INSTRUMENT CATHODE-RAY TUBE

- 14 cm diagonal rectangular flat face
- direct - view storage tube
- internal graticule
- for oscilloscope applications

QUICK REFERENCE DATA

Final accelerator voltage	$V_{g10(\ell)}$	8,5 kV
Minimum useful scan area		90 mm x 72 mm
Deflection coefficient		
horizontal	M_x	9,5 V/div
vertical	M_y	4,1 V/div
Writing speed		2,5 div/μs

blue binder, tab 4

OPTICAL DATA

Screen	metal-backed phosphor
type	GH, colour green
persistence, non-store mode	medium-short
persistence, store mode	variable
Useful screen area	min. 90 mm x 72 mm
Useful scan area	min. 90 mm x 72 mm
Spot eccentricity in horizontal and vertical directions	max. 6 mm
Internal graticule	typ. 95; see Fig. 6

HEATING

Writing section

Indirect by a.c. or d.c.*

Heater voltage	V_f	6,3 V
Heater current	I_f	240 mA
Heating time to attain 10% of the cathode current at equilibrium conditions		approx. 5 s

Viewing section

Indirect by d.c.*

Heater voltage	V_{FGf}	12,6 V
Heater current	I_{FGf}	240 mA
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 drawings)

Overall length (socket included)	⩽ 452 mm
Faceplate dimensions (final accelerator contact excluded)	118 ± 0,5 mm x 98 ± 0,5 mm
Net mass	approx. 1,3 kg
Mase	14 pin, all glass

Mounting position

The tube can be mounted in any position. It should not be supported by the base alone or near the base region, and under no circumstances should the socket be allowed to support the tube. The tags near the screen should not be subjected to mechanical stress. Avoid any force on the side contacts.

Accessories

Socket (supplied with tube)	type 55566
Side contact connector (7 required)	type 55561
Small ball contact connector (5 required)	type 4022 102 21590

FOCUSING	electrostatic
DEFLECTION	double electrostatic
x-plates	symmetrical
y-plates	symmetrical
Angle between x and y-traces	90 ± 1°
Angle between x-trace and x-axis of the internal graticule	⩽ 5°*

* The tube has a rotation coil, concentrically wound around the tube neck, to allow alignment of the x-trace with the mechanical x-axis of the screen. The coil has 2000 turns and a maximum resistance of 650 Ω. Under typical operating conditions, a maximum of 20 ampere-turns is required for the maximum rotation of 5°. This means the required supply is 10 mA maximum at 8 V maximum.

OPERATING NOTES

Modes of operations

Non-storage mode

For non-storage operation the front mesh V_{g9} is set to −50 V with respect to FGK.

The viewing guns should not be switched off in this mode of operation since slight variations in raster geometry and deflection sensitivity might otherwise be caused.

Variable persistence mode

a. Dynamic erasure

Dynamic erasure can be achieved by applying extra erasing pulses of positive polarity to the backing electrode V_{g9}. The amplitude of these extra pulses is equal to that of the original erasing pulse, the frequency is 120 Hz and the persistence of the display can be controlled by varying the duty factor.

b. Static erasure (Fig. 9)

If no dynamic erasing pulses are applied the storage time is limited by the potential shift of the storage layer due to landing of positive ions.

In order to erase a stored display, V_{g9} is increased to 150 V for 100 ms and than returned to its original potential for about 500 ms; after that, an erasing pulse of positive polarity (max. 15 V) and a duration of 600 ms should be applied.

While the erasing pulse amplitude is to be adjusted with zero d.c. level for "just black", the background illumination can be changed — even with a stored signal — by varying the d.c. level for optimum contrast or maximum writing speed.

Back ground egality can be optimized by balancing the viewing gun cathodes by means of a potentiometer of 2,2 kΩ, proper collimator adjustment, and by increasing V_{FGA}, $V_{g7\text{-}1}$, $V_{g7\text{-}2}$ and $V_{g7\text{-}3}$ in positive direction during erasure.

Before first installation, depending on transport conditions, demagnetization of the tube face region may be necessary.

NOTES

1. These values are valid at cut-off of both flood guns and the writing gun. The H.T. unit must be capable of supplying 0,5 mA. To protect the tube against excessive surge current during erasure, an RC network as shown in Fig. 10 must be connected in series with the screen terminal lead; the resistance of 15 to 20 MΩ includes the internal resistance of the H.T. supply.

