OSCILLOSCOPE TUBES

T980H T980N T980X

INTRODUCTION

The T980H, T980N and T980X are 5-inch diameter cathode ray tubes for wide band, high speed oscilloscope applications. They are identical except for their screen characteristics and similar to the T979 series but are fitted with anode modulator electrodes.

The incorporation of a post deflection accelerator mesh and an internal spiral coating, together with an improved gun design, gives the tubes the following features:

(1) Deflection sensitivities in the X and Y directions of 9V/cm and 3V/cm respectively, making them particularly suitable for use with deflection circuits employing transistors.

(2) A large useful screen area, permitting the use of either 6 × 10cm or 8 × 8cm displays.

(3) Excellent brightness, giving a visible trace at writing speeds up to 1–3nsec/cm, and with negligible distortion introduced in the post deflection accelerator (P.D.A.) system. The small amounts of barrel or pin cushion distortion, linearity distortion and astigmatism present can be eliminated by adjustment of electrode potentials.

(4) Anode modulation plates give zero spot movement under normal operating conditions, but if only beam blanking is required, and spot movement can be tolerated, then modulation can be accomplished at a lower voltage.

(5) Good sensibility due to the small spot size.

(6) Variations of deflection sensitivities with variations in P.D.A. voltage are considerably reduced.

(7) Minimum deflector plate inductance and inter-plate capacitance, due to the deflector plate connections being made via short pins sealed into the side of the bulb.

GENERAL DATA

Electrical and General

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage (*See Note* 1)	6·3	V
Heater Current	0·3 ± 10%	A
Faceplate	Flat, Clear Glass	
Screen (*See Note* 2)	Aluminised	
Deflection Method	Electrostatic	
Focus Method	Electrostatic	
Anode Modulation (*See Note* 3)	Electrostatic	
Linearity of Scan (*See Note* 4)	2	%
Raster Distortion (*See Note* 5)	±1	%
Orthogonality	90 + 1	Degrees

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Minimum useful scan

Y1 to Y2 (*See Note* 6)	8·0	cm
X1 to X2 (*See Note* 6)	10	cm

Undeflected Spot Position (to geometric centre of faceplate)

Y Orientation	±0·6	cm
X Orientation	±1·0	cm

Helix Resistance

Anode 5 to Interplate Shield	200	MΩ Min
→	1000	MΩ Max

Inter-Electrode Capacitances

(With all other electrodes not mentioned, and those marked*, earthed)

Grid to all other electrodes	6·1 pF Nom
Cathode to all other electrodes	5·7 pF Nom
Anode Modulator to all other electrodes	6·5 pF Nom
Anode Modulation Corrector to all other electrodes	8·8 pF Nom
Anode Modulator + Corrector to all other electrodes	11·4 pF Nom
Anode Modulator to anode modulation corrector	1·2 pF Nom
X1 Electrode to all other electrodes except X2*	3·5 pF Nom
X2 Electrode to all other electrodes except X1*	3·5 pF Nom
Y1 Electrode to all other electrodes except Y2*	2·9 pF Nom
Y2 Electrode to all other electrodes except Y1*	2·9 pF Nom
X1 to X2 Electrode	3·1 pF Nom
Y1 to Y2 Electrode	1·7 pF Nom
X1+X2 Electrodes to Y1+Y2 electrodes	<0·1 pF
X1+X2+Y1+Y2 Electrodes to cathode	<0·1 pF
X1+X2+Y1+Y2 Electrodes to grid	<0·1 pF

Mechanical

Overall Length	20·71 inches (526 mm)	Max
→ Overall Diameter (excluding cap)	5·37 inches (136·5 mm)	Max
Seated Height	21·260±0·236 inches (504±6 mm)	
Neck Diameter (excluding pins)	2·28 inches (58 mm)	Max
Useful Screen Area	2·36 by 3·94 or 3·15 by 3·15 inches	Min
	6·0 by 10 or 8·0 by 8·0cm	Min
Net Weight	3 pounds (1·4 kg)	Approx
Base		B.S.448–B12F
Anode 5 Cavity Cap		B.S.448–CT8
Mounting Position (*See Note* 7)		Any

→ Indicates a change

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

(All voltages are with respect to cathode except where otherwise stated)

