INSTRUMENT CATHODE-RAY TUBE

14 cm-diagonal rectangular flat-faced direct-view storage tube with split-beam writing gun, variable persistence and internal graticule, intended for oscilloscope applications.

QUICK REFERENCE DATA

Final accelerator voltage	V_{g10} (ℓ)	8,5 kV
Useful scan (10 x 8 divisions of 9 mm)		90 x 72 mm
Deflection coefficient		
horizontal	M_x	9,5 V/div
vertical, system 1	M_y'	8,5 V/div
vertical, system 2	M_y''	8,5 V/div
Overlap of the systems		100 %
Writing speed		1,25 div/μs

OPTICAL DATA

Screen	metal-backed phosphor	
type	GH, colour green	
persistence, non-store mode	medium short	
persistence, store mode	variable	
Useful screen dimensions	min.	90 x 72 mm
Useful scan		
horizontal	min.	90 mm
vertical (each system)	min.	72 mm
overlap		100 %
Spot eccentricity		
in horizontal direction	max.	6 mm
in vertical direction	max.	9 mm

The scanned raster can be aligned with the internal graticule by means of correction coils fitted around the tube by the manufacturer.

HEATING

Writing section

Indirect by AC or DC; parallel supply		
Heater voltage	V_f	6,3 V
Heater current	I_f	300 mA

Viewing section

Indirect by DC; parallel supply		
Heater voltage	V_f'	6,3 V
Heater current	I_f'	300 mA
Heater voltage	V_f''	6,3 V
Heater current	I_f''	300 mA

MECHANICAL DATA

Mounting position

The tube should not be supported by the base alone 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.

Net mass	approx.	1,1 kg
Base	14 pin, all glass	
Dimensions and connections		
See also outline drawing		
Overall length (socket included)	max.	445 mm
Face dimensions	max.	100 x 120 mm
Accessories		
Socket (supplied with tube)	type	55566
Side contact connector (16 required)	type	55561
Small ball contact connector (3 required)	type	4022 102 21590
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 beams, hence a low impedance deflection plate drive is desirable.

Angle between x and y traces, each beam	90°	
Angle between x-trace and x-axis of the internal graticule	0°	
Angle between corresponding y-traces at the centre of the screen	max.	45′

CAPACITANCES

Writing section

x_1 to all other elements except x_2	$C_{x1(x2)}$	6,5 pF
x_2 to all other elements except x_1	$C_{x2(x1)}$	6,5 pF
y_1' to all other elements except y_2'	$C_{y1'(y2')}$	5 pF
y_2' to all other elements except y_1''	$C_{y2'(y1')}$	6 pF
y_1'' to all other elements except y_2''	$C_{y1''(y2'')}$	6 pF
y_2'' to all other elements except y_1''	$C_{y2''(y1'')}$	5 pF
x_1 to x_2	$C_{x1\,x2}$	2,5 pF
y_1' to y_2'	$C_{y1'y2'}$	0,6 pF
y_1'' to y_2''	$C_{y1''y2''}$	0,6 pF
g_1 to all other elements	C_{g1}	5,5 pF
k to all other elements	C_k	4,5 pF

Viewing section

g_1' to all other elements	$C_{g1'}$	5,5 pF
g_1'' to all other elements	$C_{g1''}$	5,5 pF
k' to all other elements	$C_{k'}$	5 pF
k'' to all other elements	$C_{k''}$	5 pF
g_7 to all other elements	C_{g7}	45 pF
g_9 to all other elements	C_{g9}	75 pF

