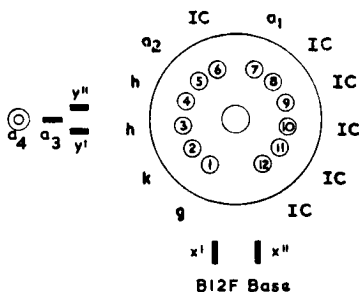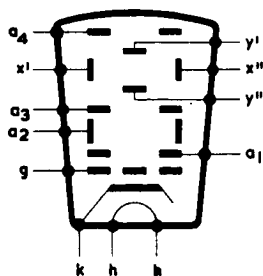# $\boxed{ETEL}$ 4EP1

OSCILLOSCOPE TUBE

General purpose oscilloscope tube with 4-in. flat screen. This tube is fitted with a post deflection accelerator and the deflection plates are brought out to side connections.

B12F Base

GENERAL DATA

Screen type		P1
Fluorescent colour of screen		green
Persistence		medium
Focus		electrostatic
Deflection		electrostatic
Post deflection acceleration		single stage
Screen diameter	90	mm
Max. overall diameter	108	mm
Max. overall length	392	mm
Weight (approx.)	$\begin{cases} 560 \\ 20 \end{cases}$	g oz
Mounting position.	Any—see section on mounting (page 4)	

CATHODE

Indirectly heated—suitable for parallel operation only

Heater voltage	V_h	6.3	V
Heater current	I_h	550	mA

CAPACITANCES

C_{g-all}	3.8 to 5.6	pF
C_{k-all}	3.2 to 4.8	pF
$C_{x'-all}$ (x" earthed)	2.9 to 4.4	pF
$C_{x"-all}$ (x' earthed)	2.9 to 4.4	pF
$C_{y'-all}$ (y" earthed)	2.4 to 3.6	pF
$C_{y"-all}$ (y' earthed)	2.4 to 3.6	pF
$C_{x'-x"}$	1.2 to 1.8	pF
$C_{y'-y"}$	1.3 to 1.9	pF
$C_{x'+x"-y'+y"}$ max.	0.1	pF
$C_{x'+x"-g+k}$ max.	0.1	pF
$C_{y'+y"-g+k}$ max.	0.1	pF

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OSCILLOSCOPE TUBE

LIMITING VALUES (absolute ratings)

Max. first anode voltage	V_{a1} max.	5.0	kV
Max. second anode voltage	V_{a2} max.	1.5	kV
Max. third anode voltage	V_{a3} max.	5.0	kV
Max. fourth anode voltage (P.D.A.)	V_{a4} max.	10	kV
Min. fourth anode voltage	V_{a4} min.	1.0	kV
Max. voltage difference	$V_{a4}-V_{a3}$ max.	5.0	kV
Max. grid voltage	V_g max.	−200	V
Min. grid voltage	V_g min.	−1.0	V
Max. grid resistor	R_{g-k} max.	1.0	MΩ
Max. peak heater to cathode voltage	$v_{h-k(pk)}$ max.	250	V
Max. total anode dissipation	$p_{a(tot)}$ max.	3.0	W
Max. power input to screen	p_t max.	3.0	mW/cm²
Max. resistance from any deflector plate to a_3	R_{x-a3} max. $\Big\}$ R_{y-a3} max.	5.0	MΩ
Max. voltage between any deflector plate and a_3	V_{x-a3} max. $\Big\}$ V_{y-a3} max.	1.0	kV
Max. V_{a4} to V_{a3} ratio for full screen x deflection	$\dfrac{V_{a4}}{V_{a3}}$ max.	2.0	

TYPICAL OPERATING CONDITIONS

First anode voltage	V_{a1}	2.0	kV
Second anode voltage for focus	V_{a2}	460 to 530	V
Third anode voltage	V_{a3}	2.0	kV
Fourth anode voltage	V_{a4}	4.0	kV
Grid voltage for visual cut-off	V_g	−28 to −60	V
Min. grid voltage (for 0.05 candelas)	V_g min.	−10	V
Beam trapping voltage	$V_{x'-a3}$	220 to 340	V
*Second anode current	I_{a2}	−100	μA
x plate sensitivity	S_x	36.2	V/cm
y plate sensitivity	S_y	23	V/cm

*With second anode set for focus and $V_g = -1.0$V.

If V_{a1}, V_{a3} and V_{a4} are altered but remain in the same ratio then the focus, cut-off and trapping voltages, and the plate sensitivities will change in the same ratio.

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OSCILLOSCOPE TUBE

DEFLECTION

Designed for symmetrical operation only on both x and y plates.

The tube may be operated asymmetrically but focus quality will fall and trapezium distortion will be introduced. Under these conditions the data given below for pattern distortion and line width will therefore not apply.

The arrangement of the plates is such that viewing the screen with the x plate connector pins vertically uppermost a positive voltage on the x' plate deflects the spot to the left and a positive voltage on the y' plate deflects the spot upwards.

The x plates are those nearest the screen.

In order to obviate the necessity for pulsing the grid when the tube is used for displaying pulse or single stroke phenomena, a beam trap is provided on the x' plate. When a positive voltage of suitable magnitude is applied to the x' plate the beam is contained on that plate and a state of minimum luminance exists.

