

TH 9432

X-RAY IMAGE INTENSIFIER TUBE

ELECTRONIC ZOOM *

- TRIPLE INPUT FIELD : 32 cm - 23 cm - 17 cm
- OUTPUT IMAGE NOMINAL DIAMETER : 24.5 mm
- HIGH RESOLUTION - HIGH CONTRAST
- LUMINANCE GAIN : $\times 10\,000$

The TH 9432 is an X-ray image intensifier tube which converts the X-ray pattern into a light image of high brightness and good contrast.

The X-ray beam emerging from the subject being examined first passes through the tube's input window, made up of special low absorption glass. Next, the X-rays reach the input fluorescent screen where the X-ray photons are converted to light photons. A photocathode, coupled to the input screen is excited by these light photons, which are thus converted to electrons. The emitted electrons are accelerated and focused by appropriate electric fields and then impinge on the output fluorescent screen. This screen's phosphor coating reconverts the electrons back to light photons providing an exceptionally bright output image. This brightness gain is obtained partly from the energy imparted to the electrons during their acceleration and partly from the reduction in diameter of the tube's output image as compared to the input image. In fact, this image is several thousand times brighter than would have been that of a conventional radioscopic screen substituted for the tube's input window.



Many improvements in the design of the TH 9432 have benefited from THOMSON-CSF wide experience and considerable expertise in the field of X-ray image intensifier tubes.

The TH 9432 uses the caesium iodide (CsI) base as the detector screen material which associates an improved absorption of the incident radiation to a fast time response.

The output screen uses a fluorescent material made of very fine crystals (in the order of the micron) ; thanks to a sophisticated technology, this screen allows to display a high resolution image of 24.5 mm diameter thus making the tube to match with the best quality optical devices presently available.

The P20 phosphor is selected in order that its spectral response coincides with the optimum correction range of the optical systems thus minimizing the reflections and loss of resolution and contrast in these optical systems ; on the other hand, the P20 phosphor is matched to 35 mm film, 100 or 70 mm spot films or to CCTV camera tubes.

The "dark output screen" also enables to minimize all light reflection (internal or due to the optical system) and thus improves the image contrast.

* Registered Trade Mark.

By a proper selection of electrode voltages, the TH 9432 can operate as an "Electronic Zoom" i.e. with adjustable magnification. The maximum field 32 cm (normal mode) is used when the overall resolution sought is not critical, for centering the subject for example, while the minimum field 17 cm or intermediate field 23 cm is selected for detailed examination. The "magnified modes" enable to reduce the input field and therefore to adapt the useful bandwidth containing the image information to the available bandwidth, the latter being limited by the "pass-band" of the information transmission channel. Thus, the tube permits to obtain higher resolution and better image contrast when operated in magnified modes.

The TH 9432 is designed to visualize radioscopic images with CCTV or to record images on film or large size spot film (100 mm). For the latter applications (movies or photos), the tube can be irradiated in pulse operation by high intensity and short duration X-rays (a few ms) without loss of resolution.

The TH 9432 is delivered with an integral housing which ensures the mechanical mounting on the equipment, the protection against stray magnetic field as well as the shielding against X-radiations.

Since the TH 9432 performs very high resolution, the power supply must be carefully designed and especially ripple voltages must not exceed 0.3 %.

The TH 9432 incorporates an automatic "active getter" which ensures a very high vacuum along tube's life avoiding the development of an ion spot or alteration of contrast and resolution.

GENERAL CHARACTERISTICS

Optical

Input screen diameter	32 ± 0.5			cm
Output image diameter	24.5 ± 0.5			mm
Input screen spectral response				X-rays
				30 to 250 kVp generator
Viewing screen :				
- type	P20 (λ max. = 520 nm)			
- fluorescence and phosphorescence	yellow - green			
Electrostatic focus - Inverted image :				
Operating modes	Normal	Magn. 1	Magn. 2	
Input field diameter	32	23	17	cm
Magnification	1/13	1/9	1/7	
Typical resolution (Note 2) :				
- central	32	36	40	lp/cm
- peripheral	24	28	32	lp/cm
Minimum contrast (Note 3) measured with JEDEC - penetrameter	2.5	2.5	2.5	%
Minimum conversion factor (Note 4)	100	50	30	cd/m ²
	or	500	250	150
				mR/s
				fL
				R/mn
Minimum luminance gain (Note 5)	10 000	5000	3000	
Maximum background luminance (Note 6)	0.06	0.06	0.06	cd/m ²
	or	0.02	0.02	fL
Maximum distortion (Note 7)	10	5	5	%
Maximum persistence at 10 ms (Note 8)	10	10	10	%