DIMENSIONS AND CONNECTIONS

Dimensions in mm

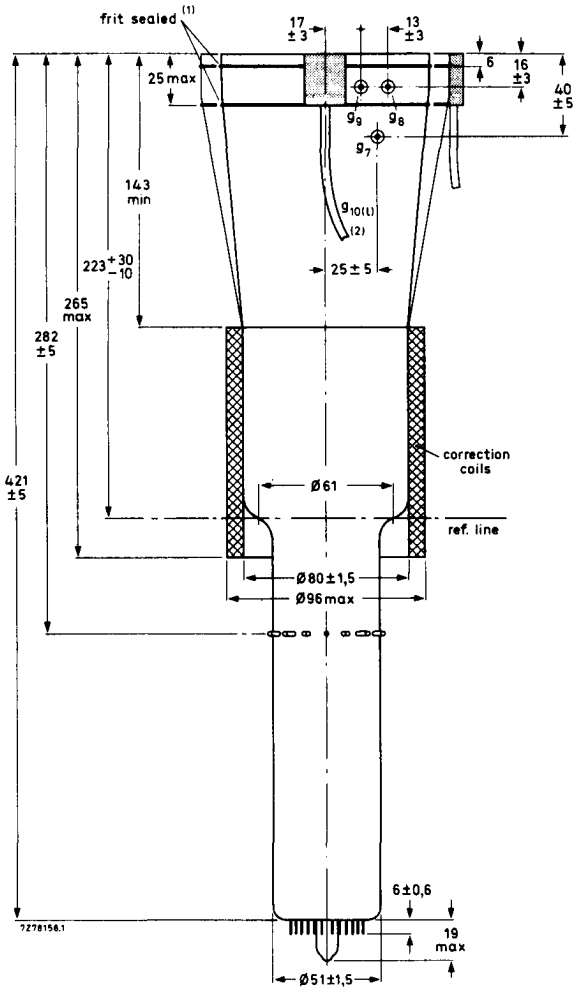

Fig. 1 Outlines.

(1) The bulge at the frit seal may increase the indicated maximum dimensions (Fig. 3) by not more than 3 mm.

(2) Minimum length of cable: 420 mm.

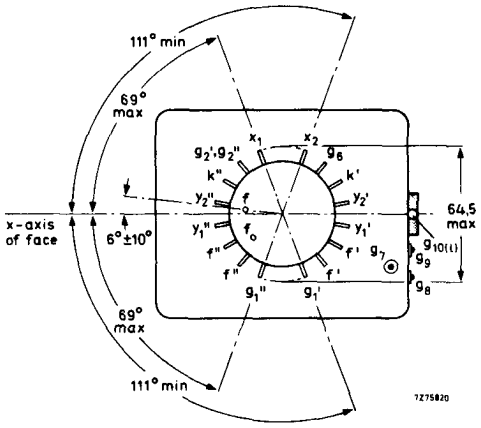

Fig. 2 Bottom view and side-contact arrangement.

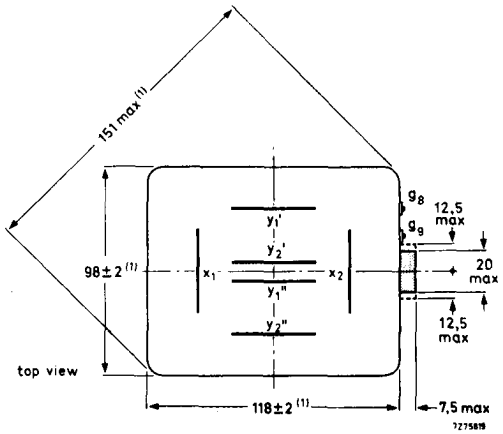

Fig. 3 Top view.

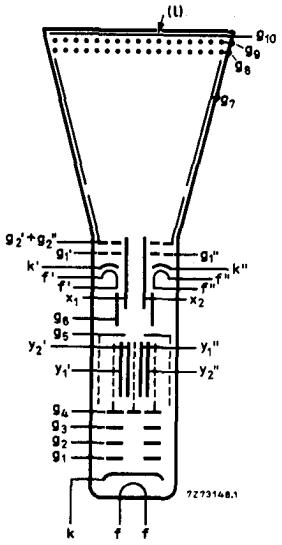

Fig. 4 Electrode configuration.

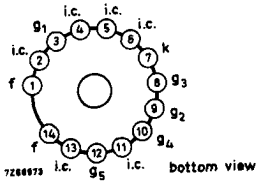

Fig. 5 Pin arrangement; bottom view.

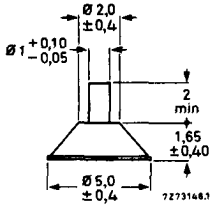

Fig. 6 Detail of side contact.

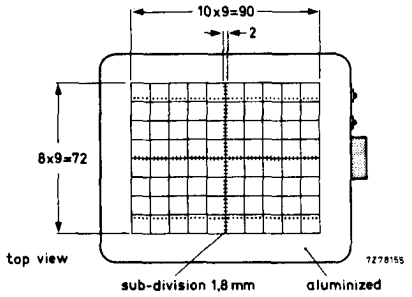

Fig. 7 Internal graticule.
Colour: brown-black;
line width: 0,15 mm;
dot diameter: 0,3 mm.