In applications where it is necessary to obtain the highest possible focus performance it may be desirable to adjust the mean potential of the deflector plates with respect to a_3. It should never be necessary for this difference to exceed 50V.

x plate sensitivity $(V_{a4} - V_{a3})$	S_x mean	$\dfrac{600}{V_{a3}}$	mm/V
y plate sensitivity $(V_{a4} - V_{a3})$	S_y mean	$\dfrac{1000}{V_{a3}}$	mm/V
x plate sensitivity $(V_{a4} - 2V_{a3})$	S_x max.	$\dfrac{625}{V_{a3}}$	mm/V
	S_x min.	$\dfrac{480}{V_{a3}}$	mm/V
y plate sensitivity $(V_{a4} - 2V_{a3})$	S_y max.	$\dfrac{985}{V_{a3}}$	mm/V
	S_y min.	$\dfrac{790}{V_{a3}}$	mm/V

PATTERN DISTORTION

As the ratio V_{a4}/V_{a3} becomes greater than unity, curvature of the path of the beam causes two effects:

(1) The available useful screen area is diminished. For full screen deflection in the x direction the max. V_{a4}/V_{a3} ratio is 2 and although greater ratios may be used (provided that the ratings are not exceeded), they will result in cut-off or distortion being produced before the edge of the screen is reached.

(2) A small amount of distortion is present even with small post deflection acceleration ratios. With $V_{a4}/V_{a3} = 2$ and symmetrical deflection on both x and y plates a square raster of nominal side 58.5mm will lie entirely inside a 60mm square and entirely outside a 57mm square i.e. max. total pattern distortion $(V_{a4} = 2V_{a3})$ is 2.5%.

If V_{a4}/V_{a3} is allowed to become greater than 2 a pattern distortion greater than 2.5% may occur.

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OSCILLOSCOPE TUBE

LINE WIDTH

A value for line width under d.c. conditions is given below.

V_{a4}	4.0	kV
V_{a3}	2.0	kV
V_{a2}	Adjusted for focus	
V_{a1}	2.0	kV
V_g Adjusted to a value corresponding to 0.05 candelas		
Writing speed	0.3	km/s
Repetition rate	20	ms
Distance from screen centre (any direction)	0	
Max. line width	0.55	mm

SPOT ECCENTRICITY

With no post deflection acceleration ($V_{a4} = V_{a3}$), an undeflected spot lies within 8.0mm of the physical screen centre.

ORIENTATION AND RECTANGULARITY

The y axis lies within 10° of the line which divides pins 6 and 7, and pins 1 and 12 symmetrically on the base.

The angle between x and y axes is $90° \pm 1.5°$.

MOUNTING

There is no restriction on the position of mounting.

In mounting the tube the main support should be at the end nearer the screen and so arranged that no stresses are produced in the glass. Adequate precautions should be taken to protect the tube from effects of shock or sudden acceleration. In particular a resilient pad should be provided between the flat face of the tube and any surrounding metal parts.

This tube is not intended to be soldered directly into the wiring. The tube socket and side pin connections should not be rigidly mounted but should have flexible leads and be allowed to move freely.

In most cases it will be necessary to provide a closely fitting magnetic shield surrounding the tube. The tube may then be mounted conveniently by means of resilient rings inside the shield, the shield being rigidly supported by the external apparatus.

SIDE CONNECTIONS

The connection of the deflector plates by means of side pins produces low input capacitances and inductances and permits operation at high frequencies. Limitation of operating frequency is produced by two effects:

(1) By resonance occurring in the deflector plates and their connections. The resonant frequency of the y plates is approximately 400Mc/s, that of the x plates is at a similar order of frequency.

(2) By considerations of the finite beam transit time through the deflector plate system. At maximum tube ratings limitation due to this effect does not occur at frequencies below the resonant frequency.

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OSCILLOSCOPE TUBE

CONNECTORS

Sockets

The B12F socket can be supplied by the Carr Fastener Co. Ltd. of Stapleford, Notts, type No. VO/842.

The tube manufacturers can supply sample quantities of this socket.

Cavity Cap Connectors

Any commercially available CT8 connector is suitable.

Typical examples are the Carr Fastener 71/529, 71/699, and 71/527.

Side Pin Connectors

There are no connectors specifically intended for use with the side pins of this tube. A standard miniature diode anode clip has been found adequate in many instances and in other applications miniature crystal microphone connectors have been used.

SHIELDING

In view of the high sensitivity of the tube it is advisable to mount it as far as possible from transformers and chokes. If transformers or chokes are in close proximity to the tube thicker or multiple shields are required to avoid saturation and trace modulation.

Mumetal shields suitable for use with this tube are made by:

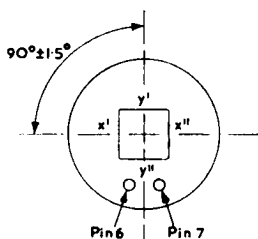|	
Telegraph Construction and Maintenance Co. Ltd., Crawley, Sussex.	Type ET1
Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire.	Types ST36 ST36A

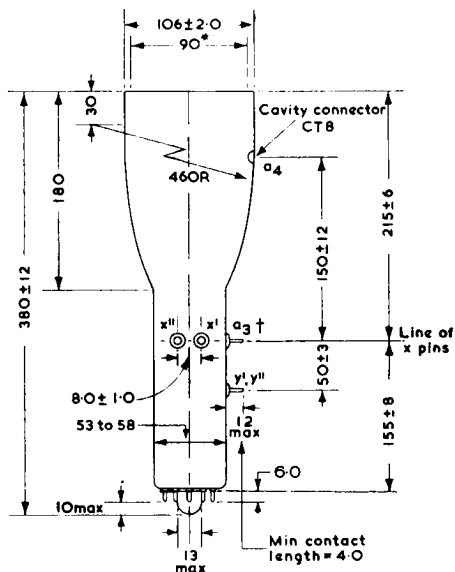In some cases modifications to these designs can also be supplied.

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OSCILLOSCOPE TUBE

ETL9

All dimensions in mm

* This face flat over a minimum area of 90 mm diameter.

† The axial distance between the radial planes of the x pins and the a₃ pin ▷ 2·0 mm

Orientation of axes of deflection as viewed from screen end.

B12F Base