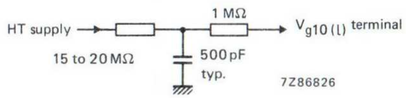

Fig. 10.

2. This voltage should be equal to the mean y-plate potential. The mean x and y-plate potentials should be equal for optimum spot quality.
3. When putting the tube into operation, the astigmatism control voltage should be adjusted only once for optimum spot size in the screen centre. The control voltage will be within the stated range, provided the conditions of note 2 are adhered to.
4. The collimator electrode voltage $V_{g7\text{-}2}$ and $V_{g7\text{-}3}$ should be adjusted for optimum uniformity of background illumination.
5. 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 μA (measured on x-plates).
6. The writing speed is defined as the maximum speed at which a written trace is just visible starting from a background which is just black. The indicated value is guaranteed for the central 75% of the minimum screen area, except the outmost 4 mm of the screen. However, in any corner not more than 4 square divisions fall outside the guaranteed area. The writing speed can be increased, if some background is tolerated. Within the same area, a trace, written with the indicated value of max. write, remains just visible within the indicated storage time of max. write.

   The writing speed in max. write, with background, is defined as the maximum speed at which the written trace remains just visible within the indicated storage time.
7. The storage time in just black mode is defined as the time required for the brightness of the unwritten background to rise from zero brightness to 10% of saturated brightness. At reduced intensity (by pulsing the flood beams) the storage time can be increased.

   The storage time in max. write is related to the writing speed.
8. The sensitivity at a deflection 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.
9. A graticule, consisting of concentric rectangles of 72 mm x 54 mm and 69,8 mm x 52,5 mm is aligned with the electrical x-axis of the tube. With optimum corrections applied, a raster will fall between these rectangles.

CAPACITANCES

x_1 to all other elements except x_2	$C_{x1(x2)}$	5,5 pF
x_2 to all other elements except x_1	$C_{x2(x1)}$	5,5 pF
y_1 to all other elements except y_2	$C_{y1(y2)}$	3,5 pF
y_2 to all other elements except y_1	$C_{y2(y1)}$	3,5 pF
x_1 to x_2	C_{x1x2}	2,5 pF
y_1 to y_2	C_{y1y2}	2 pF
g_1 to all other elements	C_{g1}	6 pF
k to all other elements	C_k	3,5 pF
g_3 to all other elements	C_{g3}	4,5 pF
$g_{7\text{-}1}$ to all other elements	$C_{g7\text{-}1}$	30 pF
$g_{7\text{-}2}$ to all other elements	$C_{g7\text{-}2}$	65 pF
$g_{7\text{-}3}$ to all other elements	$C_{g7\text{-}3}$	60 pF
g_9 to all other elements	C_{g9}	60 pF
g_{10} to all other elements	C_{g10}	80 pF
FGA to all other elements	C_{FGA}	15 pF
FGK' to all other elements	$C_{FGK'}$	8 pF
FGK'' to all other elements	$C_{FGK''}$	8 pF

