



THOMSON-CSF

DIVISION TUBES ELECTRONIQUES

TH 9303 IMAGE-INTENSIFIER TUBE WITH AUTOMATIC BRIGHTNESS CONTROL

- RUGGED CONSTRUCTION
 - EXTENDED RED PHOTOCATHODE, ϕ 25 mm
- VERY HIGH LUMINANCE GAIN : 25 000 cd/m²/lux (80 000 fL/fc)
 - VIEWING SCREEN OF 25-mm DIAMETER
- INTEGRAL OSCILLATOR AND MULTIPLIER
 - ELECTROSTATIC FOCUS
 - THREE CASCADED STAGES
 - FIBER-OPTICS FACEPLATES

The TH 9303 is a 25-mm high performance image-intensifier tube designed to meet the most stringent military specifications.

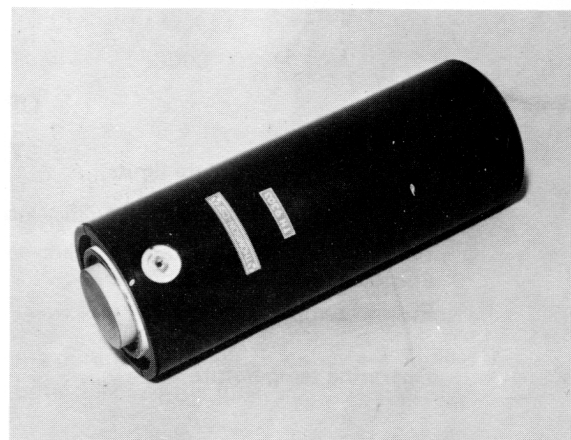
This tube is a rugged, three-cascade-stage, electrostatic-focus image intensifier, having flat fiber-optics input and output faceplates.

It is supplied with an integral high-voltage supply, potted in a silicone compound inside a precision plastic cylinder, with mechanical references for tube mounting.

The oscillator requires a dc voltage of 6.25 V (Note 1). Each stage operates with approximately 15 kVdc from the multiplier.

To avoid dazzling the observer, the design of the supply is such that luminance gain and output brightness vary with input illumination. This gain is constant up to 10⁻² lux and decreases from 10⁻² to 10² lux incident illumination. The fast-recovery (3 seconds) characteristics of the tube allow an almost uninterrupted efficient observation whatever the illumination conditions may be.

The photocathode is of S20 ER type (extended red sensitivity) and the yellow-green fluorescent P20 phosphor exhibits a high energy efficiency.



GENERAL DATA

Mechanical

Overall length	194 mm
Maximum diameter	69.8 mm
Weight, approximate	950 g
Mounting position	Any

Electrical

Focusing method	Electrostatic
Type	Three module-diodes (coupling in cascade)



Optical

PHOTOCATHODE

Type	S20 ER (extended red sensitivity)
Spectral response	See Figure 1
Minimum useful diameter	23 mm
Input face :	
- shape	Flat to within 2.5 μ
- diameter	35.55 mm
- nature	Fiber - optics

SCREEN

Phosphor	P20, aluminized
Spectral distribution	See Figure 2
Minimum useful diameter	25 mm
Fluorescence	Yellow-green
Phosphorescence	Yellow-green
Persistence	Medium
Output face :	
- shape	Flat to within 2.5 μ
- diameter	32.90 mm
- nature	Fiber - optics with external flat glass protective window

OPERATING CONDITIONS

Maximum ratings (absolute limits)

Battery dc input voltage (for 6.25 V nominal) (Note 1)	max.	6.5	V
Battery current	max.	40	mA
Photocathode illumination	max.	100	lux
Storage temperature	max.	+ 68	$^{\circ}$ C
	min.	-54	$^{\circ}$ C
Operating temperature	max.	+ 52	$^{\circ}$ C
	min.	-54	$^{\circ}$ C

TYPICAL OPERATION

Operational conditions

Ambient temperature	23 \pm 3	$^{\circ}$ C
Battery dc input voltage (Note 1)	6.25	V
Battery current (Note 2)	30	mA
Photocathode voltage	0	V
Color temperature of incident light source	2854	$^{\circ}$ K

