Technical Handbook

ISSUED BY

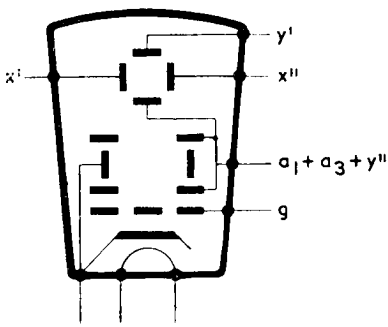
ELECTRONIC TUBES LTD.
KINGSMEAD WORKS, HIGH WYCOMBE, BUCKS, ENGLAND
Telephone: High Wycombe 2020

October 1957

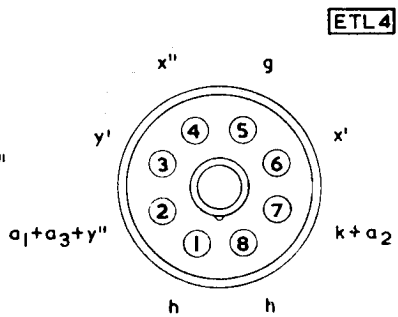
ETEL ICP1

OSCILLOSCOPE TUBE

Low voltage oscilloscope tube with 1-in. diameter screen. This tube incorporates automatic focus.



ETL4



B8G Base

GENERAL DATA

Screen type		P1
Fluorescent colour of screen		green
Persistence		medium
Focus		electrostatic (self-focusing)
Deflection		electrostatic
Maximum overall diameter	31	mm
Maximum overall length	105	mm
Weight (approx.)	39	g
	1.4	oz
Mounting position	Any—see section on mounting (page 3)	

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}	4.8 to 7.7	pF
$C_{x'-all}$	4.8 to 7.2	pF
$C_{x''-all}$	4.8 to 7.2	pF
$C_{y'-all}$	2.3 to 4.7	pF
$C_{x'-x''}$	0.5 to 1.5	pF
$C_{x'-y'}$ max.	0.3	pF
$C_{x''-y'}$ max.	0.3	pF

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ETEL ICPI

OSCILLOSCOPE TUBE

LIMITING VALUES (absolute ratings)

Max. anode voltage	$V_{a1+a3+y''}$ max.	1.0	kV
Min. anode voltage	$V_{a1+a3+y''}$ min.	350	V
Max. grid voltage	V_g max.	−100	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. power input to screen	p_1 max.	2.0	mW/cm²
Max. resistance from either x plate to anode	$R_{x\ a1+a3+y''}$ max.	5.0	MΩ
Max. resistance from y′ plate to anode	$R_{y'\ a1+a3+y''}$ max.	5.0	MΩ

TYPICAL OPERATING CONDITIONS

Anode voltage	$V_{a1+a3+y''}$	500	V
Grid voltage for visual cut-off	V_g	−8 to −27	V
Min. intensity at max. grid drive		0.004	cd
x plate sensitivity	S_x	53	V/cm
y plate sensitivity	S_y	45	V/cm

If $V_{a1+a3+y''}$ is altered, the grid cut-off voltage and the deflection sensitivities will change in the same ratio.

DEFLECTION

In the y direction, only asymmetrical operation is possible since the y″ plate is internally connected to the final anode.

In the x direction the tube is designed for symmetrical operation. Although asymmetrical operation is permissible, this will result in trapezium distortion being introduced. The x plates are those nearest the screen.

The arrangement of the plates is such that viewing the screen with the tube axis horizontal and pin 5 vertically above pin 1, 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. When symmetrically operated the mean potential of the x plates must be that of the final anode. When asymmetrical operation is used, one plate must not differ from the final anode potential by more than the deflection voltage.

x plate sensitivity	S_x max.	$\frac{125}{V_{a1+a3+y''}}$	mm/V
	S_x min.	$\frac{65}{V_{a1+a3+y''}}$	mm/V
y plate sensitivity	S_y max.	$\frac{145}{V_{a1+a3+y''}}$	mm/V
	S_y min.	$\frac{75}{V_{a1+a3+y''}}$	mm/V

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ETEL 1CP1

OSCILLOSCOPE TUBE

LINE WIDTH

With a final anode potential of 500V and under d.c. conditions, the width of a line of length 30mm and intensity 0.001candelas is approximately 0.6mm.

SPOT ECCENTRICITY

With the tube magnetically shielded an undeflected spot lies within 2.0mm of the physical screen centre.

ORIENTATION AND RECTANGULARITY

The angle between the y axis and the centre line of the base spigot key is 22.5° ± 5°.

The angle between x and y axes is 90° ± 5°.

MOUNTING

There is no restriction on the position of mounting.

The tube may be supported by the base alone provided that this is mounted in such a manner that the effects of sudden acceleration and shock are minimised. Where the tube projects through a panel, or is mounted against it, resilient material should be provided between the panel and the glass envelope.

The use of a viewing hood is recommended with this tube, especially when it is used at low h.t. voltages.

This tube is not intended to be soldered directly into the wiring and a socket of approved type should be used at all times.

SHIELDING

The 1CP1 is not very susceptible to interference from magnetic fields, especially at higher h.t. voltages. In some instances a mumetal shield may not be required, but the necessity depends on individual circuit layout.

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

Telegraph Construction and Maintenance Co. Ltd. Crawley, Sussex.	Type ET2
Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire.	Type ST39

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SUPPLY ARRANGEMENTS

In view of the simplicity of the operating requirements no additional supplies may be required when the tube is incorporated in some equipment. An arrangement suitable for use in such a case is shown in Fig. 1. Fixed bias is provided by the cathode resistor R3 which may be by-passed if necessary by a 0.5μF capacitor. Although tubes may not be identical in respect of their 'brightness-grid voltage' characteristic this method of auto-bias produces almost constant brilliance in changing from tube to tube.

Owing to the presence of a transparent conducting film connected to anode between the screen of the tube and the glass, the tube may be operated with its cathode at earth potential without any oscillogram distortion when an earthed body is brought near the screen.

Depending on the individual application, the simple arrangement shown may be unsuitable for a variety of reasons. Two of the commonest drawbacks, with suggestions for overcoming them, are:

(1) If various patterns are to be displayed on the same tube it is probable that different beam currents will be required to produce the same brightness on each oscillogram. A modified variable brilliance control can be provided merely by using a variable cathode bias resistor. Alternatively, if it is required to 'black-out' the trace a combination of tube current and bleed can be used. In either case it is desirable to incorporate a limiting resistor in order to prevent excessive beam current being drawn.

(2) Since the deflector plates are essentially at h.t. potential it is not normally possible to employ d.c. coupling to them. Should this be required it is necessary to run the tube anode at the mean potential of the deflector plates, which usually involves tapping the anode across the h.t. supply. If there is no point from which the d.c. signal can be taken which allows the necessary minimum h.t. to be obtained, it is recommended that a negative supply be utilised. This may already be incorporated in the apparatus.

Note—If it is required to run the y plate only from a d.c. signal the anode tap can be used as a centering device.

Fig. 2 shows the two modifications listed above. In it the y plates are shown d.c. connected and the x plates a.c. connected. No x shift network is included. V1 is the actual working voltage of the tube.

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OSCILLOSCOPE TUBE

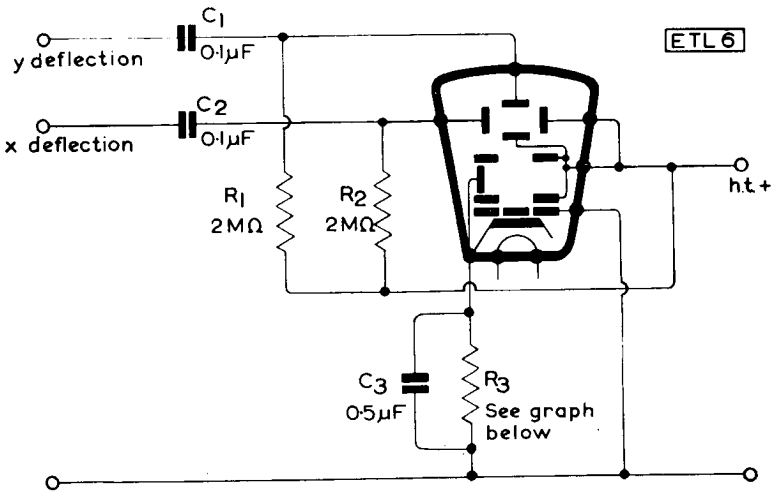
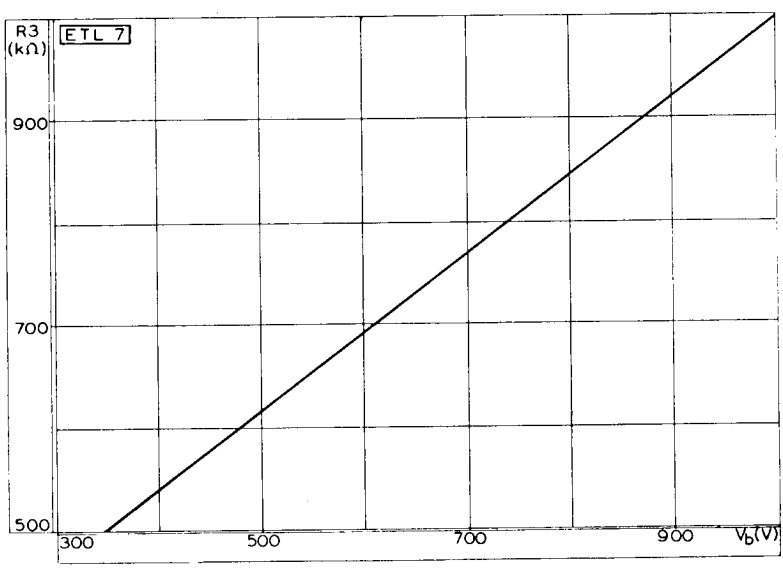


Fig. 1



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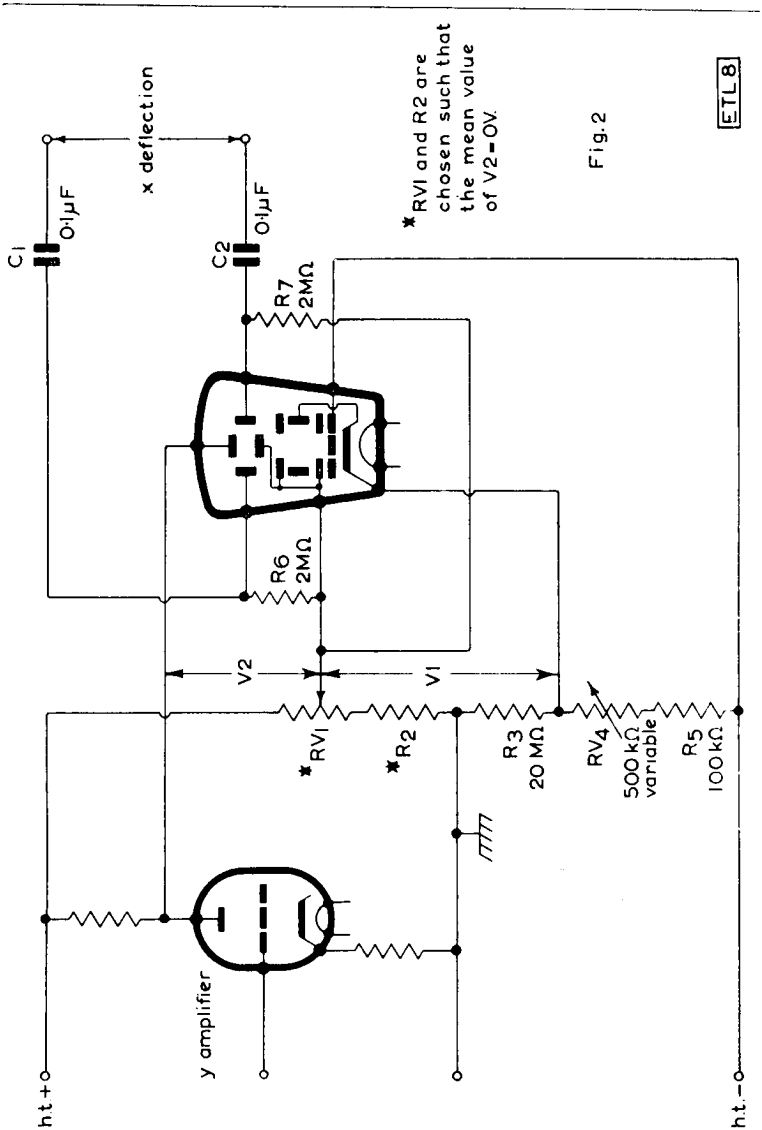
OSCILLOSCOPE TUBE