	Min	*Max*	
Anode 5 Voltage (*See Note* 8)	6·0	15*	kV
Anode 4 Voltage	1·0	3·3	kV
Anode 3 and Anode 1 Voltage	1·0	3·3	kV
Anode 2 Voltage	0	1·5	kV
Anode Modulator Voltage	−300*	+300*	V
Anode Modulation Corrector Voltage	−300*	+300*	V
Anode Modulator to Anodes 3 and 1 Impedance	—	25	kΩ
Anode Modulation Corrector to Anodes 3 and 1 Impedance	—	25	kΩ
Grid Bias Voltage (negative value)	0	200	V
Grid Voltage (positive peak value)	—	2·0	V
Cathode Current (Intermittent Mean)	—	0·3	mA
Y Plate Shield Voltage	—	3·3	kV
Interplate Shield Voltage	—	3·3	kV
Mesh Shield Voltage	—	3·3	kV
Mesh Voltage (negative with respect to mesh shield voltage)	10	20	V
Deflection Voltage on X or Y electrodes (Peak)	—	500	V
Heater to Cathode Voltage (Peak):			
Cathode positive	—	200	V
Cathode negative	—	125	V
Screen Dissipation (average)	—	5·0	mW/sq.cm
X1 or X2 to Anodes 3 and 1 Impedance	—	2·0	MΩ
Y1 or Y2 to Anodes 3 and 1 Impedance	—	1·0	MΩ
Grid to Cathode Impedance	—	1·0	MΩ
Anode 4 to Anodes 3 and 1 Impedance			(*See Note* 9)

*With respect to anode 3 and anode 1 voltage.

TYPICAL OPERATING CONDITIONS

Anode 5 (Screen) Voltage ..	12	12	12	kV
Mesh Voltage (with respect to mesh shield)	−15	−15	−15	V
Anode 4 Voltage (adjusted for minimum astigmatism) (*See Note* 10)	1·0	1·5	3·0	kV
Anode 3 and Anode 1 Voltage ..	1·0	1·5	3·0	kV
Anode 2 Voltage (for focus) ..	165 to 335	250 to 500	500 to 1000	V
Grid Voltage (for spot cut-off) ..	−30 to −57	−45 to −85	−90 to −170	V
Y Plate Shield Voltage (*See Note* 11)	1·0	1·5	3·0	kV
Interplate Shield Voltage (*See Note* 12)	1·0	1·5	3·0	kV
Mesh Shield Voltage (*See Note* 13)	1·0	1·5	3·0	kV
Anode Modulation; minimum spot movement; (30V grid drive) (*See Note* 3*a*):				
Anode Modulator Voltage*† ..	0	0	0	V
Anode Modulator Voltage*§ ..	−16	−24·2	−48·4	V
Anode Modulation Corrector Voltage*†	0	0	0	V
Anode Modulation Corrector Voltage*§	−18·3	−27·5	−55	V
Anode Modulator + Anode Modulation Corrector Current	(*See Note* 14)	(*See Note* 14)	(*See Note* 14)	
Anode Modulation for maximum sensitivity (30V grid drive) (*See Note* 3*b*):				
Anode Modulator Voltage*†	0	0	0	V
Anode Modulator Voltage*§	−8·6	−13	−26	V
Anode Modulator Current ..	(*See Note* 14)	(*See Note* 14)	(*See Note* 14)	
Mesh Current	(*See Note* 15)	(*See Note* 15)	(*See Note* 15)	
Anode 3 and Anode 1 Current ..	(*See Note* 16)	(*See Note* 16)	(*See Note* 16)	
Anode 2 Current	±15	±15	±15	μA
Cathode Current	(*See Note* 16)	(*See Note* 16)	(*See Note* 16)	
Deflection Factor (*See Note* 17):				
Mean Potential of X and Y plates	1·0	1·5	3·0	kV
X1 and X2 Electrodes:				
Mean	6·1	9·0	17·5	V/cm
Limits	5·3 to 6·8	8·0 to 10	15·5 to 19·5	V/cm
Y1 and Y2 Electrodes:				
Mean	2·0	3·0	6·2	V/cm
Limits	1·6 to 2·3	2·5 to 3·5	5·2 to 7·2	V/cm

†Zero modulation, i.e. full beam current. §For extinction of stationary spot.
*With respect to anode 3 and anode 1 voltage.