Performance

	Min.	Typical	Max.	Units
Photocathode sensitivity (Note 3)				
- luminous at 2854 °K	175	225	—	μA/lm
- radiant at 800 nm	8	15	—	mA/W
at 850 nm	3	10	—	mA/W
Conversion factor (Note 4)	10 ⁴	2.5 x 10 ⁴	—	cd/m ² /lux
Equivalent background illumination (Note 5)	—	—	2 x 10 ⁻⁷	lux
Resolution :				
- paraxial (Note 6)	25	30	—	lp/mm
- peripheral (Note 7)	23	25	—	lp/mm
Modulation transfer function (Figure 3) :				
- for 5 lp/mm	85	—	—	%
- for 10 lp/mm	65	—	—	%
- for 15 lp/mm	35	—	—	%
Magnification:				
- paraxial (Note 8)	0.82	0.88	—	
- peripheral (Note 9)	—	1.02	1.06	
Distortion (Note 10)	—	14	20	%
Image alignment (Note 11)	—	0.4	0.8	mm
Screen luminance	—	—	500	cd/m ²
Luminance uniformity (Note 12)	—	—	4	
Tube life	—	3000	—	h

ENVIRONMENTAL TESTS

The TH 9303 is designed to withstand the following environmental tests without mechanical damage or electrical failure. After completion of the tests the tube will meet all the performance characteristics specified above.

SHOCK TESTS

The tube is subjected to a 75 g peak half-sine-wave shock of 6 ±2 ms duration. Six shock pulses are applied in each of two perpendicular directions, one of which shall be parallel to the optical axis of the tube.

VIBRATION TESTS

The tube is vertically mounted with the photocathode end up and is subjected to sine wave vibrations of 1.30 mm amplitude for a vibration cycle having a duration of 1 minute during which time the frequency is varied from 10 to 55 Hz and back to 10 Hz.

Ten frequency sweeps are performed in each of three mutually perpendicular directions, one of which shall be parallel to the optical axis of the tube.

TEMPERATURE TESTS

The tube is subjected to a temperature cycle within the + 52 °C to -54 °C range and is held at these maximum and minimum values during 2 hours.

NOTES

- 1 - On request, the tube can be factory-adjusted for use with batteries producing a nominal voltage of 6.75 V.
- 2 - This current is constant between 10^{-4} and 100 lux.
- 3 - The photocathode sensitivity is measured on a surface of 3 cm^2 with a flux of 0.01 lumen.
At 800 nm and 850 nm, the radiant sensitivity is measured with the incident light being filtered before falling on the photocathode.
At 800 nm the interposed filter delivers $280 \mu\text{W}/\text{lm}$ and at 850 nm, it delivers $260 \mu\text{W}/\text{lm}$.
- 4 - The conversion factor or luminance gain is measured at 10^{-4} lux incident illumination for a photocathode surface of 3 cm^2 . It is the ratio of the output luminance in cd/m^2 to the input illumination in lux.
- 5 - Equivalent background illumination is the value of input illumination required to give an increase in screen luminance equivalent to the background luminance.
- 6 - The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated as a line pair.
Paraxial resolution is measured at the center of the photocathode.
- 7 - Peripheral resolution is measured at a distance of 10 mm from the optical axis of the tube.
- 8 - The center magnification M_c is defined as the ratio of the distance of two image points on the screen to the distance of the two corresponding points on the photocathode. The points on the photocathode are separated by a distance of 2 mm centered on the tube axis.
- 9 - The peripheral magnification M_p is measured as is M_c , except that the distance between two points of the photocathode is 20 mm.
- 10 - The per-cent distortion D is defined by the equation :
$$D = \frac{M_p - M_c}{M_c} \times 100$$
- 11 - A spot of 0.1 mm is produced at the center of the photocathode. The center of the image on the screen will fall within a circle centered on the optical axis and having a 0.8 mm diameter.
- 12 - Luminance uniformity is defined as the ratio of the maximum and minimum screen luminances over a 20-mm diameter concentric area on the image screen, for uniform photocathode illumination.

CATHODE AND SCREEN BLEMISHES

The size and quantities of blimishes are observed on the screen and shall not exceed the values shown in the table. The screen is viewed with the radiation level on the photocathode adjusted to obtain best blemish contrast.

Size of Blemishes	Number of Blemishes		
	Zone 1	Zone 2	Zone 3
$\geq 0.4 \text{ mm}$	0	0	0
0.25 mm to less than 0.4 mm	0	4	10
0.15 mm to less than 0.25 mm	0	12	26
0.08 mm to less than 0.15 mm	3	Min	Min
less than 0.08 mm	Min	Min	Min

"Zone 1" is defined as the area within a 7.5-mm diameter circle, concentric to the optical axis of the tube.

"Zone 2" is defined as the area bounded by a 7.5-mm diameter circle and a 20-mm diameter circle, both of which are concentric to the optical axis of the tube.

"Zone 3" is defined as the area bounded by a 20-mm diameter circle and a 24.5-mm diameter circle, both of which are concentric to the optical axis of the tube.