TYPICAL OPERATION

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
Astignatism control electrode voltage	V_{g4}	1500 ± 75	V	
Focusing electrode voltage	V_{g3}	400 to 650	V	
First accelerator voltage	V_{g2}	1500	V	
Control grid voltage for visual extinction of focused spot	V_{g1}	−40 to −80	V	

Viewing section (voltages with respect to viewing gun cathode k' and k'')

Final accelerator voltage	$V_{g10(\ell)}$	7050	V	note 1
Backing electrode voltage,				
storage operation	V_{g9}	1	V	
non-storage operation	V_{g9}	−35	V	
Collector voltage	V_{g8}	150	V	
Collimator voltage	V_{g7}	30 to 120	V	note 3
First accelerator voltage	$V_{g2'}$, $V_{g2''}$	50	V	note 4
Control grid voltage for cut-off	$V_{g1'}$, $V_{g1''}$	−30 to −70	V	
Cathode current (each viewing gun)	$I_{k'}$, $I_{k''}$	0,4	mA	

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, system 1	$M_{y'}$		8,5	V/div	
		max.	9,5	V/div	
vertical, system 2	$M_{y''}$		8,5	V/div	
		max.	9,5	V/div	
Line width at the centre of the screen	l.w.		0,40	mm	note 5
Writing speed in store mode		greater than	125	div/ms	note 6
Storage time		greater than	1,5	min	note 7
Deviation of linearity of deflection		max.	2	%	note 8
Geometry distortion		see note 9			
Grid drive for 5 μA beam current, per system		approx.	30	V	

LIMITING VALUES (Absolute maximum rating system)

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

Final accelerator voltage	$V_{g10(\ell)}$	max.	9500 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
Average grid drive		max.	30 V

Viewing section (voltages with respect to viewing gun cathodes k' and k'' unless otherwise specified)

Final accelerator voltage	$V_{g10(\ell)}$	max.	8000 V
		min.	5500 V
Backing electrode voltage, storage operation	V_{g9}	max.	5 V
		min.	0 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}	max.	200 V
		min.	0 V
First accelerator voltage	$V_{g2'}$, $V_{g2''}$	max.	60 V
		min.	40 V
Cathode to heater voltage			
positive	$V_{k'f'}$, $V_{k''f''}$	max.	125 V
negative	$-V_{k'f'}$, $-V_{k''f''}$	max.	125 V
Control grid voltage			
positive	$V_{g1'}$, $V_{g1''}$	max.	0 V
negative	$-V_{g1'}$, $-V_{g1''}$	max.	200 V

NOTES

1. These values are valid at cut-off of both viewing (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 adequately dimensioned RC-network must be connected in series with the screen terminal lead (Fig. 8).

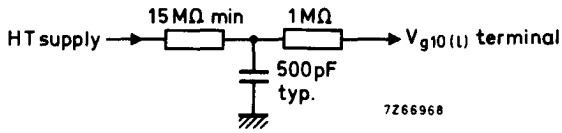

Fig. 8.

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. The collimator electrode voltage should be adjusted for optimum uniformity of background illumination.
4. The voltage $V_{g2'}$, $V_{g2''}$ should be equal to the mean x-plate potential.
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 = 5 μA per system (measured against 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 total graticule area, with the exception of maximum 5% in each corner. The writing speed can be increased to approx. 1,25 div/μs if some background is tolerated.
7. The storage time is defined as the time required for the brightness of the unwritten background to rise from just zero brightness (viewing-beam cut-off) to 10% of saturated brightness. At reduced intensity (by pulsing the flood beams) the storage time can be increased.
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 88 mm x 70 mm and 84,8 mm x 67,6 mm is aligned with the electrical x-axis of the tube. With optimum corrections applied, a raster will fall between these rectangles.

CORRECTION COILS

General

The L14-131GH/55 is provided with a coil unit (see Fig. 9) consisting of:

1. A pair of coils L3 and L4 which enable the angle between the x and y-traces at the centre of the screen to be made exactly 90° (orthogonality correction).
2. A pair of coils L1 and L2 for image rotation which enable the alignment of the x-trace with the x-lines of the graticule.

