

INSTRUMENT CATHODE-RAY TUBES

- mono accelerator
- 14 cm diagonal rectangular flat face
- internal magnetic lens system for vertical scan magnification, orthogonality, astigmatism and eccentricity correction
- quick-heating cathode
- with or without internal graticule
- flat screen edges facilitate graticule illumination
- *reference points on faceplate for graticule alignment*
- for inexpensive oscilloscopes and read-out devices

QUICK REFERENCE DATA

Accelerator voltage	$V_{g2,g4}$	2000 V
Minimum useful scan area		100 mm x 80 mm
Deflection coefficient		
horizontal	M_x	19 V/cm
vertical	M_y	11,5 V/cm

OPTICAL DATA

Screen	type	colour	persistence
	GH	green	medium short
	GY	yellowish-green	medium
	GM	yellowish-green	long
Useful screen area	$\geq 102 \text{ mm} \times 82 \text{ mm}$; note 1		
Useful scan area	$\geq 100 \text{ mm} \times 80 \text{ mm}$		
Internal graticule	type 93; see Fig. 4		

HEATING

Indirect by AC or DC*

Heater voltage	V_f	6,3 V
Heater current	I_f	0,24 A
Heating time to attain 10% of the cathode current at equilibrium conditions		approx. 5 s

* Not to be connected in series with other tubes.

MECHANICAL DATA

Dimensions and connections (see also outline drawing)

Overall length (socket included)	≤ 333 mm
Faceplate dimensions	$118 \pm 0,5$ mm x $98 \pm 0,5$ mm
Net mass	approx. 1 kg
Base	12 pin, all glass, JEDEC B12-246

Mounting

The tube can be mounted in any position. It must not be supported by the socket and not by the base region alone. The reference points on adjoining edges of the faceplate (see Fig. 4) enable the tube to be mounted accurately in the front panel, thus providing optimum alignment of the internal graticule.

Accessories

Pin protector (required for shipping)	supplied with tube
Socket with solder tags	type 55594
Socket with printed-wiring pins	type 55595
Mu-metal shield	55598

FOCUSING

electrostatic

DEFLECTION

double electrostatic

x-plates

symmetrical

y-plates

symmetrical

If use is made of the full deflection capabilities of the tube the deflection plates will block part of the electron beam, hence a low impedance deflection plate drive is desirable.

CAPACITANCES

x ₁ to all other elements except x ₂	C _{x1(x2)}	5,7 pF
x ₂ to all other elements except x ₁	C _{x2(x1)}	5 pF
y ₁ to all other elements except y ₂	C _{y1(y2)}	4 pF
y ₂ to all other elements except y ₁	C _{y2(y1)}	4 pF
x ₁ to x ₂	C _{x1x2}	2,3 pF
y ₁ to y ₂	C _{y1y2}	1 pF
Control grid to all other elements	C _{g1}	6 pF
Cathode to all other elements	C _k	3 pF

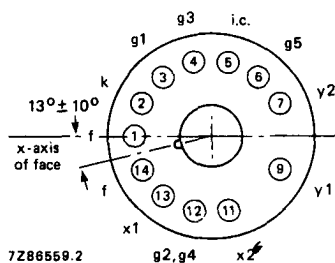


Fig. 2 Pin arrangement; bottom view.

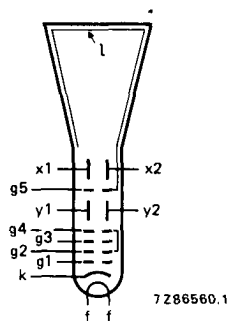


Fig. 3 Electrode configuration.

Internal graticule

The internal graticule is aligned with the faceplate by using the faceplate reference points, see Fig. 4. See also note 1.