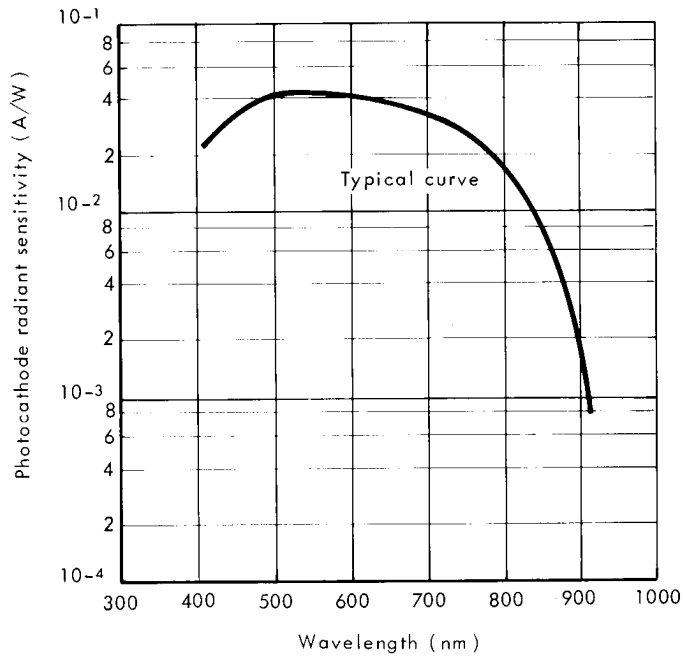


Figure 1 - S20 ER photocathode spectral response. (extended red sensitivity)

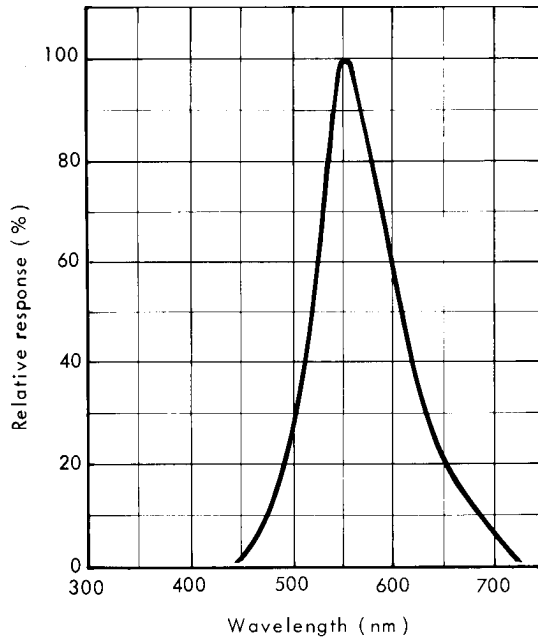


Figure 2 - Spectral efficiency characteristics of aluminized P20 phosphor screen.

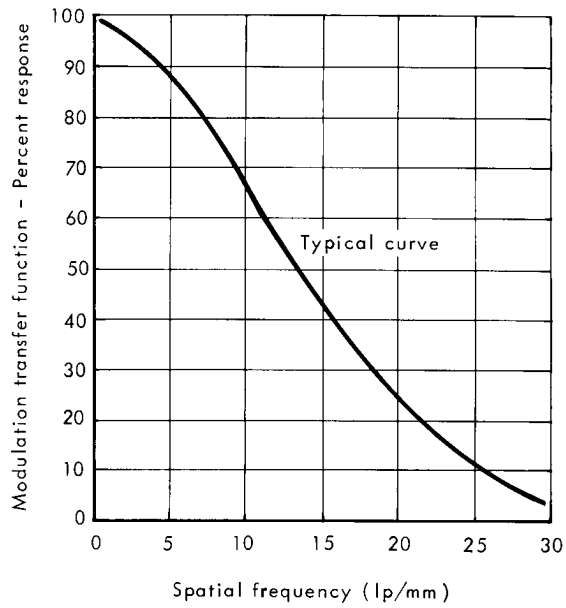


Figure 3 - Modulation transfer function.