Mechanical (see Note 1 and Drawing)

In addition to the shielding function against stray magnetic field and X-radiations, the housing permits :

- the mechanical mounting of the tube on the equipment. The tube can be fixed either by the entrance plane or by the output plane.
- the precise mounting and positioning of the associated optical system.

Operating position	any
Shipment position	tube axis horizontal
Operating and storage temperature :	
- maximum	+ 50 °C
- minimum	+ 5 °C
Net weight, approx.	20 kg
Dimensions	see drawing

OPERATING CONDITIONS

Maximum ratings

Photocathode c voltage	0	V
Electrode g1 voltage	0.5	kV
Electrode g2 voltage	3.0	kV
Electrode g3 voltage	12.0	kV
Anode a voltage	32.0	kV
Active getter voltage :		
- anode g4	3.5	kV
- cathode k	0	V
Photocathode c maximum current (continuous operation)	1	μA
Electrode g1 maximum current	5	μA
Electrode g2 maximum current	1	μA
Electrode g3 maximum current	1	μA
Electrode g4 maximum current (after post-gettering operation)	10	μA
Anode a maximum current (without X radiation)	2	μA

Typical operation (see Starting Procedures)

Operating modes	Normal	Magn. 1	Magn. 2	
Input diameter for 24.5 mm output image	32	23	17	cm
Photocathode c voltage	0	0	0	V
Electrode g1 voltage*	100 to 200	100 to 200	100 to 200	V
Electrode g2 voltage*	0.5 to 1.0	0.5 to 1.0	0.5 to 1.0	kV
Electrode g3 voltage*	3.2	6.5	10.0	kV
Anode a voltage	30.0	30.0	30.0	kV
Active getter voltage :				
- anode g4	2.5 to 3.0	2.5 to 3.0	2.5 to 3.0	kV
- cathode k	0	0	0	V

Ripple voltages must not exceed 0.3 %.

* g1, g2, g3 voltages are given for an anode voltage of 30.0 kV.

STARTING PROCEDURES

Connections

All the connections necessary for tube supply (even for the anode) are made through flexible wires with reference marks.

A 10 Megohms resistance protecting the tube against discharge must be inserted in the anode circuit. Time constant thus produced with tube capacitance contributes to ripple voltage filtering.

In series between each voltage supply and corresponding tube connection, insert in the same way a few Megohms protective resistance.

Focusing adjustments

Voltages supplies can be applied to the electrodes in a short time but with a slope not exceeding 5 kV/ms.

Let tube at rest with voltages applied for potential stabilization before adjusting it. (10 s minimum).

Set a 2 mm spaced metallic wire mesh of 5/10 mm diameter or equivalent (stainless steel, copper) in front of the tube and apply X-rays beam.

For each selected operating mode, electrode g3 voltage must be predetermined, the value of which should be within the limits specified in typical operation.

Electrode g3 voltage being selected, adjust electrode g1 and g2 voltages within the specified range. The focusing adjustment shall be made as follows :

- Adjust g1 voltage in order to obtain an image as homogeneous as possible in luminance.
- Adjust g2 voltage in order to obtain the optimum resolution.
- Optimize g1 voltage if necessary.

Focusing adjustments are made respectively for "normal mode", "magnified mode 1" and "magnified mode 2".

REMARK - *Typical operation voltages correspond to selected operating mode of 32 cm - 23 cm - 17 cm. For particular use, any input field between 32 cm and 17 cm can be selected : please contact manufacturer for information.*

Gettering operation

In order to assure a high reliability in operation and to maintain optimum performances of the tube, Instructions for Gettering operation should be strictly applied as defined in separate Data.