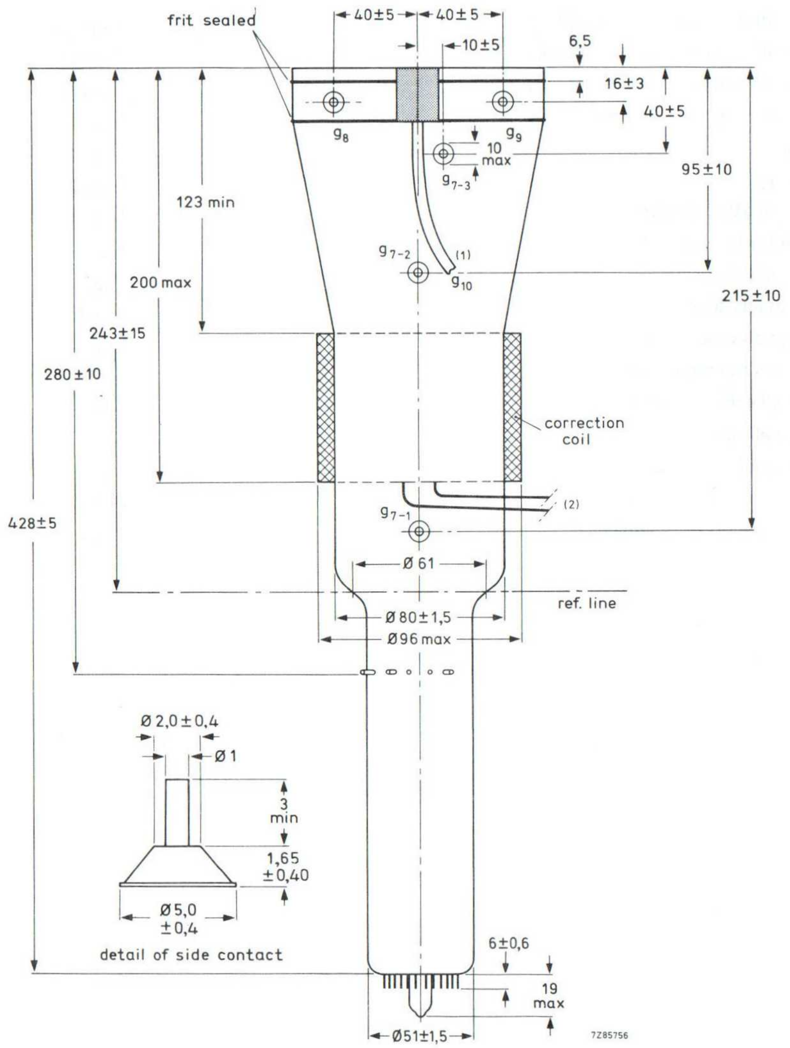

Fig. 1 Outlines.

(1) Minimum cable length is 420 mm.
(2) Minimum length of connecting leads is 350 mm.
(3) Dimensions of faceplate only. The bulge at the frit seal may increase the indicated maximum dimensions by not more than 3 mm.

LIMITING VALUES (Absolute maximum rating system)

Writing section (voltages with respect to writing gun cathode k)

Final accelerator voltage	$V_{g10(\ell)}$	max.	9000 V
		min.	7000 V
Geometry control electrode voltage	V_{g6}	max.	2100 V
Deflection plate shield voltage	V_{g5}	max.	2000 V
Astigmatism control electrode voltage	V_{g4}	max.	2100 V
		min.	1200 V
Focusing electrode voltage	V_{g3}	max.	1000 V
First accelerator voltage	V_{g2}	max.	2000 V
		min.	1250 V
Control grid voltage			
positive	V_{g1}	max.	0 V
negative	$-V_{g1}$	max.	200 V
Cathode to heater voltage			
positive	V_{kf}	max.	125 V
negative	$-V_{kf}$	max.	125 V
Voltage between astigmatism control electrode and any deflection plate	$V_{g4/x}$	max.	500 V
	$V_{g4/y}$	max.	500 V
Grid drive, averaged over 1 ms	V_d	max.	30 V
Screen dissipation	W_ℓ	max.	8 mW/cm²

Viewing section (voltages with respect to viewing gun cathode FGK)

Final accelerator voltage	$V_{g10(\ell)}$	max.	7500 V
		min.	5500 V
Backing electrode voltage			
storage operation	V_{g9}	max.	+ 150 V
		min.	−5 V
non-storage operation	$-V_{g9}$	max.	50 V
		min.	25 V
Collector voltage	V_{g8}	max.	180 V
		min.	120 V
Collimator voltage	$V_{g7-1}, V_{g7-2}, V_{g7-3}$	max.	200 V
		min.	0 V
First accelerator voltage	V_{FGA}	max.	60 V
		min.	0 V
Cathode to heater voltage			
positive	$V_{k'FGf}, V_{k''FGf}$	max.	125 V
negative	$-V_{k'FGf}, -V_{k''FGf}$	max.	125 V

Performance

Useful scan				
horizontal		min.	90 mm	
vertical		min.	72 mm	
Deflection coefficient				
horizontal	M_x		9,5 V/div	
		max.	10,5 V/div	
vertical	M_y		4,1 V/div	
		max.	4,4 V/div	
Line width at the centre of the screen	l.w.		0,35 mm	note 5
Writing speed in storage operation				
just black		⩾	250 div/ms	note 6
max. write		⩾	2,5 div/μs	note 6
Storage view time				
just black		⩾	90 s	note 7
max. write		⩾	15 s	note 7
Deviation of deflection linearity		max.	2 %	note 8
Geometry distortion		see note 9		
Grid drive for 10 μA beam current	V_d	approx.	25 V	
Grid drive for specified writing speed	V_d	max.	45 V	
Total cathode current of both viewing guns				
at FGA = 28 V		approx.	1 mA	
at FGA = 50 V		approx.	2 mA	