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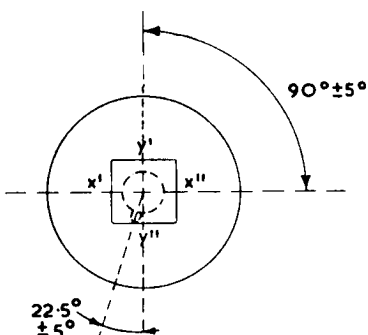
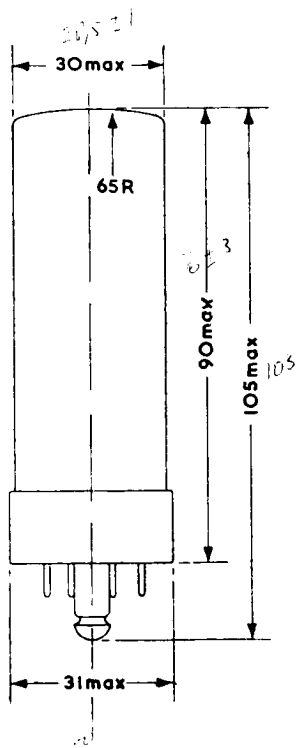
OSCILLOSCOPE TUBE

ETL3



Orientation of axes of deflection as viewed from screen end.

All dimensions in mm



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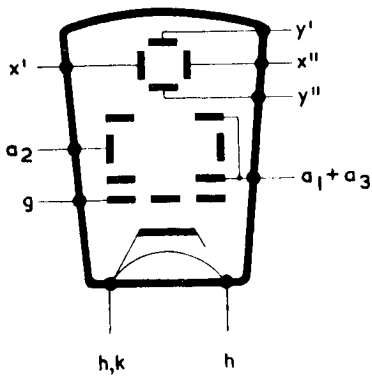
ETEL 3AFP1

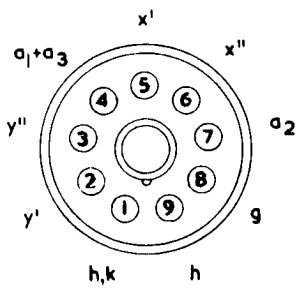
7-91

OSCILLOSCOPE TUBE

High sensitivity oscilloscope tube with $2\frac{3}{4}$-in. diameter screen, suitable for symmetrical or asymmetrical operation.



ETL 2



B9G Base

GENERAL DATA

Screen type		P1
Fluorescent colour of screen		green
Persistence		medium
Focus		electrostatic
Deflection		electrostatic
Minimum useful screen diameter	55	mm
Maximum overall diameter	71	mm
Maximum overall length	257	mm
Weight (approx.)	128	g
	4.5	oz
Mounting position	Any—see section on mounting (page 3)	

CATHODE

Indirectly heated—suitable for parallel operation only

Heater voltage	V_h	6.3	V
Heater current	I_h	550	mA

Note—The cathode is connected to one side of the heater, the common connection being to pin 1.

CAPACITANCES

C_{g-all}	5.6 to 7.6	pF
C_{k-all}	2.3 to 3.1	pF
$C_{x'-all}$ (x'' earthed)	4.3 to 7.3	pF
$C_{x''-all}$ (x' earthed)	4.3 to 7.3	pF
$C_{y'-all}$ (y'' earthed)	2.8 to 4.2	pF
$C_{y''-all}$ (y' earthed)	2.8 to 4.2	pF
$C_{x'-x''}$	1.4 to 2.6	pF
$C_{y'-y''}$	2.2 to 3.0	pF
$C_{x'+x''-y'+y''}$ max.	0.33	pF
$C_{x'+x''-g+k}$ max.	1.6	pF
$C_{y'+y''-g+k}$ max.	1.6	pF

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ETEL 3AFPI

OSCILLOSCOPE TUBE

LIMITING VALUES (absolute ratings except where stated)

Maximum first and third anode voltage	$V_{a1;a2}$ max.	1.5	kV
Minimum first and third anode voltage	$V_{a1;a3}$ min.	700	V
Minimum design centre first and third anode voltage	$V_{a1;a3}$ min.	800	V
Maximum second anode voltage	V_{a2} max.	500	V
Maximum voltage difference	$V_{a1-a3}-V_{a2}$ max.	1.2	kV
Maximum grid voltage	V_g max.	−200	V
Minimum grid voltage	V_g min.	−1.0	V
Maximum grid resistor	R_{g-k} max.	1.0	MΩ
Maximum peak total anode dissipation	$p_{a(tot)pk}$ max.	2.0	W
Maximum power input to screen	p_t max.	3.0	mW/cm²
Maximum resistance from deflector plates to first and third anodes (asymmetrical operation)	$R_{x-a1;a3}$ max. $R_{y-a1;a3}$ max.	2.0	MΩ
Maximum resistance from deflector plates to first and third anodes (symmetrical operation)	$R_{x-a1;a3}$ max. $R_{y-a1;a3}$ max.	4.0	MΩ

TYPICAL OPERATING CONDITIONS

First and third anode voltage	$V_{a1;a3}$	1.0	kV
Second anode voltage for focus	V_{a2}	210 to 320	V
Grid voltage for visual cut-off	V_g	−28 to −65	V
Grid drive for intensity of 0.008 candelas	V_{in}	20	V
*Focus electrode current	I_{a2}	−50	μA
x plate sensitivity	S_x	20	V/cm
y plate sensitivity	S_y	11.5	V/cm

*With V_{a2} set for focus and V_{g1} −1.0V.

If $V_{a1;a3}$ is altered, the grid cut-off voltage, the focus voltage and the sensitivity will change in the same ratio.

DEFLECTION

Designed for symmetrical or asymmetrical deflection on both x and y plates. The arrangement of the plates is such that viewing the tube in the horizontal position with the base spigot key vertically uppermost a positive voltage on the y′ plate deflects the spot upwards and a positive voltage on the x′ plate deflects the spot to the left. The x plates are nearest the screen.

When symmetrically operated the mean potential of the deflector plates must not differ from that of the final anode. In the asymmetrical case one plate of each pair must not differ from the final anode by more than the deflection voltage.

x plate sensitivity	S_x max.	$\frac{610}{V_{a1;a3}}$	mm/V
	S_x min.	$\frac{410}{V_{a1;a3}}$	mm/V
y plate sensitivity	S_y max.	$\frac{1050}{V_{a1;a3}}$	mm/V
	S_y min.	$\frac{685}{V_{a1;a3}}$	mm/V

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ETEL 3AFPI

OSCILLOSCOPE TUBE

PATTERN DISTORTION

With asymmetrical deflection in both x and y directions a square raster of nominal side 40mm will lie entirely inside a 41.4mm square and entirely outside a 38.6mm square, i.e., maximum total pattern distortion with asymmetrical deflection is 3.5%.

When symmetrical deflection is used, the total pattern distortion will normally be less than 2.5%.

LINE WIDTH

The nominal value for line width under d.c. conditions and for $V_{a1,a3} = 1kV$ is 0.6mm. The pattern consists of a circle of 40mm diameter supplied from a 200kc/s source. The grid voltage corresponds to a beam current (I_1) of 1μA.

SPOT ECCENTRICITY

With the tube magnetically shielded an undeflected spot lies within 6.0mm of the physical screen centre.

ORIENTATION AND RECTANGULARITY

The y axis lies within 1° of the centre line of the base spigot key.

The angle between the x and y axes is 90° ± 2.0°.

MOUNTING

There is no restriction on the position of mounting.

The screen end of the tube may conveniently be supported by insertion into a mask or rubber surround. At the rear end it is permissible to use a clamp around the tube base providing that the tube is protected against excessive tightening and shock by means of a resilient pad which should be at least $\frac{1}{4}$ in. in thickness. Alternatively the socket may be used as a support if it is mounted on a pad of shock absorbent material and sprung towards the face of the tube.

This tube is not intended to be soldered directly into the wiring and a socket of approved type should be used at all times.

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 very close proximity to the tube, thicker or multiple shields may be 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.	Types ET3a ET3b ET3c ET3d
Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire.	Type ST37

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SUPPLY ARRANGEMENTS

The circuit shown is a typical arrangement for use in a portable equipment such as a small oscilloscope. The positive supply may be used to feed the auxiliary apparatus.

Asymmetric shift networks are shown but all deflector plates are available for the application of sweep or signal voltages if required. Although the circuit employs feed to the deflector plates through isolating capacitors, d.c. connection may be used if the circuit is modified to suit. The resistors R14 to R17 and the capacitors C11 to C14 should be removed together with the shift networks R2, R3 and R4 and C5 and C6; shift may then be applied by means of variable bias in the deflection amplifiers. It may be advantageous to replace R5 and R6 by a preset potentiometer to ensure the final anode remaining at the mean deflector plate potential.

If the tube is to be run from a conventional high voltage supply, R6 and R7 may be replaced by a single 470kΩ resistor and R5 may be omitted. Shift must then be obtained by means other than those shown.

The circuit as shown includes arrangements for modulating the brightness of the tube. If positive or 'bright-up' pulses are applied, care must be exercised to ensure that the grid is not allowed to become positive with respect to the cathode. As a safety precaution it is suggested that a resistor (R13) is inserted in the grid lead with minimum value of 2000Ω per volt of signal. If no brightness modulation is to be employed, R12, R13 and C10 may be omitted.

