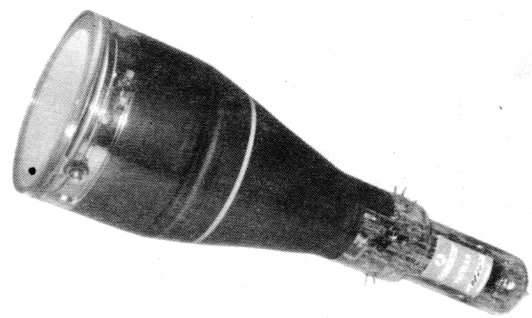
TEI 1323
DIRECT VIEW STORAGE TUBE
FOR OSCILLOSCOPIC APPLICATIONS

- 8 x 10 DIVISIONS GRATICULATED FLAT FACE
- HIGH WRITING SPEED : UP TO 10 mm/μs
- LONG STORAGE TIME : UP TO 2 HOURS

The TEI 1323 is a direct view storage cathode ray tube with a 102 mm (4") useful screen diameter designed for high frequency (50 MHz bandwidth) storage oscilloscope use.

The flat circular screen of P 31 type includes a graticule (90 mm x 72 mm) having the pattern shown in the dimensional outline. The two flood guns symetrically located with respect to tube axis enable to obtain bright display of information over the entire useful area. The on-axis writing gun features high resolution and high deflection sensitivity without geometrical distortion ; it is electrostatically focused and deflected.



The horizontal and vertical deflection voltages are supplied through pins located on tube neck which assure shorter connections with resulting in significant reduction of plate capacitances.

This tube is suitable for storage oscilloscope services with controllable viewing time and controllable persistence. In addition, it will operate as a P.D.A. oscilloscope C.R.T. without storage.

TYPICAL PERFORMANCES

Writing speed *	max.	10	mm/μs
Line width at center		0. 4	mm
Viewing time*	adjustable up to	60	mn
Erasing time*	max.	0. 5	s
Brightness * (screen voltage 8 kV)	adjustable up to	1500	cd/m^2

* *Those characteristics can be varied within wide ranges of values depending on specific application. In order to achieve full capability of the tube, please refer to " operating modes " described hereafter.*

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GENERAL CHARACTERISTICS

Electrical

Flood guns :			
Number		2	
Heater voltage		6.3 d.c.	V
Heater current		2 x 0.3	A
Writing gun :			
Heater voltage		6.3 a.c.	V
Heater current		0.6	A
Focusing method		Electrostatic	
Deflection method		Electrostatic	
Interelectrode capacitances :			
g1 to all other electrodes	max.	15	pF
k to all other electrodes	max.	6	pF
x1 or x2 to all other electrodes	max.	8	pF
y1 or y2 to all other electrodes	max.	5	pF
x1 to x2	max.	4	pF
y1 to y2	max.	3	pF

Optical

Phosphor :	
Type	P31 aluminized
Fluorescence	Green
Phosphorescence	Green
Faceplate	Flat

Mechanical

Minimum useful diameter		102 mm (4")
Overall length	max.	450 mm (17.7")
Base (14 pins)		UTE 14 C 25 (IEC 67 - I - 46 a)
Mounting position		any
Weight, approximate		1 kg (2.4 Lb)

OPERATING CONDITIONS

Maximum values (absolute ratings)

Unless otherwise stated, voltages are given with respect to ground.

FLOOD GUNS

Heater h' voltage	5.7 to	6.9	d.c.	V
Cathode k' voltage		0		V
Grid g'1 voltage (control grid or Wehnelt)	0 to	−200		V
Grid g'2 voltage (accelerating electrode) max.		200		V
Grid g'3 voltage (collimating electrode) max.		200		V
Grid g'5 voltage (collecting electrode) max.		300		V
Grid g'6 voltage (backing electrode) max.	−50 to	+20		V
Viewing screen g'7 voltage max.		9		kV
Peak heater to cathode voltage :				
- heater negative with respect to cathode max.		125		V
- heater positive with respect to cathode max.		125		V

WRITING GUN

Heater h voltage	5.7 to	6.9	a.c.	V
Cathode k voltage (negative value) max.		2.5		kV
Grid g1 voltage** (control grid or Wehnelt)	0 to	−200		V
Grid g2 voltage (accelerating electrode) max.		200		V
Grid g3 voltage (beam centering electrode) max.		200		V
Grid g4 voltage** (focusing electrode) max.		1.2		kV
Grid g5 voltage (astigmatism) max.		200		V
Grid g6 (geometry) max.		200		V
Peak heater to cathode voltage :				
- heater negative with respect to cathode max.		125		V
- heater positive with respect to cathode max.		125		V

** *With respect to writing gun cathode.*

Typical operation

Unless otherwise stated, voltages are given with respect to ground.