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Correction Potential Ranges

Mesh (with respect to mesh shield) (*See Note* 18) ..	−12 to −18	−12 to −18	−12 to −18	V
Anode 4 (astigmatism) (*See Notes* 10 *and* 18)	±40	±40	±40	V
Y Plate Shield (*See Notes* 11 *and* 18)	±20	±20	±20	V
Interplate Shield (*See Notes* 12 *and* 18)	±60	±40	±20	V
Line Width (*See Note* 19) ..	0·6	0·5	0·3	mm

ASSOCIATED COMPONENTS

The following components can be obtained from the suppliers listed; there may possibly be alternative sources:

(1) B.S.448–B12F socket	Catalogue No. 77/842	Carr Fastener Co. Ltd., Stapleford, Notts.
(2) B.S.448–CT8 Cavity Cap Connector	Catalogue No. 77/699	Carr Fastener Co. Ltd., Stapleford, Notts.
(3) Side Pin Connectors	Miniature wander socket type WS1 (colours red, black or blue).	A.E.I. Clix, Radio and Electronics Components Division, Barton Hill, Bristol.
(4) Magnetic Shield to suit T980 series (*See page* 12)		Magnetic Shields Ltd., Headcorn Road, Staplehurst, Tonbridge, Kent.

NOTES

1. The heater is suitable for parallel operation only.
2. The T980 series have screens with the following characteristics.

Type	EEV Screen	Equivalent	Fluorescent and Afterglow Colour	Persistence
T980H	H	P31	Blue-Green	Medium-Short
T980N	N	P2	Yellowish-Green	Medium
T980X	X	P7	Blue with Yellowish-Green Afterglow	Long

The tube can be manufactured with alternative screens, and customers' enquiries are invited.

3. (*a*) **Minimum Spot Movement Operation** (Patent applied for). In applications where spot movement caused by anode modulation is undesirable, the modulation electrodes can be operated as follows. The anode modulation corrector requires up to 20% more modulation voltage than the anode modulator to achieve minimum spot movement. The modulating signal is therefore connected directly to the anode modulation corrector and a proportion of the signal (adjusted for minimum spot movement) is fed to the anode modulator. The maximum signal required to cut off the beam in this case is 22V per kV of anode 1 voltage. By this method, zero spot movement can be obtained for a given value of grid drive, and at other values of grid drive the spot movement will be very small (less than one spot diameter). If a slightly greater spot movement can be tolerated, the anode modulator and anode modulation corrector may be connected together.
   (*b*) **Maximum Sensitivity Operation** In applications where spot movement is acceptable, the modulating signal is applied to the anode modulator and the anode modulation corrector is connected to Anode 1. The maximum signal required to cut off the beam in this case is 15V per kV of anode 1 voltage and the spot movement is approximately 7mm.
   N.B. The anode modulation electrodes cannot be used with positive signals to obtain beam brightening.
4. The deflection factor for a deflection of 75% of the useful scan will not differ from that for a deflection of 25% by more than 2%.
5. The edges of a 6 × 10cm raster will fall between two concentric rectangles 101 × 60·6mm and 99 × 59·4mm.
6. The tube can be used for either 6 × 10cm or 8 × 8cm displays.
7. The tube should be supported near the screen and also on the parallel neck near the base; it should not be supported by the base only. The socket should not be mounted rigidly, but should have flexible leads and be able to move freely. To avoid the need for excessive magnetic shielding the tube should be mounted as far away as possible from transformers, chokes and other sources of stray field.
8. Anode 5 may be operated at a voltage lower than the minimum specified but the light output will then be limited by the screen aluminising.
9. When high beam currents are used, anode 4 collects current and the anode 4 to anodes 3 and 1 impedance should be kept as low as possible to avoid defocusing.
10. Adjustment of the anode 4 voltage about the mean Y plate potential is used to correct astigmatism introduced in the deflection system. The range of voltage required is of the order of ±40V.
11. The Y plate shields should be operated about the mean potential of the Y1 and Y2 electrodes. Variation of the potential about this value controls the edge effects of the Y deflection electrode field and provides a fine adjustment of the deflection linearity in the Y direction.

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12. Variation of the interplate shield voltage about the mean potential of the deflector electrodes provides correction for barrel and pin cushion distortion. When the mean potentials of the X and Y deflection electrodes are equal, a range of ±40V maximum is required (with anode 3 and anode 1 voltage of 1·5kV); the range is slightly wider when the mean potentials are not equal.