Circuit Values

C1, C2	8 μF	350Vd.c.
C3, C4	0.5 μF	1000Vd.c.
C5, C6, C8, C11, C12, C13, C14	0.1 μF	350Vd.c.
C7	2.0 μF	350Vd.c.
C9	0.5 μF	250Vd.c.
C10	0.1 μF	1000Vd.c.
R1	2.2kΩ	1W
R4	150 kΩ	½W
R5	22 kΩ	½W
R6	47 kΩ	1W
R7, R9, R12	220 kΩ	¼W
R10	150 Ω	¼W
R13		See text
R14, R15, R16, R17	1 MΩ	¼W
RV2, RV3, RV8	potentiometers, 470 kΩ	½W
RV11	potentiometer, 100 kΩ	½W
V1	Full wave rectifier, type EZ80	
MR1, MR2	Rectifiers, 300V 1mA	
T1	Transformer, 300–0–300V, 2×6.3V	

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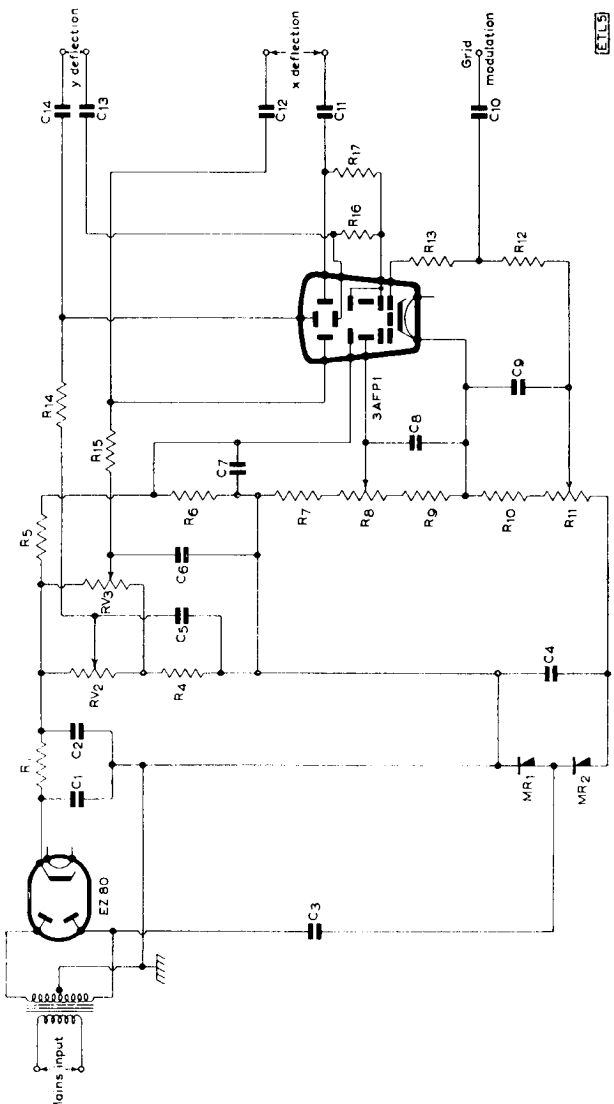
ETEL 3AFPI

OSCILLOSCOPE TUBE



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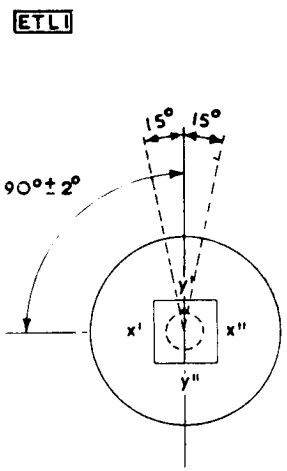
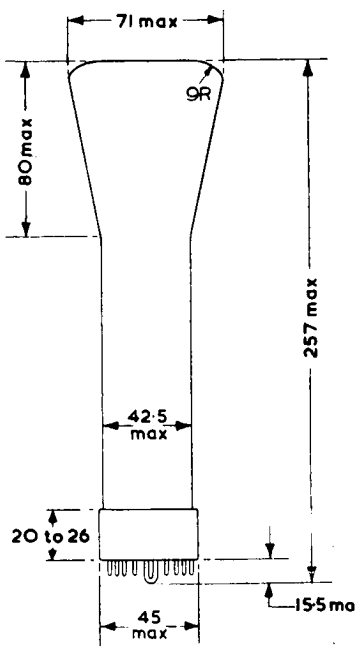
OSCILLOSCOPE TUBE



Orientation of axes of deflection as viewed from screen end.



All dimensions in mm

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IMPORTANT

The classification of the phosphor of this tube has been changed to P31, the screen characteristics remaining unaltered to E T E L tubes previously classified P1.

TEL 3AZP31

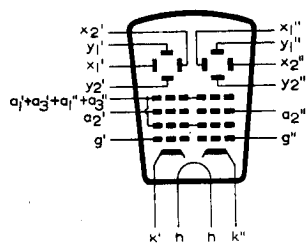
9-11

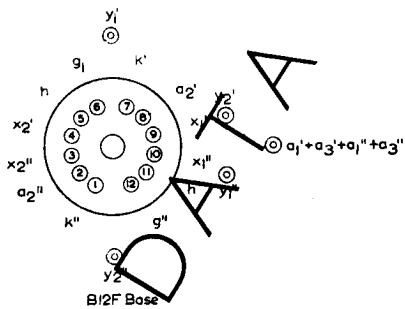
DHM9-11

OSCILLOSCOPE TUBE

General purpose double gun oscilloscope tube with 3½-in. flat screen. This tube has side connected y plates and separate x plates.

ETL14A





GENERAL DATA

Screen type	P31	
Fluorescent colour of screen	green	
Persistence	medium	
Focus	electrostatic	
Deflection	electrostatic	
Maximum overall diameter	94	mm
Maximum overall length	310	mm
Weight (approx.)	18	oz
	510	g
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 max.	I_h	1.25	A

CAPACITANCES

	Gun' Min.	Gun' Max.	Gun" Min.	Gun" Max.	
C_{g-all}	5.2	7.4	5.0	7.2	pF
C_{k-all}	3.0	4.6	3.0	4.6	pF
C_{x1-all} (x_2 earthed)	4.5	6.5	4.5	6.5	pF
C_{x2-all} (x_1 earthed)	4.6	7.2	4.6	7.2	pF
C_{y1-all} (y_2 earthed)	2.0	4.0	2.8	4.4	pF
C_{y2-all} (y_1 earthed)	2.8	4.4	2.0	4.0	pF
C_{x1-x2}	—	1.7	—	1.7	pF
C_{y1-y2}	1.5	2.5	1.5	2.5	pF
$C_{x1+x2-y1+y2}$	—	0.2	—	0.2	pF

$C_{x1'+x2'-x1"+x2"}$ max.	1.6	pF
$C_{y1'+y2'-y1"+y2"}$ max.	0.6	pF

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ETEL 3AZP31

OSCILLOSCOPE TUBE

LIMITING VALUES (absolute ratings) each gun

Maximum first and third anode voltage	V_{a1+a3} max.	1.8	kV
Minimum first and third anode voltage	V_{a1+a3} min.	1.0	kV
Maximum second anode voltage	V_{a2} max.	600	V
Maximum negative grid voltage	$-V_g$ max.	200	V
Minimum negative grid voltage	$-V_g$ min.	1.0	V
Maximum grid resistor	R_{g-k} max.	1.0	MΩ
Maximum peak heater to cathode voltage	$v_{h-k(pk)}$ max.	250	V
Maximum resistance from any deflector plate to a_1+a_3	$R_{x-a1+a3}$ max. $R_{y-a1+a3}$ max.	2.0	MΩ
Maximum voltage between any deflector plate and a_1+a_3	$V_{x-a1+a3}$ max. $V_{y-a1+a3}$ max.	300	V
Maximum total anode dissipation	$p_{a(tot)}$ max.	2.0	W
Maximum power input to screen (gun′+gun″)	p_t max.	3.0	mW/cm²

TYPICAL OPERATION (each gun)

First and third anode voltage	V_{a1+a3}	1.5	kV
Second anode voltage	V_{a2}	330 to 470	V
Grid voltage for visual cut-off	V_g	−42 to −95	V
*Maximum second anode current	I_{c2} max.	−125	μA
x plate sensitivity	S_x	23	V/cm
y plate sensitivity	S_y	16	V/cm

*With second anode voltage set for focus and $V_g = -1.0V$.
S_x, S_y and V_g for visual cut-off are proportional to V_{a1+a3}.

DEFLECTION

Designed for symmetrical operation only on both x and y plates.
Each gun may be operated asymmetrically, but focus quality will deteriorate and trapezium distortion will be introduced. The data given for raster distortion and line width will therefore not apply.
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_1+a_3.

x plate sensitivity	S_x min.	$\frac{550}{V_{a1+a3}}$	mm/V
	S_x max.	$\frac{725}{V_{a1+a3}}$	mm/V
y plate sensitivity	S_y min.	$\frac{820}{V_{a1+a3}}$	mm/V
	S_y max.	$\frac{1100}{V_{a1+a3}}$	mm/V

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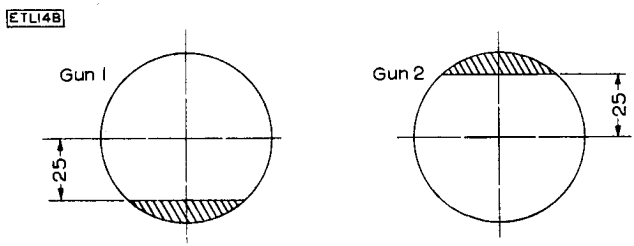
ETEL 3AZP31

OSCILLOSCOPE TUBE

Minimum useful scan from the centre of the tube face	$(x_1 - x_2)$	± 45	mm
Minimum useful scan from the centre of the tube face	$(y_1 - y_2)$	See Fig 1	



All dimensions in mm

The unshaded portions are the useful areas for y scan

Fig. 1

RASTER DISTORTION

Centred at the screen centre, a nominally square pattern from either gun separately may be inserted into the frame bounded by the squares 48.75mm and 51.25mm., i.e., maximum total pattern distortion is $\pm 2.5\%$.

RASTER ALIGNMENT

When two nominally square rasters, whose edges coincide at their centres, are superimposed at the screen centre, and when the rasters are simultaneously adjusted in size, the edges will fall within the frame bounded by the squares 48mm and 52mm., i.e., maximum total raster misalignment is $\pm 4\%$.

LINE WIDTH

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

V_{a1+a3}	1.5	kV
V_{a2}	Adjusted for focus	
I_t	1.0	μA
Pattern-circle	diameter 50	mm
Maximum line width	0.8	mm

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OSCILLOSCOPE TUBE

SPOT POSITION

With the tube magnetically shielded, the undeflected spot of each gun will fall within the appropriate 12mm circle shown on the diagram.

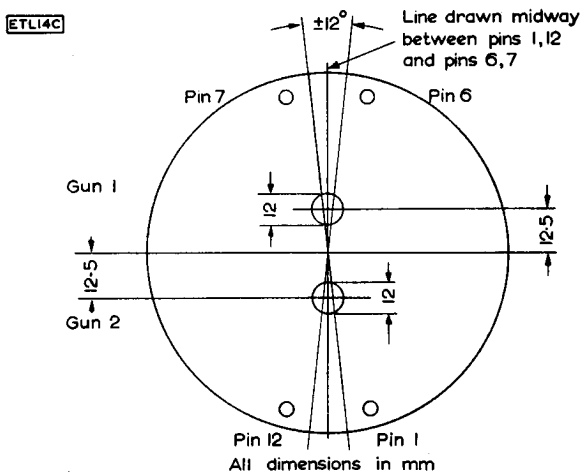

Fig. 2

ORIENTATION AND RECTANGULARITY

The y axis lies within $\pm 12°$ of the line drawn midway between pins 6 and 7 and pins 1 and 12 on the base.
The angle between x and y axes on each gun is $90° \pm 1.5°$.
The distance between the two electrical y axes at the geometric screen centre is 3.5mm max. The maximum angle between the two electrical y axes is 2.5°.
The maximum angle between the two electrical x axes is 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 connectors 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.

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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.

Cap connectors

Any commercially available CT7 is suitable.

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.

Mu-metal shields suitable for use with this tube are made by:

Telegraph Construction and Maintenance Co. Ltd.,
Crawley, Sussex.

Magnetic and Electrical Alloys Ltd.,
Burnbank, Hamilton, Lanarkshire.