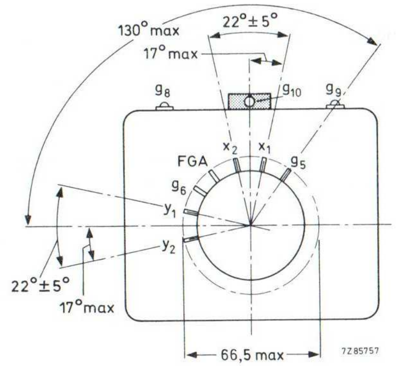

Fig. 2 Bottom view and side-contact arrangement.

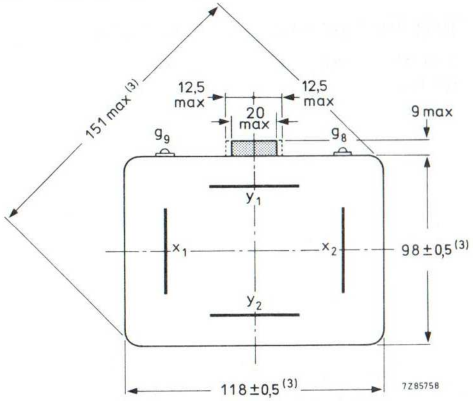

Fig. 3 Top view. For note (3) see opposite page.

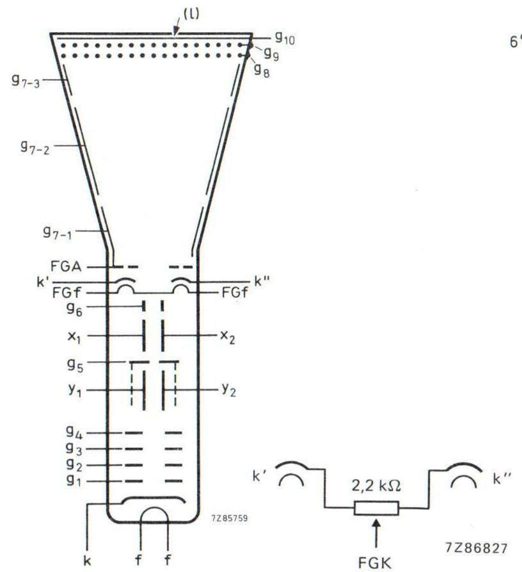

Fig. 4 Electrode configuration.

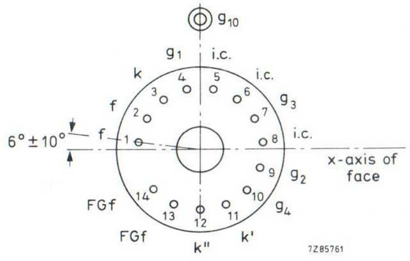

Fig. 5 Pin arrangement; bottom view.

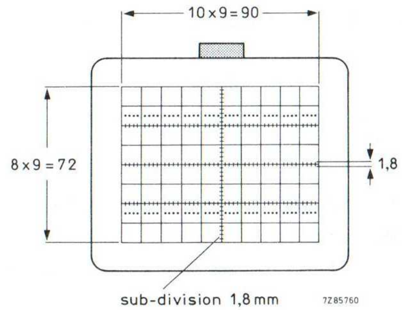

Fig. 6 Internal graticule
colour of graticule: black;
line width: 0,2 mm;
dot diameter: 0,4 mm.

INTERNAL GRATICULE ALIGNMENT

The internal graticule is aligned with the faceplate by using the faceplate reference points A1, A2 and A3, see Fig. 7.