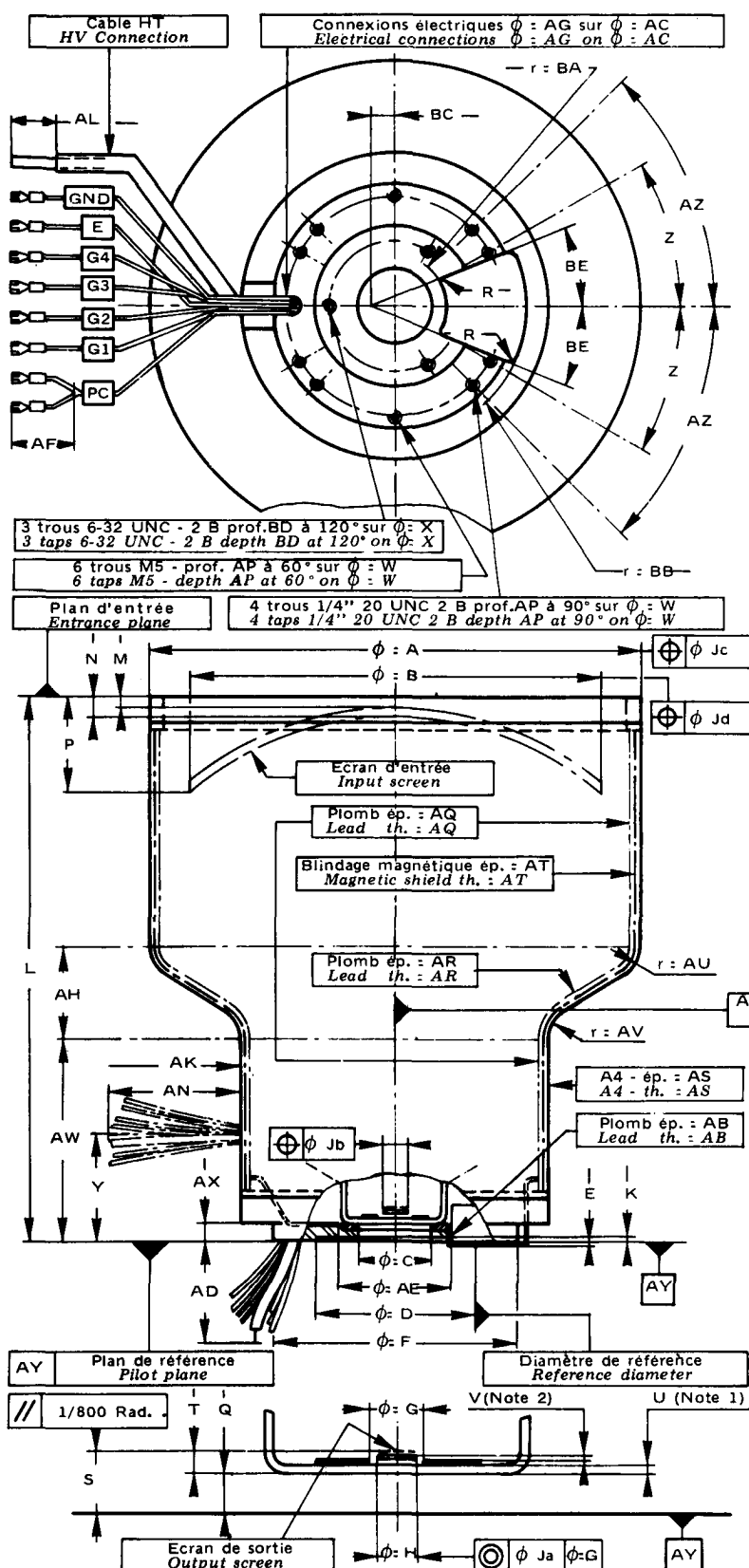
The purpose of this operation is to pump residual gas in the tube resulting in an ion spot which lowers the image contrast and resolution.