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

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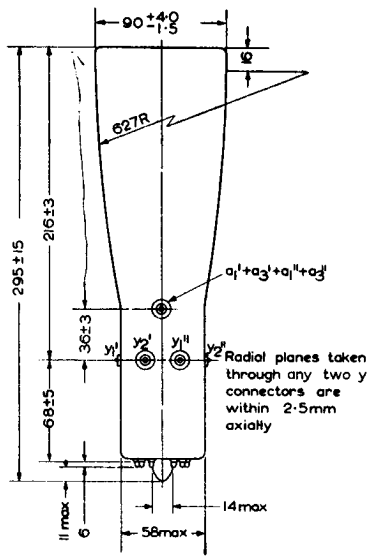
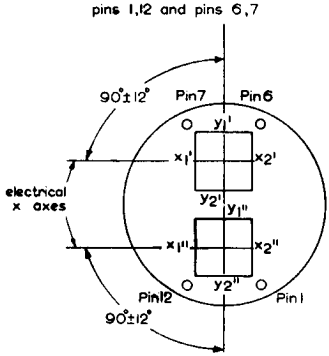
ETEL 3AZP31

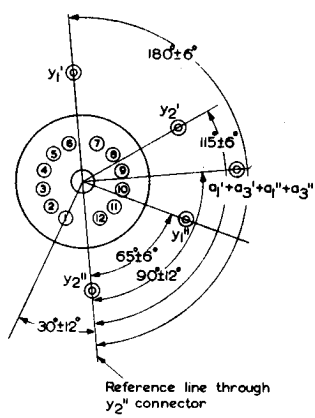
OSCILLOSCOPE TUBE

ETL14





Orientation of axes of deflection as viewed from screen end



Notes: Maximum angle between the two x axes = 1·5°
Maximum angle between the two y axes = 2·5°
Maximum distance between y axes at screen centre = 3·5mm

All connectors are CT7
All dimensions in mm

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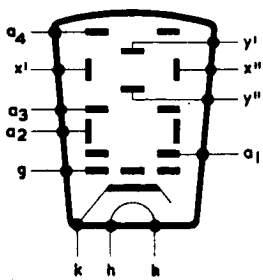
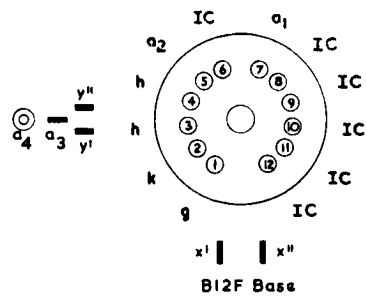
ETEL 4EP1

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.





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.)	560	g
	20	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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ETEL 4EPI

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. / R_{y-a3} max.	5.0	MΩ
Max. voltage between any deflector plate and a_3	V_{x-a3} max. / V_{y-a3} max.	1.0	kV
Max. V_{a4} to V_{a3} ratio for full screen x deflection	$\frac{V_{a4}}{V_{a3}}$ 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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ETEL 4EPI

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	$\frac{600}{V_{a3}}$	mm/V
y plate sensitivity ($V_{a4} - V_{a3}$)	S_y mean	$\frac{1000}{V_{a3}}$	mm/V
x plate sensitivity ($V_{a4} - 2V_{a3}$)	S_x max.	$\frac{625}{V_{a3}}$	mm/V
	S_x min.	$\frac{480}{V_{a3}}$	mm/V
y plate sensitivity ($V_{a4} - 2V_{a3}$)	S_y max.	$\frac{985}{V_{a3}}$	mm/V
	S_y min.	$\frac{790}{V_{a3}}$	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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ETEL 4EPI

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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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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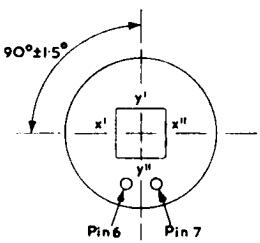
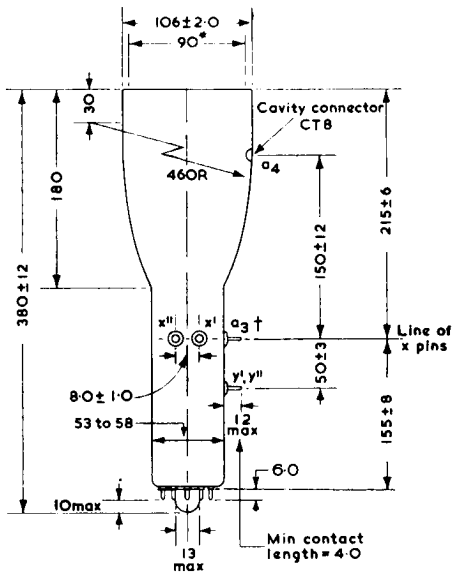
ETEL 4EPI

OSCILLOSCOPE TUBE

ETL9



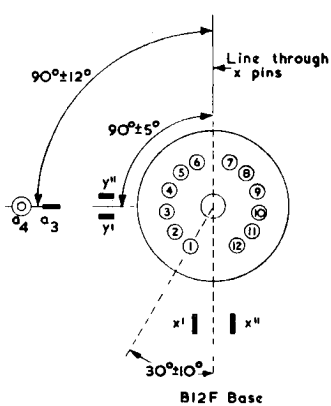
Orientation of axes of deflection as viewed from screen end.



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 a_3 pin ▷ 2·0 mm



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DHM40-93

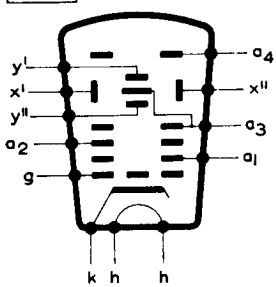
10-93

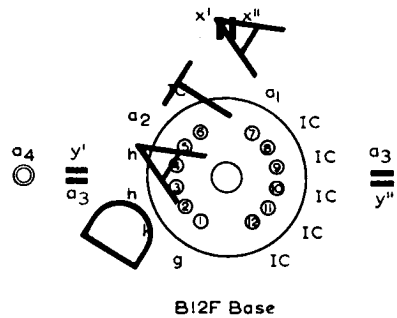
ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

Dual trace oscilloscope tube with 4-in. diameter flat screen and independent y signal deflections. This tube is fitted with a post deflection accelerator and the deflection plates are brought out to side connections.

ETL11B





B12F Base

GENERAL DATA

Screen type		P1	
Fluorescent colour of screen		green	
Persistence		medium	
Focus		electrostatic	
Deflection		x direction symmetrical electrostatic y direction asymmetrical electrostatic each trace	
Post deflection acceleration		single stage	
Max. overall diameter		108	mm
Max. overall length		393	mm
Weight (approx.)		650 23	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}	4.2 to 5.9	pF
C_{k-all}	3.5 to 4.9	pF
$C_{x'-x"}$	1.4 to 2.0	pF
$C_{x'-all\ (x"\ earthed)}$	2.7 to 3.8	pF
$C_{x"-all\ (x'\ earthed)}$	2.7 to 3.8	pF
$C_{y'-all\ (y"\ earthed)}$	2.5 to 3.8	pF
$C_{y"-all\ (y'\ earthed)}$	2.5 to 3.8	pF
$C_{y'-y"}$ max.	0.1	pF
$C_{y'-x'+x"}$ max.	0.1	pF
$C_{y"-x'+x"}$ max.	0.1	pF

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ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

LIMITING VALUES (absolute ratings)

Max. first anode voltage	V_{a1} max.	1.7	kV
Min. first anode voltage	V_{a1} min.	600	V
Max. second anode voltage	V_{a2} max.	1.2	kV
Max. third anode voltage	V_{a3} max.	4.0	kV
Min. third anode voltage	V_{a3} min.	600	V
Max. fourth anode voltage (P.D.A.)	V_{a4} max.	8.0	kV
Min. fourth anode voltage	V_{a4} min.	1.0	kV
Max. voltage difference	V_{a4}–V_{a3} max.	4.0	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 either x plate to a_3	R_{x-a3} max.	2.0	MΩ
Max. resistance from either y plate to a_3	R_{y-a3} max.	1.0	MΩ
Max. voltage between any deflector plate and a_3	V_{x-a3} max. V_{y-a3} max.	1.0	kV
Max. V_{a4} to V_{a3} ratio for full screen x deflection	V_{a4}/V_{a3} max.	2.0	

TYPICAL OPERATING CONDITIONS

First anode voltage	V_{a1}	1.5	kV
*Second anode voltage	V_{a2}	320 to 420	V
Third anode voltage	V_{a3}	1.5	kV
Fourth anode voltage	V_{a4}	3.0	kV
Grid voltage for visual cut-off	V_g	–40 to –95	V
Beam trapping voltage	$V_{x'-a3}$	170 to 290	V
x plate sensitivity	S_x	27	V/cm
y plate sensitivity	S_y	27	V/cm
**Second anode current	I_{a2}	0 to 200	μA

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.

*For focus at intensity of 0.1 candelas. It is recommended that for a full range of grid voltages the available range of V_{a2} should be 150V to 450V with $V_{a1} = V_{a3} = 1.5$kV, $V_{a4} = 3$kV.

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

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ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

DEFLECTION

The tube is designed for symmetrical operation in the x direction, and asymmetrical operation is not recommended.

In the y direction, only asymmetrical operation is possible, since the two deflecting plates are separated by a common beam dividing plate which is connected internally to a_3.

The arrangement of the plates is such that viewing the fluorescent screen with the x plate connection pins vertically downwards a positive voltage on the x′ plate deflects both spots to the left, a positive voltage on the y′ plate deflects one spot upwards and a positive voltage on the y″ plate deflects the other spot downwards.

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 incorporated 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 mimimum luminance exists.

x plate sensitivity ($V_{a4} = 2V_{a3}$)	S_x max.	$\frac{650}{V_{a3}}$	mm/V
	S_x min.	$\frac{475}{V_{a3}}$	mm/V
y′ plate sensitivity ($V_{a4} = 2V_{a3}$)	$S_{y'}$ max.	$\frac{650}{V_{a3}}$	mm/V
	$S_{y'}$ min.	$\frac{475}{V_{a3}}$	mm/V
y″ plate sensitivity ($V_{a4} = 2V_{a3}$)	$S_{y''}$ max.	$\frac{650}{V_{a3}}$	mm/V
	$S_{y''}$ min.	$\frac{475}{V_{a3}}$	mm/V

PATTERN DISTORTION

With $V_{a4} = 2V_{a3}$, symmetrical x deflection and asymmetrical y deflection, the edges of a nominally square raster lie between concentric 57mm and 60mm squares, i.e., max. total pattern distortion = 2.5%.

RESOLUTION

Under the following operating conditions, the tube resolves 35 lines/cm at the screen centre.

V_{a4}	3.0	kV
V_{a3}	1.5	kV
V_{a2}	Adjusted for focus	
V_{a1}	1.5	kV
V_g	Adjusted to a value corresponding to 0.08cd	
Writing speed	0.6	km/s
Repetition period	10	ms

SPOT ECCENTRICITY

With no post deflection acceleration ($V_{a4} = V_{a3}$) both undeflected spots lie within 8.0mm of the physical screen centre.

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KINGSMEAD WORKS, HIGH WYCOMBE, BUCKS, ENGLAND

Telephone: High Wycombe 2020

ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

ORIENTATION AND RECTANGULARITY

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

The angle between the x axis and either y axis is $90° \pm 1.5°$.

The maximum angle between the two y axes is 1°.

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.