FLOOD GUNS

Heater voltage		6.3	d.c.	V
Cathode h' voltage		0		V
Grid g'1 voltage	−30 to	0		V
Grid g'2 voltage		+40		V
Grid g'3 voltage	50 to	90		V
Grid g'5 voltage		200		V
Grid g'6 voltage :				
- store mode	0 to	+5		V
- non-store mode		−50		V
Viewing screen g'7 voltage		8		kV

WRITING GUN

Heater h voltage		6.3	a.c.	V
Cathode k voltage		−1800		V
Grid g1 voltage** (for cut-off)	−100 to	−40		V
Grid g2 voltage		+40		V
Grid g3 voltage	0 to	80		V
Grid g4 voltage**	200 to	600		V
Grid g5 voltage	0 to	80		V
Grid g6 voltage	0 to	80		V

** *With respect to writing gun cathode.*

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PHYSICAL DESCRIPTION

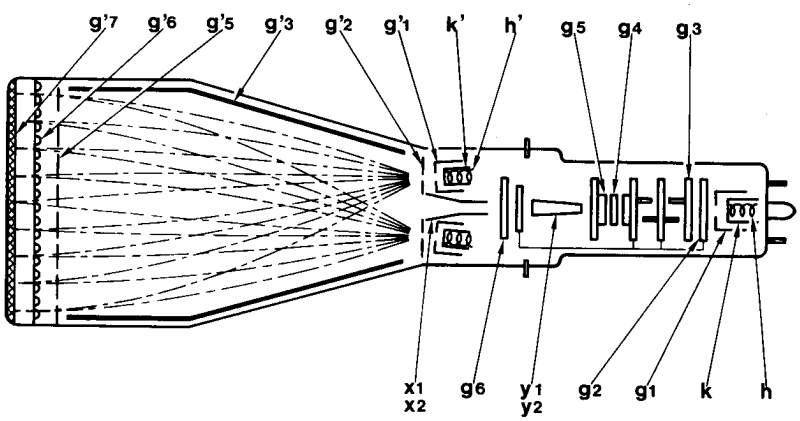
The TEI 1323 consists of 4 basic assemblies :

1 - The storage unit
the component of which are a collecting electrode and a fine metallic mesh called the backing electrode upon which the dielectric storage surface is deposited.

2 - The viewing screen
made of P31 phosphor, provides the visual output.

3 - The writing gun
located in the neck of the tube generates a high velocity electron beam electrostatically focused and deflected.

4 - The flood guns
produce wide angle low velocity electron beams which flood the storage mesh normally and at a constant current density over the useful area owing to the collimating electrode.



Flood guns

h' - heater
k' - cathode
g'1 - wehnelt
g'2 - accelerating electrode
g'3 - collimating electrode

Storage unit screen

g'5 - collecting electrode
g'6 - backing electrode
g'7 - viewing screen

Writing gun

h - heater
k - cathode
g1 - wehnelt
g2 - accelerating electrode
g3 - beam centering electrode
g4 - focusing electrode
g5 - astigmatism
y1 y2 - vertical deflection plates
g6 - geometry
x1 x2 - horizontal deflection plates

OPERATING MODES

Depending on the specific applications, the TEI 1323 can be used : - in non-store mode
- in store mode

1 - Non-store mode

The tube can be operated without storage in the same way as a conventional C.R.T. ; for doing so, a voltage of −50 V is to be applied on the backing electrode g'6. The flood gun electrons are repelled back by the storage surface and cannot reach the viewing screen while the high energy writing electrons pass through the backing electrode and can display information on the viewing screen.

It is to notice that, in this mode, the flood gun electron beams should be normally established.