N O T E S

- 1 - The mounting of the tube in its housing (see page 2 and drawing) secures the positioning of the viewing screen at a determined optical distance from the mechanical plane of reference on which may be fixed the optical system. This distance is 10.40 ± 0.25 mm. This housing assures a parallelism of the two planes with a precision higher than 1/800 radian. It assures a center of image within 0.25 mm from perpendicular axis of the reference plane defined by 6 fixing holes located on a circle of 171.50 ± 0.12 mm diameter.
- 2 - The resolution (as referred to input screen) is measured by using square lead pattern consisting in alternate black and white lines of equal width. Any two adjacent lines are designated as a line pair. The impinging X-radiation is produced by a generator operating at 65 kV and with a 2.5 mm aluminum filter.
- 3 - The contrast is defined as the differential thickness which can be detected when using a JEDEC penetrometer. This penetrometer consists in an aluminum disc of 20 mm thickness presenting holes of 6 mm diameter. The depth of those holes vary from 1.5 to 7% of the thickness of the disc. The differential thickness (expressed in %) of the hole having the minimum depth which can be detected defines the minimum contrast. X-ray conditions : 80 kVp - HVL 7 ± 0.2 mm Al - input dose rate 100 mR/mn.
- 4 - The conversion factor is the value of the viewing screen luminance corresponding to a determined X-ray dose rate.
X-ray conditions : 80 kVp - 20 mm Al filter - HVL 7 ± 0.2 mm Al.
The luminance is measured by a photometer which matches the human vision.
The conversion factor is defined as :

$$C. F. = \frac{\text{Luminance}}{\text{dose rate}} = \frac{\text{Candela/square meter}}{\text{milli Roentgen/second}} \quad \text{or} \quad \frac{\text{foot Lambert}}{\text{Roentgen/minute}}$$

- 5 - The luminance gain is the ratio of luminance of the image intensifier to the luminance of a Massiot - Fluor - Sirius fluoroscopic screen having a luminance of 0.010 cd/m² per mR/s. Both are irradiated in the same conditions : 80 kVp - 20 mm Al filter - HVL 7 ± 0.2 mm Al. The luminance is measured by a photometer which matches the human vision.
- 6 - The background luminance is the luminance of output screen when normal operating voltages are applied to the tube and X-rays are off at normal ambient temperature.
- 7 - The distortion is measured by $D = \frac{M_p - M_c}{M_c} \times 100$
where M_p = magnification measured on a circle covering 90 % of the input field.
 M_c = magnification measured on a 2 cm diameter circle centered on the input field axis.
- 8 - The image persistence is the residual luminance measured at a determined time after removal of X-ray radiations.



Dimensions en millimètres
 Angles en unités sexagésimales
 Dimensions in millimeters
 Angles in sexagesimal units

	MIN	MAX		MIN	MAX
A	378	381	AB	2,4	2,6
B	323	325	AC	155	-
C	57,15	57,23	AD	450	500
D	120,45	120,85	AE	85	87
E	0	3	AF	35	45
F	195,5	186,5	AG	-	16,1
G	26,95	27,05	AH	72	76
H	24	25	AK	224	226
K	1,27	1,77	AL	30	50
L	430	435	AN	540	590
M	2	10	AP	-	8
N	11	21	AQ	1,2	1,5
P	71	82	AR	1,5	1,8
Q	7,05	-	AS	1,8	2,0
R	3	-	AT	0,7	0,9
*S	10,15	10,65	AU	24	28
*T	2,55	3,05	AV	22	26
U	2,4	2,6	AW	157	162
V	1,0	1,3	AX	7	9
W	171,38	171,62	AY	-	-
X	104,66	104,90	AZ	44°	46°
Y	-	80	BA	39	-
Z	29°	31°	BB	-	99
			BC	-	18,51
			BD	-	6,5
			BE	-	22°
Jd	7				
Jc	3				
Jb	1				
Ja	0,5				

Note 1 : Indice - Index : 1,49

Note 2 : Indice - Index : 1,54

* : Distances optiques - Optical distances

Connexions électriques - Long. : AD ou AN
 Electrical connections - Length : AD or AN

REP MARK	FILS CABLE		CONNECTEUR TERMINAL
P C	Noir Black	Coaxial RG 174 U	AMP.61255-1
G 1	Vert Green	Wire 600 V	AMP.42628-2
G 2	Noir Black	Belden 8869	AMP.42628-2
G 3	Noir Black	Belden 8869	AMP.42628-2
G 4	Noir Black	Belden 8869	AMP.61255-1
E	Bleu Blue	Wire 600 V	AMP.31889
GND	Gris Grey	Wire 600 V	AMP.31889
A	Blanc White	50 kV dc 18 AWG BOSTON 2841 LG 18	



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