CONNECTIONS

Sockets

The B12F socket can be supplied by the Carr Fastener Co. Ltd., of Staple ford, 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 may be 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 C4
Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire.	Type ST40

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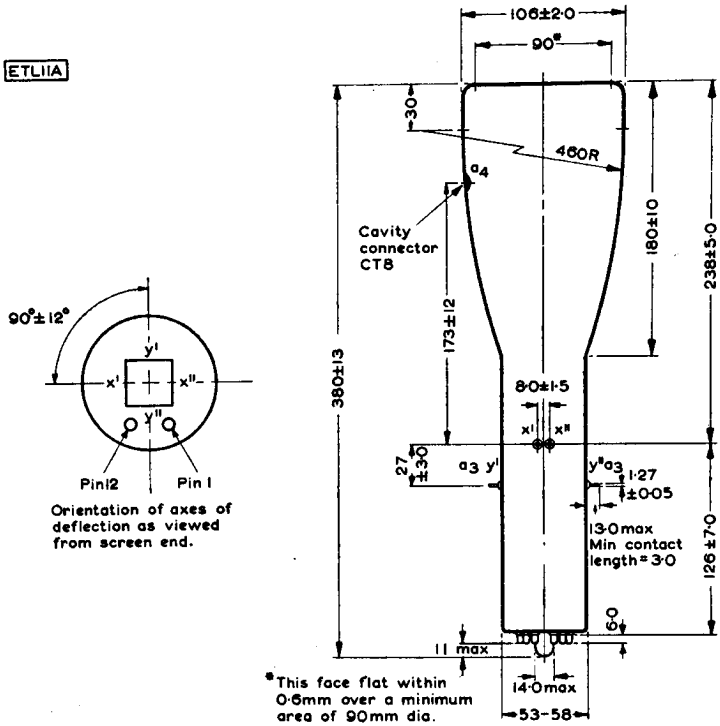
DUAL TRACE OSCILLOSCOPE TUBE

ETL11A



All dimensions in mm

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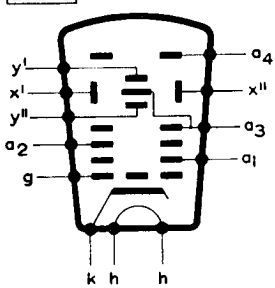
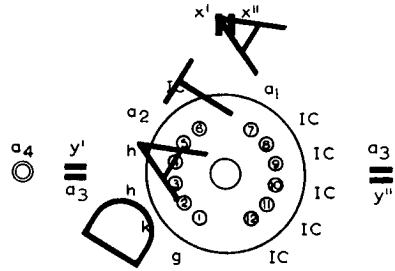
DUAL TRACE OSCILLOSCOPE TUBE

Dual trace oscilloscope tube with 4-in. diameter flat screen and independent y signal deflections. This tube is fitted with a post deflection accelerator and the deflection plates are brought out to side connections.

ETL11B





B12F Base

GENERAL DATA

Screen type		P1	
Fluorescent colour of screen		green	
Persistence		medium	
Focus		electrostatic	
Deflection		x direction symmetrical electrostatic y direction asymmetrical electrostatic each trace	
Post deflection acceleration		single stage	
Max. overall diameter		108	mm
Max. overall length		393	mm
Weight (approx.)		650 23	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}	4.2 to 5.9	pF
C_{k-all}	3.5 to 4.9	pF
$C_{x'-x''}$	1.4 to 2.0	pF
$C_{x'-all\ (x''\ earthed)}$	2.7 to 3.8	pF
$C_{x''-all\ (x'\ earthed)}$	2.7 to 3.8	pF
$C_{y'-all\ (y''\ earthed)}$	2.5 to 3.8	pF
$C_{y''-all\ (y'\ earthed)}$	2.5 to 3.8	pF
$C_{y'-y''}$ max.	0.1	pF
$C_{y'-x'+x''}$ max.	0.1	pF
$C_{y''-x'+x''}$ max.	0.1	pF

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ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

LIMITING VALUES (absolute ratings)

Max. first anode voltage	V_{a1} max.	1.7	kV
Min. first anode voltage	V_{a1} min.	600	V
Max. second anode voltage	V_{a2} max.	1.2	kV
Max. third anode voltage	V_{a3} max.	4.0	kV
Min. third anode voltage	V_{a3} min.	600	V
Max. fourth anode voltage (P.D.A.)	V_{a4} max.	8.0	kV
Min. fourth anode voltage	V_{a4} min.	1.0	kV
Max. voltage difference	V_{a4}–V_{a3} max.	4.0	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 either x plate to a_3	R_{x-a3} max.	2.0	MΩ
Max. resistance from either y plate to a_3	R_{y-a3} max.	1.0	MΩ
Max. voltage between any deflector plate and a_3	V_{x-a3} max. V_{y-a3} max.	1.0	kV
Max. V_{a4} to V_{a3} ratio for full screen x deflection	V_{a4}/V_{a3} max.	2.0	

TYPICAL OPERATING CONDITIONS

First anode voltage	V_{a1}	1.5	kV
*Second anode voltage	V_{a2}	320 to 420	V
Third anode voltage	V_{a3}	1.5	kV
Fourth anode voltage	V_{a4}	3.0	kV
Grid voltage for visual cut-off	V_g	–40 to –95	V
Beam trapping voltage	$V_{x'-a3}$	170 to 290	V
x plate sensitivity	S_x	27	V/cm
y plate sensitivity	S_y	27	V/cm
**Second anode current	I_{a2}	0 to 200	μA

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.

*For focus at intensity of 0.1 candelas. It is recommended that for a full range of grid voltages the available range of V_{a2} should be 150V to 450V with $V_{a1} = V_{a3} = 1.5$kV, $V_{a4} = 3$kV.

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

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ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

DEFLECTION

The tube is designed for symmetrical operation in the x direction, and asymmetrical operation is not recommended.

In the y direction, only asymmetrical operation is possible, since the two deflecting plates are separated by a common beam dividing plate which is connected internally to a_3.

The arrangement of the plates is such that viewing the fluorescent screen with the x plate connection pins vertically downwards a positive voltage on the x′ plate deflects both spots to the left, a positive voltage on the y′ plate deflects one spot upwards and a positive voltage on the y″ plate deflects the other spot downwards.

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 incorporated 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 mimimum luminance exists.

x plate sensitivity ($V_{a4} = 2V_{a3}$)	S_x max.	$\frac{650}{V_{a3}}$	mm/V
	S_x min.	$\frac{475}{V_{a3}}$	mm/V
y′ plate sensitivity ($V_{a4} = 2V_{a3}$)	$S_{y'}$ max.	$\frac{650}{V_{a3}}$	mm/V
	$S_{y'}$ min.	$\frac{475}{V_{a3}}$	mm/V
y″ plate sensitivity ($V_{a4} = 2V_{a3}$)	$S_{y''}$ max.	$\frac{650}{V_{a3}}$	mm/V
	$S_{y''}$ min.	$\frac{475}{V_{a3}}$	mm/V

PATTERN DISTORTION

With $V_{a4} = 2V_{a3}$, symmetrical x deflection and asymmetrical y deflection, the edges of a nominally square raster lie between concentric 57mm and 60mm squares, i.e., max. total pattern distortion = 2.5%.

RESOLUTION

Under the following operating conditions, the tube resolves 35 lines/cm at the screen centre.

V_{a4}	3.0	kV
V_{a3}	1.5	kV
V_{a2}	Adjusted for focus	
V_{a1}	1.5	kV
V_g	Adjusted to a value corresponding to 0.08cd	
Writing speed	0.6	km/s
Repetition period	10	ms

SPOT ECCENTRICITY

With no post deflection acceleration ($V_{a4} = V_{a3}$) both undeflected spots lie within 8.0mm of the physical screen centre.

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ETEL 4LP1

DUAL TRACE OSCILLOSCOPE TUBE

ORIENTATION AND RECTANGULARITY

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

The angle between the x axis and either y axis is $90° \pm 1.5°$.

The maximum angle between the two y axes is 1°.

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.

CONNECTIONS

Sockets

The B12F socket can be supplied by the Carr Fastener Co. Ltd., of Staple ford, 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 may be 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 C4
Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire.	Type ST40

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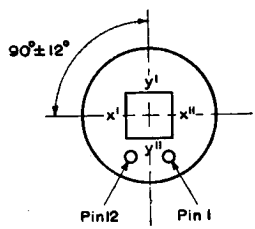
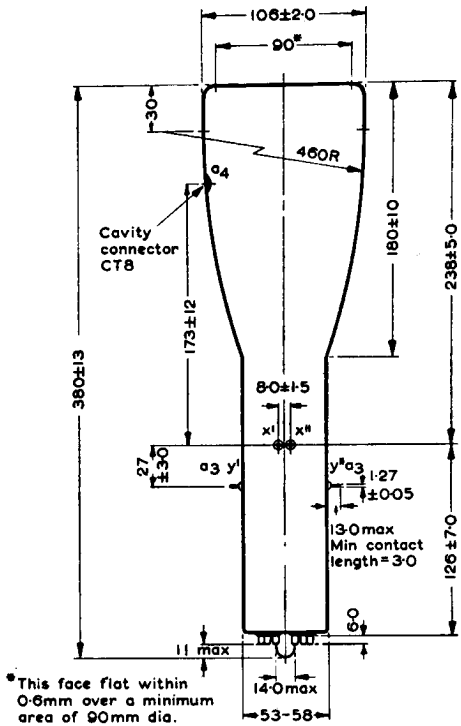
ETEL 4LP1

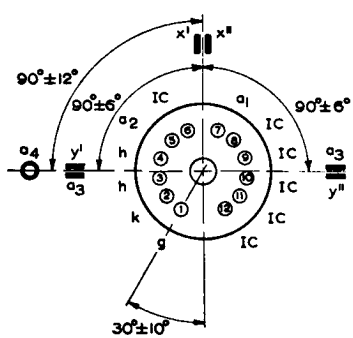
DUAL TRACE OSCILLOSCOPE TUBE

ETL11A



Orientation of axes of deflection as viewed from screen end.





B12F Base

All dimensions in mm

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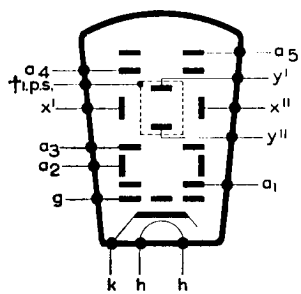
ETEL 5BKPI

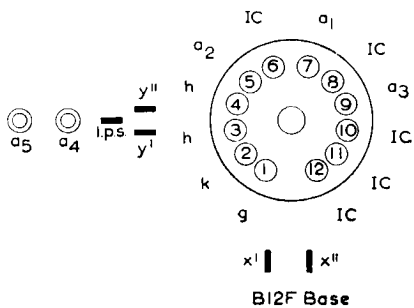
OSCILLOSCOPE TUBE

Precision oscilloscope tube with 5-in. flat screen. This tube is fitted with two stages of distributed post deflection acceleration and the deflection plates are brought out to side connections.

ETL12



†Inter-plate screen



B12F Base

GENERAL DATA

Screen type		Metal-backed P1	
Fluorescent colour of screen		green	
Persistence		medium	
Focus		electrostatic	
Deflection		electrostatic	
Post deflection acceleration		two stages distributed	
Max. faceplate diameter		133	mm
Max. overall length		452	mm
Useful screen area at $V_{a5}/V_{a3} = 5.5$, $V_{a4}/V_{a3} = 2.2$			
x direction		95	mm
y direction		60	mm
Weight (approx.)		1.25 2.75	kg lb
Mounting position		Any—see section on mounting (page 3)	

CATHODE

Indirectly-heated—suitable for parallel operation only

Heater voltage	V_h	6.3	V
Heater current	I_h	550	mA

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ETEL 5BKPI

OSCILLOSCOPE TUBE

CAPACITANCES

The following values are nominal (except where otherwise stated) and are subject to a manufacturing tolerance of ±20%.