13. The mesh shield should be operated at approximately the mean X plate potential.

14. The total current will be approximately 50% of the anode 3 and anode 1 current and will be of the opposite direction.

15. At peak beam current, the mesh current will be of the order of 5μA.

16. When anode modulation is used as the sole means of modulating the beam, ← the cathode current must never exceed 0·3mA. Where cathode modulation or grid modulation is used in addition to anode modulation, or cathode and grid modulation are used without anode modulation, the peak anode 1 and 3 current, and the peak cathode current can exceed 0·5mA, and under low duty cycle conditions, such as viewing transients, may reach 2·0mA. Under these conditions the regulation of the power supplies to the anode 1 and anode 3 circuit and cathode circuit should be adequate for such variation.

17. The X electrodes and Y electrodes are designed primarily for symmetrical operation. Some degradation of focus and trace geometry will result if the tube is operated under asymmetric conditions.

18. These figures apply when the mean potentials of the X and Y electrodes and anode 3 are equal. When the mean deflection electrode potentials differ from the anode 3 voltage, a slightly wider range will be required.

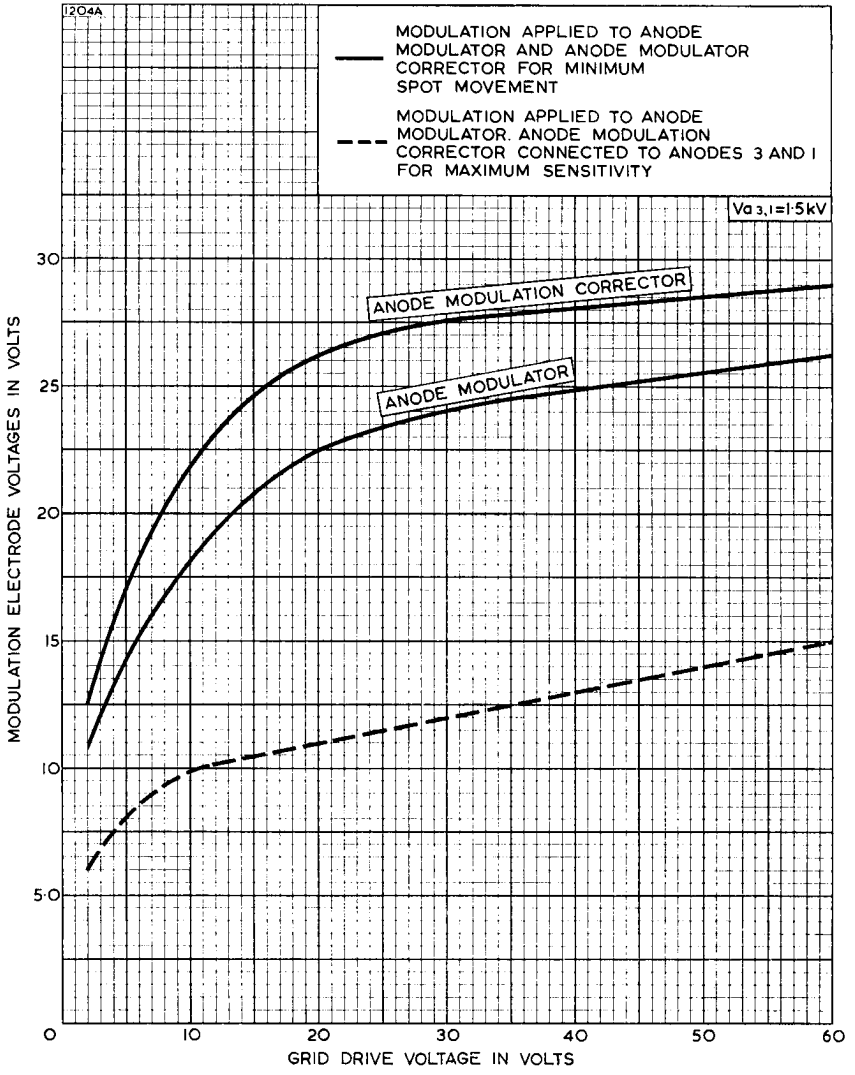
19. Measured under the following conditions:

Anode 4 Voltage	Optimised	
Anode 2 Voltage	Optimised	
Grid Drive	25	V
Raster Size	5×5	cm
Vertical Lines	200	
Frame Repetition	50	c/s
Spot Velocity	500	m/sec

The line width measured with a microscope as in K1001. Compared with the shrinking raster method, this method is more accurate but pessimistic. Thus it must be remembered that the equivalent line width measured by the shrinking raster method will be considerably less than the value stated when comparison is made with data given in these terms.

