ETEL 4EPI

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.

GENERAL DATA

Screen type
Fluorescent colour of screen
Persistency
Focus
Deflection
Post deflection acceleration
Screen diameter
Max. overall diameter
Max. overall length
Weight (approx.)
Mounting position.

P1
green
medium
electrostatic
electrostatic
single stage
90 mm
108 mm
392 mm
560 g
20 oz
Any—see section on mounting (page 4)

CATHODE

Indirectly heated—suitable for parallel operation only
Heater voltage $V_h$
Heater current $I_h$

6.3 V
550 mA

CAPACITANCES

$C_{g\text{--all}}$
$C_{k\text{--all}}$
$C_{x'\text{--all} \; (x' \text{ earthed})}$
$C_{x''\text{--all} \; (x'' \text{ earthed})}$
$C_{y'\text{--all} \; (y' \text{ earthed})}$
$C_{y''\text{--all} \; (y'' \text{ earthed})}$
$C_{x'\text{--x'}}$
$C_{y'\text{--y'}}$
$C_{x''\text{--x''} \; y' \text{ max.}}$
$C_{x''\text{--x''} \; g+k \text{ max.}}$
$C_{y''\text{--y''} \; g+k \text{ max.}}$

3.8 to 5.6 pF
3.2 to 4.8 pF
2.9 to 4.4 pF
2.9 to 4.4 pF
2.4 to 3.6 pF
2.4 to 3.6 pF
1.2 to 1.8 pF
1.3 to 1.9 pF
0.1 pF
0.1 pF
0.1 pF

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ELECTRONIC TUBES LTD.
KINGSMEAD WORKS, HIGH WYCOMBE, BUCKS, ENGLAND
Telephone: High Wycombe 2020
**LIMITING VALUES** (absolute ratings)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. first anode voltage</td>
<td>$V_{a1}$ max.</td>
<td>5.0 kV</td>
</tr>
<tr>
<td>Max. second anode voltage</td>
<td>$V_{a2}$ max.</td>
<td>1.5 kV</td>
</tr>
<tr>
<td>Max. third anode voltage</td>
<td>$V_{a3}$ max.</td>
<td>5.0 kV</td>
</tr>
<tr>
<td>Max. fourth anode voltage (P.D.A.)</td>
<td>$V_{a4}$ max.</td>
<td>10 kV</td>
</tr>
<tr>
<td>Min. fourth anode voltage</td>
<td>$V_{a4}$ min.</td>
<td>1.0 kV</td>
</tr>
<tr>
<td>Max. voltage difference</td>
<td>$V_{a4} - V_{a3}$ max.</td>
<td>5.0 kV</td>
</tr>
<tr>
<td>Max. grid voltage</td>
<td>$V_g$ max.</td>
<td>-200 V</td>
</tr>
<tr>
<td>Min. grid voltage</td>
<td>$V_g$ min.</td>
<td>-1.0 V</td>
</tr>
<tr>
<td>Max. grid resistor</td>
<td>$R_{g-k}$ max.</td>
<td>1.0 MΩ</td>
</tr>
<tr>
<td>Max. peak heater to cathode voltage</td>
<td>$V_{p-k(pk)}$ max.</td>
<td>250 V</td>
</tr>
<tr>
<td>Max. total anode dissipation</td>
<td>$P_{an(tot)}$ max.</td>
<td>3.0 W</td>
</tr>
<tr>
<td>Max. power input to screen</td>
<td>$P_1$ max.</td>
<td>3.0 mW/cm²</td>
</tr>
<tr>
<td>Max. resistance from any deflector plate to a₃</td>
<td>$R_{x-a3}$ max.</td>
<td>5.0 MΩ</td>
</tr>
<tr>
<td></td>
<td>$R_{y-a3}$ max.</td>
<td></td>
</tr>
<tr>
<td>Max. voltage between any deflector plate and a₃</td>
<td>$V_{x-a3}$ max.</td>
<td>1.0 kV</td>
</tr>
<tr>
<td></td>
<td>$V_{y-a3}$ max.</td>
<td></td>
</tr>
<tr>
<td>Max. $V_{a4}$ to $V_{a3}$ ratio for full screen x deflection</td>
<td>$V_{a4}/V_{a3}$ max.</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATING CONDITIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First anode voltage</td>
<td>$V_{a1}$</td>
</tr>
<tr>
<td>Second anode voltage for focus</td>
<td>$V_{a2}$</td>
</tr>
<tr>
<td>Third anode voltage</td>
<td>$V_{a3}$</td>
</tr>
<tr>
<td>Fourth anode voltage</td>
<td>$V_{a4}$</td>
</tr>
<tr>
<td>Grid voltage for visual cut-off</td>
<td>$V_g$</td>
</tr>
<tr>
<td>Min. grid voltage (for 0.05 candelas)</td>
<td>$V_{gmin}$</td>
</tr>
<tr>
<td>Beam trapping voltage</td>
<td>$V_{x'-a3}$</td>
</tr>
</tbody>
</table>

*Second anode current

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{a2}$</td>
<td>-100 μA</td>
</tr>
</tbody>
</table>

|x plate sensitivity

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_x$</td>
<td>36.2 V/cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>y plate sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_y$</td>
</tr>
</tbody>
</table>

*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.
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 $a_i$. It should never be necessary for this difference to exceed 50V.

\[
\begin{align*}
&x \text{ plate sensitivity } (V_{a4} - V_{a3}) \quad S_x \text{ mean} \quad \frac{600}{V_{a3}} \quad \text{mm/V} \\
&y \text{ plate sensitivity } (V_{a4} - V_{a3}) \quad S_y \text{ mean} \quad \frac{1000}{V_{a3}} \quad \text{mm/V} \\
&x \text{ plate sensitivity } (V_{a4} - 2V_{a3}) \quad S_x \text{ max.} \quad \frac{625}{V_{a3}} \quad \text{mm/V} \\
&\quad \quad S_x \text{ min.} \quad \frac{480}{V_{a3}} \quad \text{mm/V} \\
&y \text{ plate sensitivity } (V_{a4} - 2V_{a3}) \quad S_y \text{ max.} \quad \frac{985}{V_{a3}} \quad \text{mm/V} \\
&\quad \quad S_y \text{ min.} \quad \frac{790}{V_{a3}} \quad \text{mm/V}
\end{align*}
\]

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.
LINE WIDTH

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

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

SPOT ECCENTRICITY

With no post deflection acceleration ($V_{a4} = V_{a0}$), an undeflected spot lies within 8.0 mm 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 $y$ plate is approximately 400 Mc/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.
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., Type ET1
Crawley, Sussex.

Magnetic and Electrical Alloys Ltd., Types ST36
Burnbank, Hamilton, Lanarkshire. ST36A

In some cases modifications to these designs can also be supplied.
ETEL 4EPI
OSCILLOSCOPE TUBE

ETL9

Orientation of axes of deflection as viewed from screen end.

90°±15°

Pin 6 Pin 7

Cavity connector CTB

460Ω

y' x'

a4

80±1.0

53 to 58

12 max

60

10max

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 > 20 mm

B12F Base

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