C_{g-all}	7.4	pF
C_{k-all}	4.1	pF
$C_{x'-all}$ (x″ earthed)	3.6	pF
$C_{x''-all}$ (x′ earthed)	3.6	pF
$C_{y'-all}$ (y″ earthed)	1.6	pF
$C_{y''-all}$ (y′ earthed)	1.7	pF
$C_{x'-x''}$	2.3	pF
$C_{y'-y''}$	1.7	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

LIMITING VALUES (absolute ratings)

Max. first anode voltage	V_{a1} max.	1.5	kV
Max. second anode voltage	V_{a2} max.	750	V
Max. third anode voltage	V_{a3} max.	2.0	kV
Max. fourth anode voltage (P.D.A. ring)	V_{a4} max.	5.5	kV
Max. fifth anode voltage (final P.D.A.)	V_{a5} max.	12	kV
Min. fifth anode voltage (final P.D.A.)	V_{a5} min.	6.0	kV
Max. voltage differences	$V_{a1}-V_{a2}$ max.	1.5	kV
	$V_{a3}-V_{a2}$ max.	2.2	kV
	$V_{a4}-V_{a3}$ max.	3.5	kV
	$V_{a5}-V_{a4}$ max.	8.0	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. average first and third anode dissipation	p_{a1+a3} max.	2.0	W
Max. power input to screen	p_t max.	5.0	mW/cm²
Max. resistance from any deflector plate to a_3	R_{x-a3} max. / R_{y-a3} max.	5.0	MΩ
Max. voltage between any deflector plate and a_3	$V_{x\ a3}$ max. / V_{y-a3} max.	500	V
Max. V_{a5} to V_{a3} ratio for scan size of 60mm × 95mm (V_{a4}/V_{a3} — 2.2)	$\frac{V_{a5}}{V_{a3}}$ max.	5.5	
Min. insulation between fifth and third anodes	r_{a5-a3} min.	80	MΩ

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ETEL 5BKP1

OSCILLOSCOPE TUBE

TYPICAL OPERATING CONDITIONS

First anode voltage	V_{a1}	1.4	kV
Second anode voltage for focus	V_{a2}	440 to 560	V
†Third anode voltage	V_{a3}	1.8	kV
Fourth anode voltage	V_{a4}	4.0	kV
Fifth anode voltage	V_{a5}	10	kV
Grid voltage for visual cut-off	V_g	−45 to −90	V
Grid drive for intensity of 0.45 candelas	V_{in}	20	V
*Focus electrode current	I_{a2}	−25	μA
Fifth anode current	I_{a5}	25	μA
x plate sensitivity	S_x	26.5	V/cm
y plate sensitivity	S_y	12.5	V/cm

†Inter-plate screen (i.p.s.) connected to a_3.

*With V_{a2} set for focus and $V_{g1} = -1.0V$.

If V_{a1}, V_{a3}, V_{a4} and V_{a5} are altered but remain in the same ratio then the focus and cut-off voltages and the deflection sensitivities will change in the same ratio.

DEFLECTION

In the x direction the tube is designed for symmetrical operation only.

In the y direction, symmetrical or asymmetrical operation may be used, but vertical deflection defocusing and linearity may be a little worse in the asymmetric case than for symmetrical deflection.

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.

The following data for deflection sensitivities apply when $V_{a5} = 10kV$, $V_{a5}/V_{a3} = 5.5$ and $V_{a4}/V_{a3} = 2.2$. Provided that the P.D.A. ratios remain constant, the sensitivities vary inversely with the total acceleration voltage (V_{a5}).

x plate sensitivity	S_x max.	0.43	mm/V
	S_x min.	0.33	mm/V
y plate sensitivity	S_y max.	0.89	mm/V
	S_y min.	0.7	mm/V

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PATTERN DISTORTION

Compared with a normal post deflector accelerator, the use of a distributed system enables much greater P.D.A. ratios to be used, with a consequent gain in sensitivity, before serious pattern distortion occurs.

With $V_{a5}/V_{a3} = 5.5$, $V_{a4}/V_{a3} = 2.2$ and the mean potential of the x and y plates being equal to the potentials of a_3, the inter-plate screen (i.p.s.) and the external conductive coating, the following figures apply:

(1) A nominally rectangular raster may be inserted into the frame bounded by the rectangles 76.5mm × 45.9mm and 73.5mm × 44.1mm i.e. max. total pattern distortion is 2%.

(2) With the spot undeflected in the y direction the difference in deflection sensitivity at 25% useful x scan and at 75% useful x scan is less than 2%. With the spot undeflected in the x direction the difference in deflection sensitivity at 25% useful y scan and at 75% useful y scan is less than 2% i.e. max. non-linearity of deflection is 2%.

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° ± 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 the effects of shock on 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.

POWER SUPPLIES

At average high brightness the first and third anode portion of the tube requires currents up to 0.5mA. If the tube is used for displaying low-occupance pulses the peak pulse current may reach as much as 2mA if large 'bright-up' pulses are used. The power supply for this section of the tube should therefore be adequately regulated.

The positive supply for the P.D.A. system will need to provide less than 100μA tube current so that a high frequency generator is quite suitable for this purpose.

The intermediate P.D.A. ring (a_4), despite drawing very little current (of the order of 10μA) can cause pronounced hum effects if the supply to it is inadequately smoothed.

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EXTERNAL CONDUCTIVE COATING

An external conductive coating covers the distributed P.D.A. system. This should be held at earth potential or at some steady potential within 100V of the inter-plate screen.

The capacitance between the external coating and the internal system is approximately 300pF. Rapidly varying potentials applied to the external coating may vary the potential distribution on the internal coating with consequent momentary distortion of the trace.

Contact to the coating should be made by means of a smooth metal spring.

AUXILIARY COMPONENTS

Face Surround

The Standard Insulator Co. of Camberley, Surrey, manufacture a rubber face surround for this tube which fits inside the mumetal screens recommended below and which provides adequate shock insulation for the front of the tube.

Sockets

The B12F socket can be supplied by the Carr Fastener Co. Ltd. of Stapleford Notts, type V0/842.

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. In view of the proximity of the a_5 socket to the front of the tube and consequently to the metal panel, it is recommended that a high insulation type connector be used for this purpose.

Side Pin Connectors

There are no connectors specifically intended for use with the side pins for 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 thinner 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 ET4
Magnetic and Electrical Alloys Ltd., Burnbank, Hamilton, Lanarkshire.	Type ST38

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

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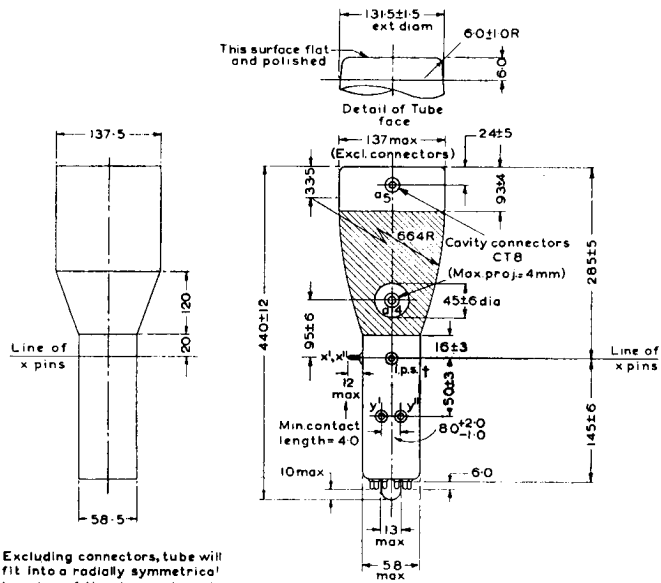
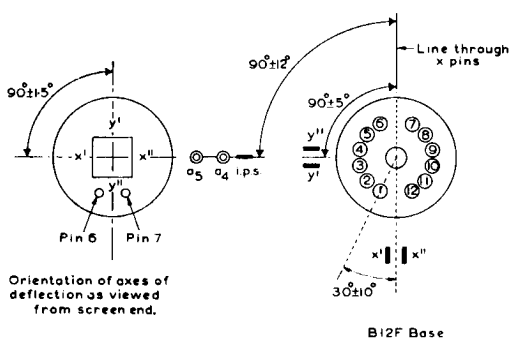
ETEL 5BKP1

OSCILLOSCOPE TUBE



Excluding connectors, tube will fit into a radially symmetrical housing of the above internal dimensions.



Orientation of axes of deflection as viewed from screen end.

B12F Base

†The axial distance between the radial planes of the x pins and the i.p.s. pin ≥ 2·0mm

ETL 11

All dimensions in mm

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IMPORTANT

The classification of the phosphor of this tube has been changed to P31, the screen characteristics remaining unaltered to E T E L tubes previously classified P1.

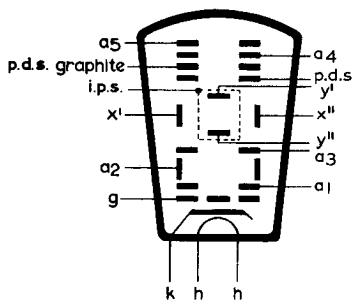
5CLP31

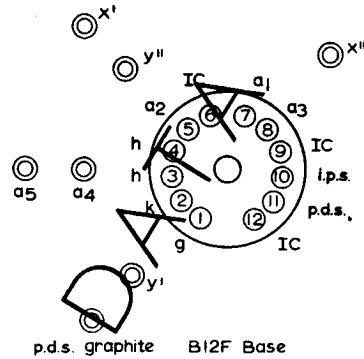
DH 13-60

OSCOPE TUBE

High sensitivity oscilloscope tube with 5-in. diameter flat screen. This tube is fitted with two stages of distributed post deflection acceleration and the deflection plates are brought out to side connections.

ETL15A





PDS. graphite and i.p.s. must be connected together externally

GENERAL DATA

Screen type	metal-backed P31	
Fluorescent colour of screen	green	
Persistence	medium	
Focus	electrostatic	
Deflection	electrostatic	
Post deflection acceleration	two stages distributed	
Max. faceplate diameter	137.5	mm
Max. overall length	508	mm
Weight	1.3 2 lb	kg 14 oz
Mounting position	any-see section on mounting	
Useful screen area at $V_{a5}/V_{a3} = 10$, $V_{a4}/V_{a3} = 10$		
x direction	100	mm
y direction	60	mm

CATHODE

Indirectly-heated – suitable for parallel operation only.

Heater voltage	V_h	6.3	V
Heater current	I_h	550	mA

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KINGSMEAD WORKS, HIGH WYCOMBE, BUCKS, ENGLAND

Telephone: High Wycombe 2020

ETEL 5CLP31

OSCILLOSCOPE TUBE

CAPACITANCES

C_{g-all}	6.0	pF
C_{k-all}	4.5	pF
$C_{x'-all}$ (x" earthed)	5.5	pF
$C_{x"-all}$ (x' earthed)	5.5	pF
$C_{y'-all}$ (y" earthed)	4.3	pF
$C_{y"-all}$ (y' earthed)	4.0	pF
$C_{x'-x"}$	2.0	pF
$C_{y'-y"}$	2.0	pF
$C_{x'+x"-y'+y"}$ max.	0.15	pF

LIMITING VALUES (absolute ratings)

Max. first anode voltage	V_{a1} max.	1.7	kV
Min. first anode voltage	V_{a1} min.	500	V
Max. second anode voltage	V_{a2} max.	1.5	kV
Max. third anode voltage	V_{a3} max.	3.3	kV
Min. third anode voltage	V_{a3} min.	800	V
Max. post deflection shield voltage	$V_{p.d.s.}$ max.	4.2	kV
Min. post deflection shield voltage	$V_{p.d.s.}$ min.	500	V
Max. post deflection graphite shield voltage	$V_{p.d.s.graphite}$ max.	4.2	kV
Min. post deflection graphite shield voltage	$V_{p.d.s.graphite}$ min.	500	V
Max. fourth anode voltage	V_{a4} max.	17.3	kV
Max. fifth anode voltage	V_{a5} max.	17.3	kV
Min. fifth anode voltage	V_{a5} min.	6.0	kV
Max. voltage differences	$V_{a4}-V_{a3}$ max.	14	kV
	$V_{a5}-V_{a4}$ max.	14	kV
Max. negative grid voltage	$-V_g$ max.	200	V
Min. negative grid voltage	$-V_g$ min.	1.0	V
Max. inter plate shield voltage	$V_{i.p.s.}$ max.	4.2	kV
Min. inter plate shield voltage	$V_{i.p.s.}$ min.	500	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. resistor between either deflector plate and a_3	R_{x-a3} max.	1.0	MΩ
	R_{y-a3} max.	1.0	MΩ
Max. voltage between either deflector plate and a_3	V_{x-a3} max.	500	V
	V_{y-a3} max.	500	V
Min. insulations	r_{a5-a4} min.	75	MΩ
	r_{a4-a3} min.	75	MΩ