← Indicates a change

MODULATION VOLTAGE CHARACTERISTICS



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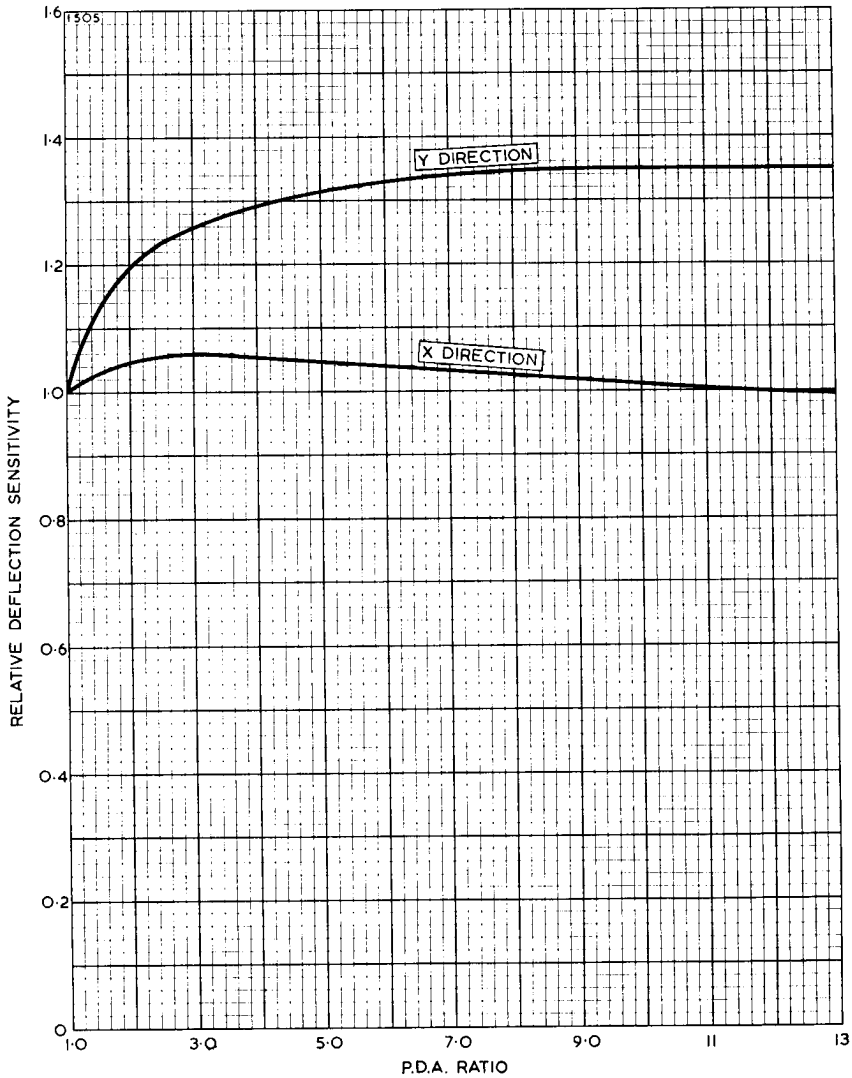
P.D.A. RATIO CHARACTERISTIC