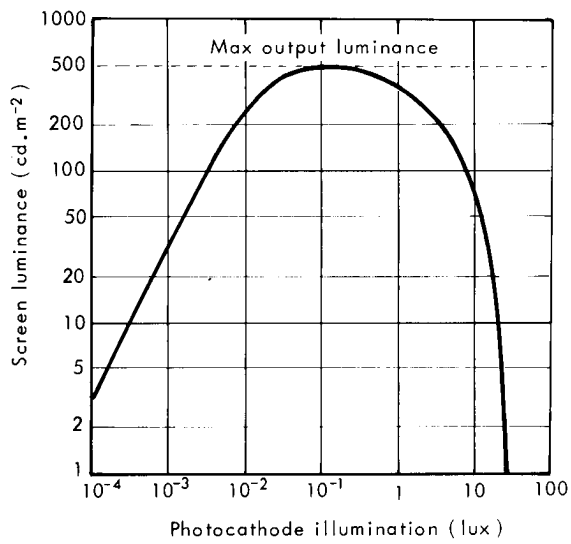
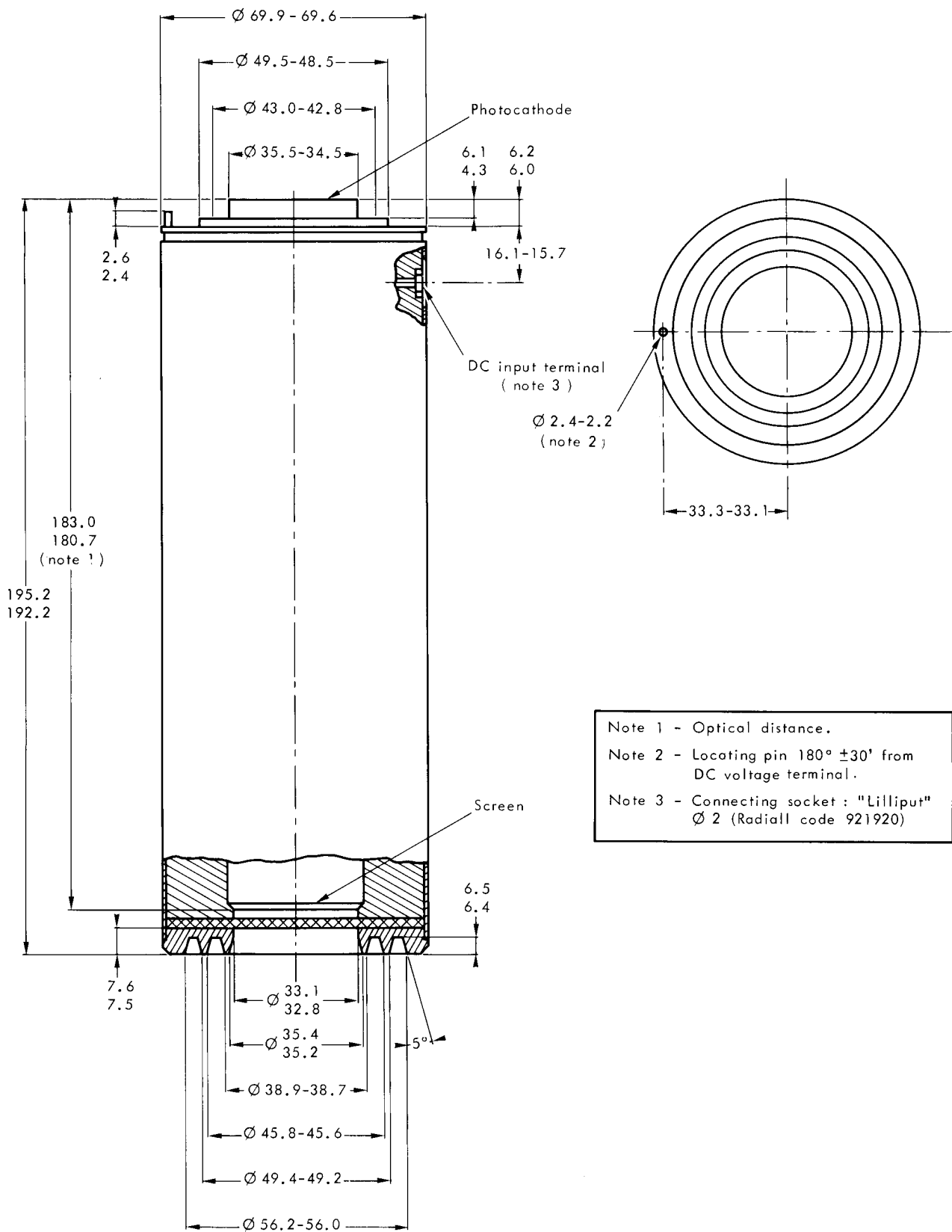
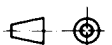


Figure 4 - Typical screen luminance as a function of photocathode illumination.

OUTLINE DRAWING



Dimensions in mm.



- Note 1 - Optical distance.
- Note 2 - Locating pin 180° ±30' from DC voltage terminal.
- Note 3 - Connecting socket: "Lilliput" Ø 2 (Radiall code 921920)



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