TYPICAL OPERATION (with the i.p.s., p.d.s., p.d.s. graphite connected to a_3)

First anode voltage	V_{a1}	1.0	1.5	kV
Second anode voltage	V_{a2}	130 to 330	200 to 500	V
Third anode voltage	V_{a3}	1.0	1.5	kV
Fourth anode voltage	V_{a4}	10	15	kV
Fifth anode voltage	V_{a5}	10	15	kV
Grid voltage for visual cut-off	V_g	−28 to −60	−42 to −90	V
x plate sensitivity	S_x	7.5	11.2	V/cm
y plate sensitivity	S_y	1.85	2.7	V/cm

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ETEL 5CLP31

OSCILLOSCOPE TUBE

DEFLECTION

The tube is designed for symmetrical operation in the x direction, and asymmetrical operation is not recommended.
In the y direction symmetrical or asymmetrical operation is permissible but the vertical deflection defocusing may be worse with asymmetric deflection. The data given for pattern distortion, therefore, do not apply to asymmetric y deflection.
The arrangement of the plates is such that viewing the screen with the x plate connectors symmetrically downwards a positive voltage on the x_1 plate deflects the spot to the left and a positive voltage on the y_1 plate deflects the spot upwards.
The x plates are nearest the screen.
In order to obviate the necessity for pulsing the grid when the tube is used for displaying low occupance or single stroke phenomena, a beam trap is provided on each x plate. When a positive voltage of suitable magnitude is applied to either plate the beam is contained on that plate and a state of minimum luminance exists.
The following data for deflection sensitivities apply when $V_{a5} = 10kV$, $V_{a4} = 10kV$, $V_{a3} = 1kV$. Provided that the p.d.a. ratios remain constant, the sensitivities vary inversely with the total accelerating voltage (V_{a5}). Due to the presence of the post deflection shield however, variation of the p.d.a. ratio does not affect sensitivity greatly provided $V_{a4} = V_{a5}$. Reducing the a_4 potential below V_{a5} reduces sensitivity and usable screen area.

x plate sensitivity	S_x max.	1.6	mm/V
	S_x min.	1.2	mm/V
y plate sensitivity	S_y max.	6.0	mm/V
	S_y min.	4.3	mm/V

USE OF THE FOURTH ANODE

For the most sensitive condition, coupled with the largest usable screen area, the fourth anode (a_4) is connected to the fifth anode (a_5). Reducing the a_4 voltage below that of a_5 has the effect of reducing the sensitivity and the usable screen area. At the same time, however, the spot size is reduced considerably and single shot photography of high speed transients is eased.

RASTER DISTORTION

The use of the post deflection shield (p.d.s.) allows p.d.a. ratios up to 15 to be used before serious raster distortion is introduced. With $V_{a4} = V_{a5}$, $V_{a5}/V_{a3} = 10$ and the mean potentials of the x and y plates being equal to the potentials of the i.p.s., the p.d.s., and the p.d.s. graphite the following apply:

(1) A nominal rectangular raster may be inserted into the frame bounded by concentric rectangles 51mm × 81.6mm and 49mm × 78.4mm.
i.e., max. total raster distortion is ±2.0%.

(2) The sensitivity (for both x′–x″ and y′–y″ plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity for a deflection of 25% of the useful scan by more than 2%.

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ETEL 5CLP31

OSCILLOSCOPE TUBE

ORIENTATION AND RECTANGULARITY

The y axis lies within $\pm 12.5°$ of the line drawn midway between pins 6 and 7, and pins 1 and 12 on the base.
The angle between x and y axes is $90° \pm 1.5°$.

MOUNTING

There is no restriction in the position of mounting.
In mounting the tube the main support should be at the end nearest the screen and so arranged that no stresses are produced in the glass. Adequate precautions should be taken to protect the tube from the 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 connections should not be rigidly mounted but should have flexible leads and be allowed to move freely.

SUPPLIES

At average high brightness the first and third anode portion of the tube may require currents up to 1mA. If the tube is used for displaying low occupance pulses the peak pulse cathode current may reach as much as 2mA, if large 'bright-up' pulses are used and the power supply should be capable of providing this current.
For optimum performance the mean potentials of the x and y plate systems should be the same, and equal to the potentials of the a_3 and the i.p.s. In cases where astigmatic adjustment is required the a_3 should be allowed to swing ± 50 volts with respect to the i.p.s. The p.d.s. should not be allowed to become positive with respect to the mean potential of the x plates.
The positive supply system will need to supply about 200μA tube current so that a high frequency generator is quite suitable for this purpose. In view of the small variations in deflection sensitivity with p.d.a. voltage it may be necessary to stabilise this supply in a number of cases.

AUXILIARY COMPONENTS

Sockets

The B12F socket can be supplied by the Carr Fastener Co. of Stapleford, Notts, type VO/842.

Cavity Cap Connectors

Any commercially available CT8 connectors are suitable, but in view of the proximity of the a_5 socket to the front of the tube and consequently to the metal panel, it is recommended that a high insulation type connector be used for this purpose.

Shields

In view of the high sensitivity of the tube it is advisable to mount it as far as possible from the transformers and chokes. If these are in close proximity to the tube thicker shields may be required to avoid saturation and trace modulation.
Magnetic and Electrical Alloys Ltd. of Burnbank, Hamilton, Lanarkshire, manufacture a shield for use with this tube.

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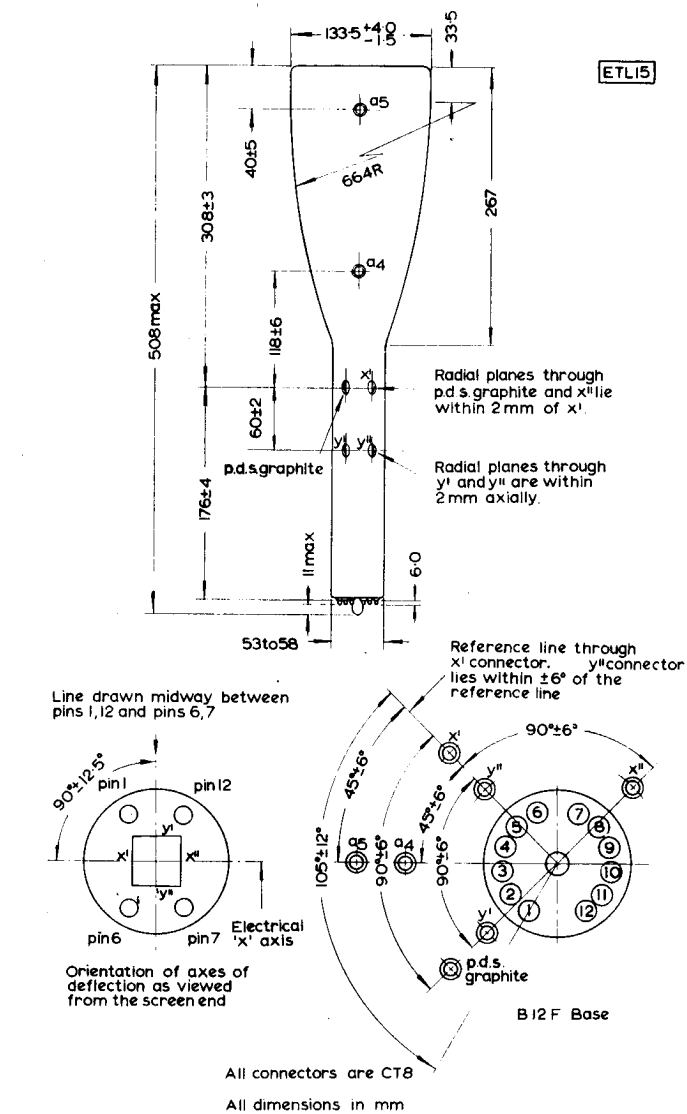
ETEL 5CLP31

OSCILLOSCOPE TUBE



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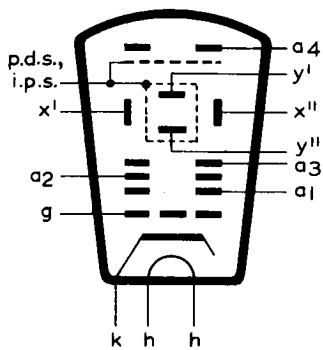
ETEL CR132

OSCILLOSCOPE TUBE

Oscilloscope tube with 3-in. diameter flat screen and distributed p.d.a. system, primarily intended for transistorised display equipment.



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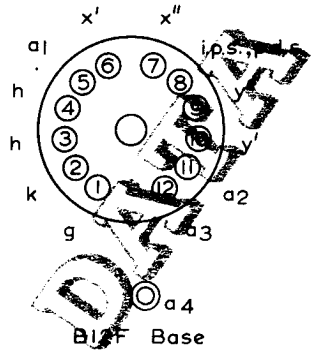

GENERAL DATA

Screen type	P31	P7
Fluorescent colour of screen	green	blue with yellow afterglow
Persistence	medium	long
Focus	electrostatic	
Deflection	double electrostatic	
Maximum overall diameter	78.3	mm
Maximum overall length	296	mm
Useful screen area at Va4/Va3=5		
x direction	Full screen	mm
y direction	50	mm
Weight (approx.)	340	g
	12	oz
Mounting position	Any - see section on mounting (page 4)	

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Kingsmead Works, High Wycombe, Bucks, England
Telephone: High Wycombe 2020

OSCILLOSCOPE TUBE

CATHODE

Indirectly heated

Heater voltage	Vh	6.3	V
Heater current	Ih	150	mA

CAPACITANCES

cg-all	6.6	pF
ck-all	4.0	pF
cx'-all (x" earthed)	6.0	pF
cx"-all (x' earthed)	6.0	pF
cy'-all (y" earthed)	4.0	pF
cy"-all (y' earthed)	4.0	pF
cx'-x"	2.0	pF
cy'-y"	2.0	pF
cx'+ x"- y'+ y"	0.3	pF

LIMITING VALUES (absolute ratings)

Maximum first anode voltage	Va1 max.	700	V
Minimum first anode voltage	Va1 min.	275	V
Maximum second anode voltage	Va2 max.	500	V
Maximum third anode voltage	Va3 max.	1.5	kV
Minimum third anode voltage	Va3 min.	275	V
Maximum inter plate shield and post deflection shield voltage	Vi.p.s.+ p.d.s.max.	1.5	kV
Minimum inter plate shield and post deflection shield voltage	Vi.p.s.+ p.d.s.min.	275	V
Maximum fourth anode voltage	Va4 max.	7.5	kV
Minimum fourth anode voltage	Va4 min.	1.0	kV
Maximum negative grid voltage	-Vg max.	200	V
Minimum negative grid voltage	-Vg min.	1.0	V
Maximum grid resistor	Rg-k max.	1.0	MΩ
Maximum heater to cathode voltage	Vh-k max.	±150	V
*Maximum Va4 to Va3 ratio	Va4/Va3 max.	10	
Minimum a4 to a3 resistance	ra4-a3 min.	100	MΩ

*Above this figure severe raster distortion will become apparent.