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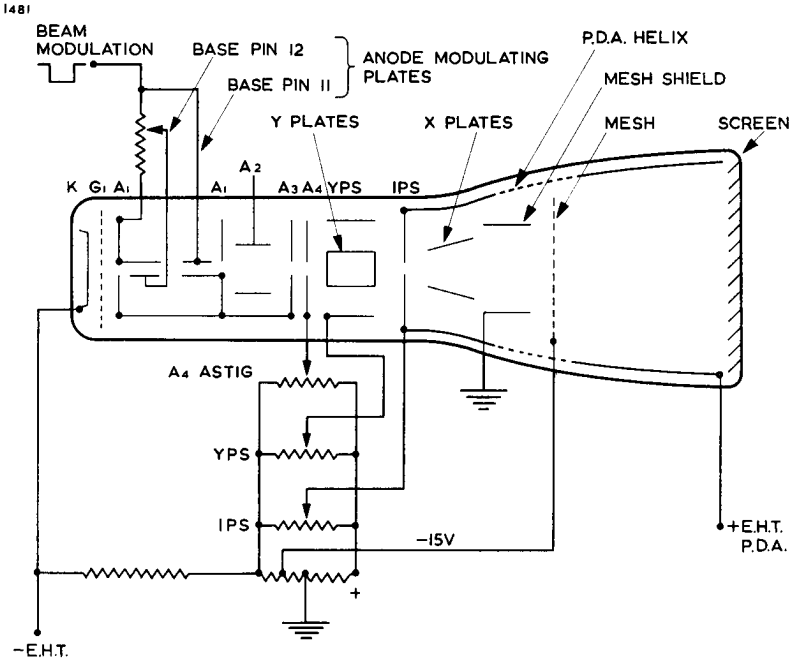
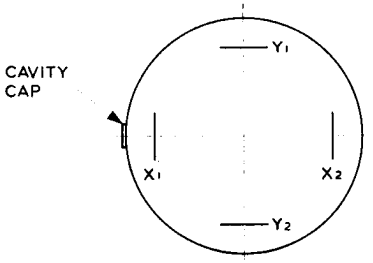
SCHEMATIC DIAGRAM

1481

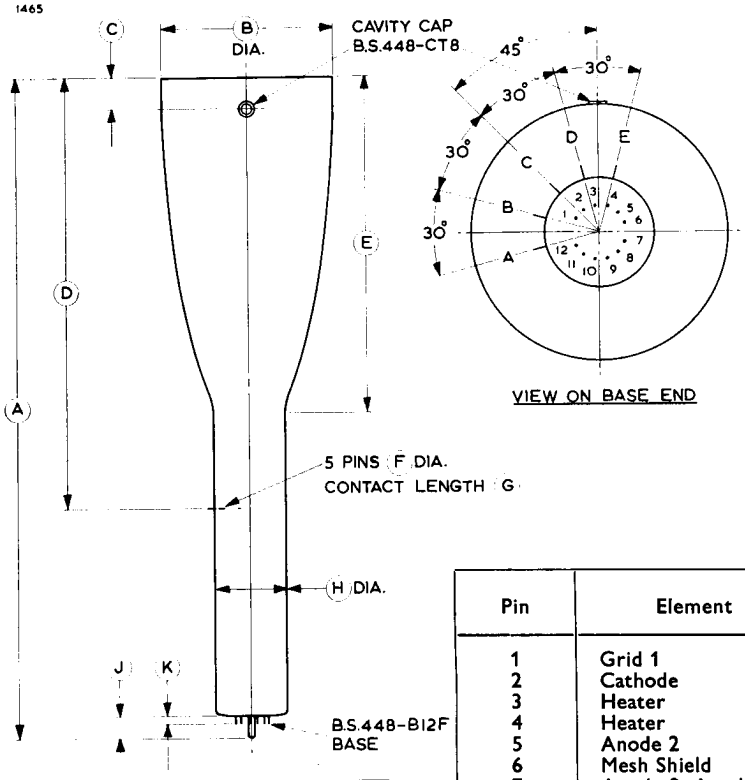


ORIENTATION OF DEFLECTION PLATES
(view on screen end of tube)

1482



OUTLINE



Ref.	Inches	Millimetres
A	20·71 Max	526·0 Max
→ B	5·374 Max	136·5 Max
→ C	1·575 ± 0·118	40·0 ± 3·0
D	13·425 ± 0·197	341·0 ± 5·0
E	10·512 ± 0·394	267·0 ± 10·0
F	0·039	1·00
G	0·236 ± 0·039	6·0 ± 1·0
H	2·283 Max	58·0 Max
J	0·709 Max	18·0 Max
K	0·248 Max	6·3 Max

Inch dimensions have been derived from millimetres.

→ Indicates a change

Pin	Element
1	Grid 1
2	Cathode
3	Heater
4	Heater
5	Anode 2
6	Mesh Shield
7	Anode 3, Anode 1
8	Anode 4
9	Mesh
10	Y Plate Shield
11	Anode Modulation Corrector
12	Anode Modulator
A	X2 Electrode
B	X1 Electrode
C	Interplate Shield
D	Y1 Electrode
E	Y2 Electrode
Cavity Cap	Anode 5 (Screen)

The overall bulb diameter 'B' does not include the cavity cap.