –2.2	4 Pin	120	45	
BU.200/14	8–20	1.8 –2.2	3 Pin	100 N.I.P.	32	Centre-tapped
BU.200/20	11–29	1.8 –2.2	ES	130	38	
BU.215/75	50/100	1.9 –2.3	ES	280	64	
BU.250/7	4–10	2.25 –2.75	4 Pin	125 N.I.P.	38	
BU.280/20	10–30	2.52 –3.08	3 Pin	130 N.I.P.	58	
BU.350/55	40–80	3.15 –3.85	Specl.	290	90	
BU.350/55/1	40–80	3.15 –3.85	GES	300 Apprx.	90	
BU.400/6	3–9	3.5 –5.0	ES	145	51	
BU.600/6	3–9	5.4 –6.6	ES	150	58	
BU.800/6	3–9	7.2 –8.8	ES	145	58	

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CONDENSED DATA ON OBSOLETE TYPES
SPECIAL PURPOSE VALVES

Type	Class	V_h (volts)	I_h (amps)	$V_{a(max)}$ (volts)	gm	
11E1	Audio Beam Tetrode	6.3	1.2	500	7.3	P_a, 25 W ; $V_{g2(max)}$ 250 volts ; P_{g2}, 3.0 W
V339	Voltmeter Triode	4.0	0.58	250	1.7	μ, 73 ; r_a, 43,000 ohms

Type	Class	Peak Output (kW)	Main Gap Voltage (kV_{pk})	Pulse Duration (μs)	Repetition Frequency (P.P.S.)	Trigger Voltage (kV_{pk})	Line & Load Impedance (ohms)
24B2	Trigatron	150	—7.2	0.5	1200	3.5	80
24D4	Trigatron	250	—16.0	2.0	400	3.8	250

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