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OSCILLOSCOPE TUBE

OPERATING CONDITIONS

First anode voltage	Va1	300	500	V
Second anode voltage	Va2	60	140	V
Third anode voltage	Va3	300	800	V
Fourth anode voltage	Va4	1.5	4.0	kV
Grid voltage for visual cut-off	Vg	-30	-50	V
x plate sensitivity	Sx	5.0	13	V/cm
y plate sensitivity	Sy	3.0	8.0	V/cm
Second anode current	Ia2	±20	±20	μA
*Line width		0.7	0.5	mm

*Measured on a circle of 40mm diameter with It=0.5μA.

DEFLECTION

Primarily intended for symmetrical operation on both x and y plates. With Va4/Va3=5, the sensitivity (for both x'- x" and y'- y" plate pairs separately) for a deflection of less than 75% of the useful scan will not differ from the sensitivity of a deflection of 25% of the useful scan by more than ±2%.

The x plates are those nearest the screen.

The arrangement of the plates is such, that viewing the fluorescent screen with the final anode connector vertically upwards, a positive voltage on the x' plate will deflect the spot to the left, and a positive voltage on the y' plate will move the spot upwards.

For optimum focus, the average potentials of the deflection plates and a3 should be approximately equal.

RASTER DISTORTION

With Va4/Va3=5, the length of the edges of a raster pattern whose mean dimensions are less than 75% of the useful scan will not deviate from those mean dimensions by more than ±2.5%.

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OSCILLOSCOPE TUBE

SPOT ECCENTRICITY

With the tube magnetically shielded, the undeflected spot will lie within a rectangle 6mm x 8mm symmetrically placed about the geometric centre of the tube face, the major axis corresponding to the x direction.

ORIENTATION AND RECTANGULARITY

The y axis lies within ±12° of the line which joins the base centre to the reference pip between pins 1 and 12. The angle between the x and y axes is 90° ± 1°.

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.

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

AUXILIARY COMPONENTS

Sockets

The B12F socket can be supplied by the Carr Fastener Co., of Stapleford, Notts., type VO/842.

Cavity Cap Connectors

Any commercially available CT8 connector is suitable.

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OSCILLOSCOPE TUBE

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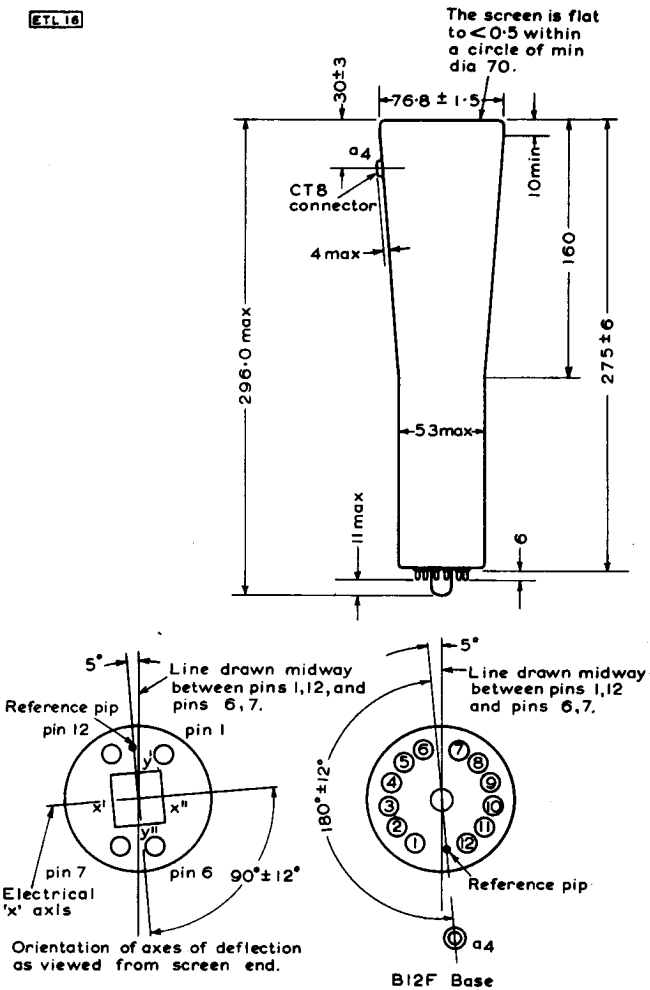

All dimensions in mm

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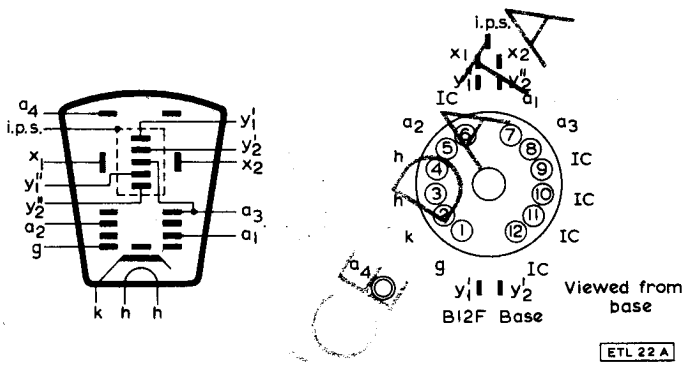
Telephone: High Wycombe 2020

ETEL

CR157

DUAL TRACE OSCILLOSCOPE TUBE

Dual trace oscilloscope tube with 4-in. diameter flat screen and distributed p.d.a. system. This tube has two independent Y signal traces with common X plates, the deflection plates being brought out to side connections.



GENERAL DATA

Screen type	P31	
Fluorescent colour of screen	blue-green	
Persistence	medium	
Focus	electrostatic	
Deflection	electrostatic	
Post deflection acceleration	single stage distributed	
Max. overall diameter (excluding connectors)	102	mm
Max. overall length	400	mm
Minimum useful screen dimensions (at Va4=4Va1)		
y (each beam)	5	cm
x (each beam)	8	cm
overlap	4	cm
Mounting position	Any - see section on mounting (page 3)	

ETEL CR157

DUAL TRACE OSCILLOSCOPE TUBE

CATHODE

Indirectly heated - suitable for parallel operation only

Heater voltage	Vh	6.3	V
Heater current	Ih	300 or 550	mA

CAPACITANCES

cg-all	7.0	pF
ck-all	5.0	pF
cx1-all (x2 earthed)	5.0	pF
cx2-all (x1 earthed)	5.0	pF
cy1''-all (y1' earthed)	6.0	pF
cy2'-all (y2'' earthed)	6.0	pF
cy1'-all (y1'' earthed)	4.0	pF
cy2''-all (y2' earthed)	4.0	pF
cx1-x2	3.0	pF
cy1'-y1''	1.0	pF
cy2'-y2''	1.0	pF
cy1'+y1''-y2'+y2'' max.	0.2	pF

ABSOLUTE MAXIMUM RATINGS

Max. first anode voltage	Va1 max.	1.2	kV
Min. first anode voltage	Va1 min.	600	V
Max. second anode voltage	Va2 max.	1.5	kV
Max. third anode voltage	Va3 max.	3.0	kV
Min. third anode voltage	Va3 min.	800	V
Max. fourth anode voltage (p.d.a.)	Va4 max.	8.0	kV
Min. fourth anode voltage	Va4 min.	1.5	kV
Max. grid voltage	Vg max.	-200	V
Min. grid voltage	Vg min.	-1.0	V
Max. peak heater to cathode voltage	vh-k(pk) max.	150	V
Max. grid resistor	Rg-k max.	1.0	MΩ
Max. resistance from either x plate to a3	Rx-a3 max.	1.0	MΩ
Max. resistance from any y plate to a3	Ry-a3 max.	100	kΩ
Max. voltage between either x deflector plate and a3	Vx-a3 max.	500	V
Max. voltage between any y deflector plate and a3	Vy-a3 max.	250	V
Min. resistance between third and fourth anode	ra4-a3 min.	50	MΩ

TYPICAL OPERATING CONDITIONS

First anode voltage	Va1	1.0	kV
Second anode voltage	Va2	100 to 350	V
Third anode voltage	Va3	1.0	kV
Fourth anode voltage	Va4	4.0	kV
Grid voltage for visual cut-off	Vg	-45 to -90	V
x plate sensitivity	Sx	17	V/cm
y plate sensitivity (both beams)	Sy	13	V/cm

DUAL TRACE OSCILLOSCOPE TUBE

DEFLECTION

The tube is designed for symmetrical operation on both x and y plates.

The x plates are those nearest the screen.

The arrangement of the plates is such that viewing the fluorescent screen with the x plate connection pins vertically downwards a positive voltage on the x1 plate deflects both spots to the left, a positive voltage on the y1' plate deflects one spot upwards and a positive voltage on the y1" plate deflects the other spot upwards.

The linearity of the scan is $\pm 2\%$.

RASTER DISTORTION

With a raster of size 37.5mm by 60mm, the total raster distortion will be $\pm 2\%$ for each beam and $\pm 2.5\%$ for both beams when they are superimposed.

SPOT ECCENTRICITY

When all the deflector plates are connected to the third anode, both beams will coincide within a rectangle 9mm x 16mm symmetrically placed about the geometric centre of the tube face and there will be no displacement between the spots in the x direction when adjusted for optimum centre focus.

The useful screen area may be offset from the geometric screen centre by a maximum of 3mm.

ORIENTATION AND RECTANGULARITY

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

The angle between the x and y axes for each trace is $90^{\circ} \pm 1^{\circ}$.

The angle between the two electrical y axes with the beams superimposed is within $\pm 1.5^{\circ}$.

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 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.

ACCESSORIES

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.

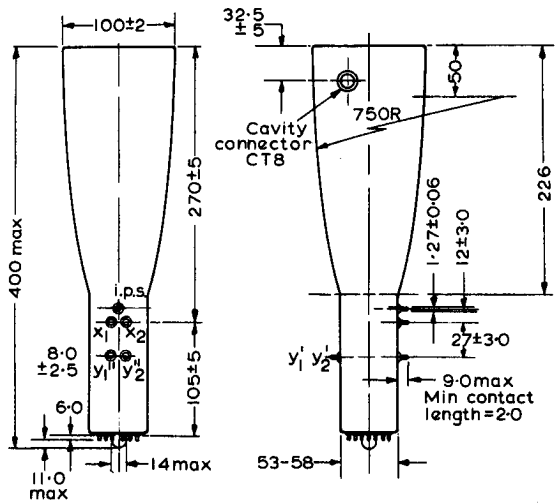
Side pin connectors

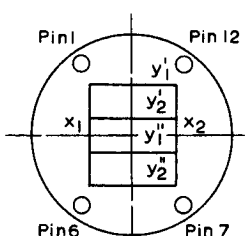
There are no connectors specifically intended for use with the side pins of this tube. A standard miniature diode clip has been found adequate in many instances and in other applications miniature crystal microphone connectors have been used.

Mumetal shields

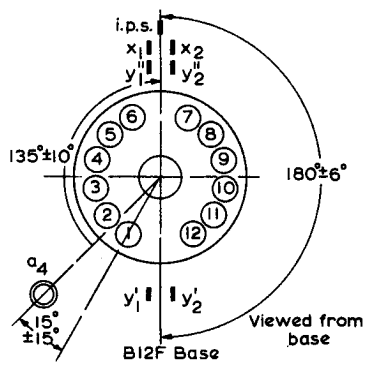
In view of the high sensitivity of the tube it is advisable to mount it as far as possible from transformers and chokes. If transformers or chokes are in close proximity to the tube, thicker or multiple shields may be required to avoid saturation and trace modulation.

DUAL TRACE OSCILLOSCOPE TUBE





Orientation of axes of deflection as viewed from screen end.



All dimensions in mm.

ETL22