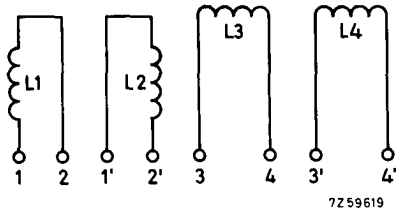

Fig. 9 Diagram of coil unit.

Orthogonality (coils L3 and L4)

The current required under typical operating conditions without a mu-metal shield being used is max. 20 mA for complete correction of orthogonality. It will be 30% to 50% lower with shield, depending on the shield diameter. The resistance of the coil is approx. 225 Ω.

Image rotation (coils L1 and L2)

The image rotation coils are wound concentrically around to the tube neck. Under typical operating conditions 22 ampere-turns are required for maximum rotation of 5°. Both coils have 850 turns. This means that a current of max. 12,5 mA per coil is required which can be obtained by using a 12 V supply when the coils are connected in series or a 6 V supply when they are in parallel.

Connecting the coils

The coils have been connected to 8 solder tags according to Fig. 10.

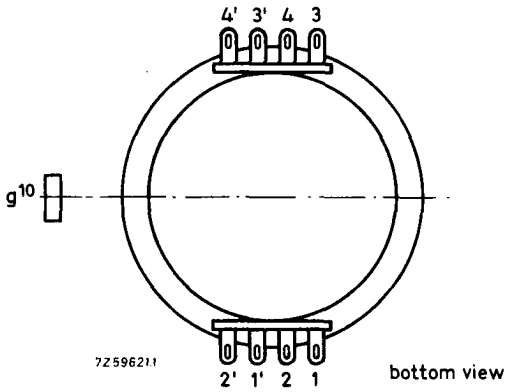

Fig. 10 Bottom view.

With L3 and L4 connected in series according to Fig. 11 a current in the direction indicated will produce a clockwise rotation of the vertical trace and an anti-clockwise rotation of the horizontal trace.

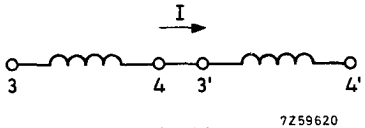

Fig. 11.

BEAM CENTRING MAGNET

Inherent to the split-beam system a slight difference between the two beam currents can occur after splitting, resulting in different intensities of the two traces. In order to equalize the beam currents, a beam centring magnet should be mounted near the base of the gun and adjusted for the required field direction and field strength.

OPERATING NOTES

Modes of operation

Store mode

a. Dynamic erasure (variable persistence).

Dynamic erasure can be achieved by applying erasing pulses of positive polarity to the backing electrode. The pulse amplitude required is approximately 9 V (< 15 V) and the persistence of a stored display can be controlled by varying the duty factor of these pulses.

b. Static erasure.

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, the backing electrode should first be connected to the collector electrode voltage and then returned to its original potential for about 100 ms; after that, an erasing pulse of positive polarity and a duration of not less than 300 ms should be applied. For the adjustment of the amplitude of this pulse see Procedure of adjustment.

Non-store mode

For non-store operation, it is sufficient to make the backing electrode about 35 V negative with respect to the viewing gun cathodes. 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. Care should be taken, especially when switching from store mode to non-store mode, that excessive writing beam current is avoided, as otherwise the storage layer may be damaged.

Procedure of adjustment

a. Adjust the cathode current of each viewing gun to 0,4 mA by means of its control grid voltage.

b. Adjustment of the erasing pulse amplitude (static erasure)

The pulse amplitude should be just sufficient to suppress any background illumination at the centre of the display area (this adjustment should be done under low ambient light conditions). Data on storage time and maximum writing speed are based on erasure to "just black". A larger pulse amplitude (erasure to "blacker than black") yields a longer storage time at the expense of maximum writing speed. On the other hand, writing speed can be increased if some background illumination is tolerated. To erase to "just black" the amplitude of this pulse is approximately 9 V.

c. Adjustment of the collimator voltage.

With dynamic erasing pulses applied and a persistence control setting that yields a convenient background illumination intensity, the collimator voltage is adjusted for optimum background uniformity. This voltage will be approximately 80 V with respect to the viewing gun cathode potential. If this voltage will be approximately 80 V with respect to the viewing gun cathode potential. If this voltage is too high or too low, there is a decrease of intensity at the four corners or at the centres of the vertical edges of the display area respectively.