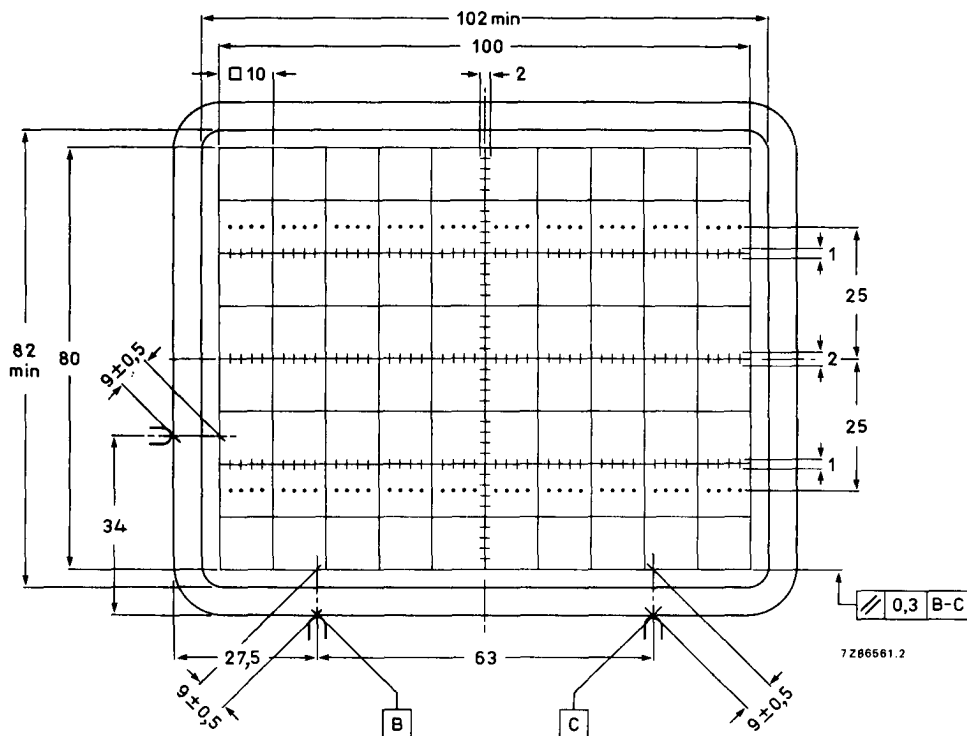


Fig. 4 Front view of tube with internal graticule, type 93.

Line thickness = 0,2 mm; dot diameter = 0,4 mm; colour: red.

TYPICAL OPERATION (voltages with respect to cathode)*

Conditions

Mean deflection plate potential		2000 V	see note 2
Shield voltage for optimum geometry	$V_{g5(l)}$	2000 V	see note 3
Accelerator and astigmatism control voltage	$V_{g2,g4}$	2000 V	see note 4
Focusing voltage	V_{g3}	220 to 370 V	see note 5
Cut-off voltage for visual extinction of focused spot	$-V_{g1}$	22 to 65 V	see note 6

Performance

Deflection coefficient			
horizontal	M_x	< 19 V/cm 21 V/cm	
vertical	M_y	< 11,5 V/cm 12 V/cm	
Deviation of deflection linearity		≤ 2 %	see note 7
Geometry distortion			see note 8
Luminance reduction at the edges of the useful scan (100 mm x 80 mm), with respect to screen centre		≤ 30 %	
Eccentricity of undeflected spot with respect to internal graticule			
horizontal		≤ 4 mm	see note 9
vertical		≤ 2 mm	
Angle between x and y-traces		90°	see note 9
Angle between x-trace and x-axis of the internal graticule		≤ 5°	see note 10
Grid drive voltage for 10 μ A screen current	V_d	≈ 10 V	see note 6
Line width	l.w.	≈ 0,3 mm	see note 11

LIMITING VALUES (Absolute maximum rating system)