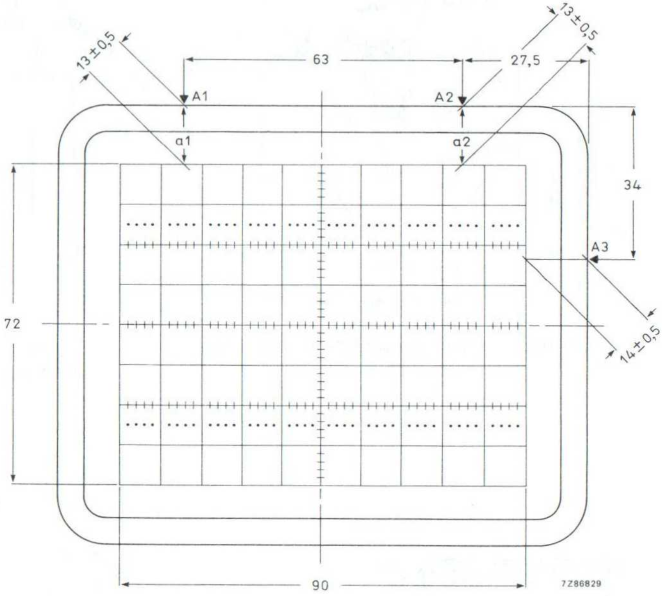

Fig. 7 Front view of tube with internal graticule.
$|a1 - a2| \leqslant 0{,}3$ mm.

TYPICAL OPERATION (for notes see page 10)

Conditions

Writing section (voltages with respect to writing gun cathode k)

Final accelerator voltage	$V_{g10(\ell)}$	8500 V	note 1
Geometry control electrode voltage	V_{g6}	1500 ± 100 V	
Deflection plate shield voltage	V_{g5}	1500 V	note 2
Astigmatism control electrode voltage	V_{g4}	1500 ± 50 V	note 3
Focusing electrode voltage	V_{g3}	400 to 600 V	
First accelerator voltage	V_{g2}	1500 V	
Cut-off voltage for visual extinction of focused spot	$-V_{g1}$	45 to 85 V	

Viewing section (voltages with respect to viewing gun cathode FGK, Fig. 8)

See Fig. 9.

Note: The d.c. voltage on the first accelerator of the flood guns (FGA) should be equal to the mean x-plate potential.

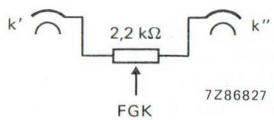

Fig. 8.

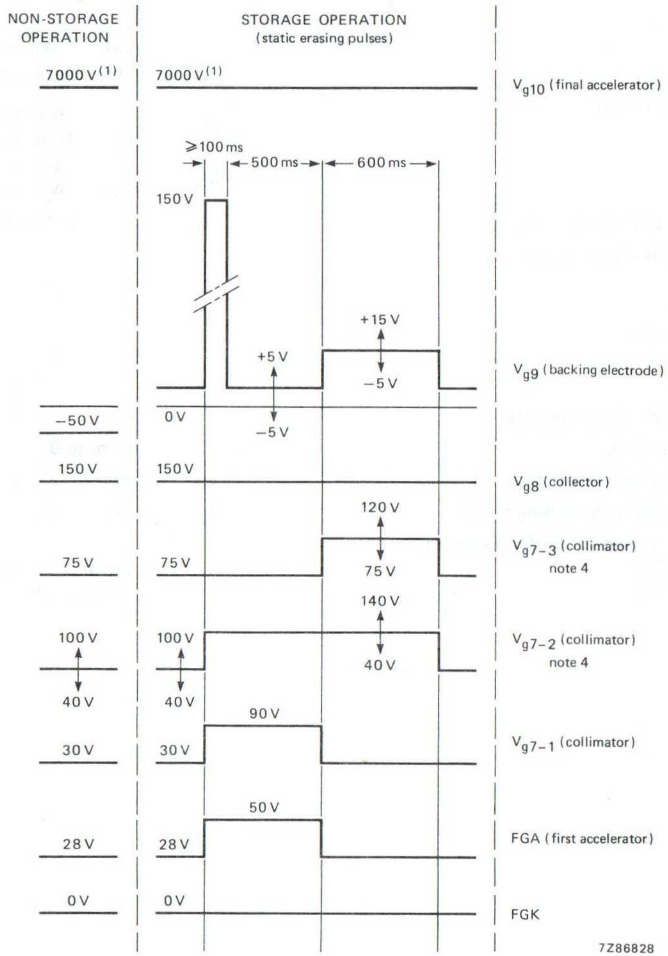

Fig. 9 Diagram of non-storage and storage operation.

(1) With respect to FGA.