Conventional oscilloscopic performances

Resolution (note 1)	0.4	mm
Spot position, focused and undeflected (deviation from center)	9	mm
Deflection characteristics :		
x plates deflection factor	10 ± 10 %	V per division
y plates deflection factor	6 ± 10 %	V per division
Useful screen area (internal graticule) :		
x axis (10 divisions of 9 mm)	90	mm
y axis (8 divisions of 9 mm)	72	mm
Trace alignment :		
angle between x and y traces	89 to 91	°
angle between x trace and horizontal axis of graticule (note 2)	±5	°
Pattern distortion (note 3)		

NOTES

1 - Line width measured for beam current of 5 μA by the shrinking raster method, in non-store mode.

2 - Without magnetic correction.

The parallelism between x trace and xx' axis on graticule can be obtained by adjusting the current of a magnetic flat coil located around the bulb.

3 - An overlay consisting of two concentric squares of 72 x 72 mm and 70 x 70 mm is centered on the face of the tube. An inscribed line should lie between this interval of 1 mm. Because of the trace width, one single line edge should be taken into account.

2 - Store mode

Erasing

Erasure of stored information is made by charging the storage surface in a negative direction. This is done by the flood gun whose low beam energy results in secondary emission ratio less than unity. A positive pulse ΔV is applied to the backing electrode. Due to capacitive coupling, the storage surface potential will rise and shifted to the same positive potential ΔV ; the flood electrons are attracted by the storage surface and charge it toward flood gun cathode potential i.e. OV. When the pulse ΔV is removed from backing electrode the storage surface potential drops by the same value by capacitive coupling and the dielectric is uniformly carried to a negative potential $-\Delta V$: the flood gun electrons can not reach the screen and the stored information is completely erased.

Writing

In writing operation, the high energy writing beam scans the storage surface and creates positive charges pattern by secondary emission from the dielectric material (secondary emission ratio greater than unity). Each storage element scanned by the modulated writing beam is brought to a less negative potential and let pass through the flood electrons.

Viewing

The amount of flood electrons which pass through each storage element is depending on the local potential of each point. Thus an information can be visualized on the viewing screen which corresponds to the charge pattern written on the storage surface.

Storage performances :

a - CONTROLLABLE VIEWING TIME

Although the viewing is not destructive, the retention or viewing time is limited by residual gas molecules in the tube. Due to collision between flood electrons and these molecules, positive ions are formed which charge gradually the storage surface in a positive direction with resulting in gradual brightening of display background and corresponding loss of display constrast.

Nevertheless, it is possible to extend the viewing time by employing flood gun pulse techniques. In this mode, ion charging rate is decreased by reducing the average electron density of flood beam in exchange of decreasing light output.

The table shown below gives the storage characteristics as a function of the writing speed and the light output.

	Writing speed 1 mm/μs	Writing speed 10 mm/μs
Storage (brightness : 800 cd/m2)	6 mn	2 mn
Long storage (brightness : 40 cd/m2)	120 mn	40 mn

b - CONTROLLABLE PERSISTENCE

Erasure can be accomplished by a single pulse as described above. If persistence is to be controlled, gradual erasure can be performed by applying a train of short pulses to the backing electrode g'6. Depending on rate and duration of pulses, required visual output decay can be obtained. The viewing time can decrease down to 200 ms from the values indicated in the table above.

c - LONG TERM STORAGE

In this mode, the flood beams are established only for viewing then removed. Written information is not degraded by ion charging and can be stored for up to many days.