Accelerator voltage	$V_{g2,g4}$	max. 2200 V
Shield voltage	$V_{g5(l)}$	max. 2200 V
Focusing electrode voltage	V_{g3}	max. 2200 V
Control grid voltage	$-V_{g1}$	max. 200 V min. 0 V
Cathode to heater voltage		
positive	V_{kf}	max. 125 V
negative	$-V_{kf}$	max. 125 V
Heater voltage	V_f	max. 6,6 V min. 6,0 V
Grid drive voltage, averaged over 1 ms	V_d	max. 20 V
Screen dissipation	W_ℓ	max. 3 mW/cm ²
Control grid circuit resistance	R_{g1}	max. 1 M Ω

NOTES

1. As the frit seal is visible through the faceplate, and not necessarily aligned with the internal graticule, application of an external passe-partout with open area of max. 102 mm x 82 mm is recommended. The internal graticule is aligned with the faceplate by using the faceplate reference points (see Fig. 4).
2. The deflection plates must be operated symmetrically; asymmetric drive introduces trace distortion. It is recommended that the tube be operated with equal mean x- and y-potentials, in order to minimize tube adjustments. Under this condition g_5 can be connected to g_2 , g_4 , and made equal to mean y-potential for optimum spot (see also notes 3 and 4).
A difference between mean x- and y-potentials up to 75 V is permissible, however this may influence the specified deflection coefficients, and a separate voltage on g_5 (equal to mean x-potential) may be required.
3. The tube meets the geometry specification (see note 8) if V_{g5} is equal to mean x-potential. A range of ± 50 V around mean x-potential may be applied for further correction.
4. Optimum spot is obtained with $V_{g2, g4}$ equal to mean y-potential (see note 2). In general a tolerance of ± 4 V has no visible effect; $V_{g2, g4}$ tends to be lower with V_{g5} more positive. The circuit impedance $R_{g2, g4}$ should be less than 10 k Ω .
5. An actual focus range of 30 V should be provided on the front panel. V_{g3} decreases with increasing grid drive (see also Fig. 5).
6. Intensity control on the front panel should be limited to the maximum useful screen current (approx. 50 μ A; see also Fig. 5). It is to be adjusted either by the grid drive (up to 22 V) or for maximum acceptable line width. The corresponding cathode current or $I_{g2, g4}$ (up to 500 μ A) depend on the cut-off voltage and cannot be used for control settings.
7. The sensitivity at a deflection of less than 75% of the useful scan will not differ from the sensitivity at a deflection of 25% of the useful scan by more than the indicated value.
8. A graticule consisting of concentric rectangles of 100 mm x 80 mm and 98 mm x 78 mm is aligned with the internal graticule. With optimum trace rotation correction the edges of a raster will fall between these rectangles.
9. The tube features internal magnetic correction for orthogonality between x- and y-traces, spot shaping (astigmatism) and eccentricity calibration.
10. The tube has a trace rotation coil, fixed onto the lower cone part. The coil has 1000 turns and a resistance of $185 \pm 25 \Omega$ at 20 °C, which increases by approx. 0,4%/K for rising temperature. Approx. 5 mA causes 1° trace rotation. Thus maximum required voltage is approx. 11 V for tube tolerances ($\pm 5^\circ$) and earth magnetic field with reasonable shielding ($\pm 2^\circ$).
11. Measured with the shrinking raster method in the centre of the screen under typical operating conditions, adjusted for optimum spot size at a beam current $I_b = 10 \mu$ A.

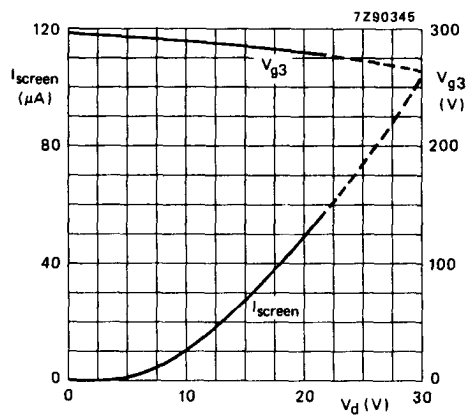


Fig. 5 Screen current (I_{screen}) and focusing voltage (V_{g3}) as a function of grid drive voltage (V_d); typical curves.