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OPERATIONAL RECOMMENDATIONS

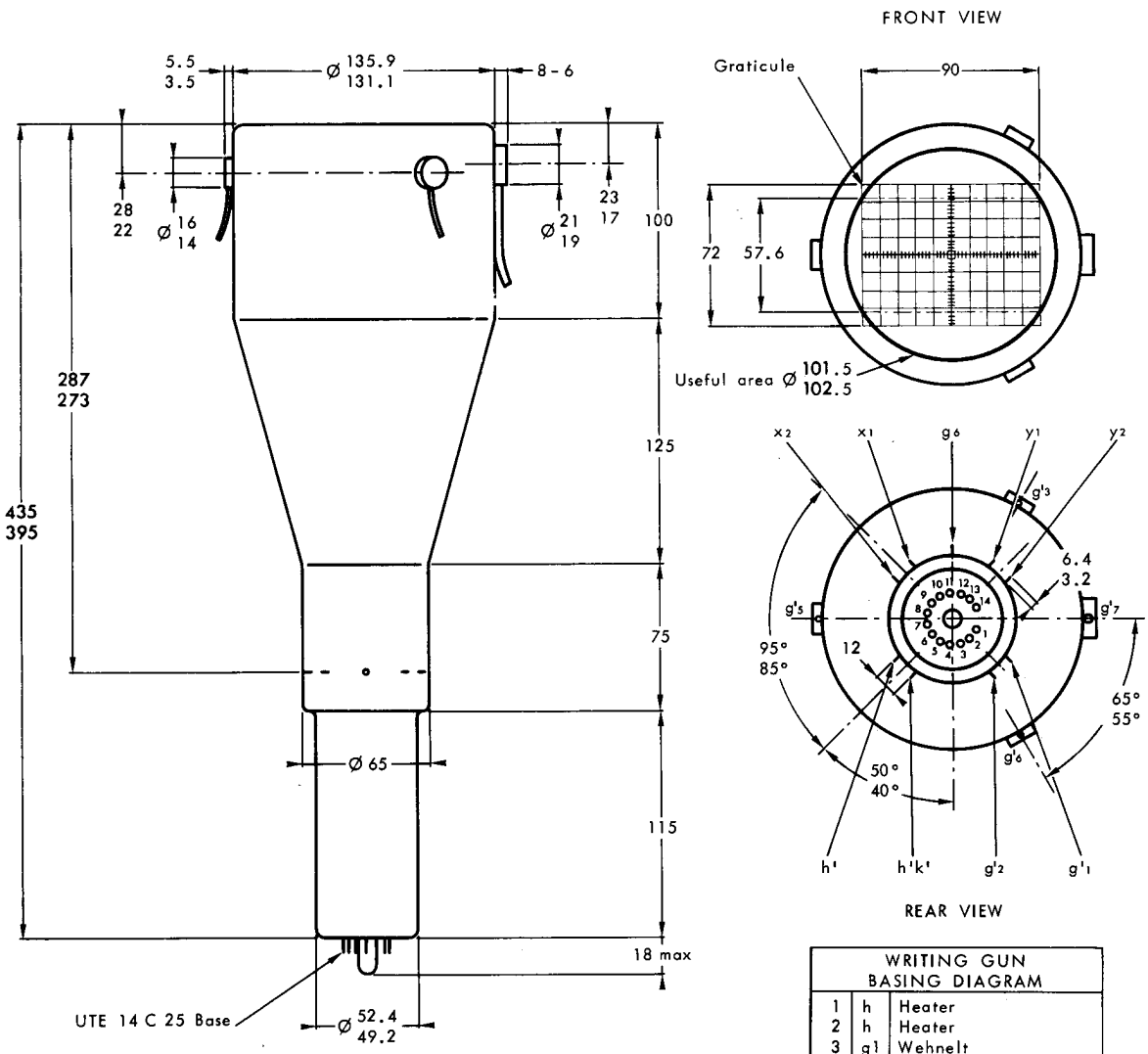
1 - The writing gun can not be allowed to write continuously without appropriate erasure otherwise the storage surface may be damaged.

2 - In the non-store mode (normal C.R.T. operating) the flood gun electron beams should be normally established otherwise the dielectric surface will be brought to a high potential detrimental to tube life.

3 - Magnetic shield is necessary to prevent stray magnetic fields altering the trajectories of low velocity flood beams.

4 - The tube should be handled screen upwards to avoid particles falling on the storage elements.

OUTLINE DRAWING



WRITING GUN BASING DIAGRAM		
1	h	Heater
2	h	Heater
3	g1	Wehnelt
4	g2	Accelerating electrode
5	g1	Wehnelt
6	-	
7	g4	Focusing electrode
8	g3	Beam centering
9	-	
10	g1	Wehnelt
11	-	
12	g5	Astigmatism
13	g1	Wehnelt
14	k	Cathode
	g6	Geometry
x1	x2	Horizontal deflection plates
y1	y2	Vertical deflection plates

FLOOD GUNS AND STORAGE UNIT	
h'	Heater
h'k'	Heater cathode
g'1	Wehnelt
g'2	Accelerating electrode
g'3	Collimating electrode
g'5	Collecting electrode
g'6	Backing electrode
g'7	Viewing screen

Dimensions in mm.